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World Bank
MENA Energy Efficiency Project

Lessons for the MENA Region from Case Studies of Utility Delivery of Energy Efficiency

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FINAL VERSION
9 December 2014

The Regulatory Assistance Project
Beijing, China • Berlin, Germany • Brussels, Belgium • Montpelier, Vermont USA • New Delhi, India
www.raponline.org

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EXECUTIVE SUMMARY

This report, produced for a World Bank project on energy efficiency in the Middle East and North Africa (MENA) region, includes detailed case studies of policy and regulatory mechanisms implemented in six countries and regions to enable utilities to assist their customers to use electricity more efficiently. The case studies were selected to demonstrate the wide range of different approaches that have been adopted to enable utility delivery of end-use energy efficiency. The purpose of the report is to provide detailed examples of relevant policy and regulatory mechanisms that may, with suitable modification, be capable of effective implementation in the MENA region.

The six case studies in the report describe relevant policy and regulatory mechanisms in the following countries and regions: California; New South Wales, Australia; South Africa; China; India; and Brazil.

California

Utility delivery of energy efficiency commenced in California more than 30 years ago and is now the largest and oldest program of its kind in both the United States and the world. The long-term California experience in utility delivery of energy efficiency represents close to the maximum level of energy savings that can be achieved through this approach. The unique feature in California is the comprehensive set of policy and regulatory mechanisms that has been developed over many years through a unique collaborative process involving the two regulatory agencies and the California legislature. This collaboration is the key to California's achievements and is the main lesson to be learnt by other jurisdictions seeking to emulate the California results.

New South Wales, Australia

The New South Wales Energy Savings Scheme (ESS) and its predecessor together comprise the longest-running energy efficiency certificate scheme in the world. The schemes' combined experience of more than 10 years has enabled progressive revision and refinement of scheme parameters, including definitions of eligible energy efficiency measures, deemed energy savings values, methodologies for calculating the numbers of certificates that can be created, and scheme administrative procedures. These changes have established the ESS as an efficient and cost-effective mechanism for delivering energy savings.

The ESS has successfully demonstrated two unique policy and regulatory mechanisms that assist in the implementation of utility delivery of energy efficiency: trading of energy efficiency certificates and the accreditation of third parties to achieve energy savings. Together these two mechanisms have enabled the establish and development of an energy services industry in New South Wales and have contributed to a major increase in the quantities of energy savings being achieved in the state. Jurisdictions looking to establish a new energy services industry or expand and existing one can learn a great deal from the experience of the NSW Energy Savings Scheme.

South Africa

In South Africa, impacts on system reliability have been a powerful motivator in delivering capacity savings in the electricity system. In the years since the capacity crisis began, the major electricity utility, Eskom, has far exceeded the load reduction and energy savings targets set by the regulator, and in most years, exceeded its own expectations by a wide margin. After almost a decade without material investment in new supply, Eskom embarked upon an aggressive plan for price increases over time coupled with time-of-use pricing and inclining block rates that complemented efforts to promote energy efficiency and DSM initiatives.

In implementing utility delivery of energy efficiency, South Africa initially pursued pathways that included heavy reliance on third party providers of energy efficiency services. However, the ESCO model proved challenging for delivery, and most of the material energy savings achieved did not rely heavily on ESCOs. The achieved reductions in demand were mostly achieved through the mass market residential program initiatives targeting lighting and industrial programs delivered by Eskom.

China

China's grid company energy efficiency obligation is one of the latest examples worldwide that uses a government-imposed obligation to ensure that utilities assist their customers to use electricity efficiently. The implementation of the EEO in China has been particularly difficult because of the very large size of the grid companies, their ability to influence the political process, and their complete lack of any experience in delivering energy efficiency. Despite the reluctance by the grid companies to engage with end-use energy efficiency, in both 2012 and 2013, they achieved their EEO energy savings and demand reduction targets though, given the size of China, these results were not particularly ambitious. Jurisdictions looking to use a government-imposed EEO in situations where there is no prior experience with utility delivery of energy efficiency may learn useful lessons from the China case study.

India

India provides an example of close involvement by the central and state governments in the development of a policy and regulatory framework to enable utility delivery of end-use energy efficiency. The Government of India has established a solid foundation of sector reform and a framework for delivering DSM that has been decades in the making. The framework relies increasingly on electric distribution utilities, but also on the national government in the form of the Bureau of Energy Efficiency (BEE). Oversight of the electric utilities and the regulations that give form to the DSM activities are established by the state electricity regulatory authorities. However, the energy efficiency and DSM industry in India is still at an early stage. Most of the projects developed and implemented by the distribution utilities are pilot projects that provide a foundation of experience that reduces uncertainty in achieving energy savings through successive stages of program delivery.

Brazil

In Brazil, there is extensive involvement in energy efficiency and DSM by both the federal government and by the electricity industry regulator, ANEEL. The federal government has funded extensive energy efficiency programs through the majority state-owned national electricity utility, Eletrobras. The regulator has imposed a progressively more stringent energy efficiency obligation on electricity distribution utilities that has, in effect, created a public benefits charge. Brazil is one of only a few developing nations that have created such a charge. However, the target of only 10 percent cumulative energy savings by 2030 is a modest ambition for utility energy efficiency programs by international standards. In Brazil, there appears to be considerable opportunities for energy efficiency investments in buildings and industry and it should be possible for utility energy efficiency programs to achieve savings in excess of the target.

Conclusion

Energy utilities can play a key role in delivering end-use energy efficiency improvements. Governments turn to energy utilities to deliver energy efficiency for several reasons. Utilities have a strategic position in energy markets, often serving as an intermediary between energy producers and energy consumers. They are well positioned to overcome the key barriers - lack of awareness of the best energy efficiency measures, the “hassle factor” of procuring the measures, and perceived risks in relation to performance and cost – that prevent consumers from investing in energy efficiency.

The six case studies presented in this report were selected to share the experience of a wide range of countries and regions located on five different continents, and a range of economies reflecting a breadth somewhat similar to that found in the MENA region. The six countries and regions either rely on, or are in the formative stages of developing, energy efficiency programs that depend on utilities for funding and implementation. Countries and regions with the longest history of experience in utility delivery of energy efficiency have a record of success that typically continues to grow. Properly relied upon, utility energy efficiency programs can fit into a deeper framework of investments in new technologies that includes supporting initiatives, such as codes, standards, and energy performance labeling, to eventually achieve market transformation in which energy efficiency becomes the norm.

ABBREVIATIONS AND ACRONYMS

ACP	Accredited Certificate Provider (New South Wales Energy Savings Scheme)
ANEEL	Agência Nacional de Energia Elétrica or National Electricity Regulatory Agency (Brazil)
AUD	Australian dollar (currency unit)
BEE	Bureau of Energy Efficiency (India)
BLY	Bachat Lamp Yojana scheme (India)
BRIC	Brazil, Russia, India and China
BRL	Brazilian real (currency unit)
CCFL	Cold cathode fluorescent lamp
CDM	Clean Development Mechanism
CEC	California Energy Commission
CERC	Central Electricity Regulatory Commission (India)
CIM	Comitê Interministerial sobre Mudança do Clima or Inter-Ministerial Committee on Climate Change (Brazil)
CFL	Compact fluorescent lamp
CMH	Ceramic metal halide
CNPE	Energy Policy National Council (Brazil)
CNY	Chinese yuan or renminbi (currency unit)
CO_2-e	Carbon dioxide equivalent
CPP	Conventional power plant
CPUC	California Public Utilities Commission
Discom	Electricity distribution company (India)
DSM	Demand-side management
EAP	Energy Action Plan (California)
EEAP	New South Wales Energy Efficiency Action Plan
EEDSM	Energy efficiency demand-side management
EESL	Energy Efficiency Services Limited (India)
EEO	Energy efficiency obligation
EERS	Energy Efficiency Resource Standard
ELV	Extra-low voltage
EM&V	Evaluation, measurement and verification
ENE	Energy Planning Authority (Brazil)
EPC	Energy performance contract
EPP	Efficiency power plant
ESC	Energy Savings Certificate (New South Wales Energy Savings Scheme)
ESCO	Energy services company
ESPI	Energy Savings Performance Incentives (California)
ESS	Energy Savings Scheme (New South Wales)
FY	Financial year
GDP	Gross domestic product
GGAS	Greenhouse Gas Reduction Scheme (New South Wales)
GHG	Greenhouse gas
GW	Gigawatt
GWh	Gigawatt-hour

HVAC	Heating ventilation and air conditioning
INR	Indian rupee (currency unit)
IOU	Investor-owned utility
IPART	Independent Pricing and Regulatory Tribunal (New South Wales)
IPMVP	International Performance Measurement and Verification Protocol
IPP	Independent power producer
IRP	Integrated resource plan
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light-emitting diode
M&V	Monitoring and verification
ME&O	Marketing, education and outreach
MMA	Ministry of Mines and Energy (Brazil)
mtoe	Million tonnes of oil equivalent
MW	Megawatt
MYPD	Multi-year Price Determination (South Africa)
MWh	Megawatt-hour
NDRC	National Development and Reform Commission (China)
NEES	National Energy Efficiency Strategy (South Africa)
NERSA	National Energy Regulator of South Africa
NMEEE	National Mission for Enhanced Energy Efficiency (India)
NSW	New South Wales
NABERS	National Australian Built Environment Rating System
NGAC	New South Wales Greenhouse Abatement Certificate
PAT	Perform, Achieve & Trade (India)
PJ	Petajoule
PEE	Programa de Eficiência Energética or Energy Efficiency Program (Brazil)
POU	Publicly-owned utility
PROCEL	Programa Nacional de Conservação de Energia Elétrica or National Electrical Energy Conservation Program (Brazil)
R&D	Research and development
RESA	Recognised Energy Savings Activity (New South Wales Energy Savings Scheme)
RRIM	Risk/return incentive mechanism (California)
SERC	State Electricity Regulatory Commission (India)
tce	Ton of standard coal equivalent; by convention one tce equals 29.3076 gigajoules. China typically converts all its energy statistics into tce.
tCO_2-e	Tonnes of carbon dioxide equivalent
TES	Thermal energy storage
TRC	Total Resource Cost (cost-effectiveness test)
TWh	Terawatt-hour
USD	United States dollar (currency unit)
ZAR	South African rand (currency unit)

1. INTRODUCTION

Energy utilities will play a pivotal role over the coming decades in managing energy demand growth and reducing greenhouse gas (GHG) emissions. In 2012, the International Energy Agency projected, under its Efficient World Scenario, that the majority of the energy savings in the power sector over the period to 2035 would come from decreased electricity demand rather than from supply-side energy efficiency measures in the power sector (see Figure 1).

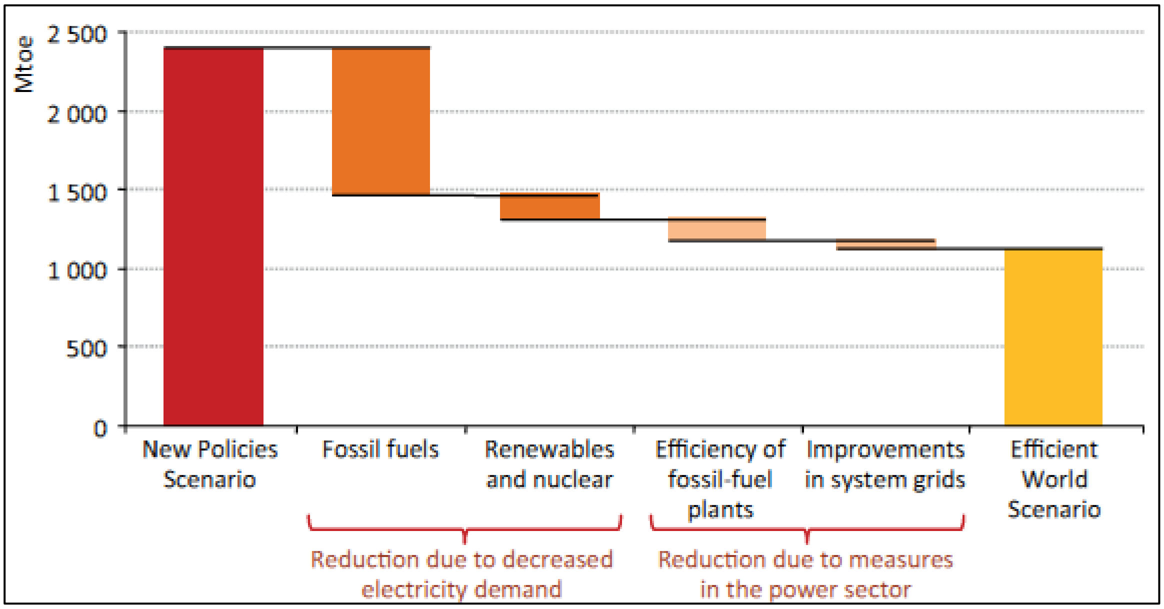

Figure 1. Projections of Energy Savings in Electricity Generation Over the Period to 2035[1]

In many countries, energy utilities play a central role in delivering end-use energy efficiency improvements. In 2012, electricity and gas utilities in the United States and Canada spent USD 8.0 billion on energy efficiency and demand-side management (DSM) programs, representing a nine percent increase over 2011 expenditures. These programs were estimated to have saved approximately 27,000 GWh of electricity and 425 million therms of gas in 2012, which represented 21 million metric tonnes of avoided CO2 emissions.[2] In the United Kingdom, annual spending by energy retailers under the Carbon Emissions Reduction Target (CERT) supplier obligation was about USD 1.6 billion in 2011, while the energy efficiency obligation placed on energy utilities in Italy accounted for over USD 260 million annually in 2010 and 2011.[3] Many other countries and regions including Belgium (Flanders), China, Denmark, France, Korea, Poland, and three Australian States have introduced energy efficiency obligations requiring energy utilities to achieve end-use energy savings.[4]

Governments turn to energy utilities to deliver energy efficiency for several reasons. Utilities have a strategic position in energy markets, often serving as an intermediary between energy producers and energy consumers. Energy utilities have long-standing commercial relationships with even the smallest end-use customers, allowing them to influence energy saving activities in

[1] International Energy Agency (2012).
[2] Consortium for Energy Efficiency (2014).
[3] Lees (2012).
[4] Crossley et al. (2012).

diffuse markets. Energy utilities have the technical capacity and infrastructure for delivering services, by virtue of offices and facilities in their area of operations or service territory. Energy utilities also enjoy name recognition by end-users, and are often viewed as impartial or objective sources of information and expertise. Energy utilities also possess detailed information on the consumption habits of energy consumers, a useful resource when providing energy savings advice. Finally, energy utilities produce very large revenue streams from selling energy which can be an alternative to public budgets as a source of energy efficiency funding.[5]

In short, energy utilities are well positioned to overcome the key barriers - lack of awareness of the best energy efficiency measures, the “hassle factor” of procuring the measures, and perceived risks in relation to performance and cost – that prevent consumers from investing in energy efficiency.

This report, produced for a World Bank project on energy efficiency in the Middle East and North Africa (MENA) region, includes detailed case studies of policy and regulatory mechanisms implemented in six countries and regions to enable utilities to assist their customers to use electricity more efficiently. The case studies were selected to demonstrate the wide range of different approaches that have been adopted to enable utility delivery of end-use energy efficiency. The purpose of the report is to provide detailed examples of relevant policy and regulatory mechanisms that may, with suitable modification, be capable of effective implementation in the MENA region.

5 Heffner et al. (2013).

2. CALIFORNIA UTILITY ENERGY EFFICIENCY PROGRAMS

2.1 Introduction

In North America, energy utilities began offering "energy conservation" programs during the energy crises in the 1970s to help customers cope with soaring energy prices. Over time, this led to the development of an expanded set of customer energy efficiency programs provided by energy utilities. Since then, in the United States, energy efficiency has become recognized as an integral and highly valuable element of utility investments and operations. Utility energy efficiency programs have yielded significant energy and economic benefits to both energy systems and energy customers. Today, energy efficiency is regarded as an important energy system resource that can also reduce greenhouse gas emissions, save money for customers, and generate jobs.[6]

In response to both economic concerns and climate change, legislators and regulators in North America are now supporting the acquisition by utilities of energy efficiency as a energy system resource at unprecedented levels. In the United States, electricity industry regulators are instituting Energy Efficiency Resource Standards (EERS) that establish specific, long-term targets for energy savings that utilities or non-utility program administrators must meet through implementing customer energy efficiency programs. Beginning in about 2007, the United States saw a substantial increase in the investments made by utilities in energy efficiency corresponding with the expanding commitments by states to an EERS. Utility investments in energy efficiency increased from USD 4.0 billion in 2008 to USD 7.2 billion by 2012.[7] By April 2014, 25 US states had enacted long-term (3+ years) EERSs. These 25 states make up nearly 60 percent of electricity sales in the United States. If each of these states maintains its current EERS target out to 2020, the overall savings would be more than 232,000 GWh by 2020, equivalent to over six percent of 2011 electricity sales throughout the United States.[8]

The main reasons that public authorities in North America encourage energy efficiency resource acquisition programs are to ensure least-cost resource development by energy utilities, reduce environmental damage from energy use, enhance energy supply security, and lower the bills of energy customers. The relative priority of these objectives varies across jurisdictions and these varying priorities shape how utility energy efficiency programs are developed and implemented in each jurisdiction.[9]

California has long been a leading US state in terms of utility-sector customer energy efficiency programs. Energy efficiency programs implemented by electricity utilities in California have been in operation since the mid-1970s and have grown and evolved substantially over four decades. During this period, per capita electricity consumption in California remained nearly flat, while per capita consumption in the rest of the United States increased by over 50 percent (see Figure 2). Although some of the difference between the Californian and national per capita consumption may be explained by factors that are independent of energy policy, such as changes in industry composition and average household size, a major contribution has been made by utility-delivered energy efficiency programs.

6 American Council for an Energy-Efficient Economy (2014a).
7 Consortium for Energy Efficiency (2014).
8 American Council for an Energy-Efficient Economy (2014b).
9 R. Taylor, Trombley, and Reinaud (2012).

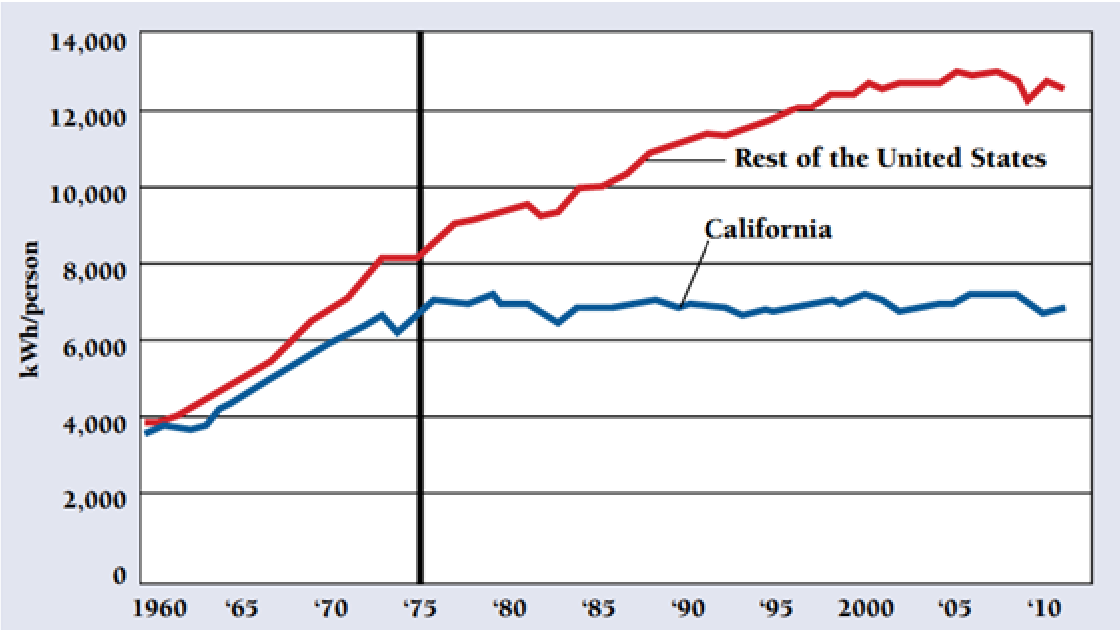

Figure 2. Per Capita Electricity Consumption in California and the Rest of the United States[10]

Figure 3 shows the annual electricity savings from energy efficiency programs implemented since 1976 in California by investor-owned utilities (IOUs) and publicly owned utilities (POUs). Note that in Figure 3, comprehensive POU data is only available from 2006 but POUs have been implementing energy efficiency programs for decades.

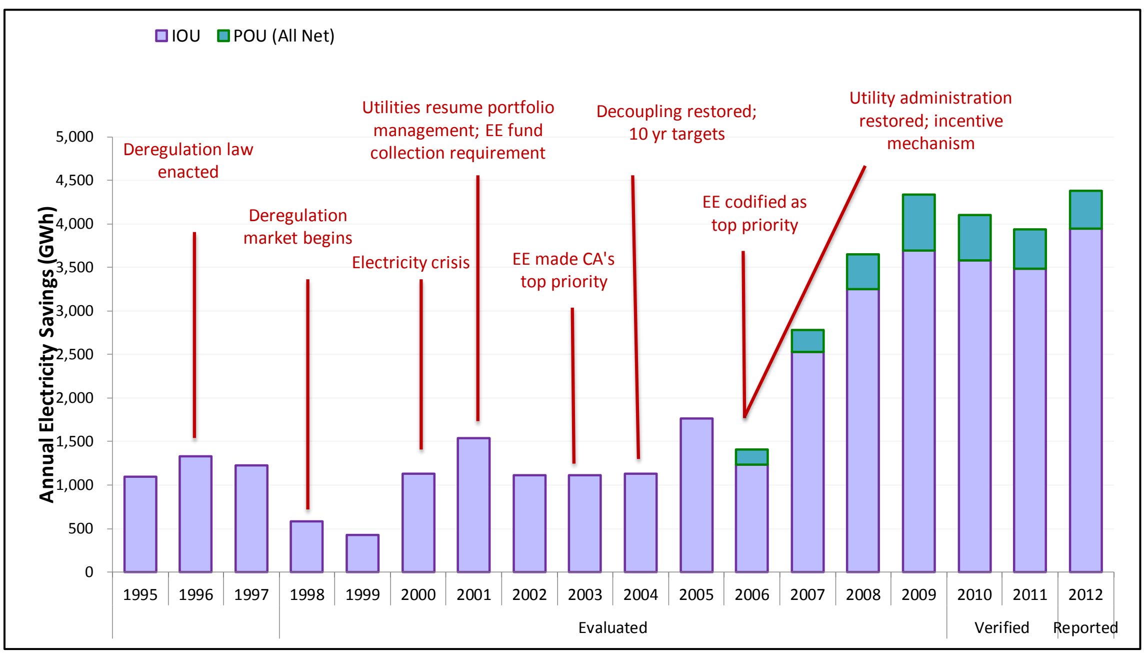

Figure 3. Annual Electricity Savings from California Utility Energy Efficiency Programs, 1995 to 2012[11]

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10 Martinez (2013a).

There are four IOUs in California – Pacific Gas and Electric Company, Southern California Edison Company, San Diego Gas & Electric Company, and Southern California Gas Company. These IOUs administer energy efficiency programs with oversight by the California Public Utilities Commission (CPUC) which establishes key policies and guidelines, establishes targets for statewide annual energy efficiency savings and demand reduction, sets program goals, and approves spending levels. California's approximately 40 POUs, including municipal utilities, electric cooperatives and irrigation districts, also administer customer energy efficiency programs with similar oversight by the California Energy Commission (CEC).[12]

2.2 Policy Objectives

California has established energy efficiency as its highest priority energy resource for procurement of new resources. In 2003, the CPUC, in collaboration with the CEC and the Consumer Power and Conservation Financing Authority (no longer in existence) issued the first Energy Action Plan (EAP),[13] comprising a high-level, coherent approach to meeting California's energy and natural gas needs.[14] The EAP is a "living" document, and there have been two subsequent plans issued since 2003.

The initial EAP established a "loading order"[15] to define future efforts to meet California's energy needs. The loading order stipulated that the state would acquire first all cost-effective efficiency resources, then cost-effective demand response, then use cost-effective renewable resources, and only after that, use the more efficient conventional energy sources to meet new load.[16] The loading order puts energy efficiency first because it is by definition the lowest-cost, environmentally preferred resource.[17]

In September 2008, the CPUC published the California *Long Term Energy Efficiency Strategic Plan*.[18] The Plan was developed through a collaborative process involving the CPUC's four regulated IOUs and over 500 individuals and organizations. The Plan establishes a roadmap for energy efficiency in California through the year 2020 and beyond. It articulates a long-term vision and goals for each economic sector and identifies specific near-term, mid-term and long-term strategies to assist in achieving those goals.

The Plan employs energy efficiency market transformation as its unifying objective. Market transformation is achieved when all cost-effective energy efficiency is adopted as a matter of standard practice.[19] The Plan seeks to effect substantial and sustained progress towards more efficient technologies and practices in each of the customer end use sectors by moving utilities, the CPUC, and other stakeholders beyond a focus on short-term energy efficiency activities into a more sustained long-term, market transformation strategic focus.[20]

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11 Updated from Martinez, Wang, and Chou (2010).

12 American Council for an Energy-Efficient Economy (2014c).

13 State of California (2003).

14 California Public Utilities Commission (2010).

15 Although the term "loading order" is often used to describe the dynamic process used by electricity system operators to meet demand on a short-term basis, in California the term is applied to the process whereby energy utilities acquire resources over the long term.

16 California Energy Commission (2005).

17 Hopper, Barbose, Goldman, and Schlegel (2009).

18 California Public Utilities Commission (2008).

19 Northwest Energy Efficiency Alliance (2014).

20 California Public Utilities Commission (2008).

Additionally, the Plan recognizes that the process of energy efficiency market transformation cannot, and should not, be driven by ratepayer-funded utility programs alone. While utilities will play a continued role in stimulating market transformation across sectors, non-utility actors may well be better positioned to drive the "push" of new technologies to market, or the "pull" for customers and business to adopt available efficiency technologies or practices.[21]

Table 1 shows the five policy tools for market transformation identified in the California *Long Term Energy Efficiency Strategic Plan*.

Table 1. Policy Tools for Market Transformation in California[22]
• ***Customer Incentives*** including rebates; innovative or discounted financing; and/or non-financial support to consumers are the "carrots" that help *pull* consumers into choosing the efficient option.
• ***Codes and Standards*** which mandate minimum efficiency thresholds for buildings, appliances and/or equipment, removing the less efficient choices from the marketplace are the "sticks" that *push* builders and manufacturers to provide efficient goods and services.
• ***Education and Information*** through marketing, education and outreach inform market actors about energy efficiency opportunities. These programs often include labeling; benchmarking; internet-based comparisons; professional and trade materials; school curricula; peer-to-peer exchanges; and other resources.
• ***Technical Assistance*** helps to ensure that knowledge barriers on the part of customers, installers or retailers are not unnecessarily hampering the progress of critical efficiency initiatives.
• ***Emerging Technologies*** rely on research, development, demonstration and/or deployment to move energy-efficient products and developments from the laboratory into the commercial marketplace.

To guide energy efficiency market transformation in a number of key sectors, the Plan embraces four specific programmatic goals, known as the "Big Bold" energy efficiency strategies (see Table 2). These goals were selected not only for their potential impact, but also for their easy comprehension and their ability to galvanize market players.[23]

Table 2. California's "Big Bold" Energy Efficiency Strategies[24]
1. All new residential construction in California will be zero net energy by 2020.
2. All new commercial construction in California will be zero net energy by 2030.
3. Heating, Ventilation and Air Conditioning will be transformed to ensure that its energy performance is optimal for California's climate.
4. All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020.

