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West Bank and Gaza
Energy Sector Review

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Abbreviations and Acronyms

AMR	Automatic Meters Reading
bcm	billion cubic meters
BG	British Gas Group
BOO	Build-Own-Operate
btu	British Thermal Unit
CCGT	combined cycle gas turbine
CIF	Cost, Insurance and Freight
cm	cubic meter
CNG	compressed natural gas
CPI	consumer price index
EAPC	Eilat-Ashkelon Pipeline Company
EC	European Community
ELNG	Egyptian LNG
EMG	East Mediterranean Gas
ESIMP	Electric Sector Investment & Management Project
FPL	Fuel Products Line
FY	fiscal year
GEDCO	Gaza Electricity Distribution Company Ltd
GDP	gross domestic product
GOI	Government of Israel
GM	Gaza Marine
GPGC	Gaza Power Generation Company
GPP	Gaza Power Plant
GWh	gigawatt-hour (1 million kWh)
HEPCO	Hebron Electric Power Company
HFO	heavy fuel oil
HHV	higher heating value
HV	high voltage
ICL	Israel Chemicals Ltd.
IEC	Israel Electric Corporation Ltd
INGL	Israel Natural Gas Lines Company
IMF	International Monetary Fund
INGL	Israel Natural Gas Lines Company
IPO	Initial Public Offering
IPP	Independent Power Producer
JDECO	Jerusalem District Electricity Company
kg	kilogram
kJ	kilojoule
km	kilometer

kV	kilovolt
LIBOR	London Interbank Offered Rate
LNG	liquid natural gas
LPG	liquid petroleum gas
LV	low voltage
MENA	Middle East and North Africa
mmbtu	million btu
mmcf/d	million cubic feet per day
MOF	Ministry of Finance
MW	megawatt (1000 kilowatts)
MV	medium voltage
MVA	megavolt-amp
NEDCO	Northern Electric Distribution Company
NGA	Natural Gas Authority (Israel)
NIS	New Israeli Shekel
O&M	Operation and Maintenance
ORL	Oil Refineries Ltd.
PA	Palestinian Authority
PCBS	Palestinian Central Bureau of Statistics
PEA	Palestinian Energy and Natural Resources Authority
PEC	Palestinian Electricity Company
PERC	Palestinian Electricity Regulatory Council
PEI	Petroleum and Energy Infrastructures Ltd.
PIF	Palestine Investment Fund
PPA	power purchase agreement
PPC	Palestinian Petroleum Commission
PPI	producer price index
PUA	Public Utilities Authority
SCADA	Supervisory Control and Data Acquisition
SELCO	Southern Electric Company
Tcf	trillion cubic feet
TJ	terajoule (1 billion joules)
ToU	time of use
VAT	value added tax
YT	Yam Thetis
WACC	weighted average cost of capital

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Acknowledgements

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1. Executive Summary

1.1 Review Perspective

From the perspective of its energy sector, West Bank and Gaza is in an unusual position in at least three respects. Firstly, as a small energy market with no developed domestic resources of commercial energy, it is almost entirely dependent on imported energy supplies, specifically electricity and oil products. Because of political and logistical factors, nearly all of these supplies at present come from Israel.

A second unusual challenge faced by West Bank and Gaza is its fragmentation into two distinct geographical zones with divergent economic characteristics. The West Bank, where most Palestinian economic activity and a majority of the population are located, is landlocked and without its own primary energy resources, but it does border Jordan which is well situated to become a regional transit centre for energy. Gaza's economy and population are smaller but still substantial, but it has a more favorable energy supply perspective: substantial gas resources lie offshore, it can receive supplies by sea, and it borders Egypt which is an energy-rich country that provides a potential low cost alternative to energy supplies from Israel.

A third unusual challenge is the constraints imposed by Israeli policies and actions on the ability of the Palestinian Authority (PA) to operate and develop its energy systems. These constraints arises from the following sources: (i) Israeli control over parts of the West Bank ("Areas C") which can impose a serious challenge to constructing the power network c in these areas in the event that Israeli cooperation and coordination is not forthcoming; (ii) Israeli control of Palestinian territorial borders, particularly in the West Bank, which can effectively deny or limit trade across international borders, including importation of electricity and petroleum products through physical interconnections; and (iii) Israeli destruction of Palestinian power system facilities by military action, such as the June 2006 attack on the Gaza Power Plant that created a serious short-term crisis for power users in Gaza. These actions undermine Palestinian efforts to attract investment to its energy sector.

This Review addresses the question of how the energy sector can make an effective contribution to the economic recovery and long-term growth of West Bank and Gaza in this situation. It therefore deals with the medium and long term outlook and beyond the short term needs of the population under the ongoing economic disruption that started in early 2006. It does so by examining the broad regional and strategic dimensions relating to the sector that form the basis of a sustainable investment and institutional development programme.

The overall framework by which a country secures its energy supplies is often discussed under the heading of "energy security". For West Bank and Gaza and its neighbours, "security" is often seen in exclusively political terms, but this is not the focus of this Review. Instead, the Review focuses on the economic and commercial dimensions of security, whereby the concept of energy security is usually interpreted in terms of diversification of supply sources from a variety of power and fuel markets in order to reduce dependency on one or more suppliers and exposure to their market power. This concept of "energy security" is generic to any country faced with uncertain energy markets and complex regional supply options, and is thus an appropriate frame of reference for this Review.

This concept of energy security is important for the large investments that will be needed within the next few years as demand growth in West Bank and Gaza begins to exceed current delivery capacity. The most important strategic issue facing the PA for meeting future energy demand is the trade-off between security of supply and cost of supply. In principle, greater security implies higher cost, and in practice the challenge is to find a trade-off that provides an acceptable degree of security at an affordable level of cost. Finding a workable combination of security and cost

requires careful consideration of the available and prospective supply options, even though this is complicated by the uncertainty about the timing and costs of these options.

In principle, the PA needs a plan for developing power supply options based on a sequence of investments sufficient to meet projected demand at an acceptable level of energy security and cost. In practice, the PA appears to be pursuing many power supply options under competitive negotiations to determine the combination that gives best value and diversity, because the availability and cost of these options are uncertain until such negotiations have taken place. In this situation, the PA needs to have a clear strategy for evaluating and prioritizing these options before selecting which ones to develop. The Review offers advice on how to approach this issue.

This Review is structured in three parts. The first part is this Executive Summary that presents the recommendations of the Review, which are grouped at the end of this summary. They are based on analysis developed in the main chapters of the Review that comprise the second part. These chapters deal with specific aspects of the energy sector, namely the current pattern of energy supply and consumption, the technical and financial performance of the power utilities, the impact of the energy sector on the PA's recurrent budget, the natural gas market, and the investment requirements in the electricity system and associated fuel supply facilities for West Bank and Gaza.

These chapters in turn are supported in the third part of the Review by technical annexes that examine in some detail specific aspects such as oil products supply and demand, the demand for electricity, and power network investment needs in West Bank and Gaza, the performance of the Gaza Power Plant (GPP), and developments in the Israeli natural gas and electricity markets that have a bearing on the energy sector in West Bank and Gaza.

1.2 Overview of the West Bank and Gaza Energy Sector

The West Bank and Gaza energy sector has a few salient characteristics that form the basis of the analysis presented in the Review:

- Total energy consumption in West Bank and Gaza is small by regional standards, let alone international standards, which limits the scope for achieving economies of scale.
- West Bank and Gaza have different energy supply options.
- Most energy demand (75%) is accounted for by the service and household sectors, since there is relatively little activity in manufacturing.
- Nearly all energy is provided by electricity and petroleum products, most of which has been purchased from Israel (some diversification is beginning to develop).
- In general, energy is lightly subsidized in comparison with most countries in the region, and energy prices reflect opportunity costs reasonably well.
- The only substantial domestic energy resource is the Gaza Marine gas field discovered offshore Gaza, which awaits development.
- The most critical institutional constraints arise in the electricity sector, where the development of the distribution companies in West Bank and Gaza is still work-in-progress.
- The electricity system in the West Bank consists of numerous isolated distribution systems that are not integrated into a distribution network, and it has no generation capacity or transmission network.
- There is no storage capacity for petroleum products in the West Bank and Gaza (plans for building some storage facilities are under preparation).

Despite the troubles of recent years, energy demand has continued to grow quite rapidly. Consumption of electricity in the West Bank – as indicated by imports from Israel - reportedly grew at 6.4% annually from 1999 to 2005. Consumption of electricity in Gaza reportedly grew on average at about 10% annually from 1999 to 2005, although imports of electricity from Israel remained fairly level since the increase in consumption was largely met by the output from GPP from late 2002 onwards. Consumption of petroleum products in 2005 – as indicated by imports from Israel – was reportedly three times the depressed level of 2002, which in turn was about 50% above the level in 2000 (some of these imports in the later years may not have been consumed in West Bank and Gaza).

The GPP is the only significant generation capacity in West Bank and Gaza, and is the only major privately financed, developed and operated power facility from which power is provided to Gaza under a long term power purchase agreement. This plant has the capacity to supply only 20% of the combined needs of West Bank and Gaza, but it can supply about two-thirds of the current maximum load on the Gazan electricity system (it is constrained to using 50% of capacity at present because of the limitations of the transmission network to take power from the plant). The plant generates electricity at high cost because it currently uses costly gasoil.

For historical reasons, and due to political upheavals, the organization and governance of energy supply in West Bank and Gaza do not reflect the sector's key role in sustaining the economy and the population's living standards. In terms of governance at the regulatory and policy levels, the PA has yet to develop the institutional capacity required for establishing overall energy policy. The most effective institution at present is the Palestine Energy and Natural Resources Authority (PEA), which deals with the power sector. For oil products, all supplies are imported and distributed by the Palestine Petroleum Commission (PPC).

The energy sector should be a major net contributor to PA's budget. In fact, total revenues from fuel excise duties and VAT on energy consumption amounted to about US$330 million in 2005, equivalent to one third of total fiscal revenues. However, these revenues were almost offset by various fiscal costs arising from the need to make up for payment and billing shortfalls by consumers of electricity and petroleum products.[1] These fiscal costs represent a very large and poorly targeted subsidy, and bringing down this drain on fiscal resources must be a major aim of PA's overall fiscal adjustment and energy sector policy for West Bank and Gaza.

The institutional set-up does not provide proper incentives for the electricity retailers, especially the municipalities, to collect bills from their customers. The Israeli Ministry of Finance has allowed the Israel Electric Corporation Ltd (IEC) to recover part of its unpaid bills from the tax revenue that the Ministry collects on behalf of the PA and by agreement is supposed to transfer to the PA on a monthly basis in advance of the regular transfer of tax revenues. The PA's assumption of the role of "financier of last resort" can be expected to undermine electricity retailers' incentive to ensure full and prompt collection of bills owing to them, especially since the PA has limited ability to enforce collection discipline through the utilities or municipalities.

As indicated in the PA's "Letter of Sector Policy" issued in 1997,[2] the PA is consolidating power supply and distribution arrangements in the West Bank into four power utilities by adding three utilities to the utility serving the central area around Jerusalem - the Jerusalem District Electricity Company (JDECO). They are the utility serving the southern area around Hebron - the Hebron Electric Power Company (HEPCO), the newly formed utility serving the rest of the southern area

[1] Overall fiscal expenditures increased from $317 million in 2005 to around $400 million in 2006 due to a rise in deductions from the clearance revenue for amounts owed to IEC.

[2] "Palestine National Authority, The Palestine Energy Authority, The Power Sector, Letter of Sector Policy", August 7, 1997.

- the Southern Electric Company (SELCO), and the utility that is being established to serve the northern area – the Northern Electricity Distribution Company (NEDCO). The three new utilities are formed by taking over the electricity assets and businesses of the municipalities and village councils in the service areas of these utilities, in return for which ownership of the shares of these utilities is vested in these municipalities and councils.

The transfer of the electricity supply and distribution business substantially affects the finances of the municipalities and villages concerned. Since the PA has traditionally not contributed substantially to municipal finances, these entities have relied mainly on their revenue-earning services to finance their non-revenue-earning services. Their electricity sales have been by far their main source of revenue earnings, especially when they have not paid fully for their purchases of bulk electricity from IEC. They and the PA have to find alternative ways to support their finances following the loss of these revenues to the new utilities.[3]

The corollary of this development is that revenues from electricity sales will be retained in the sector and applied to urgent and substantial rehabilitation and development needs, as well as to payment in full for purchase of bulk power supply. The PA will benefit from this change because it should experience a sharp and lasting increase in receipts of clearance revenue (once payments are restored) when the utilities improve collections of bills from consumers that enable them to pay their bills to IEC. Electricity consumers should receive a better service over time as the utilities use their revenues to upgrade their facilities.

Since the new utilities are owned by the municipalities, the PA has to install governance arrangements that counter any pressure from these shareholders on the utilities to indirectly subsidise electricity consumers through means such as weak collection of bills and thereby provide some income support to households, local businesses and municipal services. In essence, the PA has to use regulatory governance to counter poor corporate governance, as well as to improve the corporate governance of the utilities. The means available to the PA are the Palestinian Electricity Regulatory Council (PERC) and – if necessary – to have its nominees on the Boards of Directors of the utilities.

The present situation of the energy sector in West Bank and Gaza is closely linked with that in Israel and, to a lesser extent, that in Egypt and Jordan. The major issues in the Israeli energy market concern proposed reforms in the power sector, and the linked issue of increasing the share of natural gas in the energy mix. The Israeli power sector is still dominated by a single state owned company, IEC, and the Government has been planning for some time to liberalize the market. Proposals for the break up of IEC have been stalled. However, progress is being made in the introduction of privately developed generating capacity.

IEC's supply capacity is likely to be stretched in the near future to meet the growing level of demand on its system. This possibility means that the PA could face a major shortfall in electricity supply for meeting the power demand on its systems unless it concludes a long-term commercial agreement for supply from IEC to the Palestinian distribution companies.[4] IEC also has the incentive to conclude this agreement to protect its investments in supply capacity for sales to Palestinian utilities.

Almost any increase in power capacity in Israel over the next decade is likely to rely on natural gas. At present Israel relies on its own offshore supplies that are fully utilized, but additional

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[3] Some of the larger municipalities – such as Nablus - will gain in net financial terms from the transfer of retail electricity supply to the new utilities, because they will no longer provide power purchased from IEC to surrounding towns and villages without receiving full payment for this service from these communities.

[4] Discussions about a commercial agreement between the IEC and the Palestinian electricity distribution companies started in 2003 under the auspices of the EC, but have not yet been concluded.

supplies of gas will arrive from Egypt in 2008. The Israeli Government would like to import gas from the Gaza Marine field as a third source of supply. A potential obstacle to additional investment in both gas supply and in power generation capacity by private power producers is the low level of gas prices for Israeli and Egyptian gas enjoyed by IEC. To some extent, this is the result of historical changes in the international gas market in which Israel succeeded in "locking in" low prices before the recent rise in international energy prices. It will take some years to slowly unwind this distortion as the proportion of "cheap" gas is reduced.

1.3 Recommended Priorities

The Review recommends the following priorities in the energy sector for the PA. They are critical for meeting the growing demand for electricity sustainably whilst enhancing energy security and turning the energy sector's drain of the PA's fiscal resources into a substantial net inflow. They apply however long the current economic disruption persists.

Develop the technical, financial and institutional capacity of the power utilities. The five power distribution companies - the Gaza Electricity Distribution Company Ltd (GEDCO) and four utilities in the West Bank - are the key to improving the current low technical and financial performance of power supply and for reducing the level of the PA's fiscal support for paying from clearance revenue the amounts owing to the IEC for electricity supplied to the utilities, municipalities and other entities (US$100 million in 2005).

GEDCO and the three new utilities in the West Bank are small by regional – let alone international – standards as well as being in the formative stage institutionally. This feature will become more apparent as regional trade in electricity develops. This structure runs the risk of losing benefits from economies of scale in operations, investments and institutional development that could be obtained by forming a single utility to serve the whole of the West Bank. This risk should be managed by the PA through a specific policy to deal with this issue that focuses on standardization of plant, equipment and systems so as to benefit from joint procurement, maintenance and pooling of reserves of plant and equipment – and even bulk power - and training programmes for management and employees.

The utilities have to develop the technical, financial and institutional capacity for the following responsibilities:

- **Manage the PA's proposed investments in power transmission, distribution and customer supply facilities.** These measures are needed to reduce the high level of technical losses in the power networks and to expand the capacity to distribute more imported power to consumers as their demand grows. The investments will achieve these aims by consolidating the numerous low voltage feeders into larger medium voltage feeders served by new substations under Palestinian control. Investments are also needed in new meters and meter reading equipment to reduce the commercial losses on billings and to detect and reduce the theft of electricity. The estimated investment required during the next four years to achieve these aims totals around US$196 million (US$128 million for the West Bank and US$68 million for Gaza[5]).
- **Improve the collection of bill payments from electricity users**. Even before the collapse of payment discipline and hence collection of bill payments that occurred during 2006, the collection rates achieved by the power utilities were below normal commercial standards needed to sustain financial viability. GEDCO had a particularly low rate (66% in 2005), even allowing for the high number of its consumers in refugee camps. Among

[5] US$39 million has been committed by donors to financing the investment requirements of Gaza.

the West Bank power utilities, JDECO and HEPCO had very high collection rates, but SELCO achieved only 82% in 2005. Improvement in payment discipline has to be developed by strengthening the internal incentives for the utilities and the external incentives for consumers by the threat of penalties, and by the installation of pre-paid meters.

The Northern Electric Distribution Company in particular once it is formed needs support to develop its institutional and technical capacity. NEDCO also needs support for investments to rehabilitate and expand its distribution system to form an integrated network across the northern region of the West Bank. The northern area accounts for a substantial proportion of the fiscal expenditure on payments for bulk power to IEC. The formation of this utility – as with HEPCO and SELCO recently – provides the conduit needed to channel cash from consumers to pay for purchases of bulk electricity.

Convert the Gaza Power Plant to burn natural gas. Conversion of the GPP to burn natural gas (from Gaza Marine and/or Egypt) instead of gasoil would save around US$45 million annually for the Palestinian economy and the PA at the prevailing fuel prices and constrained level of electricity production in 2005. These savings are achievable for an investment of less than US$5 million to convert the plant and around US$10 million for construction of a gas pipeline to the plant site. The economic return to this investment would be very high. Once the conversion of the plant to natural gas is assured, this investment in combination with associated investments in transmission capacity (see next paragraph) would create the economic conditions necessary for fully utilizing, and then adding generating capacity to the GPP. Expansion of installed capacity of the plant in the longer term is feasible because the seawater intake pipe has been sized for a plant capacity of 280MW and the land allocated for the plant can accommodate four generator blocks of 140MW each.

Relieve the transmission constraint on output from the Gaza Power Plant. This investment would remove the transmission bottleneck that prevents the plant from running at more than about half of its capacity. It forms part of the development of the proposed 66kV transmission network and associated substation capacity for Gaza at an estimated cost of about US$32 million that is needed to take bulk power to load centers around Gaza (this is also needed to transmit electricity imported from Egypt and Israel). It is linked to the conversion of GPP to natural gas, since the production of power from the plant based on gasoil would cost more than imported power from Israel. The estimated savings to the PA at current prices and the 2005 level of demand would amount to around US$37 million annually. If the plant were able to produce continually from natural gas up to its full capacity of around 140MW, there would be additional savings of around US$45 million annually through converting the plant to natural gas (i.e. a total annual saving of about US$83 million). Hence, this investment offers an economic payback period of less than one year.

Select the best option for developing the Gaza Marine gas field. Development of this field should meet two priorities for the PA. Firstly, gas should be available for use in GPP on advantageous terms for the reasons given above, and secondly fiscal revenues from gas production should be maximized.

- **The PA and the Palestinian Investment Fund (PIF) should carefully assess the BG proposals for developing the gas field**. The gas field developer and operator - BG - is negotiating with the Government of Israel to send the gas to a new terminal in Ashkelon, from where it would be supplied to the Israeli grid and through a new pipeline south to Gaza. Full analysis will probably demonstrate that supply to Israel is more profitable to the PA than supply to the only alternative market, Egyptian LNG. The price to be set for

sales to Israel needs to take account of regional price trends, and should also be fully linked to alternative gas and fuel prices.

- **The PA should pay careful attention to the structure of any project to send this gas to Israel**. A key issue is whether the plans for investment in pipelines and a terminal in Israel result in value being shifted out of the Gaza project into a different jurisdiction. There has been discussion of integrating Gaza Marine development with Israel's Yam Thetys fields, which may merit consideration in view of the advantages of shared infrastructure.

Develop a long term power supply plan for Gaza and the West Bank. The PA has a good choice of options for increasing power supply to Gaza, but less so for the West Bank. Currently the PA is in negotiations that could lead to long term agreements to import power from Egypt and to increase power imports from Israel. These negotiations should take account of the attractions of expanding the capacity of the GPP once it is converted to gas. This option would require a renegotiation of the power purchase agreement with the Gaza Power Generation Company, which would probably take some time. In this situation, the PA faces the opposing risks of having a shortage of power or of having a surplus of power relative to Gaza's power needs. The latter risk could be managed by transferring power from Gaza to the West Bank. In addition to the investments for converting GPP to gas and for relieving the transmission constraints identified above, the Review considers that the PA should proceed as follows:

- **Negotiate the construction of a pipeline to import gas to Gaza from Egypt**. The PA should consider undertaking this investment soon. This is because the BG proposal for Gaza Marine development would be unlikely to bring gas to the GPP before 2011, thus exposing the PA to four more years of gasoil prices, whereas a pipeline from the Egyptian gas supply point at El Arish to the GPP could be built by 2009 at a cost of less than $30 million, which is less than the estimated annual benefits from converting the GPP to gas.

- **Negotiate long term rights to transfer power between Gaza and the West Bank through Israel.** Transferal of power in this context means both wheeling power through IEC's transmission network or making a back-to-back swap arrangement whereby for example power is sold by the PEA to IEC and an equivalent amount of power is purchased by the West Bank distribution companies from IEC. This would have two advantages for the PA. Firstly, it would greatly help the PA to manage the risk of contracting to take more electricity from the three sources identified above than actually needed to meet demand in Gaza under the considerable degree of uncertainty about the future trajectory of power demand in Gaza, because excess power supply could be sent to the West Bank. Secondly, it would create a valuable option for increasing and diversifying power supply to the West Bank, especially in view of the uncertainty about future power imports from Israel due to the prospect of restructuring power supply arrangements in Israel.

- **Direct transfer of power between the West Bank and Gaza as part of the putative territorial link between these two distinct geographical zones.**

- **Negotiate an agreement to interconnect the Gaza power network with power supply from Egypt soon, and another agreement to interconnect the West Bank power system with power supply from Jordan later.** These long-term agreements will substantially increase the amounts of imported power over the small amounts imported to southern Gaza and to Jericho in the West Bank under current agreements. They should provide for a reasonable return to the substantial investments in power supply capacity in Egypt and Jordan needed to meet supply commitments under the agreements.

Develop the capacity to regulate and attract private investors and operators to the power and natural gas markets. The planned and prospective development of power supply for meeting future power demand in West Bank and Gaza requires substantial capacity to formulate policies and to regulate electricity service providers – whether owned by public or private entities. The PA has already formed its plan for developing this capacity and started the process in the way described in this section. Given the major issues that it now faces for expanding power supply, the priority is to implement these plans.

The PA is following the medium term strategy for implementing the policy laid down for itself and the PEA in its 1997 "Letter of Sector Policy". Some of the components of this strategy have already been implemented – such as the commissioning of a privately developed power plant in Gaza and the formation of distribution companies. The PEA has made substantial progress on most of the other components of the strategy, such as extending electricity services to unserved communities, developing pragmatic tariff setting guidelines, and separating the policy and regulatory functions from the commercial functions of the power sector. The main outstanding components are consolidation of transmission networks and functions into a new transmission company and the establishment of the Palestinian Electricity Regulatory Council (PERC).

At present the PA has no institutions that are specifically dedicated to managing natural gas. Some new institutional capacity will be required as the PA becomes a gas exporter and user. However, what is required to deal with the new issues are small and focused increments to institutions or agencies. The advent of gas revenues should not lead to creation of large public sector natural gas institutions that will dissipate those revenues on additional public sector wages. As host to a major offshore gas development project, the PA needs to have the capacity to supervise and regulate the commercial and technical aspects of upstream functions of the gas sector. It will also need the capacity to deal with the downstream issues of developing and regulating a market for natural gas.

The Review recommends that the PEA procure technical assistance to examine the following issues: institutional arrangements for central procurement of bulk power, including security of cost recovery arrangements that underpin investments by the suppliers;; the contractual arrangements for bringing private management and investment into the new power distribution utilities; drafting regulations and directives for the short term, and drafting a new electricity law to support implementation of the PA's policies for the power sector for the medium and long term; and support for developing the capacity to plan, supervise and regulate the development of its natural gas resources and a natural gas market.

2. Current Energy Supply and Demand

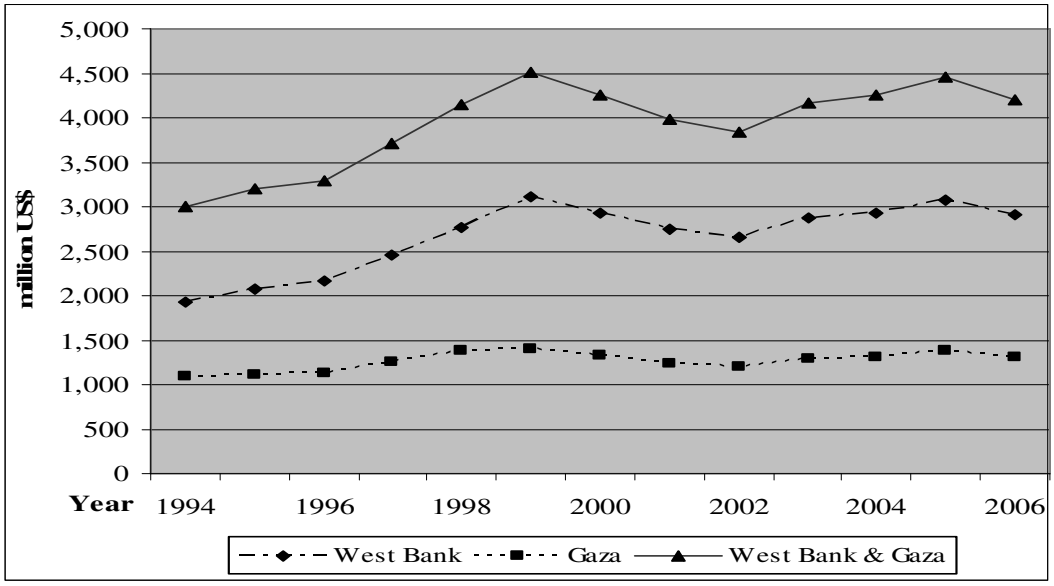
This chapter reviews the current energy supply and consumption situation in West Bank and Gaza as the starting point for identifying and analysing the issues facing the energy sector. It first sets this review in the economic and social context of these regions. It then examines the energy balance for West Bank and Gaza and shows the consumption of various forms of energy by the main economic sectors. It concludes by examining the specific balances for petroleum products and electricity – by far the most important energy forms for West Bank and Gaza.

2.1 Economic and Social Factors

The economic output of West Bank and Gaza has increased substantially since the 1990s, notwithstanding a temporary dip from 2000 on account of the current *intifada* (which began in September 2000). According to the Palestinian Central Bureau of Statistics, Gross Domestic Product (GDP) grew by about 50% from 1994 to 1999, equal to about 8.5% per year on average. It then declined by 15% from 1999 to 2002 because of the effects of the *intifada*. It increased by 16% from 2003 to 2005, but appears to have declined again in 2006 by about 6% under the current economic difficulties (Figure 1). GDP per capita in 2005 in West Bank and Gaza averaged US$1272 (1997 US$) (West Bank US$1446, Gaza US$1004).[6]

West Bank GDP grew more rapidly than Gaza GDP until 1999, but since 2000 the two areas have grown at similar rates so that proportions of total GDP have remained constant at 69% for West Bank and 31% for Gaza.

Figure 1. West Bank and Gaza GDPs 1994-2006 at Constant Prices

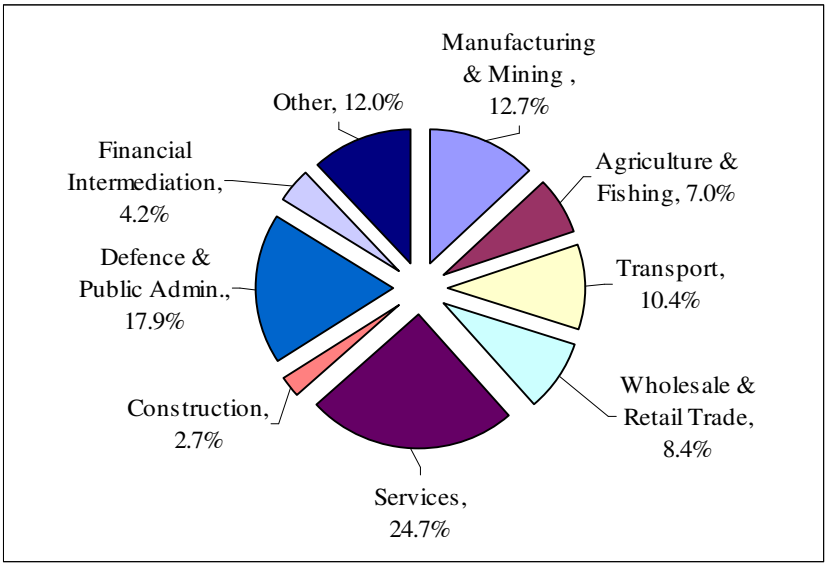


Source: Palestinian Central Bureau of Statistics (PCBS)

The Palestinian economy is based largely on services. In 2003, the various service sectors accounted for 64% of GDP, with manufacturing, mining, construction and transport together accounting for the balance (Figure 2). This economic structure is reflected in the structure of energy consumption shown in the next section.

[6] Source: PCBS. *Palestine in Figures 2005*. Ramallah, Palestine.

Figure 2. Percentage Contribution to GDP by Economic Activity at Constant Prices, 2005



Source: PCBS: *Palestine in Figures 2005*. May 2006

The population of West Bank and Gaza has grown rapidly by international standards, reaching 3.8 million in 2005 (West Bank 2.4 million, Gaza 1.4 million). Population grew at 3.8% annually (West Bank 3.5%, Gaza 4.2%) between 1997 and 2005, but growth declined in recent years (from 4.2% in 1999/1998 to 3.4% in 2005/2004). The population density is extremely high in Gaza (3,882 capita/sq.km), and moderately high in the West Bank (426 capita/sq.km).[7]

2.2 Energy Balance

The most recent comprehensive energy balance of energy supply and demand for Palestine is for the year 2003, which is reproduced in Annex 1 (Table A1). The table below summarises this energy balance. It shows that final energy consumption increased by 2% from 2001 to 2002, and by 9% from 2002 to 2003, despite the difficult economic conditions during this period.

Table 1. Summary Energy Balance of Palestine 2001, 2002, 2003

(terajoules)

Year	2001	2002	2003
Total Energy Requirements [a]	32,873	33,534	36,559
Primary production	6,189	8,775	10,126
Imports	26,646	24,773	26,389
Energy Conversion [b]	-3,111	-3,835	-6,486
Final Energy Consumption [c]	26,853	31,052	36,365
Industry and construction	2,138	2,043	2,266
Transport	5,414	5,969	6,914
Household and other sectors	19,301	23,040	27,185

Notes: (a) Includes exports and stock changes. (b) Includes electricity generation and losses in transport and distribution. (c) Statistical differences account for the difference in data between (Total Energy Requirements less Energy Conversion) and Final Energy Consumption.
Source: Derived from PCBS. *Energy Balance in Palestine 2001, 2002, 2003*. June, 2005

[7] PCBS: *Palestine in Figures 2005*. Ramallah, Palestine, May 2006

The growth in final energy consumption can be partly explained by the fact that energy consumption by the household and other services sectors accounts for about 75% of the total (see Table 2), and because energy consumption by these sectors is less responsive than in other sectors to adverse changes in economic conditions. Consumption can be sustained by substantial remittances from abroad that support household incomes and by an increase in non-payments for the supply of commercial energy.

Table 2. Sectoral Composition of Final Energy Consumption

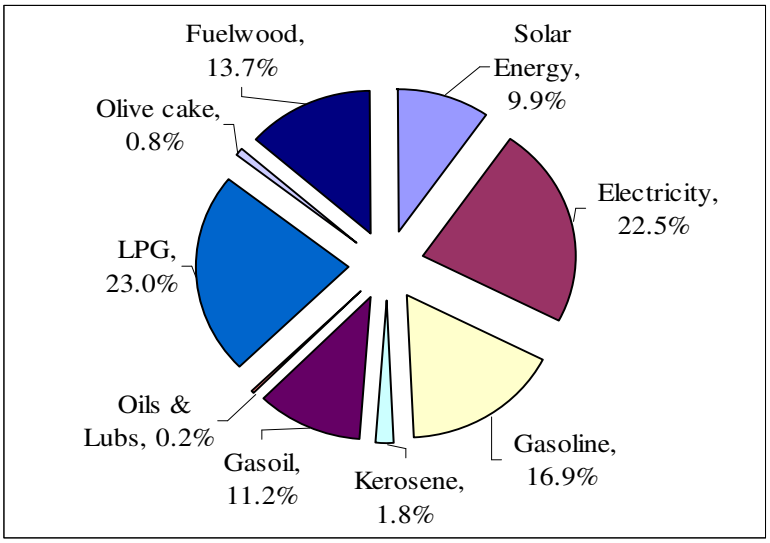
(terajoules)

Year	2001	2002	2003
Industry and construction	8%	7%	6%
Transport	20%	19%	19%
Household and other sectors	72%	74%	75%

Source: Table 1.

The breakdown of total final consumption of energy in 2003 is shown in Figure 3.

Figure 3. Breakdown of Final Consumption of Energy in 2003 by Source of Energy



Source: Derived from PCBS. *Energy Balance in Palestine 2001, 2002, 2003*. June, 2005

The dominance of the household and other service sectors in energy consumption means that they accounted for nearly all consumption of solar energy, LPG, olive cake and fuelwood, for about 90% of electricity and kerosene consumption, and for about half of the total consumption of diesel, oils and lubricants in 2003 (Annex 1 Table 3).[8]

LPG accounted for the largest proportion of energy consumption by the household and other services sectors in 2003 (29.5%), followed by electricity (26.6%), fuelwood (17.8%), solar energy (12.8%) and gasoil (9.2%) (Annex 1 Table 2). LPG is the main cooking fuel, but is also used for heating and lighting if electricity is not available. Solar energy is used for water heating, electricity is used for lighting, refrigeration, entertainment and communications, and fuelwood is

[8] Electrical appliance ownership is high in Palestine. In 2004, about 90% of households own televisions refrigerators, about 80% radio/recorder, over 70% mobile phones, over 40% landline phones, and around 26% computers (PCBS. *Palestine in Figures 2005*. Ramallah. May 2006).

used for cooking by households that cannot afford to purchase LPG or when LPG is unavailable. The small consumption of kerosene (2.2%) is used mainly for lighting by the few households that are not connected to electricity system (less than 5% of the total).

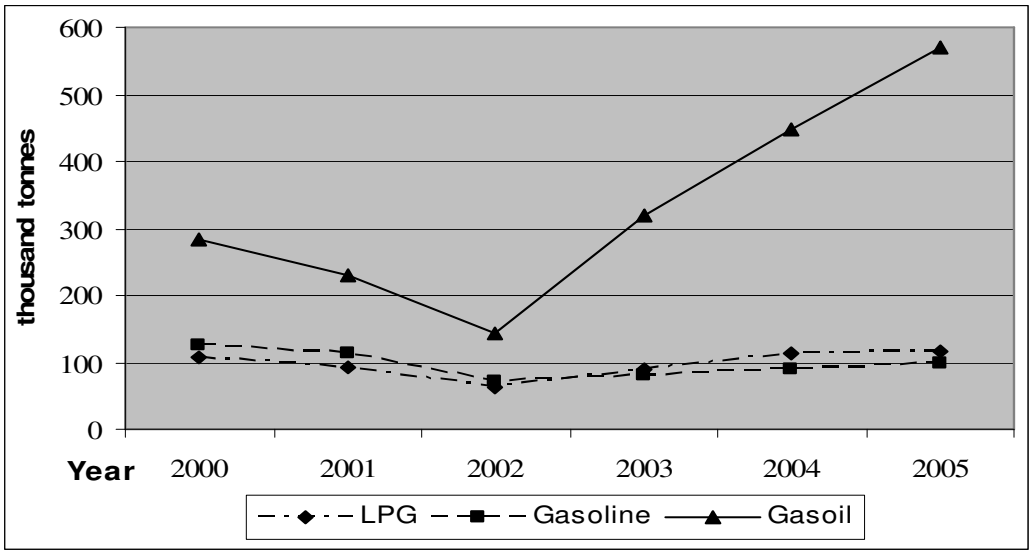
2.3 Petroleum Products Supply and Consumption

The supply of fuel to the Palestinians is anchored in agreements between the PA and Israel (Paris Agreement). The supply of fuel is conveyed centrally to a fuel terminal on the border of the Gaza Strip. In the West Bank, the supply is transferred into the West Bank at two terminals. The terminal in Nielin in the West Bank is unsafe and needs to be replaced by another facility. None of the supply facilities have storage capacity, which makes Palestinians dependent on a day-to-day supply from Israeli companies. Israeli fuel companies are not authorized to supply the fuel directly to fuel retailers and gas stations in West Bank and Gaza, and this trade is conducted by the PPC.

The Israeli company Dor Alon was the sole company chosen by the Palestinians to supply oil products for West Bank and Gaza from 1994 until the end of 2006. Starting from January 2007 the largest fuel marketing company in Israel – Paz Oil - was chosen by the PA to supply the product requirements of the West Bank.

Imports of petroleum products to West Bank and Gaza have been highly correlated with GDP (see Figure 4). Imports of petroleum products declined by between 40% and 50% from the onset of the *intifada* in 2000 to 2002 (according to Israeli data), and then increased from 2003 onwards. The surge in imports of gasoil was partly due to the entry into service of the GPP in November 2002, but much of the increase from 2003 onwards is allegedly due to gasoil being imported into the West Bank (officially) then being smuggled back to Israel (see below).

