2 Low Carbon Path for Meeting the Electricity Needs of the People

Role of Regulatory Commissions

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Introduction

Even though India has been listed as the fourth largest emitter of carbon dioxide (CO_2) in the world in 2007, with approximately 1.324 billion tonnes of CO_2 emissions,[1] its per capita emission, at 1.18 tonnes, stood well below the world average of 4.38 tonnes per capita. Further, India's CO_2 intensity of 0.33 kg per unit of gross domestic product (GDP) in terms of purchasing power parity (PPP) was below the world average of 0.47 kg per unit of GDP (US$ 2000).[2] Studies[3] have shown that, even if GDP were to grow at an aggressive rate over the next two decades, and even if developed countries were to achieve emission reduction by 25–40 per cent, India's per capita emission will be well below the average of the developed countries. So, in absolute terms, India's emission in 2031 would be comparable with the 2007 emission levels of countries such as China and the United States of America.

Recognizing its vulnerability to the consequences of climate change, India has voluntarily decided to reduce its emission intensity (emissions per unit of GDP) by 20–5 per cent of the 2005 level by the year 2020. This proactive step of an unbinding commitment to reduce emissions' intensity helps strengthen India's position as a responsible country. Besides, such a voluntary target helps in successfully defining goal-oriented initiatives for a sustained reduction in emissions' intensity.

Power Sector: Major Contributor of CO_2 Emissions

Approximately 80 to 82 per cent of electricity production in India comes from fossil fuels (Table 2.1). Of these, coal is the dominant fuel, followed by gas. This means that power generation is a major source of CO_2 emissions. Using Central Electricity Authority's (CEA's) weighted average emission factor[4] of 0.82 kg of CO_2 emission per kWh (unit) of electricity generation in India, the level of CO_2 emission from electricity generation is estimated to stand at 585–90 million tonnes per year.

Figure 2.1 shows levels of greenhouse gas (GHG) emissions from the power sector, as compared to the total emissions in India in 2007 without land use, land-

[1] Emissions referred to here denote CO_2 emissions from fuel combustion, International Energy Agency (2009: 52). The recent publication, Ministry of Environment and Forests (2010) puts the estimate at 1.728 billion tonnes of CO_2 emissions in 2007, and per capita emission is estimated at 1.5 tonnes per annum.

[2] Figures quoted here are from International Energy Agency (2009: 47–57). The GDP figures are in constant US$ terms with 2000 as the base year.

[3] Ministry of Environment and Forests (2009).

[4] The emission factor is defined as average CO_2 emitted per unit of electricity generated in the grid. The latest value comes from the CEA (2009a).

Table 2.1 Share of Different Fossil Fuels in Total Electricity Generation in India

Type of Generation	*Generation in Million kWh for 2009–10*	*Generation in Million kWh for 2008–9*	*Generation in Million kWh for 2007–8*
Coal	514757	480365	453014
Lignite	24769	22134	23713
Multi-Fuel	457	10029	10036
Gas Turbine/Combined Cycle Gas Turbine	96651	72865	68931
Diesel	4243	4709	3297
Total Fossil Fuel	640877	590101	558990
Total Generation**	766193	717895	699191
Fossil Fuel Generation as % of Total Generation	83.64	82.20	79.90

Notes: ** Domestic generation only, excludes imports from Bhutan.
Source: CEA (2009b and 2010) (Figures have been rounded off).

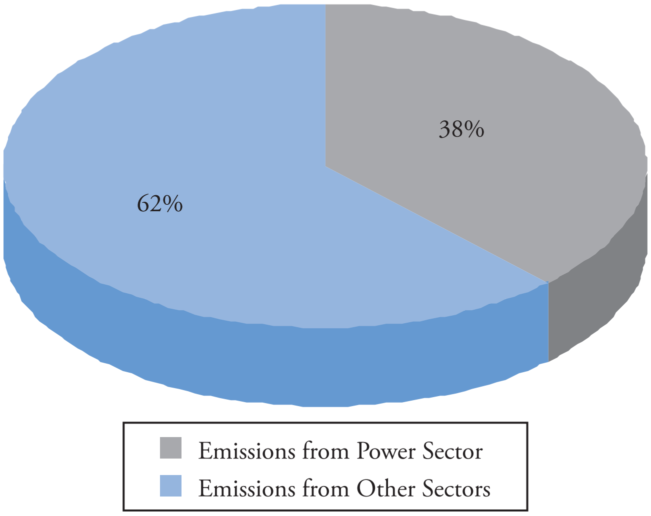


Figure 2.1 India: GHG Emissions in Million tonnes of CO_2 Equivalent in 2007

Source: Ministry of Environment and Forest (2010: Table ES1).

use change, and forestry (LULUCF).[5] It is seen that, in percentage terms, GHG emissions from the power sector constituted about 37.8 per cent of India's overall GHG emissions without LULUCF. Thus, any CO_2 emission mitigation strategy in India must pay special heed to the power sector.

Poverty Alleviation and Meeting Minimum Electricity Needs: Implications for CO_2 Emissions

The Indian economy needs to maintain a steady growth rate of eight to nine per cent per annum over the next 20 to 23 years, if it is to liberate the 450 million people currently having incomes less than Rs 60 per day from extreme poverty. Further, electricity being a vital component of infrastructure and a necessity of modern life, its availability will also have to be increased concomitantly with economic growth. As of today, there are approximately 400 million people in India with little or no access to electricity.

The Integrated Energy Policy Report (IEPR) of the Planning Commission estimates that to support and sustain eight to nine per cent economic growth rate over the next 20 to 23 years and to meet the minimum electricity needs of its populace, India's electricity generation capacity will have to increase by five to six times—from about 725 billion units and 166,000 MW in 2009 to 3600 billion units and 800,000 MW in 2031–2, respectively. Given India's energy resource endowment, however, most of the additional capacity generation will have to come from fossil fuels, mainly coal, which in turn would lead to increased levels of CO_2 emissions. At today's weighted average emission factor, this could translate into about 2.952 billion tonnes of CO_2 emissions due to power generation activity in 2031–2.

Measures to Reduce CO_2 Emissions from the Power Sector

The main stages in an electricity cycle[6] are depicted in Figure 2.2, along with a stage-wise depiction of a broad set of initiatives that are either being undertaken or could be undertaken to reduce carbon emissions from power generation and use. While initiatives under 'D'

[5] Ministry of Environment and Forest (2010).
[6] Although system operations form an important part of the overall electricity business, in the present context, this has not been included in the figure.

to 'H' can bring about reduction in generation or in the rate of growth of generation,[7] initiatives under 'B' and 'C' reduce the share of fossil fuels in electricity generation. Initiatives under 'A' result in improving the conversion efficiency of fossil fuel-based electricity generating plants. Thus, although the manner in which they achieve emission reduction differs, all initiatives have the potential to reduce emissions from electricity generation and its use.

Reduction of CO_2 Emissions from the Power Sector: Role of Regulatory Commissions

The Electricity Act, 2003 (EA, 2003) together with the National Electricity Policy (NEP), and the Tariff Policy (TP), provide the necessary regulatory and legal framework for implementation of almost all sets of initiatives mentioned in Figure 2.2. The 2003 Act mandates formulation of both the policies mentioned above for development of a power system based on optimal utilization of energy resources. It also envisages tariff interventions to encourage competition, efficiency, economical use of resources, good performance, and optimum investments. All this, together with the mandate for the regulators to provide for a multi-year tariff regime with emphasis on performance-based regulation of supply side, is proving to be instrumental in enhancing supply efficiency. The National Electricity Policy envisions that efficient technologies such as super critical technology, Integrated Gasification Combined Cycle (IGCC), and large-size units would be gradually introduced for electricity generation for their efficiency and cost-effectiveness. Further, it provides that cost-effective technologies need to be developed for high voltage power flows over long distances to minimize transmission losses. The National Electricity Policy also provides for greater application of information technology (IT) which has great potential in terms of reducing technical and commercial losses in distribution and providing consumer-friendly services.

The Electricity Act 2003, together with both policies, also mandates promotion of electricity generation from renewable energy (RE) sources and provides for specifying renewable purchase obligation (RPO). The Act also pro-

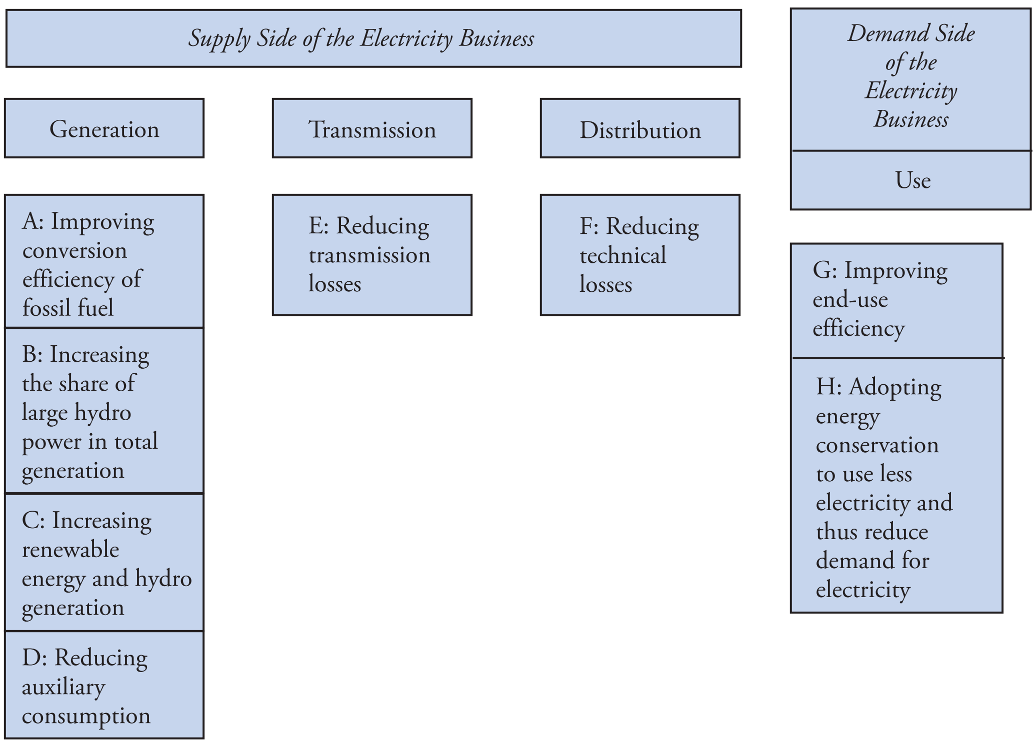


Figure 2.2 Typical Electricity Cycle

Source: Authors' own notes.