[21] California Public Utilities Commission (2008).
[22] California Public Utilities Commission (2008).
[23] California Public Utilities Commission (2008).
[24] California Public Utilities Commission (2008).

2.3 Legal Authority

The energy efficiency and demand response aspects of the loading order policy were codified by legislation in 2005.[25] The legislation requires the procurement plans developed by each of California's four investor-owned utilities to first meet the utility's unmet resource needs through all available energy efficiency and demand reduction resources that are cost-effective, reliable, and feasible. In 2006, Californian legislation required both IOUs and POUs to acquire all cost-effective energy efficiency identified by the CPUC and CEC.[26]

2.4 Coverage

Utilities in California implement a broad range of energy efficiency programs directed to customers across all sectors of the economy: residential, commercial, industrial and agricultural and covering both electricity and natural gas. Utilities also implement programs advocating and facilitating the adoption of energy efficiency codes and standards, particularly by supporting the transition of new energy-efficient products and practices into code-appropriate industry standards.[27]

2.5 Energy Savings Targets

Following California's 2001 electricity crisis, the main state resource agencies worked together with the state's utilities and other key stakeholders to develop energy savings goals for the state's IOUs. The CPUC formalized goals in September 2004 that called for cumulative electrical energy savings by 2013 of 23,000 GWh and cumulative peak electricity demand reductions of 4,900 MW from programs operated over the 2004 to 2013 period. The natural gas goals were set at annual gas savings of 67 million therms by 2013.[28] These long term savings goals were developed from analysis of technical and economic potential conducted between 2002 and 2004, and were deliberately set as "stretch goals".[29]

In 2008, the CPUC developed new electric and natural gas goals for years 2012 through 2020, which call for 16,300 GWh of cumulative gross electrical energy savings, a cumulative electricity demand reduction of 4,541 MW, and 619 million therms of cumulative gross gas savings over the nine-year period.[30]

In 2013, the CPUC updated energy saving goals for the years 2015 to 2024, and identified approximately 21,800 GWh of cumulative electrical energy savings, 4,000 MW of cumulative peak demand reduction, and 550 million therms of cumulative gas savings.[31]

2.6 Energy Efficiency Activities

In California, there are four primary customer sectors: residential, commercial, industrial and agricultural. In designing their energy efficiency programs, the utilities consider energy savings potentials and design programs to capture savings for these customer sectors. Within the policies, guidelines and targets set by the CPUC and the CEC, individual utilities determine the markets in which they will offer energy efficiency programs across all four economic sectors.

[25] California Legislature (2005).
[26] California Legislature (2006).
[27] California Public Utilities Commission (2012).
[28] American Council for an Energy-Efficient Economy (2014c).
[29] California Public Utilities Commission (2010).
[30] American Council for an Energy-Efficient Economy (2014c).
[31] Navigant Consulting (2014).

Programs are designed to address specific barriers to energy efficiency that have been identified in each market.

CPUC Decision 09-09-047 approved utility energy efficiency portfolio plans for the period 2010 to 2012 designed to support the *Long Term Energy Efficiency Strategic Plan*. In particular, the CPUC required the IOUs to administer 12 statewide programs that will be consistent throughout all the obligated utilities' service areas as well as some local and pilot programs.[32] The statewide programs include an array of energy efficiency measures in the following categories: residential; commercial; industrial; agricultural; new construction; lighting; heating, ventilation, and air conditioning; codes and standards; DSM integration and coordination; workforce education and training; marketing, education, and outreach; and emerging technologies.

2.7 Marketing, Education and Outreach

The *Long Term Energy Efficiency Strategic Plan* outlined a vision for Californians "engaged as partners in the state's energy efficiency, demand-side management and clean energy effort". This led to the launch of the website Engage360.com as part of the 2010 to 2012 energy efficiency program cycle.[33] Engage360 was intended to coordinate statewide energy efficiency efforts under one umbrella brand, integrating messaging and access points for target audiences. In October 2011, the CPUC discontinued funding of the Engage360 brand and ended the program, finding that the brand was confusing and had failed to gain traction.[34]

In May 2012, the CPUC decided to broaden the Energy Upgrade California[35] program, developed in 2011 by CPUC and CEC staff, to become the statewide "one-stop shop" for whole building upgrades, demand response, distributed generation, and low income programs.[36]

In addition to Energy Upgrade California, there were two types of marketing, education and outreach (ME&O) activities implemented during the 2010 to 2012 program cycle: (1) IOU "local" marketing targeting IOU-specific regional audiences and (2) Statewide programs with universal messaging across California. Under the IOU-specific approach, each individual energy efficiency program had a marketing budget that was administered either as part of each individual program, or through an integrated marketing and outreach effort throughout the relevant IOU's geographical territory.[37]

While a formal evaluation of the ME&O activities implemented during the 2010 to 2012 energy efficiency program cycle had not been completed as at October 2014, four trends have been identified[38]:

- face-to-face marketing efforts have proven highly effective for the Energy Upgrade California program, while advertising has resulted in high awareness of the program statewide;
- the most effective messages for Energy Upgrade California program participants are focused on comfort, incentives and lowering energy bills;
- in the 2010 to 2012 program cycle, IOUs began to take an integrated approach to their marketing materials, including energy efficiency, demand response, and on-site generation;

32 California Public Utilities Commission (2009).
33 California Public Utilities Commission (2008).
34 California Public Utilities Commission (2012).
35 California Public Utilities Commission and California Energy Commission (2014).
36 California Public Utilities Commission (2012).
37 California Public Utilities Commission (2012).
38 California Public Utilities Commission (2012).

- IOUs engaged in segmented marketing to their own ratepayers, producing more materials targeting homeowners, business owners, low income residents, industrial customers, and other segments.

2.8 Funding

From 1996 to 2011, California's utilities used to collect a public goods charge on customer utility bills to fund utility energy efficiency programs. The charge represented an electricity system benefit charge of about USD 0.003/kWh, capped at three per cent of a customer's bill; a natural gas DSM charge was also applied to the customer's bill. The public goods charge was not reauthorized by the California Legislature in 2011, and Governor Brown directed the CPUC to pursue continuation of funding for these programs before the charge expires. About one-quarter of the utility energy efficiency portfolio budgets is funded by the public goods charge; the remaining majority of the utility energy efficiency programs is funded through utility resource procurement funds and is unaffected by the expiration of the charge.[39]

Utility resource procurement budgets are recovered through rate cases brought before the CPUC. In September 2009, the CPUC approved a USD 3.1 billion IOU energy efficiency program budget for 2010 to 2012 – a 42 per cent increase over the previous three-year period.[40] The publicly-owned utilities budgeted USD 150 million for the fiscal 2008 to 2009 year. Four per cent of the energy efficiency budget is allocated to evaluation, measurement, and verification (EM&V) of energy savings.

In addition, from 2010 to 2012, USD 260 million in funding was directed to non-utility government agencies for local efforts targeting public sector building retrofits and innovative energy efficiency opportunities, and USD 175 million was earmarked to launch California's programs to achieve zero net energy homes and buildings.[41]

2.9 Results

The latest results available, as of October 2014, for the energy savings achieved through energy efficiency programs undertaken by California IOUs are for the years 2010 and 2011. These results are officially classified as "estimates" because verified results are not yet available.[42] Some independent evaluations carried out after the end of a program cycle result in significant changes to the energy saving values initially claimed by the IOUs.

Table 3 shows the estimated electricity peak demand reductions, electricity savings, and natural gas savings based on the IOUs' reported (but, as yet unverified) results for all IOU energy efficiency programs from program activity through December 2011. These are first year savings rather than savings over the lifetime of the energy efficiency measures. The first year electrical energy saving of 1.81% of retail sales is one of the highest in the world for utility-delivered energy efficiency.

[39] American Council for an Energy-Efficient Economy (2014c).
[40] California Public Utilities Commission (2009).
[41] California Public Utilities Commission (2009).
[42] California Public Utilities Commission (2012).

Table 3. Estimated Demand and Energy Savings from Energy Efficiency Programs Delivered by California IOUs, 2010 to 2011[43]			
Electricity			Natural Gas
Peak Demand Reduction (MW)	Energy Savings (GWh)	Savings as Percentage of Retail Sales	Energy Savings (Mtherms)
1,069	7,063	1.81%	84

Figure 4 shows the distribution across customer sectors of the estimated energy savings from IOU energy efficiency programs, excluding codes and standards programs. Eighty-nine percent of electrical energy savings achieved through 2011 occurred in the commercial (55 percent) and residential (34 percent) sectors, with the agricultural and industrial sectors combined making up the remaining 11 percent of savings.[44] The majority of natural gas savings occurred in the commercial and industrial sectors. Gas use in the residential sector actually increased during this period, as shown by the negative value. This was caused by extra gas being used for space heating when incandescent lights (which generate heat) are replaced.

In addition to these customer-specific interventions, IOU programs oriented to promoting energy efficiency codes and standards represented approximately 38 percent of total portfolio energy savings when all customer sectors are combined.[45]

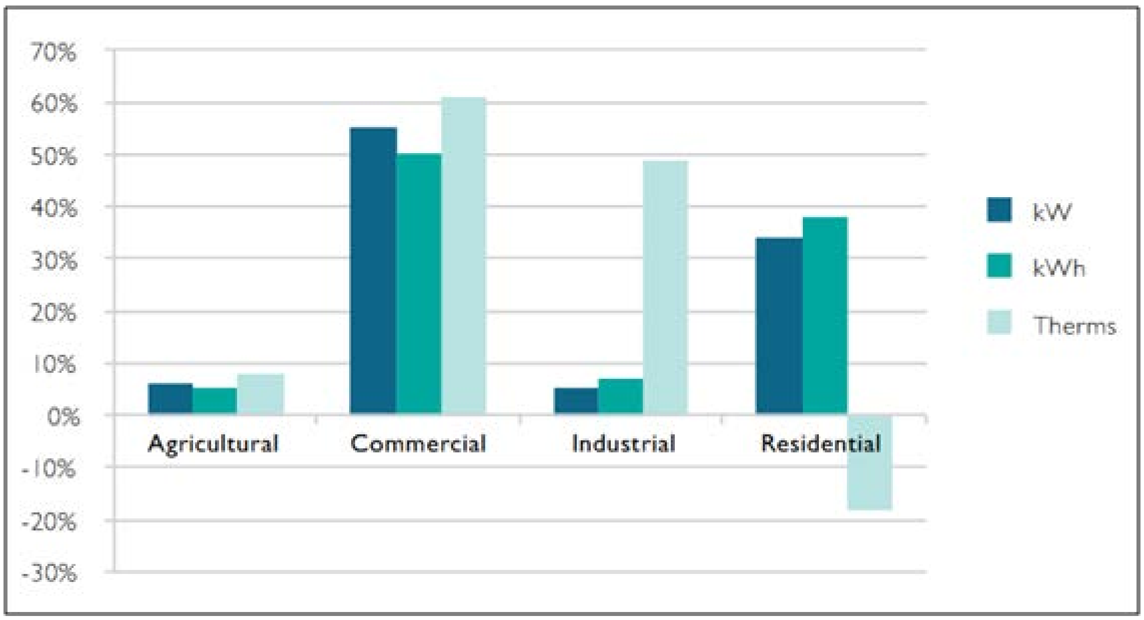

Figure 4. Sectoral Distribution of Estimated Energy Savings from Energy Efficiency Programs Delivered by California IOUs, 2010 to 2011[46]

43 Compiled by the Regulatory Assistance Project from data in California Public Utilities Commission (2012) and Energy Information Administration (2014).

44 California Public Utilities Commission (2012).

45 California Public Utilities Commission (2012).

46 California Public Utilities Commission (2012).

Table 4 shows the distribution of energy savings achieved through IOU energy efficiency programs across different technology applications. The technologies that drive savings vary across different customer sectors and segments. However, some technologies, such as high efficiency lighting and heating ventilation and air conditioning (HVAC), are prevalent across all portfolios of IOU energy efficiency programs. Through 2011, the majority of electrical energy savings were achieved through lighting (59 percent), followed by HVAC (13 percent) and process improvements (10 percent). Natural gas savings were primarily achieved through process improvements in the industrial sector, where 47 percent of the savings are generated.[47] In some technology applications, natural gas use actually increased, which is shown in Table 4 as negative percentage figures; the positive percentage figures for gas savings have to be adjusted to take account of the negative figures.

Table 4. Technology Distribution of Estimated Energy Savings from Energy Efficiency Programs Delivered by California IOUs, 2010 to 2011[48]

Technology Application	kW	kWh	therms
Indoor lighting	58.34%	58.76%	-49.64%
Process improvement	10.44%	12.20%	92.02%
HVAC	13.19%	9.48%	18.12%
Refrigeration	3.20%	5.44%	0.07%
Plug loads	2.28%	4.19%	-3.72%
Appliances	3.91%	3.75%	-3.02%
Outdoor lighting	0.24%	1.90%	-0.01%
Whole building	3.44%	1.82%	8.22%
Building envelope	2.02%	0.53%	5.27%
Residential surveys	1.34%	0.51%	1.49%
Other	0.18%	0.45%	2.29%
Laundry	0.92%	0.41%	5.47%
Water heating	0.36%	0.37%	20.43%
Food service	0.13%	0.18%	1.40%
Agricultural greenhouses	0.00%	0.00%	1.61%

Table 5 (page 12) shows the reported energy savings in 2012 for the 15 publicly-owned utilities in California with the largest retail sales. Overall, energy savings as a percentage of retail sales were less than half those achieved by the IOUs and the absolute quantity of energy saved was much smaller; POUs supply only about 25% of electricity sold in California and IOUs supply about 75%.

47 California Public Utilities Commission (2012).

48 California Public Utilities Commission (2012).

Table 5. Net Reported Energy Savings for the Largest 15 Publicly-Owned Utilities in California as a Percentage of Retail Sales, 2012[49]		
Publicly Owned Utility	**Reported Net Annual Savings (MWh)**	**Savings as Percentage of Retail Sales**
Redding	345	0.04%
Turlock	4,877	0.25%
Vernon	3,263	0.28%
LADWP	89,487	0.38%
Roseville	5,570	0.46%
Modesto	12,931	0.52%
Merced	2,568	0.57%
IID	25,305	0.75%
Burbank	10,952	0.98%
Riverside	21,244	0.98%
Anaheim	24,337	1.00%
Pasadena	13,337	1.17%
Glendale	13,519	1.22%
Palo Alto	12,302	1.32%
SMUD	162,381	1.55%
Totals	**402,416**	**0.74%**

2.10 Evaluation, Measurement and Verification

Because California energy utilities can receive substantial financial payments (incentives) based on their performance in achieving energy savings, EM&V of utility energy efficiency programs is taken very seriously.

The Energy Division of the CPUC oversees the energy efficiency portfolios implemented by the investor-owned utilities. Beginning in 2006, the Commission directed its Energy Division to conduct evaluations that are specifically tied to the impacts (energy savings, costs and emissions) of the IOU portfolios. Prior to 2006, the utilities evaluated these programs themselves with limited Energy Division oversight.[50] The Energy Division organizes evaluations of all IOU energy efficiency programs plus relevant research studies. Some of the evaluations and research studies are undertaken by the Energy Division itself; for others the Energy Division engages independent contractors.

49 California Energy Commission (2013).

50 California Public Utilities Commission (2014a).

Each IOU submits annual reports to the CPUC on the energy savings they claim to have achieved through each energy efficiency program. The savings claims are subject to a variety of field validation and verification to understand what was actually achieved "on the grid." The field research is important to validate the actual impacts of the investments and inform future updates to savings estimates and improvements in program design. Evaluation also includes an assessment of the program influence in achieving the savings over what would have happened without the program intervention (i.e., the evaluation studies estimate "net savings" that are directly achieved by the program intervention as compared to "gross savings" that result from all factors affecting energy use). This information is used to understand the relative cost-effectiveness of the programs and transitions in the market.[51]

For the 2010 to 2012 program cycle, the CPUC oversaw the implementation of a joint evaluation plan with the IOUs,[52] that allocated USD 93 million in project funds (net of management costs) to roughly 80 studies that addressed key research needs. Studies were focused on four core research areas:[53]

- **Savings measurement and verification** of energy efficiency measures and programs which inform core metrics of energy savings against goals, and cost effectiveness, as well as developing reliable estimates of load impacts;
- **Program evaluation** of specific qualitative and quantitative factors of program performance, to inform improvements in program design and support forward-looking corrections to utility energy efficiency programs and portfolios;
- **Market assessments** that gauge current market situations that inform savings baselines, identify and track appropriate baseline metrics of market change, measure progress toward achieving the objectives in the *Long Term Energy Efficiency Strategic Plan*, and inform estimates of the remaining potential for energy efficiency; and
- **Policy and planning support** that includes overarching studies to inform CPUC policy.

Publicly-owned utilities also submit reports on the energy savings they claim to have achieved through energy efficiency programs. Each POU is required by statute to report annually to its customers and to the CEC on the results of an independent evaluation that measures and verifies the energy efficiency savings and reduction in energy demand achieved by its energy efficiency and demand reduction programs.[54]

2.11 Cost-Effectiveness

California legislation requires both IOUs and POUs to acquire all cost-effective energy efficiency identified by the CPUC and CEC.[55] The methodology used for determining the cost-effectiveness of energy efficiency programs is the Total Resource Cost (TRC) test described in the *Standard Practice Manual*[56], which was developed in California for evaluating utility-delivered DSM programs and is now used in many other jurisdictions in the United States and around the world.

[51] California Public Utilities Commission (2012).
[52] California Public Utilities Commission (2010).
[53] California Public Utilities Commission (2012).
[54] Martinez (2013b).
[55] California Legislature (2006).
[56] California Public Utilities Commission (2001).

Utilities in California use the TRC test prior to implementing an energy efficiency program to check whether the energy savings are likely to be cost-effective. The cost-effectiveness of the energy savings claimed for each IOU energy efficiency program is also calculated *ex post* using the TRC test. An overall cost-benefit ratio of 2.02 was calculated for the estimated statewide energy savings achieved by IOU energy efficiency programs between 2010 and 2011.[57]

2.12 Performance Incentives and Penalties

To enable utilities to take a large role in implementing energy efficiency programs, California provides a "shared savings" incentive mechanism for IOUs. The version of shared savings adopted in 2007, was called the "risk/return incentive mechanism" (RRIM) and was designed to align ratepayer and shareholder interests by creating a significant reward or penalty for IOUs' success or failure in meeting the CPUC's targets for reducing customer demand for electricity and natural gas.[58]

The RRIM was calculated for each investor-owned utility based on how well it met the energy saving targets and the economic benefits generated from its energy efficiency portfolio. IOUs were eligible for the RRIM if they achieved 80 to 85 per cent of CPUC energy saving targets and could earn larger incentives if they exceeded the targets. Penalties might be triggered if savings were below 65 per cent of the CPUC energy saving targets. For the 2006 to 2008 program cycle, total potential incentives were capped at USD 450 million (less than one per cent of total sales) for the four utilities combined. Two interim payments were provided, first after verifying actual energy efficiency measures installed and program costs, then after evaluation, measurement, and verification studies document projected per-measure savings. Thirty per cent of the total incentive was held back pending a final post-installation EM&V "true-up".[59]

There is now a new incentive mechanism, adopted in 2012, called Energy Savings Performance Incentives (ESPI) which pays out based on units of energy saved, instead of as a percent of goals. For energy savings achieved, utilities can earn a performance-based award of up to nine percent of energy efficiency program expenditures (minus codes and standards program expenditures). ESPI also added some small amount of bonuses for complying with CPUC procedures.[60]

2.13 Response to Stress Situations

Utility-delivered energy efficiency was a key resource in responding to the crisis in California's energy markets during 2001. In January 2001, the Governor of California, Gray Davis, declared a state of emergency, announcing that electricity supply shortages would lead to rolling blackouts in the summer. In April 2001, the North American Electric Reliability Council predicted that California should expect 260-700 hours of rolling blackouts. Various sources predicted that electricity shortages would cause major disruptions to California's economy with estimates of economic damage ranging from USD 2 billion to over USD 20 billion. Yet, during summer 2001, rolling blackouts were never implemented.[61]

In response to the crisis situation, California's energy utilities explicitly targeted many of their 2001 energy efficiency programs to provide immediate electricity savings and peak demand reductions; this involved increased funding for, and redesign of, some programs. The CPUC

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[57] California Public Utilities Commission (2012).
[58] California Public Utilities Commission (2007).
[59] California Public Utilities Commission (2007).
[60] California Public Utilities Commission (2014b).
[61] Goldman, Eto, and Barbose (2002).

authorized the IOUs to spend approximately USD 320 million from the public goods charge on energy efficiency programs during 2001 and established a peak demand savings goal of 250 MW. The utilities also received about USD 105 million of incremental funding from general tax revenues for energy efficiency programs as part of “emergency” legislation passed by the State Legislature. An analysis carried out the year after the crisis events concluded that California’s energy efficiency services delivery infrastructure, which was strengthened by years of ratepayer and State-funded programs, represented a significant resource that was ramped up quickly to respond to a short-term energy emergency.[62]

2.14 Overall Effectiveness

Utility delivery of energy efficiency commenced in California more than 30 years ago and is now the largest and oldest program of its kind in both the United States and the world. Various assessments carried out in the late 2000s concluded that California energy efficiency programs provided nearly USD 5 billion in net benefits to customers statewide over the preceding decade and that the programs provided the cheapest, cleanest resource available to meet California’s energy needs, costing less than USD 0.03/kWh, or less than half the CPUC’s then benchmark for base load power.[63] Additional programs targeted specifically to help lower-income households improve their energy efficiency and lower their energy bills reached more than 1.6 million households over the preceding decade, or more than 40% of all eligible participants.[64]

These assessments, together with the high level of energy savings achieved, compared with other jurisdictions, show that utility-delivered energy efficiency programs in California are highly effective.

2.15 Lessons Learnt

The long-term California experience in utility delivery of energy efficiency represents close to the maximum level of energy savings that can be achieved through this approach. The unique feature in California is the comprehensive set of policy and regulatory mechanisms that has been developed over many years through a unique collaborative process involving the two regulatory agencies and the California legislature. This collaboration is the key to California’s achievements and is the main lesson to be learnt by other jurisdictions seeking to emulate the California results.

62 Goldman et al. (2002).
63 Martinez et al. (2010).
64 California Public Utilities Commission (2008).

3. NEW SOUTH WALES ENERGY SAVINGS SCHEME

3.1 Introduction

New South Wales (NSW) is one of three Australian states that have implemented energy efficiency obligation (EEO) schemes. In January 2003, the NSW Government implemented the first mandatory greenhouse gas emissions trading scheme in the world, the Greenhouse Gas Reduction Scheme (GGAS). GGAS included an energy efficiency component that effectively established an EEO scheme in NSW with targets denominated in metric tonnes of carbon dioxide equivalent (tCO_2-e) rather than in energy units.[65]

Under GGAS, parties obligated to meet specified carbon emissions reduction targets could create NSW Greenhouse Abatement Certificates (NGACs) by targeting:

- low emission electricity generation;
- demand-side abatement (mostly energy efficiency);
- emissions abatement by large end-users; and
- carbon sequestration through forestry.

Those NGACs created through energy efficiency projects were effectively energy efficiency certificates[66] and could be traded, thereby establishing the first operating energy efficiency certificate trading scheme in the world.[67]

Despite growth in demand-side abatement activities under GGAS, the NSW Government recognized that significant barriers to energy efficiency persisted. From 1 July 2009, demand-side abatement was no longer credited under GGAS and, instead, transitioned into a separate, expanded EEO scheme called the Energy Savings Scheme (ESS).

The ESS is a standalone energy efficiency certificate trading scheme that requires obligated parties to meet specified annual energy efficiency targets. The ESS was established to expand the original demand-side abatement provisions under GGAS and was originally planned to operate until 2020 unless a national energy efficiency scheme with similar objectives is implemented in Australia before that time. In November 2014, the NSW Government announced that it intends to extend the ESS to 2025.[68]

Parties obligated under the ESS are known as "Liable Entities". There are three groups of Liable Entities, who are also mandatory scheme participants:[69]

- all holders of NSW electricity retail licenses (i.e., electricity retailers);
- electricity generators that supply electricity directly to retail customers in NSW;[70] and
- market customers in NSW who purchase their electricity directly from the wholesale Australian National Electricity Market.

65 D. J. Crossley (2008).

66 Energy efficiency certificates are also known as "white certificates," "white tags," "energy savings certificates," and "energy efficiency credits."

67 Legislation for the Italian energy efficiency certificate trading scheme was passed in 1999, but the scheme did not start operating until January 2005.

68 New South Wales Government (2014).

69 New South Wales Independent Pricing and Regulatory Tribunal (2014g).

70 In NSW, certain large end-use customers purchase electricity under contracts directly with generators.

Organizations involved in emission-intensive and trade-exposed industries, or carrying out such activities, may be granted full or partial exemptions from their obligations under the ESS.

Liable Entities must meet individual annual energy savings targets based on their electricity market share in NSW. Each Liable Entity must calculate its individual energy savings target, and then meet that target through the surrender of NSW Energy Savings Certificates (ESCs). If a Liable Entity does not surrender sufficient ESCs to meet its target, it will be liable to pay a shortfall penalty.[71] Figure 5 explains how the ESS operates by tracking the typical lifecycle of an ESC.

Figure 5. Lifecycle of an Energy Savings Certificate in the NSW Energy Savings Scheme[72]

Each ESC represents one metric tonne of carbon dioxide equivalent (CO_2-e) abated by energy saving activities. The number of ESCs required to meet an individual Liable Entity target is calculated by multiplying total liable electricity sales[73] in MWh by the state-wide energy saving target for the year, multiplied by the individual scheme participant's share of liable electricity sales, and then multiplied by a Certificate Conversion Factor based on the average emissions intensity of electricity in New South Wales.[74] The ESS legislation sets the Certificate Conversion Factor at 0.94 until 2020, but the NSW Governor may amend the Act to change this number on the advice of the responsible Minister.[75]

Under the ESS, organizations with expertise in helping other businesses to reduce electricity use can apply to become Accredited Certificate Providers (ACPs). ACPs are voluntary participants in the ESS and are eligible to create and sell ESCs from energy savings projects. The number of ESCs that can be created depends on the type of project and energy efficiency measures

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71 New South Wales Independent Pricing and Regulatory Tribunal (2014i).

72 Sniffin (2012).

73 To calculate liable electricity sales, sales to exempt industries or activities are subtracted from the total electricity sales in NSW.

74 The Certificate Conversion Factor is a multiplier used in all ESC calculations to convert energy savings, in megawatt-hours to tonnes of carbon-dioxide equivalent. In NSW, for every MWh of electricity produced, approximately 0.94 tonnes of carbon-dioxide is released into the atmosphere. As the generation mix in NSW changes from primarily coal-based to include more gas and renewables, this multiplier will decrease to reflect the lower emissions from electricity generation.

75 New South Wales Independent Pricing and Regulatory Tribunal (2014b).

implemented. ACPs are subject to the conditions of their accreditation, which set out their compliance obligations[76]. Liable Entities may apply to be accredited as ACPs.

3.2 Policy Objectives

The legislation under which the ESS was established states that the principle objective of the scheme is to create a financial incentive to reduce the consumption of electricity by encouraging energy saving activities. Other objectives are:[77]

- to assist households and businesses to reduce electricity consumption and electricity costs;
- to complement any national scheme for carbon pollution reduction by making the reduction of greenhouse gas emissions achievable at a lower cost, and
- to reduce the cost of, and the need for, additional energy generation, transmission and distribution infrastructure.