Figure 4. Trends in Imports of Petroleum Products to West Bank and Gaza 2000 - 2005



Source: Annex 1 Table 4.

These trends are also apparent, but less pronounced, in data published by the Palestinian Central Bureau of Statistics (PCBS) on imports of petroleum products in 2001, 2002 and 2003, even though there are substantial differences between the two sets of data. For example, PCBS data on gasoline imports are much higher for all three years than the Israeli data, for gasoil for 2001 and 2002 (but lower for 2003), and LPG for 2002 (Annex 1 Table 5). Such differences have to be reconciled somehow for determining the amounts of petroleum tax owed to the PA.

According to the Paris Agreement, the Palestinians are allowed to sell fuel in West Bank and Gaza at a lower price than the price in Israel, at a rate which does not exceed 15% of excise tax on gasoline. The Palestinians chose to reduce the tax imposed on the fuel marketed in West Bank and Gaza according to the Agreement. Israel collects the taxes on the fuel for the Palestinians.

The Paris Agreement did not refer to the excise tax on gasoil, which was negligible at the time of signing it. Today, the excise tax on gasoil exceeds 50% of the price of gasoil at the refinery gate in Israel, and the tax is due to rise within two years to the level of the excise tax on gasoline – up to 100% of the refinery gate price. This high tax provides an incentive to smuggle gasoil from West Bank and Gaza to Israel in order to avoid paying this tax, and consequently smuggling of gasoil has grown.

Today it is easy to smuggle fuel from the West Bank to Israel, and the level of fuel smuggling has increased substantially in recent years in tandem with the rise in excise tax on gasoil in Israel. The Israeli Ministry of Finance estimates that the loss of excise tax due to this smuggling exceeds NIS 200 million a year (about US$45 million). Smuggling from Gaza is negligible due to the meticulous security arrangement at the only fuel terminal at Nahal Oz and the guarding of the security fence.

2.3.2 West Bank

Fuel for the West Bank is transferred via two terminals – Nielin terminal for LPG and Deir Kadiz terminal for other types of fuel. The two terminals operate in PA territory and are run by the PPC. Israeli fuel tankers arrive at the terminals and offload the fuel directly into tankers at the site. In addition, fuel can be offloaded from Israeli tankers back to back with Palestinian tankers at the Tarkumiyah crossing. The Israeli fuel companies have no terminals or installations of their own on the border of Israel with the West Bank.

For the short, medium and long terms, Israel is initiating changes in the arrangements for the transfer of fuel to the West Bank. Two new fuel terminals with large storage capacity will be constructed, one in the north West Bank at the Ephraim Gate adjacent to Tulkarem, and the second in the south at Tarkumiya adjacent to Hebron. In the future the transfer of fuel will be permitted only via these terminals. The terminals on the Israeli side will be built with the funding of the Government of Israel to resemble the Nahal Oz terminal in the Gaza Strip (see below), and will include supply points and a control and metering and billing room. The terminals on the Palestinian side will be constructed with Palestinian funding and will include installations for the reception, storage and dispatch of fuels. The programme depends upon final agreement with the PA and on finding sources to fund the terminals on the Palestinian side.

2.3.1 Gaza

The Gaza region receives all types of fuel required via the Nahal Oz terminal on the Israeli side. The Israeli terminal belongs to the Dor Alon Company. At the terminal there is a control room and metering and billing station as well as fuel supply points to which the full fuel tankers arriving from the Israeli side connect. The fuel is pumped a distance of 700 meters via pipelines to the reception terminal on the Palestinian side which includes a metering and billing station, tanks to receive the different types of fuel and fuel dispatch stations to tanker trucks.

Currently, the Nahal Oz terminal is the only terminal through which fuel can be transferred to the Gaza region. At the terminal, there is a dedicated line for the supply of fuel to GPP for power generation. The area is surrounded by a security fence through which fuel cannot be smuggled.

2.4 Electricity Supply

The pattern of electricity supply and characteristics of electricity consumption in the Gaza region are different from those in the West Bank. The difference stems mainly from the higher standard of living in the West Bank compared to the Gaza area.

2.4.1. West Bank

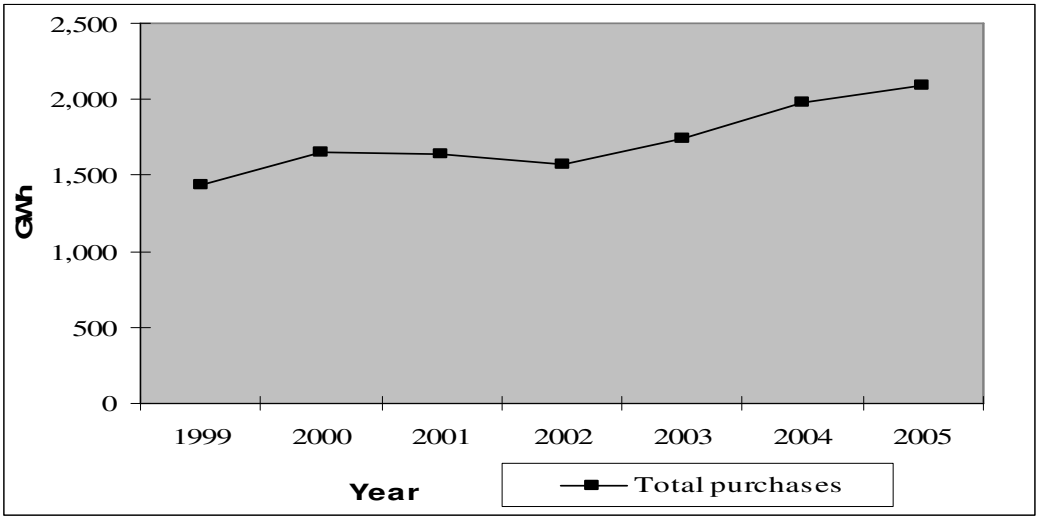
The West Bank depends almost entirely on IEC for electricity supply. It is mainly supplied by three 161/ 33 KV substations: one in the south in area C close to Hebron, a second in the north in the Ariel settlement (area C) close to Nablus, and a third in Atarot industrial area (area C) near Jerusalem. Electricity is supplied to the center of the West Bank largely through JDECO via 33kV and 11kV distribution lines at several connection points with the IEC including, Ramallah, Jericho, Bethlehem and the eastern part of Jerusalem.

West Bank consumption of electricity – as measured by purchases of bulk power from IEC - increased at an average annual rate of 6.4% between 1999 and 2005, as shown in Figure 5. The pronounced dip in this growth that occurred in 2001 and 2002 is evident due to the eruption of the *intifada*, amounting to almost 9% of purchases in 2002.

The maximum capacity of electricity supply to the West Bank is about 550MVA, 30% directly by IEC which supplies electricity in bulk to 215 towns and villages, and 70% indirectly by IEC through JDECO which supplies electricity to East Jerusalem and in bulk to 165 towns and villages in the West Bank.

The PA has agreed with Jordan to connect the Palestinian power grid to that of Jordan at Jericho through a 33kV line via King Abdallah Bridge.[9] JDECO submitted a new request recently to upgrade the line to 132 kilovolt, which is compatible with the voltage supplied by the Jordanian electricity company.[10] JDECO will execute the work on the Palestinian side. The Jericho area will be disconnected from the Israeli power grid, and JDECO will manage a separate electricity supply system for the customers connected to the electricity supply from Jordan.

Figure 5. Power Purchased by West Bank Utilities 1999-2005



Sources: PEA, JDECO, HEPCO, SELCO

[9] The Israeli Ministries of National Infrastructure and Defence (Civil Administration) have approved this connection.

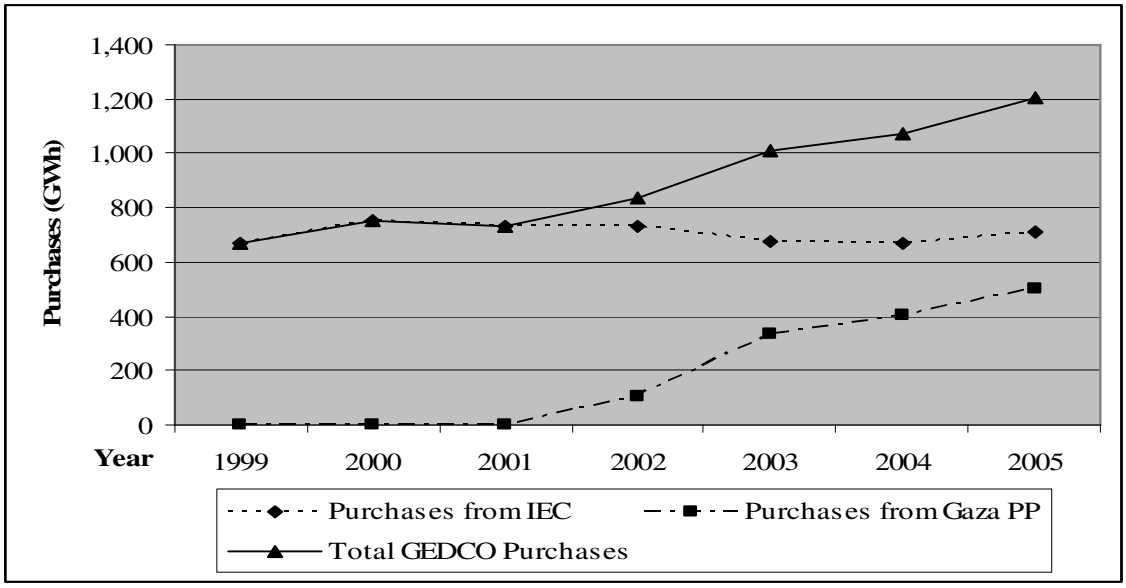
[10] This connection would not link the power grids of Israel and Jordan.

2.4.2. Gaza

Gaza receives electricity from IEC and from a gasoil (diesel) based power plant with electricity generating capacity of some 140MW located inside Gaza (GPP), which is the only major power generating facility in West Bank and Gaza. Gaza also receives a small power supply from Egypt (17MW)[11]. GEDCO distributes electricity within Gaza.

Gaza's total supply of power (purchased from IEC and GPP) increased by 80% between 1999 and 2005 at about 10% average annual rate (Figure 6). Most of this growth took place from 2003 onwards, and it coincided with the advent of power from GPP. This indicates that substantial unserved demand for electricity existed in Gaza, which would explain why power consumption increased so rapidly whilst Gazan GDP grew more slowly at 3.7% per year (Figure 1).

Figure 6. Power Purchased by GEDCO 1999-2005



Source: GEDCO

Gaza is connected to the Israeli power grid at 11 points along the border from north to south, via 22 kilovolt transmission lines with total capacity of some 115MW. The low distribution voltage of these feeders considerably constrains the ability of IEC to supply sufficient electricity for the potential demand for electricity in Gaza.

GPP produces electricity at high prices compared to the price of electricity purchased from Israel, mainly because of the high price of gasoil used for the plant.[12] Moreover, the maximum despatchable capacity of the plant has been restricted to about 90MW by the available transmission capacity from the plant to the Gaza power network. A concession based on the Build-Own-Operate (BOO) approach to project financing was granted under a Power Purchase Agreement (PPA) by the PA to Palestinian investors for a 20 year term from March 15, 2004. The PA is replacing six of the transformers at the plant substation that were destroyed by Israeli air strikes in June 2006 in the first rehabilitation phase of the power plant, and the PA through Italy is working to rehabilitate the second phase of the Power Plant.

[11]The 17MW supply from Egypt was provided as an emergency measure after the June 2006 electricity shortage that followed Israel's destruction of the substation at the GPP.
[12] Extracted from Annex 2 "Operating and Commercial Performance of the Gaza Power Plant."

The plant has actually been used at lower utilization rates than anticipated, partly because of the high cost of power from the plant when it is run on gasoil relative to the cost of power from IEC. In June 2006, for example, the cost of fuel for generating electricity from GPP (including capacity charge) was US$0.213/kWh including VAT and taxes on gasoil, and US$0.124/kWh not including VAT and taxes on gasoil, whereas the cost of power supplied by IEC was about US$0.08/kWh excluding VAT and taxes on gasoil. Nevertheless, power from GPP has been needed to help meet the peak loads on the power system that occur during daytime and which have recently averaged about 200MW, of which IEC could meet only 110MW through the transmission link with its system.

The allocation of risks under the PPA between the owner of the Gaza Power Generation Company (GPGC) as seller, and the PA as the purchaser, generally follows international practice where the PPA is the first to be negotiated in a country with a risky business environment. This does not mean, however, that the risks to which the seller and the purchaser are exposed under the PPA are allocated equitably between these parties, taking account of the seller's concern about earning a competitive rate of return on its investment and the purchaser's concern about being able to afford its payment obligations.

The PA is exposed to the following significant risks under the PPA.

- Payment of the Capacity Purchase Charge for full capacity of the plant under the "take or pay" terms, regardless of transmission constraints affecting the dispatch of the plant. About half of the current annual payment of about US$30 million is for generating capacity that cannot be used because of the prevailing transmission constraints.
- The PA bears the consequences of force majeure events.
- The lack of specific provisions in the PPA for renegotiation of the PPA in the event that bulk power prices in the Gaza power market falls well below the average total payment for power per kWh of energy taken by the Purchaser under the PPA: The Capacity Payment can be re-negotiated under the PPA only when an increase in the capacity of the power plant by adding new power units is being considered.
- The lack of remedies for the PA under the PPA if GPGC fails to deliver the electrical output in full from the plant that is requested by GEDCO within the declared available capacity of the plant.
- The PA is responsible for procuring fuel for the power plant and paying for it, so the PA takes both the risk of an increase in fuel prices and the risk of disruption to fuel supply. In fact, the price of oil has tripled, approximately, between the time that the PPA was negotiated and now. There have been no reports, however, of a disruption to the supply of gasoil to the plant, despite the disturbances of the past few years in the region.

The power grid in Gaza is in a debilitated condition and requires sizeable investment for rehabilitation and upgrades. The PA has to invest about US$ 68 million in transmission lines, substations and distribution lines.

Within this framework, a 161kV high voltage transmission line is currently being erected along a 10 km pathway on the Israeli side which will interconnect Gaza in the north. The project has been defined as an emergency project by the EC. The high voltage connection is expected to reduce the price of electricity for the Palestinians by supplying electricity at a lower tariff and by reducing technical losses in the power network. GEDCO is seeking a long term commercial agreement with the IEC to buy electricity to Gaza through this new link. The main constraint on concluding the commercial agreement is the lack of an Israeli proposal for a tariff that reflects the real cost of the bulk supply of electricity sold to the Palestinians.

In November 2006 the PEA and the IEC agreed on starting the construction of the 161kV line between Israel and Gaza. The construction of the line has been delayed for two reasons:

1. Israeli internal delay in transferring part of the withheld PA tax money from the Israeli Ministry of Finance to the IEC to cover the cost of constructing the 161kV line.
2. The Israeli military destruction of the Gaza North Substation that is expected to receive and distribute the IEC electricity.

A plan to connect the distribution grid of Gaza in the south (Rafah area) to the Egyptian distribution grid has been considered and implemented. Discussions between Egypt and the PA on a 220kV interconnection into Gaza were resumed recently. The PA secured financing for the construction of the 220kV interconnection with Egypt from the Islamic Development Bank.

In the medium to long term (2010 onward) natural gas from the Gaza Marine field or Egyptian natural gas is expected to reach Gaza. The arrival of the gas would facilitate the conversion of GPP to burn natural gas at a much lower cost than currently from gasoil,[13] as well as to expand production capacity up to 560MW (see Chapter 5).

[13] If natural gas supplied to GPP cost US$4/mmbtu, the fuel cost of power generated would be about US$0.09/kWh less than presently with gasoil. This difference would save about US$45 million per year (excluding VAT and taxes on gasoil) for the 499GWh produced in 2005 (Annex 2).

3. Technical and Financial Performance of the Power Utilities

The institutional set-up of the West Bank and Gaza electricity sector is somewhat fragmented. Four free-standing utilities are responsible for electricity distribution in Gaza and the southern and central West Bank, while electricity distribution is a municipal responsibility in the northern West Bank. JDECO services East Jerusalem and the central West Bank, HEPCO covers the Hebron area in the southern part of the West Bank, and SELCO covers the remaining Southern West Bank. NEDCO is being established to serve the northern West Bank. Nablus, the largest municipality in the northern West Bank, alone has approximately 46,000 customers and serves a district with some 215,000 citizens, (Table 3). GEDCO is the sole provider of electricity services in Gaza. The three existing utilities together cover approximately 60% of the population in the West Bank, while the remaining population in the West Bank is supplied by municipalities.

Table 3. Electricity Sales in West Bank and Gaza by Supplier 2005

	JDECO	SELCO	HEPCO	W. Bank Munic.[a]	of which Nablus[a]	GEDCO	Grand Total
Total billed consumption (GWh)							
Households	503	35	110	213	73	591	1453
Commercial	363	14	77	227	78	305	985
Number of customers (1,000)							
Households	143	15	26	104	36	129	416
Commercial	31	1	2	29	10	17	80
Average consumption (MWh)							
Households	3.5	2.4	4.2	2.1	2.1	4.6	3.5
Commercial	11.8	18.7	43.8	7.9	7.9	17.6	12.4

Note (a): Data for Nablus is 2004. Total consumption by West Bank municipalities is estimated by assuming the same customer distribution and average consumption as for Nablus.
Source: PEA, Nablus Electricity Department, and World Bank Staff estimates.

Based on information from the utilities and Nablus municipality, total billed electricity consumption in West Bank and Gaza amounted to about 2.5GWh in 2005. Households consumed between 60% and 75% of total electricity consumption, with commercial consumers making up the bulk of the remaining consumption[14]. Household's share of total consumption is highest for SELCO, which services a relatively less developed area (with relatively lower commercial consumption), while it is lowest for JDECO which services the most affluent part of West Bank and Gaza, where much of the commercial activity is concentrated.

Average consumption per household is about 3,500 kWh per year. There are quite large geographical variations. For example, average consumption for SELCO is about 3,000 kWh. Among Nablus households, the average annual consumption is only about 2,000 kWh. These variations may reflect differences in billing efficiency as well as genuine differences in consumption levels. As the average household size in West Bank and Gaza is about 6 persons, the estimated per capita consumption is about 675 kWh/year. Average consumption is highest in cities, lower in villages and lowest in refugee camps[15]. Commercial activities are most electricity intensive in the Hebron area, where the average annual consumption averaged about 41,000 kWh

[14] Other consumer types include public institutions and public water pumps, which are grouped together with commercial customers.
[15] According to data from JDECO, since this is the only utility that has detailed data by type of locality.

in 2006. This is more than twice the average level for this category in other areas possibly because of the high prevalence of energy intensive glass and pottery producers in Hebron.

3.1 Technical Performance of the Power Utilities

3.1.1 West Bank

The IEC supplies electricity to Palestinian loads adjacent to its distribution overhead lines. The present load in the West Bank is in the order of 400 to 500MW and is supplied from several points within the IEC network. There are three main supply substations at 161/33kV from the IEC grid, at Hebron, Atarot and Ariel. The electrical networks in the West Bank are all considered distribution networks at 33 and 22kV. Also, some Palestinian loads, especially in the northern area of West Bank, are supplied by distribution feeders from a 161kV substation inside Israel from which distribution feeders cross the border to supply Palestinian loads, such as the case of 22 kV feeders supplying Qalqilya and Tulkarm areas. Some 33 kV feeders from Beisan (in Israel) supply the Jenin and Tubas areas. Figure 7 shows the location of the 161kV substations and the number of distribution feeders that supply Palestinian loads.

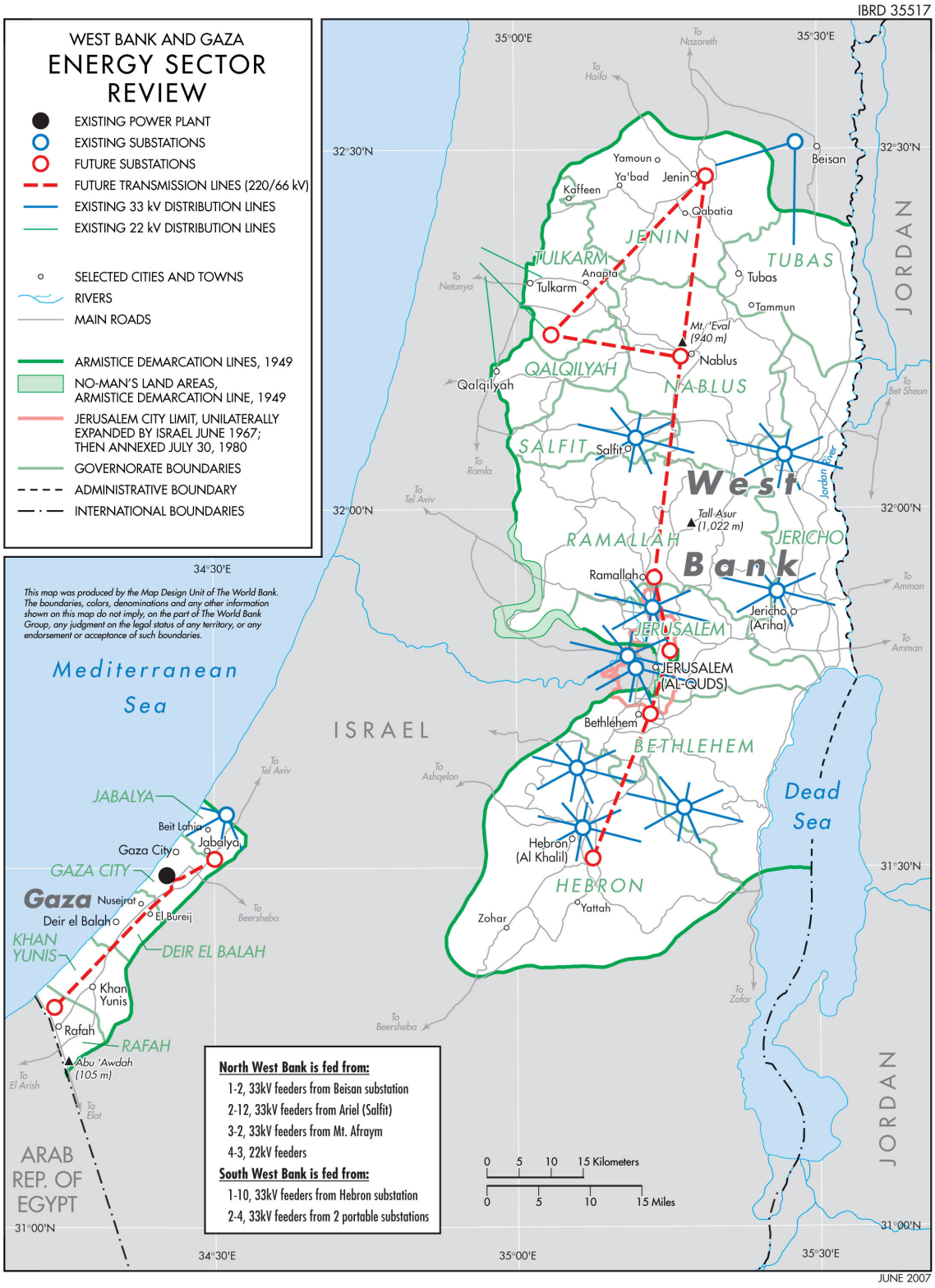
In 2006, the contracted capacity from IEC was about 550MVA, which was divided into 125MVA for the north, 95MVA for the south and 330MVA for the central area under JDECO. The situation in early-2007 has not changed much as compared to 2006, except that in the case of JDECO, another 50MVA will probably have been added.

In principle the electricity is supplied to the Palestinian loads at 33kV or 22kV through IEC owned MV lines. In most cases, the PEA and the Palestinian utilities do not have control of the supply through the transmission or the distribution lines that extend from the 161kV substations. Palestinian control begins in most cases after the connection point with these feeders, which are metered for billing purposes by IEC to the utilities and municipalities.

The number of these connection points in the Northern area exceeds 120 with a total contracted capacity of 125MVA, while in the Southern area they are more than 45 points with a contracted capacity of 95MVA and in the JDECO area they are 25 points with a capacity of 380MVA. These connection points are also mixed between LV and MV. The difference is that if the connection point is on the MV side, then the Palestinian utilities can extend the MV network and install transformers and LV lines, whereas if the connection point is on the LV side, the Palestinian utilities cannot expand the LV network.

The inability to extend the MV and LV networks has contributed to network deficiencies, such as very low voltage and high technical losses. In addition, the lack of financing due to the deteriorating situation in the collection of the electricity bills in utilities, municipalities, and villages has affected the maintenance of the networks, which in turn has increased losses, outages and overloading of feeders. The average losses are about 20%-30%. As a result of the fragmentation of the distribution system in the northern and the southern regions, the connection points are not physically connected by an integrated network that will allow the transfer of any unused capacity from one point to another or the use of one point as a backup to another point in case of an emergency situation. In the case of JDECO, this situation is not present due to the existence of an integrated network.

Figure 7. Electricity Supply System in West Bank and Gaza



There is no direct integration between the networks of the Palestinian utilities. The integration of these networks could be achieved through the IEC network. Integration of the Palestinian networks through the IEC transmission network to provide backup between the utilities, however, has never been utilized.

The IEC for the time being rejects most of the Palestinian requests in the northern and southern regions to increase the capacity of the existing connection points or to add new connection points, claiming lack of capacity in the existing 161kV substations or overloading of its distribution feeders. This in turn has created a supply bottleneck to meet the growth of demand, and it is expected that this year the peak demand in the northern region will be higher than the available contracted capacity with IEC, which will be obliged to carry out load shedding in some areas. The area most affected will be the Nablus area, which is the main load center in the northern region.

In summary, despite the several rehabilitation programmes executed in the different regions of the West Bank, several factors have adversely affected the electricity networks, namely: lack of capital and a decrease in the collection of electricity bills resulting in poor maintenance in the network; no control of the connection points by Palestinian utilities and municipalities with the result that feeders are extended at LV instead of at MV; and insufficient supply at the connection points controlled by IEC. These factors have led to an increase of technical and non technical losses, increase in network outages, deterioration of the quality of supply for the end consumer, and overloading of feeders.

3.1.2 Gaza

At present, the electricity network in Gaza is considered a distribution network at 22kV. There are plans to construct a 66kV transmission network, including two substations, in the North and in the South in addition to the substation in the GPP. These plans have not yet been implemented. Currently the distribution system in Gaza is configured to supply the load centers from the IEC supply sources and the GPP respectively.

IEC supplies Gaza with about 125MVA from four Israeli 161/22kV substations located inside Israel via 10 distribution feeders (22kV), while GPP supplies Gaza with about 65MVA. The IEC main distribution feeders are overloaded and have reached their thermal limit, and cannot carry more supply to satisfy the increasing load in Gaza. These deficiencies have resulted in increase in technical losses and system outages, and a poor quality of service. The total losses are about 17% to 25%. Following the destruction of the GPP transformers, the available supply has been about 30MVA less than the existing demand. To cope with this situation, GEDCO has put in place a load shedding programme for the disconnection of feeders. Gaza is in a similar situation as the West Bank concerning the lack of financing due to the deterioration in the collection of electricity bills, which has also impacted the maintenance of the networks and led to an increase of losses, outages and overloading of feeders. Parts of the electricity network in the northern and southern areas of Gaza were damaged by the continuous Israeli incursions during 2006.

3.2 Financial Performance of the Power Utilities

Table 4 provides an overview of the financial performance in 2005 of the four established power utilities. It shows that the utilities are under considerable financial stress due to three factors:

- The first factor is the unit mark-up (trading margin) which providers levy on their sales. Mark-ups appear to vary significantly because while purchase prices are quite similar, retail prices vary considerably. In 2005, the four utilities purchased electricity from IEC at about US$0.08/kWh excluding VAT. There were, however, considerable differences

in the retail price that utilities charged costumers.[16] In 2005, JDECO charged the highest average retail price at US$0.12/kWh, which is equivalent to a 55% mark-up over its average purchase cost from IEC. GEDCO charged the lowest average retail price at US$0.095/kWh, which is equivalent to a 17% mark-up over its average purchase cost from IEC and the GPP. HEPCO and SELCO charged mark-ups of about 26% for their average retail price of US$0.105/kWh.

- The second factor of importance for utilities' financial viability is the substantially lower amount billed to customers than the amount of electricity purchased from IEC. This loss is the result of technical transmission losses, inefficient billing, and theft. In 2005, this loss varied from 26% for GEDCO to 18% for JDECO (they include non-payments of electricity bills by consumers that live in camps, which have increased recently).
- The third factor eroding utilities' financial viability is their low cash collection rates. In 2005, cash collection rates varied between 66% by GEDCO to over 100% by JDECO. [17] According to available data, the situation for GEDCO and SELCO is now dire. During the first 10 months of 2006, reportedly, GEDCO only managed to collect about 29% of its total amount billed to customers. SELCO's collection rate was even lower, at 20%.

Based on available data, the total deficit of collections less purchase costs and overhead expenses in 2005 of the four utilities may amount to approximately US$70 million. GEDCO's deficit makes up about 60% of this total on account of its low collection rate and the low mark-up of retail tariffs over purchase costs. Reportedly, only JDECO is able to finance a cash short-fall by borrowing from commercial banks, probably in part due to its long existence and an expectation that its location in East Jerusalem/central West Bank will enable it to recover its losses. By contrast, the only source of additional working capital that appears to be available to the other utilities is to run up arrears to their main supplier, which is IEC in the case of SELCO and HEPCO and both IEC and the GPP in the case of GEDCO[18]. According to data from the PEA, at the end of 2005 both SELCO's and HEPCO's accumulated debt to the IEC stood at about US$6 million.

Table 4 also provides a broader comparison of the financial and operating performance of the four utilities in 2005 with IEC and Jordanian power companies. It shows that the Palestinian utilities are relatively small and currently perform at substantially lower standards than regional counterparts. This comparison shows the huge scope for improvement that could be realistically achievable by the Palestinian utilities in more stable circumstances.

[16] All utilities, except JDECO, charge lower prices to commercial users than to households.

[17] In calculating the cash collection rate, the total amount collected includes both the amount for the current period's bills, and bills paid covering previous periods; the collection rate calculated as current collection/current sales would therefore be lower. This also explains why JDECO's collection rate in 2005 exceeded 100%.

[18] In 2005 about 60% of total GEDCO supplied electricity to Gaza came from IEC, while the remaining 40% were generated at GPP.

Table 4. Comparative Financial and Operating Performance Measures for Selected MENA Electricity Distribution Companies in 2005

	Palestinian Territories							
Name of Company	**JDECO**	**HEPCO**	**SELCO**	**GEDCO**	**Jordanian Electric Power Company**	**Electricity Distribution Company (Jordan)**	**Irbid District Electricity Co.(Jordan)**	**Israel Electricity Company**
Measure								
Operating Margin (%)	6.7%	5.9%	-3.1%	-12.6%	22.8%	1.1%	13.9%	28.4%
Trading Margin (%)	55%	25%	26%	17%	36%	15%	28%	53%
Operating ratio (times)	0.98	1.07	1.41	0.01	0.90	0.98	0.95	0.85
Current ratio (times)	3.80	1.64	0.50	0.92	0.74	1.85	0.89	1.02
Self-Financing Ratio (%)	-67%	-86%	214%	0%	98%	93%	12%	23%
Average Billing Rate (US$/kWh)	0.119	0.105	0.105	0.095	0.069	0.056	0.061	0.100
Average Purchase Rate (US$/kWh)	0.077	0.084	0.083	0.081	0.051	0.048	0.048	0.065
Total Energy Losses (%)	17.9%	16.6%	22.9%	25.8%	9.8%	12.1%	11.1%	9.0%
Cash Collection Rate (%)	112%	98%	82%	66%	83%	48%	76%	89%
Collection Rate -- purchased energy (%)	140%	82%	80%	57%	75%	42%	67%	81%
Sales per employee (US$)	158,052	161,659	67,488	159,408	1,824,292	1,289,742	1,284,038	4,145,285
Customers per employee	232	237	178	271	252	126	266	237
Accounts Receivable (months Billings)	7.5	21.2	9.2	29.2	2.1	6.2	2.9	1.3
Accounts Payable (months Billings)	1.0	13.6	15.8	33.1	3.3	5.4	3.5	1.2
Debt Service Coverage Ratio (times)	5.7	14.8	-2.5	0	1.9	3.2	1.6	1.2

The formulas used for the derivation of these power utility performance measures are given in Annex 1.

3.2.1 JDECO

Despite the uncertain and difficult situation, JDECO has had a reasonably satisfactory performance with sales growing at an annual rate of 17% during FY02-05. System losses have gone down from a high of 20% in FY04 to 18% in FY05. The company made significant improvements in its collection performance (collection as a percentage of billing) of over 100% during the last few years. The company has been able to generate enough revenues to cover almost all its operating costs including depreciation and bad debts. Its cash revenues have been sufficient to cover debt service obligations, with its debt service coverage ratio staying above 2 since FY03. The liquidity position has been satisfactory with a current ratio of 3.8 in FY05, up from 3.1 in FY04. The audited FY05 accounts indicate net profits, which are projected to increase gradually; this is indeed commendable under the prevailing conditions.

The company has had a significant drop in trading margin (total sales less import cost) in recent years. Against the annual increase of 17% in sales in recent years, the import cost of electricity has been growing by an annual rate of 25% during the same period causing the trading margin to drop. Increased efforts for efficiency improvements together with adjustments in the sales tariff (subject to consumers' willingness and ability to pay) should result in a better margin for JDECO to cover its operating and financing costs.

In order to improve its receivable position, in 2002, JDECO adopted an "Action Plan to Reduce Accounts Receivable". As a result, overall receivables were reduced from 8.9 months at the end of FY02 to 7.2 months at the end of FY03, and further improvements were anticipated. Continued economic hardship and rising unemployment led to consumers losing their ability to pay their electricity bills, thereby making it difficult for JDECO to contain its level of receivables. This level increased again to 7.0 months by the end of FY05, but, JDECO managed to bring it down to 6.0 months by the end of September 2006. Overall cash collection performance improved significantly from 71% for FY02 to 112% by the end of FY05. But presently the PA agencies cannot pay their electricity bills, government employees cannot pay for their electricity consumption because of non-payment of salaries, and an increasing numbers of unemployed consumers are not paying for their electricity consumption. , Consequently, the overall collection rate started to decline again, and it had dropped to 82.6% by the middle of November 2006. This level is not sustainable, and the disconnection of delinquent customers has led to a rapid increase in illegal connections, which in turn has resulted in rising non-technical losses.

3.2.2 SELCO

SELCO was established as a shareholder-held company in December 1998 but the start of commercial operations was delayed until March 2004. Unlike for JDECO, there is not much historical data to carry out any trend analysis. SELCO was created by the amalgamation of the electricity departments of four municipalities - Dura, Yatta, Dahariah, and Beit Ummar. These municipalities and the municipality of Halhoul and the Ministry of Local Government as representative of other municipalities and village councils, were the initial shareholders of SELCO. To start with, this was a difficult proposition and with the beginning of the second *intifada*, continuous hostility leading to uncertainty had caused protracted delays in the start-up of SELCO's commercial operations. Subsequently, five village councils have joined SELCO.

SELCO became operational in 2004 but it has yet to gain a satisfactory customer base so as to achieve a reasonable financial performance. With 76 employees and only 13,522 consumers, the company is struggling to generate sufficient revenues to cover its costs. Upon completion of Phase-2, the total number of consumers is expected to increase to about 60,000, which should improve the financial viability of the company.

Given the current economic situation, a large number of consumers are now unable to pay their electricity bills and, as a result, SELCO's cash collection performance has deteriorated from 82% of billings for FY05 to 25% as of mid-FY06. Subsequently, this had improved somewhat to 40% by mid-November, 2006. Overall accounts receivable increased from 9.2 months at the end of FY05 to 11.6 months at mid-November. This rate is projected to deteriorate further. SELCO's fragile financial base is further weakened by its inability to pay for electricity purchased from IEC, because IEC charges interest (compounded at more than 20% per annum) on the unpaid balance. The rapid build-up in interest charges is leading SELCO towards financial insolvency. It is therefore essential that SELCO maintains strong financial discipline so as to improve its collections performance with measures such as special collection drives to reduce its accounts receivable to around three months of average annual electricity sales. Given that this measure on its own will not be sufficient to cover the entire deficit in net income, urgent financial support from external sources will be necessary until the present crisis passes.

3.2.3 HEPCO

HEPCO was established and registered in January 2000 with the Municipality of Hebron as the major shareholder, and with the council members of the Municipality comprising the Board of Directors. The Hebron Municipality Employees Housing Association owned a minor shareholding (0.004%) in HEPCO. After a shaky start, the preparatory activities were completed by 2004 and the company started its commercial operations from January 1, 2005. By the latter part of 2005, on account of pressures applied by certain sections of the population, discussions were initiated that led to the liquidation of the minor shareholding and that proposed the return of HEPCO back to the municipality. In November 2005, based on perceived popular support, the company signboard was removed and electricity bills started to be issued in the name of the municipality (rather than HEPCO). However, the bank accounts are still being operated by HEPCO and the auditors are providing audit reports for HEPCO. This has resulted in an unclear situation. Lack of authority, inability to enforce the rule of law, and the current economic crisis are preventing HEPCO from operating as a successful power distribution company. In addition, the dispute over the ownership structure of the company has resulted in withdrawal of Italian financing for badly needed system rehabilitation work, causing technical problems and rising distribution losses.

HEPCO has 121 employees and 28,663 customers. Like SELCO, it is facing financial difficulties. For FY05, system losses were at a level of about 17%, which can be reduced. HEPCO inherited NIS132.7 million of receivables from its predecessor - the Hebron Municipality; and the recovery of this amount is doubtful. HEPCO needs to assess the possibility of recovering these past dues and take targeted measures, or otherwise write off the amount in its accounts. It needs to expand its customer base so as to have a sufficient revenue base to cover its costs of operations.

