Master Thesis Sustainable Development, Energy and Resources

Applicability of White Certificates in the Indian Electricity Sector

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Abstract

This work investigates end-use electricity efficiency policies and Demand Side Management within the Indian electricity sector. Furthermore, this work performs a comparative analysis on a number of trading schemes, with a focus on the White Certificate schemes and Energy Saving Obligations of the UK, France and Italy. Differences and similarities, together with lessons learned are highlighted. These two analyses come together when lessons are identified which are applicable for a utility based Energy Saving Obligation scheme within India. Most relevant results and recommendations are that no design modalities from other trading schemes should be simply copied, that an obligation is recommended and that standardization could offer benefits to the Indian context. However, a number of steps would be required prior to successful introduction of an Energy Saving Obligation.

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Acronyms

ARP	Acid Rain Program
BEE	Bureau of Energy Efficiency
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CERC	Central Electricity Regulatory Commission
CFL	Compact Fluorescent Lamp
DOES	Distributors' Obligation on Electricity Savings
DSM	Demand Side Management
EEC	Energy Efficiency Commitment
EESoP	Energy Efficiency Standard of Performance program
ESCO	Energy Service Company
EU ETS	European Union Emission Trading Scheme
FOR	Forum of Regulators
GDP	Gross Domestic Product
GHG	Greenhouse Gas(ses)
IEA	International Energy Association
M&V	Monitoring and Verification
Mtoe	Million tons of oil equivalent
NMEEE	National Mission on Enhanced Energy Efficiency
OFGEM	Office of Gas and Electricity Markets (UK regulator)
PAT	Perform, Achieve and Trade
REC	Renewable Energy Certificate
SERC	State Electricity Regulatory Commission
TERI	The Energy and Resources Institute
UK CERT	United Kingdom's Carbon Emission Reduction Target
USD	United States Dollar: used exchanged rate in this work: 1 USD=55 Indian Rupees

1. Introduction

1.1. Background

The Indian government and, more specifically, the ministry of Power have taken an active stand on improving energy efficiency at end-users. For example, building codes, labelling schemes and Demand Side Management (DSM) schemes are under consideration or are being implemented. India has no internationally binding greenhouse gas mitigation obligations, but nonetheless there is a strong need for programs aiming for enhanced energy efficiency.

The current pace of India's economic growth, together with governmental programs such as the rural electrification policy and the Ministry of Power's "power for all"-mission suggest a strong growth in future power demand. A report by the Indian Planning Commission expects that electricity consumption will increase by a factor of three to four in 2031, compared to 2011 (GOI 2006). IEA (2007) concludes that on a global level India and China will be accountable for 45% of the increase in primary energy use in 2030, compared to 2005 (IEA 2007). This *increase* in consumption for both countries is expected to be around 2.84 billion tonnes of oil. For sake of comparison, this is around 36 times the 2009 total primary energy consumption of the Netherlands (IEA 2009). Obviously, this is quite a challenge for the supply side.

In India power shortages burden the development of the nation. For January 2012 the reported deficit with respect to demanded power requirement and demanded peak supply were 9.3% and 13.7%, respectively (CEA 2012). In order to meet this future demand and reduce shortages there is a focus on issues such as, but not limited to, adding generation capacity, improving plant load factors and efficiencies of operating power plants and DSM. Currently, there is no central legislation in place which obliges entities to participate in DSM schemes.

However, studies have shown that there is substantial potential to reduce or change electricity consumption from end-users in order to save additional generating capacity and primary energy consumption (ABPS and BEE 2007) (TERI 2007). These savings can be cost effective for both consumer and distribution utility, if one assumes this entity has to buy expensive peak power and has to sell power at low (tariff determined) prices.

Several Energy Saving Obligations and White Certificate schemes have been implemented in European countries. White Certificates refer to the certification of project based energy savings and the possibility to trade these certificates (Bertoldi, et al. 2009). However, the various national schemes differ from each other and have a varied number of characteristics (EA Energy Analyses 2007). Typically, an energy company (retailer or distributor of electricity and/or other fuels) has the obligation to achieve savings at end-users (in some cases their customers).

To date, some DSM projects have been implemented in India at the state or utility level. Barriers have prevented large scale uptake and hence benefits these schemes offer. A large scale, obligatory DSM

program, or a Distributors' Obligation on Electricity Savings (DOES), designed in order to overcome these barriers, could enhance end-use electricity efficiency and could achieve electricity savings.

DSM and DOES schemes can include many mechanisms and measures. Increased electricity efficiency at end users, load shifting, market research and awareness raising can all be eligible measures under such schemes. This internal flexibility, combined with the prospect of much needed end-use electricity savings and possible financial gains related to the avoiding of peak power purchases and addition of generation capacity, can make a DOES scheme a valuable tool within India's electricity sector.

1.2. Problem Definition

The untapped potential for end use electricity savings would offer benefits to India if harnessed efficiently. However, barriers prevent spontaneous uptake of measures which would result in the desired savings. In Europe, White Certificate schemes and Energy Saving Obligations have proven to be quite successful in achieving cost-effective energy savings at end-users (Giraudet, Bodineau and Finon 2011).

However, copying successful elements of these existing schemes to the Indian policy framework would probably be an undesirable act, as success is determined not only by that specific element, but also through its interactions with other elements within the White Certificate scheme and even through the interaction of the scheme with the (national) background.

The processes required to design and implement a DOES scheme would therefore be aided by an analyses of previous experiences and possible interactions, thereby delivering success and fail factors and lessons learned. Both Indian experiences on similar or otherwise relevant policies and international experiences on similar schemes would be useful in this regard. The following research questions have guided the research.

1.3. Research Questions

Which policy instruments to encourage end-use electricity efficiency have been used in India and which success and failure factors can be identified?

Can the standardized measures, within the White Certificate schemes of the European countries, be compared to each other and can possible differences be explained?

How (cost) effective are White Certificate schemes, which changes have influenced this effectiveness and to what extent are trading schemes compatible/do interactions occur?

What are the similarities and differences between White Certificate schemes and other trading schemes; which success and failure factors can be identified and which (success) factors and experiences might be applicable to the Indian electricity policy framework?

These questions relate to, and result in, the overall research question:

What are recommendations, based on this research, for introducing a DOES scheme to the Indian electricity policy framework?

1.4. Research Boundaries

The analysis of electricity efficiency policies implemented or initiated in India is limited to a number of policies coordinated at the central level and to India's DSM experiences. This because information on measures and regulations of these policies is relatively accessible and because these policies could provide lessons learned for the introduction of a DOES scheme within the Indian electricity policy framework.

The European Energy Saving Obligations and White Certificate schemes which have been researched are those of the UK, Italy and France. These schemes are quite mature and are hence likely to offer lessons learned. These schemes are also much discussed and covered in literature (E. Lees 2010) (Eyre, Bodineau and Pavan 2009) (Bertoldi, et al. 2009) (Giraudet, Bodineau and Finon 2011). Other Energy Saving Obligations and White Certificate schemes (e.g., Denmark, Flanders) have been excluded from the analysis as there seemed less information available. Other trading schemes, which have also been investigated, are the European Union Emission Trading Scheme (EU ETS), the United States' Acid Rain Program (ARP) and the Indian Perform, Achieve and Trade (PAT) scheme. These first two schemes have been selected because they have existed for some time and have been able to create active markets, and because lessons learned and subsequent changes have been described by various sources. The PAT scheme is a relatively new policy instrument and investigation of this trading scheme could identify barriers or successes typically for the case of introducing a new trading scheme to India. This research has also included a brief investigation on linkage possibilities with the United Nations Framework Convention on Climate Change's Clean Development Mechanism (UNFCCC-CDM) because CDM projects are numerable in India and mentioned within relevant policies. Therefore, it was considered essential to investigate possible interactions between CDM projects and the introduction of a DOES scheme to India.

The investigations on the White Certificates schemes and the other trading schemes will focus on the various design modalities, regulatory frameworks and (cost) effectiveness of the schemes. Moreover, changes made within these schemes will be highlighted and, if possible, explained.

Interactions of a DOES scheme with other Indian policy instruments have also been analysed. This analysis has been limited to possible interactions with the PAT scheme, the Indian green certificate trading scheme and relevant policies. This research will also provide some considerations and recommendations which will focus on (cost) effectiveness and cost recovery, characteristics of design modalities, interactions of a DOES scheme with other policy instruments and the institutional framework.

In Europe, the different White Certificate schemes cover various suppliers or distributors of different fuels (the natural gas and electricity suppliers/distributors are usually dominant). In India natural gas is not a dominant fuel within the residential and agricultural end users (Cropper and Bhattacharya 2010). Use of electricity is growing rapidly in India (GOI 2006) and substantial potential exist for electricity efficiency and conservation in the end use sectors (GOI 2006). Therefore the choice has been made to aim the DOES scheme, within the Indian context, purely on the electricity distribution utilities and electricity savings at the end-users. It should be noted here that the Indian electricity distributors are

both (distribution) wire operators and suppliers. Unless otherwise specified electricity efficiency refers to electricity efficiency in the end-use sectors.

1.5. Justification of Research

Substantial effort has already been put into researching topics which fall within, or relate to topics within, the research boundaries of this thesis.

There are a numerous publications on (international) trading schemes and DSM schemes, their functioning, interactions and so on. For White Certificate schemes and Energy Saving Obligations there are also various interesting works, of which some compare the design modalities of several schemes. Examples which were considered useful for this work are Lees (2010), Eyre, Bodineau and Pavan (2009) and Bertoldi and Rezessy (2009).

For India the amount of literature published on related topics is relatively limited. However, literature provides a number of works which have investigated options for enhancing electricity efficiency in India. For instance, Bhattacharya and Cropper (2010) and Dey (2007) researched barriers and options for energy efficiency in India. Moreover, there are TERI publications which specifically focus DSM related issues, such as which roles and responsibilities various stakeholders in the electricity sector should have (TERI 2009) and a case study for Delhi: 'Managing Power Demand: A case study of the residential sector in Delhi' (TERI 2007).

There have also been publications on the PAT scheme (BEE 2011) (Bhattacharya and Kapoor 2012) and on the relatively new Indian green certificate scheme (Soonee, Garg and Prakash 2010). These publications describe or evaluate these Indian trading schemes and were therefore valuable for this thesis. Useful governmental reports provide results of monitoring of the electricity sector. Ministries and other public bodies publish (annual) reports. Some stakeholders' opinions, documented from workshops or presentations, have been made publicly available through the websites of the specific organising institution. Consultancy firms have also made some reports publicly available in which (improved) frameworks are proposed for Indian DSM (ABPS and BEE 2007) and White Certificate schemes (Mercados EMI 2010).

However, in literature and other sources little attention has been given to the possibility of an obligation within the Indian context and to what extent such an obligation would interact with other policies and be effective. Few critical evaluations of current programs were found. This thesis is to perform research on the above issues, thereby answering the research questions and possibly offering useful input for further effort or literature on these topics.

1.6. Scope

This research has the intention to provide insight in market based trading schemes, White Certificate schemes and Energy Saving Obligations and which aspects of these would be able to work effectively within the Indian electricity sector. Identified success factors could facilitate a broadening of the PAT scheme and could encourage further DSM efforts. Lessons learned can provide recommendations on certain design modalities for a DOES scheme. The expected results could be also interesting for other developing countries with strong economic growth and similar challenges within the electricity sector.

1.7. Outline

This work is structured as follows. Firstly, the approach of this research and methodologies used are explained in Chapter 2. Relevant information on institutions and regulatory aspects within the Indian electricity sector is provided in Chapter 3, whereas Chapter 4 investigates barriers for electricity efficiency, identifies lessons learned from (previous) Indian policies on electricity efficiency. Barriers, recommendations and regulations related to Indian DSM frameworks are also analysed in this chapter.

Chapter 5 reviews international experiences: this chapter identifies differences and similarities between the researched trading schemes through a comparative analysis. Some standardized measures within the White Certificate schemes and Energy Saving Obligations of the UK, France and Italy are also compared to each other. Furthermore, this chapter investigates additionality and cost effectiveness of the White Certificate schemes and Energy Saving Obligations of the UK, France and Italy.

Chapter 6 looks at possible interactions between existing schemes, policies and the proposed DOES scheme. This chapter discusses which interactions would be desirable, undesirable or neither. Furthermore, it discusses which implicit links and interactions could be made explicit (or not).

Chapter 7 wraps up. This chapter puts forward a number of recommendations, based on the performed research described in Chapters 4, 5 and 6. Chapter 7 analyses the input of these chapters, gives recommendations for the short and long term and proposes certain design modalities for a DOES scheme. It also lists challenges that a DOES scheme would face. Chapter 8 concludes, reflects on the posed research questions and suggests directions for future research.

2. Approach and Methodology

2.1. Research Approach

This research has been conducted on two locations. During the first and final stages work on the thesis was carried out at the University of Utrecht, whereas in the second stage the research was conducted at The Energy and Resource Institute (TERI) in New Delhi.

First Stage

Firstly, a knowledge base was created during this first stage, which involved reading of academic and non academic work on the subjects of trading schemes, White Certificate schemes and interactions of such schemes with each other and with their (policy) background. A knowledge base and overview of changes within the researched schemes was considered a necessity for further research. Hereafter, the focus was on the design of the different White Certificates schemes. An initial comparative analysis was conducted. This was followed by an analysis of the standardized measures. Possible differences in these analyses have been investigated, and if possible, explained. Major changes, which reveal some lessons learned, have also been summarised. This analysis has produced a list of considerations, lessons learned and identified success and failure factors. During this first stage published reports and literature on the subject of the PAT scheme and other trading schemes were also investigated. An initial literature review concerning past and present energy efficiency policies in India was one of the final tasks of this stage. The general idea was to learn as much as possible in this first stage from the literature and reports available, and that gained knowledge and insights could be 'tested' during the second stage.

Second Stage

In the initial phase of this second stage more reports and documents related to the Indian energy (policy) background were studied. An assessment of differences and similarities between all the researched trading schemes was performed. Knowledge on previous experiences on Indian electricity efficiency policies and DSM measures was also expanded. Barriers, success and fail factors and lessons learned were identified. Some identified success and failure factors could be (in)applicable to the DOES scheme. Therefore, during the above process, there were interviews with experts (academic and non academic) on DSM measures, on India's energy efficiency policies and on the possibilities related to the DOES scheme. Insights gained as a result of these interviews have altered previous (preliminary) conclusions and have answered questions not provided by other sources. Moreover, discussions with other researchers and TERI staff have been very helpful at this stage of the research. A final analysis, using the identified success and failure factors, the (inter)national lessons learned, insights gained during previous analyses and input from interviews and discussions with stakeholders, identified possible recommendations and considerations for a DOES scheme.

Third Stage

This third stage had the main objective to revise and evaluate results. Moreover, the writing process had to be completed in an accurate and concise manner, resulting in this thesis.

2.2. Research Methods

In order to answer the research questions posed three dominant research methodologies have been used for this thesis.

The first method was a literature review on the topics of the researched trading schemes and the elements of the Indian electricity sector within the research boundaries. Non-academic sources, such as public reports from governments and consultancy firms have also been studied.