[7] Normally, where there are no power cuts, initiatives under 'D' to 'H' will lead to reduction in generation to meet a given load. However, in India, because there are shortages, initiative from 'D' to 'H', depending on when or where they operate, will either reduce generation or the rate of growth of generation.

vides for development of the power market and increase in competition, which in turn would improve efficiency on the supply side. On the demand side, though the Act does not directly mandate energy efficiency (EE) and energy conservation (EC), the NEP and the TP do emphasize upon efficiency in the use of electricity by consumers.

While the Electricity Act 2003 and the policies mentioned above provide the framework for the stakeholders to reduce CO_2 emission, enforcement of regulatory provisions and implementation of initiatives are the key to bringing about reduction in CO_2 emissions and their intensity in the power sector. It is the CERC and the SERCs which, by virtue of their regulatory jurisdiction, are and will remain the main drivers of India's efforts towards a low carbon-intensive power sector.

On the demand side, experiences of several countries in the world suggest that, at the ground level, it is the distribution entities which have been more successful in planning and implementing initiatives for reduction of CO_2 emissions such as 'G' and 'H' mentioned earlier. Thus, once again, the regulatory commissions, more particularly the SERCs, emerge in the role of real drivers in terms of efforts to reduce carbon intensity. An overview of the existing and planned future regulatory efforts for reducing the carbon intensity is given below.

Improving Generation Efficiency

Improving efficiency of fossil fuel-based power generation is an important way to reduce emissions from power generation. The type and quality of coal used as well as operating parameters such as excess air, make-up water consumption, condenser vacuum, secondary fuel consumption, fuel gases' temperature, steam parameters, plant load factor, and others affect the station heat rate (SHR, that is, efficiency of operation) of the thermal power plant. Whether the plant is being operated as a base load or a peaking plant also has a bearing on the operating efficiency of thermal power plants. Operating at consistently higher loads, more near the maximum continuous rating, results in the most efficient operation of the plant.

Scope for Further Improvement in Efficiency of Electricity Generation from Existing Thermal Power Plants

A Central Electricity Authority[8] review of performance of thermal power stations in India for 2007–8 shows that the pan-India weighted average operating SHR is 13.76 per cent higher than the weighted average design SHR. Similarly, an International Energy Agency (IEA) information study of July 2008[9] shows that the average efficiency of coal plants in India for 2001–5 was 27 per cent, among the lowest in the world (world average is 34 per cent). These studies demonstrate that ample scope exists for improvement in the efficiency of electricity generation from thermal power plants in India, and in the heat rate in particular.

Control and Monitoring of Efficiency in Existing Thermal Power Plants

The Central Electricity Regulatory Commission (CERC) and the SERCs have prescribed norms for SHR and secondary fuel consumption for fossil fuel-based thermal power plants under their respective regulatory jurisdictions. The tariffs payable to the generating units are fixed by the regulators after taking into consideration the prescribed norms. The profitability of the generating entities is thus linked to the achievement of the specified norms. Generating stations are prescribed a gradual, improving trajectory through progressively tighter norms every year. Usually, such trajectories are prescribed over the multi-year tariff horizon of five years. Table 2.2 shows the norms prescribed by CERC in 2009 as compared to its 2004 Regulation.

Table 2.2 Norms for Gross SHR Values in CERC (Terms and Conditions of Tariff) Regulations, 2004 and 2009

Description	*Unit Size*	*Gross Station Heat Rate: 2004 Regulation (kcal/kWh)*	*Gross Station Heat Rate: 2009 Regulation (kcal/kWh)*
Existing Thermal Power Plants	200/210/250 MW	2550	2500
Existing Power Plants	500 MW sub-critical technology	2450	2425
Badarpur Thermal Power Plant	–	2925	2825
Talcher Thermal Power Plant	–	3100	2950
Tanda Thermal Power Plant	–	3000	2825

Source: CERC (2004; 2009a).

[8] CEA (2008).
[9] IEA (2008).

In the case of secondary fuel consumption, the Central Electricity Regulatory Commission has slashed the norms from two millilitre (ml) per unit in its (Terms and Conditions of Tariff) Regulations, 2004 to one ml per unit in the (Terms and Conditions of Tariff) Regulations, 2009 (CERC 2009 Regulations). Similar trends are generally seen in respect of heat rate and secondary fuel consumption norms prescribed by the various SERCs.

Efficiency of New Plants

As mentioned above, given the projection for increase in India's energy requirements over the next 20 to 23 years and its energy-resource endowment, most of the increase in energy generation capacity will be coal-based. It, therefore, makes immense sense to ensure that the new capacity coming on stream is inherently efficient. In this context, the CEA has recommended a choice of more efficient super-critical technology with design heat rates in the region of 2079 to 2176 kcal/kWh.[10] It is envisaged that super-critical technology would result in 60 per cent and 90 per cent of the total capacity addition during the Twelfth Plan (2012–17) and Thirteenth Plan (2017–22) periods respectively. Presently, 31 super-critical units of 660–800 MW size are under construction, including all ultra mega power projects with all units based on the efficient super-critical technology.

Recognizing the importance of ensuring that new plants coming on stream are inherently efficient, CERC has provided stringent norms for design SHR for new plants in its 2009 Regulation (Table 2.3).

Reducing Auxiliary Consumption

Auxiliary[11] consumption values in Indian power plants are in the range of eight to 13 per cent for coal and lignite-based plants, zero to one per cent for hydrostations and one to three per cent for gas-based stations. Reduction in auxiliary consumption would mean increase in electricity supply for consumers, and thus reduced levels of emission on a given consumer load. The CERC and SERCs, in consultation with the CEA, have prescribed norms for auxiliary consumption for generating units (see Table 2.4). These norms are used in tariff determination by regulators and are thus linked to the profitability of the generating entities.

Harnessing Full Development of Hydro Potential

Hydroelectricity is a clean and renewable source of energy. The National Electricity Policy emphasizes the need for the development of full hydro potential in the country, which is about 148,700 MW, and out of which approximately 33,000 MW (22 per cent) has been developed. During the Eleventh Plan (2007–12), about 6874 MW of hydro-capacity is expected to be commissioned, of which 3431 MW has been commissioned by the end of 2009. Additionally, benefits from about 6447 MW hydropower capacity are expected to be realized during the period 2012–17.

A 50,000 MW hydropower initiative has been launched under which pre-feasibility reports (PFRs) for

Table 2.3 CERC Design Heat Rates for Coal-based Generating Stations for Commercial Operations after April 2009

Type of Boiler Feed Pump Drive	*Pressure Rating Kg/cm²*	*Superheat/Reheat Temperature in°C (SHT/RHT)*	*Maximum Design Unit Heat Rate (kcal/kWh)*	
			Indian Sub-Bituminious Coal	*Bituminious Imported Coal*
Electrical-driven	150	535/535	2300	2197
Turbine-driven	170	537/537	2294	2191
Turbine-driven	170	537/565	2276	2174
Turbine-driven	247	537/565	2235	2135
Turbine-driven	247	565/593	2176	2079

Source: CERC (2009a).

[10] As compared to this, the weighted average design SHR of existing thermal power plants in 2007–8 was approximately 2,376 kcal/kWh.

[11] CERC (2009a) defines auxiliary energy consumption as 'in relation to a period in case of a generating station means the quantum of energy consumed by auxiliary equipment of the generating station, and transformer losses within the generating station, expressed as a percentage of the sum of gross energy generated at the generator terminals of all the units of the generating station.'

Table 2.4 Norms for Auxiliary Consumption Values in CERC (Terms and Conditions of Tariff) Regulations, 2004 and 2009

Description	*Unit Size*	*Auxiliary Consumption: 2004 Regulation (%)*	*Auxiliary consumption: 2009 Regulation (%)*
Existing Thermal Power Plants	200/210/250 MW	9.0	8.5
Existing Power Plants: 500 MW	Electrical-driven boiler feed pump	9.0	8.5
Existing Power Plants: 500 MW	Steam-driven boiler feed pump	7.5	6.0
Talcher Thermal Power Plant		11.0	10.5
Neyveli Lignite TPS-I		12.0	12.0
Neyveli Lignite TPS-II		10.0	10.0

Source: CERC (2004; 2009a).

162 projects of about 48,000 MW capacities have been prepared in 2004. The PFRs have been made available to the developers. As a follow-up to the PFRs, 78 schemes of 34,000 MW capacities have been identified as low tariff schemes, of which 77 schemes of about 33,950 MW have been taken up for preparation of detailed project reports/implementation.

The CERC has been facilitating the development of hydro projects in view of the huge potential and environmental benefits of hydropower. These projects involve larger capital investment, have long gestation periods, and are subject to uncertainties about availability of water. The CERC has developed a tariff structure to mitigate concerns regarding cash flow for project developers. A cost-plus approach has been adopted, with provisions ensuring recovery of their capacity cost, based on their availability for three hours in a day over the initial 10 years, thus insulating against hydrological risks. The Commission has also set up a task force on peak and off-peak tariffs for generating stations to assess whether there is merit in a higher tariff for supply during peak periods when the value of electricity is the highest. A positive recommendation from the task force will pave the way for providing an incentive to hydro power generation, as storage-type hydro generation essentially caters to peak demand. On the other hand, the GoI has formulated the New Hydro Policy of 2008, wherein the private sector has been exempted from tariff-based bidding up to January 2011. Also, merchant sale up to 40 per cent of saleable energy has been allowed. One per cent additional free power from the project for local area development has been allowed to be accounted for in tariff determination.

Transmission Distribution and Loss Reduction

Transmission Loss Reduction

Overall, technical losses in the transmission system are generally low and varying across states in the range of four to five per cent. At the national level, inter-regional connectivity has been planned with hybrid systems, consisting of High Voltage Direct Current (HVDC), ultra high voltage AC (765 kV), and extra high voltage AC (400 kV) lines. The ultra high voltage systems, which enable significant reduction in transmission losses, can be built to cater to pre-fixed loads of large size. This always leaves a possibility of a certain part of the line capacity remaining unutilized for some time as transmission systems of high capacity need to be planned and executed in advance and the load growth follows. To facilitate construction of such high voltage corridors, CERC has decided to fund the capital servicing of unutilized capacity from the amount available in the Unscheduled Interchange Pool Account.

