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# Middle East and North Africa

## Integration of Electricity Networks in the Arab World

### Regional Market Structure and Design

December 2013

MNSEE

MIDDLE EAST AND NORTH AFRICA



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## Table of Contents

Executive Summary (English)		
This Study's Context and Objectives	1	
The Objective of Regional Integration, and Paths to Its Achievement	4	
Designing the Path to an Integrated Power Market	5	
The Proposed Long-Term Strategy	6	
High-Level Executive Decisions	11	
Executive Summary (Arabic)		
	Volume 1:	
1	Background, Purpose, and Organization of the Report	12
1.1	Background	12
1.2	The Context and Purpose of This Study	13
1.3	Approach and Organization of the Study and this Report	14
2	Sector and Regional Overview	18
2.1	Maghreb Region	18
2.1.1	Overview	18
2.1.2	Demand/Supply Balance	19
2.1.3	Generation Mix	20
2.1.4	Maghreb Interconnection	21
2.1.5	National Power Markets in the Maghreb	25
2.2	EIJLLPST Region	30
2.2.1	Overview	30
2.2.2	Demand/Supply Balance	30
2.2.3	Generation Mix	31
2.2.4	EIJLLPST Interconnection	33
2.2.5	EIJLLPST's National Power Markets	35
2.3	GCC Region	48
2.3.1	Overview	48
2.3.2	Demand/Supply Balance	48
2.3.3	Generation Mix	49
2.3.4	GCC Interconnection	51
2.3.5	GCC's National Power Markets	59
2.3.6	Summary of Arab Market Status	67
2.4	Neighboring Regions	68
2.4.1	Europe	68
2.4.2	Turkey	70
2.4.3	Iran	71
2.4.4	Nile Basin Initiative (NBI)	72
2.4.5	West African Power Pool (WAPP)	74
2.4.6	Trade with Countries to the East	75
2.5	Summary	76
3	The Context for Regional Electricity Trade	81
3.1	Benefits and Challenges of Integrating Regional Electricity Markets	81
3.2	Experience with Market Integration	82
3.2.1	SIEPAC	84
3.2.2	SEE	86
3.2.3	PJM	89
3.3	Evolution of the EU Electricity Market	91
3.4	Renewable Energy Development in the Arab Countries	94
3.4.1	Potential	94
3.4.2	Renewable Energy Projects and Initiatives in Arab Countries	96
3.4.3	Gulf Countries Enabling Research	97

3.4.4	Regional Integration to Enable Greater Levels of RES Penetration	98
3.5	Synchronization	99
3.6	Assessment of Arab Regional Electricity Markets	102
3.7	Requirements for Regional Integration and Trade	105
4	The “Ultimate” Regional Market Design	110
4.1	Purpose and Approach to Development of the “Ultimate” Regional Market Design	110
4.2	Proposed Ultimate Regional Market Design for Arab Countries	110
4.2.1	High-Level Description	110
4.2.2	Salient Features of Proposed Ultimate Regional Market Design	112
4.2.3	Roles and Responsibilities of Market Participants	113
4.2.4	Regional Institutions	117
4.2.5	Governance Documentation	118
4.3	Summary	118
5	Proposed Transitional Regional Electricity Market Design	120
5.1	Objective and Guiding Principles	120
5.2	Approach to Regional Electricity Market Integration	122
5.3	Proposed Path to Regional Electricity Market Integration	123
5.4	Transitional Regional Electricity Market Design: Stage 1	128
5.4.1	Market Design	128
5.4.2	Salient Features of Proposed Transitional Regional Electricity Market Design: Stage 1	129
5.4.3	Regional Market Participants and Their Roles in Stage 1	130
5.4.3	Regional Market Institutions	134
5.4.4	Transitional-Regional-Market Governance Documentation	138
6	Next Steps	142

## **Volume 2: Attachments**

**Attachment 2.A**—Retail Tariff Analysis

**Attachment 2.B**—Private Sector Investment in Arab Countries

**Attachment 2.C**—Electricity Sector in Europe

**Attachment 2.D**—Electricity Sector in Turkey

**Attachment 2.E**—Electricity Sector in Iran

**Attachment 2.F**—Nile Basin Initiative

**Attachment 3.A**—Summary of EU Legislation on Internal Market and Cross-Border Electricity Trade

**Attachment 3.B**—Prospects of Synchronizing the Power Grids of EIJLLPST Countries with ENTSO-E

## Abbreviations and Acronyms

ACER	Agency for the Cooperation of Energy Regulators (Europe)
AER	Authority for Electricity Regulation
AERF	Arab Electricity Regulators' Forum
AMU	Arab Maghreb Union
ARC	Advisory and Regulatory Committee
ASEAN	Association of Southeast Asian Nations
AUE	Arab Union of Electricity
Bbl	Barrel
BOO	build-own-operate
BOOT	build-own-operate-transfer
CAGR	compound annual growth rate
CASAREM	Central Asia Regional Electricity Market
CEGCO	Central Electricity Generating Company
CMEP	Compliance Monitoring and Enforcement Processes
COMELEC	Comité Maghrebien de l'Electricité (Maghreb Electricity Committee)
CRIE	Comisión Regional de Interconexión Eléctrica
CSP	concentrated solar power
CT	combustion turbine
DSO	distribution system operator
EAC	East African Community
EAPP	Eastern Africa Power Pool
ECRA	Electricity and Cogeneration Regulatory Authority
ECRB	Energy Community Regulatory Board
EDCO	Electricity Distribution Company
EDL	Electricité du Liban
EEHC	Egyptian Electricity Holding Company
EIA	Energy Information Administration (United States)
EIJLLPST	Eight-country Interconnection (Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey)
EIJST	Five-country Interconnection (Egypt, Iraq, Jordan, Syria, and Turkey)
EITC	Electrical Interconnection of Three Continents
ENG	Emirates National Grid
ENTRO	Eastern Nile Technical Regional Office
ENTSO-E	European Network for Transmission System Operators - Electricity
EOR	Ente Operador Regional
ERC	Electricity Regulatory Commission
ESMAP	Energy Sector Management Assistance Program
ETSO	European Transmission System Operators
EU	European Union
FERC	Federal Energy Regulatory Commission
FTRs	Financial transmission rights
GCC	Gulf Cooperation Council
GCCIA	Gulf Cooperation Council Interconnection Authority
GDP	gross domestic product
GECOL	General Electricity Company of Libya
GEDCO	Gaza Electricity Distribution Company
GRC	Gulf Research Center

GT	gas turbine
GW	Gigawatt
GWh	gigawatt-hours
HEPCO	Hebron Electric Power Company
HFO	heavy fuel oil
HVAC	high voltage alternating current
HVDC	high voltage direct current
Hz	Hertz
IAEA	International Atomic Energy Agency
ICCS-NTUA	Institute of Communications and Computer Systems of the National Technical University of Athens
IEC	Israel Electric Corporation
IPP	independent power producer
IRENA	International Renewable Energy Agency
ISO	independent system operator
IWPP	independent water and power producer
JDECO	Jerusalem District Electric Company
KACST	King Abdulaziz City for Science and Technology
KAHRAMAA	Qatar General Electricity and Water Corporation
KAUST	King Abdullah University of Science and Technology
kV	Kilovolt
kWh	kilowatt-hour
LAS	League of Arab States
LMPs	locational marginal prices
MENA	Middle East and North Africa
MER	Mercado Eléctrico Regional
MEW	Lebanon's Ministry of Energy and Water
MOU	memorandum of understanding
MW	Megawatt
MWh	megawatt-hour
NBI	Nile Basin Initiative
NEDCO	Northern Electric Distribution Company
NEPCO	Jordan's National Electric Power Company
OECD	Organisation for Economic Co-operation and Development
ONE	Office National d'Electricité
PEA	Palestinian Energy and Natural Resources Authority
PEC	Public Electricity Corporation
PEDEEE	Public Establishment for Distribution and Exploitation of Electric Energy
PEEGT	Public Establishment for Electricity Generation and Transmission
PETA	Power Exchange and Trading Agreement (GCC)
PHLG	Permanent High-Level Group
PJM	Pennsylvania-Jersey-Maryland Interconnection
PPA	power-purchase agreements
PV	Photovoltaics
PX	power exchange
REM	regional electricity market
RES	renewable energy sources
RTOs	regional transmission organizations
SEC	Saudi Electric Company

SEE	Southeast Europe
SELCO	Southern Electric Power Company
SET-Plan	European Strategic Energy Technology Plan
SIEPAC	Central American Electric Interconnection System
STEG	Société Tunisienne de l'Electricité et du Gaz
SWCC	Saline Water Conversion Corporation
TEK	Turkish Electricity Corporation
TSO	transmission system operator
TW	Terawatt
TWh	terawatt-hours
TX	Transmission
UAE	United Arab Emirates
UCTE	Union for the Coordination of Transmission of Electricity
UNMIK	United Nations Interim Administration Mission in Kosovo
WAPP	West African Power Pool
WEC	Water and Electricity Company

## **Acknowledgement**

This report was prepared jointly in 2010-2011 by the League of Arab States (LAS) and the World Bank. The report is part III of a three-part study on the feasibility of interconnecting the electrical systems of the Arab countries including:

- Part I: Study of Interconnections of Electrical Systems in the Arab World.
- Part II: Study of Electricity-Gas Trade among the Arab Countries.
- Part III: Study of Institutional and Regulatory Frameworks.

Parts I and II are prepared jointly by LAS and the Arab Fund for Social and Economic Development.

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## Executive Summary (English)

### This Study's Context and Objectives

The Arab countries have experienced rapid economic growth in recent years, and the high economic growth has triggered a significant increase in energy demand, particularly for electricity. Although part of this growing demand may be curbed through more effective energy conservation policies, including tariff adjustments, there is a clear need to expand generating capacity and fuel supply in all Arab countries. In recent years, gas availability has turned into a serious issue as countries such as Syria, Jordan, Saudi Arabia, Kuwait, the United Arab Emirates (UAE), and others have realized that their domestic gas production is insufficient to meet the needs of their power sectors. This has triggered a search for sources of imported gas or electricity, which in turn has led to attempts to construct cross-border infrastructure facilities.

Besides enabling energy imports, interconnected power networks impart a series of additional benefits such as improved system reliability, reduced reserve margins, reactive power support, and energy exchanges that take advantage of daily and seasonal demand diversity and disparities in marginal production costs. Recognizing the benefits of regional integration, several bilateral and subregional initiatives are under way to interconnect the electricity networks of Arab countries in an effort to establish integrated electricity systems for electricity exchange and trade. The primary regional interconnection schemes among Arab countries include:

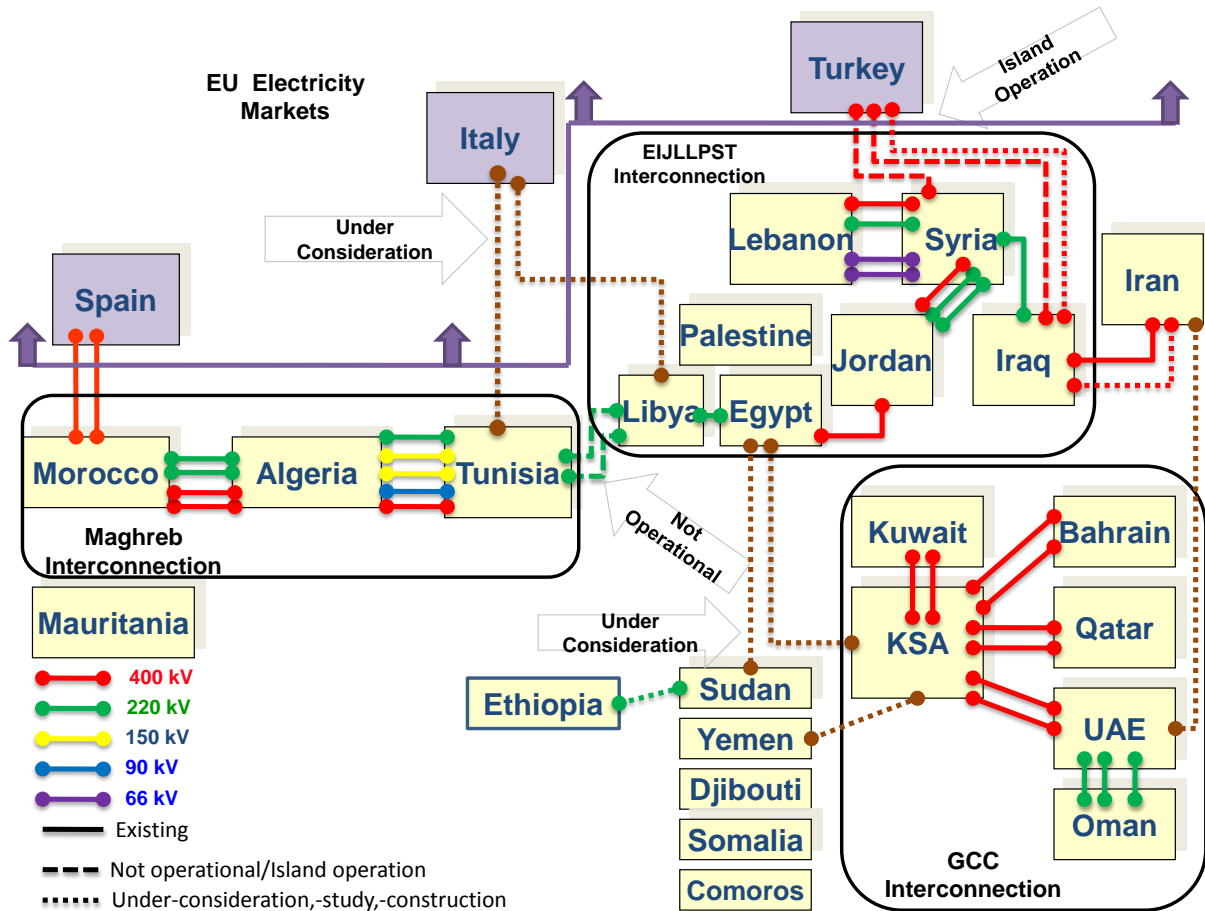
- The Maghreb regional interconnection, which includes Morocco, Algeria, and Tunisia, and which was initiated in the 1950s and evolved into multiple high-voltage transmission interconnections between the three countries. Morocco was connected to Spain in the late 1990s, and Morocco, Algeria, and Tunisia are now all synchronized with the pan-European high-voltage transmission network.
- The eight-country (Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey [EIJLLPST]) regional interconnection, which was initiated in 1988 by Egypt, Iraq, Jordan, Syria, and Turkey as part of an effort to upgrade their electricity systems to a regional standard.<sup>1</sup> Lebanon, Libya, and the Palestinian Authority later extended the agreement to eight countries.<sup>2</sup> Turkey is expected to fully synchronize to the European grid early in 2012, which will further efforts to synchronize the EIJLLPST electricity network with the grids in Turkey and Europe.
- The regional power interconnection of the Gulf Cooperation Council (GCC) allows electricity exchange among its six member states—Kuwait, Saudi Arabia, Bahrain, Qatar, the UAE, and Oman—under an agreement signed in 2009. The interconnection is targeted at sharing capacity reserve and improving supply reliability, which will reduce the need for investment in new generation capacity.

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<sup>1</sup> Although the EIJLLPST Interconnection Agreement was signed in the 1980s, physical interconnections between Syria and Jordan and between Syria and Lebanon were constructed in the 1970s.

<sup>2</sup> According to the Minutes of the Eighteenth Annual Meeting of Medelec, the EIJLLPST interconnection will be renamed the Electrical Interconnection of Three Continents (EITC) at the next ministerial meeting.

**Figure ES1. Existing and planned interconnections**



*Note: Medium voltage interconnections between Jordan and West Bank and between Egypt and Gaza exist and operate on island mode*

*Source: LAS/The World Bank*

Though the Maghreb and EIJLLPST interconnections have existed for some time, electricity trade among the Arab countries has remained at modest levels due to obstacles such as limited generation reserve margins, the absence of a harmonized regulatory framework with clear rules governing electricity trade, and institutional weaknesses at both the national and regional level (that is, governing bodies lack the tools, data, and incentives necessary to promote trade). But the desire to improve supply security through the diversification of energy supply resources, particularly in the context of the interregional programs for the development of renewable wind and solar resources, has improved motivation to deal with these weaknesses.

The League of Arab States (LAS) is carrying out a three-part study on the feasibility of interconnecting the electrical systems of the Arab countries:

Part I: Study of Interconnections of Electrical Systems in the Arab World.

Part II: Study of Electricity-Gas Trade among the Arab Countries.

Part III: Study of Institutional and Regulatory Frameworks.

The main objective and scope of the three-part study is to establish a strategy and a master plan for the development of electricity trade among Arab countries. The three parts of the study are considered complimentary. Part III of the study— which is the subject of this report—is a joint effort between the LAS and the World Bank. The World Bank has been particularly active in this area of the world. Under the Arab World Initiative, the World Bank has completed three studies assessing the potential of energy integration in the three Arab subregions, including the Maghreb, EIJLLPST, and the GCC, while implementing a major regional program for scaling up concentrated solar power (CSP) in the Middle East and North Africa (MENA) region.

This study focuses on the institutional and regulatory aspects of cross-border trade and electricity market integration among the 22 Arab countries, and between the Arab countries and potential neighboring markets. Consistent with the LAS terms of reference, the study covers six primary areas:

- Analyzing the legal and regulatory framework for the power sectors of the target countries, with particular attention to cross-border electricity trade, including the development of required governance documents such as grid code, power exchange, and supply code (market rules).
- Identifying potential obstacles to the creation of a regional electricity market (REM) as well as enabling factors, and developing operational recommendations to surmount these obstacles.
- Identifying barriers to efficient energy trading among the concerned countries and developing possible ways to facilitate trade and regional integration.
- Defining the legal support required for a gradual progression toward a competitive and efficient REM.
- Developing and assessing the general terms under which electricity is to be traded, taking into consideration international constraints such as European Union (EU) market trading rules, limitations on imports, limitations on long-term price agreements, and environmental rules.
- Proposing an action plan for the negotiation of the necessary treaties or international agreements to promote electricity trade among Arab countries and target markets.

The study comprises two phases: Phase 1 provides an overview of current regional and national electricity markets in the Arab World, including market structure, institutions, and regulations and defines the principles of electricity market integration in the Arab World. Phase 1 results are summarized in this study main report (Volume I). Phase 2 develops a draft road map for a transition path toward market integration and associated governance documentation including drafts Memorandum of Understanding (MoU), General Agreement, General Pan -Arab Electricity Agreement, and the Regional Grid Code, all included in Volume II of the report.

To facilitate the consultation process the LAS formed Steering and Technical Committees consisting of the representatives of the Arab (national and sub-regional) power utilities. The World Bank team and the LAS teams held regular meetings to review the results and recommendations of the study.

## The Objective of Regional Integration, and Paths to Its Achievement

The ultimate goal of an integrated power market is to optimize the supply of electricity within a broad, regional (rather than confined, national) framework. Often this is thought to be achievable in a market environment where every party has equal access to all networks (domestic, regional, and international); where market data and information (pricing, market operation, capacity allocation, and so on) are transparent; and where electricity tariffs cover the cost of supply, power-grid codes are harmonized, systems are synchronized, and markets liberalized.

The objective of market integration has three distinct dimensions: security of supply, sustainability, and competition. While all three dimensions appear on the regional integration agenda of various parts of the world, the emphasis on each dimension has varied depending on the priorities of each region. For example, in the EU integration agenda, the emphasis has been on competition. This emphasis indicates that market integration can be achieved through a coordinated reform process, which in turn implies that the liberalization of individual national markets is a prerequisite to regional integration. On the other hand, in East Asia, Latin America, and parts of the Arab world, the emphasis has been on improving the security of supply by building the required physical infrastructure and relying on simple rules for operation of the interconnected systems. This approach recognizes the fact that the individual national markets are at different stages of development and that the liberalization of these markets cannot be expected to proceed at the same pace.

Review of global experience is most revealing in the sense there is no evidence to suggest that any of the existing or developing regional integration schemes got the model right at the initial stage of integration. It is nevertheless clear that learning from other people's mistakes enables policy makers to avoid wasting time and resources. In the past two decades regional integration has gained a higher profile as the benefits to integrated countries receive wider recognition. But every integration scheme has taken a long time and significant effort to materialize. The more successful schemes are the ones that pursued an adaptive approach and adjusted their course when needed, and that remained persistent in dealing with challenges both foreseen and unforeseen. The success of such schemes indicates the need to prepare a clear implementation plan, establish dependable political support early on, and establish a monitoring mechanism that can quickly bring obstacles and challenges, as they emerge, to the attention of decision makers.

The Arab world's electricity integration initiatives have appropriately emphasized security of supply. But the aim of future regional electricity integration in the Arab world will incorporate sustainability and competition dimensions as well. The sustainability dimension will be a priority since most Arab countries are eager to ensure the long-term preservation of their energy resources and to mitigate local and global environmental damage. The competition dimension will also be important: most Arab countries are introducing private sector projects into the power sector but would like to ensure that these projects are able to compete at a regional level. It is therefore proposed that the approach to regional integration in the Arab world should:

- Recognize the inherent difficulty of moving a large number of member countries toward political consensus.
- Recognize the diversity of national electricity systems (markets), the varying pace of reform processes, and the differences between the three existing subregional interconnections.

- Attempt to coordinate sector reform decisions.
- Strengthen the interconnection/integration within each subregion.
- Develop the institutional framework needed for a coordinated move toward a harmonized network.

### Designing the Path to an Integrated Power Market

Elaboration of regional integration schemes often starts with an attempt to design a model for an integrated market. But it quickly becomes evident that while the desirable model has a set of clear features,<sup>3</sup> its achievement is a long-term goal. The immediate challenge is to then draw a picture of the path that takes the region from its current status to the desirable solution in a calculated, systematic, and practical manner.

The path to market integration should take account of current realities. At the top of these realities is the fact that one country is not likely to trade with another if by doing so it is placing its own customers at risk of reduced reliability. This is always a hampering factor at the initial stage of regional integration, when each participating country needs reassurance that the power systems of the other countries are reliable. This is also an important reason for making a distinction among the countries of the GCC, Maghreb, and EIJLLPST subregions. Currently, the three subregional markets are at different stages of development and must operate independently because they are either not interconnected or not synchronized. But this is likely to change in the future. Ultimately, it is anticipated that the three Arab subregional markets will merge into one, and might subsequently be interconnected with the EU and potentially with markets in Asia and Africa.

The EU experience is often looked to for lessons on integrating electricity markets. This report reviews the EU experience, with the idea that it is relevant to designing the regulatory and legal systems of the Arab electricity network. It may appear, at first glance, that the EU has achieved a high degree of electricity market integration at a rapid pace; however, in reality, the EU has been struggling with all the practical issues that are also being faced in other regions. Several EU subregions have moved more slowly than others in facilitating electricity trade and integration, and the EU continues to correct the course of market integration by revising various directives and guidelines. At the same time, it is perhaps the most valuable experience to study because of the persistent public policy and substantial professional and technical skills that have gone into keeping market integration on the right track. The review of the EU experience provides significant material in analyzing two distinct aspects of regional electricity integration: (i) the overarching agenda for integration, and (ii) a strategy to deal with the varying status of the EU subregions. Both of these aspects will be helpful in designing the transitional path of market integration in the Arab world.

Considering the international experience and the current status of the electricity sectors in Arab countries, this report sets out a path toward market integration with the following four stages:

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<sup>3</sup> These features are described in the body of the report. The basic requirements for a successful regional electricity market (REM) include: availability of the necessary physical infrastructure (that is, high-voltage transmission lines); harmonized technical rules for the operation of the interconnected systems as well as harmonized wholesale market rules; fair and nondiscriminatory access to the physical infrastructure, including transparent pricing mechanisms for use of such infrastructure; and suitable mechanisms for regional regulation and market supervision, enforcement procedures, and dispute-settlement schemes.

- **Stage 1:** Implementing a transitional regional market design, focusing on identifying and expanding trade opportunities.
- **Stage 2:** Expanding the transitional regional market's functionality, focusing on unbundling transmission system operators (TSOs), and introducing wholesale competition.
- **Stage 3:** Moving toward an ultimate regional market design, focusing on full wholesale competition supported by multiple financial markets.
- **Stage 4:** Achieving a fully integrated Arab regional market, focusing on a fully interconnected and synchronized Arab electricity network.

The above four-stage development plan is politically feasible, in line with best practices, and promises the long-term achievement of the integration objectives. Its stages ensure a gradual but consistent and coherent approach to the development of electricity trade and market integration.

### **The Proposed Long-Term Strategy**

To translate the above four-stage vision into practice, one would need to devise a clear and consistent long-term strategy that identifies specific policy actions to be undertaken in each stage of market development. Table ES1 summarizes the content of the proposed strategy, which is focused on the policy decisions pertaining to institution building and the legal and regulatory framework. The strategy recognizes that the three subregions are at different stages of market development; however, institution building for the entire Pan-Arab network would assist transfer of knowledge, skills, and information among the three subregions and also from neighboring countries. It is also noted that the institution building during each stage is devised to meet the requirements of that stage and to prepare for moving to the next stage.

**Table ES1. Summary of proposed long-term strategy**

Stage of development	Expansion of infrastructure and electricity trade	Institution building, legal framework, and policy decisions
<p><b>Stage 1:</b></p> <p><b>Transitional market focused on identifying and expanding trade opportunities</b></p>	<p>Subregional TSOs/market facilitators identify trade opportunities based on international fuel prices.</p> <p>Additional trade volume expected among GCC, EIJLLPST, and Maghreb countries.</p> <p>Trade takes place according to direct utility-to-utility bilateral contracts between contiguous and noncontiguous countries.</p> <p>Some countries provide transit/wheeling service.</p> <p>Reinforce infrastructure by:</p> <ul style="list-style-type: none"> <li>• Expanding generation to meet national requirements and exports.</li> <li>• Utilizing generation to meet seasonal and daily demand differences beyond domestic markets.</li> <li>• Reinforcing existing cross-border interconnections for bulk electricity trade (for example, Iraq–Syria, Jordan–Egypt, Egypt–Libya, Libya–Tunisia, Algeria–Morocco).</li> <li>• Upgrading national transmission networks.</li> </ul> <p>Additional international interconnections:</p> <ul style="list-style-type: none"> <li>• Egypt–Saudi Arabia</li> <li>• Egypt–Sudan</li> <li>• Mauritania–Morocco</li> <li>• Saudi Arabia–Yemen</li> </ul>	<p>Establish a secretariat.</p> <p>Establish a regional advisory and regulatory committee.</p> <p>Establish regional Arab TSOs committee.</p> <p>Establish a subregional TSO/market facilitator for each subregion.<sup>4</sup></p> <p>Develop and sign:</p> <ul style="list-style-type: none"> <li>• A memorandum of understanding and general agreement on Pan-Arab regional electricity market integration.</li> <li>• A general regional electricity market agreement.</li> <li>• A regional grid code.</li> </ul> <p>Harmonize technical and reliability standards.</p> <p>Expand the Pan-Arab electricity database to include comprehensive and up-to-date information on each country’s expansion plan, investment program, and regulatory changes.</p> <p>Prepare transmission tariffs and cross-border transmission capacity auction process.</p>

<sup>4</sup> The Gulf Cooperation Council Interconnection Authority (GCCIA) has many of the responsibilities proposed for the subregional transmission system operator (TSO)/market facilitator, but not all (for example, the GCCIA does not publish market prices); therefore, some modifications in its responsibilities would be necessary for it to take on this role.



Stage of development	Expansion of infrastructure and electricity trade	Institution building, legal framework, and policy decisions
<p><b>Stage 2:</b></p> <p><b>Expanded transitional regional market focusing on unbundling TSOs and introducing wholesale competition</b></p>	<p>Introduce competition to large consumers directly connected to the transmission network.</p> <p>Further improve sustainability and security of supply objectives.</p> <p>Facilitate trade through further strengthening of transmission networks and synchronization. Systems are synchronized at the level of each subregion (GCC and Maghreb already synchronized; synchronize all EIJLLPST countries).</p> <p>Coordinate investments in transmission infrastructure.</p>	<p>Agree to open up high-voltage supply to competition and allow tariffs for large customers to be set by competitive market.</p> <p>Separate TSOs through unbundling of the national markets and establish national independent and informed regulatory entities.</p> <p>Establish a regional regulator (will start with a reporting, coordinating, and dispute-resolution role before moving to a full-fledged regional regulator).</p> <p>Replace regional Arab TSOs committee with regional Pan-Arab TSO entity with board of directors and full complement of regular staff.</p> <p>Revise roles of secretariat and regional advisory and regulatory committee to reflect roles of new regional TSO and regulatory entities.</p> <p>Amend role of subregional TSOs/market facilitators to take on more responsibilities relating to the market operator function.</p> <p>Revise regional grid code as necessary and make extensive revisions to general regional electricity market agreement to accommodate competitive trade at wholesale level.</p>

Stage of development	Expansion of infrastructure and electricity trade	Institution building, legal framework, and policy decisions
<b>Stage 3:</b>  <b>Ultimate regional market focusing on full wholesale competition supported by multiple financial markets</b>	<p>Full wholesale competition with all large customers and distribution/supply entities allowed choice of supplier.</p> <p>Introduce new financial markets as needed by regional market participants such as bid-based balancing market, day-ahead market, intraday market, emissions trading market, and so on.</p> <p>Promote an economic-dispatch outcome consistent with objectives of competition, sustainability, and reliability/security of supply.</p> <p>Consistent with needs of regional market, further improve transmission capacity and synchronization at national and international levels.</p>	<p>Agree to open up market to full wholesale competition.</p> <p>Put into operation additional financial markets (for example, day-ahead market) as required by regional market participants.</p> <p>Replace subregional TSOs/market facilitators with regional market operator with responsibility for all functional regional financial markets that are not implemented and operated by private sector entities.</p> <p>Disband secretariat and give full regional market oversight responsibility to regional market operator, regional TSO, and regional regulator, with oversight by Arab Ministerial Council for Electricity.</p> <p>Modify regional market governance documents as necessary to incorporate full wholesale competition and newly formed financial markets.</p> <p>Ensure regional market institutions have full responsibility to establish transmission tariffs and enforce uniform technical and financial rules across regional market.</p>
<b>Stage 4:</b>  <b>Fully integrated Arab regional market focusing on fully interconnected and synchronized Arab electricity network</b>	<p>The three subregions are interconnected and synchronized (or asynchronized), including countries not currently interconnected with any of the subregions.</p> <p>The region is also synchronized with the ENT SO-E and other markets in the surrounding area.</p> <p>There is open access to all transmission and full wholesale competition with fully functional regional market institutions and governance documentation.</p>	<p>Prepare and implement a unified Pan-Arab power development plan (could include three binding subregional development plans that align with national plans and cover both conventional and renewable generation and transmission).</p> <p>Develop a plan for synchronization (or asynchronization) of the three subregions, and synchronization (or asynchronization) with the ENT SO-E and other REMs in the surrounding region.</p>

*Note:* TSO = transmission system operator; GCC = Gulf Cooperation Council; EIJLLPST = Eight-country Interconnection (Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey); ENT SO-E = European Network for Transmission System Operators - Electricity; REM = regional electricity market.

Although the four-stage strategy should provide the framework for institution building and policy decisions, the main emphasis is on articulating the details of what needs to be achieved during Stage 1. Accordingly, we have developed a specific regional market design for Stage 1 and an implementation plan containing the institutional and policy decisions to be taken during this stage. The main components of the proposed plan include preparation of the required governance documents and the regional institutions.

The proposed plan focuses the governance documentation and the regional institution building on the objective of electricity market integration. As a result, the plan suggests only a limited

number of regional documents, and also only a very few regional entities. More specifically the plan envisages the governance documentation to include only four main items:

- A high-level memorandum of understanding (MOU).
- A general agreement.
- A general Pan-Arab electricity market agreement.
- A regional grid code.<sup>5</sup>

Similarly the plan calls for formation of a secretariat, while addressing other regional requirements through certain coordinating forums and activities. The coordinating forums include:

- A regional advisory and regulatory committee that will include one member from the regulatory body of each of the countries participating in the regional market.
- A regional Arab TSOs committee.

In the longer term, each of these functions would be performed by a formal entity. However, in the near term it is desirable that these regional institutions be created in a manner that avoids additional financial commitments from the member countries. To this end, the proposed functions would be organized by drawing upon the existing entities, as follows:

- The regional advisory and regulatory function and the regional TSO function would be handled through the establishment of two corresponding committees and inviting appropriate membership relevant to the function of each committee. In addition, relevant stakeholders such as the Arab Union for Electricity and the Arab Electricity Regulators Forum would be invited to participate in their relevant committees.
- The secretariat function would be taken up by the (Energy Department) LAS Secretariat.

The plan further proposes that subregional TSOs/market facilitators be established within each of the GCC, Maghreb, and EIJLLPST regions. The main role of the subregional TSO/market facilitator is to identify trade opportunities by working closely with the participating countries. The Gulf Cooperation Council Interconnection Authority (GCCIA) is already in the process of promoting such a function within the authority. Over time one could review the advantages of creating a single TSO/market facilitator at the regional level.

Finally, it is worth mentioning that the development of renewable energy sources (RESs) has taken a prominent position in the regional integration deliberations of the EU, and is becoming a significant consideration in the network interconnection discussion of the Arab countries. The impact of RESs on regional integration is fourfold. First, most RES sites (wind farms and solar fields) are far from the power grids and would require dedicated transmission lines to evacuate power to the grid; this affects the overall transmission capacity and the possibility of electricity

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<sup>5</sup> A memorandum of understanding (MOU) would be a high-level government document signed by the Arab Ministerial Council for Electricity with the purpose of establishing their commitment to pursue market reform consistent with the objectives of regional market integration. The general agreement would be a high-level government document that identifies the objectives and principles of regional market integration and specifies the roles and responsibilities of the regional market entities. The general Pan-Arab electricity market agreement would be a lower-level document that provides more details of how the countries will meet the commitment identified in the MOU, and specifies the rules relating to trade. The regional grid code would set the minimum technical standards for the region as a whole.

trade. Second, RES power supply is expected to grow substantially and provide a source of electricity export. Third, regional integration of power networks results in larger and more diversified power generation capacity than in isolated national markets, and thereby provides a better opportunity for the development of RESs and possibly stronger commercial incentives for the development of a local industry in the manufacturing of RES equipment. Fourth, there is substantial international financial support for RES development, which could be tapped by public and private entities to expand RES-generating capacity while strengthening cross-border interconnections that offer synergy between RESs and regional integration.

RES development is of particular relevance to the development of the grid codes. Interconnection of RES generation, particularly wind, to the power grid raises specific concerns about system stability. To keep grid operations stable, there is a need to ensure that other power generation sources are available to compensate for hourly variations of RES power generation. The associated technical issues include backup systems and power quality. The grid code could also require certain technical specifications from the manufacturers and developers of RES plants to minimize the impacts on the grid stability.

### High-Level Executive Decisions

The above implementation plan would require a set of high-level executive (ministerial) decisions to move the process forward. There are two immediate decisions to be tabled as soon as possible. First, an executive decision is needed to set up a secretariat that would move the process forward. As noted, in the near-term this function would be carried out by the LAS secretariat whose main responsibilities would include:

- Providing administrative support to the Arab Ministerial Council for Electricity, its Executive Bureau, the regional advisory and regulatory committee, and the regional Arab TSOs committee.
- Reviewing the proper implementation by the parties of their obligations under the MOU, and submitting yearly progress reports to the Arab Ministerial Council for Electricity.
- Building and maintaining comprehensive information systems containing up-to-date data on member countries' expansion plans, regulatory changes, and so on.

Second, a decision is needed by the Arab Ministerial Council for Electricity to approve the Pan-Arab MOU a draft of which has been finalized by the League of Arab States and consulted with Arab Countries. This document would provide the political endorsement and direction for initiating the process. It would define the roles of the various regional market institutions and the conflict-resolution mechanism. Such documents vary in scope. It is recommended that the Pan-Arab MOU and general agreement be specific and well focused to cover:

- Energy-trade policy; mutual assistance in the event of disruption, operation and safeguard measures, and policy
- The institutional setup and the roles of the Arab Ministerial Council for Electricity, its Executive Bureau, the secretariat; the regional advisory and regulatory committee and the regional Arab TSOs committee
- The process of decision implementation and dispute settlement
- Other relevant aspects (budget, accession conditions, and so on)

Aside from the above immediate decisions, the following executive decisions are needed by the time of finalizing the draft MOU:

- Agreement to form a regional advisory and regulatory committee to provide advice to the Arab Ministerial Council for Electricity and its Executive Bureau regarding governance documents and all cross-border operational matters such as transmission tariffs, allocation of transmission capacity, proposals for expansion of international interconnections, adequacy of generation reserve criteria, enforcing credit obligations and payment default procedures, dispute resolution, and so on
- An agreement to form a regional Arab TSOs committee
- An agreement to set up a subregional TSO/market facilitator for each of the GCC, EIJLLPST, and Maghreb interconnections

## Executive Summary (Arabic)

### ملخص تنفيذي

#### سياق وأهداف هذه الدراسة

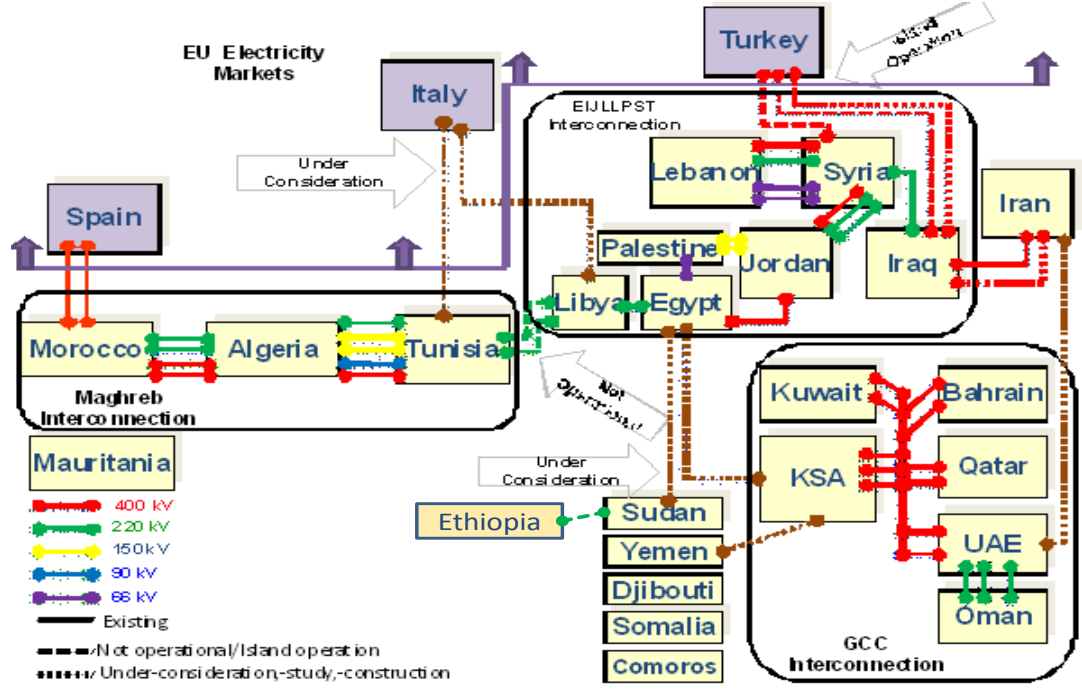
لقد تمتعت الدول العربية بنمو اقتصادي مطرد في السنوات الأخيرة، وأحدث هذا النمو الكبير زيادة سريعة في الطلب على الطاقة، ولا سيما على الكهرباء. وبالرغم من أنه يمكن تقييد هذا الطلب المتزايد من خلال سياسات أكثر فعالية تستهدف حفظ الطاقة، بما في ذلك استحداث تعديلات في تعريفات الاستهلاك، إلا أنه ثمة حاجة واضحة للتوسع في طاقة توليد الكهرباء وإمدادات الوقود في جميع البلدان العربية. وفي السنوات الأخيرة، تحولت مسألة توافر الغاز إلى قضية مهمة حيث أدركت دول مثل الجمهورية العربية السورية والمملكة الأردنية الهاشمية والمملكة العربية السعودية والكويت والإمارات العربية المتحدة، وغيرها، أن إنتاجها المحلي من الغاز غير كاف لتلبية احتياجات قطاعات الطاقة لديها. وقد أثار هذا البحث عن مصادر لاستيراد الغاز أو الكهرباء، والذي بدوره أدى إلى محاولات لبناء مرافق بنية تحتية عابرة للحدود.

تحقق شبكات الكهرباء المترابطة فيما بينها - إلى جانب توفير واردات الطاقة - سلسلة من فوائد إضافية مثل تحسين الاعتمادية في نظم الكهرباء، وخفض هوامش الاحتياطي، ودعم القدرة غير الفعالة، وتبادل للطاقة بين الدول المشتركة من خلال الاستفادة من التنوع والتباين الذي يطرأ على الطلب اليومي والموسمي وانعكاس ذلك على التكاليف الحدية للإنتاج. وإدراكاً لفوائد التكامل الإقليمي، تجري الآن عدة مبادرات لربط شبكات الكهرباء في الدول العربية في محاولة لوضع نظم متكاملة لتبادل الكهرباء والتجارة فيها. وتشمل المخططات الأساسية للربط الإقليمي للكهرباء بين الدول العربية ما يلي:

- في عام 1950 بدأ الربط المغاربي الإقليمي الذي يضم المغرب والجزائر وتونس، وتطور ليصبح شبكات ربط متعددة لنقل التيار الكهربائي عالي الجهد بين البلدان الثلاثة. وفي أواخر التسعينيات من القرن الماضي تم ربط شبكاتي المغرب وأسبانيا، وأصبح الآن، إلى جانب الجزائر وتونس، مرتبطت تزامنيا بالشبكة الأوروبية الشاملة لنقل التيار الكهربائي عالي الجهد.
- الربط الإقليمي بين ثمانية دول أو ما يسمى بالربط الثماني (وهي مصر، العراق، الأردن، ليبيا، لبنان، فلسطين، سوريا، وتركيا) بدأتها مصر والعراق والأردن وسوريا وتركيا في عام 1988 بهدف ترقية شبكات الكهرباء لديها ليكون وفق معيار إقليمي محدد<sup>6</sup>. ثم انضمت لبنان وليبيا وفلسطين بعد ذلك إلى الاتفاقية ليصبح عدد المنضمين إليها إلى ثمانية. ومن المتوقع أن تتزامن الشبكة التركية بالكامل مع الشبكة الكهربائية الأوروبية في أوائل عام 2012، وهذه خطوة على طريق تزامن شبكة كهرباء الدول الثمانية مع الشبكات في تركيا وأوروبا.
- الربط الإقليمي لدول مجلس التعاون الخليجي يتيح تبادل الكهرباء بين الدول الست الأعضاء فيها (وهي الكويت والسعودية والبحرين وقطر والإمارات العربية المتحدة وسلطنة عمان) بموجب اتفاق وقّع في عام 2009. ويستهدف الربط تقاسم احتياطي قدرة التوليد وتحسين اعتمادية إمداد الطاقة مما سيققل من الحاجة إلى الاستثمار في قدرات توليد جديدة.

#### شكل ES1: شبكات الربط القائمة والمخطط لها

<sup>6</sup> على الرغم من أن اتفاقية الربط الإقليمي بين الدول الثماني قد تم توقيعها في الثمانينات إلا أن الربط الفعلي بين سوريا والأردن وبين سوريا ولبنان قد تم إنشاؤه في السبعينيات.



المصدر: البنك الدولي- جامعة الدول العربية

على الرغم من أن شبكات الربط في المنطقة المغاربية والدول الثمانية (EIJLLPST) تعمل منذ فترة ، ظلت تجارة الكهرباء بين الدول العربية عند مستويات متواضعة بسبب عقبات تتمثل في محدودية هوامش احتياطي التوليد، وعدم وجود إطار تنظيمي متناسق يضم قواعد واضحة تنظم تجارة الكهرباء، بسبب جوانب الضعف المؤسسي على المستويين الوطني والإقليمي (بمعنى أن الهيئات المسؤولة تفتقر إلى الأدوات، والبيانات، والحوافز الضرورية لتشجيع التجارة). لكن الرغبة في تحسين تأمين الإمدادات من خلال تنوع مصادر إمدادات الطاقة، ولا سيما في سياق البرامج الإقليمية البينية لتطوير موارد الطاقة المتجددة كطاقة الرياح والطاقة الشمسية، قد حسنت من الحافز للتعامل مع نقاط الضعف هذه.

تجري جامعة الدول العربية الآن دراسة مكونة من ثلاثة أجزاء حول جدوى الربط البيني للأنظمة الكهربائية للدول العربية:

الجزء الأول: دراسة حول الربط البيني للأنظمة الكهربائية في العالم العربي.

الجزء الثاني: دراسة جدوى حول تجارة الكهرباء – الغاز بين الدول العربية.

الجزء الثالث: دراسة حول الأطر المؤسسية والتنظيمية.

يتمثل الهدف الرئيسي لهذه الدراسة ذات الأجزاء الثلاثة ونطاقها في تحديد إستراتيجية وخطة رئيسية لتطوير تجارة الكهرباء بين الدول العربية. وتعتبر الأجزاء الثلاثة للدراسة مكملية لبعضها. ويشكل الجزء الثالث من الدراسة- والذي يمثل هذا التقرير جزءاً منه- جهداً مشتركاً بين جامعة الدول العربية والبنك الدولي.

يعتبر البنك الدولي نشطاً بشكل خاص في هذه المنطقة من العالم. ففي إطار "مبادرة العالم العربي"، أنجز البنك ثلاث دراسات لتقييم إمكانات التكامل في مجال الطاقة في المناطق دون الإقليمية العربية الثلاث، بما في ذلك الربط المغاربي، ودول الربط الثماني، ودول مجلس التعاون الخليجي، مع تنفيذ برنامج إقليمي رئيسي لزيادة الطاقة الشمسية المركزة (CSP) في الشرق الأوسط وشمال أفريقيا.

تركز الدراسة التي تقوم بها الجامعة العربية بالتعاون مع البنك الدولي على الجوانب المؤسسية والتنظيمية للتجارة عبر الحدود وتكامل سوق الكهرباء بين اثنتين وعشرين دولة عربية، وبين الدول العربية والأسواق المجاورة المحتملة. وتتألف هذه الدراسة من مرحلتين: المرحلة الأولى، والواردة في هذا التقرير، تدرس هيكل وتصميم السوق الإقليمية، في حين أن المرحلة الثانية ستبحث في مبادئ لوائح السوق والترتيبات القانونية. وسيتم تحديد الشكل الدقيق ونطاق العمل الذي سيتم تنفيذه في المرحلة الثانية بعد لقاءات التشاور بشأن هذا التقرير الخاص بالمرحلة الأولى مع الجهات المعنية.

واتساقاً مع الشروط المرجعية لجامعة الدول العربية تغطي هذه الدراسة ستة مجالات:

- تحليل الإطار القانوني والتنظيمي لقطاعات الطاقة في البلدان المستهدفة، مع توجيه اهتمام خاص بتجارة الكهرباء عبر الحدود، بما في ذلك إعداد وثائق الحوكمة المطلوبة مثل كود الشبكات، وتبادل الطاقة، وأكواد التغذية والإمداد (قواعد السوق).
- تحديد العقبات المحتملة لإنشاء سوق عربية مشتركة للكهرباء بالإضافة إلى عوامل التمكين، ووضع توصيات عملية لتذليل هذه العقبات.
- تحديد الحواجز التي تعترض التبادل الفعال للطاقة بين الدول المعنية، ووضع السبل الممكنة لتسهيل التجارة والتكامل الإقليمي.
- تحديد الدعم القانوني المطلوب لإحداث تطور تدريجي نحو سوق كهرباء إقليمية تتسم بالتنافسية والكفاءة.
- تطوير وتقييم الشروط العامة التي بموجبها يتم تجارة الكهرباء، مع الأخذ بعين الاعتبار القيود الدولية، مثل قواعد الاتحاد الأوروبي للتداول في السوق، والقيود على الواردات، والقيود المفروضة على اتفاقيات الأسعار طويلة الأجل، والقواعد البيئية.
- اقتراح خطة عمل من أجل التفاوض بشأن المعاهدات أو الاتفاقات الدولية اللازمة لتعزيز تجارة الكهرباء بين الدول العربية والأسواق المستهدفة

## هدف التكامل الإقليمي، ومسارات إنجازه

الهدف النهائي لسوق الطاقة المتكاملة هو تحسين إمدادات الكهرباء في إطار إقليمي واسع (ولا ينحصر داخل الحدود الوطنية). ويغلب الاعتقاد بأن هذا يمكن تحقيقه في بيئة تتوافر لكل طرف فيها فرص متساوية تتيح الوصول إلى جميع الشبكات (المحلية والإقليمية والولية)؛ وتتسم فيه بيانات ومعلومات السوق (أي التسعير والتشغيل في السوق، وتوزيع القدرات،... الخ) بالشفافية؛ وتغطي فيه تعريفه الكهرباء تكلفة الإمداد، وتميز فيه أكواد شبكات الكهرباء بالتنافس، والنظم بالتزام، والأسواق بالتححر.

يتكون الهدف من تكامل السوق من ثلاثة أبعاد متميزة هي: تأمين الإمداد، والاستدامة، والمنافسة. وبالرغم من أن الأبعاد الثلاثة كلها تظهر في جدول أعمال التكامل الإقليمي في أجزاء مختلفة من العالم، إلا أن التركيز على كل بعد قد تباين حسب أولويات كل منطقة. على سبيل المثال، في جدول أعمال تكامل الاتحاد الأوروبي، كان التركيز منصبا على المنافسة. هذا التأكيد يدل على أنه يمكن تحقيق تكامل السوق من خلال عملية إصلاح منسقة، وهذا بدوره يعني أن تحرير الأسواق الوطنية كل على حده هو شرط أساسي لتحقيق التكامل الإقليمي. من ناحية أخرى، في شرق آسيا وأمريكا اللاتينية وأجزاء من العالم العربي، تم التركيز على تحسين تأمين إمدادات الطاقة عن طريق بناء البنية التحتية المادية اللازمة والاعتماد على قواعد بسيطة لتشغيل نظم الربط البيئي. هذا النهج يعترف بحقيقة أن مستويات التطور في الأسواق الوطنية الفردية ليست متساوية، وأنه لا يمكن توقع أن تمضي عملية تحرير هذه الأسواق بنفس الوتيرة.

إن استعراض تجارب عالمية هي الوسيلة الأكثر ملائمة لرؤية الأمور في سياقها السليم، بمعنى أنه ليس هناك أدلة تشير إلى أن أيا من خطط التكامل الإقليمية القائمة أو الجاري إعدادها قد توصلت إلى النموذج السليم في المرحلة الأولى من التكامل. ومع ذلك، من الواضح أن التعلم من أخطاء الآخرين يمكن صانعي السياسات من تفادي إهدار الوقت والموارد. وفي العقدين الماضيين للتكامل، حقق التكامل الإقليمي مكانة أعلى مع زيادة الإدراك على نطاق أوسع بالفوائد التي تعود على البلدان المتكاملة، على الرغم من أن كل مشروع تكامل استغرق وقتاً طويلاً وجهداً كبيراً لكي يخرج إلى حيز الوجود. وجدير بالذكر أن المخططات الأكثر نجاحاً هي تلك التي اتبعت نهج التكيف وتعديل مسارها عند الحاجة، والتي لا تزال مستمرة في التعامل مع التحديات المتوقعة وغير المتوقعة على حد سواء. فنجاح مثل هذه المخططات يشير إلى الحاجة إلى إعداد خطة تنفيذ واضحة، وإيجاد دعم سياسي يمكن الاعتماد عليه في وقت مبكر، وإنشاء آلية للرصد يمكن أن تجذب اهتمام صناعات القرار إلى العقبات والتحديات فور ظهورها.



وقد أكدت مبادرات تكامل الكهرباء في العالم العربي بشكل مناسب على تأمين الإمدادات. ولكن الهدف من تكامل الكهرباء الإقليمي في العالم العربي سوف يتضمن أبعاد الاستدامة و المنافسة كذلك. ستكون الأولوية للبعد الأول، أي الاستدامة، حيث تحرص معظم الدول العربية على ضمان الحفاظ على موارد الطاقة لديها على المدى الطويل والتخفيف من الأضرار البيئية المحلية والعالمية. كذلك سيكون بعد المنافسة مهم أيضا : فمعظم الدول العربية تعمل على إدخال مشاريع القطاع الخاص في قطاع الطاقة، ولكنها تود التأكد من أن هذه المشاريع قادرة على المنافسة على الصعيد الإقليمي. ولذا فمن المقترح أن يقوم نهج التكامل الإقليمي في العالم العربي على الاعتبارات التالية:

- الإقرار بالصعوبة الكامنة في تحريك عدد كبير من البلدان الأعضاء في اتجاه التوافق السياسي.
- الإقرار بتنوع النظم (والأسواق) الوطنية للكهرباء، وتنوع وتيرة عمليات الإصلاح، والاختلافات بين أنظمة الربط البيئية دون الإقليمية الثلاث القائمة.
- محاولة تنسيق القرارات المتعلقة بإصلاح القطاع.
- تعزيز الربط/ التكامل داخل كل منطقة دون إقليمية.
- وضع الإطار المؤسسي اللازم لتنسيق التحرك في اتجاه شبكة متناسقة.

### تصميم مسار الوصول إلى سوق طاقة متكامل

تبدأ عملية وضع خطط التكامل الإقليمي غالبا بمحاولة تصميم نموذج لسوق متكامل. لكن سرعان ما يصبح واضحا أنه في حين أن النموذج المنشود يحفل بمجموعة من الميزات<sup>7</sup> الواضحة، إلا أن تحقيقها هو هدف بعيد الأجل. ومن ثم فإن التحدي المباشر هو رسم صورة للمسار الذي ينقل المنطقة من وضعها الحالي إلى الحل المرغوب فيه بطريقة محسوبة ومنهجية وعملية.

ينبغي أن يأخذ مسار تكامل السوق في الحسبان الحقائق الراهنة، وعلى رأسها حقيقة أنه من غير المحتمل أن تتعامل دولة مع دولة أخرى إذا كان سيترتب على ذلك وضع المستفيدين من الدولة الأولى تحت رحمة إمدادات ضعيفة الاعتمادية. وهذا هو دائما عامل إعاقة في المرحلة الأولى من التكامل الإقليمي عندما تحتاج كل دولة مشاركة إلى الضمانات والتأكيدات بأن نظم الطاقة لدى الدول الأخرى يمكن الاعتماد عليها. وهذا هو أيضا سبب مهم للتمييز بين دول المناطق دون الإقليمية كدول مجلس التعاون الخليجي و دول المغرب العربي، و دول الربط الثماني. وحاليا، تقف الأسواق الثلاثة دون الإقليمية في مراحل مختلفة من التطور، ويجب أن تعمل بشكل مستقل بسبب إما أنه لا يوجد ربط بينها أو أنها غير مترابطة. ولكن من المرجح أن يتغير هذا في المستقبل. وفي نهاية المطاف، من المتوقع أن تندمج الأسواق العربية الثلاث الفرعية في سوق واحد، بل وربما تندمج في وقت لاحق مع أسواق الاتحاد الأوروبي وآسيا وأفريقيا.

يُنظر في كثير من الأحيان إلى تجربة الاتحاد الأوروبي لاستنباط دروس في شأن دمج أسواق الكهرباء. هذا التقرير يستعرض تجربة الاتحاد الأوروبي من خلال فكرة أنه وثيق الصلة بتصميم النظم الرقابية والقانونية لشبكة الكهرباء العربية. وقد يبدو للوهلة الأولى أن الاتحاد الأوروبي قد حقق درجة عالية من التكامل في سوق الكهرباء بوتيرة سريعة، ولكن في واقع الأمر، كان الاتحاد الأوروبي يسعى جاهدا لحل جميع المسائل العملية التي يتم مواجهتها في أقاليم أخرى. وقد انتقل العديد من المناطق الفرعية في الاتحاد الأوروبي ببطء أكثر من غيرها في مسار تسهيل تجارة الكهرباء والتكامل، ولا زال الاتحاد الأوروبي يواصل تصحيح مسار التكامل بين الأسواق المختلفة عن طريق تنقيح التوجيهات والإرشادات. في الوقت نفسه، فإنه ربما تكون التجربة الأوروبية ذات قيمة للدراسة بسبب السياسة العامة الثابتة و المهارات المهنية والتقنية العالية التي ساهمت في الحفاظ على تكامل السوق على المسار الصحيح. إن استعراض تجربة الاتحاد الأوروبي يوفر مادة هامة في تحليل جانبيين متميزين من التكامل الإقليمي للكهرباء: (أولا) وجود جدول أعمال شامل لتحقيق التكامل، و (ثانيا) وضع إستراتيجية للتعامل مع الأوضاع المختلفة السائدة في المناطق الفرعية من الاتحاد الأوروبي. كلا هذين الجانبين سيكونان مفيدان في تصميم المسار الانتقالي لتكامل الأسواق في العالم العربي.

وبالنظر إلى الخبرة الدولية والوضع الراهن لقطاعات الكهرباء في الدول العربية، يحدد هذا التقرير مسار السوق نحو التكامل من خلال المراحل الأربع التالية:

<sup>7</sup> يرد وصف هذه الميزات في متن التقرير. تشمل المتطلبات الأساسية لسوق كهرباء عربي مشترك ناجح ما يلي: توافر بنية تحتية مادية لازمة (أي خطوط النقل ذات الجهد العالي)، وقواعد فنية منسقة لتشغيل أنظمة الربط وكذلك قواعد تنسيق سوق الجملة؛ وفرص عادلة وغير تمييزية للوصول إلى البنية التحتية المادية، بما في ذلك آليات تسعير شفافة لاستخدام هذه البنية التحتية، وآليات مناسبة للتنظيم والرقابة الإقليمية على السوق، وإجراءات الإنفاذ، ومخططات لتسوية المنازعات.

- المرحلة الأولى: تنفيذ تصميم انتقالي لسوق عربي مشترك، مع التركيز على تحديد وتوسيع نطاق فرص التجارة.
- المرحلة الثانية: توسيع وظيفة السوق العربي المشترك الانتقالي، مع التركيز على تفكيك مؤسسات مشغلي نظم النقل (TSOs)، واستحداث المنافسة بنظام الجملة.
- المرحلة الثالثة: الانتقال نحو تصميم نهائي لسوق عربي مشترك، مع التركيز على منافسة كاملة بنظام الجملة مدعومة من قبل أسواق مالية متعددة.
- المرحلة الرابعة: تحقيق سوق عربي مشترك تام التكامل، مع التركيز على شبكة عربية للربط الكهربائي التام والمتزامن.

ما ورد أعلاه من خطة مراحل التنمية الأربعة ممكنة من الناحية السياسية، وذلك تمثيا مع أفضل الممارسات، وتعد بتحقيق أهداف التكامل طويلة الأجل، وتضمن مراحلها نهج تدريجي لكنه منسق ومتناسك يقود نحو تنمية تجارة الكهرباء وتكامل الأسواق.

### الإستراتيجية طويلة الأجل المقترحة

لترجمة ما ورد أعلاه من مراحل الرؤية الأربعة إلى واقع عملي، يستلزم ابتكار إستراتيجية واضحة وثابتة على المدى الطويل تحدد إجراءات محددة لتطبيق السياسات التي ينبغي اتخاذها في كل مرحلة من مراحل تطوير السوق. يلخص الجدول (ES1) مضمون الإستراتيجية المقترحة، والتي تركز على القرارات الخاصة بالسياسات المتعلقة ببناء المؤسسات والأطر القانونية والتنظيمية. وتعترف الإستراتيجية بأن المناطق الفرعية الثلاث تقف عند مراحل مختلفة من تطور السوق. ومع ذلك فإن بناء المؤسسات للشبكة العربية الشاملة بأكملها سيساعد في نقل المعرفة والمهارات والمعلومات فيما بين المناطق دون الإقليمية الثلاثة، وكذلك من الدول المجاورة. ويلاحظ أيضا أن بناء المؤسسات في كل مرحلة مصمم بحيث يلبي متطلبات تلك المرحلة والاستعداد للانتقال إلى المرحلة المقبلة

#### جدول ES1 : ملخص الإستراتيجية المقترحة طويلة الأجل

مرحلة التطور	التوسع في البنية الأساسية وتجارة الكهرباء	البناء المؤسسي، الإطار القانوني، وطرق اتخاذ القرارات
المرحلة الأولى: سوق انتقالي يركز على تحديد فرص التجارة والتوسع فيها	تحديد مؤسسات تشغيل نظام نقل الطاقة/ مسهلو السوق فرص التجارة بناء على الأسعار الدولية للوقود	تشكيل أمانة/سكترارية
زيادة حجم التجارة المتوقعة بين مجموعة دول الربط الخليجي، ومجموعة الدول للربط الثماني، ومجموعة دول الربط المغربي العربي	تنفيذ التداول وفق عقود ثنائية مباشرة بين المرافق يتم إبرامها بين الدول المجاورة وغير المجاورة	تشكيل لجنة استشارية وتنظيمية عربية مشتركة
تقدم بعض الدول خدمة النقل/ المرور	تنفيذ البنية الأساسية من خلال:	إنشاء لجنة عربية مشتركة تضم المؤسسات العربية لتشغيل نظم نقل الطاقة
توسيع توليد الطاقة لتلبية الاحتياجات الوطنية والصادرات	● توسيع توليد الطاقة لتلبية الاحتياجات الوطنية والصادرات	إنشاء مؤسسة لتشغيل نظم نقل الطاقة/ ميسر سوق لكل منطقة فرعية <sup>8</sup>
استغلال توليد الكهرباء في تلبية فروق الطلب الموسمي واليومي	● استغلال توليد الكهرباء في تلبية فروق الطلب الموسمي واليومي	تطوير ما يلي والتوقيع عليه:
لما هو أبعد من حدود الأسواق المحلية	● لما هو أبعد من حدود الأسواق المحلية	● مذكرة تفاهم واتفاقية عامة لتكامل سوق الكهرباء العربية المشترك
توسيع الربط البيني القائم عبر الحدود بالنسبة لتجارة الجملة في الكهرباء (على سبيل المثال، بين العراق وسوريا، والأردن ومصر، ومصر وليبيا، وليبيا وتونس، والجزائر والمغرب)	● توسيع الربط البيني القائم عبر الحدود بالنسبة لتجارة الجملة في الكهرباء (على سبيل المثال، بين العراق وسوريا، والأردن ومصر، ومصر وليبيا، وليبيا وتونس، والجزائر والمغرب)	● اتفاقية عامة لسوق الكهرباء العربي المشترك
تحديث شبكات النقل الوطنية	● تحديث شبكات النقل الوطنية	● اكواد الشبكة العربية الموحدة
		تتسيق الأساسيات الفنية والاعتمادية للشبكة
		توسيع قاعدة البيانات للكهرباء العربية
		المشتركة لتتضمن معلومات شاملة وحديثة

<sup>8</sup> لدى هيئة الربط الكهربائي لدول مجلس التعاون الخليجي (GCCIA) العديد من المسؤوليات المقترحة لمؤسسة تشغيل نظم نقل الطاقة/ ميسر السوق الإقليمي الفرعي، ولكن ليس لكل (على سبيل المثال، لا تنشر هذه الهيئة أسعار السوق)، وبالتالي سيكون من الضروري إدخال بعض التعديلات في مسؤولياتها لتمكين من الاضطلاع بهذا الدور.

لخطط التوسع لكل دولة وبرامج الاستثمارات  
والتغيرات التنظيمية  
إعداد تعريفات نقل الطاقة واعداد مزاد قدرة  
نقل الطاقة عبر الحدود

ربط دولي إضافي:  
● مصر – السعودية  
● مصر - السودان  
● موريتانيا- المغرب  
● السعودية- اليمن

#### البناء المؤسسي، الإطار القانوني وطرق اتخاذ القرارات

#### التوسع في البنية الأساسية وتجارة الكهرباء

#### مرحلة التطور

الموافقة على فتح إمدادات الكهرباء عالية الجهد  
أمام المنافسة والسماح بتحديد التعريفات بالنسبة  
لكبار المستهلكين بواسطة السوق التنافسي.

فصل مؤسسات تشغيل نظم نقل الطاقة من خلال  
تفكيك الأسواق الوطنية وإنشاء جهات تنظيمية  
وطنية مستقلة ومستنيرة.

إنشاء جهة رقابية عربية (تبدأ بدور يتضمن  
إعداد التقارير والتنسيق وحل المنازعات قبل أن  
تصبح جهة رقابية تتولى القيام بكامل المهام  
المنوطه بها).

استبدال اللجنة الإقليمية العربية لتشغيل نظم نقل  
الطاقة بمؤسسة عربية شاملة تتولى ذلك الأمر  
ويكون لها مجلس إدارة وهيئة كاملة من  
الموظفين المنتظمين.

مراجعة أدوار الأمانة واللجنة الإقليمية  
الاستشارية والتنظيمية بما يعكس أدوار  
المؤسسات الوطنية الجديدة لتشغيل نظم نقل  
الطاقة والجهات التنظيمية.

تعديل دور المؤسسات شبه الإقليمية لتشغيل  
نظم نقل الطاقة/ميسري السوق لتتولى  
مسئوليات أكثر تتعلق بمهام تشغيل السوق.

تعديل كود الشبكة الإقليمية حسب الحاجة، وعمل  
مراجعات موسعة في الاتفاقية العامة لسوق  
الكهرباء العربي المشترك بما يتسع لتجارة  
تنافسية على مستوى الجملة.

توفير عنصر المنافسة أمام كبار المستهلكين المتصلين بشبكة نقل  
الطاقة مباشرة  
مزيد من العمل بهدف تحسين الاستدامة وتأمين إمداد الطاقة الكهربائية  
تسهيل التجارة من خلال مزيد من التعزيز لشبكات النقل والتزامن.  
ويتم تزامن النظم على مستوى كل مجموعات الربط دون الإقليمية  
(مجموعتي الربط الخليجي و الربط المغربي متزامنين بالفعل ؛  
تزامن كافة مجموعة دول الثماني)

تنسيق الاستثمارات في البنية الأساسية لنقل الطاقة.

المرحلة الثانية :  
توسيع السوق الإقليمي  
الانتقالي مع التركيز على  
فصل مؤسسات تشغيل  
نظم نقل الطاقة  
واستحداث المنافسة  
بنظام الجملة

البناء المؤسسي، الإطار القانوني، وطرق  
اتخاذ القرارات

التوسع في البنية الأساسية وتجارة الكهرباء

مرحلة التطور

الموافقة على فتح السوق أمام المنافسة الكاملة على مستوى نظام الجملة.

تشغيل الأسواق المالية الإضافية (على سبيل المثال، سوق اليوم التالي " day-ahead market ) حسبما يحتاج المتعاملون في السوق العربية المشتركة

استبدال منتدى المؤسسات الوطنية لتشغيل نظم نقل الطاقة/ ميسر السوق بمؤسسة تشغيل سوق إقليمي يكون مسئول عن كافة الأسواق المالية الإقليمية الوظيفية التي لم يتم تنفيذها وتشغيلها بواسطة مؤسسات القطاع الخاص.

تسريح الأمانة وإعطاء مسؤولية الرقابة الكاملة على السوق العربية المشتركة لمؤسسة تشغيل السوق العربية المشتركة، ومؤسسة تشغيل نظم نقل الطاقة العربية، وجهاز التنظيم العربي، على أن تكون الرقابة من قبل المجلس الوزاري العربي للكهرباء.

تعديل وثائق حوكمة السوق العربية المشتركة حسب الحاجة لتتضمن المنافسة الكاملة بنظام الجملة والأسواق المالية المنشأة حديثاً.

ضمان أن تكون لدى مؤسسات السوق العربية المشتركة المسؤولية الكاملة عن تحديد تعريفات نقل الطاقة وإنفاذ قواعد فنية ومالية موحدة عبر السوق العربية المشتركة.

إعداد وتنفيذ خطة موحدة لتنمية الطاقة العربية الشاملة (ويمكن أن تتضمن ثلاث خطط لمجموعات الربط دون الإقليمية تتسق مع الخطط الوطنية وتغطي كل من قدرات توليد ونقل الطاقة التقليدية والمتجددة) إعداد خطة لتزامن (أو عدم تزامن) لمجموعات الربط الثلاث دون الإقليمية مع الشبكة الأوروبية لمؤسسات نظم نقل الطاقة (ENTSO-E) وأسواق الكهرباء الإقليمية في المنطقة المجاورة.

تحقيق المنافسة الكاملة على مستوى نظام الجملة مع السماح لكافة كبار المستهلكين وجهات التوزيع/ التوريد حق اختيار المورد. استحداث أسواق مالية جديدة حسبما تقتضي حاجة المتعاملين في السوق العربي المشترك سوق التوازن القائم على المزادات " bid-based balancing market"، وسوق اليوم التالي، وسوق التبادل خلال اليوم " intraday market"، وسوق تداول الانبعاثات، الخ.

تشجيع الأسلوب الاقتصادي الكفاء (بما يتسق مع أهداف المنافسة والاستدامة واعتمادية/ تأمين الإمداد.

عمل مزيد من التحسين لقدرات نقل الطاقة والتزامن على المستويات الوطنية والدولية، وذلك بالاتساق مع احتياجات السوق العربي المشترك.

المرحلة الثالثة:  
الوصول إلى السوق الإقليمي النهائي مع التركيز على المنافسة الكاملة مؤسسات تشغيل نظم نقل الطاقة واستحداث المنافسة بنظام الجملة

الربط الكهربائي المتزامن (أو غير المتزامن) لمجموعات الربط دون الإقليمية الثلاث بما في ذلك البلدان غير الموصلة حالياً بأي من مجموعات الربط دون الإقليمية. يتم تزامن المنطقة أيضاً مع الشبكة الأوروبية لمؤسسات نظم نقل الطاقة الكهربائية (ENTSO-E) والأسواق الأخرى في المنطقة المحيطة. إتاحة الوصول الكامل إلى شبكة الربط والمنافسة التامة بنظام الجملة مع تواجد مؤسسات سوق عربية مشتركة تمارس وظائفها كاملة وكذا توافر وثائق حوكمة لها.

المرحلة الرابعة:  
سوق عربية متكاملة تماماً مع التركيز على الربط البيني والمتزامن التام بين شبكات الكهرباء العربية

ملحوظة: TSO = مؤسسة تشغيل نظم نقل الطاقة؛

GCC = مجلس التعاون الخليجي؛

EJLLPST = الربط الكهربائي بين دول الثماني ( مصر، العراق، الأردن، ليبيا، لبنان، فلسطين، سوريا، تركيا)؛

ENTSO-E = الشبكة الأوروبية لمؤسسات نظم نقل الطاقة الكهربائية؛

REM = (سوق كهرباء إقليمي).

على الرغم من أنه ينبغي على الإستراتيجية الرباعية المراحل أن توفر الإطار اللازم لبناء المؤسسات و وطرق اتخاذ القرارات، إلا أنه يجب أن يكون التركيز في المقام الأول على توضيح تفاصيل ما يجب تحقيقه خلال المرحلة الأولى. تبعا لذلك، فقد قمنا بتطوير تصميم معين لسوق عربية مشتركة للمرحلة الأولى وخطة تنفيذ تحتوي على القرارات المؤسسية وتلك المتعلقة بالسياسات التي يجب اتخاذها خلال هذه المرحلة. وتشمل العناصر الرئيسية في الخطة المقترحة إعداد الوثائق المطلوبة للحكومة والمؤسسات الإقليمية.

الخطة المقترحة توجه تركيز وثائق الحوكمة وبناء المؤسسات الإقليمية على هدف تحقيق تكامل سوق الكهرباء. ومن ثم، فهي لا تقترح سوى عدد محدود من الوثائق الإقليمية، وكذلك عدد قليل جدا من الكيانات الإقليمية. بشكل أكثر تحديدا، تتصور الخطة أن تشمل وثائق الحوكمة أربعة بنود رئيسية فقط هي:

- مذكرة تفاهم رفيعة المستوى
- اتفاقية عامة
- اتفاقية عامة لسوق الكهرباء العربية المشتركة
- كود شبكة الكهرباء العربية المشتركة<sup>9</sup>

وبالمثل، فإن الخطة تدعو إلى تشكيل أمانة، مع معالجة الاحتياجات الإقليمية الأخرى من خلال محافل تنسيق معينة وأنشطة. وتتضمن محافل التنسيق ما يلي:

- لجنة عربية مشتركة استشارية وتنظيمية تشتمل على عضو واحد من الجهاز التنظيمي في كل دولة مشاركة في السوق العربي المشترك.
- لجنة عربية مشتركة للمؤسسات العربية المسؤولة عن تشغيل نظم نقل الطاقة.

وعلى الأجل الطويل سيتم تنفيذ كل هذه المهام بواسطة جهة رسمية. ومع ذلك فإنه من المرغوب فيه على الأجل القريب أن يتم إنشاء مثل هذه المؤسسات العربية المشتركة بحيث تتجنب الالتزامات المالية الإضافية من الدول الأعضاء. ولهذا الغرض فإن المهام المقترحة سيتم تنظيمها اعتمادا على الجهات القائمة طبقا لما يلي:

- المهمة الاستشارية والتنظيمية العربية المشتركة ومهمة المؤسسات العربية المسؤولة عن تشغيل نظم نقل الطاقة سيتم القيام بها من خلال إنشاء لجنتين مقابلتين ودعوة أعضاء مناسبين طبقا لمهمة كل لجنة. وبالإضافة إلى ذلك، سيتم دعوة الأطراف الرئيسية ذات الصلة مثل الاتحاد العربي للكهرباء والمنندى العربي لمنظمي الكهرباء للمشاركة في اللجان ذات الصلة.
- يتولى القيام بدور الأمانة إدارة الطاقة بجامعة الدول العربية.

تقترح الخطة كذلك أن تنشأ مؤسسات تشغيل نظم نقل الطاقة / ميسري السوق لمجموعات الربط دون إقليمية لتيسير الأسواق داخل كل مجموعة من مجموعات الربط (الخليجي والمغاربي ودول الربط الثماني). ويتمثل دور تلك المؤسسات/ ميسري السوق في مجموعات الربط دون الإقليمية في تحديد الفرص التجارية من خلال العمل بشكل وثيق مع البلدان المشاركة. وهيئة الربط لمجلس التعاون الخليجي بالفعل بصدد عملية تعزيز مثل هذه الوظيفة داخل الهيئة. وبمرور الوقت، يمكن للمرء أن يستعرض مزايا خلق مؤسسة واحدة لتشغيل نظم نقل الطاقة / ميسر سوق على المستوى العربي المشترك.

أخيرا، تجدر الإشارة إلى أن تنمية مصادر الطاقة المتجددة قد احتلت مكانا بارزا في مداولات التكامل الإقليمي في الاتحاد الأوروبي، وأصبحت تأخذ قدرا كبيرا من الاهتمام في مناقشة شبكة الربط بين الدول العربية. إن تأثير مصادر الطاقة المتجددة على التكامل الإقليمي هو أربعة أضعاف. أولا، معظم مواقع تلك المصادر (مزارع الرياح وحقول الطاقة الشمسية) بعيدة عن

<sup>9</sup> ومن شأن مذكرة التفاهم أن تكون وثيقة حكومية رفيعة المستوى يوقع عليها وزراء الكهرباء في جميع الدول العربية، بهدف وضع التزامهم بمواصلة إصلاح السوق بما يتفق مع أهداف التكامل بين الأسواق الإقليمية. وينبغي أن تكون الاتفاقية العامة وثيقة حكومية رفيعة المستوى تحدد أهداف ومبادئ تكامل الأسواق الإقليمية، وتحدد أدوار ومسؤوليات الكيانات الخاصة بالسوق العربية المشتركة. كما أن الاتفاقية العامة الخاصة بالسوق العربية المشتركة للكهرباء ستكون وثيقة ذات مستوى أدنى توفر المزيد من التفاصيل عن كيفية استيفاء البلدان الالتزام المحدد في مذكرة التفاهم، وتحدد القواعد المتعلقة بالتجارة. أما كود الشبكة العربية المشتركة فسيحدد الحد الأدنى من المعايير التقنية للمنطقة ككل.

شبكات الكهرباء وستتطلب خطوط مخصصة لنقل الطاقة إلى الشبكة، مما سيؤثر على القدرة الإجمالية للنقل وإمكانية تجارة الكهرباء. ثانياً، من المتوقع أن ينمو إمداد الكهرباء باستخدام مصادر الطاقة المتجددة بشكل متزايد بحيث تساهم كأحد المصادر لتصدير الكهرباء. ثالثاً، سينشأ عن التكامل العربي المشترك لشبكات الكهرباء قدرة أكبر وأكثر تنوعاً لتوليد الطاقة في الأسواق الوطنية المعزولة، مما سيبني فرصة أفضل لتطوير مصادر الطاقة المتجددة وربما حوافز تجارية أقوى لتطوير صناعة محلية تُعنى بتصنيع معدات خاصة بالطاقة المتجددة. رابعاً، هناك كثير من الدعم المالي الدولي لأغراض تنمية مصادر الطاقة المتجددة، والتي يمكن استغلالها من قبل مؤسسات القطاعين العام والخاص لتوسيع قدرة توليد الكهرباء من مصادر الطاقة المتجددة مع تعزيز الربط الكهربائي عبر الحدود بما يساعد على الاندماج بين مصادر الطاقة المتجددة والتكامل الإقليمي.

ولتنمية مصادر الطاقة المتجددة أهمية خاصة لتطوير أكواد الشبكة. فإدماج الكهرباء المنتجة من مصادر الطاقة المتجددة، وخاصة طاقة الرياح، بشبكة الكهرباء يثير مخاوف محددة بشأن استقرار النظام. ولكي يمكن الحفاظ على ثبات تشغيل الشبكة، وهناك حاجة للتأكد من وجود مصادر أخرى لتوليد الطاقة لتعويض التغيرات في توليد الكهرباء من مصادر الطاقة المتجددة على مدار الساعة. وتشمل القضايا الفنية المرتبطة أنظمة الدعم الاحتياطي ونوعية الطاقة. ويمكن أيضاً لكود الشبكة أن يتطلب مواصفات فنية معينة من مصنعي ومطوري مصادر الطاقة المتجددة للحد من الآثار المترتبة على استقرار الشبكة

### قرارات تنفيذية رفيعة المستوى

ستتطلب خطة التنفيذ المذكورة أعلاه مجموعة من قرارات تنفيذية على مستوى رفيع (وزاري) لدفع العملية إلى الأمام. هناك نوعان من القرارات الفورية التي ينبغي جدولتها زمنياً في أقرب وقت ممكن. أولاً، هناك حاجة إلى قرار تنفيذي لإنشاء أمانة من شأنها تحريك العملية إلى الأمام<sup>10</sup>. وكما ذكرنا، فإن هذه المهمة على الأمد القريب سيتم القيام بها بواسطة أمانة جامعة الدول العربية والتي تشمل المسؤوليات الرئيسية لها ما يلي:

- توفير الدعم الإداري للمجلس الوزاري العربي للكهرباء ومكتبه التنفيذي، واللجنة العربية المشتركة الاستشارية التنظيمية، واللجنة العربية المشتركة للمؤسسات العربية لتشغيل نظم نقل الطاقة.
- استعراض التنفيذ السليم من جانب الأطراف لالتزاماتها بموجب المعاهدة، وتقديم تقارير سنوية إلى المجلس الوزاري العربي للكهرباء عن التقدم المحرز.
- بناء وصيانة نظم معلومات شاملة تحتوي على آخر البيانات عن خطط التوسع في البلدان الأعضاء، والتغيرات التنظيمية، وهلم جرا.

ثانياً، هناك حاجة هناك حاجة لقرار مذكرة التفاهم العربي الشامل (تم اعداد مسودتها الأخيرة من قبل جامعة الدول العربية باستشارة الدول العربية). هذه الوثيقة ستوفر الدعم السياسي والتوجيه اللازم لبدء العملية، حيث ستحدد أدوار مؤسسات السوق العربية المشتركة المختلفة، وآلية لتسوية المنازعات. وستختلف هذه الوثائق من ناحية نطاقها. ومن المستحسن أن تكون مذكرة التفاهم العربي الشاملة والاتفاقية العامة محددة ومركزة بشكل جيد لتغطية ما يلي:

- السياسات المتعلقة بتجارة الطاقة؛ المساعدة المتبادلة في حالة حدوث اختلال في النظام وإجراءات التشغيل والتدابير الوقائية وخطط العمل.
- البنية المؤسسية ودور كل من المجلس الوزاري العربي للكهرباء ومكتبه التنفيذي، والأمانة، واللجنة العربية المشتركة الاستشارية التنظيمية، واللجنة المشتركة للمؤسسات العربية لتشغيل نظم نقل الطاقة.
- عملية تنفيذ القرارات وتسوية المنازعات.
- الجوانب الأخرى ذات الصلة (الموازنة، وشروط الانضمام، إلخ)

وبغض النظر عن القرارات الفورية المذكورة أعلاه، هناك حاجة لاتخاذ القرارات التنفيذية التالية بحلول موعد الانتهاء من إعداد مشروع مذكرة التفاهم:

<sup>10</sup> هناك عدد من مبادرات التكامل الإقليمي موجودة بالفعل بما في ذلك الربط بين دول مجلس التعاون الخليجي، والمغرب العربي، ودول الثماني، ومبادرة حوض النيل (النيل)، والملكية المشتركة بين غينيا ومالي وموريتانيا والسنغال وتقاسم قدرات توليد ونقل الطاقة الكهرومائية. وستحتاج الأمانة إلى الاستفادة من إنجازات وأنشطة هذه الكيانات للاضطلاع بواجباتها في المنطقة بأسرها.

- الاتفاق على تشكيل لجنة عربية مشتركة استشارية تنظيمية لتوفير المشورة للمجلس الوزاري العربي للكهرباء ومكتبه التنفيذي بشأن وثائق الحوكمة، وجميع المسائل المتعلقة بالتشغيل عبر الحدود مثل تعريفات نقل الطاقة، وتوزيع قدرات النقل، والمقترحات الخاصة بتوسيع الربط الدولي، وكفاية معايير احتياطي توليد الطاقة، وتطبيق الالتزامات الائتمانية، وإجراءات التعثر في الدفع، وتسوية المنازعات، إلخ.
- اتفاق لتشكيل لجنة مشتركة للمؤسسات العربية لتشغيل نظم نقل الطاقة.
- اتفاق لإقامة مؤسسة لتشغيل نظم نقل الطاقة / ميسر سوق لكل من شبكات الربط بدول مجلس التعاون الخليجي، ودول الربط الثماني، والمغرب العربي.

# **Volume I: Main Report**



# 1 Background, Purpose, and Organization of the Report

## 1.1 Background

The Arab countries have enjoyed sustained economic growth in recent years, and the high economic growth has triggered a rapid increase in energy demand, particularly for electricity. Although part of this growing demand may be curbed through more effective energy conservation policies, including tariff adjustments, there is a clear need to expand generating capacity and fuel supply in all Arab countries. In recent years, gas availability has turned into a serious issue as countries such as Syria, Jordan, Saudi Arabia, Kuwait, the United Arab Emirates (UAE), and others have realized that their domestic gas production is insufficient to meet the needs of their power sectors. This has triggered a search for sources of imported gas or electricity, which has in turn led to attempts to construct cross-border infrastructure facilities.

Besides enabling energy imports, interconnected power networks impart a series of additional benefits such as improved system reliability, reduced reserve margins, reactive power support, and energy exchanges that take advantage of daily and seasonal demand diversity and disparities in marginal production costs. As a result, a world-class electricity supply system can be achieved with much lower capital expenditures and ongoing expenses than would otherwise be attainable on an individual-country basis.

Recognizing the benefits of regional integration, several bilateral and subregional initiatives are under way to interconnect the electricity networks of Arab countries to enable exchange and trade (see figure 1.1). The primary regional interconnection schemes among Arab countries currently include:

- The Maghreb regional interconnection, which includes Morocco, Algeria, and Tunisia, and was initiated in the 1950s and evolved into multiple high-voltage transmission interconnections between the three countries. Morocco was connected to Spain in the late 1990s, and Morocco, Algeria, and Tunisia are now all synchronized with the pan-European high-voltage transmission network.
- The eight-country (Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey [EIJLLPST]) regional interconnection, which was initiated in 1988 by Egypt, Iraq, Jordan, Syria, and Turkey as part of an effort to upgrade their electricity systems to a regional standard.<sup>11</sup> Lebanon, Libya, and Palestine later extended the agreement to eight countries.<sup>12</sup> Turkey is expected to fully synchronize to the European grid early in 2012, which could further advance efforts to synchronize the EIJLLPST electricity network with the grids in Turkey and Europe.
- The regional power interconnection of the Gulf Cooperation Council (GCC), which allows electricity exchange among its six member states—Kuwait, Saudi Arabia, Bahrain, Qatar, the UAE, and Oman—under an agreement signed in 2009. The interconnection is targeted at sharing capacity reserve and improving supply reliability, which will reduce the need for investment in new generation capacity.

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<sup>11</sup> Although the EIJLLPST Interconnection Agreement was signed in the 1980s, physical interconnections between Syria and Jordan and between Syria and Lebanon were constructed in the 1970s.

<sup>12</sup> According to the Minutes of the Eighteenth Annual Meeting of Medelec, the EIJLLPST interconnection will be renamed Electrical Interconnection of Three Continents (EITC) at the next ministerial meeting.

Though the Maghreb and EIJLLPST interconnections have existed for some time, electricity trade among the Arab countries has remained at modest levels due to obstacles such as limited generation reserve margins, the absence of a harmonized regulatory framework with clear rules governing electricity trade, and institutional weaknesses at both the national and regional level (that is, governing bodies lack the tools, data, and incentives necessary to promote trade). But the desire to improve supply security through the diversification of energy supply resources, particularly in the context of the interregional programs for the development of renewable wind and solar resources, has boosted motivation to deal with these weaknesses.

## 1.2 The Context and Purpose of This Study

This study, which focuses on the development of the institutional and regulatory framework for electricity trade in the Arab world, is one of three currently being carried out by the League of Arab States (LAS) on the development of regional electricity markets (REMs):

Part I: Study of Interconnections of Electrical Systems in the Arab World.

Part II: Study of Electricity-Gas Trade among the Arab Countries.

Part III: Study of Institutional and Regulatory Frameworks.

The main objective and scope of the three-part study is to establish a strategy and a master plan for the development of electricity trade among Arab countries. The three parts of the study are considered complimentary. Part III of the study—which is the subject of this report—is a joint effort between the LAS and the World Bank.

The World Bank, which is conducting this study jointly with the LAS, has been particularly active in this area of the world. Under the Arab World Initiative, the World Bank has completed three studies to assess the potential of energy integration in the three Arab subregions, including Maghreb, EIJLLPST, and the GCC, while implementing a major regional program for scaling up concentrated solar power (CSP) in the Middle East and North Africa (MENA) region.

This study focuses on the institutional and regulatory aspects of cross-border trade and electricity market integration among the 22 Arab the League of Arab States member countries,<sup>13</sup> and between the Arab countries and potential neighboring markets. Consistent with the LAS Terms of Reference, the study covers six primary areas:

- Analyzing the legal and regulatory framework for the power sectors of the target countries, with particular attention to cross-border electricity trade, including development of required governance documents such as grid code, power exchange, and supply code (market rules)
- Identifying potential obstacles (and auspicious factors) to the creation of an REM and developing operational recommendations to surmount these obstacles
- Identifying barriers to efficient energy trading among the concerned countries and developing possible workable solutions to facilitate trade and regional integration
- Defining the legal support required for a gradual progression toward a competitive and efficient REM

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<sup>13</sup> Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, the United Arab Emirates (UAE), and Yemen.