The overall financial management system of HEPCO has improved considerably, and the company has produced its audited financial statements on time. However, given the current acute economic situation, consumers are quickly losing their ability to pay for electricity, and as a result HEPCO's overall cash collection performance is reported to have deteriorated from about 98% during FY05 to 50% in mid 2006. This performance improved to about 60% by November 2006. Also, during this period, the level of accounts receivable increased from 21.2 months to 29.5 months of sales. HEPCO therefore needs to maintain strong financial discipline so as to improve its collections performance. Given that this will not be sufficient to cover the entire deficit in net income, urgent financial support from external sources will be necessary until the present crisis passes.

On account of socio-economic concerns, HEPCO finds it difficult to raise its tariff. In addition, collection of bills from H2 areas (with 8,129 customers) tend to be problematic as these customers live in the neighborhood of the Israeli settlements that hinders access to them. HEPCO should conduct awareness campaigns and consider appropriate measures to increase its average revenue rate (in line with the price at which IEC sells its power to HEPCO) and to improve its collection performance. In order to improve collections, HEPCO has opened up five collection centers within its licensed area.

3.2.4 GEDCO

GEDCO has been operational since November 1998, but it continues to perform unsatisfactorily overall. The company is not generating sufficient revenues to cover its costs. During the period FY02-FY05, revenues from electricity sales grew by only 10%, while purchase costs grew by about 15%. System losses have increased to 26%, and the company does not generate any revenues towards financing its investment programme.

By the end of 2005, overall accounts receivable stood at 29 months of sales equivalent and collection as a percentage of billing was less than 70%. Clearly, this situation is not sustainable, and GEDCO has to develop ways to improve its revenue base, reduce losses and improve collection performance so as to be able to cover its costs of operations and generate funds to cover at least a portion of its future investment programme.

4. The Impact of the Energy Sector on the PA's Recurrent Budget

The energy sector affects the PA's recurrent budget through two channels. In one of them, excises and VAT on energy consumption have constituted a significant source of revenue for the PA. In the other, less than full cost recovery by Palestinian energy providers have saddled with PA with considerable financial losses. This chapter attempts to quantify the net financial impact and analyze some of its underlying determinants. At the outset, it has to be emphasized that the data available for this analysis is very sparse for a number of reasons (the fragmented nature of the electricity sector in particular, low institutional capacity and poor records, and the deteriorating situation in West Bank and Gaza during the past year). For this reason, the analysis mostly focuses on broad trends and orders of magnitude. Moreover, it does not consider the possible impacts on the PA's capital budget of the energy sector, because of the lack of consolidated information about the amounts of investments involved and how they are financed.

Total revenues from fuel excises and VAT on fuel and electricity consumption were about US$330 million in 2005, which was equivalent to about one third of the PA's total fiscal revenues. The rate of fuel excises in West Bank and Gaza follows the Israeli rates, which as of January 2007 were equivalent to US$1.90 per gallon for petroleum and US$1.12 for diesel for vehicles. According to the Ministry of Finance, the total revenue from fuel excises in 2005 was equivalent to US$180 million. Revenue from VAT on fuel and electricity is not reported separately from other VAT revenue by the Ministry of Finance, and hence it has to be estimated from information on consumed amounts of electricity that are subject to VAT. On this basis, VAT revenue is estimated to have amounted to approximately US$110 million for fuel and US$40 million for electricity.

At the same time, the PA Ministry of Finance reported that the PA incurred a total of US$317 million in energy related expenditure in 2005.[19] These expenditures fall into three categories.

- The first category is settlement of utility bills owed to IEC that Palestinian utilities and municipalities—the retail providers—have not paid. These payments are "netted out" from the monthly transfer of Palestinian customs revenue. They amounted to US$132 million in 2005, of which US$100 million was on account of outstanding electricity bills, while the remaining US$32 million concerned payments for water.
- The second category is payments by the PA to the Israeli supplier of fuel products on behalf of the PPC - the PA-owned monopoly importer of petroleum products. The PPC sells its products at a loss which has to be covered by the PA. In 2005 this loss amounted to US$98 million.
- The third category is the PA's contractual obligation to supply fuel for power generation by GPGC and to pay a "capacity charge" under the power purchase agreement with GPGC (see Annex 2). The combined cost of fuel purchase and capacity payments was US$119 million (including VAT and taxes on gasoil) in 2005.

To put this data into context, these extraordinary energy related costs are roughly equivalent to the total budget of the public schooling system in West Bank and Gaza.

The PA's fiscal revenues and expenditures related to petroleum fuels and electricity in 2005 were thus roughly in balance, as shown in Table 5.

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[19] The Ministry of Finance and the IMF have labelled these expenditures "net lending", on the basis that they are made by the PA on behalf of other entities, and as such accumulate as assets on the PA's balance sheet. The PA payments of fuel for GPP have traditionally been included in net lending, even though the PA is contractually obliged to make these payments on its own account.

Table 5. Fiscal Impact of the Energy Sector in 2005

(US$ million)

	Monthly	Annually
Revenues		
Fuel Excises	15.1	180
VAT on fuel	9.2	110
VAT on electricity	3.3	40
Total Revenues	**27.5**	**330**
Expenditures		
Electricity [a]	8.3	100
Gaza Power Generation Company (fuel and capacity charge)	9.9	119
Fuel on behalf of the Palestine Petroleum Commission	8.2	98
Total Expenditures	**26.4**	**317**

Note (a) Deducted from clearance revenue by Government of Israel.
Source: Ministry of Finance, International Monetary Fund and World Bank Staff estimates.

This balance is a matter of concern because most of the fiscal expenditure would not occur if energy suppliers operated efficiently under sound commercial incentives. In other words, the energy sector should become a substantial net contributor to the PA's fiscal budget. The origins and extent of these revenues and expenditures are examined in this chapter.

Furthermore, this concern has been heightened by the increase in the overall expenditures from $317 million in 2005 to around $400 million in 2006 due to a rise in deductions from the clearance revenue for amounts owed to IEC.

4.1 Fiscal Impact of Petroleum Fuels

The petroleum fuels market derives its institutional origin from the Oslo accords. The Palestinian fuel market is monopolised by the PPC - a publicly-owned importer and distributor to local retailers. Until 2007 the Israeli supplier Dor Alon was the sole supplier of oil products to West Bank and Gaza (see Annex 3). In view of the importance of fuel excise taxes in total PA fiscal revenue, the PPC was brought under the direct control of the Ministry of Finance in July 2003 (see Box 1).

The available data on the West Bank and Gaza fuel sector are limited. In summary, these data consist of (i) data on imported volumes of the 5 key fuel products (Gasoline 95 and 96, regular diesel, industrial diesel and kerosene) for the period January to August 2006; (ii) import prices and wholesale prices for these products during the same period; (iii) the excise tax structure as of January 1, 2007; and (iv) data for total fuel excise tax revenue on a monthly basis from January 2000 to August 2006. In addition, a limited amount of information is available about the functioning and institutional capacity of the PPC.

Some of fuel products consumed in the West Bank was probably purchased but not recorded as imports from Israel. The small price differential between the two markets suggests that such unregistered trade mostly took place for convenience rather than for financial gain. At the same time, the subsidization of fuel products in West Bank and Gaza has created incentives for "reverse smuggling", i.e. from West Bank to Israel.

Box 1. The Palestinian Petroleum Commission

The Palestinian Petroleum Commission took over the monopoly of selling petroleum products in West Bank and Gaza from Dor Alon in 1996. It regulates the petroleum products market in West Bank and Gaza, but it is also engaged in channeling and selling petroleum products to the West Bank and Gaza with an exclusive contractual agreement with Dor Alon up to end 2006. The Commission was able to exercise its monopoly power prior to the *intifada* but with the onset of the conflict and the closure of major West Bank cities, its market share fell substantially. While pricing of petroleum products in the West Bank was roughly at the same level as in Israel, there were reports of fraud, extortion, and widespread smuggling of products at lower prices either through product mixing or from sources which did not bear full taxation. This deteriorating situation prompted the Minister of Finance to take over the Commission in July 2003, change its management and conduct a full audit of its financial transactions. Petroleum product prices were reduced to the price levels of smuggled products, partly by scaling back the agency's profit margin and partly by renegotiating pricing with the Israeli supplier. The MOF expectation is that by regaining market share, the increase in tax revenue on higher volume would offset some of the lost profit margin. Since 2003, revenues from fuel excises have indeed rebounded strongly. The Commission had also engaged in various forms of distortionary marketing, for example by forcing retailers to carry particular lubricants, which it supplied from a manufacturer in Hebron. The Ministry of Finance dissolved these noncompetitive relations and took the Commission out of the lubricant business. The PA has on previous occasions expressed its intentions to eventually privatize the commercial activities of the Commission, while maintaining its regulatory functions within the PA.

Source: "Economic Performance and Reform Under Conflict Conditions". IMF, September 2003.

Data for fuel imports suggest that gasoline consumption in West Bank and Gaza during 2006 amounted to nearly 150,000 tonnes, equivalent to about 20 liters per household per month.[20] Consumption of diesel is more than three times larger, at 553,000 tonnes, reflecting both the predominant uses of diesel for commercial vehicles and the fact that many private vehicles are diesel driven. Consumption of diesel for heating amounted to 182,000 tonnes, while kerosene consumption was about 9,000 tonnes (Table 6).

Table 6. Petroleum Fuels Consumption 2006

(tonnes)

95 Gasoline	78,465
96 Gasoline	68,525
98 Gasoline	718
Industrial Diesel	552,642
Regular Diesel	181,946
Kerosene	9,188

Note: Annual values are based on monthly data from January-August 2006
Source: PA Ministry of Finance

Fuel imports impact the PA budget through two channels. One channel is the fiscal revenue from the use of Israeli excise structure. The other channel is payments by the PA treasury to the Israeli fuel supplier to cover the loss at which the PPC sells fuel products to retailers.

Regarding the first channel, fuel imports are a source of significant fiscal revenue as a result of the use of Israeli excise structure (Table 7). For gasoline, the excise tax of January 1, 2007 was NIS2.246/liter (US$1.90/gallon). In addition, 15.5% VAT is levied on the wholesale price including excises. The excise tax on gasoil (used mainly for vehicles and the GPP) and kerosene

[20] This estimate is based on the population in West Bank and Gaza of about 3.5 million and an average household size of 6. It includes registered imports.

is lower at NIS1.331/liter (US$1.12/gallon), while the excise tax on fuel oil is very low at NIS13/tonne.

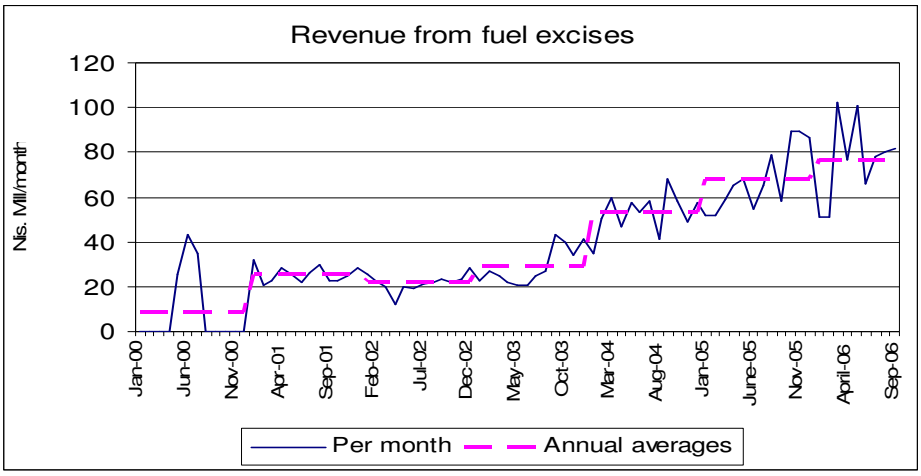
Table 7. Structure of Fuel Excises, as of January 1, 2007

	NIS/1000 liter	US$/US gallon
Gasoline	2,246.0	1.90
Kerosene	1,331.0	1.12
Gasoil	1,331.0	1.12
Fuel oil (per tonne)	13.0	0.01
LPG (per tonne)	100	0.08 equiv.

Note: In addition fuel products are subject to 15.5% VAT (levied on top of the excises). Prior to July 1, 2006, the VAT rate was 17%.
Source: Eco-Energy "Electricity and Oil Products in Israel and Supplies to the Palestinian Authority", January 3, 2007.

According to Ministry of Finance/IMF data, revenues from fuel excises amounted to NIS76 million (US$17 million) per month during January-September 2006 (Figure 8). This level of revenues is broadly equivalent to the "implicit" revenue of NIS 90 million per month that can be derived by applying the excise structure to the sales volumes in Table 7 above.[21]

Figure 8. PA Fiscal Revenues from Fuel Excises 2000-2006



Source: Ministry of Finance and IMF

Total excise revenues from fuel consumption in 2006 is expected to be about US$200 million, or about 20% of total PA revenues (excluding foreign aid and other exceptional transfers). Excise revenues increased sharply 2004 and 2005 (and continued to increase in 2006). While it is not possible to quantify, the sharp increase may at least be partly related to improved management and marketing efforts of the PPC following its take-over by the Ministry of Finance. The general rebound in the economy in 2003-05 probably also played a role.

Regarding the second channel of direct impact on the PA's budget through subsidies from the PA treasury to retailers, subsidies are largest for diesel products for which they amount to 12% of the sale price (Table 8). For petroleum products, the subsidy is considerably lower at 2%-3%.

[21] Several factors might explain the discrepancy, including timing of payments, different coverage of the date etc. If Jan 2006, when the Ministry of Finance recorded zero revenue from fuel excises, is excluded, the average monthly revenue amounts to NIS86 million, reducing the discrepancy to less than 5%.

Across fuel products, the average subsidy amounts to 10%. Based on these subsidy rates and the volumes sold, the total value of the subsidy—or the deficit of the PPC—is estimated to amount to at least NIS350 million (US$78 million) in 2006.

Table 8. Palestine Petroleum Commission's Cash-flows and Subsidy Rates

	Purchases	Sales	Net profit	Subsidy rate
	----------NIS million----------			
95 Gasoline	420	412	-9	2%
96 Gasoline	368	358	-10	3%
98 Gasoline	4	4	0	-1%
Industrial Diesel	2,267	2,020	-246	12%
Regular Diesel	751	673	-78	12%
Kerosene	30	26	-4	14%
Total	3,841	3,494	-347	10%

Note: Since the volume sold is identical to the volume purchased, the individual subsidy rates reflect exclusively the relative purchase and sales prices. When calculating the average subsidy, the individual rates are weighted by volumes.
Source: Ministry of Finance and World Bank staff calculations.

The cash-flow deficit is, however, expected to be considerably larger than this amount, because this estimate implicitly assumes a 100% collection rate by PPC which almost certainly is not the case for several reasons. First, the current situation probably impedes PPC's ability to enforce payments by fuel retailers. Second, commercial banks have reportedly retained retailers' payments to the PPC through the banking system so as to reduce their lending exposure to the PA. Third, the PPC supplies fuel for the GPP which the PA is contractually obliged to provide free of charge to the GPGC. Finally, the operating and administrative expenses of the PPC are not included in the calculation.

4.2 Fiscal Impact of the Electricity Sector

This section attempts to carry out a "bottom-up" analysis of the fiscal impact of the electricity sector. At its core, "net lending" originates from the poor financial situation of Palestinian electricity retailers, which in turn is largely the result of their inability to collect sufficient revenues from end-users and of the high prices for generated power from GPP. The electricity retailers low collection rates can be explained by a number of factors.

One important factor is that the institutional set-up does not provide proper incentives for the electricity retailers, especially the municipalities, to collect bills from their customers. As noted above, the Israeli Ministry of Finance has allowed the IEC to recover part of its unpaid bills "off the top" from the tax revenue that the Ministry collects on behalf of the PA and by agreement is supposed to transfer to the PA on a monthly basis in advance of the regular transfer of tax revenues.[22] The PA's assumption of the role of "financier of last resort" can be expected to undermine electricity retailers' incentive to ensure full and prompt collection of bills owing to them, especially since the PA has limited ability to enforce collection discipline through the utilities and municipalities.

[22] The situation has been further complicated by the GOI's decision in February 2006 to suspend the transfer of tax revenue. According to the MOF, however, the GOI has continued to make payments to the IEC for a total of NIS400 million through August 2006, the latest date for which data is available.

VAT revenues from electricity consumption in 2005 are estimated to total nearly NIS180 million (US$40 million) (Table 9). The bulk of VAT revenue is collected by the Israeli Ministry of Finance from IEC sales to West Bank and Gaza utilities and municipalities. The collected VAT is subsequently supposed to be transferred to the PA's Ministry of Finance as part of the so-called clearance mechanism established under the Oslo Accords. In addition, utilities and municipalities are liable for VAT on the "margin" they charge consumers, i.e. the difference between the purchase price from IEC and the sales price to consumers. In practice, however, by far the largest share (approximately 75%) of VAT revenues is collected by the Israeli MOF as electricity retailers "profit margin" is quite low, as shown in Table 9 which reports estimated VAT revenues based on electricity consumption in 2005.

Table 9. Potential Revenues from VAT on Electricity Consumption in 2005

(NIS million)

	JDECO	SELCO	HEPCO	W. Bank Munic.	GEDCO	Grand Total
Purchases from IEC	400	23	78	148	248	896
- of which VAT	58	3	11	21	36	130
Billed sales less purchases	179	-1	11	73	66	328
- of which VAT	26	0	2	11	10	48
Total VAT	84	3	13	32	46	178

Source: PEA and World Bank estimates. The reported revenue numbers most likely overestimate the actual revenues as they implicitly assume a 100% VAT collection rate.

The considerable financial stress of electricity utilities and municipal electricity providers is a key determinant of their drag on public sector finances. Three factors have particular implications for the finances of these providers. They are the low mark-up on the cost of bulk power purchased from IEC in their retail tariffs (by GEDCO in particular), the amount of electricity consumption that is not billed, and the amount of billings that is not collected. These factors are examined in Chapter 3.

There is a significant discrepancy between the "net lending" reported by the PA Ministry of Finance and the "bottom-up" analysis of sales by the electricity utilities and municipalities. While the MOF reports that US$100 million was deducted from clearance revenue to cover outstanding electricity bills to IEC in 2005, the estimated operating surplus of all electricity providers in West Bank and Gaza only amounted to US$45 million (NIS200 million). The following explanations may account for this discrepancy.

- First, and critically, the estimates assume that providers in fact have paid their bills to IEC. This is a particularly problematic assumption for the West Bank municipalities since the operating surplus from electricity provision has traditionally been used to finance expenditures beyond provision of electricity. The municipalities have undoubtedly been aware that any shortfall would be covered by deductions from clearance revenues because of the PA's limited ability to enforce payments by the municipalities. The utilities have also faced the incentive to let the PA settle part of their dues to IEC in the same way.
- Second, the process that determines both the timing and the magnitude of the deductions from clearance revenue appears extremely ad hoc. Deductions seem to be determined by a combination of pressure by IEC on the Israeli Ministry of Finance and by bargaining

between the Israeli and PA Ministries of Finance.[23] There appear to be no clear rules for when IEC is allowed to access the clearance revenue and by what amount.

- Third, JDECO in particular has historically been able to cover temporary financial shortfalls through borrowing from commercial lending.
- Finally, there are significant deficiencies in reporting by all parties - the municipalities, the utilities and the PA.

[23] Since the advent of the Hamas government in January 2006, there have been no contacts between the GOI and the PA government. There have been some discussions between the President's office and the GOI regarding release of clearance revenue.

5. Natural Gas Supply and Demand

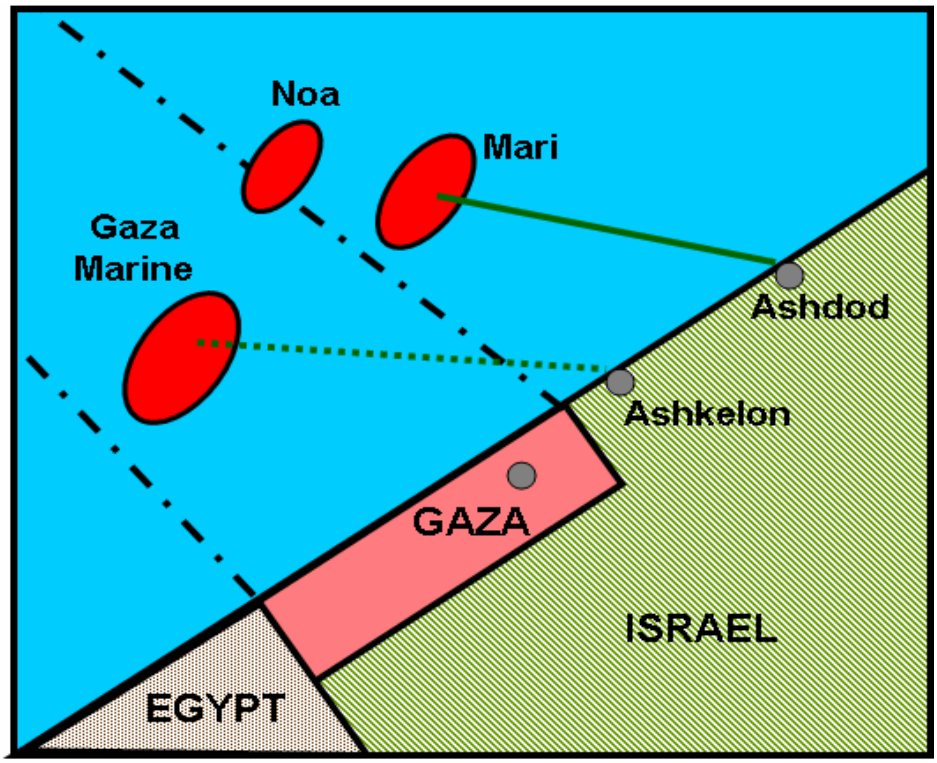
Although West Bank and Gaza do not as yet have access to natural gas, this fuel will play an important role in future in two respects: firstly, discovery of large gas resources offshore Gaza should allow the PA to benefit from substantial resource revenues, and secondly, gas will be the lowest cost and most desirable fuel for domestic uses.

However, the prospects for gas in West Bank and Gaza depend crucially upon regional developments in Israel and Egypt since the local market alone cannot justify development of significant gas reserves. Demand for gas in Israel is growing rapidly, driven by the power sector. On the supply side, Egypt is by far the dominant regional player. Egyptian gas is priced below international parity levels, creating distortions in Egyptian, Israeli and other energy markets. These circumstances all affect the marketing options for Palestinian gas. In this section, the policy options for the PA in the gas sector are reviewed in the light of regional developments and of strategic and policy considerations relating to natural gas trade.

5.1 Israeli Gas Market

Following the discovery of natural gas offshore Israel (Figure 9), the country is rapidly developing this fuel alongside oil and coal as its third major source of primary energy. Domestic and imported gas is expected to supply most of the growth in electricity capacity in the coming decade, as well as providing energy to industry and for desalination. The growth in gas use will come both from displacement of fuel oil and gasoil, and from new gas fired facilities. Prospects for the development and use of gas in West Bank and Gaza depend largely upon developments in the relatively large Israeli market (see Annex 4 for details).

Figure 9. Schematic Map of Offshore Gaza/Israel Gas Fields



Note: This map is purely schematic. It is not to scale and does not represent any political or other boundaries.

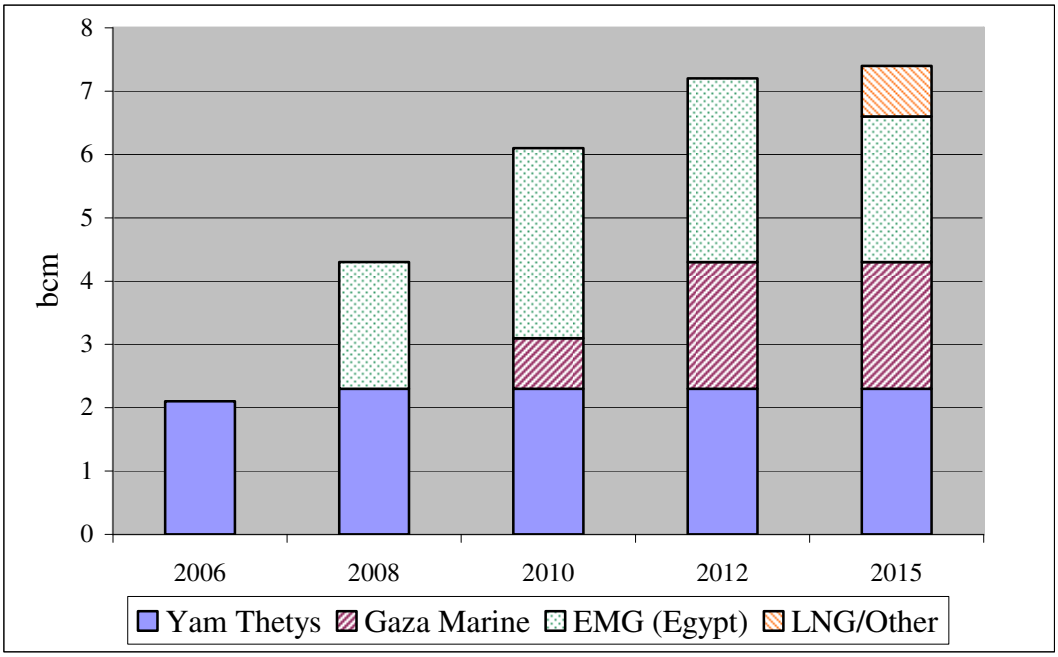
Gas demand outlook. Gas use began in 2004 and reached 2bcm in 2006. By 2015 demand could reach between 7bcm and 8bcm. Demand comes mainly from the power sector which will account for about 75% of the demand for natural gas in the country by 2015. Natural gas will be used in both existing steam turbines converted from heavy fuel oil and new gas turbines, primarily CCGTs. Future expansion of power generation is expected to be largely gas based, although one or more large additional coal plants could be built from 2015 onwards which would moderate gas demand growth.

Gas supply. Israel's gas supplies over the next decade are expected to come from three sources: domestic production, imports from Egypt and production from offshore Gaza (Figure 10).

- **Domestic production**: In the late 1990s gas was discovered offshore of Israel's Mediterranean coast. Proved reserves are estimated at around 35bcm (1.2tcf) in two fields, Mari and Noa.[24] The gas has been developed by the Yam Thetis (YT) consortium (comprising Noble Energy of the US and Delek of Israel). Natural gas flow to the Ashdod coastal HFO-based power plant commenced on December 2003. Annual production reached 2.1bcm in 2006 and is expected to remain above 2bcm before declining from 2012 onwards.

  Yam Thetis plans to drill the deepwater Gal exploration permit (90 km offshore Haifa) in late-2007. Any reserves discovered at Gal would not be produced before 2014, but will affect Israel's supply planning well before then.

Figure 10. Israel Gas Supply by Source – One Possible Scenario



Source: Eco-Energy

- **Egypt**: East Mediterranean Gas (EMG – a consortium of the Israeli company Merhav, and Egyptian companies) has a Government permit to export Egyptian gas, and plans to commence gas supply to Israel in 2008. EMG has signed a long term contract with IEC for the supply of 1.7 bcm/year and is marketing to Independent Power Producers (IPPs)

[24] About one third of Noa lies on the Palestinian side of the currently defined offshore boundary (this may amount to approximately 2bcm for the PA). See Annex 4.

and industrial customers. The gas will be supplied via a new undersea pipeline from El Arish in Northern Sinai to Ashkelon.

- **Palestinian Authority (offshore Gaza)**: In 2000 about 35bcm (proved) was discovered in the Gaza Marine field, 36km offshore Gaza, by BG and partners (the PIF and CCC – a Greek/Lebanese infrastructure company). Prolonged discussions regarding possible sales to the Israeli market crystallized into formal negotiations in 2006. By the end of 2006 BG (as operator) was negotiating to sell up to 2bcm/year to Israel via a sub-sea development and pipeline to a terminal at Ashkelon. The buyer could be an Israeli Government subsidiary or agency.

Israel is considering construction of a terminal to import LNG, and importing European gas from Turkey via pipeline. Such sources are unlikely to reach the Israeli market before 2015.

Gas pipelines: Israel Natural Gas Lines Company (INGL), a government subsidiary, was established in 2004 as a monopoly to construct and operate a national high pressure gas transmission system. Pipelines linking the main consumption centers are substantially in place, with completion of the whole system expected by end-2008. INGL operates purely as a transmission carrier, serving large customers at high pressure.

Gas pricing: Israel's gas market is relatively immature and gas prices are set by long term supply contracts for large customers. This has lead to a situation in which price rigidities have kept prices artificially low, leading to distortions in the domestic energy market. These distortions have reduced the potential price for gas from Gaza Marine. There are at present two key contracts in place with IEC as the buyer, and YT and EMG as sellers; prices for the two contracts are similar. YT had an initial price of US$2.75/mmbtu (cif Ashdod) at the start of deliveries in 2004. Prices are not well linked to other energy sources and have not risen in line with global oil and gas prices since 2004. Price levels are now far below the level of about US$7/mmbtu prevailing in international markets, and are also well below oil product equivalents. [25]

Future prices for natural gas in Israel are expected to be set by what IPPs can afford to pay and by the fuel substitution equation for industry and power. In the medium term prices are expected to rise to around US$5/mmbtu. In order to compete with IEC (which benefits from low cost gas contracts), IPPs probably need a gas price no higher than US$4/mmbtu. Industrial users substituting gas for oil products can pay over US$6/mmbtu. Reports of the price levels being discussed between BG and the Israeli Government for the Gaza Marine development quote prices of between US$4/mmbtu and US$5/mmbtu.

5.2 Regional Gas Supplies: Egypt

Egypt is the only exporter of gas that can compete with the PA in Israeli and neighboring markets. Hence, as discussed above, the low export gas price being maintained by Egypt adversely affects potential revenues from the sale of Gaza Marine gas. The marketing options and price available for Gaza Marine gas depend in large part upon the outlook for gas supplies from Egypt. Two elements need to be considered in this respect: Firstly, the availability of infrastructure to export Egyptian gas and secondly, the availability of supplies for export.

Egypt's has export capacity of up to 30 bcm/year though LNG plants and pipelines, and could increase its sales to Israel and neighboring countries (e.g. Jordan) in the near term. However, domestic consumption in Egypt has been rising very rapidly - Egyptian domestic gas prices are heavily subsidized - and there have been questions about Egypt's ability to further increase exports in future. Shortages or surpluses in Egyptian regional supplies are likely to impact the terms and availability of new supplies to the Israeli market. Many observers now believe that any

[25] See Annex 4 for further details on pricing.

new export sales from Egypt to neighboring countries will take place at substantially higher prices than in the past.

5.3 Gas Supply and Demand in West Bank and Gaza

The Gaza Marine deposit is a major asset for the PA. It is unlikely that substantial additional reserves of oil or gas will be found in the limited territory of West Bank and Gaza (onshore and offshore). Hence the decision on how to develop the Gaza Marine deposit is extremely important for the PA, because it represents a one-off chance to secure a large amount of resource rent and because it is the PA's only significant domestic energy resource.

5.3.1 Potential for Gas Use in West Bank and Gaza

The total potential for gas in West Bank and Gaza is limited by the relatively small size of the economic base and energy requirement. In the short term, the only demand that could arise from conversion of existing facilities would come from the GPP. Replacement of oil products with gas at the plant would require up to 0.24bcm/year if all power generating capacity could be used. Conversion of the GPP from oil to natural gas would produce substantial savings whose magnitude would depend upon the level of gas prices. At current oil prices and the gas prices being discussed by BG and the Israel Government, the savings from using natural gas would be up to US$83 million/year (see Box 2).

Box 2. Conversion of Gaza Power Plant from Gasoil to Natural Gas

If natural gas were to be connected the GPP, the economic benefit from using gas instead of gasoil to generate power would amount to US$45 million annually based upon recent usage of 70MW of capacity, and at least US$83 million per year if the full capacity (ca. 140MW) were used.

The GPP is a combined cycle plant that consists of two identical power blocks with a capacity of 70MW, each incorporating two gas turbines of 23MW and one steam turbine of 24MW. The nominal capacity of the plant is 139.6MW. The maximum despatchable capacity has been restricted to about 70MW by the available transmission capacity from the plant to the Gaza power network. The plant has considerable development possibilities since the capacity can be expanded up to a total of 560MW.

The plant has run on gasoil supplied by the PPC on behalf of the PA. The Commission purchases this gasoil from Israel at market price. The cost of gasoil has increased to about three times the level at the time that the PPA was signed. The unit cost of gasoil in June 2006 was US$553/cm excluding taxes. At these fuel costs and at the plant's energy conversion rate of 5.26 kWh/kg of gasoil, the fuel cost of electrical energy produced is US$0.120/kWh excluding taxes.

The level of investment required for conversion to gas use is modest. The required modifications to the turbines to burn natural gas would cost about US$1million, while installation of gas receiving facilities (pressure reduction station and a metering system), would cost US$1.5 million.

If natural gas supplied to the GPP cost US$4/mmbtu, the fuel cost of power generated at the plant would be equal to about US$0.03/kWh excluding taxes. This cost is only about 25% of the fuel cost of power generated with gasoil (US$0.124/kWh) in June 2006. For the 499GWh produced in 2005, a switch from gasoil to natural gas under these terms would save Palestine of about US$45 million (excluding taxes).

If the transmission capacity were to be upgraded to allow full despatch of 139.6MW from the GPP, power production above the present despatch limit of 70MW would magnify these savings. The benefit to Palestine of using natural gas for capacity of over 70MW is at least the savings from reducing the amount of power purchased from IEC at its current tariff (US$0.08/kWh). The economic benefit would be the combined saving of US$83 million/year from the following two sources:

- from not generating with gasoil - say 500GWh, which would be equal to US$45 million at a cost difference of US$0.09/kWh; and
- from reduced purchases from IEC - say 625GWh, which would be equal to US$38 million at a cost difference of US$0.06/kWh.

Source: Annex 2

Additional demand for gas could be created through construction of new gas fired power stations in West Bank and Gaza. Given total power requirements in West Bank and Gaza of about 500MW within the next few years, the total requirements of gas for power generation are unlikely to exceed 1 bcm/year before 2015. Construction of new power capacity in Gaza and the West Bank fuelled by Gaza Marine gas needs to be assessed against the option of continuing to rely upon expanding supplies of electricity from Israel.

Beyond power, there is limited potential demand for gas from industry or other sectors. Nonetheless, the environmental and cost advantages of gas are such that it would be desirable for it to be available to any industrial or commercial user in West Bank and Gaza who is willing to pay. This may require development of a modest domestic transmission and distribution system. Another option to be considered is transport of gas as compressed natural gas (CNG), which may be economic over short distances (such as in Gaza). CNG could also be developed as a fuel for transport, particularly in fleet applications such as public transport, where it should compete effectively with imported diesel and gasoline.

5.3.2 Potential Gas Supplies to West Bank and Gaza

Gas for West Bank and Gaza could come from three sources: (a) Gaza Marine, (b) Egypt to Gaza (via El Arish), and (c) Egypt to West Bank (via Jordan). The first two options are under consideration by the PA. Supply from El Arish could offer an alternative to Gaza Marine that would have similar gas cost but provide supplies sooner. Since conversion of the GPP to gas should have large benefits for the PA, imports from Egypt in advance of any purchases from Gaza Marine could well be justified. Supply facilities for gas from both Egypt and Gaza Marine to the GPP could be seen as enhancing security of supply. At present there are no plans to bring either Gaza Marine or Egyptian gas to the West Bank.

5.3.3 Development Options for Gaza Marine

While Gaza Marine gas could play a significant role in Palestinian energy supplies, the small size of the Palestinian market cannot justify the costs of field development on its own.

Given the size and location of the Gaza Marine field, there are only two marketing options that would justify the cost of development: (a) sale to the Israeli market, and (b) sale for export via Egyptian LNG plants. Both options have the advantage of being relatively large markets for the size of the Gaza Marine gas field that need new sources of gas. Sale of the bulk of Gaza Marine gas to Israel would have the additional advantage of proximity to demand centers. This is consequently the option that has been most consistently pursued and is the present plan of both Israel and of the field operator, BG.

With the two potential main markets identified, there are at least three scenarios for development, two for the Israeli market and one to Egypt. Two development models have been publicly mooted for Gaza Marine gas to Israel. The scheme being planned by BG appears most likely to materialize, but an alternative has been advocated by the Yam Thetys consortium.

BG Scheme: The BG scheme being considered with Israel is essentially a "stand-alone" development that is not linked to the YT facilities and does not incorporate secondary special investments to supply the Gaza market. It consists of:

- An offshore development with sub-sea completions, controlled remotely from Ashkelon,
- A 50 km offshore pipeline from Gaza Marine to Ashkelon,
- A receiving terminal at Ashkelon, which will process the gas received directly from the sub-sea wells.

The commercial structure of this scheme would probably entail BG purchasing the gas at the offshore sale point between Israel and Gaza. BG would then sell the processed gas (ex-terminal) to a public sector Israeli entity. This entity would in turn sell the gas into the Israeli market. The offshore segment in Israeli waters and the gas terminal would thus be run on a stand-alone basis, separate from the Gaza Marine development. The Noa field could be developed through a tie-back to the Gaza Marine offshore facilities. The Noa field extends from the Palestinian maritime area across the interim maritime boundaries[26] with Israel to the Israeli maritime area. Any development of the Noa field would need an agreement between Palestinians and Israelis on each party's share of the Noa field.

Supplies to Israel under this scheme would be up to 2.0 bcm/year. The project would take 3 to 4 years to complete (i.e. by 2011-2012). The total cost is said to be around US$700 million to US$800 million, of which about US$100 to US$150 million represents the cost of the Ashkelon terminal.

Under this scheme, supplies to Gaza would come through an onshore pipeline from the terminal at Ashkelon, which is located about 10km north of the Israeli border. The cost of a pipeline to the Gaza border would be about US$6-7 million. Since such a pipeline would require some 3 years to go through the usual Israeli planning permission for infrastructure it is important that its planning and construction be conducted in parallel with upstream Gaza Marine development. From the border gas would be taken to GPP through a pipeline costing a further US$10 million.