Distribution Loss Reduction

The lower the distribution losses[12] the higher the proportion of generated electricity available for meeting consumers' demand, thus making it possible to meet their demands with lower CO_2 emissions. The total distribution losses of Distribution Companies (DISCOMs) comprise both technical losses and commercial losses. The technical losses are associated with thermal energy loss, and commercial losses include all other components of financial losses broadly comprising electricity thefts and metering errors.

[12] As explained subsequently, it is actually the technical loss part of the distribution losses that is more important from the CO_2 emissions perspective.

The all-India average Aggregate Technical and Commercial (ATC) loss is about 29 per cent, which includes billing and collection inefficiencies. Since losses have a significant bearing on the financial health of DISCOMs, SERCs set loss reduction trajectories for them to monitor the actual loss against the set target. They also determine tariffs chargeable by DISCOMs, taking cognizance of the regulator-specified loss trajectory (see Table 2.5). Thus, the profitability of DISCOMs is linked to achievement of the loss reduction targets. Incentives are also provided for exceeding the set targets in this regard.

Significance of Technical Losses from the Perspective of CO_2 Emissions

Reduction in carbon dioxide emissions happens when reduction of technical losses results in reduction in electricity generation requirement. Although reduction in commercial losses too can reduce electricity demand, it is not commensurate and cannot be estimated.[13] Although SERCs are rigorously pursuing reduction in distribution losses, only a few DISCOMs such as those in Mumbai have estimated technical losses, and these are evidence

Table 2.5 Approved Loss Targets for DISCOMS (2007–8 to 2009–10)

DISCOM	*Parameter*	*2007–8*	*2008–9*	*2009–10*
Andhra Pradesh				
APCPDCL	Distribution	18.90	16.90	15.90
APEPDCL	Distribution	17.10	15.80	15.10
APNPDCL	Distribution	19.90	18.00	17.10
APSPDCL	Distribution	17.30	15.90	14.90
Delhi				
BRPL	AT&C	31.10	26.69	23.46
BYPL	AT&C	39.95	34.77	30.52
NDPL	AT&C	31.10	22.03	20.35
Gujarat				
DGVCL	Distribution	19.90	15.59	14.45
MGVCL	Distribution	21.60	21.09	15.00
PGVCL	Distribution	36.50	30.22	30.00
UGVCL	Distribution	25.10	16.95	16.00
Haryana				
UHBVNL	Distribution	30.50	28.50	26.00
DHBVNL	Distribution	30.50	28.50	26.00
Himachal Pradesh	T&D	18.50	17.50	15.75
Karnataka				
BESCOM	Distribution	20.50	21.35	20.40
CESC	Distribution	22.00	24.10	23.10
GESCOM	Distribution	27.05	31.00	30.50
HESCOM	Distribution	25.00	25.00	24.00
MESCOM	Distribution	15.00	16.15	16.05

(*contd.*)

[13] As regards commercial losses, it is important to note that electricity is being consumed but is not billed and paid for either because it is stolen or the meter is faulty. In such situations, when a commercial loss reduction initiative is launched, it does not eliminate the consumption that was happening before. At best, it reduces the consumption as it now has to be paid for.

Table 2.5 (*contd.*)

DISCOM	*Parameter*	*2007–8*	*2008–9*	*2009–10*
Kerala	T&D	20.45	19.55	17.92
Madhya Pradesh				
MPPKVVC (East)	T&D	34.50	32.50	29.50
MPPaKVVC (West)	T&D	30.00	28.50	27.00
MPMKVVC (Central)	T&D	43.00	40.00	37.00
Maharashtra				
MSEDCL	T&D	34.97	31.70	22.50
TPC	T&D	2.93	2.93	2.93
R Infra	T&D	11.52	11.50	10.75
BEST	T&D	11.50	11.00	10.50
Punjab	T&D	20.75	19.50	19.50
Rajasthan				
Ajmer	T&D	34.08	35.00	32.00
Jaipur	T&D	29.51	28.50	23.90
Jodhpur	T&D	31.29	33.00	30.00
Uttar Pradesh				
Agra	T&D	29.10	29.10	29.10
Lucknow	T&D	22.40	22.40	22.40
Meerut	T&D	29.10	29.10	29.10
Varanasi	T&D	26.70	26.70	26.70
Uttarakhand	AT&C	30.17	24.32	22.32
West Bengal				
CESC Limited	Distribution	15.75	15.36	15.11
DPL	Distribution	6.50	6.50	6.10
DPSC Limited	Distribution	5.74	5.60	5.54
WBSEDCL	Distribution	23.00	19.53	18.75

Source: Forum of Regulators (2009).

enough for the extent of reduction in electricity generation that is possible through technical loss reduction. From the CO_2 emissions perspective, therefore, it is clear that SERCs must order the DISCOMs under their jurisdiction to initiate steps to estimate technical losses and, based on these estimates, draw up a technical loss reduction trajectory.

Emission Reduction via Efficiency Improvement through Distribution Franchisees

The EA, 2003 introduced 'franchisee' as a person authorized by a distribution licensee to distribute electricity on its behalf in a particular area within his area of supply without a separate licence from the concerned SERC. Wherever such franchise arrangements are in operation, there has been remarkable improvement in distribution efficiency. Under this scheme, the distribution licensee supplies electricity to the franchisee on payment of a power supply charge committed in the franchise agreement. The committed input rate reflects the franchisee's commitment to improve distribution efficiency, including reduction in ATC losses in the franchise area. The revenue from the sale of electricity in the franchised area is retained by the franchisee, which serves as a source of payment to the distribution licensee as well as for carrying out business in the franchise area. The franchisee is able to improve efficiency, resulting in higher availability of electricity to consumers from the same input energy, thus demonstrating the potential to significantly reduce carbon emissions by supplying the required electricity to consumers out of a much lower level of input energy.

The franchisee model is in operation in few franchise areas in the country and has been particularly successful in Bhiwandi in Maharashtra, where in the first two years of franchise, the franchisee has been able to reduce the ATC losses from 63 per cent in 2006–7 to 19 per cent in 2008–9. This is a real success story.

Considering its potential for increasing distribution efficiency and concomitantly reduction of carbon emissions, the Forum of Regulators (FoR) has in May 2010, commissioned a study for preparing a 'standard model for the distribution franchisee'.

Increasing Renewable Energy-based Generation

Renewable energy sources reduce the share of fossil fuel-based generation and thus contribute directly to the reduction of carbon emissions. During the year 2008–9, RE-based generation was about 3.5 per cent of the total generation in the country—generated from grid-connected RE capacity of about 13,242 MW. In line with the provisions of the 2003 Act, and the directions contained in the TP and the NEP, CERC and SERCs have been promoting the use of renewable sources for grid-connected electricity generation. There are also instances of regulators promoting the use of renewable energy to substitute for grid-connected electricity in some uses. For example, the Karnataka Electricity Regulatory Commission (KERC), through its tariff orders, has incentivized the use of solar

Box 2.1
Promotion of RE-based Generation: Relevant Provisions from Electricity Act 2003 and Tariff Policy

- The preamble of the EA, 2003 states that one of its important objects is promotion of *efficient* and *environmentally benign* policies relating to generation, transmission, distribution, trading, and use of electricity
- Section 86 (1) of the Electricity Act 2003 states that the State Commission shall discharge the following functions, namely:
  - *(e) promote co-generation and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;*
- Section 61 of the EA, 2003 states that the appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely:
  - *(h) the promotion of cogeneration and generation of electricity from renewable sources of energy;*
- Section 3(1) of the EA, 2003 states: 'The Central Government shall, from time to time, prepare the NEP and Tariff Policy, in consultation with the state governments and the authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro, and renewable sources of energy.' *(emphasis added)*
- Section 4 of the EA, 2003, regarding policy for stand-alone systems, states that:
  - 'The Central Government shall, after consultation with the state governments, prepare and notify a national policy, permitting stand-alone systems (including those based on renewable sources of energy and non-conventional sources of energy) for rural areas.'
- Section 6.4 of the Tariff Policy recognizes that it will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity, and therefore, states that the procurement of electricity from non-conventional energy sources by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission. The section further states that:
  - Pursuant to provisions of section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources, taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs at the latest by 1 April 2006.
  - Such procurement by distribution licensees for future requirements shall be done, as far as possible, through a competitive bidding process under Section 63 of the Act, within suppliers offering energy from same type of non-conventional sources. In the long term, these technologies would need to compete with other sources in terms of full costs.
  - The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding.

water heaters by providing a monthly rebate of Rs 50 to 80 in the electricity bills of all domestic consumers using solar water heaters on a regular basis.

Electricity Act, 2003 and Promotion of Renewable Energy-based Power Generation

The real impetus to renewable energy for power generation was provided by the 2003 Act. Prior to the Act, RE-based power generation was mainly being developed through private investments by prescribing fixed tariffs for renewable energy (along with annual escalation rates) and allowing banking and wheeling of power thus generated. These attempts, however, achieved mixed results, as prior to the Act, no specific legal provisions existed to make purchase of renewable energy mandatory. The Act explicitly provides for the development and promotion of RE-based power generation (see Box 2.2 for details). The regulations, formulated by SERCs under the provisions of the Act, have helped to overcome barriers being faced by stakeholders. The promoters and investors in RE-based generating plants are now assured that their plants will be connected to the grid, and the electricity thus generated will be bought by the DISCOMs at a preferential tariff determined by the respective SERCs over the life of the plant. Similarly, bankers and financiers have better assurance that there is a ready market for the electricity generated by their clients. Also, the preferential tariffs with long-term validity have enabled promoters, investors, bankers, and financiers to estimate future cash flows and profits from the RE projects with greater certainty. On the other hand, this has also provided assurance to DISCOMs that power purchase cost from RE sources, which is more expensive than conventional power, will be allowed as a strategic pass-through in the annual revenue requirement of the DISCOMs.

Preferential Renewable Energy Tariffs

Following the provisions of the EA, 2003 and the Tariff Policy, several SERCs have come up with preferential tariffs (see Table 2.6), while SERCs in Orissa, Jammu and Kashmir, and Arunachal Pradesh are yet to specify preferential tariffs from RE sources.