- Developing and assessing the general terms under which electricity is to be traded, taking into consideration international constraints such as European Union (EU) market trading rules, limitations on imports, limitations on long-term price agreements, and environmental rules
- Proposing an action plan for the negotiation of the necessary treaties or international agreements to promote electricity trade among Arab countries and target markets

This study comprises two phases. Phase 1, contained in this main report (Volume I), examines regional market structure and design (see table 1.1). Phase 2 (Volume 2) examines principles of market regulations and legal arrangements including a draft road map for a transition path toward market integration and governance documentation including drafts Memorandum of Understanding, General Agreement, General Pan Arab Electricity Market Agreement, and Regional Grid Code (see table 1.2)

**Table 1.1 Summary of Phase 1 Tasks and Volume I Report Structure**

Task	Report Location
1. Sector and regional overview	Chapter 2
2. Current market structure and operation	Chapter 2
3. Context for regional electricity trade	Chapter 3
4. Strategic and technical consultation meeting (I)	N/A
5. The “ultimate regional market” parameters	Chapter 4
6. The “transitional regional market” design	Chapter 5
7. Strategic and consultation meeting (II)	N/A
8. Final phase I report	N/A

N/A = Not applicable.

**Table 1.2 Summary of Phase 2 Tasks and Volume II Report Structure**

Task	Report Location
1. Draft Roadmap for Implementing the Pan-Arab Electricity Market Integration	Section 1
2. Draft Memorandum of Understanding for Development of the Pan-Arab Electricity Market	Section 2
3. Draft General Agreement	Section 3
4. Draft General Pan-Arab Electricity Market Agreement	Section 4
5. Draft Regional Grid Code	Section 5

### 1.3 Approach and Organization of the Study and this Report

The study starts by recognizing that the eventual objective of power sector integration is to optimize the supply of electricity within a broad, regional (rather than confined, national) framework. Such optimization is possible if every party has equal access to all networks (domestic, regional, and international), if market data (pricing, market operation, capacity allocation, and so on) are transparent, tariffs cover the cost of supply, power grid codes are harmonized, systems are synchronized, and markets liberalized. But the study also recognizes that Arab countries are at various stages of power sector development, each with its own characteristics and constraints. Therefore, the cross-border interconnection plans must take current sector conditions into consideration.

While this study identifies current issues associated with transmission infrastructure and the synchronization of power networks, it does not attempt to analyze and present solutions to overcome such constraints. Such issues are the focus of the LAS’s feasibility study (Part I), as mentioned above.

This study's approach is to consider Pan-Arab regional electricity market development from the perspective of building on the three current Arab REMs: Maghreb, EIJLLPST, and the GCC. Six of the 22 Arab countries—Mauritania, Sudan, Yemen, Somalia, Djibouti, and Comoros—are not currently interconnected with these regions, and are therefore not addressed in as much detail in this report. While these countries may at some point become important partners in a Pan-Arab electricity market, in the absence of electrical interconnection, such prospects appear to be far off in the future.

This Volume 1 report is organized into six chapters, with this introduction as chapter 1. The remaining chapters are:

**Chapter 2—Current Market Structure and Organization:** Provides an overview of current regional and national electricity markets, including market structure, institutions, and regulation.

**Chapter 3—Context for Regional Electricity Trade:** Develops the context for regional trade, identifying opportunities as well as the primary obstacles and challenges to the development of a regional electricity market.

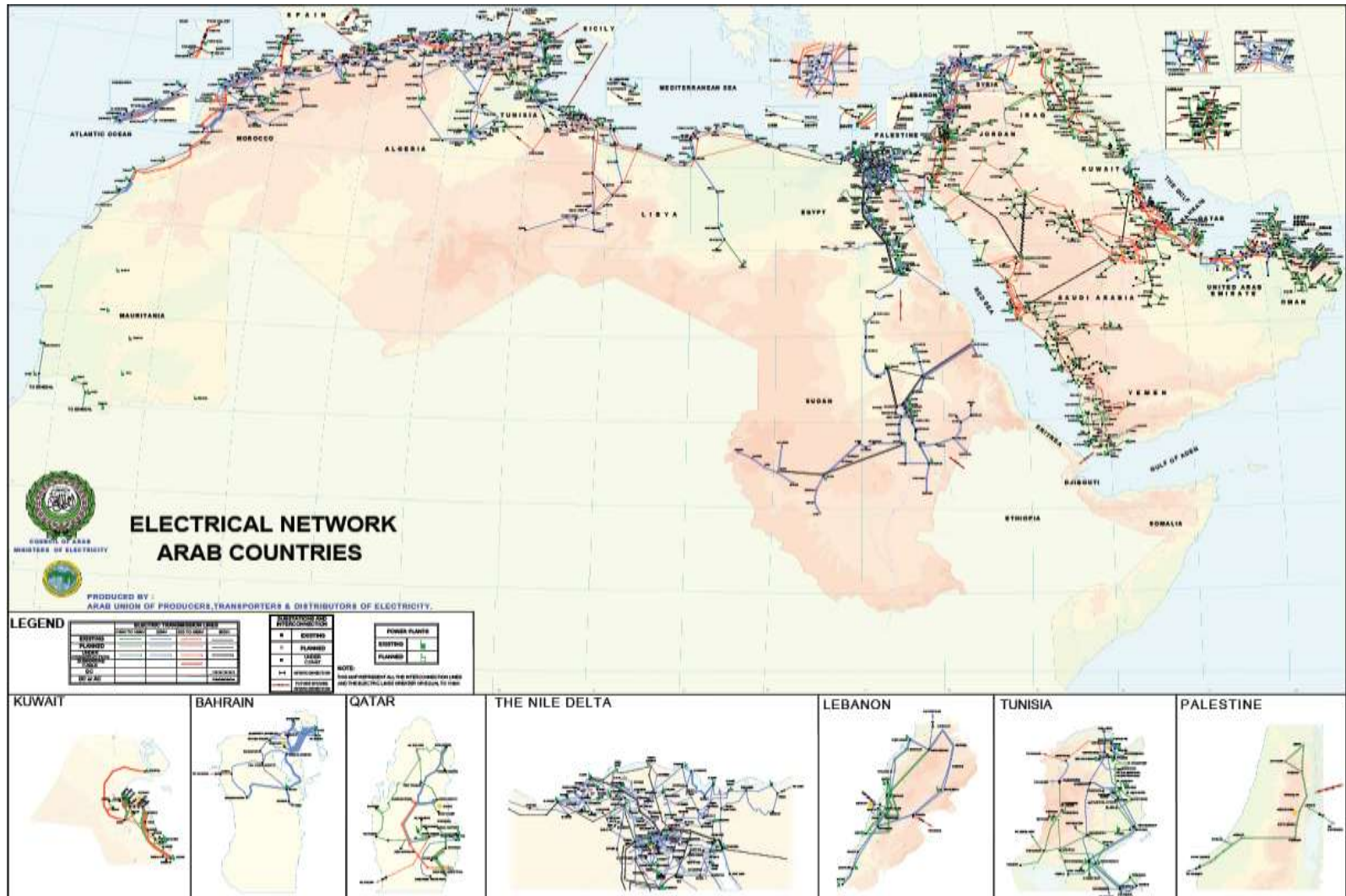
**Chapter 4—Ultimate Regional Electricity Market Design:** Develops a proposed ultimate regional market design as a long-term goal to serve as a guide for market restructuring.

**Chapter 5—Transitional Regional Electricity Market Design:** Develops a transitional market design that takes current constraints and obstacles into account.

**Chapter 6—Next Steps:** Considers what may be involved in Phase 2 of the study.

There are a number of terms used throughout the report relating to market restructuring and reform. These terms often mean different things to different people, so in an attempt to clarify, we provide our definitions in table 1.3.

Figure 1.1 The Arab electricity network



Source: Arab Union of Electricity.

### Table 1.3 Definitions of commonly used terms

**Market restructuring and reform:** The process whereby changes are made in a power sector in an attempt to provide incentives for improvement in the efficiency of power production, delivery, and consumption. It often includes the introduction of competition in certain components of the electricity sector.

**Vertically integrated utility:** A utility, often state owned, that performs most or all functions of a power market including generation, system operation, transmission, distribution, and supply.

**Unbundling:** The separation of the various components of a vertically integrated utility into smaller groups or companies by function, including generation, system operation, transmission, distribution, and supply.

**Single buyer:** The single buyer in an unbundled electricity sector responsible for purchasing all power from generators and selling that power at the wholesale level to supply companies or directly to large industrial customers.

**Wholesale competition:** A system under which customers at the wholesale level, including supply companies, large industrial customers directly connected to the transmission system, and traders and brokers, have the right to choose their supplier.

**Independent and informed regulation:** A regulator that provides oversight of the electricity sector. An “independent regulator” is able to make decisions in the absence of political interference. An “informed regulator” has the background, expertise, and skills necessary to make decisions on behalf of all participants in the power sector.

**Economic dispatch:** The practice of operating a coordinated power system so that the lowest-cost generators are used as much as possible to meet demand, with more expensive generators brought into production as loads increase (and conversely, more expensive generation eliminated from production as loads fall). The United States Environmental Protection Act’s definition of economic dispatch is: “the operation of generation facilities to produce energy at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities.”

**Grid code:** A document that includes the technical rules governing connection to, and use of, the transmission network.

**Market rules or commercial code:** A document that includes the commercial and financial rules governing participation in the electricity market.

**Open access:** All authorized market participants are allowed fair and nondiscriminatory access to the transmission network under published terms, conditions, and prices.



## 2 Sector and Regional Overview

This chapter of the report discusses the current regional markets in the Arab world, including its three existing regional interconnections: the Maghreb; Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey (EIJLLPST); and the Gulf Cooperation Council (GCC). The chapter also examines the state of each national market served by the interconnections, with a focus on the structure, institutions, regulation, and development of electricity markets. The chapter also includes a brief summary of a number of markets bordering the Arab countries, including Europe, Turkey, Iran, the Nile Basin Initiative (NBI), and the West African Power Pool (WAPP).

Key energy statistics relating to the 22 Arab countries are provided in table 2.1.

**Table 2.1 Arab country key statistics**

Country	Population (millions)	GDP (US\$ billions)	Electricity generation capacity (MW)	Peak electricity demand (MW)	Capacity reserve margin (%)	Electrical energysales (TWh)	Average electricity tariff (US cents/kWh)
EIJLLPST							
Egypt	83.0	441.6	24,504	22,079	11	119.4	2.5
Iraq	26.1	105.8	8210	9950	-17	26.9	1.2
Jordan	5.9	31.2	2979	2482	20	12.8	7.1
Syria	21.2	94.2	8025	7873	2	29.7	5.0
Lebanon	4.1	47.9	2312	2499	-7	4.9	6.1
West Bank and Gaza	3.9	4.0	140	810	-83	3.9	14.1
Libya	6.3	102	6006	5759	4	21.1	3.3
GCC							
Kuwait	2.7	121.1	12,579	10,970	15	49.3	0.6
Saudi Arabia	25.4	589.5	49,138	45,661	8	211.1	3.3
Bahrain	0.8	21.9	3227	2633	23	11.0	2.6
Qatar	1.7	71.0	7881	5090	55	18.8	2.2
UAE	4.5	226.1	25,252	18,111	39	83.0	9.0
Oman	2.8	56.6	4100	3594	14	11.4	3.6
Maghreb							
Algeria	34	276	11,332	7718	47	35.7	4.7
Morocco	31.3	136.9	5596	4550	23	23.3	11.2
Tunisia	10.3	82.1	3580	2793	28	12.9	9.5
Others							
Mauritania	3.0	6.0	189	86	120	0.6	24.0
Yemen	22.9	26.4	1334	1125	19	4.7	6.8
Sudan	40.3	54.7	2585	1386	36.8	6.0	8.7
Somalia	8.9	0.9	80	72	11	0.3	---
Djibouti	0.8	1.0	130	63	106	0.3	25.7
Comoros	0.6	0.5	10	---	---	0.1	---

Note: (1) Population and GDP data based on World Bank Statistics for 2009. GDP data is based on purchasing power parity. The World Bank had not yet compiled 2010 data at the time the report was submitted.

(2) Data reflect 2010 values supplied by the League of Arab States (LAS).

(3) Reserve margin is based on installed capacity. It may actually be lower depending on generation and fuel availability. In the case of Sudan, reserve margin based on available capacity.

(4) Unless provided directly by the LAS, average tariff from February 2009 World Bank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

GDP = gross domestic product; kWh = kilowatt-hour; TWh = terawatt-hour; MW = megawatt.

### 2.1 Maghreb Region

#### 2.1.1 Overview

The Maghreb regional market lies in the northwestern part of the African continent, comprising Algeria, Morocco, and Tunisia. Work on the Maghreb interconnection began in the 1950s, and evolved into multiple high-voltage transmission interconnections between the three nations.<sup>14</sup>

The Maghreb regional market comprises a mix of resource endowment: Algeria is a major producer of crude oil and gas and is a net exporter of energy; Morocco is a net importer of energy; and Tunisia produces small amounts of crude oil and gas and is a net exporter of crude oil, albeit in small amounts. Although the electricity grids of the Maghreb countries are connected, power exchange is limited to specific annual contracts.

Key electrical statistics for each of the Maghreb countries are provided in table 2.2.

**Table 2.2 Key Statistics for Maghreb countries—2010**

Country	Peak demand (MW)	Installed capacity (MW)	Annual sales (TWh)	Forecast annual growth rate (%), 2010–20	Average tariff (US cents/kWh)	Electricity consumption (kWh/capita)
Algeria	7,718	11,332	35.7	6.0	4.7	1050
Morocco	4,550	5596	23.3	6.0	11.2	744
Tunisia	2,793	3580	12.9	5.7	9.5	1252

*Source:* League of Arab States. Growth rates based on various World Bank reports.

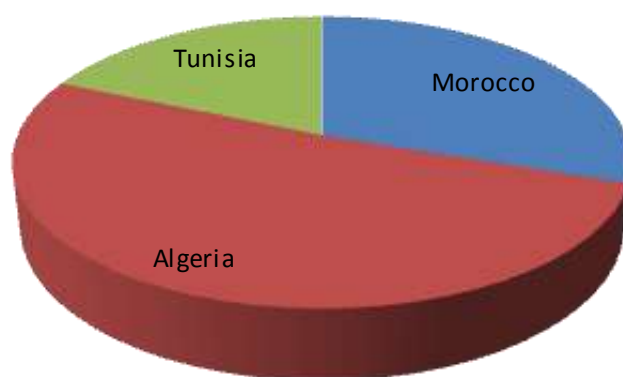
*Note:* kWh = kilowatt-hour; TWh = terawatt-hour; MW = megawatt.

### 2.1.2 Demand/Supply Balance

Electricity demand in the Maghreb region has been growing over the past decade at an annual rate of 5 to 7 percent. This is primarily attributed to a growing population, increased economic development, and increased electricity access.

Figure 2.1 shows each country's contribution to Maghreb's peak demand. Figure 2.2 gives the appearance that there is enough installed capacity to meet this demand reliably, but in reality, not all of the installed capacity is available. For example, 20 percent of installed capacity in Morocco is hydropower, which, owing to water limitations, is not always available.

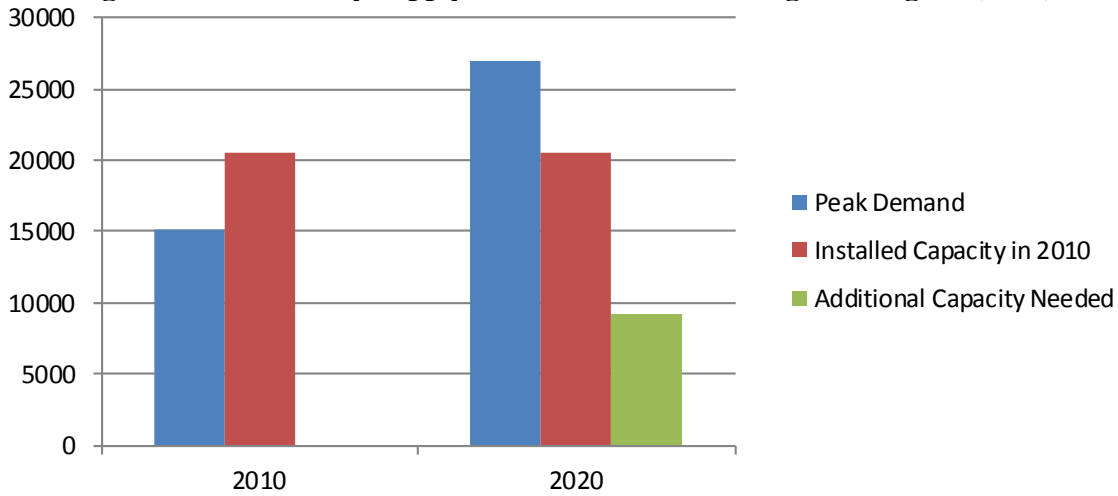
**Figure 2.1 Contribution by country to Maghreb peak demand**



<sup>14</sup> In February 1989, the Maghreb countries signed a treaty with Mauritania and Libya focusing on economic integration and establishing the Arab Maghreb Union (AMU), which is closely modeled on the European Union (EU). Currently, Mauritania is not interconnected with the Maghreb countries, and Libya, although interconnected, is not synchronized, so for the purposes of this report, they are not considered part of the Maghreb regional market.



**Figure 2.2 Electricity supply and demand in the Maghreb region (MW)**

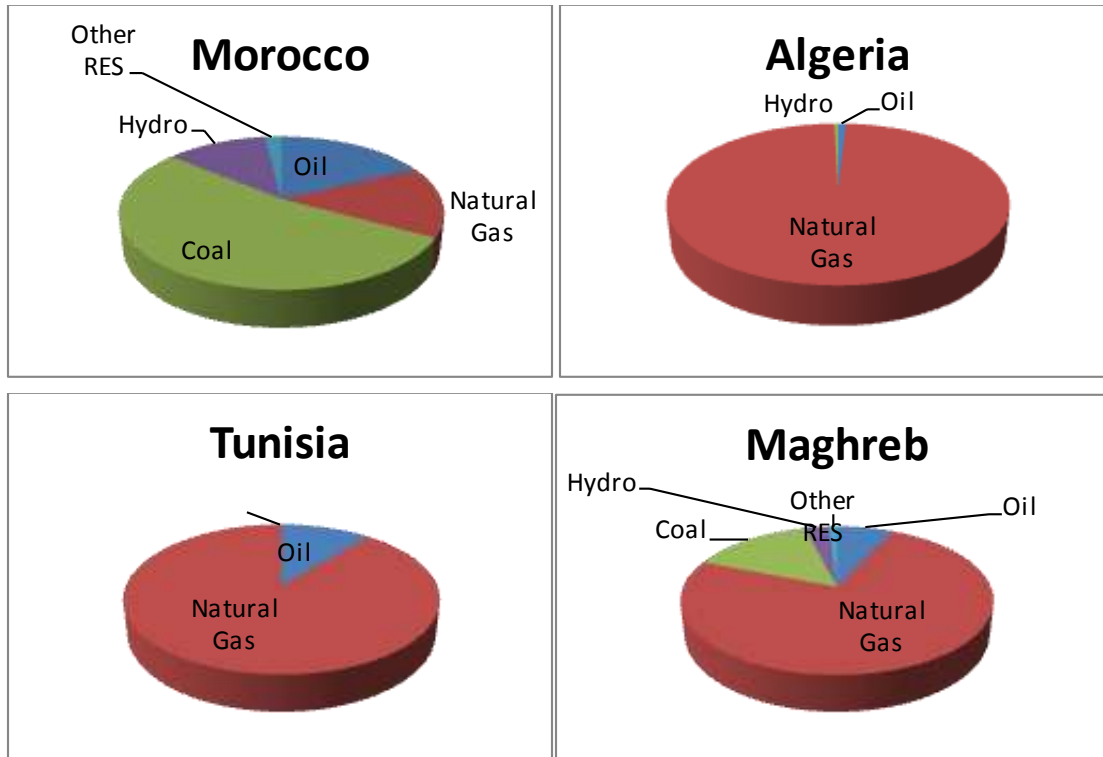


While the Maghreb region does not currently experience significant outages in electricity supply, it is forecast that demand growth will continue into the next decade, leading to an 80 percent increase in peak demand between 2010 and 2020 (see figure 2.2). This growth will require significant investment in new generation, on the order of an additional 16 gigawatts (GW) by 2020, and this does not include investment necessary to replace retired plants. Additionally, capacity may need to be increased if renewable energy production is scaled up in the region as suggested by a number of solar plans. For example, Morocco has announced plans to add 2,000 megawatts (MW) of solar power by 2020. Integrated regional electricity markets (REMs) with reserve sharing will help to incorporate large-scale renewable energy development and reduce the amount of capacity needed for backup.

### 2.1.3 Generation Mix

The generation mix varies by country in the Maghreb region (see figure 2.3), dependent to a large extent on each country's natural resources. Given Algeria's significant gas resources, and to a lesser extent Tunisia's, natural-gas-fired generation makes up the majority of the generation mix in these countries and in the region as a whole. Generally, gas-fired generation has relied on low-efficiency simple-cycle gas turbines, but combined-cycle generation has recently been gaining market share, reflecting a heightened awareness of the limited nature of gas resources. Unlike Algeria and Tunisia, Morocco relies heavily on imported coal, which represents about 52 percent of its generation mix. Hydropower contributes another 20 percent to Morocco's generating capacity but only represents 12 percent of its production. Imports from Spain meet about 20 percent of Morocco's electricity requirements.

**Figure 2.3 Generation mix in the Maghreb region**



Source: The League of Arab States (LAS) and various World Bank reports.

Note: RES = renewable energy source.

### 2.1.4 Maghreb Interconnection

As stated above, work on the Maghreb interconnection began in the 1950s and led to several interconnections between member nations. Meanwhile, the Maghreb countries have committed to further development. At the Euro-Mediterranean Ministerial meeting in late 2003, the European Commission and the energy ministers of the Maghreb nations signed a protocol aimed at developing a REM that would be progressively integrated into the EU electricity market. The protocol is not legally binding, but rather a declaration of intent, indicating commitment to reform (see table 2.3). Algeria has clearly committed to the introduction of competition in generation, distribution, and supply in the gas and electricity market, and to the liberalization of electricity imports and exports. Morocco is willing to open its market to retail competition over time by gradually reducing the threshold on the size of customers eligible to select their own supplier. Tunisia is less aggressive in its commitment.<sup>15</sup> The protocol creates a number of joint forums and institutions to bring the Maghreb countries together in the formation of an electricity market. The institutions envisaged are shown in table 2.4.

<sup>15</sup> See ECA report prepared for The World Bank entitled, *Maghreb: Scoping Study—Regional Energy Trade in the Maghreb Region*, dated June 2007.

**Table 2.3 Maghreb reform objectives in the 2003 protocol**

Algeria	Morocco	Tunisia
Intention to adopt the new law on the gas and electricity sector within the Algerian market to introduce competition in:	Intention to proceed to the partial opening of the electricity market to certain eligible customers in a progressively evolving fashion	Bearing in mind the specificities of the energy sector in Tunisia
Electricity production and distribution	Adopt an organisational structure specific to the needs of Moroccan electricity	
Gas distribution		
Commercialization of gas and electricity		
Free exports and imports of electricity		

Source: Union of the Electricity Industry - EURELECTRIC website (2007), 'Protocol for the progressive integration of electricity markets in Algeria, Morocco and Tunisia in EU Internal Electricity Market, Rome, December 2, 2003'.

**Table 2.4 Institutions arising from the 2003 protocol**

Institution	Function	Composition	Meetings	Other details
Ministerial Council	Takes strategic decisions and formulates recommendations  Identifies priority infrastructure projects financed by internal and external sources both public and private	Energy ministers from the three countries and the European Commission member for energy as an invitee	At least once a year	yearly presidency rotated among them  Ministers of energy of EU member states could be invited as observers
Permanent High Level Group	Prepares the Ministerial council meetings and sends proposals for integration of the electricity market of the three countries with that of the EU	Representatives of the energy ministers of the three countries and of the European Commission energy DG	Ad-hoc meetings initiated by any signatory to the protocol or by the representatives of the EU Commission-energy DG	Presents a yearly report of all the measures undertaken to ensure universal service and security of supply
Expert groups	Undertaking of specific studies or work conducive to the achievement of the regional electricity market	May be formed at the request of the permanent high level group		Reports results of work to the high level group
Forum of electricity rules for participating countries	Examines progress on progressive integration of the Maghreb to the EU electricity market and prepares relevant recommendations	Representatives of the Maghreb countries, the EU Commission-energy DG, regulators, network operators, energy companies	At east twice a year	Other participants: the council of energy regulators of Europe, the European association of network operators and

Source: Union of the Electricity Industry - EURELECTRIC website (2007), 'Protocol for the progressive integration of electricity markets in Algeria, Morocco and Tunisia in EU Internal Electricity Market, Rome, December 2, 2003'.

The protocol envisages the creation of a number of mechanisms to facilitate trade, including how to deal with tariffs, transborder networks and constraints, and compensation for network damage.

The Algiers Declaration, signed in 2010, further shows the Maghreb nations' commitment to integration. According to this declaration, the nations agree to pursue actions aimed at harmonizing laws and regulatory frameworks and economic and technical conditions for the creation of a viable market for electricity in and between the three Maghreb countries and integration with the EU. Further, the nations agree to work toward creating a genuine Maghreb electricity market, with network access provided on a nondiscriminatory and transparent basis and properly priced to promote trade. They also invite the network operators to draft a common set of rules to facilitate cross-border trade in electricity, and the regulators (or public authorities who are currently assuming this position) to present a draft common methodology for pricing and cross-border access to transmission infrastructure for electricity, with reference to the principles used in the EU. They agree to work together toward the improvement and harmonization of market rules for electricity, access to the network, and operating systems. The document emphasizes the importance of developing new and renewable energy, and promoting energy efficiency and environmental conservation in the integration of electricity markets using a sustainable development approach. The nations' electricity ministers agreed to meet in June 2011 to assess progress and provide, where appropriate, necessary guidance.

Currently, exchanges among Maghreb countries are mainly limited to mutual aid, with each country's yearly balance close to zero (see table 2.5). The only exception, of course, is Morocco's large imports from Spain, representing 20 percent of its power needs.

**Table 2.5 Power exchanges between Maghreb countries**

Interconnection	Max transfer capacity (MW)	Energy exchanged (GWh/Year)	Load factor (%)
Algeria–Tunisia	150	141	11.0
Tunisia–Algeria	150	122	9.0
Morocco–Algeria	400	613	17.0
Algeria–Morocco	400	662	19.0
Morocco–Spain	700	15	0.2
Spain–Morocco	700	4227	69.0

Source: The LAS and various World Bank reports.

Note: Data for 2010 or most recent year available.

MW = megawatt; GWh = gigawatt-hour.

The Maghreb nations have been synchronized with the European Network for Transmission System Operators–Electricity (ENTSO-E) since 1997 via the 2x400 kilovolt (kV) AC interconnection between Spain and Morocco. But a number of transmission interconnection reinforcement projects among the Maghreb countries are planned:

- A 400 kV interconnection between Morocco and Algeria with a thermal limit of 1,200 MW is planned for operation in 2011.
- A 400 kV interconnection between Algeria and Tunisia with a thermal limit of 1,200 MW is planned for operation in 2011.
- A 400 kV interconnection between Tunisia and Libya with a thermal limit of 1,200 MW is planned for operation in 2012.

Consideration has been given to establishing interconnections between Algeria and Spain, Algeria and Italy, and Tunisia and Italy (Sicily), the one between Tunisia and Sicily being the most promising. The plan is to export electricity generated from a new power plant (3x400 MW gas or 2x660 MW coal) through a 400 kV high-voltage direct current (HVDC) submarine cable (30 kilometers on land and 195 km undersea at a depth of 600 meters). The capacity of the line would be 1,000 MW, and commissioning is planned for 2016. About 80 percent of the line capacity would be allocated to the new power plant, leaving 20 percent for other parties.<sup>16</sup>

As part of the Medring initiative, a test of the Libya-Maghreb synchronization in April 2010 failed; future synchronization studies are under way. Mauritania is not interconnected with the Maghreb countries, but there have been studies of a potential interconnection with Morocco.

## 2.1.5 National Power Markets in the Maghreb

### 2.1.5.1 Morocco

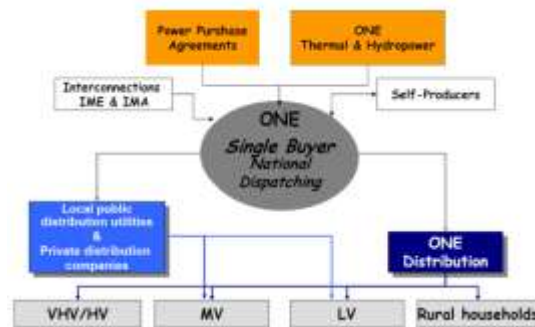
Morocco's power sector includes public and private operators; principle players include the Office National d'Electricité (ONE), independent power producers (IPPs), and the distributors. ONE is responsible for managing and operating the country's transmission grid, its generators, and part of the distribution network, and it serves about 50 percent of the nation's customers, primarily in rural areas. ONE holds power-purchase agreements (PPAs) with private producers. Morocco has both public and private distribution companies. Private distribution companies are located in Rabat, Casablanca, Tangiers, and Tetouan.

The activities of the electricity market participants are regulated by various ministries, including the Ministry of Energy and Mines, the Ministry of Interior, the Ministry of Finance, and the Ministry of Economic Affairs. Since 1994 (Law Dahir 2-94-502), Morocco has a single-buyer market model with state-owned ONE purchasing all power generated in Morocco through PPAs and importing power from Spain and Algeria. A schematic showing the organization of Morocco's power sector is provided in figure 2.4.

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<sup>16</sup> See Minutes of the Eighteenth Annual Meeting of Medelec—Algiers, September 27–29, 2010.

**Figure 2.4 Organization of Morocco’s power sector**



Note: IME: Interconnection Morocco–Europe; IMA: Interconnection Morocco–Algeria.

Morocco needs to make some legal and regulatory adjustments to allow for change. Currently, there is no independent regulatory authority in Morocco. Neither is there a published transmission tariff for establishing access to the transmission system. But the nation is currently undertaking a study on power sector reform that would include the creation of a free market to operate in parallel with the regulated market, and a consultant has been hired to define the parameters of a new regulatory authority. The Government of Morocco supports renewable energy and energy efficiency through a number of laws that are met through several programs with objectives relating to energy security and low-carbon energy developments.

Morocco’s retail tariffs are less than the economic cost of supply. The World Bank has reported that residential customers in Morocco consuming 700 kilowatt-hour (kWh) per month pay only 63 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>17</sup>

Morocco’s electricity sector is summarized as follows:

- **Reform:** Limited, but under study.
- **Market structure:** Single buyer with some unbundling.
- **Separate regulator**<sup>18</sup>: No.
- **Open access:** No.
- **Grid code/distribution code:** No/no.
- **Private-sector participation:** Yes, in generation and distribution.

<sup>17</sup> See February 2009 World Bank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

<sup>18</sup> A separate regulator means that an entity exists with sole responsibility for regulating the electricity sector. The regulator may or may not be independent in the sense that it is free to set tariffs in the absence of political interference.

- **Tariffs:** Subsidized.

### 2.1.5.2 Algeria

Liberalization of Algeria's power sector started with the approval of Law no. 02-01 on February 5, 2002. The law includes provisions for unbundling the former vertically integrated utility, SONELGAZ; the roles and responsibilities for each market participant; and the market model, including the creation of a power exchange. SONELGAZ has since been restructured as a holding company. The primary companies within the holding company are shown in table 2.6.

**Table 2.6 Companies within SONELGAZ holding company**

Sector	Initials	Name
Generation	SPE	Société Algérienne de production de l'électricité
Transmission	GRTE	Société Algérienne de Gestion du Réseau de Transport de l'Electricite
	OS	Operateur Systeme Electrique
Distribution	SDA	Société de Distribution de l'Electricite et du Gaz d'Alger
	SDC	Société de Distribution de l'Electricite et du Gaz du Centre
	SDE	Société de Distribution de l'Electricite et du Gaz de l'Est
	SDO	Société de Distribution de l'Electricite et du Gaz de l'Ouest

Algeria has implemented a single-buyer market model with SONELGAZ/OS as the independent system operator (ISO) responsible for transmission grid planning and operation. The transmission assets are owned by SONELGAZ/GRTE. Four IPPs with significant international ownership also participate in the Algerian power market. There are four distribution companies with franchises covering the various geographic areas across the country.

Law 02-01 created a regulatory authority known as CREG which contributed significantly to the adoption of legislation, including on tariffs on the power sector's regulated activities. The law also envisions a market operator, but it has not yet been implemented. Procedures for the operation of the power exchange also have yet to be implemented, though they were defined in 2008.

The government has been increasingly emphasizing efficiency and renewable energy. The current share of renewable energy sources (RESs) is not significant in the total energy balance, but an ambitious development program was established under a 2004 law that includes incentives for RES use and created a support fund and a renewable energy institute known as the IAER. Algeria currently envisages the development of 2,570 MW of renewable generation by 2020, including 1,500 MW of CSP; 800 MW of photovoltaics (PV); and 270 MW of wind power. By 2030 it is envisaged that 12,000 MW of renewable generation will be developed, including 7,200 MW of concentrated solar power; 2,800 MW of photovoltaics; and 2,000 MW of wind.



Retail electricity tariffs in Algeria are well below the economic cost of supply. The World Bank reports that residential customers in Algeria consuming 700 kWh per month pay only 31 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>19</sup>

Algeria's electricity sector is summarized as follows:

- **Reform:** Under way with new law passed.
- **Market structure:** Single buyer with unbundling.
- **Separate regulator:** Yes.
- **Open access:** No.
- **Grid code/distribution code:** Yes/yes.
- **Private sector participation:** Yes, in generation and distribution.
- **Tariffs:** Subsidized.

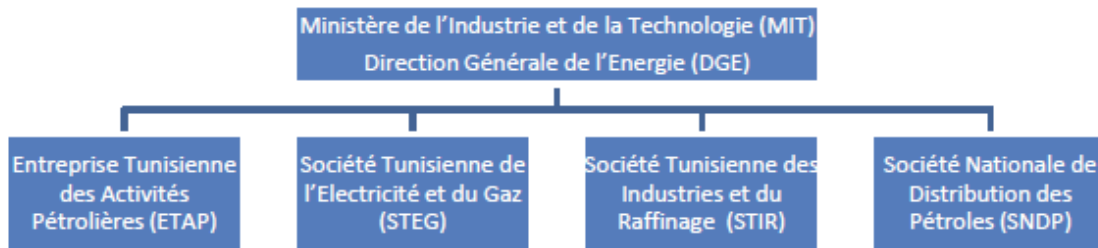
#### **2.1.5.3 Tunisia**

Until 2002 Tunisia's sole supplier of electricity generation, transmission, and distribution was Société Tunisienne de l'Electricité et du Gaz (STEG), a state-owned, vertically integrated monopoly. The Tunisian government terminated STEG's monopoly over power generation in 1996 to encourage private power generation (April 1, 1996, Decree no. 96-27). The first IPP in Tunisia was the 471 MW combined-cycle plant at Rades (Rades II), which commenced operation in 2002. The second IPP followed shortly thereafter, commencing operation in 2004. STEG continues to maintain control over distribution, but the Tunisian government is seeking to encourage further private investment in power generation. STEG and the two IPPs are the main participants in Tunisia's power sector today. The organization of Tunisia's energy sector is shown in figure 2.5.

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<sup>19</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

**Figure 2.5 Organization of Tunisia’s Energy Sector**



In February 2009, a new law (no. 2009-7) was promulgated requiring STEG to purchase the surplus power generated by self-producers from RES and to lease its transmission system to transport the surplus from one establishment to another within the same group. The law also allowed companies to equip themselves with cogeneration equipment for their own consumption. Nonetheless, Tunisia’s power sector remains vertically integrated (STEG) without independent regulation.

Tunisia has been a pioneer among developing countries in terms of its energy management policy, having formulated and implemented a policy for the rational use of energy and the promotion of RESs as early as 1985. The 11th Development Plan (2007–11) sets the broad direction of energy policy, including the gradual reduction of energy subsidies, and calls for a scaling up of investment in renewable energy and energy efficiency. The Tunisian Solar Plan was launched in 2009 for the period 2010–16. It aims at increasing the share of RESs and energy efficiency.

Retail tariffs in Tunisia are below the economic cost of supply. The World Bank reports that residential customers in Tunisia consuming 700 kWh per month pay only 61 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>20</sup>

Tunisia’s electricity sector is summarized as follows:

- **Reform:** Limited.
- **Market structure:** Vertically integrated.
- **Separate regulator:** No.
- **Open access:** No.

<sup>20</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

- **Grid code/distribution code:** No/No.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

## 2.2 EIJLLPST Region

### 2.2.1 Overview

The EIJLLPST regional market lies along the eastern half of the Middle East and North Africa (MENA) region. It includes Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, and Syria. The EIJLLPST countries have signed a comprehensive interconnection agreement, and numerous regional projects and initiatives are under way to enhance cooperation and development within the EIJLLPST as well as across the region.

Electricity demand has been on the rise in the EIJLLPST region over the past few years, with peak demand increasing from 19,040 MW in 1990 to 51,452 MW in 2010—a 170 percent increase. Peak demand is expected to increase more than 4 percent annually until 2030.

The EIJLLPST region is endowed with significant gas resources, which are predominantly concentrated in Egypt, Libya, and Iraq. Because gas is central to electricity generation in the EIJLLPST region, future capacity constraints could create issues.

Key statistics for the EIJLLPST countries are provided in table 2.7.

**Table 2.7 Key statistics for EIJLLPST countries, 2010**

Country	Peak demand (MW)	Installed capacity (MW)	Annual sales (TWh)	Forecast annual growth rate (%), 2010–20	Average tariff (US cents/kWh)	Electricity consumption (kWh/capita)
Egypt	22,079	24,504	119.4	6.6	2.5	1,439
Iraq	9,950	8,210	26.9	3.3	1.2	1,031
Jordan	2,482	2,979	12.9	6.0	7.1	2,169
Syria	7,873	8,025	29.7	3.8	5.0	1,401
Lebanon	2,499	2,312	4.9	2.4	6.1	1,195
Libya	5,759	6,006	21.1	5.4	3.3	3,349
West Bank and Gaza	810	140	3.9	6.0	14.1	1,000

*Source:* The League of Arab States. Demand growth rates from various World Bank reports.

*Note:* kWh = kilowatt-hour; TWh = terawatt-hour; MW = megawatt.

### 2.2.2 Demand/Supply Balance

Sustained high economic growth in the EIJLLPST countries has triggered a rapid increase in energy demand. From 2010 through 2020, peak demand is forecast to increase by more than 36,000 MW, representing an average annual growth rate of 5.5 percent. Each country's contribution to the EIJLLPST peak demand is shown in figure 2.6.

Although part of this demand may be curbed through more effective energy conservation policies and technologies, there is a clear need to expand generating capacity in all countries in

the region. Indeed, most countries have been facing power disruptions, which impose a heavy burden on economic activities. To ensure reliable electricity supply, each country would need to maintain reserve margins (that is, the difference between installed generating capacity and peak demand) on the order of 10 to 15 percent. The reserve margin in the EIJLLPST countries declined from 55 percent in 1990 to -1 percent in 2010,<sup>21</sup> resulting in frequent power outages.

**Figure 2.6 Contribution by country to EIJLLPST peak demand**

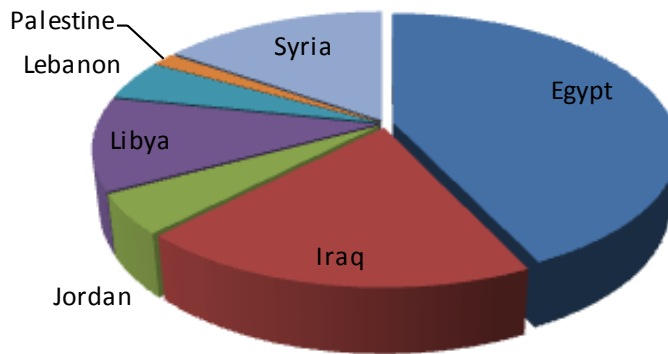
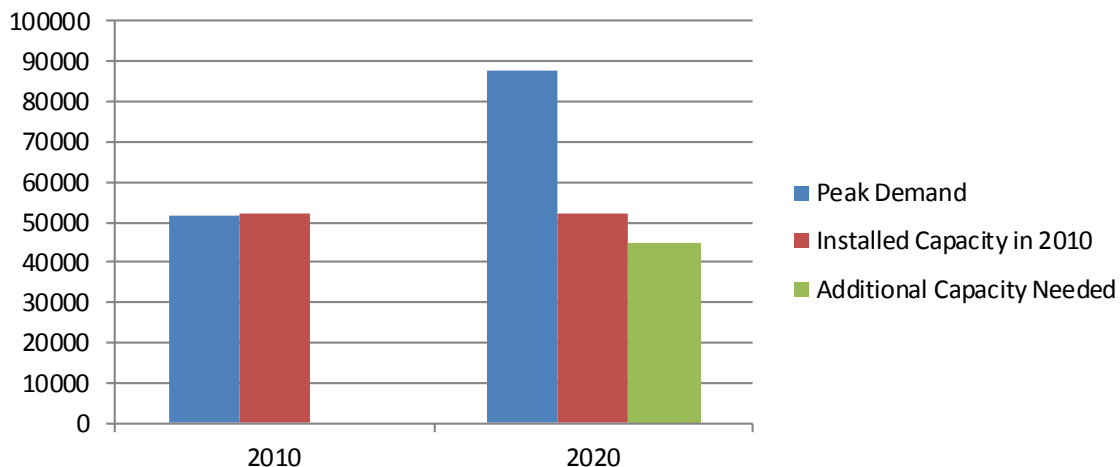


Figure 2.7 shows the supply-demand situation in the EIJLLPST countries, illustrating that at least 44,000 MW of new capacity will be needed by 2020. But the EIJLLPST countries have struggled thus far to bring new generating capacity online. Iraq, Syria, and Lebanon have all experienced significant electricity outages in recent years. Jordan and Syria have recently added new generation capacity, but challenges remain. Egypt's current supply capacity is meeting demand with adequate levels of reliability, but the level of unsupplied energy has been increasing. All EIJLLPST countries must continue to aggressively expand generation capacity if they are to meet high levels of demand growth in the future.

**Figure 2.7 EIJLLPST demand/supply situation (MW)**



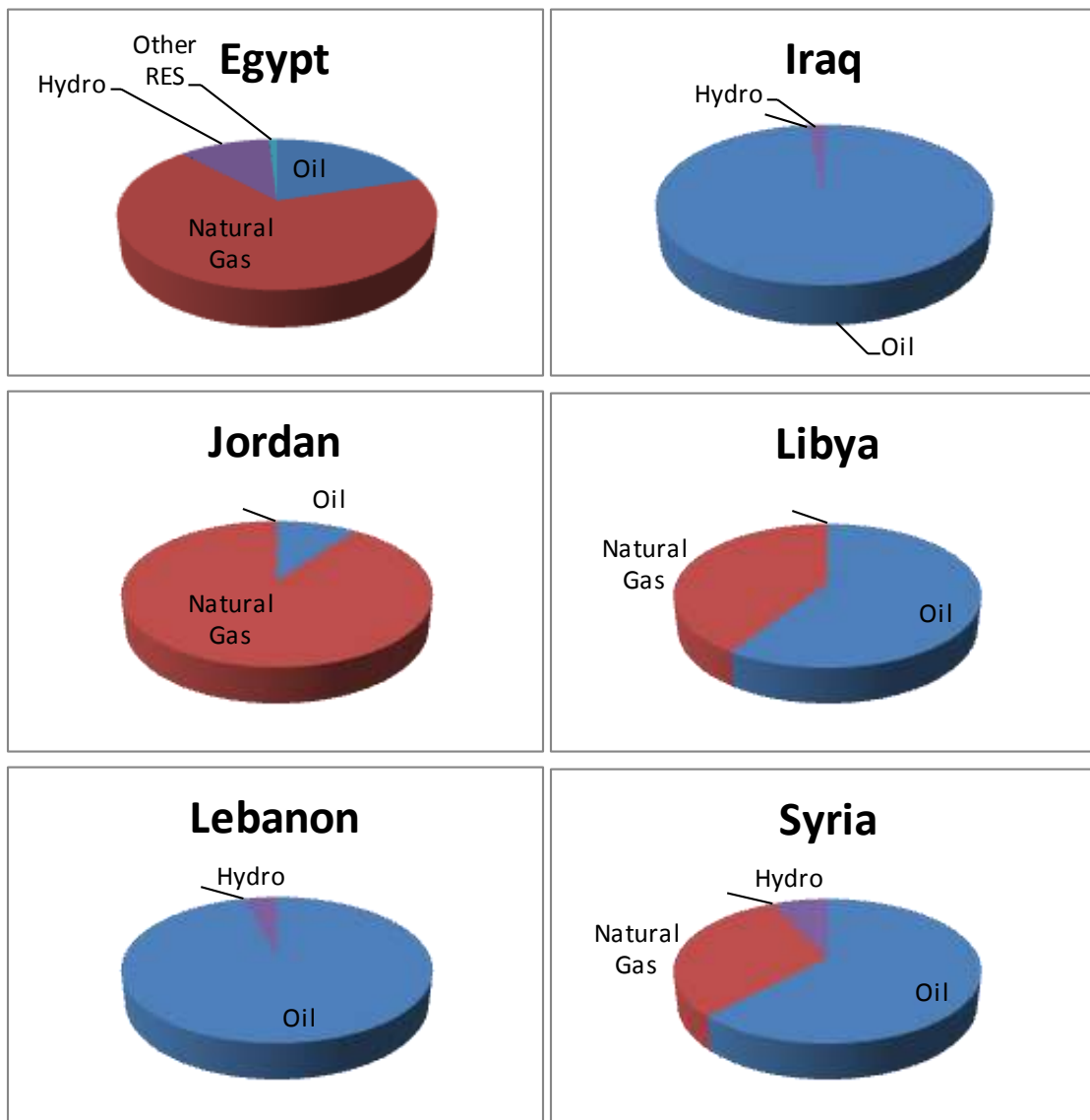
### 2.2.3 Generation Mix

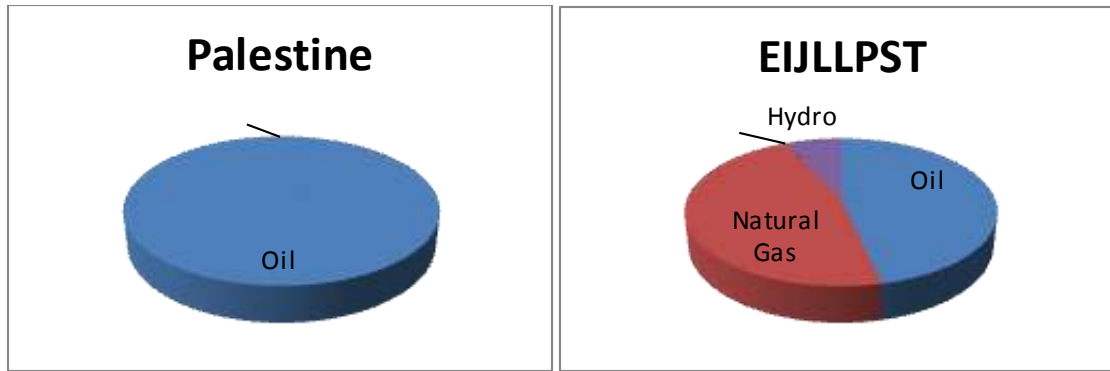
<sup>21</sup> The reserve figures for both 1990 and 2010 are somewhat overstated as available generation was likely lower.

One of the significant bottlenecks in developing new generating capacity in the EIJLLPST region is the supply of fuel. The region depended in the past on oil for power generation. This dependence was substantially reduced as gas became a desirable substitute owing to its economic and environmental attributes. But in recent years gas availability has turned into a serious issue, as countries such as Syria and Jordan have realized that their domestic gas production and existing contracts for gas imports are not sufficient to meet their generating needs. This has triggered a search for sources of imported gas or electricity.

The generation fuel mix for the EIJLLPST region is shown in figure 2.8. Oil and gas generation are split about evenly, at 47 percent, with hydropower accounting for the remaining 6 percent. The specific ratio of fuels varies by country; Egypt and Jordan rely primarily on natural gas and the remaining countries rely primarily on oil.

**Figure 2.8 Generation fuel mix in the EIJLLPST region**





Source: The LAS and various World Bank reports.

Note: RES = renewable energy sources.

#### 2.2.4 EIJLLPST Interconnection

The EIJLLPST interconnection was initiated in 1988 by a five-country agreement between Egypt, Iraq, Jordan, Syria, and Turkey, and has since grown to include Libya, Lebanon, and Palestine. Through the agreement, each country committed to upgrading its electricity system to a minimum standard.

In October 1992 the original five countries signed a general trading agreement<sup>22</sup> documenting their commitment to cooperate fully on interconnection, to provide mutual assistance and share benefits, to improve the reliability of supply, and to improve the region's economies through the exchange of surplus power. This agreement was followed up in 1996 with a comprehensive agreement<sup>23</sup> outlining the terms and conditions for use of the interconnection, including:

- Reserve sharing during emergencies
- Capacity transactions
- Interchange of surplus power and energy
- Regulation of energy flows to maintain schedules
- Regulation of reactive power flows
- Transmission services, making available each country's transmission facilities for the purpose of transmitting power and energy to other parties
- Operating reserves, including the maintenance of minimum levels of reserves and their sharing between countries
- Coordination of maintenance schedules
- Coordination of planning so as to increase reliability and maximize the value of the interconnection

<sup>22</sup> See General Trading Agreement for the Electrical Interconnection among the Five Countries (EIJST).

<sup>23</sup> See General Interconnection Agreement for the Electrical Interconnection among the Five Electrical Power Utilities of Egypt, Iraq, Jordan, Syria, and Turkey (EIJST) dated November 1996.

The interconnection agreement also set out the scope and duties for permanent committees including a Steering Committee, a Planning Committee, and an Operating Committee. The committees meet regularly and their decisions must be unanimous.

- **Steering committee.** Includes one member from each country. Responsible for coordinating design, planning, and operating activities to promote the reliable and efficient operation of the interconnection and the interconnected power systems.
- **Planning committee.** Includes two members from each country. Each country determines the capacity and energy requirements for a 10-year planning period identifying significant generation and transmission additions. The Planning Committee meets once per year to analyze the plans to ensure coordination among the countries and determine if the plans conform to Steering Committee rules and guidelines.
- **Operating Committee.** Each pair of neighboring countries is required to maintain a bilateral operating committee. The operating committees are required to take all actions necessary to ensure delivery and payment for power in accordance with the interconnection agreement and any agreement between the countries.

Despite the interconnection agreement, trade among the EIJLLPST countries has been modest. The committees do not appear to be fully functional. Primary obstacles to electricity trade are tight generation supply, lack of a harmonized regulatory framework, limited access to national transmission networks, and the fact that trade is generally limited to a single government-owned entity in each country. Additionally, the interconnected systems are often not synchronized, meaning that part of a national grid system may have to be isolated from the main grid to accept imports from another country. Additionally, the lack of surplus generating capacity and generation fuel in the interconnected countries means they often do not have spare energy to trade. Further, in some areas the transmission system is not synchronized, necessitating isolated generation to facilitate trade. For example, when Syria exports energy to Lebanon, part of the Lebanese grid must be disconnected from the main national grid. Power exchanges among the EIJLLPST countries are shown in table 2.8.

**Table 2.8 Power exchanges among EIJLLPST countries**

	Max transfer capacity (MW)	Energy exchanged (GWh/year)	Load factor (%)
Syria–Jordan	200	20	1
Jordan–Syria	350	69	2
Syria–Lebanon	50	144	33
Lebanon–Syria	160	419	30
Jordan–West Bank	20	158	90
Egypt–Gaza	17	134	90
Turkey–Syria	250	97	4
Libya–Egypt	180	152	10
Egypt–Libya	180	70	4
Jordan–Egypt	200	9	1
Egypt–Jordan	450	363	9
Egypt–Syria		140	
Syria–Egypt		5	
Egypt–Lebanon		527	

Note: GWh = gigawatt-hour; MW = megawatt.

Regardless, the EIJLLPST interconnection has brought significant benefits. For example, Jordan can rely on its interconnections with Egypt and Syria for about 250 MW of capacity during system emergencies. In 2007 Jordan's reserve margin was negative 130 MW. In the absence of its interconnections, Jordan's loss-of-load expectation was 53 hours, more than triple the target level of 15 hours. The interconnections therefore enabled Jordan to avoid considerable load shedding in 2007. In addition, Jordan, Egypt, and Syria share spinning reserves. By minimizing spinning reserve requirements in this manner, generation is operated closer to its optimum output level, thus improving efficiency and reducing fuel and maintenance costs. Opportunities for short-term trades have also been realized through the diversity of demand. Syria has a winter peak while Egypt and Jordan have summer peaks. Syria can make sales to Egypt and Jordan during summer when it has surplus generating capacity, and Jordan and Egypt can make sales to Syria in winter when they have surplus generating capacity. These staggered sales are particularly relevant when there are different generation technologies in the countries.

Overall, the value of the EIJLLPST interconnection is currently suboptimal. It is used primarily for ancillary services such as reserve sharing, while energy transactions to take advantage of differences in production costs are limited.

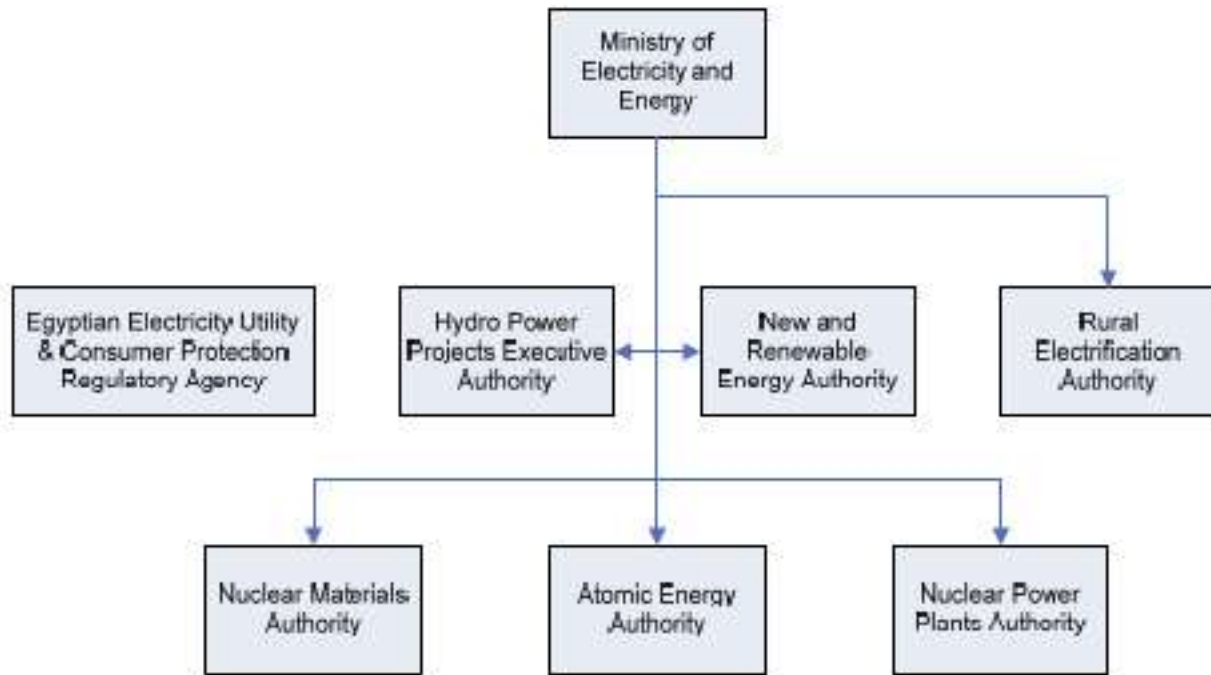
## **2.2.5 EIJLLPST's National Power Markets**

### **2.2.5.1 Egypt**

In Egypt the Ministry of Electricity and Energy is responsible for the electricity sector, including policy formation and the implementation of government decrees. The Egyptian Electricity Utility and Consumer Protection Regulatory Agency has regulatory oversight responsibility for the electricity sector. The agency's role is to optimize the technical, operational, financial, and procedural systems of the electricity business. But it does not have responsibility for tariffs; these remain the responsibility of government. The structure of the electricity sector is shown in figure 2.9.



**Figure 2.9 Structure of Egypt’s electricity sector**



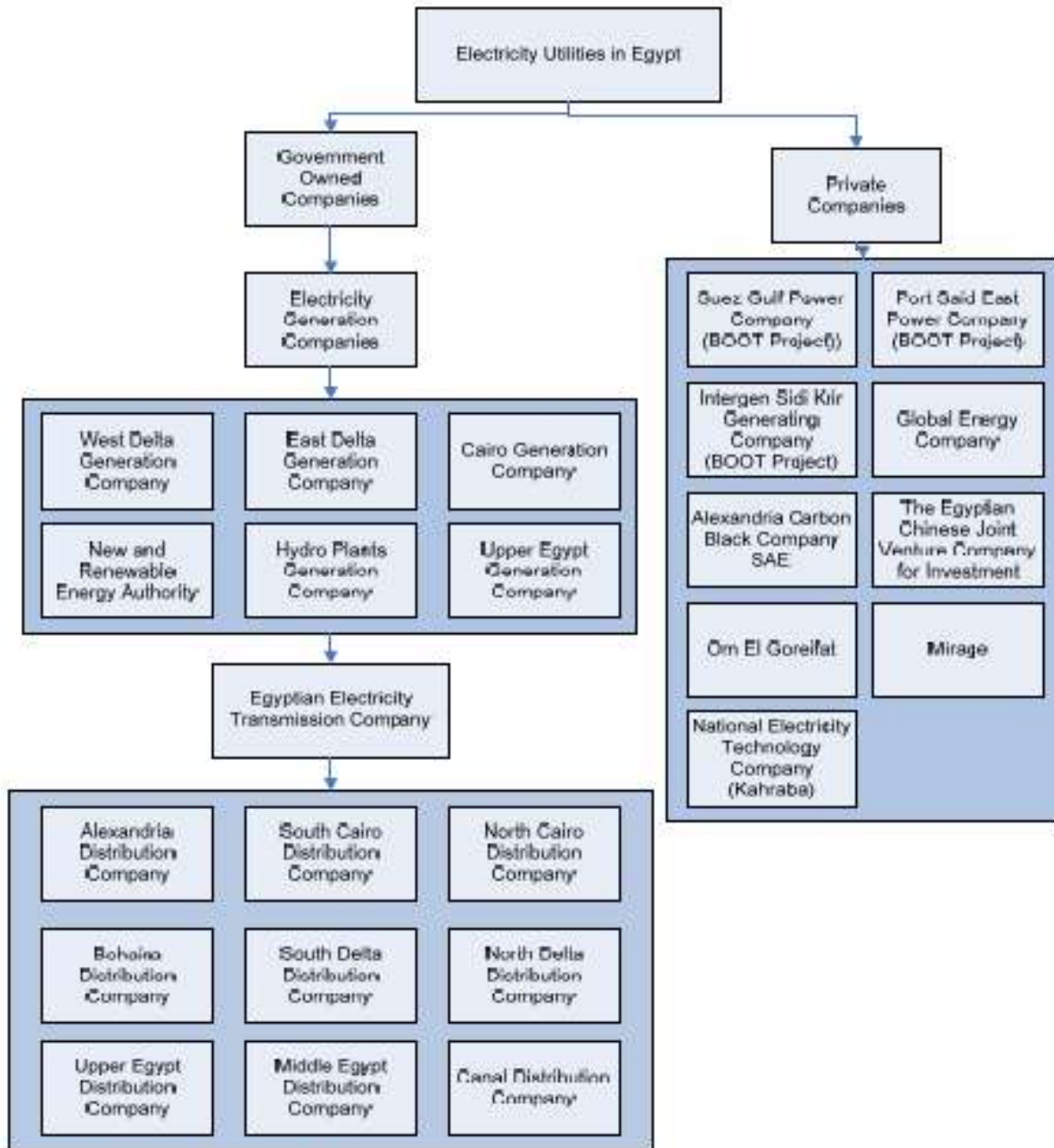
Source: Ministry of Electricity

Reporting to the Ministry of Electricity and Energy are a number of executive authorities with responsibility for specific components of the electricity sector. These authorities are the Hydropower Projects Executive Authority, New and Renewable Energy Authority,<sup>24</sup> Rural Electrification Authority, Nuclear Materials Authority, Atomic Energy Authority, and Nuclear Power Plants Authority.

The Egyptian Electricity Holding Company (EEHC) and its affiliates are responsible for the day-to-day operation of the electricity industry including generation, transmission, and distribution. In the generation sector, there are six government-owned companies, three private build-own-operate-transfer (BOOT) companies, and six IPPs. The government-owned generating companies include hydropower plants, RES plants, and four companies divided by geographic area, including Cairo, East Delta, West Delta, and Upper Egypt. The state-owned Electricity Transmission Company carries out all transmission activities and acts as the single buyer of all generation. The transmission company, in turn, sells all power to the nine state-owned regional distribution companies. Therefore, Egypt has a single-buyer market model with elements of a monopoly model under the EEHC. A schematic of EEHC and its affiliates is shown in figure 2.10.

<sup>24</sup> The New and Renewable Energy Authority acts as the national focal point for expanding development of renewable energy technologies in Egypt on a commercial scale.

**Figure 2.10 Organization of Egypt's electric utilities**



Source: Ministry of Electricity

Egypt's retail electricity prices are far below levels reflecting the economic cost of supply. The World Bank reports that a residential customer in Egypt consuming 700 kWh per month pays only 17 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy,

Spain, Portugal, and Turkey. Egypt's retail tariff for its industrial customers is likewise far below the European benchmark.<sup>25</sup>

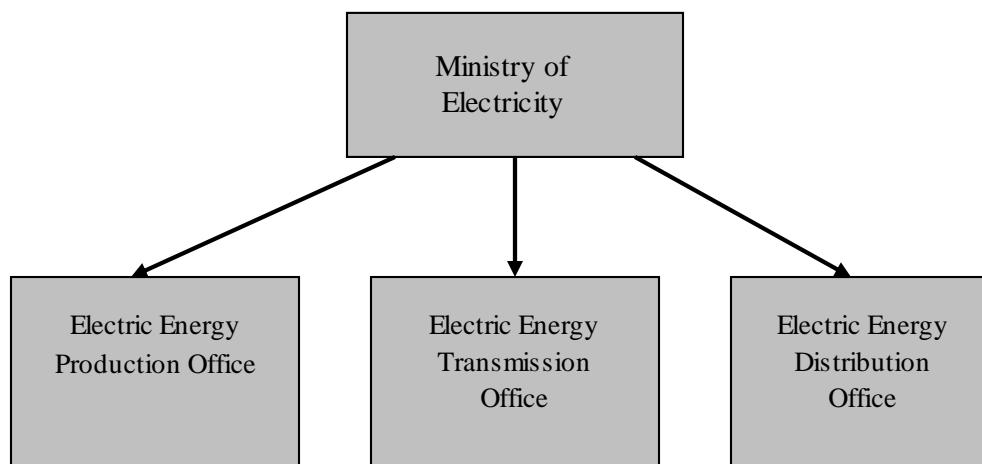
Egypt's electricity sector is summarized as follows:

- **Reform:** Limited.
- **Market structure:** Vertically integrated under the EEHC.
- **Separate regulator:** Yes, but without responsibility for tariffs.
- **Open access:** No.
- **Grid code/distribution code:** No/no.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

#### 2.2.5.2 Iraq

In Iraq the Ministry of Electricity is responsible for generating, transmitting, and distributing electrical energy. The ministry has three departments that report to the minister: the Electric Energy Production Office, the Electric Energy Transmission Office, and the Electric Energy Distribution Office. Each office has a number of directors-general who cover various geographic areas of the country. The organization of the ministry is shown in figure 2.11.

**Figure 2.11 Iraq's energy sector structure**



<sup>25</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

Despite the separate divisions for generation, transmission, and distribution under the ministry, the electricity sector acts as a vertically integrated monopoly without the benefit of independent regulation. The Ministry of Electricity is responsible for policy development, regulatory oversight, and planning for the sector.

Retail electricity tariffs are heavily subsidized and woefully inadequate to generate the revenues necessary to expand the power sector. The World Bank reports that Iraq's retail electricity price for a residential customer consuming 700 kWh per month is less than 1 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Portugal, Spain, and Turkey.<sup>26</sup> The country's retail tariff for industrial customers likewise is far below the European benchmark.

Iraq's electricity sector is summarized as follows:

- **Reform:** None.
- **Market structure:** Vertically integrated.
- **Separate regulator:** No.
- **Open access:** No.
- **Grid code/distribution code:** No/no.
- **Private sector participation:** No.
- **Tariffs:** Subsidized.

### 2.2.5.3 Jordan

In 1999 Jordan's National Electric Power Company (NEPCO) was unbundled into three operating companies: the Central Electricity Generating Company (CEGCO), Electricity Distribution Company (EDC), and NEPCO, which retained responsibility for transmission.

In 2001 the Electricity Regulatory Commission (ERC) was formed to regulate the electricity sector. The ERC is responsible for setting tariffs and issuing licenses for activities in the sector. The commission monitors and ensures that entities operate consistently with the obligations documented in their licenses. The ERC exists to ensure that tariffs enable power companies to finance operations and earn a fair return on investment.

Jordan currently has a single-buyer market structure, but the law allows progression to a competitive market. The ERC suggests the timetable for the introduction of competition through annual reports issued to the minister. The competitive market, once introduced, would feature bilateral contracts at the wholesale level, similar to that in Europe.

The state-owned NEPCO performs the role of a single buyer, purchasing all supply from generators and, in turn, selling all purchased power to the distribution companies and large consumers directly connected to the transmission system. The NEPCO is also responsible for transmission asset management, dispatch, demand forecasting, and purchasing natural gas to meet the needs of the power generation companies.

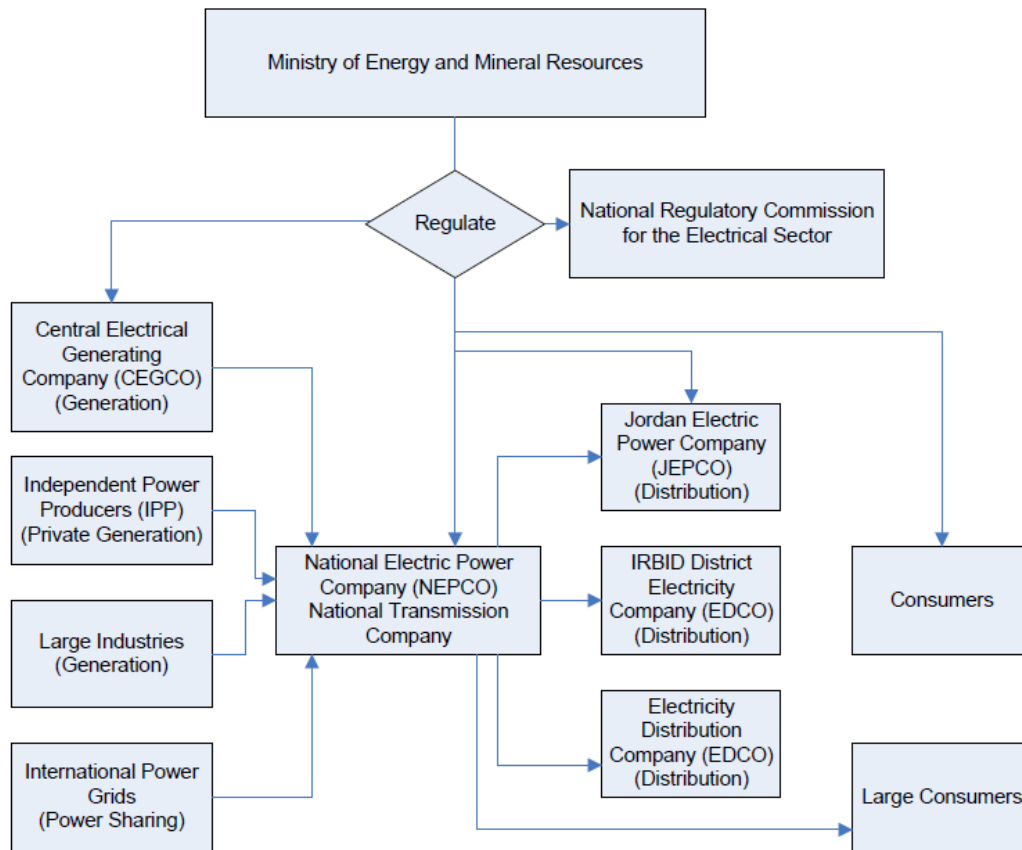
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<sup>26</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

The CEGCO is the primary generation company in Jordan. The company was privatized in 2007 and is currently 51 percent privately owned. It generated 8,009 gigawatt-hours (GWh) in 2009, which accounted for 56 percent of the country’s total in 2009. Jordan has a second private power generation company, AES PCS Jordan, which accounted for 16 percent of production in 2009, as well as a state-owned generation company known as Samra, which accounted for 25 percent of Jordan’s electricity production in the same year. A number of industrial complexes, a small hydropower project, and a biogas facility accounted for the remaining 3 percent of production.

Jordan has three private distribution companies: the Jordan Electric Power Company (JEPCO), the Electricity Distribution Company (EDCO), and the IRBID District Electricity Distribution Company. The private sector is mainly responsible for generation and distribution, while the public sector is responsible for transmission and dispatch, with some limited involvement in generation. The organization of Jordan’s power sector is shown in figure 2.12.

**Figure 2.12 Organization of Jordan’s electricity sector**



Source: MEMR

The World Bank reports that a residential customer in Jordan consuming 700 kWh per month pays only about 50 percent of a benchmark tariff based on an average of the tariffs of France,

Greece, Italy, Portugal, Spain, and Turkey.<sup>27</sup> Jordan's retail tariff for its industrial customers is likewise well below the European benchmark. But Jordan's retail electricity prices reflect the cost of electricity supply in the country. Jordan has done an excellent job of expanding its electricity supply, relying on low-cost gas imports and reserve-sharing arrangements with Egypt and Syria over its interconnections. Cost-reflective tariffs have enabled Jordan to launch a successful IPP program aided by the elimination of all primary fuel subsidies in 2008.

Jordan's electricity sector is summarized as follows:

- **Reform:** In advanced stage.
- **Market structure:** Single buyer with unbundling.
- **Separate regulator:** Yes.
- **Open access:** No.
- **Grid code/distribution code:** Yes/yes.
- **Private sector participation:** Yes, in generation and distribution.
- **Tariffs:** Reflect cost of supply.

#### 2.2.5.4 Libya

The General Electricity Company of Libya (GECOL) is a vertically integrated monopoly with control and ownership over all electricity generation, transmission, and distribution in Libya. The GECOL reports to the General Peoples Committee for Electricity, Water and Gas, which is responsible for policy, planning, and regulation of Libya's electricity sector. Therefore, Libya's power sector does not have an independent regulatory authority.

In 2010 Libya's peak electricity demand was 5,759 MW, and it had an installed generating capacity of 6,006 MW. About 60 percent of generation fuel requirements were met with oil products and the other 40 percent met with natural gas. Demand has been growing rapidly and is forecast to continue doing so in the future at growth rates of about 5.5 percent through 2020.

Generation additions have struggled to keep pace with demand, and Libya has responded with an aggressive generation and transmission expansion plan. Libya plans to add 13,000 MW of generating capacity by 2020. About 4,600 MW are already under construction and 2,400 of new generation capacity has been awarded contracts. New generating capacity will be a mix of cogeneration, combined-cycle, and steam plants relying heavily on natural gas as the fuel. Libya also has numerous transmission projects planned to transmit the new generation to areas of the country with rapidly increasing demand. The transmission plans include a number of studies for expanding international interconnections as discussed earlier in the report.

Currently, the primary objective for the power sector is to ensure the secure and adequate supply of power to all areas of the country. Libya has a goal to improve service quality and efficiency, reduce technical and nontechnical losses, and reinforce interconnections with neighboring countries.

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<sup>27</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

Libya does not have independent regulation of its power sector, and not surprisingly, its retail electricity prices are heavily subsidized. The World Bank reports that residential customers in Libya consuming 700 kWh per month pay only 10 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>28</sup> Heavily subsidized retail tariffs will pose a significant challenge to Libya’s aggressive expansion plans.

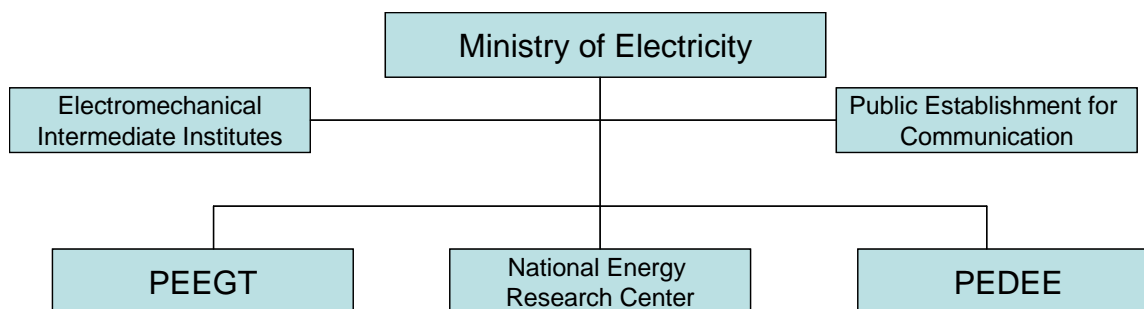
Libya’s electricity sector is summarized as follows:

- **Reform:** None.
- **Market structure:** Vertically integrated.
- **Separate regulator:** No.
- **Open access:** No.
- **Grid code/distribution code:** No/no.
- **Private sector participation:** No.
- **Tariffs:** Subsidized.

#### 2.2.5.5 Syria

Syria’s electricity sector is managed and regulated by the Ministry of Electricity, while the Public Establishment for Electricity Generation and Transmission (PEEGT) plans, develops, operates, and maintains the generation and transmission components of the electricity sector, and the Public Establishment for Distribution and Exploitation of Electric Energy (PEDEEE) and its 14 regional subsidiaries are responsible for the power distribution network. Figure 2.13 shows the organization of Syria’s electricity sector.

**Figure 2.13 Organization of Syria’s electricity sector**



The Ministry of Electricity is responsible for both policy and regulation. Although distribution is separate from generation and transmission, the electricity sector operates as a vertically integrated, monopolistic structure without competition or independent regulation.

In the summer of 2007, Damascus experienced daily power interruptions lasting as long as five hours. In response, Syria’s government has indicated that addressing electricity supply shortages is a top priority. A November 15, 2010, decree mandates that the electricity sector be unbundled

<sup>28</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.



into three institutions for generation, transmission, and distribution; the private sector will be allowed to invest in generation and distribution in partnership with the government, but privatization of existing assets does not appear likely.<sup>29</sup>

Syria's retail electricity prices are far below the economic cost of supply. The World Bank reports<sup>30</sup> that Syria's retail electricity prices for a residential customer consuming 700 kWh per month are only 10 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Portugal, Spain, and Turkey. Its retail tariff for industrial customers is likewise far below the European benchmark.

Syria's electricity sector is summarized as follows:

- **Reform:** Limited, but new law recently passed.
- **Market structure:** Vertically integrated, but some unbundling could be implemented following the passage of a new law.
- **Separate regulator:** No.
- **Open access:** No.
- **Grid code/distribution code:** In development/no.
- **Private sector participation:** No, but IPP generation projects (fuel and wind) are being tendered now, and the new electricity law allows private participation in generation and distribution.
- **Tariffs:** Subsidized.

#### 2.2.5.6 Lebanon

Lebanon's Ministry of Energy and Water (MEW) directs the country's energy policy, while Electricité du Liban (EDL) is a state-owned, vertically integrated utility with a monopoly over generation, transmission, and distribution of electricity. EDL incurs significant financial losses owing to high primary fuel costs and low retail tariffs. As a result, the utility receives significant subsidies from the government via the Ministry of Finance. Lebanon does not have independent regulation. Figure 2.14 shows the country's energy sector structure.

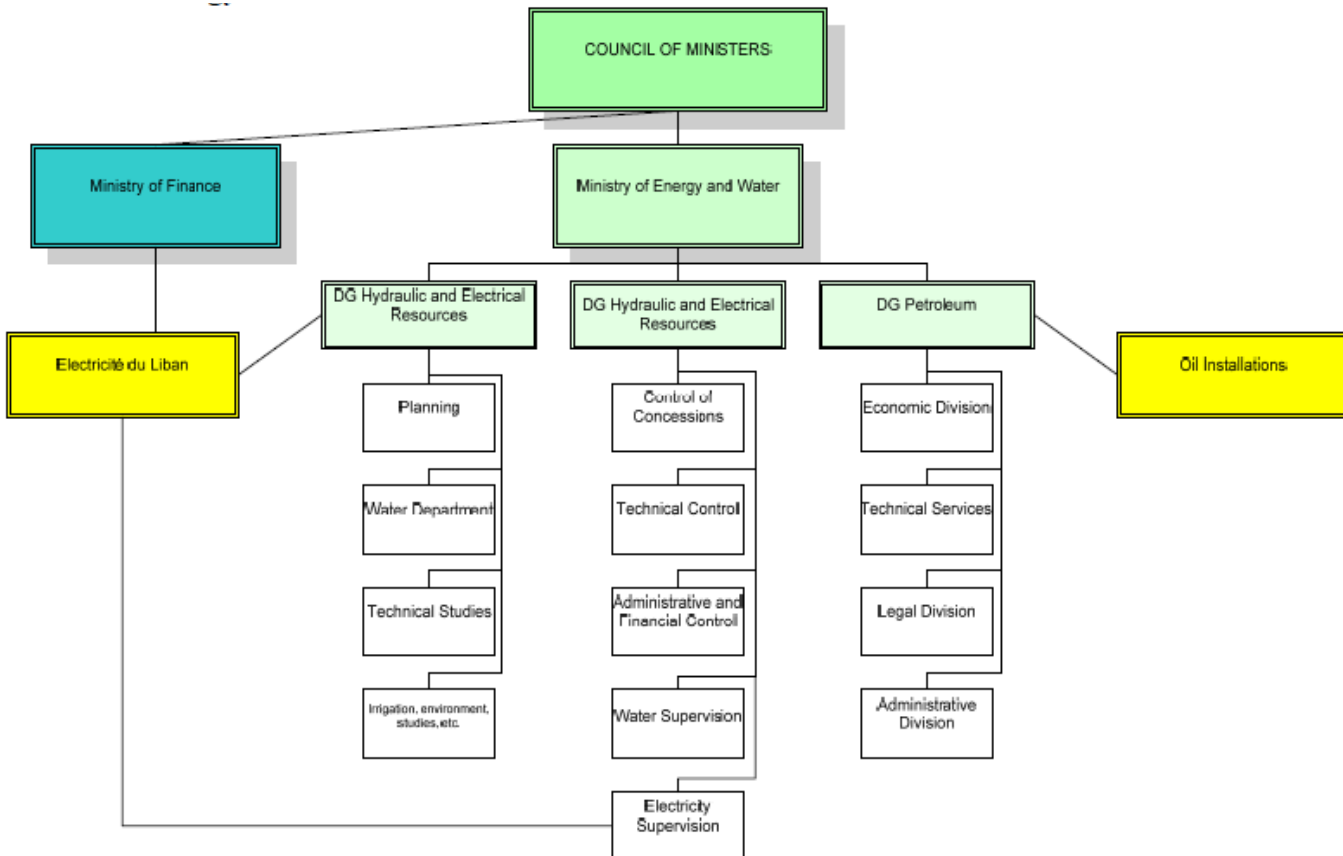
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<sup>29</sup> See November 15, 2010, announcement entitled, "President al-Assad Issues Decree No. 32 Regulating Electricity Sector Policy in Syria."

<sup>30</sup> See February 2009 World Bank report entitled, *Tapping a Hidden Resource—Energy Efficiency in the Middle East and North Africa*.



**Figure 2.14 Structure of Lebanon’s energy sector**



Source: Ministry of Energy and Water.

Lebanon’s retail electricity prices are far below the levels necessary to recover the cost of supply. The World Bank reports that Lebanon’s retail electricity tariff for a residential customer consuming 700 kWh per month is only 31 percent of the benchmark tariff based on an average of the tariffs of France, Greece, Italy, Portugal, Spain, and Turkey.<sup>31</sup> The retail tariff for Lebanon’s industrial customers is also far below the European benchmark. The financial impact of Lebanon’s retail tariffs is particularly dismal when one considers that the country’s cost to supply electricity is well above industry norms.

Lebanon’s electricity sector is summarized as follows:

- **Reform:** None.
- **Market structure:** Vertically integrated.
- **Separate regulator:** No.
- **Open access:** No.
- **Grid code/distribution code:** No/no.

<sup>31</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency in the Middle East and North Africa*.

- **Private sector participation:** None.
- **Tariffs:** Subsidized.

### 2.2.5.7 Palestine

The Palestinian Energy and Natural Resources Authority (PEA) oversees the development of the Palestinian energy sector development in West Bank and Gaza. It has wide-ranging powers over the policy, coordination, and development of the energy sector. The PEA is responsible for consolidating power supply and distribution arrangements in the West Bank into four electricity distribution utilities. It has created three utilities for the West Bank: the Northern Electric Distribution Company (NEDCO), Hebron Electric Power Company (HEPCO), and Southern Electric Power Company (SELCO). Additionally, the long-established Jerusalem District Electric Company (JDECO) serves the central area around Jerusalem, and the Gaza Electricity Distribution Company (GEDCO) is responsible for electricity transmission and distribution in Gaza.

The Palestinian Authority encourages private sector investment in the energy sector. The law requires that new generation capacity be developed by the private sector, and also allows private shareholders of the public distribution companies. The PEA has established an internal Energy and Environment Research Center in charge of preparing studies and conducting research on RES in cooperation with Palestinian universities.

The electricity supply to West Bank and Gaza depends almost entirely on the Israel Electric Corporation (IEC) for electricity supply. The West Bank is also served through a 2 x 33 kV interconnection with Jordan (about 30 km in length), which supplies up to 20 MW, but the electricity can be supplied only on an isolated-grid basis to Jericho. The Gaza IPP power plant, a 2 x 70 MW combined-cycle plant burning diesel fuel, supplements Gaza's power supply. Since 2006 Gaza has also received up to 17 MW from Egypt on an emergency basis over a 1 x 22 kV line to Rafah that is operated in an islanded mode

Retail electricity prices in West Bank are close to collecting the full economic cost of supply. The World Bank reports that the retail electricity tariff for a residential customer in West Bank and Gaza consuming 700 kWh per month is 86 percent of the benchmark tariff, based on an average of the tariffs of France, Greece, Italy, Portugal, Spain, and Turkey.<sup>32</sup> The Palestinian industrial tariff is about 65 percent of the European benchmark.

A new law passed in May 2009 set the policy and framework for developing the Palestinian electricity sector included in this was the establishment of a new regulatory commission, a transmission company, and distribution companies to which electricity services will be transferred from the municipalities and villages. Figure 2.15 shows the structure of the electricity sector as envisaged by the law.

The Palestinian electricity sector is summarized as follows:

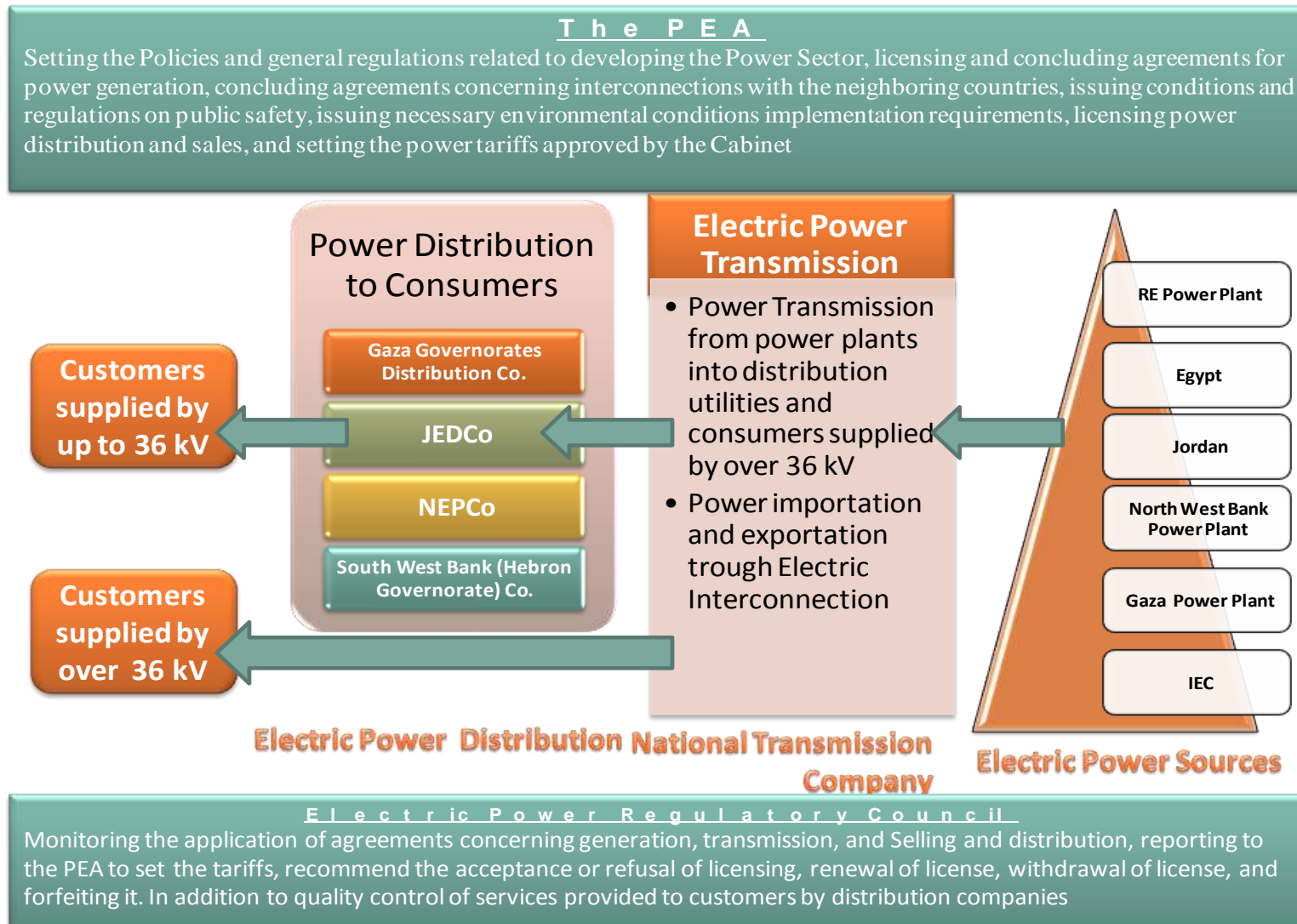
- **Reform:** Under way with passage of new law.
- **Market structure:** Unbundled into regional distribution companies.

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<sup>32</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency in the Middle East and North Africa*.

- *Separate regulator*: Yes.
- *Open access*: No.
- *Grid code/distribution code*: No/no.
- *Private sector participation*: Yes, in generation and part of distribution.
- *Tariffs*: Reflect cost of supply.

**Figure 2.15 Structure of Palestinian electricity sector as required by the electricity law**



Source: Draft Energy Sector by the Palestinian Energy and Natural Resources Authority (PEA).

## 2.3 GCC Region

### 2.3.1 Overview

The GCC regional market was established in May 1981 by a cooperation agreement between Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE.<sup>33</sup> The GCC states account for 40 percent of the world's crude oil reserves and 25 percent of its gas reserves. Electricity and energy demand is projected to increase by 6.8 percent annually in the region, requiring substantial investment in energy infrastructure. The GCC states have made significant progress integrating their electricity networks to facilitate cross-border trade in electricity, through the GCC interconnection.

Key electricity statistics for the GCC countries are shown in table 2.9. Saudi Arabia is the dominant electricity player in the region.