In August2013, the NSW Government published the *NSW Energy Efficiency Action Plan* (EEAP).[78] The EAAP represents a shift to a more open and competitive market-based delivery of energy efficiency services that provide assistance to customers through their existing service providers. The EEAP details 30 actions to deliver savings on energy bills and reduce pressure on future prices.

The EEAP places the ESS at the centre of the NSW Government's intended actions on energy efficiency. Of the 30 actions identified, seven relate directly to the ESS. The EEAP includes a target to assist businesses and households to realise annual energy savings of 16,000 GWh by 2020. Figure 6 shows the expected contribution by various programs, including the ESS, to achieving this target.

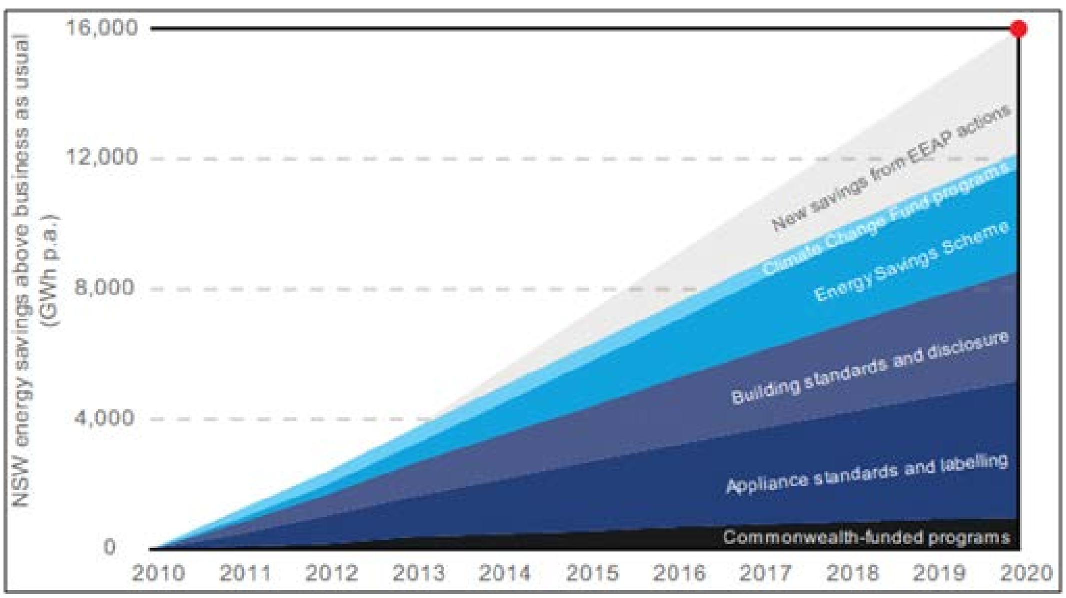

Figure 6. Intended Contribution by Various Programs to the NSW Government's Energy Savings Target[79]

76 New South Wales Independent Pricing and Regulatory Tribunal (2014a).
77 New South Wales Legislation (1995).
78 State of New South Wales and Office of Environment and Heritage (2013).
79 State of New South Wales and Office of Environment and Heritage (2013)

3.3 Legal Authority

The ESS is governed by a combination of legislation and regulation. The Scheme was established under Part 9 of the *Electricity Supply Act 1995* (the Act)[80] and Part 6 of the *Electricity Supply (General) Regulation 2014* (the Regulation).[81] The Scheme Administrator administers the scheme according to the legislation and the *Energy Savings Scheme (Amendment No. 2) Rule 2014* (ESS Rule).[82]

The Act sets out the legal and technical framework of the ESS and also sets out the functions and responsibilities of the Scheme Administrator and Scheme Regulator. The Act is supported by the Regulation, which describes the core functions of the Scheme Administrator and the Scheme Regulator. For the Scheme Administrator, the Regulation sets requirements for accrediting and auditing ACPs, and rules around the creation and transfer of ESCs. For the Scheme Regulator, the Regulation provides the principles governing compliance with the individual energy savings targets for Liable Entities.[83]

The ESS Rule applies to ACPs and their energy savings projects. It provides detail about eligibility requirements for ACPs, and calculation methods for determining the number of ESCs that can be created through different types of projects.

The Act also allows the Minister to grant full or partial exemption from the ESS for any electricity load used in conjunction with emission-intensive and trade-exposed industries or activities, including: manganese production; ammonia production; ceramic floor and wall tile production; magnetite concentrate production; petroleum refining; and ethene production.[84] The exemption is provided by a Ministerial Order,[85] as gazetted from time to time. The Order lists the exempted sites, their location, the emissions-intensive trade-exposed activity being carried out, and the proportion of exemption granted. A further deduction is allowed for network losses. As part of the Ministerial Order, the Minister also authorizes the Scheme Regulator to make rules about assessing deductions of exempt loads by Liable Entities.

The NSW Independent Pricing and Regulatory Tribunal (IPART) carries out the functions of both the Scheme Administrator and the Scheme Regulator. The NSW Department of Trade and Investment, Regional Infrastructure and Services has responsibility for policy development in relation to the ESS and ultimate responsibility for any legislative changes introduced to the ESS and is also responsible for recommending any Rule changes to the Minister for Resources and Energy. The NSW Office of Environment and Heritage provides policy support and makes recommendations on further development of the ESS.

3.4 Coverage

As of November 2014, the ESS covers only electricity. Electricity savings from the residential, commercial, and industrial sectors and from all premises and facilities within these sectors are eligible to contribute to ESS targets. In November 2014, the NSW Government announced that, during 2015, it intends to expand the ESS to include gas.[86]

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80 New South Wales Legislation (1995).
81 New South Wales Legislation (2014).
82 New South Wales Minister for Resources and Energy (2014).
83 New South Wales Independent Pricing and Regulatory Tribunal (2014f).
84 New South Wales Independent Pricing and Regulatory Tribunal (2014c).
85 New South Wales Government (2013).
86 New South Wales Government (2014).

3.5 Energy Savings Targets

The ESS energy saving targets were established through amendments to the *Electricity Supply Act*. Table 6 shows that in 2009, the first year of the ESS, the target was set to 0.4 percent of total electricity sales in New South Wales, expressed in MWh. This target is calculated on the basis of the total energy savings achieved over the lifetimes of each energy efficiency measure implemented. The target increases gradually over time, reaching four percent of total sales in 2014, and continuing at that level through 2020. Targets are specified in Schedule 5 to the Act, and are subject to amendment by the NSW Governor on the recommendation of the relevant Minister. Any such regulation must be made at least 12 months in advance.

Table 6. Targets* for the NSW Energy Savings Scheme[87]

Year	Effective Scheme Target (% of annual NSW electricity sales)	Retailer Compliance Obligation (% of annual liable electricity sales)
2009**	0.4%	0.5%
2010	1.2%	1.5%
2011	2.0%	2.5%
2012	2.8%	3.5%
2013	3.6%	4.5%
2014–2020	4.0%	5.0%

* Calculated on the basis of the total energy savings achieved over the lifetimes of each energy efficiency measure implemented.

** Half year from 1 July.

3.6 Energy Efficiency Activities

Energy savings that are eligible to meet ESS targets are created through energy savings projects carried out by ACPs. Parties seeking accreditation must submit an application for a particular energy savings project. There is an AUD 500 fee for a project to become accredited. The purpose of accreditation is to filter out projects that are unlikely to result in the creation of Energy Savings Certificates.

The application for accreditation must contain information on the energy saving activities included in the project for which accreditation is sought, including details of the methodologies to be applied to calculate the number of ESCs that can be created from each activity. The application for accreditation must demonstrate that the proposed activities meet the requirements of the ESS as Recognised Energy Savings Activities (RESAs).[88] Clause 5.3 of the ESS Rule defines the requirements for an energy saving activity to be eligible for accreditation as a RESA. A RESA is any activity that increases the efficiency of electricity consumption by:[89]

[87] New South Wales Independent Pricing and Regulatory Tribunal (2014j).

[88] New South Wales Independent Pricing and Regulatory Tribunal (2014e).

[89] New South Wales Minister for Resources and Energy (2014).

- modifying end-user equipment or the usage of end-user equipment with the result that there is a reduction in the consumption of electricity compared to what would have otherwise been consumed;
- replacing end-user equipment with other equipment that consumes less electricity;
- installing new end-user equipment that consumes less electricity than other comparable equipment of the same type, function, output or service; or
- removing end-user equipment with the result that there is a reduction in the consumption of electricity compared to what would have otherwise been consumed, provided that the ACP does not refurbish, re-use or resell that equipment.

In addition, a RESA must:

- not result in a reduction in electricity consumption by reducing production or service levels (including safety levels);
- be implemented at a site or sites in the state of New South Wales or in a jurisdiction with an approved similar scheme to the ESS[90]; and
- not be unlawful to carry out.

Before a RESA can be implemented, the ACP must be accredited for the RESA; and the ACP must be the original Energy Saver or be nominated by the original Energy Saver. The original Energy Saver is defined by the ESS Rule as:[91]

- the purchaser of the upgrade or equipment;
- the person contractually liable to pay for the energy consumption at the site where the energy saving activity occurs;
- the retailer for the sale of new appliances;
- the person contracted to remove old appliances; or
- the person on the NABERS Rating Certificate where the National Australian Built Environment Rating System (NABERS) is used to calculate the number of ESCs that can be created from a project.

The ESS Rule also defines the following activities as specifically excluded from the Scheme:[92]

- activities undertaken to comply with any statutory requirement;
- activities that reduce the scope or quantity of production or service from the use of electricity, such as closing part of a factory;
- the purchase of Green Power;
- activities that are eligible to create energy savings certificates or Renewable Energy Certificates at the point of generation;
- reducing electricity consumption through electricity generation or fuel switching.

[90] As at October 2014, no such schemes have been approved by the relevant Minister.
[91] New South Wales Minister for Resources and Energy (2014).
[92] New South Wales Minister for Resources and Energy (2014).

3.7 Marketing, Education and Outreach

A study carried out in 2011, concluded that obligated electricity retailers were taking a variety of approaches to comply with their obligations under the ESS:[93]

- Reactive – sourcing ESCs where possible by working with ACPs and brokers;
- Proactive – getting involved in ACP activity, and looking to improve relationships with their customers by undertaking energy efficiency projects and claiming ESCs;
- Paying penalties – in a few cases, retailers simply paid penalties. However, most retailers made efforts to avoid paying penalties because of the negative connotations involved.

Consequently, with the exception of proactive retailers, most marketing, education and outreach (ME&O) activities are implemented by ACPs who identify opportunities for energy savings projects and then seek to persuade facility owners to allow the projects to be carried out.

3.8 Funding

For Liable Entities, the costs of meeting their ESS targets are implicitly assumed to be costs of doing business and, where possible, are passed on to customers.

For ACPs, funds to carry out energy savings projects are obtained by selling ESCs. Parties interested in buying ESCs include:[94]

- Liable Entities, who are required to acquire and surrender sufficient ESCs to meet their individual ESS targets, or pay a penalty. The number of ESCs required by a Liable Entity depends on their compliance obligations;
- intermediary agents who might subsequently sell the ESCs to Liable Entities;
- organizations or individuals interested in voluntarily purchasing ESCs as offsets to manage their carbon footprints.

The Scheme Administrator does not get involved in any market transactions or negotiations involved in buying and selling ESCs but does facilitate the market by managing ACPs and Liable Entities. The Scheme Administrator also operates a registry, which is a web-based database that tracks the creation, ownership transfer, and surrender of ESCs. The registry is not a trading platform. ACPs are authorized by the Scheme Administrator to create a set number of ESCs for each energy savings project they implement, and they can do this through the registry when a project has been completed. The registration fee is AUD 0.70 per ESC and the revenue from this fee covers the majority of the administrative costs of the ESS.

Anyone who owns ESCs can negotiate directly with Liable Entities or other parties to sell their ESCs. Some Liable Entities require small numbers of certificates to meet their compliance obligations, and prefer to negotiate with sellers directly to avoid dealing with standard parcel sizes (typically 5,000 ESCs) traded in wholesale markets. Most ESCs are traded through bilateral contracts between an ACP and a buyer.[95]

As at October 2014, there are no standard contracts for trading ESCs or a recognized trading exchange, but three types of contracts are commonly used:

- **Spot contract** – a contract for a physical exchange of a specified quantity of ESCs at an agreed price.

[93] Databuild Research and Solutions (2011).

[94] New South Wales Independent Pricing and Regulatory Tribunal (2014h).

[95] New South Wales Independent Pricing and Regulatory Tribunal (2014h).

- **Forward contract** – a contract for the exchange of a specified quantity of ESCs at a predetermined price on a fixed date.
- **Option contract** – the buyer pays the seller a premium to acquire a right, but not the obligation, to buy (call option) or sell (put option) a quantity of ESCs at a predetermined price.

The price of ESCs varies due to supply and demand and can fluctuate considerably depending on market conditions. There is no obligation to disclose the prices paid for ESCs, though some brokers provide regular updates on spot market prices for ESCs. Historically, ESCs have traded at prices around AUD 14.00 to AUD 32.00.[96] Figure 7 shows spot market prices for ESCs from the commencement of the ESS.

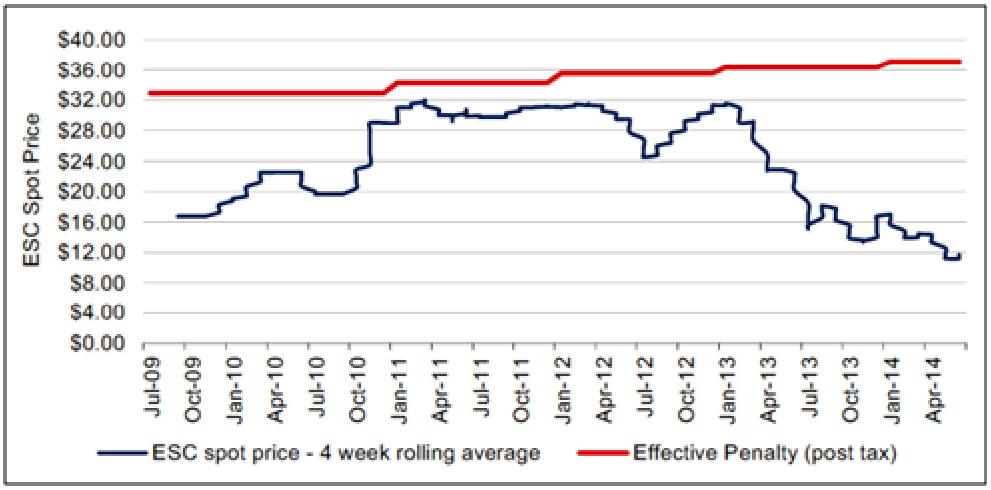

Figure 7. Spot Market Prices for NSW Energy Savings Certificates, July 2009 to June 2014[97]

3.9 Results

Table 7 (page 24) shows the number of ESCs created in the ESS between July 2009 and June 2013 by the type of energy savings project. Over this period, a total of 8,826,129 ESCs were created.

When an energy savings project is completed, the ACP is authorized by the Scheme Administrator to create set numbers of ESCs over specified time periods relating to the lifetimes of the energy efficiency measures implemented in the project. Because, in some cases, ESCs may be created in advance of actual savings, calculating the energy savings achieved under the ESS requires pro-rating the ESCs created in any year across the forward creation period of the relevant energy savings measures. The Scheme Administrator estimates that as a result of ESCs created between 2009 and 2013, the ESS achieved, and will achieve, actual energy savings of:[98]

- 1,619,407 MWh during the period 2009-2012;
- 1,206,574 MWh during 2013, and
- 5,500,556 MWh over the period 2014 to 2023.

[96] New South Wales Independent Pricing and Regulatory Tribunal (2014h).
[97] New South Wales Independent Pricing and Regulatory Tribunal (2014l).
[98] New South Wales Independent Pricing and Regulatory Tribunal (2014l).

Table 7. Number of Energy Savings Certificates Created by Project Type in the NSW Energy Savings Scheme, July 2009 to June 2013[99]

Project Type	2009	2010	2011	2012	2013	Total
Lighting (CLF)	10,123	70,343	502,382	2,043,448	**3,519,325**	6,145,621
Multiple activities	7,720	13,735	15,829	68,815	**190,329**	296,428
Process Change/Control Systems	118,871	173,527	145,209	231,358	**147,560**	816,525
Building Upgrade	4,073	14,339	37,577	56,379	**72,014**	184,382
HVAC/Chiller	7	16,683	37,878	40,965	**65,030**	160,563
Refrigerator & freezer removal	0	0	0	35,196	**45,500**	80,696
Refrigeration	0	1,606	9,696	23,428	**39,254**	73,984
Compressed Air	4,424	19,200	24,274	30,297	**24,880**	103,075
Fans/Pumps	6,968	9,245	8,216	6,453	**21,083**	51,965
Lighting (PIAM)	87,023	19,725	28,943	20,168	**17,440**	173,299
High Efficiency Motors	0	0	0	0	**3,970**	3,970
Power Systems	0	0	0	0	**2,305**	2,305
Whitegoods	701	258	38	108	**88**	1,193
Lighting (DSF)	0	1,039	2,831	0	**0**	3,870
Power Factor Correction	0	0	228	0	**0**	228
Showerheads	37,032	424,685	266,308	0	**0**	728,025
Number of certificates created each year	**276,942**	**764,385**	**1,079,409**	**2,556,615**	**4,148,778**	**8,826,129**

99 New South Wales Independent Pricing and Regulatory Tribunal (2014l).

Table 7 shows that the large majority of ESCs in the ESS were created through energy-efficient lighting projects. A common occurrence in energy efficiency certificate schemes is that most certificates are created through the implementation of energy efficiency measures that are low-cost to implement. This has been observed in the New South Wales and Victorian schemes in Australia, and in the Italian scheme.[100] Concentrating on installing low-cost measures can result in higher-cost measures that may save more energy over time being ignored. Also, energy projects that install only low-cost measures at a site may render financially unviable returning to the same site at another time to install higher-cost measures. Several schemes have attempted to resolve these problems by changing the parameters of eligible energy savings activities.

Under the Demand Side Abatement Rule in GGAS, most of the energy savings in the residential sector were created through projects in which compact fluorescent lamps and water-efficient showerheads were sold at a discount or given away free of charge to households by firms that purchased the appliances in bulk and generated a profit by selling the resulting certificates that were assigned to them by householders.[101]

In establishing the ESS, particular attention was paid to minimising the opportunities for large-scale distribution of low-cost energy-efficient appliances. Compact fluorescent lamps were not included as a RESA and procedures were established to identify instances in which a large number of showerheads were replaced at a single address, or in which installations were claimed by more than one ACP at a single address. Where duplicates were discovered for an individual address, only the first installation was recognised and all subsequent installations were deemed as invalid. In 2011, showerhead replacement activities were removed from the ESS. In 2014, the installation of energy efficient showerheads was reinstated to ESS, but only as part of a Home Energy Efficiency Retrofit in which a bundle of energy efficiency products and services is offered as to meet households' needs and includes multiple eligible energy savings activities.[102]

3.10 Evaluation, Measurement and Verification

The ESS Rule sets out three methodologies used for calculating the numbers of certificates that can be created from energy savings activities. The methodologies are:[103]

- Project Impact Assessment Method;
- Metered Baseline Method; and
- Deemed Energy Savings Method.

3.10.1 Project Impact Assessment Method

The Project Impact Assessment Method calculates savings from one-off energy savings projects. This method is most appropriate when:[104]

- energy savings are small compared to the site's consumption;
- baseline energy consumption data for the site is unavailable, or
- the variation in the baseline energy consumption due to other factors is high.

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[100] Crossley et al. (2012).
[101] D. J. Crossley (2008).
[102] New South Wales Independent Pricing and Regulatory Tribunal (2014d).
[103] New South Wales Independent Pricing and Regulatory Tribunal (2014k).
[104] New South Wales Independent Pricing and Regulatory Tribunal (2014k).

The energy savings can be determined by various means, including by direct measurement or by an engineering assessment. The Project Impact Assessment Method applies a confidence factor which reflects the accuracy and/or reliability of the data used to calculate energy savings.

One of the advantages of the Project Impact Assessment Method is that it is possible to make an up-front assessment of estimated future energy savings (known as forward creation of ESCs). This is considered to be an incentive where projects achieve small annual savings that might be insufficient to warrant accreditation under the ESS. The ESS Rule allows the forward creation of up to five years of certificates from a RESA that has ongoing energy savings as soon as the RESA is commenced. However, discount factors apply to any forward creation (see Table 8).

Table 8. Discount Factors for Calculating Forward Creation of ESCs under the Project Impact Assessment Method in the NSW Energy Savings Scheme[105]

Year	Discount Factor
1	1.0
2	0.8
3	0.6
4	0.5
5	0.4

The ESS Rule also allows ACPs who use the forward creation provisions to revisit the savings claimed at the end of the five-year period and to 'top up' the savings if a greater level of savings can be verified. To do this ACPs must maintain adequate records so that any additional savings claimed can be validated by an independent audit of the project.[106]

3.10.2 Metered Baseline Method

The Metered Baseline Method involves measuring the electricity consumption before the RESA commences to establish a baseline electricity consumption standard for the site, and then measuring this consumption again after the RESA has commenced to establish new levels of electricity consumption. The difference between these measurements represents the impact of the RESA (assuming that the remainder of the site continues to operate as it did before the RESA commenced). This idea of 'before' and 'after' measurements is fundamental to the design of the ESS as the recognition of energy savings is based on being able to confirm savings against a baseline.[107]

The Metered Baseline Method comprises four sub-methods for measuring consumption. Which of these is most appropriate depends on the nature of the project. These methods comprise:

- the **baseline per unit of output method**, used where consumption is strongly linked to output;

[105] New South Wales Independent Pricing and Regulatory Tribunal (2014k).
[106] New South Wales Independent Pricing and Regulatory Tribunal (2014k).
[107] New South Wales Independent Pricing and Regulatory Tribunal (2014k).

- the **baseline unaffected by output method**, used where energy consumption is not linked to output;
- the **normalised baseline method**, used where the baseline needs to be normalised to remove explainable variation from the baseline, such as changes to ambient conditions or input characteristics;
- the **NABERS method** is based on the normalised baseline approach and is used for buildings that have a National Australian Built Environment Rating System (NABERS) energy rating.

3.10.3 Deemed Energy Savings Method

The Deemed Energy Savings Method is used for the installation of common end-user equipment, such as refrigerators and energy-efficient lighting. The method comprises four sub-methods, which provide robust and easy-to-use equations and factors to calculate the energy savings and number of ESCs that can be claimed for specific energy savings activities. The method allows ESCs to be claimed at the time of implementation of the energy savings activity, for the energy savings that will occur over the deemed lifetime for the activity. As part of the calculation methodology of each sub-method, there are assumed deeming periods for different activities. The Scheme Administrator also takes account of these deeming periods when determining actual annual energy savings from accredited RESAs.

Table 9 shows the deeming periods for some of the common energy savings activities.

Table 9. Deeming Periods for Certain Energy Savings Activities Under the Deemed Energy Savings Method in the NSW Energy Savings Scheme[108]

Energy Savings Activity	Deeming Period
Replacement of 50W ELV halogen lamp with 35W ELV halogen lamp	4,000-10,000 hours
Replacement of 50W ELV halogen lamp and magnetic transformer with 35W ELV halogen lamp and electronic transformer – Residential & Commercial	4,000-10,000 hours
Replacement of a 50W halogen ELV lamp and transformer with a CFL, CCFL, LED or CMH, which has a Lamp Life of ≥10,000 hours	10,000 hours
Purchase of a new high efficiency Clothes Washer	12 years
Purchase of a new high efficiency Dishwasher	16 years
Destruction of refrigerator or freezer built before 1996	7 years
Purchase of a new high efficiency Refrigerator	16 years
Purchase of a new high efficiency Freezer	20 years
Upgrade of commercial lighting, where the upgrade cannot be easily 'reversed': Other lighting	10 years
Upgrade of commercial lighting, where the upgrade cannot be easily 'reversed': Road lighting	12 years
Installation of high efficiency motor	12-25 years
Power factor correction equipment	10 years

[108] New South Wales Independent Pricing and Regulatory Tribunal (2014k).

The four sub-methods are:[109]

- **default savings factors**, used for projects that involve the installation or supply of particular end-user equipment types that are listed in the ESS Rule with their specified default savings factors. Energy savings activities covered under this sub-method include: replacement of halogen down-lights with energy efficient alternatives; sale or purchase of energy efficient clothes washers, dishwashers, fridges or freezers; retirement of old spare fridges and freezers; and installation of energy-efficient showerheads as part of a bundle of products and services included in a Home Energy Efficiency Retrofit;
- **commercial lighting energy savings formula**, used for projects that only involve energy savings attributable to commercial lighting upgrades. An electronic Commercial Lighting Calculation Tool is available on the ESS website for persons to calculate the number of certificates they may create from a commercial lighting upgrade. The Tool sets out the correct factors and discounts applicable for all eligible types of commercial lighting installations. As new technologies become available, both the ESS Rule and this tool will be updated to take account of new developments;
- **high-efficiency motor energy savings formula**, used for projects that only involve energy savings attributable to the sale or installation of one or more high efficiency motors. The ESS Rule contains an extensive list of default load utilisation factors for high efficiency motors where the end-user equipment and end-use are known. The load utilisation factors are divided into different categories depending on the end-use industry sector (eg, agriculture, mining, construction etc);
- **power factor correction energy savings formula**, used for projects that only involve energy savings attributable to the reduced losses from the installation of power factor correction equipment that increases the power factor of a site above 0.9 to a maximum of 0.98.

3.11 Cost-Effectiveness

In 2011 and 2013, the Scheme Administrator engaged consultants to carry out studies of the cost of participation in the ESS. The 2013 report summarized results from 2009, 2010 and 2013.[110]

Table 10 shows the shows the total costs to ACPs of participating in the ESS by creating ESCs. In Table 10, the costs are presented as a cost per ESC, and the value of each major cost item (project delivery cost and business cost) is shown. Data are a weighted average of the number of ESCs generated by the interviewed sample of ACPs, as opposed to an average of the responses of each ACP, which would not reflect the large differences between the number of ESC's generated by each ACP. Because there was substantial variation in delivery costs for ACPs in 2012, a range is presented.

[109] New South Wales Independent Pricing and Regulatory Tribunal (2014k).
[110] Databuild Research and Solutions (2013).

Table 10. Total Costs of Creating ESCs for Accredited Certificate Providers Compared with the Sale Price in the NSW Energy Savings Scheme[111]				
	2012		2010	2009
No of interviews	13		18	
Sale price per ESC	AUD25.36		AUD25.05	AUD21.70
	High Delivery Cost	Low Delivery Cost		
Project delivery cost	AUD15.92	AUD9.06	AUD19.28	AUD19.28
Business cost	AUD5.78	AUD5.78	AUD7.45	AUD3.88
Total cost per ESC	**AUD21.70**	**AUD14.84**	**AUD26.73**	**AUD23.16**

Table 10 shows that the costs to ACPs of participating in the ESS reduced between 2009 and 2012. Moreover, it appears that, on average, it did not become cost-effective for ACPs to participate in the ESS until 2012. However, there are some uncertainties in the estimates of delivery cost because the data are based on a small sample, and ACPs had difficulty in identifying this cost, leading to variability in the data provided.

Table 11 shows the costs to electricity retailers of meeting their ESS targets by acquiring ESCs.

Table 11. Total Costs of Acquiring ESCs for Electricity Retailers in the NSW Energy Savings Scheme[112]			
	2012	2010	2009
Cost of purchasing ESCs	AUD29.08	AUD29.96	AUD20.18
Staff, management and admin	AUD0.24	AUD0.59	AUD3.24
Preparing Annual Energy Savings Statements		AUD0.10	AUD0.26
ESC purchase negotiations		AUD0.08	AUD0.27
Auditing	AUD0.04	AUD0.23	AUD0.71
Other costs	AUD0.02	AUD0.25	AUD0.66
Total Costs per ESC	**AUD29.39**	**AUD24.20**	**AUD25.32**
Based on interviews with seven electricity retailers.			