The second method comprised comparative analyses of the researched trading schemes. These analyses identified similarities and differences, lessons learned, success and fail factors and relevant considerations for design modalities of such schemes.

Thirdly, consultations and discussions with stakeholders provided additional information and new insights for this thesis. A brief overview of consulted organisations is provided below. These methodologies combined were to deliver satisfactory answers on the posed research questions.

2.2.1. Input from Stakeholders

After discussions with TERI professionals a number of organisations were contacted so that further insight for this research could be gained. Below a list of organisations which have provided valuable input for this thesis through interview and discussion.

- **ABPS Infrastructure**, an Indian consultancy organisation that researches, among others, options related to Indian DSM frameworks – personal contact with Managing Partner.
- **Bureau of Energy Efficiency** – personal contact with Energy Economist
- **Delhi Electricity Regulatory Commission**, the electricity regulator in the state of Delhi – personal contact with Joint Director.
- **Shakti Sustainable Energy Foundation**, which is an Indian organisation that wishes to catalyse innovative policy solutions that encourage energy efficiency and new energy sources – personal contact with Strategy leader and head of DSM.
- **TATA Power Delhi Distribution Limited**, the electricity distributor and retailer in North Delhi- personal contact with Head Demand Side Management.

Furthermore professionals at both the Maharashtra Electricity Regulatory Commission (the electricity regulator in the state of Maharashtra) and at TERI have been so kind to answer questions and engage in discussions.

3. Regulatory and Institutional Aspects of the Indian Electricity Sector

A number of acts, policies and institutions outline the (future) activity India undertakes in the area of electricity efficiency. This chapter is to provide an overview of relevant acts, entities and regulations related to the Indian electricity sector; reviews and evaluations of relevant policies and programs are performed in Chapter 4.

3.1. Introduction to the Indian Electricity Sector

The distribution, transmission and generation companies were formerly bundled in the State Electricity Boards. Most states have now unbundled these activities, which is obliged by central regulations. Whereas generation facilities are owned at the state level, the central level or by private firms (44.6%, 30.8% and 24.6% of installed capacity respectively[1]), most transmission and distribution utilities are state owned. Inter-state trading and transmission of electricity is regulated by the central level. There are substantial differences between the electricity sectors of the Indian states when one looks at various indicators. Some examples which highlight this heterogeneity (2009-2010 data[2] (PFC 2011)):

- generation capacity - more than 10 000 MW in Maharashtra and only 42 MW in Sikkim,
- electricity losses (difference in electricity available for sale and electricity billed) - 8% in Goa versus 53% in Arunachal Pradesh, and
- financial health of electricity sector - a total (all utilities) profit of 167 million USD[3] in Delhi versus a total loss of 1.76 billion USD in Tamil Nadu.

All states have an electricity regulator, though some of these Electricity Regulatory Commissions are relatively new. These state regulators had to be constituted within the states due to central regulation. There have been some issues and conflicts related to state governments rejecting or not fully supporting decisions of these new regulators (IMM 2009). The regulators determine tariffs for all intra state generation, transmission, distribution and retail prices. Tariffs vary substantially between states. Many state governments ensure that certain end-users pay little for their electricity (e.g., election promises, equity issues) and hence direct subsidization of utilities and cross-subsidization (other end-users pay for the cheap electricity of subsidised end-users) occur (PFC 2011).

The following sections provide some more details on the acts and policies (3.2), institutions (3.3), distribution utilities (3.4) and subsidies and tariffs (3.5) within the Indian electricity sector.

3.2. Acts and Policies

The two acts which regulate issues related to electricity efficiency at the end-users are the Energy Conservation Act (2001) and the Electricity Act (2003). These Acts have called for various policies and authorities to be created within the electricity sector. The National Mission on Enhanced Energy Efficiency was cause for some amendments (within the energy conservation act) and has initiated some

[1] as on 31-01-2012 (CEA 2012)

[2] Indian administration works with financial years, which run from April, 1st to March 31st. A single year is therefore often mentioned as (FY) 20XX-20XX+1.

[3] Used Exchange rate in this work: 1 USD=55 Indian Rupees (20th May 2012), original documentation states amount in Rupees.

additional policies related to electricity efficiency. Information provided on the acts and policies below has been found within the described acts and policies.

The Energy Conservation Act, 2001:
This act calls for the creation of a single authority responsible for energy conservation, the Bureau of Energy Efficiency. This act provides the bureau, central and state governments with necessary authority to implement energy efficiency policies. An account of measures implemented and coordinated by the bureau can be found in Section 3.3. The act also states that certain users of energy may be specified as designated consumers and thereby obliged to comply with provisions stipulated in the act or by the Bureau of Energy Efficiency. This includes compliance to certain energy standards and norms. Furthermore, the Energy Conservation Act states that the national government may stipulate norms and standards for specified appliances and may set building codes. At a state level, the state governments have the power to amend building codes to local conditions, are to create a state agency which is to regulate and enforce the provisions of the act and are to set up an Energy Conservation Fund.

In 2010 some amendments were made to the Energy Conservation Act. Specifically, these amendments created the possibility to certify surplus energy savings from designated consumers and specified that obliged actors who would not reach their target can purchase these certificates in order to comply with the obligation (legal basis for the PAT scheme-more details in Chapter 5).

The Electricity Act, 2003: This act is to ensure adequate supply and availability of the electricity. Moreover, this act is to protect consumers, promote competition and provide transparent regulations for all aspects within the electricity sector. The Electricity Act lays down regulations for generation, transmission and distribution of electricity, for the central and state regulators and governments, for licensing procedures and more. The Act consolidates all electricity affairs. Furthermore, the act calls for the creation of the Central Electricity Authority, which is to implement and coordinate the provisions of this act. Some important tasks of the Central Electricity Authority are described in Section 3.3. Also, the Electricity Act provided the central government with increased authority within the (States') electricity sectors. For example, the states were to establish the State Electricity Regulatory Commissions and each state was to provide funds for this commission. Furthermore, the central government established regional (state) centres which were to monitor and despatch load efficiently. Historically, distribution of electricity was a state affair.

The Electricity Act also called for The National Electricity Policy (2005) and the Tariff Policy (2006), which is a combined task for the central government, the Central Electricity Authority and the state governments. The National Electricity Policy is to develop the power system based on optimal utilization of available resources. The Tariff Policy can be seen as a continuation of the National Electricity Policy and calls for rational tariff setting and more competition within various segments of the power sector. Specific stipulations, among others, are that no category of end-users should pay less than 50% of the cost of supply and that cross-subsidization should be limited to ±20% of cost of supply by 2011. Both policies aim for a financially viable sector with increased transparency, efficiency, predictability and competition and for availability of quality electricity to consumers.

National Mission on Enhanced Energy Efficiency: The National Mission for Enhanced Energy Efficiency (NMEEE), one of the eight missions which fall under the Prime Minister's office 'National Action Plan on Climate Change', aims to give energy efficiency a thrust.

The mission has been institutionalized by the Ministry of Power. The Ministry of Power and Bureau of Energy Efficiency are responsible for implementation of the NMEEE. By 2014-2015, it is expected that the mission has saved 23 Mtoe of primary energy and has avoided 19 GW of capacity addition (Ministry of Power 2012). The mission contains four major initiatives (Ibid.):

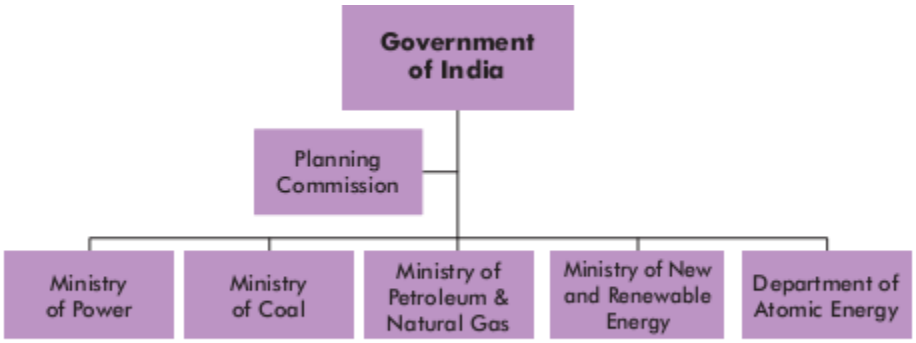
- The PAT scheme, an energy efficiency trading scheme for industrial energy users which will be discussed in detail in Chapter 5;
- The Market Transformation for Energy Efficiency, which is to promote energy efficient appliances by raising awareness and lowering the costs and barriers. International financial instruments, such as the CDM, are intended to be harnessed. (Programmatic) CDM measures are to be promoted and a national strategy is to be developed;
- The Energy Efficiency Financing Platform, which is to stimulate funding for Energy Service Companies (ESCOs). Memorandums of Understanding have been signed between the Bureau of Energy Efficiency and financial institutions. Capacity development of ESCOs is also part of the Energy Efficiency Financing Platform.
- The Framework for Energy Efficient Economic Development, a fiscal instrument that contains risk sharing possibilities and government funds. This initiative is aimed to supplement (governmental) efforts and policies for energy efficiency.

Amendments in the Energy Conservation act have ensured that the initiatives of the NMEEE have legal backing.

3.3. Institutions

A number of ministries and departments have core tasks related to energy. Figure 1 shows the relevant ministries and departments. Most of the research in this work falls under the sphere covered by the Ministry of Power.

Figure 1: Indian ministries responsible for areas within the energy sector



Adapted from (TERI 2012a)

The Planning Commission formulates plans on how available resources may be used in a most effective manner. The Planning Commission works on long-term visions and determines priorities and steps which are to be taken. In 2006 the Planning Commission published the Integrated Energy report, an influential document that recommended future steps in the energy sector.

For the purpose of this research, the ministries other than the Ministry of Power (focussing mainly on mining/supply of fuels and power) are less relevant. The Ministry of New and Renewable Energy (MNRE) has introduced an obligation on distributors to purchase power from renewable sources and a green certificate trading scheme: these will be investigated in Chapter 4, due to possible similarities with, and lessons for, a DOES scheme.

3.3.1. Ministry of Power

The Ministry of Power has a number of representing regulatory and implementing bodies operating on certain tasks. Below an overview, modified and extended from TERI Energy Data Directory and Yearbook 2011/2012 (TERI 2012a):

Bureau of Energy Efficiency: a statutory body responsible for design and coordination of energy conservation measures across different sectors. Roles and responsibilities are described in the Energy Conservation Act. Some major programs coordinated by the Bureau are the standards and labelling scheme (for appliances); the energy conservation building code; DSM projects within agricultural, municipal and residential sectors; development of programmatic CDM funding possibilities for such projects; industrial energy efficiency guidelines, norms and standards; training and certifying energy managers and auditors and implementation of NMEEE. Other than these, awareness raising, providing information and support to energy efficient initiatives are important roles for the Bureau. Chapter 4 describes and reviews those measures implemented/coordinated by the Bureau relevant for this work.
At the state level, **State Designated Agencies** are to coordinate, regulate and enforce the provisions of the Electricity Conservation Act. As the Bureau of Energy Efficiency, State Designated Agencies have been constituted by provisions of the Energy Conservation Act.

Other Bodies

Other bodies representing the Ministry of Power are:

- **Central Electricity Authority**: The Central Electricity Authority's tasks include, but are not limited to, specifying technical standards for the grid and new power plants, monitoring generation, transmission and distribution of electricity and performing research into matters related to efficiency, costs, etc. of the electricity sector. The Central Electricity Authority was created by the Electricity Act 2003 and other tasks are also stipulated herein.
- **Central Electricity Regulatory Commission**, which stated goal, is to promote competition, transparency and economic efficiency in bulk power markets. Main tasks are to facilitate and advise on electricity trading and transmission aspects and to regulate the tariffs for inter state transmission and generating companies owned by the central government.
    - At a state level, the **State Electricity Regulatory Commissions** (SERCs) are to set tariffs for state owned generation, transmission and distribution (including prices for end-

users). They are the regulators enforcing regulation on the licensed utilities within their state.

- **Forum of Regulators** (FOR), which was constituted by the Electricity Act, comprises of the chairpersons of the Central and State Electricity Regulatory Commissions. The primary roles the Forum of Regulators is charged with are harmonizing regulations in the power sector, providing information and guidelines among the members and evolving measures in accordance with the Electricity Act.
- **Power Grid Corporation of India Limited**, which has the status of the central transmission utility and is to update and improve the national transmission network and the (technical) ability to trade and transmit power efficiently between states.
    - National Load Despatch Centre (owned subsidiary of Power Grid Corporation of India Limited) is to account for transmission usage, to collect possible fees from utilities, supervise and monitor inter regional links and to cooperate with the State Load Dispatch Centres.
    - State Load Despatch Centres are to monitor and despatch loads on intra state transmissions, so that the network is used optimally.
- **Energy Efficiency Services Limited** is to provide consultations, support and trainings to ESCOs and other companies in order to promote energy efficiency. It also has an implementing/facilitating role concerned to governmental energy efficiency programs and projects.
- **Power Exchange India Limited and Indian Energy Exchange** provides platforms for electricity trades.
- **Power Finance Corporation Limited**, a financial institution which is to finance and promote efficient investments in power sector so that consumers can receive quality power at minimum costs.

There are many more public or corporatized bodies affiliated to the Ministry of Power which have roles within the Indian power sector, though for this work the bodies mentioned above are most relevant.

3.4. Distribution Utilities

The distribution utilities usually have a poor financial record (PFC 2011) and this puts additional strains on investing in new projects. As most distribution companies are state owned (private distributors to be found in Delhi, Mumbai and Orissa), state governments make up the deficit, or, alternatively, the losses increase/financial situation worsens. Without state subsidies the aggregate losses for all distribution utilities was just above USD 11.5 billion for the year 2009-2010, whereas this figure was just over USD 3.69 billion for the year 2005-2006 (PFC 2011). This is an average USD 0.015/kWh (2009-2010), which is a substantial amount considering the cost of supply hovers between USD 0.04-0.10/kWh (FOR 2010a). There are however large differences between the states, with some distribution utilities making profits, whereas other distribution utilities are not able to recover half of their costs (PFC 2011). These losses may be due to low collection efficiencies, improper tariff setting and high distribution losses. Aggregate Technical and Commercial (AT&C) losses is the term used to indicate all technical (e.g., capacity of wires,

transformation losses) and commercial (e.g., theft, collection rates) losses within a distribution network. Many distributors endure high AT&C losses, which for 2009-2010 were an average 27.15% (PFC 2011). SERCs are to control performance and expenditures of distribution utilities within their specific state. Furthermore, SERCs set tariffs and obligations for the distribution utilities. A relatively new obligation is the 'Renewable Purchase Obligation'.