Renewable Purchase Obligation (RPO)

Following the provisions of the Electricity Act, 2003 and the Tariff Policy, each DISCOM or the state as a whole is given, through Renewable Purchase Obligation (RPO), a mandate to ensure that a certain percentage of energy consumed comes from RE-based generation. Such targets are being issued by different SERCs, either as consolidated targets or as separate targets for each RE source such as biomass, wind, and small hydro power. The RPO targets

Table 2.6 Preferential Tariffs in Various States

(*Rs per kWh*)

State	*Wind*	*SHP**	*Biomass*	*Bagasse*	*Solar PV***	*Solar Thermal***
Andhra Pradesh	3.37	2.6	4.15	3.29	7	7
Gujarat	3.37	–	3.08	3	–	–
Himachal Pradesh	–	2.87	–	–	–	–
Haryana	4.08	3.67	4	3.74	15.96	
Karnataka	3.40	2.8	3.1	3.06	15.4	3.4+12
Madhya Pradesh	3.97	–	3.40	2.82		
Maharashtra	3.5	3	3.04	3.05	3+12	15
Rajasthan	3.65	–	4.48	–	15.7	
Tamil Nadu	3.39	–	4.5	4.38	3.15	3.15
West Bengal	4	3.6	4	2.55	11	11
Punjab	4.04	3.81	4.04	3.81	–	–
Uttarakhand	–	3.25	–	2.33	–	–
Bihar	–	–	3.33	3.51	–	–
Chhattisgarh	–	–	3.05	–	–	–
Kerala	3.14	2.44	–	2.8	15.8	–

Notes: *Small hydro power; ** generation-based incentive, wherever applicable.
Source: Various tariff orders of SERCs.

have also been mandatory for open-access consumers as well as for captive consumers. Several states have come up with RPO targets for various RE sources (see Table 2.7). However, SERCs from Jharkhand and the north-eastern states are yet to issue RPO orders.

Renewable Energy-based Power Generation Capacity and Potential

India today has approximately 17,593 MW (on 30 June 2010) of RE-based generation capacity (Table 2.8). The national share of renewable energy in total installed generation capacity is approximately nine to 10 per cent and the share of RE generation in total generation is approximately 3.5 per cent. Almost 75 per cent of this capacity has come on stream in the past five to six years, thereby indicating the boost that has been provided to RE by the facilitative provisions of the 2003 Act and the subsequent policies and regulations. Although recent years have witnessed accelerated RE-based generation capacity addition, the current RE-based installed capacity is only eight per cent of the total RE potential (Table 2.8), which at the current commercially exploitable levels, is of the order of 183000 MW. Thus, there exists huge untapped potential to reduce the share of fossil fuels.

Emerging Challenges and Recent CERC and Forum of Regulators (FoR) Initiatives to Further Accelerate the Pace of RE Generation and Future Actions

The regulatory framework for the promotion and development of RE-based generation has been in place for the past five to six years and has thrown up the need for regulatory refinements to address challenges that have cropped up. The Forum of Regulators (FoR)[14] had set up a Working Group on renewable energy to provide guidelines, methodologies, and framework for its development. The working group[15] addressed issues pertaining to RPO percentage specification, pricing of renewable

Table 2.7 RPO as Specified by Tariff Orders of SERCs (as percentage of total sale of electricity)

State	*Source/Utility/DISCOM*	*RPO for the Year*					
		2006–7	*2007–8*	*2008–9*	*2009–10*	*2010–11*	*2011–12*
Andhra Pradesh		5	5	5			
Chhattisgarh	Biomass	–	–	5	5	5	
	Small hydro power	–	–	3	3	3	
	Others	–	–	2	2	2	
Delhi			1	1	1		
Gujarat		1	2	–	–	–	–
Haryana			3	5	10	10	10
Karnataka		10	10	10	–	–	–
Kerala		5	5	5	–	—	–
Madhya Pradesh				10	10	10	10
Maharashtra		3	4	5	6	–	–
Punjab			1	1	2	3	4
Rajasthan		2.5	4.88	6.25	7.45	8.5	9.5
Tamil Nadu		10	10	10			
Uttar Pradesh		7.5	7.5	7.5	7.5	7.5	
Uttarakhand			5	5	8	9	10
West Bengal	WBSEB			4.8	6.8	8.3	10
	CESC Limited			4	6	8	10
	DPL			2.5	4	7	10

Source: Various tariff orders.

[14] FoR is a statutory body constituted under Section 166 (2) of the EA, 2003 for harmonization, coordination, and ensuring uniformity of approach amongst regulatory commissions (CERC and SERCs) across the country.

[15] Forum of Regulators (2008).

Table 2.8 Installed RE-based Generation Capacity till 31 October 2009 and RE-based Generation Potential

Type of Generation	*Source*	*Achievement till (31.6.2010) (MW)*	*Overall Potential (MW)*
Grid Connected Power Generation	Bio-power	901	16881
	Wind power	12010	45195
	Small hydro power	2767	15000
	Cogeneration (bagasse)	1412	5000
	Waste to energy	72	7000
Sub-Total Grid Connected Capacity		17,162	133,000*
Distributed Generation	Solar power	12	50000
	Biomass	238	
	Biomass gassifier	125	
	Waste to energy	53	
	Solar PV power plants + street lights	3	
	Aero-generators/hybrid systems	1	
Sub-Total Distributed Generation Capacity	432	50000	
Total RE Based Generation Capacity	17593	183,000	

Note: * When additional potential of about 45,000 MW is considered from fuel wood plantations on 20 million hectares of wasteland, yielding woody biomass with calorific value of 4000 kcal/kg, and efficiency of 30 per cent and plant load factor of 75 per cent for biomass.
Source: Planning Commission, Eleventh Plan document and MNRE major achievements (available on MNRE web site: www.mnre.gov.in)

energy, incentives, and grid connectivity for RE-based generating units.

Variation in Preferential Tariffs across Different States

The preferential tariffs issued by various State Electricity Regulatory Commissions (SERCs) differ widely, as can be seen in Table 2.6. Such varying tariffs can create doubts in the minds of investors and financiers about returns from investing in RE-based generating plants. On 16 September 2009, drawing upon the provisions of Section 61 (a)[16] of the EA, 2003, the CERC issued a comprehensive regulation for tariff determination from RE sources (Renewable Tariff Regulation). This Regulation, besides defining norms, also provides guidance on the methodology for tariff determination with respect to RE-based generation from wind, solar, small hydro-power, biomass, and non-fossil fuel-based co-generation for uniformity in preferential tariff computation process across different states.

The Central Electricity Regulatory Commission followed up its Regulation with a *suo moto* Order on 3 December 2009, which provides generic tariffs for RE technologies (see Table 2.9) determined in accordance with the norms and methodology clearly specified in the Renewable Tariff Regulation.

These tariffs are expected to serve as benchmarks and reference tariffs for various stakeholders at the state level, including SERCs. This Regulation also provides for CERC to determine the generic tariff on the basis of the *suo moto* petition at least six months in advance at the beginning of each year of the control period for RE technologies, thus allowing the Commission to capture advances in technology and its effects on generic tariffs, if any, for future projects only.[17]

Non-compliance with RPO Targets

In some states, DISCOMs have failed complying with or have been finding it difficult to meet the RPO targets. For example, as against an RPO[18] target of 10 per cent,

[16] Section 61(a) of the EA, 2003, which provides that the SERCs in determining tariffs for generating and transmission companies shall be guided by the principles and methodologies specified by the CERC.

[17] Tariff determined each year will have a validity period. Any RE-based generation coming on stream during the validity period will have the same levelized tariff, as is applicable for the period, throughout its life.

[18] Per cent of total energy consumed/sold in the state or by the DISCOM has to come from RE-based generation.

Table 2.9 Generic Tariffs for RE Technologies as Contained in CERC Order of 3 December 2009

RE Technology	*Zone/Region*	*Levelized Tariff (Rs/kWh) without tax incentives**	*Levelized Tariff (Rs/kWh) with tax incentives**
Wind	Wind Zone 1, Capacity utilization (CU) of 20%	5.63	5.26
	Wind Zone 2, CU of 23 %	4.90	4.58
	Wind Zone 3, CU of 27%	4.17	3.89
	Wind Zone 4, CU of 30%	3.75	3.50
Small Hydro Power	Himachal Pradesh, Uttarakhand, and North-eastern states (Below 5 MW)	3.90	3.67
	Himachal Pradesh, Uttarakhand, and North-eastern states (5 MW to 25 MW)	3.35	3.14
	Other states (below 5 MW)	4.62	4.35
	Other states (5–25 MW)	4.00	3.75
Solar PV	All India	18.44	17.14
Solar Thermal	All India	13.45	12.54
Biomass Power Plants	Andhra Pradesh	4.25	4.05
	Haryana	5.52	5.42
	Madhya Pradesh	3.93	3.83
	Maharashtra	4.76	4.66
	Punjab	5.49	5.39
	Rajasthan	4.73	4.63
	Tamil Nadu	5.08	4.98
	Uttar Pradesh	4.47	4.37
	Others	4.88	4.78
Non-Fossil Fuel- based	Andhra Pradesh	4.93	4.78
Co-generation	Haryana	5.78	5.65
	Madhya Pradesh	4.80	4.68
	Maharashtra	4.29	4.16
	Punjab	5.75	5.62
	Tamil Nadu	5.10	4.98
	Uttar Pradesh	5.21	5.06
	Others	5.17	5.04

Note: *Such as accelerated depreciation.
Source: CERC (2009).

in Madhya Pradesh and Chhattisgarh, the achievement is 0.11 per cent and 3.7 per cent respectively. In Maharashtra, the achievement is 3.17 per cent against the target of five per cent. Similarly, the achievement in Uttar Pradesh is 2.44 per cent against the target of 7.5 per cent. In Rajasthan, against a target of 9.5 per cent, the achievement is approximately 7.5 per cent. On the other side, there are also instances where the targets have been achieved or over-achieved. Tamil Nadu, Karnataka, and Punjab are some of the states which have either achieved the RPO targets or have exceeded them.

The inability of DISCOMs to meet the targets under RPO is often attributed to the fact that these targets are either too stiff to start with or are being ramped up over the years for it to be practically achievable. In some instances, these targets have not been in line with the potential and infrastructure available in the state.

The absence of disincentives for not meeting these targets is also one of the reasons for complacency.[19] In order to resolve the issue of the appropriate level of RPO targets for various states, FoR has commissioned a comprehensive study to estimate the RE generation potential

[19] CERC (2010).