Purchasing ESCs was the major cost for electricity retailers; after this, the main items in internal costs were staff costs and auditing costs. Whilst the distribution of internal costs by categories remained broadly similar over the period, the actual cost levels decreased substantially. Reasons for this include:[113]

[111] Databuild Research and Solutions (2013).
[112] Databuild Research and Solutions (2013).
[113] Databuild Research and Solutions (2013).

- efficiencies in administering participation in the ESS made by the electricity retailers since the scheme was established;
- the absence of investment costs in 2012 – costs in 2009 and 2010 included investment in systems to administer electricity retailers' participation in the ESS;
- participating in the ESS, and the costs involved in participation, became progressively more embedded into electricity retailers' operations between 2009 and 2012.

The 2011 study also carried out a cost-benefit analysis of the ESS on a total resource costs basis, taking into account benefits such as reduced energy bills. In the context of the study, 'total resource costs' means the total net cost or benefit to society as a whole, taking into account the activities of all ESS stakeholders, and eliminating transfer costs which occur where there is a cost incurred by one party (e.g., to electricity retailers), that is a benefit elsewhere (e.g., to ACPs). The cost benefit analysis was calculated on all energy savings activities delivered by the ESS and the calculations are based on forecast ESS activities over the expected life of the scheme from 2009 to 2020, as estimated by a forecast of ESC creation developed by the Scheme Administrator.[114]

Table 12 shows the total net costs and benefits per ESC over the period 2009-2020. In Table 7, *benefits* are shown as *positive* numbers, and *costs* as *negative* numbers in brackets. The major conclusion from Table 7 is that **the total net benefit is AUD24.56 per ESC created under the ESS**.

Table 12. Total Net Costs and Benefits per ESC in the NSW Energy Savings Scheme, 2009-2020[115]	
Net creation cost per ESC	(AUD15.07)
Net lifetime benefit per MWh saved	AUD39.63
Total net benefit per ESC	**AUD24.56**

3.12 Performance Incentives and Penalties

There are no incentives provided to Liable Entities that achieve energy savings in excess of their ESS targets. ESCs that a Liable Entity acquires in excess of its annual target may be used to meet targets in subsequent years.

All Liable Entities must lodge an Annual Energy Savings Statement with the Scheme Regulator by 30 April each year. These statements must be audited by independent auditors selected from a panel established by the Scheme Administrator. Failure to submit a statement carries a penalty. The Scheme Regulator must prepare an annual report to the Minister on the extent to which scheme participants have complied, or failed to comply, with their individual ESS targets during the previous year.

If a Liable Entity does not surrender the required number of ESCs in a given year, it must pay a shortfall penalty. The penalty price acts as a practical maximum price for ESCs. The penalty rate is normally adjusted in November each year, for the following year, to account for changes in the Consumer Price Index. For the 2014 compliance year the penalty rate is AUD25.97 per ESC in

[114] Databuild Research and Solutions (2011).
[115] Databuild Research and Solutions (2011).

shortfall. The penalty is not tax deductible and; once tax impacts are taken into account, the 2014 penalty rate is equivalent to AUD37.10 per ESC.[116]

As an alternative to paying the penalty, a Liable Entity may choose to carry forward all or part of its shortfall to the following compliance period. The maximum shortfall that may be carried forward in any given year is 10 percent of a Liable Entity's individual energy savings target, with the exception of 2009, when up to 50 percent of the target could be carried forward into 2010. Any shortfall carried forward must be made up in the following year.

3.13 Response to Stress Situations

Energy savings achieved under the ESS and its predecessor GGAS have not been used to respond to any stress situations. Because of the way the energy savings are achieved, through closely-defined energy savings activities, it would be difficult to target energy savings achieved through the ESS to relieve particular stresses on the electricity system.

3.14 Overall Effectiveness

The ESS and its predecessor GGAS together comprise the longest-running energy efficiency certificate scheme in the world. The schemes' combined experience of more than 10 years has enabled progressive revision and refinement of scheme parameters, including definitions of eligible energy efficiency measures, deemed energy savings values, methodologies for calculating the numbers of certificates that can be created, and scheme administrative procedures. These changes have established the ESS as an efficient and cost-effective mechanism for delivering energy savings.

Energy efficiency certificates are an effective mechanism to provide funding for energy efficiency activities. This method of funding enables governments, as the initiator of energy efficiency certificate schemes, to achieve their energy savings objectives without contributing government funds. Ultimately, the cost of such schemes is paid by end-use energy customers through increases in energy prices, though downward pressure is maintained on prices when obligated energy suppliers operate in competitive markets, as do NSW electricity retailers.

Enabling non-obligated third parties to implement energy savings projects and create energy savings certificates is a unique characteristic of two Australian energy efficiency certificate schemes: the ESS and the Victorian Energy Efficiency Target scheme. Third party acquisition of energy savings increases the number of delivery agents involved and arguably also increases innovation in identifying energy savings opportunities and implementing energy savings projects.

In NSW, the establishment of ACPs as energy savings delivery agents, together with the funding available through the sale of ESCs, has resulted in the development and growth of an energy services industry and the creation of significant numbers of new jobs.

The limitation of the ESS to cover electricity only has not changed since the commencement of the scheme and its predecessor GGAS. The NSW government has now decided to expand the coverage of the ESS to gas during 2015, and this will position the scheme to significantly expand the quantity of energy savings delivered.

[116] New South Wales Independent Pricing and Regulatory Tribunal (2014h).

3.15 Lessons Learnt

The ESS has successfully demonstrated two unique policy and regulatory mechanisms that assist in the implementation of utility delivery of energy efficiency: trading of energy efficiency certificates and the accreditation of third parties to achieve energy savings. Together these two mechanisms have enabled the establish and development of an energy services industry in New South Wales and have contributed to a major increase in the quantities of energy savings being achieved in the state. Jurisdictions looking to establish a new energy services industry or expand and existing one can learn a great deal from the experience of the NSW Energy Savings Scheme.

4. SOUTH AFRICA'S UTILITY INTEGRATED DSM PROGRAMS

4.1 Introduction

Electricity is the most important source of energy for end users in South Africa. Electricity is therefore an appropriate focus for its energy efficiency initiatives. Electricity is central to both the economy and household needs. The South African economy is driven by mining and related industries that are energy-intensive.[117] The major export industries, especially non-ferrous metal exports and mining, rely heavily on electricity.[118] Households are similarly dependent on electricity. Most households use electricity for all their major needs, including lighting, cooking, and heating. The penetration of major kitchen appliances and cell phones depend on access to electricity.[119] Indeed, 40% of the electricity used on the African continent is used by South Africa.[120]

Electricity in South Africa is also important for its environmental footprint. Coal is the primary fuel for electricity generation, providing 90% of the electricity produced in South Africa. The coal used by South African generators is increasingly less efficient, lower quality/high ash content due to exports of higher grade coal. Electricity is consequently a major source of CO2 and toxic pollutants. South Africa is one of the highest per capita emitters of CO2 among middle income nations.[121]

Extending the reach of electricity throughout the nation remains an important aspiration for a nation still trying to overcome its legacy of apartheid. South Africa embarked upon, and largely succeeded in, providing wider access to electricity. The share of households with access to electricity has improved from 44% in 1994 to 85% in 2014.[122] Nevertheless, issues of poor rural access and electricity affordability loom large in the country.

The key institutions in the South Africa power system include Eskom, the government-owned largely vertically-integrated monopoly provider of electricity generation, transmission and distribution services. Municipal utilities purchase electricity from Eskom, own their own generation projects, or purchase from independent power producers (IPPs) and distribute power. Eskom reports to its own Board, but electricity prices are overseen by the National Energy Regulator of South Africa (NERSA). The prices established by the municipal utilities are also subject to NERSA oversight.

Eskom is responsible for generating 96 percent of electricity in South Africa, municipalities generate about 1 percent and independent power about 3 percent.[123] One hundred and eighty municipalities distribute approximately 41 percent of the electricity to 60 percent of end-use customers, the remainder is distributed by Eskom. Eskom is also responsible for the delivery of most energy efficiency programs and services to South Africans. Efforts around energy efficiency have provided some early success, but further progress may be a victim of a system seemingly in perpetual transition.

[117] Wang et al. (2011).
[118] de la Rue du Can, Letschert, Leventis, Covary, and Xia (2013).
[119] de la Rue du Can et al. (2013).
[120] South Africa Department of Minerals and Energy (2005).
[121] Wang et al. (2011).
[122] Eskom (2013b).
[123] Wang et al. (2011).

Early successes suggest that Eskom has employed energy efficiency and demand-side management (DSM) to reduce loads by about 3.6 GW from 2005 through 2012, or roughly 12 percent of system peak load requirements. Energy efficiency efforts also reduced electricity demands by over 4TWh.[124] Since 2007, South Africa has managed to keep loads flat to declining. The lack of growth in electricity sales can be attributed, in part, to significant increases in electricity tariffs from 2008 to the present.[125]

Until 2008, South Africa successfully met loads and provided a high quality service at some of the lowest prices for electricity internationally. In 2008, some underlying failures of the system began to emerge that resulted in a serious shortage of electric generation capacity, resulting in load shedding or planned blackouts on a rolling basis.

Many load shedding or rolling blackout events were precipitated by the shortfall in 2008 and 2009. According to one source, the size of "the power shortage was staggering—about 3500 MW or about 10 percent of peak demand, every weekday from 6 am to 10 pm." The causes of the shortfall were many but boiled down to Eskom's owners (the Government of South Africa) not making the investments identified a decade prior, at least in time for delivery by 2008. Demand-side solutions, including DSM became an important part of the overall response.[126]

Eskom emerged from this period of shortages in May 2009 with some additional peaking capacity, but still facing narrow reserve margins. However, commitments to new base load generation capacity came later with some delays. Following the 2009 shortage, another shortage in capacity emerged in 2013, forcing appeals to the public and one planned blackout in March 2014. As at October 2014, the shortfall is expected to continue at least until 2015.

Historically, South Africa has enjoyed low prices for retail power. This began to change in 2007 when South Africa embarked on an effort to raise the price of electricity to reflect the long term price of power under its framework of regulation that allowed for Multi-year Price Determinations (MYPD). In FY 2007, the price level approved by NERSA was ZAR 0.179/kWh. The price level approved for the FY 2015 year is ZAR 0.7075/kWh or nearly four times the levels that existed in FY 2007.[127,128]

NERSA approves electricity tariffs that include a DSM component, which is collected by Eskom and used in DSM and energy efficiency initiatives. In 2013 Eskom appealed to the regulator for a successive round of price increases over the next five years of 16 percent annually and was rebuffed, with the regulator allowing only about half the proposed increases. One of the apparent casualties of the effort was Eskom's integrated demand-side management initiatives. Of the roughly ZAR 13 billion investment proposed, only about 40% (ZAR 5 billion) was approved by NERSA.[129]

This decision followed a period of seeming success in which the combination of rate increases and demand-side program initiatives (combined with the addition of some peaking capacity) resulted in stable and declining loads, that helped to address reliability challenges.

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124 Eskom (2013b).
125 Wang et al. (2011).
126 Wang et al. (2011).
127 National Energy Regulator of South Africa (2010).
128 National Energy Regulator of South Africa (2013).
129 National Energy Regulator of South Africa (2013).

4.2 Policy Objectives

In December 1998, the South African Cabinet approved a White Paper on energy policy. In the White Paper, the government declared that 40 percent of the population was still without access to electricity, making electrification a priority.[130] Portions of the White Paper recognized the need to implement energy efficiency across all sectors of the economy in support of economic development and affordable access.[131]

In 2004, NERSA promulgated the *Regulatory Policy on Energy Efficiency and Demand-Side Management for the South African Electricity Industry*.[132] This policy made energy efficiency and DSM planning and implementation a license condition for all major electricity distributors. It also defined the potential roles of energy services companies (ESCOs) and created an independent monitoring and verification (M&V) body, accountable to NERSA.

In 2005, a national energy efficiency strategy was published that outlined a vision and goals for energy efficiency in South Africa (see Figure 8).[133]

Energy Efficiency Strategy of the Republic of South Africa

Vision

To encourage sustainable energy sector development and energy use through efficient practices thereby minimizing the undesirable impacts of energy usage upon health and the environment, and contributing toward secure and affordable energy for all.

Goals

Social Sustainability

1. Improve the health of the nation
2. Create jobs
3. Alleviate energy poverty

Environmental Sustainability

4. Reduce environmental pollution
5. Reduce CO_2 emissions

Economic Sustainability

6. Improve industrial competitiveness
7. Enhance energy security
8. Reduce the need for additional generating capacity

Source: Department of Minerals and Energy, 2005.

Figure 8. Summary of South Africa's National Energy Efficiency Strategy[134]

[130] South Africa Department of Minerals and Energy (1998).
[131] South Africa Department of Minerals and Energy (1998).
[132] National Electricity Regulator (2004).
[133] South Africa Department of Minerals and Energy (2005).

In South Africa, energy efficiency is recognized as a component of a broader planning and decision-making environment known as integrated resource planning that includes consideration of both supply-side and demand-side resources. In 2010, the South African Department of Energy recognized investments in energy efficiency DSM as “no-regret” policies that have been underfunded.[135] In 2011, South Africa adopted an Integrated Resource Plan (IRP)[136] that went through a subsequent round of revisions for final release in 2013.[137]

4.3 Legal Authority

The *Electricity Regulation Act of 2006* introduced a regulatory framework for the power industry.[138] NERSA established under the *National Energy Regulator Act of 2004* serves as the entity responsible for carrying out the functions included in the 2006 law.[139]

Section 15 of the 2006 Act requires every electricity distributor licensee to comply with energy efficiency standards and demand side management. The Act also creates mechanisms for cost recovery of energy efficiency investments. The Act authorized NERSA to implement the national government’s electricity policy through regulations and modifications of license terms. In effect, NERSA became the institution for implementing the policy framework to deliver energy efficiency through licensed utility service providers.

4.4 Coverage

In South Africa, energy efficiency and demand-side management initiatives are administered by the state owned electricity company, Eskom. Because of the capacity shortfalls, the strategy is especially focused on reducing capacity or demand during peak periods on the electricity system. Other fuels are addressed through investment tax credits that are administered nationally. All sectors of the economy are covered by Eskom’s integrated DSM program, although the cumulative savings have fallen disproportionately on the residential and municipal distribution company efforts (76 percent); industry cumulative savings is another 19 percent, while commercial and agricultural savings are roughly 5 percent.[140]

4.5 Energy Savings Targets

The *National Energy Efficiency Strategy* (NEES) established initial targets for energy efficiency improvement of 12 percent by 2015 as approved by Cabinet in March 2005. Further review occurred in October 2008 and through the *Energy Act of 2008*.[141] These targets are aspirational without practical consequence for either success or failure. Sector specific targets are shown in Table 13.

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[134] South Africa Department of Minerals and Energy (2005)
[135] South Africa Department of Energy (2010).
[136] South Africa Department of Energy (2011).
[137] South Africa Department of Energy (2013).
[138] South Africa Legislation (2006).
[139] South Africa Legislation (2004).
[140] de la Rue du Can et al. (2013).
[141] de la Rue du Can et al. (2013)

Table 13. Sectoral Energy Efficiency Targets in South Africa's National Energy Efficiency Strategy[142]	
Sectors	**Target by 2015**
Industry	15%
Mining	15%
Power Sector	15%
Commercial & Public Buildings	15%
Residential	10%
Transport	10%

By 2013 it was recognized that the NEES electricity savings targets for 2015 were not going to be achieved.[143] However, the regulatory targets set for the period of the second Multi-year Price Determinations (MYPD2) for FY 2011, 2012, and 2013 appear to have been met.[144] A determination by NERSA to reduce funding for energy efficiency and DSM will challenge the utilities' ability to deliver in the future.

4.6 Energy Efficiency Activities

Figure 9 summarizes Eskom's energy efficiency and DSM activities.

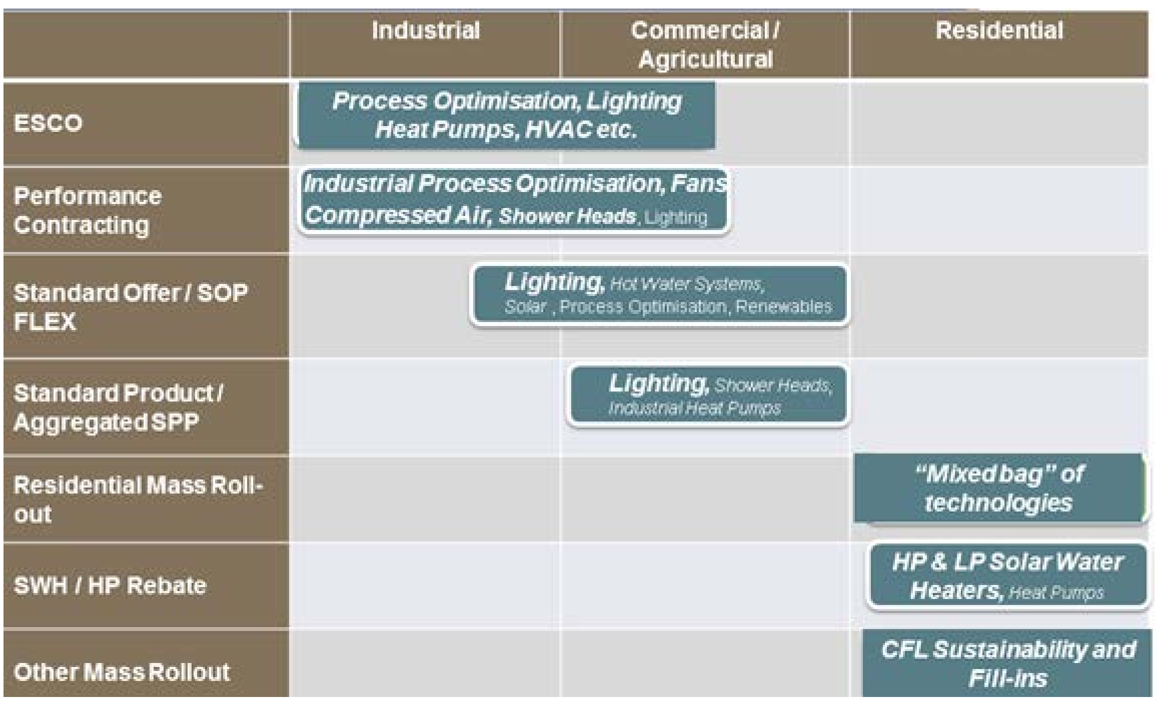

Figure 9. Eskom's Energy Efficiency and DSM Activities[145]

[142] South Africa Department of Minerals and Energy (2005).
[143] de la Rue du Can et al. (2013).
[144] Eskom (2013a).
[145] Eskom (2013b).

Eskom's ESCO program has been in existence for many years. From FY 2005 through FY 2012 and into FY 2013, Eskom reported that they had engaged in approximately 450 ESCO projects producing 869 MW of demand reductions and 2727 GWh of energy savings. The ESCO program targeted customers over 500 kW. Despite the successes, there were complaints from both the ESCO industry and Eskom about difficulties with the program.[146,147]

The Eskom standard offer program was analogous to a renewable feed-in tariff program. The program involved the replacement of inefficient equipment with efficient equipment and targeted customers between 10 kW and 5 MW.[148] The program proved successful and rapidly achieved 113.5 MW of demand reductions and 609 GWh of savings in less than two years of active delivery.

The Standard Product program provided set payments for deemed savings associated with efficient replacements including lighting, shower heads and heat pumps. The target audience was commercial customers under 500 kW. This program also proved highly successful and achieved over 112 MW demand reduction and 493 GWh of savings during the initial two years.

The residential CFL mass roll-out program proved to be Eskom's most enduring successful program, although Eskom expect to rely on this program significantly less in the future. Under the distinct residential mass-rollout initiative, Eskom segmented the residential market into three housing segments along largely income characteristics. The type of delivery mechanisms included door-to-door delivery, direct installation, and leveraging retailers offering product discounts. The most significant share of future demand reductions are expected from this program.[149]

4.7 Marketing, Education and Outreach

Throughout the period from 2008 through 2014, South Africa's government, and especially Eskom, have faced major consumer education and public awareness concerns not just with the delivery of its energy efficiency programs, but also more broadly with a capacity shortfall that led poor system reliability and a crisis of confidence in Eskom and government.

Adding to the challenges were the significant price increases that were required to recover the costs of investments in major new power stations. After decades of declining nominal and real prices of electricity, South Africa experienced annual price increases in excess of 20 percent annually during the seven-year period from FY 2007 to FY 2014. Eskom engaged in a significant campaign of public outreach to explain the price increases, and appeal to customers to gain public cooperation around load shedding (rolling blackouts) and its DSM programs.

4.8 Funding

In 2004, NERSA established the Energy Efficiency and Demand-side Management Fund, administered by Eskom, and defined the rules for its implementation (see Figure 10).

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[146] Eskom (2013b).
[147] Wang et al. (2011).
[148] Eskom (2013b).
[149] Eskom (2013b).

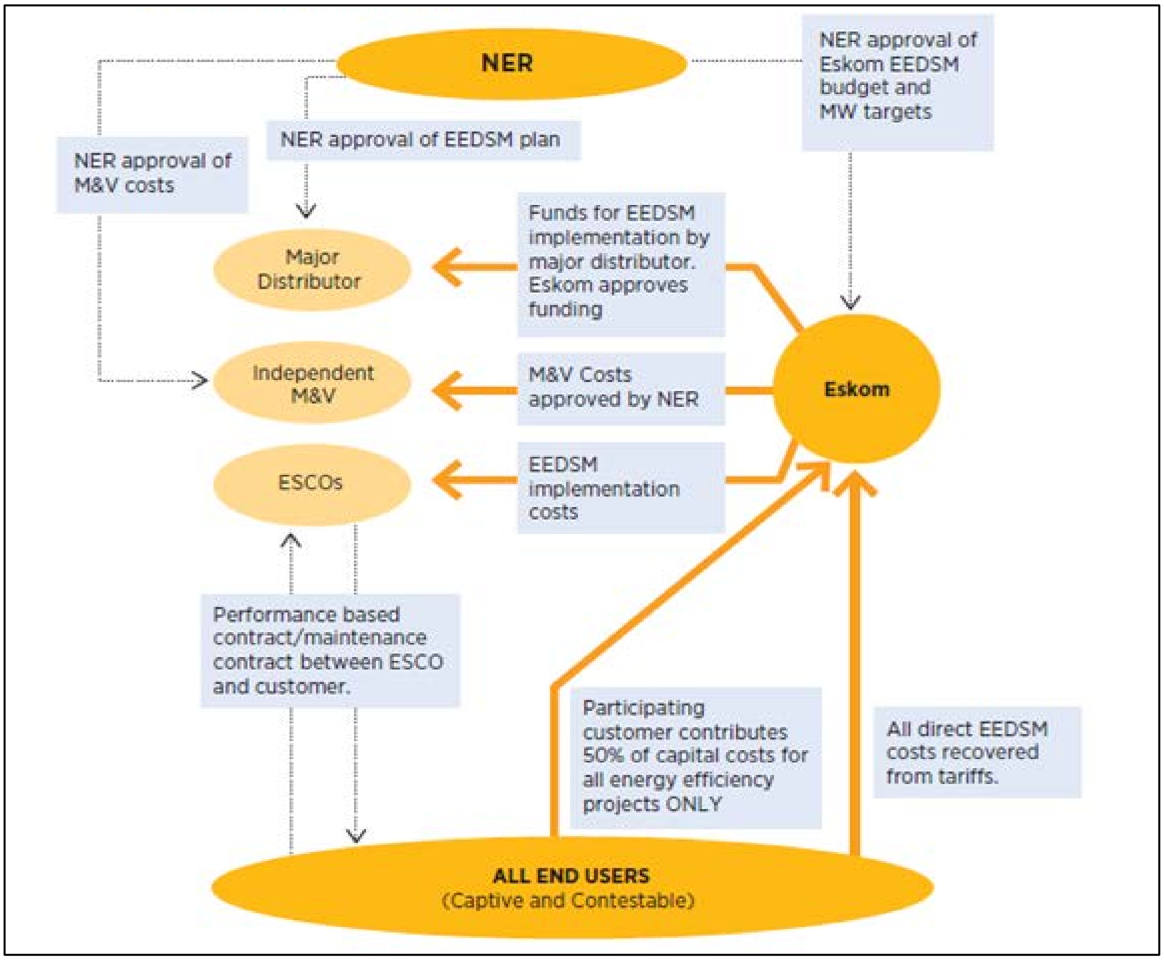

Figure 10. Operation of the Eskom Energy Efficiency and Demand Side Management Fund[150]

NERSA sets electricity prices for multi-year periods under its multi-year price determinations (MYPD). These determinations have become the main instrument for funding energy efficiency and DSM in South Africa, at least so far as they cover Eskom. Recent price determinations were for FY 2010 through FY 2013 (MYPD2)[151] and FY 2014 through FY 2018 (MYPD3).[152] NERSA issued approvals for budgets and prices to allow recovery of DSM investments in both MYPD2 and MYPD3.

In MYPD2, investment levels for DSM for the period from FY 2010 through FY 2013 were approved at about 1.5 percent of gross revenues. Table 14 shows budgets and energy efficiency targets for MYPD 2 implemented by Eskom.

[150] Wang et al. (2011).
[151] National Energy Regulator of South Africa (2010).
[152] National Energy Regulator of South Africa (2013).

Table 14. Funding Provided to Eskom for Energy Efficiency and DSM, 2010 to 2013[153]					
Applied for by Eskom	Period	FY 2010/11	FY 2011/12	FY 2012/13	Total
	Funding Required (Rm)	1 521	1 882	2 809	**6 212**
	Demand Savings (MW)	301	313	459	**1 073**
	Energy Savings (GWh)	994	1 280	1 827	**4 101**
	R/kWh	1.53	1.47	1.54	
Allowed by NERSA	Funding Required (Rm)	1 406	1 688	2 351	**5 445**
	Demand Savings (MW)	289	301	447	**1 037**
	Energy Savings (GWh)	977	1 263	1 815	**4 055**
	R/kWh	1.44	1.34	1.30	
Disallowed(R'm)		115	193	459	**767**

For MYPD3, Eskom proposed, but did not receive, funding levels for DSM for the period from FY 2010 through FY 2013 that more than doubled the earlier investments in MYPD2. Approximately ZAR 5.2 billion in investments were approved by NERSA in MYPD3, well below the funding levels proposed by Eskom.

Table 15 shows the approved expenditure levels for Eskom during the period 2014 to 2018, including the expenditure levels for integrated DSM. In other regions, especially the United States, funding levels for the most ambitious energy efficiency and DSM programs exceed three percent of revenues and aggressive programs are between one and three percent.[154] In comparison, South Africa's DSM funding for the period 2014 to 2018, at least through Eskom, is now considerably below one percent of revenues.

Table 15. Approved Expenditure Levels for Eskom, 2014 to 2018 (ZAR million)[155]						
	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Return	23 477	26 511	26 436	27 657	33 667	137 748
Primary Energy Costs	51 067	54 966	56 779	62 060	68 620	293 492
Independent Power Producers	2 686	5 108	14 826	19 269	23 018	64 907
Depreciation	25 733	27 481	28 564	28 911	29 197	139 886
Integrated Demand-side Management	1 455	953	819	712	1 244	5 183
Operating costs	45 519	48 565	52 908	57 769	60 576	265 337
Total Allowed Revenues	149 937	163 584	180 332	196 378	216 322	906 553

153 National Energy Regulator of South Africa (2010).
154 Wang et al. (2011).
155 National Energy Regulator of South Africa (2013).