Yam Thetys Scheme: The Yam Thetis group has proposed a scheme to link Gaza Marine to existing facilities on the Mari field. This scheme has been considered by BG, but was rejected in favor of the separate scheme described above.

The YT scheme would involve a short 15-20km submarine pipeline from Gaza Marine to the Mari platform. The gas would be treated in the facilities on this platform and sent via the existing infrastructure of YT to the Israeli natural gas grid. The Noa field would be developed as a tie-back to the Mari field, either simultaneously with Gaza Marine or at a later date.

Under this scheme, supplies to the GPP could come directly from the Mari field via a dedicated offshore pipeline from the Mari platform to Gaza. While the Gaza Marine development and the connection to YT's marine platform would take at least three years, the connection from the Mari field to Gaza could be constructed within two years, allowing early delivery of gas to the GPP.

The linking of Gaza Marine and Mari may allow increased daily variation in production compared with the operation of two separate systems. This would meet the peaking needs of the Israeli market and perhaps allow the project to obtain a higher average price (i.e. a greater proportion of sales would be for peak power usage).

The Noa field could be developed as a tie-back to the Mari field, either simultaneously with Gaza Marine or at a later date. In fact, a tie-in of Noa to Mari could take place even if BG's main development for Gaza Marine were to proceed as presently proposed. This arrangement may be particularly attractive if the timing was such that Noa could begin producing as Mari production was coming off plateau thus freeing capacity in the Mari facilities.

The costs of the YT project alternatives are not known. It would not require the establishment of a gas treatment facility in Ashkelon (cost of US$100-150 million). However, this saving may be offset by additional costs elsewhere in the system.

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[26] The interim maritime boundaries are the boundaries that were identified in the Interim Agreement between the PLO and Israeli in 1994. The permanent boundaries are to be negotiated in the Permanent Status Negotiations for Peace between Palestinians and Israelis.

Sale to Egypt: BG, as operator of Gaza Marine field has considered the option of sending gas to the Egyptian grid, for use as feedstock for the expansion of the Egyptian LNG (ELNG) export project at Idku, in which BG is a major partner. This would involve linking Gaza Marine to the Egyptian gas grid via a short offshore pipeline to the vicinity of El Arish. Gas would be swapped in the Egyptian system for supplies to Idku in the Nile Delta. Gas could be supplied to Gaza via an onshore pipeline from Egypt (near El Arish) to Gaza.

The scheme would lead to prices for gas from Gaza Marine that reflected the netback received from the LNG exports from Idku. These would be calculated based upon the LNG export price less applicable shipping, liquefaction and processing costs.

5.3.4 Benefits to West Bank and Gaza from Gaza Marine Development Options

Development of Gaza Marine will yield two types of benefits to West Bank and Gaza: Firstly it will represent a significant source of revenue from offshore production, and secondly it could provide low cost gas for domestic use.

The three development options described above could lead to substantially different outcomes for the PA in terms of revenue streams and gas supplies. A full ranking of these options would require the modeling of outcomes based upon the contract terms for Gaza Marine, the costs and timing of projects and the supply options for gas to Gaza. A rough estimate of fiscal revenues to the PA from sales to Israel under the BG scheme are in the range of $50 million in early years (as costs of development are recouped by the operator) and US$100 million once cost recovery has been completed.

In the absence of a full modeling exercise, a number of basic considerations can guide a review of development options:

- Cost of development of Gaza Marine production facilities and related infrastructure that is counted as a cost within the Gaza Marine production license.
- Price of gas at the point of contract sale (i.e. the point at which the gas sale price is established within the Gaza Marine production license).
- Timing of production start up.
- Production profile over time.
- Market risk: Strength and security of off take (sales) agreements.
- Payment risk: Ability of buyers to pay for gas purchases.
- Price risk: Degree of price uncertainty.
- Local equity share upstream and downstream and in other supplies to the gas market.
- Timing and price of gas supply to Gaza.

These considerations each apply differently to the above schemes:

1. It is likely that all three schemes will have similar costs for offshore production facilities (assuming the same sub-sea design). Costs of offshore pipelines will vary slightly.
2. The BG scheme may yield a different price for gas at the offshore sale point than a development via YT. Under the former the price to the PA would be the Israel market price (onshore ex-plant) less the cost of processing the gas at the US$100-US$150 million terminal. The terminal costs may largely be avoided by using the YT facilities, although other costs for adapting the YT system could offset this saving. The price of gas from export to Egypt is likely to be below any price to Israel, given the need to account for the costs of transmission in Egypt, LNG conversion and shipping.

3. All three schemes may have similar production start dates determined by the time needed to build the offshore production facilities.

4. The production profile of the Israel options may be lower and more extended (slower depletion) than of the LNG option. This is because the LNG option would be less constrained by the size of the market and production could be at the maximum technically feasible rate.

5. The Israel options face the same end-market risk in Israel. However, they may differ in how risk is shared between YT and Gaza Marine. Under BG's scheme the onshore buyer (Israeli Government agency) would control offtake of Gaza Marine gas alone, giving it substantial direct control over Gaza Marine throughput. Under a YT scheme, it may be possible for the gas to be sold directly to end-users jointly with YT gas (through a shared pipeline system). Such an arrangement would potentially eliminate the Israeli Government as an intermediary with an ability to control Gaza Marine supplies separately from those from YT.[27].

6. The underlying price risk of both the Israel options is similar in that it is linked to the Israeli gas market. How this risk is addressed will depend upon whether there is a single fixed price contract with a Government agency or several flexible sales contracts to end users (e.g. IEC, IPPs, industry). The price risk profile of Egypt relates to the global LNG market, in which the LNG price is linked to spot gas prices in the US and Europe. In comparison with sales to Israel, prices for Gaza Marine sales to Egypt are likely to be more volatile and give less scope to the Gaza Marine seller to renegotiate or influence price levels.

7. As regards the risk of payment for supplies to Israel, the issue is whether Gaza Marine sellers are taking Government or individual buyers' risk. Prospective purchasers in Israel (such as IPPs and industrial users) may have differing credit profiles which will generally be below the sovereign credit risk of Israel. Sales to the Israeli Government or to an entity guaranteed by it, present a low payment risk from a purely financial perspective. From a contractual perspective, some payment risk could arise in the event of disputes between the parties. An Israeli Government buyer could withhold payment. The question would then be whether the Gaza Marine sellers could withhold gas supplies pending resolution of the dispute.[28] Any agreement on Gaza Marine development for the Israeli market will need to set out procedures for the transfer of payments from Israel to the PA.

8. The PIF may have an option to take an equity share in the Gaza Marine development. Such a share may be advantageous provided it does not result in onerous financial or contractual commitments. Equity participation by a state entity on a commercial basis often improves coordination between the project and the authorities, and provides a basis for developing some local technical and commercial capacity.

9. A PIF share of gas production could be dedicated to domestic sales, such as to the Gaza Power Plant. This would increase security of fuel supply to the power plant because it would eliminate the unaffordability of the large quantities high cost gasoil that would

[27] The regulatory and practical aspects in Israel of such commingling and joint marketing of Gaza Marine and YT gas would need further consideration.

[28] The ability of the PA to control production from the Gaza Marine field will depend upon the physical and legal aspects of the project design. In principle under the BG scheme, all physical control could lie with the Israeli side, since sub-sea production, pipelines and the terminal will be operated from Israeli territory.

otherwise be needed to run the plant at reasonably capacity utilisation. The PA could derive substantial fiscal benefits from gas sales to the power plant by capturing the economic rent from using natural gas instead of gasoil.

10. The isolated offshore nature of the project may not yield many opportunities for domestic equipment and service suppliers. However, development of local human resources and business capacity by the operator is a feature of many production agreements, and should be considered by the PA.

11. Under BG's scheme, supply to Gaza will occur some time after initial production from Gaza Marine, via an onshore pipeline from Israel to Gaza (i.e. around 2011- 2012). Supply to Gaza from YT could occur earlier via an offshore pipeline from Mari to Gaza (e.g. 2009-2010). Under the Egypt option, supplies to Gaza could start with Egyptian gas within two years (pipeline from El Arish).

Based upon these considerations, it is fairly clear that development of the Gaza Marine field for the Israeli market is likely to yield greater benefits for the PA than sale to Egypt. The BG and YT projects may in theory present different sets of risks and benefits to the PA, but it is not possible to compare them directly in the absence of complete data on costs and contracts. Further review of the relative merits of the BG and YT plans may be warranted, although the scope for this may be limited by considerations of timing and by other extraneous issues.[29]

5.3.5 Strategic Issues Relating to Gas Development in West Bank and Gaza

The political situation in the region will clearly have an impact on the development of gas in West Bank and Gaza. However, regardless of the specific political circumstances, there are certain strategic issues that need to be considered by any gas exporter. These relate primarily to: (i) the exporter's competitive position in relation to other suppliers and buyers, and (ii) the supply of gas in the exporter's home market. While the advanced stage of current discussions on the BG scheme may constrain the PA's options for maneuver at present, these considerations may be increasingly relevant for the PA as circumstances evolve.

For the PA, the following strategic issues need to be considered:

a. **Diversity of buyers**: Gas exporters need to balance the potential advantages of committing large volumes to a single buyer against the risks of dealing with a monopsonist. Israel may be the only export market for Gaza, but it could make a difference to the PA's competitive position if it is able to sell to more than one buyer in this market (i.e. direct marketing versus selling to a single Israeli entity).[30]

b. **Competing suppliers**: In terms of economic cost, Gaza Marine is likely to be the most competitive supplier to Israel. Egypt may be able to supply gas at a lower cost in the medium term from established production, but in the long run Egyptian supplies will be more expensive once the cost of transmission is factored in. Gaza Marine's costs will be comparable with any new discoveries offshore Israel, and will certainly be far below other options such as LNG or imports from Turkey. This suggests that Gaza Marine could aim to capture significant rent as long as competitors are not subsidizing their sales to Israel. Any price formula for Gaza Marine gas to Israel should fully capture variations

[29] The conclusions reached in this Review about gas development options have been reached without sight the relevant development and production agreements. These agreements would have to be analysed to firm up these conclusions.

[30] The Gaza Marine partners' ability to sell to Israeli end-users will depend upon regulatory and political factors.

in both the cost of gas substitutes (e.g. gasoil) and changes in the marginal cost of gas to Israel (e.g. LNG).

c. **Transit risk**: Gas exporters usually seek to minimize the number of jurisdictions through which their gas travels to end-users. Sale from Gaza Marine to end-users in Israel involves transit from Gaza to Israel only. In the case of sale to Egypt for LNG export, gas must go to both Egypt and the country receiving the LNG. The Egypt option thus has a higher theoretical transit risk than any Israel option.

d. **Integration with other supply sources**: Gas can be delivered either via a system dedicated to Gaza Marine supplies only, or via a system that also carries other gas. A dedicated system can have advantages in terms of control and logistics. However, a system with multiple users may have benefits in terms of maximizing flexibility (obtaining peak pricing rates), capturing economies of scale (larger pipelines, processing), and improving physical security (a dedicated system may be more vulnerable to selective shutdown). In the case of Gaza Marine it may in principle be possible to mix Gaza Marine gas with gas from YT, or with gas exported from Egypt.

e. **Security and cost of domestic supplies**: Gas export projects usually need to ensure that domestic supplies are received on advantageous terms. Thus a development of Gaza Marine that precluded easy supply to Gaza may be undesirable, and one that provides the lowest cost option to increase use of gas in West Bank and Gaza in future may be favored. Moreover, supply security to Gaza would be greater if gas from Gaza Marine were landed directly in Gaza, rather than transiting through Israel. Supplying the domestic market from more than one source may also diversify and reduce risk; hence import of Egyptian gas to West Bank and Gaza could be desirable in the medium term, as a supplement to Gaza Marine gas.

f. **Strategic positioning**: A gas exporter will in general try to use their infrastructure and marketing options to obtain as much leverage and information as possible about other markets. For example, if the PA was to import Egyptian gas, this could provide both some leverage on Egypt, and information about competing Egyptian supplies.

g. **Downstream integration**: Gas exporters often seek to control as much of the gas supply chain as possible, from production to end-consumer. The aim is to ensure that the full value of gas is captured at each point of the chain. Regulators may attempt to prevent this as it can lead to abuse of monopoly power. In the case of the projects for sale to Israel there is unlikely to be integration of ownership along the chain between production, offshore pipeline and processing terminal. This could create conflicts of interest between the parties in the field that will need to be carefully managed in any development agreement.

h. **Transfer of revenues to the PA:** The PA is concerned about the possibility that Israel may withhold the gas payments to the PA if Gaza Marine gas is sold to Israel. The mechanism for the transfer of payments mechanism needs to be agreed and guaranteed in any sales agreement.

5.3.6 Institutional Issues Relating to Natural Gas in West Bank and Gaza

At present the PA has no institutions that are specifically dedicated to managing natural gas. Some new institutional capacity will be required as the PA becomes a gas exporter and user. However, what is required to deal with the new issues are small and focused increments to institutions or agencies. The advent of gas revenues should not lead to creation of large public sector natural gas institutions that will dissipate those revenues on additional public sector wages.

Upstream: As host to a major offshore gas development project, the PA needs to have the capacity to supervise and regulate the commercial and technical aspects of the project (i.e. the upstream). These capacities will be modest if the PA is not an equity partner in the project, and more substantial if the PA is to be a partner:

- **Commercial**: The PA needs to be able to evaluate the risks and rewards for the PA of alternative development options. Once the project is underway, the PA needs the capacity to monitor project costs and revenues, engage in contractual issues, and assess fiscal liabilities.
- **Technical**: The PA needs to be able to ensure that the operator of Gaza Marine is following best industry practice in development and incurring reasonable costs. The safety and environmental aspects of the project need to be monitored in accordance with international standards.

Downstream: Natural gas will be a valuable fuel for West Bank and Gaza, initially in power but later also in small industrial and commercial uses, which has the following policy implications:

- Gas transmission and distribution are natural monopolies and require some degree of regulation.
- Gas markets often require a degree of public promotion in their initial phases, at a minimum to provide assurances to users that gas supplies will be reliable. This can be provided by some gas promotion and development role for the PA.
- Decisions will be required on the public sector's role in creating a basic transmission and distribution infrastructure. As the Israeli example shows, the initial risk of building a new gas grid often needs to be underwritten by the state (whether the actual construction and operation are managed by a public or private contractor). Privatization may be appropriate once the initial gas market is established, possibly as part of the development of a gas grid.

The upstream and downstream functions outlined above could be carried out within existing Palestinian entities. Responsibilities for these functions should be separated, with policy making and regulation by the PEA and management of state investments by the Palestine Investment Fund.

6. Strategic Issues for Supplying Future Electricity Demand

This chapter reviews the strategies for meeting future electricity needs in West Band and Gaza. Such strategies encompass more than just the electricity sector since they involve other fuels, notably gasoil and natural gas used to generate electricity, and regional trade via imports of electricity or fuels for generating electricity within West Bank and Gaza. Such strategies also have to take account of the considerable uncertainty about future demand for electricity as well as about the timing, amount and cost of options for increasing electricity supply.

The review approaches these issues by first presenting scenarios for growth in electricity demand in West Bank and Gaza, and then assessing the issues in deciding what investments and long-term purchase commitments should be selected for meeting future demand for electricity in West Bank and Gaza. From these requirements, the review examines the institutional and commercial issues for developing supply capacity to meet future demand efficiently.

6.1 Scenarios for Electricity Demand

An understanding of the underlying demand for electricity that can be justifiably met in economic terms is important for economic and market analysis of investments in facilities that expand power supply. This issue is examined in Annex 5 through (i) an analysis of past consumption data to estimate the current effective demand for electricity in West Bank and Gaza, and (ii) a review of recent forecasts for power demand in these regions as a basis for forming scenarios of future demand for electricity. Demand for electricity is not always the same as actual consumption of electricity, especially when supply capacity is inadequate to meet demand fully.

The two key factors for projecting the demand for electricity are:

- The value of demand for electricity in the initial (base) year from which demand is projected, which is taken to be 2005 since this is the latest year for which reasonably comprehensive data are available and it is the latest year without major economic disruptions.
- The formulation of an economic and technical relationship between demand for electricity and the variables that influence the development of this demand over time.

6.1.1 Estimation of Base Year Electricity Demand

In a stable market with no more than minor distortions to factors that influence supply and demand for electricity, the observed consumption of electricity can often be used as a proxy measure of efficient demand. This situation does not apply, however, to the power markets of West Bank and Gaza for the following reasons:

- Substantial amounts of consumption of electricity in West Bank and Gaza are not paid for and therefore do not necessarily reflect demand at the prevailing price for electricity (i.e. consumers would consume less electricity if they had to pay for it fully and promptly than they would without paying for it).
- Some of the demand for electricity from the public supply system has not been met because of insufficient supply capacity (for both energy generation and for transmission and distribution) caused by prolonged underinvestment in the power system as well as heavy damage to supply facilities.
- The power market has experienced unstable economic conditions since 1999 because of disruption to economic life during the i*ntifada*, especially in the period from late 1999 to 2002, and also from early 2006 to the present. These disruptions suppressed consumption of electricity by reducing household incomes and economic activity.

The second and third factors caused consumption to fall below the level of demand, whilst the first factor caused consumption to exceed the level of demand. Consequently, the trend in observed consumption of electricity since 1999 in West Bank and Gaza may not provide a reliable indication of the trend in the underlying demand for electricity. The impacts of these factors on historic consumption of electricity are therefore analysed in Annex 5, from which estimates of demand for electricity in 2005 are derived.

The total bulk requirement for electricity based on these estimates of demand – that is electricity purchased from IEC and Gaza Power Station and fed into the local power networks – in 2005 is 1,105 GWh in Gaza and 2,090 GWh in the West Bank. The estimates are compared to actual purchases of bulk electricity in Table 10.

Table 10. Comparison of Estimated Demand with Actual Purchases of Bulk Electricity in 2005

	West Bank	**Gaza**
Total bulk requirement based on estimated demand (GWh)	2,090	1,105
Actual purchases of bulk power (GWh)	2,123	1,207
Difference (% actual purchases)	–1.5%	–8.5%

Source: Annex 5

This comparison shows that the requirement for bulk electricity based on the estimated underlying demand for electricity was close to actual purchases of bulk electricity for the West Bank as a whole, whereas the requirement for bulk electricity based on the estimated underlying demand for electricity was substantially lower at 8.5% than actual purchases of bulk electricity for Gaza. In other words, if demand for electricity were to be met fully and efficiently – including full and prompt payment, then the requirements for power purchases would be reduced below current consumption levels in Gaza, but would not change much for the West Bank.

The peak loads on power systems are projected from the scenario estimates of energy demand and the projected values for the annual system load factor (SLF) used by PEA's consultants for their load forecast (see Annex 5). A value of 52% for the SLF in both West Bank and Gaza for 2005 was used by the consultants, which produces peak load estimates of 438MW for the West Bank as a whole and 239MW for Gaza. The peak load estimate for the West Bank is very close to PEA's estimate (434MW), but the peak load estimate for Gaza is 44MW above PEA's estimate. Assuming that PEA's estimate refers to the measured peak load actually met, then these comparisons indicate that there was little suppression of peak load in the West Bank during 2005, but up to 10% suppression of peak load in Gaza during 2005.[31]

6.1.2 Scenarios for Electricity Demand

In the current state of unpredictability about the economic and political situation of West Bank and Gaza, medium to long term forecasts of power demand for these regions have low probabilities of falling near to the actual levels of power demand in the future. If a forecast happened to come close to the actual outturn, it could be more of coincidence than due to

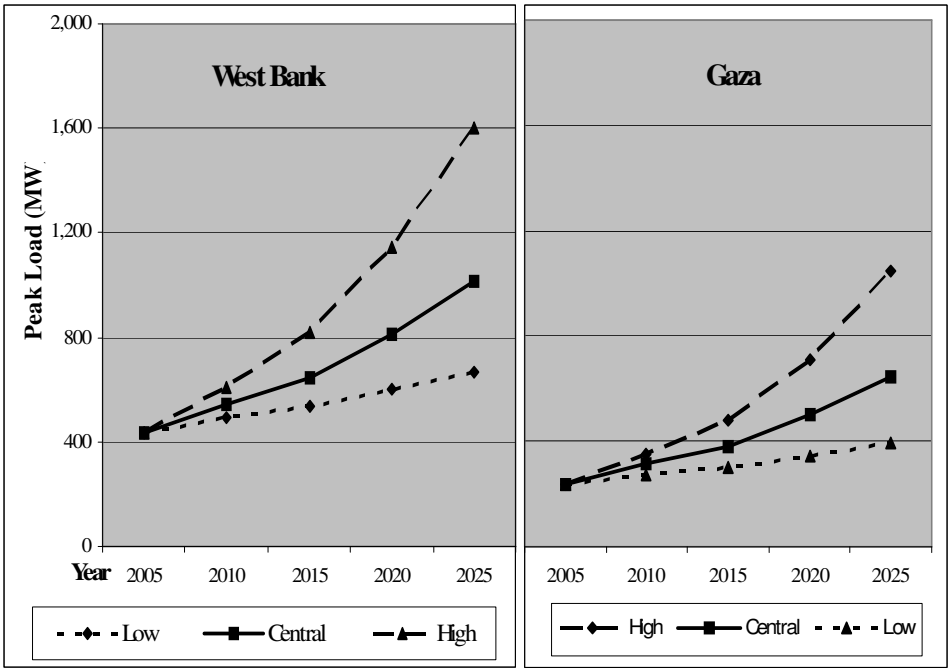
[31] The assertion of little suppression of peak load in the West Bank does not indicate that no power outages or unserved demand took place, because there could have been extensive shortages of this nature in periods outside peak load periods. The assertion of substantial peak load shedding in Gaza accords with the situation described in Annex 2.

forecasting performance. Projections of future trends in power demand can be considered at most as no more than possible scenarios with even less credibility than that usually given to forecasts.

This perspective applies in principle to PEA's recent forecast for power demand in West Bank and Gaza, especially because PEA's forecast appears to be based on a forecast prepared by consultants that should be viewed with reservation for reasons given in Annex 5. However, the projections for energy and peak demand under both PEA's forecast and the consultants forecast fall reasonably between higher growth rates that tend towards optimism about prospects for the economy, and lower growth rates that tend towards pessimism about these prospects. Hence the demand growth rates used for these projections can be used as a central case in a range of scenarios for future power demand, based on the estimated demand for the base year (2005).

Two more scenarios for future power demand are needed to show the impact of uncertainty about the economic future, one that is lower than the central scenario, and another that is higher than the central scenario. The growth rates somewhat arbitrarily chosen for these scenarios are half the growth rate of the central scenario for the low scenario, and one-and-a-half times the growth rate of the central scenario for the high scenario. These growth rates and the resulting energy and peak load scenarios are given in Annex 5, and the energy scenarios are depicted in Figure 11.

Figure 11. Scenarios for Electricity Demand



Source: World Bank – Annex 5

These scenarios are subject to the proviso that the depressed state of the energy market - especially in Gaza – during 2006 and into 2007 does not persist sufficiently to cause future power demand to follow a much lower scenario than presented here.

Table 11 illustrates ways for meeting these demand scenarios under different supply strategies. Theses illustrations are based on indicative estimates of the amount of capacity available under new supply capacity options, and do not take account of any operating constraints in the power systems concerned that might reduce their available capacity. Decisions on new capacity require a proper power system planning study.

Table 11. Illustrative Supply Strategies under Power Demand Scenarios for West Bank and Gaza

Demand scenario	West Bank	Gaza
Case A: Existing supply capacity		
	500MW – IEC (existing) 20MW – Jordan to Jericho 520MW – total existing capacity	110MW – IEC (existing) 140MW – GPP (existing) 250MW – total existing capacity
Year when future demand overtakes existing supply capacity in Case A		
Low scenario	2008	2005
Central scenario	2007	2005
High scenario	2006	2005
Case B: Undiversified from Israel - 150MW to Gaza and 200MW to the West Bank from Israel (without a private generation plant in the West Bank or more power from Jordan)		
Options for additional supply capacity	500MW – IEC (existing) 20MW – Jordan to Jericho 200MW – IEC or Israeli IPP 720MW – total	110MW – IEC (existing) 140MW – GPP (existing) 150MW – IEC (new) 400MW – total inc. existing supply
Year when future demand overtakes increased supply capacity in Case B		
Low scenario	2024	2022
Central scenario	2015	2014
High scenario	2011	2010
Case C: Diversified - New non-Israeli supply to Gaza with wheeling power from Gaza to the West Bank (without a private generation plant in the West Bank or more power from Jordan or IEC)		
Options for additional supply capacity	500MW – IEC (existing) 20MW – Jordan to Jericho 200MW – transferred from Gaza 720MW – total capacity	110MW – IEC (existing) 140MW – GPP (existing) 140MW – GPP expansion 150MW – Egypt less 200MW – transferred to the W. Bank 340MW – available for Gaza
Year when future demand overtakes increased supply capacity in Case C		
Low scenario	2024	2016
Central scenario	2015	2010
High scenario	2011	2008
Case D: Semi-independent - New private generation plant in the West Bank or more power from Jordan		
Options for additional supply capacity	500MW – IEC (existing) 20MW – Jordan to Jericho 250MW – new IPP or f/Jordan 770MW – total capacity	110MW – IEC (existing) 140MW – GPP (existing) 140MW – GPP expansion 150MW – Egypt or IEC (new) 540MW - total inc. existing capacity
Year when future demand overtakes increased supply capacity in Case D		
Low scenario	2027	2027
Central scenario	2016	2020
High scenario	2012	2015

Note: A capacity reserve margin of 10% of the peak load is included in the capacity requirement
Source: World Bank based on demand scenarios in Annex 5

The different supply strategies shown in Table 11 bring out the following important factors for planning new power supply capacity.

- Existing supply capacity is already inadequate to meet demand in Gaza for all three growth scenarios, and is near to full utilization to meet demand in the West Bank (Case A in Table 11).
- A supply strategy that extends the dependency of West Bank and Gaza on electricity supply from Israel by 200MW in the West Bank and 150MW in Gaza (Case B in Table 11) could supply demand under the central scenario up to 2015 in the West Bank and to 2014 in Gaza.
- A supply strategy that develops substantial diversity from Israeli sources by adding 140MW to GPP and importing 150MW from Egypt, but then transferring 200MW of this power through the Israeli network to the West Bank (Case C in Table 11) could supply demand under the central scenario up to 2015 in the West Bank and to 2010 in Gaza.[32]
- A supply strategy that aims at semi-independence for new power supplies from Israel and avoids increasing dependency on the Israeli network for transferring power between Gaza and the West Bank is shown in Case D in Table 11. Such a strategy could be based on developing a new 250MW power plant in the West Bank or in Jordan to supply the West Bank, together with 150MW from Egypt and 140MW additional capacity at GPP for Gaza. This strategy could supply demand under the central scenario up to 2016 in the West Bank and to 2020 in Gaza.

These strategies illustrate the sort of choices open to the PA for meeting future power demand. The PA should commission a study to develop and evaluate such strategies in detail and compared them to identify the strategy that offers the best trade-off between energy cost and security, as discussed in the next section.

6.2 Strategic Issues for Supplying Power to West Bank and Gaza

Future demand for electricity in West Bank and Gaza will be met from a combination of investments in power supply facilities and of long-term power purchase commitments. The selection of this combination involves a number of strategic issues that are examined in this section.

6.2.1 Energy Security

The most important strategic issue facing the PA for meeting future demand for electricity is the trade-off between security of supply and cost of supply. In principle, greater security implies higher cost, and in practice the challenge is to find a trade-off that provides an acceptable degree of security at an affordable level of cost. The need to build some physical redundancy into a power system (in terms of investment in reserve generating capacity and alternative transmission paths, for example) that is necessary for meeting a high level of supply reliability also relates to the broader concept of supply security.

In economics and commerce, the concept of energy security is usually interpreted in terms of diversification of supply sources from a variety of power and fuel markets in order to reduce dependency on one or more suppliers and exposure to their market power. The relationship between these important perspectives – the economic one and the commercial one –is briefly examined in Box 3. In the context of the two small power systems reliant on imported electricity and fuel (even allowing for access to natural gas from the Gaza Marine field for generating electricity in Gaza) that serve West Bank and Gaza, this concept involves finding the right combination of investment in generating capacity with interconnection facilities for fuel supply

[32] Diversification of generation capacity does not necessarily imply diversification of fuel sources, since most new generation capacity in Israel, Jordan and Egypt is likely to use Egyptian gas for many years.

for power generation and investment in the interconnection facilities required for trade in electricity.

Box 3. The Economic and Commercial Perspectives

The development of electricity supply has to account for both economic considerations from the perspective of West Bank and Gaza and commercial considerations from the standpoint of the power utilities. Where these perceptions differ, economic considerations should prevail, especially when the main electricity service providers are state-owned, as are most of the distribution utilities (JDECO is privately owned. HEPCO and SELCO are owned by the municipalities and village councils in their service areas. GEDCO is owned 51% by the PA and 49% by Gazan municipalities; and the Gaza Power Generation Company is wholly privately owned).

Since the PA's policy is to attract more private investment and management to the electricity sector, however, the economic perspective should be reflected in the commercial perspective. This means that commercial costs and revenues excluding taxes and duties should closely reflect economic costs. Electricity retail tariffs in West Bank and Gaza should not be seriously distorted from the economic costs of meeting the demands of each consumer group; the level of electricity supply should be adequate to meet demand reliably; and subsidies should be provided to meet government social objectives rather than to make up for the present low levels of collections by the utilities. As shown earlier in this report, these conditions are only partly met in the case of West Bank and Gaza.

In the PA's situation, the acuteness of general security issues could lead to a desired level of energy security that costs more than would be the case in the absence of these issues, despite the PA's difficulty in financing investments and payment obligations for power supply. Finding a workable combination of security and cost requires careful consideration of the available and prospective supply options, but this is complicated by the uncertainty about the timing and costs of these options.

In principle, the PA needs a plan for developing power supply options based on a sequence of investments sufficient to meet projected demand at an acceptable level of energy security and cost. In practice, the PA appears to be pursuing many power supply options under competitive negotiations to determine the combination that gives best value and diversity, because the availability and cost of these options are uncertain until such negotiations have taken place. In this situation, the PA needs to have a clear strategy for evaluating and prioritizing these options before selecting which ones to develop.

The analysis of supply options to formulate a supply development strategy is routinely handled under the standard techniques for planning the development of power systems, whereby events that threaten supply security are stochastically modeled to find optimal solutions. What cannot be rigorously analysed under these techniques, however, are random events that result in the destruction of key facilities in the power system. Such events can only be analysed through scenario analysis.

One issue that further complicates the development of energy security is how to treat the physical separation of the power systems of West Bank and Gaza, given that the medium term prospect for a physical interconnection between them appears tenuous.[33] The possibility of forming an indirect connection by wheeling electricity through the Israeli power network should be considered in the same as way as for regional trade in electricity, namely by trading at arm's length between two or more commercial enterprises. Each of these systems should therefore be considered individually from the economic and technical perspective of supply security.

[33] The networks and large number of feeder points with IEC's network that are covered by the four West Bank utilities are treated as a single power system for strategic planning.

6.2.2 Issues for Developing Power Supply to West Bank and Gaza

The trade-off between security of electricity supply and cost of electricity supply involves the following issues for power system development in West Bank and Gaza:

- How the PA should respond to the prospective reform of the Israeli power market (described in Annex 7), notably the restructuring of the power supply chain and the introduction of trading in bulk power under evolving regulations, and the possibility that Palestine will have to compete for power supply from Israel in the future, given that Israel has been and is likely to continue to be the source of most electricity and fuel for power generation at least for the medium term.
- The PA's need to conclude with IEC a long-term commercial agreement for future power supply, to replace the present highly decentralized retail supply arrangements between IEC and Palestinian utilities, municipalities and village councils based largely on IEC's general obligation to serve captive customers in its service area.
- How the PA should develop trade in electricity, natural gas and petroleum fuels with neighbours, notably through upgrading the power interconnections with Israel and the planned power interconnections with Jordan for the West Bank and Egypt for Gaza (described in Annex 5), and developing natural gas connections between Gaza and Israel and between Gaza and Egypt (described in Chapter 5), in keeping with the general move towards regional power trade.
- How the power distribution utilities can improve their present poor technical and financial performance (described in Chapter 3) to become creditworthy entities that can procure their bulk power needs on sound commercial terms without needing to receive the sort of fiscal support currently provided by the PA (described in Chapter 4), since the cost and adequacy of future bulk power supply to meet future power demand in West Bank and Gaza depends on the development of creditworthy utilities.
- What parts of the power supply chain and power market will be passed to private sector investors and operators of power supply capacity, what parts will be retained by the public sector agencies, how both sets of service providers will be given incentives to supply electricity services efficiently, and how the roles of the PA and its agencies should evolve to support these providers.
- The need to develop transmission and distribution networks in line with bulk power supply capacity, given the PA's estimates of investment needs in the T&D networks of West Bank and Gaza as summarized in Annex 6, broken down into the short term (1-2 years), the medium term (3-4 years), and long term (5-7 years). In this breakdown, all the investments for the short term are considered urgent and are needed whatever development strategy is adopted. The same consideration applies to most of the medium term investments. Some of the medium term investments and most of the long term investments are related to how new sources of bulk power supply are developed.

The range of these issues shows that energy security encompasses financial and institutional issues in addition to technical, economic and commercial issues and - ultimately - political issues.

6.3 Bulk Power Supply Priorities

The following priorities follow from the issues identified above for developing electricity supply to West Bank and Gaza.

Convert the Gaza Power Plant to burn natural gas. Conversion of GPP to burn natural gas (from Gaza Marine and/or Egypt) instead of gasoil would save around $45 million annually for the Palestinian economy and the PA at the prevailing fuel prices and constrained level of

electricity production in 2005. These savings are achievable for an investment of less than US$5 million to convert the plant and around $10 million for construction of a gas pipeline to the plant site. The economic return to this investment would be very high.

Once the conversion of the plant to natural gas is assured, this investment in combination with associated investments in transmission capacity (see next paragraph) would create the economic conditions necessary for adding generating capacity to GPP. Expansion of installed capacity of the plant in the longer term is feasible because the seawater intake pipe has been sized for a plant capacity of 280MW and the land allocated for the plant can accommodate four generator blocks of 140MW each.

Relieve the transmission constraint on output from the Gaza Power Plant. This investment would remove the transmission bottleneck that prevents the plant from running at more than about half of its capacity. It forms part of the development of the proposed 66kV transmission network and associated substation capacity for Gaza at an estimated cost of about US$32 million that is needed to take bulk power to load centers around Gaza (this is also needed to transmit electricity imported from Egypt and Israel).

This investment is linked to the conversion of GPP to natural gas, since the production of power from the plant based on gasoil would cost more than imported power from Israel. If the plant were able to produce continually from natural gas up to its full capacity of around 140MW, the estimated savings to the PA at current prices and the 2005 level of demand would amount to around US$37 million annually in addition to the savings of around $45 million annually through converting the plant to natural gas. Hence, this investment offers an economic payback period of around one year.

Develop a long term power supply plan for Gaza and the West Bank. The PA has a good choice of options for increasing power supply to Gaza, and needs to do the same for the West Bank. Currently the PA is in negotiations that could lead to long term agreements to import power from Egypt and to increase power imports from Israel. These negotiations should take account of the attractions of expanding the capacity of GPP once it is converted to gas. This option would require a renegotiation of the power purchase agreement with the Gaza Power Generation Company, which would probably take some time. The options for the West Bank include supply from Jordanian utilities and private developers in Jordan setting up power plants in Jordan to supply the West Bank and possibly also the Jordanian market.

In this situation, the PA faces the opposing risks of having a shortage of power or of having a surplus of power relative to Gaza's power needs. The latter risk could be managed by wheeling power from Gaza to the West Bank. In addition to the investments for converting GPP to gas and for relieving the transmission constraints identified above, this Review considers that the PA should proceed as follows:

- **Negotiate the construction of a pipeline to import gas to Gaza from Egypt**. The PA should consider undertaking this investment soon. This is because the BG proposal for Gaza Marine development would unlikely bring gas to GPP before 2011, thus exposing the PA to four more years of gasoil prices, whereas a pipeline from the Egyptian gas supply point at El Arish to GPP could be built by 2009 at a cost of less than $30 million, which is less than the estimated annual benefits from converting GPP to gas.
- **Negotiate long term rights to transfer power between Gaza and the West Bank through Israel.** Transferal of power in this context means both wheeling power through IEC's transmission network or as part of the putative territorial link between Gaza and the West Bank, or a back-to-back swap arrangement whereby for example power is sold by GEDCO to IEC and an equivalent amount of power is purchased by the West Bank

distribution companies from IEC. This would have two advantages for the PA. Firstly, it would greatly help manage the risk of oversupply of electricity to Gaza from the three sources identified above under the considerable degree of uncertainty about the future trajectory of power demand in Gaza, because excess power supply could be sent to the West Bank. Secondly, it would create a valuable option for increasing and diversifying power supply to the West Bank, especially in view of the uncertainty about future power imports from Israel from the prospect of restructuring power supply arrangements in Israel.

- **Negotiate an agreement to interconnect the Gaza power network with power supply from Egypt soon, and another agreement to interconnect the West Bank power system with power supply in Jordan later.** These long-term agreements are likely to substantially increase the amounts of imported power above the small amounts of power to southern Gaza and to Jericho in the West Bank under current agreements. They should provide for a reasonable return to the substantial investments in power supply capacity in Egypt and Jordan needed to meet supply commitments under the agreements.
- **Establishment of substations in the northern, middle and southern parts of the West Bank:** This project is important for replacing the hundreds of connection points between the West Bank utilities and the IEC and for enabling the PA to take bulk power supply from IEC's network.
- **Establishment of a transmission network.** This project will integrate the networks of the West Bank utilities networks and this allow them to share reserve supply capacity.
- **Install prepaid meters for the different utilities especially in areas that do not pay electricity fees.** This project will help consumers in managing their electricity consumption and will help the utilities in enforcing payments of electricity bills.

6.4. The PA's Power Sector Policy

The planned and prospective development of power supply for meeting future power demand in West Bank and Gaza requires substantial capacity to formulate policies and to regulate electricity service providers – whether owned by public or private entities. The PA has already formed its plan for developing this capacity and started the process in the way described in this section. Given the major issues that it now faces for expanding power supply, the priority is to implement these plans.