3.4.1. Renewable Purchase Obligation and Renewable Energy Certificate Trading

The Electricity Act aims, inter alia, to promote use of renewable power and specifies that SERCs are to impose a Renewable Purchase Obligation on distribution utilities within their state. The target of the Renewable Purchase Obligation is expressed as a percentage of a distribution utility's total power requirement and varies between states (ABPS 2009). For (various) renewable energy sources a tariff has been determined at the state level, which is to be paid by the distribution utilities. Because these tariffs are higher than the average power purchase costs distribution utilities would barely contract renewable power once their Renewable Purchase Obligation was fulfilled. In other states, with a shortage of renewable power supply, the obligations could not be fulfilled. The Renewable Purchase Obligations of the various states differ and obliged entities could only buy renewable power from suppliers within their state. A large share of the (national) untapped potential for increased renewable power lies within states which already have high Renewable Purchase Obligations. Since 2011, an inter-state Renewable Energy Certificate trading scheme complements the Renewable Purchase Obligation in order to overcome these geographical constraints and is to diminish risks related to over- and under- supply within a state. A more detailed analysis on the Renewable Purchase Obligation and Renewable Energy Certificate trading can be found in Appendix C.

3.5. Electricity Subsidies and Prices

In India electricity prices are regulated through tariff structures. In many states cross-subsidization occurs: the electricity prices for certain end users are subsidised by other end-users who have to pay higher prices. National regulation calls for tariffs to be within 20% of cost of supply, e.g. if cost of supply is USD 0.05/kWh than tariffs should be between USD 0.04/kWh and USD 0.06/kWh (Tariff policy, paragraph 8.3). This policy also calls for a 'reasonable' level of user charges to be levied for agricultural purposes and suggest direct subsidies or other measures if states want to reimburse another part of the already lower tariffs. Practice can differ though, some tariffs do not comply with central regulations and cross-subsidisation remains an issue. Electricity tariff regulations and practises will be evaluated in Chapter 4. Appendix A shows an exemplary tariff structure for the year 2012-2013 of the state of Haryana.

Transmission and distribution charges are also determined by tariffs. For inter state transport of electricity these tariffs are determined by the respective SERC, whereas inter state transmission charges are determined by the Central Electricity Regulatory Commission. This body also sets tariffs for centrally owned generating companies. Private generating companies usually sell their electricity based on (long term) power purchase arrangements with distribution utilities. State owned generating companies sell their electricity based on tariffs approved by the respective SERC.

4. Indian Policies for Electricity Efficiency and DSM: Barriers, Existing Programmes and Lessons Learned

This chapter investigates barriers, existing policies and programmes and lessons learned within the domain of electricity efficiency (at end-users) and DSM. Section 4.1 identifies major barriers for end-use electricity efficiency in India and discusses electricity pricing, a large barrier, in more detail. Section 4.2 reviews relevant programs implemented by the Bureau of Energy Efficiency. Section 4.3 discusses barriers and recommendations related to utility based DSM programmes, whereas Section 4.4 investigates states' experiences with DSM. Section 4.5 reviews regulation on DSM obligations and Section 4.6 concludes.

4.1. Barriers for Electricity Efficiency at End-Users

A number of barriers prevent spontaneous market uptake of cost effective electricity efficiency measures at end-users in India. Table 1 provides an overview of barriers mentioned in reports and literature.

Table 1: Barriers for end-use electricity efficiency in India

Barrier	Especially relevant for	Source
High Initial cost	End-user	(TERI 2007) (EMT 2012b)
Inefficient pricing of electricity/ distortion of prices/ misdirected subsidies	End-user	(TERI 2007) (Bhattacharya and Cropper 2010) (Dey 2007)
Non availability of efficient equipment	End-user	(TERI 2007)
Insufficient information, limited awareness	End-user	(TERI 2007) (Bhattacharya and Cropper 2010) (EMT 2012b)
Uncertain outcome/ doubts	End-user	(TERI 2007) (EMT 2012b)
Split Incentives	End-user/Landlord	(Bhattacharya and Cropper 2010)
Lack of seriousness and leadership	Government	(Dey 2007)
(past) limited exposure to global trade	Government/Manufacturer	(Dey 2007)
Easy and cheap access to (alternative) energy sources, theft, illegal mining	Government/End-user	(Dey 2007)

Barriers often mentioned are the pricing of energy and insufficient information and limited awareness. This will need to be considered in relation to a possible DOES scheme. A DOES scheme can address a number of these barriers. For example, the obligation could include awareness raising programmes or research which will take away uncertainties and doubts related to electricity efficient measures. Chapter 5 explores possibilities and options White Certificate schemes and Energy Saving Obligations have with regard to these aspects. However, what should also be highlighted is which barriers a DOES scheme cannot address. The barriers related to inefficient pricing of electricity, to the non-availability of efficient equipment and to lack of seriousness and leadership are relevant barriers which are not addressed directly by a DOES scheme. Alternative or supportive measures would be needed for these barriers. The following subsection details more on the barriers related to electricity pricing and tariff policies. More

specific barriers related to successful implementation of a DSM or DOES scheme are discussed in Section 4.3 of this chapter.

4.1.1. Electricity Subsidies and Prices

The electricity prices for end users are determined at a state level, where the respective SERC has the function to review proposals from utilities and define multi year tariff structures. In many states the tariffs for agricultural end users are very low and thus (in) directly subsidised by those who have to pay higher tariffs. Domestic consumers who consume little electricity (and are likely to be below the poverty line) also get subsidized electricity, whereas domestic consumers who consume much electricity can be subsidizing consumers. Many (agricultural) end-users do not have meters so a fixed price (sometimes related to maximum load of the connection) is used. However, this does mean that the marginal costs for these end users to use more electricity are zero and hence incentives for increasing electricity efficiency are limited.

As previously mentioned, national regulation aims to place the subsidies in an appropriate fashion and calls for tariffs to be within 20% of cost of supply. In practice though, the difference in tariffs are larger and cross-subsidisation remains an issue. An overview provided by the Forum of Regulators shows that almost in all states agricultures consumer pay less than 50% of the approved cost of supply (FOR 2010a) and thus tariffs are not in line with the Tariff Policy (2006). Distribution utilities are allowed to charge below the set tariffs, though this is unlikely considering their financial situation.

Tariff orders are usually set based on Annual Revenue Requirement or on a multi year tariff framework. In the first case the tariff is determined annually after a process of reporting and reviewing expected efforts, sales and related expenditures of the utility. When tariffs are set in a multi year tariff framework, tariffs are to a large extent predetermined for a number of following years. Furthermore an incentive framework is used within the multi year tariff framework, aimed to reduce AT&C losses. Though the electricity act stipulates the use of multi year tariff framework from 2006 onwards, the Annual Revenue Requirement methods are still used (FOR 2010a). It seems that the regulations and required changes set in slowly. Tariff setting processes can be politically sensitive, constituencies of subsidised groups thwarting any increase of their tariffs. Promises of free electricity for agricultural end-users occur within the political arena (GOI 2006). In most states the residential and agricultural end-users are the subsidised and heavily subsidised sectors respectively, whereas the industrial and commercial sectors are the subsidizing sectors (FOR 2010a).

In this sense the tariffs remain quite ineffective in the field of improving electricity efficiency at the end-users. Absence of metering and reduced financial incentives obviously discourages electricity efficiency within subsidised sectors (on which utilities lose money), whereas some industrial end-users have turned to captive generation (security of supply, more cost effective), which in turns leads to lower revenues for the utility.

4.2. Review of Programs Implemented by the Bureau of Energy Efficiency

The Bureau of Energy Efficiency is responsible for a variety of programs related to energy efficiency. This subsection discusses standards and labelling, the energy conservation building code and DSM projects.

The topics reviewed are believed to be relevant for the case of a Distributor's Obligation on Electricity Savings because the selected programmes may have supportive elements for a DOES scheme. Utility based DSM programmes are reviewed in the following sections. Note that DSM projects differ from utility based DSM programs or obligations. DSM projects are implemented by a third party (not BEE or utility) on a voluntary basis and involve funding through CDM mechanisms or private parties. There is no actual obligation for the utility, though the utility may be involved.

The Energy Conservation Building Code

The Energy Conservation Building Code was launched in 2007. The code prescribes energy standards for commercial buildings whose connected load is above a certain threshold. This connected load was initially set at 500 kW, but has been lowered to 100 kW (EMT 2009). Participation is currently on a voluntary basis. The scheme participation process involves an energy audit by accredited auditors, a two year period allowing implementation of any (suggested) changes, the application process for the label and the issuance of the label by the Bureau of Energy Efficiency. After this first stage the label application process has to be done on an annual basis, so that any changes can be reflected in (updated) labels.

The Bureau of Energy Efficiency publishes a list of star label awarded buildings on their site. At time of this writing (May 2012) a total of 119 buildings have been awarded a label (BEE 2012b). The building code is only applicable to commercial buildings; there is a focus on day time offices, outsourcing buildings, schools, hotels and hospitals. Residential and other non-commercial buildings or buildings with smaller connected loads are excluded and this limits the potential of this scheme. Though the voluntary aspect does not burden any new development (which is booming) and offers learning experiences, an obligatory scheme is felt to have more potential savings. Considering all the newly build buildings of today will be responsible for a major part of the increasing energy demands of future India, there is a lot of potential to be tapped.

Standards and Labelling: The program was launched in May 2006 and has been altered/expanded on a couple of occasions since. The scheme started voluntarily, but at date (January 2012) 14 appliances fall under the scheme of which four are obligatory (frost free refrigerators, tubular fluorescent lamps, room air conditioners and distribution transformers). Most appliances are household appliances, though induction motors and agricultural pump sets also fall under this scheme. There are also minimum requirements for the obligatory appliances.

The number of appliances within this scheme could be extended. For instance, no CFLs, (non-ceiling) fans and water boilers are included. The number of obligatory appliances is obviously quite low. An additional detail refers to the savings claimed to be made through the labelling scheme. Achieved savings seem compared against the set standard, rather than against the sales average. Though this can be considered as an accounting detail, this aspect would be relevant in case efficient appliances would have to ensure additional savings in a DOES scheme.

Agricultural and Lighting DSM Projects the Bureau of Energy Efficiency has initiated some DSM projects. Financing occurs either through ESCO (private investment) mode or through CDM funding (in case of lighting). The initiated projects are implemented on a voluntary basis, in which investor, distribution utility, end-users and the Bureau of Energy Efficiency cooperate. Note that these DSM

projects are very different in (institutional) design from possible obligations on distribution utilities to implement DSM measures, though results may be similar.

For the Agricultural DSM programs a project in Solapur, Maharashtra has been initiated. The Detailed Project Report was completed in July 2009. As of March 2012, 500 of the planned 2000 pumps have been installed (BEE 2012c). Though other project reports have been completed or are in the pipeline, the pace of actual implementation seems low. The idea is that through public private partnerships savings are achieved. An ESCO would implement the measure (pump set); the utility is to monitor savings. Benefits arise due to less subsidy to be paid by the state or revenue gains for the utility (electricity for agriculture is heavily (cross-) subsidized). Part of these benefits could be paid to the ESCO.
This pilot is to show that this ESCO approach is workable. In such voluntary DSM projects, there might be lack of awareness and incentives for farmers: they are to work with the pumps, but do not care a lot. Some farmers pay a flat rate for electricity, which means that marginal costs for using more electricity are zero. The incentives for the farmers are thus not always clear. Though this would be an ideal learning experience few lessons learned have been made publicly available.

The lighting DSM program, 'Bachat Lamp Yogana', started in 2009 and is still running. This is a voluntary scheme in which households connected to the grid can swop up to four incandescent, working light bulbs and approximately USD 0.27 for a Compact Fluorescent Lamp (CFL). The investor can overcome the cost differential through selling issued Certified Emission Reductions (the tradable certificates of the CDM mechanism). This is the responsibility of the Bureau of Energy Efficiency who registers and oversees Bachat Lamp Yogana projects and distributes allocated Certified Emission Reductions. CDM funds should be enough to make project cost effective for investor. However, low carbon prices will limit revenue arising from the sales of Certified Emission Reductions (CERs). Currently, carbon prices are low[4] and future demand for Indian CERs is expected to be limited. Reasons for this are recent changes in EU ETS regulation. The EU ETS directive describes that after 2012, eligibility will be limited to CERs resulting certain projects within Least Developed Countries (EC 2009). India, a large emerging economy, is thus excluded. Additional information on CDM methods, CDM project requirements and future options herein for India is provided in Appendix B.

Utilities, which have an important supportive role, do not receive direct (financial) gains. Tata Power Delhi Distribution Limited - a Delhi distributor - considered this as a good (learning) experience related to customers' services and satisfaction (TPDDL 2012), but without state support/ strong internal vision few utilities will spontaneously take up such projects. The CDM pipeline produced on February 1st, 2012 shows that 17 projects have been registered within Bachat Lamp Yogana. Twelve of these are within the states of Punjab and Delhi (UNEP Risoe 2012b). The news letter on the Bureau of Energy Efficiency site (BEE 2012) mentioned that 23 million CFLs have replaced incandescent lamps so far (December 2011), which is a substantial amount, but not near the envisioned goals yet (approximately 150 million replacements).

[4] Spot prices for European Union emission Allowances (1 tonne CO_2) were below 9 USD during May 2012 (EEX 2012)

Box 1: ESCO Development in India

The ESCO market is relatively small in India. The integrated energy report states that ESCOs are needed and that their development should be encouraged. A number of measures to do so are proposed (GOI 2006). Proposed measures include tax breaks and financing possibilities. The initiatives within the NMEEE call for such measures. The Bureau of Energy Efficiency and (state) governments are implementing projects in "ESCO" mode, requiring an ESCO for implementation and financing of these projects. Examples are the DSM projects and measures within commercial buildings applying for an Energy Conservation Building Code label. So there are definitely tools in place to encourage ESCO development, though this is still largely dependent on government effort. No recent figures could be found, though Murakoshi and Nagakami (2009) report that in 2008 there were at least 15 ESCOs, compared to 4 to 8 ESCOs in 2003. Current ESCOs are stated to be small, lacking in financial means and reliability. Some ESCOs are nothing more than manufacturers trying to sell their own equipment. Nonetheless strong ESCO growth due to the large potential, the Energy Conservation act and government efforts is expected (Murakoshi and Nakagami 2009).

In India ESCOs are still very much focussed on the industrial sectors. ESCOs can be the market-based actors much needed in the public sphere that is hard to motivate, i.e. the distribution utilities and their end-users. However, such actors would need to be capable and efficient.

4.3. Barriers and Recommendations for utility based DSM programmes

Within India, there have been a number of publications and workshops related to DSM options and measures. Because of the similarities between Indian utility-based DSM schemes and a possible DOES scheme, this section reviews barriers and recommendations on DSM schemes as mentioned in these sources. DSM can come in various forms and measures, such as load-shifting, time of day pricing, electricity efficiency and electricity savings at end users. This work focuses on a Distributors' Obligation on Electricity Savings at end-users and therefore only lists points relevant for a DOES scheme. Selected barriers and recommendations are shown in Table 2. Own findings follow Table 2.