**Table 2.9 Key statistics for GCC countries, 2010**

	Peak demand (MW)	Installed capacity (MW)	Annual sales (TWh)	Forecast annual growth rate (%), 2010–20	Average tariff (US cents/ kWh)	Electricity consumption (kWh/capita)
Kuwait	10,970	12,579	49.3	8.5	0.6	18,259
Saudi Arabia	45,661	49,138	211.1	5.1	3.3	8,311
Bahrain	2,633	3,227	11.0	5.4	2.6	13,750
Qatar	5,090	7,881	18.8	9.5	2.2	11,059
UAE	18,111	25,252	83	9.0	9.0	18,444
Oman	3,594	4,100	11.4	8.7	3.6	4,071

*Source:* LAS. Forecast load growth figures derived from various World Bank reports.

*Note:* kWh = kilowatt-hour; TWh = terawatt-hour; MW = megawatt.

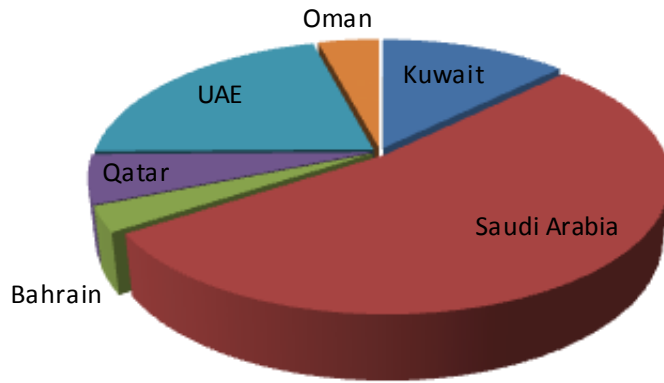
### 2.3.2 Demand/Supply Balance

There is currently adequate generation capacity to reliably supply demand. Figure 2.16 shows the breakdown of GCC peak demand by country. But demand is growing rapidly, and the GCC countries have struggled to invest in enough generation capacity to keep pace. Increasing growth in demand will require significant investment, exceeding 80 GW of new generation capacity by 2020 (see figure 2.17).

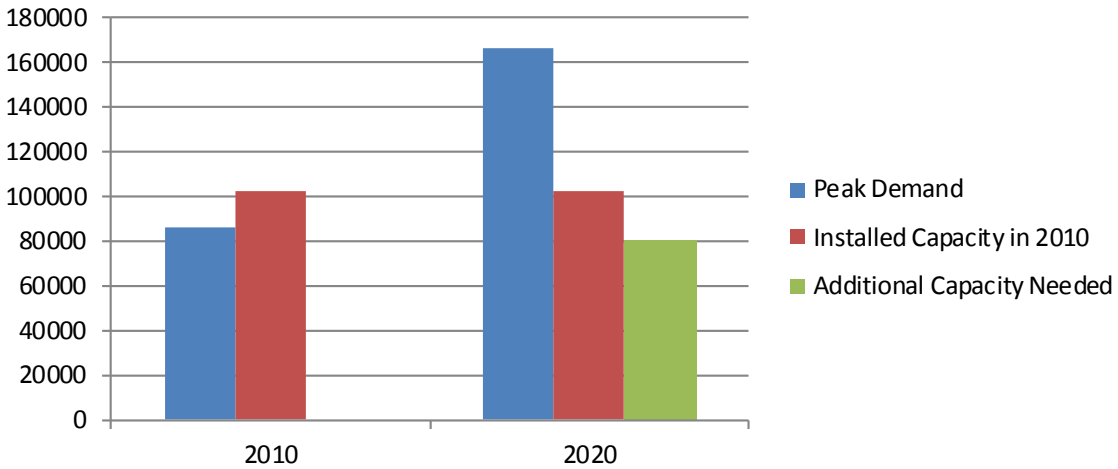
**Figure 2.16 Contribution by country to GCC peak demand**

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<sup>33</sup> Yemen is currently negotiating accession to the GCC.



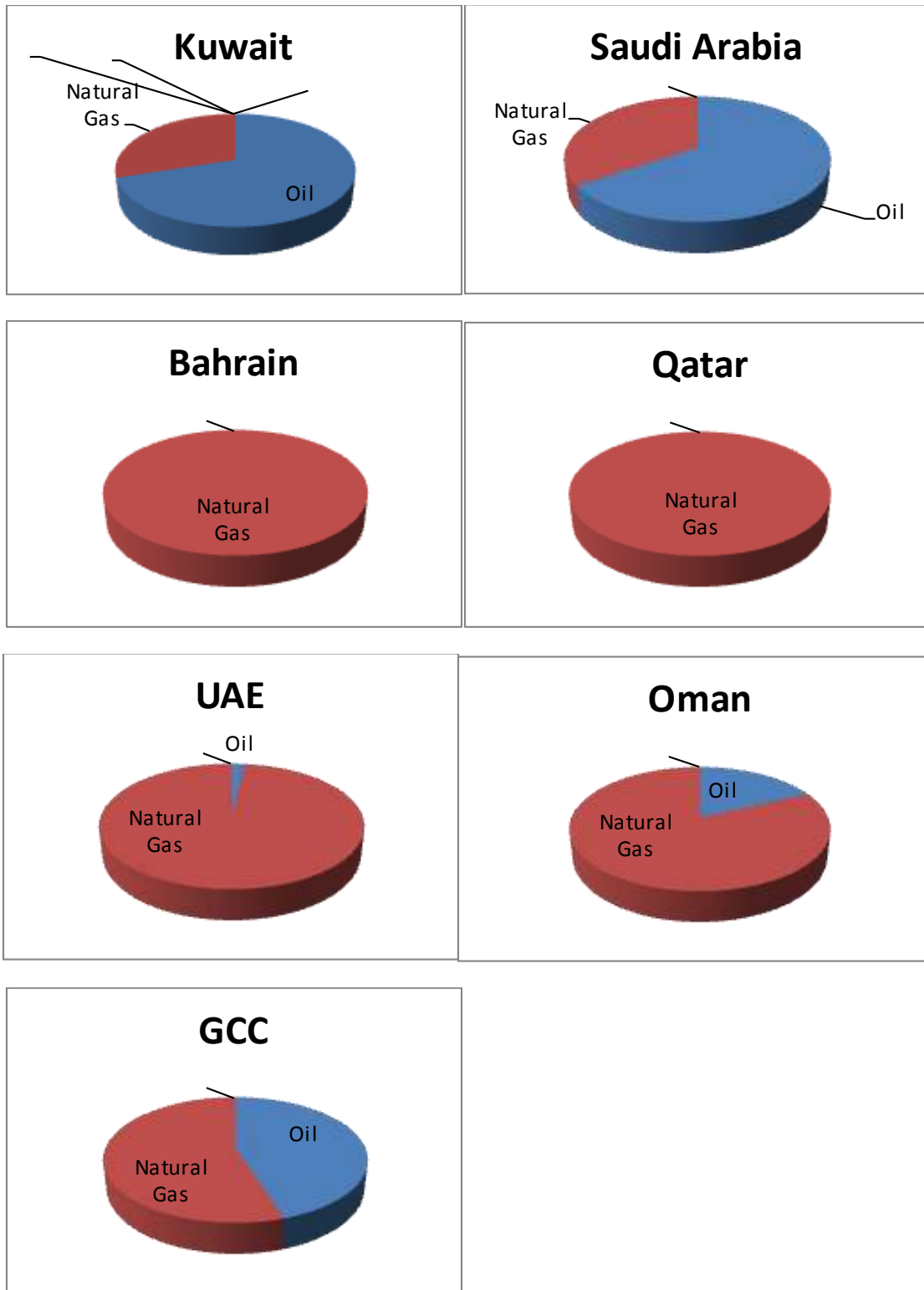
**Figure 2.17 GCC demand/supply situation (MW)**



### 2.3.3 Generation Mix

The current generation mix in the GCC region, as shown in figure 2.18, is split between natural gas with a 55 percent share, and oil with a 45 percent share. In the GCC, the demand for water and the use of multipurpose power and water desalination plants makes it more attractive to generate electricity close to the water demand centers and to import natural gas rather than electricity. The UAE has embarked on a plan to develop nuclear as a generation supply option in the future, but currently generates 98 percent of its electricity from natural gas.

Figure 2.18 Generation fuel mix in the GCC region



Source: The LAS and various World Bank reports.

Note: GCC = Gulf Cooperation Council.

### 2.3.4 GCC Interconnection

The GCC interconnection, shown in figure 2.19, allows for electricity exchange among the six member states. The interconnection is aimed at capacity reserve sharing and improved supply reliability. The interconnection reduces the investment needs for new generation.

The GCC member states established an Interconnection Authority in 2001 and signed a power exchange and trading agreement in 2009. Although transfer capacities are relatively high, scheduled power exchanges to date have been limited owing to the emphasis on reserve sharing and the limited experience in trade under the new trading agreement (see table 2.10). Trade has in fact been increasing as experience is gained with energy exchanges to date in 2011 about 60% greater than 2010 levels.

**Table 2.10 Power exchanges among GCC countries**

	Max transfer capacity (MW)	Energy exchanged (MWh/year)	Load factor (%)
Saudi Arabia – Import	1200	207	-
Saudi Arabia – Export	1200	25,072	0.3
Kuwait – Import	1200	54,551	0.7
Kuwait Export	1200	98,849	1.2
Qatar – Import	750	41,554	0.8
Qatar – Export	750	73,078	1.4
Bahrain – Import	600	57,268	1.4
Bahrain – Export	600	48,426	1.2
UAE – Import	900	27,513	0.4
UAE – Export	900	35,941	0.6

Note: MWh = megawatt-hour; MW = megawatt.

Exchange data relevant for period January 1, 2011 through October 17, 2011.

Exchange data include both scheduled and unscheduled transactions.

#### 2.3.4.1 Background

The GCC region accounts for 40 percent of the world’s oil reserves and 25 percent of its natural gas reserves, making the region a significant player in global primary fuels markets. The grid allows electricity exchange among the six member states, with the primary objective being capacity reserve sharing to reduce the need for investment in new generation capacity and improve supply reliability.

The GCC interconnection project is almost completed. It includes three phases:

- **Phase I:** The power grids of the northern states of Kuwait, Saudi Arabia, Bahrain, and Qatar were interconnected in 2009 to form the GCC north grid. Phase I included the construction of a 400 kV grid in Kuwait, Saudi Arabia, and Qatar with a 400 kV submarine cable link to Bahrain. It also included a back-to-back HVDC transmission line to connect the 60 hertz (Hz) Saudi Arabian system with the 50 Hz systems of the other GCC countries.
- **Phase II:** The UAE and Oman completed interconnection in 2006 through a 220 kV line to form the GCC south grid. The project also integrated the isolated networks of the various emirates into the Emirates National Grid (ENG) and created an integrated northern grid in Oman.



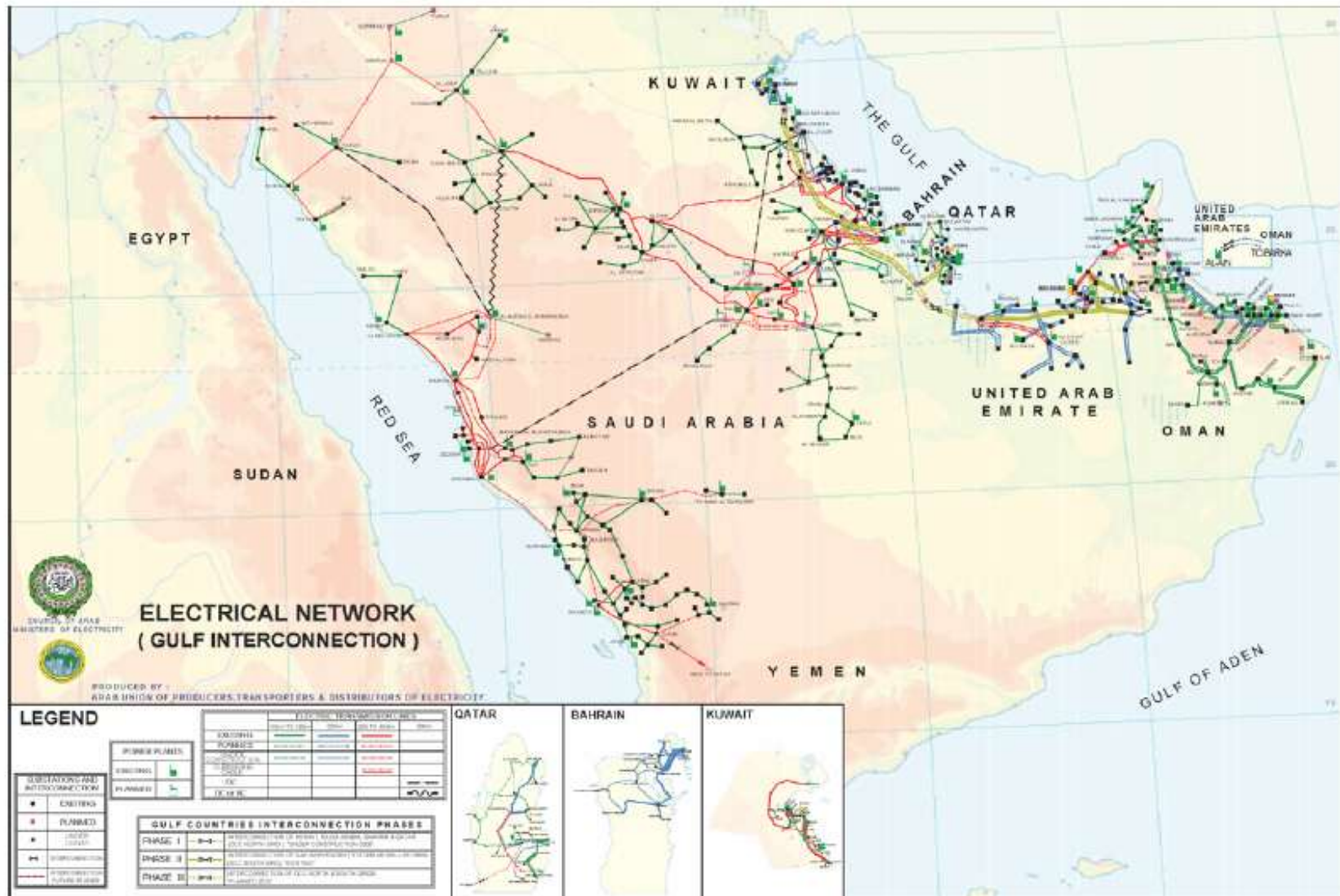
- **Phase III:** The GCC north and south grids are to be interconnected in 2011. Phase III includes a double-circuit 400 kV line from Salwa to Shuwaihat (UAE); and a double- and single-circuit 220 kV, 50 Hz line from Al Ouhah (UAE) to Al Waseet (Oman).<sup>34</sup>

The GCC interconnection allows imports of 1,200 MW between Kuwait and Saudi Arabia, and between 600 MW and 900 MW between Bahrain, Qatar, and the UAE. The interconnection to Oman will be 400 MW. Figure 2.20 is a single-line diagram showing transfer limits between countries.

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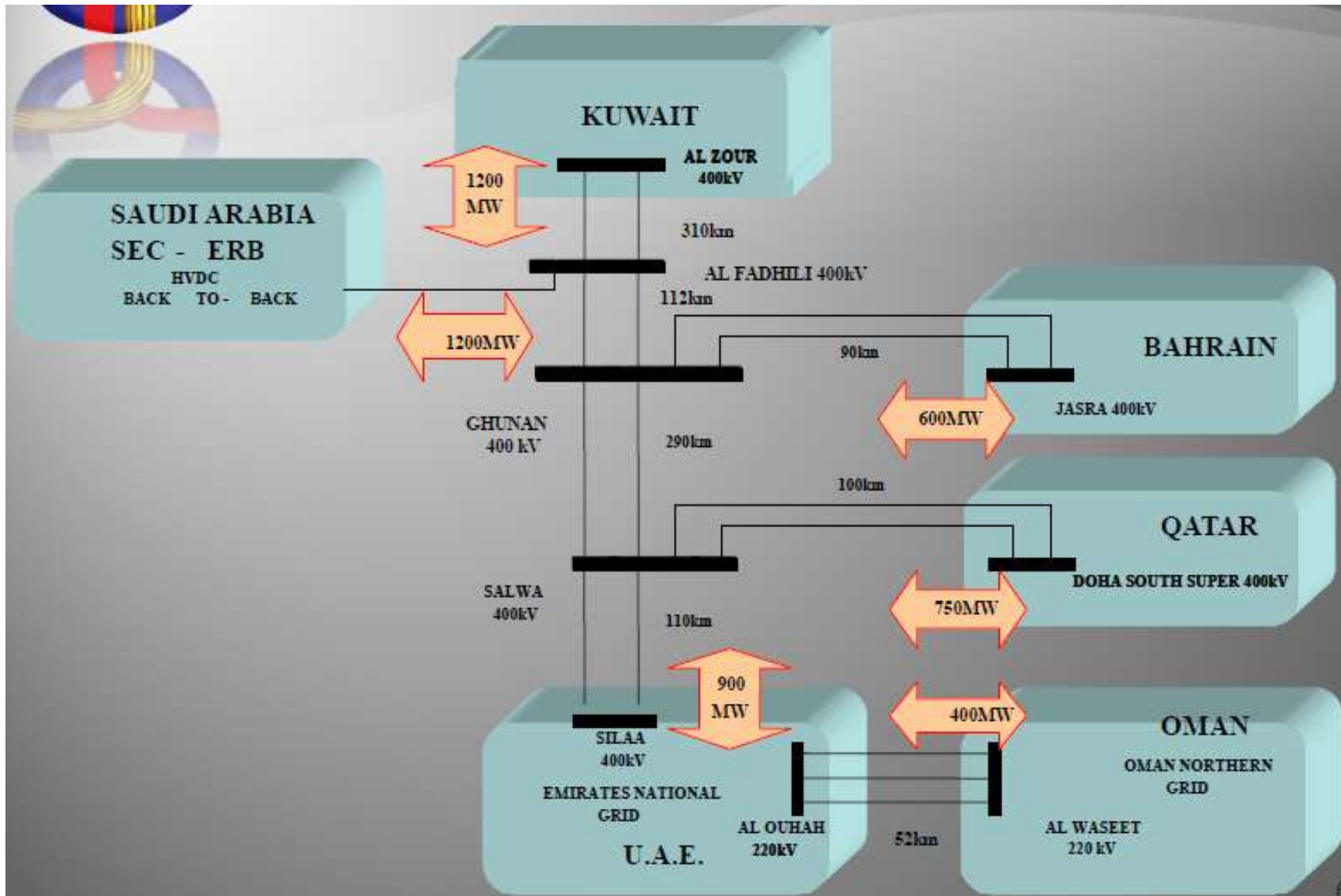
<sup>34</sup> It is understood that Phase III may not go as planned. It has been suggested that it may be more desirable for Oman to connect directly to the GCC grid rather than through the UAE network.

Figure 2.19 GCC interconnection



Source: Arab Union of Electricity.

Figure 2.20 Single-line diagram of GCC interconnection showing transfer limits



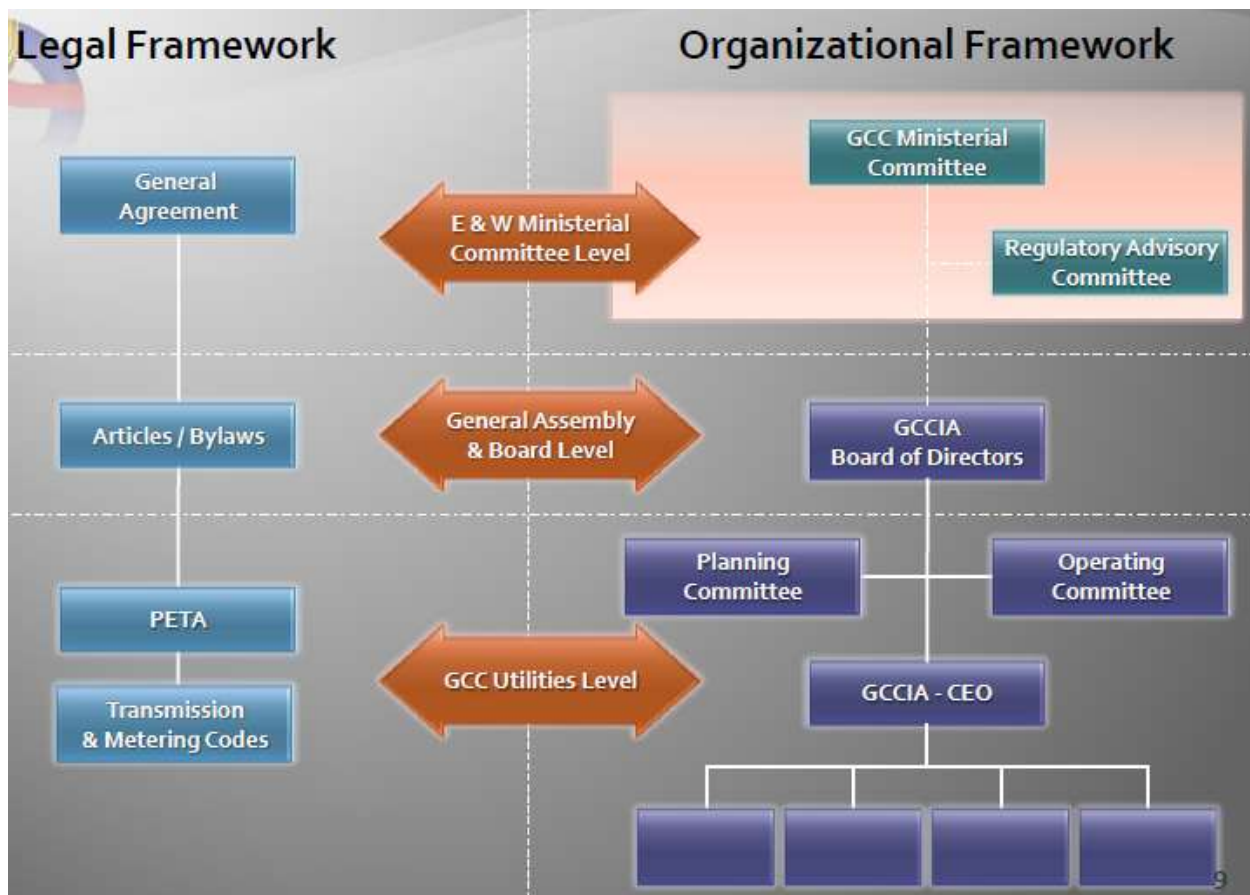
Source: GCCIA.

A distinguishing feature of the GCC network is its HVDC function, which automatically supports system stability on the national power systems during severe disturbances through a dynamic power reserve sharing control system. This and other systems have enabled the GCC Interconnection Authority (GCCIA), to be discussed further, to achieve a high level of stability and reliability in the region.

#### 2.3.4.2 GCC Interconnection Authority

The GCCIA is a regional grid operator based in Dammam, Saudi Arabia. It was established in 2001 by royal decree to manage the interconnection and eventually become a regional player in the electricity-trading market. The GCCIA is a joint-stock commercially registered entity that acts independently of any country and organization. It has a 12-member board, with 2 members from each GCC member country, and a chief executive officer who oversees four operational divisions: system operations and maintenance, engineering and planning, finance and accounting, and support services. Figure 2.21 shows the GCCIA’s legal and organizational framework.

**Figure 2.21 Legal and organizational framework of the GCCIA**



Source: GCCIA.

#### 2.3.4.3 Legal Framework

The GCC interconnection is governed by a General Agreement and a Power Exchange Trading Agreement (PETA). The General Agreement sets out the terms for each member’s rights of

interconnection, connection fees, performance standards, defaults, governing law, and termination, as well as defining regulatory principles in terms of policy and regulation. The PETA includes three primary components:

- A trading agreement setting out the terms and conditions for use of the interconnection and for scheduling power and energy transfers
- An interconnection and use of system agreement, setting out the terms and conditions for connecting to and accessing the interconnection
- A transmission code setting out detailed technical rules for connection and access to the interconnection

Parties to the PETA are determined by the structure and legislation of each member state, and include TSOs responsible for transmission and the procurement and sale of power and energy. When a member state has separate entities for transmission and procurement, it is allowed two parties: one TSO and one procurement entity. Currently, there are eight parties to the PETA.

#### ***2.3.4.4 Organization***

The GCC has established a cooperative and fully regulated environment for power exchange, as described below.

#### **GCC Electricity and Water Ministerial Committee**

The GCC Ministerial Committee, which comprises ministers of electricity and water from each of the member countries, is the forum where member states make necessary decisions pursuant to legal agreements and receive and consider submissions and recommendations from the Advisory and Regulatory Committee (ARC). The committee guides the GCCIA Board of Directors on its policies and procedures.

#### **Advisory and Regulatory Committee**

The ARC meets every three months and is responsible for ensuring all concerned parties comply with regulatory principles and performance standards. Each member state nominates a senior national electrical regulatory official to be its representative on the ARC. The ARC also advises the member states and GCCIA on the use of the interconnection. Member states must enforce the regulatory decisions of the ARC, consistent with its charter.

The regulatory duties of the ARC include:

- Reviewing and approving the principles and methodologies applied by the GCCIA in preparing its annual budget, tariffs, and charges in line with the PETA, and reviewing and recommending the GCCIA's budget for approval by its shareholders
- Ensuring that the GCCIA and member states comply with their roles
- Reviewing and approving performance standards proposed by the GCCIA and setting the standards' effective date
- Conducting hearings in the event of default, whether alleged or admitted, under the PETA
- Applying the appropriate actions to be taken when standards are not met
- Resolving any disputes and obtaining expert opinions or appointing mediators as needed

- Coordinating with national regulatory agencies in the member states
- Reviewing, approving, and supervising the implementation of revisions to the interconnector transmission code
- Penalizing parties in default under the PETA
- Supervising the implementation of charges, compensations, fees, and tariffs
- Evaluating modifications and amendments to the legal documents
- Reviewing proposals for the expansion of the interconnection
- Reviewing the installed capacity obligations for each party
- Taking actions necessary to execute the decisions of the GCC Electricity and Water Ministerial Committee related to regulating the interconnection's use

### **GCCIA Board of Directors**

The GCCIA Board of Directors includes 12 members—2 from each country—with the chair rotated among member states every three years. It addresses issues of policy (board of directors), strategy (CEO, corporate services, and executive affairs), and operations (support services, finance and accounting, system operations and maintenance, and engineering and planning).

### **Planning and Operations Committees**

Each member state nominates a representative for the Operations Committee and the Planning Committee. The objective of the Planning Committee is to coordinate planning between the GCCIA and member states and to advise the GCCIA on planning issues. The Planning Committee's duties include:

- Collecting information pertaining to load forecasts, generation and transmission expansion plans, installed capacity obligations, and operating reserve requirements from each national TSO
- Assessing member states' compliance with their installed-capacity obligations
- Recommending rules and procedures to the GCCIA as required to determine the capability of installed capacity resources and produce coincident peak-load forecasts, and publishing rules and procedures once approved
- Advising the GCCIA and member states on the adequacy of the interconnection with respect to reliability, reserves, delivery of operating reserves, and power exchange flexibility
- Advising the GCCIA and member states on load-forecast accuracy, loss-of-load expectation, installed reserve-margin target values, and transition periods, and proposing long-term solutions to operational problems and issues that may arise
- Reviewing changes or additions proposed by the GCCIA to the interconnection as well as related estimates of the required expenditures, and raising recommendations to the ARC
- Recommending to the GCCIA charges to be imposed on procurement parties



- Ensuring that each member state meets its installed capacity obligation, and recommending corrective action for any deviations to the ARC
- Overseeing the development of the interconnection and presenting recommendations to the GCCIA
- Reviewing fees, charges, and tariff proposals raised by the Operations Committee and presenting recommendations to the ARC
- Advising the Operations Committee on required changes to the interconnector transmission code

The objective of the Operations Committee is to coordinate operations issues between the GCCIA and the member states and to advise the GCCIA on operations matters. The Operations Committee's duties include:

- Handling operational matters such as metering, accounting, and payment
- Handling security and stability, including proposing Loss of Load Expectation (LOLE) target values to the Planning Committee
- Coordinating maintenance schedules
- Considering short-range load forecasts and related capacity requirements
- Advising the GCCIA on the operating-reserve measurement methodology
- Determining and allocating losses
- Handling interconnector transmission code matters
- Recommending tariff-, rate-, and charge-calculation methodologies to the Planning Committee
- Annually reviewing the operation and use of the interconnection to identify any actions that need to be taken and to monitor actions previously agreed to by the parties
- Investigating major faults related to the interconnection and reporting the findings to the GCCIA for forwarding to the member states and the Planning Committee
- Considering such other operating matters as may arise in carrying out the above duties, or such other matters as may be referred to it by the board

#### 2.3.4.5 Trade

Currently, there are two primary vehicles for trade on the GCC interconnection:

- **Scheduled exchanges.** Prearranged bilateral trades between member states. These transactions are freely negotiated between the members. Once agreement is reached, the members must procure transmission capacity rights for use of the GCC interconnection from the GCCIA. Following GCCIA confirmation, the trade is consummated. A standard template has been developed and approved by the board to be used as a guideline for bilateral contracts.
- **Unscheduled exchanges.** Unscheduled exchanges may be needed during unforeseen contingencies. Member states are entitled to use the interconnection during emergency

situations to improve their reliability of supply. Member states are required to maintain operating reserves, to be called upon to support other members states when contingencies occur.

There have been a significant number of unscheduled transactions that have had a positive impact on supply reliability, avoiding a number of cases where loads would have been interrupted if not for the interconnection. Unscheduled transactions are paid for in kind; that is, energy taken during the peak period is returned in the peak period. No money exchanges hands.

There has been only one scheduled exchange on the GCC interconnection to date, though member states have requested the GCCIA to facilitate bilateral trades between interested members in the future. The tariff for use of the interconnection is determined through an auction process, with a floor price in place. If an emergency situation arises on the system during a scheduled transaction, the transaction is cancelled.

The GCCIA believes it can become a launch pad for energy trading, opening the door to the establishment of a common market in the region. A next step is to implement competition in generation, with vertical and horizontal unbundling of the power sectors in each GCC country. This would be accompanied by open access to the transmission system and full wholesale competition, allowing generators in one country to sell power to buyers in another.

A brief description of the power sector in each GCC country follows. Although not currently interconnected with the GCC, Yemen's national electricity market is discussed owing to its close proximity and the possibility of interconnecting with Saudi Arabia in the future.

### **2.3.5 GCC's National Power Markets**

#### **2.3.5.1 Saudi Arabia**

The Saudi Electric Company (SEC), a vertically integrated monopoly, dominates all aspects of Saudi Arabia's electric supply. SEC is a joint-stock company with shares traded publicly in the Saudi Capital Market, though about 81 percent of the company is owned by the government and the Saudi Arabian Oil Company.

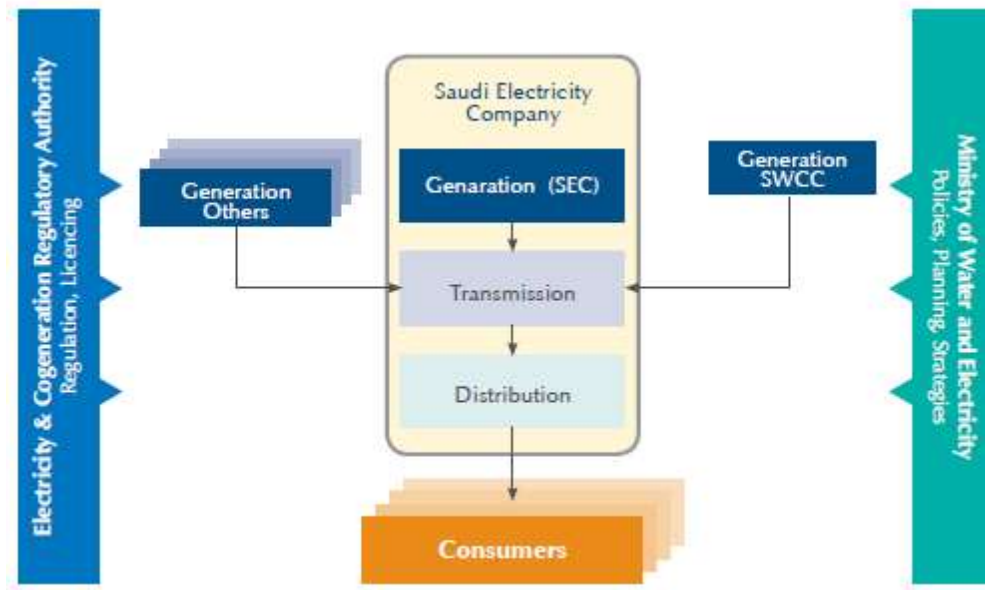
The Saline Water Conversion Corporation (SWCC), Saudi Aramco, Tihamah Power Generation Company, the Power and Water Utility Company (MARAFIQ), the Water and Electricity Company (WEC), and a number of large industrial firms also generate electricity. The SEC is responsible for tendering and procurement of IPPs, while the WEC, which is equally owned by the SEC and SWCC, is responsible for tendering and procurement of independent water and power producers (IWPPs).

Government agencies involved in the electricity system include the Ministry of Water and Electricity, which establishes policy, plans, and strategy for the electricity sector, and the Electricity and Cogeneration Regulatory Authority (ECRA), which reviews electricity costs and tariffs. Electricity prices in Saudi Arabia must reflect the economic costs of providing service, and the industry is not entitled to government subsidies.

The current structure of the electricity sector is shown in figure 2.22.

**Figure 2.22 Structure of Saudi Arabia's electricity sector**





Source: ECRA 2007 Annual Report.

The ECRA provides regulatory oversight and issues licenses to entities engaged in activities in the electricity and water desalination industry. The ECRA is a financially and administratively independent Saudi organization. Its mission is to develop and pursue a regulatory framework in accordance with government laws, regulations, policies, and standards, as well as international best practices, to guarantee the provision of safe, reliable, reasonably priced, and efficient electric power and desalinated water to the consumers of Saudi Arabia. A key responsibility of the ECRA is to encourage private sector participation and investment in the electricity sector, which is considered essential to the development and sustainability of the sector.

A 2005 law granted the ministry and the ECRA joint responsibility for transitioning the power sector to a competitive market. They are to encourage the private sector to invest in the electricity sector and ensure consumers' right to choose their electricity supplier. The law also ensures third-party access to the transmission and distribution networks and guards against uncompetitive behavior and abuse of market power. The ECRA has approved a transmission grid code and a distribution code to govern operation and use of the grid.

Saudi Arabia is far from having a competitive electricity market at this time. But the next stage in the electricity sector reform effort, which will include unbundling and third-party access to the transmission system, is under way. The first stage of the unbundling plan is expected to be implemented in 2011. At this time, it appears that the SEC will be unbundled into one transmission company, one distribution company, and four generation companies, all under the direction of an SEC holding company. The SEC holding company would also be responsible for fuel procurement on behalf of all generators in the country. The transmission company, which has already been established, will lease the transmission assets from the SEC holding company. Later, it is expected that distribution will be further unbundled into four or more companies.

It is anticipated that there will initially be a single-buyer market structure with the single buyer purchasing all generation in the country and selling all power to wholesale buyers—the distribution company, or, later, companies. The single buyer will reside within the SEC holding

company. But it will be some time before any significant competition is introduced in the electricity sector.

Retail tariffs in Saudi Arabia are far below the economic cost of supply. The World Bank reports that residential customers consuming 700 kWh per month pay only 8 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>35</sup>

Saudi Arabia's electricity sector is summarized as follows:

- **Reform:** Under way with passage of new law, but progress is slow.
- **Market structure:** Vertically integrated, but there are plans for the unbundling and implementation of a single-buyer market.
- **Separate regulator:** Yes.
- **Open access:** No.
- **Grid code/distribution code:** Yes/yes.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

#### 2.3.5.2 Kuwait

Kuwait's power sector is dominated by a vertically integrated utility owned and operated by the Ministry of Electricity and Water. There has been little reform—there is no independent regulation and Kuwait has only recently approved its first IPP.

There are five generating stations located along the Arabian Gulf coast. All are steam or gas turbines with the bulk of generation fuelled with oil. With high levels of forecast demand growth, Kuwait will need over 18 GW of new generation capacity by 2020, and has announced plans to tender new generation capacity requiring investment exceeding \$2.5 billion. But the proposed new plants will have total nominal capacity of only 4.8 GW, making Kuwait a prime candidate for long-term electricity purchases over the GCC interconnection.

Retail tariffs in Kuwait are far below the economic cost of supply. The World Bank reports that residential customers in Kuwait consuming 700 kWh per month pay only 4.5 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>36</sup>

Kuwait's electricity sector is summarized as follows:

- **Reform:** Limited.
- **Market structure:** Vertically integrated with no unbundling.
- **Separate regulator:** No.
- **Open access:** No.

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<sup>35</sup> See February 2009 World Bank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

<sup>36</sup> See February 2009 World Bank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

- **Grid code/distribution code:** No/no.
- **Private sector participation:** None, but plans for introducing IPPs in generation.
- **Tariffs:** Subsidized.

### 2.3.5.3 Bahrain

Generation in Bahrain follows the build-own-operate (BOO) model, with several privately owned facilities. The Electricity and Water Authority acts as the single buyer of power from the BOO plants. But it also acts as the regulatory authority for the power sector, so there is no independent regulatory agency. The Ministry of Electricity and Water is responsible for electricity production and distribution in Bahrain.

Bahrain is a very small player in the region in terms of electricity, with only about 3,000 MW of installed generating capacity in 2010. At present, two combined water and power production complexes and two smaller electricity-only plants provide all of Bahrain's electricity. Recently, the government announced an international bid for an additional 1,200 MW power and desalination plant, which is expected to be commissioned by the summer of 2011.

Bahrain's retail electricity prices are far below the economic cost of supply. The World Bank reports that residential customers in Bahrain consuming 700 kWh per month pay only 4.5 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>37</sup>

Bahrain's electricity sector is summarized as follows:

- **Reform:** Limited.
- **Market structure:** Single buyer, partial unbundling.
- **Separate regulator:** No.
- **Open access:** No.
- **Grid code/distribution code:** No/no.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

### 2.3.5.4 Qatar

Qatar has embarked on the restructuring and privatization of its electricity sector. All power generation in Qatar is now done by the private sector and IWPPs. Qatar Petroleum supplies the IWPPs with natural gas, and the Qatar General Electricity and Water Corporation (KAHRAMAA) buys power from the IWPPs. KAHRAMAA is also responsible for planning new generating capacity, and is working on several large-scale power projects with foreign companies. Installed generating capacity in Qatar in 2010 was 7,660 MW. Planned additions will bring the total to 8,750 MW in 2011. KAHRAMAA is required to privatize its power and water transmission and distribution systems, but a firm date for the privatization has not yet been established.

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<sup>37</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

The Ministry of Energy and Industry issues licenses for power generation and transmission. The ministry monitors and ensures that licensees comply with standards, specifications, and laws regulating these activities. The government has not yet appointed a regulator, so KAHRAMAA takes on this role, administering a transmission grid code, a distribution planning manual, a distribution code of practice, and a distribution construction manual.

Owing to the small size of the transmission and distribution system, the government is considering the implementation of a single-buyer market model. KAHRAMAA will purchase all electrical energy and act as the single wholesaler, or bulk trader, of electrical energy in Qatar.

Qatar's residential tariff is 2.2 US cents/kWh for consumption up to 4,000 kWh/month, and 2.7 US cents/kWh for consumption above 4,000 kWh/month. The World Bank reports that residential customers in Qatar consuming 700 kWh per month pay only 12 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>38</sup>

Qatar's electricity sector is summarized as follows:

- **Reform:** Under way.
- **Market structure:** Moving to single buyer with some unbundling.
- **Separate regulator:** No.
- **Open access:** No.
- **Grid code/distribution code:** Yes/yes.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

#### 2.3.5.5 The UAE

The UAE's power sector is organized differently in each of the seven emirates. Currently, there are four service providers: ADWEA, DEWA, SEWA, and FEWA. Each operates as a separate entity, but the Ministry of Energy is studying a common federal framework. The UAE's governing body, the Federal National Council, has approved a plan to privatize the FEWA.

Abu Dhabi has one of the more advanced power reform programs in the GCC, including an independent regulatory agency, the Abu Dhabi Regulation and Supervision Bureau, which regulates all companies undertaking activities associated with electricity production, transmission, and distribution. The ADWEA, a public agency owned by the Abu Dhabi government, is a holding company for unbundled electricity entities, including two generation companies, the single buyer (ADWEC), the transmission company, and two distribution companies. The ADWEA also develops, implements, and manages electricity policy. Abu Dhabi has both a grid code and distribution code to govern connection to, and use of, the networks.

Five IWPPs have been commissioned on a BOO basis as joint ventures between the ADWEA and various international companies. In each IWPP, the ADWEA has a 60 percent share while

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<sup>38</sup> See February 2009 World Bank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

overseas private investors own the remaining 40 percent. All IWPPs sell electricity to the single buyer.

Abu Dhabi is the only emirate to implement a privatization program in the electricity sector, and the only emirate to separate the transmission function from generation (albeit under the same holding company). But Dubai has also introduced the IWPP model for new generation and plans to reform its power sector similar to that of Abu Dhabi and privatize assets as was done with the ADWEA.

In 2008 the UAE projected escalating electricity demand from 15.5 GW in 2008 to over 40 GW in 2020. With natural gas supplies sufficient for only half of this amount, coal dismissed owing to environmental and energy security implications, and renewables able to supply only 6 to 7 percent of the needed power by 2020, the UAE is taking steps to embark on a nuclear power program in close consultation with the International Atomic Energy Agency (IAEA). It has accepted a \$20 billion bid from a South Korean consortium to build four commercial nuclear power reactors with a combined capacity of 5,600 MW by 2020.

Retail electricity tariffs continue to be subsidized. According to the government website, residential customers in the UAE consuming 700 kWh per month pay only 28 percent of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>39</sup>

The UAE's electricity sector is summarized as follows:

- **Reform:** Under way in several of the Emirates.
- **Market structure:** Single buyer in Abu Dhabi with partial unbundling. Other Emirates mostly vertically integrated with little unbundling.
- **Separate regulator:** Yes, in Abu Dhabi; no, in other Emirates.
- **Open access:** No.
- **Grid code/distribution code:** Yes, in Abu Dhabi; no, in other Emirates.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

#### 2.3.5.6 Oman

Oman was the first GCC country to introduce the IPP and IWPP models and has successfully privatized many of its power plants. The state-owned Oman Electricity Transmission Company is responsible for the transmission network, while the state-owned Oman Power and Water Procurement Company acts as the single buyer, purchasing all electricity from generators and selling it on to the distribution companies and large consumers. The Oman Power and Water Procurement Company is responsible for determining and securing new capacity when needed, subject to regulatory approval, and has the exclusive right to import and export power. There are three state-owned distribution and supply companies of which the Electricity Holding Company owns 99.99 percent and the Ministry of Finance owns the other 0.01 percent. There is a high level of private ownership in the generation sector.

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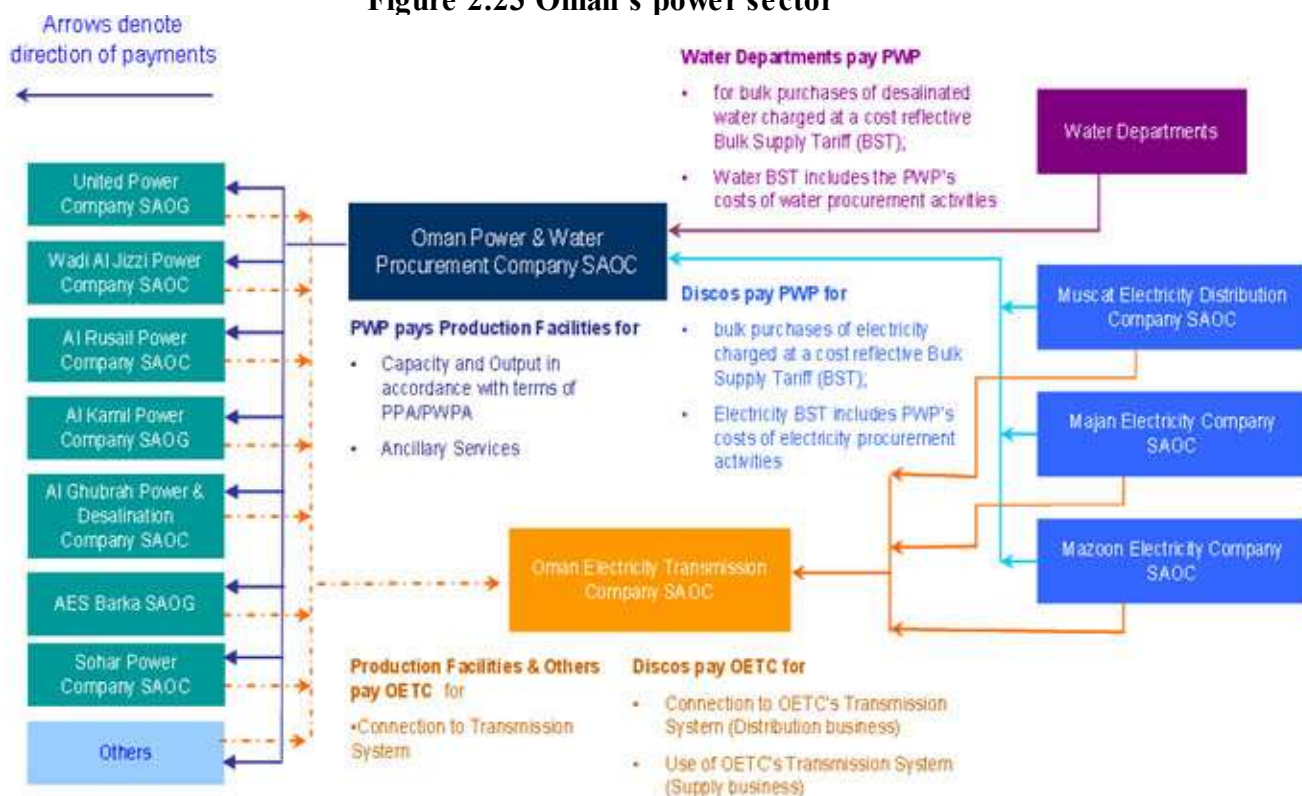
<sup>39</sup> www.rsb.gov.ae.



Oman’s Ministry of Water and Electricity is responsible for policy while regulation is the responsibility of the financially and administratively independent Authority for Electricity Regulation (AER). The AER is also responsible for facilitating privatization of the electricity sector. The law requires the AER to document tariffs and quantify the government subsidy to be paid by the Ministry of Finance. The AER has approved a grid code, a distribution code, and a formal connection-and-use-of-system charging methodology for Oman.

Figure 2.23 shows the organization of Oman’s power sector.

**Figure 2.23 Oman’s power sector**



**All intra sector transactions: (i) regulated & (ii) cost reflective (no direct subsidy)**

Source: [www.aer-oman.org/index.php?option=com\\_content&view=article&id=120&Itemid=178](http://www.aer-oman.org/index.php?option=com_content&view=article&id=120&Itemid=178).

Oman will require between 3,000 and 4,000 MW of new generating capacity by 2016. The Oman Power and Water Procurement Company has initiated competitive procurement for two new gas-fired IPPs, each having a capacity of 650–750 MW with an expected commissioning in 2013. Temporary generating capacity using diesel or open-cycle gas-turbine technology is also under consideration for 2011.<sup>40</sup> Use of gas for power generation is expected to double by 2020.

Retail electricity tariffs remain far below the economic cost of supply in Oman. The World Bank reports that residential customers in Oman consuming 700 kWh per month pay only 15 percent

<sup>40</sup> See Oman Power and Water Procurement Company’s 7-Year Statement, 2010–16.

of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>41</sup>

Oman's electricity sector is summarized as follows:

- **Reform:** Under way with passage of new law.
- **Market structure:** Single buyer with full unbundling. Potential to move to wholesale competition under new law.
- **Separate regulator:** Yes.
- **Open access:** No.
- **Grid code/distribution code:** Yes/yes.
- **Private sector participation:** Yes, in generation.
- **Tariffs:** Subsidized.

#### 2.3.5.7 Yemen

Yemen is discussed in this section of the report owing to its close proximity to the GCC and the possibility that it might be interconnected with the GCC in the future.

In Yemen the Ministry of Electricity and Power is responsible for policy making in the electricity sector. The state-owned Public Electricity Corporation (PEC) is a vertically integrated utility and the country's primary provider of electricity.

A 2009 law establishes an independent regulator and access to the transmission and distribution networks on a fair and nondiscriminatory basis. The PEC is to be unbundled into generation, transmission, and distribution companies. But detailed regulations have not yet been developed under the new law. The law allows for a three-year transition period during which the PEC is required to create generation, transmission, and distribution companies.

The new independent regulator, the Regulating Board of Electricity Activities, will prepare the detailed regulations required under the law. The Minister of Electricity and Power will chair the board, which will regulate tariffs for generation, transmission, and wholesale supply and distribution. Although the board has responsibility for regulating tariffs, ultimate approval of tariffs lies with the Council of Ministers. Transmission access will be governed by the regulations being developed by the board.

Yemen has a small power sector with generating capacity of about 1,200 MW installed and an additional 1,068 MW available. Demand is expected to increase substantially in the future, to over 3,000 MW (peak) by 2020. Over 3,000 MW of new generating capacity will be required by 2020 after allowing for retirements. Most new generation is expected to be fired with gas. A 180 MW wind farm is also under consideration.

Yemen's retail electricity tariffs are below the economic cost of supply. The World Bank reports that residential customers in Yemen consuming 700 kWh per month pay only 24 percent of a

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<sup>41</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.

benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal, and Turkey.<sup>42</sup>

Yemen's electricity sector is summarized as follows:

- **Reform:** Under way with passage of new law, but progress stalled.
- **Market structure:** Vertically integrated, but plans for unbundling and implementation of single-buyer market.
- **Separate regulator:** Yes, but does not have full responsibility for tariffs.
- **Open access:** No.
- **Grid code/distribution code:** No/no.
- **Private sector participation:** None.
- **Tariffs:** Subsidized.

### 2.3.6 Summary of Arab Market Status

The power sectors in the Arab countries are facing significant challenges. High levels of electricity demand growth that are expected to continue into the future are taxing the ability of the countries to finance and construct new generating capacity necessary to meet this demand with adequate levels of reliability while replacing older plants due for retirement. Retail tariffs are woefully inadequate in most Arab countries; an assessment of retail tariffs in Arab countries is provided in attachment 2.A.

In order to address the financing and construction challenges, significant institutional reform is necessary, going well beyond retail tariff reform if the Arab countries are to successfully attract investment. Private sector investment can play a major role in meeting the Arab countries' electricity sector challenges, as has been proved around the world. The private sector can help mobilize the huge amounts of capital necessary to fund projects needed to meet increasing electricity demand. Further, private sector management expertise can significantly improve the operational efficiency of an electricity market. Details of private sector participation in 14 Arab countries are provided in attachment 2.B.

As will be addressed in chapter 3, institutional reforms generally relate to leveling the playing field so that investors, both public and private, are assured of a fair opportunity to recover their investment plus profit. This generally means that the market will be administered in a fair and transparent manner, with open access to the transmission system and key administrators of the market (that is, regulator, system operator, market operator, and so on) skilled and informed in market operations and independent of outside influences. A summary of key institutional bodies and governance documents in place in Arab countries is provided in table 2.11.

**Table 2.11 Key institutions and governance documents**

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<sup>42</sup> See February 2009 WorldBank report entitled, *Tapping a Hidden Resource—Energy Efficiency on the Middle East and North Africa*.



		Regulator	Electricity Law	Transmission Grid Code	Distribution Grid Code	Regulator Structure/reform	Regional electricity forums
Maghreb	Algeria	CREG	Yes	Yes	Yes	SB/UNB	AUE, AMU, IMME, EU, COMELEC
	Morocco	No	No (RES)	No	No	SB/Part UNB	
	Tunisia	No	Decree	No	No	VER	
EJLLPST	Egypt	ERA	Yes (RES)	No	No	VER	AUE, AERF, Steering, Planning & Operating Committees
	Iraq	No	No	No	No	VER	
	Jordan	ERC	Yes (EE&RES)	Yes	Yes	SB/UNB	
	Lebanon	No	Yes (PPP)	No	No	VER	
	Palestine	PERC	Yes	No	No	SB/UNB	
	Syria	No	Yes (EE&PPP)	No	No	VER	
	Libya	No	No	No	No	VER	
GCC	Bahrain	No	No	No	No	SB/Part UNB	AUE, AERF, GCC Ministerial Committee, ARC, GCCIA
	Kuwait	No	No	No	No	VER	
	Oman	AER	Yes	Yes	Yes	SB/UNB	
	Qatar	No	Yes	Yes	Yes	SB/UNB	
	Saudi Arabia	ECRA	Yes (RES-Future)	Yes	Yes	VER	
	UAE	Bureau	Yes	Yes	Yes	SB/Part UNB	
Others	Yemen	No	No	No	No	VER	AUE
	Comoros	?	?	?	?	?	
	Somalia	?	?	?	?	?	
	Sudan	Yes	Yes	Yes	Yes	SB/UNB	
	Mauritania	ARE	Yes	No	No	VER	
	Djibouti	No	No	No	No	VER	

Note: SB = single buyer; UNB = unbundling exists; VER = vertically integrated; ? = no information; RES = renewable energy source; EE = energy efficiency; PPP = private-public partnership; UAE = United Arab Emirates.

## 2.4 Neighboring Regions

### 2.4.1 Europe

The European Commission's Electricity Market Directives have significantly transformed Europe's energy industry with the objective of promoting competition in the internal electricity market. The focus of the directives has been on unbundling monopoly elements such as network operation from the other functions, ensuring third-party transmission access, ensuring independent regulatory oversight including for cross-border exchanges and trade, and providing that all customers choose their supplier.

During the past 15 years electricity consumption in the EU has increased at an average annual rate of 1.7 percent. Based on the International Energy Agency's (IEA's) World Energy Outlook (2009) reference scenario forecast, electricity demand in the EU is expected to grow at a compounded annual average rate (CAGR) of 0.9 percent from 2,840 terrawatt-hours (TWh) in

2007 to 3,485 TWh in 2030. This compares with a forecast of 1 percent annual growth for the Organisation for Economic Co-operation and Development (OECD) member countries and 2.5 percent for the world.

Table 2.12 summarizes the electricity supply-demand balance in the EU for the period 2002–07. The installed generation capacity has increased from 716 GW in 2002 to around 811 GW in 2008. About 7 percent of this capacity was owned by auto-producers (industries producing power mainly for their own consumption). The remaining 93 percent was for public supply.

**Table 2.12 EU electricity demand/supply balance, 2002–07**

Item/unit	2002	2003	2004	2005	2006	2007	2008
Total installed capacity (GW)	716	728	737	747	762	779	
Hydro	142	137	138	139	140	140	
Wind	23	29	34	41	48	56	65
Geothermal	0.68	0.72	0.66	0.69	0.70	0.70	0.85
Nuclear	138	137	136	135	134	133	
Conventional thermal	412	424	427	432	440	449	
Capacity in utilities (GW)	670	682	685	690	717	731	
Capacity of auto producers (GW)	46	47	51	53	53	54	
Gross generation (TWh)	3,117	3,216	3,288	3,309	3,540	3,362	3,260
Hydro	348	338	357	341	345	344	414
Wind	36	44	59	70	82	104	
Geothermal	5	5	6	5	6	6	6
Nuclear	990	996	1,008	998	990	935	936
Conventional thermal	1,738	1,832	1,857	1,893	1,929	1,969	1,904
Net generation (TWh)	2,953	3,049	3,117	3,134	3,178	3,185	3,096
Imports into EU (TWh)	285	290	281	324	311	318	297
Exports from EU (TWh)	272	292	288	313	307	308	285
Self-consumption by producers (including pumped storage)	289	298	302	305	296	298	45
Network losses (TWh)	208	215	223	219	202	204	
Final consumption (TWh)	2,600	2,668	2,722	2,763	2,826	2,843	
Of this industry	1,092	1,102	1,126	1,135	1,133	1,150	
Transport	72	72	72	74	71	72	
Households	739	771	784	795	807	801	
Services, others	697	722	738	758	816	821	

Source: [http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-PC-09-001/EN/KS-PC-09-001-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-PC-09-001/EN/KS-PC-09-001-EN.PDF).

Note: Data for 2008 are provisional from *Monthly Statistics* issue 11/2009 of Eurostat. In 2008 hydropower generation includes wind power and self-consumption relates to pumped storage units. The data exclude solar, biomass, and waste-based generation and capacity.

The IEA forecasts that the total annual electricity generation will increase from 3,325 TWh in 2007 to 3,765 TWh in 2030, an annual increase of 0.8 percent. The generation levels and generation mix envisaged for 2015, 2020, and 2030 are summarized in table 2.13.

**Table 2.13 Forecast generation levels and generation mix in the EU through 2030**

Electricity generation (TWh)	1990						Share (%)		CAGR (%)
	1990	2007	2015	2020	2025	2030	2007	2030	2007–30
Total generation	2,568	3,325	3,432	3,587	3,765	3,968	100	100	0.8
Coal	1,050	1,024	907	870	876	862	31	22	-0.7
Oil	221	112	69	51	43	43	3	1	-4.1
Gas	191	725	746	861	929	995	22	25	1.4
Nuclear	795	935	874	773	721	736	28	19	-1.0
Hydro	286	309	351	381	400	408	9	10	1.2
Biomass and waste	20	105	143	172	191	212	3	5	3.1
Wind	1	104	300	412	508	581	3	15	7.8

Geothermal	3	6	8	9	11	13	0	0	3.6
Solar	0	4	34	56	80	107	0	3	15.7
Total and wave	1	1	1	2	4	9	0	0	13.4

Source: World Energy Outlook, IEA 2009.

Note: CAGR = compound annual growth rate.

The EU currently depends on imports for 50 percent of its overall energy needs, and this figure is expected to rise to 64 percent by 2020 and 67 percent by 2030. Between now and 2030 the import dependency for gas is expected to increase from 59 percent to 84 percent, the oil import dependency will rise to 95 percent, and the import dependency for solid fuels is expected to rise from 40 percent to 63 percent. Import dependency for uranium is already at nearly 98 percent (IEA Energy Policy Review EU 2008). Aside from this dependency on fuel imports, there is little direct import dependency for electricity.

The EU is a desirable trading partner for the Arab countries due to its diversity of demand. Demand in the EU peaks in winter, while the Arab countries, with the exception of Syria, are all summer peaking. This poses significant potential for reserve sharing and economy energy trade to take advantage of production cost differences in the summer and winter periods.

More details on Europe's power sector are provided in attachment 2.C.

#### 2.4.2 Turkey

Turkey has been implementing significant reforms in recent years in an effort to join the EU internal electricity market. The original state-owned vertically integrated Turkish Electricity Corporation (TEK) has been unbundled to enable private sector participation and the implementation of a competitive electricity market.

Electricity demand has been growing at an average annual rate of about 8 percent during the past four decades. The Turkish Power Transmission Company forecasts a compound annual growth rate (CAGR) of 7.45 percent in the base case and 6.6 percent in the low case over 2008–17 (see table 2.14).

**Table 2.14 Demand forecast for the Turkish electricity system**

Year	Base Case		Low Case	
	Peak demand (MW)	Gross energy demand (GWh)	Peak demand (MW)	Gross energy demand (GWh)
2008	32,478	204,000	32,143	204,000
2009	35,053	219,013	34,571	216,992
2010	37,832	236,182	37,182	230,705
2011	40,716	253,837	39,573	246,181
2012	43,819	272,812	42,331	262,696
2013	47,159	293,205	45,167	280,319
2014	50,753	315,123	48,193	299,124
2015	54,622	338,679	51,421	319,190
2016	58,560	363,695	54,788	340,379
2017	62,782	390,559	58,376	362,975
CAGR (%)	7.60	7.45	6.85	6.60

Source: 10-Year Generation Capacity Projection (2008–17), [www.teias.gov.tr](http://www.teias.gov.tr).

Note: CAGR = compound annual growth rate; GWh = gigawatt-hour; MW = megawatt.

Turkey nearly doubled its generation capacity between 1998 and 2008, but the demand-supply balance remained tight. Demand is expected to outstrip supply in 2011 if additional new generation capacity does not come on line. In response, Turkey plans to add 17,136 MW of new

generating capacity with an annual production capability of 77.9 TWh during the 2008–15 time frame. About 68 percent of the new capacity will be hydroelectric, 26 percent will be thermal, and the remaining 6 percent will be based on renewable sources such as wind and geothermal. The expansion plan scenarios are shown in table 2.15.

**Table 2.15 Turkey’s generation expansion plan (2008–15)**

Categories	Additional generation capacity (MW)	Additional annual generation (GWh)	Additional annual firm power generation (GWh)
<b>A. Base case</b>			
State-owned power plants under construction	4,318.7	16,825.9	12,520.4
Private sector power plants licensed	12,817.5	61,061.8	47,339.7
<b>Total</b>	<b>17,136.2</b>	<b>77,887.7</b>	<b>59,860.1</b>
Hydropower capacity	11,682.4	41,587.4	24,537.9
Thermal power capacity	4,523.2	32,586.4	32,312.8
Wind/ geothermal/ other	930.6	3,713.9	3,189.4
<b>Total</b>	<b>17,136.2</b>	<b>77,887.7</b>	<b>59,860.1</b>
<b>B. Low case</b>			
State-owned power plants under construction	4,318.7	16,825.9	12,520.4
Private sector power plants licensed	8,598.8	41,848.9	33,581.6
<b>Total</b>	<b>12,917.5</b>	<b>58,674.8</b>	<b>46,102.0</b>
Hydropower capacity	8,627.2	29,455.4	17,542.9
Thermal power capacity	3,791.5	27,194.7	26,921.1
Wind/ geothermal/ other	498.8	2,024.7	1,638.0
<b>Total</b>	<b>12,917.5</b>	<b>58,674.8</b>	<b>12,520.4</b>

Source: [www.teias.gov.tr](http://www.teias.gov.tr).

Note: GWh = gigawatt-hour; MW = megawatt.

Turkey has electrical interconnections with Bulgaria, Greece, Georgia, Armenia, Azerbaijan, Iraq, Iran, and Syria; however, the volume of electricity exchanges has been less than 2 percent of Turkey’s annual consumption. Turkey has plans to expand interconnection capacity with Georgia, Iran, Iraq, and Romania. Turkey has excellent prospects as an electricity export destination and as a transit country for exports to the EU. It has attractive electricity prices, an open, competitive market structure with third-party access, and numerous market participants, and it will soon be a member of the ENTSO-E with synchronous operation with the European grid. More details on Turkey’s electricity sector are provided in attachment 2.D.

### 2.4.3 Iran

Iran is well endowed in terms of oil and gas with proven oil reserves at year end 2008 estimated at 18.9 billion tonnes (10.9 percent of the world’s total and the second-largest in the world after Saudi Arabia) and proven natural gas reserves estimated at 29.61 trillion cubic meters (16 percent of the world’s total and the second-largest in the world after Russia).

The electricity sector is unbundled vertically by function and horizontally by the existence of multiple companies for generation and distribution. The Ministry of Energy is very much involved in the power sector, owning and operating hydropower and thermal generating stations, as well as the Iranian Grid Management Company, which is responsible for the operation of the transmission system, system dispatch, and market operations at the wholesale level. In the generation segment, public sector generation units owned by the regional electric companies operate alongside a number of privately owned IPPs. As shown in table 2.16, Iran uses a broad variety of generation methods.

**Table 2.16 Energy generation in FY 2007–08, by type of unit (GWh)**

Types of power-plant units	Units under MOE	Other units	System total	Percentage share
Steam power stations	90,900	13,953	131,832	64.6
Simple cycle gas turbines	26,979			
Gas-fired combined-cycle units	53,796	0	53,796	26.4
Diesels	225	0	225	0.1
Subtotal for thermal power units	171,900	13,953	185,853	91.1
Hydropower units	17987	0	17,987	8.8
Wind power units	141	0	141	0.1
Subtotal for hydro and wind units	18,128	0	18,128	8.9
Total for all units	190,028	13,953	203,983	100.0

Source: [www.tavanir.ir](http://www.tavanir.ir).

Note: MOE = ministry of energy; GWh = gigawatt-hour.

The Iranian Ministry of Energy estimated in 2008 that peak demand of the system was forecast to grow from 37,053 MW in FY 2007–08 to 88,166 MW by FY 2020–21 (see table 2.17). To meet the forecast demand, the ministry planned to raise total installed generation capacity to about 125,000 MW by FY 2020–21. So far, 22,204 MW of new generating capacity is expected to be added during FY 2008–16, bringing the total installed capacity in the country to 71,617 MW by that date. The new capacity will consist of 14,380 MW of gas-fired combined-cycle units; 4,570 MW of hydropower units; 2,614 MW of gas-turbine units; and 640 MW of steam-turbine units. About 55 percent of the total capacity additions will be in the private sector in the form of BOT and BOO projects; the remainder will come from the public sector.

**Table 2.17 Peak demand forecast**

Year	Peak demand (MW)	Annual growth rate (%)
2007–08	37,053	-
2008–09	40,189	8
2009–10	43,762	9
2010–11	47,501	9
2011–12	51,484	8
2012–13	55,797	8
2013–14	60,500	8
2014–15	64,843	7
2015–16	69,473	7
2016–17	72,293	4
2017–18	76,261	5
2018–19	80,230	5
2019–20	84,198	5
2010–21	88,166	5

Source: Presentation by the Ministry of Energy of Iran on February 19, 2008, [www.igmc.ir/usrFiles/./ElectricPowerIndustry-iri-feb2008](http://www.igmc.ir/usrFiles/./ElectricPowerIndustry-iri-feb2008).

Iran has numerous international interconnections with the power systems of Armenia, Azerbaijan, Turkey, Turkmenistan, Afghanistan, Pakistan, and Iraq. In spite of the large number of international interconnections, trade plays a relatively minor role in the Iranian power sector. The total volume of trade of 4.36 TWh in FY 2007–08 was about 2.1 percent of the total generation in the country. Details of Iran’s power sector are provided in attachment 2.D.

#### 2.4.4 Nile Basin Initiative (NBI)

The riparian states of the Nile River<sup>43</sup> have formed a partnership called the Nile Basin Initiative (NBI) seeking to develop the river in a cooperative manner, share its socioeconomic benefits equitably, and promote regional peace and security. One of the subsidiary programs is the Eastern Nile Subsidiary Action Program sponsored and advanced by the Eastern Nile Technical Regional Office (ENTRO). The Ethiopia-Sudan electricity interconnection project was implemented as part of this subsidiary program. Promoting power trade through regional cooperation to increase access to electricity and lower costs is a key part of the program. Several major hydropower projects are being studied under the program for facilitating energy trade among Ethiopia, Sudan, Kenya, and Egypt.

Meanwhile, countries belonging to the East African Community (EAC)<sup>44</sup> are promoting the Eastern Africa Power Pool (EAPP), which will be greatly facilitated by the interconnections and studies pursued under the NBI's program. The interconnections implemented and under consideration in the EAPP are shown in figure 2.24. The project, with a total cost of \$43.1 million, consists of a recently completed 296.5 km double-circuit 230 kV transmission link between Bahir Dar substation in Ethiopia and the Sudan border. Additionally, the Sudanese National Electric Corporation is constructing a 155 km double-circuit 230 kV link from the Sudan-Ethiopia border to Gedaref Substation in Sudan. Power export from Ethiopia to Sudan would be on the basis of a three-year power-purchase agreement (PPA) under which an annual firm supply of 100 MW would be purchased. Additional supply would be agreed upon in the future.

Ethiopia has a large hydropower potential and, having recently commissioned three new hydropower projects, will have surplus power to export. The nation could however benefit from imports of thermal power from Sudan to manage seasonal variations in domestic generation. Ethiopia has already completed an interconnection to Djibouti and is pursuing an interconnection with Kenya to export the surplus from these projects and those under construction. Sudan also has significant hydropower resources; it has recently commissioned two new plants and is investigating and preparing studies and designs for several more.

### **Figure 2.24 Eastern Africa Power Pool**

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<sup>43</sup> The countries include Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda with Eritrea as an observer.

<sup>44</sup> These countries are Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, and Sudan.





Further details of the NBI are provided in attachment 2.F.

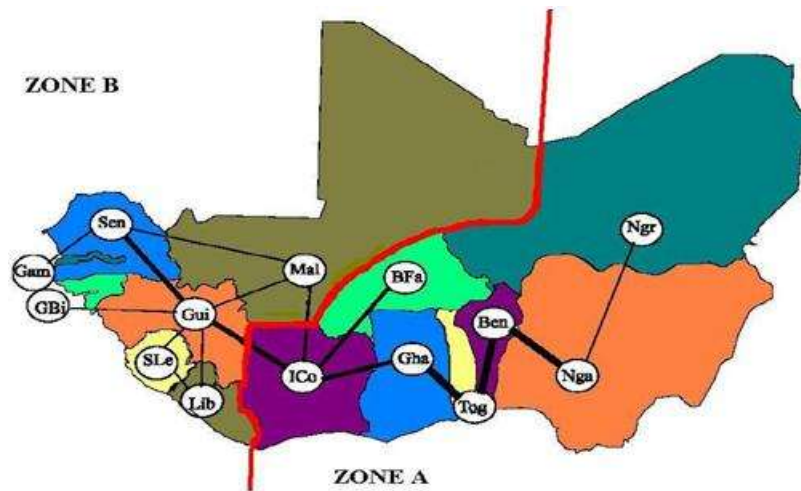
#### 2.4.5 West African Power Pool (WAPP)

The Economic Community of West African States (ECOWAS) adopted the West African Power Pool (WAPP) initiative in 1999 to integrate electricity markets and address lack of electricity access in its 15 member countries—Benin, Burkina Faso, Cape Verde, Côte d’Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. Following the adoption of the WAPP Articles of Agreement in October 2005, the WAPP organization was established in January 2006. The WAPP aims to enhance information sharing among the ECOWAS member countries, harmonize electricity operating standards, design priority investments, improve electricity system reliability and cost effectiveness, and encourage cross-border electricity trade.

A number of interconnection projects are either under way or in the planning stages in the WAPP (see figure 2.25). The goal of these projects is to establish secure, reliable transmission corridors

for the transfer of low-cost hydroelectric and gas-fired power to displace diesel-based sources. The WAPP generation and transmission projects are shown in figures 2.26 and 2.27.

**Figure 2.25 WAPP interconnection projects**



Source: ECOWAS WAPP Project, Nigeria, Benin, Togo, and Ghana Interconnection Project.

**Figure 2.26 WAPP generation projects      Figure 2.27 WAPP transmission integration**



Source: WAPP Presentation, Africa Investment Project Summit, November 8, 2007.

#### 2.4.6 Trade with Countries to the East

The market vision for the Pan-Arab network has the flexibility to accommodate electricity trade with its Asian neighbors to the east. There are numerous initiatives in the Asian region to interconnect electricity systems. The Association of Southeast Asian Nations (ASEAN) countries have launched the most systematic effort. The first interconnection project was implemented in 1971 when the Nam Ngum 1 hydropower project between Laos and Thailand commenced operation. This was followed by power exchange agreements among Thailand, Malaysia, and Singapore in 1978, and introduction of the concept of the ASEAN Power Grid in 1980, which did not receive formal high-level endorsement until 1997, but moved rather quickly afterwards. The underlying vision of the ASEAN Power Grid is based on a stepwise progression where initial trade takes place on cross-border, bilateral terms, gradually expanding to subregional and eventually regional levels. Of the 14 interconnection projects identified by the ASEAN Power Grid master plan, 3 are already in operation and the other 11 are planned through 2015.

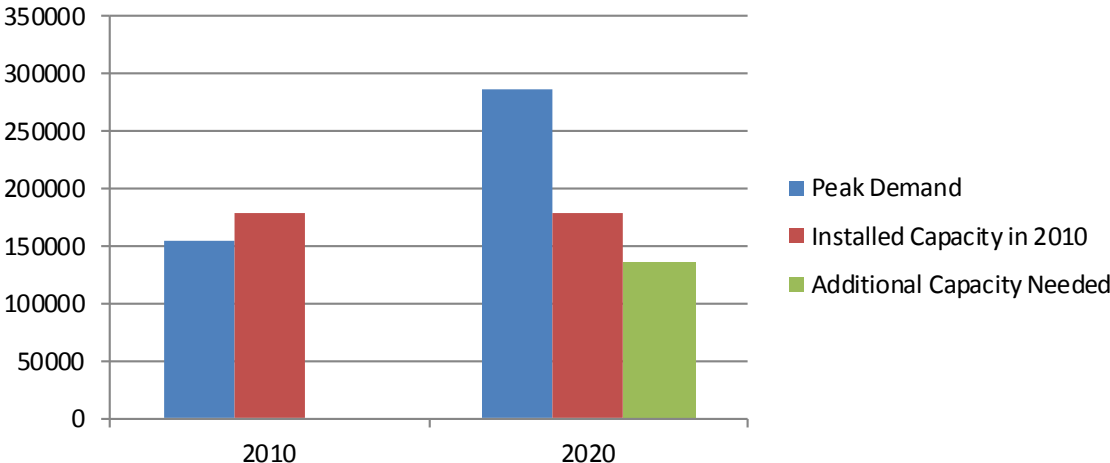


Aside from the ASEAN network, there have been some other relevant experiences in South and Central Asia. The Central Asia projects have a high profile in the international community due to their prevailing controversies. Central Asia has considerable hydropower resources that could be developed and traded within or outside the region. But the prospects for expanding electricity generation and trade are uncertain due to the lack of trust and genuine cooperation among the relevant stakeholders. The infamous energy-water nexus among the Central Asian states has been addressed by a number of international institutions, with limited success. Frustrated with the slow progress in intraregional trade, Central Asian countries are now seeking the possibility of exporting electricity to countries outside the region, including Afghanistan, China, Iran, and Pakistan. This has resulted in a new initiative among Afghanistan, Kyrgyzstan, Pakistan, and Tajikistan to develop a Central Asia Regional Electricity Market (CASAREM). The idea behind this initiative is to utilize the Central Asia’s surplus hydropower in summer to meet high and growing demand in South Asia.

**2.5 Summary**

The high growth in electricity demand that Arab countries have experienced in recent years is expected to continue into the future (see figure 2.28). Peak demand is forecast to be 84 percent greater than 2010 levels by 2020, requiring an additional 135 GW of generating capacity. The total investment that will be needed for the expansion of generation, transmission, and distribution (to meet additional energy demand of about 700 TWh) in the Arab countries could exceed \$450 billion by 2020.<sup>45</sup> Mobilizing such levels of investment poses a huge challenge for the Arab countries, particularly considering the poor financial condition of many of the incumbent utilities.

**Figure 2.28 Supply/demand balance without regional planning**



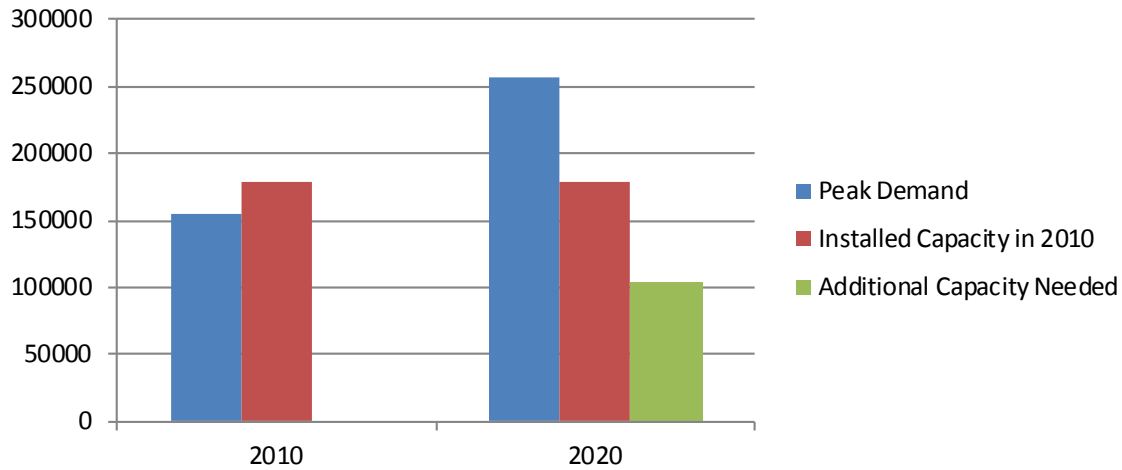
Source: The LAS and various World Bank reports.

Regional integration could provide significant assistance in this regard as demand profiles across countries differ and peak demands are not coincidental. If it is assumed that global coincidental

<sup>45</sup> Based on estimates for Egypt’s expansion plan of approximately \$101 billion to meet 150,000 GWh of demand growth (October 10, 2008, World-Bank-sponsored report, *Energy Cost of Supply and Pricing Report*).

peak demand is 10 percent below the sum of the peak demands in each country, there would be a reduction of 31 GW in required generation capacity by 2020 (see figure 2.29).

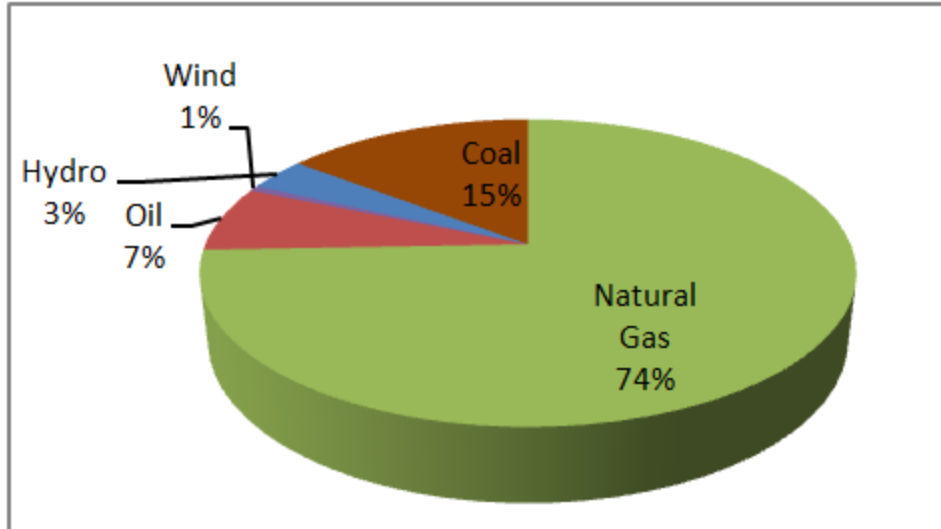
**Figure 2.29 Supply/demand balance with regional planning**



In addition, enhanced interconnections across the Arab countries and increased electricity trade would reduce the share of expensive fuel oil and gas-oil in favor of more competitive and clean natural gas, assuming natural gas is available. For instance, Qatar, a country abundant with natural gas resources, could sell gas-fueled electricity to Kuwait or Saudi Arabia, which would save large amounts of oil for more value-added sectors. Similar opportunities exist in the EIJLLPST countries. For example, Egypt has significant amounts of gas generation that could be used to displace oil generation in places such as Syria.

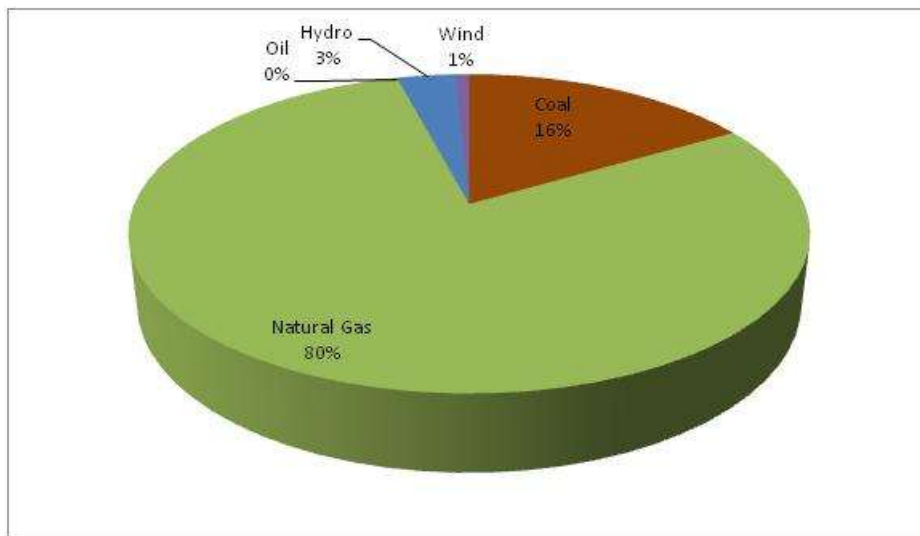
A simulation was performed on Morocco, Algeria, and Tunisia to quantify the benefits of increased trade among the three countries. Utilities dispatch their generation according to economic merit, so the units with the lowest production costs are used as much as possible while higher cost units are brought online only when load increases during peak periods of demand. The current generation mix with no electricity exchange between the countries is shown in figure 2.30. Using Matlab, a linear-programming software package, optimal dispatch among the three countries is solved with energy freely exchanged between the countries to minimize production costs for the region, assuming no capacity constraints. The resulting generation mix is shown figure 2.31.

**Figure 2.30 Morocco, Algeria, and Tunisia current generating mix in MWh**



Note: Imports from Spain are not included. MWh = megawatt-hour.

**Figure 2.31 Morocco, Algeria, and Tunisia optimized generation mix (regional dispatch)**

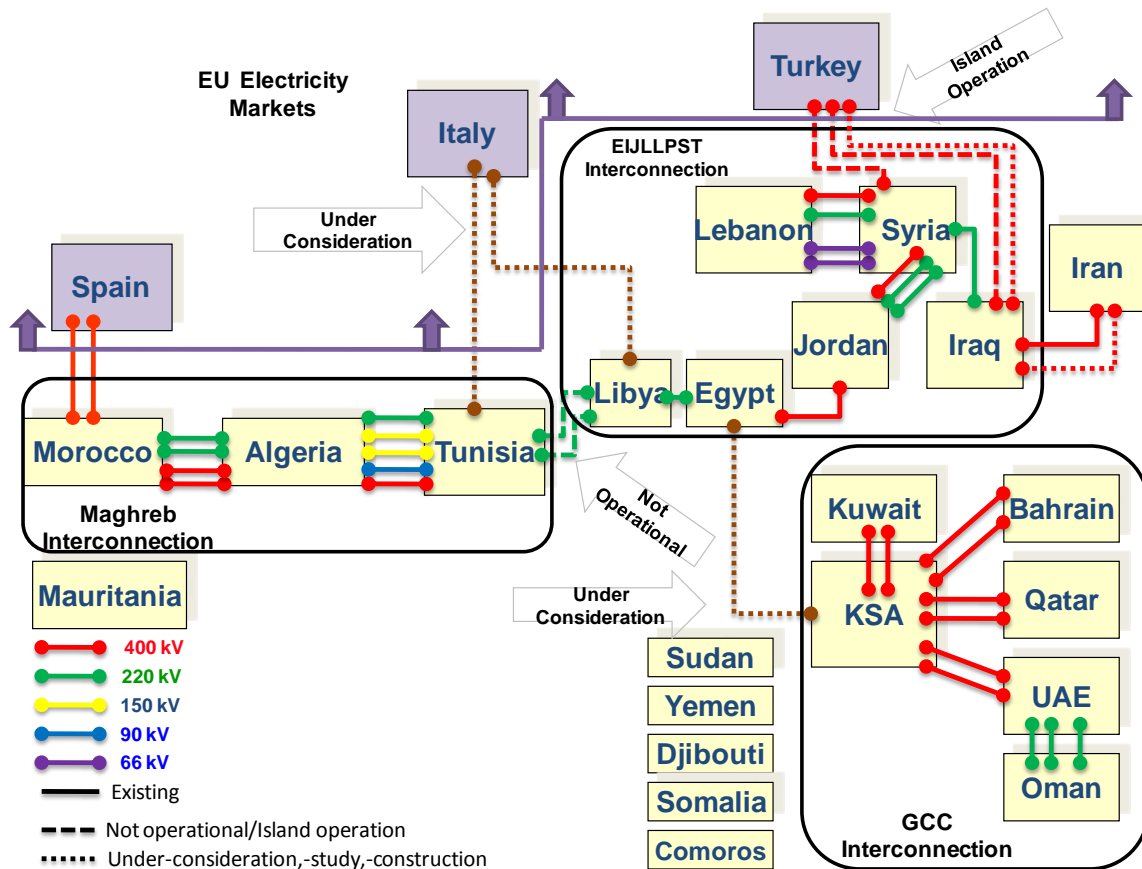


In the case of regional economic dispatch, natural-gas-fueled generation in Algeria and Tunisia would substitute oil-fueled generation in Morocco, increasing the share of natural gas in the global generation mix from 74 to 80 percent, while oil-fueled electricity would become negligible. Algeria and Tunisia would become net exporters of electricity, while Morocco would become a net importer (3 TWh,<sup>46</sup> or 1,000 MW on average over 8 hours per day). This is equivalent to annual savings estimated at \$300 million.

Existing/committed and potential electrical interconnections between Arab countries are summarized in figure 2.32. It is anticipated that the EIJLLPST and the GCC regions will ultimately be synchronized with the ENTSO-E.

<sup>46</sup> This is in addition to the current 4.6 TWh import from Spain.

**Figure 2.32 Existing/committed and potential interconnections among Arab countries**



Note: Medium voltage interconnections between Jordan and West Bank and between Egypt and Gaza exist and operate in island mode. - Source: The World Bank

Regional electricity market initiatives in the neighboring regions of Europe, Turkey, Iran, the NBI, and the WAPP provide valuable lessons learned for the regional integration of electricity markets in Arab countries. Further, these neighboring regions represent potential trading partners, so their electricity market designs influence regional market integration initiatives in the Arab countries.

Europe's REM design has been evolving over the past 14 years, and will continue to evolve in the future. It has a huge regional market with robust trade among numerous market participants. Joining the EU market would vault the electricity sectors of the Arab countries to world-class status with its attendant economic benefits. Europe also provides a market for potential RES developments being pursued by many of the Arab countries.

Turkey is expected to join the EU electricity market in 2012. This would pave the way for the EIJLLPST countries, and potentially the GCC through the proposed Saudi Arabia–Egypt interconnection, to synchronize and join the EU market in the future.

A new interconnection that is under consideration between the UAE and Iran could open the door to electricity trade between Iran and the GCC. Iran also provides a gateway to further trade through its international interconnections with Armenia, Azerbaijan, Turkey, Turkmenistan, Afghanistan, Pakistan, and Iraq.

The EAC is promoting the EAPP, along with several potential new hydropower projects and interconnections. This would facilitate trade among Ethiopia, Sudan, Kenya, and Egypt, and through Egypt to the rest of the EIJLLPST and Arab REM.

In the WAPP, a number of transmission interconnection projects are either under way or in the planning stages. As Mauritania already shares generation and transmission facilities with some of the WAPP countries, and is considering interconnection with Maghreb, the WAPP could ultimately become integrated with Maghreb and the rest of the Arab regional market.

### **3 The Context for Regional Electricity Trade**

This chapter covers the context for regional electricity trade, including the benefits of developing and implementing regional electricity markets (REMs) and the challenges and lessons learned from attempts to establish REMs elsewhere in the world. Several sections address efforts to develop large-scale renewable energy projects in the Arab countries, and discuss the need to synchronize regional power systems to support trade. The chapter finishes with a discussion of the requirements for regional integration and trade and an assessment of the REMs in the Arab world.