(technology-wise) in various states. The study further assesses the impact of recommended RPO targets on the cost of power and tariffs in various states, provide guidance to SERCs, and will lead to setting up of realistic and achievable targets.

Incremental RE Capacity Additions Reaching a Plateau in the Past Two or Three Years

Having witnessed the initial burst in incremental capacity additions after the EA, 2003 was notified, incremental renewable energy power generation capacity seems to have reached a plateau. Thus, 430 MW of incremental RE capacity came up in 2002–3, 849 MW in 2003–4, 1366 MW in 2004–5, 2011 MW in 2005–6, and 2138 MW in 2006–7. Since then, however, the yearly incremental capacity has remained in the region of 2000–2200 MW. One reason cited for incremental renewable energy capacity reaching a plateau is that states who were aggressively promoting RE generation have achieved RPO targets (for example, Karnataka and Tamil Nadu) and in spite of exploitable renewable energy potential still left, neither the state governments nor the DISCOMs have enough incentive to continue purchasing costly RE power, as that increases the overall power cost, and consequently, the consumer tariffs. Table 2.10 shows average cost of power procurement for DISCOMs in various states. Although the average cost of power in one or two DISCOMs is comparable

Table 2.10 Average Cost of Power Procurement for Distribution Companies for 2005–6 to 2007–8

(Rs/kWh)

State	*DISCOM/Procurement Entity*	*2005–6*	*2006–7*	*2007–8*
Andhra Pradesh	APCPDCL	1.94	2.04	2.21
	APEPDCL	2.12	2.21	2.43
	APNPDCL	1.96	2.11	2.35
	APSPDCL	2.04	2.08	2.38
Assam	ASEB	1.84	2.04	1.84
	CAEDCL	1.74	1.93	3.04
	LAEDCL	2.21	2.37	3.42
	UAEDCL	2.42	2.64	3.14
Bihar	BSEB	1.79	1.82	2.01
Chhattisgarh	CSEB	0.72	0.78	0.99
Delhi	BRPL	2.17	2.31	2.83
	BYPL	1.71	1.88	2.62
	NDPL	2.11	2.19	2.70
Gujarat	DGVCL	3.02	3.18	3.22
	MGVCL	2.46	2.70	2.80
	PGVCL	1.59	1.95	2.17
	UGVCL	1.83	2.09	2.25
	GUVNL	2.11	2.36	2.60
Haryana	DHBVNL	2.05	2.37	2.92
	HPGCL	1.23	1.32	1.54
	UHBVNL	2.08	2.33	2.83
Himachal Pradesh	HSEB	1.73	1.95	2.13
Karnataka	BESCOM	2.14	2.47	2.65
	GESCOM	1.84	1.76	2.10
	HESCOM	1.90	1.81	1.97
	MESCON	2.06	2.41	2.42
	CESC	1.89	1.91	1.89

(contd.)

Table 2.10 (*contd.*)

State	*DISCOM/Procurement Entity*	*2005–6*	*2006–7*	*2007–8*
Kerala	KSEB	1.08	1.03	1.26
Maharashtra	MSEDCL	2.04	2.16	2.16
Madhya Pradesh	MPMKVVCL	1.74	1.92	1.91
	MPPaKVVCL	1.69	1.85	2.14
	MPPKVVCL	1.88	2.06	2.11
Orissa	CESCO	1.25	1.41	1.42
	GRIDCO	1.41	1.17	1.20
	NESCO	1.22	1.17	1.47
	SESCO	1.16	1.10	0.88
	WESCO	1.44	1.30	1.76
Punjab	PSEB	0.71	1.19	1.47
Rajasthan	AVVNL	2.09	2.17	2.68
	JDVVNL	2.15	2.18	2.61
	JVVNL	2.13	2.19	2.67
Tamil Nadu	TNEB	1.48	1.63	1.90
Uttar Pradesh	DVVNL	2.34	2.41	2.36
	MVVNL	2.08	2.41	2.55
	Paschim VVNL	2.34	2.41	2.55
	Poorvi VVNL	3.83	2.41	2.55
	UPPCL	2.09	2.12	2.22
	KESCO	2.33	2.40	2.55
West Bengal	WSEB/WSEDCL	1.86	1.85	2.22

Source: Extracted from Power Finance Corportion (2009).

to the generic tariffs of renewable energy power, the overall average cost of power in states are generally lower than generic RE tariffs.

Realizing that higher cost of renewable energy generation is the key impediment to further harnessing its large potential in states which have fulfilled their RPO targets despite it still remaining unexploited, both CERC and FoR initiated efforts to develop a mechanism that would combine the merits of instruments such as the RECs with the RPO to enable sharing of the economic burden of higher RE costs of electricity consumers in India, and not just consumers from the states who have this substantial potential. The efforts culminated in framing of CERCs REC Regulations, 2010 (see Box 2.2). This Regulation provides a mechanism whereby states having a relatively poor endowment of renewable energy resources, for example, Delhi, can meet their RPO targets by acquiring requisite levels or numbers of RECs from the market. In practice, the Regulation allows only the RE generators to own the RECs, whose level or number depends on the amount of renewable energy (in MWH terms) generated and injected. The DISCOMS from states such as Delhi, who want to fulfil their RPO targets, will have to acquire the RECs from the RE generators. The REC mechanism is such that the DISCOM actually absorbing this generation will not have to pay more than its liability to meet its own RPO target, even though it may be absorbing renewable energy power over and above its RPO target. The state or DISCOM is thus cost-neutral to the amount of generation taking place and being absorbed in the state by the DISCOMS. It is this aspect of the mechanism that is expected to provide the much needed boost to successfully harnessing the true RE potential in any state.

In a sense, therefore, the Renewable Energy Certificate (REC) mechanism entails transfer of the economic burden of higher RE generation costs from states having achieved their RPO targets to states yet to do so, although the actual production of RE-based electricity may still take place in states that have already fulfilled their targets. Further, besides providing the necessary thrust to better exploiting the RE potential in the country, this mechanism would provide a platform for open-access, captive, individual, and corporate consumers of electricity to meet their targets (when such targets are prescribed); and also provide them a platform to express in a big way their 'green intents' or 'green credentials'.

Promotion of Solar Energy-Based Power Generation

The launch of the Jawaharlal Nehru National Solar Mission (JNNSM) has provided a major thrust to India's virtually unexploited (see Table 2.8) solar electricity generation potential of 50,000 MW. Under the Mission, 20,000 MW of solar power generation capacity is expected to be created by 2022. In Phase 1 lasting up to 2013, the JNNSM targets 1000 MW of capacity creation and another 3000 MW capacity is envisaged to be created in Phase 2 by 2017.[20]

The Mission envisages the use of the regulatory framework of RPOs and RECs as the key driver for promotion of solar power generation in the first two phases. It, however, envisages creation of solar-specific RPOs and RECs to provide exclusive priority to the development of solar power. The Mission also proposes to start with an RPO target of 0.25 per cent for Phase 1 and to reach a level of three per cent by 2022—strategically envisages generation from small solar PV located on roof-tops and small solar plants connected to low tension (LT) or 11 KV grid.

Accommodating the provisions of the Mission, the CERC, in its REC regulation, has provided for creation and transfer of solar-based RECs. Further, to facilitate the interconnection of small and roof-top solar PV systems with LT and/or 11 KV grid, CERC, FoR, and the CEA are already working on initiatives such as: (i) development of appropriate interconnection standards; (ii) development

Box 2.2
Salient Features of REC Framework

- Cost of electricity generation from RE sources is classified as cost of generation equivalent to conventional energy sources and cost for environmental attributes.
- RE generators will have two options: (i) either sell the renewable energy at preferential tariff or (ii) sell electricity generation and environmental attributes associated with RE generations separately.
- The environmental attributes can be exchanged in the form of REC.
- REC will be issued to the RE generators for 1 MWh of electricity injected into the grid from RE sources.
- REC would be issued to RE generators only.
- REC could be purchased by the obligated entities to meet their RPO target under Section 86 (1) (e) of the Act. Purchase of REC would be deemed as purchase of RE for RPO compliance.
- Grid-connected RE technologies with minimum capacity of 250 KW and approved by the Ministry of New and Renewable Energy (MNRE), Government of India,would be eligible under this scheme.
- RE generations with existing power purchase agreements (PPAs) are not eligible for REC mechanism.
- SERC to recognize REC as valid instrument for RPO compliance.
- SERC would define open access consumers, captive consumers as obligated entities along with distribution companies.
- SERC to designate state agency for accreditation for RPO compliance and REC mechanism at the state level.
- CERC to designate central agency for registration, repository, and other functions for implementation of REC framework at national level. (The National Load Dispatch Centre has been designated as a central agency)
- Only accredited projects can register for REC at the central agency.
- Central agency would issue REC to renewable energy generators for specified quantity of electricity injected into the grid.
- REC would be exchanged only in the CERC-approved power exchanges.
- Price of electricity component of RE generation would be equivalent to average power purchase cost of the DISCOM including short-term power purchase but excluding renewable power purchase.
- REC would be exchanged within the forbearance price and floor price. The forbearance and floor price would be determined by CERC in consultation with the central agency and FoR from time to time.
- In case of default, SERC may direct the obligated entity to deposit into a separate fund to purchase the shortfall of REC at forbearance price.
- However, in case of genuine difficulty in complying with the renewable purchase obligation because of non-availability of certificates, the obligated entity can approach the Commission for 'carry-forward' of the compliance requirement to the next year.

Source: CERC (2010).

[20] The discussion is mostly based on the JNNSM document available on the MNRE website *www.mnre.gov.in*

of specifications for equipments that could be used for generating roof-top or small solar PV power; (iii) metering arrangements required for accounting of electricity generated from such small systems (net metering protocols); and (iv) development of model power purchase agreements between roof-top and small solar PV generators and the distribution companies with a view to converting each of the initiatives into model guidelines/regulations at a later date.

Together, the efforts to promote renewable energy generation are expected to increase its quantum and also its share in total electricity generation in the country, thereby contributing to the reduction of CO_2 emissions and rate of growth of emissions.

Conservation and Efficient Utilization of Electricity

Conservation and utilization of electricity in end uses such as lighting, heating, cooling, and pumping is one of the most economical ways to bring about low carbon-intensive economic growth and development. Conservation and efficiency either reduce the demand for electricity or reduce the rate at which this demand rises, leading to reduction in growth rate or demand for electricity generation. In the Indian context, one unit of electricity saved at the point of use translates into reduction in generation requirement by 1.26 units.[21] Considering that the weighted average emission factor per unit of electricity generation in India is 0.82 kg of CO_2, one unit of electricity saved through conservation or by improving the efficiency of use of electricity translates into saving of about 1.03 kg of carbon emissions.