The PA is following the medium term strategy for implementing the policy laid down for itself and the PEA in its 1997 "Letter of Sector Policy". Some of the components of this strategy have already been implemented – such as the commissioning of a privately developed power plant in Gaza and the formation of distribution companies. The PEA has made substantial progress on most of the other components of the strategy, such as extending electricity services to unserved communities, establishing regional distribution utilities (as noted in Chapter 3), developing pragmatic tariff setting guidelines, and separating the policy and regulatory functions from the commercial functions of the power sector. Under this policy, the PEA is the sole PA agency responsible for overall sector coordination, policy formation, and system development.

The main outstanding component is consolidation of transmission networks and functions into a new transmission company and the establishment of PERC. The formation of a transmission company is motivated by the PA's desire to take over control of power transmission within its borders. Plans for developing the transmission system in Gaza are ahead of plans for developing one in the West Bank, as described in Chapter 3 and Annex 6.

The strategy also calls for turning the new transmission company into a trader of bulk power by entering into power purchase agreements with independent power producers and generating companies from within West Bank and Gaza and from neighbouring countries (as illustrated in section 6.1), so as to sell bulk power to the regional distribution companies. Experience in other countries shows that this "single buyer" function can expose a transmission company to serious financial risks that it is not well equipped to manage. Other institutional arrangements for central procurement of bulk power have been developed that might be of interest to the PEA.

Furthermore, central procurement of bulk power creates a need for arrangements to manage credit risks in order to conclude long term power purchase agreements with a reasonable allocation of risks to the PA that avoids some of the risks assumed under the agreement for GPP. These arrangements should protect the PA from becoming the guarantor of last resort by providing adequate incentives on the distributors to control this risk (contrary to the PA's present role as lender of last resort for the purchasers of bulk power from IEC). The PEA should consider undertaking a review of various arrangements for using third party guarantees for this purpose.

Under the strategy, the PEA will contract technical assistance services from utilities elsewhere for a period of up to five years to help establish the new distribution utilities as efficiently as possible. There is now a substantial body of practical experience with such "twinning arrangements", and they can provide substantial benefits if suitably designed and implemented in the right institutional environment.

The Policy Letter states that privatisation of the utilities is not considered to be practicable at this stage, but provision would be made for significant private participation "within five years". Again, by now a substantial amount of global experience has been gained with privatizing distribution utilities through long term concessions whereby many of the regulatory conditions are incorporated into the concession terms, as well as by change of ownership whereby much of the regulation is carried out by a regulatory agency. Many lessons have been learned for sustaining these efforts, including the factors that matter most for private investors and the advantages and disadvantages of giving regulatory agencies more or less discretion during their formative years. The PEA should commission a review of how to apply these lessons for the power markets of West Bank and Gaza.

Finally, the Policy Letter states that the existing legislation will be amended or a new law passed. The PEA retained consultants (Acres International) who reported in early 2003 on the preparation of a new electricity law to enact the PA's power policy as set out in the policy letter. Even though this legislation has not been enacted yet, it is clear that the PA has the legal powers to implement most of its power policy. One of the main advantages of a new law is to embed the new sector structure and regulatory arrangements in primary legislation to provide private investors with the assurance that the sector framework would not be changed arbitrarily by a future government. Countries that have relied on a series of decrees and lesser legal instruments have experienced difficulty in creating a business environment that sustains private investments on sound terms for the countries (i.e. without having to provide excessive guarantees). Hence this law would help the PA's policy of procuring bulk power from private producers and granting long term distribution concessions to private investors and operators. If necessary, the PA should retain the services of legal advisers to help draft the law.

In summary, this review of the PA's power sector policy recommends that the PEA procure technical assistance to examine the following issues:

- Institutional arrangements for central procurement of bulk power, including arrangements for the use of third party guarantees.

- The contractual arrangements for bringing private management and investment into the new distribution utilities.
- Drafting a new electricity law to support implementation of the PA's policies for the power sector.

Annex 1. Energy Statistics for West Bank and Gaza

Annex 1 Table 1. Energy Balance of West Bank and Gaza in 2003

Production and Utilization	Energy sources and products								
	Solar Energy	**Electricity**	**Gasoline**	**Kerosene**	**Gasoil**	**Oils and Lubricants**	**LPG**	**Olive cake**	**Fuelwood and coal**
	(MWh)	(MWh)	(1000 liters)	(1000 liters)	(1000 liters)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)
1.Primary production	1,385,319	-	-	-	-	-	-	17,829	381,095
2.Imports	-	2,315,614	102,101	4,553	282,797	1,491	88,946	-	35
3.Exports	-	-	0	-	-	-142	-	-	-1
5.Stock change	-	-	51	-6	1,273	29	14	-	2
6.Total energy requirements	1,385,319	2,315,614	102,152	4,547	284,070	1,378	88,961	17,829	381,131
7.Energy converted	-	342,380	-128	-295	-131,465	-86	-82	-	-
8.Electricity generation	-	342,380	-128	-295	-131,465	-86	-82	-	-
11.Losses in transport and distribution	-415,596	-372,119	-	-	-12	-1	-1	-	-
12.Statistical differences	-	68,056	-81,646	-14,417	45,507	-454	-89,933	1,248	-922
13.Final consumption	969,723	2,217,818	183,670	18,669	107,086	1,745	178,812	16,581	382,053
14.By industry and construction	-	186,072	3,299	1,236	34,603	922	2,700	-	337
15.Mining	-	985	19	0	4,018	84	33	-	0
16.Manufacturing	-	160,241	2,724	1,136	24,044	739	2,633	-	337
17.Electricity and water supply	-	18,535	3	46	2,015	20	11	-	0
18.Construction	-	6,312	554	54	4,526	80	23	-	0
19.By transport	-	20,008	175,387	193	30,338	112	37	-	0
20.Road	-	.	175,387	.	30,338	-	-	-	-
23.Other	-	20,008	-	193	-	112	37	-	0
24.By household and other sectors	969,723	2,011,738	4,983	17,240	42,145	711	176,075	16,581	381,717
25.Households	969,723	1,822,722	-	16,307	16,394	-	171,568	16,581	381,095
27.Internal trade	-	130,960	3,612	644	22,134	486	1,524	-	157
28.Services	-	58,056	1,372	289	3,618	225	2,982	-	465

Source: Palestinian Central Bureau of Statistics. *Energy Balance in Palestine 2001, 2002, 2003.* June, 2005

Notes to Annex 1 Table 1. Energy Balance of West Bank and Gaza in physical units in 2003

1. For the data related to wood and coal, the sum was considered excluding production and household, the data is for wood only.
2. The technical losses in electricity is considered to be 14%.
3. In all data related to transport sector, the transport informal sector is not included.
4. The efficiency of the solar water heater was considered to be 45%, and the losses in water distribution are 13.5%.
5. Data dos not include those parts of Jerusalem, which were annexed by Israel in 1967.
6. Lines numbers 4 Bunkers; 9 Heat production; 10 Consumption for non-energy purposes; 21 Air; 22 Inland and coastal waterways; and 26 Agriculture/fishing, are removed from the table since they have zero values.

Annex 1 Table 2. Breakdown of Final Consumption of Energy in 2003 by Source of Energy

Production and Utilization	Total	Energy sources and products in 2003								
		Solar Energy	Electricity	Gasoline	Kerosene	Gasoil	Oils & Lubs	LPG	Olive cake	Fuelwood
Final consumption (TJ)	35,413	3,491	7,984	5,976	653	3,960	74	8,145	278	4,852
proportion of Final Consumption	*100.0%*	*9.9%*	*22.5%*	*16.9%*	*1.8%*	*11.2%*	*0.2%*	*23.0%*	*0.8%*	*13.7%*
Industry and construction (TJ)	2,266	..	670	107	43	1,279	39	123	..	4
proportion of Industrial etc.	*100.0%*	*0.0%*	*29.6%*	*4.7%*	*1.9%*	*56.5%*	*1.7%*	*5.4%*	*0.0%*	*0.2%*
Transport (TJ)	6,914	-	72	5,707	7	1,122	5	2	..	0
proportion of Transport	*100.0%*	*0.0%*	*1.0%*	*82.5%*	*0.1%*	*16.2%*	*0.1%*	*0.0%*	*0.0%*	*0.0%*
Household and other sectors (TJ)	27,185	3,491	7,242	162	603	2,511	30	8,020	278	4,848
proportion of Household etc.	*100.0%*	*12.8%*	*26.6%*	*0.6%*	*2.2%*	*9.2%*	*0.1%*	*29.5%*	*1.0%*	*17.8%*

Source: Derived from Annex 1 Table 1

Annex 1 Table 3. Breakdown of Source of Energy in 2003 by Consumption Sector

Production and Utilization	Total	Energy sources and products in 200								
		Solar Energy	Electricity	Gasoline	Kerosene	Gasoil	Oils & Lubs	LPG	Olive cake	Fuelwood
Industry and construction	6.2%	0.0%	8.4%	1.8%	6.6%	26.0%	52.8%	1.5%	0.0%	0.1%
Transport	19.0%	0.0%	0.9%	95.5%	1.0%	22.8%	6.4%	0.0%	0.0%	0.0%
Household and other sectors	74.8%	100.0%	90.7%	2.7%	92.3%	51.1%	40.7%	98.5%	100.0%	99.9%

Source: Derived from Annex Table 1

Annex 1 Table 4. Export of Petroleum Products from Israel to the Palestinian Authority 2000-2006

(thousand tonnes)

Year	Petroleum Product			
	LPG	Gasoline	Gasoil	Total
2000	107.1	126.8	284.3	518.2
2001	93.7	114.8	228.6	437.1
2002	61.4	71.4	143.0	275.8
2003	90.6	79.5	318.2	488.3
2004	112.5	90.2	448.9	651.6
2005	115.3	99.6	568.8	783.7

Note: Export of small amounts of heavy fuel oil (about 4.8 tonnes in 2005) and bitumen is not included.
Source: Eco-Energy

Annex 1 Table 5. Imports of Petroleum Products 2001-2003: Comparison of Data Sources

Year	2001		2002		2003	
Data source	PCBS[a]	Israel[b]	PCBS[a]	Israel[b]	PCBS[a]	Israel[b]
Product	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)
Gasoline	124,041	114,800	103,886	71,400	102,101	79,500
Gasoil	276,173	228,600	207,078	143,000	282,797	318,200
Gaza PP[c]			29,000		92,000	
Other uses	276,173		178,078		190,797	
LPG	90,899	93,700	95,336	61,400	88,946	90,600

Note a: Palestinian Central Bureau of Statistics
Note b: Eco-Energy
Note c: See Annex 2. "Operating and Commercial Performance of the Gaza Power Plant"

Annex 1 Table 6. Formulas for Derivation of Power Utility Performance Measures

Operating Margin (%)	Total Revenue from Sales/Total Cost of Energy Purchased – 1
Trading Margin (%)	Average Billing Rate/Average Purchase Rate – 1
Operating ratio (times)	Operating Costs/Operating Revenues
Current ratio (times)	Current Assets/Current Liabilities
Self-Financing Ratio (%)	Funds from Internal Sources/ 3-yr. moving average investment programme; Funds from internal sources = Net income after interest, taxes, dividends and principal repayment; and adjusted for non-cash expenses (depreciation, bad debt provisions etc) and net changes in non-cash working capital
Average Billing Rate (US$/kWh)	Total Billed Revenues/Total Billed Amount of Energy
Average Purchase Rate (US$/kWh)	Total Cost of Energy Purchased/Total Purchased Amount of Energy
Total Energy Losses (%)	1 –- Total Billed Amount of Energy/Total Purchased Amount of Energy
Cash Collection Rate (%)	Total Collected Revenue/Total Billed Revenues
Collection Rate -- Purchased Energy (%)	Total Collected Revenue/Total Billed Value of Purchased Energy
Sales per employee (US$)	Total Billed Amount of Energy/Number of employees
Customers per employee (number)	Number of registered active customers/Number of employees
Accounts Receivable (months Billings)	Accounts Receivable/Total Billed Revenues*12
Accounts Payable (months Billings)	Accounts Payable/Total Billed Revenues*12
Debt Service Coverage Ratio (times)	Net income after tax but before interest, depreciation and other non-cash charges (bad debt provisions), divided by the sum of interest charged to operations and repayment of principal due during the year.
Total Billed Value of Purchased Energy (US$)	Total Purchased Amount of Energy*Average Billing Rate
Total Consumption of Energy (GWh)	Total Purchased Amount of Energy –- Technical Losses of Energy
Technical Losses of Energy (GWh)	X% of Total Purchased Amount of Energy (for T&D)
Total Billed Amount of Energy (GWh)	Total Billed Revenues/Average Billing Rate
Funds from Internal Sources (US$)	Net income after interest, taxes, dividends and principal repayment + Non-cash expenses (depreciation, bad debt provisions etc) –- Net changes in non-cash working capital
Net changes in non-cash working capital (= Non-cash Current Assets - Current Liabilities) (US$)	Net Working Capital (2005) –- Net Working Capital (2004)

Annex 2. Operating and Commercial Performance of the Gaza Power Plant

Introduction

The Gaza Power Station contains a combined cycle power plant that consists of two identical power blocks with a capacity of 70MW each. Each block consists of two gas turbines of 23MW and one steam turbine of 24MW. The gas turbines are of type GT10B2 manufactured by ABB Stal. The nominal capacity of the plant under reference conditions (20 C, 79% Relative Humidity, 1.012 atmospheres) is 139.6MW. The capacity varies according to the ambient conditions around the plant. This is the maximum dispatchable capacity of the plant under normal operating conditions without any constraints.[34] The maximum dispatchable capacity of the plant, however, is currently restricted to about 70MW, equivalent to the capacity of one of the two power blocks in the plant, by the available substation and transmission capacity from the plant to the Gaza power network.[35] Expansion of the installed capacity of the plant is technically feasible because the seawater intake pipe has been sized for a plant capacity of 280MW and the land allocated for the plant can accommodate four generator blocks of 140MW each.

Current commercial arrangements

A 20-year concession based on the BOO approach to project financing was granted by the PA to the Palestinian Electricity Company (PEC) which is privately owned by Palestinian investors, of whom Consolidated Contractors Company - a Greek/Lebanese based infrastructure company - (CCC) and the Palestinian Services Company are the major partners. This concession was granted under a PPA for a 20 year term from March 15, 2004, when the plant entered into commercial operation in combined cycle mode.[36]

PEC established GPGC to build and operate GPP with an initial equity of US$60 million, of which CCC is the largest shareholder.[37] GPGC also received a loan of US$90 million from the Arab Bank. These amounts indicate that about US$150 million was invested in developing and constructing GPP, financed 60% by long-term debt and 40% by equity. This level of investment is equivalent to US$1,070/kW of installed generating capacity,

GPGC owns four transformers and the PA owns two transformers (funded by Sweden) in the station substation to transfer power from the station to the transmission network. These transformers were destroyed by Israeli air strikes in June 2006. GPGC are taking responsibility for replacing their four transformers, and the PA is taking responsibility for replacing its two transformers. Normally, 1 to 2 years would be required to restore the substation to its previous capacity. However, the PA is receiving two transformers from Egypt in early 2007 to resume supply from the station.

Operating record

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[34] The maximum dispachable capacity could rise to above 139.6MW in winters when temperature falls below reference temperature 20C.

[35] GPP could dispatch up to 105MW, equivalent to the output of one and a half generator blocks, before the Israeli Air Force bombed the substation to the in June 2006. However, after the strike and rehabilitation of part of the substation, the maximum dispatchable capacity of the plant has been restricted to 70MW.

[36] The plant operated in simple cycle mode with the gas turbines only from June 2002 whilst the plant was being constructed and commissioned.

[37] This equity was initially divided in three equal holdings of US$20 million between the Palestinian public investors, Enron, and a group of investors under CCC. CCC bought out Enron's shareholding subsequently, thus making CCC the largest shareholder in GPGC.

The minimum energy output based on available plant capacity of 139.6MW should be 92%, according to the PPA. However, the plant has never been operated at this output due to inadequate transmission system for taking power from the plant and to the high cost of gasoil. The annual off-take of energy from the plant would be about 613 GWh were the plant to be operated at 100% utilization of the 70MW capacity of the transmission system for taking power from GPP.

The plant has actually been used at the lower utilization rates shown in Table 1 below, partly because of the high cost of power from the plant when it is run on gasoil relative to the cost of power supplied by the Israel Electricity Corporation. In June 2006, for example, the cost of fuel for generating electricity from GPP was US$0.213/kWh including VAT & taxes on gasoil, and US$0.124/kWh not including VAT & taxes on gasoil, whereas the cost of power supplied by the Israel Electricity Corporation was about US$0.08/kWh.

Annex 2 Table 1. Output and Fuel Consumption at Gaza Power Plant

	2002	**2003**	**2004**	**2005**
GEDCO purchases of power from GPP (GWh)	106.6	337.1	404.5	499.3
Plant annual capacity utilization rate at 139.6MW maximum despatchable capacity[38]	-	28%	33%	41%
Approximate amount of gasoil consumed (tonnes)[39]	29,000	92,000	81,000	95,000

Power from GPP has been needed to help meet the peak loads on the power system that occur during daytime. For example, in January 2006 the daytime peak demand averaged about 200MW, of which IEC could meet only 110MW through the transmission link with its system. In view of the constraint on output to about two-thirds of the plant generating capacity imposed by transmission limitations, the generating units have been operated at near to full load in rotation during day times to help meet these peak loads at least fuel consumption. For example, from June 2005 to June 2006, one and a half power blocks (3 gas turbines and related steam turbines) were operated continuously.

During night times when power demand dropped considerably, GEDCO relied mostly on electricity from Israel because of the lower cost from this source than from GPP. Nevertheless, the turbines in GPP were operated on part load, even though the heat rate of the turbines increases under part-load operation. This was because of the restriction on the number of starts of gas turbines at the sellers's cost under to PPA, so that to the PA and GEDCO faced substantial additional charges for the extra number of starts involved in shutting down the turbines each night. Moreover, the operating staff at GPP was reluctant to stop and re-start the turbines nightly because of concern about how this would cause the performance of the units to deteriorate. The PPA only states that the units will be dispatched according to prudent utility practices in power plants, without providing a definition of such practices.[40]

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[38] The dispatchable capacity of the generation plant operated in simple cycle mode was higher than the transmission capacity of 70MW from the plant.

[39] The consumption of gasoil is based on a heat rate of 8,389 kJ/kWh generated (5.26 kWh/kg sent out) when operated in combined cycle mode from March 2004 (see box 2). It is based on a heat rate of 12,085 kJ/kWh generated (3.65 kWh/kg sent out) when operated mainly in simple cycle mode. For the purpose of this exercise, the heat rate for simple cycle mode is used prior to April 2004, even though the units were converted sequentially over some months from simple cycle mode to combined cycle mode up to this date.

[40] The following definition of "prudent utility practices" is taken from a PPA for a power project in another country: "Those standard practices, methods and procedures conforming to safety and legal requirements

Cost of power under the PPA

Under the PPA, the PA pays a monthly Capacity Payment to the investors and supplies fuel for the plant at no cost to the investors. The current Capacity Payment for the third contract year (April 1, 2006 to March 31, 2007, following the definition of the first month of the first contract year in the PPA) is US$17.977/kW/month (US$2.5 million/month total).[41] This level of capacity payment is equivalent to an energy charge of US$0.061/kWh at the annual capacity utilization of 41% achieved in 2005.

The level of the Capacity Payment and the amount of investment involved in the plant implies that the weighted average cost of capital (WACC) for the project financing package was around 18% and the ex ante rate of return on equity invested was around 25% (Box 1 below). These levels are consistent with the returns sought by IPPs for investments in business environments such as that found in Gaza that expose investors to high risks. It is understood that OPIC provided insurance cover to the project lenders for defined risks, which would have allowed the project sponsors to raise debt financing on better terms (lower interest rate, longer tenor).

Annex 2 Box 1. Estimate of Weighted Average Cost of Capital under the PPA

Under the PPA for GPP, the capacity payment was set at US$17.365/kW/month for the first contract year after commercial operation.

The capacity payment includes O&M, general administration and insurance costs, which are assumed for the purposes of this computation of the WACC to be equivalent to US$3.0/kW/month (based on PPAs for similar types of power plants in other countries)

Hence the capacity payment for recovering the cost of developing, constructing and commissioning the plant was set initially at about US$14.365/kW/month over 20 year term of the PPA, or US$172.38/kW/year.

Since the total project cost was $150 million, the unit capital cost is equivalent to US$1,071/kW installed for the 140MW plant.

The WACC is equal to 18.4% under these parameter values.

Since the financing structure for the project was 60% debt and 40% equity (US$90 million and US$60 million, respectively), and if the cost of debt were 12% (with OPIC cover), then the *ex ante* rate of return to equity (ROE) would be equal to:

(18.4-0.6*12)/0.4 = 28%.

This level of ROE lies in the range of ROEs sought by IPPs for investments in high risk business environments.

The plant has run on gasoil supplied by the PEA on behalf of the PA at no cost to the plant owners since it entered into service. The Authority purchases this gasoil from Israel at the market price. The cost of gasoil has increased to about three times the level at the time that the PPA was signed. The unit cost of gasoil in June 2006 was US$908/$m^3$ (equivalent to US$1.122/kg) including VAT and taxes on gasoil, and US$553/$m^3$ (equivalent to US$0.654/kg) not including VAT and taxes on gasoil. At these fuel costs and at the plant's energy conversion rate of 5.26 kWh/kg of gasoil consumed, the fuel component of the cost of electrical energy produced amounts to US$0.213/kWh including VAT and taxes on gasoil, and US$0.124/kWh not including

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which are attained by exercising that degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced international operator of a power facility engaged in the same type of undertaking under the same or similar circumstances to those pertaining in (the country)."

[41] The payment was US$17.365/kW/month during the first contract year (April 2004 to March 2005), and US$17.673/kW/month during the second contract year (March 2005 to February 2006). The capacity payment was US$24.1/kW/month from June 2002 until March 2004.

VAT and taxes on gasoil (Box 2 below). If capacity utilization in June 2006 was similar to the annual average rate in 2005, the combined average cost of Capacity Payment and fuel cost at that time would have been US$0.272/kWh including VAT and taxes on gasoil, and US$0.183/kWh not including VAT and taxes on gasoil**.**

Annex 2 Box 2. Cost of Power Gaza Power Plant using Gasoil in June 2006

Fuel cost per unit of energy

The plant currently runs on gasoil for heating (0.2% sulphur content):

- average density of 845kg/m^3
- average calorific value of 45,481 kJ/kg (HHV)

The average heat rate of the power plant from March 2004 onwards achieved in actual operations is 8,389 kJ/kWh, taking account of site conditions, starts and stops, and fuel characteristics.

Hence 1kg gasoil produces 45,481/8,389 = 5.42 kWh generated

With 3% power consumption by the power plant, 1kg gasoil produces 5.26 kWh sent out from the plant.

The energy conversion efficiency of the power plant = 3,600/8,389 = 43%, with 1kWh = 3,600kJ on an energy equivalence basis.

The unit cost of gasoil in June 2006 was US$908/$m^3$ including VAT and taxes on gasoil, and US$553 /$m^3$ not including VAT and taxes on gasoil.

These costs equal US$1.122/kg and US$0.654/kg of fuel at the specific gravity of 845kg/m^3 for the fuel.

At these fuel costs and at the energy conversion rate of 5.26 kWh sent out/kg of gasoil consumed, the cost of electrical energy produced amounts to:

- US$0.213/kWh sent out from the plant including VAT and taxes on gasoil.
- US$0.124/kWh sent out from the plant not including VAT and taxes on gasoil.

Capacity payment per unit of energy

At 41% utilization of the 139.6MW capacity of GPP (the average annual rate for 2005), the monthly off-take of energy = 0.41*139.6*720*1000 = 41.21 million kWh.

At a capacity charge of US$17.977/kW of plant capacity of 136MW (the capacity charge is calculated based on 136MW produced from the plant as a net output, although the guaranteed net output is 139.6MW), the average capacity payment = US$17.977*136*1000 = US$2.445 million per month (US$29.34 million per year).

Hence, the capacity payment is equivalent to an energy charge equal to US$2.445 million/41.21 million kWh, or US$0.0593/kWh.

Total cost of power per unit of energy

At 41% capacity utilization and June 2006 fuel costs, the total cost of power is the sum of the capacity payment is US$0.0593/kWh sent out from the plant and the fuel cost of US$0.213/kWh sent out from the plant including VAT and taxes on gasoil, and US$0.124/kWh sent out from the plant not including VAT and taxes on gasoil:

Total cost of power

- US$0.272/kWh sent out from the plant including VAT and taxes on gasoil
- US$0.183/kWh sent out from the plant not including VAT and taxes on gasoil

The capacity payment represents 22% of the total cost of power including VAT and taxes on gasoil, and 32% of the total cost of power excluding VAT and taxes on gasoil.

On this basis, the total cost averages US$11.21 million/month (US$134.5 million/year) including VAT and taxes on gasoil, and US$7.54 million/month (US$90.5 million/year) excluding VAT and taxes on gasoil.

Cost of power generated from natural gas

If a supply of natural gas were to be connected to GPP, the economic benefit from using natural gas instead of gasoil to generate power at the plant can be estimated roughly as follows.

The required modifications to the gas turbines to burn natural gas would include replacing the existing burners with dual fuel burners, and modifying the existing control system and some piping works, which would cost about one million dollars. In addition, gas receiving facilities would have to be installed that include a pressure reduction station and a metering system, which would cost also about US$1.5 million. This level of investment is minor compared to the savings in the cost of fuel, as shown below.

Assuming that the average energy conversion efficiency of the power plant would be 46% when burning natural gas, the plant would use 7,842 kJ/kWh generated, which is equivalent to 7,440 Btu/kWh generated.

If natural gas supplied to GPP cost US$4/mmbtu,[42] the fuel cost of power generated at the plant would be equal to about US$0.03/kWh (excluding VAT and any fuel tax). This cost is only about 25% of the fuel cost of power generated with gasoil (US$0.120/kWh excluding VAT and taxes on gasoil) that prevailed in June 2006.

The difference in fuel cost of power generated would be about US$0.09/kWh under these assumptions. This difference would yield large savings on the energy provided by the plant. For the 499 GWh produced in 2005, a switch from gasoil to natural gas under these terms would save Palestine about US$45 million (excluding VAT and taxes on gasoil).

If the transmission capacity were to be upgraded to allow full dispatch of 139.6MW from GPP, then levels of power production above the present dispatch limit of 70MW would magnify these savings. The comparison with burning gasoil becomes hypothetical at much higher levels than in 2005, however, because the amounts of gasoil needed would be unaffordable to the PA from its fiscal resources (the source of payment for this fuel from the time the plant was commissioned) at current oil prices.

Hence the benefit to Palestine of using natural gas at much higher levels of capacity utilization for the plant is the savings from reducing the amount of power purchased from other sources for Gaza, and in particular from IEC at its current tariff of about US$0.09 /kWh. In 2005, GEDCO purchased 708GWh of power from IEC. If, for example, the Gaza plant were to be operated at 92% capacity utilization of 139.6MW given in the PPA, it would generate 1,125GWh annually from natural gas. The economic benefit would be the combined saving from the following two sources:

- from not generating with gasoil - say 500GWh, which would be equal to US$45 million at a cost difference of US$0.09/kWh; and
- from reduced purchases from IEC - say 625GWh, which would be equal to US$37.5 million at a cost difference of US$0.06/kWh.

The combined saving, and therefore the economic benefit of switching to natural gas, would amount to US$82.5 million annually under the terms used for computing this estimate, compared to an initial investment for converting the plant of about US$2.5 million.

[42] MMBTU = million BTU

Risk allocation under the PPA

The allocation of risks between the Gaza Power Generation Company (GPGC) -as the seller and the PA and GEDCO - as the purchaser - under the PPA generally follows international practice where the PPA is the first in a country with a risky business environment. This does not mean, however, that the risks to which the seller and the purchaser are exposed under the PPA are allocated equitably between these parties, taking account of the seller's concern about earning a competitive rate of return on its investment and the purchaser's concern about being able to afford its payment obligations. The way that risks are allocated under the PPA is detailed at the end of this review of GPP.

The PA is exposed to the following risks under the PPA.

- Payment of the Capacity Purchase Charge for full capacity of the plant under the "take or pay" terms, regardless of any type of constraints affecting the dispatch of the plant. About half of the current annual payment of about US$30 million is for generating capacity that cannot be used because of the prevailing transmission constraints.
- In the interim period, the PA has absorbed the costs resulting from damages caused by Israel's military operations. When GPP was put out of operation by an Israeli air strike on the dispatching step up transformers that are owned by the GPCC. This situation necessitated that the PA absorb the capacity cost. The cost of the four damaged step up transformers owned by GPGC will be paid back to PA once GPGC receives the insurance payout.
- Financial penalties due to a delay in the commercial operation date resulting from political force majeure due to security reasons.
- The lack of specific provisions in the PPA for renegotiation of the PPA in the event that bulk power prices in the Gaza power market falls well below the average total payment for power per kWh of energy taken by the Purchaser under the PPA. The Capacity Payment can be re-negotiated under the PPA only when an increase in the capacity of the power plant by adding new power units is being considered.
- The lack of remedies for the PA under the PPA if GPGC fails to deliver the electrical output in full from the plant within the declared available capacity of the plant. However, GPGC has to pay an energy deficiency charge at the end of contract year if the accumulated availability of the plant falls below the contractual availability of 92% specified in the PPA. This condition has not arisen to date because PA has always dispatched less than the available capacity.
- The PA is responsible for procuring fuel for the power plant and paying for it, so the PA takes both the risk of an increase in fuel prices and the risk of disruption to fuel supply. Hence GEDCO bears the consequential costs of lost power output due to a shortage of fuel for the plant – including delay in delivery - or fuel supplied below the specified quality. In fact, the price of oil has tripled, approximately, between the time that the PPA was negotiated and now. There have been no reports, however, of a disruption to the supply of gasoil to the plant, despite the disturbances of the past few years in the region.
- No penalty is payable by GPGC to the PA if the plant heat rate falls below the contractual heat rate during the term of the PPA, even though the PA supplies the fuel. GPPC was supposed to be liable a one-time penalty to PA had the plant heat rate fallen below the contractual heat rate at the time of commissioning of the plant in 2004.

Appendix. Allocation of Operating Risks under the Power Purchase Agreement for the Gaza Power Plant

Capacity payment and availability

The Purchaser is obliged to pay the Capacity Purchase Charge for full capacity of the plant under the "take or pay" terms of the PPA, regardless of any type of constraints affecting the dispatch of the plant. The payment is related to the "Selected Capacity" of the power plant in MW as determined by performance tests from time to time.

The Purchaser has the right to call for a capacity test twice per year or on any time the Seller fails in two consecutive dispatch requests. In any case the number of tests should not exceed 6 tests per year. The Seller has to supply a test plan to the Purchaser at least 60 days before carrying out the test.

If the plant fails an availability test, the Seller has 90 days to restore the plant to its declared available capacity before a default situation arises.

When the Seller is at fault for forced outage/derating or temporary shortfall in capacity below the declared available capacity between availability tests, the Seller pays back to the Purchaser the difference in payment between the previous capacity and the tested capacity.

When the Purchaser is at fault for forced outage/derating or shortfall in transmission capacity below the declared available capacity between availability tests, the Purchaser has to pay the capacity payment in full as if the Purchaser has received the full capacity.

The Purchaser has no remedies if the Seller fails to deliver the electrical output in full from the plant that is requested by the Purchaser or system operator within the declared available capacity of the plant. However, the Seller has to pay an energy deficiency charge at the end of contract year if the accumulated availability of the plant falls below the contractual availability of 92% specified in the PPA.

Energy output and operating costs

The Purchaser – The PEA - is responsible for procuring fuel for the power plant and paying for it.

The Seller pays a one-time penalty to the Purchaser if the plant heat rate falls below the contractual heat rate at the time of commissioning of the plant. No penalty is payable by Seller to the Purchaser if the heat rate falls below the contractual heat rate during the term of the PPA, even though the Purchaser supplies the fuel.

Any errors in measurement or calculation of amount of energy invoiced by the Seller and that are agreed by both parties are corrected by means of adjusting a subsequent invoice, and the difference shall be settled within 30 days of the issuing the invoice.

The Purchaser does not bear the consequential costs of lost power output due to a shortage of fuel for the plant – including delay in delivery - or fuel supplied below the specified quality.

Increases in operating costs arising from the actions or inactions of the Seller and/or power plant operator are borne by the Seller.

The Purchaser faces fixed and predetermined O&M charges -including insurance - for the duration of PPA.

The Purchaser pays for cold starts and hot starts in excess of an agreed number stated in PPA, if it is responsible for conditions that require these starts.

The Purchaser has to find alternative sources of power supply for any shortfalls in power output from the plant that arise from plant operating constraints that affect the dispatch and scheduling of maintenance of the generation plant.

The gas turbines at Gaza Power Plant are dual-fuel turbines that can work on both gasoil and natural gas. The PPA provides for switching to natural gas once gas is available.

The PPA does not directly state whether the Purchaser is committed to paying the Capacity Charge during a prolonged outage of the plant due to causes such as major damage to equipment. If the Seller fails to supply electricity for 180 consecutive days, however, the Purchaser will notify the Seller to correct this fault before this failure to supply constitutes an Event of Default.

The credit support due to be provided by the Purchaser to the Seller according to PPA, is a security deposit of US$20 million.

Assignment, termination, and dispute resolution

Prior written consent is required from the Purchaser for assignment of the PPA by the Seller. Such consent is not required from the Purchaser for assignment of the PPA to project lenders for sake of financing and refinancing of the project.

The Capacity Payment can be re-negotiated under the PPA only when an increase in the capacity of the power plant by adding new power units is being considered.

There are no specific provisions in the PPA for renegotiation of the PPA in the event that bulk power prices in the Gaza power market falls well below the average total payment for power per kWh of energy taken by the Purchaser under the PPA.

In the event of non-availability or non-convertibility of foreign exchange due to the Seller for the Capacity Payment, the Purchaser is liable to a penalty rate on unpaid monies which is indexed to LIBOR. Continual default on making Capacity Payments by the Purchaser constitutes an Event of Default on the part of the Purchaser for which the Seller has the right to terminate the agreement.

Under the buy out terms of the PPA, the termination cost in the case of an Event of Default depends on the party which elects to terminate and also on the cause for termination.

If either party terminates as a result of natural force majeure, the termination cost would cover (i) outstanding debt, (ii) third party liabilities, and (iii) equity value.

If the Purchaser elects to terminate as a result of Event of Default by the Seller, the termination cost would cover (i) outstanding debt, and (ii) third party liabilities.

If the Seller elects to terminate as a result of an Event of Default by the Purchaser or as a result of political force majeure, the termination cost would cover (i) outstanding debt, (ii) third party liabilities, (iii) equity value, and (iv) project value.

The PPA provides for a period of 30 days to settle disputes between the parties to the PPA by mutual agreement; if the dispute is not settled within this period, the parties can go to arbitration under English Law.

Annex 3. Oil Products Supply-Demand in West Bank and Gaza

This Annex draws on the background paper for this Review: "Options for energy supply to the Palestinian Authority and the Israeli Dimension". Eco-Energy M.S. (2001) Ltd., February 6, 2007.

Demand-Supply for oil products in West Bank and Gaza: Current status

The supply of fuel to the Palestinians is anchored in agreements between the PA and Israel (Paris Agreement). The supply of fuel is conducted centrally through fuel terminals on the border of the Gaza Strip and the West Bank. The Israeli fuel companies are not authorized to supply the fuel directly to fuel retailers and gas stations in West Bank and Gaza.

From 1994 until the end of 2006 the Israeli fuel company Dor Alon was the only company authorized by the Palestinians. Dor Alon supplied all types of fuel required in West Bank and Gaza. Starting from January 2007 the largest fuel marketing company in Israel – Paz Oil Company - was chosen by the PA to supply the fuel requirements of the West Bank.

According to the Paris Agreement, the Palestinian authorities are allowed to sell fuel in the West Bank and Gaza at a lower price than the price in Israel, at a rate which does not exceed 15% of excise tax on gasoline. The PA chose to reduce the tax imposed on the fuel marketed in West Bank and Gaza according to the Agreement. It should be noted that Israel collects the taxes on the fuel for the PA.[43]

The Paris Agreement did not relate to the excise tax on diesel which was negligible at the time of the signing. Today, the excise tax on diesel exceeds 50% of the price of diesel at the refinery gate and the tax is slated to rise within two years to the level of excise tax on gasoline – up to 100% of the price at the refinery gate. The incentive to smuggle diesel in order to "save" the tax has therefore grown and indeed most of the fuel that is smuggled is diesel.

Today it is easy to smuggle fuel from the PA to Israel especially from the West Bank in those places where the Israel "security barrier" has not been completed. The amount of smuggling from Gaza is negligible due to the meticulous security arrangement at the only fuel terminal at Nahal Oz and the guarding of the security fence. The fuel smuggling illegal activity from the West Bank has assumed worrying proportions in recent years in tandem with the rise in excise tax on diesel in Israel. The Israeli Ministry of Finance estimates that the loss in income from excise tax due to the illegal smuggling exceeds NIS200 million a year.

Gaza

The Gaza region receives all types of fuel required via the Nahal Oz terminal on the Israeli side. The Israeli terminal belongs to the Dor Alon Company. At the terminal there is a control room and a metering and billing station as well as fuel supply points to which the full fuel tankers arriving from the Israeli side connect. The fuel is pumped a distance of 700 meters via pipelines to the reception terminal on the Palestinian side which includes a metering and billing station, tanks to receive the different types of fuel and fuel issue stations to tanker trucks.

Currently, Nahal Oz terminal is the only terminal through which fuel can be transferred to the Gaza region. The area is surrounded by a security fence through which fuel cannot be smuggled.

Although, Paz Oil Company was chosen to supply fuel to the Palestinians beginning January 1, 2007, it was later on decided by the PA that Dor Alon will continue the supply all fuels to Gaza.