4.9 Results

Overall, Eskom claims levels of achievement with respect to capacity reductions that far exceed the targets set by the regulator. Figure 11 shows the targets set by Eskom and NERSA and the levels of demand reductions actually achieved. The strongest performance occurred during the period in which the system was under the greatest stress in 2008 and 2009.

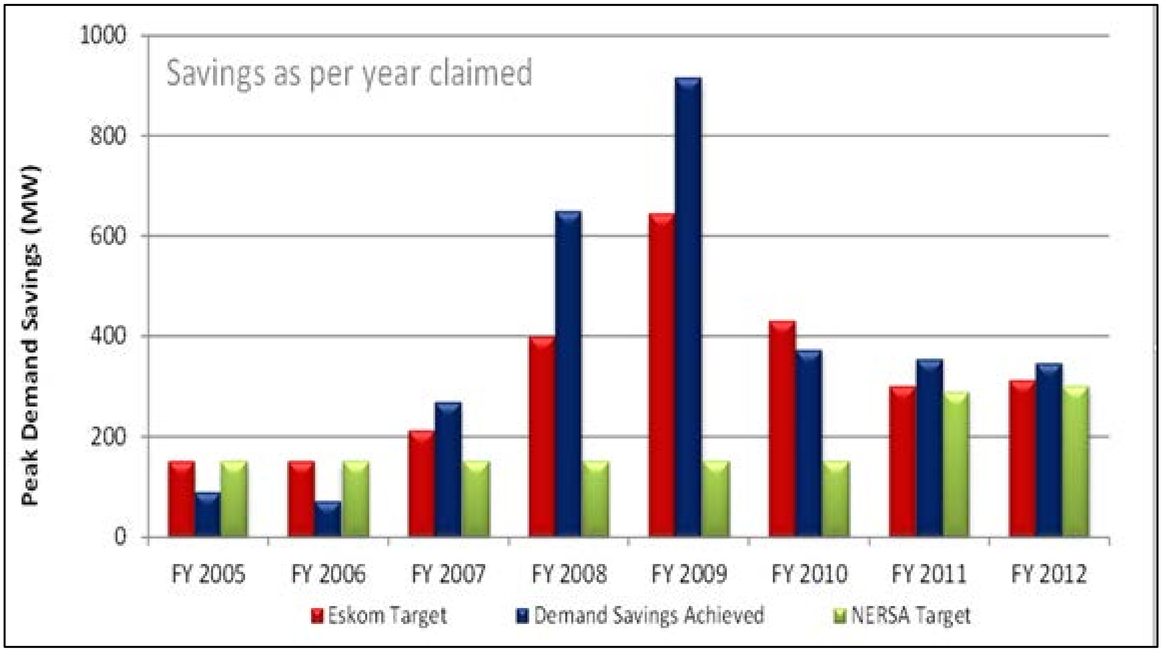

Figure 11. Peak Demand Reductions Achieved by Eskom Energy Efficiency and DSM Programs Compared with Targets, 2005 to 2012[156]

Over the eight years that demand reductions were pursued through integrated DSM and other initiatives, Eskom claims net savings of 3073 MW from FY 2005 through FY 2012 and savings of 3400 MW through March of 2013.[157]

4.10 Evaluation, Measurement and Verification

Monitoring and verification of the results of Eskom's integrated DSM efforts has received considerable attention by NERSA and the academic community in South Africa.[158] M&V is incorporated into energy efficiency and DSM programs and M&V costs are allowed up to eight percent of the total project costs.[159] During MYPD2, Eskom was allowed ZAR 128 million for the M&V costs of programs. However, discussions with experts estimate that about 3 percent in average are spent on M&V.[160]

Eskom administers the M&V process and its Energy Audit Division contracts with universities across South Africa to conduct M&V assessments reflecting some measure of independence from Eskom.

[156] Eskom (2013b).
[157] Eskom (2013b).
[158] Xia (2013).
[159] National Energy Regulator of South Africa (2010).
[160] de la Rue du Can et al. (2013).

Standard guidelines for M&V of energy savings are established in the South African Standard SANS 50010, which was developed based on the International Performance Measurement and Verification Protocol (IPMVP) documentation.[161] SANS 50010 provides a standard approach to measurement and verification of energy savings and energy efficiency for use in voluntary and regulatory process in South Africa.[162] More specific guidelines are also developed for each program type or for specific energy efficiency measures. South Africa has also an independent professional body called the Council of Measurement and Verification Professionals of South Africa (CMVPSA) which offers training and certification of professionals.

4.11 Cost-Effectiveness

Energy efficiency gained in stature with the establishment in 2005 of the *National Energy Efficiency Strategy*. At the time, energy efficiency was recognized by Government as one of the most cost-effective ways of meeting the demands of sustainable development because in excess of 50 percent of energy efficiency measures were no-cost/low cost with payback periods of less than three years (see Table 16).[163]

Table16. Potential Average Energy Savings and Costs from Implementing South Africa's National Energy Efficiency Strategy[164]

Energy Savings (PJ)	Energy Savings (GWh)	Average Cost per kWh Saved	Total Cost
29	8.1	ZAR 0.2	ZAR 1,611,111.11
45	12.5	ZAR 0.2	ZAR 2,500,000.00
63	17.5	ZAR 0.3	ZAR 5,250,000.00
81	22.5	ZAR 0.3	ZAR 6,750,000.00
101	28.1	ZAR 0.4	ZAR 11,222,222.22
		Total for 5 years	**ZAR 27,333,333.33**

4.12 Performance Incentives and Penalties

Eskom is responsible for meeting its savings targets over the course of the multi-year performance plan. In the case of a failure to meet the performance targets, a non-performance the penalty is imposed. Non-performance in this case means that Eskom does not reach the goal set in term of savings in MW and GWh. The penalty is calculated as follows:[165]

Penalty(R/MW) = total allowed revenue ÷ proposed MW =R/MW x MW (unsaved MW)

No other provision has been made for removing disincentives associated with reduced sales growth.[166] However, maintaining system reliability and avoiding the need for load shedding as occurred in 2008 and 2009 are also believed to be important motivation for effective delivery of energy efficiency and DSM programs.

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[161] Efficiency Valuation Organization (2012).
[162] de la Rue du Can et al. (2013).
[163] South Africa Department of Minerals and Energy (2005).
[164] South Africa Department of Minerals and Energy (2005).
[165] National Energy Regulator of South Africa (2010).
[166] de la Rue du Can et al. (2013).

4.13 Response to Stress Situations

In its 2005 *National Energy Efficiency Strategy*, South Africa indicated that:

> *"[I]t is estimated that the country's existing power generation capacity will be insufficient to meet the rising national maximum demand by 2007-2012. Energy efficiency is integral to Eskom's Demand Side Management programme, which is intended to reduce the level of the load growth by a cumulative value of 4255 MW by 2025."*[167]

The forecast proved probably more accurate than was realized at the time. The shortfall in generation capacity was felt acutely by all of South Africa in 2008 and has persisted through 2014. Eskom exceeded even its own ambitions for demand reduction. Since the inception of its integrated DSM program initiatives, Eskom has achieved verified savings of 3,400 MW. During the period in which the capacity shortfall was most acute in FY 2009, South Africa saved over 900 MW in a single year.

4.14 Overall Effectiveness

The effectiveness of the early energy efficiency and DSM program initiatives that focused on the ESCO model for delivery proved to be poor performance years. The achieved reductions in demand were mostly achieved through the mass market residential program initiatives targeting lighting and industrial programs delivered by Eskom. Despite the successes of the integrated DSM program, NERSA has reduced the budgets for these programs over the five years from 2014.

4.15 Lessons Learnt

Impacts on system reliability have been a powerful motivator in delivering capacity savings. In the years since the capacity crisis began, Eskom has far exceeded the targets set by the regulator, and in most years, exceeded its own expectations by a wide margin.

After almost a decade without material investment in new supply, Eskom embarked upon an aggressive plan for price increases over time coupled with time-of-use pricing and inclining block rates that complemented efforts to promote energy efficiency and DSM initiatives. Price increases that occurred during the course of the last two multi-year price determination plans (MYPD2 and MYPD3) had a significant impact on demand levels.

South Africa initially pursued pathways that included heavy reliance on third party providers of energy efficiency services. However, the ESCO model proved challenging for delivery, and most of the material energy savings achieved did not rely heavily on ESCOs. The problems that were cited by Eskom include the following:[168,169]

- individual project approvals and long lead times;
- programs not applicable to the mass market;
- inconsistent evaluation criteria;
- cumbersome governance processes; and
- complex and onerous contracts.

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[167] South Africa Department of Minerals and Energy (2005).
[168] Eskom (2013b).
[169] de la Rue du Can et al. (2013).

5. CHINA'S GRID COMPANY ENERGY EFFICIENCY OBLIGATION

5.1 Introduction

China's consumption of primary energy has been growing rapidly for many years, as shown in Figure 12. While energy consumption is increasing in tandem with the growth in gross domestic product (GDP), the energy intensity of the Chinese economy has been decreasing steadily since 1980, except for a short-term blip between 2002 and 2005 (Figure 13, page 45). Currently, energy intensity in China is still higher than in the United States but is continuing to trend downward, whereas the energy intensity trend in the United States Is essentially flat.

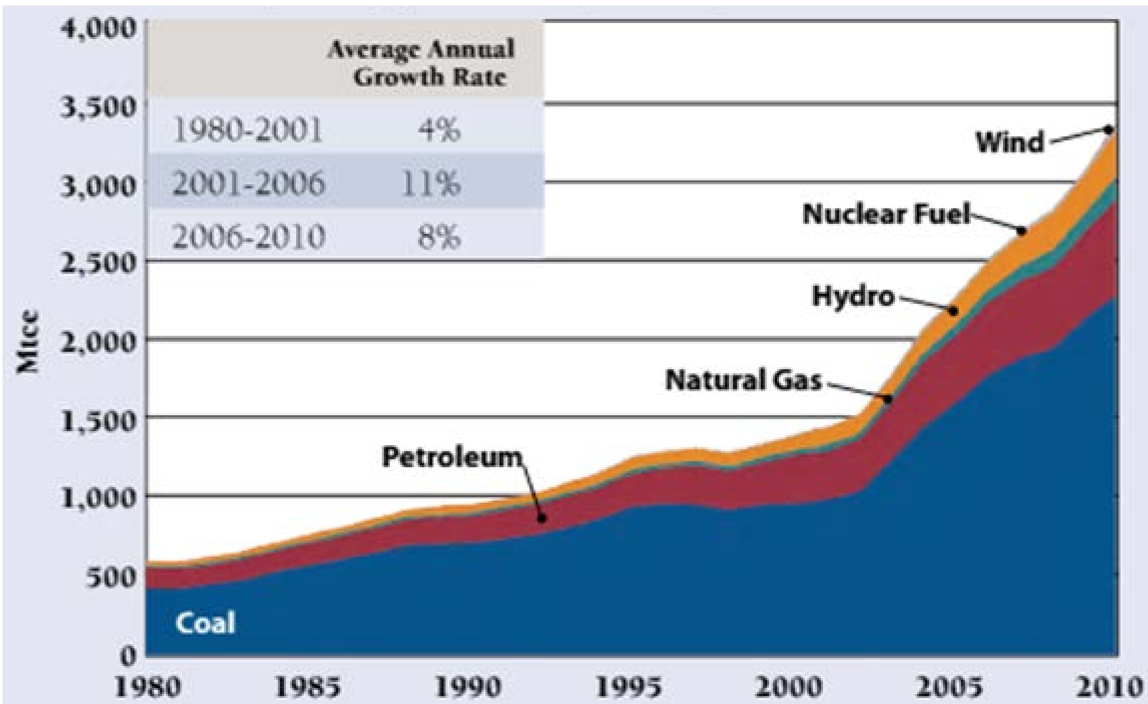

Figure 12. China's Primary Energy Consumption by Source, 1980 to 2010[170]

The continuing reduction in the energy intensity of the Chinese economy is largely the result of government policies and programs. In China, development of the country's broad and comprehensive energy efficiency programs stems from a realization that, if energy is not used more efficiently, the country's economic growth will be compromised by inadequate energy supply. The main goal of government energy efficiency policy is to uncouple economic growth from proportionate increases in energy use. Severe environmental consequences of continued rapid growth in coal consumption also are a key concern.[171]

Industry accounts for about 70 percent of final energy use (with electricity accounted at thermal replacement value) and is the largest single focus of China's energy efficiency programs, but programs cover all sectors and are implemented primarily through government agencies.

[170] Levine (2012).
[171] R. Taylor (2013).

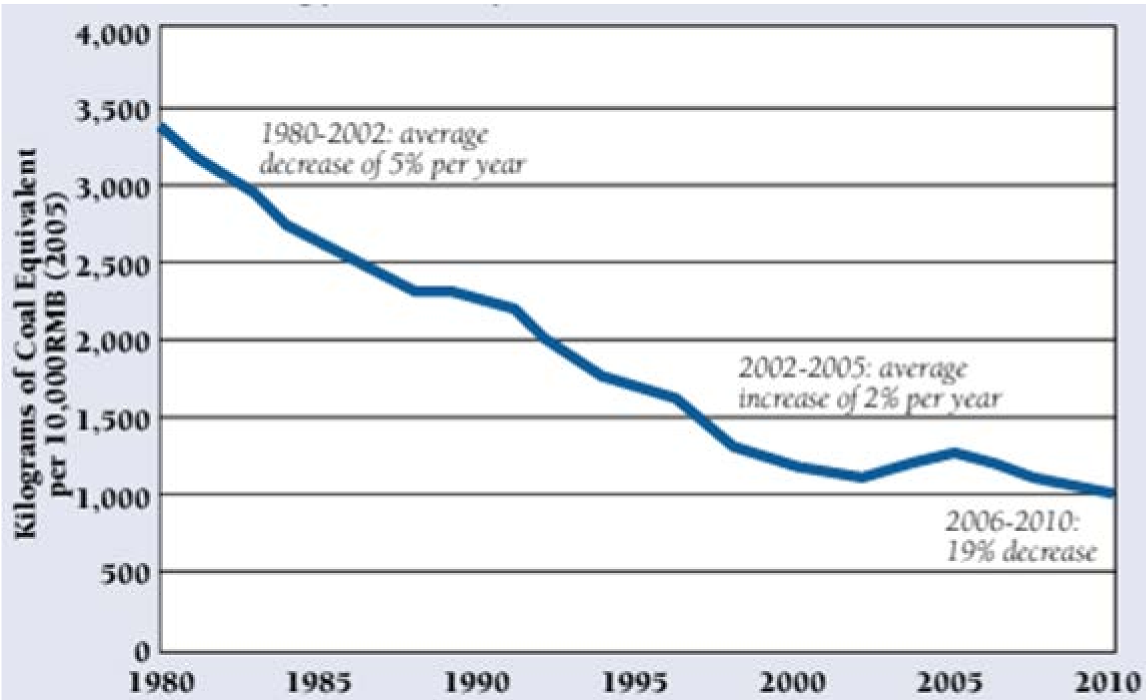

Figure 13. Energy Intensity in China, 1980 to 2010[172]

Demand-side management (DSM) was first introduced in China in the early 1990s when there was growing recognition of energy and environmental problems resulting from increasing electricity consumption driven by rapid economic growth. During the early years, DSM in China was mainly supported by government funding. Targeted load management, rather than energy efficiency DSM, was seen as a systematic way to balance economic, environmental, and social development.

After ten years' experience with DSM, the central government in China realised that energy utilities can take an important role in achieving energy savings through end-use energy efficiency measures. In November 2010, the government issued *Guidance on Electricity Demand-Side Management Regulations* (*关于印发《电力需求侧管理办法》的通知（发改运行［2010］2643)*).[173] This guidance document for the first time placed an energy efficiency obligation (EEO) on the State Grid Corporation of China and China Southern Grid Company, the two large government-owned entities that operate electricity transmission and distribution networks and sell electricity directly to end-use customers in the majority of China.[174]

The obligation requires the grid companies to achieve energy savings of at least 0.3 percent in sales volumes and demand savings of at least 0.3 percent in maximum load, both compared with the previous year's results. The EEO, which went into effect on 1 January 2011, also lays a foundation for the expansion of demand response programs by requiring the installation of load

[172] Lin, He, He, Hu, and Lu (2011); data from National Bureau of Statistics, China Statistical Abstract, various years.

[173] China National Development and Reform Commission (2010a).

[174] Electricity generation in China is carried out by separate generation companies and the grid companies purchase electricity in bulk from the generators.

monitoring equipment on 70 percent of the peak load, and load control equipment on ten percent of the peak load, in any locality.[175]

5.2 Policy Objectives

Chinese government involvement in energy efficiency commenced in the 1980s with the establishment at various levels of government of energy efficiency agencies with managerial functions.[176] Energy engineers and energy administrative bodies were also introduced into large and medium-sized state-owned enterprises, and specialized personnel were assigned to manage energy efficiency. Over 200 Energy Conservation Centers were set up by local governments and sectoral agencies; their mission was to serve as consultants to government, and to provide energy efficiency services to end users, including training and information. The Centers were originally supported with government funds, but later became dependent on revenues from sales of their services.

In 1997, an *Energy Conservation Law* was passed by the National People's Congress. This Law provided a policy framework that enabled China's 33 provincial-level governments to promulgate detailed local bylaws and regulations on energy conservation. In particular, the Law required all levels of government to arrange funds to implement energy conservation measures and to set limits, in terms of energy consumption per physical unit of product, for products that are energy-intensive to produce.

The Law also required local governments to establish a system for discontinuing backward, over energy-intensive, energy-consuming products and equipment. This led to major programs to close down old, small-scale, and inefficient energy-intensive industrial capacity, including the progressive closure of old, emissions-intensive power stations. These programs continue today.

The 1997 *Energy Conservation Law* identified key energy-using entities as those that had an annual energy consumption equivalent to more than 10,000 tons of standard coal equivalent (tce). These entities were required to appoint an energy manager and to submit periodic reports to the government on energy consumption, energy use efficiency, and the energy conservation measures they implemented.

The Law also authorized various levels of government to "supervise and manage" energy conservation work in their jurisdictions. This led to the establishment of Energy Conservation Supervision Centers by many provincial-level governments, with powers to inspect facilities, to levy fines on offenders, and even to close down offenders.

In 2004, in response to the short-term increase in energy intensity that commenced in 2002, a *Medium and Long-Term Energy Conservation Plan* was issued by the National Development and Reform Commission (NDRC), the central government's powerful agency responsible for planning economic and social development in China. The overriding goal of the Plan was to reduce by 2010 national energy intensity by 20 percent from its level in 2005.[177]

The Plan specifically defined "Ten Key Energy-Saving Projects," including: coal-fired industrial boiler retrofits, residual heat and pressure utilization, petroleum saving and substitution, motor system energy saving, and energy system optimization. The Plan set energy intensity targets for the years 2010 and 2020 for individual energy-intensive industries, including cement, steel,

175 China National Development and Reform Commission (2010a).
176 Crossley (2013a).
177 In the event, this goal was almost achieved with a 19.1 percent reduction in energy intensity over this period.

petrochemicals, oil refining, and electricity generation. The Plan also specified raising energy efficiency standards for major energy-using appliances to international levels by 2010. In 2007, many of the same targets, objectives, and policies appeared in both the *11th Five-Year Plan* and the *China National Climate Change Program*. Currently, the *12th Five Year Plan* (2011 to 2015) includes targets to reduce by 2015 energy intensity by 16 percent and carbon intensity by 17 percent from their levels in 2010.

In 2007, the National People's Congress passed an amended *Energy Conservation Law*. The 2007 Law includes a provision that the state "will implement a system of accountability for energy conservation targets and a system for energy evaluation whereby the fulfilment of energy conservation targets is taken as one part of the evaluation of local people's governments and their responsible persons." The Law therefore makes achievement of energy intensity targets a component of the performance evaluation of local governments and their officials. Individual government officials may be subject to sanctions if energy intensity targets in their areas of responsibility are not met.

The 2007 Law requires reports to government by key energy-using entities to be made annually. In addition to the requirements under the 1997 Law, these reports must also contain information about whether the entity's energy intensity targets were achieved. The Law authorizes the imposition of penalties on key energy-using entities that fail to achieve targets or implement energy efficiency measures; this covers more than 15,000 enterprises. The Law also authorizes the implementation of a system of differential electricity pricing whereby enterprises that are identified to have certain energy-inefficient production processes and/or equipment that the government requires to be limited or phased out can be charged higher prices.

The EEO placed on Chinese grid companies in 2011 is a further extension of the government involvement in energy efficiency that commenced in the 1980s. The EEO guidance document stated that DSM should be prioritised to meet electricity demand in the tight supply situation and power shortages that occur in most of China's central and southern provinces.[178] DSM is currently considered to be a mechanism that will help to deal with power shortages as well as long-term sustainability issues, such as:

- achieving end-use energy efficiency at lowest cost;
- reducing greenhouse gas emissions;
- improving environmental quality;
- integrating demand-side resources into energy, social, and economic planning; and
- enhancing grid security and reliability.

5.3 Legal Authority

The guidance document that placed the EEO on the grid companies was issued by six central government agencies under the auspices of the State Council. The lead agency is NDRC which is designated as the responsible party for DSM in China. The other five agencies are to carry out DSM-related work within the scope of their existing general duties and responsibilities.[179]

At the central government level, NDRC is the main authority responsible for DSM short-term and long-term planning, strategic policy design, and electricity pricing regulation. The Ministry of

[178] China National Development and Reform Commission (2010a).
[179] China National Development and Reform Commission (2010a).

Finance takes responsibility for DSM financing issues, such as funding, budget approval, and expense supervision. The role of the Ministry of Industry and Information Technology is to propose clean products and technologies, set up industrial plans, and promote the implementation of the EEO in industrial enterprises. The State-owned Assets Supervision and Administration Commission is responsible for overseeing public assets and evaluating the grid companies' performance in general. The National Energy Administration ensures that DSM is included as a resource in power generation, transmission, and distribution development, and that the grid companies produce good results in reducing electricity consumption and improving end-use energy efficiency. The National Energy Council is involved in energy policy design and coordination of the various central government agencies.

At the provincial government level, provinces are responsible for developing detailed implementation rules. In general, provincial Development and Reform Commissions or Economic and Information Commissions are responsible for implementing the EEO in their jurisdictions. Other provincial agencies assist in specific fields, including: DSM planning; setting annual DSM targets for provincial grid companies and reviewing their DSM implementation plans; and investigating and analysing the DSM resource potential in their respective provinces.

5.4 Coverage

The EEO placed on the grid companies covers electricity. In addition, energy savings from other fuel types may be converted to the equivalent electricity saving using standard coefficients published by the National Statistics Bureau and can then be counted toward the energy savings target.

The energy savings and demand reduction targets set by the obligation can be met with end-use energy savings from all economic sectors and from any facility. In addition, reduction of losses in transmission and distribution networks can also be used to meet part of the targets.

5.5 Energy Savings Targets

The EEO requires the grid companies to produce energy savings equivalent to at least 0.3 percent of electricity sales in the previous year and to reduce load by at least 0.3 percent of maximum load in the previous year.

The EEO also establishes a sub-target that requires the installation of load monitoring equipment on 70 percent of the peak load, and load control equipment on ten percent of the peak load, in any locality.

5.6 Energy Efficiency Activities

In practice, there are five types of activities that grid companies can undertake to produce eligible energy savings that contribute to meeting their energy savings targets, subject to constraints specified in a *Compliance Evaluation Scheme* originally published by NDRC in 2011 as a trial version,[180] and updated in 2014[181]:

- directly implement energy efficiency projects in the grid company's own premises and in their end-use customers' premises;
- establish an energy services company (ESCO) affiliated with the grid company to implement energy efficiency projects;

[180] China National Development and Reform Commission (2011).
[181] China National Development and Reform Commission (2014a).

- purchase energy savings by means of business transactions/trading[182] (not to exceed 40 percent of total eligible energy savings);
- promote energy efficiency to the grid company's end-use customers (grid companies may claim only ten percent of any energy savings made by customers as a result of energy efficiency promotions and these savings must not exceed five percent of total eligible energy savings); and
- directly carry out grid system upgrades and operational management improvements that save energy and reduce losses in transmission and distribution networks.

As a further constraint, grid companies can only claim 100 percent of the value of those energy savings that are audited by a third party or recorded by online monitoring equipment; otherwise only 80 percent of the value can be claimed.

Three types of energy savings are identified as not eligible to contribute to meeting EEO targets:[183]

- energy savings from commercially operated renewable energy projects;
- electricity savings that cannot be measured and verified; and
- electricity saved through implementing government policy on the orderly use of electricity.[184]

The grid companies also use their claimed eligible energy savings to calculate load reductions that contribute to meeting their load reduction targets. Eligible load reductions are calculated as the annual eligible electricity savings (not including energy savings converted from other fuel types), divided by the average dispatched operation hours of electricity generation units. In addition, grid companies may achieve eligible load reductions by assisting customers to rearrange their production schedules, and by using load shifting technologies and installing new equipment (such as heat pumps or reverse cycle air conditioners) to improve load factors at end-use customers' premises.

The EEO guidance document does not include provisions for approving eligible energy efficiency measures nor for deeming energy saving values for specific measures. The guidance document does require each province to develop its own implementation rule that will identify provincial eligible energy efficiency measures based on best practices adapted to local situations.[185]

In the *Compliance Evaluation Scheme*, the NDRC recommends, but does not require, implementation of the following energy efficiency measures:[186]

- energy saving in transmission and distribution system;
- energy efficient electric motors, energy efficient upgrade of boilers, using waste heat and pressure, installation of heat pumps;
- energy saving in buildings, green lighting; and electricity thermal (ice) storage and other energy management projects.

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182 A grid company may purchase energy savings from customers (or other ESCOs) if the grid company does not itself implement energy efficiency projects.

183 China National Development and Reform Commission (2011).

184 Orderly use of electricity refers to involuntary supply curtailments that may be imposed by provincial governments on selected end-use customers during periods of supply shortages.

185 China National Development and Reform Commission (2010a).

186 China National Development and Reform Commission (2011).

The NDRC also encourages grid companies to reduce transmission line losses at different voltage levels, to use efficient power transformers, to improve power supply coverage, and to enforce power factor correction at customers' premises.

5.7 Marketing, Education and Outreach

The EEO guidance document states that promoting energy efficiency to the grid company's end-use customers is an eligible energy efficiency measure. In response, the grid companies have implemented a range of marketing, education and outreach (ME&O) activities to contribute towards meeting their EEO targets.[187]

State Grid ESCOs have constructed an energy efficiency service platform where experts and energy users can get together to study energy efficiency policies and technologies and conduct energy audits. In June 2011, State Grid also launched a campaign to promote end-use energy efficiency. The campaign broadly disseminates information about energy efficiency and educates people to change to a high-efficiency and low-carbon lifestyle.[188]

Southern Grid provides energy audits to large end-users, and conducts energy efficiency demonstration projects in steelmaking, chemical, and non-ferrous metal industries.[189] Southern Grid has also developed an energy savings service platform "Nandudu".[190]

5.8 Funding

The EEO guidance document states that DSM programme implementation, management, and evaluation costs can be funded in four ways:[191]

- through a city utility surcharge (城市公共事业附加费), collected through electricity tariffs:[192]
- through revenues from differential electricity prices (差别电价), mainly through implementing differential prices for energy-intensive industries;[193,194]
- through DSM special funds created and managed by each provincial government; these provincial special funds may provide subsidies for key energy efficiency projects, as well as communication, education, and evaluation of energy efficiency programs;

187 Grid companies may claim only ten percent of any energy savings made by customers as a result of energy efficiency promotions and these savings must not exceed five percent of total eligible energy savings.