Table 2: Barriers and recommendations related to utility based DSM programmes in India

Barriers	Recommendation	Source
Lack of interest and motivation, lack of capacity utilities.	DSM cells should be constituted in all the distribution utilities.	(FOR 2012) (GERC 2012) (TERI 2009) (Gupta and Kumar under review Energy Policy)
No (clarity on) financial incentives.	Recovery of cost mechanisms necessary (e.g., through Annual Revenue Requirement).	(FOR 2012) (GERC 2012) (TERI 2009)
Lack of clarity about obligations on Distribution Utilities. Absence of Regulations/guidelines for DSM implementation.	Formulation of an action plan, Create mandatory tasks for utilities.	(GERC 2012) (TERI 2009) (GERC 2012) (CEA 2012b)
Poor financial health of DISCOMs and cross subsidization. Lack of investment capability/ project financing.	The State Governments should consider financially supporting the DSM programs and reduction in taxes on energy-efficient	(CEA 2012b) (FOR 2012) (TERI 2009) (Gupta and Kumar under review Energy Policy)

	appliances.	
No proper load research/evaluations; Inadequate measurement and verification of DSM processes, lack of load data (uncertain results).		(CEA 2012b) (TERI 2009) (Gupta and Kumar under review Energy Policy)
Non availability of efficient equipment.	Involve manufacturers.	(TERI 2009)
Lack of public awareness/participation/confidence.	Trust building Arrange information to consumers, generate awareness.	(GERC 2012) (TERI 2012b) (CEA 2012b) (TERI 2009)
Lack of Monitoring and Verification understanding.	Keep Monitoring and Verification simple.	(Dalkia 2012)

The absence of incentives for utilities, clear regulation, reliable information and awareness are mentioned as important barriers in almost all sources. Though some barriers are common for enhanced electricity efficiency (Table 1) and utility based DSM programmes (Table 2), other barriers are not. A successful DOES scheme would need to be designed in a manner that the barriers mentioned above (Table 2) would become virtually non-existent, whereas the DOES scheme would furthermore need to address barriers for electricity efficiency at end-users (Table 1).

Own Findings

Personal consultation with stakeholders also confirmed some of the above and highlighted certain other barriers for successful implementation of a DOES scheme, such as:

- No clarity on outcome, amount of savings and benefits
- Financial health distribution utilities and investment capabilities
- Small ESCO market
- Limited possibilities to give incentives to (mainly public) utilities
- Political difficulties related to rising tariffs (cost recovery)
- Deficiencies in regulatory and policy framework
- Willingness of end-users to participate; awareness of energy use/savings at end-users. This is especially troublesome in the agricultural sector.

On national level uptake of DSM measures is slow. There have been pilot projects, but many have been implemented on a piecemeal basis (Shakti Foundation 2012). Critical review of these programmes could not be found. Due to the absence of (central) legislation, voluntary action and schemes are set up so that no momentum is lost. Obligations would require political will and would take time (BEE 2012c). Another barrier experienced is the low priority DSM has in some states/SERCs. Obviously (political) will would be required for successful implementation of a DOES scheme. This, however, is a barrier at a level not researched in this work.

4.4. Experiences of States

In order to highlight differences between states and to review experienced gained on the areas of DSM and electricity efficiency, experiences of three states are described below.

Experiences of Maharashtra

In the state of Maharashtra, and especially within the Mumbai area, there have been a number of utility based DSM projects. The state regulator, the Maharashtra Electricity Regulatory Commission, can be seen as responsible for these uptakes. Due to (projected) demand-supply gaps in the metropolis of Mumbai Maharashtra has taken an active stance on DSM. In April 2010 regulations for distribution licensees concerning a DSM implementation framework were issued. These regulations are quite similar to draft DSM regulations published at national level by the Bureau of Energy Efficiency and the Forum of Regulators and will be shortly reviewed later in this section.

Measures implemented include replacement of street lights, replacement of lighting in residential sector, replacement of inefficient agricultural pumps (Solapur project-with the Bureau of Energy Efficiency), time of day tariffs, reduction of load shredding through power purchase arrangements with captive power plants and the introduction of a surcharge on electricity bills for load management resulting in a load management fund. Most of these measures have been completed and are considered to have achieved their targets. Only two slightly critical notes are provided. Firstly, the Solapur project is not finished yet and the Bureau of Energy Efficiency/MERC are looking for ESCOs/implementers. The reasons for the limited ESCO interest were not mentioned. Secondly, power purchases from the captive power plants for the grid were quite expensive and hence a security charge was added to the tariffs. There is an obligation on Maharashtran distribution utilities, but there is no target in energy/capacity saving terms. In practice a number of approved projects are to be carried out. Most relevant barriers are considered to be consumer awareness and willingness of utilities (MERC 2012).

Experiences of Kerala

In the state of Kerala some DSM measures have been implemented. Not the state utility, but the Energy Management Centre, has been very active (and awarded nationally) in the area of energy conservation (EMC 2011). In this state the responsibility for energy conservation lies here, whereas the Kerala State Electricity Board (distribution utility) has other functions. This small paragraph is included in order to show that an Indian wide obligation, solely on the utilities, might be difficult to accept/implement in some states. There should at least be possibility for subcontracting.

Experiences of Delhi

The Delhi Electricity Regulatory Commission considers that there is large potential for end-use electricity savings and DSM. Recently (February 2012) DERC has published draft DSM regulations. The annual report of FY 2008-2009 also stated that in FY 2009-2010 utilities had the possibility to recover some costs related to DSM activity (DERC 2009). An interview with Tata Power Delhi Distribution Limited, a Delhi based utility, confirmed that so far one project has been able to recover cost through tariff structure. Other initiatives, however, had to be funded externally (TPDDL 2012). For the tariff period FY 2012-2015 additional actions are supposed to be implemented (DERC 2012).

Box 2: Aggregate Technical and Commercial Loss Reductions in Delhi

Recently the private utilities (a share of 51% is private) in Delhi have made impressive progress on reducing the Aggregate Technical and Commercial losses within their distribution networks. According to an interview with DERC the main reasons for this success were (DERC 2012):

- Availability of funding (governmental loan)
- They bought their share on basis of a bidding process based on reducing Aggregate Technical and Commercial losses.
- In case of overachievement, there was a profit sharing mechanism. In case of underachievement, the costs were for the utility.

Between 2005 and 2009 the Aggregate Technical and Commercial losses, trued up by the DERC, have been reduced by approximately 20 percentage points (!) for all three private Delhi based utilities (FOR 2010a). This is considered quite successful and shows that, under (such) circumstances, economic incentives can work.

4.5. Review of Utility Based DSM Regulations

Utility based DSM programmes are given priority within the NMEEE. The proposed DSM programmes build on previous work implemented by the Bureau of Energy Efficiency. The Bureau of Energy Efficiency and the Forum of Regulators provide support and push for adoption of DSM regulations within states. Though the central level has no power to stipulate DSM action within states, SERCs do have this power within their state. Nonetheless, BEE and the FOR have the aim is to get 80% of the states to initiate utility based DSM programs (BEE 2012c). This section discusses the model DSM regulations published by the Forum of Regulators and the DSM regulations notified in the state of Maharashtra. It is expected that SERCs will base their future DSM regulations on these relatively similar regulations.

Model DSM Regulations (FOR 2010b)

These regulations are intended to be a model for the SERCs. Published by the Forum of Regulators in 2010, these model DSM regulations call for efforts from both SERC and distribution utility. No actual target or timeframe is mentioned, though it is suggested that the SERC formulates DSM objectives and sets a target which can be expressed as:

- *Percentage reductions in load growth;*
- *Savings in kW, kWh;*
- *Savings as a percent of total resources to meet load;*

Furthermore it is proposed that the timeframe for DSM could coincide with the multi year tariff frameworks. Also stated is '*The Commission may provide incentives to Distribution Utilities for achieving or exceeding DSM Objectives* '

This obviously reveals that there is a lot of freedom for the states. The central level does not have the authority to put the obligation directly on state utilities. The model DSM regulations propose that the roles of the SERCs are to set targets, issue guidelines on the DSM processes, approve DSM plans and funding and to evaluate proposed Monitoring and Verification (M&V) methodologies. The distribution utility is to research the market, their load and economic potential for DSM, to propose DSM plans, to implement these (once approved) and to monitor and verify the savings resulting the implemented measures.

Maharashtra Electricity Regulatory Commission (Demand Side Management Implementation Framework) Regulations (MERC 2010)

These regulations do not mention any target, but do explicitly state that there is an obligation. This obligation stipulates that DSM programmes should be implemented. Focus seems to be on:

Cost effectiveness: programs should be cost effective for end user as well as for utility. Furthermore program should result in overall tariff reductions (Article 3.2).

Awareness raising Programs should be developed in consultation with stakeholders and should ensure consumer awareness. Programs should remove barriers and motivate consumers to adopt energy efficiency (Article 4).

Other aspects of these regulations include that distribution utilities are to propose a DSM plan and targets and funding will be what is described within an approved DSM plan. The period of the multi year tariff framework will also be the period in which DSM programs need to be implemented.

Discussion

The above regulations require substantial effort from the distribution utility. They are to develop measures and methods which will suffice guidelines. Additional costs will be made during researching the possible measures, programs and monitoring methodologies. If many utilities are obliged to research and identify cost effective measures, potential savings and market conditions , it would be more efficient to do this at another (more central) level.

Despite the effort required and the risk that DSM plans are not approved, these regulations provide a large degree of freedom for the distribution utilities. The utility can propose 'own' measures in their DSM plan and no explicit target is mentioned. The choice regarding in which end use sector to implement measures is currently also a free choice. The flexibility can be considered a pro, but without harmonization these DSM regulations could go into very different directions, making a future national obligation more difficult to implement and design effectively.

The requirement that there should be no incremental cost, i.e. that the measures should be cost effective for the utility is something understandable, but difficult to work with. For most utilities, costs of supply is higher than tariffs for the agricultural sector, approximately equal to tariffs in residential sector and lower than tariffs for industrial and commercial sectors. This means that the utility is unlikely to implement electricity saving measures within the industrial and commercial sectors, because then they would loose revenue from these well paying, subsidising sectors. With respect to the agricultural sector, end use savings will be cost effective for the utility, because they would be **loosing less**. This said, the issues and barriers related to agricultural DSM are significant and probably vary geographically. The pilot project has not delivered results yet. Incentives for farmers are limited. There is more experience with projects in the residential sector. Load shifting measures would probably be cost effective (avoidance of peak power purchases), though many measures are actually aimed at electricity efficiency and will thus reduce peak and off-peak load. Actual cost effectiveness for utility would therefore be difficult to determine and limited. Additionality, which is very relevant for the cost effectiveness of a scheme (Chapter 5), is barely mentioned. Cost recovery is not explicitly mentioned and hence occurs through (business as usual) tariff structures.

The requirement for no incremental costs is based on the idea that electricity should not become too expensive. As previously mentioned, subsidised tariffs and cross subsidization currently exist. An increase in tariff of the subsidising sectors would lead to an even more skewed situation, and an increase in tariff of the subsidised sectors due to DSM measures would be difficult to justify (especially if measure has been implemented in another sector).

4.6. Conclusion

Major barriers exist within the Indian electricity sector for electricity efficiency at end-users and for successful implementation of DSM programmes. Electricity prices remain (cross-) subsidized which leads to a skewed situation for electricity efficiency. The economic incentive for end users to install electricity efficiency measures is therefore limited or absent.

Furthermore, information flows can become asymmetric due to the numbers of stakeholders. In the end, the savings will have to be achieved by the end-users. So they need to have an incentive to invest in electric efficient measures. There seems to be a lot of voluntary elements within the policies from the Bureau of Energy Efficiency and an expected, voluntary uptake of these measures; voluntary measures in general only work when strong incentives exist.

In cases of low awareness or uncertain outcomes this probably will not work. In some cases the voluntary aspect is needed in order to comply with the CDM framework or because there is simply no regulation in place. Funds are not always certain and incentives for implementing entities are limited when no certain and direct gains are involved. Funding is a challenge as the utility and (subsidised) end-users are reluctant to do so. In general the Bureau of Energy Efficiency tries to achieve efficiency goals through public private partnerships (involvement of state and national governments, utilities, ESCOs, financiers and end users). This increases administrative burden and transaction costs. ESCO development is a (sub) goal and is expected to offer benefits, but whether this outweighs additional program costs (and uncertainties) remains unclear. DSM experiences are relatively limited but results have been booked. This is especially the case within the residential sector. The Bachat Lamp Yogana program has been able register 17 projects in which savings will be achieved. The fact that the Bureau of Energy Efficiency and the respective utilities were supporting this program has definitely helped. In the Mumbai area projects have also been completed. Electricity savings were considered important and funding was made available (through tariff). This obviously contributes to successful implementation.

Finally, the transparency and information on progress made could be increased. The speed in which measures are carried through is somewhat slow. Lesson learned and success or fail factors are not clearly (publicly) available. Important barriers such as (political) will within states, interest of regulators and utilities and trust and awareness amongst end-users should not be overlooked.

5. Comparative Analysis of Trading Schemes

In this section a number of existing, or soon to be existing energy related trading schemes have been investigated. After a brief description of each scheme the main design modalities will be compared with each other. Differences and similarities will be highlighted and, if possible, explained. Major changes within the schemes are also explained. As noted in the Introduction, the schemes which will be investigated are the European Union Emission trading Scheme (EU ETS), the Acid Rain Program (ARP) from the US, the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy and the Perform, Achieve and Trade (PAT) scheme which has recently started in India. Special attention is given to additionality, standardized savings and (cost-) effectiveness within the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy. Any lessons learned or success and fail factors identified, possibly revealed through changes made within these schemes, will be summarised at the end of this chapter.

5.1. Brief Overview of Investigated Schemes

European Union Emission trading Scheme (EU ETS)

The EU ETS is the largest GHG cap and trade scheme and covers some 11 000 sites (power and industry sectors) in 30 countries (EC 2012). The obliged entities are the major emitters within industrial and the power sectors. Scheme is focussed on reducing CO_2 emissions and the target, or cap, is expressed in tonnes of carbon. Units of trade are European Union emission Allowances, which permit emission of a carbon unit (tonne). Certified Emission Reductions from the CDM and Emission Reduction Units from the Joint Implementation framework, both flexibility mechanisms of the Kyoto Protocol, also have (limited) eligibility within the EU ETS.

Acid Rain Program (ARP)

The ARP is a continental scheme (48 US states) focused on power producers. The scheme focuses on air quality improvement through reducing SO_2 and NO_x emissions. The ARP puts a cap on SO_2 emissions, but also stipulates obligations for NO_x emissions and control technologies (Napolitano, et al. 2007a). The trading element only covers the SO_2 emissions. Units of trade are allowances of SO_2 emissions. The Acid Rain Program ended in 2010, after two cycles of operation. SO_2 and NO_x emissions are now covered through other schemes and regulations.

Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy

The Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy are well covered and discussed in literature (Bertoldi and Rezessy 2009) (Eyre, Bodineau and Pavan 2009) (Bertoldi, et al. 2009). Though they differ on many aspects, these schemes share in common that energy related utilities have an energy saving obligation in end-use sectors. The targets (and units of trade) are expressed in energy savings or carbon savings. If the obligation includes the certification and trading of certificates as a flexibility mechanism for the obliged entities, the scheme is usually referred to as a White Certificate scheme. In the UK scheme certification and trading does not occur, whereas this does occur within the schemes of France and Italy.