[43] The Israeli fuel companies Dor Alon and Paz charge the Palestinian buyers for the cost of fuels supplied including excise tax and VAT, and transfer the excise tax and VAT to the Israeli tax Authority.

West Bank

Fuel for the West Bank is transferred via two terminals – Nihalin terminal for LPG and Kadiz terminal for other types of fuel. The two terminals operate within the West Bank and are run by the Palestinians. Israeli fuel tankers arrive at the terminals and offload the fuel directly into tankers at the site. In addition, fuel can be offloaded from Israeli tankers back to back with Palestinian tankers at the Tarkumiyah crossing.

In the past, facilities for the transfer of fuel were planned for the Galama crossing which serves as a terminal for the transfer of goods to the West Bank. However this plan has been shelved. It is possible that cargoes of heavy fuel oil and bitumen are transferred via the Galama terminal.

The transfer of fuel at all the crossings is run and operated by the Palestinians agencies directly with the Israeli fuel companies.

The Israeli fuel companies have no terminals or installations of their own on the border of Israel with the West Bank, such as the Nahal Oz terminal on the border with Gaza Strip. Paz Oil Company which was chosen as the fuel supplier for the West Bank replaced Dor Alon as of January 2007 and transfers fuels directly to the existing terminals run by the Palestinians.

Entities in the Israeli defense system, in the fuel administration of the Ministry of Infrastructure and at the Ministry of Finance, assume that the lax control and deficient security conditions in the area of the crossings as well as the ease of transfer in the areas where the fence has not yet been completed allow large scale smuggling of fuel.

For the mid and long term Israel is changing the arrangements for the transfer of fuel to the West Bank. Two new fuel terminals with large capacity will be constructed, one in the north at the Ephraim Gate adjacent to Tulkarem, and the second in the south at Tarkumiya adjacent to Hebron. In the future the transfer of fuel to the West Bank will be permitted only via these terminals. The terminals on the Israeli side will be built with the funding of the Government of Israel, will resemble the Nahal Oz terminal in the Gaza Strip and will include supply points and a control, metering and billing room. The terminals on the Palestinian side will be constructed with Palestinian funding and will include installations for the reception, storage and issue of fuels.

The entire programme hinges to a great extent on the cooperation of the Palestinian authorities and on finding sources to finance the construction of the terminals on the Palestinian side.

Annex 3 Table 1. Export of Fuel Products from Israel to the Palestinian Authority 2000-2006

(thousand tonnes)

	LPG	Gasoline	Gasoil	Total
2000	107.1	126.8	284.3	**518.2**
2001	93.7	114.8	228.6	**437.1**
2002	61.4	71.4	143.0	**275.8**
2003	90.6	79.5	318.2	**488.3**
2004	112.5	90.2	448.9	**651.6**
2005	115.3	99.6	568.8	**783.7**
2006 (to Sept.	NA	133.7	531.0	
of which West Bank	NA	82%	61%	

1) Export of small amounts of heavy fuel oil (about 4.8 tonnes in 2005) and bitumen is not included.
2) A substantial portion of the large increase in the export of gasoil starting from 2003 can be attributed to smuggling as well as to the entry into operation of GPP.
Source: Eco-Energy

Oil products in West Bank and Gaza: Potential for future Israeli – PA Cooperation

Paz Oil Company

Paz, the largest fuel distribution company in Israel, was not involved in the Palestinian market for the past 12 years. Recently, after it purchased the Ashdod Oil Refinery, when it was privatized by the Israeli Government, the company was chosen by the PA to serve the fuel requirements of the West Bank, instead of Dor Alon Company. Dor Alon will continue to supply fuels to Gaza.

Paz management has stated that it is willing to supply the PA with fuel products in exchange for crude oil that the PA may buy from Arab sources and transfer for refining at the Ashdod Oil Refinery. The cost to the PA would be the refining margin. Such a transaction could reduce the credit risk of Paz to finance the fuel, and accordingly the fuel price to the PA could also decrease. It is also possible that crude form the Arab states would be discounted in some form for Palestinian use. To meet the PA needs, Paz is ready to place at its disposal up to 30% of the refining capacity of Ashdod Oil Refinery which stands at some 4 million tonnes a year (especially with regard to gasoline, gasoil and LPG). This amount is more than enough to supply all the fuel needs of the PA.

In addition, Paz can offer the Palestinians a solution to the problem of storage of crude oil and distillates. The Palestinians particularly require a solution for LPG storage, since LPG serves the cooking and some heating needs of much of the PA population. The PA needs storage of up to 1,000 tonnes of LPG in the Gaza region and some 500 tonnes in the West Bank.

In the future there is a possibility that local and foreign fuel companies will become active in the supply of fuel products to the Gaza Strip and the West Bank, replacing the single-source Israeli suppliers.

The fuel supply and marketing infrastructure in West Bank and Gaza is poor. There is no clear identification of the gas stations and there are no well known fuel companies in West Bank and Gaza. Under these conditions the system is plagued by numerous environmental, safety and security problems and by the lack of investment in protection against fuel leaks and pollution.

Under conditions of political stability and political settlement between Israel and the Palestinians, Paz and local fuel companies as well as other Israeli or foreign companies that operate in the Arab countries could invest in upgrading and in purchasing fuel terminals, in fuel marketing companies and in gas stations in Gaza and the West Bank.

Eilat-Ashkelon Pipeline Company (EAPC)

EAPC operates the crude oil pipelines, systems and oil terminals of Israel (Eilat and Ashkelon). The EAPC site and the oil terminal in Ashkelon are strategically located 9km north of Gaza. The terminal in Ashkelon is connected by an oil pipeline to the refineries in Israel and to the oil terminal in Eilat. The company operates as a land bridge between the Red Sea and the Mediterranean and serves as a rapid, efficient and economical route for transporting crude oil from the production areas to oil consumers around the world.

EAPC offers a wide range of infrastructure services in the fuel and gas field which could be suitable for cooperation with the PA:

a) EAPC provides storage services for varying periods (storage volume for some 2.5 million tonnes) and is active in a wide range of activities in energy infrastructure.

b) At its oil terminal in Ashkelon, EAPC operates the offloading of LPG cargo from ocean tankers and an LPG storage farm, installations for the distribution of LPG to tanker trucks and a facility for filling moveable gas containers (canisters).

c) EAPC's site in Ashkelon was chosen to serve as the port of entry for natural gas into Israel. EAPC signed an agreement with EMG Company for the construction of a receiving station for Egyptian natural gas from EMG's marine pipeline. According to the agreement, EAPC will operate and maintain the gas reception station for EMG.

d) EAPC is also preparing for the arrival of Palestinian gas from the Gaza Marine field of BG Company, should it be marketed in Israel.

e) The Dorad Group, of which EAPC is a partner, plans to build a 800MW private power plant at the EAPC site in Ashkelon. The plant which is planned to be commissioned at the beginning of 2009 and based on natural gas is interested in selling electricity to consumers in Israel and in the PA. It is useful to note that Dorad is considering operating this IPP as a peak and intermediate load plant to compete with IEC's high peak load tariffs, rather than as a base load plant. This indicates that IPPs will find it difficult to compete with IEC's CCGTs that use gas under its contract with Egypt and the Israeli supplier Yam Thetis.

f) EAPC is preparing for cooperation with Paz Company and with the Ashdod Oil Refinery which belongs to it. It is possible that distillate transportation lines will be laid down which will connect the Ashdod Oil Refinery with the EAPC terminal in Ashkelon, thereby facilitating the export and import of oil products and distillates for Ashdod Oil Refinery. It can be expected that in the future, should cooperation with the PA expand, transmission lines for fuel and natural gas will also be laid down from the EAPC site in Ashkelon to the Gaza region.

g) A large water desalination plant (100 million cm per annum – the larger reverse-osmosis plant in the world) is also located at the EAPC site in Ashkelon.

It should be added that EAPC is owned 50% by the Government of Israel, with the remaining 50% belonging to the government of Iran, which is held in trust. This ownership structure could be most convenient for the PA in the long term in the event of normalization and improvement in geopolitical relations between the parties.

Petroleum and Energy Infrastructures Ltd.

Petroleum and Energy Infrastructures Ltd. (PEI), together with its wholly-owned subsidiary Fuel Products Line (FPL), constitutes a central entity in the fuel sector in Israel, in terms of infrastructure that includes a fuel terminal for distillates in Haifa, a fuel jetty for offloading crude oil in Kiryat Yam, some 800 km of transmission pipeline for fuel products, 7 storage facilities with overall capacity of about 2.6 million tonnes (of which about 1.0 tonne is crude oil), pumping facilities and fuel supply plants spread country-wide.

PEI offers a range of infrastructure services in the fuel field which could be of interest to the PA especially related to the establishment and operation of fuel terminals (storage tanks and facilities for the issue and handling of fuel) in the West Bank and the Gaza Strip. Two of PEI's storage facilities are located adjacent to the Gaza region: one in the Ashkelon area, adjacent to EAPC's facility, and one near Beer Sheva. PEI is a government-owned company, parts of which may be privatized in the future.

Oil Refineries Ltd. and local fuel marketing companies

The main structural change in the downstream oil sector in Israel is now underway, with the split of ownership of Israel Oil Refineries Ltd's two refineries in Haifa and Ashdod and their privatization. The Ashdod Oil Refinery has been privatized and sold to Paz Oil Company. Oil Refineries Ltd. which currently owns the refinery in Haifa and the adjacent petrochemical plants

will be privatized in 2007 through an IPO on the Tel Aviv stock exchange. The overall refining capacity of Haifa oil refinery is 8.5 million tonnes crude oil a year.

The structural change which is due to be completed following the privatization of Oil Refineries Ltd. in Haifa is expected to bring about a change in the pattern of competition in the fuel sector in Israel, in light of the possible vertical integration of refining and marketing .

It can be assumed that following the split of Oil Refineries Ltd. two separately owned vertical fuel companies will operate in the local fuel market in Israel: Haifa Oil Refineries with petrochemical plants and the other subsidiaries of Oil Refineries Ltd. will operate as part of a single company, and the Ashdod Oil Refineries will operate within the framework of Paz Oil Company. In addition, distillates will be imported and marketed by other local fuel marketing companies (Delek, Sonol, Dor Alon, and smaller companies).

There is a reasonable possibility that one or more local fuel companies will be bound in the future in ownership or long term cooperation agreements with the refining companies. In addition, international fuel companies could enter activity in Israel through acquisition of parts of the local fuel companies.

In a scenario of this type a range of cooperation possibilities with the PA will open up, some of which may materialize in the long run.

Annex 4. Developments in the Israeli Natural Gas Market

This Annex draws on the background paper for this Review: "Prospects of natural Gas supply to Israel and the Palestinian Authority". Eco-Energy M.S. (2001) Ltd., February 13, 2007.

Following the discovery of natural gas offshore Israel, the country is rapidly developing this fuel alongside oil and coal as its third major source of primary energy. Domestic and imported gas is expected to supply most of the growth in electricity capacity in the coming decade, as well as providing energy to industry and for desalination. The growth in gas use will come both from displacement of fuel oil and gasoil, and from new gas fired facilities.

Demand outlook

Gas use began in 2004 and reached 2bcm in 2006. By 2016 demand could reach between 7bcm and 9bcm, depending upon the extent of additions of coal fired capacity. In the long run natural gas expected to account for about one third of total primary energy supply in Israel.

At present gas demand comes from the power sector, and this will remain dominant, accounting for about 75% of the demand for natural gas in the country by 2016. Natural gas will be used in both existing steam turbines converted from heavy fuel oil, and gas turbines, primarily CCGTs. Future expansion of power generation is expected to be largely gas based, although one or more large additional coal plants could be built from 2015 onwards which would moderate gas demand growth (Table 1).

An important feature of Israeli gas demand is the large intra-day fluctuation in demand. The swing in electricity use between day and night has a corresponding impact on gas requirements for power generation. In the absence of gas storage this needs to be handled through a combination of production variation, line pack and power system adjustments (possible reduction in base load coal use at night).

Annex 4 Table 1. Projected Natural Gas Demand in the Israeli Power Sector 2003-2025

(bcm/year)

Year	Steam Turbines	Gas Turbines	Water Desalination	Total Gas Demand
2003	0.0	0.0	0.0	0.0
2006	2.2	0.0	0.0	2.0
2008	2.4	1.5	0.1	4.1
2010	2.4	2.1	0.1	4.7
2012	2.4	2.8	0.2	5.4
2015	2.4	2.8	0.2	5.5
2017	2.4	2.7	0.2	5.4
2020	2.4	3.8	0.3	6.5
2025	2.4	5.9	0.3	8.7

Source: Eco-Energy

Total demand from the industrial, commercial and residential sector is likely to reach about 2bcm by 2016. The chemicals industry and the two national oil refineries will require about 1bcm/yr. Demand from other industries, the services and institutional sectors and residential consumers is likely to account for the balance of non-power demand. Demand for natural gas by industrial consumers is sensitive to the gas price, and the forecast assumes that natural gas prices will

remain competitive with alternative fuels (i.e. HFO, gasoil and LPG). Total demand for gas in Israel is shown in Table 2 below.

Annex 4 Table 2. Projected Total Israeli Natural Gas Demand 2003-2025

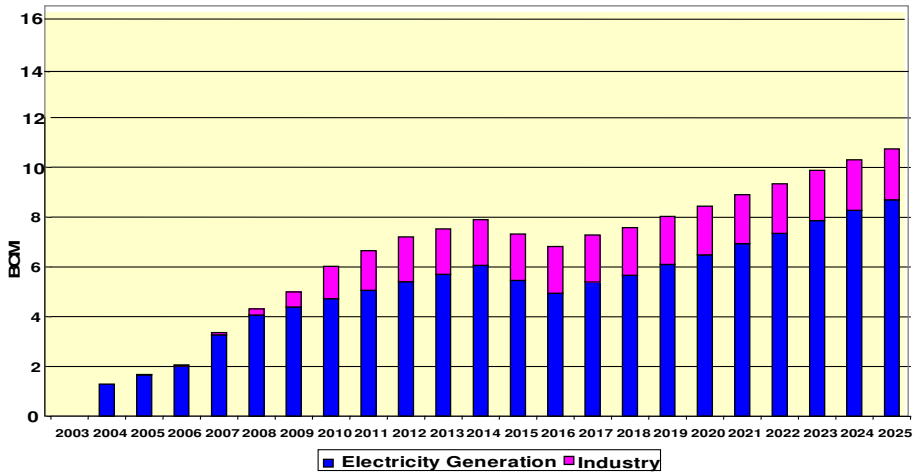
(bcm/year)

Year	Electricity Generation	Industry	Total
2003	0.0	0.0	0.0
2006	2.0	0.1	2.1
2008	4.1	0.3	4.3
2010	4.7	1.3	6.0
2012	5.4	1.8	7.2
2015	5.5	1.9	7.3
2017	5.4	1.9	7.3
2020	6.5	1.9	8.4
2025	8.7	2.0	10.7

Source: Eco-Energy

Annex 4 Figure 1. Projected Natural Gas Demand in Israel 2003-2025

(bcm/year)

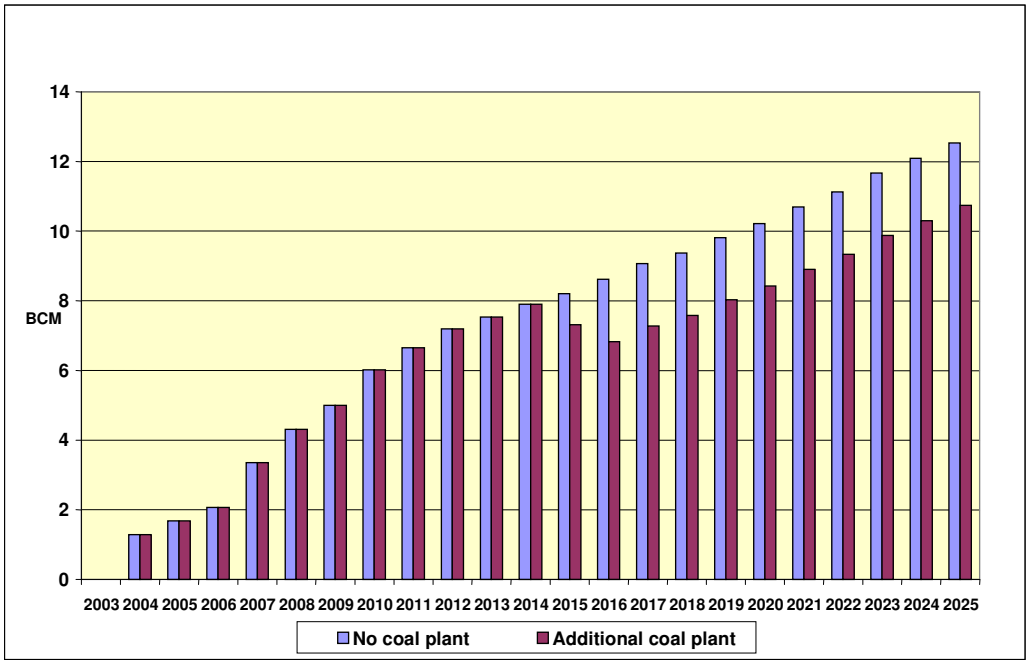


Alternative natural gas demand scenario

The main natural gas demand forecast assumed that an additional coal-based power plant of 1,200MW will be constructed and commissioned in 2015. Specifically, it is assumed that the first 600MW unit will be commissioned in 2015 and the second 600MW unit in 2016. In its public statements, IEC says that it plans to commission these units in 2012 and 2013. Although in 2001 the Government approved the construction of such a power station in Ashkelon, the debate over the construction of this plant is still not over. The high investment cost that is estimated at some

$1.5 billion, environmental objections, and plans for privatization of IEC are among the arguments being used against the construction of such a plant. Hence some delay in start-up is probable. The need to diversify energy supply sources and lower the dependency on imported natural gas favors eventual construction of a coal plant. However, since it is still not evident that this plant will be built it is prudent to examine an alternative natural gas demand scenario in which this coal plant is not built. In this case additional gas demand will amount to around 1.8bcm/yr from 2015. The following figure presents the alternative natural gas demand scenario compared with the "coal plant case" shown above.

Annex 4 Figure 2. Projected Israeli Natural Gas Demand in Two Coal Plant Scenarios (bcm/year)



Gas supply

Israel's gas supplies over the next decade are expected to come from three sources: domestic production, imports from Egypt and production from offshore Gaza. Other sources may be available in the longer term.

The following are the current and possible natural gas supply sources for Israel in the short and intermediate future:

Israel

- Yam Thetis (U.S Noble Energy and Israel's Delek) established some 35bcm of proved reserves in two fields (Marie and Noa) 20 to 40km offshore Ashkelon.[44] In 2003 the partnership signed a 1.8bcm/yr contract with Israel Electric (IEC) for 11 years to be initially

[44] According to Noble Energy's annual report, the gross reserves at these fields are estimated to be in excess of 1 tcf (35.3bcm). The reserves of the Marie field are estimated to be about 25bcm and that of Noa about 8bcm (about one third of the reserve of the Noa field is located in Palestinian territorial waters). It is expected that Noa will be developed at the beginning of the next decade. The gas from the Mari field is reportedly of high quality with 99% methane content.

supplied from its Mari field. Natural gas flow to the Ashdod coastal HFO-based power plant commenced on December 2003, and reached about 2bcm/yr in 2006. The rest of the gas will be supplied to IEC's plants following the construction of pipeline infrastructure, as well as to smaller industrial users.

- BG, Isramco, MEE, Dor Gas and others established some 4bcm in two small fields offshore Ashkelon, mostly in the Or field. It is possible that the Or field will be developed next decade, in parallel to the development of the Noa field by Yam Thetis. Independent development of this field was not found viable.

Israel's domestic natural gas reserves, mostly owned by the Yam Thetis group, are thus limited to some 35bcm, 25bcm of which are already contracted, primarily to IEC. Yam Thetis has long term supply contracts with IEC of 19.8bcm (1.8bcm/yr starting in 2004 for 11 years) and 2-3bcm with other consumers (e.g. the Ashdod refinery, Hadera Paper mills, Ashkelon water desalination plant).

In July 2006 IEC entered into an additional contract with Yam Thetis to purchase additional gas quantities to supply the company's gas requirements until Egyptian gas is available (planned for 2008). It is estimated that IEC's total purchase from Yam Thetis in 2007 could thus amount to some 3.0bcm/year. The actual volume purchased is somewhat uncertain, and depends upon the timing of the connection of IEC's CCGT sites to the gas grid and upon IEC's peak demand requirements. This volume will be reduced significantly when EMG's Egyptian gas comes on board and replaces Yam Thetis which will return to original contractual annual supply volume (1.8bcm/year to IEC). The actual supply volumes of Yam Thetis in 2004 and 2005 and estimates for 2006 and 2007 are as follows (these include both IEC and industrial sales).

Annex 4 Table 3. Projected Yam Thetis Natural Gas Supply 2004-2008

Year	**Gas Supply** (bcm/year)
2004	1.2
2005	1.5
2006 est.	2.1
2007 est.	3.0
2008 est.	2.6

Source: Eco-Energy

Yam Thetis supply capacity is limited by its pipeline size (30") and production facilities. It is understood that Yam Thetis can accommodate supplies of up to 350 mmcf/d (3.6 bcm/year), perhaps with additional investments of some US$20 million. Yam Thetys's fields are expected to reach a production peak by 2012 and possibly be depleted by 2020.

It should be noted that the partners in Yam Thetis, and other companies, are planning to continue with natural gas exploration offshore Israel. In late 2007 Yam Thetys intend to drill in the Gal permit which is located some 90 km offshore Haifa at a water depth of 1,600 meters. If significant gas reserves are proved by this well, it is possible that the field would be developed towards the beginning of the next decade. The development costs of such a field are estimated at some US$1.5 billion.

Under Israeli law, all hydrocarbons produced in Israel are subject to royalty of 12.5%. The Israeli producers are also subject to corporate tax (currently 32%).

Egypt

Egypt is expected to be the leading supplier of natural gas to Israel in the next two decades. The Egyptian Government has assigned East Mediterranean Gas Co. (EMG) [45] to export gas to Israel and possibly other markets. EMG reportedly received a mandate from Egypt to supply natural gas to Israel in quantities of up to 7bcm/year for 20 years. The company has initiated construction of a 36 inch submarine pipeline from El-Arish (in north Sinai, adjacent to the Israeli/Gaza border) to Israel's Ashkelon bypassing the territorial water of the PA. The cost of the 120 km pipeline and related facilities in El Arish and Ashkelon is estimated at some US$300 million. The company is planning to commence gas supply to Israel in late-200 or early-2008. EMG has signed a long term Take or Pay contract of 15 years with IEC (with an option to extend for 5 years) for the supply of 1.7bcm/year. The company is negotiating gas sales contracts with additional consumers in Israel, among which are Dorad and other prospective IPPs, Israel Chemicals and the Nesher cement plant. Dorad and Nesher have announced that they have signed heads of agreement with EMG.

Palestinian Authority (offshore Gaza)

In 2000 about 35bcm (proved) were discovered in the Gaza Marine field, 36km offshore Gaza, by BG and partners (the PA and CCC). Prolonged discussions have been held regarding possible sales to the Israeli market. These discussions crystallized into formal negotiations in 2006. By the end of 2006 BG (as operator) was negotiating to sell approximately 1.5bcm/year to Israel via a sub-sea development and pipeline to a terminal at Ashkelon. The buyer could be an Israeli Government subsidiary or agency.

LNG and pipeline imports

Israel is considering construction of a terminal to import LNG, or development of a subsea pipeline to supply Russian or Azeri gas from Turkey, initially at a rate of some 2bcm/year. However, while potential schemes have been assessed there is no concrete project. The difficulty of finding a site and permitting delays mean that it could take 8-10 years to complete an LNG terminal. In terms of the need for gas system flexibility, introduction of LNG would ameliorate the problem by providing gas storage.

Conclusion - Supply

The aggregated natural gas demand in Israel in the years 2004-2025 accounts for some 150bcm, out of which we estimate that EMG will supply about 70bcm, Yam Thetis - 30bcm, BG - 30bcm, and LNG or other sources - 20bcm.

In the case where no additional coal plant is constructed the total natural gas demand in the years 2007-2025 accounts for some 170bcm, out of which BG could supply 30bcm or more and EMG could possibly supply about 90bcm.

Table 3 and Figure 3 below present a possible natural gas supply sources scenario that meets the annual demand forecast (with coal plant).

[45] EMG is a private company that is owned by the Egyptian businessmen (65%); Merhav and Ampal of Israel (25%), and a subsidiary of Egypt's Government subsidiary EGPC (10%). Both Merhav (a private company) and Ampal (a public company) are controlled by the Israeli businessman Yossi Meyman.

Annex 4 Table 4. Projected Israeli Natural Gas Supply Sources 2003-2025

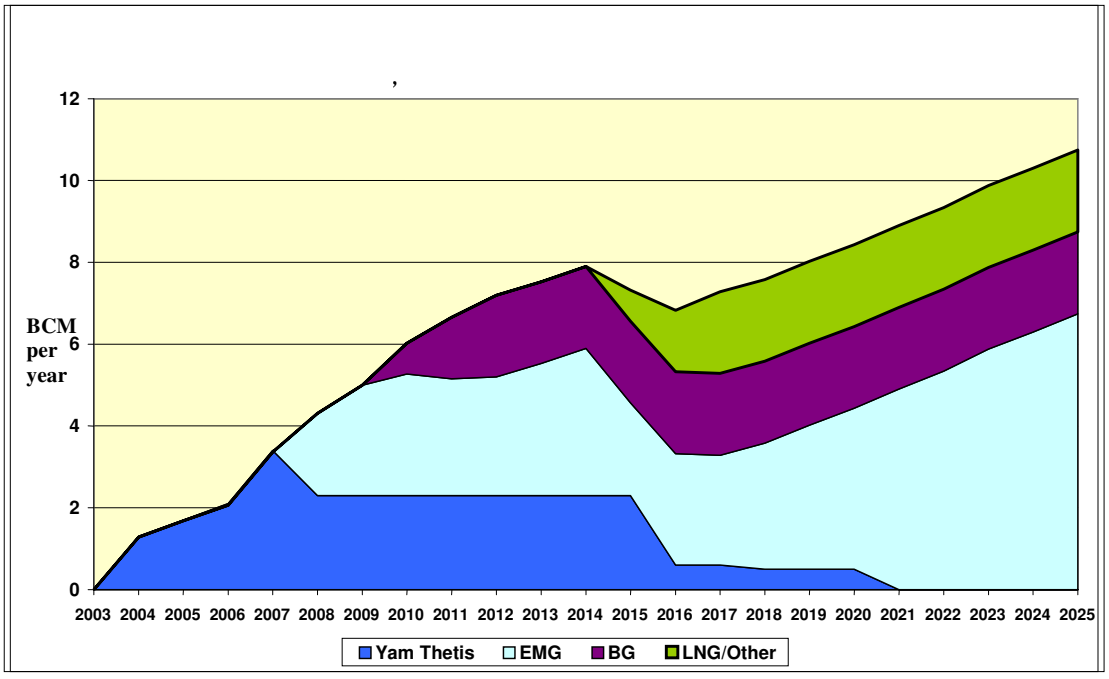
Additional Coal Plant Scenario (bcm/year)*

Year	Yam Thetis	BG	LNG/Other	EMG	Total
2003	0.0	2.0	0.0	0.0	0.0
2006	2.1	0.0	0.0	0.0	2.1
2008	2.3	0.0	0.0	2.0	4.3
2010	2.3	0.8	0.0	3.0	6.0
2012	2.3	2.0	0.0	2.9	7.2
2015	2.3	2.0	0.8	2.3	7.3
2017	0.6	2.0	2.0	2.7	7.3
2020	0.5	2.0	2.0	3.9	8.4
2025	0.0	2.0	2.0	6.7	10.7

*One possible scenario
Source: Eco-Energy

Annex 4 Figure 3. Israel Projected Natural Gas Supply Sources 2003-2025

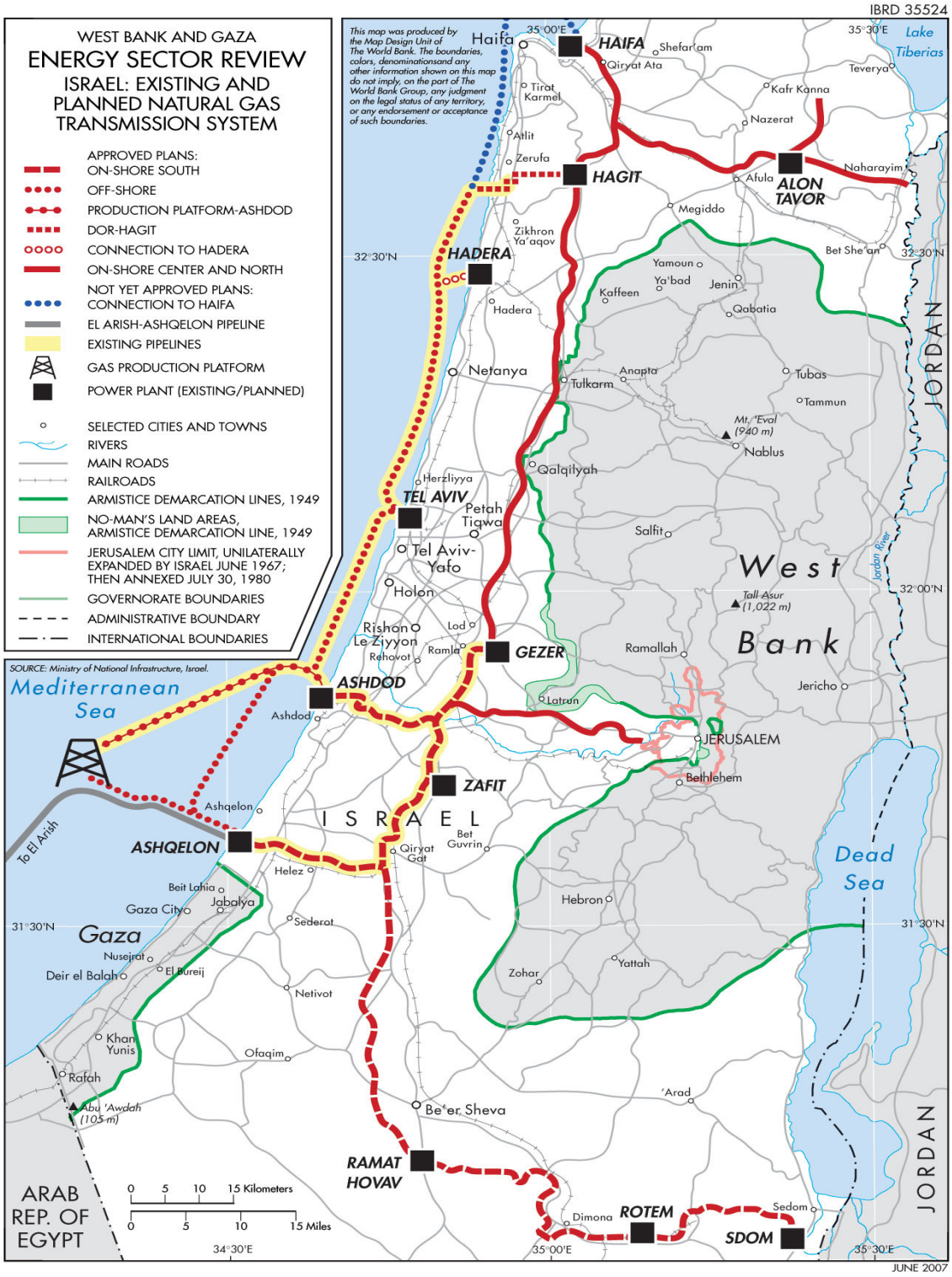
(Additional coal plant scenario)



Gas pipelines

Israel Natural Gas Lines Co. (INGL), a government subsidiary that was established in 2003, is constructing the onshore natural gas infrastructure in the country. The company has a monopoly on the construction and operation of the high pressure gas grid. The pipeline grid will have an initial capacity of 15bcm/year (see map).

Annex 4 Figure 4. Israel Natural Gas Transmission System



Source: Ministry of National Infrastructures (http://www.mni.gov.il/mni/en-US/Energy/NaturalGas/NGTransportation.htm)

The offshore segments of the grid were constructed by Yam Thetis (from the Mari field to Ashdod) and by IEC (from Ashdod to Dor). As of December 2006 the offshore pipeline from the Mari field to Ashdod and Tel Aviv is operating; the offshore line from Tel Aviv to Dor has been constructed. The onshore segment from Ashdod to Gezer and via Zafit to Ashkelon is under construction (and should be commissioned in early 2007); the extension from Dor to Hagit is planned to be constructed and commissioned in 2007; and the southern extension to Ramat Hovav, Rotem and Sedom is planned to be constructed in 2007-2008.

Thus, it is expected that the power plants in Hagit, Gezer and Zafit will start using gas during 2007. The Ramat Hovav power plant and ICL's industrial plants in Rotem and Dead Sea Works are expected to receive gas during 2008.

The schedule of constructing the onshore extensions from Hagit to Haifa and Alon Tavor is not clear yet (the plan is in the process of authorization). The onshore segment from Gezer to Hagit is a low priority and not likely to be constructed prior to the beginning of the next decade. The offshore segments from Dor to Haifa, from Marie field to Ashkelon and from Ashdod to Ashkelon were not approved.

In addition, the Natural Gas Authority in the Ministry of National Infrastructure is conducting a survey of potential locations for an LNG terminal in Israel. One of the options is to construct an LNG re-gasification terminal at the petroleum port in Ashkelon, where the BG and EMG pipelines are expected to arrive.

The location of major natural gas consumers and estimated annual consumption levels are presented in Table 4 below.

Annex 4 Table 5. Main Natural Gas Consumers by 2010

Site	**Consumer**	**Quantity** (bcm/year)
Dead Sea Works & Rotem	ICL	0.4
Ramat Homav	IEC	0.4
Zafit	IEC	0.3
Eshcol power plant (Ashdod)	IEC	1.5
Gezer	IEC	1.0
Reading (Tel Aviv)	IEC	0.4
Hagit	IEC	0.6
Alon Tower	IEC	0.4
Haifa power plant	IEC	0.4
Haifa oil refinery	ORL	0.6

Sources: ICL, ORL, Eco-Energy's estimates of IEC's consumption

The Natural Gas Authority (NGA) in the Ministry of National Infrastructure, the sector regulator, is responsible for issuing licenses for operating natural gas infrastructure and setting natural gas transmission tariffs. In March 2006 the NGA published the natural gas transmission tariffs that gas shippers have to pay to the transmission company (INGL). The tariffs comprise two elements as follows:

1. Capacity tariff of NIS0.5368/mmbtu (US cents 11.414/mmbtu, according to an exchange rate of US$1 = NIS4.703 as of March 1, 2006)

2. Energy transmission tariff of NIS0.1129/mmbtu (US cents 2.401/mmbtu, according to an exchange rate of US$1 = NIS4.703 as of March 1, 2006).

The tariffs are indexed as follows:

1. One third of the tariff is indexed to the change in the consumer price index (CPI) between the known CPI at March 1, 2006 and the date of issuing the invoice to the consumer); and
2. Two thirds of the tariff is indexed to the change in the NIS/US$ exchange rate between the known exchange rate at March 1, 2006 and the date of issuing the invoice to the consumer.

Low pressure consumers (below 16 Bars) will pay additional tariffs to the gas distribution companies. This tariffs are not determined yet (it is estimated that they will be between US$0.5 to US$1/mmbtu, according to the volume shipped to the consumer).

Gas Pricing

Israel's gas market is still in an early stage of development, and gas prices are set by long term supply contracts for large customers. There are at present two key contracts in place with IEC as the buyer in both, and YT and EMG as sellers. The initial price of the Yam Thetis contract with IEC is currently about US$2.75/mmbtu.[46] The price formula is understood to have a cap and ceiling and is indexed to a basket of fuels (75%) and to an American PPI (25%). The fuel price index can fluctuate 20% up and down from a US$17/barrel of oil-equivalent base (1999 prices). It is reported that IEC's contract with EMG has a similar price formula. It should be noted that these low tariffs were determined in a tender that IEC conducted in 2000-2001 that was based on the low oil prices that prevailed in 1999.

The contracts establish a price level for gas in Israel which distorts the power and gas markets, since price levels are far below those in most international markets. For example, current border prices for Russian gas to Europe are about US$7/mmbtu, a level similar to prices in the US and to LNG imports in the Atlantic Basin. The IEC contract prices are also well below international oil product equivalents (which set ex-refinery prices in Israel). In January 2007, Mediterranean gasoil prices were about US$12/mmbt equivalent, while heavy fuel oil prices were US$6/mmbtu.

The IEC contract prices are, however, closer to prices for Egyptian gas in regional markets. Egypt pays gas producers no more that US$2.65/mmbtu for gas, and sells to domestic industry at only US$1/mmbtu. Egypt's exports to Jordan through the Arab Gasline are reportedly priced at US$2.00/mmbtu (CIF Aqaba). At present international energy price levels, these low prices represent an unsustainable subsidy cost in the medium term

It is estimated that in the period 2007-2010 new contracts for supply of natural gas to major consumers in Israel will be set at initial prices that range between US$4.0 to US$5.0/mmbtu. As an example, the price of gas for the additional contract for 2006-2008 that IEC signed with Yam Thetis is reported to be US$5.2/mmbtu. Future prices will be indexed to a formula that is primarily linked to international petroleum and fuel prices.[47] In the long run gas prices would be determined by the cost of LNG (average price US$5 to US$7/mmbtu) which may provide the

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[46] CIF Ashdod prior to domestic transmission cost.

[47] It is expected that the initial contract price will be indexed to the price of a basket of fuels, especially HFO and gasoil, which would vary among the type of consumer and its main alternative or backup fuel. Thus, the weight of HFO price in the indexation formula for a HFO user will be greater than the weight for a gasoil user, and visa-versa. In some cases it is possible that a ceiling and/or floor would be set to the price of gas, depends on the bargaining position of the consumer and the supplier.

higher ceiling for natural gas prices in the country. However, the cost of substitute fuels (HFO and gasoil) will also play a part in setting prices.