188 State Grid Corporation of China (2011).

189 China Southern Grid Company (2010).

190 China Southern Grid Company (2014).

191 China National Development and Reform Commission (2010a).

192 This surcharge took effect in 1964 to support public utilities. Provincial governments set the surcharge amounts for each item (e.g., the industrial power use surcharge is five to ten percent of the electricity price). In Ningxia Autonomous Region and Jilin province, the rate for DSM special use is fixed at CNY 0.001/kWh.

193 State Council of China (2006).

194 Differential electricity pricing is applied to energy-intensive enterprises in eight industries (electrolytic aluminium, ferroalloy, calcium carbide, caustic soda, cement, steel, yellow phosphorus, and zinc smelting). Enterprises are divided into three categories according to resource consumption and technology level. The three categories and their applicable prices are: "permit and promote" paying the standard provincial industrial power price; "restrict" paying a surcharge of CNY 0.05 to 0.1/kWh; and "eliminate" paying a surcharge of CNY 0.2 to 0.3/kWh in addition to the first class power price. New pricing mechanisms such as time-of-use prices, inclining block tariffs, seasonal prices, and price discounts for interruptible loads, are only applied in some large cities in China.

- through other fiscal means, for example, an energy saving and emission reduction special fund（节能减排专项资金）established through the budgets of central and provincial governments.[195]

The EEO guidance document also states that reasonable DSM expenses incurred by grid companies can be recovered as part of power supply costs.[196] Currently, grid companies are recovering their costs by including all DSM expenses under a broad accounting category "power supply cost". There is no accounting mechanism that enables grid companies to separately identify DSM expenditures.

Grid companies that establish ESCO subsidiaries to implement energy efficiency projects may be eligible for targeted ESCO funding from the central and provincial governments. In June 2010, the central government's Ministry of Finance and the NDRC released a new financial incentives policy for ESCOs carrying out projects under shared savings energy performance contracts (EPCs)[197]. In October 2010, a further regulation[198] stipulated that financial incentives would be provided for projects involving boiler/furnace retrofitting, waste heat and waste pressure utilization, motor system energy conservation, energy system optimization, green lighting, and energy conservation in buildings. This regulation also listed categories of projects that are not eligible for funding, such as projects with the purpose of increasing production capacity, and projects involving solar, wind, biomass, and combined heat and power.

To receive the incentives, ESCOs are required to officially register with the NDRC and to have equipment and statistical systems in place to measure achieved energy savings. Under the policy, qualified EPC projects receive from the central government CNY240 per ton of standard coal equivalent (tce) energy saved and at least CNY60/tce from provincial and municipal governments, with some of these governments opting to pledge more. Grid company ESCOs that qualify to register with the NDRC are eligible to receive this funding.

Despite the various funding sources available, grid companies in China face significant costs in acquiring energy and demand savings that are not fully covered by government financial incentives. In addition, grid company revenues are reduced because they sell less electricity. At present, the regulatory regime in China does not compensate grid companies for this reduction in revenue. In common with electricity utilities in other jurisdictions, Chinese grid companies are concerned about the revenue reduction that results from encouraging customers to use electricity more efficiently. This is exacerbated in China because the State-Owned Assets Supervision and Administration Commission evaluates grid company performance primarily on the revenue they earn and the profit they make. There are no performance metrics that recognize grid companies' achievements in acquiring energy savings. Grid company management are concerned that the performance of their companies may be downgraded because of the reduction in profit resulting from their implementation of energy efficiency projects in compliance with the EEO.[199]

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[195] The main objective of this fund is to encourage green production and environmental protection projects by giving subsidies, interest discounts, or other incentives. Local governments select projects based on proposals; the financial requirements and support amount vary among provinces. According to energy savings and emission reduction audits in 20 provinces, from 2007 to 2009, up to CNY 124 billion was allocated to support energy saving projects.

[196] China National Development and Reform Commission (2010a).

[197] China Ministry of Finance and National Development and Reform Commission (2010).

[198] China National Development and Reform Commission (2010b).

[199] Crossley (2014).

5.9 Results

In both 2012 and 2013, the grid companies achieved their EEO energy savings and demand reduction targets. In 2013, the total energy savings (on a first-year savings basis) were 16.2 TWh, and the total load reduction was 3.44 GW. Under the *Compliance Evaluation Scheme*, all provincial grid companies, except for Tibet, passed the evaluation, with 17 assessed as Excellent, 12 Good and one Qualified.[200] Table 17 shows detailed performance data by region in 2013.

Table 17. Electricity Savings and Load Reductions Achieved by Grid Companies in China, 2013[201]

Region	Electricity savings (GWh)		Load reduction (MW)		Evaluation Level
	Target	Actual achievement	Target	Actual achievement	
Beijing	236	255	47.2	56.9	Excellent
Tianjin	182	194	34.9	37.2	Excellent
Hebei	785	1001	131.1	160.9	Excellent
Shanxi	384	646	66.5	114.4	Excellent
Inner Mongolia	299	342	40	49.4	Good
Shandong	403	1252	152.1	283.9	Excellent
Liaoning	449	582	71.5	144.3	Good
Jilin	107	175	29.2	47.6	Good
Heilongjiang	141	169	33.9	42.5	Excellent
Shanghai	329	490	78	99.2	Excellent
Jiangsu	1136	1190	205.7	238.1	Excellent
Zhejiang	327	384	155.2	199.2	Excellent
Anhui	317	782	68.1	148.9	Excellent
Fujian	165	432	76.1	120.4	Good
Hubei	349	604	70.7	155.4	Good
Hunan	358	668	105.6	190.4	Excellent
Henan	421	708	133.3	188.5	Excellent
Jiangxi	102	209	41.2	55	Excellent
Sichuan	438	1008	73.2	193.1	Good
Chongqing	160	249	35.7	59.3	Good
Guangdong	1226	1727	235.4	333.1	Excellent
Guangxi	212	259	40.7	49.9	Good
Guizhou	243	275	44.9	54.6	Good
Yunnan	271	271	44.7	73	Good
Hainan	47	52	8.4	11.3	Good
Shan'xi	191	367	46.4	75.8	Excellent
Gansu	210	506	37.5	83.2	Good
Qinghai	163	207	22.9	33.7	Excellent
Ningxia	185	311	29.1	58.9	Excellent
Xinjiang	161	923	41.1	77.8	Qualified

[200] China National Development and Reform Commission (2014b).
[201] China National Development and Reform Commission (2014b).

State Grid Corporation of China

In response to the EEO, State Grid created ESCOs in all 26 provinces within its service territory as subsidiaries of the State Grid-owned provincial grid companies, plus an additional ESCO at the corporate level. As of October 2014, all of these ESCOs, except for Tibet, are registered with the NDRC and the Ministry of Finance. Their main roles are implementing energy efficiency projects, delivering specialised energy and consultancy services, and helping to organise workshops and seminars to better engage end-users in energy efficiency programs. State Grid has also built high-voltage DC transmission lines and reduced line losses. In addition, State Grid also strengthened its commitment to green procurement, promoting energy efficient products, high-efficiency electric motors, and other energy efficient equipment.[202]

China Southern Grid Company

Southern Grid established a single ESCO at the corporate level that covers all four provinces within the Southern Grid service territory. In 2007, Southern Grid commenced its "Green Action" program, which it is now using to meet its EEO targets. Under this program, Southern Grid has: [203]

- increased the efficiency of transmission and distribution networks by optimising grid structure, selecting energy efficient transformers, and introducing innovative transmission system designs;
- implemented energy saving (environmental) dispatch by giving priority to renewables and more efficient coal-fired power plants;
- planned to save 27.2 TWh of electricity from 2010 to 2015 by building efficiency power plants[204] fully exploiting the energy efficiency potential in green lighting, high-efficiency electrical devices, and residential appliances; and
- emphasised energy services by changing from pure peak load management to end-use energy efficiency, and from concentrating on electricity consumption management to providing comprehensive energy services through the Southern Grid ESCO subsidiary.

5.10 Evaluation, Measurement and Verification

The *Compliance Evaluation Scheme* for the grid company EEO was established by the NRDC in 2011 on a trial basis[205] and updated in 2014[206] (see Table 18). Evaluation of grid company performance in relation to the EEO is based on a scoring system that awards points for both energy savings achieved and implementation actions completed. The maximum achievable score is 100 points, with measures related to the EEO target receiving a maximum of 60 points and DSM implementation receiving a maximum of 40 points. There are four defined

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[202] State Grid Corporation of China (2011).

[203] China Southern Grid Company (2010).

[204] The efficiency power plant (EPP) concept was first developed in China by the Regulatory Assistance Project in 2004, in recognition of the fact that conventional power plants (CPPs) have well defined planning and investment frameworks whereas energy efficiency does not. An EPP is a carefully selected portfolio of energy efficiency projects that provides a specified quantity of load reduction over a particular time period, with a level of reliability similar to the output from a CPP.

[205] China National Development and Reform Commission (2011).

[206] China National Development and Reform Commission (2014a).

performance levels in the draft scheme: Excellent (>90 points), Good (80-90 points), Qualified (70-79 points), and Failed (<70 points). [207]

Table 18. Compliance Evaluation Scheme for the Grid Company Energy Efficiency Obligation in China[208,209]

Criteria	Points		Evaluation Standard (2014)
	2011	2014	
Electricity Savings (60 points)			
*Electricity consumption saving	30	20	Achieve 100% of target: 20 points Achieve 50%-90% of target: 10-18 points Achieve less than 50% target: 0 points
*Electricity load reduction	30	30	Achieve 100% of target: 30 points Achieve 50%-90% of target: 15-27 points Achieve less than 50% target: 0 points
End-use electricity savings		10	End-use savings contribute at least 10% of total electricity savings 2 points; 20% 5 points; 30% 8 points; 40% 10 points; less than 10% 0 points
DSM Implementation Performance (40 points)			
System design	3	3	Develop DSM regulation and policy: 1 point Develop DSM regulation working plan: 1 point Understand the compliance evaluation scheme, clarify rewards and punishment system: 1 point
Institutional management	2	4	Clarify DSM managers' responsibility, regularly hold working meetings:1 point Allocate DSM experts:1 point Accomplish annual evaluation on schedule: 2 points
Communication and training	3	4	Conduct at least four communication activities each year: 1 point Hold at least 2 training activities: 2 points Develop training plans for relevant employees: 1 point
Building data platforms		6	Establish and apply data platform: 3 points Achieve end-use customer on-line monitoring, provide energy services: 3 points
Technical assistance	5	2	Load monitoring capacity reaches 70% of peak load in the region: 1 point Load control capacity reaches 10% of peak load in the region: 1 point
Financial input	5	5	Establish and operate DSM special fund: 5 points
Implementation of DSM rules	6	6	Establish energy saving service organization and carry out energy contract management projects: 1 point Use pricing signal such as critical peak pricing, double storage pricing to help customers with DSM programs: 1 point Establish demand response new mechanism: 2 points Cooperate with financial institutes, build DSM financing new channels: 2 points
Key project results	6	5	Deduct 1 point if one key energy saving project fails according to the evaluation results
Other evaluation	10	5	These points may be allocated by provincial government agencies that manage electricity industry operations

* These are threshold criteria; grid companies that do not meet their targets for electricity consumption reduction or electricity load reduction are considered to have failed.

[207] Grid companies that do not meet their targets for electricity consumption reduction or electricity load reduction are also considered to have failed.

[208] China National Development and Reform Commission (2011).

[209] China National Development and Reform Commission (2014a).

The 2014 update of the *Compliance Evaluation Scheme* was based on the grid companies' experience in achieving their EEO targets. There were some changes in the allocation of points to sub-categories, as shown in Table 18. Two new sub-categories were created that assigned points for grid companies achieving end-use energy savings (as distinct from supply-side savings such as reducing line losses) and for grid companies' progress in building data platforms to monitor energy savings.

Claimed energy savings were originally self-reported by the grid companies using their own EM&V methodologies, including deemed savings values developed for some energy efficiency measures by China Electric Power Research Institute, a subsidiary of State Grid. In early 2013, NDRC circulated a draft procedures manual for measurement, reporting, and verification of energy savings for trial by the grid companies and provincial governments that was largely based on EM&V practices in the United States. This methodology was subsequently revised based on experiences in the trial.

The EEO placed on grid companies also requires the installation of load monitoring equipment on 70 percent of the peak load. The energy use data being collected from this equipment and aggregated through data platforms will eventually form a valuable national resource that will provide a unique insight into how energy is being used in China.[210] These data will also open up major opportunities for the development and implementation of highly accurate EM&V of energy efficiency projects and programs.

5.11 Cost-Effectiveness

In China, total resource costs and supply-side benefits are not factored into cost effectiveness considerations when designing energy efficiency programs. Energy efficiency projects are usually implemented mainly to meet government energy efficiency targets, such as the grid company EEO, though cost-effectiveness may be taken into consideration for individual projects. In the United States, utilities often find that acquiring energy efficiency resources is often cheaper, and more economically efficient than generating or purchasing electricity. In China, the grid companies currently do not assess the cost-effectiveness of acquiring energy efficiency resources as compared with purchasing bulk electricity from generators. It difficult for the grid companies to carry out this assessment because of the lack of a mechanism to separately account for DSM expenses. Locating the acquisition of energy efficiency resources in ESCO subsidiaries outside grid companies' core businesses also makes cost-effectiveness assessment difficult.[211]

5.12 Performance Incentives and Penalties

The *Compliance Evaluation Scheme*[212] states that the NDRC will reward those grid companies that achieve an "Excellent" result but there are no further details about how performance incentives will be provided. At present, no sanction is applied to grid companies that fail to meet their EEO targets, but details of non-compliance are published by the NDRC.

[210] Crossley (2013c).
[211] Crossley (2013b).
[212] China National Development and Reform Commission (2011).

5.13 Response to Stress Situations

Tight electricity supply situations and power shortages often occur in most of China's central and southern provinces, particularly on hot days in summer. Currently, electricity peak load problems are generally dealt with administratively through a planning and rationing process known as ”orderly use of electricity”. Plans are prepared each year at provincial and local levels defining how to ration grid capacity under different degrees of expected shortage. These plans try to rely first on peak load shifting and peak load avoidance measures, but also provide for mandatory demand rationing and finally involuntary curtailment of supply, if needed. Some priority customers are provided with guaranteed (“firm”) supply, while the others are ranked for involuntary rationing measures, with advanced warning if possible.

Provincial and local government power operation departments (or their counterparts) oversee the orderly use of electricity process. Individual end-users propose how much load reduction they can provide, if required. The order in which curtailments will be implemented is decided through a government-led process in conjunction with grid companies and end-users. When peak loads exceed available grid capacity and curtailments are necessary, government officials decide which end-users are going to be shut off at peak times, according to the predetermined order. Once the order of curtailments is decided, end-users' ability to negotiate whether they will be curtailed and the timing of actual curtailments is very limited.

While the EEO guidance document states that grid company DSM activities should be prioritised to meet electricity demand during tight supply situations and power shortages, taking action to deal with these situations is the responsibility of provincial and local governments rather than the grid companies.

5.14 Overall Effectiveness

China's grid company energy efficiency obligation is relatively new and the grid companies have experienced some difficulties in changing their business models to achieve the EEO energy savings and load reduction targets. Both grid companies have chosen to establish subsidiary ESCOs to carry out energy efficiency projects. This use of ESCOs as the main delivery mechanism locates the acquisition of energy efficiency resources in a separate, subsidiary business unit outside the grid company core business rather than incorporating energy efficiency into the grid company business model.[213] This raises questions about the commitment of the grid companies to achieving the EEO targets and suggests that the EEO mechanism may not continue over the long term without further policy action by government. In addition, the levels of the two EEO targets are very low compared with targets for utility delivery of energy efficiency in other jurisdictions.[214] In 2013, the total energy savings (on a first-year savings basis) were 16.2 TWh, and the total load reduction was 3.44 GW. These savings may seem large, but in a country the size of China they are not particularly ambitious. While it is too soon to enable a robust assessment of the effectiveness of the grid company EEO in China, performance to date has not been outstanding.

[213] Crossley (2013b).

[214] Crossley et al. (2012).

5.15 Lessons Learnt

China's grid company energy efficiency obligation is one of the latest examples worldwide that uses a government-imposed obligation to ensure that utilities assist their customers to use electricity efficiently. The implementation of the EEO in China has been particularly difficult because of the very large size of the grid companies, their ability to influence the political process, and their complete lack of any experience in delivering energy efficiency. Despite the reluctance by the grid companies to engage with end-use energy efficiency, in both 2012 and 2013, the grid companies achieved their EEO energy savings and demand reduction targets though, given the size of China, these results were not particularly ambitious. Jurisdictions looking to use a government-imposed EEO in situations where there is no prior experience with utility delivery of energy efficiency may learn useful lessons from the China case study.

6. UTILITY DSM PROGRAMS IN INDIA

6.1 Introduction

In 2012, India consumed 940 TWh of electricity, or about 760 kWh per capita, a figure that is about one-fifth of the world average per capita electricity consumption.[215,216] Nearly 300 million of the 1.2 billion population remain without access to electricity.[217] Coal provides the majority of electricity generation, at 68 percent, and is a large part of the 1.9 gigatonnes per year of greenhouse gas emissions from India, 5.6 percent of the world's total.[218] India also suffers chronic nationwide shortages of electricity due in large measure to fuel availability and costs.[219,220,221] India has a long history of subsidizing the prices of electricity, especially for agricultural needs and low-end domestic /residential consumers that has contributed to high demands and confounded efforts to encourage greater conservation and energy efficiency.[222] The government considers DSM, energy efficiency, and conservation to be central to its goal of delivering "power for all".[223]

From 1985, the Ministry of Power (then the Department of Power) functioned as the nodal point for the Government of India to facilitate the implementation of a coordinated strategy on energy conservation. The Ministry also provided funding support for strengthening energy conservation programs, including outreach programs. In 1989, with the assistance of the World Bank and the United Nations Development Programme, an Energy Management Center was established in New Delhi as an autonomous organization to promote energy conservation. The Centre coordinated energy auditing of consumers' facilities, energy management systems, education and training, and energy generation and conservation-based employment and poverty alleviation programs.[224]

Subsequently, decades of interest and work by the Government of India on energy efficiency and conservation led to the *Energy Conservation Act* of 2001[225] and state level DSM regulatory initiatives a decade later. One of the outcomes of the 2001 Act was the establishment of the Bureau of Energy Efficiency (BEE) in March 2002. The BEE is a government agency devoted to the task of promoting energy conservation and efficiency, and is an agency of the Ministry of Power. The 2001 Act created BEE as a combined regulatory authority and program

215 International Energy Agency (2014b).
216 Ahn and Graczyk (2012).
217 International Energy Agency (2014a).
218 International Energy Agency (2014a).
219 Today, India's 260 GW of installed electric generating capacity is significantly higher than the roughly 140 GW of peak demand. Yet blackouts are common. The primary problem is fuel availability and cost. Coal generation is somewhat dependent on imported coal and significant price volatility. Discoms that buy electricity from plants fired with imported coal face significant and unpredictable upward pressure on tariffs, a situation that state utilities as well as state regulators have tried to avoid by simply not buying, even in the face of local shortages and rolling blackouts. (Personal communication from Cathie Murray, The Regulatory Assistance Project.)
220 Ahn and Graczyk (2012).
221 DSM-India (2014).
222 Government of India: Planning Commission (2003).
223 Government of India. Central Electricity Authority (2012).
224 Slote, Sherman, and Crossley (2014).
225 India Legislation (2001).

implementation body.[226] The BEE also functions as an entity that collaborates with electricity distribution companies (Discoms) in the implementation of nationally-coordinated energy efficiency and DSM programs. In at least 14 states in India, regulators have established formal DSM implementation rules and requirements.[227]

In India, electricity distribution is owned primarily by government, with some private ownership, comprising roughly five percent of energy use. Seventy percent of government-owned electricity utilities in India today have an energy department that operates DSM programs. The utility programs delivered through these entities are still in the formative stages of development; awareness and technical expertise in India promise to grow with the capacity building efforts of BEE. Utilities are being provided with financial aid from the central government, and international organizations such as the United States Agency for International Development, the United Kingdom's Department for International Development, Germany's Deutsche Gesellschaft fur Internationale Zusammenarbeit, the Japan International Cooperation Agency , and the World Bank provide funds to the central government to indirectly help run these programs. State regulators have authority to permit recovery of DSM program costs and also provide incentives for delivery of DSM through electricity prices.[228,229]

Private sector utilities have been more active in implementing DSM programs than their publicly-owned counterparts. Private utilities only function in eight to 10 cities and account for approximately two percent of India's end-use electricity consumption. Government-owned and operated discoms still control some 98 percent of the distribution system by customer share. The largest private sector utilities, Tata Power and Reliance Energy, have been involved in DSM programs since 2002 and work in collaboration with the central government and various manufacturers to provide programs to their customers.

Figure 14 (page 60) shows the power sector and the role of government in each segment of the electricity industry. The bottom row in Figure 14 shows electricity consumption by customer class; industry accounts for 46 per cent of electricity consumption followed by the residential sector (21 percent), agriculture (17 percent), and then the commercial sector (nine percent).

Regulatory oversight of the electricity sector in India is carried out by both the Central Electricity Regulatory Commission (CEA or CERC) and the state electricity regulatory commissions (SERCs) that exist in most states. Figure 15 (page 60) shows that the Bureau of Energy Efficiency (BEE) is the main Government of India agency responsible for implementing energy efficiency policies and programs. The BEE figures prominently in the delivery of energy efficiency and conservation in India. Part of that role involves some coordination of state institutions and utilities responsible for the delivery of DSM. Indeed the BEE is credited with responsibility for creating DSM and energy efficiency cells in utilities, encouraging state regulators to allow the recovery of DSM and energy efficiency expenditures in electricity prices, and creating better tariff designs, including time-of-use pricing to complement DSM initiatives.[230]

[226] Patankar (2013).
[227] Patankar (2012).
[228] Slote et al. (2014).
[229] Government of India. Central Electricity Authority (2012).
[230] Government of India. Central Electricity Authority (2012).

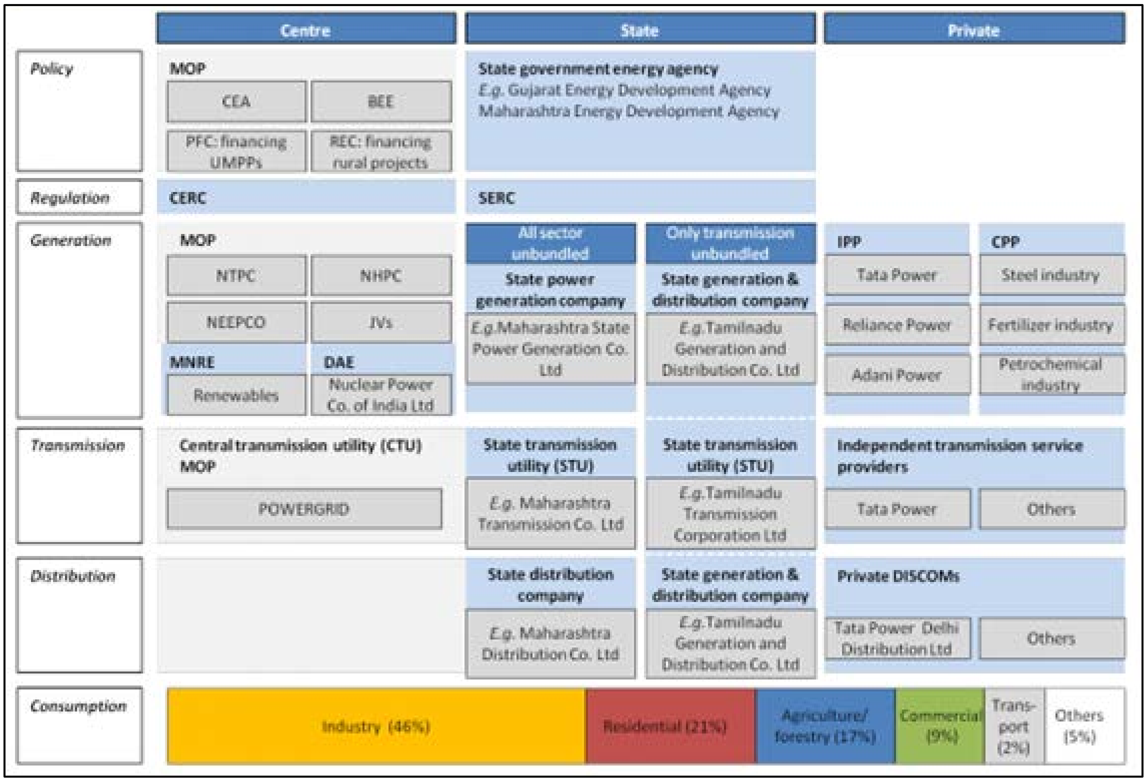

Figure 14. Key Players in the Power Sector in India[231]

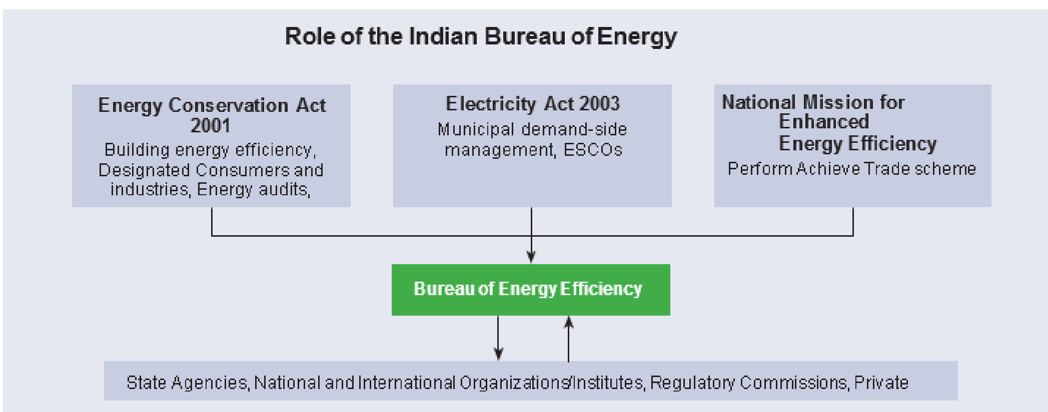

Figure 15. Role of the Indian Bureau of Energy Efficiency[232]

India embarked on an innovative energy efficiency initiative in 2012 called Perform, Achieve & Trade (or "PAT") to require improvements in energy efficiency performance among some 478 industrial establishments as part of the National Mission for Enhanced Energy Efficiency (NMEEE). While the PAT initiative is distinct from traditional DSM initiatives that rely on utilities or third parties, it has some common elements; generation has a role as a targeted subsector, as do large industrial end use customers. In all, the PAT initiative was expected to produce 10 GW of savings by 2012, and 19 GW by 2014/15.[233]

[231] Ahn and Graczyk (2012).
[232] Vasudevan, Cherail, Bhatia, and Jayaram (2011).
[233] Government of India. Bureau of Energy Efficiency (2011).

6.2 Policy Objectives

The policy objectives for energy efficiency and DSM in India are largely set out in the *Electricity Act* of 2003, the National Electricity Policy and the National Electricity Plan. The Act includes some sections that emphasize a role for energy efficiency.[234] The National Electricity Policy was adopted in February 2005.[235] Section 5.9 of the Policy emphasizes the role of efficient pumping in agriculture, the potential role of ESCOs in delivering energy efficiency services, the need for an energy awareness campaign, the importance of rate design, particularly time-of-use pricing to motivate load shifting and better capital utilization. The Policy includes strategies such as energy performance labeling that encourage voluntary (or market transformational) changes in electricity use. The Policy further establishes a role for the BEE in estimating the energy efficiency resource potential and costs.[236] The current National Electricity Plan was adopted by the Central Electricity Authority in 2012.[237] The Plan established targets and strategies for implementing and achieving electricity savings equal to approximately 45 TWh.