Perform, Achieve and Trade (PAT)

Perform, Achieve and Trade (PAT) is an Indian scheme under the NMEEE which is to ensure enhanced energy efficiency in energy intensive industrial sectors. Those industrial units which are to comply, the Designated Consumers, have reported their energy intensities. Targets, set in energy intensity terms and calculated as a percentage reduction from this reported energy intensity, have been notified on March, 31st 2012 (BEE 2012a).The Designated Consumers have a three year period to comply with their target. Penalties for non compliance are in place and encompass a fixed charge besides a charge dependent on the degree of non-compliance (GOI 2010). Designated Energy Auditors are to monitor and verify whether the unit specific targets have been achieved. The trading unit in the PAT mechanism will be an ESCert, an Energy Saving Certificate. One ESCert represents 1 unit of energy saved compared to the projected intensity baseline (target).

5.2. Comparison of the Main Design Modalities

The Energy Saving Obligations and White Certificate schemes of the United Kingdom, France and Italy can be somewhat easier compared to each other and share more common characteristics than the other schemes analysed here. The other schemes, from now onwards referred to as the cap-and-trade schemes, also share some common characteristics. Therefore this comparison will subcategorize these schemes accordingly.

The design modalities that will be compared to each other fall under the following categories:

- Duration of scheme, obliged entities and targets
- Eligible sectors, parties and compliance routes
- M&V, Certificates and trading
- Regulatory and Legal aspects

These categories form the subsequent sections of this chapter. Besides the actual comparison each sector also explains why these differences exist and which considerations are related to these. Furthermore, changes of the schemes (or their predeccors) over time are also investigated. These changes have been due to, and based on, previous experiences of the scheme and of similar schemes.

5.2.1. Duration of Scheme, Obliged Entities and Targets

Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy

In the UK the CERT scheme is considered to be the third of its kind. The targets for the previous schemes, Energy Efficiency Commitment I and Energy Efficiency Commitment II (EEC I and EEC II), were 62 and 130 TWh fuel standardized, lifetime energy savings. Fuel standardized refers to the weighting of different fuel according to their carbon content. The UK Carbon Emission Reduction Target (CERT) scheme, which measures activity of the obliged parties in carbon units, has a relatively more ambitious target. Within the UK CERT the aim is hence even more focussed on achieving carbon savings, though there are some additional obligations set on the obliged parties. These ring fence a share of the savings to be implemented on insulation measures and a share of measures to be implemented at customers in receipt of income related benefits and tax credits (priority group). This because it is considered undesirable that low income consumers pay the bill for this scheme. The implemented measures are accredited with lifetime savings in the UK CERT. Lifetime savings mean that a measure, once

implemented, is attributed all savings that will occur in its determined lifetime ex ante. In the UK CERT there are only 6 obliged entities. These are the large electricity and natural gas suppliers (to households). The threshold for suppliers to become obliged entity has increased from 15 000 customers (EEC I) to the current 50 000 customers; this in order to reduce administrative burden and costs connected with relatively small amounts of savings. Though equitable distribution of benefits (priority group) and insulation have always been considered important in the previous schemes, the CERT saw the additional insulation obligation and a super priority group obligation. These additional obligations, which limit the flexibility for the obliged entities, are to ensure that sufficient savings are achieved within these domains. Another very important change in the UK schemes is the discount factor. In EEC I this was 6%, in EEC II this was reduced to 3.5% and no discounting occurs in CERT. The first reduction in the discount rate is because the energy savings in EECI and EECII were discounted at the same rate as the rate the Treasury used for the value of future money. This rate was adjusted between EECI and EECII. In the CERT scheme discounting no longer occurs because savings are now expressed in carbon units and key concern is the quantity of CO_2 in the atmosphere (Lees 2008). A consequence of this change was that insulation measures became more attractive from the utilities' point of view - more lifetime savings were suddenly attributed to these measures.

In France, the target of the first obligation period, which ran from 2006-2009, was 54 TWh and was considered a learning phase. France had no previous experiences with similar schemes. The discussed second period, with a target of 345 TWh, is more ambitious. France measures savings in final energy and hence puts relatively more weight on end-use fossil fuel combustion - less on electricity use. An explanation could be that due to the nuclear electricity supply France rather focuses on fossil fuel use (and emissions). The targets are expressed in TWh-*cumac*, which refers to lifetime and discounted energy savings.
The obliged entities are suppliers of electricity and fuels. A change in the second phase is the inclusion of suppliers of motor fuels in the scheme, which is considered to result in a more equitable distribution of required effort among energy suppliers and is hoped to result in more energy efficiency savings in the transport sector (Ministère du Développement durable 2011b). The threshold for inclusion is based on annual sales. Similarly, there is a threshold for suppliers of domestic (heating) oil in the second obligation period, whereas all suppliers of domestic oil were obliged parties in the first obligation period. This change has occurred to lighten administrative burden related to relatively small savings.

In Italy, the scheme has been extended in duration. Originally the scheme was planned to last five years. In 2007, when prices for certificates were low, reflecting oversupply and uncertainties for future (post 2009), the scheme was extended to 2012. Each year the annual target has roughly doubled resulting in quite an ambitious target for 2012. In Italy savings are measured, determined and certified annually; this makes it difficult to fully reward measures with long lifetimes -the scheme only last for eight years. Probably Italy has chosen for this approach as it enhances liquidity of the market and annual monitoring and verification can result in more certain savings.
Initially, most targets were met, though in 2010 this was not the case (AEEG 2011). In the Italian scheme borrowing up to 40 % is allowed (40% of under-achievement in year t can be offset by achievements in year t+1), so few penalties have been issued yet. It would seem that targets will also be hard to reach in

2012. Initially distributors were obliged to achieve 50% of savings within the fuel type distributed. This condition was removed in 2008 (Ettore 2010) in order to get rid of the price differences between the types of Certificates and hence to achieve the target in the most cost effective way. The obliged entities are the electricity and gas distributors (network operator). The threshold is based on number of customers and this number has been reduced from 100 000 to 50 000 in 2008. This resulted in an increase of obliged entities. An overview of the discussed design modalities of the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy is provided by Table 3.

Table 3: Duration of scheme, obliged entities and targets

	UK CERT	France	Italy
Duration of scheme	April 1st 2008- December 31st 2012 (4.75 years)	January 1st 2011- December 31st 2013 (3 years)	January 1st 2005- December 31st 2012 (8 years)
Overall Target	293 Mt CO_2	255 Twh cumac[1]+ 90 Twh cumac	Annual savings of 6 Mtoe (2012)
Characteristics overall target	Lifetime savings, target compliance at end of scheme;	Lifetime savings, target compliance at end of scheme;	Annual savings, annual targets;
Energy/Carbon savings discounted	Carbon savings no	Final energy Yes: r=0.04	Primary energy no
Sub targets	- Insulation obligation - Priority and super priority group obligation	-	-
Obliged parties	Six major energy (electricity and gas) suppliers - competing firms in free market (no tariffs)	Suppliers of electricity, gas, fuel oil, heat or cold (networks), LPG and motor fuel -competing firms in regulated market (tariffs)	Electricity and gas distributors -firms operating in a natural monopoly, regulated (tariffs).
Threshold	50 000 domestic customers	Threshold based on sales (quantity), different thresholds for different fuel types[a]	50 000 domestic customers
Target appointment	based on number of customers	Based on turnover and market share of energy sales	relative market size, adjustment mechanism in case of substantial (5%<) over supply
Compliance targets previous schemes	Met and exceeded	Met and exceeded	Met and exceeded, recent (2011) shortages of certificates on market

Sources	CERT 2011 annual report (OFGEM 2012)	Le ministère du Développement durable, 2011a	Pavan (2009) Di Santo, et al. (2009)

[1]cumac savings stand for cumulative, realised savings *(lifetime savings)*, [a] Bertoldi and Rezessy(2009)

The targets of the three schemes are expressed in different units. These units refer to lifetime savings or annual savings, to energy savings or carbon savings and target compliance can be annual or at the end of the compliance period. The French scheme is the only scheme which discounts savings. Discounting is in essence a financial tool and refers to (human) time preferences for a commodity. The reason for discounting energy or carbons savings is not always clear. According to Lees (2010) discounting can be done for economic or environmental reasons. Environmental discounting relates to lifetimes of a CO_2 molecule in the atmosphere, and in this case one is concerned about the actual avoided CO_2 quantity in the atmosphere at the end of the technical lifetime of the measure. Economic discounting should reflect time preferences for a commodity. Discounting enables comparison of future value versus current value of a unit. Another stated reason for discounting is that discounting can reflect the deterioration of a measure over time (Bertoldi and Rezessy 2009). In any case discounting reduces the amount of savings accredited, especially for those measures with long lifetimes.

In France energy suppliers of all types of energy are included, whereas the obliged entities in the UK CERT scheme are the major electricity and natural gas suppliers. More savings can be achieved by including more types of fuel suppliers or by lowering the threshold. However, this will also increase administrative burden and transaction costs for relatively smaller savings. Whereas suppliers face the obligation in France and the UK, the obliged entities in Italy are the distributors. The distributors might have less disincentives to achieve energy savings (provided tariff structure is changed/designed accordingly), whereas the suppliers might have better contact possibilities with their customers/end-users.

Box 3: **Absolute and Relative Caps and Targets**

These sections discuss the various caps and targets of the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy and the other trading schemes. In general, absolute caps such as used within the EU ETS and the ARP guarantee a desired outcome. Absolute emissions are determined, and these will not be influenced by prices, economic growth or technological development. The cost for compliance, required effort and the effectiveness of the scheme are the changing variables here. For example, in case of recessions and technological breakthroughs the obliged actors will reach their targets with ease, whereas strong growth of output will make compliance a harder and costlier affair. In case of a relative cap, which is used within the PAT scheme, energy use and emissions will be reduced by a set percentage, regardless of the total output. A relative cap does not limit energy use and emissions, but limits energy or carbon intensities. Obliged actors will need to invest in intensity reducing measures, regardless of growth rates. Other aspects, such as technological change can still influence cost of compliance, but the effect of economic growth on compliance costs and effectiveness is not as large as is the case with the absolute caps.

Saving targets are another form of reducing energy use and emissions. In this case there is no obligation on actual energy use, but on energy savings. Relative saving targets are, in theory, similar to a relative

cap. However, in case of a cap output is the variable monitored and verified, whereas the amount of savings is to be monitored and verified when the target is expressed as an amount of savings. Absolute saving targets give the obliged actors certainty on what they need to do and hence an opportunity to minimise related costs. Monitoring and verification is a more complex affair in the case of energy savings. This is because savings are not directly measurable. Savings are calculated against an appropriate baseline, which will rest on assumptions. Such saving values and baselines would need to be updated regularly as relevant circumstances keep changing.

The Other Trading Schemes

The other trading schemes comprise of slightly different design modalities than the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy. These differences partly exist because the 'traditional' cap & trade schemes put an absolute limit on emissions or consumption (the cap), while the energy saving schemes have a target which does not limit output directly.

In the EU ETS, the annual cap is expressed in tonnes of CO_2 equivalent. Obliged entities are large emitters of greenhouse gasses, which are thermal power plants and certain industrial plants. Allocation of allowances occurred at the national level as set in National Allocation Plans. These National Allocation Plans could however be rejected by the European Commission, in which case the specific National Allocation Plan had to be changed. From 2013 onwards allocations will be distributed from the community level using harmonized rules. In the previous EU ETS cycles, target allocation was mainly based on grandfathering. From 2013 onwards the auctioning and benchmarking approach will become the norm, which is believed to be fair and transparent, putting firms/competitors from the different member states in the same situation. The EU ETS will expand in scope and some examples are the inclusion of the aviation sector, certain industrial processes (e.g. chemicals) and inclusion of some non CO_2 emissions (N_2O from industrial sectors). Croatia will likely enter the scheme in 2014.

In the ARP, the annual cap is expressed in tonnes of SO_2. Distribution of allowances in the ARP was determined by the regulator. Initially only the largest coal-fired power plants were included in the scheme, but in the second phase the obliged entities were power producers with a capacity above 25 MW. The majority of allowances were distributed for free, using fixed series of formulas. A small percentage (2.8%) of allowances was auctioned, in order to send the market an allowance price signal. Previously, the ARP also made use of 'direct sales' so that power producers had the possibility to buy (expensive) allowances, ensuring them that they could access needed allowances. This element proved to be unnecessary (EPA 2011). Industrial entities were not faced any obligations in the ARP. A voluntary opt-in was possible however: industrial entities could enter the scheme and hence be rewarded for/in case of low SO_2 emissions. As the voluntary entities that choose to opt in would be able to reduce emissions at low cost, this measure is believed to reduce overall costs of the scheme (EPA 2011). The ARP also included a pool of reserved allocations, which obliged entities could claim if they had put additional effort/resources in energy efficiency or renewable energy supply options.

The **PAT scheme** puts an obligation on large energy users (referred to as Designated Consumers) from eight sectors which are the aluminium, Chlor-alkali, textile, pulp and paper, iron and steel, fertilizer, cement and thermal power sectors. The cap, or target, is expressed in intensity terms (units of energy/units of production) and the individual obliged entities have been notified a specific target intensity. The high grow rates in India make it difficult, and politically infeasible, to put an absolute limit on output. Those obliged entities which have a higher energy efficiency performance will be appointed a relatively low target. Other, less energy efficient, obliged entities in this scheme will be appointed a target based on the relative difference in performance between their plant/site and the plant/site within their (sub) sector which is most energy efficient. Compliance or non compliance is termed in energy units. Compliance must be demonstrated at the end of the scheme, though it is possible to 'check' compliance on an annual basis; this could lead to early issuance of the tradable certificates. The overall aim is an approximate 4% reduction in energy intensity. An overview of similarities and differences between the design modalities of the three trading schemes is provided by Table 4.

Table 4: Characteristics of caps and obligation

	EU ETS	ARP	PAT
Duration of scheme	Since 2005. Third phase 2013-2020 (8 years)	Second phase 2000-2010 (10 years)	First phase 2012-2015 (3 years)
Overall Cap (Target)	~2.04 billion allowances (2013) Annual cap	(2000): 9.97 million allowances; annual cap	Aggregate SEC reduction of approx. 4% in 3 years Compliance obligatory after 3 years, annual compliance voluntary
Characteristics overall Cap	Will be tightened annually by 1.74%	(2000-2010) annual reduction of 1.07%	Cap is sum of specific, individual unit caps
Obliged parties	Power producers Industrial units Aviation (post 2012)	Power producers Eligible parties (voluntary inclusion)	Power producers Industrial units
Threshold	Based on capacity-sectoral differences	Installed capacity of 25 MW. Coal, oil and gas fired power producers.	Based on Energy Consumption
Target Appointment /Allocation	Auctioning, benchmark approaches (free)	Automatic, based on a series of formulas Some auctioning	Based on sectoral energy consumption, current SEC, compared to others within (sub)sector
Compliance targets previous schemes	Met (phase I over-allocation)	Met	-
Sources	(EC 2012)	(Napolitano, et al. 2007b)	(BEE 2011)

The duration of these schemes vary substantially. It is worth noticing, however, that all trial/first cycles of the various schemes are/have been relatively short. The following cycles are usually longer in order to provide investor security and reduced administrative costs.