#### **3.1 Benefits and Challenges of Integrating Regional Electricity Markets**

Countries around the world are increasingly pursuing and benefitting from the integration of national electricity markets into larger regional power markets to provide reliable, affordable electricity to consumers. Increased cooperation in the trade of power among countries can bring numerous benefits, including:

- Increased energy security
- Improved reliability
- Access to resources
- More efficient and effective use of infrastructure
- Economies of scale in investments
- Facilitation of financing for new investments
- Increased energy efficiency
- Greater renewable energy penetration
- Reduced environmental impact—that is, reductions in greenhouse gases
- Reduced cost of supply for consumers

At the same time, many regional electricity market (REM) development efforts around the world are facing challenges that slow progress and reduce the benefits of regional integration. It is important to understand these challenges when designing a strategy for increased trade among Arab countries. The challenges include:

- Difficulty in aligning national and regional investment decisions
- Differences in regulatory environments between countries
- Limited scope of regional institutions
- Limited financing
- Changes in political framework
- Concerns about national sovereignty and energy independence

Establishing regional markets is more complex than establishing single-country markets because the number and scope of risks increase with the number of countries involved. The technology risks associated with electricity trade are relatively minor; generation, transmission, distribution,

and fuel-delivery technologies are all well developed. If tariffs reflect costs, the economic risks are relatively minor as well, since demand is significantly increasing in all Arab countries. The economic risks would be further reduced if power markets were more fully integrated, as this would increase the number of potential buyers of services. But while increasing demand reduces market risk by increasing the probability of a buyer for generation and transmission services, it also elevates risks in that it places increasing pressure on the financial, economic, and technical capacity of each country. Developing a regional market with regional coordination and governance would reduce risks because it would optimize generation and transmission planning and operations for the broader region.

Regardless of the type of regional trade, there needs to be a legal, regulatory, and governance structure in place conducive to international trade, even if trade is only bilateral between two countries. The participating countries must have the political will to relinquish a portion of their energy supply responsibilities to the greater good of the region.

### 3.2 Experience with Market Integration

A report commissioned by the World Bank/Energy Sector Management Assistance Program (ESMAP)<sup>47</sup> provides a summary of lessons learned in the development of REMs around the world. The report is based on the analysis of 12 regional power markets. The cases included in the study cover a broad spectrum of market types, from simple bilateral trade between two countries through multicountry trading around a set of regional rules with fully integrated competition. The findings of the report indicate that:

- ***One size does not fit all.*** The circumstances under which regional markets are being developed vary enormously. Countries have diverse motivations, electricity sectors are at different stages of reform and development, financial capabilities and levels of openness to private sector involvement differ, and social and environmental impacts vary. As a result, the approach to regional market development must be tailor-made to suit the circumstances. Political factors and the historical evolution of the regional arrangements are typically at least as important as the technical and economic factors. Regional market development is almost always a fractured process with temporary reversals as well as periods of progress and consolidation. The design, approach, and phasing of regional integration efforts must adapt to local realities with considerable room for flexibility and adjustment as conditions and attitudes change. There is no unique regional power market design, institutions, or processes, and no hard-and-fast rules about issues such as ownership, financing, and pricing that will ensure the success of regional integration efforts.
- ***There are various levels of regional power integration.*** There are many levels and types of regional power sector integration, ranging from simpler forms that may include only individual cross-border generation projects, to more advanced forms that may include some combination of unified multinational power markets, technical and regulatory harmonization, a single power exchange, high interconnection levels, regional coordination of investment, and competition across borders with few impediments. Full integration of multiple national electricity systems into an REM offers the greatest

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<sup>47</sup> An ESMAP report prepared by the (Economic Consulting Associates (ECA) entitled “Regional Power Sector Integration—Lessons from Global Case Studies and a Literature Review” (March 2010).

benefits. However, few regions have yet achieved this—Nordpool in Scandinavia is probably the closest. Substantial benefits can still be achieved at all levels of regional market integration. Simple interconnections between national systems and one-off cross-border electricity trade projects can offer substantial benefits, and countries may be content to stay at this or other intermediate levels of integration. The time needed to move from no integration to full integration can be measured in decades, but moving from intermediate to higher levels of integration can be relatively rapid. The rate at which progress is made toward full power sector integration depends on many factors, including the institutional capacity of the participating countries.

- ***There are efficiencies to be gained under any integration scheme.*** The optimization of generation and transmission investment on a regional rather than a national basis can offer substantial cost reductions. But these cost reductions often go unrealized when countries follow national priorities, including domestic energy security, economic nationalism, and sovereignty concerns. Recognizing as legitimate and appropriately addressing these and other important national priorities is essential to achieving regional investment optimization and the full benefits of regional integration. Approaches for doing so will differ depending on local circumstances and the combinations of planning and market forces that drive investment decisions. Few, if any, regions impose mandatory regional planning, although several encourage the use of indicative regional plans with buy-in from politicians to ensure commitment. Explicit mechanisms to share benefits, such as allocating shares in cross-border projects, may help overcome reluctance to implement regional plans.
- ***There is a need to establish the required regional institutions.*** Regional institutions are vital for regional markets, but there is no single institutional form that is appropriate for all regional power integration schemes. The strongest institutions are those that grow organically from local initiatives rather than being imposed from outside. Opportunities to build on existing arrangements should be explored first before new institutions are created.
- ***Technical and regulatory harmonization should be addressed as soon as possible.*** Harmonization of technical standards is needed to avoid endangering the reliability of neighboring systems or loading excessive costs from one country to another. Harmonization of relevant economic regulations among participating countries is not a prerequisite for initial levels of regional integration, but is increasingly required as cross-border competitive power trade develops. Deepening regional integration will tend to require a gradual move toward uniform approaches by national regulators, creating a common regulatory framework for regional markets, or possibly some form of “regional regulator” with discretionary powers in the regional market.
- ***There should be a flexible approach to power sector reform.*** Competitive power markets are not a prerequisite for initial regional market integration. Different levels of power sector reform among participating countries can be accommodated by careful design of regional integration schemes. Deeper levels of integration will tend to require national power markets to be at similar stages of reform to address concerns that the benefits of integration are captured by countries where power monopolies persist. Competitive power markets can facilitate and complement regional market integration,



but can also create barriers to electricity trade due to the potential to reduce the market power of incumbents and added difficulties associated with financing cross-border projects as long-term contracting becomes more challenging.

Although each case study offers valuable lessons, there are three cases that are of particular interest to the Arab countries, in terms of how they have developed institutional capacity and processes; these include the Central American Electric Interconnection System (SIEPAC), South East Europe (SEE), and the Pennsylvania-Jersey-Maryland (PJM) interconnection. Table 3.1 provides key characteristics of these three regional markets. A brief description of the salient points of each experience is provided below.<sup>48</sup>

**Table 3.1 Characteristics of SIEPAC, SEE, and PJM regional markets**

Market	Year	Number of participants	MW	Maximum trade (%)	Trade arrangements
SIEPAC	2010	6	9,700		MER regional market
SEE	2005	9	43,600	14	EU single market
PJM	1927	14	163,500	100	Multiple markets

*Note:* EU = European Union; MER = Mercado Eléctrico Regional; MW = megawatt; PJM = Pennsylvania-Jersey-Maryland Interconnection; SEE = Southeast Europe; SIEPAC = Central American Electric Interconnection System.

### 3.2.1 SIEPAC

The large-scale development of generation projects in Central America, particularly hydropower, can only be attained in the broader regional market, which includes, potentially, Central America’s large neighboring systems in Mexico and Colombia. Meanwhile, six Central American countries—Guatemala, El Salvador, Honduras, Costa Rica, Nicaragua, and Panama—have created the Central American Electrical Interconnection System (SIEPAC), an integrated REM, to expand international trade. The SIEPAC promises to generate efficiency gains through economic dispatch on the broader regional level as well as shared reserves. The objective of the SIEPAC project is to achieve potential gains from integration.

The initial feasibility study for the SIEPAC was completed in 1987. The legal foundation for the project is an intergovernmental framework agreement known as the Marco Treaty, which was signed in 1996 and came into effect in 1999. This treaty provides the legal basis for both the regional market and the supporting institutional and physical infrastructure. A regional planning organization represents the six national utilities and includes planning, advisory, and steering groups.

The market structures among the six countries vary from fully competitive wholesale markets to monopoly-integrated utilities acting as single buyers. Some countries have significant private sector participation in their power sectors, while others are limited to independent power producer (IPP) investment in generation. All countries have cross-subsidization in their tariff structures. To accommodate the wide range of development and capacity in the national markets, the REM known as the Mercado Eléctrico Regional (MER) has been designed as a seventh market that operates on top of the six national markets, connecting the national markets while remaining separate from them. The design is an attempt to allow the individual countries to

<sup>48</sup> This summary is based on a report by ECA entitled, “The Potential of Regional Power Sector Integration—Central American Electric Interconnection System (SIEPAC) Transmission and Trading Case Study,” dated March 2010.

develop at their own pace while enabling trade at the regional level. Gradualism is explicitly identified in the Marco Treaty.

The SIEPAC consists of two components. The first is an REM referred to as the Mercado Eléctrico Regional (MER), which includes a set of market rules to govern trade at the regional level on top of trade in the national markets. The MER includes a regional regulator and a regional transmission system operator that were specifically identified in the Marco Treaty. The regional regulator, known as the Comisión Regional de Interconexión Eléctrica (CRIE), began operations in 2000, and the regional system and market operator, known as the Ente Operador Regional (EOR), began operations in 2001. The design of the MER was based on principles enshrined in the Marco Treaty and took two years to develop before being approved by the six governments in 2000. The CRIE and EOR have supranational legal status, granting them independence from the six national legal systems. The regional market and supporting institutions are now operating, and trade in the MER using the existing interconnectors is under way, albeit at very low levels.

The second component of the SIEPAC is the construction of a new 1,800 km transmission line from Panama in the south to Guatemala in the north. The new transmission line will increase the transfer capacity from something less than 50 megawatts (MW) to 300 MW at all borders in the region. The transmission route is shown in figure 3.1.

**Figure 3.1 SIEPAC transmission line route**



Source: EPR.

Construction of the new transmission line has been delayed since its original 2008 commissioning. It is now expected that the line will be operational in 2011. It will be owned and operated by a project company formed for this purpose. The company is owned in equal shares by each of the six state-owned national transmission companies, the dominant state-owned utilities of Mexico and Colombia, and a private sector partner that is managing the transmission project.

In addition to the main SIEPAC line, an interconnection between Mexico and Guatemala is under construction. A southern extension of the SIEPAC line is also under study, which would interconnect the SIEPAC with Colombia.

### 3.2.2 SEE

Combined with the potential for future European Union (EU) membership, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo, Macedonia, Montenegro, Romania, Serbia, and the EU signed the treaty establishing the Energy Community in 2005.<sup>49</sup> A study commissioned as part of

<sup>49</sup> Bulgaria and Romania have since become EU members; Kosovo is not universally recognized as an independent country—the signatory in 2005 was the United Nations Interim Administration Mission in Kosovo (UNMIK) pursuant to the UN Security Council Resolution 1244.

the regional power integration process determined that the least-cost investment in generation and transmission in southeast Europe (SEE) would achieve savings of €3 billion in the period between 2005 and 2020.<sup>50</sup> There are numerous potential benefits from increased electricity trade in the SEE region, owing to:

- Coordination of a regional least-cost investment plan, particularly in SEE where investment requirements are substantial due to growing demand and old and inefficient generation and transmission infrastructure
- Many of the countries in the region being small and only able to reap economies of scale through exports to a broader regional market
- Power exports that provide a significant source of revenue in some countries
- Enhanced security of supply and economic efficiencies from cross-border trading

The treaty establishing the Energy Community was the last of a number of documents forming the REM in SEE. The first agreement was the Thessaloniki Declaration in 1999, signed by Albania, Bosnia & Herzegovina, Macedonia, Bulgaria, Romania, Greece, and the EU. The Thessaloniki Declaration established the objectives of the REM and targeted 2006 as the initial year of operation. But the declaration failed to identify steps for practical implementation, and made no reference to the EU, and was replaced by the Athens Memorandum of 2002. The signatories to the Athens Memorandum included the Republic of Albania, Bosnia & Herzegovina, the Republic of Bulgaria, the Republic of Croatia (to sign later), the Hellenic Republic, the of Romania, Turkey, the Federal Republic of Yugoslavia, the Former Yugoslav Republic of Macedonia, and the United Nations Interim Administration Mission in Kosovo (UNMIK).

The Athens Memorandum includes a detailed blueprint of what each party must do to prepare for a regional market, and an approximate timetable. The European Commission, in conformance with the legal constraints of Article 300 of the EC Treaty, obtained a negotiating directive from the council in May 2004 to conclude a legally binding agreement, the Energy Community Treaty, with essentially the same content as the two memoranda. The Energy Community Treaty was signed in Athens in October 2005 and came into force in July 2006.

The Energy Community Treaty established government-level institutions supplemented by regulatory and technical working groups. The primary features of the regional power integration process in SEE include:

- Competition, over time, in wholesale and retail supply
- A common regulatory framework with independent national regulators
- Functionally and financially unbundled transmission system operators (TSOs)
- Unbundling of previously vertically integrated utilities
- Establishment of a regionally integrated network linked to the wider EU network, including a common set of rules governing generation, transmission, and distribution

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<sup>50</sup> REBIS, Generation Investment Study (the GIS study) undertaken under the EU CARDS framework: [http://siteresources.worldbank.org/INTECAREGTOPPOWER/Home/20551044/Volume%201%20-%20Exec%20sum\\_final.pdf](http://siteresources.worldbank.org/INTECAREGTOPPOWER/Home/20551044/Volume%201%20-%20Exec%20sum_final.pdf).

- Coordination of regional planning and facilitation of competitive investment; the treaty itself does not mandate investment

The various treaties led to the following organizational structure to develop the regional market in SEE:

- A ministerial council to lead the effort, making strategic decisions
- A permanent high-level group (PHLG) to support the ministerial council and ensure its smooth operation
- A regional energy community secretariat (residing in Vienna) funded out of the EU general budget as a separate legal body to serve the ministerial council and PHLG
- The South East Europe Electricity Regulation Forum to coordinate the expertise of two working groups, including:
  - The SEE Energy Regulators Work Group that manages the regulatory aspects of market coordination
  - The SEE Transmission System Operators Work Group that manages the technical aspects of market coordination

A new body has been created to replace the working groups, and is known as the Energy Community Regulatory Board (ECRB). It provides a cross-border dispute board, but also plays the role of advisor to the ministerial council and PHLG on statutory technical and regulatory rules. It has extended its role to establish working groups, which can coordinate development work.

Progress toward meeting the objectives of the Energy Community Treaty has been substantial. Each country has been resynchronized with the European Network for Transmission System Operators for Electricity (ENTSO-E),<sup>51</sup> and has established institutions and working groups that can call on the support of industry players through organizations such as the ENTSO-E and that provide benchmarking and monitoring processes to measure progress against commitments under the Energy Community Treaty. A compensation mechanism for cross-border transmission has been developed to share revenues from cross-border trade among the transmission providers, based on EU principles. Independent regulation and transmission system operators (TSOs) have been formed, and progress has been made toward development of independent distribution network operators in most countries. The status of progress in 2006 toward achieving the goals of the treaty is summarized in table 3.2.

**Table 3.2 Progress toward power market development in SEE**

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<sup>51</sup> Driven by the Union for the Coordination of Transmission of Electricity (UCTE), which imposed a unified operational handbook on the different transmission system operators (TSOs) and undertook all necessary testing.

	PRIMARY LEGISLATION ADOPTED	MARKET OPERATOR ESTABLISHED	SECONDARY LEGISLATION ADOPTED	BALANCING MARKET ESTABLISHED	MARKETING OPENING COMMENCED
Albania	Yes	Yes	No	No	No
Bosnia & Herzegovina	Yes	No	No	No	No
Bulgaria	Yes	Yes	Yes	Yes	Yes
Croatia	Yes	Yes	No	No	No
Kosovo	Yes	No	No	No	No
Macedonia	Yes	Yes	No	No	No
Montenegro	Yes	No	No	No	No
Romania	Yes	Yes	Yes	Yes	Yes
Serbia	Yes	Yes	No	No	No
Turkey	Yes	Yes	Yes	Yes	Yes

Source: “World Bank Framework for Development of a Power Market in South East Europe,” March 2006.

Countries are following parallel paths to harmonize rules governing national markets; each country is adopting the EU Directives and establishing market rules that permit competition. The goal to integrate the national markets into a broader, single regional market for wholesale trading has not yet been reached, but progress is being made in the sense that simultaneous allocation of all cross-border transmission capacity in the region is being tested.

Although progress has been made to integrate SEE into a single regional market, much work remains. Current plans are focused on continued progress toward achieving the goals stated in the EU Directives, including market opening (all consumers must have a choice of supplier), transparency, nondiscriminatory pricing, and development of the following:

- A coordinated transmission plan
- Competitive cross-border trading arrangements to replace bilateral deals between the incumbent utilities, which limit competitive access to consumers
- Regional balancing capability
- A day-ahead regional power exchange
- An integrated cross-border congestion management system to determine congestion costs and maximize cross-border transfers

### 3.2.3 PJM

The Pennsylvania-Jersey-Maryland (PJM) interconnection started as a fully regulated power pool in 1927. The objective was for the member utilities in the states of Pennsylvania, New Jersey, and Maryland (which joined in 1956) to share generation resources to improve efficiency and minimize investment in generation and transmission capacity. While the utilities in the three states were the beneficiaries of the power pool, the benefits were ultimately extended to consumers and shareholders. Over time, the power pool was expanded to utilities in other states in the Mid-Atlantic region.

The 1973 energy crisis caused the federal government to rethink energy policy, resulting in establishment of the Federal Energy Regulatory Commission (FERC) to act as the regulator of interstate energy commerce. Open access was subsequently introduced, leading to the advent of independent power producers (IPPs), which increased demands on the PJM power pool. Ultimately, the FERC introduced full wholesale competition and the concept of independent system operators (ISOs, and subsequently, regional transmission organizations, or RTOs), and forced utilities to transfer control, but not ownership, of the transmission system to the newly created ISOs and RTOs. The PJM interconnection formally gained RTO status in 2002. It extended its control over transmission to the west later, in 2002, and to the south and west in 2004. Expansion of the control area highlighted the importance of longer-distance transmission development and the desire to increase economic gains by combining smaller markets into larger regional markets with economic dispatch promoted through competitive bids across the entire region.

The initial power-pool arrangement of this interconnection was sought to deliver least-cost dispatch of the mix of generation owned by the utilities in the PJM. With expansion both geographically and through the addition of IPPs, the PJM evolved to become independent of its utility owners in 1993 and became a not-for-profit limited-liability company in 1997. The PJM's current management structure is a two-tier arrangement with a management board supervising day-to-day operations and reporting to an elected Members Committee. The Members Committee is arranged by constituency and includes representation from each member interest group including generators, transmission owners, distributors, traders, and consumers.

The PJM board includes nine voting members and a president. The board is responsible for maintaining system reliability and for ensuring that the markets are competitive. The board is also responsible for operational matters. Members of the board must be independent of any party that has signed the PJM operating agreement. The Members Committee elects board members from candidates proposed by an independent consultant.

The PJM members can trade bilaterally or can self-supply. The PJM operates additional markets for energy, capacity, and ancillary services. The markets are monitored by an independent market-monitoring company that ensures effective competition and thus protects the interests of all market participants. The primary markets operated by the PJM include:

- A day-ahead market in which hourly locational marginal prices (LMPs) are calculated for the next operating day based on generation offers and demand bids in a day-ahead auction. LMPs reflect the marginal cost of production at different nodes when constraints arise on the transmission system.
- A real-time energy market in which a spot market during the day determines LMPs separately from day-ahead LMPs.

- A capacity market for capacity up to three years into the future, which secures capacity commitments from generators through competitive auctions.
- A financial transmission rights (FTRs) market where market participants can participate in an auction to secure payments to hedge their exposure to locational marginal pricing. FTRs pay out differences between the prices at the entry and exit nodes of specific transmission paths.

The PJM offers two types of transmission services: (i) network services allowing any market participant full access to the transmission system for a monthly fee, charged according to usage, and (ii) point-to-point firm and nonfirm services for specific bilateral contract routes from generators to loads.

The PJM dispatches about 163,500 MW of generating capacity over 56,350 miles of transmission. Since the opening of the regional wholesale market in 1997, the PJM has administered more than \$103 billion in energy transactions. The PJM delivers about 700 terrawatt-hours (TWh) of energy per year and serves utilities in 13 states and the District of Columbia.

The PJM plans to expand its area of operation by cooperating with neighboring systems in New York and the Midwest. Locational marginal pricing was initiated in 1998, providing price signals for the location of generation and demand-side technologies, as well as for transmission investment. In 2007 the PJM initiated operation of its reliability pricing model as an auction for forward commitments to deliver new generation and transmission. It is modeled to reward development in energy-deficit areas, signaling that LMP pricing, by itself, is not enough to promote development of adequate generation and transmission to ensure reliable operation of the system.

### **3.3 Evolution of the EU Electricity Market**

The evolution of the EU electricity market also has valuable lessons to offer. Changes in the European electricity industry have been imposed over the past 14 years through a number of legislative directives with the objective of ensuring the security and economy of electricity supply through the promotion of a functional and competitive integrated REM in Europe. The focus of the directives has been on unbundling the monopoly elements, mainly the network operation from the other functions, ensuring third-party transmission access, independent regulation including oversight of cross-border exchanges and trade, and the opportunity for all consumers to choose their supplier. A detailed summary of the EU legislation relating to gas and electricity reform is provided in attachment 3.A, while an overview of the EU electricity market design is provided in attachment 2.C. As experience in Europe suggests, gas sector deregulation and reform is an important element of the electricity reform process: gas has become the fossil fuel of choice for electricity generation, owing to its environmental benefits relative to other fossil fuels.

The first package of directives included Electricity Directive 96/92/EC, issued in 1996. This granted the largest consumers the right to choose suppliers and provided for open access to the transmission grid, although without a regulated access framework. It required the unbundling of the transmission-system operation function from the vertically integrated utilities through accounting separation. It also introduced the concept of a single buyer as the sole supplier in a specific domain.



To accelerate reform and improve the provisions relating to access and regulation, a second package of directives was issued in 2003. This included the Electricity Directive 2003/54/EC and the Regulation Directive 2003/1228/EC. The former required a stepwise opening of the retail market with a target for full market opening by July 2007, and made the unbundling provisions stricter by requiring legal separation (establishing a separate company), or full ownership unbundling of TSOs to ensure they operate independently from generation and supply interests to enable fair and open access to the transmission grid.<sup>52</sup> In addition, establishing independent regulators was made mandatory.

The regulation directive dealt with cross-border electricity trade, providing for:

- Market-based allocation of transmission capacity
- Collection of congestion rents from transmission-capacity auctions to be used to fund projects to eliminate bottlenecks in the grid
- Calculating in a transparent and nondiscriminatory manner the available transmission capacity based on real physical bottlenecks

Various subsequent reviews, however, found that electricity markets largely remained national in scope and continued to have high levels of market concentration. The level of unbundling was found to be inadequate and the limited cross-border transmission capacity constrained trade and competition across borders. There was a lack of transparent and reliable market data and timely price information to foster competition. The markets tended to favor the incumbents.

These reviews led to the third package of directives in June 2009. Full retail-market liberalization had been achieved ahead of the target date of July 2007. The wholesale electricity market evolved gradually, encouraged by progress in sector unbundling and increasing transmission access. A review of the wholesale market prices (day-ahead spot prices) in select exchanges (such as EMEL in Spain, APX in Great Britain, EEX in Germany, and so on) between January 2005 and January 2008 showed some convergence of prices, but scope for improvement remained. Market liquidity increased substantially, with traded electricity volumes in the United Kingdom, Germany, the Netherlands, and the Nordic markets up to six times national consumption levels.

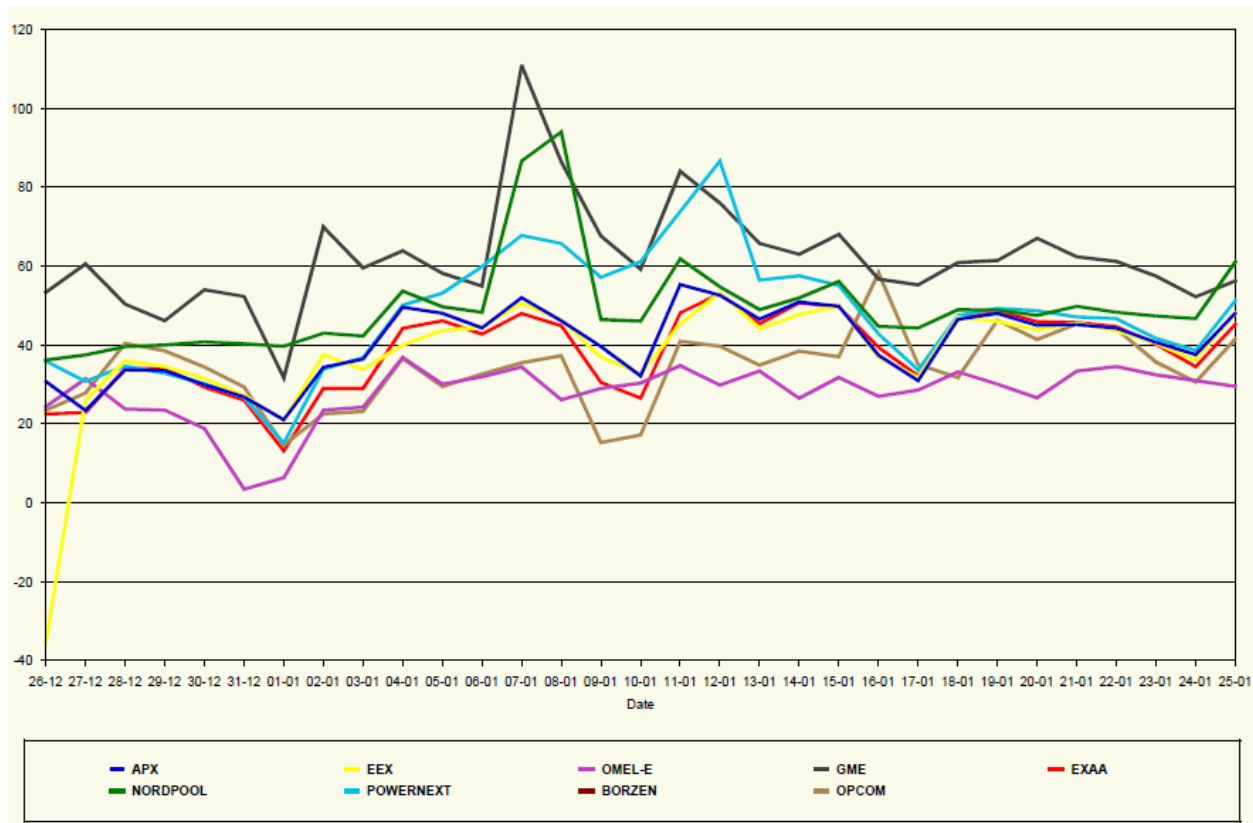
Although full retail-market opening was achieved well before the target date of July 2007, only three countries saw more than 5 percent of small consumers switch suppliers, with levels much lower in other countries. Switching of suppliers for large consumers was much greater, with more than 50 percent switching suppliers in 7 countries, and more than 15 percent switching suppliers in another 16 countries.

This third package of directives seems to be having a positive impact on prices. Figure 3.2 shows the daily arithmetic average spot prices in Euros/megawatt-hour (MWh) in the various European power exchanges for the period December 26, 2009, to January 25, 2010. The degree of convergence in prices among the various exchanges appears to have improved.

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<sup>52</sup> More than half of the EU member states have chosen to fully unbundle TSOs through ownership separation. According to the Commission, only 16 countries (including Norway) had unambiguously and effectively implemented unbundling requirements for transmission system operation in 2005.

**Figure 3.2 Daily arithmetic average spot electricity prices in European power exchanges, December 26, 2009, to January 25, 2010**



Source: [www.eurpex.org/default.asp?kaj=markets](http://www.eurpex.org/default.asp?kaj=markets).

The European transmission network is highly meshed. Though developed with a national focus, its interconnections allow robust system operation across the main synchronized blocks and significant exchange of power across national borders. The network has long been facilitated by international organizations, including the Association of European Transmission System Operators (ETSO), which focused on facilitating an internal competitive European electricity market and on the market rules and harmonization needed to make it work, and the Union for the Coordination of Transmission of Electricity (UCTE), which coordinated the interconnected, synchronized operation of 29 TSOs from 24 countries in Europe.

For over 40 years, compliance with the UCTE rules was voluntary, relying on the common interests of all members in maintaining secure operations of the synchronized grid. But a network failure in 2003 (when supply to Italy was temporarily lost) led to a realization that system security had become more complex. By then, the UCTE had also grown geographically, and members' interests had become less homogenous. The UCTE produced an operational handbook that codified all its regulations, and in 2005 each member country was required to sign a multilateral agreement as a condition of membership. This agreement obliged each member to adhere strictly to the operational handbook, especially in relation to frequency control, scheduling and accounting, operational security, coordinated operational planning, emergency procedures, communication protocols, data exchanges, and operational training. In 2007 compliance monitoring and enforcement processes (CMEP) came into operation. This enabled

the UCTE to gather all relevant information on compliance with the operational handbook and impose penalties or remedial measures on transgressors. Enforcement was on a contractual rather than statutory basis.

The third package of EU directives created the ENTSO-E, which came into existence in mid-2009 and absorbed the UCTE, the ETSO, and similar organizations such as UKTSOA, NORDEL, BALTSO, and ATSOI.<sup>53</sup> The ENTSO-E has a wider mandate than the UCTE, including a specific legal role and powers.

The EU continues to modify and refine its electricity market model. The Commission has proposed a Europe 2020 Strategy that includes promotion of a “resource-efficient Europe,” which incorporates the 20-20-20 targets on greenhouse gas emissions, renewable energy, and energy savings. It also requires completing the internal energy market and implementing the European Strategic Energy Technology Plan (SET-Plan).

To summarize, the EU electricity market design has progressed over the past 14 years through legislative directives designed to further market reform and improve competition. The market will continue to develop in the future through additional proposals aimed at strengthening competition. The EU electricity-market design is characterized by full retail competition (all customers have the right to choose their supplier), legal unbundling of the transmission system operator, freely negotiated bilateral contracts between buyers and sellers supported by a competitive balancing market to settle differences, fair and open access to the transmission network, and full compliance with the ENTSO-E standards and directives. While a fully integrated regional market has not yet been attained, progress is being made through market-based allocation of cross-border transmission capacity with the use of auctions to eliminate bottlenecks and calculate available transmission capacity in a transparent and nondiscriminatory manner.

### **3.4 Renewable Energy Development in the Arab Countries**

#### **3.4.1 Potential**

There is huge potential for wind and solar energy development in the Arab countries, estimated by the firm Frost and Sullivan to have a potential to generate 630,000,000 MW (630 TW) of solar power and 75,000 MW of wind power. Unlike oil and gas, wind and solar energy are more evenly spread across the countries; this presents a unique opportunity for further regional integration as an instrument for enhancing economic growth and reducing poverty. For oil and gas importers, renewable energy would provide energy security, whereas for oil and gas exporters, it frees up fossil fuels for higher value-added usage and exports.

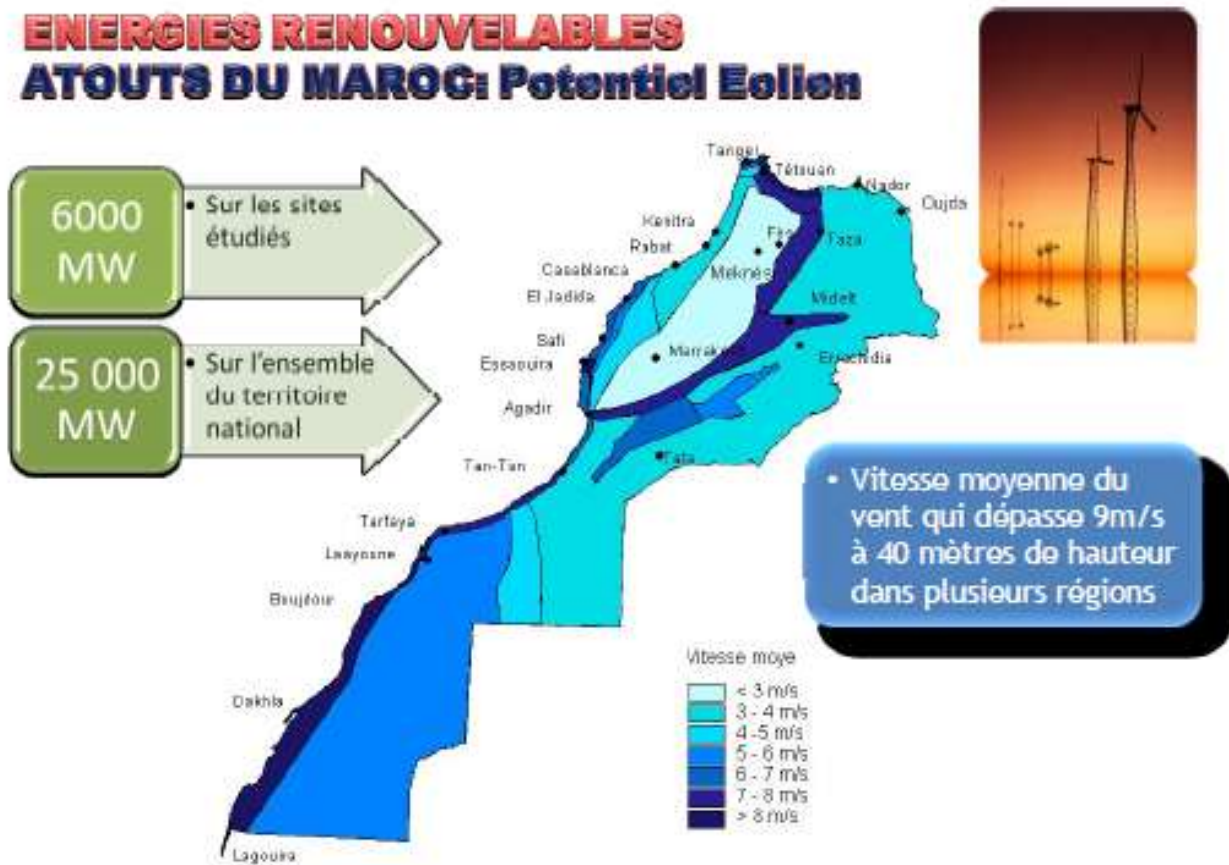
For example, Morocco has estimated the country’s wind potential at 25,000 MW (see figure 3.3) with some sites such as Tarfaya having a load factor exceeding 40 percent, which is attractive to private sector investors. Some of the world’s best wind power resources are in Egypt, in the area of the Gulf of Suez, where at least 7,000 MW can be developed by the year 2020, and the East and West banks of the Nile, where a further 3,000 MW can be developed. Solar power in the United Arab Emirates (UAE) has the capability to outdo U.S. and European targets of producing

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<sup>53</sup> These are organizations similar to the UCTE for the United Kingdom, Nordic countries, Baltic countries, and Ireland, respectively.

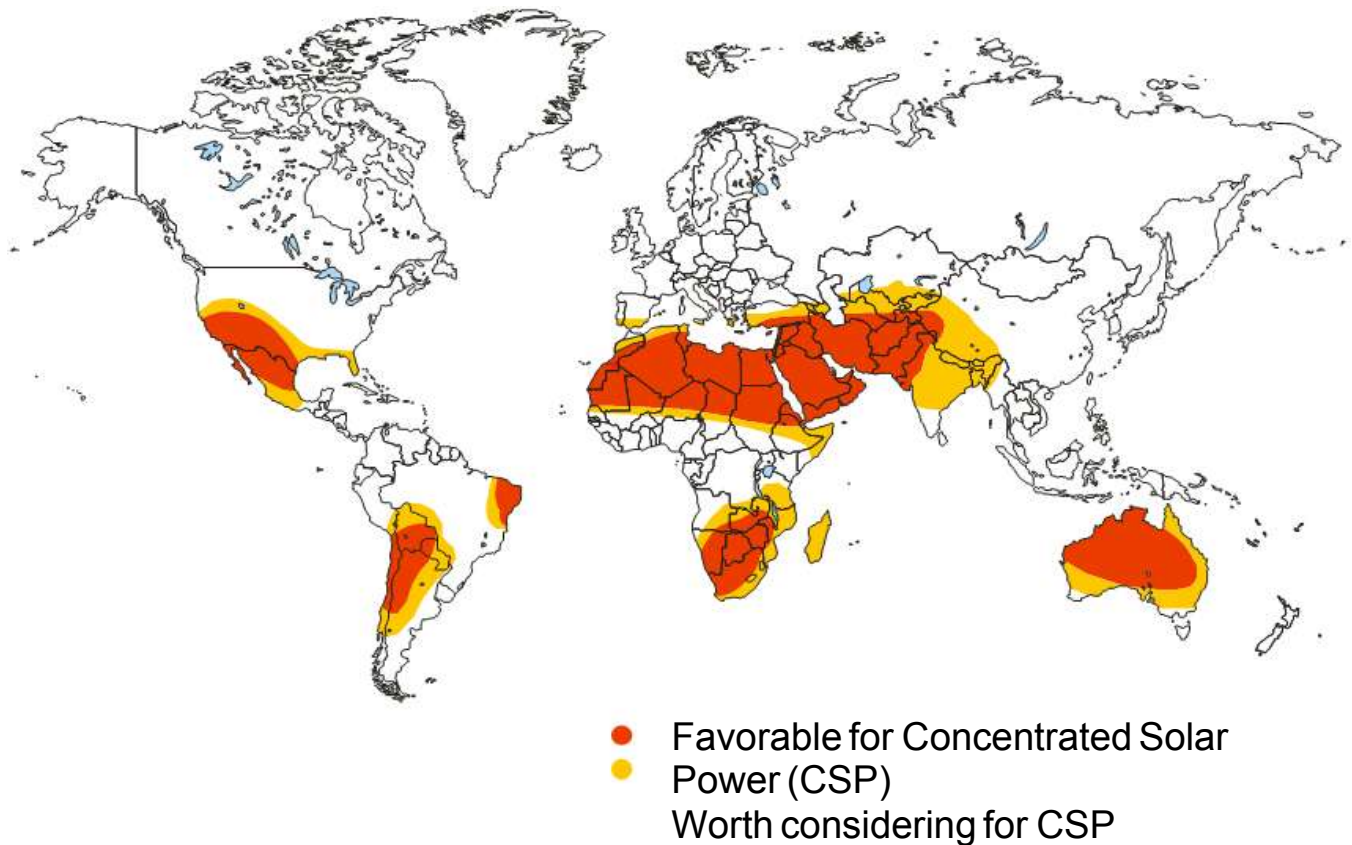
20 to 30 percent of energy from renewable sources by 2020 (according to Suntech Power, the largest manufacturer of solar panels in the world).

**Figure 3.3 Morocco's wind atlas**



The prospect of exporting green energy to Europe at high prices further enhances the Arab nations' renewable energy potential. This is particularly relevant for the Maghreb region, which is already synchronized with Europe—exports of green energy to Europe could become an important and reliable source of revenues for these countries (see figure 3.4). This vision is in tandem with the Desertec concept, which would provide Middle Eastern, North African, and European countries with a sustainable supply of renewable energy by 2050. The Desertec concept inspired the design of the Mediterranean Solar Plan, one of the six pillars of the Union for the Mediterranean, which aims to develop 20 gigawatts (GW) of renewable energy (mainly solar), with 5 GW to be exported to Europe.

**Figure 3.4 Global solar potential**



### 3.4.2 Renewable Energy Projects and Initiatives in Arab Countries

Most Arab countries have only a modest share of renewable energy in their generation mixes. Egypt, Morocco, and Syria have some renewable generation, but the share is less than 10 percent and is composed mostly of hydropower. Sudan and Mauritania, with a 20–25 percent share of hydropower in their generation mixes, are exceptions, although their respective power systems are small relative to other Arab power systems.

Nevertheless, some renewable projects (or projects with a renewable component) have emerged recently in the region, paving the way for more diversified sources of renewable energy in the future. Algeria, Egypt, and Morocco have developed integrated solar combined-cycle plants each with a solar component (parabolic trough) ranging between 20 and 30 MW. These projects were financed partially by the Global Environment Facility through a grant, and have either become operational in the past year, or are expected to become operational shortly.

Several wind projects are also being developed in the Arab world:

- Egypt plans to develop 7,200 MW of wind capacity by 2022. A 3,000 MW wind project with associated transmission infrastructure was approved last year by the World Bank and endorsed by the Clean Technology Fund.
- Morocco has already installed 280 MW of wind turbines and has announced an integrated wind program that aims to increase wind capacity to 2,000 MW by 2020 by adding five new wind farms. This program is estimated to cost \$3.5 billion and would generate about 5 TWh per year.



- Tunisia has installed 55 MW of wind turbine capacity.
- Algeria envisages development of 2,000 MW of wind power by 2030.
- There are other individual projects scattered across the Arab world as well.

Arguably the most prominent energy-relevant initiative in the Middle East and North Africa (MENA) is the scale-up of concentrated solar power (CSP) throughout the region. On December 1, 2009, the Clean Technology Fund endorsed a \$5.6 billion investment plan for this scale-up with \$750 million of concessional funding from the Clean Technology Fund. The investment plan includes deployment of 1 GW of CSP in five countries in the region (Algeria, Egypt, Jordan, Morocco, and Tunisia) and supports financing of two transmission lines—the ELMED line between Tunisia and Italy and the reinforcement of the Jordan network on the east coast of the Mediterranean. This initiative has a strong regional component:

- It is part of the Mediterranean Solar Plan.
- It supports associated transmission infrastructure in the Maghreb and Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey (EIJLLPST) for domestic supply and exports of green energy to Europe as a source of revenues.
- It supports development of local manufacturing of CSP components across the region, which would increase the industrial competitiveness of the region and derive economic benefits such as job creation.
- It has the potential to be replicated in Gulf countries.

Several individual projects are also in the works. Morocco plans to develop 2,000 MW of solar energy. Tunisia plans to achieve 10 million tonnes of oil equivalent (Mtoe) of fuel savings over the period 2005–30, 80 percent from energy conservation and 20 percent from renewable energy. Algeria aims at generating 20 percent of its electricity from renewable sources by 2030, including 70 percent from CSP, 20 percent from photovoltaics (PV), and 10 percent from wind. Egypt has committed to increasing its share of renewable energy to 20 percent by 2020 as a means of meeting growing electricity demand and achieving the economic objective of utilizing natural gas for higher-value purposes. Jordan, which has a keen interest in the development of renewable generation capacity—considering that it is almost entirely dependent on fuel imports for its energy requirements—adopted a new energy strategy in 2007 that emphasizes renewable energy sources (RESs) and set a target of 10 percent by 2020. Syria is implementing an ambitious wind power program and is considering development of both CSP and PV solar projects.

Policies and reforms are necessary to spur the development of renewable generation. Laws encouraging RESs and energy efficiency have begun to emerge in the Arab world, led by the Maghreb region and Egypt. But one important hurdle for renewable development is the issue of subsidized tariffs. Some Arab countries have recently made progress in this area, such as Egypt, Jordan, and Morocco; however, larger and more consistent efforts are required to reach cost-effective tariffs that would enable a more rational and sustainable use of energy, make renewable technologies more competitive, and attract the private sector investment necessary to realize this potential. The recent economic crisis has unfortunately slowed down these efforts.

### **3.4.3 Gulf Countries Enabling Research**

New institutions established in the Gulf countries, in partnership with U.S. and European institutions, have directed energy research on topics relevant to the region. A few examples are listed here among the many projects within the Gulf Cooperation Council (GCC) countries:

- The Gulf Research Center (GRC) in the UAE, in association with the Institute of Communications and Computer Systems of the National Technical University of Athens (ICCS-NTUA), is working to establish a permanent network of institutions from the GCC and EU to act as catalysts to coordinate and develop cooperation on clean energy and related policy and technology needs among various stakeholders in the EU and GCC countries.
- Masdar Sustainable City is producing its electricity through solar-power complexes. Masdar Institute of Technology (in cooperation with the Massachusetts Institute of Technology) is pursuing advanced research in areas of energy efficiency and renewable energy, tackling hybrid solar thermoelectric and PV conversion at low cost and high efficiency, examining energy generation from waste, and improving the efficiency of building cooling systems.
- The UAE is now hosting the newly established International Renewable Energy Agency (IRENA), a step that may encourage other Arab countries to engage more fully in renewable energy generation.
- At King Abdulaziz City for Science and Technology (KACST) in Saudi Arabia, the Energy Research Institute has launched the Middle East Energy Efficiency Research Center, which aims to promote more efficient use of energy in technology devices through conducting and sharing research with leading universities across the Middle East.
- King Abdullah University of Science and Technology (KAUST) identifies energy research as one of its strategic research thrusts. It has established the Clean Combustion Research Center, the Solar and Alternative Energy Science and Engineering Research Center, and the Water Desalination Research Center.
- King Abdullah City for Atomic and Renewable Energy has been established to promote the application of renewable technologies (wind and solar) as part of the future generation mix in Saudi Arabia.

#### **3.4.4 Regional Integration to Enable Greater Levels of RES Penetration**

Scaling up variable renewable energy technologies at the utility level could pose short-term operational challenges to transmission systems. Renewable power sources such as wind and solar are inherently variable, and current technologies are less easily controlled than traditional power sources. Given that power output from RESs varies “naturally” (that is, depending on sunlight or wind conditions), these provide secure quantities when considered over long periods, but not necessarily as and when needed.

Even though transmission companies and system operators have always dealt with uncertainty and limitations in operating power systems, these new technologies have brought two new dimensions to short-term power system operations. First, power output from RESs can change drastically, within minutes, requiring scheduling functions to quickly respond by pooling other generation sources and reserves to maintain the balance between supply and demand. As the number of variable sources in the power system increases, the operational challenges multiply.

Second, variable renewable generation technologies such as wind and solar do not have the same voltage- and frequency-control capabilities as traditional power sources. To maintain the performance of these technologies while maintaining system stability, special electrical-interconnection norms have been developed and continue to evolve; these include upgrading conductors on existing lines, installing reactive compensation devices to improve voltage performance, phase-shifting transformers to control sharing of power among circuits, and so on. In addition, any storage system (pumped storage, chemical storage, and so on) can work in tandem with RESs since it allows storing the energy when an RES is at its highest levels of output and delivering the energy to the system when demand is high.

Regional integration is a cost-effective approach to resolving intermittency issues. Enhanced interconnection of electricity systems provides a larger, more diverse (and thus more reliable) generation portfolio that utilities can tap to meet their demand, increase reliability, and obviate the need for backup power. Not only does regional integration result in substantial economic savings (operational and investment), but also enables the addition of a higher share of RESs to the interconnected grid. Furthermore, scaling-up renewable energy technology manufacture on a regional basis, rather than on a country-by-country basis, will allow economies of scale to be realized.

### 3.5 Synchronization

Technical requirements relating to transmission infrastructure and synchronization necessary to support regional integration of the Arab countries are being addressed in a parallel study being undertaken by the League of Arab States (the feasibility study). For this reason, they are not addressed in detail in this study, which concentrates on the institutional and regulatory framework. But to complete the picture, a brief discussion of synchronization and its impact on regional integration is warranted. This section of the report discusses synchronization at a very high level, leaving the details to the feasibility study.

Currently among the Arab countries, only Morocco, Algeria, and Tunisia are synchronized with Europe (ENTSO-E). Efforts are under way to synchronize Libya and Egypt with the Maghreb countries, but a test conducted in 2010 failed, concluding that additional work was needed before full synchronization could be achieved. The GCC countries are synchronized with one another, but not with any power systems outside of the GCC owing to the absence of international interconnections. In EIJLLPST, Libya, Egypt, Jordan, and Syria are synchronized with one another, but not with the other EIJLLPST countries, and not with Turkey. As noted earlier, Turkey expects to be fully synchronized with Europe in early 2012.

The interconnected systems of Maghreb, EIJLLPST, and the GCC must be synchronized if the full benefits of electricity trade are to be realized. A synchronized power system consists of multisystem operators synchronously interconnecting their power grids during normal operations. Operators are obliged to maintain a common system frequency during steady-state conditions. Operators are mutually dependent and coordinate with a central control center that oversees system operation for the entire synchronized area. Normally, a common coordinating body is created to assure adherence to agreed technical rules and standards. This body supports close coordination between the operators to maintain system stability during normal and abnormal operating conditions.

Synchronization can be a complex and lengthy process, requiring a high level of commitment to manage costs and mitigate associated risks. The dominating risk is the likelihood of cascading



failure due to an outage that leads to overloading on some part of the system and subsequent failures expanding into other systems. Such failures can jeopardize the synchronized system, so all system operators must explicitly commit to adherence to technical standards and procedures. This is enforced through legally binding agreements among the system operators. Generally, the rules of a synchronized power system cover energy-exchange codes such as system security standards (voltage control, frequency control, and reserve/capacity requirement), procedures for maintaining system stability, scheduling and settlement rules, and rules for coordination of planning.

The objectives of synchronization often evolve over time and therefore require consistent cooperation and flexibility among the participants. A relevant example to this study is the UCTE (since replaced by the ENTSO-E) in continental Europe. The UCTE was established in 1951 to coordinate the operation and development of transmission networks and generation. In 1999 the UCTE was redefined with a primary objective of committing to technical and operation coordination of a synchronous system to ensure reliable electricity supply across continental Europe. The ETSO was created in the same year to concentrate on market-related issues within the synchronous system. A major network failure in 2003 that started in Italy highlighted deficiencies in TSO coordination leading to a need for better-quality harmonization of operational practices within the UCTE. Thus in 2005 technical standards were enforced through an operational handbook and became legally binding through a multilateral agreement between its members. The UCTE synchronous area comprised 29 TSOs operating across 24 member countries in addition to other nonmember countries that were synchronized with the UCTE region. In response to the complexity of coordinating numerous electricity bodies, the European Commission adopted in 2007 the so-called Third Legislative Package, which included a proposal for establishing a new European Network for Transmission System Operators for Electricity (ENTSO-E), and another proposal for establishing the Agency for the Cooperation of Energy Regulators (ACER). The ENTSO-E became operational in 2009 through 42 European member TSOs in 34 countries. It replaced all formerly existing TSO associations including the ATSOI, BALTSO, NORDEL, UCTE, ETSO, and UKTSOA. The ACER will be operational in 2011.

The Third Legislative Package also requires the ENTSO-E to develop new network codes that overcome the limitations of the Operation Handbook (a complete discussion of EU legislation relating to electricity sector reform is provided in attachment 3.A). These limitations are relevant to the inability to establish binding rules (for example, network access and economic rules) for grid users at the national level such as power plants, consumers, and distribution that could be potentially affected by grid operations. Such limitations can be addressed at the national level (for example, grid codes, laws) as the scope of the Operation Handbook is only binding on TSOs. Thus, Article 8 (6) of Regulation (EC) 714/2009 binds the ENTSO-E's network codes on all those affected by the grid to ensure secure system operations in the synchronous areas and efficient market integration toward a successful internal electricity market.

Experience demonstrates the benefits and challenges of synchronization. Synchronization requires the willingness of system operators (and governments) to support the synchronization process by taking the necessary actions to develop their network and generation capacity, develop markets in a transparent manner, enhance their institutional framework, and advocate electricity trade. Benefits of synchronization include:

- ***Cooperation in investment planning.*** Investment planning can be coordinated at the synchronized-system level (with sufficient national collaboration) to justify the elimination (or

deferring) of investments in generation or transmission. The common coordinating body is authorized to oversee development and expansion in the synchronized area. This requires a very high level of cooperation between the system operators. But in regionally synchronized systems such as the ENTSO-E, the full delegation of powers to enforce regional investment plans has been a complex task that has not yet been fully achieved because of the superseding impact on national plans.

- **More efficient operational planning.** Key operational tasks can be jointly managed between the operators of the synchronized system to achieve mutually desired system reliability levels (adequacy of supply to meet demand and system security) and quality of supply. These tasks include maintenance planning, capacity and energy balancing arrangements, frequency and voltage control, reserve provisions, congestion management, and management of system operating conditions.
- **Cost reduction.** An overall cost reduction can be achieved through the utilization of low-cost generation sources to meet demand (through economic dispatch), and joint contribution of reserves by system operators. Synchronization alone will not accomplish these cost reductions as witnessed by the fact that Egypt, Jordan, and Syria are synchronized yet use of the interconnections between the countries is far from optimal.
- **Trade facilitation.** The autonomous operation of the synchronized system, which is carefully coordinated between system operators, facilitates electricity trade (capacity, energy, and ancillary services) through several market mechanisms such as the spot market, day-ahead market, and auctions. These mechanisms enable competition in cross-border trade and can enable energy swaps between system operators or beyond. Realizing these benefits requires a high level of trade volume, which entails complex transactions and settlement arrangements. Therefore, close coordination and transparent data and information are critical to the success of the market.
- **Harmonization.** In a synchronized system, harmonization of technical standards is required to maintain system reliability and efficient market operations. Harmonization contributes significantly to facilitating competitive cross-border trade in a synchronized system and in streamlining the flow of private sector investments in national and regional projects. The most relevant areas of harmonization that need to be realized through the synchronization-development process are technical standards, operational procedures (including grid access), pricing and balancing arrangements, and legal procedures.

High voltage direct current (HVDC) offers a potential solution for synchronizing the Arab countries with the ENTSO-E as it has a number of advantages over high voltage alternating current (HVAC) solutions as it:

- Minimizes measures for addressing stability issues (frequency, voltage, and dynamic).
- Boosts the net transfer capacity and energy trade.
- Strengthens weaknesses in the transmission networks.
- Brings more certainty to interconnecting with the ENTSO-E.
- Overcomes the condition that grids of neighboring countries must be permanently isolated.
- Allows greater control over cross-border flows.

- Enables interconnecting synchronous areas with different operating rules.

HVDC provides safeguards while enabling most of the benefits from AC synchronization to be met. In any regard, HVDC, HVAC, and hybrid solutions including both HVAC and HVDC should be considered in the feasibility study being conducted by the League of Arab States.

A complete discussion of synchronization of EIJLLPST with the ENTSO-E is provided in attachment 3.B.

### 3.6 Assessment of Arab Regional Electricity Markets

The achievements and open issues of the Maghreb, EIJLLPST, and GCC regional markets are summarized in table 3.3. In the case of EIJLLPST, with the exception of Jordan, none of the countries have made power sector reform and regional-market development a high priority. In the case of the GCC, it is important to note that the GCC Interconnection and the Power Exchange and Trading Agreement (PETA) has recently been commissioned and put into operation, so there has only recently been a physical means for trade. The fact that the GCC countries were able to cooperate on a project as grand as the GCC Interconnection shows promise for further regional integration and cooperation.

The main conclusion that can be drawn is that although interconnected, the regional markets have very little trade. By interconnecting they have realized the substantial benefits associated with reserve sharing, but have not taken advantage of energy-trade opportunities that arise when there are differences in production costs between the national electricity markets. There has been limited effort expended to put in place a mechanism that promotes economic dispatch from a regional perspective, so the value of existing interconnections is far from optimal, and resources (that is, fuel) are not being used in a sustainable manner.

**Table 3.3 Summary of achievements and open issues**

Maghreb		EIJLLPST		GCC	
Achievements	Open issues	Achievements	Open issues	Achievements	Open issues
Synchronized to the EU.	Although physically interconnected with the EU, trade with the EU limited to Morocco's purchases from Spain.	Reasonably strong international connections.	Libya, Egypt, Jordan, and Syria are synchronized. Considering further cross-border connections and upgrades to national transmission networks to enable synchronization within EIJLLPST and ultimately with Turkey and the EU.	Synchronized with strong international connections within the GCC.	The GCC connections strong, but not with other regions. Connection with Egypt would provide gateway to EIJLLPST and the EU, significantly increasing trade opportunities and potential for the Pan-Arab regional market.
Reasonably strong international connections.	Considering further connections with Europe.	Some reserves and energy sharing at regional market level.	Mostly limited to Egypt and Jordan, and to a lesser extent, Syria and Lebanon. There is still no third-party access or published tariffs for using transmission.	Progress on commitment to regional market with extensive governance documentation.	Scheduled trades remain limited. Subsidized fuel prices remain a deterrent.
Some progress on commitment to regional market; that is, 2003 Protocol and 2010 Algiers	Progress has stalled, although ministers indicated their commitment to the regional market in	Some limited progress on market reform such as unbundling.	Limited primarily to Jordan. Independent regulation remains an issue. Retail tariffs remain	Some progress on market reform such as unbundling.	Progress limited, but still early. Abu Dhabi has taken significant steps and Saudi Arabia, Abu

Maghreb Achievements	Open issues	EIJLLPST Achievements	Open issues	GCC Achievements	Open issues
Declaration.	June 2010. There are still no regional governance documents or published tariffs for using interconnections.		heavily subsidized in all countries but Jordan.		Dhabi and Yemen all have independent regulation. Retail tariffs remain well below the economic cost of supply in all the GCC countries.
Some progress on market reform such as unbundling.	Progress has stalled. Independent regulation remains an issue. Retail tariffs remain below the economic cost of supply in all countries.	Some regional planning.	Jordan relies on its interconnections for reserves, but no planning is done from the perspective of EIJLLPST in part owing to national transmission network limitations.	Progress on regional market institutions.	The GCC Interconnection Authority is functioning in Dammam, but acts as transmission provider with limited authority to promote trade.
				S	
Some regional market institutions.	These institutions appear to have little authority, limiting their effectiveness.	Regional documentation governing trade exists in the form of the Interconnection Agreement with regional steering, operating, and planning committees.	Although regular meetings are held, regional institutions appear to have limited functionality.	Some success in attracting private sector capital to the power sector.	Private sector involvement limited primarily to IPPs and IWPPs.
Some success in attracting private sector capital to the power sector.	Private sector involvement limited primarily to IPPs.	Some success in attracting private sector capital to the power sector.	Private sector involvement limited primarily to IPPs with some private sector involvement in distribution in Jordan.		

*Note:* GCC = Gulf Cooperation Council; EIJLLPST = Eight-country interconnection (Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey); EU = European Union; IPP = independent power producer; IWPP = independent water and power producer.

To gain an understanding of how far the Arab countries have to go to establish a REM, a number of benchmarks relating to regional market integration are identified. These benchmarks are based on the authors' experience and a desk review of existing literature on international experience in cross-border electricity trade. The benchmarks enable countries to monitor progress toward the creation of a regional power market among the Arab countries. Progress toward meeting each benchmark can be rated on a scale of 1 to 10, or alternatively as high, medium, or low as defined below.

### ***Access to markets***

- Existence of spot or day-ahead market power exchange(s) open to all market participants: "High" if such markets exist.

### ***Access to customers***

- Actual market opening: Percentage of customers with choice of supplier: "High" if greater than 80 percent of customers have choice; "Medium" if between 20 and 80 percent have choice; and "Low" if less than 20 percent have choice.

### ***Allocation of cross-border interconnection capacity***

- Transparent process for fair and open access to cross-border transmission capacity: “High” if documented process exists; “Low” if no documented process in place.
- Price differentiation for use of cross-border capacity under constrained conditions: “High” if price differential exists determined through market-based solution; “Low” if no transparent price differentiation process exists.

### ***Network tariffs and grid access***

- Regulated (nondiscriminatory) third-party access to grids established: “High” if documented and functioning third-party access exists.

### **Technical**

- Adequacy of interconnection capacity with other countries: “High” if strongly interconnected and synchronized with other countries; “Medium” if interconnections exist but not synchronized; and “Low” if not strongly interconnected.
- Meeting minimum technical standards: “High” if meeting minimum technical standards, that is, EU Operational Handbook; “Low” if not meeting minimum international technical standards.

### **Prices: transparency and subsidization**

- Price transparency—existence of daily published market prices: “High” if market prices are published daily.
- Existence of regulated (energy) prices: “High” if energy prices are not regulated; “Medium” if regulated prices reflect cost of supply; and “Low” if regulated prices are far below the cost of supply.

### **Market structure and competition**

- Market share: “High” if no generator has greater than 30 percent of market share in country.
- Vertical unbundling and independent TSO<sup>54</sup>: High if full legal unbundling.
- Explicit entity with market monitoring responsibility: “High” if such an entity exists and is functional, and “Low” if no such entity exists.

### **Balance responsibilities and balancing markets**

- Balancing market established: “High” if liquid balancing market exists at national and regional level; “Medium” if liquid balancing market exists at national level only; and “Low” if no balancing market at either national or regional level.

### **Independent regulators, harmonization of regulations, and regional market entities**

- Independent and informed regulator exists: “High” if exists with financial independence and reports regionally; “Low” if does not exist.

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<sup>54</sup> Measurements should be based on legal requirements that are enforced.

- Harmonized licensing framework—Licensing framework meeting the basic requirements of the market design: “High” if exists at national and regional level; “Medium” if exists at national level; and “Low” if does not exist.
- Existence of regional market entities: “High” if such bodies exist and are functional; “Low” if they do not exist.

Using the above benchmarks one can easily observe that Arab countries have not made electricity market reform a priority. Indeed, Arab countries have a long way to go if they are to form a fully integrated and functional REM.

### 3.7 Requirements for Regional Integration and Trade

A review of global experience indicates that: (i) regional integration has taken a high profile because of the widespread recognition of the positive outcomes for all the participating countries; (ii) there is no evidence to suggest that any of the existing or developing schemes got the model right at the initial stage of integration; (iii) the more successful schemes are the ones that pursued an adaptive approach and adjusted the course when needed, and the ones that remained persistent in dealing with foreseen and unforeseen challenges; (iv) this requirement translates into the features of the implementation plan that needs to be developed as clearly as possible; and (v) the establishment of powerful political support, and a strong monitoring mechanism that can quickly bring to the attention of the decision makers the obstacles and challenges as they emerge.

For a REM to be successful, the governance documents at the national level must allow all market participants, regardless of origin,<sup>55</sup> fair and open access to the transmission system. This includes not only the transmission facilities interconnecting the national markets, but also the transmission facilities forming the national transmission network. It requires that there be reciprocity and a level playing field. For example, it would be unfair for one country to incur the costs of adhering to a strict greenhouse gas emissions policy while another country bears no such costs. There is also a need for formation of high-level institutions with the expertise and authority to guide, and if necessary, enforce a level of consistency across the region. For example, the ENTSO-E and ACER are institutions in Europe with the authority and expertise to guide development of the EU electricity market.

The basic requirements for a successful REM include:

- The necessary physical infrastructure (that is, high-voltage transmission lines) must be available for cross-border trade.
- Harmonized technical rules for the operation of the interconnected systems and appropriate cooperation mechanisms among TSOs must be in place to ensure minimum levels of supply quality and reliability are maintained.
- There must be fair and nondiscriminatory access to the physical infrastructure, including transparent pricing mechanisms for use of such infrastructure.

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<sup>55</sup> Provided the market participant can show it has the necessary expertise and financial resources to conduct the roles and responsibilities in a manner consistent with those spelled out for the type of market participant in the governance documents.

- At least wholesale market rules must be harmonized (deeper integration also requires harmonization of rules governing retail markets).
- Suitable mechanisms for regional regulation and market supervision must be implemented, including enforcement procedures and dispute-settlement schemes.
- A certain degree of harmonization concerning energy taxation, as well as energy subsidies and incentives, must be achieved.

There is considerable potential for increased electricity trade among Arab countries, and there are many factors that are positive for increased trade opportunities:

- High-voltage interconnecting transmission lines exist. While there are limitations—for example, not all Arab countries are interconnected and not all systems are synchronized—the interconnecting transmission lines that exist are underutilized and have capacity available to support increased trade.
- The power systems in Arab countries are generally small, so regional integration has significant value in terms of improved reliability and system security, economies of scale, improved opportunities for financing, increased production and delivery efficiency, long- and short-term reserve sharing, and overall reduced cost of supply.
- There are a number of regional integration initiatives already in place which can be utilized to expand trade, including the GCC, Maghreb, and EIJLLPST interconnections; the Nile Basin Initiative; and the joint ownership and sharing of hydroelectric generation and transmission capacity among Mauritania, Senegal, Mali, and Guinea.
- Some regional organizations exist, such as the GCC Interconnection Authority; the various regional organizations in Maghreb; the Steering, Planning and Operating Committees in EIJLLPST; and the Mauritania/Mali/Senegal/Guinea regional organizations including SOGEM, the Manantali asset holding company, and EEM, the entity responsible for the operation and maintenance of the power station and the grid, the commercial aspects of sale of power to the three systems, and collection of dues.
- Some countries have shown an interest in electricity market reform at the national level. For example, Saudi Arabia, Algeria, and Oman all have laws in place that will open their electricity markets up to competition over time.
- Part of the Arab grid, including the Maghreb region, is synchronized to the EU. Turkey expects to be fully synchronized with the EU in early 2012, paving the way for many of the other Arab countries to synchronize with Europe. A key component of this initiative is the potential transmission link between Saudi Arabia and Egypt.
- There is significant diversity of demand affording short-term trade. For example, Syria is winter peaking, while Egypt and Jordan are summer peaking. Further, there is diversity of demand over the day. For example, Egypt peaks during the late evening, while Saudi Arabia peaks in the afternoon. Trade taking advantage of demand diversity is further supported by a broad range of generation technologies and fuels among Arab countries with vastly different production costs. Therefore, there are numerous opportunities to

improve production efficiency and reduce the cost and improve the sustainability of fuel supply across the Arab power systems.<sup>56</sup>

- With many Arab countries facing generation capacity and fuel supply shortages, and availability of financing limited, there is a strong incentive to expand trade and capture the huge benefits associated with regional integration.

While there are opportunities to increase electricity trade among Arab countries, there are also many physical, structural/institutional, and regulatory challenges, as outlined below.

### *Physical challenges*

- While high-voltage interconnecting transmission lines exist, there are limitations in the sense that not all Arab countries are interconnected and not all systems are synchronized. While there is interconnection capacity available to increase trade, the capacity is somewhat limited.
- The electricity systems of many of the Arab countries have not been designed to meet minimum standards, meaning there may be reliability and security risks associated with expanding interconnection capacity in the region. Only three countries—Algeria, Morocco, and Tunisia—are currently synchronized with the EU grid.
- As demonstrated in chapter 2, there is a limited amount of surplus power available in the Arab countries to support long-term trades that require delivery during both peak and off-peak periods.

### *Structural/institutional challenges*

- There is minimal coordinated control over many national networks, making it very difficult to determine and verify if international trade transactions are feasible. There are no coordinated control centers responsible for generation and transmission dispatch for each region (although the Gulf Cooperation Council Interconnection Authority [GCCIA] has limited control over international transactions in the GCC). Further, there is not an agreed dispatch algorithm and software with a consistent set of data for multiple national systems to enable verification of the feasibility of trade transactions by different national control centers (again, the GCCIA may soon have this capacity).
- There are limited overarching documents representing a commitment by Arab countries to pursue power market reform and increased regional integration and trade. For example, there are few treaties or protocols (that is, the Energy Community Treaty) committing the Arab countries to the pursuit of greater regional integration and trade.
- The electricity markets in most Arab countries remain vertically integrated, state-owned monopolies. There are no “eligible customers” with the opportunity to choose their supplier. As a result, international transactions take a long time to negotiate, are cumbersome in the sense that they are unable to respond to short-term opportunities (such

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<sup>56</sup> Studies carried out by regional transmission organizations (RTOs) in the United States compare centralized dispatch of a large portfolio of generating units aggregated over multiple control areas to the current practice of simultaneous, independent dispatch of subsets of this portfolio by individual control areas. RTO studies have found economic-dispatch benefits ranging from \$80 million to over \$40 billion, depending on the region and length of time studied. Normalized, these benefits range from 1 to 5 percent of total wholesale electricity costs.



as sudden changes in generation availability), are not transparent, and are often conducted by individuals who do not have a direct stake in the outcome; that is, a government official conducts negotiations rather than an industrial customer whose profitability is impacted by the outcome. Markets that are not liquid (meaning the number of transactions is limited), that are not transparent, and have the majority of trades conducted by government officials, tend to further exacerbate the problem of market liquidity as potential market participants are not trusting that the market price is truly “fair” and governed by market forces. As a result, these potential market participants refuse to participate.

- While there are some regional integration organizations in place, they are few, covering too few countries, and have limited duties and power to enforce their decisions. Regional committees could significantly increase trade among Arab countries. Committees formed with participants from all countries involved in the regional trade initiative could cover such areas as regulation, technical rules, and operating and planning standards such as those covered by a grid code, tariffs, expansion planning, trade, settlement, dispute resolution, and so on. Committees with the relevant expertise and formed with representatives from each involved country would afford greater acceptance and commitment on the important issues. The ENTSO-E provides an excellent example of such an organization.
- Only a limited number of Arab countries have shown an interest in electricity market reform at the national level. As competition is limited, market monitoring and surveillance guidelines have not been established.
- Private sector participation in electricity markets is generally limited to IPPs and independent water and power producers (IWPPs) in Arab countries. While privatization in itself is not necessarily a requirement, it can be a significant contributor to successful regional integration. The private sector can help mobilize the huge amounts of capital necessary to fund projects needed to meet increasing electricity demand. Further, private sector management expertise can significantly improve the operational efficiency of an electricity market.
- A number of Arab countries have high technical and commercial losses and poor collection rates, adding to the financial woes and creditworthiness of the power companies.

### ***Regulatory challenges***

- There is minimal harmonization of legislation among the Arab countries with respect to energy, environment, and safety.
- Few Arab countries have what could be considered “independent and informed” regulatory agencies. Independence refers to the ability to make decisions in the absence of political interference. Informed means that the members of the regulatory agency have the background, expertise, and skills to make decisions on behalf of all participants in the power sector. Regulation should be the primary job of the staff of the regulatory agencies, which is often not the case in Arab countries.
- There is significant subsidization and cross-subsidization of pricing in the power sectors of the Arab countries. Retail tariffs are generally well below the cost of supply and there

is often cross-subsidization of tariffs by larger industrial customers on behalf of smaller households. It is difficult to find a creditworthy off-taker since many power companies are at or near bankruptcy. It also makes it difficult to find a buyer since potential customers are paying prices for power that are well below cost (that is, a potential customer is unlikely to buy power at international prices when it can purchase power in the domestic market at subsidized prices).

- Gas markets in Arab countries have generally not been deregulated. This poses a significant challenge to sustainability/environmental objectives and the promotion of competition. Internationally, gas markets are often liberalized in tandem with electricity markets. The environmental advantages of gas make it the fossil fuel of choice for electricity generation. In the Arab countries both oil and gas prices used for electricity generation are often subsidized at levels well below international prices. As a result, fuel is being used inefficiently in the production process, and consumption is inefficient because retail electricity prices are well below the opportunity cost of supply. Further, subsidized fuel prices complicate electricity pricing, as it is difficult to determine a fair price for both long- and short-term trades.
- Most Arab countries do not allow access to their transmission networks under published terms, conditions, and prices—meaning access cannot be considered fair and nondiscriminatory.
- There is very little published information concerning market prices and transmission availability.
- There is excessive diversity of accounting practices and an absence of secure and stable legal framework among Arab countries.

These challenges provide significant obstacles to increased electricity trade, but numerous other jurisdictions have overcome such obstacles. The key to increasing opportunities for trade is to implement a plan that accommodates the challenges by providing the flexibility and time needed to gradually address the challenges and mitigate the risks.

## **4 The “Ultimate” Regional Market Design**

This chapter sets out the concept and main design components of the ultimate regional electricity market (REM) design that will serve as a “target” to be met over the long term by the Arab countries. First, the need for an ultimate market design is explained along with the approach used to develop the proposed design. Then an ultimate REM design is proposed for the Arab countries including a description of the market, the roles and responsibilities of market participants, and recommended regional entities and documentation to provide market oversight and governance.

### **4.1 Purpose and Approach to Development of the “Ultimate” Regional Market Design**

The electricity sectors in the Arab countries are at much different stages of development, and the reform effort and commitment to furthering regional trade varies by nation. Therefore, any plan to integrate regional markets and increase the opportunity for trade among the Arab countries must be flexible, allowing each country to proceed at its own pace with implementation of the necessary reforms in its national power market.

It would be unfortunate if each country were to proceed down its own path to reform and develop its own market design without regard to what neighboring countries are doing. This would complicate and reduce understanding of trade between countries, hinder development of trade, and reduce the confidence, transparency, and liquidity of a regional market. A REM will only be successful if there is reciprocity. Establishing an ultimate REM design to serve as a common goal to reach in the future will help to harmonize development of the national and subregional markets in the Arab countries during the transition period, which is expected to take many years. This approach to market development has served Western Europe well, and continues to serve countries not yet fully enshrined in the European electricity market.

There are two primary considerations in developing an ultimate regional market design for the Arab countries:

- What market designs have potential/desirable trading partners implemented or begun to implement, and what requirements have they imposed on potential trading partners?
- What are the generally accepted best practices in the various components of market design based on experience and lessons learned?

Owing to geographic proximity and potential benefits, a market design that meets the requirements of the European Union (EU) warrants serious consideration as the ultimate regional electricity market design for Arab countries.

### **4.2 Proposed Ultimate Regional Market Design for Arab Countries**

#### **4.2.1 High-Level Description**

Table 4.1 outlines a high-level, ultimate regional electricity market design to serve as the long-term target for Arab countries, and figure 4.1 provides a schematic of the design. This ultimate REM design is proposed in an effort to harmonize legislation and electricity market governance documentation over the long term, thus avoiding unnecessary delays and costs. It is proposed as a target for each country in the Arab world wishing to partake in the benefits afforded a REM.

The proposed design is what is commonly referred to as a bilateral contracts market. It has a great deal of flexibility, enabling trade with countries in Europe, Asia, and Africa because:

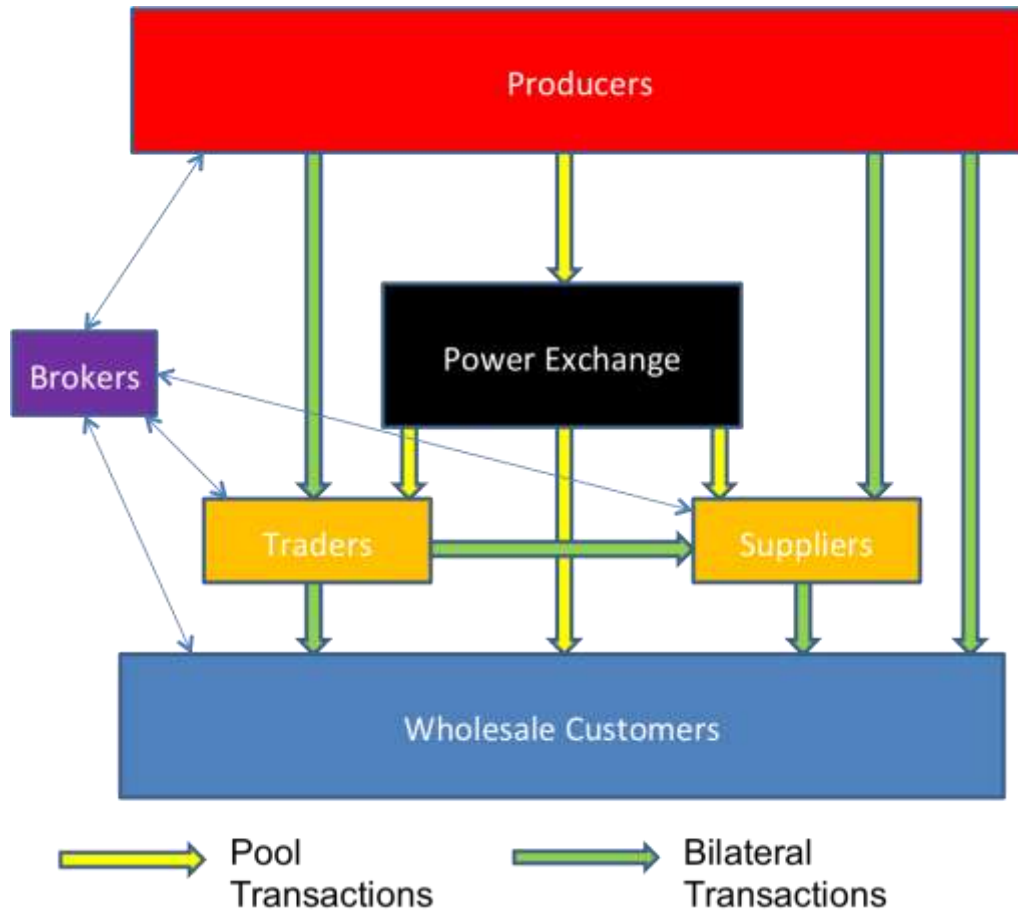
- It is a simple matter to negotiate a bilateral contract with an entity in a neighboring country, particularly once all countries adopt minimum technical standards and open access to transmission networks. It is not a simple matter in pool-type markets (that is, Pennsylvania-Jersey-Maryland [PJM], New England and New York, Eastern Australia, and Singapore) where all generators are required to bid their capacity into the pool.
- The bilateral contracts market model is generally considered best practice, so countries in surrounding regions are likely to adopt this market model in the future. A bilateral contracts-type market is also a requirement if a country wishes to trade with Europe.

The proposed design is robust, allowing the national markets in the Arab countries to incorporate their own nuances and circumstances. It is anticipated that the ultimate market design adopted by the Arab countries will be modified in future years to remain consistent with market design changes in the surrounding region. As proven over the past 14 years in Europe, market reform is an ongoing process.

**Table 4.1 High-level description of proposed ultimate regional market design**

- Unbundled generation, transmission, and distribution/supply functions with legal unbundling of the transmission-operator function.
- Fair, open, and nondiscriminatory access to the transmission network with published terms, conditions, and prices; transmission service harmonized regionwide.
- Independent and informed regulation in each country with reporting at regional level.
- Bilateral contracts with terms, conditions, and prices freely negotiated by the parties to the contract.
- Bilateral contracts supported by balancing market with market-based prices; balancing-market pricing and settlement harmonized region-wide.
- Self-scheduling of generation, that is, the generators/suppliers submit their supply/demand schedules to the transmission system operators (TSOs).
- A power exchange offering services as needed by the regional market, such as a competitively bid day-ahead market, intraday market, emissions contracts, and so on.
- Market-based allocation of cross-border transmission capacity with use of auctions to eliminate bottlenecks; calculation of available transmission capacity in a transparent and nondiscriminatory manner based on real physical bottlenecks.
- Full compliance across the region with developed and agreed-upon standards.
- Separate regional entities relating to financial operations (a regional power exchange), technical operations (a regional TSO), regulation (a regional regulatory entity), and general market oversight.

**Figure 4.1 Schematic of transactions in proposed ultimate market design**



#### 4.2.2 Salient Features of Proposed Ultimate Regional Market Design

Further details of the proposed ultimate REM design for Arab countries are provided below.

##### ***Grid access***

All market participants will have transparent, fair, and nondiscriminatory access to the grid, meaning there should be no legal, administrative, or discriminatory barriers to the networks. There will be a nondiscriminatory and transparent licensing process, and no barriers to connection.

There will be clear and readily accessible governance documentation, that is, a commercial code, a grid code, and so on. There will also be timely and nondiscriminatory access to information related to the market (that is, system constraints) so that market participants can make informed choices. Network tariffs will reflect costs and will be harmonized among Arab countries. Costs of current and future investments will be included in the tariffs, as will costs of operation, maintenance, and losses.

Cross-border transmission capacity will be allocated based on market-based principles such as capacity auctions. Collection of congestion rents (that is, from transmission capacity auctions) will be used to fund projects to eliminate bottlenecks in the grid. Available transmission capacity

will be calculated in a transparent and nondiscriminatory manner based on real physical bottlenecks.

### ***Balancing market***

Market participants will be required to enter into balancing supply agreements to cover the imbalances they cause on the system. The balancing market will be utilized to settle differences between quantities specified in bilateral contracts and actual quantities of energy consumed and produced. The balancing market will be bid based and settled regionwide, and will be used for ancillary services such as reserves. Balancing supply agreements can be established with other market participants or with TSOs. Each TSO will be responsible for balancing its national market including imports from and exports to other countries.

### ***Power exchange***

The power exchange will provide a transparent regional market reference price for all market participants. The exchange will not be compulsory; market participants will freely choose whether or not to bid. There may be more than one bidding area depending on how congestion develops. The power exchange will be fully transparent.<sup>57</sup> It will offer standardized contracts (for example, hourly bids, block bids, linked block bids, and so on), and participants will comply with a number of administrative requirements such as establishment of accounts, waiver of confidentiality, agreement on balancing responsibility, reporting obligations, and audit.

### ***Market access***

Market participants will be qualified, authorized, and registered to participate in the market. Market participants will agree to abide by their license agreements and the responsibilities specified in market-governance documents. Participants must also provide any credit guarantees as defined in governance documentation.

### ***Market surveillance***

Market surveillance will be the responsibility of all parties, including the TSOs, the power exchange, regulators, market participants, and commissions responsible for stock exchanges when financial products are at issue. A market-surveillance unit will reside within the market operator and will monitor trading activities to determine if a market participant is behaving in a manner that has a substantial and ongoing impact on prices without a response from the market. The market surveillance unit will identify the need for investigations when it believes a breach of the rules and regulations has occurred. All information acquired during investigations will be treated as strictly confidential.

## **4.2.3 Roles and Responsibilities of Market Participants**

Each market participant has its own role and set of responsibilities to fulfill in the regional market. Roles and responsibilities of the various market participants follow. A summary is provided in table 4.2.

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<sup>57</sup> ERGEG North European Electricity Regional Initiative provides a good reference.

**Table 4.2 Summary of Market Participant Responsibilities**

<b>Market participant</b>	<b>Role</b>	<b>Primary responsibility</b>
Market operator	Manage power exchange.	Establish market price, coordinate billing and settlement.
TSOs	Transmit electricity and ensure third-party access.	Balance the national power system.
DSOs	Distribute electricity.	Deliver electricity from transmission network to customers.
Producers	Generate electricity.	Deliver electricity according to bids and contracts.
Suppliers	Arrange for electricity supply to customers.	Secure demand and supply portfolio and manage procurement risk.
Traders	Offer electricity market services.	Secure demand and supply portfolio and manage risk.
Brokers	Match buyers and sellers of market products.	None.
Regulator	Regulate proper functioning of market.	Monitor market and take action when market participants are not in compliance with governance documentation.

*Note:* DSO = distribution system operator; TSO = transmission system operator.

### ***Market operator***

The market operator will be a regional entity that is regulated to ensure its transparency, nondiscriminatory nature, and independence. It will coordinate closely with the national TSOs. Owing to this close relationship, there must be clear interfaces between the market operator and the TSOs, particularly with regard to available transmission capacity.

The market operator's primary responsibilities will include:

- Registration of participants in the power exchange.
- Bid analysis and settlement.
- Publication of market prices subject to confidentiality considerations.

The market operator is not responsible for balancing—this is the responsibility of the TSOs.

### ***Transmission system operators (TSOs)***

The TSOs will be national entities retaining full control and responsibility for the operation and planning of the national transmission networks. They will be regulated entities providing third-party access to the transmission grid on a nondiscriminatory basis. Although operating at a

national level, they will coordinate activities with neighboring countries and the regional organization for TSOs. The TSOs are vital to the operation of the integrated REM.

TSOs will be responsible for balancing their national systems and providing ancillary services to all network users in their country. They will be responsible for settlement of financial transactions at the national level, but will collaborate with other TSOs on the settlement of imbalances, and may enter into contracts for the purpose of balancing and ancillary services with producers or traders throughout the Arab REM (and neighboring markets once included).

Each TSO will be responsible for:

- Ensuring adequate transmission capacity is available to meet the short- and long-term demands for transmission service in a reliable and secure manner.
- Balancing the system on a moment-to-moment basis, taking into account exchanges with other countries, and including the provision of ancillary services.
- Exchanging information with TSOs of other interconnected systems necessary to ensure secure and efficient operation, and the coordinated development and interoperability of the interconnected system.
- Ensuring nondiscriminatory transmission service for system users.
- Publishing information needed by users in a timely and nondiscriminatory manner including such things as tariffs and connection rules.
- Coordinating regularly and in a timely manner with the market operator on available transmission capacity including capacity on the international interconnections.

The TSO will be legally unbundled, meaning that it should have no interests or activities in the electricity market other than operating the transmission system.<sup>58</sup> Transmission tariffs will be cost reflective and will not be subsidized by any other activity.

The TSO will preserve the confidentiality of commercially sensitive information, and will take actions necessary to promote greater efficiency in the electricity market.

#### ***Distribution system operators (DSOs):***

The DSOs will be responsible for delivering electricity to consumers through the low-voltage distribution networks. They are responsible for maintaining a secure, reliable, and efficient electricity-distribution network and will be required to procure energy to cover losses and reserve capacity to meet the needs of their distribution system according to transparent, nondiscriminatory, and market-based procedures. The DSOs will be responsible for planning the development of their distribution networks taking into consideration all available options for network expansion or upgrade, including measures that might defer these actions such as energy efficiency, demand-side management, and distributed generation.

The DSOs will be independent to ensure their decision making is not influenced by activities that are not related to distribution.

#### ***Producers***

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<sup>58</sup> The provisions of the European Electricity Directive (Directive 2003/54/EC, art. 10) provide a good reference.



Producers, which generate the electricity, will have the right to:

- Enter into bilateral contracts to sell electricity to wholesale customers or suppliers.
- Enter into bilateral contracts with TSOs to provide ancillary services.
- Export electricity to other Arab and non-Arab countries.

A producer provides information on how much it will produce and when, depending on current and forecast market prices.

### ***Suppliers***

Suppliers are load-serving entities responsible for supplying customers in the Arab countries and importing and exporting electricity from and to non-Arab countries. They will have the right to enter into bilateral contracts with producers or other suppliers and to purchase energy in the power exchange. Suppliers will also have the right to buy electricity from traders or through brokers.

Suppliers will ensure that the electricity consumed by their customers is physically produced to support bilateral contracts. A supplier procures the least-expensive energy available consistent with the level of risk it is willing to take.

### ***Traders***

Traders will have the right to offer physical and financial portfolio-management services, meaning they will optimize the portfolios of producers and suppliers and manage their risk. Traders will have the right to buy and sell energy to support their services.

A trader makes arbitrage profits on differences between buy and sell prices. A trader may provide other products besides electricity, such as fuel-supply optimization, carbon-credit management, or other environmental products such as green certificates.

### ***Brokers***

Brokers bring together sellers and buyers of electricity or other products such as fuel and carbon credits. The broker participates in the wholesale market, matching buyers and sellers wishing to buy a particular product. Brokers act independently and are not balancing responsible parties.

### ***Regulator***

Each country will have a regulatory authority to ensure effective and efficient competition and that wholesale customers and suppliers are treated in a fair and nondiscriminatory manner. The regulator will monitor the electricity sector to ensure compliance with technical standards and performance benchmarks. The regulator will be independent of interests in the electricity industry.

The regulator will monitor and report on:

- The management and allocation of interconnection capacity by the TSOs of the interconnected countries.
- Mechanisms that deal with transmission congestion within the national electricity system.
- Performance of the transmission and distribution entities.
- Interconnections, grid use, and capacity allocation provided by TSOs.

- Unbundling of market participants to ensure against cross-subsidies between market activities.
- The terms, conditions, and tariffs for connecting new users to the networks.
- The extent to which TSOs and DSOs complete their tasks.
- The level of transparency and competition in the market.
- TSO compliance with rules relating to third-party access, balancing, congestion, and interconnection management.
- TSO investment plans and their consistency with regionwide investment plans.
- Network security and reliability.
- Network security and reliability rules.
- Transparency.
- The level of market opening and competition.
- Effectiveness of consumer-protection measures.

The national regulators will cooperate at the regional level with the regional regulatory authority to ensure competitive, secure, and environmentally sustainable electricity markets both nationally and regionally in the Arab countries.

#### 4.2.4 Regional Institutions

Formation of supranational organizations will improve the prospects for electricity trade among the Arab countries. Europe has formed the ENTSO-E and ACER in hopes of furthering the development of its internal REM; the Arab countries would do well to take advantage of the lessons learned in Europe by establishing the following regional organizations:

- Regional market operator
- Regional TSO
- Regional regulatory agency

These institutions would be responsible for all Arab countries that choose to participate in the regional market. In the long term, when the ultimate market design is fully implemented, it is anticipated that the three current subregional markets, and Arab countries not currently connected to any of the three subregional markets, will be fully interconnected, synchronized, and operating as a single regional market. Any existing institutions at the subregional-market level will be dissolved, and replaced with the regional institutions with the roles and responsibilities described in table 4.3.