Gas prices may in future be differentiated between different types of consumers. Industrial consumers and co-generators would pay higher prices than IPPs; thus the price would be determined according to the willingness of the consumer to pay, which is primarily determined by the cost of its alternative fuels.

It should be noted that the rise in natural gas prices from the initial contracts of IEC (about. US$2.75/mmbtu) to the current price level (US$4-5/mmbtu) possesses a major challenge for the prospective IPPs. This is because IPPs need to compete with an IEC that is purchasing gas for its new CCGTs at much lower tariffs. This lowers the economic viability of the IPPs and makes their financing more difficult.

Average fuel prices in Israel in 2006 are specified in Table 5 below:

Annex 4 Table 6. Fuel Prices for IEC and Industry

(2006 average, at consumer gate, including taxes)

Fuel	**Price (US$/mmbtu)**
Coal (for IEC)	2.5
Natural gas	3.0
Heavy fuel oil (1.7% sulphur)	8.2
Low sulphur heavy fuel oil	9.3
Gasoil (0.2% sulphur)	16 - 17
LPG	12.5 - 13

Source: Based on ex-refinery prices, plus excise tax, plus Eco-Energy's estimate of fuel distribution costs.

Annex 5. The Demand for Electricity in West Bank and Gaza

An understanding of the underlying demand for electricity that can be justifiably met in economic terms is important for economic and market analysis of investments in facilities that expand power supply. This issue is examined in this annex through (i) an analysis of past consumption data to estimate the current effective demand for electricity in West Bank and Gaza, and (ii) a review of recent forecasts for power demand in these regions as a basis for forming scenarios of future demand for electricity.

Historic and present electricity consumption and demand

In a stable market with no more than minor distortions to factors that influence supply and demand for electricity, the observed consumption of electricity can often be used as a proxy measure of efficient demand.

This situation does not apply, however, to the power markets of West Bank and Gaza for the following factors.

- Substantial amounts of consumption of electricity in West Bank and Gaza are not paid for and therefore does not necessarily reflect demand at the prevailing price for electricity (i.e. consumers would consume less electricity if they had to pay for it fully and promptly than they would without paying for it).
- Some of the demand for electricity from the public supply system has not been met because of insufficient supply capacity (for both energy generation and for transmission and distribution) caused by prolonged underinvestment in the power system as well as heavy damage to supply facilities.
- The power market has experienced unstable economic conditions since 1999 because of disruption to economic life during the *intifada*, especially in the period from late 1999 to 2002, and also from early 2006 to the present. These disruptions suppressed consumption of electricity – as well as other goods and services - by reducing household incomes and economic activity. If the disturbances are severe and long lasting, they administer a shock to the economy that can require some years to recover from, especially in a small economy such as that of West Bank and Gaza that has limited capacity to absorb shocks.

The second and third of these factors have caused observed consumption to fall below the level of demand, whilst the first factor has caused consumption to exceed the level of demand. These relationships is summarised in the following expression:

Demand = Total consumption (equal to total supply less technical losses)

less Reduction for unpaid consumption

plus Addition for unserved demand due to insufficient supply capacity

plus Adjustment for temporary drops in consumption caused by disturbances.

Even though one of the factors offsets the other two, the difference between efficient demand and actual consumption of electricity becomes significant when the situations described above persist and worsen. Consequently, the trend in observed consumption of electricity since 1999 in West Bank and Gaza may not provide a reliable indication of the trend in the underlying demand for electricity.

Addition for unserved demand

Estimates of the amount of unserved demand on a power system are often based as much on anecdotal accounts as on measurements of consumption that would have occurred but didn't

because of interruptions to power supply ("outages"), unsatisfied demand for connections by consumers to the power system, and inadequate supply capacity for the demand (especially during periods of peak loading on the power system). Both forms of evidence indicate the existence of unserved demand on the power systems of West Bank and Gaza that has persisted in one form or another. Unserved connected demand (from power outages and inadequate supply capacity) may be equivalent to around 5% of total served demand, although this proportion probably varies from year to year.[48] Unconnected demand is relatively small since the connection rate is above 95%.[49]

Reduction for unpaid consumption of electricity

The reduction to total consumption for the economic effect of unbilled consumption can be estimated from available data based on the simple analysis described in Box 1. The concept of equivalent demand for the amount of unpaid consumption is used to estimate this reduction. Equivalent demand corresponds to the amount of consumption that would replace the unpaid consumption that actually takes place if consumers had to pay for all of their electricity consumption (and so could not have any unpaid consumption). Equivalent demand is less than the unpaid consumption that it replaces. The ratio of equivalent demand to consumption constitutes a reduction factor for dealing with unpaid consumption.

The analysis of the reduction factor for unpaid consumption of electricity is based on data for power utilities, since this is how such data is routinely assembled. Hence the length of the time series for this data depends on the age of the utility. JDECO should have a very long series since it was-established many decades ago. GEDCO can have a data series back to 1999 – the year of its formation. HEPCO and SELCO were formed too recently to provide data for before 2005. NEDCO, of course, cannot provide this sort of data since it is only now being formed. Hence two data sets are analysed:

- Cross sectional analysis for JDECO, HEPCO, SELCO and GEDCO in 2005.
- Time-series analysis for JDECO and GEDCO, separately.

The derivation of reduction factors for unpaid consumption of electricity for these data sets is tabulated at the end of this annex. The values for 2005 are summarised in Table 1 below shows that JDECO's ratio is the highest and reflects good management of consumption on its power system. HEPCO's ratio is reasonably good, but the lower ratios for GEDCO and SELCO indicate the need to reduce losses from billing and collections in these systems.

Annex 5 Table 1. Reduction Factors for Unpaid Electricity Consumption in 2005

	JDECO	HEPCO	SELCO	GEDCO
Ratio Total Equivalent Demand to Total Consumption	0.95	0.91	0.86	0.87

Source: Table 3 at the end of this annex.

[48] This observation applies in particular to industrial and commercial establishments, most of whom reportedly have their own on-site back-up generators that they have to use frequently.

[49] According to Acres load forecast report, the 1997 population census records that about 95% of households had access to the public electricity network, and that household energy surveys conducted in 1999 and 2003 confirm these figures. In 1999, 97.2% of the households were supplied through the public system (98.1% in the West Bank and 95.4% in Gaza) and 93.1% reported that they service for 24 hours a day. In 2003, 99.3% reported access to public electricity. Many of the remaining unconnected households in the West Bank – which lie in the northern part – are being connected under a donor funded program.

Annex 5 Box 1. Computation of Equivalent Demand for Unpaid Consumption of Electricity

A reduction factor applied to the total consumption of electricity for unpaid consumption of electricity is computed from the following steps using observed data.

- Step 1. Compute Total consumption of electricity from (Total bulk electricity supply (produced and purchased) less Technical T&D losses (assume to be 15% of total bulk supply)).
- Step 2: Compute Unbilled consumption from (Total consumption less Billed consumption)
- Step 3. Compute Uncollected billed consumption from (Billed consumption less Collections)
- Step 4. Compute Total unpaid consumption from (Unbilled consumption plus Uncollected billed consumption)
- Step 5. Compute Equivalent demand of total unpaid consumption by assuming a price elasticity of demand of -1.5 at the billed rate and a linear demand curve around the billed rate (see below)
- Step 6. Compute Total equivalent demand at point of consumption from (Collections plus Equivalent Demand of total unpaid consumption)
- Step 7. Compute the reduction factor from (the ratio of Total equivalent demand to Total consumption)

Derivation of the Formula for the Equivalent Demand of Total unpaid consumption

Assume that the price elasticity of power demand is equal to –0.3 for level of power demand at the prevailing tariff for electricity, which is at point (P_T, Q_T) on the demand curve where P_T and Q_T represent the price of electricity and the demand for electricity at the prevailing electricity tariff T.

Assume the demand curve is linear between the point (P_T, Q_T) and the point (P_0, Q_0) at which the price of electricity is zero and the demand curve intersects the axis for demand, so that Q_0 represents the demand for electricity that has zero price to the consumer. This means that the price elasticity of demand is also –0.3 at point (P_0, Q_0).

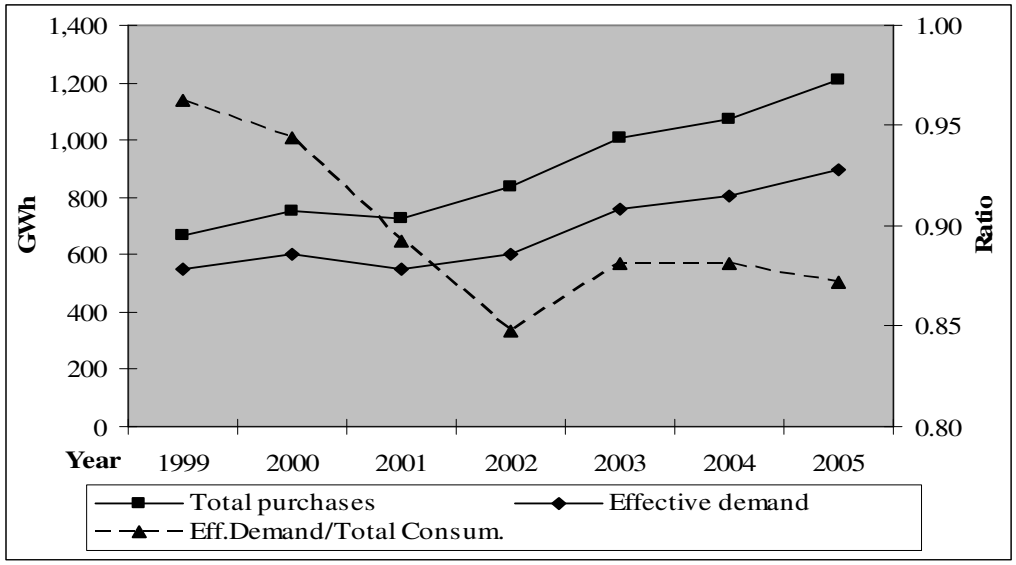
The observed level of total consumption is the sum of (i) consumption that is paid for at tariff P_T and (ii) consumption that is not paid for (at zero price). Let consumption that is not paid for (at zero price) be a proportion m of total consumption, and consumption that is paid for at tariff P_T be a proportion (1-m) of total consumption.

If consumption that is not paid for becomes liable to payment at the tariff P_T at a price elasticity of –0.3, it would be reduced by a proportion of (1–0.3) times = 0.7 times. This would reduce total consumption to [0.7*m +(1–m] times the observed level of total consumption, which equals **[1-0.3*m] times the observed level of total consumption**

The time series for GEDCO's ratio of total equivalent demand to total consumption shows a marked deterioration from a good level of 0.96 in 1999 to a mediocre level of 0.83 in 2002, which coincided with a downturn in Gazan economic output (see Figure 1 in Chapter 2) but when power consumption remained fairly constant (Figure1 below). The ratio recovered to 0.87 in 2003 and remained around this level in 2004 and 2005 whilst power consumption increased substantially with the new supply from GPP.

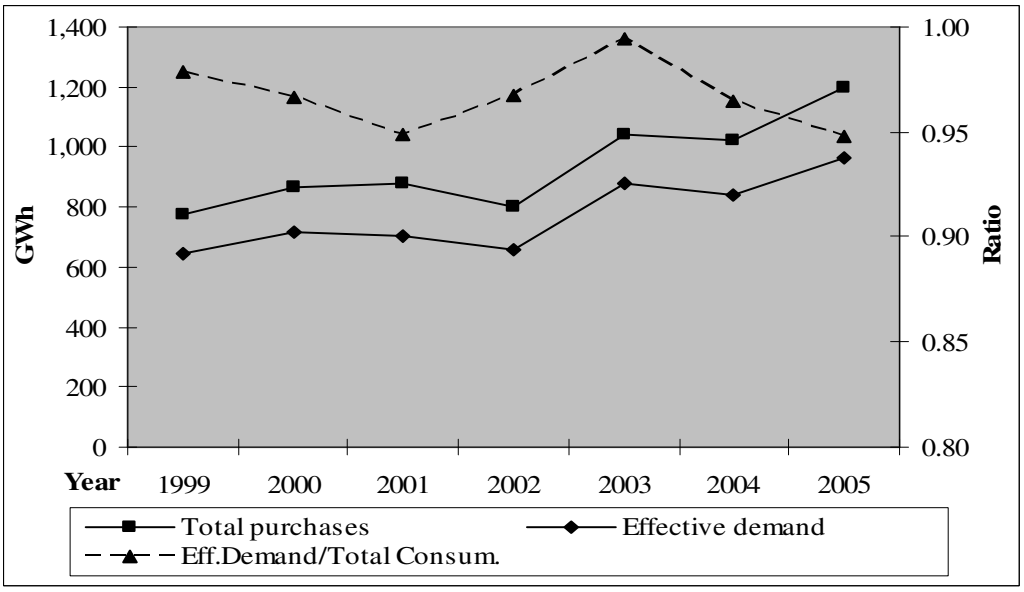
JDECO's ratio of total equivalent demand to total consumption has been consistently higher than the ratio for GEDCO. It declined from 1999 to 2001, then increased to 2003, and then declined again from 0.99 in 2003 to 0.95 in 2005 (Figure 2 below). Power consumption and effective demand in JDECO's service area was also more sensitive to the general economic downturn in 2002 than in the case of GEDCO.

Annex 5 Figure 1. GEDCO Power Supply and Equivalent Demand 1999-2005



Source: Annex 5 Table 5

Annex 5 Figure 2. JDECO Power Supply and Equivalent Demand 1999-2005



Source: Annex 5 Table 4

Reduction in consumption from general disturbances

An adjustment to observed consumption that allows for temporary drops in consumption caused by disturbances essentially attempts to identify a counterfactual case of what would have happened in the absence of disturbances. For the purposes of identifying effective demand for electricity, only a simple adjustment is considered based on interpolation during the period when disturbances appeared to have a significant impact on power consumption. This approach has the theoretical drawback of implying that power consumption recovers rapidly from the shock of the disturbances and soon resumes a long-term growth trend that would have taken place in the absence of the disturbances. In effect, the assumption is that disturbances have only a short-run

impact on power consumption. Under this simplified approach, the efficient level of demand for electricity is not affected by the disturbances.[50]

This approach to dealing with the effect of disturbances on electricity consumption and demand can be clearly shown for the case of Gaza. In this case, the counterfactual case consists of an imaginary straight line that joins the points for 2000 and 2003 on the curves for total electricity purchases and effective power demand in Figure 1 above. In this case, this line appears to fit a linear trend from 1999 until 2005 with a very high correlation coefficient (Box 2).

Projecting the demand for electricity

The two key factors for projecting the demand for electricity are:

- The value of demand for electricity in the initial (base) year from which demand is projected.
- The formulation of an economic and technical relationship between demand for electricity and the variables that influence the development of this demand over time.

The value of demand for electricity in the base year (2005) consists of the following components:

- the actual equivalent demand for electricity that incorporates an adjustment for unpaid consumption (880GWh in Gaza, 1,692GWh in the West Bank – see Box 2)
- plus an allowance for unserved connected demand (5% in Gaza and the West Bank).

The base year (2005) demand is therefore 939GWh in Gaza and 1,777GWh in the West Bank.

Annex 5 Box 2. Derivation of Total Bulk Power Requirement for the West Bank in 2005

In the absence of comprehensive data for the northern load centres in the West Bank, the total effective demand in 2005 for the West Bank was derived with data from the Acres load forecast (which is described in the next section "Recent power load forecasts") as follows.

Total Bulk Power Requirement for the West Bank in 2005 =

[Total Bulk Power Requirement for (JDECO+HEPCO+SELCO) in 2005] multiplied by [Acres Forecast for West Bank in 2003] divided by [Acres Forecast for (JDECO+HEPCO+SELCO) in 2003]

The two values used from the Acres forecast are obtained by aggregating the forecasts at the level of main sub-stations that fall into the service areas of each distribution utility.

According to the Acres forecast, total bulk power purchased in 2003 to serve:

all of the West Bank was 1,741GWh

the areas served by JDECO, HEPCO and SELCO in 2003 was 1,217GWh

Hence, the total bulk power purchased to serve the West Bank equals 1.4304 times the total bulk power purchased to serve the areas served by JDECO, HEPCO and SELCO.

The actual equivalent demand for electricity that incorporates an adjustment for unpaid consumption for the areas served by JDECO, HEPCO and SELCO in 2005 (see Table 3 at the end of this annex) = (964,226+172,140+46,532)*1.4304/1000 = 1,692GWh in the West Bank.

Adding an allowance for unserved connected demand of 5%:

Total Bulk Power Requirement for the West Bank in 2005 = 1,692*1.05 = 1,776.7GWh

The total bulk power requirement is equal to the total bulk power supply to meet the equivalent demand plus technical losses in the power system. These losses are estimated to be 15% of total bulk power supplied in the cases of West Bank and Gaza. The base year (2005) total bulk power

[50] This approach may appear to exclude by definition the effect of disturbances on demand for power. In the circumstances of West Bank and Gaza, such a definition has the merit of simplicity.

requirement is therefore 1,105GWh in Gaza and 2,090GWh in the West Bank, which are less than the actual purchases of bulk electricity (Table 2).

Annex 5 Table 2. Estimated Demand and Actual Purchases of Bulk Electricity in 2005

	West Bank	Gaza
Total bulk requirement based on estimated demand (GWh)	2,090	1,105
Actual purchases of bulk power (GWh)	2,123	1,207
Difference (% actual purchases)	–1.5%	–8.5%

This comparison shows that the requirement for bulk electricity based on the estimated underlying demand for electricity was close to actual purchases of bulk electricity for the West Bank as a whole, whereas the requirement for bulk electricity based on the estimated underlying demand for electricity was substantially lower at 8.5% than actual purchases of bulk electricity for Gaza. In other words, if demand for electricity were to be met fully and efficiently – including full and prompt payment, then the requirements for power purchases would be reduced below current consumption levels in Gaza, but would not change much for the West Bank.

Regarding the second factor for projecting demand, it is tempting to use a curve fitted to historic data to avoid the complication of analysing relationships between demand and other variables. Box 3 below shows two curves that fit the data on total bulk power requirement based on the total equivalent demand for electricity in Gaza for the period 1999 to 2005. Both these curves have high correlation coefficients. However, when projected forward over the long term (to 2025), they display low and declining growth rates for power demand, despite the substantial average annual growth rate in Gazan power demand of 7.5% between 1999 and 2005. These projections do not have the degree of confidence needed for a forecast.

Annex 5 Box 3. Curve Fitting for Gaza's Demand for Electricity

The following two curves fit closely the data for Gaza's total bulk power requirement based on the total equivalent demand for electricity as described in the text, for the period 1999 to 2005. The data for 2001 and 2002 are linearly interpolated between data for 2000 and 2003 as an adjustment for the effects of disturbances, as described in the text.

Curve A: $Y = Y = 68.178*X + 603.56$ $R^2 = 0.9914$

Curve B: $Y = 646.15*X^{0.2401}$ $R^2 = 0.9395$

X represents data for total equivalent annual demand for electricity (in GWh), and Y represents the year (for which 1999 has the value 1, 2000 the value 2, etc).

These values for correlation coefficient are much higher than the values when actual data are used for 2001 and 2002 (0.86 for Curve A and 0.68 for Curve B). Even though these two curves have similar correlation coefficients, they diverge substantially in their values for equivalent demand over the long term, as shown below. The low projected growth rates from these curves are also shown, especially for Curve B (due to the low power for X).

Year	2005	2010	2015	2020	2025
Curve A (GWh)	1,081[a]	1,422	1,763	2,103	2,444
5-year lagging growth rate	7.8%	5.6%	4.4%	3.6%	3.0%
Curve B (GWh)	1,031[a]	1,173	1,276	1,357	1,426
5-year lagging growth rate	6.8%	2.6%	1.7%	1.2%	1.0%

Note a: The values for 2005 are for the total bulk power requirement derived from the equations, rather than the actual value of 1,207 GWh for total purchases of bulk power in 2005.

Recent power load forecasts

The PEA has recently prepared a power load forecast for West Bank and Gaza.[51] This forecast is based on a load forecast prepared for a recently completed transmission and distribution study for West Bank and Gaza ("the Acres forecast").[52] These forecasts are shown in Table 3 below. The base year for the Acres forecast was 2003, and the measure of demand is taken to be total purchases of power without adjustments for unpaid consumption, etc.[53]

Annex 5 Table 3. Recent Power Load Forecasts

Forecast[a]	2005	2010	2015	2020	2025
West Bank					
PEA (MW)[b]	434	544	641	802	-
Acres (GWh) Acres (MW)[b]	1,981 438	2,683 545	3,396 646	4,252 809	5,324 1,013
Annual Load factor	52%	56%	60%	60%	60%
5-year average annual growth rate: -for energy -for peak load		 6.3% 4.5%	 4.8% 3.5%	 4.6% 4.6%	 4.6% 4.6%
Population forecast (thousands) Per capita energy demand (kWh/y)	2,531.2 783	3,104.2 864	3,558.7 954	4,026.4 1,056	4,555.5 1,169
Gaza					
PEA (MW)[b]	195	293	414	538	-
Acres (GWh) Acres (MW)[b]	1,170 258	1,648 337	2,171 413	2,829 538	3,685 701
Annual Load factor	52%	56%	60%	60%	60%
5-year average annual growth rate -for energy -for peak load	 8.0%[c] -	 7.1% 5.5%	 5.7% 4.2%	 5.4% 5.4%	 5.4% 5.4%
Population forecast (thousands) Per capita energy demand (kWh/y)	1,481.1 790	1,889.5 872	2,255.1 963	2,601.6 1,087	3,001.3 1,228

Note a: These forecasts are for bulk power supply, and they therefore include technical losses in the transmission and distribution networks.
Note b: Peak Load forecasts for West Bank and Gaza are undiversified totals of forecast loads at substations in these regions. According to the Acres load forecast report, a coincidence factor of 0.972 was applied to the sum of substation loads in a load forecast prepared in 1995 by Kennedy & Donkin.
Note c: This growth rate is for Effective Demand for 2000 and 2005 given in Table 5 of this annex.
Sources: For Acres: see footnote on the previous page. For the PEA: presentation by Dr. Omar Kittaneh, October 24, 2006 at the World Bank, Washington, D.C.

[51] The terms "demand forecast" and "load forecast" tend to be used interchangeably for electricity. "Load forecast" refers explicitly to the peak load on the power system (usually expressed in MW), and indicates the requirement for supply capacity. "Demand forecast" is used both for electrical energy (usually expressed in GWh) and capacity.
[52] Acres International. *Feasibility Study for Electric Transmission & Distribution – West Bank and Gaza. Technical Feasibility Report. Volume 1 – Load Forecast*". November, 2005
[53] The Acres forecast is for energy and load on the main substations that receive bulk power supply and transform it for distribution throughout West Bank and Gaza, and so it includes distribution losses.

The Acres forecast for Gazan energy demand in 2005 (1170GWh) is 65GWh (5.9%) higher than the total bulk power requirement for Gaza of 1,105GWh estimated from effective demand. However, the Acres forecast for West Bank energy demand in 2005 (1981GWh) is 109GWh (5.2%) lower than the total bulk power requirement for the West Bank of 2,090GWh estimated from effective demand.

The Acres forecast adopted growth in population and growth in national income as the independent variables for a power demand forecast. The number of households is multiplied by the average specific consumption of electricity for households in each locality to determine the amount of energy required in the locality for each year in the forecast to 2025. The formulation was therefore as follows:

Forecast consumption for year X =

Base year consumption*(cumulative increase in average customer consumption from 2003 to year X)*(cumulative population growth from 2003 to year X)

- To allow for consumption growth within each household as new appliances are purchased or energy use changes, the specific consumption value is increased by 2% per year.
- The base population and number of households for each of the 688 localities in West Bank and Gaza are expanded at an average population growth rate set for each governate. Cumulative population growth is used as an indicator of household formation. The overall forecast annual growth rates for the West Bank population decline steadily from 4.8% in 2003 to 2.5% in 2015 and beyond, and for the Gaza population from 5.5% in 2003 to 3.4% in 2015 and beyond.

It is noteworthy that the 2% annual increase the specific consumption of electricity by households implies that the household income elasticity of consumption is 1 if GDP is forecast to grow at between 2% per year, and 2 at 1% growth in GDP.[54] This seems logically coherent since household incomes are likely to increase at approximately the same rate as GDP in West Bank and Gaza,[55] and GDP grew at about 1% per year during the period 2000 to 2005.[56]

This conclusion excludes the effect of price elasticity of demand, which is reasonable given that the current prices for electricity are not low by economic criteria since they would cover supply costs fully if billings and collections were managed efficiently. No explicit function is included for future changes in the real price of electricity in the formulation for the Acres forecast.

The Acres load report states explicitly that it avoids using economic growth as a driver of load demand because of the lack of the information needed for a meaningful econometric analysis. But the report does not examine any implications for future economic growth arising from its methodology, and in particular whether a growth rate as low as 1% over the next 20 years for economic output was a reasonable projection.

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[54] A value of between 1 and 2 is consistent with norms used in developing countries. The use of price and income elasticities in demand forecasting is shown in Robert Bacon. *Reality Checks for Power Forecasts: Two Simple Checks Relating Power Sector Demand Forecasts to the Macroeconomy*. Public Policy for the Private Sector Series. FPD Note Number 9. The World Bank. June 1994. http://rru.worldbank.org/Documents/PublicPolicyJournal/009bacon.pdf

[55] This assertion is reasonable for West Bank and Gaza since the construction and service sectors – many of which are linked to the residential sector – form a large share of total economic output (see Chapter 2).

[56] See Chapter 2. According to the Palestinian Central Bureau of Statistics, GDP in millions of dollars at 1997 prices increased from 2,933 in 2000 to 3,075 in 2005 for the West Bank, and from 1,328 in 2000 to 1,381 in 2005 for Gaza. These values show an average growth rate of about 1.01%/year for the West Bank and 0.79% for Gaza.

No separate components are included in the Acres forecast for modeling the demand for electricity in sectors other than households.[57] Only one forecast was derived, whereas others are usually developed to show the sensitivity of this forecast to uncertainty about future economic and social trends. Such uncertainty is a prominent consideration for planning investments that are capital-intensive and long-lived in the environment of West Bank and Gaza.

Overall, both Acres and the PEA forecast long-term growth rates for power demand of around 4.5% for the West Bank and 5.5% for Gaza. These rates are considerably lower than growth in consumption during the last 5 to 10 years. The declining trend in forecast population growth rates account for the declining trend in the forecast growth rates for power demand. But per capita power demand is forecast to increase steadily at 2% annually, and would not reach high levels in 20 years time by the standard of current average per capita consumption levels in neighbouring countries.[58]

Scenarios for future power demand

In the current unpredictability about the economic and political situation of West Bank and Gaza, long term forecasts of power demand for these regions have low probabilities of falling near to the actual levels of power demand in the future. If a forecast happened to come close to the actual outturn, it could be more of coincidence than due to forecasting performance.[59]

The methodology used for the Acres load forecast lacks analytical rigour because of the concerns expressed above about it. Nevertheless, the resulting projections for energy and peak demand fall reasonably between higher growth rates that tend towards optimism about prospects for the economy, and lower growth rates that tend towards pessimism about prospects for the economy. Hence the demand growth rates used for these projections can be used as a central case in a range of scenarios for future power demand, based on the estimated demand for the base year (2005).[60]

The peak loads on power systems are projected from the scenario estimates of energy demand and the projected values for the annual system load factor (SLF) used by the consultants for their load forecast. A value of 52% for the SLF in both West Bank and Gaza for 2005 was used by the consultants, which produces peak load estimates of 438MW for the West Bank as a whole and 239MW for Gaza. The peak load estimate for the West Bank is very close to PEA's estimate (434MW), but the peak load estimate for Gaza is 44MW above PEA's estimate. Assuming that PEA's estimate refers to the measured peak load actually met, then these comparisons indicate that there was little suppression of peak load in the West Bank during 2005, but up to 10% suppression of peak load in Gaza during 2005.[61]

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[57] This omission would generally be considered a serious weakness in a methodology for forecasting power demand, but it is less serious than elsewhere in the case of West Bank and Gaza where non-household sectors account for a minor part of total power demand.

[58] Average per capita electricity consumption in 2004 was 1,087kWh in Egypt, 1,420kWh in Syria, 1,455kWh in Jordan, 1,917kWh in Iran, 2,412kWh in Libya, 2,924 kWh in Lebanon, 3,362kWh in Oman, and 5,819kWh in Israel (Source: The Israel Electricity Corporation Ltd. *Statistical Report Year 2005*.)

[59] In other words, the balance of errors in forecasting methodology and assumptions about the independent variables could combine to produce forecasts that were near to the actual outturns.

[60] The PEA forecast is not used for the scenario analysis because it does not provide details of the data and methodology used. These details, however, are likely to be similar to the details for the Acres forecast because the PEA forecast appears to be an update of the Acres forecast. Hence scenarios based on the PEA forecast would be similar to scenarios based on the Acres forecast.

[61] The assertion of little suppression of peak load in the West Bank does not indicate that no power outages or unserved demand took place, because there could have been extensive shortages of this nature in periods outside peak load periods. The assertion of substantial peak load shedding in Gaza accords with the situation described in Annex 2.

Two more scenarios for future power demand are needed to show the impact of uncertainty about the economic future, one that is lower than the Acres forecast, and another that is higher than the Acres forecast. The growth rates somewhat arbitrarily chosen for these scenarios are half the growth rate of the Acres forecast for the low scenario, and one-and-a-half times the growth rate of the Acres forecast for the high scenario. These growth rates and the resulting energy and peak load scenarios are presented in Table 6 below.

Annex 5 Table 4. Derivation of Equivalent Demand for Electricity in 2005 for All Utilities

	JDECO		HEPCO		SELCO		GEDCO	
	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS
Purchases from IEC	1,197,306	399,900	223,229	77,806	63,926	22,621	708,001	176,009
VAT on purchases from IEC (NIS)								43,259
Purchases from Gaza Power plant							499,319	174,662
Fuel cost for Gaza Power Plant (to Pet. Auth.)								
Total purchases	1,197,306	399,900	223,229	77,806	63,926	22,621	1,207,320	393,930
Average purchase cost from IEC (NIS/kWh)		0.334		0.349		0.354		0.310
Average cost of power from Gaza Power Plant (NIS/kWh)								0.350
Average cost of total purchases (NISW/kWh)		0.334		0.349		0.354		0.326
Technical losses[a]	179,596		33,484		9,589		181,098	
Total consumption[b]	1,017,710		189,745		54,337		1,026,222	
Billed consumption	866,025	497,484	186,334	88,538	49,044	22,009	896,397	369,461
Average billed rate (NIS/kWh)		0.574		0.475		0.449		0.412
Unbilled consumption[c]	151,685		3,411		5,292		129,825	
Collections (= Paid consumption)[d]	839,549	482,275	131,063	62,276	28,320	12,709	587,398	242,103
Uncollected billed consumption[e]	26,476		55,271		20,724		308,999	
Total Unpaid consumption[f]	178,162		58,682		26,017		438,824	
Proportion of Total consumption that is unpaid	0.18		0.31		0.48		0.43	
Total Equivalent Demand at point of consumption[g]	**964,262**		**172,140**		**46,532**		**894,575**	
Annual growth in equivalent demand	13.3%		13.3%		13.3%		11.1%	
Ratio Total Equivalent Demand to Total Consumption	0.95		0.91		0.86		0.87	

Note a: Assume equals 15% of total bulk supply

Note b: Equals Total Bulk Supply less Technical losses

Note c: Equals Total consumption less Billed consumption

Note d: kWh value computed from NIS value and average billed rate

Note e: Equals Billed consumption less Collections

Note f: Equals Unbilled consumption plus Uncollected billed consumption

Note g: Assumes price elasticity of demand of –0.3 at billed rate and linear demand curve around the billed rate

Source: Derived from data provided through PEA

Annex 5 Table 5. Derivation of Equivalent Demand for Electricity for JDECO 1999 - 2005

	1999		2000		2001		2002		2003		2004		2005	
	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS
Power purchases from IEC	777,000	178,536	869,000	222,515	876,000	213,710	802,000	216,667	1,038,625	267,266	1,024,346	327,969	1,197,306	399,900
Average purchase cost (NIS/kWh)		0.230		0.256		0.244		0.270		0.257		0.320		0.334
Technical losses[a]	116,550		130,350		131,400		120,300		155,794		153,652		179,596	
Total consumption[b]	660,450		738,650		744,600		681,700		882,831		870,694		1,017,710	
Billed consumption	682,000	209,606	728,000	280,333	708,000	269,262	650,000	260,000	870,056	345,072	822,765	408,890	866,025	497,484
Average billed rate (NIS/kWh)		0.307		0.385		0.380		0.400		0.397		0.497		0.574
Unbilled consumption[c]	-21,550		10,650		36,600		31,700		12,775		47,929		151,685	
Collections (= Paid consumption)[d]	613,684	188,610	655,076	252,252	617,272	234,757	607,698	243,079	867,294	343,977	768,657	382,000	839,549	482,275
Uncollected billed consumption[e]	68,316		72,924		90,728	252252	42,303	234757	2,762		54,108		26,476	
Total Unpaid consumption[f]	46,766		83,574		127,328		74,003		15,537		102,038		178,162	
Proportion of Total consumption that is unpaid	0.07		0.11		0.17		0.11		0.02		0.12		0.18	
Total Equivalent Demand at point of consumption[g]	**646,420**		**713,578**		**706,402**		**659,499**		**878,170**		**840,083**		**964,262**	
Annual growth in equivalent demand											-4.3%		14.8%	
Ratio Total Equivalent Demand to Total Consumption	0.98		0.97		0.95		0.97		0.99		0.96		0.95	

Note a: Assume equals 15% of total bulk supply

Note b: Equals Total Bulk Supply less Technical losses

Note c: Equals Total consumption less Billed consumption

Note d: kWh value computed from NIS value and average billed rate

Note e: Equals Billed consumption less Collections

Note f: Equals Unbilled consumption plus Uncollected billed consumption

Note g: Assumes price elasticity of demand of –0.3 at billed rate and linear demand curve around the billed rate

Source: Derived from data provided through PEA

Annex 5 Table 6. Derivation of Equivalent Demand for Electricity for GEDCO 1999-2005

	1999		2000		2001		2002		2003		2004		2005	
	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS	MWh	thou.NIS
Purchases from IEC	668,873	167,253	752,288	187,349	728,094	187,572	728,835	180,692	672,848	182,515	669,161	182,526	708,001	176,009
VAT on purchases from IEC (NIS)		37,278		31,919		31,696		38,576		36,753		36,742		43,259
Purchases from Gaza Power plant							106,556	35,880	337,066	111,733	404,502	127,256	499,319	174,662
Fuel cost for Gaza Power Plant (to Pet. Auth.)														
Total purchases	668,873	204,531	752,288	219,268	728,094	219,268	835,391	255,148	1,009,914	331,002	1,073,663	346,525	1,207,320	393,930
Average purchase cost from IEC (NIS/kWh)		0.306		0.291		0.311		0.301		0.326		0.328		0.310
Average cost of power from Gaza Power Plant (NIS/kWh)								0.337		0.331		0.315		0.350
Average cost of total purchases (NISW/kWh)		0.306		0.291		0.301		0.305		0.328		0.323		0.326
Technical losses[a]	100,331		112,843		109,214		125,309		151,487		161,049		181,098	
Total consumption[b]	568,542		639,445		618,880		710,082		858,427		912,614		1,026,222	
Billed consumption	650,779	264,458	582,561	243,307	590,123	254,092	612,840	275,995	734,633	310,916	796,726	322,245	896,397	369,461
Average billed rate (NIS/kWh)		0.406		0.418		0.431		0.450		0.423		0.404		0.412
Unbilled consumption[c]	-82,237		56,884		28,757		97,242		123,794		115,888		129,825	
Collections (= Paid consumption)[d]	497,392	202,126	519,815	217,102	396,463	170,707	349,424	157,365	517,617	219,069	551,564	223,087	587,398	242,103
Uncollected billed consumption[e]	153,386		62,745		193,660		263,416		217,016		245,161		308,999	
Total Unpaid consumption[f]	71,150		119,630		222,417		360,658		340,810		361,050		438,824	
Proportion of Total consumption that is unpaid	0.13		0.19		0.36		0.51		0.40		0.40		0.43	
Total Equivalent Demand at point of consumption[g]	**547,197**		**603,556**		**552,155**		**601,885**		**756,184**		**804,299**		**894,575**	
Annual growth in equivalent demand			10.3%		-8.5%		9.0%		25.6%		6.4%		11.2%	
Ratio Total Equivalent Demand to Total Consumption	0.96		0.94		0.89		0.85		0.88		0.88		0.87	

Note a: Assume equals 15% of total bulk supply

Note b: Equals Total Bulk Supply less Technical losses

Note c: Equals Total consumption less Billed consumption

Note d: kWh value computed from NIS value and average billed rate

Note e: Equals Billed consumption less Collections

Note f: Equals Unbilled consumption plus Uncollected billed consumption

Note g: Assumes price elasticity of demand of –0.3 at billed rate and linear demand curve around the billed rate

Annex 5 Table 7. Power Demand Scenarios for West Bank and Gaza 2005-2025

Scenario	2005	2010	2015	2020	2025	2005	2010	2015	2020	2025
	West Bank					Gaza				
Low Scenario						**Low Scenario**				
5-year average annual growth rate:										
-for energy		3.15%	2.40%	2.30%	2.30%	8.00%	3.55%	2.85%	2.70%	2.70%
-for peak load		2.25%	1.75%	2.30%	2.30%	-	2.75%	2.10%	2.70%	2.70%
Energy (GWh)	2,090	2,441	2,748	3,079	3,449	1,087	1,294	1,489	1,702	1,944
Peak load (MW)	438	490	534	598	670	239	273	303	346	396
Per capita energy demand (kWh/y)	783	786	772	765	757	734	685	660	654	648
Central Scenario						**Central Scenario**				
5-year average annual growth rate										
-for energy		6.30%	4.80%	4.60%	4.60%	8.00%	7.10%	5.70%	5.40%	5.40%
-for peak load		4.50%	3.50%	4.60%	4.60%	-	5.50%	4.20%	5.40%	5.40%
Energy (GWh)	2,090	2,837	3,586	4,490	5,623	1,087	1,532	2,021	2,629	3,419
Peak load (MW)	438	546	648	812	1,016	239	312	383	498	648
Per capita energy demand (kWh/y)	783	914	1,008	1,115	1,234	734	811	896	1,010	1,139
High Scenario						**High Scenario**				
5-year average annual growth rate:										
-for energy		9.45%	7.20%	6.90%	6.90%	8.00%	10.65%	8.55%	8.10%	8.10%
-for peak load		6.75%	6.25%	6.90%	6.90%	-	8.25%	6.30%	8.10%	8.10%
Energy (GWh)	2,090	3,283	4,647	6,488	9,057	1,087	1,803	2,717	4,011	5,921
Peak load (MW)	438	607	822	1,148	1,602	239	355	481	711	1,049
Per capita energy demand (kWh/y)	783	1,057	1,306	1,611	1,988	734	954	1,205	1,542	1,973
Annual Load factor	52%	56%	60%	60%	60%	52%	56%	60%	60%	60%
Population forecast	2,531,150	3,104,171	3,558,743	4,026,391	4,555,492	1,481,050	1,889,479	2,255,056	2,601,562	3,001,311

Note a: These scenarios adopt the base year (2005) total bulk power requirement based on the estimates of effective demand.