Annual caps are used in the EU ETS and the ARP, whereas the PAT scheme requires compliance after the first three year cycle. Looking at the schemes, the annual percentage reduction in case of EU ETS, ARP and PAT seems similar. However, the target for PAT is a reduction in intensity of energy use, whereas the target for the other schemes is an absolute reduction (in emissions). India is a country which has high GDP and productivity growth rates; an absolute cap might be difficult to determine and put a constraint on growth which is politically infeasible.
Target allocation (distribution of allowances) can be based on benchmarks, set formulas or on auctioning processes. In the target allocation process differences between the schemes exists related to what is or what is not considered a controllable parameter. For instance, in the EU ETS the benchmark is purely based on product, whereas in the Indian PAT scheme the types of fuel used and current performance is included in the allocation process. A consequence of this difference is that in the EU ETS some installations might receive enough allowances to cover their emissions, while the target will be very hard to achieve for other installations. In the PAT scheme all plants with the same product have (different) targets which cannot be achieved if no changes compared to the current situation are made.

5.2.2. Eligible Sectors, Entities and Delivery Routes

Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy

The energy saving target within the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy can be reached through implementation of energy saving measures. In all three schemes these measures have to be implemented in end-use sectors. As can be seen in Table 5 there are some restrictions and differences between which end use sectors are eligible. In all three schemes most measures implemented are standard measures, i.e. measures which have a set calculated saving value (based on national stock/sales assumptions) and are automatically approved.

In the UK CERT some standard measures assume behavioural change and therefore this is also rewarded. Micro-generation measures, such as PV and heat pumps, are also eligible. The UK CERT also accredits savings to demonstration projects, i.e. relatively new projects (no standard measures) which are reasonably expected to achieve savings. In the UK CERT the only eligible entities are the obliged entities. However, third parties are involved as (sub) contractors. Some appliances are not eligible anymore, as the additionality of the related savings proved minimal (Lees 2008). Some measures have been made more attractive, either through the previously discussed reduction on discount rates or because of an uplift of savings attached to certain measures. The UK CERT now rewards 'market transformation actions', which are not-widely adopted measures, with an uplift of 50%. This is hoped to increase market transformation effects, rather than just installing mature technologies in bulk. Dominant measures are insulation measures.

In France standards measures are also the dominant measures in terms of savings accredited, though non standard and bigger projects could also be eligible for savings. In the second obligation period, the

administrator has aimed to further increase the number of standardized measures, thereby possibly reducing transaction and administration costs for suppliers. Especially some new standardized measures for the transport sector have been included (such as low resistance tyres, fuel consumption monitoring, and trainings) so that the suppliers of motor fuel can focus on measures within their sector. The number of eligible entities has been reduced in the second phase of the scheme. Non obliged, private entities are no longer allowed to certify energy savings themselves. The reasons for this were the administrative burden and the risk of double-counting savings. Such entities could still partner up with eligible/obliged entities to have their measures rewarded with certificates.

In Italy, three types of measures are eligible. These are the standardized measures, so called engineering estimates and energy monitoring plans. Engineering estimates resemble the standardized measures, though implemented measures deal with a greater amount of energy savings and a limited number of parameters must be measured through the year in order to accredit savings (e.g. operating hours). Energy monitoring plans deal with annual energy savings expected to be above 100 toe and require pre-approval as well as more complex monitoring and verification methodologies. Eligible entities are the obliged entities, ESCOs and large energy consumers (firms with an energy manager). ESCOs are the dominant implementers of measures. Therefore, most obliged entities comply with their target through buying certificates in the market place. Some standard measures, such as CFL distribution, were initially very cost effective and lead to windfall profits. Certain (additionality) coefficients have therefore been altered and have reduced the cost effectiveness of these measures. Alternatively, some measures have barely been implemented due to lack of cost effectiveness/attractiveness for obliged and eligible entities. One of the reasons for this is that measures with long technical lifetimes were not awarded with their full savings in the scheme. Only annual savings were accredited, with a maximum certification period of eight years. Recently (October 2011), a durability factor has been introduced. This factor, which is equal to or larger than one, addresses this issue. For instance, this durability factor is 2.91 for insulation measures (AEEG 2011) (AEEG 2012). One could hence consider that the accredited lifetime has increased from 8 to 23.28 years. This factor can result in greater supply of certificates and increased (and cheaper) compliance, which was an issue in 2010 and 2011. Table 5 provides an overview of the discussed design modalities.

Table 5: Eligible sectors, parties and measures

	UK CERT	France	Italy
Eligible sectors	Residential only	All end use sectors (excluding EU ETS)	All end use sectors, except transport
Eligible parties	-Obliged entities only	-Obliged entities - Public collectives - Social housing corporations	-Obliged entities -companies controlled by obliged entities -ESCOs -Large energy end-users (with energy manager)
Eligible measures	Fuel switching, Energy efficiency, Behavioural change,	Fuel switching, Energy efficiency, Behavioural change	Fuel switching, Energy efficiency, Micro generation

Types of measures	Micro generation, - Standard measures - Demonstration activity - Market transformation measures	Micro generation - Standard measures - Specific projects	-Standard measures -Engineering estimates -Energy monitoring plans
Dominant measures (in terms of savings)	Standard measures: -insulation: cavity wall, loft, loft DIY -CFLs[a]	Standard measures: -(condensing) boilers - heat pumps - insulation	Standard measures: -electrical measures in residential sector (CFLs[a]) -ESCOs dominant implementers
Sources	CERT scheme spreadsheet (OFGEM 2011b) CERT supplier guidance V3 (OFGEM 2011a) [1]CERT 2011 update V14 (OFGEM, 2011b)	Bertoldi and Rezessy 2009 [2] Letter d'information (Ministère du Développement durable 2012)	Pavan 2009 [3]intermediate statistical report (AEEG 2011)

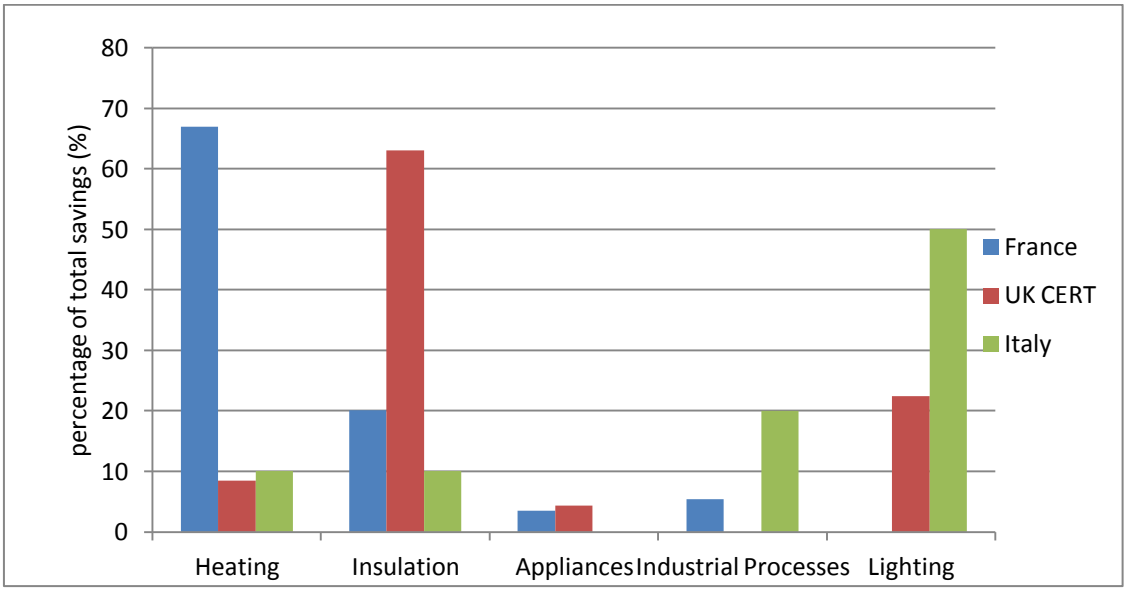
[a] all lightning, except LED removed from CERT scheme since April 2011 (OFGEM 2012); CFL lightning also not eligible in Italian scheme anymore

For some measures in France (information and training measures, relatively expensive measures at low income households) and in the UK CERT (demonstration projects) a conversion value between financial expenditure and amount of savings accredited determines total savings in these cases. This has been done because it would be very difficult to determine actual savings for these measures. Furthermore, such a conversion value could be an incentive to finance these measures (up to a certain limit). Such incentives or sub-obligations can obviously push towards certain measures, which would be considered appropriate. National policy priorities are reflected in types of measures installed. Figure 2 shows the differences between types of measures implemented in each scheme, since the start of the scheme to the end of 2011 (Italy) and March 2012 (UK CERT and France).

The Other Trading Schemes

For the other trading schemes, these design elements (eligible sectors, parties and delivery routes) are not of primary importance as the obliged entities do not have to fulfil their target with specific (pre-approved) measures. The monitoring and verification methodologies are to ensure accountability and effectiveness in the cap and trade schemes, whereas appropriate standard measures, since this is by far the dominant route of compliance, do so for Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy.

Figure 2: Dominant measures implemented in UK CERT, France and Italy



Sources (OFGEM 2012) (AEEG 2011) (Ministère du Développement durable 2012). For Italy a rough assumption was made as 22% of savings was due to gas use in residential sector and hence there was no distinction between heating and insulation measures. Lighting is included in appliances for the French scheme.

5.2.3. Reporting, Monitoring and Verification, Certificate Trading and Cost Recovery

Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy

As mentioned previously the standard measures have a fixed savings value. Monitoring and verification (M&V) processes are, in these cases, limited to verifying that the measures have actually been installed. Random audits are used in the three countries for this purpose.

In the UK CERT the only eligible measures are the standardized measures and hence monitoring and verification is not a complex affair. The obliged entities are to report progress and need a pre-approval on measures and delivery routes they are planning to implement. The regulator does conduct surveys at end-users, but this forms only input for possible future changes. Saving values and additionality coefficients are not changed ex post. Trading has been very limited in the UK schemes, with the exception of banking. There has been substantial carry-over of savings from EECI to EEC II and from EECII to CERT. No certification occurs, but reported savings can be traded bilateral. These trades only allowed between the obliged entities. In practice this barely happens. Cost recovery is undefined, but it is assumed that the competition in the free market in which the suppliers operate will limit costs (for the end-users).

In France, non standard projects may be eligible, though this needs to be assessed on a case-by-case basis. Bilateral trades are allowed between eligible parties, via the central (online) registry. In France, there has been no explicit pass though of costs through tariff structures (for electricity and natural gas). Most cost are actually covered though government subsidies and thus by tax payers. Product prices from

some obliged entities (fuel oil) are not regulated and related costs for these obliged entities will hence be passed through directly. Certification threshold is 1GWh cumac, but measures can be clustered in order to reach this threshold.

In Italy, certificate trading is substantial. Numerous ESCOs have entered the market. Trading does not require any pre-approval or authorisation in Italy. The Italian White Certificate scheme is aimed at achieving the obligation in a most cost effective manner and therefore the trading platform (bilateral trades and spot market trades) are open to all eligible entities. Price and quantity of bilateral trades also needs to be registered, which was initially not the case. This has been decided in order to create increased transparency for market operators and the administrator (setting tariffs). Initially, there were some windfall profits as electricity distributors received a fixed 100 € per certificate. The prices for certificates were then approximately €60, which also meant that consumers were paying more than necessary. Besides the adjustments of the additionality coefficient for these attractive measures, cost recovery is now also based on previous expenditures. Cost recovery through the tariff infrastructure occurs in Italy, this is a flat and technology neutral rate per unit of savings verified; this in order to maximise the economic effectiveness of the savings. Those measures which accredit relatively large savings for relatively low costs are implemented, as there are direct financial gains for the obliged entities. Certification threshold is 25 toe, but clustering is allowed. Table 6 summarises.

Table 6: M&V, certificate trading and cost recovery

	UK CERT	France	Italy
M&V	Standard measures: Random audits, questionnaires	-Standard measures: audits -Specific projects: case by case assessment	-Standard measures: audits -Engineering estimates: partial measurement -Energy monitoring plans: pre-approval required, case by case assessment
Certification 'Size' of Certificate Lifetime Certificate Threshold size (in order to apply for certification)	No certification NA NA: Banking between phases allowed NA	Certification 1 certifcate~1 kWh cumac Banking allowed for three compliance periods 1 GWh cumac	Certification 1 Certificate ~ 1 toe primary energy savings Banking and borrowing allowed to 2012 25 toe
Issuing/tracking Certificates	NA	Registry: Emmy.fr, also for bilateral trades	Not required - 'free' trade
Trading	Trading of savings only allowed between obliged parties	Bilateral Certificate trading between eligible parties	Active bilateral and spot market
Market operator	NA (OFGEM can approve	NA-registry: Emmy.fr	GME

	bilateral trade of achieved savings)		
Cost recovery	None-pass through in electricity and gas price expected: 'cost of operation'	Tariff setting (undefined)	Tariff setting (defined) by AEEG
Sources	CERT supplier guidance V3 (OFGEM 2011a)	Bertoldi and Rezessy 2009	Pavan 2009

Trading only adds value to a scheme if the savings can be achieved heterogeneously and if there are substantial cost differentials in achieving certified savings. This heterogeneity can be created by allowing a variety of measures, end-use sectors and delivery mechanisms. Trading provides additional flexibility for the obliged entities. Flexibility can be provided by other means, such as banking, borrowing and number of eligible measures. Cost recovery also differs between the schemes; this is mainly due to the difference in the obliged entities and the markets they are working in.

The Other Trading Schemes

In the EU ETS verification was performed at a national level. For the third cycle more uniform guidelines, made obligatory at the EU level, should ensure greater transparency and accountability in this process. Offsetting with Kyoto protocol mechanisms can be done with tighter restrictions in the third cycle. From 2013 onwards, only projects registered within Least Developed Countries will be eligible within the EU ETS. Moreover, Certified Emission Reductions from CDM projects on industrial gasses are no longer eligible. Banking between compliance periods is allowed, but this was not the case between the first and second phase of the EU ETS. Borrowing within a compliance period is also allowed in the EU ETS. The European Union emission Allowances can be traded on spot markets of various platforms as well as bilaterally. In principle, any body can enter the market.

Trading experiences show that the price of a European Union emission Allowance has varied substantially in the past. In the initial (trial) cycle there were too many allowances leading to a carbon price of effectively zero after a collapsed in April 2006. Two reasons for the sudden collapse were an information discrepancy (release of relevant information in April 2006) and restriction of banking between trial and second period. The provision on banking, however, can be understood as no failures were desired to spill over into the second compliance period (Ellerman and Joskow 2008).

In the ARP, obliged entities have a choice with regard to which monitoring methodology to follow. The more inexpensive options are less accurate, but biased (assumed to be an over estimation of real emissions). The largest emitters were obliged to use the most accurate methodologies. In some cases, continuous monitoring and hourly reporting were required. The public or environmental agencies were also allowed to purchase (and do nothing else with) allowances for SO_2 emissions, thereby reducing the overall cap.