Immense potential exists to save electricity in every sector of the Indian economy. The Integrated Energy Policy Report (IEPR) of the Planning Commission[22] estimates that the cost-effective saving potential through conservation and energy efficiency is at least 15 per cent of the total generation. Considering that the total national generation in 2008–09 was approximately 725 billion units, it can be estimated that conservation and efficiency have the potential to realize large reduction in carbon emissions, by about 112 million tonnes per year, if all the available existing saving potential is realized and strategically taken into consideration.

Energy efficiency also assumes importance in the wake of the huge demand-supply gap in India, high transmission and distribution (T&D) losses, fuel constraints, and environmental concerns that the power sector faces today. Capacity addition involves long gestation periods and is beset with several constraints. The demand-side management and energy efficiency can provide, although partly, an alternative to capacity addition.

Energy Conservation Act, 2001 (ECA), Bureau of Energy Efficiency (BEE), and National Mission on Enhanced Energy Efficiency (NMEEE)

While the Energy Conservation Act (ECA), 2001 provides an overall strategic framework for energy efficiency improvement, the BEE and the State Designated Agencies (SDAs), which are institutions created under the 2001 Act, are entrusted with the strategic roles of capturing the available energy efficiency and energy conservation potential in the country.

The Bureau of Energy Efficiency (BEE), over the past three to four years, has initiated a number of programmes to capture EE potential in various sectors. Three main instruments as laid down in the ECA, 2001, which are EE labelling, energy conservation building codes, and energy efficiency in 'designated' and notified industries under the ECA have been operationalized. The EE programmes have also been launched in agricultural pumping, government buildings, and municipal and local bodies. Capacity building and strengthening of the SDAs has also been initiated. A large pool of BEE-certified energy managers and energy auditors has been created under its national certification programme and this pool of professionals will be supplemented by a cadre of certified EE measurement and verification professionals. In addition, under the NMEEE, which is one out of the eight missions planned under the National Action Plan on Climate Change (NAPCC), it is envisaged that the ongoing efforts of BEE will be provided further depth and breadth through the development of market-tradable instruments such as energy efficiency certificates (EECs) under the proposed Perform, Achieve, and Trade (PAT) programme. Support will also be provided through initiatives such as the market-transformation initiative, power sector technology-strategy initiative, EE-financing initiative, and the setting up of Energy Service Companies (ESCO) to strengthen the delivery function of EE/EC. Although the norms for designated industries under the PAT are being designed by BEE, CERC is finalizing the strategic norms for thermal power plants.

[21] The figure is arrived at, assuming average auxiliary consumption of seven per cent, transmission losses of five per cent, and distribution system technical losses of approximately 10 per cent.

[22] Planning Commission (2006a).

Separate Independent but Coordinated Efforts and Role of DISCOMs and Power Sector Regulators in Demand Side Management

Notwithstanding the efforts of the Bureau of Energy Efficiency (BEE) and the initiatives proposed under the NMEEE, it is recognized that these efforts need to be supplemented by several independent, but coordinated initiatives, if wide coverage and penetration of EE and EC practices are to be achieved. The fact that a well-functioning EE market[23] does not exist in India further strengthens the need for independent but co-ordinated supplementary efforts in the area of energy efficiency.

In many parts of the world, such independent efforts in the area of energy efficiency have come from power sector utilities. American, European, Australian, and even some Asian power utilities have been involved in EE and EC activities since the 1970s with a view to bringing about desired changes in consumer demand. In the 1980s, this broad set of EE activities, undertaken by power utilities to bring about a desired change in consumer demand, came to be known as demand side management (DSM) in the US (see Box 2.3 and 2.4 for DSM components and nature and type of DSM initiatives). Utilities in the US and other countries continue to be engaged in these activities and have mainstreamed DSM in their organizational structure.

The importance of demand side management in the functioning of utilities in the US can be gauged from the fact that power utilities there now spend as much as two per cent to over 3.3 per cent of their annual revenues on these activities.[24]

Similar to power utilities in the US and other countries, there is nothing in the EA, 2003 to stop the DISCOMs in India, which are closest to the consumers, from launching independent supplementary initiatives in the DSM area under the supervision of the Electricity Regulatory Commissions (ERCs). Although there is no specific provision in the 2003 Act that directly mandates DISCOMs and/or regulatory commissions to encourage DSM/EE in various end-uses, the National Electricity Policy put emphasis on DSM, EE, and EC. Section 61 of the EA, 2003, inter alia, mandates the Regulatory Commissions to determine tariff after considering factors that would encourage efficiency, economical use of resources, and optimum investments. Section 42(1) of the 2003 Act provides that the distribution licensee should develop and maintain an efficient, co-ordinated, and economical distribution system in his area of supply.

While these sections in the 2003 Act can be considered to be pointing towards efficient and economical use of electricity, it cannot be considered to be pointing exclusively towards DSM. A more direct reference to DSM can be found in Section 86 (4) of the Act, which states that the SERCs shall be guided by the National Electricity Policy (NEP) and the National Electricity Plan. The NEP, notified by GoI in February 2005, explicitly provides for energy conservation, wherein the Policy stipulates that ERCs should ensure adherence to energy-efficiency standards by utilities (see Clause 5.9.6 of the NEP). In Maharashtra, where DSM activities in a planned manner are being implemented since 2004–05, the SERC has been actively promoting efficient utilization of electricity, its conservation, and DSM as a power shortage mitigation strategy by exercising its power vested under Section 23 of the EA, 2003 to regulate supply, distribution, consumption, or use of electricity in times of exigencies. It is, however, evident that in India so far the ERCs' initiatives in the EE and EC space have been motivated to do so more by the existing situation of energy shortage rather than by environmental concerns.

Status of Implementation of DSM

The peak load management part of the demand side management is being addressed by using the instrument of time-of-the-day (TOD) tariffs. However, given that India has demand as well as energy shortages and hydro generation is often used for peaking purposes, not much by way of reduction in emissions is being achieved by TOD tariffs, as the tariffs while helping in shifting the consumption of electricity, are not helping in reducing consumption. Also, it is not as if non-peak power generation is non-fossil fuel-based.

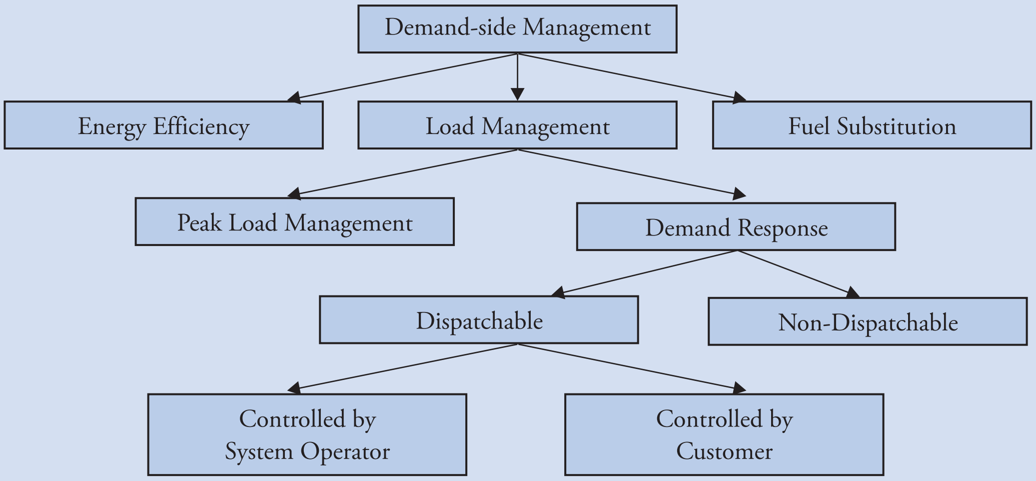
The energy efficiency, the fuel substitution part or the demand response part of the DSM, however, is not

[23] A well-functioning EE market is characterized by a market that has a large number of manufacturers willing and interested in producing energy-efficient products, goods, and services; adequate supply of efficient products, appliances, and goods; large number of consumers who are willing, interested, and motivated to buy/adopt EE goods, services, and practices; large number of financiers and bankers who are willing, interested, and motivated to finance these goods, services, and practices; and large number of EE delivery entities to provide these services.

[24] CAMPUT, 2006. *Demand Side Management: Determining Appropriate Spending Levels and Cost-Effectiveness Testing*, A Report prepared by Summit Blue Consulting LLC and The Regulatory Assistance Project (RAP). The Report has been prepared for the Canadian Association of Members of Public Utility Tribunals (CAMPUT), 30 June 2006.

Box 2.3
DSM Components

Demand side management (DSM) consists of three components: energy efficiency, load management (LM), and fuel substitution (FS) where another source of energy is used in lieu of electricity. FS would lead to reduction in electricity demand; at the same time it would also lead to increased use of another energy source (for example, natural gas). Consequently, analysis of this resource would need to consider non-electricity sector issues also.



Energy Efficiency is designed to reduce electricity consumption during all hours of the year, attempting to permanently reduce the demand for energy in intervals ranging from seasons to years and concentrates on end-use energy solutions.

Load Management is designed to change demand for energy in intervals from minutes to hours and associated timing of electric demand (that is, lowering during peak periods) through appropriate pricing, load control signals, or other incentives to reflect existing production, and all delivery costs.

Load Management resources can be further classified in two types —peak-load management (PLM) and demand response (DR). PLM attempts to 'shift load permanently from the peak period to off-peak period'. A simple example of the PLM programme is the time-of-day (TOD) tariff. In contrast, DR attempts to either 'shift or 'forego electricity usage only during specific events (for example, system emergencies). In some years, there may be many DR events while in others there may be no DR events. Examples of DR include direct load control (DLC) and interruptible tariffs, critical peak-pricing programmes (CPPs).