Note b: These scenarios use Acres projected values of annual load factors for 2005 to derive peak loads from the estimated demand for energy.

Note c: These scenarios use Acres projected populations of the West Bank and Gaza.

Source: World Bank estimates, and Acres International: *Feasibility Study for Electric Transmission & Distribution – West Bank and Gaza. Technical Feasibility Report. Volume 1 – Load Forecast". November, 2005*

Annex 6. Power Network Investment Needs in West Bank and Gaza

This compilation of investment needs for the power networks of West Bank and Gaza has been prepared under the auspices of the PEA.

West Bank - Urgent network needs (1-2years)

- **Assistance for operation and maintenance of the networks.** The existing *intifada* together with the resulting economic situation and lack of capital has affected the maintenance of the power system. The quality of supply to the end consumer is deteriorating due to the lack of maintenance. Immediate assistance is needed to supply the equipment and to cover part of the costs of operating and maintaining the power networks. The assistance is needed for 2 years.
- **Installation of prepaid meters and automatic meter reading systems.** Modern prepaid meters are needed to increase the collection of revenues by the utilities. The PEA is in the process of installing in all West Bank regions about 30,000 meters donated by the governments of Norway and Sweden. An additional 80,000-100,000 meters are needed in the next 2 years. This is in addition to Automatic Meters Reading systems (AMR).
- **Development of the distribution system in the northern area.** Investments are needed to develop a distribution system (at medium voltage 33kV, 22kV) in the northern area of the West Bank to transfer power from the planned 161/33/22kV substations to the load centers in the north (to the districts of: Nablus, Qalqilya, Jenin, Tulkarm, Salfeet and Tubas). This will connect these districts in an integrated distribution system, which will be operated and maintained under the new power utility (NEDCO). This system will remove the overloading of the existing feeders and will be capable of handling emergency situations. The implementation of this project will have a positive impact on the northern network, such as by reducing the overloading of existing feeders and the LV network, increasing the quality of supply, reducing technical losses, increasing reliability, and reducing outages.
- **Development of new bulk 161/33/22kV supply substations in the northern area.** Investments are needed to install a transmission system (high voltage) in the northern area of the West Bank to transfer supply from the existing 161kV substations controlled by IEC to new Palestinian HV substations. The concept is to replace all the existing scattered connection points by two substations located near Nablus and Jenin. These substations will supply the load by the proposed 33kV distribution system mentioned above. Each substation will start with a capacity of 90MVA and be fed from IEC's 161kV line as a first phase. IEC has given an assurance that the existing 161kV lines can feed this load without the need to reinforce these lines. Another advantage of this investment is that the purchase tariff from IEC will be reduced by about 10%-12% by shifting from MV to HV supply.

.**West Bank - Medium term needs (3-4 years)**

- **Development of new bulk 161/33kV supply substations in the central area and reconfiguration of the distribution system.** The distribution system in the central area (i.e. the area under the concession of JDECO) is an integrated system and has been well rehabilitated under the recently completed World Bank ESIMP project. The system needs to increase the available supply from IEC by constructing in the first phase two 161/33kV substations of 90MVA capacity each. One substation will be located near Ramallah to

cover most of the Ramallah district load, and the other will be located near Jerusalem to cover most of the Jerusalem load. These two substations will replace the existing connection points, and they will supply the load on the existing distribution system with some needed modification in terms of connection to these substations. Also, as discussed above, this investment will also be to reduce the purchase tariff paid to IEC.

- **Development of distribution in the southern area.** The distribution system in the south has the same problems as the northern distribution system, i.e. no integration, high technical losses, and feeders that are overloaded and controlled by IEC. Similar to the proposed northern system, the development of the distribution system is needed by adding new feeders that are capable of carrying the power to the load centers even under emergency conditions. This integrated network system will be operated and maintained by the existing utilities SELCO and HEPCO and by southern villages. The implementation of this investment will have a positive impact on the network in the south similar to the one in the north (see above).
- **Development of new bulk 161/33kV supply substation in the southern area.** Investment is needed to implement a transmission system (high voltage) in the southern area of West Bank to transfer supply from the existing 161kV substation controlled by IEC and located near Hebron to a new Palestinian HV substation to be located also near Hebron. The concept is to replace all the existing scattered connection points by this substation which will supply the load by the proposed 33kV distribution system mentioned above. The substation will start with a capacity of 90MVA and be fed from the IEC 161kV line as a first phase. The IEC given an assurance that the existing 161kV lines can feed this load without the need for reinforcement of these lines. Another advantage of this investment is that the purchase tariff from IEC will be reduced by about 10%-12% by shifting from MV to HV supply.

West Bank - Long term needs (5-7 years)

Recently Palestine became an observer in the seven countries interconnection project (Jordan, Egypt, Iraq, Libya, Lebanon, Syria and Turkey) and will be a full member soon. This membership will open the way for Palestine to benefit from the interconnection with Jordan and Egypt, and to diversity its supply from IEC. The need for the interconnection with Jordan will be determined after finalizing the ongoing technical study scheduled to be completed within a year that will determine the size and voltage of the available supply in Jordan to be transferred to Palestine and the timeframe for implementing this project. The PEA expects to move this project from the long term (5-7) years to the medium term (3-4 years). The cost of the project will be determined by the interconnection technical study.

The interconnection with Jordan will reinforce the need for new bulk supply HV substations (under the urgent and medium terms above) interconnected by a new transmission line (voltage level to be determined) that will extend from the Jenin substation in the northern area of the West Bank to the Hebron substation in the southern area of the West Bank. The Jordan interconnection would be connected to these substations and provide power to the load centers.

Due to the expected demand within 4-7 years in the districts of Tulkarm and Qalqilya, a third HV substation (90MVA capacity) will be needed in the north to be located between these two districts. The introduction of this third substation will remove overloading that would occur under the expected demand in these districts. This third substation will be fed from the Palestinian HV line that crosses the West Bank from north to south. The same situation applies for a third HV substation in JDECO's service area (near Bethlehem). Otherwise, the distribution system will not be capable of serving the demand of this district without lowering the quality of supply and overloading the system.

In addition, the capacity of the substations at Nablus, Jenin, Ramallah, Jerusalem and Hebron will need to be increased to satisfy the growing demand within 4-7 years, by adding one 45MVA transformer with the associated switchgear.

The investment needs for the West Bank are estimated to total US$ 210.8 million as shown in Table 1 below. The breakdown is shown between urgent needs, medium needs and long term needs. The financing for this investment has not been mobilized.

Network investment needs in Gaza

Gaza - Urgent networks needs (1-2 years)

- **Assistance for operation and maintenance of the networks.** The situation in the West Bank also applies to Gaza under GEDCO's operation and maintenance of the network. Immediate assistance is needed to supply equipment and to cover part of GEDCO's operating costs. This assistance is required for 2 years. It should be noted that the quality of supply to the end consumer is deteriorating due to lack of maintenance to the network.
- **Installation of prepaid meters and automatic meters reading systems.** GEDCO's collection rate is the lowest of all the utilities in West Bank and Gaza. In order to increase GEDCO's collection and revenue, modern prepaid meters are needed. The PEA is in the process of installing about 10,000 meters on GEDCO's network. They are donated by the governments of Norway and Sweden. This number needs to be extended in the next 2 years by 30,000 to 40,000 meters. This is in addition to AMR systems.
- **Development of GEDCO's distribution system.** The major problem in Gaza is the lack of power supply, especially after the destruction of part of GPP. In order to solve this problem, immediate actions are to be taken by reconfiguring the distribution system and adding new feeders, especially in the northern and southern areas of Gaza. In the meantime, three new distribution feeders from IEC are proposed in the south to increase the available supply for this area by 20MW. These new feeders will be in place in the coming four months in order to overcome the shortage of power in the South of Gaza strip.
- **Additional step-up and step-down transformers at the Gaza Power Plant, development of SCADA and second phase rehabilitation of GPP.** GPP mostly supplies the surrounding areas in Gaza City with about 65MVA. Before the 2007 summer peak, new transformers will be added in the GPP substation to reduce power outages. Two step-up transformers and one step-down transformer are needed to meet the summer peak load. This is a temporary measure until the complete restoration of the power plant that will take at least 1 to 1.5 years. The distribution system lacks automatic controls to assist the control of the system during outages and scheduled load shedding. To fix this problem, GEDCO will need to install a mini SCADA system. Concerning the second and final rehabilitation phase of the GPP, additional transformers and switchgear will be required.

Gaza - Medium term needs (3-4 years)

- **Development of bulk HV supply substations and completion of 66kV transmission lines.** Based on various demand scenarios until 2020, a study recently completed by the firm Norconsult has concluded that building a 66kV transmission network in the Gaza Strip (instead of 220kV) will be cost effective. The PEA has secured financing from the Islamic Bank to construct the 220/66/22kV Gaza South Substation and the 66kV line (28km) from the Gaza South Substation to GPP Substation, as well as the interconnection line between the South Substation in Gaza and the border with Egypt. The second 66kV

line that extends from the GPP substation to the Gaza North Substation is financed by the Government of Sweden and is on hold for the time being due to the present security and right of way problems. The Gaza North substation is part of the Swedish project, but a major part of the substation has been destroyed by repeated Israeli incursions into Gaza. This substation has to be repaired as soon as possible, as it will be the link between the Palestinian transmission system and the Israeli 161kV system.

- **Interconnection with IEC and Egypt.** Gaza will be connected to Egypt via the Gaza South substation. Initially, the power transfer from Egypt is expected to be 150MW. Only 4 to7 km of 220kV HV lines will be constructed inside Gaza to connect with the line from Egypt. The section of the 220kV interconnection line inside Egypt is 50km and will be constructed and financed by the Egyptian side. The 161kV interconnection line that connects the Israeli and the Palestinian systems (via the Gaza North Substation) will be ready and fully constructed within 4 months. The PA has paid the cost of this line in full. The repair of the Gaza North substation and the reconfiguration of the system in the north to be connected to this substation will be needed.

Gaza - Long term needs (5-7 years)

With regard to increasing the GPP capacity, it is expected that natural gas will be available at the power plant within 4 years, which will substantially reduce the cost of generating power. It is expected that the cost of generated power at the power plant will be cheaper than imported power from Egypt and Israel. It is expected that Gaza power demand could be supplied by the GPP and Egypt, in which case the available supply from Israel would be used as backup. However, more analysis and study will need to be carried out to define the best technical and economic options to supply the future demand in Gaza and the West Bank, taking into account the various interconnections from Egypt, Jordan and IEC as well as the possible capacity increase of the GPP to 560MW (assuming gas availability).

The investment needs for Gaza is estimated to be US$58.0 million as shown in the Table 2 below. The breakdown is shown between urgent and medium needs. Out of the US$58.0 million, US$39.0 million has been committed by financiers.

Annex 6 Table 1. Investment Needs in the West Bank Power Network

Project	Total Amount ($US million)	Years with amounts in US$ million						
		Urgent (1-2 yrs)		Medium term (3-4 yrs)		Long term (5-7 yrs)		
		1	2	3	4	5	6	7
Assistance for Operation and Maintenance of the Networks	16.00	8.00	8.00					
Installing Prepaid meters and automatic meters reading systems	7.00	3.50	3.50					
Development of Distribution System in the North area	20.00	10.00	10.00					
Development of new bulk 161/33/22 kV supply substations in the North area	24.00	12.00	12.00					
Rehabilitation and extension of distribution network	15	7.5	7.5					
Development of new bulk 161/33 kV supply substations in the central area & Reconfiguration of the distribution system	25.00			13.00	12.00			
Development of distribution in the South Area	11.00			6.00	5.00			
Development of new bulk 161/33 kV supply substations in the south area	9.80			6.00	3.80			
Interconnection with Jordan	tbc							
Development of Palestinian HV Lines from North to South in West Bank	68.00					24.00	22.00	22.00
Development of a third substation in the North (near Tulkarm/Qalqilya)	10.00					5.00	5.00	
Development of a third substation in JDECO (near Bethlehem)	10.00					5.00	5.00	
Increasing the capacity of the substations	10.00					5.00	5.00	
Total Investment Needs	**225.80**	**41.0**	**41.0**	**25.00**	**20.80**	**39.00**	**37.00**	**22.00**
		82.00		**45.80**		**98.00**		

Source: PEA

Annex 6 Table 2. Investment Needs in the Gaza Power Network

Project	Total Amount ($US million)	Years with amounts in US$ million						
		Urgent (1-2 yrs)		Medium term (3-4 yrs)		Long term (5-7 yrs)		
		1	2	3	4	5	6	7
Assistance for Operation and Maintenance of the Networks	4.00	2.00	2.00					
Installing Prepaid meters and automatic meters reading systems	3.00	1.50	1.50					
Development of GEDCO distribution system	1.60	1.60						
Additional Step up and Step down Transformers at GPP	1.65	1.65						
Rehabilitation and extension of distribution network	10	5	5					
Development of SCADA	1.00			1.00				
Rehabilitation of GPP, second phase	6.50			6.50				
Development of bulk HV supplies substations and completion of 66kV transmission lines	32.50			32.50				
Interconnection with Egypt								
Interconnection with IEC	8.00			8.00				
Total Investment Needs	**68.25**	**11.75**	**8.50**	**48.00**	**tbc**	**tbc**	**tbc**	**tbc**
Secured Finance	**39.00**	**0**		**39.00**				
Needed Finance	**29.25**	**20.25**		**9.00**				

Source: PEA

Annex 7. Developments in the Israeli Electricity Market

This Annex draws on two of Eco-Energy's background papers for this Review: (a) "Electricity and oil products in Israel & supplies to the Palestinian Authority". Eco-Energy M.S. (2001) Ltd., January 3, 2007 and (b) "Options for energy supply to the Palestinian Authority and the Israeli Dimension". Eco-Energy M.S. (2001) Ltd., February 6, 2007.

Consumption and supply of electricity in Israel

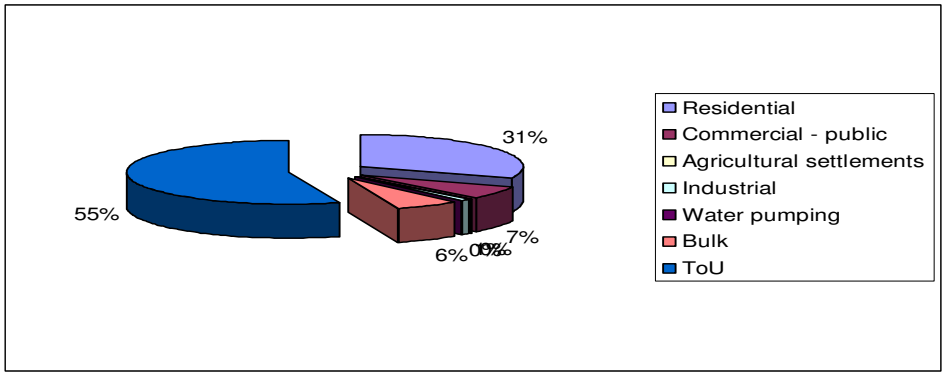
As of December 2006, Israel's installed power generation capacity was about 11,000MW in 55 generating stations ranging from large coal units to small jet and diesel-fueled turbines. The two largest stations, Orot Rabin (Hadera) and Rutenberg (Ashkelon), are coal-fired plants with a total installed capacity of 4,840MW. These units produce about 75% of total electricity generation. Most of the remaining capacity consists of steam and combined cycle units, many of which were heavy fuel oil- or gasoil-fired units that are gradually being converted to natural gas (pending the construction of the natural gas infrastructure). These plants would maintain dual-fuel capability to operate on liquid fuels as required.

The Israel Public Utilities Authority – Electricity (PUA) is the independent regulator responsible for issuing licenses to market participants, setting tariffs and service standards, and resolving customer complaints against IEC. The PUA sets electricity tariffs based on IEC's costs of service, with disallowance of costs considered excessive or unnecessary for providing those services. To the extent possible, marginal costs are used as a basis for setting the generation cost component of retail tariffs. The tariff also includes allowed returns on equity for the generation, transmission, and distribution sectors that reflect the relative riskiness of each sector. Moreover, in accordance with the Electricity Law, the PUA is prohibited from setting tariffs that deliberately create cross subsidies among rate classes.

The tariff system consists of the following four groups of electricity rates:

1. Interconnection tariffs for connection to the transmission and distribution system by generators, suppliers and consumers.
2. Electricity usage tariffs for customers consuming electricity at various transmission and distribution voltages.
3. Network service tariffs for transporting electricity over the transmission and distribution system.
4. Production tariffs paid by the transmission license holder (currently IEC) to independent power producers for electricity generation sold to that transmission license holder.

Annex 7 Figure 1. Distribution of IEC's Electricity Sales in 2005 by Customer Type.



Source: IEC 2005 Statistical Report

The PUA accounts for electricity demand's significant intraday and seasonal variation, and the need to meet this demand instantaneously, by designing Time-of-Use (ToU) rates that provide economic signals for this variation. These ToU rates reflect the direct costs of meeting load at marginal cost over all given year. For ratemaking purposes, the PUA then divides these hours into nine electricity consumption time blocks, each of which has similar marginal cost characteristics. Currently, ToU customers comprise approximately half of IEC's revenues and 55% of all electricity consumption as shown in Figure 1 above.

Tables 1 and 2 below show the current base tariffs and the ToU tariffs at the low-voltage distribution level.

Annex 7 Table 1. IEC's Base Tariffs as of December 1, 2006

(US$ per kWh billed)

Residential	General	Street Lighting	Bulk – low voltage distribution	Bulk – high voltage distribution
9.69	10.97	7.56	9.08	7.66

(NIS4.3 =US$1)
Source: PUA.

The PUA has been advocating a tight consistency between tariffs and policies governing IEC's distribution sector and those governing JDECO, with the possible exceptions of the mandatory ToU programme for IEC customers, and the need to address substantial energy losses on JDECO's distribution system due to difficult meter access, theft, and grid quality. These losses, and their reflection in infrastructure usage charges that are nearly 30% higher than those included in IEC rates, explain the slightly higher overall tariff paid by JDECO customers relative to IEC customers.

Annex 7 Table 2. IEC's Time-of-Use Tariffs as of December 1, 2006

(US$ cents per kWh)

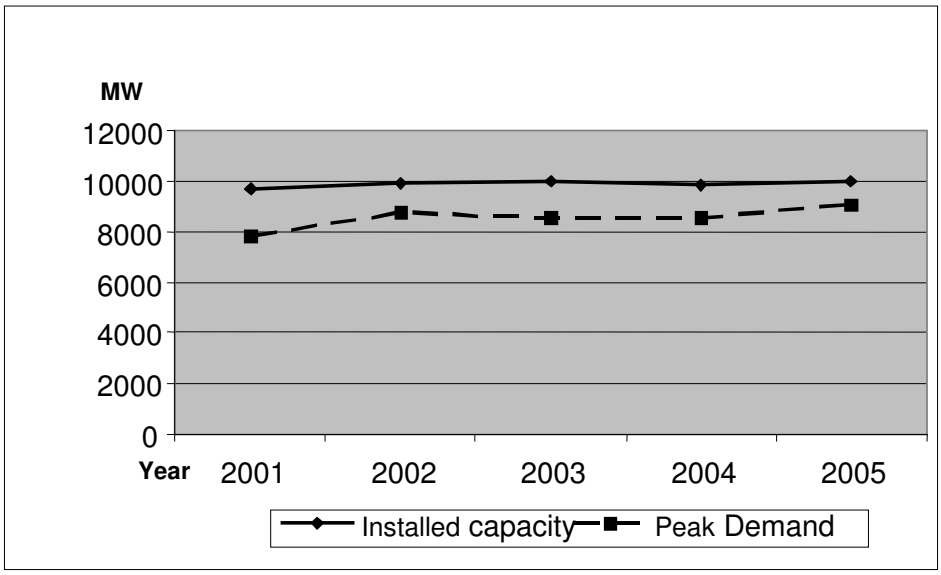
Season	ToU block	Low voltage distribution		Medium voltage distribution		ToU tariff for Transmission Customers**
		ToU tariff*	ToU for centralized sales	ToU tariff*	ToU for centralized sales	
Winter	Off-peak	4.00	3.07	2.56	2.35	2.04
	Shoulder	9.79	8.77	8.05	7.77	7.37
	Peak	17.3	16.13	14.81	14.35	13.57
Transition	Off-peak	4.07	3.14	2.63	2.42	2.12
	Shoulder	8.46	7.48	6.86	6.62	6.27
	Peak	13.44	12.38	11.62	11.32	10.91
Summer	Off-peak	4.25	3.32	2.79	2.57	2.25
	Shoulder	11.49	10.43	9.5	9.15	8.59
	Peak	18.72	17.53	15.9	15.33	14.31

(NIS4.3 = US$1)
* Excluding customers providing centralized sales. Centralized-sales customers distribute and supply electricity to others under historical agreements with Israel Electric Corporation. Moreover, since they take service at the transformers and own the distribution lines originating from the transformers, their tariff is

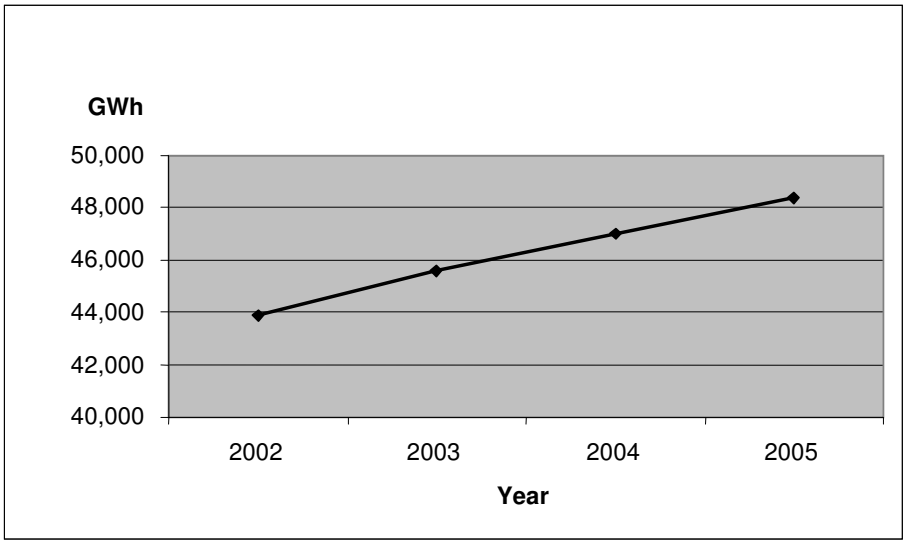
lower than that for IEC customers taking service at the same voltage levels. (Source: PUA Decision #145 and conversation with PUA staff).
** ToU tariff for customers served at high transmission voltage levels
Source: PUA

Since 2002, Israel's peak power load has grown by nearly 300MW, while generating capacity has increased by about 1,000MW, thus maintaining a reserve margin of 15% to 20%. The current forecast of capacity shortages by 2009 is an issue being addressed by the Government of Israel and IEC, both in terms of demand-side and supply-side solutions. Figures 2, 3 and 4 below present information about the installed electricity capacity, generation and consumption in Israel during the past several years (source – CBSI):

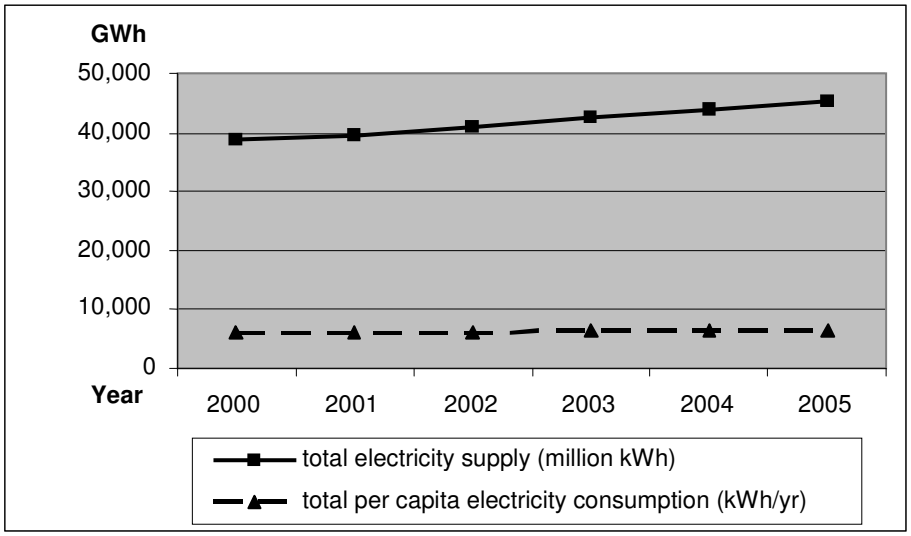
Annex 7 Figure 2. Israel's Power Generating Capacity and Peak Demand 2002-2005



Annex 7 Figure 3. Israel's Electricity Production 2002 - 2005



Annex 7 Figure 4. Israel's Electricity Consumption 2002 - 2005



Source: Israel Central Bureau of Statistics

IEC is the primary supplier of electricity to the PA. In 2005 IEC supplied the PA with 1,667GWh (both West Bank and Gaza, excluding supplies to JDECO). Table 3 below shows the sales volumes between 2000 and 2005 based on Israeli data.

Annex 7 Table 3. Electricity Supplies to West Bank and Gaza 2001-2005

(GWh)

Year	IEC supply to West Bank* and Gaza	West Bank		Gaza		
		IEC supply to the West Bank	of which IEC supply to JDECO	Total supply	IEC supply to GEDCO	Gaza Power Plant
2001	2,275		876			
2002	2,271		884			
2003	2,509	1,836	1,039	1,010	673	337
2004	2,403	1,823	1,024	1,065	660	405
2005	2,708	2,000	1,041	1,207	708	499

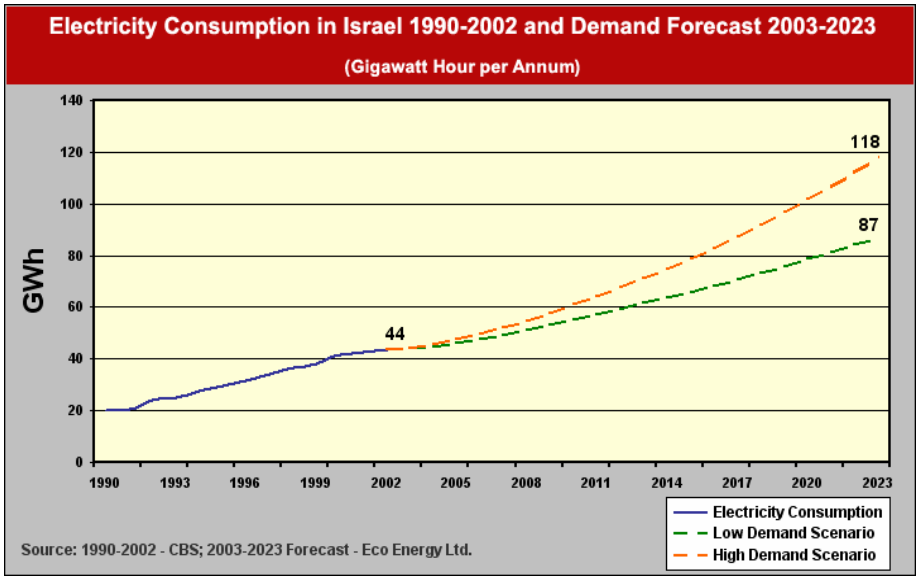
*including supply to JDECO that supplies both the neighbourhoods of East Jerusalem and the areas in the West Bank

Source: World Bank, IEC, Israel Central Bureau of Statistics

In 2005, 442 of 521 Palestinian towns and villages in West Bank and Gaza were connected to the grid, comprising 99.4% of the entire population. IEC supplied 215 of these 442 towns, with the Jerusalem District Electricity Company supplying an additional 165. The remaining towns were supplied by local authorities. The main feeders from Israel to West Bank consist of the 161kV – interconnections near Kalkilya, Ramallah and Hebron.

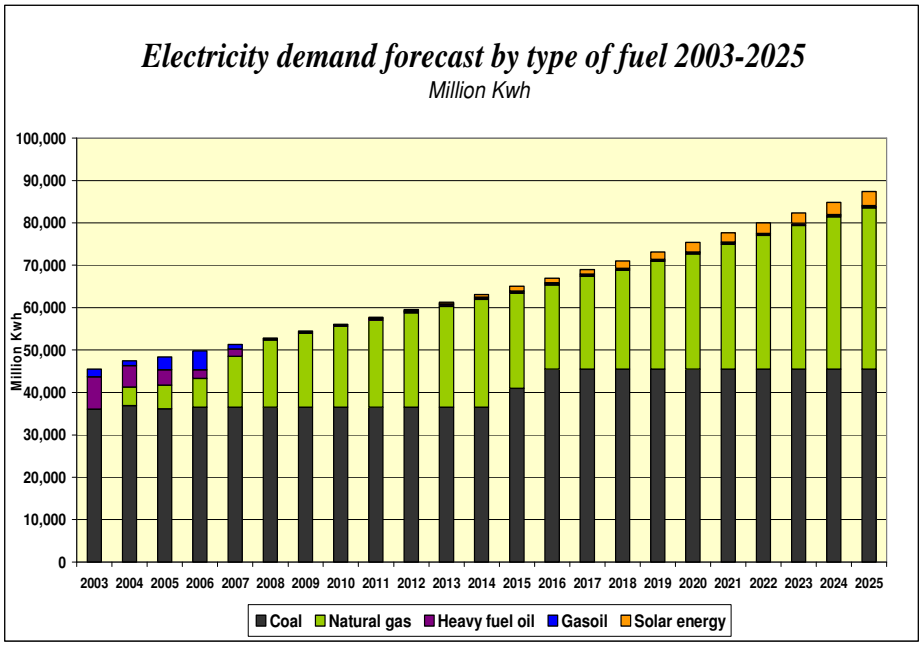
Electricity consumption in Israel has more than doubled during the past 15 years. It may double again in the next 20 years, although a threefold increase may occur under high demand scenario. Figure 5 below presents these two demand scenarios to the year 2023, Figure 6 illustrates how the fuel mix for power generation could develop under the lower forecast scenario, and Figure 7 shows the power development plan for 2006-2013 approved by the Government of Israel in 2001.

Annex 7 Figure 5. Forecast Electricity Consumption in Israel to 2023



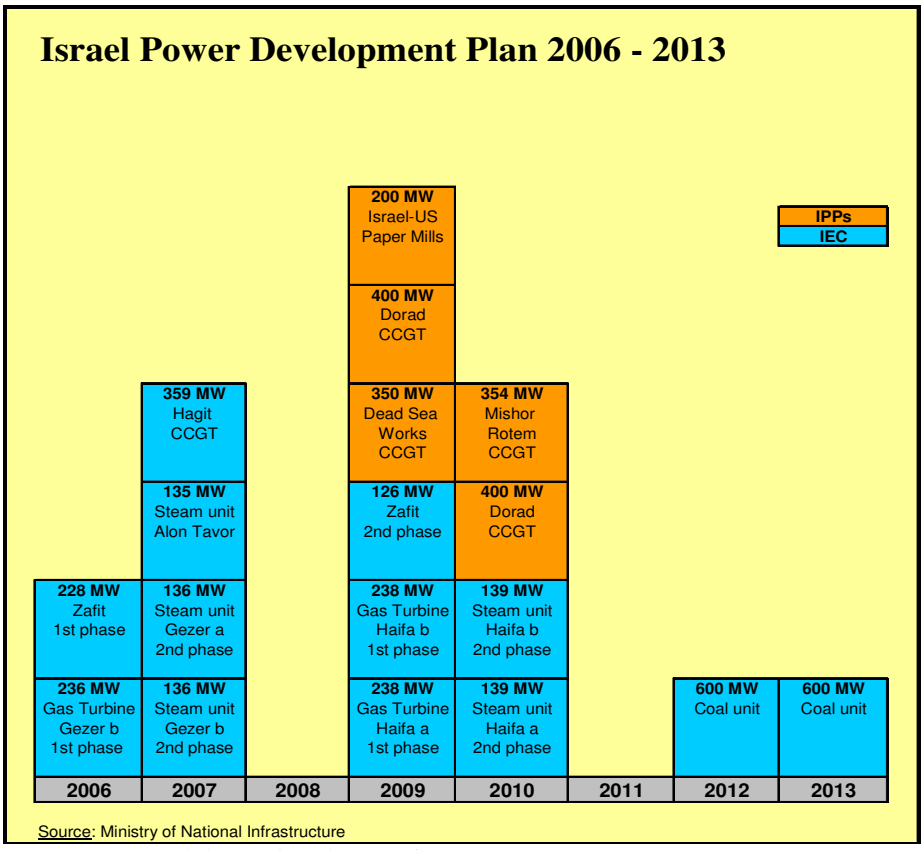
Source: Eco-Energy, Reference scenario

Annex 7 Figure 6. Forecast Electricity Generation in Israel by Type of Fuel



Source: Eco-Energy, Reference scenario

Annex 7 Figure 7. Israel Power Development Plan 2006-2013



Source. Israel Ministry of National Infrastructure

The latest power development plan of IEC was authorized by the Israeli government in 2001. According to this plan by 2010 IEC is planned to commission additional CCGTs in total capacity of 2249MW and 1,200MW of coal units in the next decade. In addition, initial license were granted by the PUA and MNI to prospective IPPs in a magnitude of 2000 to 2,700MW (the major ones are specified in the above chart and in the table below). At this stage it is not clear if and when the IPP plants will be constructed (the main obstacle is the price of natural gas that they are facing which is significantly higher than IEC's long term initial contract prices). Nevertheless it is more likely that several smaller plants by co-generators and self power producers will be constructed during the next several years (e.g. Ashdod refinery, Nesher, Hedera Paper Mills). In case where the major IPPs are not built it is likely that IEC will eventually develop this capacity.

Reform of the Israeli power market

According to the Electricity Law (2002 modification), Israel's electricity market should be reformed from an industry dominated by a government-owned vertically integrated monopoly, the Israel Electric Corporation (IEC), to an industry in which generators and suppliers trade electricity competitively and IEC is divided into separate generation, transmission, and distribution companies. The generation and distribution companies will be divided into smaller companies for future privatization. The interim restructuring plan calls for IEC to be restructured into a holding company with generation companies as subsidiaries by March 2007, and for the entire restructuring and privatization process to be completed by 2012.

The Government of Israel has set a goal for power production by independent power producers (IPP) to equal 20% of total generating produced. While current IPP capacity is far short of that target (about 40MW out of the 11,000MW installed capacity of IEC), nearly 1,100MW of IPP

capacity has received conditional licenses. The main issues for IPP development are the availability and pricing of natural gas, since nearly all of the larger plants to be developed by IPPs are combined-cycle gas turbine (CCGT) units, and the uncertainty about the timeframe of electricity sector.

The main points of the proposed reform to Israel's electricity sector are summarized herewith, as reflected in the Electricity Law and the relevant government resolutions. A large part of these resolutions have yet to be implemented due to opposition of the employees, the delay in entry of natural gas into Israel and the lack of sufficient resolve on the part of the government.

The Electricity Economy Law, 5757-1996 terminated the mandate concession of IEC, giving it instead a group of licenses which will remain consolidated for all sectors of the electricity economy, for a transition period of 10 years up to 2006. Recently the consolidated license was extended for another year (until March 2007).

The prevailing centralist structure of the electricity economy in which there is one dominant electricity company which has a monopoly over all the activity in the electricity economy is about to change in the coming years. The government is preparing for this through a series of government resolutions which are meant to encourage the entry of private electricity producers once natural gas enters as an additional energy source for the economy. Furthermore these resolutions are meant to create conditions which will facilitate the production of electricity from renewable energy and from co-generation.

The reform of the Israel electricity sector and the entry of natural gas into the Gaza would open for the PA a wide range of far-reaching possibilities in the electricity sphere, some of which are listed below:

a) To purchase electricity under competitive market terms from private power producers or from IEC or from electricity producing companies that will be separated from IEC.

b) To expand the power plant in Gaza, to convert it to natural gas and to export electricity under competitive market terms to electricity distribution companies in Israel or directly to large electricity consumers in Israel.

c) To transfer electricity from the Gaza region to consumers in the West Bank via the Israeli transmission network for a transmission tariff that can be supervised.

d) To erect power plants in the West Bank, fuelled by Egyptian gas (via Israel or Jordan), or Palestinian natural gas from the Gaza Marine field, or gas from other sources via Israel, some of which will be sold under competitive market terms to distribution companies in Israel or to large consumers in Israel.

e) Egyptian-Israeli-Jordanian-Palestinian (or some of these parties) cooperation in erecting a solar power plant or duel solar-natural gas based power plant. The plant can be erected in the area of Raffah or in the Sinai close to Raffah or in Jordan. The plant would supply electricity to Gaza, the West Bank and/or to Israel. A by-product of this type of project would be connection of the power grids of Egypt, Jordan, Gaza, the West Bank, and/or Israel.