The PAT scheme has had some initial critique related to the design around the trading aspects: only after the M&V phase (at the end of the three year period) it will become definite how many Energy Saving

Certificates will be available on the market. This prevents that stakeholders have clear information on Energy Saving Certificate availability and prices (EVI 2011) beforehand and could raise cost of compliance. The benefits of trading (lower overall compliance costs) would hence be reduced. However, it is possible to verify progress on an annual basis. This voluntary action could lead to early issuance of Energy Saving Certificates and could give the market a price signal. Table 7 provides an overview.

Table 7: M&V and certificate trading

	EU ETS	ARP	PAT
RM&V	Legally binding guidelines for reporting and monitoring. Verification by accredited verifier. Kyoto mechanisms are also eligible; hence this M&V is accepted for those emission reductions.	Regular (even continuous) monitoring and reporting required. Various methodologies used. Some obliged entities have a choice.	Annual reporting required. Verification possible on annual basis, but obliged at end of first cycle. Verification of baseline intensities and final intensities by designated energy auditors.
Certification 'Size' of Certificate Lifetime Certificate	Allowance allows emission of 1 ton CO2. Banking and borrowing (within a trading period) allowed.	Allowance allows emission of 1 ton SO_2. Banking allowed.	1 toe. Banking allowed.
Trading	Open market-free entry Various trading platforms Linked with Kyoto protocol mechanisms	Open market-free entry Various trading platforms	Creation of trading platform in process
Sources	(EC 2012)	(Napolitano, et al. 2007a), (Napolitano, et al. 2007b)	(BEE 2011)

Trading is obviously considered an integral part of these three trading schemes. In both the EU ETS and the ARP the obliged entities have an account, set up by the regulator, which shows number of allowances in possession. Tracking of allowances and possible transfers between obliged entities and non-obliged entities (also eligible to open accounts) occurs through these digital accounts. Issued certificates have a unique certificate number. Banking is allowed for all schemes, though limits and restrictions on banking and borrowing differ.

5.2.4. Regulatory and Legal Framework

Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy

In the UK CERT the national gas and electricity regulator (OFGEM) is the overall administrator of the scheme. OFGEM also determines energy saving values, but does this in consultation with (technical) bodies. Non compliance has not occurred. There was no stated penalty, but it was clear that the costs would have been substantially higher (in case of non compliance).

In France the responsible Ministry (Ministère de l'Écologie, du Développement durable, des Transports et du Logement) is the regulator and administrator of the scheme. All forms of non compliance were considered as a criminal act in the first cycle of the scheme. Now some administrative penalties have been included, as this reduced burden for the regulator.

In Italy the AEEG (the energy and gas market regulator) used to be responsible for day-to-day administration and regulation and for the technical details of the savings/standardized measures. These tasks have been split and this is a recommended model of governance (Pavan 2009). An independent market operator provides a trading platform for the Italian certificates. A one year grace period exists: obliged entities are not to pay any penalty provided they have at least achieved 60% of their obligation, and will fulfil this annual obligation in the next year. Table 8 provides an overview.

Table 8: Regulatory and legal framework

	UK CERT	France	Italy
Target setting	Government: Department of Energy and Climate (DECC)	Government: Ministère de l'Écologie, du Développement durable, des Transports et du Logement (MEDDTL)	Government:
Administrator	OFGEM: national regulator gas and electricity markets	Government: MEDDTL	AEEG – national regulator gas and electricity markets
Backed by law, acts	yes	Yes: all regulation is described in law	yes
Technical details savings, updating measures/ saving methodologies	OFGEM, in consultation with stakeholders and external third parties	External third parties	AEEG and external third parties
Verification	OFGEM	Government: MEDDTL	AEEG
Market operator	NA (OFGEM can approve bilateral trade of achieved savings)	NA-registry: Emmy.fr	GME
Penalty in case of non compliance	Yes: not defined, in any case exceeding cost of delivery	Yes, fixed: 20€ /MWh cumac	Yes: case by case assessment, value between 25000-155M euro, one year grace period.

Sources	(Bertoldi and Rezessy 2009) (OFGEM 2011a)	(Bertoldi and Rezessy 2009)	(Bertoldi and Rezessy 2009)

In all three countries supportive acts have been passed through, creating legal back up. Another common similarity is that the administrator is also responsible for verification of implemented measures. The amount of savings attributed to measures however is determined by either a different party (France), or through consultation of third parties (UK CERT and Italy). Only the French scheme has a fixed penalty, thereby creating a ceiling price for a unit of energy savings. In all cases the government sets the targets.

The Other Trading Schemes

In EU ETS, the Directorate-General for Climate Action is the body within the European Commission that develops and implements EU ETS regulation. The legal backing of the EU ETS policies is provided by the EU ETS directives, which need to be approved by the European Parliament and the Council of the European Union. In the previous phases of the EU ETS allocation was principally determined at national level, whereas community wide allocation will occur for the third cycle. Monitoring and Verification, accreditation of verifiers, registry of allowances, determination of (sub) sectors which are exposed to carbon leakage and definitions on new entrant were also national affairs. The amendments (EC 2009) made in the EU ETS regulation empowers the European Commission to harmonise these affairs at the EU level. In a sense, there has been a shift of power and responsibilities from national to community level. This has been in order to increase (administrative) efficiency and harmonization. Penalties for non compliance have been determined (100 € per ton-which does not cancel the obligation) and will increase, from 2013 onwards, in accordance with consumer prices.
Source: EU ETS directives (EC 2003) (EC 2009)

The ARP was established due to the 1990 amendments enacted on the Clean Air Act. The regulator of the scheme is the Environmental Protection Agency, which enforcement authority and new responsibilities were a provision within these amendments. Prior to the 1990 amendments there were no harmonized (federal) obligations on polluting sources. The 1990 amendments prescribe maximum allowances for the regulated sources and prescribed that EPA was to design and, once approved, implement a trading element. The penalty was set at 2000USD per ton of excessive emissions/shortage of number of allowances. Polluting sources were also required to acquire a permit for operation; these were introduced so that a polluting source would need to comply with all applicable requirements of the Clean Air Act.
Source: Clean Air Act-1990 Amendments (EPA 1990) (EPA 2008)

The legal basis for the **PAT scheme** is the energy conservation act, 2001. This act outlines the powers and responsibilities of Bureau of Energy Efficiency and central government. It also states that the central government has the power to appoint Designated Consumers, which consequently face obligations and, in case of non compliance, penalties (article 14, 15 and 26).
The institutional design puts Bureau of Energy Efficiency and CERC forward as the overall regulator and administrator of the scheme. Bureau of Energy Efficiency also is responsible for the accreditation of Designated Energy Auditors, which will fulfil the role of independent verifiers in the PAT mechanism. The

Energy Saving Certificates is to be traded on existing power exchanges. For the legislation which affects the power sector CERC is the body that will formulate the legislation. CERC is also the body which will provide necessary regulation for the proper functioning of the PAT scheme (BEE 2011).
Source: Energy Conservation Act- and Amendments. (GOI 2010)

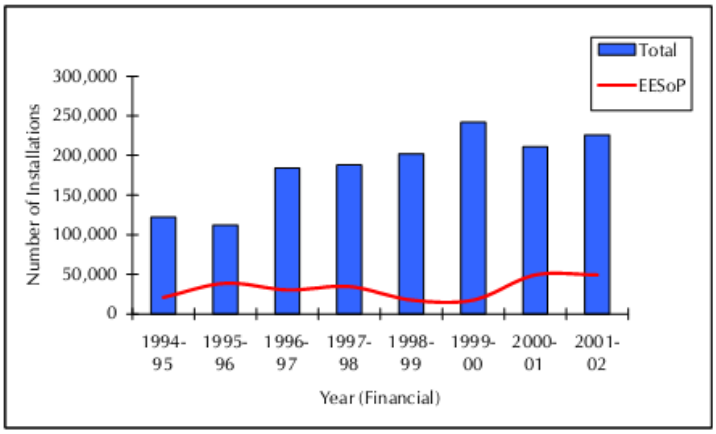
5.3. Additionality

This section will briefly analyse aspects related to additionality within the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy. Savings are achieved as newly installed measures consume less energy than what would have been the case without the installation of these measures. In order to calculate the amount of savings, a baseline can be used. Common baselines are based on sales or market averages and stock averages. Another type of additionality refers to whether the measure would have been installed without the scheme. Measures can be much more efficient than market averages, but if an eligible measure within a scheme would have been installed anyway due to, for instance, subsidies, this measure cannot be considered additional within the scheme.

5.3.1. UK CERT and its Predecessors

In the UK, the Energy Efficiency Standards of Performance programs (EESoP), which ran from 1994 to 2002, can be seen as the predecessors of the Energy Efficiency Commitment (EEC) and CERT schemes. The design of these schemes was quite different from the more recent schemes. Figure 3 shows the cavity wall insulation installations during this period. The red line indicates the number of installations through the EESoP schemes, whereas the blue bars represent the total number of installations for the given year (OFGEM & Energy Savings Trust 2003). It can be observed that the number of installations within the EESoP schemes was a fraction of total installations. The total number of installations is composed of the number of installations within the EESoP schemes, the number of installations due to other governmental insulation programs and the number of installations due to autonomous uptake. Additionality had to be demonstrated (proof that measures would not have been implemented without the EESoP scheme) for each specific case.

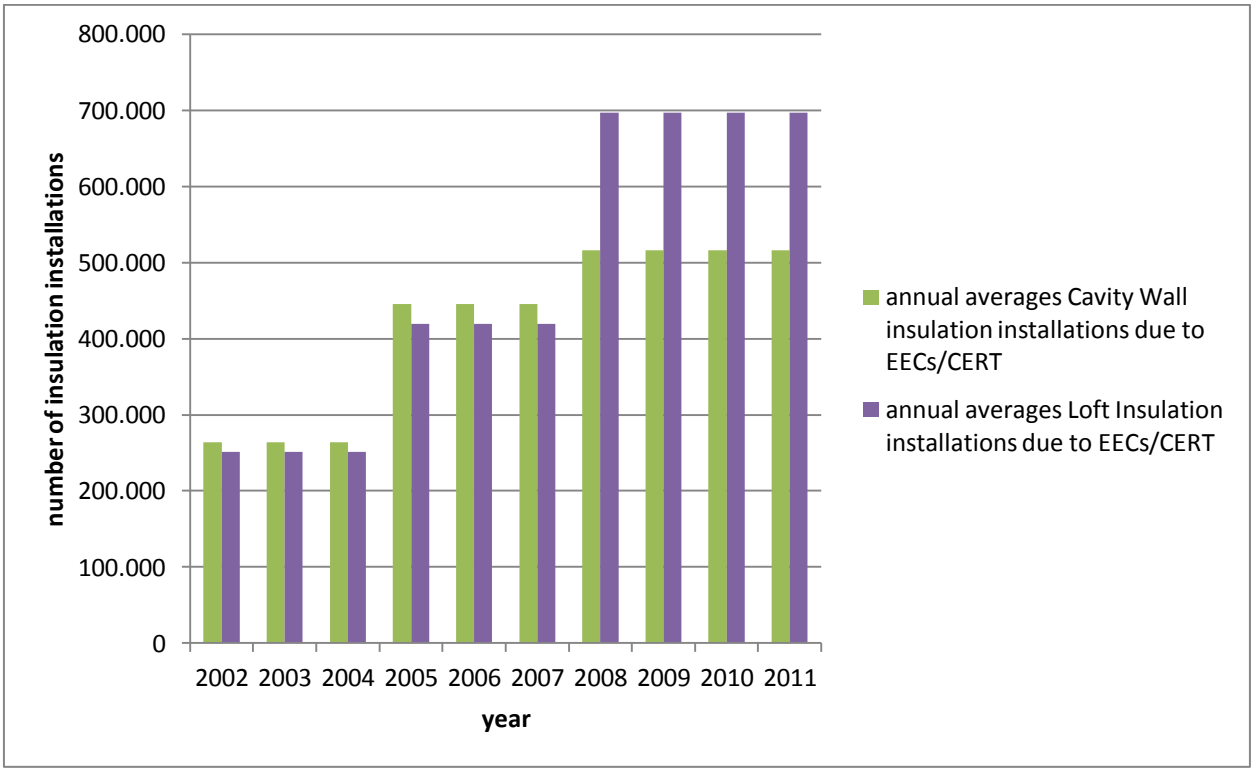
Figure 3: Cavity wall insulation activity 1994-2002



(OFGEM & Energy Savings Trust 2003)

Cavity wall insulation and loft insulation have been two of the most implemented standard measures within EECI, EECII and CERT. Therefore additionality of these measures also determines, to a large extent, the additionality of the schemes. Figure 4 shows annual average number of cavity wall insulation measures installed within the EEC/CERT schemes (green) and annual average number of loft insulation measures installed within the EEC/CERT schemes (purple).

Figure 4: Installations of loft insulation and cavity wall insulation 2002-2011



Sources OFGEM data (OFGEM 2005) (OFGEM 2008) (OFGEM 2012)

Definitely the scale of measures implemented due to governmental programs has increased substantially. It can be noted that from 2002 onwards (start of EECI) the number of cavity wall insulation measures installed is larger than autonomous number of measures installed-which lies between a 100 000 and 200 000 installations (1994-2002 data, Figure 3).

Especially since 2008, the CERT scheme has therefore delivered additional measures due to large number of measures installed. Each measure still has to prove additionality: this is mostly done by showing that the obliged entities have provided a share of the costs and by statements from involved parties. The large number of insulation measures installed, however, makes it almost impossible to ensure that measures would not have been implemented without the CERT scheme. Measures that would have been installed anyway are referred to as non-additional or deadweight. A figure for deadweight is included within the CERT scheme. This is no direct concern for the obliged suppliers or effectiveness of the scheme, though ex-post evaluations would need to subtract this figure in order to look at additional savings. For cavity wall insulation installations, deadweight was initially estimated at 80 000 per annum. In 2010 the deadweight was considered negligible because the size and spread of the CERT scheme gives

disincentives to home owners to install insulation autonomously; they would rather use services (and financial gains) the obliged entities in the CERT scheme provide.

The EESoP, EEC and CERT schemes have been influencing the market since the nineties. However, based on numbers of cavity wall insulation installations and deadweight estimates ranging from zero, to 80.000, up to 100.000-150.000 deadweight in the CERT scheme ranges between 0 and 30% (for cavity wall insulation). Additionality was ensured on a case-by-case basis during the early EESoP schemes and this is still a prerequisite for measures within CERT. However, with consequently increasing targets and awareness of the actions of the obliged entities by the public, additionality is also ensured through the large scale uptake of insulation measures.