**Table 4.3 Regional institutions for ultimate regional market**

Institution	Responsibilities
Regional market operator	- Manage regional market power exchange. - Monitor market-participant behavior and proper functioning of market.
Regional TSO	- Provide oversight on technical aspects of regional market. - Ensure fair and nondiscriminatory access to grid and international interconnections. - Coordinate actions of national TSOs.

Regional regulatory authority	<ul style="list-style-type: none"> <li>- Review, approve, and ensure compliance with regional market governance documents.</li> <li>- Review, approve, and ensure fair application of national transmission tariffs.</li> <li>- Provide market surveillance.</li> <li>- Provide dispute resolution.</li> <li>- Report on various aspects of the market.</li> <li>- Coordinate actions of national regulators.</li> </ul>
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*Note:* TSO = transmission system operator.

## 4.2.5 Governance Documentation

Ensuring the basic tenets of fairness, nondiscrimination, and reciprocity in the regional market will require a number of governance documents. These documents establish the minimum standards for the region as a whole; however, each country may issue its own documentation, in particular a grid code, to accommodate its peculiarities, and in some cases, its desire for stricter requirements than those set out in the regional documents. The national documents will be reviewed by the regional-market organizations to ensure harmonization and consistency with regional-market documents and the regional market’s objectives of fairness, nondiscrimination, and reciprocity.

Table 4.4 sets out the necessary documents for the ultimate regional market.

**Table 4.4 Regional market governance documentation for ultimate regional market**

Document	Primary content
Memorandum of understanding/general agreement	<ul style="list-style-type: none"> <li>- Commitment of Arab countries to REM integration.</li> <li>- Legal basis for regional market and subsequent reforms.</li> <li>- Legal basis for regional market institutions.</li> <li>- Objectives of REM.</li> <li>- Guiding principles for development of market.</li> <li>- Formation of, and roles and responsibilities of regional institutions.</li> <li>- Overview of market design and transition path.</li> </ul>
General market rules	<ul style="list-style-type: none"> <li>- Specifies commercial aspects of regional market, including operation, participation, and administration.</li> <li>- Roles and responsibilities.</li> <li>- Metering, billing, and settlement.</li> </ul>
Regional grid code	<ul style="list-style-type: none"> <li>- Specifies minimum technical requirements for operation and planning national transmission networks and international interconnections.</li> <li>- Roles and responsibilities.</li> <li>- Reporting requirements.</li> </ul>

*Note:* REM = regional electricity market.

While these documents are essential for the ultimate regional market, they are even more important during the market’s transitional period, acting as the primary means for implementing reform. Therefore, a detailed discussion of the content of these documents is left until the next chapter, which focuses on the transitional regional electricity market design.

## 4.3 Summary

This chapter has proposed an ultimate regional electricity market design for the Arab countries. The design presents a target for development of the national and subregional markets in the Arab countries during the transition period, which is expected to last many years. The proposed

ultimate regional market design takes into consideration international practices and experience, and will enable trade with countries in Europe, Asia, and Africa.

In the next chapter, we discuss a transitional market design that will set the Arab countries on a path toward increased international trade, more optimal use of international interconnections, and, in the longer term, full implementation of the ultimate REM design.

## 5 Proposed Transitional Regional Electricity Market Design

While the ultimate regional electricity market (REM) design is expected to deliver the greatest benefits to the Arab countries and maximize the value of the interconnections, proceeding with implementation of such a complex market design in the near or even the medium term would not be possible. Numerous constraints and risks outlined in chapter 3 must be mitigated before the ultimate regional market design can be successfully implemented. Therefore, consistent with experience elsewhere in the world, a phased approach to regional-market integration is proposed that will increase regional trade while allowing time for the Arab countries to address obstacles and mitigate risks. It is anticipated that the phased approach will include multiple steps, with each step moving the regional market toward the ultimate regional market design described in chapter 4.

This chapter discusses the objectives and guiding principles used in the development of the transitional regional electricity market design, identifies an approach to increase regional integration, proposes a path to regional integration, and proposes a transitional regional electricity market design. The transitional market design includes an overview of the design, salient features of the market design, a description of the roles and responsibilities of regional-market participants, recommended regional-market institutions and their roles and responsibilities, and a high-level description of the regional-market governance documents.

### 5.1 Objective and Guiding Principles

The objective of the transitional design is to expand regional electricity trade, which will maximize the value of international interconnections and national electricity system infrastructure. This benefits the interconnected nations by improving:

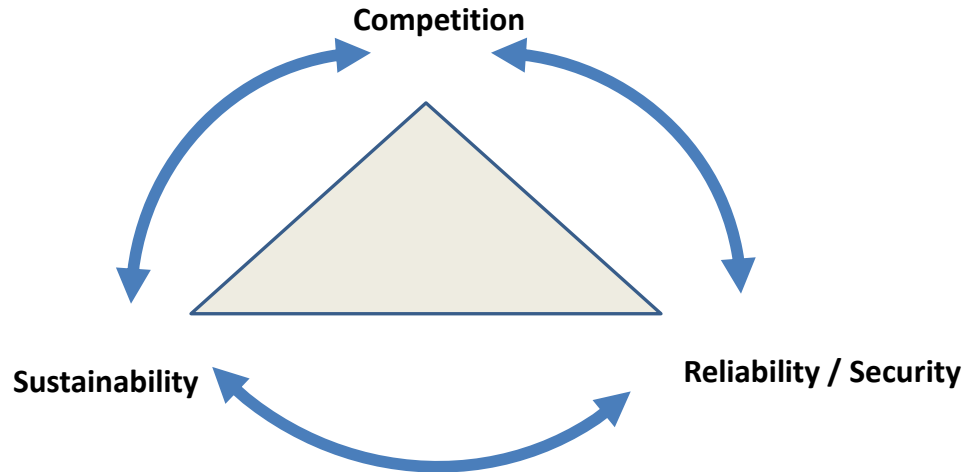
- Reliability and security of supply.
- Sustainability, as it relates to use of natural resources and their impact on the environment.
- Competition in electricity production and delivery.

The objective, similar to that of the European Union (EU),<sup>59</sup> is shown schematically in figure 5.1.

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<sup>59</sup> The EU has established targets relating to energy production from renewable sources, greenhouse gas emissions, and energy efficiency gains (the 20-20-20 target criteria to be reached by 2020) against a background of increasing international competition for the world's resources. Adequate, integrated, and reliable energy networks are judged to be a crucial prerequisite for EU energy-policy goals.

**Figure 5.1 Objectives of regional electricity market integration**



### ***Guiding principles***

The guiding principles used in the development of the transitional REM design include:

- As a first step, considering easily implementable design concepts that promote increased regional integration and trade while making progress on removal of existing barriers to trade.
- Recognizing that market pricing and competition in fuels and electricity markets is a relatively new concept in the Arab countries, and that the Arab countries are at different stages of market reform with different levels of commitment to reform. The transition plan must be flexible and allow adequate time for addressing obstacles and mitigating risks.
- Incorporating lessons learned and experienced elsewhere to the maximum extent possible.
- Building on the existing REM integration framework and regional market institutions.
- Maintaining consistency with the ultimate regional electricity market design described in chapter 4.
- Maintaining consistency with the electricity market reform objectives among Arab countries while allowing each country to proceed with reform at its own pace (at least initially).
- Establishing regional institutions, regional market participants, and regional governance documentation that provide:
  - The responsibility and authority to promote regional integration and trade.
  - The incentives to participate in the regional market and maximize value.
  - The training and capacity building necessary for the regional-market institutions and participants to properly carry out their roles and responsibilities.

## 5.2 Approach to Regional Electricity Market Integration

International trade has traditionally started with an interconnection project linking the power networks of two adjoining countries. Such interconnections are accompanied by documentation (that is, a general interconnection agreement) that sets out the goals and objectives of the interconnection; operation, planning, and services to be traded over the interconnection; and the commitments of each party to complete its portion of the interconnection project in a timely manner. This document is often a political document signed by government officials, such as the ministers responsible for electricity. Following completion of the interconnection project, the general interconnection agreement is normally superseded by a more complex interconnection operation-and-planning agreement that is consistent with the general interconnection agreement, but provides greater detail relating to planning and operation of the interconnected power systems. This document is normally signed by high-level utility personnel. The Gulf Cooperation Council (GCC) and Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey (EIJLLPST) interconnection are good examples of this process, although they apply to multiple countries rather than only two countries.

This stage of market integration might be followed up by market reforms that increase the level of integration at the operating level, for example, through centralized economic dispatch of the combined power systems. Likewise, planning might be done on the basis of least cost from the perspective of the combined power systems, rather than each country in isolation. Moving to combined-system operation will result in improved asset utilization and generation production (that is, fuel) efficiency. As the power systems of additional countries are integrated into the regional market, the asset utilization and production efficiency will improve even further.

Generally, it has been necessary to install a legal arrangement with some level of centralized oversight over bilateral or regional integration efforts. Decentralized arrangements, with each power system operating fully independently, have had limited success. International experience has shown that centralized operation and control has delivered benefits as long as the centralized entity placed in control has the necessary expertise and independence from the market participants.

Centralized operation and planning can be accomplished between multiple countries in a fully regulated manner. But in recent years integration efforts have relied on the introduction of competition in the production and supply components of the electricity sector, while delivery at the transmission and distribution levels has remained a monopoly service. The goal of competition is to provide continued pressure on producers and suppliers to improve efficiency, performance, and customer service, and to provide a better allocation of risk between suppliers and customers. A market-based, rather than command-and-control-based, approach is utilized to promote an economic-dispatch outcome. Competition is enhanced by international interconnections, which enable entities outside a country to compete with incumbent utilities that have traditionally held monopoly positions within their country. As has been discussed previously in this report, international competition ultimately requires that there be open access to the national transmission networks, and that there be consistency in market reform, regulation (technical, economic, and environmental), and governance documentation (market rules, grid codes, and so on) at the national level. This is necessary to level the playing field and promote competition.

Economic dispatch can be achieved in a variety of ways. In a regulated environment, economic dispatch can be promoted by paying each generator for each kilowatt-hour (kWh) dispatched on the basis of an audited production cost. The centralized dispatcher would construct the dispatch schedule on the basis of lowest production cost to reliably meet the forecast demand while taking into consideration technical constraints such as generator limitations, fuel limitations, transmission limitations, and so on. The generators would collect their fixed costs on the basis of a regulated payment, possibly tied to availability. In a competitive environment, economic dispatch can be promoted through a mandatory pool concept, where generators are dispatched on the basis of lowest cost in a cost-based pool, or lowest price in a price-based pool. Generators receive the market price for each kWh delivered to the grid. The market price is the production cost of the highest-cost generator dispatched during the hour (ignoring transmission constraints). The portion of the market price that a generator receives in excess of its production cost represents the contribution to its fixed cost. Cost-based pools are the predominant market mechanism used in South and Central America, while price-based pools are the predominant market mechanism used in the northeastern United States (Pennsylvania-Jersey-Maryland [PJM], New York, and New England), eastern Australia, and Singapore. Alternatively, economic dispatch can be promoted through a bilateral-contracts market mechanism where generators and wholesale buyers freely negotiate the terms and conditions of their contracts. The negotiated price compensates the generator for its fixed and variable production costs. The addition of a balancing market and a day-ahead market enhance the prospects for economic dispatch and promote price discovery and transparency. A bilateral contracts market is the predominant market mechanism used in Europe, and the mid-western United States (for example, Midwest ISO and Texas).

Both pool and bilateral-contract market mechanisms are enhanced through the addition of other markets to increase efficiency and price discovery. Pool markets often include financial bilateral contracts to hedge fluctuations in market prices. They might also include an intraday market or a capacity market. Bilateral-contract markets are normally accompanied by balancing markets and day-ahead markets, and might include intraday markets as well. Balancing markets are used to assign costs to the parties of bilateral contracts when production and consumption vary from amounts declared in bilateral contracts.

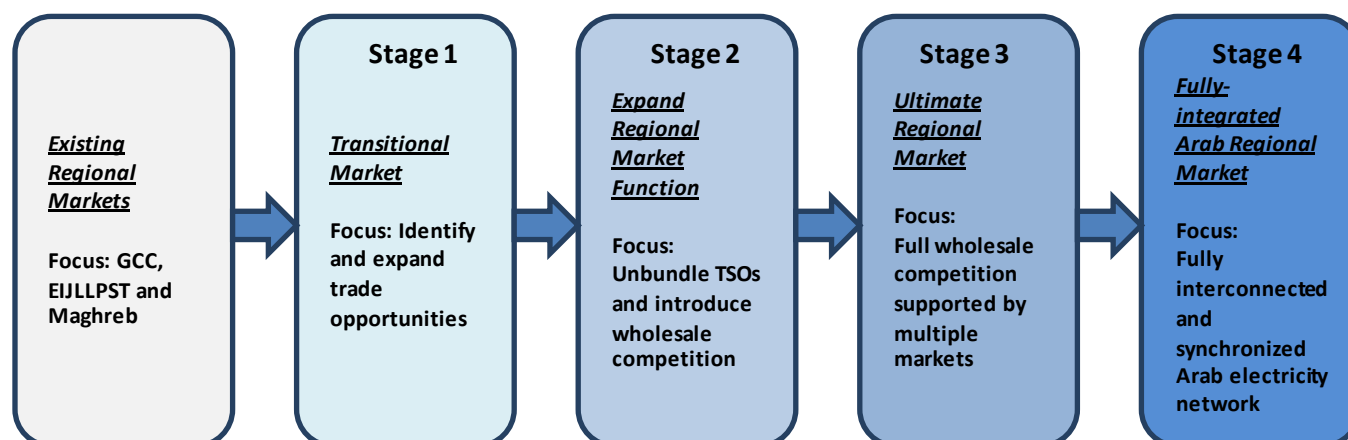
Because the ultimate regional electricity market design proposed in chapter 4 uses a bilateral-contracts market mechanism, the transitional market design should use one as well. Implementing a pool market mechanism as an interim measure before proceeding to a bilateral-contract mechanism would result in significant, and unnecessary, implementation costs and delays.

### **5.3 Proposed Path to Regional Electricity Market Integration**

Figure 5.2 shows a schematic of the proposed path to regional electricity market integration. Each step is discussed briefly below.



**Figure 5.2 Stages of regional electricity market integration**



### *Existing regional markets*

In the first stage, regional integration is focused on the three existing REMs—the GCC, EIJLLPST, and Maghreb. These three markets are described in detail in chapter 2.

### *Stage 1—Transitional market focused on identifying and expanding trade opportunities.*

Looking to build on existing infrastructure, governance documentation, and regional institutions, this market phase will emphasize strengthening and improving the efficiency of existing and planned interconnections, improving reliability, and eventually increasing opportunities for trade in the three existing subregional markets. It will require modifications to governance documentation and regional institutions, but will not require reform of the national power sectors.<sup>60</sup> It will result in improved reliability by bringing national power markets up to a minimum reliability standard through the introduction of a standardized grid code, and will result in improved sustainability by identifying and promoting regional trade opportunities that will result in increased operation of the most-efficient power plants in the region. It will assign responsibility and authority for increasing regional trade, provide incentives for increasing regional trade, and establish capacity-building programs to train stakeholders on increasing the value of national and international power-system assets. More specifically, during this phase trade volume is expected to expand through an increase in the number of transactions between contiguous countries as well as among noncontiguous countries. Trade will take place through direct utility-to-utility bilateral contracts while intermediate countries provide transit service. Infrastructure will be improved and expanded to increase capacity and synchronization to enhance trade opportunities. Part of this stage’s infrastructure improvement will be focused on reinforcing existing cross-border interconnections for bulk electricity trade (for example, Iraq–Syria, Jordan–Egypt, Egypt–Libya, Libya–Tunisia, Algeria–Morocco), and upgrading national transmission networks. Another component of the infrastructure improvement will involve construction of new interconnections, for example, Egypt–Saudi Arabia, Egypt–Sudan, Mauritania–Morocco, and Saudi Arabia–Yemen. In this stage, regional-market institutions will be formed to cover all Arab countries, including a secretariat, a regional advisory and regulatory committee, and a regional Arab TSOs committee including the national TSOs and three

<sup>60</sup>Although doing so would improve the functionality of the transitional market and set the stage for subsequent steps in the regional-market reform process.

subregional TSOs/market facilitators, one for each of Maghreb, EIJLLPST, and the GCC. Further, regional-market governance documentation covering all Arab countries will be drafted including a regional grid code and a general regional electricity market agreement defining the commercial or market rules. Regional-market governance documents will be consistent with a memorandum of understanding (MOU) and general agreement signed by participating Arab countries prior to implementation of this stage of the market integration scheme. The MOU establishes the commitment to market integration, an intergovernmental framework, and a legal basis for the regional market and its supporting institutional infrastructure. The general agreement defines the roles and responsibilities of the regional market institutions, sets out objectives and principles of the market, and provides an overview of the market design and transitional steps for market reform. By the end of this stage, cross-border electricity trade will cover the cost of supply, and coupled with the expected increase in trade volume, will trigger incentives for expanding generation capacity in certain countries for export to other market destinations.

***Stage 2—Expanded transitional regional market.*** This represents the initial stage of subregional markets opening. Access to the markets and competition are introduced at the wholesale level for third-party suppliers and large consumers, generally those directly connected to the transmission system. This step requires reform at the national level, including unbundling of the TSOs, establishment of an independent regulatory entity, and development and implementation of market (or commercial) rules for both the regulated and competitive components of the market. Expanding access to the REMs is expected to result in higher levels of regional electricity trade and further improvements in the sustainability and security of supply objectives. Wholesale tariffs for the large customers in this stage will reflect the opportunity cost of supply. Trade will be facilitated by further improvements in transmission capacity and synchronization at the regional and national levels. A regional regulatory entity will be formed with initial responsibilities relating to dispute resolution and reporting at the regional market level. The regional Arab TSOs committee instituted in the previous stage will be replaced by a regional TSO entity with a board of directors and full complement of regular staff. The roles and responsibilities of the secretariat and the regional advisory and regulatory committee will be modified to be consistent with the roles and responsibilities of the new regional TSO and regulatory entities. The role of the subregional TSOs/market facilitators will be expanded to take on more of the responsibilities of a regional-market operator consistent with regulated and competitive market components. The regional grid code will be modified as necessary, and the general regional electricity market agreement will require significant revision to accommodate competitive trade at the wholesale level.

***Stage 3—Ultimate REM with full wholesale competition supported by multiple financial markets.*** This stage will improve the efficiency, economy, and transparency of the REMs in the three subregions with the introduction of full wholesale competition—distributors, suppliers, and large customers directly connected to the transmission system will have a choice of supplier consistent with the ultimate regional electricity market design documented in chapter 4. As suppliers will be responsible for procuring the power requirements of their retail customers in the competitive market, retail tariffs will be raised to levels reflecting the full cost of power, and if social subsidies are to remain, they will be funded directly by government with full transparency and in a manner that least impacts market prices. Additional markets that support bilateral trade and improve liquidity and price transparency and discovery will be opened, such as a competitively bid balancing market, a bid-based day-ahead market and, potentially, intraday

market, environmental-emissions-trading markets, and a capacity market. The extent of the markets to be added will be determined by the demand for such markets by regional market participants. The regional market operators will have fully replaced the market-facilitation function of the subregional TSOs/market facilitators and will operate the supporting markets as demand warrants, filling the void when private sector interests do not come forward to implement and operate such markets. The combination of markets will result in a robust, liquid, and transparent REM that promotes an economic-dispatch outcome consistent with the objectives of competition, sustainability, and reliability of supply. At this stage, the secretariat function will be disbanded, and the regional market operator, the regional TSO entity, and the regional regulatory entity will take on full regional-market oversight responsibilities under the guidance of the Arab Ministerial Council for Electricity and the Executive Bureau. Governance documentation will be modified as necessary and further improvements in transmission capacity and synchronization at the regional and national levels will be implemented as necessary to support trade. The three subregional markets—the GCC, EIJLLPST, and Maghreb—might be collapsed into one or two markets depending on progress made on transmission capacity and synchronization.

***Stage 4—Fully integrated and synchronized Pan-Arab electricity market.*** This stage represents the final step in the journey to a fully integrated Pan-Arab REM. The REM will have wholesale competition with functional regional market institutions and governance documentation. The only thing that remains to achieve full regional market integration is to complete interconnections and synchronization between the three subregional markets of Maghreb, EIJLLPST, and GCC, within the three subregional markets (both nationally and internationally) and with Arab countries that are still not interconnected or synchronized with any of the three subregional markets. Before any new countries are allowed to connect with the Pan-Arab market, they will need to bring their power systems up to the full requirements of the regional grid code and abide by regional-market governance documentation. Note that interconnection and synchronization to support trade will be ongoing at each stage of regional-market integration. Regional-market institutions and participants will determine the ordering and prioritization of each enhancement.<sup>61</sup>

The above four-stage market development approach portrays a vision of the path toward regional integration. To translate this vision into practice, one would need to devise a clear and consistent long-term strategy that identifies specific policy actions to be undertaken during each stage of market development. Table 5.1 sets out our proposed strategy, which is focused on the policy decisions pertaining to building institutions and a legal and regulatory framework. The strategy recognizes that the three subregions are at different stages of market development; however, institution building for the entire Pan-Arab network would assist transfer of knowledge, skills, and information among the three subregions and from the neighboring countries. Institution building during each stage is devised to meet the requirements of that stage and to prepare for moving to the next stage.

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<sup>61</sup> The League of Arab States (LAS) is carrying out a companion study that will address the technical feasibility of electrical interconnection and trade among Arab countries.

**Table 5.1 Proposed long-term strategy**

Stage of development	Expansion of infrastructure and electricity trade	Institution building/legal framework and policy decisions
<b>Stage 1: Transitional market focused on identifying and expanding trade opportunities</b>	<p>Subregional TSOs/market facilitators identify trade opportunities based on international fuel prices.</p> <p>Additional trade volume expected among the GCC, EIJLLPST, and Maghreb countries.</p> <p>Trade takes place according to direct utility-to-utility bilateral contracts between contiguous and noncontiguous countries.</p> <p>Some countries provide transit/wheeling service.</p> <p>Reinforce infrastructure by:</p> <ul style="list-style-type: none"> <li>• Expanding generation to meet national requirements and exports.</li> <li>• Utilizing generation to meet seasonal and daily demand differences beyond domestic market.</li> <li>• Reinforcing existing cross-border interconnections for bulk electricity trade (for example, Iraq–Syria, Jordan–Egypt, Egypt–Libya, Libya–Tunisia, Algeria–Morocco).</li> <li>• Upgrading national transmission networks.</li> </ul> <p>Additional international interconnections:</p> <ul style="list-style-type: none"> <li>• Egypt–Saudi Arabia</li> <li>• Egypt–Sudan</li> <li>• Mauritania–Morocco</li> <li>• Saudi Arabia–Yemen</li> </ul>	<p>Establish a secretariat.</p> <p>Establish a regional advisory and regulatory committee.</p> <p>Establish regional Arab TSOs committee.</p> <p>Establish a subregional TSO/market facilitator for each subregion.<sup>62</sup></p> <p>Develop and sign:</p> <ul style="list-style-type: none"> <li>• A memorandum of understanding and general agreement on Pan-Arab regional electricity market integration.</li> <li>• A general regional electricity market agreement.</li> <li>• A regional grid code.</li> </ul> <p>Harmonize technical and reliability standards.</p> <p>Expand the Pan-Arab electricity database to include comprehensive and up-to-date information on each country’s expansion plan, investment program, and regulatory changes.</p> <p>Prepare transmission tariffs and cross-border transmission-capacity auction process.</p>
<b>Stage 2: Expanded transitional regional market focusing on unbundling TSOs and introducing wholesale competition</b>	<p>Introduce competition to large consumers directly connected to the transmission network.</p> <p>Further improve sustainability and security of supply objectives.</p> <p>Facilitate trade through further strengthening of transmission networks and synchronization.</p> <p>Systems are synchronized at the level of each subregion (GCC and Maghreb already synchronized; synchronize all EIJLLPST countries).</p> <p>Coordinate investments in transmission infrastructure.</p>	<p>Agree to open up high-voltage supply to competition and allow tariffs for large customers to be set by competitive market.</p> <p>Separate TSOs through unbundling of the national markets and establish national independent and informed regulatory entities.</p> <p>Establish a regional regulator (will start with a reporting, coordinating, and dispute-resolution role before moving to a full-fledged regional regulator).</p> <p>Replace regional Arab TSOs committee with regional Pan-Arab TSO entity with board of directors and full complement of regular staff.</p> <p>Revise roles of secretariat and regional advisory and regulatory committee to reflect roles of new regional TSOs and regulatory entities.</p> <p>Amend role of subregional TSOs/market facilitators to take on more responsibilities relating to market operator function.</p> <p>Revise regional grid code as necessary and make extensive revisions to general regional electricity market agreement to accommodate competitive trade at wholesale level.</p>

<sup>62</sup> The Gulf Cooperation Council Interconnection Authority (GCCIA) has many of the responsibilities proposed for the subregional TSO/market facilitator, but not all (for example, the GCCIA does not publish market prices); therefore, some modifications in its responsibilities would be necessary for it to take on this role.

Stage of development	Expansion of infrastructure and electricity trade	Institution building/legal framework and policy decisions
<b>Stage 3: Ultimate regional market focusing on full wholesale competition supported by multiple financial markets</b>	<p>Full wholesale competition with all large customers and distribution/supply entities allowed choice of supplier.</p> <p>Introduce new financial markets as needed by regional market participants such as bid-based balancing market, day-ahead market, intraday market, emissions trading market, and so on.</p> <p>Promote an economic-dispatch outcome consistent with objectives of competition, sustainability, and reliability/security of supply.</p> <p>Consistent with needs of regional market, further improve transmission capacity and synchronization at national and international levels.</p>	<p>Agree to open up market to full wholesale competition.</p> <p>Put into operation additional financial markets (for example, day-ahead market) as required by regional market participants.</p> <p>Replace subregional TSOs/market facilitators with regional market operator with responsibility for all functional regional financial markets that are not implemented and operated by private sector entities.</p> <p>Disband secretariat and give full regional market oversight responsibility to regional market operator, regional TSO, and regional regulator, with oversight by Arab Ministerial Council for Electricity.</p> <p>Modify regional market governance documents as necessary to incorporate full wholesale competition and newly formed financial markets.</p> <p>Ensure regional market institutions have full responsibility to establish transmission tariffs and enforce uniform technical and financial rules across regional market.</p>
<b>Stage 4: Fully integrated Arab regional market focusing on fully interconnected and synchronized Arab electricity network</b>	<p>The three subregions are interconnected and synchronized (or asynchronous) including countries not currently interconnected with any of the subregions.</p> <p>The region is also synchronized with the ENTSO-E and other markets in the surrounding area.</p> <p>There is open access to all transmission and full wholesale competition with fully functional regional market institutions and governance documentation.</p>	<p>Prepare and implement a unified Pan-Arab power development plan (could include three binding subregional development plans that align with national plans and cover both conventional and renewable generation and transmission).</p> <p>Develop a plan for synchronization (or asynchronous) of the three subregions, and synchronization (or asynchronous) with the ENTSO-E and other REMs in the surrounding region.</p>

*Note:* TSO = transmission system operator; GCC = Gulf Cooperation Council; EIJLLPST = Eight-country Interconnection (Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey); ENTSO-E = European Network for Transmission System Operators - Electricity; REM = regional electricity market.

As mentioned earlier, the above four stages of market development depict a long-term path toward achieving an integrated Pan-Arab electricity market. Although the four-stage strategy should provide the framework for institution building and policy decisions, the main emphasis here is on articulating the details of what needs to be achieved during stage 1. Accordingly, the remainder of this chapter presents a regional-market design for stage 1, developing detailed recommendations about the institutional and policy decisions to be taken during this stage.

## 5.4 Transitional Regional Electricity Market Design: Stage 1

### 5.4.1 Market Design

Currently, a number of Arab countries are not physically interconnected; furthermore, many of the Arab countries are not synchronized with one another, and do not meet what might be judged to be the minimum technical requirements for the design and operation of their power systems. A country is not likely to trade with another country if by doing so it is placing its own customers at risk of reduced reliability. Therefore, it is proposed that the transitional REM design be implemented in each of the existing REMs:

GCC, including Saudi Arabia, Bahrain, Kuwait, Qatar, the UAE, and Oman.

EIJLLPST, including Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, and Syria.

Maghreb, including Morocco, Algeria, and Tunisia.

The GCC, EIJLLPST, and Maghreb are at different stages of development and the countries within these regional markets have different levels of commitment to reform. Therefore, it is proposed that each country commit to implementation of the proposed transitional regional market design, but each subregional electricity market would proceed with implementation of the transitional market at its own pace, consistent with direction given by the regional market institutions.

Currently, the three subregional markets of the GCC, EIJLLPST, and Maghreb must operate independently because they are either not interconnected or not synchronized. But this may change in the future. For example, an interconnection is planned for construction between Saudi Arabia and Egypt. Once completed, consideration might be given to merging the GCC and EIJLLPST regional markets into a single REM during Stage 1, or possibly during subsequent stages of the proposed regional-market development plan. Ultimately, it is anticipated that the three Arab subregional markets will merge into one, and might subsequently be merged with markets outside the Arab countries such as the EU, markets east in Asia, and/or markets south in Africa.

Other Arab countries that are not currently interconnected with any of the three subregional markets (Mauritania, Sudan, Yemen, Somalia, Djibouti, and Comoros) would be allowed to petition to join any of the three subregional markets if they so desire once they are physically interconnected and synchronized, and meet minimum design and operating requirements to ensure reliability. The merits of the petition would be determined by regional institutions that have been delegated the authority to make such decisions. The goal would be for these countries to be willingly accepted into the subregional markets once they meet minimum reliability requirements and agree to follow the market governance documentation.

#### **5.4.2 Salient Features of Proposed Transitional Regional Electricity Market Design: Stage 1**

As outlined above, the first stage of the proposed transitional-regional-market design requires progress in a variety of areas, including grid access, reliability, market transparency, bilateral contracts, market access, and market surveillance.

##### ***Grid access***

Regional-market participants approved in market-governance documents will have transparent, fair, and nondiscriminatory access to the national grids and international interconnections, meaning there will be no legal, administrative, or discriminatory barriers to the transmission networks.

Transmission tariffs will reflect costs and will be harmonized among the countries in the subregional markets. Costs of current and future investments will be included in the tariffs as will costs of operation, maintenance, losses, and ancillary services such as the balancing necessary to support trade.

Cross-border transmission capacity will be allocated based on transparent capacity auctions. Available transmission capacity will be calculated in a transparent and nondiscriminatory manner based on real physical bottlenecks.

##### ***Reliability***

There will be a clear and readily accessible regional grid code that will govern all national electricity markets. The national electricity markets must prove to the regional advisory and regulatory committee that they meet the minimum requirements set out in the regional grid code, or otherwise have acceptable plans in place to meet such minimum requirements in a timely manner.

***Market transparency***

There will be timely and nondiscriminatory access to information related to market prices in each national electricity market to promote transparency and enable regional-market participants to make informed choices when negotiating bilateral contracts. Market prices will not be compulsory, meaning regional-market participants will freely negotiate prices and terms in bilateral contracts. The subregional TSOs/market facilitators will publish standardized contracts to assist regional-market participants with bilateral trade.

***Bilateral contracts verification process***

The parties to a bilateral contract will file their bilateral contracts with their respective subregional TSO/market facilitator who will in turn inform each impacted national TSO of the proposed trade. The subregional TSO/market facilitator will verify in a timely manner if the transaction is technically feasible, and if not, will publish the reasons why. Discrepancies between the subregional TSO/market facilitator and national TSOs will be settled by the regional advisory and regulatory committee when the parties are unable to resolve the issue themselves.

***Market access***

Regional-market participants will be qualified and authorized/registered to participate in the regional market. They will agree to abide by requirements set out in regional-market documentation including provisions of any credit guarantees.

***Market surveillance***

Market surveillance will be the responsibility of all parties including the national TSOs, the national regulators, and the subregional TSOs/market facilitators. Each subregional TSO/market facilitator will be responsible for monitoring trading activities to determine if regional-market participants and the regional market are behaving in a manner consistent with the spirit and intent of the market-governance documentation. The regional advisory and regulatory committee will conduct investigations when it believes a breach of the rules and regulations has occurred. All information acquired during investigations will be treated as confidential.

**5.4.3 Regional Market Participants and Their Roles in Stage 1**

The preceding sections have mentioned a variety of participants in the proposed regional market, each with its own responsibilities. Each of the subregional markets including the GCC, EIJLLPST, and Maghreb will have its own set of market participants as summarized in table 5.2.

**Table 5.2 Summary of regional market participant responsibilities**

<b>Regional market participant</b>	<b>Role</b>	<b>Primary responsibility</b>
Sub-regional TSO/market facilitator	Publish market prices, verify technical feasibility of regional trade, conduct auctions for interconnection capacity, and coordinate billing and settlement of transmission service for international trades.	Facilitate trade in REM.

National TSOs	Transmit electricity and ensure third-party access.	Balance the national power systems.
Regional market participants	Trade electricity services through bilateral contracts.	Provide and/or secure capacity and/or energy.
National regulators	Regulate proper functioning of market.	Monitor market and take action when market participants are not in compliance with governance documentation.

The participants' roles in Stage 1 of the transitional regional market are as follows.

***Subregional transmission system operator (TSO)/market facilitator***

The subregional TSOs/market facilitators will be subregional entities (that is, there will be one for each of the GCC, EIJLLPST, and Maghreb) regulated by the regional advisory and regulatory committee to ensure their transparency, nondiscrimination, and independence. They will coordinate closely with the national TSOs, particularly with regard to available transmission capacity. They will be responsible for facilitating and identifying trade opportunities and will publish a report on regional trade, subject to confidentiality considerations, at least annually, and more often as necessary. Their responsibilities will include:

- Determining and publishing nonbinding national market prices based on international fuel prices.
- Verifying the technical feasibility of bilateral-contract transactions.
- Auctioning interconnection capacity.
- Billing and settlement for transmission services for international transactions.
- Market surveillance.

***National transmission system operator (TSO)***

The national TSOs will retain control and responsibility for operating and planning the national transmission networks. They will be regulated entities providing third-party access to the transmission grid on a nondiscriminatory basis, meaning regional entities will have the same rights to the transmission system as national entities. Although operating at a national level, TSOs will coordinate activities with their respective subregional TSO/market facilitator and TSOs in neighboring countries. The TSOs will be vital to the operation of the integrated REM.

TSOs will be responsible for balancing their national systems and providing ancillary services to all network users in their country. Each TSO will be responsible for:

- Ensuring adequate transmission capacity is available to meet the short- and long-term demands for transmission service in a reliable and secure manner.
- Balancing the national power system on a moment-to-moment basis, including providing ancillary services, taking into account exchanges with other countries.
- Exchanging information with TSOs of other interconnected systems necessary to ensure secure and efficient operation and the coordinated development and interoperability of the interconnected system.
- Ensuring nondiscriminatory transmission service for regional-market participants and other TSOs.



- Publishing information needed by transmission users, such as tariffs, in a timely and nondiscriminatory manner.
- Coordinating timely and regularly with their respective subregional TSO/market facilitator on available transmission capacity including capacity on the international interconnections.
- Preserving the confidentiality of commercially sensitive information and promoting greater efficiency in the national and REMs.

### ***Qualified regional-market participants***

Qualified regional-market participants will have the right to offer and procure capacity and energy through freely negotiated bilateral contracts with other qualified regional-market participants and TSOs in the regional market. The subregional TSOs/market facilitators will maintain a current list of qualified regional-market participants for their respective markets.

### ***Regulators***

Each country will have a regulatory authority to ensure effective and efficient operation of the national and REMs and that regional-market participants, TSOs, and customers are treated in a fair and nondiscriminatory manner. The regulator will monitor and report on the electricity sector to ensure compliance with technical standards and performance benchmarks, including:

- The management and allocation of interconnection capacity.
- Mechanisms that deal with transmission congestion within the national electricity system.
- Performance of the transmission entities.
- Information relating to interconnections, grid use, and capacity allocation as provided by TSOs.
- Risk of cross-subsidization between transmission activities and other activities in the national electricity markets.
- The extent to which TSOs complete their tasks and are in compliance with rules relating to third-party access, congestion, and interconnection management.
- TSO investment plans, assessing consistency with regionwide investment plans.
- Network security and reliability.
- Network security and reliability rules.
- Transparency.
- Effectiveness of consumer-protection measures.

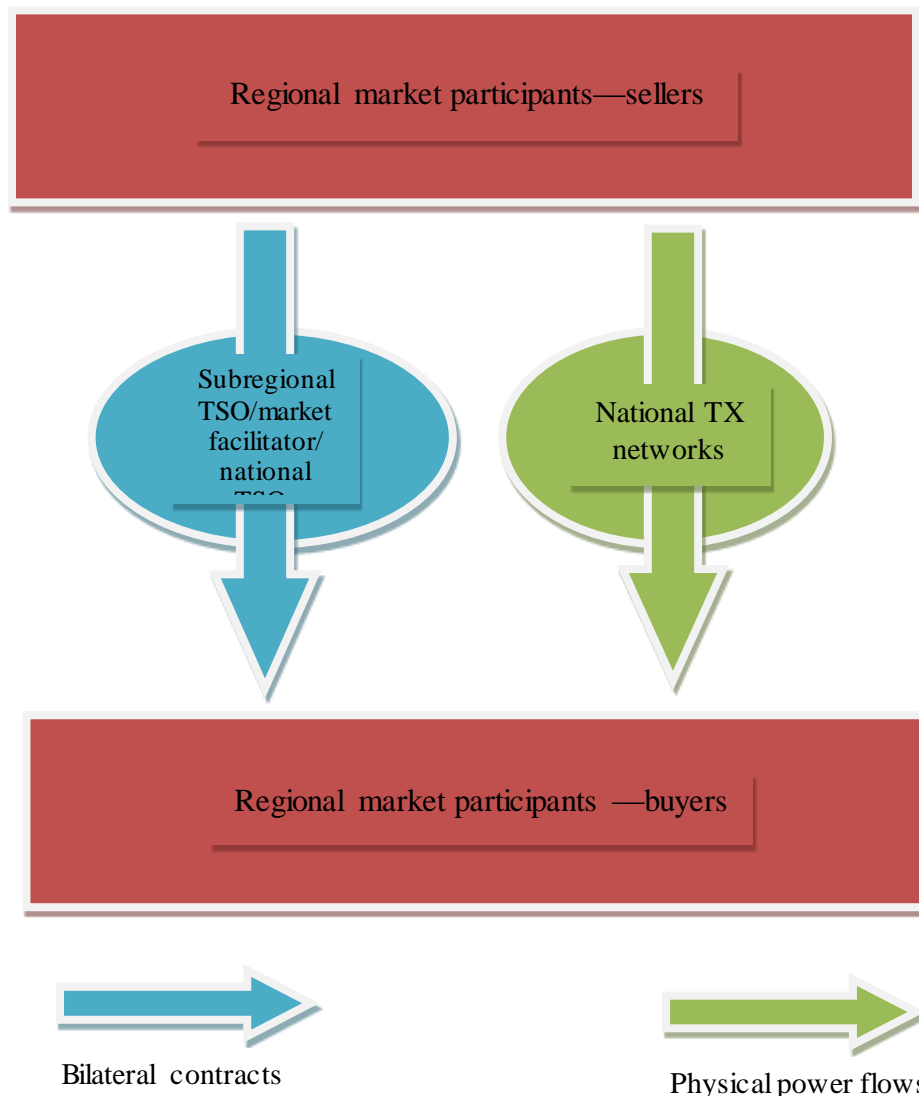
The national regulators will cooperate at the regional level with the regional advisory and regulatory committee.

The high-level description of the proposed transitional regional market design is provided in table 5.3. Figure 5.3 illustrates the relationships among these market participants.

**Table 5.3 High-level description of transitional REM design**

- Each country required to meet minimum reliability criteria as documented in Regional Grid Code.
- Eligible regional market participants free to negotiate bilateral contracts for capacity or energy with any other eligible regional market participant in the relevant regional market.
- The technical feasibility of bilateral contracts must be confirmed in advance by the subregional TSO/market facilitator who in turn informs each national TSO impacted by the transaction.
- Fair and open access to the transmission networks of each country at published terms, conditions, and prices. Transmission service harmonized across each subregional market.
- Transmission service tariff recovers cost of capital and operation and maintenance of transmission assets, losses, and other ancillary services necessary to support bilateral contracts transactions. Tariffs will also recover the cost of network expansion.
- Allocation of cross-border transmission capacity based on auctions to eliminate bottlenecks when they arise. Calculation of available transmission capacity in a transparent and nondiscriminatory manner based on real physical bottlenecks.
- The role of the subregional TSO/market facilitator is to facilitate trade at the subregional level. The subregional TSO/market facilitator will publish market prices for each country based on each country's marginal production cost using international fuel prices as the basis. The market prices will be nonbinding, intended to identify trade opportunities, and provide a reference price for use in freely negotiated bilateral contracts.
- When national TSOs claim that a bilateral contract cannot be physically transacted, the subregional TSO/market facilitator will verify such claims. The subregional TSO/market facilitator's verification will be nonbinding, but if differences arise between national TSOs and the subregional TSO/market facilitator, the regional advisory and regulatory committee will be called on to conduct a review and render a decision that is binding on the parties.
- There will be three subregional TSOs/market facilitators, at least initially, one for each of the three subregional markets. The subregional TSOs/market facilitators will be independent, and include a number of committees; i.e., planning and operating committees).

**Figure 5.3 Transactions in proposed transitional REM**



### 5.4.3 Regional Market Institutions

As mentioned above, the transitional regional market envisages the creation of three new regional institutions—a regional Arab TSOs committee, a regional advisory and regulatory committee, and a secretariat. These three regional institutions will provide oversight of the REM, including all Arab countries whether or not they are currently interconnected with any of the three subregional markets, to ensure consistency, fairness, and reciprocity.

Some regional groups with similar roles are already active among the Arab countries. Two such groups, the Arab Union of Electricity (AUE) and the Arab Electricity Regulators' Forum (AERF), might be modified to become the necessary regional-market institutions. The AUE comprises Algeria, Bahrain, Egypt, Iraq, Jordan, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, the UAE, and Yemen. Established in 1987 by a group of Arab electrical companies, the aim of this forum is to strengthen ties among members to improve power manufacturing in the Arab world. The AERF, which comprises

Algeria, Bahrain, Egypt, Jordan, Lebanon, Palestine, Oman, Qatar, Saudi Arabia, and the UAE, is a consultative assembly of authorities for regulating and restructuring the electricity sectors in their respective countries.

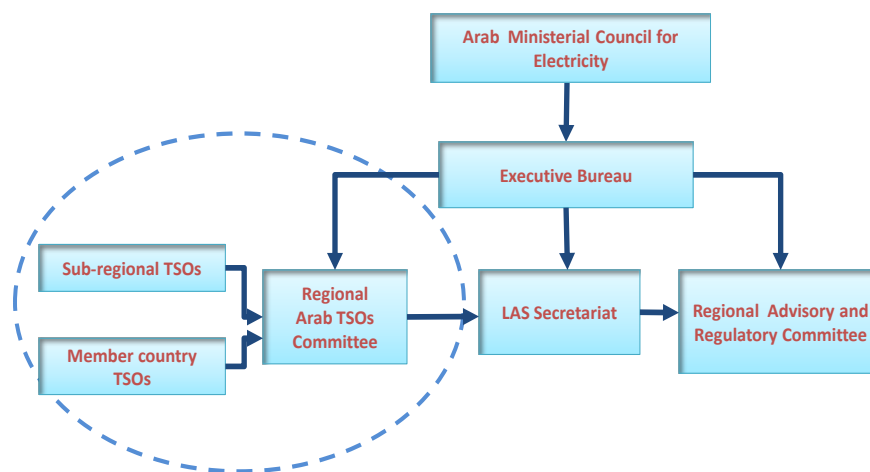
In the longer term, the regional Arab TSOs committee, the regional advisory and regulatory committee and the secretariat should be performed by formal entities. However, in the interim period these functions should be created in a manner that avoids additional financial commitments from the member countries. To this end, the proposed functions should be organized by drawing upon the existing entities. Therefore, it is proposed that:

- The regional advisory and regulatory function and the regional TSO function be formed by establishing two corresponding committees and inviting appropriate membership relevant to the function of each committee. In addition, relevant stakeholders such as the Arab Union for Electricity and the Arab Electricity Regulators Forum would be invited to participate in the relevant committees.
- The secretariat function would be taken up by the (Energy Department) LAS Secretariat.

Figure 5.4 illustrates how the three proposed new regional-market institutions fit into the regulatory scheme. The responsibilities of each institution are summarized in table 5.4.

It may be desirable to combine the regional advisory and regulatory committee and the secretariat into a single Arab regional-market entity (perhaps to be known as the Arab regional advisory and regulatory committee).

**Figure 5.4 Proposed regional market institutional structure**



**Table 5.4 Regional institutions for transitional regional electricity market: Stage 1**

<b>Institution</b>	<b>Responsibilities</b>
Regional advisory and regulatory committee	Review and advise on market governance documents, changes to Grid Code, transmission tariffs, generation reserve criteria, cross-border transmission allocation, available transmission capacity, and so on. Ensure compliance with governance documentation including nondiscriminatory access Market surveillance. Dispute resolution.
Regional Arab TSOs committee	Coordinate and cooperate with national TSOs. Play active role in rule-setting process. Promote market integration, reliability, and security of supply. Research and development, promote public acceptability. Participate in energy policy.
Secretariat	Provide administrative support to regional market entities. Ensure parties carry out their obligations. Maintain comprehensive information systems. Carry out other tasks as assigned.

Note: TSO = transmission system operator.

#### *5.4.3.1 Regional Arab TSOs Committee*

During Stage 1 of the transitional regional market, the regional Arab TSOs committee will not have specific roles and responsibilities—this will lie with the subregional TSOs/market facilitators and national TSOs. Instead, the committee will be a forum whose purpose will be the exchange and promotion of ideas to improve and progress the regional market with the following roles:

- Cooperation among national TSOs.
- Market integration, reliability and security of supply, efficiency, and technical innovation.
- Coordinated implementation of network plans.
- Coordinated administration of network codes.
- Research and development.
- Public acceptability.
- Energy policy including as necessary preparing positions and consultation on environmental and renewable initiatives.

It is recommended that the committee meet annually and more often when considered beneficial. The annual meeting will be attended by representatives of the TSOs in the three regional markets and the countries that are not currently participating in any of the regional markets. The meetings will include representatives from the subregional TSOs/market facilitators, the LAS secretariat, the AUE and the regional advisory and regulatory committee. The annual meetings will enable the exchange of ideas and experiences, and enable each country and subregional market to gain perspective on current events and undertakings elsewhere in the Arab world.

It is anticipated that following implementation of subsequent stages of the regional-market reform (stage two and beyond), the committee will become a going concern with a board of directors and a full complement of regular staff. The Board would be made up of senior staff members of the national TSOs. Ultimately, the association will have similar roles and

responsibilities as the European Network of Transmission System Operators for Electricity (ENTSO-E). Its purpose will be to coordinate and cooperate with national TSOs, promote the interests of national TSOs, and play an active role in the rule-setting process.

#### *5.4.3.2 Regional Advisory and Regulatory Committee*

The regional advisory and regulatory committee will have the following duties and responsibilities. It will not have approval authority, but rather will send advisories to the Executive Bureau which will approve the advisory, or alternatively, send the advisory to the Arab Ministerial Council for Electricity for approval.

- Reviewing and advising on regional-market governance documents including the regional grid code and the general regional electricity market agreement.
- Approving subsequent changes to the grid code.
- Ensuring compliance with regional-market governance documentation.
- Reviewing and advising on each member country's national transmission tariff.
- Ensuring that transmission tariffs are applied in a fair and nondiscriminatory manner.
- Reviewing and advising on generation-reserve criteria.
- Reviewing and advising on rules governing allocation of cross-border transmission capacity to eliminate bottlenecks.
- Reviewing and advising on the methodology for calculation of available transmission capacity.
- Regulation of the subregional TSOs/market facilitators and the national TSOs with regard to the regional market.
- Market surveillance to ensure regional-market participants and the regional market are functioning consistent with the spirit and intent of the market objectives.
- Advising on credit obligations and payment-default procedures.
- Reviewing proposals for expansion of international interconnections.
- Dispute resolution.
- Coordinating with national regulatory entities.

The committee will be staffed through invitation of appropriate membership relevant to the function of the committee, but is anticipated to include one member from each of the countries participating in the regional market. Each country will be responsible for nominating a senior member of the entity responsible for regulating its power sector. No member will be entitled to remuneration incurred in the performance of its duties as a member of the committee. Decisions will be approved by simple majority and chairmanship will be rotated among the members. The regional advisory and regulatory committee will meet regularly, at least every quarter, and will draw on the support and expertise of the LAS secretariat as necessary. The AERF will attend the meetings of the regional advisory and regulatory committee as necessary.

#### *5.4.3.3 Secretariat*

The role of the secretariat will be to move the regional-market-integration process forward.<sup>63</sup> Its main responsibilities will include:

- Providing administrative support to other regional-market institutions.
- Reviewing proper implementation of governing documents and submitting yearly progress reports to the Arab Ministerial Council for Electricity and Executive Bureau.
- Building and maintaining comprehensive information systems with up-to-date data on member countries' expansion plans, regulatory changes, and so on.
- Other tasks as assigned by the Arab Ministerial Council for Electricity and Executive Bureau or by market governance documentation.

The secretariat will include staff with expertise in most areas of electricity-market reform and design, but will be allowed to contract outside assistance when comprehensive areas of expertise are needed. As already discussed, it may be desirable to combine the regional advisory and regulatory committee and the secretariat into a single entity.

#### 5.4.4 Transitional-Regional-Market Governance Documentation

The transitional-regional-market design calls for four principle documents to meet the objectives of the REM and ensure the basic tenets of fairness, nondiscrimination, and reciprocity:

- Memorandum of understanding (MOU)
- General agreement
- General Pan-Arab electricity market agreement
- Regional grid code

While the MOU and the general agreement would cover all Arab countries, it is anticipated that the three subregional markets would have their own versions of the general Pan-Arab electricity market agreement<sup>64</sup> and regional grid code, although the basic principles covered in each region would be the same.

A brief description of the content of each document is provided below and a summary is provided in table 5.5. Greater detail of the content of governance documentation and the framework for such documentation applicable to the recommended transitional regional market design is provided in Volume 2.

**Table 5.5** Regional market governance documentation for transitional REM: Stage 1

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<sup>63</sup> This pertains to all regional integration initiatives including: the GCC, Maghreb, and EIJLLPST interconnections, the Nile Basin Initiative (NBI), and the joint ownership and sharing of hydrogeneration and transmission capacity among Guinea, Mali, Mauritania, and Senegal. The secretariat would need to draw upon the accomplishments and activities of these entities to carry out its duties.

<sup>64</sup> The fact that the GCC interconnection is a shared facility constructed by the member states requires that regional-market governance documentation be somewhat different from that of EIJLLPST and Maghreb, which do not have such shared facilities.

Document	Primary content
Memorandum of understanding	Commitment of Arab countries to REM integration. Legal basis for regional market and subsequent reforms. Legal basis for regional market institutions.
General agreement	Objectives and guiding principles for development of REM.  Formation of, and roles and responsibilities of regional institutions. Bylaws of regional institutions; i.e., membership, chairperson, meetings, voting rights, expenses, remuneration, etc.
General Pan-Arab electricity market agreement	Specifies commercial aspects of regional market, including operation, participation, and administration. Roles and responsibilities. Metering, billing, and settlement.
Regional grid code	Specifies minimum technical requirements for operation and planning national transmission networks and international interconnections. Roles and responsibilities. Reporting requirements.

#### ***5.4.4.1 Memorandum of Understanding (MOU)***

The MOU would be a high-level document signed by the Arab Ministerial Council for Electricity with the purpose of establishing their commitment to pursue market integration and reform. It establishes the intergovernmental framework and legal basis for the regional market and its supporting institutional infrastructure. Examples of such documents include the Marco Treaty in Central America and the Energy Community Treaty in southeast Europe. In effect, all market governance documentation stems from the MOU, which would cover the following:

- The commitment of the countries to regional integration and cooperation in the development of a REM.
- The legal basis for the regional market and subsequent reforms.
- The legal basis for the regional institutions.

#### ***5.4.4.2 General Agreement***

The general agreement would be signed by the governments of the member states, and would set out the objectives and principles of the REM and identify the roles and responsibilities of the regional-market institutions. The document would cover:

- The objectives and guiding principles to be followed in the development of the REM.
- Formation, roles, and responsibilities of the regional institutions.
- Bylaws of regional institutions; i.e., membership, chairperson, meetings, voting rights, expenses, remuneration, etc.

#### ***5.4.4.3 General Pan-Arab Electricity Market Agreement***

The general Pan-Arab electricity market agreement would be a lower-level document that provides more detail governing how the countries will meet the commitments identified in the MOU and the general agreement. It will cover commercial aspects of the regional market, in effect, incorporating the market rules (or commercial code). The GCC provides a good example of a general regional electricity market agreement (known as the “General Agreement Relating to the Interconnector”), as does the EIJLLPST interconnection (known as the “General Interconnection Agreement for the Electrical Interconnection among the Five Electrical Power Utilities of Egypt, Iraq, Jordan, Syria and Turkey [EIJST]”).

The agreement would cover:



- Authorization and commitment of the parties.
- Objectives.
- Definitions.
- Description of the regional market.
- Legal status, roles, and responsibilities of the regional-market institutions.
- Identification and roles and responsibilities of regional-market participants.
- Services to be traded and procedures for trade.
- Responsibilities and payment for transmission services.
- Metering, billing, settlement, and payment guarantees.
- Planning and coordination.
- Operation and maintenance practices.
- Exchange and publishing of information.
- Administrative matters such as force majeure, confidentiality, liability, applicable law, review and amendment, dispute resolution, effective date, validity, and termination.

#### *5.4.4.4 Regional Grid Code*

A grid code is a document that legally establishes the technical requirements for the connection to, and use of, the transmission system by network users in a manner that ensures reliable, efficient, and safe operation. Grid codes become necessary due to changes in regulatory structure, industry structure (that is, unbundling), or industry ownership, and the need for “open access” to the transmission system. The grid code enables the TSO to manage the high-voltage transmission network in a safe, secure, and economical manner. It provides a level playing field for the nondiscriminatory and transparent use of the transmission network. In Europe, the Operation Handbook serves as the grid code.

At the national level, the national TSO is responsible for ensuring that market participants comply with the grid code. The grid code is generally approved by the national regulatory authority and updated as necessary through a defined process, with changes also approved by the regulator. At the regional level, the regional advisory and regulatory committee will be responsible for ensuring each national grid code meets the minimum requirements set out in the regional grid code.

Grid codes are legally binding on all parties and provide guidance for interfaces between the network and the network users, including generators, distributors, nonembedded consumers, and external interconnections. It specifies the duties of both network users and the TSO. Its purpose is to bring the power systems in all countries up to a minimum standard to ensure that international interconnections are not detrimental to the overall reliability of the interconnected power systems.

The regional grid code should comprise the following sections:

- **Definitions:** Set industry standards.

- **Planning:** Define roles in the development and expansion of the network.
- **Connection:** Set asset boundaries and ensures compliance.
- **Demand forecasting:** Provide for data collection from market participants to improve accuracy of forecast.
- **Outage scheduling:** Provide for authorization and approval of transmission and generation maintenance schedules.
- **Frequency and voltage control:** Specify procedures for setting frequency and voltage control to meet relevant standards.
- **Operating margins:** Provide for adequate response and reserves for sufficient system regulation.
- **Testing and monitoring:** Enable assessment of user compliance.
- **Demand control:** Provide action plans to cover generation/demand mismatch under either planned or emergency conditions.
- **Information exchange:** Set agreed level of disclosure.
- **Safety coordination:** Provide for common safety practices by all users at connection sites.
- **Contingency planning:** Set procedures and obligations for contingencies.
- **High-voltage apparatus identification:** Establish procedures to minimize risk of conflicting configurations.
- **System tests:** Formalize requirements for arranging tests for simulating conditions on the system.
- **Scheduling and dispatch:** Set out responsibilities of market participants for system operation.
- **Metering:** Set out minimum technical requirements of metering installations
- **Data registration:** Set out data-reporting requirements
- **General conditions:** Set out procedures for grid-code review, dispute resolution, rules change process, and other miscellany.

## 6 Next Steps

This report has proposed a transition path to help Arab countries move gradually from the current status of their electricity markets to an “ultimate” integrated regional market that would enable efficient and open participation by all market players in cross-border trade. The proposed transitional market design will go a long way toward meeting the Arab countries’ objectives relating to sustainability, reliability, and security of supply without the need for significant national power sector reform. This will allow time for the Arab countries to eliminate constraints and mitigate risks associated with the more-complex market designs proposed for later stages of regional-market integration.

As mentioned at the outset, this report covers the first of two phases of a study on the development of the institutional and regulatory framework for electricity trade in the Arab world. The second phase (Volume II) focuses on articulating the governance and legal framework for the market and providing technical support for the dialog among the relevant stakeholders. Phase 2 of the study addresses:

- ***Preparation of governance documents.*** The immediate priority is to assist in preparing the four governance documents discussed above: a memorandum of understanding, a general agreement, a general regional electricity market agreement, and a regional grid code.
  - Creating the legal authority and governing institutions.
  - Establishing the terms under which electricity will be traded, including the conditions for access to interconnections, the basis for determination and allocation of available interconnection capacity, and the basis for pricing of access and use of available interconnection capacity.
  - Establishing the principles relating to operational, control, and connection requirements on national and regional systems including operating procedures governing dispatch during system emergencies, metering quality at points of interconnections, and billing and settlement.
  - Establishing the principles and process for rulemaking and dispute resolution.
- ***Preparation of a roadmap and action plan for market integration and negotiations.*** The governance documents will develop steps for institutional setup and market harmonization, and the second phase must propose a roadmap and action plan that can be used by the Arab countries to implement these steps. The report will also provide support, as required, for negotiation of the governance documents.

The above tasks would pursue two distinct objectives: (i) supporting each subregion as it moves toward market integration while identifying and promoting opportunities for increased cross-border trade volume; and (ii) creating the institutional infrastructure for a Pan-Arab electricity network. In regard to the first objective, the three subregions are in distinct situations and may require different types of support. The GCC has a well-designed organizational setup and a systematic approach to encouraging trade transactions among the participating countries, but EIJLLPST and Maghreb have limited functional organizational capacity. Phase 2 of the study will attempt to bring to the attention of the Arab countries lessons from international experience in increasing trade volume and, more importantly, will assist in transferring international experience to the subregions. In regard to the second objective, Phase 2 of the study will support the development of consensus among Arab countries while also assisting in capacity building. Account will be taken of existing governance documentation of each subregion when preparing

the governance documentation for the Pan-Arab region. Phase 2 of the study will also help in developing the terms of reference for the various regional entities, and if appropriate, in setting up the proposed secretariat. The study brings about a comparative advantage in identifying the relevant required skills and the options to access and recruit such expertise.

**Interactions between this study and the other LAS studies:** As mentioned earlier this joint League of Arab States (LAS)–World Bank study constitutes part of a broader three-part effort being launched by the LAS and its development partners. The three parts are as follows:

Part I: Study of Interconnections of Electrical Systems in the Arab World.

Part II: Study of Electricity-Gas Trade among the Arab Countries.

Part III: Study of Institutional and Regulatory Frameworks (this joint LAS–World Bank study).

Therefore, this LAS–World Bank study is interlinked with the other two studies. In particular, this study must be consistent with the Part I study regarding energy profiles of Arab countries, the generation expansion plans of each country, the plans for future interconnections, and the present and future potential for electricity trade among Arab countries. Though the Part I study was not yet complete, the LAS and the World Bank decided to proceed with the Part III study based on the World Bank’s previous work on the technical feasibility of electricity interconnections in the Arab world to progress the regional-integration agenda. While this arrangement does not preempt the need for the Part I study, it has enabled the LAS and the World Bank to analyze and deliberate the institutional and regulatory issues involved in integrating the power networks of the Arab countries. It has at the same time fully understood that the results of the Part I study will be analyzed and incorporated in the final report of this LAS–World Bank joint study as soon as the Part I study is completed.

**Interaction between this study, the World Bank’s gas-trade study, and the Part II gas-trade study:** Because development and trade of natural gas in the Arab world may have a significant impact on cross-border electricity trade, the LAS intends to carry out a gas-trade study among Arab countries. The World Bank also plans to review the opportunities and constraints in cross-border gas development in the Arab world. The two studies are considered complimentary as the LAS study will concentrate on the technical aspects of the subject matter, and the World Bank study will focus on the policy issues. Both of these studies could also have implications for electricity trade. In particular, there are various trade-offs in the costs and benefits of electricity versus gas interconnections that are normally taken into account by the policy makers of each country while addressing cross-border energy trade. There are also collective benefits that would emerge if one takes a regional perspective in assessing the optimum use of energy resources.

This LAS–World Bank study (Part III) will be updated to take account of the conclusions and possible implications of both gas-trade studies as soon as the results are available. In particular, the World Bank gas-trade study will address the regulatory and contractual aspects of cross-border gas trade, which could affect so-called gas-to-gas versus gas-to-power competition. It is therefore important to align the development of legal and regulatory frameworks of cross-border electricity and gas trade.

# **Volume II: Attachments**

# Attachment 2.A

## Retail Tariff Analysis

As discussed throughout this report, retail tariffs in the Arab countries are generally far below the economic cost of supply. Subsidized energy prices negatively impact trade because they place power companies in a precarious financial position, making it difficult for them to raise funds to invest themselves, and denying them the cash flow necessary to pay their suppliers. Traders and investors are highly unlikely to make deals with power companies that are not in a position to pay for services provided - they will simply look elsewhere for more credit-worthy off-takers. If they do decide to deal with customers who are not credit-worthy, they will require a significant mark-up, or risk premium, to compensate for the increased risk, leading to higher electricity prices (or a further deterioration in the company's creditworthiness). Traders and investors may require payment guarantees which may not be forthcoming from commercial banks and/or Governments. This is particularly important to investors/traders in energy because they are the last in the chain to get paid; i.e., retail customers pay the distribution company which in turn pays the single buyer which in turn pays the generators.

A fundamental problem in the region is the near absence of what would be considered "independent and informed" regulation. Tariffs have often been established on the basis of political expediency and do not reflect the economic cost of supply. This holds for both electricity and primary fuels for generation such as gas and oil. The Governments convey substantial subsidies to the domestic energy sectors, and cross-subsidization between and within customer classes goes well beyond assistance for the socially disadvantaged. In some cases, large segments of the population are unable to pay prices that reflect the economic cost of supply, but the difficult challenge facing Governments is that the long history of subsidization and cross-subsidization in the prices of fuels and electricity have resulted in an unwillingness of the population to pay for energy. It is a difficult task to eliminate the complex system of subsidies that have developed over the years.

Countries that are energy deficient are under pressure to reduce subsidization because the subsidies are taking a significant toll on the government budget. Even countries that are relatively rich in energy resources will be unable to sustain subsidies indefinitely, particularly under the very high levels of growth in energy consumption forecast for the Arab countries in the immediate and longer terms. In addition to the problems relating to investment and trade, subsidies lead to a number of performance, efficiency and resource allocation issues, including:

- Utilities do not have the funds necessary to maintain, let alone expand the system to meet increasing demands and replace retired plant, thus leading to decreased reliability;
- The signals for investment are distorted, leading to less than optimal investment decisions and higher energy costs; and
- Subsidies distort consumption decisions resulting in an inefficient allocation of resources. Generally, subsidized prices lead to increased consumption, and provide incentives for consumers to use the subsidized energy form rather than alternative energy forms that may be more economic in certain applications.

The use of subsidies distorts investment, production and consumption decisions, leading to significant costs that are largely hidden. The costs of energy production and delivery are incurred whether or not they are reflected in tariffs. By not reflecting economic costs in tariffs consumers are making unwise consumption decisions that result in even higher costs of energy supply and delivery, and/or further reductions in the reliability and quality of supply.

Electricity tariffs for residential and industrial customers in the Arab countries are shown in table 1. The tariffs shown include taxes. The average tariff for the residential class is based on a monthly consumption of 500 kWh. The tariff for industrial customers is for supply at high voltage. The Iraq figures are based on tariffs for Kurdistan, the UAE figures are based on tariffs for Abu Dhabi. The average shown is a simple average of the residential and industrial tariff.

It can be difficult to determine the actual cost of electricity supply in many Arab countries because the subsidies provided by Government to the energy sector are largely hidden. However, a good proxy of the level of subsidization is provided by comparing tariffs to a benchmark based on the average of the tariffs of countries whose tariffs reflect the full economic cost of supply. The February 2009 World Bank report referenced earlier provides such a comparison of countries in the Middle East and Africa to a benchmark based on an average of the tariffs of France, Greece, Italy, Spain, Portugal and Turkey. This benchmark provides a reasonable approximation of the opportunity cost of electricity. For comparison purposes, this “EU benchmark” is included in table 1. As can be seen, the average of the tariffs of the Arab countries is far below the EU benchmark. In fact, the average residential tariff in Arab countries is only 43 percent of the EU benchmark tariff, and the average industrial tariff is only 46 percent of the EU benchmark tariff. Tariffs would be far less relative to the EU benchmark if it were not for the very high tariff levels in Djibouti, Mauritania and Palestine. Tariffs for residential and industrial tariffs in the region are compared graphically in figures 1 and 2, respectively.

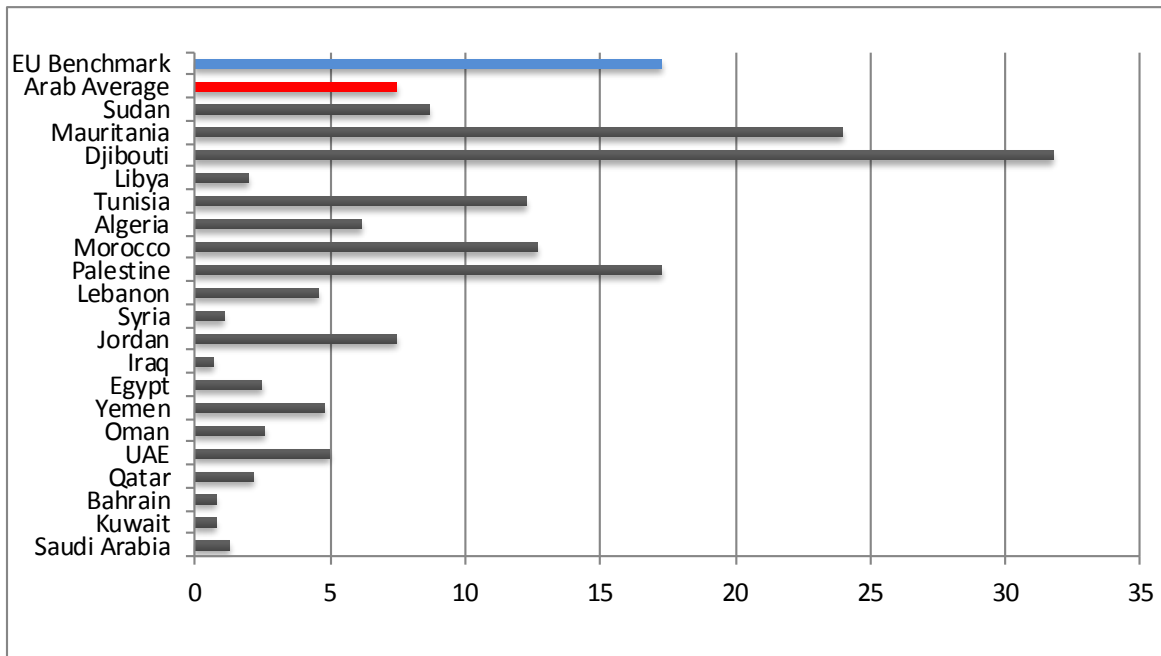
The cross-subsidization in the tariff systems is evidenced by the fact that in many cases the industrial tariff is greater than the residential tariff. Tariffs for residential customers should be higher than tariffs for industrial customers because it costs more to supply them. More facilities (i.e., transformers and distribution lines and substations) are needed and greater losses are incurred to supply residential customers because they are supplied at lower voltage levels. As can be seen in the EU benchmark case, industrial tariffs are lower than residential tariffs. Cross-subsidization in the tariff regime results in many of the same problems discussed above; in particular, it distorts consumption decisions and leads to an inefficient allocation of resources. It can also make a country’s industry less competitive internationally leading to job loss.

**Table 1: Electricity Tariff Comparison (US cents/kWh)**

Country	Residential	Industrial	Average*
Saudi Arabia	1.3	3.2	2.3
Kuwait	0.8	0.4	0.6
Bahrain	0.8	4.4	2.6
Qatar	2.2	1.9	2.0
UAE <sup>65</sup>	5.0	15.0	10.0
Oman	2.6	4.7	3.6
Yemen	4.8	8.7	6.8
Egypt	2.5	2.5	2.5
Iraq	0.7	1.6	1.2
Jordan	7.5	6.7	7.1
Syria	1.1	8.9	5.0
Lebanon	4.6	7.6	6.1
Palestine	17.3	10.8	14.1
Morocco	12.7	9.7	11.2
Algeria	6.2	3.6	4.9
Tunisia	12.3	6.7	9.5
Libya	2.0	2.5	2.3
Djibouti	31.8	19.7	25.7
Sudan	8.7	8.7	8.7
Mauritania	24	24	24
Somalia	N/A	N/A	N/A
Comoros	N/A	N/A	N/A
<b>Arab Country Average</b>	<b>7.5</b>	<b>7.6</b>	<b>7.5</b>
<b>EU Benchmark</b>	<b>17.3</b>	<b>16.5</b>	<b>16.9</b>

\* Represents a simple average of the Residential and Industrial tariffs. N/A - Unavailable

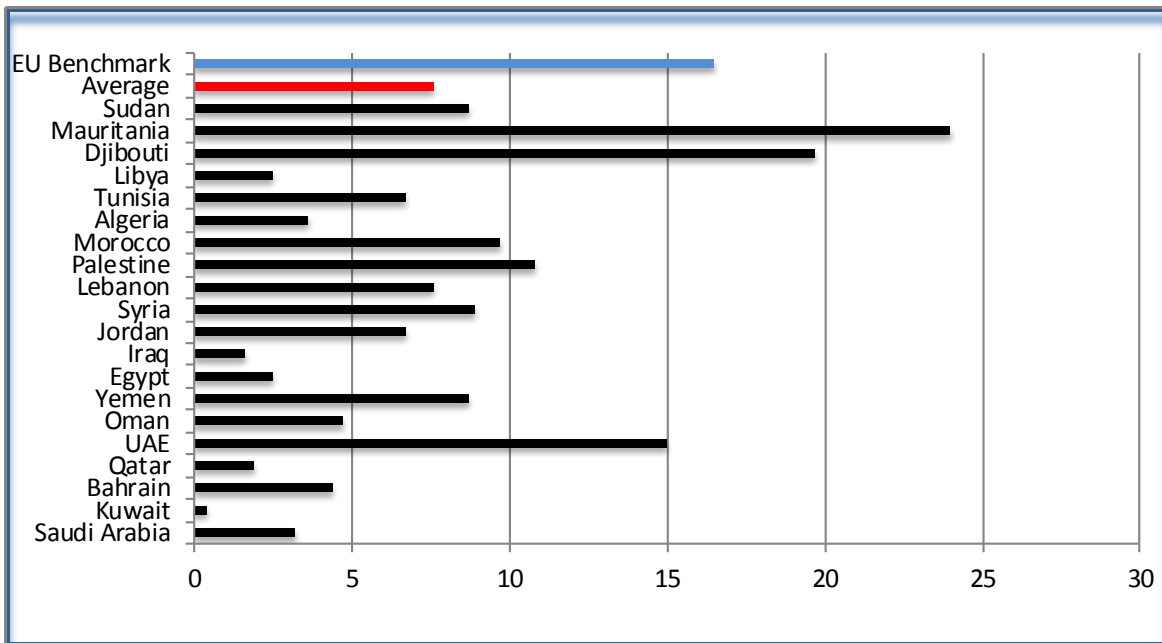
**Figure 1: Comparison of Residential Tariffs in the Arab Countries to Benchmark Tariff (US cents/kWh)**



**Figure 2: Comparison of Industrial Tariffs in the Arab Countries to Benchmark Tariff (US cents/kWh)**

<sup>65</sup> The UAE was not included in the World Bank study, so information for UAE was based on information at [www.rsb.gov.ae](http://www.rsb.gov.ae).

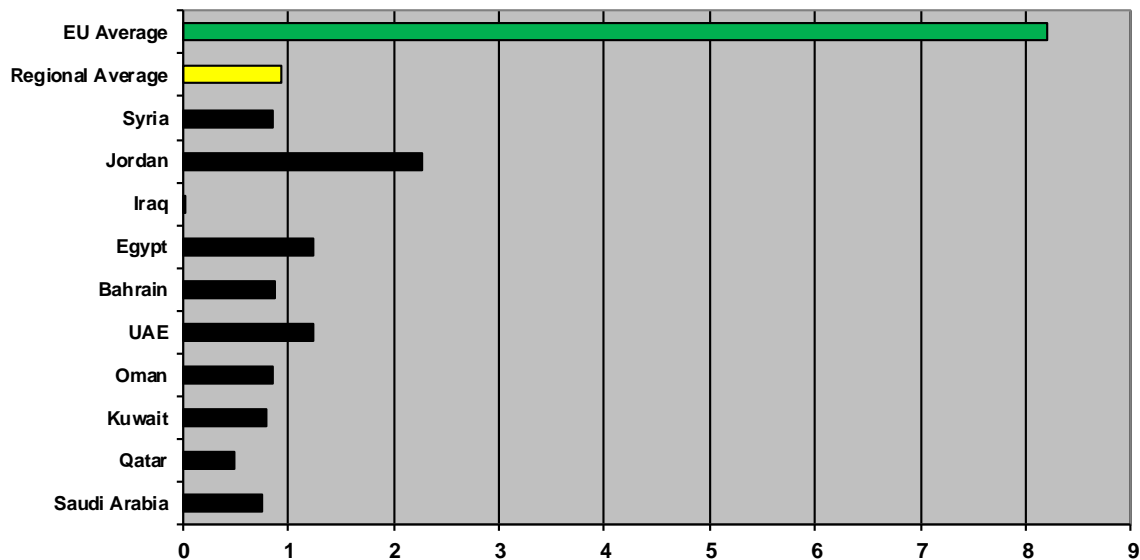




The situation in the gas sector is much the same with many Arab countries providing significant subsidies to domestic gas consumers, including power generation. This leads to inefficient allocation of resources. For example, there may be an over-reliance on gas generation because gas prices are lower than the economic cost of supply. Further, when gas prices are subsidized, there may not be enough capital generated from sales to fund expansion of supply to meet the needs of the domestic market, thus forcing consumers such as the power sector to seek alternative supplies; i.e., oil or coal.

An example of the level of subsidization of gas prices in Arab countries is provided in figure 3. The internal bulk prices of gas for countries in the region are compared to the average border price for gas imports to the EU from Russia. The EU average represents the benchmark price for the region. As can be seen, the internal gas prices for a sampling of Arab countries fall well below the benchmark, with the average price for the region only 11% of the benchmarks.

**Figure 3:** Comparison of Internal Bulk Price of Gas to Benchmarks (US\$/MMBTU)



Iran provides a good example of how subsidized energy prices can negatively impact trade. Current domestic gas prices for various classes of consumers in Iran are in the range of 1 to 2 cents/cubic meter compared to the range of 4 to 6 cents required for financial cost recovery in the sector.<sup>66</sup> The government estimates that the subsidy to gas consumers was \$5.76 billion borne by the state budget. Such low prices have fostered rapid growth in consumption leading to a tight supply demand balance, especially during the winter season when the domestic demand peaks. In January 2008, the weather became very cold and the demand for gas rose sharply and a gas crisis ensued. This was aggravated by the price dispute with Turkmenistan which suspended exports to Iran. Iran in turn had to renege on its export contracts to Turkey and divert export gas for domestic use. Similarly supplies to industries were suspended and gas was diverted for household use.<sup>67</sup>

<sup>66</sup> Source: Hossein Razavi, Natural Gas Pricing in countries of the Middle East and North Africa, The Energy Journal Volume 30, Issue #3 of 2009, p15

<sup>67</sup> Narsi Ghorban, Iran's future gas development and exports in view of the January 2008 Crisis, Middle East Economic Survey, Volume LI No.8 , 25 February, 2008 available at [www.mees.com/postedarticles/oped/v51n08-5OD01.htm](http://www.mees.com/postedarticles/oped/v51n08-5OD01.htm)

## Attachment 2.B

# Private Sector Investment in Arab Countries

Item		Algeria	Djibouti	Egypt
<b>Electricity System and Existing Available Capacity</b>		Installed capacity of 8,500 MW. Algeria is interconnected with Morocco and Tunisia.	Capacity of 115MW small diesel generators. Interconnected with Ethiopia from 2011.	Installed generation capacity of 23,000 MW. Interconnections with Jordan and Libya.
<b>Industry Structure</b>		Sonelgaz, the former state owned electricity and downstream gas monopoly, was reorganized into SPE (generation) and GRTE (transmission). The 4 regional distribution companies are also subsidiaries of Sonelgaz. Generation is open to independent producers like AEC, a 50/50 joint venture between Sonelgaz and Sonatrach	Vertically integrated state-owned monopoly, Electricité De Djibouti	Egypt's power industry organized into the Egyptian Electricity Holding Company (EEHC), which includes six generation, nine distribution, and one transmission-and-dispatch company, which also acts as the singly-buyer of electricity. The sector continues to operate as vertically integrated due to the single-buyer trading arrangements and firm financial and corporate control of EEHC over its subsidiaries.
<b>private sector participation</b>	<b>Generation</b>	The 4 existing IPPs account for 2.9 GW. They are mostly owned by public sector Algerian companies, but also have some international private ownership.	Auto-production for the Djibouti Port facility	There are three private IPPs with total generation capacity of about 2,049 MW, which started operating in 2002/2003, under long-term power purchase agreements with EEHC.
	<b>Transmission</b>	Nil	Nil	Nil
	<b>Distribution</b>	Nil	Nil	nil (except for several very small decentralized providers)
<b>Private Sector Policy</b>		Priorities include construction of new capacity (8 GW over 2009-2015), modernization of existing capacity (replacement of steam plants with gas turbines), development of interconnection with neighboring countries. Algeria also aims to generate 15% of its electricity from renewables by 2025-2030 (60% solar, 40% wind)	Main focus is to increase access to electricity, reduce cost of service delivery and improve the financial stability of the utility.	Main focus is to ensure secure supply by increasing electricity generation capacity. All new investments are financed by EEHC, but the government wants to attract private investment as well. The challenge is to do it in a way which minimizes government exposure and guarantees and also de-monopolizes electricity supply.
<b>Pricing and Regulation</b>		Power prices are very low in Algeria, especially for residential customers, thanks to low internal gas prices. Average price was 6.2 USc/kWh in 2008 for residential customers, and 3.6 USc/kWh for industrial customers. CREG regulates the electricity and gas markets	Djibouti stands out as having by far the highest electricity rates in MENA, around \$0.32 per kWh for residential use and \$0.2/kWh for industrial use, reflecting the high running cost of small diesel generators.	The Egyptian Electric Utility and Consumer Protection Regulatory Agency (EEUCPRA) licenses companies that operate in the sector, and creates conditions for competitive trading arrangements. It has no tariff-setting powers. The new Electricity Law should strengthen the authority of EEUCPRA. Significant underpricing of electricity. Electricity prices increased in 2004 (first time since 1992). There is program for increasing energy prices. Natural gas price for energy intensive industries was set to US\$3 per mmbtu in June 2008, with subsequent increase in electricity prices for industrial consumers as follows (in USc/kWh): 6.3 for medium voltage; 4.6 for high voltage, and 3.8 for ultra high voltage consumers. For comparison, the average sale tariff in FY2008 was about 3.1 USc/kWh, in which fuel cost was 0.7 USc/kWh. EEHC purchased electricity from IPPs and NhREA at the average price of about 2.5 USc/kWh, only about 5% above the average cost of thermal generation from EEHC plants.
<b>Perspective for Private Sector Participation</b>		Out of the 8 GW that are expected to be built by 2015, 2.2 GW would come from SPE, and 5.8 GW from other producers. Identified projects include international private partners such as Alstom, Ansaldo, GE, Orascom, and Iberdrola	Potential for small IPP exploiting geothermal resources. Being explored by IFC and the Bank (Argeo project).	There is significant potential for private investments, especially in electricity generation.

Item		Iraq	Jordan	Libya
<b>Electricity System and Existing Available Capacity</b>		Total capacity of 6,100 MW. Large capacity needs.	2,500 MW of installed electricity generation capacity. System interconnected with Egypt and Syria.	6,200 MW of installed generating capacity. Interconnected with Egypt and Tunisia.
<b>Industry Structure</b>		MoE is responsible for the policymaking and the electricity supply. The operational functions were reorganized into 18 geographically based directorates within MoE. Regional directorates in KRG report to the Ministry of Electricity in KRG and appear to have minimum coordination with the MoE in Baghdad	Unbundled into 4 generating companies, 1 single-buyer transmission company, and 3 distribution companies	The General Peoples Committee for Electricity, Water and Gas is responsible for policy, planning and regulation of Libya's electricity sector. The General Electricity Company of Libya (GECOL) is a vertically-integrated monopoly with control and ownership over all electricity generation, transmission and distribution.
private sector participation	<b>Generation</b>	Two power plants have been developed in KRG through private investment. (500 MW Erbil Power Plant, 750 MW Chamchamal Power Plant). KRG is providing fuel and receiving their electricity.	3 of 4 generating companies are either wholly-owned or majority-owned by the private sector. Only one company remains wholly-government owned	Nil
	<b>Transmission</b>	Nil	Nil	Nil
	<b>Distribution</b>	Nil	All 3 distribution companies are either wholly-owned or majority-owned by the private sector	Nil
<b>Private Sector Policy</b>		Government policy focused on rehabilitation of existing assets and development of new generation projects to improve electricity supply in Iraq	Main focus is to ensure adequate electricity supply. New electricity generation capacity being added via public-private partnership (PPP).	Main focus is to ensure the secure and adequate supply of power to all areas of the country. Libya has a goal to improve service quality and efficiency, reduce technical and non-technical losses and reinforce interconnections with neighboring countries.
<b>Pricing and Regulation</b>		Electricity tariffs in Iraq remain far below cost recovery levels. Collection rates are low, estimated at 40%. Improvement of electricity supply would advance electricity tariff reforms to ensure electricity tariffs reach full cost recovery within a reasonable timeframe.	Electricity pricing is cost-reflective, including some cross-subsidization. Regulation supports full cost-recovery for the state-owned transmission company, competitive procurement of private electricity generation, and efficient loss-reducing service delivery in distribution.	Libya's retail tariffs are far below cost recovery levels. Government regulates industry and supports subsidies. Residential customers pay only 2.0 US cents/kWh, about 10% of a benchmark tariff that reflects the opportunity cost of power. This poses a significant challenge to Libya's aggressive expansion plans.
<b>Perspective for Private Sector Participation</b>		The Iraqi government is very much interested in attracting private sector investments in power generation. The Bank is developing a technical assistance for preparation of project documents and tender packages for potential power projects.	Jordan is committed to private electricity generation. The second IPP is under construction. Procurement of a private wind power project development is underway. Oil shale-based, nuclear and concentrated solar thermal electricity generation are planned under PPP.	Government does not appear interested in attracting private sector capital. However, GECOL is finding it difficult to bring on enough new generation and transmission to meet growing demand, so policy toward private sector may change in the future.

(continued)

Item		Kuwait	Lebanon	Morocco
<b>Electricity System and Existing Available Capacity</b>		Total installed generation capacity of about 11,600MW.	2,300 MW installed capacity. Large capacity needs.	Installed capacity of 5,300 MW (hydro, coal, gas mostly). Imports from Spain growing.
<b>Industry Structure</b>		Kuwait's electric power system is vertically integrated with the utility owned and operated by the Ministry of Electricity and Water.	The sector is operated by EdL, a vertically integrated, non-commercial, public establishment.	State-owned Office National de l'Electricite (ONE) holds transmission monopoly. Since 1994, ONE has been allowed to sign contracts with private generators. Distribution is shared between ONE, municipalities and private operators (in large cities)
private sector participation	<b>Generation</b>	Nil	Nil	Three IPPs account for 1,800MW.
	<b>Transmission</b>	Nil	Nil	Nil
	<b>Distribution</b>	Nil	nil, except for four concessions for the distribution of electricity in 4 city areas of Zahle, Jbeil, Aley and Bhamdoun.	Municipal operators have been active since 1961 and private operators since 1997. ONE is in charge of rural areas, of a few urban centers, and of direct delivery to some large customers
<b>Private Sector Policy</b>		It seems that there is a government intention to diversify power generation through utilizing alternative energy resources (e.g. solar) and natural gas; and implementing electricity DSM policies.	The development policy includes unbundling of the sector and the incorporation under commercial law of the new entities. Lack of political agreement on a final objective for sector restructuring has impeded progress.	Short-medium term focus is on building capacity. Coal is key to the country owing to low cost and availability (Morocco doesn't produce significant amounts of any fuel). Wind policy also very active.
<b>Pricing and Regulation</b>		Electricity prices are highly subsidized	Electricity tariffs are well-below cost and have not been changed since 1996 (oil price was US\$21/barrel). The sector is regulated by the Ministry of Electricity and Water and Council of Ministers.	ONE's financial situation is squeezed between high cost of power (cost of fuels, cost of PPAs) and relatively low tariffs
<b>Perspective for Private Sector Participation</b>		Kuwait has not yet introduced the IPP/IWPP model but is seeking foreign investment for the construction of new plants.	IFC provided advisory assistance on due diligence for the development of generation through IPP arrangements. Lack of political agreement on private participation as well as uncertainty on fuel supply options inhibited progress.	Private sector generation projects include: (i) extension of Jorf Lasfar coal-fired plant; (ii) Safi 1,320 MW coal-fired plant; (iii) Tarfaya 300 MW wind farm; (iv) Energipro program, to favor renewable (mostly wind) self generation by industrial users - 1 GW expected by 2012

(continued)

Item		Oman	Tunisia	Saudi Arabia
<b>Electricity System and Existing Available Capacity</b>		Capacity of above 3,300 MW. Plans for interconnections with other Gulf countries.	Total installed capacity has reached 3,300MW.	Installed capacity of 37,200 MW. SEC (state-owned utility) share in the installed capacity is 89%.
<b>Industry Structure</b>		Unbundled generation and distribution, with a state-owned single buyer of bulk electricity and a state-owned transmission company.	The vertically integrated utility Société Tunisienne de l'Electricité et du Gaz (STEG) generates approximately 75% of Tunisia's power, and has a monopoly over transmission and distribution of electricity (and gas)	The Ministry of Water and Electricity is responsible for planning and policy making. SEC is vertically integrated. The Saudi Electricity Regulatory Authority was formed in 2001 and in 2004 became the Electricity and Co-Generation Regulatory Authority (ECRA). ECRA is a financially and administratively independent, and regulates tariffs (except residential) and market access.
private sector participation	<b>Generation</b>	Privatization is high on the Omani agenda and all new generation plants are IPPs.	Private operators are entitled to produce electricity under public concessions. There are two independent power producers in operation: 471 MW combined cycle gas turbine (CCGT) and 30 MW gas fired plants	Private sector participation was limited until Jubail IWPP and the establishment of WEC in 2003. The first IWPP project became operational in 2009. Large IPPs will play a major role in the sector. ARAMCO project is under-construction and will be operational in 2013
	<b>Transmission</b>	Nil	Nil	Nil
	<b>Distribution</b>	Nil	Nil	Nil
<b>Private Sector Policy</b>		Main focus is to meet growing demand, reduce reliance on gas by introducing other generation sources in the electricity mix and gradually implement cost-reflective tariffs	To increase generation capacity and promote IPPs.	Saudi Arabia has plans to restructure the electricity sector, including unbundling of SEC and the introduction of competition. The issue of financing critical power generation projects is currently putting the system's reliability at high risk as the reserve margin is rapidly shrinking.
<b>Pricing and Regulation</b>		Oman's electricity tariffs are amongst the lowest in the region. Residential tariffs average \$0.026/kWh and industrial tariffs average \$0.047/kWh	Tariffs are low. Frequently increased to achieve STEG's financial balance, and averages for domestic consumers \$12.3c/kWh, and for industrial consumers \$6.7c/kWh (2008).	The current tariff level does not cover the cost of supply. ECRA has been developing a tariff adjustment program as part of its regulatory mandate to assure cost-recovery. ECRA does not have approval authority for residential tariffs.
<b>Perspective for Private Sector Participation</b>		Significant with five new IPPs planned by 2015	New IPP planned in Bizerte (400MW CCGT, 2014-2015) and new interconnector project planned with Italy to come on line around 2016 with potential private sector involvement	SEC has introduced IPP Program and defined new potential IPPs to meet critical generation requirements in 2009-2020. Recent private sector activity was the selection of the developer for the first project of SEC IPP program.