Source: Based on personal communication with Ranjit Bharvirkar of Lawrence Berkeley National Laboratory (LBNL) in December 2007/January 2008, and MERC Background Paper: Draft Cost-Effectiveness Assessment Guidelines for DSM Measures and Programmes, January 2009.

being practised on a large scale, except by DISCOMs in Maharashtra (see Box 2.5), Delhi and, to an extent, in Karnataka and Haryana. In Maharashtra, under the directions and guidance of the Maharashtra Electricity Regulatory Commission (MERC), DISCOMs have been running DSM programmes since 2005. To give impetus to DSM, its programme cost-effectiveness assessment and implementation framework regulations have been prepared by MERC in April 2010. The SERCs of Gujarat, West Bengal, Haryana, Rajasthan, Himachal Pradesh, and Chhattisgarh are discussing introduction of DSM in DISCOMs coming under their respective jurisdictions.

Experiences in Maharashtra and Delhi have shown that the SERCs can play an important role in inducting the DISCOMs in supplementing the efforts of BEE and NMEEE to bring about widespread and accelerated adoption of EE and EC practices. DISCOMs, hitherto, have only been involved in the supply side of the business and have responded to their consumers' rising electricity demand or to the rising demand-supply deficit through supply side options such as purchasing electricity from outside sources and reducing transmission and distribution losses. They have thus not been involved in harnessing the potential of demand side resources through DSM programmes. Keeping this in mind, the Forum of Regulators (FoR) constituted a Working Group (WG) on DSM and EE in July 2008, which has since brought out a strategy report. As per its recommendations, a major initiative is being undertaken by FoR to introduce DSM

Box 2.4
Nature and Type of DSM Initiatives

Demand side management (DSM) programmes, as practised the world over, have varied in their character from being simple 'information only' programmes that inform the users about the generic options available for conservation of electricity and its efficient utilization, to DSM 'resource acquisition' programmes that reduce electricity consumption and load, including peak load, through appropriately formulated DSM initiatives by consumers, energy service companies (ESCOs), equipment manufacturers/suppliers or others, with payments made to them by the utility in return for the resulting energy and load reductions. Thus, DSM programmes include:

- information programmes that inform the target consumers about the possibilities for energy efficiency and conservation in specific end-use and specific technology;
- technical assistance that provide energy audit services for consumers to identify where the energy conservation or demand reduction potential exists, what is its quantum and what its cost-benefit analysis is;
- financial assistance programmes that help consumers pay for DSM. These programmes could include providing initial capital, hire-purchase schemes, leasing, low-interest loans, rebates/discounts, etc.;
- direct installation programmes that provide comprehensive design, financial and installation services to the consumers to physically install equipment or put in place energy conservation/energy efficiency measures at the consumers' end, either by the utility's own staff or through utility hired contractors;
- alternative tariff programmes that include time-of-day (TOD) tariffs and tariffs that foster conservation and efficient utilization of electricity in target consumer segment and/or target end-use; and
- market transformation programmes that promote accelerated and wide-scale penetration of a particular type of energy efficient service, practice, or technology without the need for any continuous intervention by the utility.

Source: From 'Demand-side management from a sustainable development perspective: experiences from Quebec (Canada) and India', by Quebec Agence de l'efficacite energetique, Econolar International, IREDA and TERI, 2003.

in all states on a uniform basis, which includes training of personnel from the SERCs and distribution utilities[25] and also preparing guiding documents such as:

- Report on institutionalizing DSM;
- DSM regulations;
- Manual on cost-benefit analysis of DSM programmes;
- Manual on development of standard processes for design, development, and implementation of DSM programmes;
- Report on tariff restructuring and impact assessment; and
- Manual on monitoring and verification protocol for DSM programmes.

With these efforts, it is envisaged that target-based DSM programmes, which capture the available EE/EC potential, could be introduced in almost all states in 2010–11.

Funding for DSM

World-wide experience has shown that the funding for demand side management activities essentially comes from the consumers of utilities. Once the DSM targets are set, its related programmes to meet these targets are identified and the funds required for implementing these programmes determined. The required funds are collected from the consumers of the utility by:

- a rate surcharge, such as the 'system benefit charge' or 'societal benefit charge (SBC)' or public goods charge (California): these surcharges are typically mandated by legislation and are charged as a percentage of utility revenue and are collected from consumers either as a percentage of their bills or as per unit charge; and/or
- the utility's overall rates: the DSM funds requirement and budget is included in the utility's ARR.

The State Electricity Regulating Commissions (SERCs) of Maharashtra and Delhi have adopted the second approach. Thus, these two SERCs have allowed DISCOMs in the states to recover all costs incurred by them in any DSM-related activity by adding these costs to their ARR to enable their funding through tariff rates.

From studies in North America, it is generally seen that the present energy efficiency funding level for a number of

[25] FoR has signed an MoU with the Lawrence Berkeley National Laboratory (LBNL), for providing advice and capacity building. NABL has already conducted training programmes of SERC and DISCOM personnel in March, June, and August 2009.

Box 2.5
DSM Initiatives in Maharashtra

In Maharashtra, under the leadership of the then Chairperson of the Maharashtra Electricity Regulatory Commission (MERC), Pramod Deo, DSM was introduced in 2005. As a result of MERC's directives, the first ever serious effort was made by the DISCOMs in the state to implement DSM and EE programmes. Recognizing that mere directions to the utilities to capture the available DSM and EE and EC potential would not suffice, MERC took the following complementary measures:

Recovery of DSM and energy efficiency-related costs

Recognizing that the DISCOMs would need regulatory approval to recover costs associated with undertaking EE/DSM programmes, MERC allowed DISCOMs in the state to recover all costs incurred in any DSM and EE related activity, including planning, designing, implementing, monitoring, and evaluating DSM, EE, and EC programmes through aggregate revenue requirement.

Capacity Building

The Commission enhanced its internal capacity by creating a dedicated DSM cell within the organization in early 2006, in order to ensure compliance with the Commission's directions and to facilitate the regulatory process in EE and DSM activities. Further, recognizing that the DISCOMs in the state have limited experience and knowledge in the establishment of a self-sustaining, market-based cycle of DSM and EE programme development, financing and implementation, the Commission provided support and guidance to the DISCOMs in DSM and EE programmes. Further, the Commission entered into a Memorandum of Understanding (MoU) with the California Energy Commission (CEC), California Public Utilities Commission (CPUC), and Lawrence Berkeley National Laboratory (LBNL) of the US, to develop its own capacity and also that of the utilities in the areas of EE, DSM, load research, integrated resource planning, and demand response, etc.

Load Research

Recognizing that DISCOMs in the state had virtually no category-wise demand and consumption data beyond the system level demand (that is, no data on contribution of sector or segment or end-use or technology to the total demand, both in terms of quantum or timing) which is so vital in strategizing and planning EE or DSM programmes, the MERC through its multi-year tariff (MYT) orders of April/May 2007, directed all the DISCOMs in the state to undertake systematic load research and to make this research an integral part of their day-to-day operations.

In addition, the Commission, through its orders on load management penalties and incentives, was able to create a fund of Rs 700 million, which the MERC allowed the DISCOMs to use in the initial years for DSM pilot projects such as promotion of both CFLs and efficient fluorescent lamps; energy saving in high rise building pumping; promotion of efficient street lights; promotion of LED-based traffic signals; of DSM resource acquisition through DSM bidding mechanism; a combined energy conservation awareness campaign by Mumbai DISCOMs; agricultural pumps capacitor installation project; and training programmes for DISCOM personnel in DSM.

Source: Author's own.

major utilities and jurisdictions varies between two per cent to slightly above 3.3 per cent of their respective revenues. The studies also indicate that even after spending as much as 3.3 per cent of the annual revenues on yearly DSM activities, many of the jurisdictions in North America could not fully exploit all the cost-effective DSM potential available in their jurisdictions. In India, back-of-the-envelope calculations show that spending three per cent of the annual revenue of the distribution utilities on DSM would in all likelihood put a burden of approximately Rs 0.09–0.10 per kWh[26] on consumers, if the burden is shared across the entire consumer base of the DISCOMs, including below poverty line (BPL) and agricultural consumers. If these categories of consumers are excluded, then the burden on the rest of the consumers, assuming consumption in the BPL and agricultural category to be 25 per cent of the total consumption, could be anywhere between Rs 0.13 to Rs 0.15 per kWh. Since this may be unsustainable, a modest spending of approximately 0.5 to one per cent of the annual revenue on DSM could be an acceptable level of spending. However, looking at the North American experience, this level of funding may not be able to exploit all the available DSM potential. The funding from ARR will, therefore, have to be supplemented by funding from the states in the nature of budgetary support. It is here that the additional funding

[26] Data for the year 2007–8 from the Power Finance Corporation report on performance of power utilities shows that DISCOMs covered in the report had revenue of approximately Rs 150 billion and the corresponding sale was 456 billion units.

to the states, under the centre–state mechanism, in the form of incentives for meeting the pre-specified DSM targets could be considered to exploit the available DSM potential.

Summary and Future Work

There are enormous opportunities to make the power sector less carbon-intensive and reduce the rate of growth of emissions at every stage of the electricity cycle. While some of the ongoing initiatives such as improving generation efficiency, reducing auxiliary consumption, or reducing the transmission and distribution losses, etc. do result in reducing the CO_2 emissions, they are being emphasized by the regulators more for the impact they have on reducing the cost of electricity generation or on reducing the cost of electricity to the consumers rather than for reducing the CO_2 emissions. On the other hand, regulatory emphasis on promotion of RE-based generation and electricity conservation and its efficient use are two areas which are being emphasized by the regulators for their direct bearing on the reduction of CO_2 emissions from the power sector. Both these areas have very high potential in reducing carbon intensity and carbon emissions from the power sector. From the IEPR of the Planning Commission, it is seen that by 2031–32, reduction in CO_2 emissions from the power sector, because of DSM and RE-based power generation (see Scenario 11 in the Report) as compared to the scenario where these two options are not considered (Scenario 5) will be about 600–700 million tonnes—about 400 million tonnes from DSM and the balance from RE-based generation. If India is to succeed in bringing about a meaningful and sustained reduction in its carbon intensity and carbon footprint, it is these two areas which will provide the key.

Direction of Future Efforts to Promote RE-based Generation

While the preferential tariffs and renewable purchase obligations (RPO) targets coupled with market–tradable RECs are expected to lead to accelerated creation of RE-based generation capacity, regulatory attention will also need to focus on the issues arising out of the in-firm nature of RE power. Power output from RE-based generation, especially from wind, small hydropower, and solar-based power generation, is in-firm, that is, it varies by the minute, by the time of the day, and also seasonally. To facilitate implementation of the National Action Plan on Climate Change, which calls for significantly increasing the share of electricity generated from renewable energy, CERC in April 2010, notified the new Grid Code, to facilitate larger integration of renewable energy sources with the grid. As per the new Grid Code, the financial burden of all the fluctuations from schedule in case of new solar energy plants and the fluctuations within ±30 per cent of schedule in case of new wind energy plants will be borne by all the users of the inter-state grid.