6.3 Legal Authority

The legal foundation for private utility investment in DSM is included in the *Electricity Act* of 2003[238] and state level statutes governing the authority of state regulators. State level regulations governing utility delivery of DSM currently exist in at least 14 states.[239] The legal authority for the establishment of the Bureau of Energy Efficiency is the 2001 *Energy Conservation Act*.[240] *The Electricity Regulatory Commission Act* 1998 constituted the Central Electricity Regulatory Authority (CEA or CERC).[241] The 1998 Act also encouraged the states to establish their own State Electricity Regulatory Commissions (SERCs) to regulate retail and distribution tariffs.

6.4 Coverage

Utility energy efficiency and DSM projects in India target all economic sectors and all premises and facilities within these sectors.

6.5 Energy Savings Targets

In 2012, the National Mission on Enhanced Energy Efficiency (NMEEE) proposed electricity savings targets to be established in the 12th Five Year Plan ending in 2016/17 (see Table 19, page 62). At current exchange rates, the approximately INR 74.8 billion budget in Table 19 is equal to USD 1.23 billion, assuming INR 61 per USD. These targets represent ambitions for electricity savings at the national level through mechanisms to potentially build on or complement utility DSM initiatives, highlighting the scale of opportunity that exists through utility programs. This represents a national target that is distinct from the state and utility targets that are set by state policy makers and utilities that engage in some form of integrated planning efforts to include DSM.

[234] India Legislation (2003).
[235] Government of India. Ministry of Power (2005).
[236] Government of India. Ministry of Power (2005).
[237] Government of India. Central Electricity Authority (2012).
[238] India Legislation (2003).
[239] Patankar (2012).
[240] India Legislation (2001).
[241] India Legislation (1998).

Table 19. Electricity Savings Targets Proposed for India's 12th Five Year Plan[242]

No	Sectors	Schemes	Total Fund requirement in schemes (INR 10M or crore)	Total Fund requirement in sector (INR 10M or crore)	Targeted Electricity Saving (TWh)	Targeted Thermal Fuel Saving (mtoe)
1	Utility Based DSM	DSM Programme for Utilities	300	300	-	-
2	Industries	Industries	3767	4222	11.96	10.41
		SMEs	455		1.83	1.59
3	Residential Sector	Bachat Lamp Yojana	6	6	4.40	-
4	Equipment & Appliances	Standards & Labeling (S & L)	183	1653	10.40	4.30
		SEEP	1470		6.60	-
5	Agriculture Sector	Agricultural Demand Side Management	393	393	0.70	-
6	Commercial Sector	ECBC & Energy Efficiency in Existing Buildings	65	65	5.07	
7	Municipal Sector	Municipal Demand Side Management	45	45	0.47	-
8	State Designated Agencies	SDA Strengthening	140	210	-	-
		State Energy Conservation Fund	70		-	-
9	National Awards, Painting & Awareness	National Awards, Painting & Awareness	100	100	3.42	5.00
10	Innovative Technologies/Areas	Energy Efficiency Research Centre	200	200	-	-
11	HRD	HRD	288	288	-	-
Total				7482	44.85	21.30
Total electricity saving at demand side, TWh					44.85	
Total electricity saving at bus bars, TWh					60.17	

6.6 Energy Efficiency Activities

The Indian Forum of Regulators has been entrusted with the responsibility to evolve common and coordinated approaches to the issues faced by the various state electricity regulatory commissions in India. The Forum of Regulators constituted a working group on "DSM and Energy Efficiency" to address issues related to the implementation of energy efficiency and DSM measures in the electricity distribution sector in India.[243]

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[242] Government of India. Central Electricity Authority (2012).
[243] Slote et al. (2014).

In India, all economic sectors are targeted for DSM and energy efficiency projects and the number of projects implemented is increasing. Figure 16 shows the trends for DSM programs by sector over time.

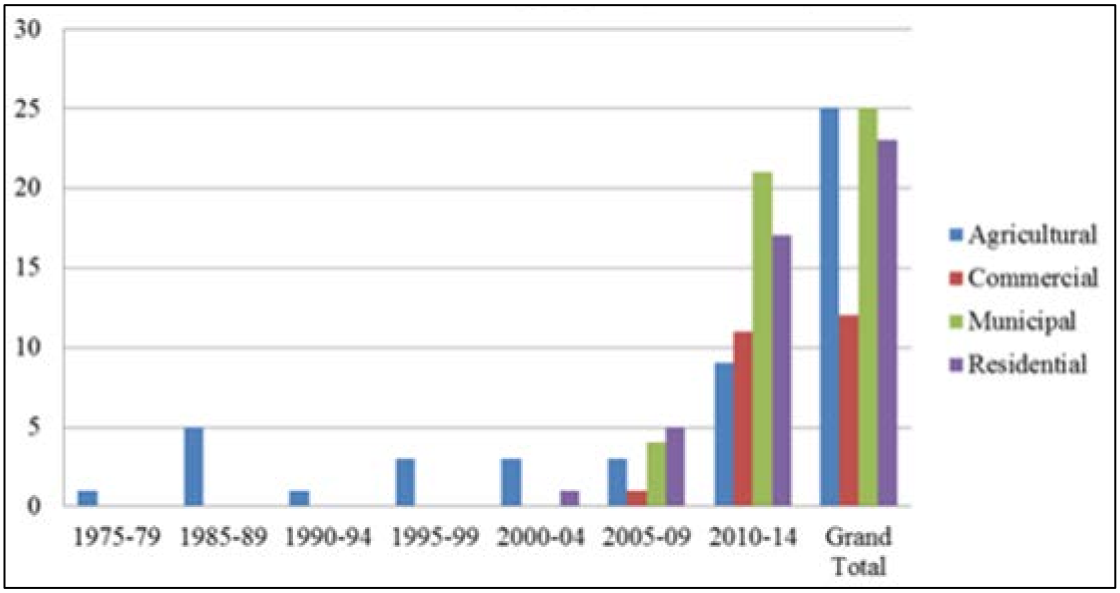

Figure 16. Numbers of DSM Project Implemented in India by Sector, 1979 to 2014[244]

Agriculture

Roughly 50 percent of India's populations are farmers and 20 percent of the farmers rely on electric pumps. Lack of perennial rivers has necessitates heavy reliance on ground water tapping for irrigation in south India and contributed to the increase in consumption of electricity by the agricultural sector.[245]

Water pumping load in the agricultural sector in India is important to utilities for several reasons. Agricultural pump sets are often at the end of long rural lines. They are costly to build and maintain and are responsible for large line losses. The electricity supply to pumps is often unmetered, providing electricity that is essentially free of charge. In such cases there is little incentive for agricultural customers to use electricity efficiently.

Maharastra State Electricity Distribution Co. Ltd, a distribution company in the state of Maharashtra, has implemented an agricultural DSM project pilot with a target replacement of 3,530 existing pumps with energy efficient pumps.[246] The project is noteworthy for the complex set of variables that combine to influence existing inefficient pumping, including a tariff design that charges at a price that is independent of energy demand, an unreliable grid that effectively reinforces pumping during the hours when the grid is up and running, and poor knowledge of equipment selection and operation for better efficiency. Each pump replacement offers the potential for electricity savings of up to a 40 percent.

If the program were successful and extended to the roughly 20 million pumps nationally, the savings from this project alone could reduce demand by 62.1 TWh annually, or roughly 6.5

[244] DSM-India (2014).
[245] Electricity in India (2011).
[246] DSM-India (2014).

percent of total energy demand.[247] Depending on the particulars of the program implementation, which may involve reliance on ESCOs and Clean Development Mechanism funding, the internal rate of return on the project may be between 19 and 23 percent.[248]

Thermal Energy Storage

Thermal energy storage (TES) involves shifting the load of large central air-conditioning plants from peak to off-peak periods. With TES, the central air-conditioning plants run at night and convert water to ice. During the day, air-conditioning is switched off and the building is cooled by the energy stored in ice.

Tata Power offers a pilot TES program that provides users with incentives for shifting their air-conditioning load to off-peak hours. The pilot program incentivizes the consumers by offering a special rebate. To carry out EM&V of the energy savings, Tata Power will install metering and energy monitoring systems on chiller plants using the TES technology. Customers benefit from the lower energy costs from shifting use under the time-of-use tariffs, from lower demand charges and from the incentives offered by Tata. The utility benefits from better capacity utilization from improving load factors, lower generation costs from shifting loads off the most expensive resources, and from improvements to grid reliability.[249]

Bachat Lamp Yojana (BLY)

The BEE functions as a coordinator of Discom utility programs including efforts to promote certain energy efficiency initiatives. A good example of this coordination is the compact fluorescent light program known as the Bachat Lamp Yojana scheme (BLY).

The objective of the BLY scheme is to promote energy efficient lighting and provide access to energy efficient compact fluorescent lamps (CFLs) at the same cost as that of incandescent light bulbs. The cost differential is made up by project implementers through carbon credits earned which can be traded in the international market under the Clean Development Mechanism (CDM) of the Kyoto Protocol. There are no requirements in India requiring the use or purchase of energy efficient CFLs. All the key players in the BLY scheme, including the BEE and participating implementer(s), Discoms and households are voluntarily taking part in the scheme.

Perform, Achieve, and Trade Scheme (PAT)

The National Mission for Enhanced Energy Efficiency (NMEEE) was established as a result of the National Action Plan on Climate Change released by the Prime Minister in June 2008. Among the principles articulated in that plan was that of "devising efficient and cost-effective strategies for end-use demand-side measures." The National Action Plan listed eight missions for achieving the goals related to climate change, including the National Mission for Enhanced Energy Efficiency. BEE was tasked by the Ministry of Power with implementing the mission.

Among the four NMEEE initiatives advanced through BEE was the Perform, Achieve, & Trade (PAT) scheme. PAT is a market-based mechanism designed to make improvements in energy efficiency in energy-intensive large industries. The targets for energy consumption reduction by the 478 industrial enterprises obligated under the PAT scheme (including 144 thermal power units) were established by BEE. The trade component of the scheme allows for some market flexibility through trading between obligated enterprises to achieve energy savings results cost-

[247] Electricity in India (2011).
[248] Electricity in India (2011).
[249] Tata Power (2014).

effectively. The BEE initiatives also included components related to market transformation, economic development, and financing of energy efficiency.[250]

Because the energy efficiency obligation is placed on end-users, the PAT scheme is not technically a DSM program implemented by distribution utilities and it is not limited to electricity. However, it does provide an innovative approach for national governments seeking similar savings from large industry, employing some measure of market flexibility toward the achievement of energy savings targets. While BEE is responsible for the program design, setting targets and accrediting auditors, it is the obligated industrial enterprises that bear the responsibility of meeting their energy savings targets. The power sector is responsible for achieving their own savings targets. The CERC has responsibility for addressing regulations relevant to the implementation of the PAT as it applies to the electric utilities.[251]

Joint Venture ESCO Delivery

Growth of energy services companies (ESCOs) has been slow in India and ESCOs have captured only about five percent of the market for energy efficiency services. However, the potential is thought to be quite large. The concept of performance contracting by ESCOs is increasingly considered as a mechanism for implementing large-scale energy efficiency projects. To help address the low level of ESCO activity, the Ministry of Power set up Energy Efficiency Services Limited (EESL) as a joint venture of a several companies. EESL has an exclusive charge to deliver energy efficiency or energy efficiency-related services.[252] These services include the following:

- perform and promote energy efficiency, including the manufacture and supply of energy efficiency services and products;
- implement energy efficiency projects for municipal functions, agriculture, public building, lighting etc.;
- implement initiatives of central and state governments., Bureau of Energy Efficiency, or any other agencies related to energy efficiency;
- partner with other companies to promote energy efficiency;
- provide energy efficiency consultancy services in the field of Clean Development Mechanism projects;
- help build sector capacity for relevant stakeholders;
- serve as a resource center in the field of energy efficiency.

EESL has been involved in several street light replacement programs and a large-scale LED replacement program involving utility customers in two states. An ESCO LED initiative, the DSM Electric Lighting Program (DELP) responds to the major contribution of domestic electric lighting to overall demand. According to promotional materials, the replacement of inefficient lighting with efficient lighting in domestic situations can reduce demand in India by 50 TWh.[253]

[250] Government of India. Bureau of Energy Efficiency (2011).
[251] Government of India. Bureau of Energy Efficiency (2011).
[252] Energy Efficiency Services Limited (2014a).
[253] Energy Efficiency Services Limited (2014b).

6.7 Marketing, Education and Outreach

In India, marketing, education and outreach related to energy efficiency broadly occurs through the BEE. The importance of effective outreach was highlighted in the 2005National Electricity Policy.[254] BEE serves as the national focal point for all communications, marketing and outreach that occurs at the national level. The BEE website provides information on ESCO, programs, projects, and partners.[255]

One form of education and outreach is through awards. The Ministry of Power, through BEE, organizes the annual energy conservation awards on National Energy Conservation Day (each 14th of December). These awards recognize innovation and achievements in energy conservation by industry and commercial buildings.[256]

In India, utility-delivered DSM is still in the early stages of implementation. Funds from the Shakti Foundation have been used to create a portal for sharing information about DSM pilot projects in India. Inputs obtained from distribution companies, utilities and regulators and collaborators map the landscape and technology potential for DSM and present this in the form of website reports.[257]

6.8 Funding

In India, utility DSM programs are provided with financial aid from the central government, and from international organizations such as the United States Agency for International Development and the World Bank who provide funds to the central government to indirectly help implement DSM programs.[258] Although there is funding from different sources, it has not yet been significant enough to establish utility DSM programs on a large scale.[259]

State regulatory commissions are authorized to fund energy conservation and efficiency initiatives through the tariff approval process.[260] In 2012, the CERC proposed the establishment of State Energy Conservation Funds in each of the 29 states to include provisions for matching funds for implementation of programs through state-designated agencies.[261] At least 10 states have DSM regulations and another three have draft regulations in progress that includes funding provisions in tariffs.[262,263]

6.9 Results

India scores highly on international comparisons among nations with regard to energy efficiency across all sectors, largely due to its successes with transportation and establishing voluntary standards for commercial buildings. More than 65 percent of passenger travel relies on some

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[254] Government of India. Ministry of Power (2005).
[255] Government of India. Bureau of Energy Efficiency (2014).
[256] National Productivity Council (2010).
[257] DSM-India (2014).
[258] USAID, Japan’s International Cooperation Agency, and Germany’s Deutsche Gesellschaft Internationale Zusammenarbeit provide technical assistance grants. The World Bank, and Germany’s development bank, KfW provide funds for revolving loans. (Personal communication from Mahesh Patankar, The Regulatory Assistance Project.)
[259] Slote et al. (2014).
[260] India Legislation (1998).
[261] Government of India. Central Electricity Authority (2012).
[262] Gujarat Electricity Regulatory Commission (2012).
[263] Patankar (2012).

form of public transportation.[264] The BEE reports that avoided generation capacity of 415 MW has been achieved by the CFL distribution program during the 11th Five Year plan. These results are verified by a third party.[265]

Indian electricity distribution utilities have demonstrated some success with respect to utility delivered energy efficiency or DSM through pilots. Results from earlier pilot projects to date are promising.

Agricultural Pumps -- Noida Power Company Limited (NPCL), which services the Greater Noida regional of Uttar Pradesh, engaged in a pilot project with 100 customers completed in 2008 to improve power factors and energy efficiency of hydro pumping for agricultural needs. Results of the project suggested an average customer peak load reduction of 4.5 kW (from 7.6 kW to 3 kW), improvements in the power factor of each pump from 0.65 to 0.85, and energy savings of roughly 7,300 per pump annually (10,800 kWh to 3,510 kWh per year).[266]

Efficient Lighting 1 – In 2005, Bangalore Efficient Lighting Program was developed by Bangalore Electricity Supply Company partnered with the BEE under bilateral funding from USAID. The lack of quantitative results makes evaluation difficult. Nevertheless, implementation of the program resulted in reduced electricity bills and increased availability of low cost, high quality CFLs to customers. The program benefited the utility in peak load reduction and improved customer relations and to society through reduced greenhouse gas emissions.[267]

Efficient Lighting 2 – Also in 2005, Maharastra State Electricity Distribution Co. Ltd engaged in a lighting program to bridge the demand/supply gap and to reduce load shedding. The Discom wanted to implement a State level CFL program by making CFLs available to residential and small commercial sector consumers at discounted rates. The main objective of the proposed state level CFL program was to reduce demand during peak hours. Before doing so, it implemented a pilot in Nashik. About 100,000 residential and commercial customers participated in the project involving 380,000 CFL bulbs. The project resulted in savings of 12 to 16 megawatt-hours of energy per year and 7 to 9 megawatts of peak load reduction.[268]

Street Light Replacement – In 2006, there was an expected demand/supply gap in the Mumbai region of 250 to 275 MW during peak hours. In 2008, Reliance Infrastructure Limited initiated and implemented a DSM program that involved replacement of existing lamps with high-efficiency lamps used for street lighting. The program replaced 36,559 lamps of 80 and 125 watts with 70 watt high-efficiency lamps. Total annual energy savings from the program were 5.4 GWh, with a peak load reduction of 1.33 MW on a project investment of INR 54.8 million.[269]

6.10 Evaluation, Measurement and Verification

EM&V is still taking shape in India and it is likely that markets for energy savings will determine what sort of EM&V is necessary and suitable. In the meantime, Indian organizations are currently putting a great deal of time and effort into establishing an energy efficiency EM&V industry.

264 Young et al. (2014).
265 Government of India. Bureau of Energy Efficiency (2014).
266 D. Crossley (2008).
267 D. Crossley (2008).
268 D. Crossley (2008).
269 D. Crossley (2008).

A member-driven industry association founded in 2008, the Alliance for an Energy Efficient Economy (AEEE), has been actively involved in developing EM&V regulations, as well as working with organizations such as the Lawrence Berkeley National Laboratory to build EM&V capacity at regulatory agencies and utilities. AEEE has been the primary Efficiency Valuation Organization Indian affiliate since 2009. As part of this affiliation, the Alliance has conducted a number of awareness seminars and training certification programs on the International Performance, Measurement, and Verification Protocol. Between 2008 and 2011, EM&V training programs run by AEEE reached out to more than 250 professionals, and 65 were certified eligible to apply IPMVP standards. AEEE has also sponsored a number of EM&V conferences, including an international conference in October 2012 on India's EM&V experiences that mostly concentrated on the PAT scheme.[270]

6.11 Cost-Effectiveness

Estimates suggest that reduction in greenhouse gas emissions totalling about 260 MtCO2e by 2030 can be achieved through negative- or moderate-cost energy efficiency initiatives.[271]

Certain DSM programs that improve load factor and improve system reliability offer the potential for immediate returns to utilities as they improve revenue streams and better manage their costs of generation and delivery. The calculations based on pilots for agricultural pump initiatives suggest a quick payback for utilities involved.

6.12 Performance Incentives and Penalties

Provision for cost recovery of DSM expenditures occurs through state regulators in the tariff setting process. The DSM regulations from each of the state regulators contain provisions for the implementation of penalties and incentives. Model DSM regulations were developed in 2009 for the Forum of Regulators.[272] This model includes provisions for incentives. Similar provisions have been incorporated in state regulatory authority provisions to date.[273]

6.13 Response to Stress Situations

India is somewhat unusual among middle income countries in the persistence of issues around the energy production capacity of its generation fleet. As the CERC notes, "The gap between electricity supply and demand in terms of both capacity (i.e. MW) and energy (i.e. MWh) has been steadily growing in India."[274] DSM initiatives, especially those that shift loads, such as thermal energy storage and agricultural pumping, offer promise of improving system reliability.

6.14 Overall Effectiveness

Given the early stage of DSM activities in India, the overall effectiveness of these efforts is still difficult to gauge. The combined role of the BEE, the state regulators, and electric utilities appears to offer considerable opportunity to weave together a framework that capitalizes on the respective strengths of each group. [275] Elements of this complementary relationship are already evident. The results of the case studies shared on the BEE DSM Information Hub

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[270] Slote et al. (2014).
[271] Bharvirkar, Sathaye, and Phadke (2010).
[272] ABPS Infrastructure Advisory Private Ltd (2009).
[273] Gujarat Electricity Regulatory Commission (2012).
[274] Government of India. Central Electricity Authority (2012).
[275] Bharvirkar et al. (2010).

suggests that the opportunities extend widely and quick paybacks are realized from the investments in energy efficiency.[276]

6.15 Lessons Learnt

India provides an example of close involvement by the central and state governments in the development of a policy and regulatory framework to enable utility delivery of end-use energy efficiency. The Government of India has established a solid foundation of sector reform and a framework for delivering DSM that has been decades in the making. The framework relies increasingly on electric distribution utilities, but also on the national government in the form of the Bureau of Energy Efficiency (BEE). Oversight of the electric utilities and the regulations that give form to the DSM activities are established by the state electricity regulatory authorities. However, the energy efficiency and DSM industry in India is still at an early stage. Most of the projects developed and implemented by the distribution utilities are pilot projects that reduce the uncertainty involved in achieving energy savings.[277]

The introduction of what amounts to a super-ESCO in Energy Efficiency Services Limited (EESL) introduces a promising new way to spur the development of third-party delivery models that can be coupled with funding from utility customers and the Clean Development Mechanism for additional opportunities in developing regions.

While not typically a direct part of the DSM delivery system, the BEE is a useful and constructive complement to a nation with many utilities in different states subject to the jurisdiction of both state and national electricity regulators. BEE helps provide cohesion among the state activities, and a centralizing instrument for implementation national government policy around energy efficiency and DSM. The BEE is also provides a focal point for communications, an instrument for the sharing of ideas and materials, and for sharing experiences among state level initiatives around energy efficiency and DSM. The BEE also provides a centralized mechanism for promoting EM&V capabilities at scale and in a way that consistently high standards.

There is considerable opportunity for the Government of India to move beyond the demonstration projects around DSM and employ utilities to deliver energy efficiency and DSM. Tariff design and persistent subsidies in the agricultural sector continue to confound efforts to promote greater energy efficiency in agricultural pumping.

[276] Government of India. Bureau of Energy Efficiency (2014).
[277] Government of India. Bureau of Energy Efficiency (2014).

7. BRAZIL'S UTILITY ENERGY EFFICIENCY PROGRAMS

7.1 Introduction

Brazil is the fifth largest nation in the world by population and by area and the tenth largest economy in the world. More than 99 percent of Brazilians have access to electricity and Brazil is poised to achieve its target of 100 percent electrification in the near term.[278] Sixty percent of the electricity demand is in the southeast region of the country, including Rio de Janeiro and São Paulo.

Brazil is somewhat unique in its rich endowment of clean energy resources. Brazil relies disproportionately on hydro resources and is well positioned to expand the mix of variable renewable energy resources. It is also rich in natural gas and oil capacity.

Brazil has over 120 GW of generation capacity and 68 percent is hydro-electric. There are nearly 900 hydro-electric facilities on Brazilian rivers, ranging in size from the very large (14 GW) to the very small. The remaining generation facilities are renewables (primarily wind, solar, and bioenergy), fossil-fuel thermal plants, and nuclear reactors. Nearly 85 percent of Brazil's electricity comes from renewable sources.[279] Figure 17 shows energy production in Brazil and the predominance of hydro as a source of generation which is the major contributor to the low carbon footprint of the electricity sector in Brazil. The numerous hydro reservoirs give the Brazilian electricity system a significant degree of flexibility, making the system an enabler of variable energy resources such as wind.

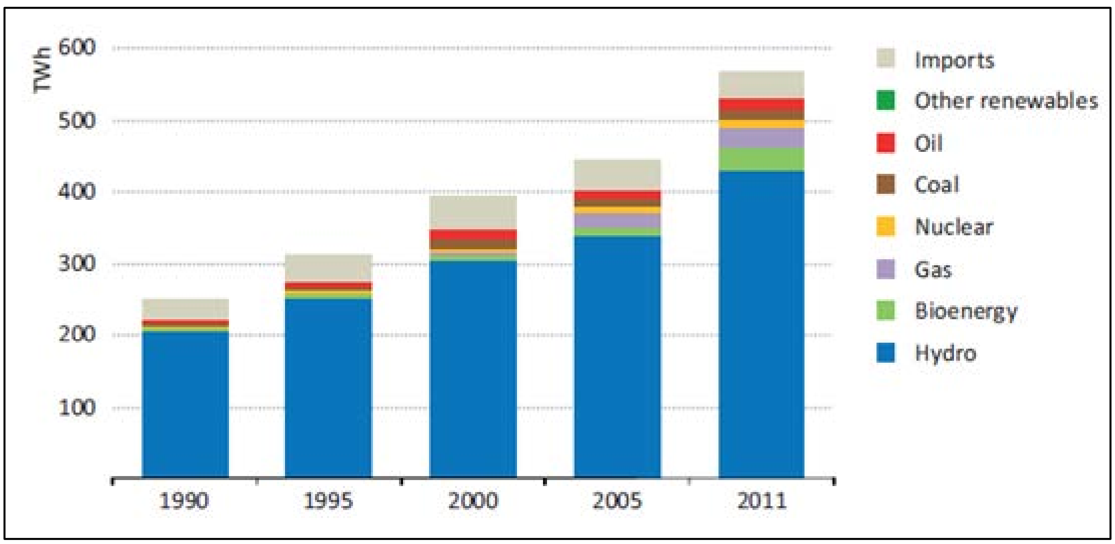

Figure 17. Energy Production in Brazil, 1990 to 2011[280]

Figure 18 (page 71) shows the structure of the power market in Brazil. Generation facilities are owned by a mix of public and private sector entities.

[278] International Energy Agency (2013).
[279] International Energy Agency (2013).
[280] International Energy Agency (2013).

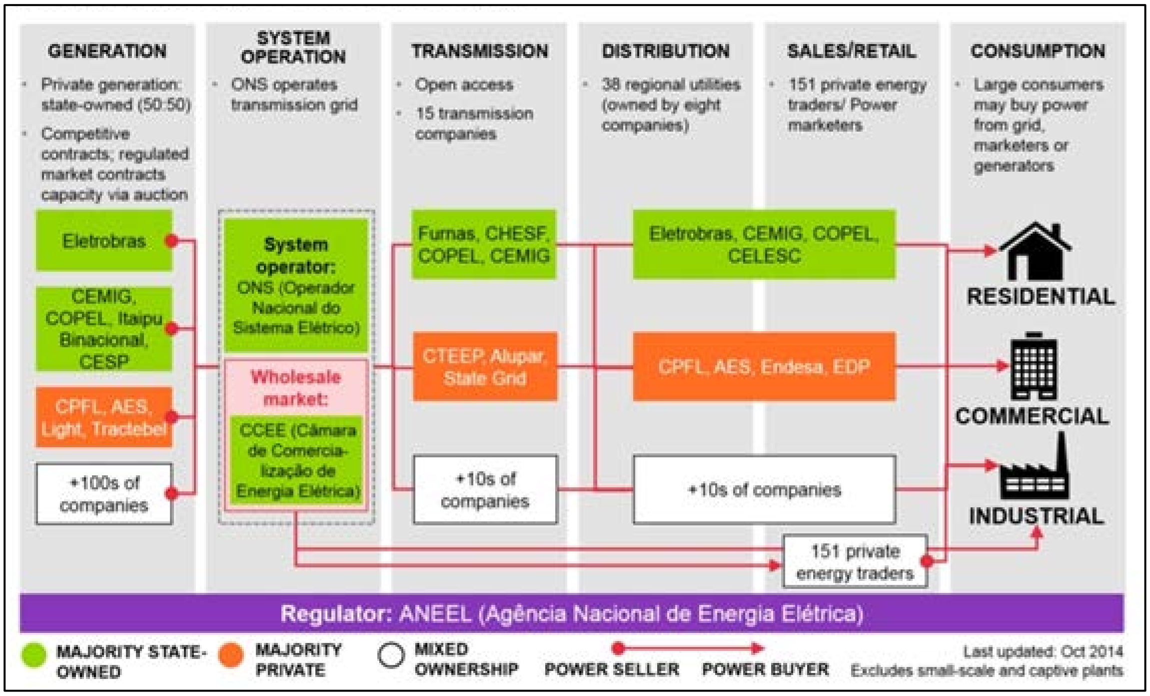

Figure 18. Power Market Structure in Brazil[281]

The institutions responsible for policy setting for the power sector are the Ministry of Mines and Energy (MMA) and the Energy Policy National Council (CNPE). ANEEL (Agência Nacional de Energia Elétrica or National Electricity Regulatory Agency) is the power sector regulator. In addition to other functions, ANEEL is responsible for establishing energy efficiency targets and funding DSM.[282] The Energy Planning Authority (ENE) is the research arm of the MMA and is responsible for guidance to the ministry on the resource potential for energy efficiency and DSM investments.