(continued)

Item		Syria	Yemen	Palestine
<b>Electricity System and Existing Available Capacity</b>		7,700MW installed capacity.	Installed capacity of 1,200 MW, mostly heavy fuel oil and diesel	The Palestinian Territories (West Bank and Gaza) are dependent on the Israel Electric Co. (IEC) for nearly 95% of their electric needs. The Gaza Power Plant (privately owned and operated) has a capacity of 140 MW but only operates at about 40-60MW. Gaza also supplied by about 17 MW from Egypt, while the West Bank is supplied by about 20MW from Jordan.
<b>Industry Structure</b>		State-owned <i>PEEGT</i> is responsible for the generating plants and transmission networks. <i>PEDEEE</i> has similar responsibilities for the distribution network.	Vertically integrated state-owned monopoly, Public Electricity Corporation (PEC)	For many years electricity services were provided in most parts of WBG by municipal and village councils and by the Jerusalem District Electric Company (JDECO). Recently distribution companies have been established, but not all are yet fully operational. The new Electricity Law requires the transfer of municipal electricity operations to the distribution companies
private sector participation	<b>Generation</b>	Nil, however, MoE has launched a process for the development of a 230-250 MW power plant by private developers. The Government requested IFC to assist for private sector participation in this Project.	nil, apart from providing rental capacity to PEC, and for auto generation	Gaza Power Plant is privately owned and operated
	<b>Transmission</b>	nil	nil	Nil
	<b>Distribution</b>	Nil	Nil	JDECO is publicly owned with, in addition to municipal shareholders, some private shareholders
<b>Private Sector Policy</b>		Main focus is on developing new generation capacity and substituting oil fueled power plants with natural gas. The Government recognizes the inadequacy of domestic gas supply and is keen to secure gas from regional market. The Government has issued decrees to facilitate engagement with private sector.	A new electricity law was approved by the GOY in Feb. 2009 which calls for unbundling PEC into separate generation, transmission and distribution entities, and the creation of regulatory agency	A new Electricity Law was enacted in May 2009. The law envisages private investment in generation and distribution.
<b>Pricing and Regulation</b>		The average tariff level in Syria is low and is not enough to cover the cost operating costs let alone its investment needs. It is particularly low for residential consumers at an average of US Cents 1.1/kWh.	Electricity prices are far below the cost of production and heavily subsidized for most consumers. A regulatory agency is expected to be set up according to the new electricity law.	Electricity supplied by IEC is priced at IEC medium voltage tariff levels. Retail tariffs are set by municipal councils or distribution councils, in areas where they exist and operate. The new Electricity Law requires the establishment of a regulator with tariff setting responsibilities.
<b>Perspective for Private Sector Participation</b>		The Government of Syria is very keen to attract private investments in generation. The Bank and IFC are helping the Government develop a PPP framework and advising the Government on its first IPP project.	Potential for IPP exploiting renewable energy like wind, solar and geothermal resources. IFC is assisting with IPP for new oil-fired plants. Under the current country and sector risks conditions for private investment presents challenges for the government.	Potential for IPP in northern West Bank is being considered. Private sector participation in development and/or operation of a concentrated solar power plant in Jericho is likely.

(Continued)

Item		Bahrain	Qatar	UAE
<b>Electricity System and Existing Available Capacity</b>		Small power sector with only 2,500 MW of generating capacity. Part of GCC Interconnection.	7,660 MW of installed generation capacity in 2010, increasing to 8750 MW in 2011. Part of GCC Interconnection.	25,250 MW of installed generating capacity spread among 7 Emirates. Part of GCC Interconnection.
<b>Industry Structure</b>		The Electricity and Water Authority acts as the single buyer of power from the BOO plants. It also acts as the regulatory authority for the power sector. The Ministry of Electricity and Water is responsible for electricity production and distribution. Private sector responsible for generation.	The state-owned Qatar General Electricity & Water Corporation (Kahramaa) purchases electricity from private producers and acts as the sole transmitter and distributor of electricity in the country. Kahramaa buys power from IWPPs under 25-year agreements and Qatar Petroleum supplies gas under long-term contracts.	Structure varies for each Emirate. Abu Dhabi has one of the more advanced power reform programs with an independent regulatory agency (the Abu Dhabi Regulation & Supervision Bureau). ADWEA, a public agency owned by the Abu Dhabi government, is a holding company for the unbundled electricity entities, owning the electricity and water transmission company (TRANSCO), two electricity and water distribution companies, two of the emirate's generation companies and the single buyer, the Abu Dhabi Water and Electricity Company (ADWEC). In addition, ADWEA develops, implements, and manages water and electricity policy conducted by its subsidiaries.
<b>private sector participation</b>	<b>Generation</b>	The 950 MW CCGT plant is owned by the Bahraini Al Ezzel Power Company on a build-own-operate (BOO) basis. In January 2007, International Power, Suez Energy of Belgium and Sumitomo of Japan acquired the Al Hidd power and water plant from the government.	Kahramaa accounts for about 68% of all electricity generation – the private sector accounts for the rest. Captive generation owned by industry accounts for close to 2000 MW. All new generation constructed by private sector and IWPPs.	Five IWPPs have been commissioned on a BOO basis as joint ventures between ADWEA and various international companies. ADWEA has a 60% share-holding while the remaining 40% is owned by private investors. All IWPPs sell water and electricity to the single buyer (ADWEC) under long-term contracts.
	<b>Transmission</b>	Nil	Nil	Nil
	<b>Distribution</b>	Nil	Nil	Nil
<b>Private Sector Policy</b>		Government focus is on private sector development of new generation. Recently, the government announced an international bid for a 1,200 MW Al Dur power and desalination plant expected to be commissioned in 2011.	All new generation constructed by private sector. Kahramaa is working on several large-scale power projects with foreign companies, and is required to privatize its transmission and distribution systems.	Policy varies for each Emirate. Abu Dhabi expects the private sector to build new generation as IPPs/IWPPs. Dubai has also introduced the IWPP model for new generation and plans to reform its power sector similar to that of Abu Dhabi and privatize assets as was done with ADWEA.
<b>Pricing and Regulation</b>		Government sets tariffs and they are heavily subsidized. Residential customers pay only 0.8 US cents/kWh, about 4.5% of a benchmark tariff that reflects the opportunity cost of power.	Tariffs are heavily subsidized and well below the economic cost of supply. Residential customers pay only 2.2 US cents/kWh (for consumption up to 4000 kWh/month, and 2.7 US cents/kWh for consumption above this level), about 12% of a benchmark tariff that reflects the opportunity cost of power.	Retail electricity tariffs continue to be subsidized. Residential customers pay 5.0 US cents/kWh, only 28% of a benchmark tariff that reflects the opportunity cost of power.
<b>Perspective for Private Sector Participation</b>		The Bahraini government is very much interested in attracting private sector investments in power generation.	Good, but highly subsidized electricity tariffs pose a significant barrier.	Good in the generation sector, at least in the Emirates of Abu Dhabi and Dubai.



(Continued)

Item		Sudan	Mauritania
<b>Electricity System and Existing Available Capacity</b>		Sudan has over 2585 MW of generating capacity. Not currently interconnected with any Arab countries.	Power system is small and fragmented with only 90 MW of installed generation capacity. Not currently interconnected with any Arab countries.
<b>Industry Structure</b>		The Ministry of Electricity and Dams is responsible for policy formulation and oversight of the electricity sector including the Dams Implementation unit and the Kenana and Rahad Canals in Sudan. The National Electricity Corporation (NEC) was unbundled and replaced with five companies, including: Sudanese Thermal Power Generation Co., Ltd., Sudanese Hydro Generation Co., Ltd, Merowe Dam Electricity Co., Ltd., Sudanese Power Transmission Co., Ltd., and Sudanese Electricity Distribution Co., Ltd. These companies were established under the Law of Sudan (Companies Act 1925). The Sudanese Power Transmission Company is responsible for purchasing power from producers and development and expansion of the national grid.	The Ministry of Hydraulics and Energy is responsible for the energy sector in Mauritania. State-owned Société Mauritanienne d'électricité (SOMELEC) is the national power utility and the major player in the power sector with responsibility for owning and operating power facilities. Agence de développement de l'électrification rurale (ADER) is the agency with responsibility for rural electrification. Autorité de regulation (ARE) is the body which regulates the power, water and telecom sectors. Participation in the regional power projects is handled by the government and SOMELEC with the latter having responsibility for power purchase and payment.
<b>private sector participation</b>	<b>Generation</b>	Nil	Nil
	<b>Transmission</b>	Nil	Nil
	<b>Distribution</b>	Nil	Nil
<b>Private Sector Policy</b>		Sudanese law allows private investment in the power sector (most likely generation, and perhaps distribution). Seeking to expand energy trade with Ethiopia, Eretrea and Egypt.	Appears to be little in the way of policy relating to the private sector. Instead, the Government has concentrated on regional projects. Mauritania is allocated 28 MW of capacity from the Manantali Hydropower project and Aggriko Diesel plants in Mali, owned jointly by Mali, Senegal and Mauritania and operated by SOGEM and OMVS. Further regional projects are under study.
<b>Pricing and Regulation</b>		Government sets tariffs and they are subsidized, although not as much as other Arab countries. Average tariff is 8.7 US cents/kWh.	Tariffs have been revised upwards several times in the last decade to about 24 US cents/kWh, but remain below the cost of supply placing SOMELEC in a precarious financial position.
<b>Perspective for Private Sector Participation</b>		Sudanese law allows private sector investment in the electricity sector.	Perhaps, but currently Government is concentrating on regional projects which may include a role for the private sector.

## Attachment 2.C: Electricity Sector in Europe

### 1. Overview

The combined GDP of the EU member countries in 2009 was about Euro 11.8 trillion while the per capita GDP (on the basis of purchase power parity) was about Euro 23,600.

The import dependency of the EU energy economy is rapidly rising. The import dependency with respect to overall energy is expected to rise from the current level of 50% to 64% by 2020 and 67% by 2030. Between now and 2030 the import dependency for gas is expected to increase from 59% to 84%, the oil import dependency will rise to 95%, while the import dependency with respect to solid fuels is expected to rise from 40% to 63%. The import dependency for uranium for nuclear power plants is nearly 98% (IEA Energy Policy Review EU 2008). There is little import dependency with respect to electricity except through import dependency relating to the fuels for power generation.

In this context the key objectives of the EU electricity policy initiatives relate to efficiency improvements in electricity production, transmission, distribution and use, emissions reduction, environmental mitigation, and ushering in a fully competitive internal electricity market. The overarching concern is to ensure energy security through diversification of the forms of energy imports and diversification of supply sources.

For the purposes of this report the European Union (EU) is dealt with as it exists today consisting of 27 member countries (Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom) with a total population of about 500 million people and a surface area exceeding 4 million sq.km – about half the size of the USA.<sup>68</sup> Often data provided will relate to the group of 23 European members referred to as the Organization of Economic Cooperation and Development (OECD-Europe) consisting of: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom, as some data are not readily or consistently available for the EU.

### 2. Power Sector Structure

The European electricity industry is one of the largest industries in the EU employing more than 700,000 people directly. A transformation of the industry has taken place during the past decade owing to technological change and the introduction of the Commission's Electricity Market Directives (since 1996). Monopoly network components have been unbundled and considerable merger and acquisition activity has taken place, some involving cross-border mergers and acquisitions leading to "European utilities".

The electricity industry in the EU is still highly concentrated, at both the EU and member state level. The seven largest utilities in the EU had sales representing 72% of total demand in 2006. The same companies produced 49% of total generation and owned 49% of total installed

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<sup>68</sup> Much of the statistical data used do not cover Cyprus and Malta.

capacity. According to the Commission, generation markets in Belgium, France, Estonia, Ireland, Greece, Portugal, Latvia, Slovenia and Slovakia were highly concentrated in 2005.

The retail market for sales to final customers is slightly more concentrated than the generation market. This picture is reinforced when looking at the market position of the largest European utilities (Exhibit 1). Several of these utilities also have other activities, most notably gas, making them significantly more important in terms of their role in the EU energy sector.

**Exhibit 1:** Market Share of the Seven Largest Utilities in the EU

<i>Company</i>	<i>Sales TWh</i>	<i>EU market share in %</i>	<i>Generation TWh</i>	<i>EU market share in %</i>	<i>Capacity GW</i>	<i>EU market share in %</i>
EDF <sup>1</sup>	635	23	643	19	134	18
E.ON	369	13	195	6	46	6
RWE	312	11	224	7	43	6
Vattenfall	200 <sup>2</sup>	7	165	5	35	5
Endesa	162	6	124	4	33	4
SUEZ/Electrabel	157	6	136	4	30	4
Enel	152	6	129	4	50	7
Total (7 largest companies)	1 987	72	1 616	49	371	49
Total EU <sup>2</sup>	2 756		3 310		757	

1. Including EnBW in Germany (45.1% stake) and Edison in Italy (51.58% stake).

2. Data for 2005.

Sources: Company annual reports for 2006.

A total of 104 generation companies in the EU had a national market share of installed capacity exceeding 5% in 2005 according to the Commission. In terms of generation output, 90 generation companies had national market shares above 5% in 2003 according to Eurelectric (an industry association). In seven countries, the 3 largest generators had national market shares above 90% in 2005.

According to Eurelectric, there were almost 3 000 distribution companies in the European Union in 2003. Consolidation has continued since then, but there are still a high number of relatively small distribution companies in some member states. In 2003 there were five or more distribution companies in 15 EU countries. According to the Commission, there were 85 companies in the EU with a 5% market share or higher in each country in 2005. In seven countries there is only one company with a market share higher than 5%. In 12 of the 25 EU countries, the three largest companies had a retail market share of 90% or higher in 2005.

The distribution and retail supply component of the industry has a very high number of companies, but relatively few companies have large market shares in half of the EU countries. The second Electricity Market Directive includes requirements for all distribution companies with more than 100,000 customers to unbundle network activities at the distribution level from sales and generation. The unbundling can be either legal or functional separation. However, according to the Commission, only six countries had complied fully and unambiguously with the distribution network unbundling requirements by the end of 2005.

The second Electricity Market Directive requires legal separation of transmission system operators (TSOs) to ensure that they operate independently from generation and supply interests, and to enable fair and open access to the transmission grid. More than half of the EU member states have chosen to fully unbundle TSOs through ownership separation. According to the Commission, only 16 countries (including Norway<sup>69</sup>) had unambiguously and effectively implemented unbundling requirements for transmission system operation in 2005.

European TSOs have a long tradition of co-operation at the regional level and beyond. They have formed the association of European Transmission System Operators (ETSO) to facilitate co-operation on European Union issues, including cross-border trade. Within UCTE, a system of operational agreements has developed. Since the large blackout in Italy in 2003, the agreements have been more detailed, formalized and contractually binding. In the Nordic region, the TSOs have formed NORDEL, which is the platform for co-operation on operation, market design issues and network planning. ETSO has since been replaced by ENTSO-E as described below.

### **3. Electricity Sector Reform and Market Organization**

Several reform measures have been undertaken in the EU through various directives with the objective of promoting competition in the internal electricity market. Their focus had been on unbundling the monopoly elements, mainly the network operation from the other functions, ensuring third party transmission access, independent regulatory oversight including cross border exchanges and trade, as well as the provision that all customers have to choose their supplier.

The first package of directives included Electricity Directive 96/92/EC issued in 1996. This enabled the largest consumers to choose their suppliers and also provided for open access, but without a regulated access framework. It required the unbundling of the transmission system operation function from the vertically integrated utilities through separation of accounts. It also introduced the concept of a single buyer, acting in the internal energy market, but appointed to be the sole supplier in a specific domain.

In order to accelerate reform and improve the provisions relating to access and regulation, a second package of directives were issued in 2003. This included the Electricity Directive 2003/54/EC and the Regulation Directive 2003/1228/EC. The former required a step-wise opening of the retail market with the target of full opening by July 2007, and made unbundling provisions stricter by requiring legal separation (establishing a separate company) or full ownership unbundling. Establishment of independent regulators was made mandatory.

The Regulation Directive dealt with cross border electricity trade, made provisions for market-based allocation of transmission capacity and for the collection of congestion rents from transmission capacity auctions and their use for investments to eliminate bottlenecks in the grid. It also included provisions for calculating in a transparent and non-discriminatory manner the available transmission capacity based on real physical bottlenecks.

Various reviews found that electricity markets largely remained national in scope and had high levels of market concentration. The level of effective unbundling was inadequate and lack of adequate cross border transfer capacity constrained trade and competition across the borders. There was a lack of transparent and reliable market data and timely price information to foster competition. The balancing markets tended to favor the incumbents. This led to issue of the third

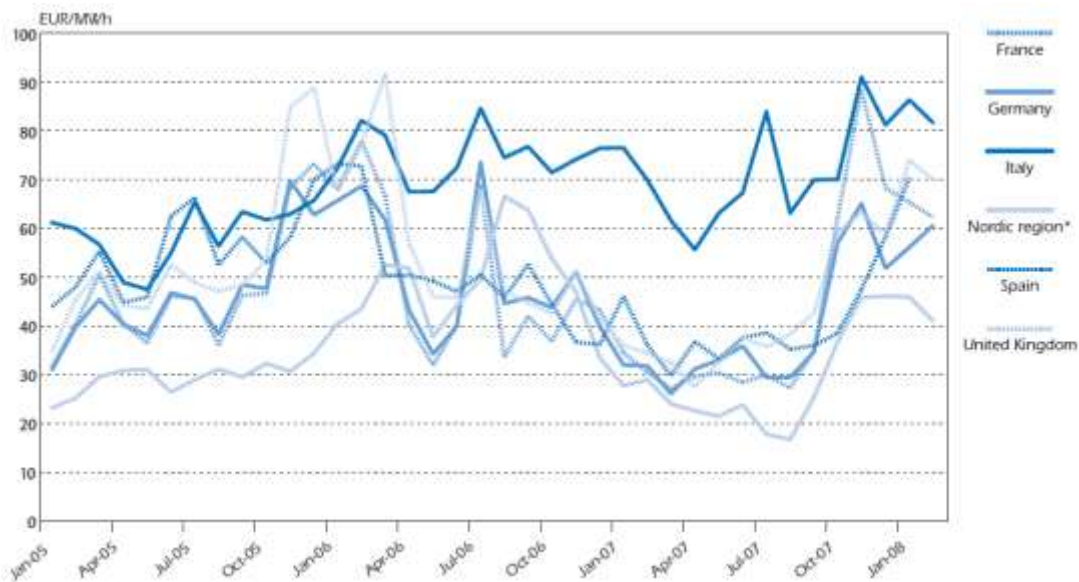
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<sup>69</sup> Though Norway is not a member of the EU, it conforms to the key principles of the EU Directives voluntarily.

package of directives in June 2009 which resulted in full retail market liberalization ahead of the target date of July 2007.

The wholesale electricity market evolved gradually, encouraged by progress in sector unbundling and increasing transmission access. The association of European power exchanges, EuroPEX, has members from power exchanges in 14 EU member states. Some of the oldest exchanges are NordPool in the Nordic region, OMEL in Spain, APX in Great Britain and the Netherlands and EEX in Germany. A review of the wholesale market prices in select exchanges (in terms of day ahead spot prices) during Jan 2005-Jan 2008 shows some convergence of prices, but still there is a great deal of scope for improvement (Exhibit 2). Traded volumes of electricity in the UK, Germany and the Netherlands and in the Nordic market in 2005 were 1 to 6 times the national electricity consumption. Market liquidity has since increased substantially.

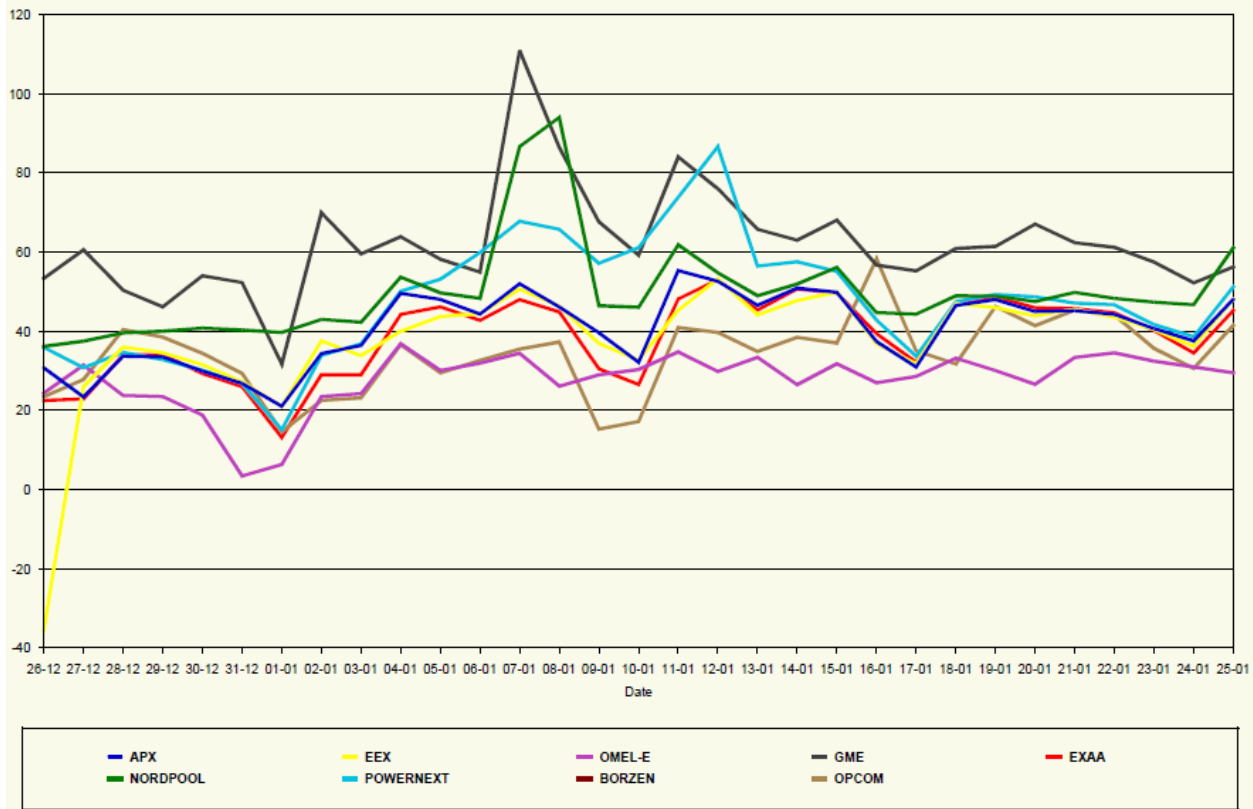
**Exhibit 2: Monthly Average Day-Ahead Spot Prices in Select EU Markets**



Source: IEA Energy Policy Review EU (2008)

The latest available daily arithmetic average spot prices in Euros/MWh (vertical axis) in the various European power exchanges for the period December 26, 2009 to January 25, 2010 is provided in Exhibit 3. The degree of convergence in prices among various exchanges seems to have improved.

**Exhibit 3: Daily Arithmetic Average Spot Prices for Electricity in European Power Exchanges 12/26/09 to 1/25/10**



Source: <http://www.europex.org/default.asp?kaj=markets>

Though full retail market opening was achieved well before the target date of July 2007, switching of suppliers for smaller consumers was about 5% in three countries and much lower in others. With respect to large consumers there has been extensive switching of suppliers. More than 50% of the largest consumers switched suppliers in seven countries, while more than 15% of the largest consumers switched suppliers in another 16 countries.

## 4. Demand and Supply

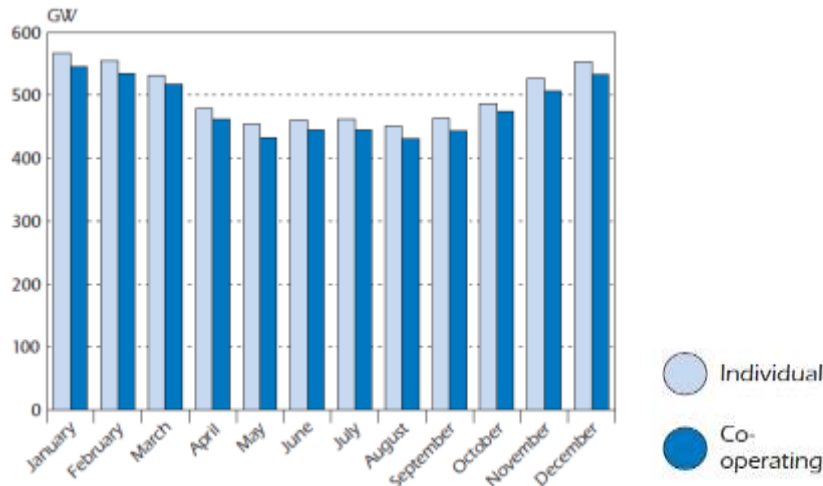
### 4.1 Demand

Simultaneous peak demand in 2006 in the UCTE area<sup>70</sup>, Great Britain and Nordel (excluding Norway) was 546 GW in January 2006, whereas aggregate individual peak load in the same countries was 568 GW (Exhibit 4). This is the challenge that individual countries had to meet in the absence of trade and co-operation. The difference results from diversity in the timing of peak demand, and corresponds to 22 GW, approximately 4% of the simultaneous peak load, or 3% of total installed capacity. The potential benefits derived from dynamic trade, co-operation and appropriate transmission capacity are therefore obvious, both in terms of improved security of supply and improved efficiency.

**Exhibit 4:** Hourly Peak Load in UCTE, Great Britain and Nordel (excluding Norway), Aggregate of Individual Countries and Simultaneous across All Countries, 2006

<sup>70</sup> The UCTE area includes most of the EU.





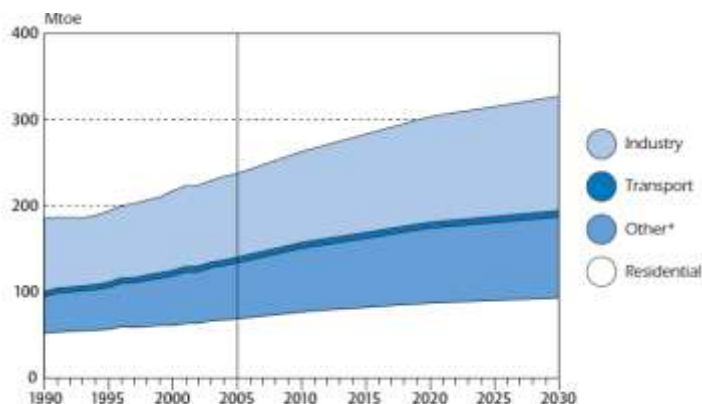
Source: IEA Energy Policy Review EU 2008

Exhibit 4 shows the annual load curve of the overall system in terms of monthly peak loads. As can be seen the overall annual system peak occurs in January, and monthly peak demands are lowest in summer.

During the past 15 years electricity consumption in the EU has increased at a rate of 1.7% per year on average. From 1990 to 1995, the annual average growth rate was only 1%, owing to the economic recession in Eastern Europe following the fall of the iron curtain. From 1990 to 1992 total electricity consumption in the EU fell slightly with a steep reduction in electricity consumption in the former communist countries. Growth increased markedly from 1995 to 2000, with annual average growth rates of 2.3%, slowing down again from 2000 to 2005 to an average annual growth rate of 1.8%. Economic growth outpaced growth in electricity consumption from 1995 to 2000 with average annual real growth rates of 2.8%. From 2000 to 2005, economic growth was at par with growth in electricity consumption.

This general picture obscures some important developments in parts of the EU, in particular the rapid growth in electricity demand on the Iberian Peninsula, and the shift of consumption growth from the industrial to the tertiary sector. The EU has several large industrial nations as member states, and this is reflected in electricity consumption patterns. In 2005, about 41% of electricity was consumed in industry. This is a high share compared to the IEA countries in general and remarkably, it is a relatively small decline from the 46% share in 1990 compared to non-EU IEA member countries. It is expected that this share will remain stable, although this expectation is subject to developments in electricity supply costs driven by increasing fuel prices, investment in renewables, and the cost of CO<sub>2</sub> certificates after 2013. Growth of electricity consumption has been particularly rapid in the consumer groups covering government, households, agriculture, and the services sector, both in volume and in share. Households alone consumed about 29% of total electricity in 2005, and the expected growth in the use of appliances makes it likely that demand in the residential sector will continue to increase strongly throughout the EU. Transport electricity consumption is relatively small, at only 3%, and is expected to remain stable (Exhibit 5).

**Exhibit 5:** Electricity Consumption Mix in the Past and Forecast through 2030



Source: IEA Energy Policy Review EU 2008

Based on the reference scenario forecast made by the IEA in its World Energy Outlook (2009), electricity demand in the EU is expected to grow at a compounded annual average rate (CAGR) of only 0.9% during the period 2007-2030 from 2840 TWh in 2007 to 3485 TWh in 2030. This compares with a forecast of 1% annual rate for OECD (Europe) and 2.5% for the world (Exhibit 6).

**Exhibit 6:** Electricity Demand Projection for the EU (TWh)

<i>Item</i>	<i>1980</i>	<i>2000</i>	<i>2007</i>	<i>2015</i>	<i>2030</i>	<i>CAGR 2007-2030</i>
EU	na	2520	2840	2973	3485	0.9%
OECD (E)	1709	2696	3062	3202	3855	1.0%
World	6799	12642	16429	20381	28930	2.5%

Source: World Energy Outlook, IEA (2009)

## 4.2 Supply

The electricity demand/supply balance in the EU for the period 2002-2007 is summarized in Exhibit 7. The installed generation capacity has increased from 716 GW in 2002 to 779 GW in 2007 and further to around 811 GW in 2008. About 7% of this capacity was owned by auto-producers (industries producing power mainly for their own consumption). The remaining 93% was for public supply.

**Exhibit 7:** Electricity Demand/Supply Balance, 2002-2007 (GW)

<i>Item /unit</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>
Total Installed Capacity GW	716	728	737	747	762	779	
Of which Hydro	142	137	138	139	140	140	
Wind	23	29	34	41	48	56	65
Geothermal	0.68	0.72	0.66	0.69	0.70	0.70	0.85
Nuclear	138	137	136	135	134	133	
Conventional Thermal	412	424	427	432	440	449	
Capacity in Utilities (GW)	670	682	685	690	717	731	
Capacity of Auto producers (GW)	46	47	51	53	53	54	
Gross Generation (TWh)	3117	3216	3288	3309	3540	3362	3260
Of which Hydro	348	338	357	341	345	344	414
Wind	36	44	59	70	82	104	
Geothermal	5	5	6	5	6	6	6
Nuclear	990	996	1008	998	990	935	936
Conventional Thermal	1738	1832	1857	1893	1929	1969	1904
Net Generation (TWh)	2953	3049	3117	3134	3178	3185	3096
Imports into EU (TWh)	285	290	281	324	311	318	297
Exports from EU (TWh)	272	292	288	313	307	308	285



Self consumption by producers (including pumped storage)	289	298	302	305	296	298	45
Network losses (TWh)	208	215	223	219	202	204	
Final consumption (TWh)	2600	2668	2722	2763	2826	2843	
Of this Industry	1092	1102	1126	1135	1133	1150	
Transport	72	72	72	74	71	72	
Households	739	771	784	795	807	801	
Services, others	697	722	738	758	816	821	

Source: [http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-PC-09-001/EN/KS-PC-09-001-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-PC-09-001/EN/KS-PC-09-001-EN.PDF)

Note : Data for 2008 are provisional from Monthly Statistics of Issue 11/2009 of Eurostat. In 2008 hydropower generation includes wind power and self consumption relates to pumped storage units. Also note that the above data exclude solar, biomass and waste-based generation and capacity.

About 57.6% of the capacity was fired by fossil fuels including coal, lignite, gas and oil. Hydropower capacity had a share of 17.9% followed by nuclear power at 17.0% and wind power at 7.2%. Geothermal at 700 MW had only a tiny share. Gross generation in 2007 amounted to 3362 TWh and the largest share in generation came from fossil fuel fired plants at 58.7%, followed by nuclear generation at 28%, hydropower at 10.2% and wind power at 3.1%.

Natural gas has been replacing coal-fired capacity, increasing its share from 7% in 1990 to 21.8% in 2007. This trend is expected to continue, with natural gas station output growing further to 24% by 2020, and becoming the second most important source of power after coal and ahead of nuclear towards the end of the next decade. By 2030, gas-fired power output is expected to reach 995 TWh per year, up from 600 TWh in 2005. Gas has also replaced oil which still played a prominent role in 1990, contributing 8% of generation, but fell to 3.4% in 2007. Renewable energy sources contribute the remainder. In 1990 their share was 12%, almost entirely from hydro. In 2007 the share had increased to nearly 16% with the importance of hydro reduced to 9.3% and marked increases in wind power and power from biomass, each contributing about 3.2% in 2007. An indicative target of 20% of electricity generation from renewables by 2010 has been set by the Commission.

IEA forecasts under its reference scenario in its World Energy Outlook (2009) that the total annual electricity generation will increase from 3,325 TWh in 2007 to 3,765 TWh in 2030, and annual increase of 0.77%. The generation levels and generation mix envisaged for 2015, 2020 and 2030 are summarized in Exhibit 8.

**Exhibit 8:** Forecast Generation Levels and Generation Mix in the EU through 2030

	Electricity generation (TWh)						Shares (%)		CAAGR (%)
	1990	2007	2015	2020	2025	2030	2007	2030	2007-2030
<b>Total generation</b>	<b>2 568</b>	<b>3 325</b>	<b>3 432</b>	<b>3 587</b>	<b>3 765</b>	<b>3 968</b>	<b>100</b>	<b>100</b>	<b>0.8</b>
Coal	1 050	1 024	907	870	876	862	31	22	-0.7
Oil	221	112	69	51	43	43	3	1	-4.1
Gas	191	725	746	861	929	995	22	25	1.4
Nuclear	795	935	874	773	721	736	28	19	-1.0
Hydro	286	309	351	381	400	408	9	10	1.2
Biomass and waste	20	105	143	172	191	212	3	5	3.1
Wind	1	104	300	412	508	581	3	15	7.8
Geothermal	3	6	8	9	11	13	0	0	3.6
Solar	0	4	34	56	80	107	0	3	15.7
Tide and wave	1	1	1	2	4	9	0	0	13.4

Source: World Energy Outlook, IEA 2009

In 2007 coal and gas capacity shares were at about 25% and 22%, respectively. There were 146 nuclear power plants (NPPs) operating in 15 member states. Nuclear power represented 16% of installed capacity but generated 28% of the energy. This corresponds to an average capacity factor of 81%, a notable increase from the average nuclear capacity factor of 72% in 1990, indicating the progress made in increasing the performance of the plants. Average coal and gas capacity factors were both at 53.2% in 2007. This reflects that some coal plants are old and see little utilization, but are still present as a source of flexibility. Gas plants are often used as mid-merit order plants, with utilization rates varying with the price of gas. Capacity factors from hydro plants are relatively stable, depending on precipitation levels. Hydro is an essential source of short-term flexibility but is dependent on precipitation to deliver seasonal flexibility. Wind power is fully dependent on wind resources. Hence, seasonal flexibility to meet changes in resource or demand conditions will have to come from coal-, gas- and to a certain extent, biomass plants. Wind provided 37% of capacity additions and replacements in the EU from 2000 to 2007.

In 2007 alone, 11.5 GW of net new natural gas capacity was added, and from 2000 to 2006, net capacity additions stood at 92 GW, roughly equivalent to the total generating capacity of the United Kingdom. From 2000 to 2006, net capacity of nuclear power generation was reduced by 2.6 GW in the EU. There will be no significant new nuclear capacity before 2011 when the new Finnish reactor is expected to be commissioned. Later in the next decade, a new French reactor currently under construction will come on line, while there are expectations that some new reactors may begin generating towards the end of the next decade in Great Britain. Over the next decade these additions, even when combined with capacity increases at some existing reactors, will not suffice to reverse the trend of declining nuclear power generation capacity in the EU because of the parallel decommissioning of significant capacity in a number of member states.

Coal capacity has also declined by more than 11 GW since 2000. Increasingly demanding environmental performance standards from the Large Combustion Plant Directive, together with the expected impact from the move towards full auctioning in the next phase of the Emissions Trading Scheme (ETS), will put pressure on the economics of investment in new coal plant as long as carbon capture and storage is not a commercial technology.

Based on the reference scenario, IEA has forecasted the EU's total generation capacity growth and the changes in the capacity mix through 2030, which is summarized in Exhibit 9.

**Exhibit 9: Growth in EU Generation Capacity and Changes in Capacity Mix**

	Capacity (GW)					Shares (%)		CAAGR (%)
	2007	2015	2020	2025	2030	2007	2030	2007-2030
<b>Total capacity</b>	<b>804</b>	<b>951</b>	<b>973</b>	<b>1 019</b>	<b>1 067</b>	<b>100</b>	<b>100</b>	<b>1.2</b>
Coal	200	207	182	167	158	25	15	-1.0
Oil	74	61	45	34	25	9	2	-4.6
Gas	175	207	208	223	242	22	23	1.4
Nuclear	132	123	108	101	103	16	10	-1.1
Hydro	140	156	166	172	175	17	16	1.0
Biomass and waste	20	27	32	35	39	2	4	3.0
Wind	57	138	183	220	241	7	23	6.5
Geothermal	1	1	2	2	2	0	0	2.7
Solar	5	30	48	65	81	1	8	12.9
Tide and wave	0	0	1	1	3	0	0	10.5

Source: World Energy Outlook (2009), IEA

The increasing share of wind power, competition and trade within and across regions, pressure from the EU emission trading scheme (ETS) since 2005, and most importantly the preference for highly-efficient gas turbine plants, have resulted in significantly increased efficiency of power generation in the EU between 1990 and 2005 (from 34% to 38%) despite the accession of some new member states with relatively inefficient power generation. It is expected that this trend will continue and that generation efficiency will reach 42% by 2030. Further the system loss volumes are expected to remain constant at current low levels despite a major increase in production volume.

Generation capacity additions of 213 GW from 2008-2015, and 460 GW from 2016-2030 will be needed to replace retiring units and meet incremental growth in demand. Generation investments of the order of \$467 billion during 2008-2015 and \$996 billion during 2016-2030 will be needed. Transmission and distribution investments would amount to about \$276 billion and \$557 billion for the two time frames (Exhibit 10)

**Exhibit 10: Power Capacity Additions and Investments in the EU through 2030**

<i>Item</i>	<i>2008-2015</i>				<i>2016-2030</i>			
	<i>Capacity Addition GW</i>	<i>Generation \$b</i>	<i>Transmission \$b</i>	<i>Distribution \$b</i>	<i>Capacity Addition GW</i>	<i>Generation \$b</i>	<i>Transmission \$b</i>	<i>Distribution \$b</i>
EU 27	213	467	69	206	460	996	140	417
OECD (E)	220	477	71	214	492	1047	155	470

Source: World Energy Outlook (2009), IEA

### 4.3 Trade

Unlike in the case of gas and oil, most of the electricity needed in the EU is produced within the EU; import dependency with respect to electricity is small, and mostly confined to the former Soviet Union states which have since become members of the EU. While electricity trade among the members of the EU is substantial and growing, import of electricity into the EU from outside remains modest.

The EU was a net importer of comparatively small volumes of electricity in 2005, primarily from Norway, Ukraine, and Russia (directly or through Belarus). Some EU members, in particular the

Baltic States, which acceded in 2004, are very heavily dependent on energy imports from outside the EU. Electricity imports are highly variable, depending to large extent on annual precipitation levels. The EU is also exporting electricity, for example to Morocco.

As can be seen in Exhibit 11, imports and exports in the EU are around 10% of net generation, and net imports/exports are insignificant. Most of the exports and imports are among the EU member countries.

**Exhibit 11: EU Electricity Imports and Exports (TWh)**

Item	2002	2003	2004	2005	2006	2007	2008
Net Generation in EU (TWh)	2953	3049	3117	3134	3178	3185	3096
Imports into EU (TWh)	285	290	281	324	311	318	297
Imports as a % of net generation	9.6%	9.5%	9.0%	10.4%	9.8%	10%	9.6%
Exports from EU (TWh)	272	292	288	313	307	308	285
Exports as a % of net generation	9.2%	9.6%	9.2%	10%	9.7%	9.7%	9.2%

Source: [http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-PC-09-001/EN/KS-PC-09-001-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-PC-09-001/EN/KS-PC-09-001-EN.PDF)

With respect to OECD (Europe), imports and exports in 2007 amounted to 338 TWh and 336 TWh, respectively. Of this, trade among member countries of OECD (Europe) covered about 92% of the imports and exports. The remaining 8% of the imports came mostly from Russia and former Soviet Union states (16 TWh), and the Balkan states in South East Europe (9 TWh). About 14 TWh of exports went to the Balkans, and about 3 TWh went to the former Soviet Union states.

#### 4.4 Role of ENTSO-E/UCTE

The European transmission network is highly integrated. Though developed with a national focus, it has interconnections among nations that allow robust system operation across the main synchronized blocks and for significant exchange of power across national borders and across synchronized blocks. Cross border transmission capacity is viewed not only as improving dispatch efficiency and system security, but also as an essential element to enable competition in the internal market. The liberalization of the European electricity markets has encouraged more integrated dispatch based on economic grounds across larger and larger regions. It has also highlighted important bottlenecks to electricity flows.

The Association of European Transmission System Operators (ETSO) focused on facilitation of the emergence and operation of the internal competitive European electricity market, and on the market rules and harmonization needed. Its focus encompassed issues relating to: inter-TSO compensation, congestion management, real time electronic data exchange, tariffs, system security and legal and regulatory aspects.

Any discussion of the EU power sector would be incomplete without mentioning the Union for the Coordination of Transmission of Electricity (UCTE) which coordinated the interconnected and synchronized operation of 29 Transmission System Operators (TSOs) from 24 countries in Europe. Unlike the gas sector, the interconnected synchronous operation of the electricity grid covers most of the EU, and several other countries which are not members of the EU, including:

- The 18 countries which are members of both the EU and the UCTE: Austria, Belgium, Bulgaria, Czech Republic, Denmark (West), France, Germany, Greece, Hungary, Italy, Luxemburg, Netherlands, Poland, Portugal, Romania, Slovenia, Slovak Republic and Spain.

- The six countries which are part of the UCTE, but not members of the EU are: Bosnia-Herzegovina, Croatia, Former Yugoslavian Republic of Macedonia, Montenegro, Serbia and Switzerland.
- The nine countries which are members of the EU but are not operating in synchronism with UCTE are: Cyprus, Estonia, Finland, Ireland, Latvia, Lithuania, Malta, Sweden and UK, apart from the rest of Denmark.<sup>71</sup>

The former Yugoslavian states in the Balkans disconnected from the main UCTE owing to war damages sustained in 1991, but were successfully reconnected to UCTE and synchronized in October 2004. At present, ENTSO-E, the successor of UCTE, is examining the possibility of: (a) Turkey joining ENTSO-E; and (b) the interconnection between Tunisia-Libya that would bring the UCTE frequency up to Syria and Lebanon. It is also studying requests from Ukraine and Moldova to join ENTSO-E, and the possibility of interconnecting two of the largest systems in the world, namely ENTSO-E and IPS/UPS of Russia.

For over fifty years UCTE coordinated the synchronized operation and development of the European grid which supplies 500 million people and is one of the largest synchronized grids in the world. It provided a market platform for all participants in the European internal electricity market, and was responsible for the efficient and secure operation of the synchronized European grid issuing all of the technical standards for coordination of the international operation (cross border energy transfers) of the high voltage grids.

For over 40 years, enforcement of UCTE rules was voluntary, relying on the common interests of members to maintain secure operation of the synchronized grid. However, the network failure in 2003 when supply to much of Italy was temporarily lost led to the realization that system security had become more complex. At that time, UCTE had also grown geographically and members' interests had become less homogenous. The UCTE produced the *Operational Handbook* which codified all regulations and in 2005, each member country of UCTC was obliged to sign a *Multilateral Agreement* as a condition of membership. This agreement obliged each member to adhere strictly to the Operational Handbook, especially in relation to: frequency control, scheduling and accounting, operational security, coordinated operational planning, emergency procedures, communications protocols, data exchanges, and operational training. In 2007 the Compliance Monitoring and Enforcement Processes (CMEP) came into operation. This enabled UCTE to gather all relevant information on compliance with the Operational Handbook and impose penalties and/or remedial measures on transgressors. The enforcement is on a civil contractual basis, and not on a statutory basis.

At the end of 2008 the UCTE area had a total generating capacity of 672 GW (16.7% nuclear, 20.4 % hydro, 51.6% fossil fuel fired, and 11.3% others including wind and other renewables) and generated 2,543 TWh of electricity (52.6% from fossil fuel plants, 29.3% from nuclear plants, 11.6% from hydropower plants, and 6.1% from other sources including wind power units). Germany had 20% of this generating capacity, followed by France at 17.5%, Italy at 14.6% and Spain at 13.2%. Consumption in 2008 amounted to 2,602 TWh. The annual maximum load of 392 GW occurred on January 16, 2008, and the annual minimum load of 217 GW occurred on August 20, 2008. Total energy exchanges amounted to 334.7 TWh of which

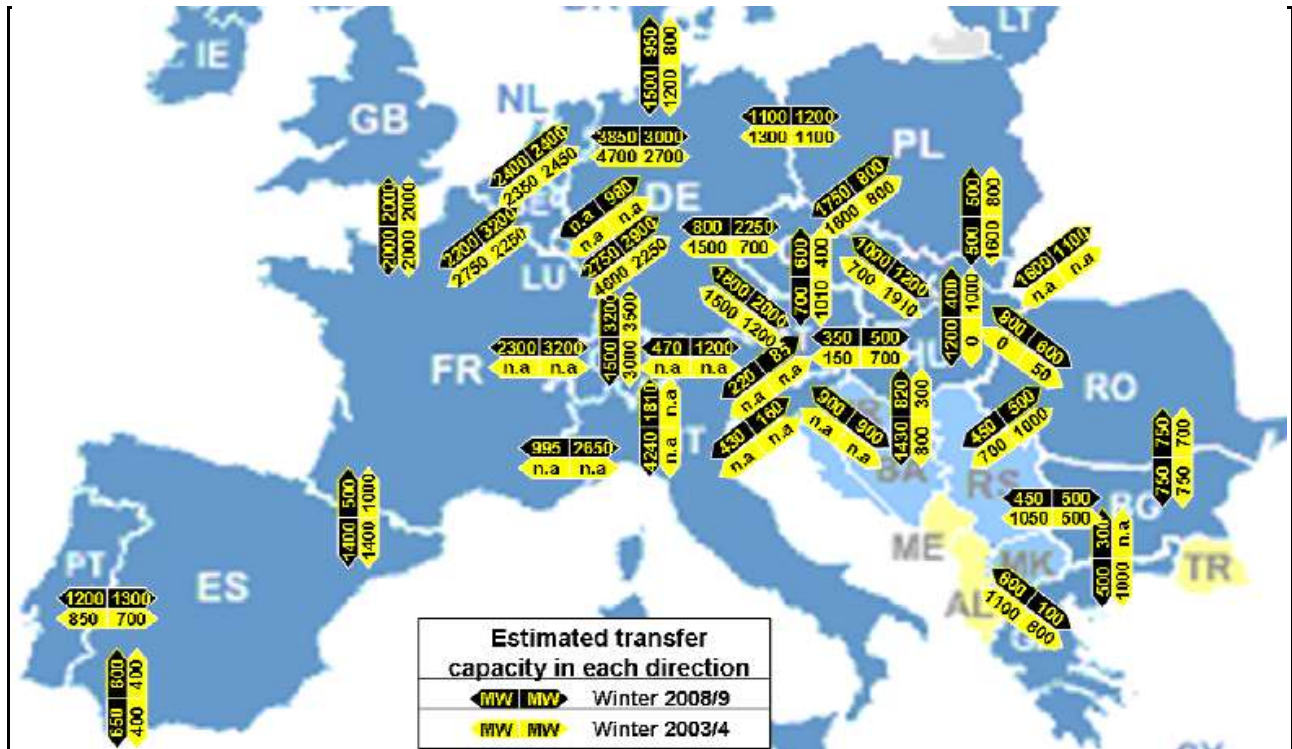
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<sup>71</sup> UK and the Scandinavian countries have no AC linkage to the UCTE network owing to technical difficulties relating to synchronization across the sea. They have asynchronous DC links for power transfer. Similar is the case with respect to the Baltic countries.

285.2 TWh was exchanged among member countries and 49.5 TWh was exchanged with third country systems.

As of 2008, the UCTE network had 117,316 km of 220 kV lines, 104,532 km of 400 kV lines and 170,854 km of composite 400 kV lines.<sup>72</sup> Exhibit 12 graphically presents the available power transfer capacity across national borders in the UCTE area during the winters of 2003 and 2008.

**Exhibit 12:** Available Transfer Capacities (MW) across State Borders in UCTE 2003-2008



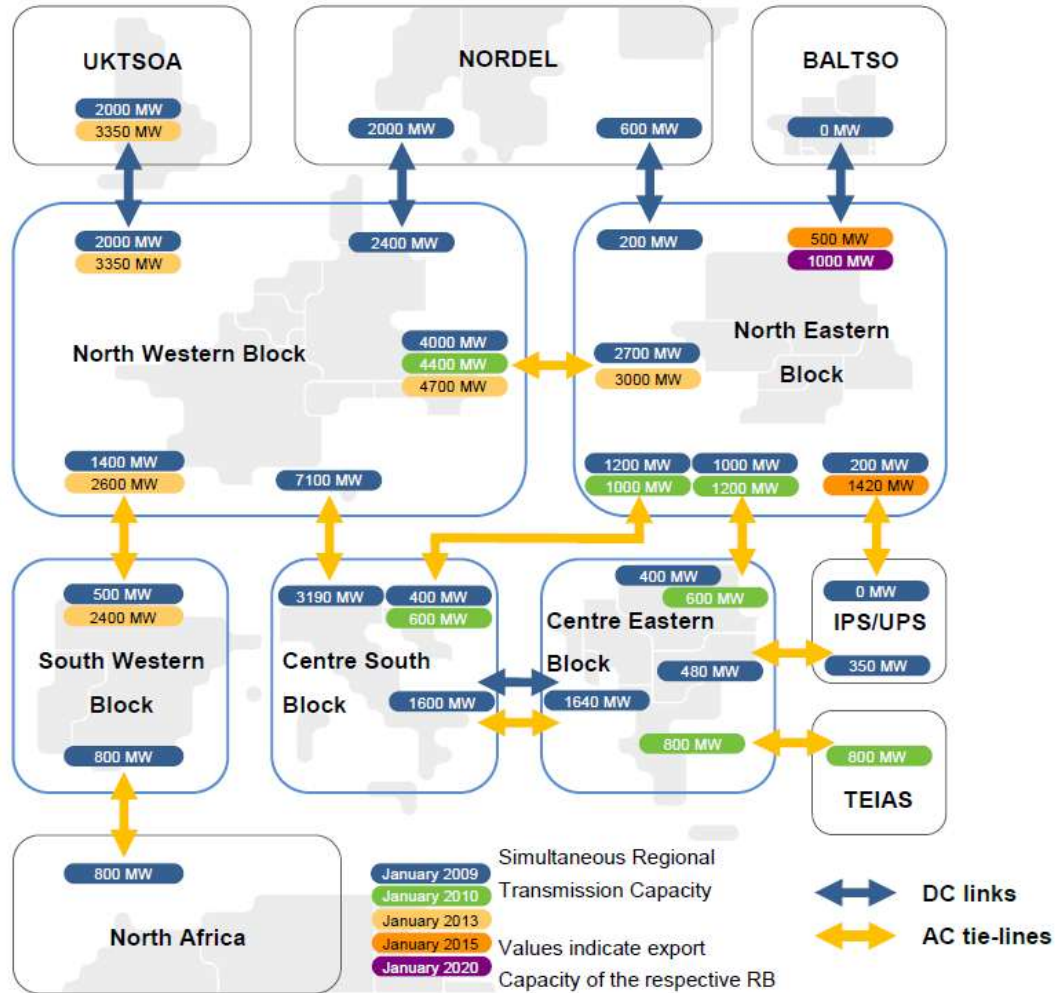
Source; UCTE website

The overall area is divided into five blocks for system adequacy analyses. Exhibit 13 reproduced from the System Adequacy Forecast Report of UCTE for 2009-2020 shows forecast growth in the Simultaneous Regional Transmission Capacity for the period 2009 to 2020.

**Exhibit 13:** Simultaneous Regional Transmission Growth 2009-2020

<sup>72</sup> The composite measure grosses up or down the km of lines at the different voltage levels to a 400kV equivalent. For example a km of 220kV line is considered to be equivalent to (220÷400) km of 400kV line. This is not a proper measure of the change in power that can be transmitted but is still useful for illustration.





Exchange within UCTE member countries grew from 48.4 TWh in 1975 to 285.2 TWh in 2008, a rate exceeding the rate of demand growth. Exchange with third countries grew during the same period from 3.2 TWh to 49.6 TWh (Exhibit 14.)

**Exhibit 8-14:** Electricity Exchanges (TWh)

Year	Exchange among UCTE member countries	Exchange with third countries	Total electricity exchange
1975	48.4	3.2	51.6
1990	115.8	23.9	139.7
1995	139.4	34.9	172.3
2000	177.5	51.7	229.2
2005	298.9	48.8	347.7
2008	285.2	49.5	334.7

Source: Statistical Report of UCTE for 2008

The export and import levels as a percentage of national demand vary considerably among the five blocks and among the individual countries (Exhibit 15).

**Exhibit 15: Exports and Imports from UCTE Member States (2008)**

Regional Block	Country	Exports GWh/yr	Exports as % of national demand	Imports GWh/yr	Imports as % of national demand
<b>North Western</b>	Austria	16,528	24 %	22,033	32 %
	Belgium	6,561	7 %	17,036	19 %
	Switzerland	30,525	47 %	30,494	47 %
	Germany	62,695	11 %	40,245	7 %
	Denmark West	8,799	41 %	7,764	36 %
	France	56,495	11 %	10,176	2 %
	Luxembourg	2,464	37 %	6,819	102 %
	The Netherlands	9,282	8 %	25,023	21 %
<b>North Eastern</b>	Czech Republic	19,986	31 %	8,524	13 %
	Hungary	8,867	23 %	12,772	33 %
	Poland	9,704	7 %	9,021	6 %
	Slovak Republic	8,889	32 %	9,414	34 %
	West Ukraine (Bumhtyn Island)	5,966	129 %	1,274	31 %
<b>South Eastern</b>	Bosnia-Herzegovina	5,004	43 %	3,354	29 %
	Bulgaria	8,440	24 %	3,096	9 %
	Greece	1,964	3 %	7,575	13 %
	Montenegro	1,484	32 %	3,378	74 %
	FYROM	1,203	14 %	3,920	45 %
	Romania	7,042	13 %	2,609	5 %
	Serbia	8,574	22 %	9,136	23 %
	Yugoslavia	0	0 %	0	0 %
<b>Central Southern</b>	Croatia	5,669	32 %	12,247	69 %
	Italy	3,394	1 %	43,234	13 %
	Slovenia	7,827	62 %	6,233	49 %
<b>South Western</b>	Spain	16,485	6 %	5,894	2 %
	Portugal	1,315	3 %	10,597	20 %

Source: Data from the UCTE website

Among the reforms implemented under the third package of EU directives, one related to the creation of ENTSO-E to absorb UCTE, ETSO and other similar organizations such as UKTSOA, NORDEL, BALTSO, and ATSOI.<sup>73</sup> In mid-2009 ENTSO-E came into existence and now all UCTE functions are carried out in the name of ENTSO-E. In order to achieve fully its objective of creating a single internal competitive market, EU foresees the need for supra-national organizations in certain sectors. ENTSO-E in electricity and ENTSO-G in the gas sector are to

<sup>73</sup> These are UCTE like organizations for UK, Nordic countries, Baltic countries and Ireland respectively.



evolve as single transnational TSOs to fully oversee market and market platform development. ENTSO-E has a wider mandate than UCTE, and has a specific legal role and legal powers.

## 5. Tariffs

Electricity retail prices including all taxes and duties for households and industries as of July 2009 for some of the key markets in the EU are summarized in Exhibit 16.

**Exhibit 16: Electricity Prices for Household and Industrial Consumers in Select EU Retail Markets (Euro Cents/kWh)**

Country	Households with consumption of 3500 kWh/year (30% at night)	Households with consumption of 7500 kWh/year (30% at night)	Industries with consumption of 2000 MWh/year. Maximum Demand 500 kW load factor 4000 hours/year	Industries with consumption of 24 GWh/year. Maximum Demand 4 MW load factor 6000 hours/year
Austria	17.05	14.36	12.30	10.23
Belgium	17.22	14.92	12.59	10.26
Bulgaria	7.39	7.01	6.70	6.42
Czech Republic	11.42	8.57	9.86	8.66
Denmark	26.71	23.25	12.93	12.48
Estonia	8.15	7.27	6.98	4.88
Finland	12.35	9.84	7.53	7.03
France	13.19	11.83	7.65	6.63
Germany	21.25	20.10	13.89	12.73
Hungary	14.45	13.73	12.70	11.05
Italy	25.54	22.13	17.07	14.01
Netherlands	23.77	23.34	13.38	9.18
Poland	13.69	12.36	8.31	7.51
Romania	12.60	11.30	12.85	9.76
Spain	13.36	11.40	8.82	7.61
Sweden	18.73	18.32	6.89	6.04
United Kingdom	13.76	12.85	9.90	3.95

Source: <http://www.energy.eu/>

EU-wide average price movements for medium size households and industries during 2005-2009 are provided in Exhibit 17. Medium size industrial consumers have annual consumption between 500 MWh and 2000 MWh. Medium size households consume between 2,500 and 5000 kWh/year. The prices do not include taxes and duties.

**Exhibit 17: Price Changes for Industries and Households in EU (2005-2009)**

### Prices in Eurocents/kWh

Consumer Category	2005	2006	2007	2008	2009
Medium Households	10.13	10.68	11.73	11.87	12.36
Medium Industry	6.72	7.52	8.20	8.78	9.41

Source: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsier040&plugin=1>

## 6. Prospects for Trade

ENTSO-E continues to expand. In order to interconnect to the ENTSO-E grid, the supplying grid is required to conform to EU regulations and directives, and strictly adhere to them. The principal objective of the EU synchronized operation of larger and larger areas is to reap the benefits of increased reliability and system security, including reduced capacity reserve margins, better utilization of capacity by taking advantage of diversity in peak demand among the member countries which are stretched across a continent with different time zones and different weather conditions, and above all, to develop a platform for competitive trade and exchange of power among the member countries. The EU is an excellent export destination with attractive electricity prices, an open, competitive market structure with third party access, multiple market

participants and synchronous network operation. However, exports must enter the EU through countries that have power systems that meet the ENTSO-E requirements.

## Attachment 2.D: Electricity Sector in Turkey

### 1. Overview

Turkey has a population of 72.8 million, a GDP of US\$ 957 billion (purchasing power parity) and a per capita GDP of US\$ 13,392 (estimated 2010). Its economy grew steadily from 2002-2008 at a high annual rate of about 7%. Inflation has come down to single digits and interest rates have declined significantly. Growth has been sustained largely by rising exports and substantial capital inflows to the private sector. Since the fourth quarter of 2008, the effect of world-wide recession has been felt through a decline in export demand and capital inflows. As a result, the overall growth for 2008 was only 1.7%.

Oil has the largest share of Turkey's total energy consumption at 35% followed by natural gas at 29%, coal/lignite at 25%, and hydropower and other renewable energy at 11%. Its energy resource endowments are modest, requiring that major portions of the energy demand be met by oil, gas and coal imports. The cost of energy imports in 2008 amounted to US\$ 48 billion or about 36% of the value of Turkey's corresponding total exports.

As of January 2009, Turkey's proven oil and natural gas resources were estimated at 300 million barrels and 300 billion cubic feet (bcf), respectively. Domestic production of oil at 46,120 barrels per day (2008) was only 6.8% of the total oil consumption. The share of the domestic production of natural gas was even lower at 2.5% of the total gas consumption.<sup>74</sup> Domestic production of hard coal (with high sulfur) at around 2.0 million tons is about 10% of domestic consumption. The country has extensive lignite deposits (also with high sulfur) and the reserves are estimated at 8.1 billion tons (about 80% of which has calorific values lower than 2,500 kcal/kg). About 34% of the deposits have been developed and another 3% is in the process of being developed. Annual production was at about 55 million tons in 2005 to meet the demands of the power, cement and steel industries.<sup>75</sup>

With respect to renewable energy, the country's economically exploitable potential has been estimated at: (a) 126 to 128 TWh for hydroelectricity (about 30% of which has been developed); (b) 48,000 MW (or 96 TWh) for wind energy; and (c) 600 MW for geothermal with another 30,000 MW of possible geothermal sources suitable mainly for heating.

The state-owned Turkish Petroleum Corporation competes with the private sector in oil exploration, production and refining and has a 70% share of domestic production. It has preferential rights and many foreign oil companies form joint ventures and partnerships with it for these activities. The state owned Petroleum Pipeline Corporation (BOTAS) dominates the gas industry and owns the gas transmission networks. In order to increase the role of the private sector, BOTAS is required to transfer a good part of its long term import contracts to the private sector. Gas distribution has been entirely privatized. In the power sector, the role of the private sector is increasing and a competitive market structure is in the process of being implemented as part of electricity sector reform.

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<sup>74</sup> Data from Country Analysis Brief on Turkey (updated as of April 24, 2009) available at [www.eia.doe.gov](http://www.eia.doe.gov)

<sup>75</sup> Mustafa Balat, Energy Consumption and economic growth in Turkey during the last two decades in Energy Policy 36 (2008) 118-127

## 2. Power Sector Structure

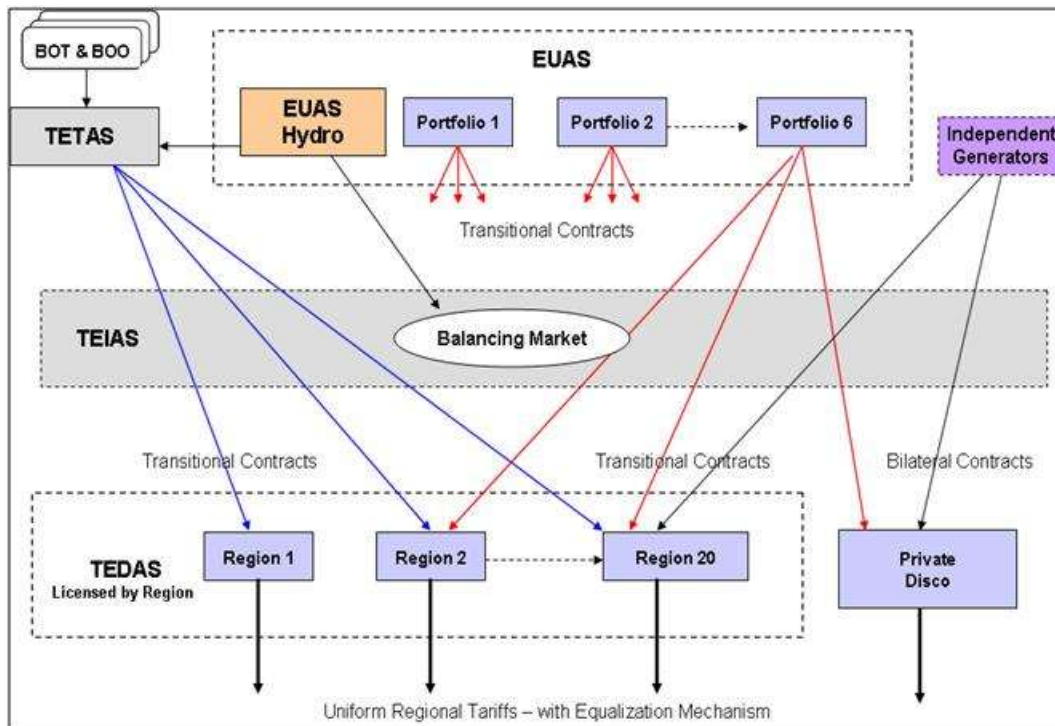
The original state owned vertically integrated Turkish Electricity Corporation (TEK) has been unbundled over several years to enable private sector participation and the implementation of a competitive electricity market. Currently:

- Generation in the public sector is handled by the Electricity Generation Company of Turkey (EUAS). It directly owns most hydropower units, and also acts as the holding company for six portfolio generation companies with thermal power units and some hydropower units. In addition there are several private sector generating units established under BOT and BOO arrangements supplying power to the grid on the basis of power purchase agreements guaranteed by the government. There are also a few privately owned independent power producers (IPPs). Industries with captive generating units (called auto-producers) and privately owned renewable energy units also supply power to the grid.
- Transmission and dispatch are handled by the Turkish Electricity Transmission company (TEIAS). It also operates the balancing market and acts as the settlement agent.
- Distribution is handled by 21 regional distribution companies, twenty of which are the holders of operating rights for their franchise areas from the Turkish Electricity Distribution Company (TEDAS). The remaining one (Kayseri) is a privately owned distribution company.
- Turkish Electricity Trading and Contracting Company (TETAS) acts as the buyer of all power from BOT and BOO units under the terms and conditions of the PPAs, and in turn markets the power to distribution companies.
- Electricity Market Regulatory Authority (EMRA) is the independent regulator of power, gas, petroleum and LPG, responsible for licensing, tariff setting and other associated responsibilities.

### 3. Market Organization

The current market structure is shown in Exhibit 1.

**Exhibit 1: Turkey's Current Electricity Market Structure**



TETAS blends the more expensive power from BOT and BOO units with the less expensive power from the hydropower units of EUAS, and sells it to the 20 distribution companies on the basis of long term contracts (called transitional or vesting contracts) valid through 2010 initially, but since extended by a few years. The six portfolio companies of EUAS have similar transitional long term contracts with the 20 distribution companies. The IPPs have bilateral contracts with the buyers. The buyers include not only the distribution companies, but also “eligible consumers” who are large consumers (with an annual consumption of 6 GWh or higher) eligible to choose their suppliers. As a part of the progressive liberalization of the market, the eligibility threshold was reduced in 2008 to 1.2 GWh. Eligible consumers have a 41% share of the total electricity market. The consumption threshold for eligibility is being further lowered with the aim of making all non-residential consumers eligible by 2011. By 2015 all consumers are expected to be eligible.<sup>76</sup>

The transitional contracts enable absorption of the high cost power under guaranteed PPAs and provide guaranteed supply to the distribution companies (which are being privatized). The distribution companies can cover only up to 85% of their demand by such contracts and must use the balancing market for the remaining requirements. Dispatch is based on long term contracts supplemented by the balancing market where prices fluctuate as a function of supply and demand. In 2007 about 31.3 TWh (or 19% of all electricity sold in Turkey) traded in the balancing market. In all, there are 129 licensed market participants consisting of 103 private

<sup>76</sup> The threshold has come down to 0.4 GWh/ year in 2009.

entities and 20 regional distribution companies besides TETAS, EUAS and its portfolio companies.

The current balancing and settlement system involves day-ahead bidding and scheduling administered by the market operator unit of TEIAS, and real time pay-as-bid balancing administered by the national load dispatch center of TEIAS. Settlement is monthly. Improvements actively under consideration include:

- (a) Change from monthly to hourly settlement periods;
- (b) Progressive development of balancing and settlement into a separate and complementary day-ahead spot market<sup>77</sup> operated by a market operator (expected to be a TEIAS subsidiary with adequate financing and autonomy) and a real time balancing market operated by TEIAS dispatch center; and
- (c) Introduction of a capacity mechanism (capacity obligations and trading of capacity certificates) to complement energy trading through bilateral contracts and the balancing market.

The prices in the balancing market reflect the marginal cost of electricity at the wholesale market level. The average price at which power was sold in the balancing market in 2007 was YTL 128/MWh (or about 11 US cents/kWh). By March 2008 the average price rose to 160 YTL reflecting the increasingly tight supply position.<sup>78</sup> Owners of most wind power and other renewable energy units prefer to sell in the balancing market rather than use the government guaranteed “feed-in” rate as they get much higher prices in the balancing market.<sup>79</sup> Further, the wholesale electricity price moved up sharply by 44% during 2007-2008 largely as a result of gas price increases. During the period May 2007 to May 2008 prices remained above 10 US cents / kWh throughout the day during the months of January and February. In the remaining months prices tended to dip to the 4 to 7 US cent range during the off-peak period (1AM to 7AM). During the remainder of the day prices in the range of 11 to 14 cents prevailed, reflecting both high gas prices and a relatively tight supply condition.<sup>80</sup> The average base load price during the period from August 2006 to April 2009 was Euro 73.88 / MWh. The highest base load price occurred in August 2008 at Euro 98.14 / MWh, while the lowest base load price was in February 2009 at Euro 59.17/MWh.<sup>81</sup>

## 4. Demand and Supply

### 4.1 Demand

In 2007 the peak demand was 29,249 MW and the ratio of the base load to peak load was 38%. The system load factor had been around 70% for the past decade. The daily load curve of the Turkish grid on the day of the annual peak in 2007 is provided in Exhibit 2.

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<sup>77</sup> The dry run for the day-ahead trading was to start in July/ August 2009.

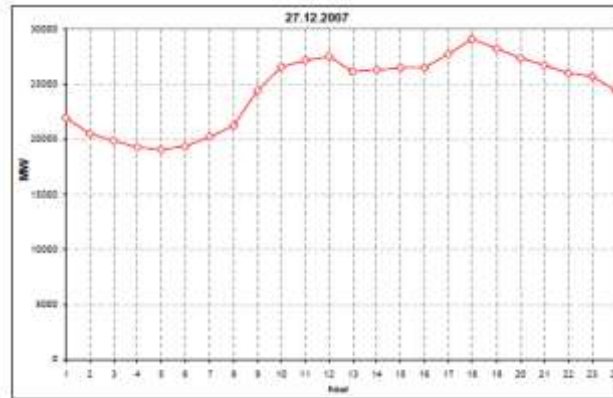
<sup>78</sup> World Bank, Implementation Completion Report on Turkish National Transmission Grid Project, June 2008

<sup>79</sup> The balancing market prices in 2006 and 2007 ranged from 7 to 10 Euro cents / kWh compared to the government guaranteed feed-in price of 5 to 6 Euro cents / kWh. See Latham & Watkins and Fidan & Fidan, *Turkish renewable energy—blowing in the right direction?* (Feb 24, 2009) available at [www.lw.com](http://www.lw.com)

<sup>80</sup> Electricity Export Opportunities from Georgia and Azerbaijan to Turkey, a Report prepared by Econ Poyry AS, of Norway for the government of Georgia available at [www.minenergy.gov.ge](http://www.minenergy.gov.ge)

<sup>81</sup> *A Spotlight on Turkish Electricity Market*, a presentation by Cem Ali Atilgan in Budapest on June 3-4, 2009, available at [www.atilganenergy.com](http://www.atilganenergy.com)

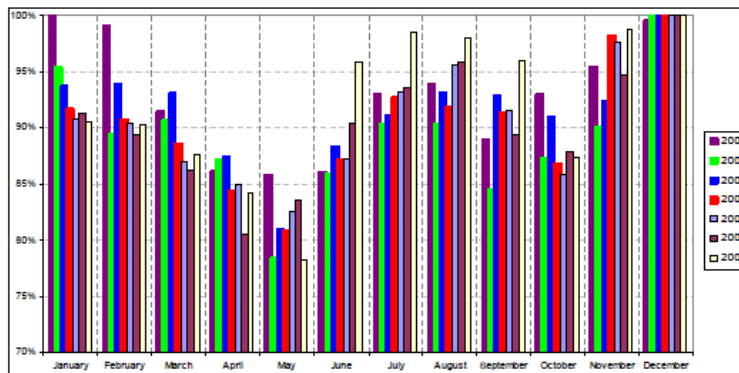
**Exhibit 2: Daily Load Curve on Day of 2007 Annual Peak**



Source: [www.teias.gov.tr](http://www.teias.gov.tr)

In the Turkish grid the annual peak occurs in winter, and during the last several years the annual peak occurred in December. As a result of rise in tourism and air conditioning load, summer loads (especially in July and August) are rising rapidly and from time to time approach the level of the winter peak load. The monthly variation in the loads over the year during 2001-2007 can be gauged from Exhibit 3 which shows the ratio of monthly peaks to annual peaks.

**Exhibit 3: The Ratio of Monthly Peaks to Annual Peak in Turkish System**



Source: [www.teias.gov.tr](http://www.teias.gov.tr)

The primary generators are in the east and south-east of the country, while the major load centers are in the west and north-west. This necessitates long transmission lines. Transmission is by 400 kV, 154 kV and 66 kV lines with a total length exceeding 46,000 km and 535 substations with a total transformer capacity exceeding 82,000 MVA. The Turkish grid is interconnected with those of Bulgaria, Iran, Georgia, Syria, Azerbaijan, Iraq, and Greece. Despite the long distances involved in the transmission grid, transmission losses are only about 2.6% (2007).

Most areas in the country have access to grid-supplied electricity; electrification of the country is near 100%. Distribution is by 33 kV, 15.8 kV, 10.5 kV, and 0.4 kV. Total length of distribution lines in 2007 was about 0.923 million km. The total transformer capacity in the distribution system was greater than 100,000 MVA. Overall losses in the distribution system (including theft) were reported at 21.6% in 2000, but have come down to about 14.8% by 2007. However, losses



range widely among the 21 distribution entities—from 6.3% for the Osmangazi distribution company to 64% for the Dicle distribution company.<sup>82</sup>

Electricity demand has been growing at an average annual rate of about 8% during the last four decades. From 1998-2007 peak demand grew at a compounded annual growth rate (CAGR) of 5.7% while the energy demand grew at a CAGR of 5.8%. The growth was more rapid during 2003-2007 facilitating a steady spurt in economic growth (see Exhibit 4). However, energy demand growth slowed down to 3.7% in 2008. Demand actually declined in the last months of 2008 and first months of 2009 by 5-7% on a monthly basis compared to the previous year as a result of the deceleration of economic growth and economic contraction.

**Exhibit 4:** Historical Growth in Turkey’s Electricity Demand

Year	Peak Demand (MW)	Energy Demand (GWh)
1998	17,799	114,023
1999	18,938	118,485
2000	19,390	128,276
2001	19,612	126,871
2002	21,006	132,553
2003	21,729	141,151
2004	23,485	150,018
2005	25,174	160,794
2006	27,594	174,637
2007	29,249	190,000
CAGR (%)	5.67%	5.84%

Source: 10-Year Generation Capacity Projection (2008-2017) available at [www.teias.gov.tr](http://www.teias.gov.tr)

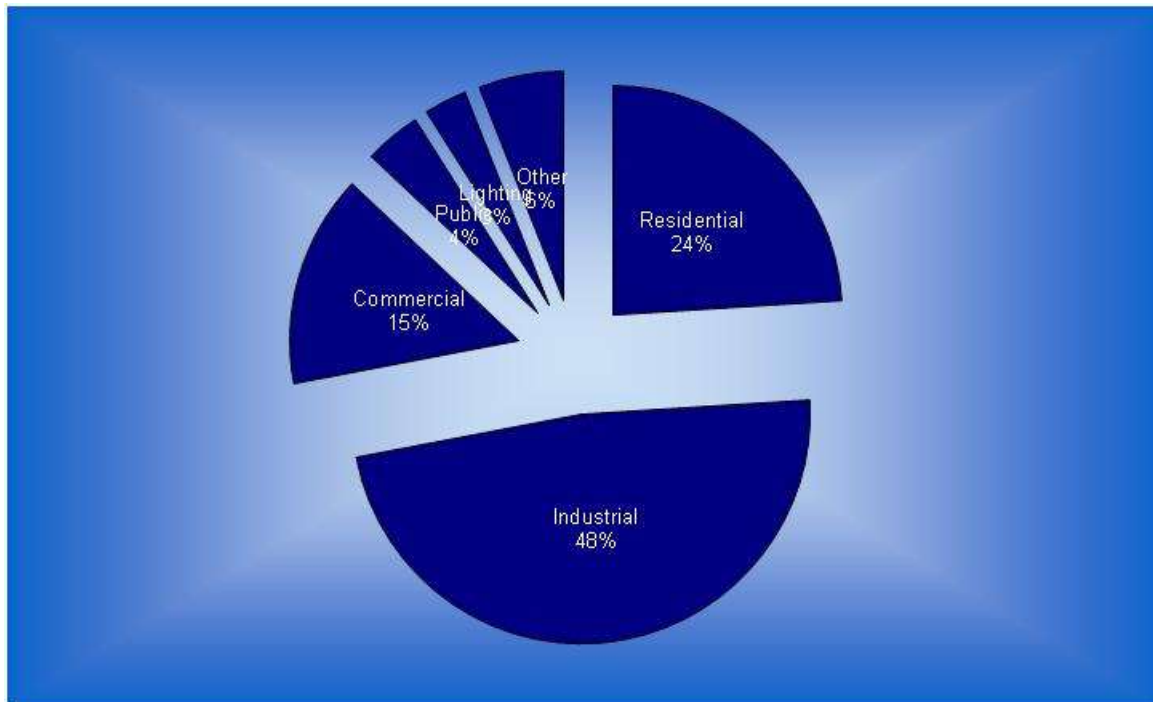
Per capita annual electricity consumption in Turkey at 2,150 kWh is around a third of that in the EU.

In 2007, industrial consumers had the largest share in total consumption at about 48%, followed by residential consumers at 24%, commercial consumers at 15%, public offices at 4%, street lighting at 3% and others at 6% (see Exhibit 5).

<sup>82</sup> Teaser for Distribution Privatization in 2008 available at [www.oib.gov.tr](http://www.oib.gov.tr) the website of the Privatization Agency of the Turkish government



**Exhibit 5: Breakdown of Electricity Consumption by Customer Class**



A demand forecast has been made by the Turkish Power Transmission Company (TEIAS) for the period 2008-2017. In the base case, gross energy demand is expected to have a CAGR of 7.45% and in the low case scenario the CAGR is expected to be 6.6% (see Exhibit 6).

**Exhibit 6: Demand Forecast for the Turkish Electricity System**

Year	Base Case		Low Case	
	Peak Demand (MW)	Gross energy demand (GWh)	Peak Demand (MW)	Gross energy demand (GWh)
2008	32,478	204,000	32,143	204,000
2009	35,053	219,013	34,571	216,992
2010	37,832	236,182	37,182	230,705
2011	40,716	253,837	39,573	246,181
2012	43,819	272,812	42,331	262,696
2013	47,159	293,205	45,167	280,319
2014	50,753	315,123	48,193	299,124
2015	54,622	338,679	51,421	319,190
2016	58,560	363,695	54,788	340,379
2017	62,782	390,559	58,376	362,975
CAGR (%)	7.60%	7.45%	6.85%	6.60%

Source: 10-Year Generation Capacity Projection (2008-2017) available at [www.teias.gov.tr](http://www.teias.gov.tr)

## 4.2 Supply

Turkey operates a national grid with an installed generating capacity of 42,186 MW of which about 66% is thermal, 33% is hydroelectric and the rest based on geothermal and wind. Annual energy generation in 2008 was 198.6 TWh serving 29.5 million consumers.

From 1998-2008 supply expanded from 111 TWh to 199 TWh at a CAGR of 6.0%, and installed generation capacity increased from 23,354 MW to 42,186 MW at a CAGR of 6.1% (see Exhibit 7).

**Exhibit 7: Historical Expansion of Electricity Generation in Turkey**

Year	Installed Generation Capacity (MW)			Annual Power Generation (TWh)		
	Thermal	Hydro	Total	Thermal	Hydro	Total
1998	13,039	10,315	22,354	69	42	111
1999	15,573	10,546	26,119	82	34	116
2000	16,070	11,194	27,264	94	31	125
2001	16,641	11,692	28,332	99	24	123
2002	19,586	12,260	31,846	96	33	129
2003	22,989	12,598	35,587	105	36	141
2004	24,160	12,664	36,824	105	46	151
2005	25,917	12,926	38,844	122	40	162
2006	27,380	13,122	40,565	132	44	176
2007	27,295	13,541	40,836	156	36	192
2008	27,782	14,404	42,186	164	35	199

Source: [www.teias.gov.tr](http://www.teias.gov.tr) - Note: Hydro figures include wind power and geothermal power

Installed generation capacity at 42,186 MW was well above the peak demand of about 32,500 MW in 2008 providing an apparent reserve margin of about 30%. However, the demand/supply balance was tight because available capacity was only about 33,000 MW owing to wide fluctuations in annual river flows in respect of hydropower units and the old age of lignite fired thermal power plants.<sup>83</sup> Demand is expected to outstrip supply in 2011 if additional new generation capacity does not come on line.

In 2008, hydropower had the largest share of generation capacity at 32.9%, but contributed only 16.8% of the total electrical energy production in that year. Natural gas fired combined cycle units had a 32.3% share of the capacity, but made the largest contribution to energy at 48.4%. Lignite and hard coal had a share of 23.9% of the capacity and contributed 29.0% of the energy (see Exhibit 8). The rising cost of imported natural gas has significantly increased the average cost of generation in Turkey.

**Exhibit 8:** Generation Capacity and Energy Production in Terms of Fuel

Category of Generation Unit	Installed capacity (MW)	Percentage in total capacity	Generation in 2008 (GWh)	Percentage in total generation
Hard Coal fired	1,986	4.7	15,618	7.9
Lignite fired	8,110	19.2	41,939	21.1
Fuel oil fired	1,745	4.1	9,315	4.7
Diesel, LPG, Naphtha	48	0.1	1311	0.7
Natural Gas	13,612	32.3	96,041	48.4
Multi-fuel	2,214	5.2	--	--
Bio-gas /waste	67	0.2	195	0.1
All Thermal	27,782	65.9	164,419	82.8
Hydropower	13,875	32.9	33,283	16.8
Geothermal	77	0.2	98	..
Wind power	452	1.0	798	0.4
All Renewables	14,404	34.1	34,179	17.2
Grand Total	42186	100.0	198,598	100.0

Source: Info available at [www.teias.gov.tr](http://www.teias.gov.tr) and World Bank (May 2009)

In 2007 thermal power plants in Turkey consumed 5.6 million tons of hard coal, 50.6 million tons of lignite, 1.8 million tons of liquid fuels (fuel oil, diesel and naphtha) and 17.0 bcm of natural gas, and generated 155.2 TWh of electricity. The heat value of the total fuels used has been estimated at 333,654 Tcal.

Of the total installed capacity of 40,836 MW in 2007, state-owned power plants had a 58.6% share while the private sector had a 41.4% share. The private plants include units under build and

<sup>83</sup> About 57% of the thermal plants owned by the state had been in operation for 20 years or more

operate contracts (BO), build, operate and transfer contracts (BOT), transfer of operational rights contracts (TOOR), mobile units, privately owned generating companies and “auto-producers” (captive generating units owned by industries). The share of the state-owned power plants has come down from about 90% in 1990 to 58.6% in 2007.

Of the 191,558 GWh of electricity generated in 2007, private sector plants had a share of 51.8%, while the state owned units had a lower share of 48.2%. The private sector share in generation has grown from about 8% in 1990 to 51.8% in 2007. A substantial portion of the output from the private plants is covered by power purchase agreements with the state owned utilities and guaranteed by the state.

In order to meet forecast demand under the base case scenario, Turkey plans the addition of 17,136 MW with an annual production capability of 77.9 TWh during 2008-2015 time frame. State-owned plants under construction amount to 4,518.7 MW with an annual production capability of 16.8 TWh. A total capacity of 12,817.5 MW with an annual production capability of 61.1 TWh is covered by generation licenses granted to private investors. About 68% of the new capacity will be hydroelectric, 26% will be thermal and the remaining 6% will be based on renewable sources such as wind and geothermal.

Under the low load growth scenario, capacity additions envisaged during the same period amount to 12,917 MW of which 33% will be from state-owned entities and the remainder from private licensees. The expansion plan scenarios are shown in Exhibit 9.

**Exhibit 9:** Generation Expansion Plan (2008-2015)

Categories	Additional generation capacity (MW)	Additional Annual generation (GWh)	Additional annual firm power generation (GWh)
<b>A. Base Case</b>			
State owned power plants under construction	4,318.7	16,825.9	12,520.4
Private Sector power plants licensed	12,817.5	61,061.8	47,339.7
<b>Total</b>	<b>17,136.2</b>	<b>77,887.7</b>	<b>59,860.1</b>
Hydropower Capacity	11,682.4	41,587.4	24,537.9
Thermal power Capacity	4,523.2	32,586.4	32,312.8
Wind / Geothermal / other	930.6	3,713.9	3,189.4
<b>Total</b>	<b>17,136.2</b>	<b>77,887.7</b>	<b>59,860.1</b>
<b>B. Low Case</b>			
State owned power plants under construction	4,318.7	16,825.9	12,520.4
Private Sector power plants licensed	8,598.8	41,848.9	33,581.6
<b>Total</b>	<b>12,917.5</b>	<b>58,674.8</b>	<b>46,102.0</b>
Hydropower Capacity	8,627.2	29,455.4	17,542.9
Thermal power Capacity	3,791.5	27,194.7	26,921.1
Wind / Geothermal / other	498.8	2,024.7	1,638.0
<b>Total</b>	<b>12,917.5</b>	<b>58,674.8</b>	<b>46,102.0</b>

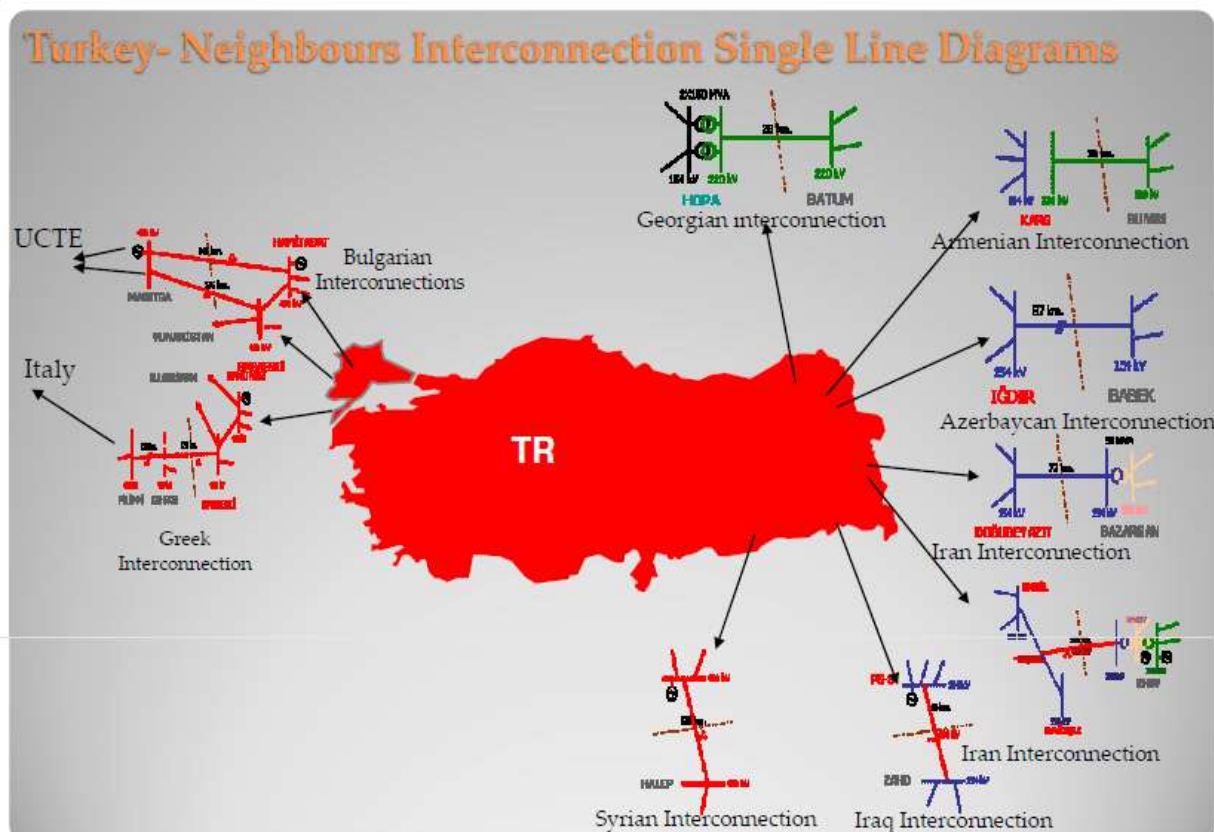
Source: [www.teias.gov.tr](http://www.teias.gov.tr)

The approach to generation expansion is to give high priority to hydropower, lignite fired thermal units, wind power and to lower the predominance of gas fired thermal units in view of the high and rising imported gas prices. In the recently announced sector strategy paper, the government has set an ambitious target of 20,000 MW for wind power by 2023. The government is also pursuing the possibility of constructing an investor-owned nuclear power plant of 4000 to 5000 MW by 2020.