Thus project developers and the host states will not be at a disadvantage from such fluctuations. New wind energy generators will be able to fine-tune their schedules (based on forecasting) as close as three hours before actual generation.

The absorption of renewable energy-based in-firm generation in the grid can be also increased by inducting the Smart Grid technology, which is a platform for integrating renewable energy generation (such as solar and wind), smart meters, demand response, and many more technologies into the DISCOM's distribution system. In recognition of the importance of Smart Grid, the US Energy Secretary, Steven Chu, has placed the Smart Grid at the top of the US Department of Energy's priorities. China has also recognized the importance of the Smart Grid technology. Considering the importance of this technology, regulatory steps are being contemplated to induct it to facilitate absorption of larger amounts of in-firm RE-based power into the grid (Box 2.6 provides a brief description of the Smart Grid concept).

Direction of Future Efforts to Promote DSM

It is evident that both energy efficiency and conservation have a large potential to reduce the growth of carbon emissions. Besides, they also have the potential to obviate the need for new capacity additions as well as to mitigate the power shortages in the country. The EA, 2003 and NEP provide the necessary legal framework for its implementation through DISCOMs under regulatory supervision. Besides the ongoing initiatives of the Forum of Regulators, the following actions are needed to strategically operationalize DSM faster:

DSM Capacity Building

Today, there is a dearth of qualified demand side management experts in India. Training and capacity building, especially in finance and marketing, which are the essence of the DSM programme, are vital for the success of the programme's initiatives. Hence, efforts to strengthen planning, designing, and implementation of DSM by creating a cadre of DSM professionals are being contemplated. FoR is expected to play a lead role in this effort, for which it has entered into a Memorandum of Understanding (MoU) with the regulatory and research entities, namely, the California Public Utilities Commission (CPUC), California Energy Commission (CEC), and Lawrence

Box 2.6
Smart Grids

Smart Grid means a grid which increases the robustness, efficiency, and flexibility of the power system. It is also sometimes called a 'self-healing grid.'

A power system or grid operator would like to have in place a system where the grid either solves its problems itself or the operator is informed in advance of an impending grid disturbance so that remedial action can be taken to prevent the disturbance. From the point of view of consumers, they would like to have optimum utilization of the power system, that is, network optimally loaded at all times, so as to minimize the cost. Consumers would also like to have minimum interruption of supply. It is desirable to reduce the effects of carbon emissions on the environment and, at the same time, get power supply in a reliable manner. The grid operator would not like the unpredictable nature of wind and solar energy to give him nightmares due to inadequate predictability of these sources. The Smart Grid achieves all these and more.

The US Department of Energy lists seven objectives of a Smart Grid:

- enabling informed participation by customers;
- accommodating all generation and storage options;
- enabling new products, services, and markets;
- providing the power quality for the range of needs in the twenty-first century economy;
- optimizing asset utilization and operating efficiently; addressing disturbances through automated prevention, containment, and restoration; and
- operating resiliently against all hazards.

Source: V.S. Verma, CERC (2010).

Berkeley National Laboratory (LBNL). Entities from California have been chosen as partners of the MoU in view of the significant achievements of the State of California in the US. The state has managed to maintain its consumption per capita at about the same level for more than 30 years since 1975. CEC and CPUC have played a lead role in limiting energy and load growth during both the short- and long-term periods by directing and facilitating the California Utilities to plan and implement target-based DSM programmes. The CPUC, in September 2009, approved EE programmes for 2010–12 with a total budget of $3.1 billion for California utilities—Southern California Edison, Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Gas Company. This is the largest commitment ever made by a state to energy efficiency. These programmes are expected to create energy savings of almost 7,000 gigawatt hours: the equivalent of three 500 MW power plants and will avoid three million tonnes of greenhouse gas emissions. In addition, the EE programmes are expected to result in creation of about 15,000–18,000 skilled green jobs. Already, under the MoU, experts from LBNL, CPUC, and CEC have conducted three training programmes for the SERCs and DISCOMs.

Database Development

There is also a need under the Forum of Regulators' (FoR) umbrella to initiate efforts to create a DSM database. It is envisaged that the database will develop information on deemed savings possible due to EE and EC (kWh/kW/KVA), cost of measures, life (how long savings are available), timing (when savings are available—daily, morning, afternoon, evening, night, seasonally), avoided-costs of power procurement and capacity addition, and tariffs.

Load Research

As has been done in Maharashtra, there is a need for the SERCs in other states to direct the DISCOMs under their jurisdictions to undertake load research and consumer survey exercise on a continuous basis and make these activities an integral part of the DISCOMs' day-to-day operations. Load research is the starting point of any DSM planning and programme design exercise, and unless the required inputs are available from load research and consumer survey studies, very little progress can be made towards capturing the available EE and EC savings through DSM programmes on a sustained basis. To facilitate introduction of load research and consumer surveys, necessary efforts under the FoR umbrella need to be initiated.

Incentives to DISCOMS

In the cost plus regulatory regime under which DISCOMs operate in India, they neither stand to lose nor gain by running DSM programmes, provided they are allowed to recover the costs they incur to run these programmes. In a strict sense, therefore, DISCOMs have no motivation to run these programmes, except as fulfilment of a regulatory requirement. To motivate DISCOMs to take up DSM activities voluntarily, they would need to be incentivized. The September 2008 Report of the Forum on DSM provides a broad outline of the possible ways to incentivize DISCOMs to undertake DSM, including:

- allowing them to earn additional return on equity for undertaking DSM in place of supply side resources. Such an incentive could be in the form of additional return on equity (say, one per cent incremental return on equity) for DSM/EE programmes in subsidized consumer categories.
- higher incremental return on equity (say two per cent) to be provided to utility for investments in DSM programmes in subsidizing categories such as commercial and industrial sectors. This will encourage utilities to undertake DSM even in subsidized categories.

Also, since demand side management in the long run would obviate or defer the need for augmentation of the distribution capacity, it would also obviate or defer the need for capital/equity infusion. However, since DISCOM profitability is linked to return on equity, DSM in the long run might affect this profitability. To overcome this, it has been suggested that DISCOMs be incentivized to take up DSM by developing a mechanism to treat part or whole of the expenses incurred on DSM similar to any capital expenditure, with its attendant return on investment benefits.

Thus, in view of the recommendations of the Report, the Forum will formulate suitable incentive mechanisms for implementing DSM.

Ensuring Subsidy Payments by State Governments

There is a need for State Electricity Regulatory Commissions to ensure that consumers, who are being provided subsidy by the state governments, are billed by the DISCOMs at the SERC-determined unsubsidized tariff, if the state governments fail to pay the subsidy on time in accordance with Section 65 of the EA, 2003. It has been observed that although the state governments fail to pay the subsidy, the DISCOMS continue to bill the consumers who are being provided subsidy at the subsidized rates rather than at the unsubsidized rates. This action by DISCOMs perpetuates wasteful use of electricity as the consumers being provided subsidy either pay nothing or pay very nominal charges for electricity they consume, and hence have no motivation to economize electricity use. SERCs' insistence on following the provisions of Section 65 of EA, 2003 will induce state governments to reduce the subsidy being provided or will make the DISCOMs financially better and prevent wasteful use of electricity.

Other Areas Requiring Regulatory Attention

Ensuring Compliance of Regulatory Directives

From the rendition provided above, it is clear that India has a good deal of ongoing regulatory initiatives to address, directly or indirectly, the CO_2 emissions issue in the power sector. But having in place good regulations is only half the work done. What is perhaps more important is that regulatory directions and intentions are translated into intended results for which acting on the regulatory instruments available for enforcing compliance in line with regulatory directions is very important. It is in this respect that power sector regulators, especially the regulators in the states (the SERCs) need gearing up on an urgent basis.

Under the cost-plus-regulatory regime, the utilities in India should not be making losses if they meet the norms prescribed by regulators for various operating parameters, provided the subsidy claimed/booked by the utilities is paid to them by the state governments. In reality, however, DISCOMs directly supplying electricity to consumers suffer heavy cash losses, as depicted in Table 2.11.

Table 2.11 Aggregate Cash Loss of DISCOMs

(Figures in Rs Million)

Description	*Formula*	*Year 2005–6*	*Year 2006–7*	*Year 2007–8*
Cash Profit Loss on subsidy received basis (+)	A	(-)32680	(-)83110	(-)109630
Subsidy booked	B	122330	135900	193790
Subsidy received from government	C	109380	128360	163030
Subsidy shortfall	D= B-C	12950	7540	30760
Cash Profit considering all the booked subsidy was received	E= A+D	(-)19730	(-)75570	(-)78870

Note: Minus sign (-) indicates loss; (+) = Cash Profit = (Profit after tax + depreciation + miscellaneous expenses written off + deferred tax)
Source: Extract from Power Finance Corporation (2009: Annexure 1.2.1, 1.2.2, 1.2.3, and 1.4.1).

Under the cost-plus-regime, explanation for the major portion of such losses could be non-adherence to the operating performance norms prescribed by the regulators. The sustained level of cash losses are not only critically affecting viability of the power sector, but also point to the fact that the operating performance norms prescribed by the regulators are not being met. Thus, any regulatory intent to bring about a reduction in CO_2 emissions through adherence to the prescribed norms may not materialize unless regulatory compliance is strictly enforced. The regulators are, of course, seized of the problem and recognize the need to make compliance monitoring more effective. In fact, in the recent (1 February 2010) meeting of the Forum, it was agreed that the mechanisms ensuring compliance of various regulatory directives need to be institutionalized. As an important step in this direction, it has been agreed by the Forum that a draft regulation for compliance audit by the Regulatory Commissions would be prepared. Such a regulation would, it is envisaged, help in effective monitoring of the compliance and not just remain an issue to be discussed on the sidelines at the stage of annual tariff determination.

Tracking and Monitoring Technical Losses in the Distribution Systems

Reduction in distribution losses also has the potential to bring about reduction in the growth rate of emissions. However, there is a need to formulate specific targets for technical loss reduction. Since no data exists on the level of technical losses, such estimation studies will have to be taken up and SERCs will have to direct the DISCOMS under their jurisdiction to take up technical loss estimation studies as well as making the necessary resources available for them.

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