The 52 percent state-owned electricity utility Eletrobras is responsible for 38 percent of Brazil's generation, most of its transmission (either directly or as part of a consortium) and for six of the smaller distribution companies.

Brazil has a comparatively low electricity intensity relative to other nations. The average Brazilian consumed around 2,300 kWh of electricity in 2011, 40 percent below the equivalent figure for South Africa (even though GDP per capita in the two countries is very similar) and 20 percent below the figure for China (despite Brazil's higher per capita income).[283]

The prices paid for electricity are high by the standards of middle income countries. The International Energy Agency reported prices paid in 2012 by industry at USD 178 per MWh and around USD 237 per MWh for residential customers.[284] These price levels are roughly in the median of OECD nations. Similar to other BRIC nations, like South Africa and China, residential electricity customers in Brazil have access to an inclining block tariff structure that serves the dual purpose of providing both a discount for low-usage customers who are also typically lower-income, and an efficiency signal to higher use customers in the upper tariff blocks. Customers

[281] Bloomberg New Energy Finance (2014).
[282] International Energy Agency (2013).
[283] International Energy Agency (2013).
[284] International Energy Agency (2013).

with monthly consumption less than 30 kWh receive a discount of 65 percent for that initial block. A 40 percent discount applies to the block from 31 kWh through 100 kWh, and a 10 percent discount applies from 101 kWh to 220 kWh.[285]

In Brazil, there is extensive involvement in energy efficiency and DSM by both the federal government and by the regulator, ANEEL. The federal government has funded extensive energy efficiency programs through the majority state-owned national electricity utility, Eletrobras. The regulator, ANEEL, has imposed a progressively more stringent energy efficiency obligation[286] on electricity distribution utilities that has, in effect, created a public benefits charge. Brazil is one of only a few developing nations that have created such a charge.[287]

7.2 Policy Objectives

Brazil's emphasis on energy efficiency dates back to the oil crisis of the 1980s and is rooted in its desire for greater energy independence. The quest for energy independence also accounts for development of renewable source of energy in Brazil and exploration for domestic sources of fossil fuels.

Federal government involvement in energy efficiency commenced in 1985 with the implementation of an electricity conservation policy that resulted in the establishment by the federal government of the National Electrical Energy Conservation Program known as PROCEL (Programa Nacional de Conservação de Energia Elétrica). PROCEL has invested in energy conservation and energy efficiency from 1986 through to the present. Capacity shortfalls that occurred during the 2001/02 drought contributed to the emphasis on energy efficiency program initiatives focused on the power sector.[288] Originally, PROCEL was managed within Eletrobras. In 1991, PROCEL was transformed into a government program coordinated by the Ministry of Mines and Energy but it still depends on resources from both Eletrobras and a federal loan fund, the Global Revision Reserve. Eletrobras manages the funds from the Global Revision Reserve.[289]

A separate initiative, the Energy Efficiency Program (Programa de Eficiência Energética – PEE), uses funds from the public benefits charge levied under the utility energy efficiency obligation administered by ANEEL to promote the efficient and rational use of electricity in all sectors of the economy through projects that demonstrate how to fight waste and improve energy efficiency in relation to equipment, processes, and energy end-uses.

Concerns associated with climate change came into focus in 2007 when a presidential decree was issued and created the Inter-Ministerial Committee on Climate Change (Comitê Interministerial sobre Mudança do Clima – CIM). The CIM was given the function of preparing the National Policy on Climate Change and the National Climate Change Plan. The Plan identifies actions to mitigate climate change, including a plan for the establishment of a National Action Plan on Energy Efficiency.[290] Brazil has a national carbon reduction target of between 36.1 and 38.9 percent by 2020, compared to a 2005 baseline.[291]

[285] International Energy Agency (2013).
[286] International Energy Agency (2013).
[287] R. P. Taylor, Govindarajalu, Levin, Meyer, and Ward (2008).
[288] International Energy Agency (2013).
[289] Lees (2010).
[290] Government of Brazil. Interministerial Committee on Climate Change (2008).
[291] Bloomberg New Energy Finance (2014).

7.3 Legal Authority

Brazilian energy policy is set by means of laws (legislation) and decrees (executive or regulatory authority). Federal government involvement in energy efficiency commenced in 1985 with Administrative Directive Number 1877 that established the PROCEL energy efficiency program.

ANEEL, established in 1996 by Law No. 9.427, performs the functions that are normally associated with economic regulation, including price setting, fixing the conditions for accessing the networks, supervising auctions, granting concessions, approving market rules and grid codes, and supervising the Market Operator and System Operator.[292,293]

Commencing in 1998, the utility energy efficiency obligation established by ANEEL requires that a proportion of the net revenues of electricity utilities be allocated for energy efficiency. The obligation was codified in Law Number 9.991 of 24 July, 2000 requiring that one percent of the net operating revenue of electricity distribution companies was to be invested into research and development (R&D) and in end-use energy efficiency programs. The ANEEL *Energy Efficiency Program Manual* indicates that "net operating revenues" comprises gross revenues less taxes, training program expenses, contributions to social security, contributions to the Global Revision Reserve, investments in R&D and energy efficiency, and contributions to an energy development account. [294]

Law Number 9.991 was later modified by Law No. 12.212 of 20 January 2010, clarifying that up to 31 December 2015, at least 0.5 percent of utility revenue was to be invested in each sector (R&D and energy efficiency) respectively and that, additionally, 60 percent of the investment in energy efficiency was to be targeted towards the population which benefit from the 'Tarifa Social' - the social tariff.[295] Distributors whose electricity sales total less than 1,000GWh are required to invest 0.25% of their net operating revenues in energy efficiency programs, increasing to 0.5% in 1 January 2016.[296]

There are other Brazilian laws (see Table 20, page 74) that relate to energy efficiency in general and also complement utility DSM efforts. For example, in 2001, an *Energy Efficiency Law* was passed by the Brazilian Congress (Law Number 10,295 of 17 October, 2001). This Law provided for a National Policy for the Conservation and Rational Use of Energy.

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[292] Tolmasquim (2012).
[293] Salcedo and Porter (2013).
[294] Agência Nacional de Energia Elétrica (2008).
[295] Bloomberg New Energy Finance (2014).
[296] Bloomberg New Energy Finance (2014).

Table 20. Programs, Standards and Laws Regarding Energy Efficiency in Brazil[297]			
Year	**Program/Law**	**Objective**	**Comments**
1985	PROCEL	Implementation of an electric power conservation policy.	Available investment and energy efficiency data are not precise, they are estimated.
As of 1990	Environmental Comfort Standards	Establish standards for buildings, adequate to reality.	It must be pointed out that these measures need to be more participative if they are to be incorporated by actors.
1990	ESCO	Remunerated according to the savings obtained from energy projects, through own funding, or with third party funds used toward this end.	The expected activities have yet to be developed, due to funding constraints.
1990	CICE	Creation of CICEs in each government agency so as to propose, implement and follow up effective rational electric power use measures, controlling and publishing more relevant information.	This is currently not taking place in the country due to the lack of a legal framework and financial support.
1993	GERE	To monitor and orient the development of CICE activities and to propose legislation changes, so as to ensure greater efficiency in energy production and consumption, operating as an overall CICE manager.	This is currently not taking place in the country due to the lack of an oversight agency providing legal and economic support.
2000	Law N.Â° 9.991, of 24 July, 2000	The government obliges utilities to invest a minimum of 1% of their net operational revenue in R&D and EEPs each year.	There is the need for an investment policy that also includes the supervision, verification and measurement of the results yielded by the use of these funds.
2001	Law N.Â° 10.295, of 17 October, 2001 (Energy Efficiency Law)	Establishes the National Policy on the Conservation and Rational Use of Energy.	There are only norms for MIT, CFL and electronic ballasts.
2006	PROESCO	First source of funding aimed specifically at ESCOs, with guarantee provided by the borrowing individual.	The government needs to reconsider the current restrictions to BNDES funding.
2009	RAC	Aware that public buildings consume nearly 3% of all the energy consumed in the country, this voluntary program is introduced.	Since participation is not mandatory, there are no economic incentives to energy efficient projects.

[297] De Oliveira, Shayani, and De Oliveira (2013).

7.4 Coverage

PROCEL funds or co-funds a wide range of energy efficiency projects that extend beyond the electricity sector. Activities are focused mainly on: research, development and demonstration; education and training; testing, labeling and standards; marketing and promotion; private sector support; utility DSM programs; and direct implementation of efficiency measures.[298]

Electricity distribution utilities use funds from the Energy Efficiency Program (PEE) administered by ANEEL to invest in public sector projects, residential, commercial and industrial sector projects, educational projects, community-based projects, and rural energy efficiency projects.[299]

7.5 Energy Savings Targets

In October, 2011, the Ministry of Mines and Energy (MMA) approved a National Plan for Energy Efficiency. The Plan adopted the earlier targets of the National Action Plan on Climate Change for 109 TWh of cumulative targeted annual electricity savings by 2030. The targets were adopted by Interministerial Decree No. 6263 on November 21, 2003.[300,301]

7.6 Energy Efficiency Activities

The PEE energy efficiency program has invested over BRL 4.6 billion in the municipal, residential, commercial and industrial sectors, including education projects. Figure 19 (page 76) shows that over the period 1998/99 to 2001/02, the majority of expenditure on energy efficiency by Brazilian utilities was on public lighting programs, followed by residential programs, and industrial sector and commercial sector programs. After 2002, the Brazilian government increased the minimum cost benefit ratio required for lighting investments.

ESCOs have played an important role in the design of Brazil's utility energy efficiency programs and the delivery of energy savings. Some of the largest utilities in the country have outsourced the design of energy efficiency projects to ESCOs. In these cases, the utilities decide the types of projects they intend to pursue and ESCOs compete to design and implement the projects.[302]

7.7 Marketing, Education and Outreach

A portion of the PROCEL funds goes to education and training and marketing and promotion, including school education about energy efficiency technologies. Brazil implemented a voluntary energy performance labeling program through PROCEL in 1993 that became mandatory with the promulgation of Law No. 10.395, October 17, 2001.

The ANEEL *Energy Efficiency Manual* allows for up to five percent of administration and marketing costs to be included in the costs of program delivery. Distribution utility projects may also use PEE funds to sponsor energy efficiency education program involving schools, community groups and low income consumers.[303]

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298 International Energy Agency (2014a).
299 Agência Nacional de Energia Elétrica (2008).
300 Government of Brazil. Interministerial Committee on Climate Change (2008).
301 Young et al. (2014).
302 Jannuzzi (2005).
303 Agência Nacional de Energia Elétrica (2008).

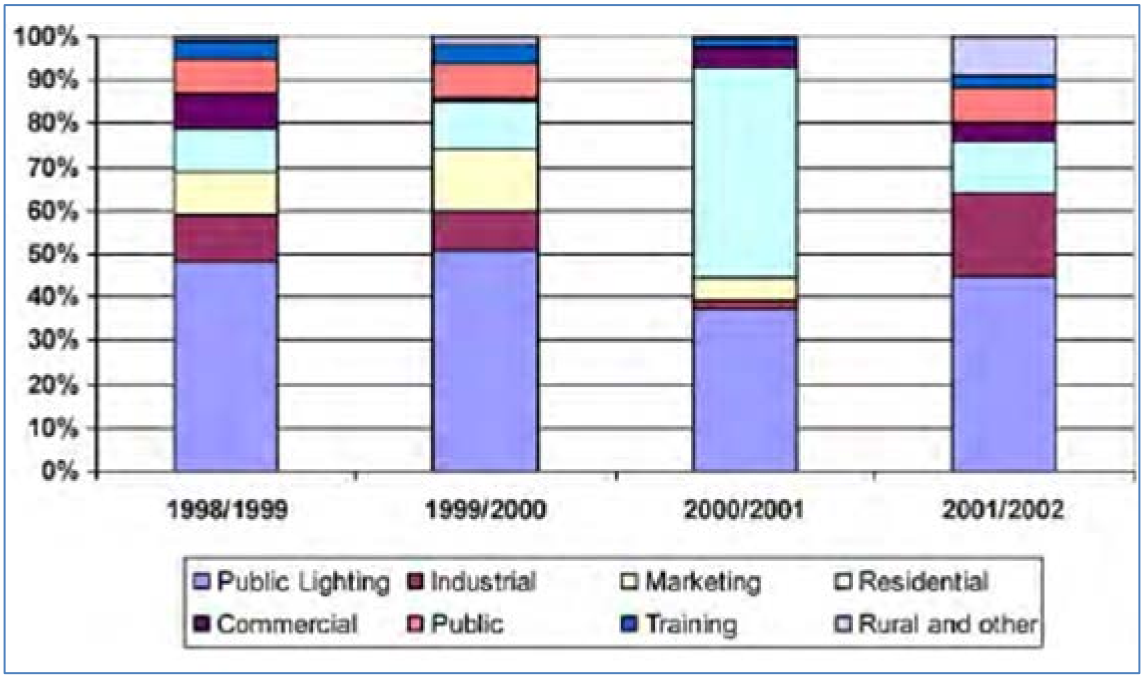

Figure 19. Expenditure by Brazilian Utilities on End-use Energy Efficiency Programs, 1998/99 to 2001/02[304]

7.8 Funding

The PEE energy efficiency program began in 1998 using funds from the public benefits charge levied under the utility energy efficiency obligation. Table 21 shows the investment levels by Brazilian utilities in energy efficiency under the PEE program.

Table 21. Investments by Brazilian Utilities in End-use Energy Efficiency, 1998/99 to 2003/04[305]

Cycle	No. of utilities	Total investments (US$ million)	% in end-use programs	Avoided demand (MW)	Energy savings (GWh)
1998–99	17	68.3	32	250	754
1999–2000	42	75.9	40	369	994
2000–01	53	35.4	94	n.a.	n.a.
2001–02	60	57.2	99	496	1,498
2002–03[a]	28	39.8	100	n.a.	n.a.
2003–04[b]	40	66.8	100	n.a.	n.a.

The energy efficiency obligation increased by several times the level of investment in energy efficiency historically made by the PROCEL program. PROCEL invested an average of USD 14 million per year during the period 1994-2003; during the period 1998-2004, utility investments under the PEE program averaged USD 57 million per year.

304 Jannuzzi (2005).
305 R. P. Taylor et al. (2008).

The level of funding for the PEE program is a function of utility revenues. Utilities designated by ANEEL must collect a percentage share of their net operating revenues as a public benefits charge.[306] A share of the collections are allocated to energy efficiency. The allocation of revenues has changed very significantly since the initial implementation of the charge in 1998, and the Brazilian Congress has since passed several laws that impact the specifics of the public benefits charge. While the total obligation has remained at one percent of utility revenue, the proportion allocated to energy efficiency programs has varied between 0.9 percent and 0.25 percent. A 2007 law passed by the Brazilian Congress reinstated the energy efficiency allocation to 0.5 percent, half of which must be spent on energy efficiency measures targeted at low-income households.[307] A small proportion (about 0.1 percent) is also used to support the activities of EPE.

Some energy efficiency programs implemented in Brazil are self-funding. Energy performance labeling programs and a ban in incandescent light bulbs required no explicit involvement of utility DSM program initiatives.

7.9 Results

Currently, ANEEL initiatives under the PEE program using funds from the public benefits charge levied under the utility energy efficiency obligation are producing energy savings in excess of 8.5 TWh per year and the reduction in peak demand is around 2.5 GWh. The PROCEL program saved nearly 70 TWh in 2010 with another 100 TWh expected in 2011. [308] As noted previously, the activities of PROCEL extend well beyond the delivery of utility delivery of DSM or energy efficiency programs.

7.10 Evaluation, Measurement and Verification

At present, no independent ex-post evaluation of the energy savings achieved by programs implemented under the PEE energy efficiency program has been carried out, so the impacts in terms of avoided capacity and energy savings cannot be determined accurately.[309] In contrast, a thorough accounting audit of program expenses is performed by ANEEL, in order to ensure that utilities are complying with their one percent system benefit charge obligation.[310] Since 2007, ANEEL has also required that evaluation plans must be provided for delivered programs, but these plans do not require independent evaluations.[311]

Concern is sometimes expressed that PROCEL lacks adequate authority to ensure that the deemed savings levels from equipment purchases may not reflect the reality of PROCEL activities. Concerns also exist with respect to the M&V activities around utility equipment replacement programs that target lower income households. Stronger EM&V is needed to ensure the programs that focus on efficient equipment replacement actually result in the retirement of inefficient equipment.[312]

[306] International Partnership for Energy Efficiency Cooperation (2012).
[307] R. P. Taylor et al. (2008).
[308] Da Nobrega (2014).
[309] Jannuzzi (2005).
[310] Jannuzzi (2005).
[311] International Energy Agency (2014c).
[312] De Oliveira et al. (2013).

7.11 Cost-Effectiveness

Information regarding the costs and benefits of projects funded under the PEE energy efficiency program must be posted on a website[313]. Starting in 2001, ANEEL required a cost-benefit ratio of 0.85 or less for project approval.[314]

7.12 Performance Incentives and Penalties

Penalties are applied to electricity distribution companies that maintain underspent system benefits charge balances that exceed prior year expenditures on energy efficiency programs.[315]

7.13 Response to Stress Situations

Brazil has persistent concerns about adequate electricity generation capacity in the face of drought conditions. The most recent stress situation was in 2001/2002 season. Brazil confronted a shortage in capacity during a period in which its hydro capacity was adversely affected by the drought conditions.

In many ways, the capacity shortfall that occurred paralleled the events that precipitated the 2000/2001 crisis in California, and the 2008/2009 crisis that occurred in South Africa. In each case, there was a period of uncertainty associated with power sector reform initiatives that resulted in periods of inadequate investment in new capacity. In the case of South Africa, there was an actual moratorium placed on investment in new generation plant during a period in which reserve margins declined.[316] Brazil experienced similar reform initiatives during the 1990s that were intended to introduce elements of a competitive market. However, what followed was a period in which investors had difficulty obtaining financing as the regulatory uncertainty created weak incentives for additional investment.[317] This period led to increasing exposure to the adverse hydrological conditions that occurred in 2001 and 2001.

The options available to government to respond were limited. Government managed the shortfall through the implementation of a quota program on all residential, industrial and commercial customers. A monthly ceiling was set at 80 percent of the previous year. Customers were penalized for excess consumption. The result was that electricity consumption was reduced by 20 percent and avoided the rolling blackouts that would otherwise have resulted.[318] The PROCEL investments in energy efficiency leading up to this period contributed to the solutions. However, activities under the PEE energy efficiency program were only just beginning to take effect.

7.14 Overall Effectiveness

Overall, the Brazilian planning process has been successful and reasonably transparent, although it has fallen short of its “lowest cost” objectives by failing to adequately integrate end-use energy efficiency resources into the process.

There have been some positive interactions between the PEE and PROCEL energy efficiency programs that have taken effect over time. In 2002, ANEEL started explicitly requiring that all

[313] Agência Nacional de Energia Elétrica (2008).
[314] Jannuzzi (2005).
[315] Agência Nacional de Energia Elétrica (2008).
[316] Dagut and Bernstein (2008).
[317] International Energy Agency (2013).
[318] International Energy Agency (2013).

appliances and equipment considered in utilities' PEE energy efficiency programs comply with the PROCEL energy performance labelling or efficiency standards set by PROCEL.[319]

7.15 Lessons Learnt

The target of only 10 percent cumulative energy savings by 2030 is a modest ambition for utility energy efficiency programs by international standards. In Brazil, there appears to be considerable opportunities for energy efficiency investments in buildings and industry. The opportunities for energy efficiency improvements appear to be considerable in commercial buildings alone.[320] Brazil has no mandatory building codes and few equipment suppliers. Buildings account for roughly half of electricity demand in Brazil.[321]

Even with these modest ambitions, there is considerable room for doubt about whether the energy efficiency targets can be achieved. For example, although Brazil established a legal framework for the implementation of appliance efficiency standards, the implementation of those standards has been slow, creating additional opportunities for energy efficiency programs delivered by utilities. The non-mandatory features of the energy performance labeling program create additional opportunities for stop-gap utility interventions.[322]

There are also questions about utility energy efficiency programs that are aimed at replacement of older inefficient appliances with new and efficient ones. The focus here is on lower income households. Strengthening EM&V activities are needed to ensure that the replaced equipment is indeed retired.

In 2012, ACEEE reviewed the energy efficiency performance of twelve of the largest economies in the world. Despite the progress in residential buildings and appliance labelling, Brazil scored in the bottom quarter of the countries listed, just below the US and China, but above Canada and Russia.[323] Brazil is achieving only a small share of the energy efficiency potential from ESCOs and is well behind China and the US in developing shared savings contracts for industry.

[319] Jannuzzi (2005).
[320] Young et al. (2014).
[321] International Energy Agency (2013).
[322] De Oliveira et al. (2013).
[323] Hayes, Young, and Sciortino (2013).

8. LESSONS FOR THE MENA REGION FROM THE CASE STUDIES

The six case studies included in this report provide detailed examples of relevant policy and regulatory mechanisms that may, with suitable modification, be capable of effective implementation in the MENA region. The case studies were selected to demonstrate the wide range of different approaches that have been adopted to enable utility delivery of end-use energy efficiency.

California

Utility delivery of energy efficiency commenced in California more than 30 years ago and is now the largest and oldest program of its kind in both the United States and the world. The long-term California experience in utility delivery of energy efficiency represents close to the maximum level of energy savings that can be achieved through this approach. The unique feature in California is the comprehensive set of policy and regulatory mechanisms that has been developed over many years through a unique collaborative process involving the two regulatory agencies and the California legislature. This collaboration is the key to California's achievements and is the main lesson to be learnt by other jurisdictions seeking to emulate the California results.

New South Wales, Australia

The New South Wales Energy Savings Scheme (ESS) and its predecessor together comprise the longest-running energy efficiency certificate scheme in the world. The schemes' combined experience of more than 10 years has enabled progressive revision and refinement of scheme parameters, including definitions of eligible energy efficiency measures, deemed energy savings values, methodologies for calculating the numbers of certificates that can be created, and scheme administrative procedures. These changes have established the ESS as an efficient and cost-effective mechanism for delivering energy savings.

The ESS has successfully demonstrated two unique policy and regulatory mechanisms that assist in the implementation of utility delivery of energy efficiency: trading of energy efficiency certificates and the accreditation of third parties to achieve energy savings. Together these two mechanisms have enabled the establish and development of an energy services industry in New South Wales and have contributed to a major increase in the quantities of energy savings being achieved in the state. Jurisdictions looking to establish a new energy services industry or expand and existing one can learn a great deal from the experience of the NSW Energy Savings Scheme.

South Africa

In South Africa, impacts on system reliability have been a powerful motivator in delivering capacity savings in the electricity system. In the years since the capacity crisis began, the major electricity utility, Eskom, has far exceeded the load reduction and energy savings targets set by the regulator, and in most years, exceeded its own expectations by a wide margin. After almost a decade without material investment in new supply, Eskom embarked upon an aggressive plan for price increases over time coupled with time-of-use pricing and inclining block rates that complemented efforts to promote energy efficiency and DSM initiatives.

In implementing utility delivery of energy efficiency, South Africa initially pursued pathways that included heavy reliance on third party providers of energy efficiency services. However, the ESCO model proved challenging for delivery, and most of the material energy savings achieved did not rely heavily on ESCOs. The achieved reductions in demand were mostly achieved through the mass market residential program initiatives targeting lighting and industrial programs delivered by Eskom.

China

China's grid company energy efficiency obligation is one of the latest examples worldwide that uses a government-imposed obligation to ensure that utilities assist their customers to use electricity efficiently. The implementation of the EEO in China has been particularly difficult because of the very large size of the grid companies, their ability to influence the political process, and their complete lack of any experience in delivering energy efficiency. Despite the reluctance by the grid companies to engage with end-use energy efficiency, in both 2012 and 2013, they achieved their EEO energy savings and demand reduction targets though, given the size of China, these results were not particularly ambitious. Jurisdictions looking to use a government-imposed EEO in situations where there is no prior experience with utility delivery of energy efficiency may learn useful lessons from the China case study.

India

India provides an example of close involvement by the central and state governments in the development of a policy and regulatory framework to enable utility delivery of end-use energy efficiency. The Government of India has established a solid foundation of sector reform and a framework for delivering DSM that has been decades in the making. The framework relies increasingly on electric distribution utilities, but also on the national government in the form of the Bureau of Energy Efficiency (BEE). Oversight of the electric utilities and the regulations that give form to the DSM activities are established by the state electricity regulatory authorities. However, the energy efficiency and DSM industry in India is still at an early stage. Most of the projects developed and implemented by the distribution utilities are pilot projects that provide a foundation of experience that reduces uncertainty in achieving energy savings through successive stages of program delivery.

Brazil

In Brazil, there is extensive involvement in energy efficiency and DSM by both the federal government and by the electricity industry regulator, ANEEL. The federal government has funded extensive energy efficiency programs through the majority state-owned national electricity utility, Eletrobras. The regulator has imposed a progressively more stringent energy efficiency obligation on electricity distribution utilities that has, in effect, created a public benefits charge. Brazil is one of only a few developing nations that have created such a charge. However, the target of only 10 percent cumulative energy savings by 2030 is a modest ambition for utility energy efficiency programs by international standards. In Brazil, there appears to be considerable opportunities for energy efficiency investments in buildings and industry and it should be possible for utility energy efficiency programs to achieve savings in excess of the target.

9. CONCLUSION

Energy utilities can play a key role in delivering end-use energy efficiency improvements. Governments turn to energy utilities to deliver energy efficiency for several reasons. Utilities have a strategic position in energy markets, often serving as an intermediary between energy producers and energy consumers. They are well positioned to overcome the key barriers - lack of awareness of the best energy efficiency measures, the “hassle factor” of procuring the measures, and perceived risks in relation to performance and cost – that prevent consumers from investing in energy efficiency.

The six case studies presented in this report were selected to share the experience of a wide range of countries and regions located on five different continents, and a range of economies reflecting a breadth somewhat similar to that found in the MENA region. The six countries and regions either rely on, or are in the formative stages of developing, energy efficiency programs that depend on utilities for funding and implementation. Countries and regions with the longest history of experience in utility delivery of energy efficiency have a record of success that typically continues to grow. Properly relied upon, utility energy efficiency programs can fit into a deeper framework of investments in new technologies that includes supporting initiatives, such as codes, standards, and energy performance labeling, to eventually achieve market transformation in which energy efficiency becomes the norm.

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