### 4.3 Trade

Details of the existing interconnections between Turkey and its neighbors are provided in Exhibits 10 and 11.

**Exhibit 10:** Turkey's International Interconnections



Source: Cem Ali Atilgan, *A Spotlight on the Turkish Electricity Market*, June 2009

**Exhibit 11:** Details of Existing International Power Interconnections

Country	Details of existing interconnection
Bulgaria	Two 400 kV lines from Babaeski in Turkey to Maritsa East Power station in Bulgaria. The first one is 136 km long and its thermal limit for transmission is 1000 MW. The second line is 150 km long and its thermal limit for transmission capacity is 2000 MW.
Greece	400 kV line from Babaeski to Nea Santa in Greece. Turkish portion was completed in 2006 and operated at 154 kV and connects to Greece 154 kV network. The Greece portion was completed in mid-2008. When operated at 400 kV, its transmission capacity is 2000 MW.
Georgia	220 kV line from Hopa (Turkey) to Batumi. Price paid 2.6 cents/kWh in 2007. Import in island mode.
Armenia	220 kV. This has not been operated in recent years.
Azerbaijan	One 110 kV line and one 154 kV line from Nakhchivan enclave of Azerbaijan to Turkey via Iran. Operates in island mode for import and export.
Iraq	400 kV line operated at 154 kV. Exports to Iraq take place in island mode. Prices paid by Iraq were reported at 4.9 Euro cents/kWh (about 6.3 US cents/kWh).
Iran	154 kV link currently not in operation, but the new 400 kV link is operated at 154 kV. Import of power from Iran takes place in island mode. Import price from Iran was reported at 3.5 US cents/kWh in 2007.
Syria	400 kV AC line from Birecik (Turkey) to Halep (Syria). Exports to Syria were done in unit direction mode in 2007 and in 2008.

Although the Turkish grid is interconnected to those of Bulgaria, Greece, Syria, Iran, Iraq, Georgia, Azerbaijan and Armenia, the volume of electricity exchanges has been modest at less

than 2% of Turkey's annual consumption in recent years (see Exhibit 12). Imports from Bulgaria (significant in earlier years) ceased in 2004. Imports from Turkmenistan via Iran have increased significantly since 2003 following commissioning of: 1) the 270 km, 220 kV line from Balkanabat (Turkmenistan) to Gonbad (Iran) and further on to Khoy Bashkale (Turkey), and 2) the transmission line linking of Serakhs (in Turkmenistan) to Sarakhs (in Iran).<sup>84</sup>

In 2004 the price for imports from Turkmenistan were reported as 3.45 US cents/kWh. The transit fee payable to Iran was 0.65 cents/kWh.<sup>85</sup> Georgia and Azerbaijan are seriously examining the possibilities of expanding their exports to Turkey by promoting investments in new Georgian hydropower projects and Azeri thermal power projects.

**Exhibit 12:** Historical Electricity Import-Export Trade Volumes of Turkey (GWh)

Country	Exports from Turkey					Imports to Turkey				
	2001	2003	2004	2006	2007	2001	2003	2004	2006	2007
Bulgaria						3776	1135	0	0	0
Greece				0.0	90					
Georgia				107	118	523			41	216
Azerbaijan	433	402	379	326	15					15
Iraq		186	766	1669	1237					
Iran						281	0	0	0	0
Syria				135	962					
Turkmenistan	0	0	0	0	0		24	464	533	633
Total	433	588	1145	2237	2422	4580	1159	464	574	864

Source: [www.teias.gov.tr](http://www.teias.gov.tr)

Turkey's electricity imports have increased steadily from 433 GWh in 2001 to 2422 GWh in 2007. Exports to Azerbaijan have decreased reflecting the domestic supply improvements there. Exports to Iraq and Syria have increased significantly.

## 5. Tariffs

End-user tariffs are the sum of the energy cost, the transmission charge and the distribution charge. Energy costs are determined by the cost of power purchased under bilateral contracts and energy prices in the balancing market. The transmission charge and the distribution charge are regulated. The distribution companies are being privatized and will have a cost reflective tariff based on a trajectory of performance improvements in such areas as loss reduction, billing and collection. The electricity purchase cost will have a price cap, and distribution charges will have revenue caps which cover operating expenses and investment needs. The transmission charge is a full pass through item. This approach results in different tariffs for different distribution companies depending on their cost structure.

To avoid sudden price fluctuations, the government is maintaining the national uniform tariff scheme under which the tariff for each customer class is uniform across the country during a transition period from 2006-2010. This is accompanied by an equalization scheme involving transfer of revenues across the various distribution companies so that each distribution company is able to secure revenues to cover its costs. The transition period has since been extended until year-end 2012 to facilitate the orderly completion of the privatization of distribution and generation companies.

<sup>84</sup> Based on information from [www.turkemenistan.ru](http://www.turkemenistan.ru) news items dated April 12, 2004 and August 23, 2004.

<sup>85</sup> Based info at [www.eurasianet.org/resource/hypermail/200404/0013.shtml](http://www.eurasianet.org/resource/hypermail/200404/0013.shtml)

The average cost of supply/kWh in the distribution segment rose from YTL 0.118 in 2005 to YTL 0.121 in 2008, while the average retail tariff rose from YTL 0.120 to YTL 0.154 enabling full cost recovery. This was achieved through tariff increases in January, July and October 2008 resulting in an overall increase of 50%.<sup>86</sup> Further, an automatic mechanism enabling full pass-through of cost increases such as fuel price changes has been implemented.

The average end-user price/kWh in the fourth quarter of 2008 was 15.28 US cents/kWh including taxes (12.68 US cents/kWh excluding taxes). Corresponding average residential prices were 15.81 cents (with taxes) and 12.82 cents (without taxes) while the average non-residential prices stood at 15.02 cents (with taxes) and 12.62 cents (without taxes).<sup>87</sup>

Considering Turkey's tariffs from an international perspective, Turkey's average residential tariff of 15.81 US cents/kWh (including taxes) is comparable to tariffs of countries in the EU.

## 6. Prospects for Trade

Turkey's joining the UCTE through interconnections with Greece is a key element of the Mediterranean Electricity Ring interconnecting the systems of France, Spain, Morocco, Algeria, Tunisia, Libya, Egypt, Near Eastern countries, Turkey, Greece and Italy. Similarly, the Turkey-Bulgaria link is a key element of the Black Sea Electricity Ring initiative interconnecting the systems of Russia, Ukraine, Romania, Bulgaria, Turkey and Georgia.

Interconnections of Turkey with Syria and Iraq are key components of the Eight Countries Interconnection Project linking the systems of Egypt, Iraq, Jordan, Lebanon, Libya, Syria, Palestine and Turkey.

Azerbaijan, Georgia and Turkey have recently signed an MOU for a "Power Bridge project" to facilitate a much greater level of electricity trade among the three countries. This envisages:

- a) The construction of a new 500 kV AC line from Azgunz (Azerbaijan) to Zeastaponi (Georgia) via Garadabani (Georgia);
- b) The construction of 500 kV AC lines from Zestaponi and Gardabani to Akhalsikhe (Georgia);
- c) A back-to-back AC to DC and DC to AC facility at Akhalsikhe; and
- d) The construction of a 400 kV AC line from this facility (in Georgia) to Borchka in north eastern Turkey.

Total cost is expected to be about US\$ 312 million. Power transfer capacity of this "Power Bridge" would be about 1000MW. Georgia is promoting investments in hydropower projects with export objectives, and Azerbaijan hopes to export its surplus thermal power. Tendering is expected for the line in 2009.<sup>88</sup>

Details of other Interconnection Proposals under consideration are given in Exhibit 13.

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<sup>86</sup> World Bank (May 2009) Program Document for the First Programmatic electricity sector loan to Turkey

<sup>87</sup> Information from [www.erra.net](http://www.erra.net)

<sup>88</sup> Electricity Export Opportunities from Georgia and Azerbaijan to Turkey, a report by ECON Poyry AS to the Government of Georgia available at [www.minenergy.gov.ge](http://www.minenergy.gov.ge) See also (a) the Presentation to Medelec on March 24, 2009 entitled Electricity Network Interconnections of Turkey by TEIAS officials, and (b) Presentation entitled "Recent developments in Turkish Power System" by TEIAS in BSTPP WG Meeting at Lviv, Ukraine, on 3-4 December 2008



### Exhibit 13: Details of Other Electricity Interconnection Proposals

Country	Details of proposals
Georgia	Converting the 220 kV line Hopa- Batumi to 400 kV AC with back to back AC/DC/AC convertor station at Batumi (Georgia) is under consideration.
Iran	Asynchronous connection through a back-to-back DC/AC convertor on the existing 400 kV line and construction of an additional 400 kV line are being considered.
Iraq	Construction of an additional 400 kV line is underway. The cross border point has been determined. Construction of the line on the Iraqi side has been initiated and construction on the Turkish side is to begin soon.
Romania	A 400 km, 400 kV HVDC submarine cable under the Black Sea from Constanta in Romania to Pasakhoy in Turkey with an expected commissioning date of 2018 is being pursued. <sup>89</sup> It will have convertor stations at either end, and will have a transfer capacity of 600 MW.

Turkey has excellent prospects as an electricity export destination and as a transit country for exports to the EU. It has attractive electricity prices, an open, competitive market structure with third party access, multiple market participants and in light of its impending membership in ENTSO-E, synchronous operation with the European grid (expected in 2012). Exhibit 14 provides an update on the status of Turkey's application to join ENTSO-E, and on its involvement in the Energy Community of South East Europe (ECSEE) Treaty.

Turkey's tightening supply position and the rising cost of generation has prompted increased interest in relatively less expensive imports. Further, its use of high sulfur coal and lignite for power generation has raised environmental concerns which can be partially mitigated through imports of non-, or less-, polluting power imports.

Import and export of electricity in Turkey is liberalized. Turkish electricity market import/export regulations follow Regulation 1228/2003 of the European Commission. Besides TETAS, the state owned power trading company, and the 22 distribution companies, there are over 36 licensed private sector wholesale power traders – all of which are eligible to import and export electricity on the national grid. Many of the private licensees are large multinational firms with substantial annual turnovers (in the range of US\$ 5 million to US\$ 168 million).

The *Electricity Market and Security of Supply Strategy Paper* approved by the High Planning Council of Turkey on May 18, 2009 outlines the approach for increasing electricity trade in the following terms:

- The goal is to join UCTE and operate the Turkish system in a parallel and synchronous manner with the European Transmission network by 2010;
- Complete studies and improvements to the grid in time to achieve this goal;
- Carry out cross border trade with Europe in conformity with the EU Cross- Border Trade Directive and national legislation;
- Connections with other non-EU countries will be required to comply with conditions associated with Turkey's membership in UCTE and its connection to the European grid;
- For such countries, Direct Current (DC) methods will generally be necessary including the construction and use of AC to DC and DC to AC convertor stations. Such convertor stations and facilities which must be constructed within Turkey's border will be constructed by TEIAS as a part of the national transmission system;

<sup>89</sup> Transmission Development Plan (2008), UCTE available at [www.ucte.org](http://www.ucte.org)

- Until such DC connection facilities become available, imports and exports will only be possible through unit direction or in an island mode; and
- Trade carried out by unit direction or in island mode must not adversely affect the quality and security of supply on the Turkish system. The quality of imports must comply with Turkish legislation.

The Electricity Market Law of 2001 obliges the transmission and distribution companies to allow open, guaranteed and non-discriminatory access to the network by third parties to facilitate competition in the electricity market. Such third party access to the networks, connection fees, and system usage tariffs are all regulated by EMRA. The Grid Code and the electricity market licensing regulations incorporate the principles and practices of third party access and its requirements. Transmission system capacity for export-import transactions is allocated by TEIAS on a pro-rata basis. TEIAS is obliged to make use of a bidding process when demand from traders exceeds currently available capacity. Procedures relating to transmission access are broadly in line with EU directives. When the capacity demand for imports / exports is within the available capacity, normal regulated transmission prices apply.

Transmission tariffs generally follow EU guidelines for transmission pricing and consist of:

- a) A connection charge;
- b) A use-of-system charge related to the investment and O & M costs of the system for bulk transfer of electricity, system security and quality of supply; and
- c) A system operation charge related to the costs of real time balancing of supply and demand and ancillary services.

The use of system charge is based on the concept of long run marginal costs, while the system operation charge is regulated on the basis of a revenue cap methodology. Further, the use of system charge varies among the 22 regions to provide incentives for the location of generation where it is most needed from the point of view of regional supply-demand balance.

The average transmission revenue for TEIAS was estimated at 0.46 US cents/kWh in 2008.<sup>90</sup> The transmission charges are shared on a 50:50 basis between the generators and the distributors (or more generally, the buyers and sellers in the wholesale and balancing markets).

There appears to be no special regulation regarding the wheeling of power to third countries via the Turkish grid. When Turkey becomes a member of the ENTSO-E, the basis for wheeling charges is likely to follow EU and ENTSO-E guidelines.

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<sup>90</sup>World Bank, Implementation Completion Report on Turkish National Transmission Grid Project, June 2008



## Attachment 2.E: Electricity Sector in Iran

### 1. Overview

Iran's 2010 estimated population is 76.9 million and GDP is US\$ 830.7 billion (purchasing power parity). The real GDP growth rate during 2001-2007 was in the range of 3.0% to 7.5% per annum and it declined sharply to 2.5% in 2008, largely due to oil and gas price movements. Government revenues as a percentage of GDP fell during FY 2007-08 to 24.5% from the previous year level of 30%, while expenditures increased from 24.8% to 25.1%. A large part of the expenditures were met by drawing down the Oil Stabilization Fund. The year was expected to end with a fiscal deficit of 0.6%. Trade surplus declined from \$40.8 billion to \$21.0 billion. Current account surplus fell from 11.9% of GDP to 6.7%. Tight monetary policies helped to lower the annual inflation rate to 18% from the previous year level of 22.4%.<sup>91</sup>

Iran is well endowed in terms of oil and gas. Its proven oil reserves at year-end 2008 were estimated at 18.9 billion tons (10.9% of the world total and second largest in the world after Saudi Arabia) with reserves to production ratio of 86.9 years. Iran's proven natural gas reserves were estimated at 29.61 trillion cubic meters (16% of the world total and the second largest in the world after Russia) with a reserve-to-production ratio exceeding 100 years. It has also modest reserves of coal estimated at about 462 million tons.

Iran's technical hydropower potential had been estimated at 42,000 MW, of which only 23,000 MW is considered practical. About 7,500 MW have actually been developed.<sup>92</sup> Its primary energy consumption in 2008 was estimated at 192.1 million tonnes of oil equivalent (MTOE) of which 105.8 MTOE (55%) was gas, 83.3 MTOE (43.4%) was oil, 1.7 MTOE (0.9%) was hydroelectric power and 1.3 MTOE (0.7%) was coal.<sup>93</sup> Primary energy consumption increased from 2000 to 2008 at an average annual rate of 6.4%, and one source forecasts that from 2008 to 2020 it may increase at an annual rate of 4.7%.<sup>94</sup>

### 2. Power Sector Structure

The Ministry of Energy is responsible for energy policy and for the regulation and control of the electricity sector in all respects including the formulation of tariffs for approval by the Majlis. The Ministry also fully owns Tavanir, the sector holding company, which in turn is the main shareholder of the 16 Regional Electric Companies (which own the thermal generation and transmission facilities within their territory) and the 42 Distribution companies.

The electricity sector is unbundled vertically by function and horizontally by the existence of multiple companies for generation and distribution. Hydropower stations are owned and operated by either the Regional Water Companies or by the Iran Water Resource Management Company, which is fully owned by the Ministry of Energy. In addition, the Ministry of Energy fully owns Iranian Grid Management Company which, though it does not own the transmission system, is

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<sup>91</sup> Economic Update, Spring 2009 of the World Bank/IMF

<sup>92</sup> GH Bahmannia, *Developing Gas Markets in Persian Gulf Case Study: Iran*, Paper presented in the 23 Gas Conference at Amsterdam in 2006 available at [www.igu.org/html/wgc2990/pdf/paper/add9935.pdf](http://www.igu.org/html/wgc2990/pdf/paper/add9935.pdf)

<sup>93</sup> The main data source is BP Statistical Review of World Energy, June 2009. A recoverable coal reserve of 462 million tons (2007) was indicated in the Iran Country Analysis Brief of US Department of Energy available at [www.eis.doe.gov](http://www.eis.doe.gov)

<sup>94</sup> Presentation by Dr. Fereidun Fesharaki on September 18-19, 2009 at University of Southern California in the seminar on Iranian Economy at Crossroads: Domestic and Global Challenges.

responsible for the operation of the transmission system (TSO), for system dispatch and for market operations at the wholesale level. It is thus both a TSO and a MO. However, it is not independent as it reports to Tavanir and the Ministry of Energy and is bound by their directives.

In the generation segment, besides the generation units (in the public sector) owned by the Regional Electric Companies, there are a number of privately owned IPPs which are organized as BOT or BOO units operating with energy conversion agreements (ECAs) with Tavanir. Tavanir supplies them with free fuel and they produce power and supply it to Tavanir for a conversion fee which covers capacity costs (related to the available capacity) and actual energy conversion costs (related to the volume of electricity delivered).

### **3. Market Organization**

Iran operates a mandatory power pool. IPPs have energy conversion agreements with Tavanir, which sells the power purchased from them to the pool. All public sector generating units sell their output directly to the pool. All sales to the pool are on the basis of hourly bids with price-quantity pairs submitted three days ahead of the day of dispatch. Power plants can submit up to 10 price-quantity pairs for each hour. The maximum capacity available can be changed up to 14 hours ahead of the day of dispatch. As of January 2009, about 90 power plants submitted bids in the power pool for about 400 generating units.

The pool follows the principle of “pay-as-bid”. The sellers to the pool receive energy payments, capacity payments and fuel payments (except in the case of hydro power units). The bid prices for energy reflect non-fuel operating and maintenance costs plus a fuel price component equivalent to about 0.5 US cents/cubic meter of gas. Bid prices are limited by a price cap of 1.3 US cents/kWh (as of January 2009). The capacity payment for each hour of the year for which the plant was available is based on the annualized unit investment cost (typically \$80/kW/year for a gas turbine plant) suitably adjusted for the reserve margin. Payment for fuel is calculated on the basis of about 7 US cents/cubic meter of gas and the same fuel charge /kWh is paid for all units irrespective of the fuel used and the heat rate of the plant to encourage the more efficient units and penalize the less efficient units. Payments for ancillary services such as reactive support, primary frequency regulation and black start are currently based on negotiated contracts. The rates for these services range from 1% to 6% of the availability payments.

The buyers in the pool are the 42 distribution companies and a few “independent licensees” who can arrange for bulk electricity purchases for third party consumers. The buyers are obliged to submit their estimated average demand (MW) and peak demand (MW) for each hour of the day. The sale price from the pool to the buyers is based on the pooled average hourly prices and consists of a capacity charge and an energy charge which are suitably adjusted for deviations from the declared demand and energy.

The dispatch schedule is prepared on the basis of running a security constrained economic dispatch model using the price-quantity pairs submitted by the generators and the demand schedules submitted by the buyers.

The objective of the Government is to promote private investment, especially in the generation segment, and to promote the use of bilateral contracts to create a competitive market environment and to ensure a greater level of transparency in generation costs. All consumers irrespective of the size of their annual consumption and the voltage level of their connection to

the network have been given, under the law, the right to choose their supplier. In practice, only large industrial consumers make use of this right.

All privately owned power plants connected to the network have three options: (a) to participate in the Wholesale Electricity Market (WEM) either directly or through the mechanism of ECAs with Tavanir; (b) to supply to the distribution companies, or other consumers on the basis of bilateral contracts; and (c) to sell to IGMC on the basis of a guaranteed pre-determined rate which varies from 0.5 US cents/kWh during off-peak hours to 3.1 US cents/kWh during peak hours (also adjusted to reflect variations in seasonal demand). However, to this point, all power plants supply to the pool either directly or through Tavanir and have not used the other options. The only exceptions are the captive generating units owned by large industries which sell their surplus generation to IGMC under the guaranteed rate.

The Market Monitoring Unit of the Ministry of Energy monitors the performance of the electricity market. Market operations are also subject to regulatory oversight by the Electricity Market Regulatory Board in relation to compliance with the market rules and the need to modify or amend the rules. The Board consists of seven professionals appointed by the Minister of Energy.

In spite of the elaborate market structure, there does not appear to be adequate competition attracting new investments to meet the narrowing reserve margins owing to:

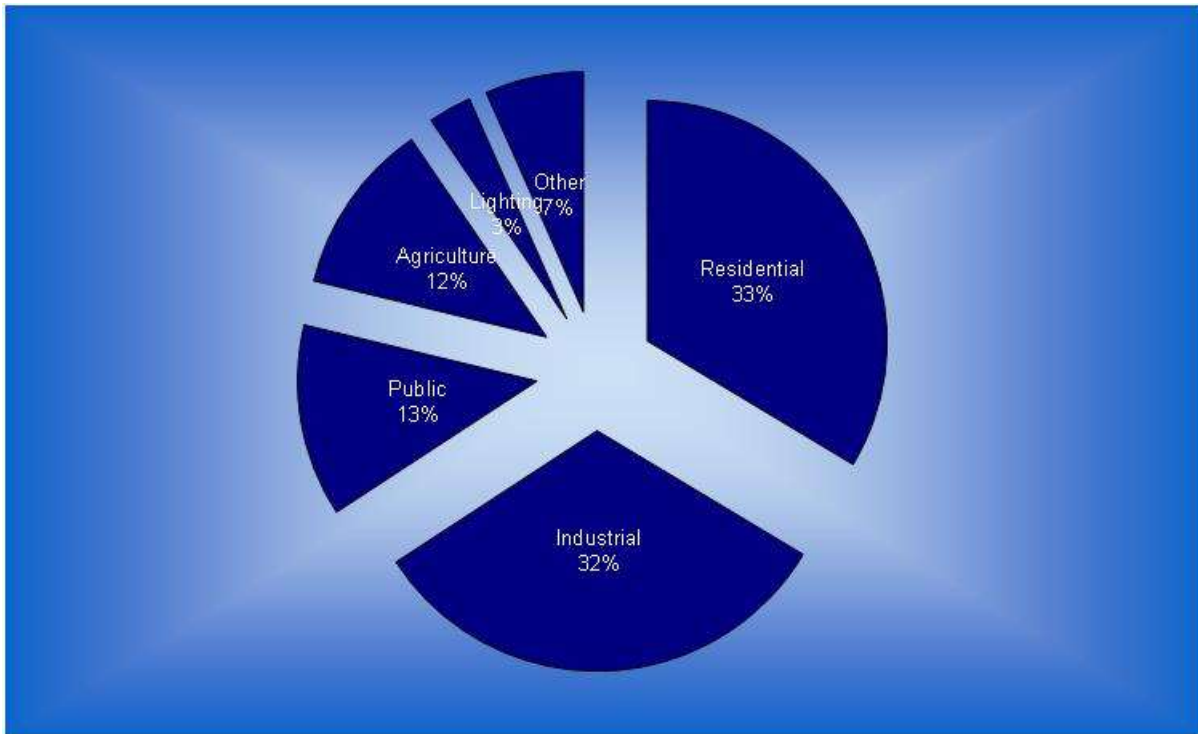
1. Inadequate commercialization of the state-owned generation and distribution companies;
2. Low price caps on spot energy bids;
3. Low capacity payments that do not adequately reflect the scarcity of capacity; and
4. Most importantly, monopoly and price distortions in the primary fuel markets.

#### **4. Demand and Supply**

##### **4.1 Demand**

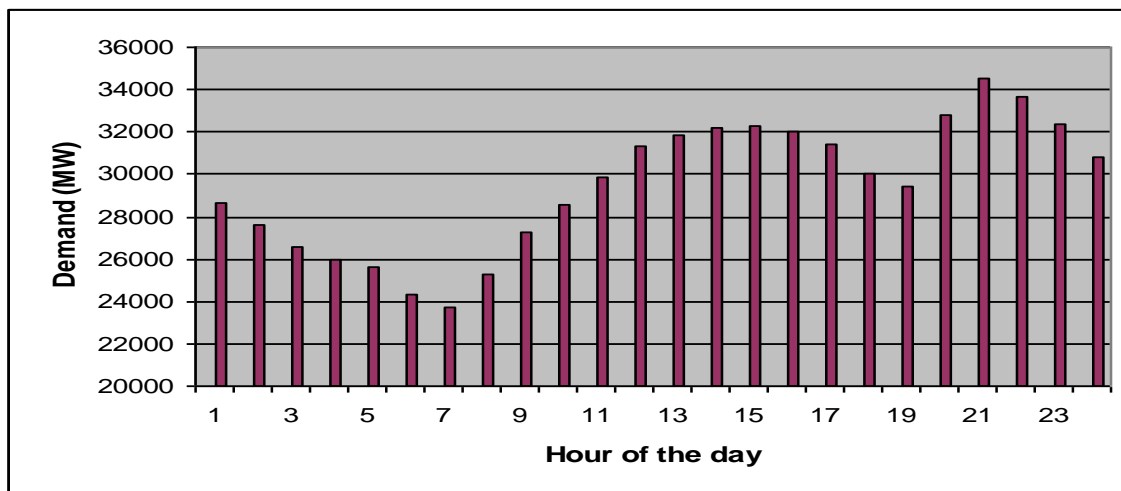
The breakdown of consumption by customer class is shown in Exhibit 1. Residential customers have the largest share at 33.4%, followed by industrial customers at 32.6%, public offices and services at 12.9%, agricultural customers at 11.6%, street lighting at 2.9%, and miscellaneous customers (mostly commercial) at 6.6%. The annual load factor of the system is around 67%.

**Exhibit 1: Electricity Sales by Sector**



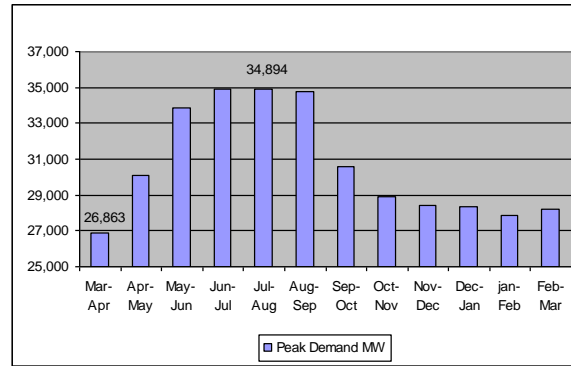
Iran's daily peak demand occurs around 9 pm and the base load demand is about 40% of the peak demand (Exhibit 2). System annual peak occurs in summer and the system minimum peak occurs in winter or early spring. The seasonal variation in load is significant (Exhibit 3).

**Exhibit 2: Daily Load Curve (MW)**



Source: [www.tanavir.org.ir](http://www.tanavir.org.ir)

### Exhibit 3: Monthly Variation of Peak Demand (MW)



Source: [www.tanavir.org.ir](http://www.tanavir.org.ir)

During the last eight years electricity sales (in GWh) and Peak Demand (in MW) grew at compounded annual growth rates of 7.8% and 7.6% respectively, compared to the real GDP growth rate of 5.9%. Installed generation capacity and actual gross energy generation grew during the same period at a compounded annual rate of 8.6% and 8.1%, respectively (Exhibit 4). Lower availability of generation capacity and relatively high levels of network losses and self consumption by generating units has resulted in reserve margins becoming tight with supply constraints emerging, particularly in the summer months.

### Exhibit 4: Historical Growth in Electricity Supply and Demand

Year	Installed Generation Capacity MW	Energy Generation GWh	Peak Demand MW	Energy sales GWh
2000-01	27,188	118,441	20,609	90,366
2001-02	28,944	127,169	21,853	97,171
2002-03	31,517	137,814	23,494	105,077
2003-04	34,328	149,676	26,216	114,624
2004-05	37,300	162,871	27,600	124,468
2005-06	41,003	178,072	30,754	132,897
2006-07	45,288	192,535	32,977	144,598
2007-08	48,413	203,983	34,581	152,853
<b>Compound Annual Growth Rate (%)</b>	<b>8.6</b>	<b>8.1</b>	<b>7.6</b>	<b>7.8</b>

Source: System statistics available at [www.tavanir.org.ir](http://www.tavanir.org.ir)

According to an Iranian Ministry of Energy presentation made in February 2008, peak demand of the system was forecast to grow from 37,053 MW in FY 2007-08 to 88,166 MW by FY 2020-21, initially at 8 - 9% per year and later tapering off to 5% as can be seen in Exhibit 5. To meet the forecast demand the Ministry's plan was to raise the total installed generation capacity to about 125,000 MW to 130,000 MW by FY 2020-21.

### Exhibit 5: Peak Demand Forecast

Year	Peak Demand (MW)	Annual Growth Rate ( % )
2007-08	37053	-
2008-09	40189	8
2009-10	43762	9
2010-11	47501	9
2011-12	51484	8
2012-13	55797	8
2013-14	60500	8
2014-15	64843	7

2015-16	69473	7
2016-17	72293	4
2017-18	76261	5
2018-19	80230	5
2019-20	84198	5
2010-21	88166	5

Source: Presentation by the Ministry of Energy of Iran on February 19, 2008  
Available at [www.igmc.ir/usrFiles/./ElectricPowerIndustry-iri-feb2008](http://www.igmc.ir/usrFiles/./ElectricPowerIndustry-iri-feb2008)

Earlier in 2004, the Iranian Power Holding Company Tavanir developed a load forecast for the period FY2005-06 to FY2015-16 taking into account GDP growth forecasts and the efforts to reduce price subsidies. According to their forecast, energy at the generation level would need to increase from 175,528 GWh in FY 2005-06 to 400,539 GWh in FY 2015-16 representing an average annual growth rate of 8.6%. During the same period, peak demand was projected to grow at a slightly lower growth rate, from 31,494 MW to 69,473 MW. The actual growth during the first three years suggests that the above forecasts might be optimistic. Financial resource constraints arising from the very low levels of electricity tariffs which are well below the cost of supply seems to be slowing capacity additions in the public sector. A much greater degree of reform would be needed to attract private sector investment. Owing to the slower pace of capacity additions and other related reasons, the peak demand forecast for FY 2015-16 appears to have been scaled down by Tanavir to slightly less than 55,000 MW.

#### 4.2 Supply

At the end of FY 2007-08, total installed generation capacity was 49.4 GW, meeting a system peak demand of 34.9 GW and annual energy generation of 204 TWh. Iran imported 1.84 TWh of electricity and exported 2.52 TWh. Domestic electricity sales amounted to 152.9 TWh. The overall power losses in the system were about 24% (consisting of about 3.9% in auxiliary consumption of generating stations, about 4.85% in transmission and sub-transmission losses, and about 17.9% of distribution losses).<sup>95</sup> The system had transmission and sub-transmission lines (400 kV, 220 kV, 132 kV, 66 kV) exceeding 99,000 circuit km, medium and low voltage lines exceeding 593,500 km serving over 21.6 million customers, about 82% of whom were residential consumers. Access to electricity is close to 100%.

The nominal generation capacity at the end of FY 2007-08 was 49,413 MW of which 43,907 MW (or 88.9%) was in the public sector under the control of Ministry of Energy, and the remaining 5,506 MW was in the private sector in the form of IPPs and captive generating units of large industries. The type of technology at the end of FY 2007-08 is shown in Exhibit 6 with 84.9 % thermal, 15% hydroelectric and the remaining 0.1% wind. Nearly 63% of the capacity consists of steam turbines and simple cycle gas turbines which use natural gas.

**Exhibit 6: Generation Technology (MW)**

Types of Power Plant units	Units under MOE	Other Units	System Total	Percentage share
Steam Power stations	14,935	663	15,598	31.6%
Gas fired Combined Cycle units	10,479	0	10,479	21.2%
Simple Cycle Gas Turbines	10,590	4,844	15,434	31.2%
Diesels	418	0	418	0.9%
<b>Subtotal for thermal power units</b>	<b>36,422</b>	<b>5,507</b>	<b>41,929</b>	<b>84.9%</b>

<sup>95</sup> Auxiliary consumption is a percentage of gross generation, transmission and sub-transmission loss is a percentage of net generation plus imports and distribution loss (technical +non-technical) is a percentage of the net input into the distribution system. More than 50% of the distribution companies had higher loss levels than the average of 17.9%. In a few, technical losses alone were 38%.

Hydropower units	7,422	0	7,422	15.0%
Wind Power Units	63	0	63	0.1%
<b>Subtotal for Hydro and wind units</b>	<b>7,485</b>	<b>0</b>	<b>7,485</b>	<b>15.1%</b>
Total for all units	43,907	5,507	49,414	100%

Source: [www.tavanir.ir](http://www.tavanir.ir)

The average available capacity of the public sector generators in FY 2007-08 was about 40,066 MW accounting for ambient temperature variations (which affect the rated capacity of gas turbine units and combined cycle units) and the drought adversely affecting the hydrology of the hydropower units.

Total gross electricity generation in FY 2007-08 was 203,983 GWh of which 91.1% was from thermal power plants, 8.8% from hydropower units and 0.1% from wind power units. Public sector units under the control of the Ministry of Energy produced 93% of the total output (see Exhibit 7).

**Exhibit 7: Energy Generation in FY 2007-08 by Type of Unit (GWh)**

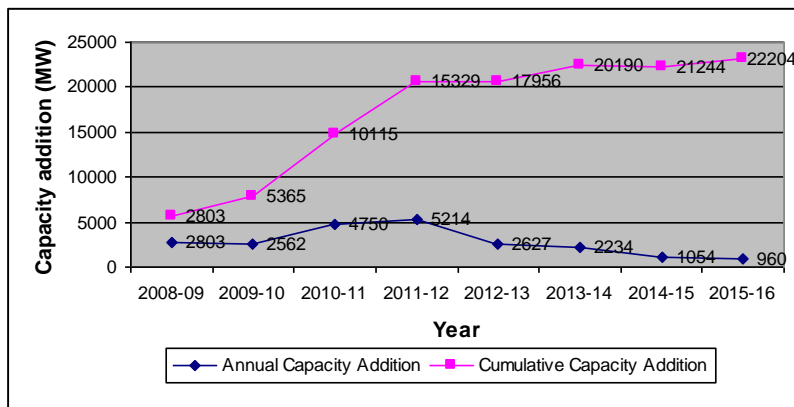
Types of Power Plant units	Units under MOE	Other Units	System Total	Percentage share
Steam Power stations	90,900	13,953	131,832	64.6%
Simple Cycle Gas Turbines	26,979			
Gas fired Combined Cycle units	53,796	0	53,796	26.4%
Diesels	225	0	225	0.1%
Subtotal for thermal power units	171,900	13,953	185,853	91.1%
Hydropower units	17987	0	17,987	8.8%
Wind Power Units	141	0	141	0.1%
Subtotal for Hydro and wind units	18,128	0	18,128	8.9%
Total for all units	190,028	13,953	203,983	100%

Source: [www.tavanir.ir](http://www.tavanir.ir)



In order to meet increasing demand, new generation capacity of 22,204 MW is expected to be added during FY 2007-08 – FY 2015-16, bringing the total installed capacity in the country to 71,617 MW. The new capacity will consist of 14,380 MW of gas fired combined cycle units, 4,570 MW of hydropower units, 2,614 MW of gas turbine units and 640 MW of steam turbine units (Exhibit 8). About 55% of the total capacity additions will be in the private sector in the form of BOT and BOO projects. The remainder will come from public sector.

**Exhibit 8: Generation Expansion Plan (MW)**



In FY 2007-08, privately owned power generating plants accounted for 11% of the total generating capacity in the country. This included captive generation units owned by large industrial companies that supply their surplus energy to the grid. These private units, however, had only a share of 6.8% of the total annual generation of electricity. Most of the privately owned IPPs had long term energy conversion agreements with Tavanir and sold their outputs to the power pool through Tavanir. Capacity addition plans through FY 2015-16 envisage that out of a total of 22,204 MW of new capacity, 12,312 MW (or 55.5%) would be private sector units with energy conversion agreements with Tavanir. These are considered “confirmed” power plants. About 62% of the capacity will be in the form of BOO units and the rest will be BOT units. More than 7,200 MW of the new private sector capacity were under construction and the rest were negotiating their ECAs.

In addition the Government plans to privatize about 7,500 MW of gas turbine units, so that the buyers could make the necessary investments to convert them into combined cycle units. For this purpose the government is planning to provide to the winning bidders five year loans to help them meet the non-equity part of the acquisition costs and part of new investment costs. Private sector management contractors appear to be operating the generating units of the RECs. The government also plans to privatize the distribution companies eventually.

The fuel consumption by the thermal power plants in FY 2007-08 amounted to 36.98 bcm of gas, 8,435 million liters of heavy fuel oil and 4,557 million liters of diesel oil with a total heating value of 446,059 billion kcal.

#### 4.3 Trade

Iran has numerous international interconnections to the power systems of Armenia, Azerbaijan, Turkey, Turkmenistan, Afghanistan, Pakistan and Iraq. Details of the existing interconnections and the type of trade taking place are provided in Exhibit 9.



### Exhibit 9: Details of Existing Interconnections and Trade

Country	Number of Tie-lines	Voltage level/s	Type of trade	Capacity
Armenia	2	230 kV	Balanced Energy exchange	300 MW
Azerbaijan	3+	230/132/20/11 kV	Transit	250 MW
Turkey	2	154 kV	Transit	250 MW
Turkmenistan	3	230 kV	Import & Transit	300 MW
Afghanistan	2	132/20 kV	Export	40 MW
Pakistan	1+	132/20 kV	Export	40 MW
Iraq	2+	132/63 kV	Export	150 MW

Source: Presentation by the Iranian Ministry of Energy on Feb 19, 2008 available at [www.igmc.ir/usrFiles/.../ElectricPowerIndustry-IRI-Feb-2008.ppt](http://www.igmc.ir/usrFiles/.../ElectricPowerIndustry-IRI-Feb-2008.ppt) -

In spite of the large number of international interconnections, trade plays a relatively minor role in the Iranian power sector. The total volume of trade in FY 2007-08 was 4.36 TWh representing about 2.1% of the total generation in the country. The country was a small net exporter with a net export volume of 678 GWh (see Exhibit 10).

### Exhibit 10: Volumes of Exports and Imports during FY 2007-08 (GWh)

Item	Nakhjavan	Turkey	Armenia	Azerbaijan	Turkmenistan	Pakistan	Afghanistan	Iraq	Total
Exports to	75	608	361	0	4	181	206	1085	2520
Import from	56	0	310	298	1178	0	0	0	1842
Net Trade	19	608	51	-298	-1174	181	206	1085	678

Source: [www.tavanir.org.ir](http://www.tavanir.org.ir)

## 5. Tariffs

The overall average end-user electricity tariff was 164.98 Rials/kWh (1.8 US cents/kWh) in FY 2007-08. Agricultural consumers had the lowest tariff at 0.23 US cents/kWh followed by households at 1.36 US cents/kWh, public facilities at 1.74 US cents/kWh, industry at 2.25 US cents/kWh and commercial consumers at 5.55 US cents/kWh.<sup>96</sup>

Tavanir estimates the total average cost of supply at 310 Rial/kWh or 3.39 US cents/kWh.<sup>97</sup> Thus all consumers with the possible exception of the commercial consumers are subsidized. The cost of supply had been calculated on the basis of highly subsidized fuel prices.<sup>98</sup> Adjusting for this and other subsidies to the sector the “full average cost of supply” in FY 2006-07 has been estimated at 749 Rials/kWh (8.1 US cents/kWh).<sup>99</sup> At such low tariff levels supply entities are unable to generate the internal resources needed for system expansion to cope with increasing demand. Tariff structures allow for time-of-use and seasonal demand variation considerations. However, they do not reflect the cost of supply at different voltage levels, and are very complex covering a wide range of consumer categories.

Considering Iran’s tariffs from an international perspective, a February 2009 World Bank report shows that a residential customer in Iran (Tehran) consuming 700 kWh per month pays only

<sup>96</sup> Based on data found at [www.tavanir.gov.ir](http://www.tavanir.gov.ir) and using the exchange rate of 9158 Rials to a US dollar as at the end of FY 2007-08

<sup>97</sup> About 53% of this was attributed by Tavanir to generation costs, 21% to transmission costs and 26% to distribution costs

<sup>98</sup> Fuel prices for the power sector, even after substantial revision in 2007, remained low. Natural gas at about US\$ 2/million BTU was less than a third of the prices prevailing in North American and European markets. The consumers were insulated from the impact of the fuel price increases which fell on the state budget. The government estimated the subsidies to the power consumers to be of the order of US\$ 9.3 billion in 2007 (FACTS Global)

<sup>99</sup> *Islamic Republic of Iran Power Sector Report*, June 2009, World Bank. The full cost of supply in 2007-08 is believed to be about 773 Rials/kWh or 8.44 US cents/kWh.

35% of a benchmark tariff based on an average of the tariffs of France, Greece, Italy, Spain, Portugal and Turkey. These countries were chosen as the benchmark because their tariffs reflect the cost of supply, and as such, provide a reasonable approximation of the opportunity cost of electricity. Iran's tariffs are even below the average tariff paid by other countries in the Middle East and Africa (MENA). A residential customer in Iran consuming 700 kWh per month pays only 90% of the MENA average. Iran's retail tariff for its industrial customers is likewise far below the benchmark, and even well-below the MENA average.

## 6. Prospects for Trade

Several new interconnections are either under construction or in the planning and negotiations stage. They are summarized in Exhibit 11. Interconnections with Russia (presumably via Azerbaijan), Tajikistan via Afghanistan, United Arab Emirates via submarine HVDC link, and Turkey via an HVDC link are under active discussion and study.

**Exhibit 11:** Electricity Interconnections under Construction or in the Planning Stages

Country	Number of Tie-lines	Voltage level/s	Type of trade	Capacity
Armenia	1	400 kV	Barter-ECA	300-600 MW
Azerbaijan	1	400 kV	Inter-state trade	Under study
Russia	NA	Under Negotiation	Transit or Inter-state trades	Under negotiation
Turkey	1	400 kV	Export	250-650 MW
Turkmenistan	1	400 kV	Import and Transit	300 MW + 500 MW
Tajikistan	Via Afghanistan	400 kV	SWAP (ECO initiative)	1000 MW
Pakistan	Under study	400 kV		
Pakistan	1	230 kV	Export	120 MW
Iraq	Up to 9	400 /230/132 kV	Export	900 MW

Source: Presentation by the Iranian Ministry of Energy on Feb 19, 2008 available at: [www.igmc.ir/usrFiles/.../ElectricPowerIndustry-IRI-Feb-2008.ppt](http://www.igmc.ir/usrFiles/.../ElectricPowerIndustry-IRI-Feb-2008.ppt) -

The 180 km submarine HVDC link between Iran and UAE will have a transfer capacity of 1,500 MW and will connect Iran to the Gulf Cooperation Council (GCC) Grid. The interconnection among the power systems of these six countries is being coordinated by the GCC Interconnection Authority. Iran's HVDC link to this grid has significant implications to its export prospects.

Similarly Iran's interconnections to Turkey and Iraq will connect it to the evolving regional grid among Egypt, Libya, Jordan, Iraq, Syria, Lebanon, Palestine and Turkey (EIJLLPST).<sup>100</sup>

Interconnection from Iran to the 230 kV line from Tajikistan to Afghanistan would enable Iran to export winter power to Tajikistan.

Iran is well-endowed with energy resources and has aggressive plans to expand international trade. However, implementing these plans poses numerous challenges for Iran, including:

- There is an urgent need for tariff reform, both in terms of tariff levels and structure, to reflect the cost to supply the various classes of consumers (reduce cross-subsidies) and to simplify tariff categories and reflect supply voltage levels.
- The subsidies on primary fuel used for power generation needs to be eliminated by raising prices to the full economic cost of supply. This will promote greater generation efficiency and optimize investment costs.

<sup>100</sup> H.Shakouri et ale, Economically optimized electricity trade modeling: Iran-Turkey Case, *Energy Policy* 37 (2009) pp 472-483

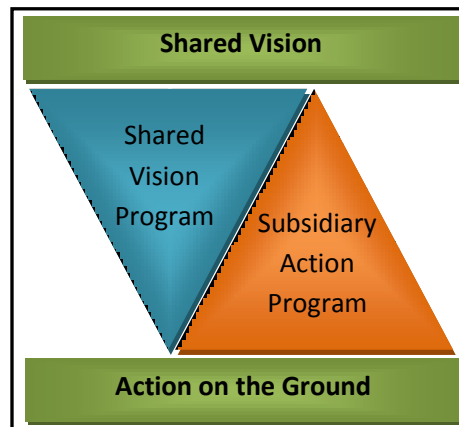
- More rapid and comprehensive reform of the power sector is necessary to foster commercialization of the supply entities and promote improved efficiency of operation through elimination of cross subsidization between entities.
- More realistic price caps and capacity payments are necessary to generate funds for power supply entities to invest.
- Competition in the electricity market will be improved with transmission network expansion to remove bottlenecks, and by making third party transmission access a practical proposition.
- ECA contracts should be abandoned obliging generating entities to assume fuel supply and market risks.

Iran's substantial gas reserves and its location give it a comparative advantage for electricity exports to Turkey and possibly the European Union via Turkey. Iran will also be a key transit country for electricity exports from Turkmenistan to Turkey and beyond. To achieve its export and transit ambitions, Iran will have to invest in domestic transmission system improvements and will have to improve the investment climate including sector marketing arrangements and transmission access. International sanctions and Iran's domestic policy and organizational complexity are not conducive to attracting the foreign investment needed to increase electricity and gas production.

## Attachment 2.F: Nile Basin Initiative

### 1. Overview

The Nile Basin Initiative (NBI) was established in 1999 between nine Nile riparian countries namely Burundi, Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda,<sup>101</sup> with the mandate and shared vision to “achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources.” The NBI is chaired by a Council of Water Ministers (Nile-COM) from each of these countries and advised by a Technical Advisory Committee (Nile-TAC). The NBI aims to build integrated regional programs in seven thematic areas through the Shared Vision Program. One of the thematic projects pursued is to create a platform for cross-border electricity trade among the Nile riparian countries through a Regional Power Trade Project (RPTP). The implementation arm of NBI’s vision is carried out by the Subsidiary Action Program which comprises: (i) the Eastern Nile Subsidiary Action Program (ENSAP)<sup>102</sup>; and (ii) the Nile Equatorial Lakes Subsidiary Action Program (NELSAP).<sup>103</sup>



Source: <http://www.nilebasin.org/>

### 2. Regional Power Trade Project (RPTP)

The RPTP aims to establish a basin-wide framework for low-cost electricity trade that once implemented will create an enabling environment for regional investments in NBI countries. Initially, the RPTP is focused on providing technical assistance to foster compatible policy and regulatory frameworks, common technical operating standards, access rules and cross-border trade principles, among others. Once the regional regulations and relevant institutions are in place, the RPTP will focus on infrastructure development, specifically regional electricity investments and cross-border interconnections.

Thus far, the RPTP has successfully created a Nile Basin Power Forum for technical integration where national power experts from riparian countries can exchange ideas on how to develop power supply facilities and ways to expand power trade in the Nile Basin. The creation of this forum was strategically designed to allow for a participatory process among the riparian countries and to enhance understanding of the common benefits that can be attained. Furthermore, a number of studies have been completed including an Environmental Impact Assessment, a Power Trade Study, and a preliminary Basin Wide Study.

### 3. Legal and Regulatory Framework

A trade treaty that has to be signed by the riparian countries will outline the principles of trade that have to be implemented between NBI countries. The treaty will also create regional institutions and establish their roles among other key elements. A study entitled ‘Institutional,

<sup>101</sup> Although Eretria is a Nile riparian country, it is not an active participant in the NBI

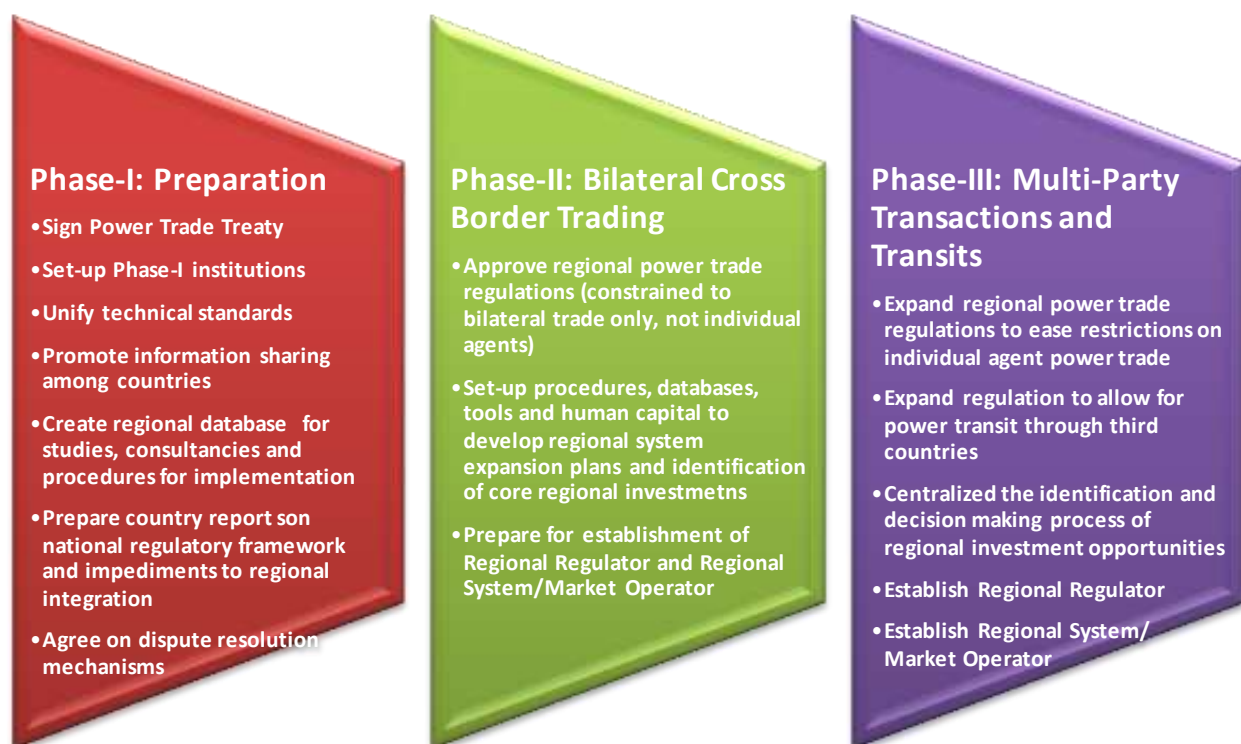
<sup>102</sup> Investment program for Egypt, Ethiopia and Sudan

<sup>103</sup> Investment program for Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania and Uganda—as well as the downstream riparians Egypt and Sudan

Regulatory and Cooperative Framework Model for the Nile Basin Power Trade' completed in December 2007 proposes a phased approach to the roll-out of NBI regional trade (see Exhibit 1).

Bilateral cross-border trading is only envisaged to commence once the implementation of Phase-I is completed. Under Phase-II, an important feature is the approval of a regional regulatory framework by all NBI countries which will govern cross-border electricity trade. Due to the significant disparity in the regulatory environments and power sector structures among the Nile riparian countries and in order to facilitate power trade, it is envisioned that the regional regulatory framework established will only apply to cross border trading, i.e. from one country's interconnection point to that of its trading partner, without impacting or modifying the divergent national regulatory frameworks.<sup>104</sup> Moreover, regional regulation will only apply to permanent or frequent transactions where standardization may be necessary and where common interests and benefits of NBI members are involved. Therefore, bilateral trade decisions that do not involve all member countries are left to negotiations between the countries involved.

### Exhibit 1: Phased Roll-Out of Regional Regulation and Integration



## 4. Institutions

The aforementioned study recognizes the need to set up new regional institutions to manage, monitor and regulate cross-border electricity trade. Upon treaty signature, and as mentioned above, the study proposes a phased approach to institutional establishment in order to allow for the market to evolve in a sustainable manner. Exhibit 2 describes the institutions to be established and their respective roles.

<sup>104</sup> Deep reforms and uniform national regulations were proposed, but not considered

## Exhibit 2: Institutions and their Functions

	Phase-I	Phase-II	Phase-III
<b>Nile Basin Initiative Council of Ministers (Nile-COM)</b>	Existing as the highest level of authority in NBI Gives final clearance to Electricity Ministers to Treaty according to NBI procedures	Coordinate with NBI Power Trade Council of Ministers (PT-COM) only in those issues where water intervenes	
<b>Power Trade Council of Ministers (PT-COM)</b>	Created through Treaty signed in Phase-I	Performs activities established in the Treaty including guidance on power trade development, approval of strategic action plan and approval of rules, regulations and agreements submitted by the Secretariat	
<b>Steering Committee (SC)</b>	Created through Treaty signed in Phase-I	Performs activities established in the Treaty including oversight over power trade development, oversight over Power Trade Secretariat (PTS) activities, reviews PTS products issued for PT-COM final approval and communication channel between PT-COM and PTS	
<b>Power Trade Secretariat (PTS)</b>	Created through Treaty signed in Phase-I	Performs activities established in the Treaty including implementation of PT-COM issued policies, creates or eliminates working groups (WG) with TORs, supervises and coordinates activities of WGs, submits WGs recommendations to PT-COM through SC, submits rules, regulations, agreements to the PT-COM for approval, prepares 3-year action plan for SC and PT-COM approval, prepares implementation of Regional Regulator and Regional System Operator and establishes coordination mechanism with other institutions.	
<b>NELSAP</b>	Participates in regional planning activities as coordinated by PTS in Phases I and II and by Regional System Market Operator in Phase-III		
<b>ENSAP</b>	Participates in regional planning activities as coordinated by PTS in Phases I and II and by Regional System Market Operator in Phase-III		
<b>Regional System/Market Operator</b>		Created at the end of Phase-II as required to begin in Phase-III	Leads and coordinates regional planning.  Performs the function of Regional System/Market Operator
<b>Regional Regulator</b>		Created at the end of Phase-II as required to begin in Phase-III	Enforces regional regulation, develops rules and regulations to be presented to PT-COM for approval and participates in dispute resolution as established by Treaty
<b>Regional Court of Justice</b>	Already exists in international regional institutions		Provides its Court of Justice as forum for dispute resolution

### 5. NBI Generation Development and Cross Border Interconnections

Through the implementation arm of the NBI namely the Subsidiary Action Program, two electricity projects are currently under development:

- (i) The NELSAP Regional Rusumo Falls Hydro-electric and Multipurpose Project which aims to generate 60 to 80 MW of electricity to support the development of Burundi, Rwanda and Western Tanzania at an estimated cost of US\$250 million. Currently, US\$4 million from the NBI Trust Fund and other donors has been allocated for project preparation. Project implementation is expected to commence in early 2012; and
- (ii) The ENSAP Ethiopia Power Export Project (formerly Ethiopia-Sudan Transmission Interconnection Project) aims to facilitate, through 230/220 kV transmission lines, cross-border power trade between Ethiopia and Sudan. The project which was recently completed was financed by the International Development Association for US\$41 million on the Ethiopian side and by the Sudanese Government for the Sudan interconnection for about US\$ 25 million.



## 6. Trade Opportunities among Nile Riparian and Arab Countries

A number of NBI member countries are pursuing independent generation development and interconnection opportunities (see Exhibit 3). Some of those in closer proximity to the Arab world are discussed below.

### 6.1 Ethiopia

**Generation:** Ethiopia recently commissioned three hydropower plants: Gilgel Gibe II generating 420 MW, Tekeze Hydroelectric Project generating 300 MW and Tana Beles Multi-purpose Hydro-electric Power Project generating 460 MW. Moreover Ethiopia has launched the construction of the Amerti Neshi Gibe III and Finchaa hydropower projects with a combined generating capacity of over 2200 MW. Other projects in the pipeline include the 254 MW Genale Dawa 3 hydropower project and other hydro and wind projects expected to generate an additional 500 MW.<sup>105</sup>

**Transmission:** Ethiopia and Djibouti received a loan from the African Development Bank to finance the construction of interconnecting transmission lines (283 km of 220 kV; 84.5 km of 63 kV; and 3.2 km of 33kV lines). Moreover, the Ethiopia Electric Power Corporation also plans to invest in additional interconnections with Kenya and at a later stage, Egypt, Tanzania, Somalia and Yemen.

### 6.2 Sudan

**Generation:** Sudan has a highly-constrained electricity supply system. At the end of 2008, Sudan had a total installed generation capacity of 1,235 MW of which 343 MW was hydroelectric. Some new generation capacity has been commissioned: the Merowe Hydropower project<sup>106</sup> on the Nile River with a generation capacity of 1,250 MW and the Al-Fula Thermal Power Station (oil-fired) with about 400 MW generating capacity. By the end of March 2010, the total installed capacity is estimated to have increased to over 2,890 MW. Moreover, a number of projects are in an advanced stage of construction/commissioning: (i) the 300 MW Kajbar Hydropower project close to the northern border of Sudan, (ii) Kosti steam power plant (about 500 MW) using crude oil as fuel; (iii) Garri 4 power plant (110 MW) using sponge coke and LDO as fuel; (iv) Khartoum North (phase III) Steam Power Station 200 MW using Bunker C oil as fuel; (v) a 500 MW coal fired thermal power project at Port Sudan<sup>107</sup> using coal imported from South Africa,<sup>108</sup> and (vi) a number of diesel power generators at several locations.

**Transmission:** At the end of 2009, the Sudanese power system had 966 circuit km of 500 kV lines, 4,983 circuit km of 220 kV lines and 1,350 circuit km of 110 kV and 66kV lines. The substation capacity was 1,500 MVA (at the 500 kV level), 5,027 MVA (at the 220 kV level), 2,261 MVA (at the 110 kV and 66 kV level). As part of the Merowe project, about 1,745 km of 500 kV and 220 kV transmission lines as well as 7 substations were also added. Sudan-Eritrea, and Sudan-Uganda interconnections are planned and will link the Eastern African grid to the Northern African grid.

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<sup>105</sup> See Ethiopian News at <http://www.ethiopian-news.com/power-export-to-sudan-starts-in-october/>.

<sup>106</sup> This is a major multipurpose project also providing irrigation facilities to about 400,000 ha of land in North Sudan. See *Startup at Merowe: A major boost for the Socioeconomic development of Sudan*, in *Hydropower and Dams*, Issue 3, 2009 pp 115-120

<sup>107</sup> This may also have a configuration of 2 x 300 MW

<sup>108</sup> See news item at [http://us-cdn.creamermedia.co.za/assets/articles/attachments/22474\\_namane.pdf](http://us-cdn.creamermedia.co.za/assets/articles/attachments/22474_namane.pdf)

# **Attachment 3.A**

## **Summary of EU Legislation on Internal Market and Cross-Border Electricity Trade<sup>109</sup>**

### **Introduction**

This document presents an overview of the key EU legislation related to electricity issues in the following areas: internal energy market, security of supply, external dimension, enlargement, and renewable energy. This document is not intended to be a comprehensive list of all EU acts in this sector, but a user-friendly tool of the main legislation driving the EU internal market in electricity.

The summaries of the legislation contained in this document have been compiled from EU sources<sup>110</sup>. An introduction to the different types of EU legislation and a brief overview of the construction of the internal energy market are included to facilitate the reading of the five sections: a competitive internal market, an interconnected EU internal market, taxation, security of supply, external dimension, EU enlargement, and renewable energy.

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<sup>109</sup> All legislation can be found in the “EU Directive” folder: P:\!UNIT S\MNSSD\Arab League-WBStudy\_Energy

<sup>110</sup> [http://europa.eu/legislation\\_summaries/energy/index\\_en.htm](http://europa.eu/legislation_summaries/energy/index_en.htm)



## Table of Contents

Introduction	203
Table of Contents	204
Basics of EU legislation	205
Milestones in the construction of the EU internal energy market	205
I. A competitive internal market	206
1. Regulation 713/2009 establishing an Agency for the Cooperation of Energy Regulators.....	206
2. Directive 2003/54 concerning common rules for the internal market in electricity.....	207
3. Directive 2009/72 concerning common rules for the internal market in electricity and repealing Directive 2003/54 as from March 3 2011 .....	208
4. Communication COM(2006) 841 “Prospects for the internal gas and electricity market” of 10 January 2007.....	210
5. Council Directive 90/377 of 29 June 1990 concerning the transparency of gas and electricity prices charged to industrial end-users .....	212
6. Directive 2003/87 establishing a scheme of greenhouse gas emission allowance trading.....	213
II. An interconnected EU internal market	214
7. Green paper – towards a secure, sustainable, and competitive European energy network.....	214
8. Decision 1364/2006 laying down guidelines for trans-European energy networks.....	215
9. Communication COM(2006) 846 on Priority Interconnection Plan.....	217
10. Regulation 1228/2003 on conditions for access to the network for cross-border exchanges in electricity.....	217
11. Regulation 714/2009 of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation 1228/2003.....	219
III. Taxation	220
12. Council Directive 2003/96 of 27 October 2003 on taxation of energy products and electricity	220
IV. Security of supply	222
13. Directive 2005/89 concerning measures to safeguard security of electricity supply and infrastructure investment.....	222
V. EU External dimension	223
14. Council Decision 2006/500 on the conclusion by the European Community of the Energy Community Treaty .....	223
VI. EU Enlargement – Turkey (ongoing)	225
15. Commission Report COM (2008) 674 final – SEC (2008) 2699 –not published in the Official Journal.....	225
VII. Renewable energy	227
16. Directive 2009/28 of 23 April 2009 on the promotion of the use of energy from renewable sources.....	227

## Basics of EU legislation

EU institutions adopt three types of laws, directives, regulations and decisions, which take precedence over national law and are binding on national authorities. The EU also issues non-binding instruments, such as recommendations and opinions.

### 1. Directive

EU directives lay down certain end results that must be achieved in every Member State. National authorities have to adapt their laws to meet these goals, but are free to decide how to do so. Directives may concern one or more EU countries, or all of them.

Each directive specifies the date by which the national laws must be adapted - giving national authorities room to maneuver within the deadlines necessary to take account of differing national situations. Directives are used to bring different national laws into line with each other, and are particularly common in matters that affect the operation of the single market (e.g. product safety standards).

### 2. Regulation

Regulations are the most direct form of EU law - as soon as they are passed, they have binding legal force throughout every Member State, on a par with national laws. National governments do not have to take action themselves to implement EU regulations.

They are different from directives, which are addressed to national authorities, who must then take action to make them part of national law, and decisions, which apply in specific cases only, involving particular authorities or individuals. Regulations are passed both jointly by the EU Council and European Parliament, and by the Commission alone.

### 3. Decision

Decisions are EU laws relating to specific cases. They can come from the EU Council (sometimes jointly with the European Parliament) or the Commission.

They can require authorities and individuals in Member States either do something or stop doing something, and can also confer rights on them.

EU decisions are:

- addressed to specific parties (unlike regulations),
- fully binding.

## Milestones in the construction of the EU internal energy market<sup>111</sup>

The first electricity and gas directives were adopted in the late 1990s, with the objective of opening up the electricity and gas markets by gradually introducing competition. The Commission has consistently argued that liberalization increases the efficiency of the energy sector and the competitiveness of the European economy as a whole. But a number of stakeholders and member states, notably France and Germany, vehemently disagree with this assessment.

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<sup>111</sup> Source: <http://www.euractiv.com/en/energy/liberalising-eu-energy-sector/article-145320>

While most member states had implemented the electricity and gas directives by September 2000, a 2001 Commission inquiry concluded that further measures were necessary in order to complete the internal energy market and to reap its benefits.

The second gas and electricity directives, adopted in June 2003, include '**unbundling**', whereby energy transmission networks have to be run independently from the production and supply side.

According to the directives, markets for all non-household gas and electricity customers are to be liberalized by July 2004. For private households, the deadline is July 2007. After these dates, businesses and private customers would theoretically have been able to choose their power and gas suppliers freely in a competitive marketplace.

But a competition enquiry in the electricity sector, published in January 2007, revealed some "serious malfunctions" in the market for industrial consumers.

For example, market concentration still reflects the 'old' market structure, characterized by national or regional monopolies - usually dominated by vertically integrated companies - which control electricity prices in the wholesale market and block new entrants to the market. In the gas sector, "incumbents tend to control imports and/or domestic production," according to the Commission.

Corrective action was promised by the EU executive, which tabled a further package of proposals in September 2007. After long negotiations, the Parliament and the Czech Presidency struck a compromise deal on the legislative package on 23 March 2009 (see Directives 2009/72 and 2009/73 below)

## **I. A competitive internal market**

### **1. Regulation 713/2009 establishing an Agency for the Cooperation of Energy Regulators**

#### **SUMMARY**

This Regulation establishes the Agency for the Cooperation of Energy Regulators with the aim of exercising at Community level the tasks performed by the Member States' regulatory authorities.

The Agency for the Cooperation of Energy Regulators is a Community body with legal personality. It shall issue opinions on all questions related to the field of energy regulators. It shall participate in the creation of network codes in the fields of electricity and gas and it can make decisions regarding cross-border infrastructure, including derogations from certain provisions in the applicable regulations.

#### **Tasks**

##### *Tasks concerning the cooperation of transmission system operators*

The Agency is responsible for issuing an opinion on the draft statutes, the list of members and the draft rules of procedure of the ENTSO (European Network of Transmission System Operators) for electricity and gas, and for monitoring the execution of the tasks. The Agency shall play an important role in drafting the framework guidelines which the network codes must comply with. In addition, the Agency shall monitor regional cooperation between transmission

system operators in the electricity and gas sectors, and the execution of tasks by the ENTSO for electricity and gas.

#### *Tasks concerning national regulatory authorities*

The Agency is responsible for adopting, under certain conditions, individual decisions on technical issues. It may make recommendations with the aim of promoting the exchange of good practice between regulatory authorities and market players. It shall also provide a framework for cooperation between the national regulatory authorities.

The Agency may issue an opinion on whether a decision taken by a regulatory authority complies with the applicable Community rules. If its opinion is not followed, the Agency shall inform the European Commission and the Member State concerned.

The Agency is also responsible for determining, under certain conditions, the terms and conditions for access to and operational security of electricity and gas infrastructure, which connects at least two Member States.

#### *Tasks concerning cross-border infrastructure*

The terms and conditions for access applicable to cross-border infrastructure include:

- a procedure for capacity allocation;
- a time-frame for allocation;
- shared congestion revenues;
- the levying of charges on the users of the infrastructure.

The Agency is responsible for the terms and conditions for access and security only when the national regulatory authorities have not been able to reach an agreement within a period of six months or they have jointly requested it.

The Agency is responsible for monitoring the internal markets in electricity and natural gas, in particular the retail prices of electricity and natural gas.

To facilitate the consultation of Member States' regulatory bodies, Commission Decision 2003/796/EC has established an independent consultation group for the electricity and gas sectors (European Regulatory Group for Electricity and Gas or ERGEG). Although the results of its work are positive, it became apparent that Member States need to cooperate under a Community structure in order to strengthen the internal market in gas and electricity.

## **2. Directive 2003/54 concerning common rules for the internal market in electricity**

### **SUMMARY**

This Directive establishes common rules for the generation, transmission and distribution of electricity. It lays down the rules relating to the organization and functioning of the electricity sector, access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorizations and the operation of systems.

### **Public service obligations and customer protection**

Electricity undertakings must be operated in accordance with commercial principles, with no discrimination between undertakings as regards either rights or obligations. The objective is to achieve a competitive, secure and environmentally sustainable market in electricity.

Member States must:

- impose on undertakings operating in the electricity sector public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies and environmental protection, including energy efficiency and climate protection;
- ensure that all household customers and small enterprises, at least, enjoy the right to be supplied with electricity of a specified quality within their territory at reasonable, easily and clearly comparable and transparent prices;
- take appropriate measures to protect end-users and vulnerable customers, including measures to help them avoid disconnection;
- ensure the implementation of a system of third party access to the transmission and distribution systems for all eligible customers;
- inform the Commission upon implementation of this Directive.
- providing the operator of any other system to which its system is interconnected with sufficient information to ensure secure and efficient operation;
- ensuring non-discrimination between system users;
- providing system users with the information they need for efficient access to the system.

### **3. Directive 2009/72 concerning common rules for the internal market in electricity and repealing Directive 2003/54 as from March 3 2011**

#### **SUMMARY**

This Directive aims at introducing common rules for the generation, transmission, distribution and supply of electricity. It also lays down universal service obligations and consumer rights, and clarifies competition requirements.

#### **Rules for the organization of the sector**

The rules for the organization of the sector are aimed at developing a competitive, secure and environmentally sustainable market in electricity.

Member States may impose on undertakings operating in the electricity sector public service obligations which cover issues of security and security of supply, regularity and quality of service, price, environmental protection and energy efficiency.

Member States shall ensure that all customers have the right to choose their electricity supplier and to change supplier easily, with the operator's assistance, within three weeks. They shall also ensure that customers receive relevant consumption data.

Electricity suppliers are obliged to inform final customers about:

- the contribution of each energy source;
- the environmental impact caused;
- their rights in the event of a dispute.

Member States shall put in place an independent mechanism (energy ombudsman or consumer body) to manage complaints or disputes efficiently.

Member States are also obliged to ensure the monitoring of security of supply. They shall define technical safety criteria to ensure the integration of their national markets at one or more regional levels. In addition, the national regulatory authorities are to cooperate with the Agency for the Cooperation of Energy Regulators to guarantee the compatibility of regulatory frameworks between regions.

### **Generation**

Member States shall define criteria for the construction of generating capacity in their territory taking account of aspects such as:

- the security and safety of electricity networks;
- the protection of health and public safety;
- the contribution made towards the Commission's "20-20-20" objectives.

### **Transmission system operation**

From 3 March 2012, Member States must unbundle transmission systems and transmission system operators.

An undertaking must first be certified before being officially designated as a transmission system operator. A list of transmission system operators designated by Member States shall then be published in the Official Journal of the European Union.

Transmission system operators are mainly responsible for:

- ensuring the long-term ability of the system to meet demands for electricity;
- ensuring adequate means to meet service obligations;
- contributing to security of supply;
- managing electricity flows on the system;
- providing to the operator of any other system information related to the operation, development and interoperability of the interconnected system;
- ensuring non-discrimination between system users;
- providing system users with the information they need to access the system;
- collecting congestion rents and payments under the inter-transmission system operator compensation mechanism.

### **Distribution network operation**

Member States shall designate distribution system operators or require undertakings that own or are responsible for distribution systems to do so.

Distribution system operators are mainly responsible for:

- ensuring long-term capacity of the system in terms of the distribution of electricity, operation, maintenance, development and environmental protection;

- ensuring transparency with respect to system users;
- providing system users with information;
- covering energy losses and maintaining reserve electricity capacity.

### **Organization of access to the system**

Member States shall organize a system of third party access to transmission and distribution systems. The tariffs based on that system shall be published.

Member States shall also lay down criteria for the granting of authorizations to construct direct lines in their territory, on an objective and non-discriminatory basis.

### **National regulatory authorities**

Member States shall designate a regulatory authority at national level. It shall be independent and exercise its powers impartially. It is mainly responsible for:

- fixing transmission or distribution tariffs;
- cooperating in regard to cross-border issues;
- monitoring investment plans of the transmission system operators;
- ensuring access to customer consumption data.

### **Context**

The Communications entitled ‘Prospects for the internal gas and electricity market’ and ‘Sector inquiry into the gas and electricity markets’ emphasized the inadequate framing of the rules and measures in force relating to the internal electricity market. The Commission deemed it important to amend the current rules with a view to ensuring fair competition and supplying electricity at the lowest possible price in order to complete the internal market in energy.

## **4. Communication COM(2006) 841 “Prospects for the internal gas and electricity market” of 10 January 2007**

### **SUMMARY**

The aim of the European Union (EU) is to set up a truly competitive internal market for gas and electricity to offer consumers a real freedom of choice at fair, competitive prices, to stimulate clean energy production and to improve security of supply.

Although the internal energy market is well established, malfunctioning (identified by the sector inquiry into the gas and electricity markets) persists, preventing both consumers and the economy from getting the full benefit of the advantages of opening up the national gas and electricity markets.

As current rules do not allow effective correction of this malfunctioning, new measures must be taken as the final step in achieving integrated operation of the internal energy market in Europe.

### **Advantages of creating the internal energy market**

The opening of national markets in gas and electricity to competition visibly gives consumers the freedom to choose their energy supplier and, therefore, the opportunity to make savings. It also improves the security of supply by encouraging, on the one hand, investment in facilities, so that interruptions to supply can be prevented, and, on the other hand, diversification of transport

routes and energy sources. The existence of a truly competitive energy market also contributes to sustainable development, notably by enabling suppliers of electricity from renewable energy sources to enter the market.

### **Continued malfunctioning**

In practice, the EU is still a long way from achieving its objective of a real internal market in which each consumer has the legal right to choose his supplier and exercise this right simply and effectively armed with the facts, and the current rules do not effectively prevent market malfunctioning.

The legal and functional unbundling of system operators vertically connected to suppliers and producers has proven insufficient to guarantee equal access to the networks. The traditional operators thus maintain their dominant position and new companies wishing to enter the market encounter many problems caused by discriminatory access conditions, lack of available network capacity, a lack of transparent data on the network situation and poor investment.

National regulators do not have the powers or independence necessary for succeeding in their mission. Their powers vary considerably from one Member State to the next, hindering cross-border trade and access to consumers in other Member States.

### **New set of rules for completion of the internal energy market**

- Provision of non-discriminatory access to the networks through unbundling

Current legal and functional unbundling has proven insufficient in removing the conflict of interests arising from vertical integration. Clearer separation between operation of transmission systems and production or supply activities must be introduced to ensure that operators maintain, operate and develop the networks in the general interest of the network users.

The separation may be based either on complete ownership unbundling, due to transmission system operators being both operators and owners of the system, or on introduction of an independent transmission system operator for maintenance, development and operation of the systems, which remain the property of the vertically integrated companies.

Complete ownership unbundling appears to be the most economically effective way to ensure development of a real internal energy market. Not only does it eliminate the different interests of system operators but also avoids the need for excessively detailed and complex regulations ensuring independence of vertically integrated system operators.

- Strengthening of the role of regulators at national and Community level

The regulatory framework and therefore the powers of the regulators must be strengthened to ensure the conditions of transparency, stability and non-discrimination necessary for development of competition and for investment.

Better coordination of national regulators at European level is, in addition, needed to mitigate the market segmentation resulting from the regulatory differences between Member States. In this sense, it is possible either to improve the present approach, with the disadvantage of continuing to rely on voluntary agreements between 27 national regulators often with different interests, or to formalize the role of the European Regulators Group for Electricity and Gas (ERGEG) into a European Network of Independent Regulators (ERGEG +), or lastly to set up a new single body at Community level.



- Cooperation of transmission system operators (TSOs)

To enable free circulation of gas and electricity within the EU, it is essential to establish compatible technical rules and regular exchange of information, increase investment in the network and, in particular, in cross-border interconnections, and move towards regional system operators.

- Reduction in possibilities for unfair competition

Due to the monopolies held by the traditional operators before liberalization, the lack of integration and their natural characteristics, in particular low elasticity of demand, the gas and electricity markets are particularly exposed to the risk of dominant positions.

Greater transparency, recourse to the ‘use-it-or-lose-it’ principle, genuine access to gas storage facilities and maintenance of incentives in favor of new storage capacities would facilitate the transition to a more competitive gas and electricity market.

- Encouragement of investment in electricity power plants and gas infrastructures

Creating a stable environment for investment is a priority. Other factors may also influence investment, such as the award of emission certificates or specific incentive measures, for example for production of electricity from renewable energy sources.

- Consumer protection

Consumer protection and public service obligations must be an integral part of the process of opening up the gas and electricity markets. An energy consumers’ charter must therefore protect their essential rights: the right to relevant information on the different suppliers and supply possibilities, the right to a straightforward procedure for changing supplier, protection against energy poverty for the most vulnerable consumers, protection against unfair commercial practices, etc.

## **5. Council Directive 90/377 of 29 June 1990 concerning the transparency of gas and electricity prices charged to industrial end-users**

### **SUMMARY**

The transparency of energy prices contributes to the creation and smooth operation of the internal energy market.

The transparency of gas and electricity prices in fact improves the conditions ensuring fair competition within the market. It can help eliminate discrimination of consumers, by promoting their freedom to choose between different energy sources (oil, coal, fossil fuels and renewable energy sources) and between different suppliers.

The Member States make sure that companies supplying gas or electricity to European end-users send the Statistical Office of the European Communities ([Eurostat](#)) information relating to:

- prices and conditions of sale of gas and electricity to these consumers;
- the pricing systems in force;
- breakdown of consumers by category and their respective market share.

Information regarding gas and electricity prices is sent to Eurostat twice a year whereas information on consumer breakdown by category is only sent every two years.

The methods adopted by Eurostat guarantee that the confidentiality of the information is not compromised and that, as a consequence, commercial confidentiality is respected.

For energy price transparency to be truly effective, prices and pricing systems must be published and broadcast for consumers as widely as possible. Furthermore, the reliability of data sent to Eurostat can be checked.

## **6. Directive 2003/87 establishing a scheme of greenhouse gas emission allowance trading**

### **SUMMARY**

This Directive establishes a Community greenhouse gas emission trading scheme from 1 January 2005. In this context, 'allowance' means the entitlement to emit a tonne of carbon dioxide or an amount of any other greenhouse gas with an equivalent global warming potential during a specified period.

#### **Greenhouse gas emission permits**

With effect from 1 January 2005, all installations carrying out any of the activities listed in Annex I to this Directive (activities in the energy sector, iron and steel production and processing, the mineral industry and the wood pulp, paper and board industry) and emitting the specific greenhouse gases associated with that activity must be in possession of an appropriate permit issued by the competent authorities.

Applications for greenhouse gas emission permits must describe:

- the installation, its activities and the technology used;
- the materials used which could emit the greenhouse gases listed in Annex II;
- the sources of gas emissions;
- the measures planned to monitor and report emissions.

The authorities will issue a permit provided that they are satisfied that the operator of the installation is capable of monitoring and reporting the emissions. A permit may cover one or more installations on the same site operated by the same operator. The permit will contain details of:

- the name and address of the operator;
- the installation's activities and emissions;
- the monitoring methodology and frequency;
- the reporting requirements in respect of emissions;
- the obligation to surrender, during the first four months of each year, a quantity of allowances commensurate with the total emissions over the previous year.

#### **Management of allowances**

Each Member State must draw up a national plan complying with the criteria set out in Annex III to this Directive, indicating the allowances it intends to allocate for the relevant period and how it proposes to allocate them to each installation. The plans covering the initial three-year period specified in the Directive (1 January 2005 to 1 January 2008) had to be published by 31 March

2004 at the latest, and those relating to the subsequent five-year periods are to be published at least eighteen months before the beginning of the relevant period. When drawing up the plans, Member States should take due account of comments from the public. If a plan does not comply with the criteria in Article 10 of or Annex III to this Directive, the Commission may reject it within three months of notification.

Under the Directive, at least 95% of the allowances for the initial three-year period were to be allocated to the installations free of charge. For the five-year period beginning 1 January 2008, Member States must allocate 90% of the allowances free of charge.

Member States will ensure the free circulation of allowances within the European Community. Each year, no later than 30 April, they will also make sure that the operators of the installations surrender the correct quantity of allowances commensurate with the total emissions over the previous year. The surrendered allowances are subsequently cancelled.

### **Kyoto Protocol project mechanisms**

Directive 2004/101/EC reinforces the link between the EU's emission allowance trading scheme and the Kyoto Protocol by making the latter's 'project-based' mechanisms (Joint Implementation and the Clean Development Mechanism) compatible with the scheme. This will enable operators to use these two mechanisms in the allowance trading scheme to fulfill their obligations. The result will be lower compliance costs for installations in the scheme. It is estimated that annual compliance costs in the period 2008-12 for all installations covered in the enlarged EU will be reduced by more than 20%.

This Directive thus recognizes joint implementation (JI) and clean development mechanism (CDM) credits as equivalent to EU emission allowances, except for those from land use, land use change and forestry activities. Credits from JI projects are called 'emission reduction units' (ERU), while credits from CDM projects are called 'certified emission reductions' (CER). The Directive also takes steps to prevent ERUs and CERs being counted twice where they result from activities which also lead to a reduction in, or limitation of, emissions from installations covered by Directive 2003/87/EC.

## **II. An interconnected EU internal market**

### **7. Green paper – towards a secure, sustainable, and competitive European energy network**

#### **SUMMARY**

Through this Green Paper, the Commission launches a public consultation with a view to developing a new strategic approach to energy networks which aims to achieve the climate and energy objectives of the European Union.

#### **Priorities**

The main priority is to improve the Community framework with a view to developing the energy networks of the Member States of the Union and to integrate them better so as to enhance the operation of the internal energy market.

Energy transportation networks make up the keystone of energy policy. For this reason the Trans-European Energy Networks (TEN-E) should correspond to the new requirements of energy policy with regard to sustainability, supply and competitiveness. Adopted in 1996, they

should be amended so that they correspond to the objectives set out in the 2007 Energy Policy for Europe.

**The external dimension** is also a significant issue for the development of energy networks. The internal energy market depends strongly on imports. New import routes will need to be integrated into the network from:

- Central Asia;
- the Caspian Sea;
- the Middle East;
- Africa.

The coordination and management of the networks will be carried out by the future Agency for the Cooperation of Energy Regulators, and by two European Networks of Transmission System Operators. The infrastructure plans will be implemented for a duration of ten years.

There is also an urgent need (in addition to the investments necessary to modernize energy networks and to replace obsolete infrastructures) at European level, for new projects that allow all Member States to be integrated in the internal market and also integrate new technologies. New energy resources must therefore be developed and be accessible across the best interregional connections.

### **A new approach to energy network development**

Energy network development should become a central issue when implementing energy policy.

The 20-20-20 objectives should be implemented effectively through programs relating to both the public and private sectors. These objectives consist of:

- the integration of renewable energy sources in the network;
- the transport of energy from resource-rich areas to consumption centers;
- the use of technologies for the decentralization of energy production and intelligent networks;
- the use of energy coming from offshore wind farms;
- the development of technologies for the transport and storage of CO<sub>2</sub>.

## **8. Decision 1364/2006 laying down guidelines for trans-European energy networks**

### **SUMMARY**

The new guidelines for trans-European energy networks (TEN-E) list and rank, according to the objectives and priorities laid down, projects eligible for Community assistance. They also introduce the concept of 'project of European interest'.

### **Defining the objectives of the TEN-E**

The interconnection, interoperability and development of trans-European networks for transporting electricity and gas are essential for the **effective operation of the internal energy market** in particular and the internal market in general. Users should have access to higher-quality services and a wider choice as a result of the diversification of energy sources, at more competitive prices. Closer links should therefore be established between national markets and the

EU as a whole. With that in mind, the new Member States are now fully incorporated into the Community TEN-E guidelines.

TEN-E also play a crucial role in ensuring the **security and diversification of supply**. Interoperability with the energy networks of third countries (accession and candidate countries and other countries in Europe, in the Mediterranean, Black Sea and Caspian Sea basins, and in the Middle East and Gulf regions) is essential.

Access to TEN-E also helps to reduce the isolation of the less-favored, island, landlocked or remote regions, thus strengthening **territorial cohesion** in the European Union (EU).

The interconnection of TEN-E also promotes **sustainable development**, in particular by improving the links between renewable energy production installations and using more efficient technologies, thus reducing losses and the environmental risks associated with the transportation and transmission of energy.

### **Projects of common interest, priority projects and projects of European interest**

Decision 1364/2006/EC lists projects eligible for Community assistance under Regulation (EC) No 2236/95 and ranks them in three categories.

**Projects of common interest** relate to the electricity and gas networks referred to in the Decision meeting the objectives and priorities laid down in it. They must display potential economic viability. The economic viability of a project is assessed by means of a cost-benefit analysis in terms of the environment, the security of supply and territorial cohesion. Projects of common interest are listed in Annexes II and III to the Decision.

**Priority projects** are selected from among the projects of common interest. To be eligible, they must have a significant impact on the proper functioning of the internal market, on the security of supply and/or the use of renewable energy sources. Priority projects, which are listed in Annex I to the Decision, have priority for the granting of Community financial assistance.

Certain priority projects of a cross-border nature or which have a significant impact on cross-border transmission capacity are declared to be **projects of European interest**. Also listed in Annex I, projects of European interest have priority for the granting of Community funding under the TEN-E budget and particular attention is given to their funding under other Community budgets.

### **A favorable framework for the development of TEN-E**

The Community guidelines for TEN-E stress the importance of facilitating and speeding up the completion of projects, in particular projects of European interest.

The Member States must take all measures necessary to minimize delays while complying with environmental rules. The authorization procedures must be completed rapidly. The third countries involved must also facilitate the completion of projects partly situated on their territory in accordance with the Energy Charter Treaty.

The new guidelines also establish a framework for closer cooperation, in particular for projects of European interest. They provide for an exchange of information and the organization of coordination meetings between the Member States for implementing the cross-border sections of networks.

## **9. Communication COM (2006) 846 on Priority Interconnection Plan**

### **SUMMARY**

Interconnection of networks allows the transmission of electricity and gas between markets usually organized on a national basis, and is a key element in setting up trans-European gas and electricity networks.

Interconnected networks are vital to the development of healthy competition and constitute a prerequisite to successfully creating an internal energy market. They also prevent the risk of short supply by diversifying sources, for example for electricity, by facilitating the introduction of a "green network" based on renewable energies.

### **Development of energy structures in Europe**

The trans-European networks are currently underdeveloped as a result of insufficient funding. Certain malfunctions demonstrate the lack of coordination between the national energy networks and of a genuine separation of production, transport and distribution functions. System operators belonging to vertically-integrated companies have no incentive to develop their interconnections with other networks and expose themselves to competition from new producers and suppliers in the sector.

The infrastructures are increasingly operated at the limit of their physical capacities which hampers the integration of additional energy resources necessary for market growth. Thus the large-scale production of electricity from renewable sources could be compromised in certain regions. The saturation of the networks also threatens to generate temporary breakdowns in supply and an increase in energy prices. Numerous regions remain "energy islands" with poor interconnections, or none at all, with the rest of the internal market.

The Priority Interconnection Plan (PIP) details the progress of the 42 projects of European interest listed in the Guidelines for trans-European energy networks (TEN-E) adopted in 2006.

Sixty percent of electricity network projects are behind schedule, largely due to the complexity and lack of harmonization in planning and authorization procedures. Funding problems and environmental or health objections also constitute obstacles.

Although the gas projects of European interest are progressing more satisfactorily, the completion of terminals and storage facilities for liquefied natural gas (LNG) sometimes encounter major problems in some Member States where a number of projects have been abandoned or frozen. External interconnections require particular attention since they are responsible for more than 50% of our supplies and are becoming increasingly political.

## **10. Regulation 1228/2003 on conditions for access to the network for cross-border exchanges in electricity**

### **SUMMARY**

The purpose of the Regulation is to stimulate cross-border exchanges in electricity by establishing a compensation mechanism for transit flows of electricity and by introducing harmonized principles on cross-border transmission charges and the allocation of available interconnection capacities between national transmission systems.

### **Compensation mechanism between operators of transmission systems**

Transmission system operators (TSOs) receive compensation for costs incurred as a result of hosting cross-border flows of electricity on their network. This compensation is paid by the operators of national transmission systems from which the cross-border flows originate. Compensation received by TSOs for hosting cross-border flows will be calculated based on the costs of the infrastructure "used" for the flows.

Charges applied by network-operators for access to networks are transparent and take into account the need for network security and reflect actual costs incurred.

### **Information on interconnection capacities**

TSOs install coordination and information exchange mechanisms to ensure security of the networks in the context of congestion management. Network congestion problems are addressed with non-discriminatory solutions, i.e. methods that do not involve a selection between contracts of individual market participants.

### **General principles of congestion management**

Market participants must inform the transmission system operators concerned whether they intend to use allocated capacity a reasonable time ahead of the relevant operational period. Any allocated capacity that will not be used is reattributed to the market in an open, transparent and non-discriminatory manner.

### **New interconnectors**

New direct current interconnectors may, under certain strict conditions, benefit from exemptions. In this context, the Commission has to monitor Member States' decisions regarding exemptions and the restrictive way these measures are to be interpreted.

### **Guidelines**

The guidelines specify in particular:

- details of methods for determining the quantity of cross-border flows hosted and the magnitudes of such flows;
- details of the treatment in the context of the inter-TSO compensation mechanism of electricity flows originating or ending in countries outside the European Economic Area (EEA);

### **Provision of information and confidentiality**

Member States and the regulatory authorities provide the Commission, on request, with all necessary information. The Commission fixes a reasonable time limit, taking into account the complexity of the information required and the urgency with which the information is needed. The Commission does not disclose this information which is covered by the obligation of professional secrecy.

### **Penalties**

The Member States lay down the rules on penalties applicable to infringements of the provisions of this Regulation and take all measures necessary to ensure that they are implemented. The Member States notify those provisions to the Commission by 1 July 2004 at the latest.

## **11. Regulation 714/2009 of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation 1228/2003**

### **SUMMARY**

This Regulation aims at laying down rules for cross-border exchanges in electricity with a view to improving competition and harmonization in the internal market for electricity.

#### **Certification of transmission system operators**

National regulatory authorities shall send the European Commission notification of decisions concerning the certification of a transmission system operator. The Commission then has a period of two months to deliver its opinion to the national regulatory authority. The authority then adopts the final decision concerning the certification of the transmission system operator. This decision and the Commission's opinion are published.

#### **European Network of Transmission System Operators (ENTSO) for electricity**

##### *Creation of the ENTSO for Electricity*

The European Network of Transmission System Operators (ENTSO) for electricity is responsible for managing the electricity transmission system and for allowing the trading and supplying of electricity across borders in the Community. By 3 March 2011, the transmission system operators for electricity shall submit to the Commission and to the Agency for the Cooperation of Energy Regulators the draft statutes for the ENTSO for electricity, a list of members and draft rules of procedure.

##### *Tasks of the ENTSO concerning network codes*

The Commission shall consult the Agency for the Cooperation of Energy Regulators and the ENTSO for Electricity in order to establish an annual list of the priorities which are to contribute to developing network codes. These codes shall be developed using a non-binding framework guideline submitted to the Commission by the Agency. The codes include rules and procedures relating in particular to:

- network security and reliability;
- data interexchange;
- technical and operational exchanges;
- transparency rules;
- harmonized transmission tariff structures;
- energy efficiency.

##### *Tasks of the ENTSO for Electricity*

The ENTSO for Electricity is responsible for adopting:

- common network operation tools;
- a ten-year network development plan;
- recommendations relating to the coordination of technical cooperation between Community transmission system operators;



- an annual work program;
- an annual report;
- annual summer and winter generation supply outlooks.

### *Costs and financing*

The costs related to the activities of the ENTSO for electricity shall be borne by the transmission system operators. They shall establish regional cooperation within the ENTSO for electricity and publish a regional investment plan every two years, on which investments may be based.

Transmission system operators shall receive compensation for costs incurred as a result of hosting cross-border flows of electricity on their networks. The compensation shall be paid by the operators of national transmission systems from which cross-border flows originate. The costs shall be established on the basis of forecasted costs.

Charges for access to networks shall also be applied by operators.

### *Information and congestion management*

Transmission system operators shall put in place information exchange mechanisms to ensure the security of networks in the context of congestion management.

Network congestion problems shall be addressed with non-discriminatory market-based solutions which give economic signals to the market participants and transmission system operators.

New interconnectors may, upon request, be exempted, for a limited period of time, from the general provisions governing congestion management on condition that:

- their installation increases competition in electricity supply;
- the level of risk necessitates the exemption;
- the interconnection must be owned by a natural or legal person;
- charges are levied on users of the interconnection;
- the exemption must not be to the detriment of competition in the internal market.

This Regulation repeals Regulation (EC) No 1228/2003 as from 3 March 2011.

## **III. Taxation**

### **12. Council Directive 2003/96 of 27 October 2003 on taxation of energy products and electricity**

#### **SUMMARY**

Energy products and electricity are only taxed when they are used as motor or heating fuel, and not when they are used as raw materials or for the purposes of chemical reduction or in electrolytic and metallurgical processes.

On the basis of this principle, the Directive sets minimum rates of taxation for motor fuel, motor fuel for industrial or commercial use, heating fuel and electricity. The "levels of taxation" \* applied by the Member States may not be lower than the minimum rates set in the Directive.

The minimum levels of taxation applicable to heating fuels and electricity are the following:

-	Current minimum excise rates	Minimum excise rates from 1.1.2004 (business use)	Minimum excise rates from 1.1.2004 (non-business use)
Diesel (/1000 l.)	18	21	21
Heavy fuel oil (/1000 kg.)	13	15	15
Kerosene (/1000 l.)	0	0	0
LPG (/1000 kg.)	0	0	0
Natural gas (/gigajoule)	-	0.15	0.3
Coal and coke (/gigajoule)	-	0.15	0.3
Electricity (/MWh)	-	0.5	1.0

(The volumes are measured at a temperature of 15° C).

The Member States which on 1 January 2003 were authorized to apply a monitoring charge for heating gas-oil may continue to apply a reduced rate of EUR 10 per 1000 liters for that product. This authorization will be repealed on 1 January 2007 if the Council, acting unanimously on the basis of a report and a proposal from the Commission, so decides, having noted that the level of the reduced rate is too low to avoid problems of trade distortion between the Member States.

### **Differentiated rates of taxation**

Provided that they comply with the minimum levels of taxation prescribed by the Directive and are compatible with Community law, differentiated rates of taxation may be applied by Member States, under fiscal control, in the following cases:

- when the differentiated rates are directly linked to product quality;
- when the differentiated rates depend on quantitative consumption levels for electricity and energy products used for heating purposes;
- for the following uses: local public passenger transport (including taxis), waste collection, armed forces and public administration, disabled people, ambulances;
- between business and non-business use, for the energy products and electricity referred to above.

### **Exemptions and reductions**

The following are exempt from taxation:

- energy products and electricity used to produce electricity and electricity used to maintain the ability to produce electricity. However, Member States may, for reasons of environmental policy, subject these products to taxation;
- energy products supplied for use as fuel for the purpose of air navigation other than in private pleasure-flying;
- energy products supplied for use as fuel for the purposes of navigation within Community waters, including fishing, other than private pleasure craft, and electricity produced on board a craft.

## **IV. Security of supply**

### **13. Directive 2005/89 concerning measures to safeguard security of electricity supply and infrastructure investment**

#### **SUMMARY**

##### **Subject matter and scope**

This Directive establishes measures aimed at safeguarding security of electricity supply so as to ensure the proper functioning of the EU internal market for electricity, an adequate level of interconnection between Member States, an adequate level of generation capacity and balance between supply and demand.

Member States must define general, transparent and non-discriminatory policies on security of electricity supply compatible with the requirements of a competitive single market for electricity. They must define and publish the role and responsibilities of competent authorities and different players in the market.

When adopting policy implementation measures, Member States must take certain elements into account, in particular the need to:

- ensure continuity of electricity supplies;
- study the internal market and the possibilities for cross-border cooperation in relation to security of electricity supply;
- reduce the long-term effects of growth of electricity demand;
- introduce a degree of diversity in electricity generation in order to ensure a reasonable balance between different primary fuels;
- promote energy efficiency and the use of new technologies;
- continuously renew transmission and distribution networks to maintain performance.

##### **Operational network security**

Transmission network operators must set minimum rules and obligations to ensure continuous operation of the transmission and, where appropriate, the distribution network under foreseeable circumstances. Member States may decide that these rules and obligations must be approved by the competent authorities and, where appropriate, also respected by the transmission network operators.

The network operators must set and meet quality of supply and network security performance objectives. Curtailment of supply in emergency situations must be based on predefined criteria and the relevant measures taken in consultation with other transmission system operators concerned.

##### **Balancing supply and demand**

The Directive provides for specific measures necessary to maintain the balance between electricity demand and available generation capacity, to avoid Member States taking more interventionist measures which are incompatible with competition. They will need to have a clear policy in place to maintain the balance between supply and demand. In particular Member States

need to encourage the establishment of wholesale markets, require network operators to ensure that an appropriate level of generation reserve capacity is maintained, facilitate the development of new generation capacity, or encourage energy conservation and technology for demand management in real time.

### **Network investment**

Investment is crucial for competition and the future security of electricity supply in the EU. Member States must lay down a framework for providing information to network operators which facilitates investment.

## **V. EU External dimension**

### **14. Council Decision 2006/500 on the conclusion by the European Community of the Energy Community Treaty**

#### **SUMMARY**

The Energy Community Treaty provides for the creation of an integrated energy market (electricity and gas) between the European Community and the contracting parties.

The members of the Energy Community are the European Community, Albania, Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia and the United Nations Interim Administration Mission in Kosovo pursuant to United Nations Security Council Resolution 1244. In addition, one or more Member States of the European Union (EU) may participate in the Energy Community at the request of the Ministerial Council. Third countries may be accepted as observers.

The Treaty applies to the territory of the contracting parties and the territory under the jurisdiction of the United Nations Interim Administration Mission in Kosovo.

The Treaty entered into force on 1 July 2006. It is concluded for a term of ten years. Its application may be extended either for all parties by unanimous decision of the Ministerial Council, or for the parties who vote for extension (as long as they number at least two thirds of the number of Energy Community members).

#### **Role of the Energy Community**

The objectives of the Energy Community are:

- to create a stable legal and market framework capable of attracting investment in order to ensure a stable and continuous energy supply;
- to create a single regulatory space for trade in network energy;
- to enhance security of supply in this space and develop cross-border relations;
- to improve energy efficiency and the environmental situation related to network energy and develop renewable energy sources;
- to develop network energy market competition.

#### **Activities of the Energy Community**

An important part of the Energy Community's activities involves the implementation of a part of Community legislation, or 'acquis communautaire'<sup>112</sup>, in all the States parties to the Treaty, on energy, environment, competition and renewable energies, as well as compliance with certain general Community standards relating to technical systems, for example on the subject of cross-border transportation or connection.

In addition, the Treaty establishes a mechanism for operation of regional energy markets which covers the territory of the parties to the Treaty and the EU Member States involved (Austria, Bulgaria, Greece, Hungary, Italy, Romania and Slovenia). This system provides a framework of measures relating to long-distance transportation of network energy, security of supply, provision of energy to citizens, harmonization, promotion of renewable energy sources and energy efficiency, as well as in the event of sudden crisis on the network energy market in the territory of an Energy Community member.

Furthermore, the Treaty creates an energy market without internal frontiers between the parties, in which customs duties and quantitative energy import and export restrictions, and any measures having equivalent effect, are prohibited between the parties, unless exceptional circumstances apply (relating to public order, public safety, protection of human and animal health, preservation of plants, protection of industrial and commercial property). The Treaty also contains provisions on relations with third countries and mutual assistance in case of disturbance.

The Commission acts as coordinator of these activities.

### **Institutions and decision-making**

The Ministerial Council, made up of one representative for each party to the Treaty, provides general policy guidelines, takes measures to meet the Treaty's objectives and adopts procedural acts such as allocation of tasks, powers or obligations. The presidency is held in turn by each party for a term of six months and is assisted by one representative of the European Community and one representative of the incoming presidency. The Council submits an annual report to the European Parliament and to the parliaments of the contracting parties.

The key mission of the Permanent High Level Group is to prepare the work of the Ministerial Council. It consists of one representative of each party to the Treaty.

The Regulatory Board's primary role is to advise the other institutions and issue recommendations in the event of cross-border disputes. It is composed of, for each party to the Treaty, one representative of the energy regulator, with the European Community being represented by the European Commission, assisted by one regulator from each participating Member State, and one representative of the European Regulators Group for Electricity and Gas (EREG).

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<sup>112</sup> The Community *acquis* is the body of common rights and obligations which bind all the Member States together within the European Union. It is constantly evolving and comprises:

- the content, principles and political objectives of the Treaties;
- the legislation adopted in application of the treaties and the case law of the Court of Justice;
- the declarations and resolutions adopted by the Union;
- measures relating to the common foreign and security policy;
- measures relating to justice and home affairs;
- international agreements concluded by the Community and those concluded by the Member States between themselves in the field of the Union's activities

Moreover, the Energy Community is advised by two fora composed of representatives of all interested parties.

The permanent Secretariat, based in Vienna, provides, amongst other things, administrative support to the other institutions of the Energy Community and reviews proper fulfillment by the parties of their obligations.

The Energy Community makes decisions (binding) and recommendations (non-binding). These steps are taken, as appropriate, either on proposal from the European Commission (application of the *acquis communautaire*), or on proposal by a party to the Treaty (other activities), and are adopted either by a simple majority (application of the *acquis communautaire*), or by a two-thirds majority (mechanism for operation of markets), or by unanimity (internal energy market).

In the event of serious and persistent breach by a party of its obligations, the Ministerial Council may, acting by unanimity, suspend certain rights granted to this party by the Treaty.

## **VI. EU Enlargement – Turkey (ongoing)**

### **15. Commission Report COM (2008) 674 final – SEC (2008) 2699 –not published in the Official Journal**

#### **SUMMARY**

The energy sector in Turkey used to be dominated by State-owned companies. A privatization program was nevertheless devised with a view to privatizing areas such as coal, oil, electricity and gas. Turkey had to open up the energy sector to foreign investment in order to meet the increasing demand for energy consumption. Efforts had to be made to ensure that the sector was compatible with the Community internal energy market. The European strategy gave high priority to the approximation of laws in this sector. The first step towards this objective was to draw up a detailed inventory of the existing legislation.

The **1999 Report** emphasized that the objectives of Turkish energy policy were largely in line with those of the European Union (EU). They were concerned with security and diversification of sources of supply, market principles, environmental standards and improving efficiency. The amendment of the Constitution, paving the way for privatization, and international arbitration procedures were important steps forward in this connection. A list of Turkish and Community legislation in this field drawn up by Turkey with a view to alignment with the *acquis* would be evaluated by the Commission. Much still remained to be done in this area.

In its **November 2000 Report**, the Commission noted that progress with transposing the Community *acquis* in the field of energy had been limited. In total, only 16 out of 120 provisions on energy were in harmony with EC legislation. The restructuring of the sector was under way and the ratification of the Energy Charter Treaty and related instruments had been a positive step, but much remained to be done.

In its **November 2001 Report**, the Commission confirmed that progress had been made since the last report, in particular as regards the internal energy market. Turkey had adopted two key laws concerning the electricity and gas market which concerned in particular the definition of the new structure of the sectors and the status of the players in the two sectors. However, Turkish legislation had not been completely aligned with the Community legislation in this field. There had been no progress as regards security of supply, but Turkey's total oil reserves were in any case largely equivalent to the levels required by the Community *acquis*. Particular attention still

needed to be paid to energy efficiency since there had been no progress in this connection since the last report.

The **October 2002 Report** emphasized that Turkey had made significant progress in further aligning its legislation with the *acquis* in this area, particularly in the internal energy market.

The **2003 Report** noted that Turkey had continued to make progress with aligning its energy legislation, notably by adopting implementing legislation in the last year which made the internal energy market more competitive by opening up the gas market, among other things. Some progress had also been achieved in the field of energy efficiency and renewables.

The **2004 Report** noted that overall alignment remained limited and uneven across the different areas of energy policy. Further efforts were necessary, throughout the sector, to align with the *acquis* and to ensure effective implementation and enforcement of the legislation.

The **November 2005 Report** noted the continuation of efforts to align Turkey's energy laws. However, legislation needed to be implemented more effectively, especially as regards the opening up of the energy market. A reasonable and ambitious timetable needed to be adopted on energy efficiency and renewables. The various administrative bodies needed to be strengthened, especially in the field of nuclear energy.

The **November 2006 Report** noted that alignment in the energy sector was uneven and that progress was still needed in some areas, particularly as regards energy efficiency.

In its **November 2007 Report**, the Commission emphasized that some progress has been made, particularly in terms of energy efficiency. It encouraged Turkey to continue alignment with the *acquis*, to promote the adoption of ambitious targets for renewable energy and to reinforce the independence and capacity of the regulatory authorities.

The **2008 report** notes uneven progress in implementing the *acquis*. Competition is still limited and there are delays in the implementation of a transparent pricing scheme. Moreover, national objectives in terms of energy efficiency and renewable energy are still to be set.

### **Body of EU law (Community *Acquis*) (according to the Commission)**

Community energy policy objectives include the improvement of competitiveness, security of energy supplies and the protection of the environment. The energy *acquis* consists of rules and policies, notably regarding competition and State aid (including in the coal sector), the internal energy market (for example, opening up of the electricity and gas markets, promotion of renewable energy sources, crisis management and oil stock security obligations), energy efficiency and nuclear energy.

### **EVALUATION**

Turkey has made progress in aligning with the *acquis* and in its preparations for the internal energy market through the adoption of two major framework laws for the electricity and gas sectors concerning in particular restructuring and the players in the sectors. Those two laws should, however, be aligned to a greater extent with the two key Community directives concerning the internal energy market. Following the adoption of the 2002 Electricity Market Law, around 20% of the electricity market was opened up in 2002. The aim is to complete the opening up of the market by 2011. Five new implementing regulations have been adopted since the last report. The threshold for eligible consumers has moreover been reduced to 3 GWh. In July 2008, a cost-based pricing mechanism entered into force to enable enterprises operating in

the field of energy to reflect changes in production costs in their sale prices. The 2008 report also notes that the privatization of electricity distribution has been successful in four regions and that the market share of autonomous electricity producers has increased from 30 to 50 %.

Turkey has also set up an Energy Regulatory Board to monitor the energy sector. It should be noted that the adoption of the two key laws and the establishment of an Energy Regulatory Board were conditions for IMF (International Monetary Fund) support for Turkey. In general, Turkey's priority in restructuring the energy sector is to attract investment and reduce State control. The two laws have paved the way for this but much remains to be done.

On security of supply, Turkey has already introduced major measures and its oil reserves are more or less at the level of the 90 days required by the *acquis*. Turkey also has an important role to play in the EU's security of supply since it is a transit country for oil and gas from the Caspian Sea, the Black Sea and Central Asia. The construction of the Blue Stream gas pipeline to bring natural gas from Russia to Turkey is continuing. In 2002, Turkey took steps to further diversify its supply resources and to strengthen its role as a transit country for the transportation of oil and gas.

Implementing legislation on gas market licensing was adopted in September 2002. In 2003 Turkey and Greece signed an agreement on the construction of a gas interconnector between the two countries. The new Petroleum Law of 2004 is a step forward in terms of alignment with the oil stocks *acquis*. However, oil stocks are still not calculated according to EU methodology. The 2008 report notes that the natural gas pipeline between Turkey and Greece is now operational.

With regard to energy efficiency, Turkey has made some progress by adopting a framework law on energy efficiency, in order to reduce the high energy intensity of the Turkish economy. The law does not, however, contain any objectives and the provisions on high-efficiency cogeneration do not comply with the *acquis*. The 2008 report describes the adoption of a regulation implementing the Framework Law on energy efficiency for the transport sector. 2008 was declared the year of energy efficiency and an action plan was adopted to coordinate action in this field.

In the area of renewable energy sources, Turkey had already adopted a Law on the use of renewable energy sources for energy production and an implementing regulation on the guarantee of origin. The framework law also increases the potential for promoting the production of electricity from renewable energy sources. This legal framework still needs to be supplemented by ambitious objectives in order to exploit the vast unused potential of renewable energy sources in Turkey.

## **VII. Renewable energy**

### **16. Directive 2009/28 of 23 April 2009 on the promotion of the use of energy from renewable sources**

#### **SUMMARY**

##### ***Background***

In January 2007, the EU Commission published a Renewable Energy Roadmap outlining a long-term strategy. It called for a mandatory target of a 20% share of renewable energies in the EU's energy mix by 2020. The target was endorsed by EU leaders in March 2007.



To achieve this objective, the EU adopted a new Renewables Directive in April 2009 (RES Directive 2009/28), which set individual targets for each member state.

### *EU Member states' targets*

A new EU directive on renewable energies, agreed in December 2008, requires each member state to increase its share of renewable energies - such as solar, wind or hydro - in the bloc's energy mix to raise the overall share from 8.5% today to 20% by 2020. A 10% share of 'green fuels' in transport is also included within the overall EU target.

To achieve the objective, every nation in the 27-member bloc is required to increase its share of renewables by 5.5% from 2005 levels, with the remaining increase calculated on the basis of per capita gross domestic product (GDP).

<i>Member State</i>	<i>Share of renewables in 2005</i>	<i>Share required by 2020</i>
Austria	23.3%	34%
Belgium	2.2%	13%
Bulgaria	9.4%	16%
Cyprus	2.9%	13%
Czech Republic	6.1%	13%
Denmark	17%	30%
Estonia	18%	25%
Finland	28.5%	38%
France	10.3%	23%
Germany	5.8%	18%
Greece	6.9%	18%
Hungary	4.3%	13%
Ireland	3.1%	16%
Italy	5.2%	17%
Latvia	32.6%	40%
Lithuania	15%	23%
Luxembourg	0.9%	11%
Malta	0%	10%
The Netherlands	2.4%	14%
Poland	7.2%	15%
Portugal	20.5%	31%
Romania	17.8%	24%
Slovak Republic	6.7%	14%
Slovenia	16%	25%
Spain	8.7%	20%
Sweden	39.8%	49%
United Kingdom	1.3%	15%

### *Interim targets*

The directive set a series of interim targets, known as 'indicative trajectories', in order to ensure steady progress towards the 2020 targets.

- 20% average between 2011 and 2012;
- 30% average between 2013 and 2014;
- 45% average between 2015 and 2016, and;

- 65% average between 2017 and 2018.

EU countries are free to decide their own preferred 'mix' of renewables, allowing them to take account of their different potentials. They must present national action plans (NAPs) based on the indicative trajectories to the European Commission by 30 June 2010, followed by progress reports submitted every two years. The plans will need to be defined across three sectors: electricity, heating and cooling, and transport.

The compromise agreement eventually rejected a regime whereby member states would have faced financial penalties for failing to reach interim targets towards the 2020 goal. Member states are, however, required to submit amended NAPs, setting out measures for rejoining the indicative trajectories.

Brussels reserves the right to enact infringement proceedings if states do not take 'appropriate measures' towards their targets, meaning the decision to take legal action will be at the Commission's discretion rather than based on strict criteria.

### ***Flexibility with EU national support schemes***

Member states will be permitted to link their national support schemes to those of other EU states, and will be allowed under certain conditions to import 'physical' renewable energy from third-country sources, such as large solar farms in North Africa (see "Cooperation between Member States" below). However, so-called 'virtual' imports, based on renewable energy investments in third countries, cannot be counted towards national targets.

A system of open trading in renewable energy certificates between EU member states, favored by electricity market traders and large electricity utilities, was rejected in favor of a system whereby one member state can sell or trade excess renewables credits to another, based on statistical values.

These so-called 'statistical transfers', which can only take place if the selling member state has reached its interim renewables targets, can also be applied in cases where member states cooperate on joint projects.

### ***Cooperation between EU Member States***

Member States can “exchange” an amount of energy from renewable sources using a statistical transfer, and set up joint projects concerning the production of electricity and heating from renewable sources.

It is also possible to establish cooperation with third countries (Art. 9 of RES Directive attached). The following conditions must be met:

- the electricity must be consumed in the Community;
- the electricity must be produced by a newly constructed installation (after June 2009);
- the quantity of electricity produced and exported must not benefit from any other support.

### ***Grid access***

Many smaller producers of renewable energy argue that a lack of transparency and blocked access to energy grids are preventing them from competing on the market.

The text seeks to address the problem by requesting member states to ensure that transmission and distribution system operators provide "either priority access or guaranteed access to the grid system of electricity produced from renewable energy sources".

## **Attachment 3.B**

# Prospects of Synchronizing the Power Grids of EIJLLPST Countries with ENTSO-E

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## Contents

Background	233
Lessons from advanced synchronous systems	234
The emergence of ENTSO-E	237
ENTSO-E's Ten-Year Network Development Plan (TYNDP)	239
TYNDP versus National and Regional Investment Plans	240
New Network Codes	240
About EIJLLPST Countries	241
Status of EIJLLPST Regional Initiatives	241
Barriers to Moving Forward	242
Physical Infrastructure Barriers	243
Lack of Generation Capacity	243
Organizational Inflexibility	244
Transmission Network Access	244
Economic Constraints	244
Non-binding Trading Arrangements	244
Lessons from Synchronization Schemes with the UCTE	244
Case of Turkey	244
Case of IPS/UPS	245
Case of Ukraine and Moldova	246
Status of the EU Internal Electricity Market	246
Prospects for EIJLLPST Synchronization with ENTSO-E	247
Readiness for synchronization	248
Synchronization Prospects	249
Prerequisites for EIJLLPST Synchronization with ENTSO-E	251
Successful Synchronization of Turkey and Libya with ENTSO-E	251
Inevitable Technological measures	252

## Background

A synchronized power system is an advanced level of system integration which consists of multi system operators synchronously interconnecting their power grids during normal operation. Operators could be within a country, regional/cross-border, or beyond. Under the synchronized system, operators are obliged to maintain a common system frequency at the steady state. Operators are mutually dependent and coordinate with a central control center that oversees the system operations. Generally, a common coordinating body is created to assure the adherence to agreed technical rules and standards by the operators. Such body normally supports a close coordination between the operators to maintain system stability during normal and abnormal operating conditions.

The common rules in a synchronized power system cover energy exchange rules; system security standards (voltage control, frequency control and reserve/capacity requirement) and procedures for maintaining system stability; scheduling and settlement rules; coordination of planning rules. An example is the Union for the Co-ordination of Transmission of Electricity (UCTE) in continental Europe<sup>113</sup>. It consists of a very large area of synchronized systems which has been developing since its establishment in 1951. The UCTE created an Operation Handbook as a thorough set of operation principles and rules to support the TSOs in the technical operation of the UCTE's synchronized system. The handbook provides the technical rules for interconnection to secure the interoperability between all the TSOs in the UCTE's synchronized system.

The Purpose of this annex is to discuss the prospects of advancing regional integration initiatives between EIJLLPST courtiers and the European Network of Transmission System Operators for Electricity (ENTSO-E).

In a synchronized power system resources can be exploited between its participants. The foremost advantage is that it provides a medium for more efficient system operation and energy resource use within the synchronized area. The following is an outline of the main advantages/benefits of synchronized systems:

- *Investment Planning:* it can be coordinated at the synchronized system level (with sufficient national collaboration) to justify the elimination (or deferring) any excessive investments in generation and/or transmission. The common coordinating body is authorized to oversee the development and expansion in the synchronized area. This requires a very high level of cooperation between the system operators. However, in regionally synchronized systems (e.g. UCTE), the full delegation of powers to enforce regional investment plans has been a complex task and not fully achieved yet because of their over-riding nature on national plans.
- *Operational Planning:* key operational tasks can be jointly managed between the operators of the synchronized system to achieve mutually desired system reliability levels (adequacy of supply to meet demand and system security) and quality of supply. These tasks include maintenance planning, capacity and energy balancing arrangements, frequency and voltage controls, reserve provisions, congestion management, and management of system operating conditions.

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<sup>113</sup> UCTE was wound up on July 01, 2009 and all of its operational tasks were transferred to ENTSO-E. Any description for UCTE in this review reflects its operations before that.

- *Cost Reduction*: an overall cost reduction could be achieved through the utilization of low cost generation sources to meet demand (using the approach of economic dispatch), and joint contribution of reserves by system operators.
- *Electricity Trade facilitations*: the autonomous operation of the synchronized system, which is carefully coordinated between system operators, facilitates the electricity trade (capacity and energy) through several market mechanisms such as spot market, day ahead, auctions, etc. These mechanisms enable competition in cross-border trade and could enable energy swap between system operators or beyond. However, realizing these benefits requires high level of trade volumes which entails complex transactions and settlement arrangements.
- *Harmonization*: it is about creating consistency and minimizing differences between regulations and practices of system operators. In a synchronized system, harmonization of technical standards is required to maintain system reliability and efficient market operations. Besides, harmonization would significantly contribute in facilitating competitive cross-border trade in a synchronized system, and in streamlining the flow of private sector investments in national and regional projects. The most relevant areas of harmonization that need to be realized through the synchronization development process are technical standards, operational procedures ( including grid access) , pricing and balancing arrangements, and legal procedures.

The process of synchronizing different power grids is lengthy and requires high level of commitments to manage its costs and mitigate associated risks. The costs are driven by infrastructure reinforcements, technical rules development and execution, organizational capacity improvements (technical and operational), and legal arrangements. Significant resources would be required to set the sufficient task forces to manage the overall process and execute the agreed projects for system synchronization.

Regarding the synchronization risks, the dominating risk is the likelihood of cascading failure due to an outage that leads to over-loadings in some parts of the system and subsequent failures. Such failure could jeopardize any part of the synchronized system, and thus, require explicit commitment by all system operators to adhere to technical standards and procedures. This is enforced through legally binding agreements among the system operators. Another risk could be the reluctance of system operators to forgo the autonomy of their systems by joining a synchronized area at high implementation costs.

Benefits, costs, and risks are shared by operators of the synchronized system to protect its security and assure efficient market practices. That requires the willingness of system operators (and governments) to support the synchronization process through taking the necessary actions to (1) develop their networks and generation capacities (2) develop markets in a transparent manner (3) enhance institutional framework, and (4) advocate electricity trade.

### **Lessons from advanced synchronous systems**

The purpose of regionally synchronized system varies among the participating countries. It can be greatly influenced by governments' desire toward integration and trade, inconsistencies of regulations, incompatibilities of markets' rules, readiness of national and/or regional institutions,

and availability of reliable national and regional transmission capacities. These factors could hinder the development of fully synchronized system at the regional level.

Alignment of national and regional initiatives is one of the utmost enablers to achieve common objectives and transparent governance in a synchronized system. The objectives of synchronization evolve over time and require consistent cooperation among the participants. The evolution of objectives is associated with the different stages of the synchronization process. Transparency in governance (roles and responsibilities) would support the participants in achieving the objectives and overseeing the factors described above.

The following is an overview of some synchronized power systems- their objectives and market data are summarized (exhibit 2 illustrates a snapshot of these systems). These systems played a major role in establishing the ENTSO-E. Later in this section, a description of the association of ENTSO-E will be presented.<sup>114</sup>

**UCTE:** is the Union for the Coordination of Transmission of Electricity in Continental Europe. Since its establishment in 1951, it used to be the Union for the Coordination of Production and Transmission of Electricity (UCPTE) to coordinate the operation and development of transmission networks and generation. In 1999, UCTE has been re-defined as the association of Transmission System Operators (TSOs) with a primary objective of committing to technical and operation coordination of a synchronous system to ensure reliable electricity supply across Continental Europe. In addition, the Association of European Transmission System Operators (ETSO) was created in the same year to concentrate on market-related issues within the synchronous system.

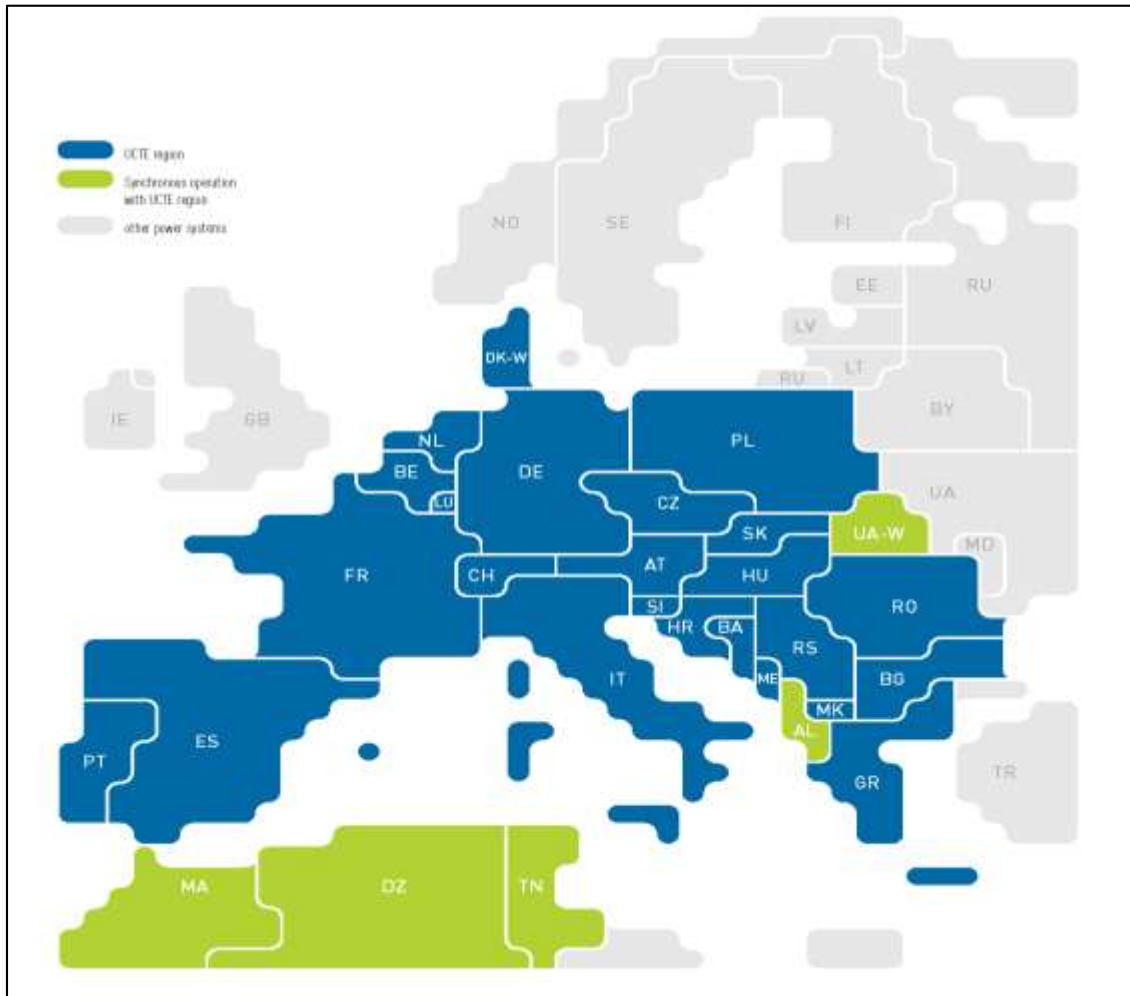
A major network failure in 2003, affecting Italy in particular, highlighted deficiencies in TSOs' coordination, leading to a need for better-quality harmonization of operational practice within UCTE. Thus, in 2005, UCTE turned to make its technical standards more enforced through an Operation Handbook and legally binding Multi-Lateral Agreement between its members. By the end of 2008, the installed capacity within the UCTE was 671.5GW with an annual generation of 2,643TWh; serving about 500 million consumers with an annual consumption of 2,603TWh of which 285.2TWh (10%) was traded. The UCTE synchronous area comprised 29 TSOs operating across 24 member countries, in addition to other non-member countries that are synchronized with the UCTE region (exhibit 1).

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<sup>114</sup> All the sources of the ENTSO-E and its members (former associations) discussed in this annex are from [www.entsoe.eu](http://www.entsoe.eu) and former associations reports



## Exhibit 1 UCTE Synchronous Area



**ETSO:** is the association of European Transmission System Operators that was created in 1999 to work in parallel with UCTE but on market-related initiatives to advance cross-border electricity trade. The founding members of the ETSO are the associations of UCTE, NORDEL, UKTROA, and ATSOI. The main motives, objectives, of creating the ETSO were to focus on harmonizing network access rules to market players for better network operations and system security, and facilitate the development of the European electricity market that is supported by the European Union. ETSO represented 40 TSOs member companies before transferring its activities to ENTSO-E.

**NORDEL:** is the organization of the Transmission System Operators (TSOs) of Denmark, Finland, Iceland, Norway, and Sweden. NORDEL was established in 1963 which has developed over time through interconnections between the NORDEL countries and other European countries (e.g. Germany, Netherlands, Russia, and Estonia). The objective of NORDEL was focused on ensuring system security, maintaining supply-demand balance through adequate transmission to maintain at all times, and supporting efficient electricity market. In 2008, the installed capacity reached 97.2GW, annual generation of 414TWh, 25.2 consumers with annual consumption of 412.7TWh of which 66.3TWh (16%) was traded.

**BALTSO** – is Baltic Transmission System Operators that was founded in 2006 as the cooperation organization of Estonian, Latvian and Lithuanian TSOs. BALTSO’s objectives were concentrated on creating conditions to ensure reliable system operations and protection of the electricity market, develop the necessary network interconnections, and initiate cooperation and build relationships with its members and other institutions in the Baltic States, Europe and beyond. In 2008, BALTSO’s installed capacity was 9.3GW and annual generation of 28TWh; serving 6.9 million consumers with a total annual consumption of 27.1TWh of which 8.9TWh (32%) was traded.

### Exhibit 2 A snapshot of the advanced synchronous system schemes

Market	Years of operation (from-to)	Number of countries (#TSOs)	Population (million)	Installed capacity (GW) <sup>115</sup>	Peak load (GW)	Annual generation (TWh)	Annual Consumption (TWh)	Sum of exports (TWh)
UCTE-2008	1951-2009	24 (29)	over 500	671.5	392	2,643 (net)	2,603 (net)	285.2
ETSO	1999-2009	? (40)	?	?	?	?	?	?
NORDEL-2008	1963-2009	5 (4)	25.2	97.2	61	414	412.7	66.3
BALTSO-2008	2006-2009	3 (3)	6.9	9.3	4.7	28 (net)	27.1 (net)	8.9

It can be noted that there are common characteristics among the development of the above described synchronous schemes. The following is a list of the main features:

- Protecting system reliability (adequacy and security) and network access to market players (mainly electricity trade) are among the common objectives in synchronous power grids;
- Synchronizing power grids is a long-process process with an evolving technical and economic objectives that require consistent and close cooperation;
- Separating the roles of technical operation and electricity trade could facilitate the development of electricity market, and improve the levels of system reliability;
- Expanding the synchronous area beyond the boundaries of the participating countries can be done with an assurance of maintaining system reliability and transparent electricity trade; and
- TSOs work independently from other electricity functions (generation and distribution) but must comply with strict network access rules and security of supply.

### The emergence of ENTSO-E

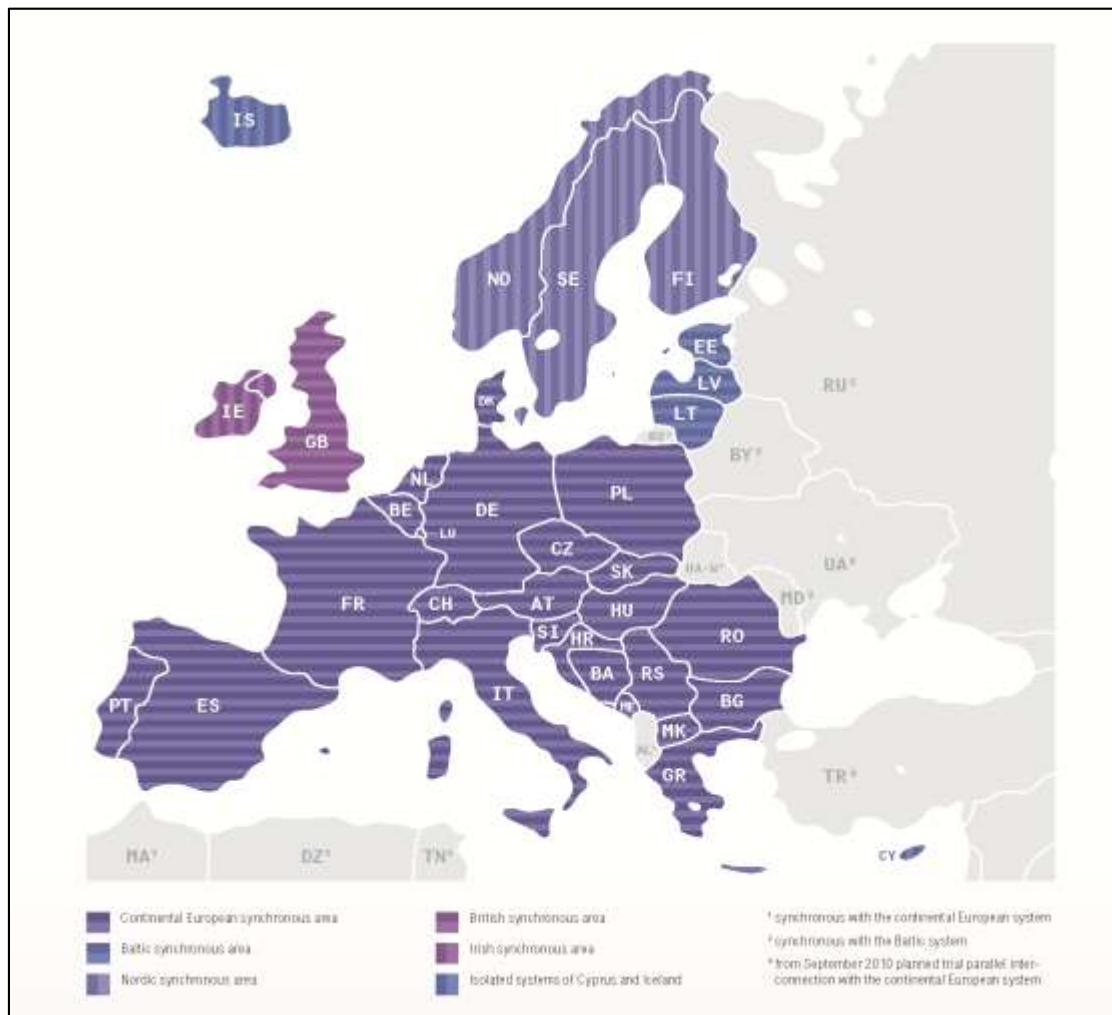
In September 2007, the European Commission adopted the Third Legislative Package in which included a proposal for establishing a new European Network for Transmission System Operators for electricity (ENTSO-E), and another proposal for establishing the Agency for the Cooperation of Energy Regulators (ACER) that was needed to strengthen the powers of the national regulatory authorities. The latter will be effective in March 2011 and will play a major role in assuring cooperation and consistency at the European level. In June 2008, the leaders of

<sup>115</sup>Installed capacity comprises renewables and other sources but the actual available capacity is much less due to unusable capacity, planned outages, forced outages, and system reserve

the existing European TSOs signed a declaration of intent to establish ENTSO-E association. This showed the TSOs' commitment and level of cooperation to facilitate the development of an internal electricity market at the European level.

In December 2008, ENTSO-E was founded as a voluntary association- as of 1 July 2009, ENTSO-E became fully operational through 42 European member TSOs in 34 countries. ENTSO-E replaced all formerly existing TSOs' associations: ATSOI, BALTSO, NORDEL, UCTE, ETSO and UKTSOA, and took new mandates under the Third Legislative Package. That is followed by the Third Legislative Package for the Internal Energy Market (IEM) being adopted by the European Commission on 3 September 2009. Exhibit 3 illustrates the synchronous areas of the ENTSO-E member countries.

**Exhibit 3 ENTSO-E Synchronous Areas**



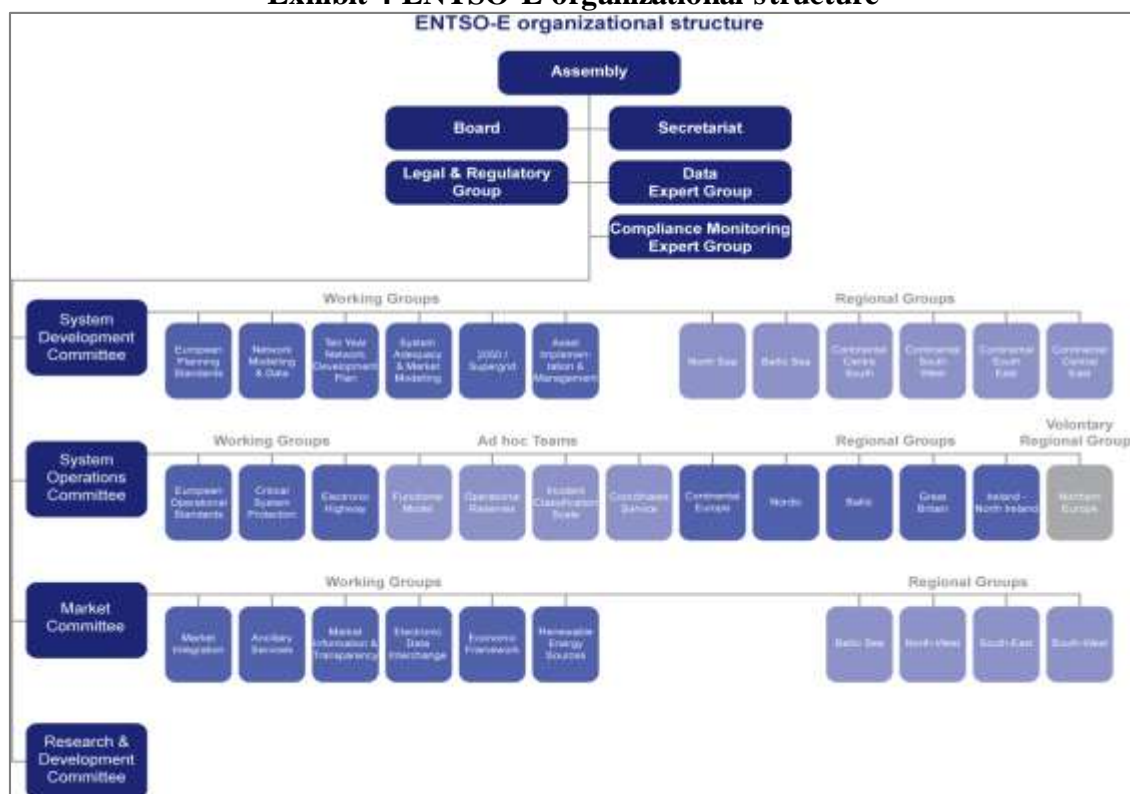
ENTSO-E comprises of 828GW installed capacity, 305,000km of transmission lines operated by the member TSOs to serve 525 million citizens with a consumption of 3,400 TWh/year of which 400 TWh of energy exchanges annually. The TSOs cooperate regionally and at a European level through ENTSO-E as one common organization. ENTSO-E's activities are organized into three committees: System Development in charge of TSO cooperation regarding the network development and planning; System Operations in charge of technical and operational

cooperation of the TSOs; and Market in charge of facilitating competitive markets. The committees are supported by a Legal & Regulatory Group (Exhibit 4).

ENTSO-E activities are determined by its three principal objectives<sup>116</sup>:

1. “Ensuring the secure and reliable operation of the European power transmission system in an increasingly complex pan-European electricity transmission network.
2. Facilitating the secure integration of renewable energy sources and thus the achievement of the EU’s greenhouse gases reduction goals.
3. Enhancing the integration of the Internal Energy Market (IEM) by proposing and implementing standardized market integration and transparency frameworks.”

**Exhibit 4 ENTSO-E organizational structure**



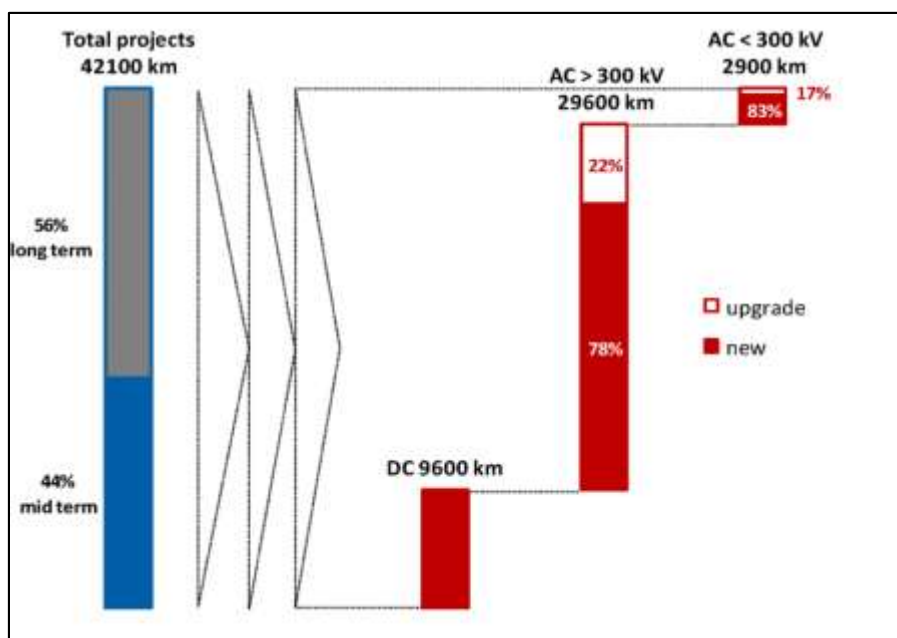
### ENTSO-E’s Ten-Year Network Development Plan (TYNDP)

The Third Legislative Package required ENTSO-E to prepare a Ten-Year Network Development Plan (TYNDP), a consolidated R & D Plan, and measures for improved operational coordination. The TYNDP is a non-binding plan with the objectives of ensuring transparency in developing the electricity transmission networks and supporting decision-making processes at regional and European level. The first release of the TYNDP was in June 2010, it put forward a total of more than 500 transmission investment projects. These projects are expected to help in realizing the three pillars of the EU energy policy, namely (1) ensuring Security of Supply (SoS) and system reliability (2) increasing the use of renewable energy sources (RES) to 20% of production in

<sup>116</sup> ENTSO-E 2009 annual report

2020, and (3) advancing the development of the Internal Electricity Market (IEM) by eliminating congestion in the transmission networks. The projects are seen as pre-requisites for achieving highly efficient cross-border trade and competitive internal electricity market across Europe. The TYNDP underlined over 42,000km, about 14% of existing transmission lines, of new transmission projects to be constructed, of which about 35,000km of new transmission lines and 7,000 km of existing line upgrades (exhibit 5). Furthermore, the new transmission projects support the three pillars of the EU energy policy as follows: 28,500 of new transmission lines are driven by IEM, 26,000km by the SoS, and 20,000 km by RES <sup>117</sup>. This demonstrates that several individual projects could be driven by more than one pillar.

**Exhibit 5 Transmission Investment Projects in the TYNDP**



### TYNDP versus National and Regional Investment Plans

As stated above, the TYNDP is non-binding but has to be updated every two years with take into consideration the national development plans. At the national level, investment plans are binding, updated annually, and are anticipated to build national generation adequacy outlook and investment plans to meet national consumption and potential exchanges. Regional investment plans are non-binding and have to be updated every two years with consideration to the TYNDP and national investment plans.

### New Network Codes

The Third Legislative Package requires ENTSO-E to develop new Network codes that overcome the limitations of the Operation Handbook. These limitations are relevant to inability of establishing binding rules (e.g. network access and economic rules) for grid users at the national level such as power plants, consumers, and distribution that could be potential affected by the grid operations. Such limitations can be addressed at the national level (e.g. grid codes, laws) as the scope of Operation Handbook is only binding for TSOs. Thus, Article 8 (6) of Regulation

<sup>117</sup> TYNDP report



(EC) 714 / 2009 empowers ENTSO-E's network codes to be binding to all those affected by the grid to ensure secure system operation in the synchronous areas and efficient market integration towards a successful IEM. The mentioned Article defines 12 specific areas of network codes that falls under three categories (1) Operations-related code topics, (2) Development-related code topics, and (3) Market-related code topics.

### About EIJLLPST Countries

EIJLLPST countries have undertaken tremendous efforts to improve the security of electricity supply and meet the remarkable demand growth<sup>118</sup>. However, most of the endeavors were primarily concentrated within the confines of each country's power system. Nearly all initiatives of cross-border interconnections were limited to emergency operations instead of energy exchange at normal system operations. Recently, the peak demand growth in most of the EIJLLPST countries had surpassed the generation capacity expansion. The accumulated effect of that phenomenon was an additional pressure on generation capacity and aggressive load shedding. The latter was a measure that most of the utilities had to take to maintain an acceptable level of system reliability which is needed for two main reasons; first, to assure the availability of sufficient supply to instantaneously meet the demand requirements; and second, to achieve high level of system security at normal and abnormal operations. Therefore, EIJLLPST countries' investments were dedicated to maintain and develop their domestic power grids.

Reserve margin remains an issue in most of the countries and will continue in the foreseeable future because of the accumulated deficiency in generation capacity and rapid demand growth (see exhibit 6). Besides, the recent financial crisis brought on additional burden on the governments of EIJLLPST countries. Major infrastructure projects (generation, transmission, and distribution) have been postponed due to the lack of financing sources. The limited means of private sector access to the power sector had also added more constraints to developing the power grids. However, these factors did not harness the demand growth which has been mostly driven by changes in the residential demand behavior (e.g. increasing use of air-conditioning).

**Exhibit 6 Key indicators of the power systems in the EIJLLPST<sup>1</sup> countries in 2008**

Indicators	Egypt	Iraq	Jordan	Syria	Lebanon	Palestine	Libya
Population (million)	83.0	26.1	5.9	21.2	4.1	3.9	6.3
Installed Capacity (GW) <sup>119</sup>	22.8	6.1	2.5	7.7	2.3	.14	6.0
Peak Demand (GW)	19.7	10.9	2.2	6.7	2.1	0.8	5.8
Reserve Margin (%) <sup>120</sup>	16	-44	14	15	8	-83	4
Consumption (TWh)	125.4	66.8	13.4	38.4	11.2	3.9	32.5

### Status of EIJLLPST Regional Initiatives

Electricity cross-border interconnection projects between the EIJLLPST countries started in ad hoc approach since early seventies. The main purpose of these interconnections was the security of supply in abnormal operations and/or critical emergency conditions. Thus, the benefits of

<sup>118</sup> EIJLLPST countries are located on the South East of Mediterranean, namely: Egypt, Iraq, Jordan, Syria, Lebanon, and Palestine. Libya is also a member of EIJLLPST, but has been excluded from this analysis.

<sup>119</sup> The available capacity during peak demand would be the installed capacity minus planned outages, forced outages, and unusable capacity (mainly from renewables and industries)

<sup>120</sup> Reserve margin is based on installed capacity, which would be much lower after considering the available capacity as described in footnote 5

these projects were not fully exploited as operations were not continuous and in most cases below the designed voltage and capacity of the interconnections.

Economic growth and rapid increase in population of EIJLLPST countries encouraged the governments to consider potential areas for collaboration at the regional level. Electricity cross-border interconnections were among the major areas to exploit for several reasons such as reducing generation investment costs, enhancing system reliability, sharing reserves, improving generation efficiency, and exploiting other benefits of economies of scale.

In 1988, five countries, namely: Jordan, Syria, Egypt, Turkey and Iraq, agreed to construct a cross-border interconnection between their power grids. Turkey was included because its potential role that could play in future electricity trade with Europe. A major part of the agreement was the commitment by each country to upgrade its power grid to meet regional requirements. The project was extended to eight countries with the addition of Lebanon, Libya and Palestine. The project feasibility studies concluded that the interconnection project voltage is AC at levels of 400kV and 500kV that will be completed in different stages<sup>121</sup>. Exhibit 7 presents a list of existing cross-border interconnections between the EIJLLPST countries and Turkey.

**Exhibit 7 Existing cross-border interconnections between EIJLLPST countries and Turkey**

Countries	Circuits/Voltage	Capacity	Year of Operation	Sum of exports (GWh) in 2007
Turkey – Syria	1 x 400 kV	1135 MVA	2007	
Syria – Jordan	1 x 230 kV	55 MVA	1977?	
Syria – Jordan	1 x 230 kV	267 MVA	1980?	
Syria – Jordan	1 x 400 kV	1135 MVA	2000	167
Syria – Lebanon	2 x 66 kV	110 MVA	1972	
Syria – Lebanon	1 x 230 kV	267 MVA	1977	
Syria – Lebanon	1 x 400 kV	1135 MVA	April 2010	
Syria – Iraq	1 x 230 kV	267 MVA	2000	
Jordan – Egypt	1 x 400 kV	550 MVA	1998	212.6
Jordan – West Bank	2 x 132 kV (operated on 33 kV)	20 MW	2007	
Egypt – Libya	1 x 220 kV (to be upgraded to 400kV on 2012)	120 MVA	1998	6.6
Egypt – Gaza	1 x 22 kV	17 MW	2006	?
Iraq – Turkey	1 x 400 kV (operated on 154 kV)	200 MW	2002	?

### Barriers to Moving Forward

Nearly all stages of the eight-country interconnection project were completed but only the grids of Egypt, Jordan, and Syria are synchronized<sup>122</sup>. Yet, there is no bulk electricity trade between the three grids, instead a moderate exchange to overcome critical system operations. Thus, the true merits of synchronization are not realized and energy trade benefits (technical and economic) are under-exploited. On Syria-Turkey 400kV interconnection, it is either operated in islanded-mode or not operational. The current status of the eight-country project underlines the level of readiness of EIJLLPST countries to move for full synchronization within their power grids and/or beyond. The following is an overview of the observed barriers to moving forward.

<sup>121</sup> The interconnection project was divided into six stages: Egypt-Jordan-Syria, Egypt-Libya, Syria-Turkey, Syria-Lebanon, Syria- Iraq-Turkey, and Jordan-Palestine

<sup>122</sup> Libya is synchronized with Egypt on the 220kV but there is not sufficient information on the continuity of synchronization per year.

## Physical Infrastructure Barriers

### Lack of Generation Capacity

As noted above, the majority of EIJLLPST countries are facing the challenge of balancing supply and demand. There is a lack of surplus generating capacity which creates inadequate reserve margin that could lead to critical system operations. Despite of higher installed capacity values, available capacity to meet the peak demand and maintain a sufficient reserve margin remains the key factor. Thus, during peak time systems would be under enormous pressure as they run under very thin reserve margins (negative in most countries) which could lead to inefficient operations and an unstable system performance. The following is an overview of the possible implications of inadequate generating capacity on system operations:

- *Reliability risk*: it is triggered when the system is unable to meet demand (peak and energy) at any point of time with consideration of different types of system outages and/or when it does not safely handle any sudden disturbances. The latter is a system security issue. Therefore, operators of power grids in EIJLLPST countries could be forced to apply rigorous load shedding actions and to disconnect cross-border interconnections to maintain the security of supply at the national level.
- *Stability risk*: it is about maintaining system synchronism during normal and abnormal operations. System operators have to control voltage and frequency to maintain the stability of the synchronized power grids. Therefore, a double equilibrium must be achieved (1) active power equilibrium to maintain frequency, and (2) reactive power equilibrium to maintain voltage. In the case of EIJLLPST power grids, the lack of sufficient reserve margin (mainly spinning reserve) is likely to create an imbalance between system generation and demand. This would lead to non-equilibrium in active power which results in deviations from nominal frequency (50Hz in EIJLLPST power grids). For the currently synchronized systems ( Egypt, Jordan, and Syria), coordination to share extra power to boost spinning reserve that is needed for maintaining an active power equilibrium is limited due to the lack of available generating capacity in mostly all of these systems<sup>123</sup>. Moreover, the lack of generating capacity would require intensive frequency control measures (primary and secondary) to maintain nominal system frequency within the synchronized systems of EIJLLPST countries<sup>124</sup>.

On voltage control (reactive power equilibrium), there is no sufficient information to raise the issue of voltage. However, the long distance of the AC interconnection between EIJLLPST power grids may require voltage control measures (e.g. static var compensators-SVCs) at the regional level to assure voltage stability and close compensation of inductive loads.

- *Low system inertia*: the larger number of synchronized machines the higher system inertia. As system is never at steady state due to the changing nature of consumption behavior and its exposure to different types of disruptions. If the imbalances between

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<sup>123</sup> The nominal frequency in the synchronized power grids of Egypt, Jordan, and Syria is the frequency of Egypt's system. This is due to the size of the Egyptian power system (i.e. higher system inertia)

<sup>124</sup> Primary control is operated by a governor control that is fast and local at the generator. Secondary control is operated by the control center (system operators) but it is slow and over the whole system to maintain steady-state frequency; it is maintained by Automatic Generation Control (AGC) or Load Frequency Control (LFC).



generation and demand are relatively small to the inertia of the total rotational mass of all machines, synchronism can be maintained. Some of EIJLLPST power grids are likely to have very low system inertia which makes synchronization to high inertia system very complex due to potential deviation from nominal frequency. This situation would require significant reinforcement to secondary frequency control at the generation side before full synchronization of the entire EIJLLPST power grids.

## **Organizational Inflexibility**

### **Transmission Network Access**

Transmission function is still managed as part of a vertically integrated system under a ministry in most of the power grids in EIJLLPST countries. The organizational attachment (mainly in decision making) of the transmission and the unavailability of regulatory rules are blocking the means for third party access to power grids. Therefore, attracting market players (such as IPPs, industrial consumers, traders) would require non-discriminatory and transparent market rules. This situation of organizational inflexibility contributes to the slow development of EIJLLPST countries' electricity market. In contrast, the independence of the transmission as a function (so-called: transmission system operator (TSO)) with defined responsibilities and decision-making authority over system operations would facilitate the synchronization process and market development

### **Economic Constraints**

#### **Non-binding Trading Arrangements:**

The current trading arrangements between the system operators of the synchronized power grids are bilateral. Each agreement is signed at the ministerial level but does not include binding articles for trading electricity in bulk amounts. Instead, most of the agreements seem to limit electricity trade to exchanges during emergency operations. Thus, the attractiveness of electricity trade in EIJLLPST countries would be very limited by the current trading arrangements.

### **Lessons from Synchronization Schemes with the UCTE**

Prior to the formation of ENTSO-E, several synchronization schemes with the UCTE were initiated. They aimed at exploiting the benefits of full synchronization with the UCTE. The experiences of these schemes varied in terms of process and timeline but all have a common condition they have to comply with in order to be fully synchronized with the UCTE. The condition requires any country (or group of countries) under each scheme to permanently disconnect its interconnections with neighboring countries. Once this condition is met, the synchronization must meet the technical standard terms described in the Operation Handbook. The following is a brief on these synchronization schemes<sup>125</sup>.

#### **Case of Turkey**

It started with a request from Turkish Electricity Transmission Corporation (TEIAS) to UCTE for synchronization and membership. The technical objective of the scheme is to improve the security of supply and stable system performance. A dedicated project group was established to oversee project studies, preliminary tests, and interconnection options. In 2007, the feasibility

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<sup>125</sup> All these schemes are currently handled through the ENTSO-E

study concluded the feasible interconnection of Turkish power system to the UCTE. However, the study identified two prerequisites for reliable synchronism:

1. Enhancing the performance of primary and secondary frequency control of the Turkish power system; and
2. Improving the damping performance of the generation units regarding low inter-area oscillations

In 2008, TEIAS launched the project of “Rehabilitation of the Frequency Control Performance of the Turkish Power System for Synchronous Operation with UCTE”. The scope of this project addresses several tasks on power and frequency control, steady state, and transient stability that should be taken by the Turkish power system for synchronous operations with the UCTE. This included a preliminary monitoring of the dynamic performances was made possible by the installation of Wide Area Monitoring System (WAMS) in five substations in Turkey.

The net transfer capacity (NTC) for import to Turkey is within the range of 800–1300MW, while the NTC for export from Turkey is within the range of 1000–1100MW (Exhibit 8). Studies identified the maximum NTC for export not exceeding 500MW during the trial operations. The first isolated tests were started early 2010. After a successful completion of these tests, the one year trial period for synchronous parallel operation of the interconnection was started in September 2010. During the trial period, the synchronized systems will be closely monitored to assure a secure and stable performance.

**Exhibit 8 Existing Interconnections of Turkey with UCTE<sup>126</sup>**

Interconnection	Type	Voltage (kV)	Capacity (MVA)
Bulgaria-Turkey	AC single	400	1000
Bulgaria-Turkey	AC single circuit	400	1500
Greece-Turkey	AC single/double circuit <sup>127</sup>	400	1510

The contractual agreement is a legally binding document to TEIAS and UCTE (currently ENTSO-E). The signature of the agreement means the beginning of an official synchronous operation and energy exchange between the two systems. The agreement includes different clauses to cover technical (including grid code), institutional, regulatory, and legal aspects. As the trial parallel operation started in September 18, 2010, it means that the agreement has been signed or at least the technical sections were signed.

### Case of IPS/UPS

The project scope is very ambitious as it would serve over 700 million consumers in 36 countries spanning more than ten time zones. The project is driven by various factors (political, economical, energy security, and efficient operation and control). A feasibility study was completed in 2004-2008 through a consortium representing the UCTE and another for the IPS/UPS. The study investigated the feasibility of a possible synchronous coupling of the power systems of the IPS/ UPS with the UCTE. The study evaluated all the technical, organizational, and legal issues with consideration of maintaining the current levels of the two systems with

<sup>126</sup> MEDRING UPDATE Study: Analysis and Proposals of Solutions for the Closure of the Ring and North-South Electrical Corridors”, Volume II, April, 2010.

<sup>127</sup> It interconnects three substations through double-circuit in one side and single-circuit in the other side.

regards to system security and reliability. Considering system security and market issues, the findings underlined the complexity of the synchronous coupling. If that becomes feasible, it must be considered as a long-term option. Besides, asynchronous system coupling (through BTB-HVDC) lines can be considered as alternative in the medium-term. The BTB-HVDC option would be considered a new separate project.

### **Case of Ukraine and Moldova**

With the objective of enhancing energy security in Europe, the Ukrainian company NPC Ukrenergo and the Moldovan Company Moldelectrica applied for a separate investigation of the full synchronous interconnection of the Ukrainian IPS and Power System of Moldova with the UCTE. This project is related to the IPS/UPS project and is one of the projects of European significance. The initial estimated cost of the Project is about €4.5 billion and would require feasibility studies, tests, and trial operation. The assigned working groups will carry out the steady state and dynamic assessments, and power system control analysis. The current coordination is through the ENTSO-E's Continental Europe for the launch of the feasibility study.

### **Status of the EU Internal Electricity Market**

There are two major issues on the progress towards the Internal Electricity Market in Europe. The following is a summary of these issues<sup>128</sup>:

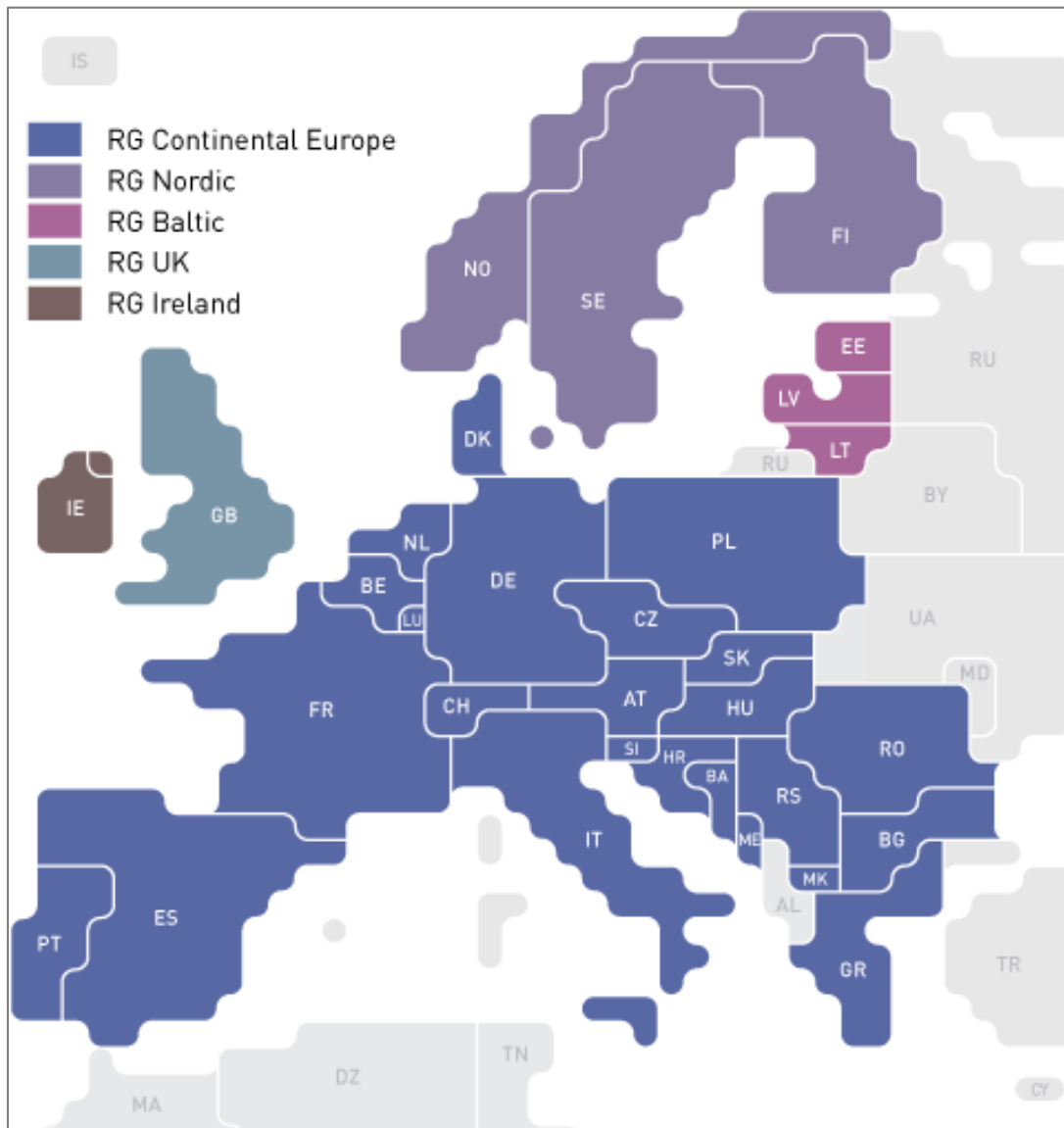
1. Increasing renewable energy sources (RES): the future large-scale of intermittent wind penetration in the North Sea Region may create new grid constraints. In order to overcome such inevitable constraints, the North Sea countries would need to develop sufficient interconnections and reinforce their networks through deeper integration in the next ten years.
2. Open grid access and electricity trade: the current grid constraints could lead insecure system performance due to high amounts of electricity trade (i.e. an increase in cross-border exchanges). In the mid-term, the issue of the need for higher exchange capacity is emerging in several interconnections (either between individual countries or regions within the ENTSO-E). This applies on the long-term perspective as well.

Therefore, the above issues pose significant challenges before the realization of the Internal Electricity Market. All the ENTSO-E regions will be facing these challenges except the Baltic region (see exhibit 9).

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<sup>128</sup> Source: TYNDP

## Exhibit 9 ENTSO-E Synchronous Regions



### Prospects for EIJLLPST Synchronization with ENTSO-E

The conclusions of the first feasibility of MEDRING study (conducted in 2001-2003) underlined the complex operations of using full AC interconnections to close the Mediterranean electricity ring to enable electricity trade within the Southern and Eastern Mediterranean countries (SEMC) and between SEMC and Europe. The complexity was illustrated through several system operation issues relevant to system stability due small and large (transient) disturbances. Frequency control was clearly a major issue in the AC closure of the ring. The study was updated in 2010 and raised the need for investigating a combined solution of AC and DC interconnections. The revisit of study has been triggered by governments, regional institutions (e.g. Union for the Mediterranean, Mediterranean Solar Plan, Desertec Initiative), and private companies. The common interest of these parties was driven by realization for potential mutual benefits from synchronization such as the exploitation of solar and wind power resources in the EIJLLPST and Maghreb countries.

The learned lessons from the early described synchronization schemes illustrate the lengthy and complex process of synchronization that addresses technical (including grid code), institutional, regulatory, and legal aspects. Besides, it requires complete feasibility studies, isolated tests, and trial parallel operations. Other lessons can be observed in the case of synchronizing Libya and Tunis that was agreed between UCTE and countries of Maghreb and EIJLLPST in 2003. The synchronization attempt between Libya and Tunisia failed in 2005 due to deficiencies in power grid, system protection, power-frequency control, and high normal load deviations.

### Readiness for synchronization

The potential for synchronizing the entire EIJLLPST countries with ENTSO-E is not likely to occur in the foreseeable future. Considering the current conditions in the EIJLLPST power grids, a complete synchronization of ENTSO-E with these grids should be a long-term goal and through a gradual approach. Over the short and medium timeframes, systems operators in EIJLLPST countries need to address physical infrastructure and technical issues (as noted earlier, stability issues concerning frequency, voltage, and dynamic [also called rotor angle]). Besides, a very important issue that requires the attention of EIJLLPST countries is the condition of permanently disconnecting neighboring systems before synchronization with the ENTSO-E. This could lead to critical decisions by EIJLLPST's systems operators on the approach and type of synchronization.

In regard to the physical infrastructure status of each country in EIJLLPST and its readiness for cross-border synchronization, exhibit 10 highlights the required system improvements by each country according to its progress in the current eight-country project.

**Exhibit 10 Required System improvements for synchronization**

Country	Transmission system improvements		Readiness for synchronization Mashreq/eight project for with country	Readiness for synchronization (or asynchronoization) with ENTSO-E
	National	Cross-border		
Egypt	Strengthening the 500kV transmission networks	Upgrade from 220kV to 500kV in the Egyptian side of Libya interconnection	Currently synchronized with Jordan and Syria	likely in the medium- to long-term
Jordan	Strengthening the 400kV network		Currently synchronized with Egypt and Syria	likely in the medium- to long-term
Syria	Completing the Upgrade of transmission networks to 400kV		Currently synchronized with Egypt and Jordan	likely in the medium- to long-term
Iraq	System rehabilitation (includes generation)	Completing the interconnection project with Syria and Turkey	-	Potential and partially in the long-term-after 2020
Lebanon	System rehabilitation (includes generation)	-	Islanded mode with Syria	Potential and partially in the long-term, after 2020
Palestine	System rehabilitation (includes generation)	Upgrading the operation with Jordan to 132kV	Islanded mode with Egypt and Jordan	Potential and partially in the long-term, after 2025
Turkey	-		Islanded mode with Syria and Iraq	Under one year trial period Synchronization started in September 2010
Libya	Completing the Upgrade of transmission networks to 400kV		Synchronized with Egypt but type of synchronization (full or islanded) is unclear	Likely in the medium- term

The above matrix illustrates the readiness of each country for synchronization (or asynchronization) with any of EIJLLPST countries and/or ENTSO-E. The readiness is estimated

based on the under-construction or planned physical infrastructure development in generation and transmission. The characterization of that readiness means identifying which countries in the EIJLLPST could be ready for synchronization as such. Thus, a country could synchronize with ENTSO-E but not EIJLLPST countries. However, any country plans to approach EMTSO-E for synchronization assessment should prepare to fulfill the condition of permanently isolating its system from neighboring countries. Notably, synchronization with ENTSO-E could impact the full AC synchronization within EIJLLPST.

The matrix shows that a full AC synchronization within the EIJLLPST countries is not likely to happen before 2020. Moreover, Egypt, Jordan, and Syria are the only EIJLLPST countries with recognizable potential to start the preparatory work for synchronization with the ENTSO-E in the medium- to long-term. However, time and likelihood for accomplishing such a goal can be determined after conducting the main assessment steps (feasibility studies, isolated tests, trial parallel operations, etc.) which could be different from one country to another.

The above described readiness addresses synchronization from the physical infrastructure perspective. Yet, the feasibility studies will assess the technical readiness and required measures (physical and operational) for each country or a group of countries in EIJLLPST to synchronize (or asynchronize) with ENTSO-E. Furthermore, the entire synchronization process would be influenced by other aspects than physical and technical such as political will, regulatory, institutional, and legal aspects. *In this document, these aspects are not covered in the assessment of prospects for synchronizing EIJLLPST countries with ENTSO-E. Thus, in addition to the discussion or prospects in the following sections, the influence and requirements of these aspects should be added to complement the overall assessment.*

### Synchronization Prospects

The exploitation of synchronization prospects between individual countries (or a group of countries) in EIJLLPST and the ENTSO-E would require devoted feasibility study (ies) to investigate the operations over HVAC and HVDC transmission technologies. There is a need to address all possible synchronization solutions to ensure overcoming the constraints of technical and physical readiness in the power systems of EIJLLPST countries and the long distances for trading bulk electricity with ENTSO-E.

In regard to EU commitments to renewables, the 20% renewable energy sources (RES) in 2020 (one of the EU energy policy pillars) could create new prospect for direct interconnections with the ENTSO-E for EIJLLPST countries that are endowed with renewable sources. Egypt could be the main potential among EIJLLPST countries for exploiting its renewable resources (solar and wind) for direct exports to the EU. Directive 2009/28/EC “on the promotion of the use of energy from renewable sources” reaffirmed that “the European Council endorsed a mandatory target of a 20 % share of energy from renewable sources in overall Community energy consumption by 2020”. The Directive states that “the third country (i.e. non-EU member) concerned should be encouraged by the Commission and Member States to develop a renewable energy policy, including ambitious targets”. The updated MEDRING study identified three issues of exporting bulk electricity from RES in EIJLLPST countries to ENTSO-E. They are (1) weak transmission grid in SEMC and potential design constraints to accommodate large RES production (2) complex morphology of the Mediterranean Sea and possible impact on the technical limits of submarine cables (3) technical and design limitations to import bulk electricity through the existing EU transmission grid at the Northern Mediterranean.



In the medium- to long-term period, as noted above, Egypt, Jordan, and Syria are the potential EIJLLPST countries to start preparing the synchronization schemes with ENTSO-E. There are different scenarios for synchronizing (or asynchronizing) these countries (1) individually: for Egypt and Syria, (2) two countries: Egypt-Jordan or Syria-Jordan, or (3) all the three countries. Exhibit 11 depicts the possible scenarios for synchronizing these countries with ENTSO-E associated requirements and impacts for each scenario.

**Exhibit 11 Scenarios of prospects for synchronization (or asynchronization) with ENTSO-E**

#	Scenario	Possible solutions	Physical Requirements	Impacts
<b>Turkey is the interfacing system with ENTSO-E</b>				
1	Syria- ENTSO-E	Syria-Turkey - ENTSO-E (HVAC and/or HVDC should be assessed)	Depend on the results of Turkey's trial Synchronization period- one from September 2010	1-An assessment of converting the existing HVAC to HVDC or Back-to-Back HVDC could be conducted 2-if HVAC synchronization, Syrian power grid has to be isolated from neighboring countries
2	Jordan-Syria- ENTSO-E	Jordan-Syria-Turkey - ENTSO-E (HVAC and/or HVDC should be assessed)	refer to scenario 1	1-An assessment of converting the existing HVAC to HVDC or Back-to-Back HVDC could be conducted 2-if HVAC synchronization, Syrian and Jordanian power grids has to isolated from neighboring countries
3	Egypt-Jordan-Syria- ENTSO-E	Egypt-Jordan-Syria-Turkey-ENTSO-E (HVAC and/or HVDC should be assessed)	1-Depend on the results of Turkey's trial Synchronization period- one from September 2010 2-may require dedicated HVDC lines for RES (wind and solar) and/ or redesigning of existing transmission grid in Egypt	1-As described in scenarios 1 and 2. 2-In addition to the possibility of permanent isolation of Egypt from Libya
<b>Libya is the interfacing system with ENTSO-E</b>				
4	Egypt-Libya-ENTSO-E	Egypt-Libya- Maghreb-ENTSO-E (HVAC and/or HVDC should be assessed)	1-may require dedicated HVDC lines for RES (wind and solar) and/ or redesigning of existing transmission grid in Egypt 2-requires a successful synchronization of Libya with ENTSO-E through Tunisia 3- requires upgrading the existing interconnection from 220kV to 500kV at the Egyptian grid	1-HVAC synchronization with ENTSO-E requires isolation from neighboring countries. 2-Considering the high number of solutions, long distances between the possible interconnection countries with ENTSO-E a hybrid solution of HVDC and HVAC is likely to happen
5	Jordan-Egypt-Libya- ENTSO-E	Jordan-Egypt-Libya Maghreb-ENTSO-E (HVAC and/or HVDC should be assessed)	1-refer to scenario 4 2- may require a reinforcement of the existing Jordan-Egypt 400kV HVAC	Refer to scenario 4
6	Syria-Jordan-Egypt-Libya- ENTSO-E	Syria- Jordan-Egypt-Libya - Maghreb-ENTSO-E (HVAC and/or HVDC should be assessed)		
<b>Turkey and Libya are the interfacing systems with ENTSO-E</b>				
	Egypt-Jordan-Syria- ENTSO-E	Combination of the solutions described in all the above scenarios	Refer to scenarios 1,2,3,4,5, and 6 for each relevant combination of solutions	Refer to scenarios 1,2,3,4,5, and 6 for each relevant combination of solutions

There are three possible interconnecting countries with ENTSO-E synchronous grid; they are Turkey, Egypt, and Libya. There is a mixture of possible solutions for synchronizing (or asynchronizing) the three potential EIJLLPST countries with ENTSO-E through these interconnecting countries. As Egypt, Jordan, and Syria did not initiate the process for synchronization with the ENTSO-E, it would be feasible to consider the assessment of interconnection with ENTSO-E through HVAC and/or HVDC solutions.

Considering HVDC as part of the solution(s) for synchronizing with ENTSO-E would be effective for these countries because HVDC: (1) minimizes measures for addressing stability issues (frequency, voltage, and dynamic); (2) boosts the net transfer capacity and energy trade; (3) strengthens weaknesses in the transmission networks; (4) brings more certainty to interconnecting with ENTSO-E; (5) overcomes the condition that grids from neighboring countries must be permanently isolated; (6) allows greater control over cross-border flows; and (6) enables interconnecting synchronous areas with different operating rules. HVDC provides safeguards while enabling most of the benefits from AC synchronization to be met. Most of the above benefits of using HVDC were discussed in the updated MEDRING study for closing the Mediterranean ring on the DC mode. However, for the case of synchronizing Egypt Jordan, and Syria with ENTSO-E, broader assessment of potential hybrid solutions of HVAC and HVDC need to be conducted to identify the technically and financially viable solutions to trade energy produced from different generation sources (conventional and RES) in the three countries.

In summary, Egypt, Jordan, and Syria have the greatest potential among EIJLLPST countries to start working on the synchronization process with the ENTSO-E. This would entail several requirements to be completed by the relevant ministries and utilities. Timing for completing the synchronization process could be envisaged around 2018-2020. For the other EIJLLPST countries, a successful synchronization with ENTSO-E of any or all the three potential countries would be a major milestone in determining the prospects for the other countries.

#### **Prerequisites for EIJLLPST Synchronization with ENTSO-E**

Dedicated feasibility studies need to be conducted for the scenarios and possible solutions described above. As Egypt, Jordan, and Syria are currently synchronized, a close coordination between them should take place at an early stage to decide on the scenarios of synchronization with ENTSO-E. Such coordination would entail the ministries of electricity and utilities (generation and transmission) of each country to be involved. Once an agreement is reached between the three countries, a request with a synchronization proposal could be sent to the ENTSO-E. The following is an outline of the main prerequisites for synchronizing

#### **Successful Synchronization of Turkey and Libya with ENTSO-E**

For Turkey, the successful completion of the one year trial period of synchronization with ENTSO-E over HVAC will determine the decision of commercial operation. Thus, the current islanded operation between Syria and Turkey will remain until the completion of the trial period. If Turkey starts the commercial operation with ENTSO-E, Syria has to remain connected in an islanded-mode and cannot be synchronized with Turkey unless it fulfills ENTSO-E requirements. This, HVDC or HVDC BtB with Turkey could be an option to assess in the feasibility studies that could be conducted before the completion of the trial period.

As for Libya, the synchronization with the ENTSO-E could be through the Maghreb (Tunisia) countries or any future HVDC between Libya and Northern Mediterranean countries. The failure of synchronizing Libya and Tunisia in 2005 led to defining a certain measures as prerequisites for the second attempt for synchronization. These measures include: Load-frequency control improvements in Algeria and Libya, structural changes of the transmission network in Morocco and between Algeria and Morocco, and set up the new defense plans mainly on cross-border lines. The first measure has been completed while the remaining measures are still in progress. Once Libya-Tunisia are successfully synchronized and passed through a minimum of one year



trial period with ENTSO-E, an investigation could be conducted to synchronizing Libya with Egypt could start. Other requirements and possible impacts are described earlier in exhibit 10.

Therefore, a successful synchronization of ENTOS-E with Turkey and Libya over HVAC would determine the prospects for Egypt, Jordan, and Syria to synchronize with ENTSO-E. Thus, as noted earlier, investigating HVDC solutions could identify the prospects for asynchronization with ENTSO-E in a shorter period of time without the condition of successful synchronization of ENTSO-E with Turkey and Libya.

### Inevitable Technological measures

Technical measures need to be taken by Egypt, Jordan, and Syria either separately from or in line with the scenarios and solutions for synchronization with ENTSO-E. The current operation of the existing cross-border interconnections in EIJLLPST entails several stability issues. An assessment would be required to identify the exact technical measures that have to be taken by each country. It could be more effective to incorporate the assessment in the feasibility studies for synchronization with ENTSO-E. If the three countries agreed to include the assessment of technical measures in the feasibility studies, technical measures can be defined for each scenario and associated solutions for synchronization. Exhibit 12 demonstrates the main assessments to identify the technical measures to be taken by each country. The assessments would differ according to the analyzed solutions (HVAC and/or HVDC).

#### Exhibit 12 required assessment to identify the technical measures for the power grids in Egypt, Jordan, and Syria

Assessment area	Sub-criteria	description
Stability Analysis	Frequency stability (to manage real power)	Define defense plans and devices to be installed to maintain nominal frequency in the case of large disturbances
	Voltage stability (to manage reactive power)	Define defense plans and devices to be installed to maintain voltage level in the case of small and large disturbances
	Dynamic (rotor angle) stability	Define defense plans and devices to be installed to maintain synchronism of generating units (i.e. maintain synchronous speed) in the case of small and transient disturbances
Generation capacity adequacy	Analyze the required amounts of generation to meet domestic demand and trade for both conventional and RES generation	A consideration of 20% EU targets of imports from RES should be counted. A focus should be made on efficient generation plants
Congestion management Analysis	Power flow with bulk power export between EIJLLPST countries and ENTSO-E	Identify main bottlenecks of electricity trade and required reinforcements either by HVAC and/or HVDC. Identify any dedicated transmission lines for RES.