Other eligible measures within UK CERT need to go beyond current legislation or market trends in order to accredit savings. Lees (2008) remarked that the additionality of savings due to certain energy efficient appliances was overestimated in the second phase of the obligation (EECII), as autonomous market sales of these appliances were projected to be substantial. Within CERT some appliances are therefore required to be even more efficient, or are no longer eligible (such as CFLs).
Within the UK CERT, additionality is quite a central concept, and guidelines have been created for suppliers to ensure their actions will be additional and thus accepted. OFGEM looks at the delivery mechanism (e.g. how is the measure installed?), the measure itself (e.g. where is the measure installed/what is the baseline?) and the activity of the supplier (e.g. how much has the supplier contributed to installation of measure?). If OFGEM finds one of these three aspects unsatisfactory the measure is not considered additional.

5.3.2. White Certificates in France

In France the obliged entities have made good use of existing tax structures. Table 9 shows 2009 data of the popular measures installed and the tax credit consumers could receive on these measures (CIRED 2011). The additionality of the White Certificate scheme cannot be answered as such because the tax credits and obligations on utilities are seen as complementary. Within the French White Certificate scheme, all measures are considered additional, since obliged entities would not implement measures without the obligation. This definition differs from the meaning additionality has within UK CERT and Italy and is definitely less stringent. Some measures (partly) use stock average as a baseline, which therefore also reward moderately efficient appliances/measures on the market today (Bertoldi and Rezessy 2009).

Table 9: Dominant measures (France) and related tax credits

10 most important measures	% of total delivered savings	Tax credit, if any
Individual condensing boiler	22.5	25-40%
Individual low-temperature boiler	12.8	15%
Collective condensing boiler	7.1	25-40%
Air-to-air heat pump	6.9	50%
Roof and attic insulation	5.8	25-40%
Efficient window	4.6	25%
Air-to-water heat pump	4.0	50%

Electronic speed control for motors in industry	3.3	-
Collective low temperature boiler	2.7	15%
Independent wood furnace	2.6	50%

Source (CIRED 2011)

5.3.3. White Certificates in Italy

In Italy savings have to be over and above spontaneous market trends or current legislation (Pavan 2009). The standardized measures have an additionality coefficient which determines which share of savings is additional. However, Di Santo, et al. (2011) state that additional savings do not mean additional actions. An example mentioned is that for replacement of boilers the market (sales) average (not the old boiler) is used as the baseline. This would be correct. However, the financial incentive the White Certificate scheme offers for high efficient boilers was limited (3-9 € /boiler/year) and hence becomes only a premium, unlikely affecting consumers' choices. The new durability factor might lead to some changes on this area.

5.4. Comparison of Standardized Measures

The standardized measures, which are dominant in terms of savings achieved, are briefly discussed in this section. This is considered relevant because the cost-effectiveness and cost efficiency depends heavily on the amount of savings accredited through these dominant measures. If, or when, these values reflect actual additional savings, which admittedly is difficult or impossible to determine ex ante, the calculated cost indices are meaningful. Because this work cannot compare all measures, a selection has been made. Therefore, this section will have a focus on insulation measures and boilers.

Housing stock, domestic fuel use, climate and (national) habits are some of the factors that do definitely influence savings. For example, insulation will be more effective within a previously poorly insulated villa in North England than within a modern apartment in Rome. However, there are also differences in the methodologies that accredit standardized measures, such as insulation, with energy savings.

In the **UK CERT**, savings accredited to insulation do not depend on age of dwelling or fuel used to warm the dwelling, nor is there any geographical differentiation. Two thirds of the cavity walls/lofts need to be insulated in order to become eligible. What does determine amount of savings is the type of dwelling and the number of rooms this dwelling has. Furthermore, the old and new thickness of loft insulation is taken into account. Lifetimes of insulation measures are 40 years and no discounting occurs. A correction factor has been included in stated savings in order to account for increased comfort (rebound effect).
Newly installed boilers have a lifetime of 12 years within the UK CERT and savings depend on fuel type boiler and, again, type of dwelling and number of rooms. Additional savings can be accredited if boiler is installed in combination with heating controls/smart thermostats.
Source: CERT Scheme spreadsheet V13 (OFGEM 2011b)

In **France**, savings due to insulation depends on area of loft/wall insulated and on the new, improved thickness of the insulation. Whether dwelling is electricity or fuel heated also influences the accredited savings. In France there are three climate zones which determines amount of savings for all insulation

and heating measures. Lifetime of insulation is 35 years and a 4% discount rate is used for all standardized measures.
There are various boilers within the French scheme, lifetimes are 16 years. Floor space and type of boiler influences the amount of savings. For apartments, amount of savings is independent from floor space.
Sources: BAR-EN-05, BAR-TH-06 (Ministère du Développement durable 2011a)

In **Italy,** savings due to insulation depend on thickness of insulation before additional insulation material is installed. There is a requirement for the minimum new thickness. Total savings depend on area insulated and type of dwelling (differentiation between residential dwellings, hospitals, and commercial). Fuel type has to be reported, but this does not influence the amount of savings. In Italy 6 climate zones are also used for to distinguish climate influences for insulation and boiler measures. Lifetime of insulation measures is 8 years and no discounting occurs. Recently the durability factor (1<) has been introduced, which multiplies annual savings (AEEG 2011).
The amount of savings boilers accredit depends on purpose (space heating only, water heating only or both), but not on the area or type of the dwelling. Lifetime is 5 years. Again, the recently introduced durability conversion results in a theoretical multiplication of this lifetime.
Sources: Scheda N03T, Scheda N06T (AEEG 2012)

In none of the three countries insulation levels are taken into account when determining savings for boilers. Other apparently important factors, such as behavioural aspects, are also excluded. This is justified by the claim that 'national averages' or estimates are used. Rather than constantly requiring reports on e.g. heating behaviour and state of insulation assumptions are made, which are believed to reflect the standard behaviour/type of dwelling etc. As mentioned previously, this greatly reduces administrative burden and costs of measures. The effectiveness should however not be under or overestimated because this will affect the actual effectiveness of the scheme.
Table 10 provides a short overview between annual savings, lifetime savings and corresponding factor for loft insulation and efficient boilers within the three schemes.

Table 10: Comparison of savings due to loft insulation and boilers within the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy

	Annual savings (various units)	Lifetime savings (various units)	Annual savings & **lifetime savings (GJ)**	Conversion factor
Loft Insulation, UK CERT	790 kg CO_2, less than 60 mm to 200 mm 3 room apartment	31.58 ton CO_2	13.6-14.5 **541.7-581.6**	40 (lifetime)
Loft Insulation, France	Approx. 45,3 kWh/m^2 of insulation for first year (own calculation)	880 kWh/m^2 of insulation, dwelling heated through fuel combustion, coldest climate zone	0.2/m^2 **3.2/m^2**	19.41 (lifetime-discounted)
Loft Insulation, Italy	0.0061 toe/m^2 of insulation, installed in	0.14 toe/m^2 of insulation (own	0.3/m^2 **5.9/m^2**	8 (lifetime) 23.28

	homes with previous insulation rates between 1.1 and 1.3 W/m^2/K, coldest climate zone 2.92 durability factor	calculation)		(lifetime•durability factor)
Efficient boilers, UK CERT	287 kg CO_2, gas boiler 3 room apartment	3.44 ton CO_2	4.9-5.3 **59.0-63.4**	12 (lifetime)
Efficient boilers, France	Approx. 5030 kWh for first year (own calculation)	61000 kWh for apartment in coldest climate zone, condensation boiler	18.1 **219.6**	12.12 (lifetime-discounted)
Efficient boilers, Italy	0.117 toe for efficient four star NG fired boiler for water and space heating, coldest climate zone 2.65 durability factor	1.55 toe (own calculation)	4.9 **64.9**	5 (lifetime) 13.25 (lifetime•durability factor)
Conversions 1 kWh=0.0036 GJ 1 toe=41.868 GJ 54,3-58,3 kg CO_2/GJ (IPCC 2006): default emission factor for natural gas		Sources: (OFGEM 2011b) (AEEG 2012) (Ministère du Développement durable 2011a)		

Table 10 shows that annual savings are different. And due to different national backgrounds and methodologies it is quite difficult to compare these and to judge which are overestimated/ underestimated savings. All savings are determined by (technical) agencies knowledgeable on energy savings. The factor between annual and lifetime savings also differs and this is interesting as this seems less related to national background and more to type of measure. Nonetheless, large differences occur between them. Most remarkable is that in UK CERT this factor is 40 for insulation measures, whereas around 20 for Italy and France. Before, the respective lifetime savings in Italy were even smaller, because the durability factor has been introduced since this amendment came into force in October 2011 (AEEG 2011). For boilers the French savings seem substantially higher than the savings this measure accredits in the UK CERT and Italy. This may be due to the different baseline definition - the French scheme does use stock averages, rather than market averages for building envelopes and heating, ventilation and air-conditioning systems (Bertoldi and Rezessy 2009).

This section will not investigate these differences any deeper as the technical details and made assumptions are not of primary interest. As mentioned, differences probably could be justified to some extent. However, a valuable note is that differences are rather large and especially the factor between annual and lifetime savings seem to reflect more than just technicalities. A lesson to draw from this comparison is that harmonisation of the saving values and related methodologies of these measures, for these three schemes, would be very hard.

5.5. Cost Effectiveness

Strongly related to 'additionality' as discussed in the previous section are effectiveness and cost-effectiveness. Additionality directly influences effectiveness of the achieved (or claimed) savings. The direct costs from obliged entities, consumers and third parties, together with the estimated monetary

gains of the scheme then determine the cost effectiveness. Several studies have investigated (cost) effectiveness of the Energy Saving Obligations and White Certificate Schemes of the UK, France and Italy (CIRED 2011) (Giraudet, Bodineau and Finon 2011) (Eyre, Bodineau and Pavan 2009) (Bertoldi and Rezessy 2009).

Giraudet, Bodineau and Finon (2011) discuss that effectiveness and cost effectiveness are static terms with limited use. Their findings include that both the UK EEC II and the French White Certificate scheme are both very cost effective. However, they comment that the analysis is based on ex-ante saving values of the (standardized) savings, that obliged parties are reluctant to share information on their costs and that dynamic efficiency effects, such as market transformation and organisational arrangements are not included.

Table 11 displays costs and cost effectiveness of the UK EECII and French White Certificate scheme, as provided by Giraudet, Bodineau and Finon (2011). The benefits are the monetary value of energy savings only. There is also a monetary value related to carbon savings, which would increase the cost effectiveness of both schemes. This value has been excluded. Results from Italy are also not included, as the regulator has not conducted evaluations on these aspects yet. The market price for an Italian White Certificate provides an indication on costs for the obliged entities, though this is the marginal cost and does not give insights to the average costs or the costs for other involved parties.

Table 11: Comparison of cost-effectiveness between UK EEC II and French White Certificates 2006-2009

	UK EEC II	France 2006-2009
Program costs		
Obliged parties direct costs (M€)	1085	74
Obliged parties indirect cost (M€)	195	136
Customer costs (M€)	325	504
Other party costs (M€)	153	1305
Total costs	1758	2019
Benefits		
Energy savings (TWh)	192	54
Monetary value of energy savings (M€)	13 020	4320
Net Benefits (M€)	11 262	2301
Cost-efficiency (€ gained per € spend)	**7,41**	**2,14**
Cost-effectiveness (c€/kWh saved)	**0,92**	**3,74**
Unitary cost for obliged parties (c€/kWh saved)	**0,67**	**0,39**

(Giraudet, Bodineau and Finon 2011)

Table 11 highlights that the cost efficiency and cost effectiveness within the UK EECII compared to the French scheme are relatively higher. Another notable difference is the low costs for the obliged parties in France. These differences can be explained by the fact that within the UK EECII additionality had to be

proven, which meant that the obliged parties had to pay a share of the measure. The fact that there is an additional obligation on low income households (priority and super priority group) also increases costs for the British suppliers. More and larger subsidies/rebates are provided by the British suppliers compared to those in France. In France, parties are allowed to make use of existing government subsidies and any standardized measure is considered additional/eligible without further investigation. The French obliged entities focus, in general, more on awareness raising/information provision. This can explain the differences in the cost sharing.

Related to cost-efficiency and cost-effectiveness the dominant measures provide some insight into the stated differences. Within the UK EEC II cavity wall insulation measures were dominant. These measures are long lasting and relatively cheap. Economies of scale have also ensured low prices for these measures. In France (condensing) boilers are relatively expensive- a sum of €8600 is mentioned-CIRED (2011). Lifetimes of boilers are also shorter. As boilers and heat pumps make up the dominant measures in the French scheme the cost effectiveness of this scheme is relatively lower. It must be added that within the French scheme costs differ substantially between types of suppliers. The large electricity and gas suppliers have a much lower per unit cost (effects of scales, use of subsidies) than the smaller fuel oil suppliers, whose prices are not regulated. These suppliers are more willing to provide higher rebates in order to save their (declining) market share (Giraudet, Bodineau and Finon 2011) (CIRED 2011).

In Italy, the short time lifetimes (maximum of eight years) related to long lasting measures reduced the attractiveness of these measures within the scheme. Measures were not fully rewarded for their savings. The Italian cost recovery mechanism and annual targets did not favour these measures, which are initially more expensive (though cost effective). This possibly reduced cost effectiveness. It would be interesting to see how the new changes will influence supply of certificates and cost-effectiveness of the scheme.

In general, the obliged entities will implement those measures cost effectively for them, rather than those measures cost effectively for society. In order for a cost effective scheme, the ratio of savings accredited to measures and the costs the obliged entities have to pay for these measures should reflect the societal cost-effectiveness. Subsidies from government, uplifts on some (standardized) measures, incorrect lifetimes or accredited savings will distort this cost effectiveness. However, these 'distortions' can also serve other goals, such as market transformations or national policy priorities.

5.6. Summary of Considerations and Lessons Learned

First of all it should be noted that the schemes differ substantially between each other but **all have been able to work within their settings**. Lessons learned in one scheme should not be blindly copied to another scheme, as **goals, background and design modalities differ** and all influence each other. National policy priorities may be, and indeed are, reflected in White Certificate schemes.

There are a lot of apparent trade-offs. Environmental effectiveness, for instance, could be more secured through more stringent M&V, though this will also bring additional burden and costs. Flexibility is important with respect to securing effectiveness of a scheme under changing circumstances, but too many changes can create a lack of transparency and long term security for investors.

One lesson might be that the **learning process is important**. Stakeholders can get used to a new scheme, whereas scope, lessons learned and targets can be updated in following cycles. Requirements for proper learning, however, are **ex-ante and ex-post analyses** of the scheme's functioning.

In any case both the regulator and the obliged entities must be capable and secure enough to successfully work with/develop a new scheme. **Legal backing and penalties can increase compliance**, **though the regulator should also communicate with, cooperate with and support the obliged entities** to create high compliance levels.

If trading is a central aspect of the scheme other design modalities gain importance. Incentives should exist for obliged and eligible parties to install measures resulting in tradable certificates. Moreover**, one should let the market work**. Trading only makes sense when the costs of trade are smaller than benefits gained through buying certificates. To do this a variety within eligible measures, delivery routes and implementing bodies is necessary. Furthermore, a **White Certificate scheme requires supporting measures, updating of regulatory and technical issues and possibilities to adapt to new situations**. It must not be seen as a single policy instrument with guaranteed success.

Cost effectiveness is, in theory, maximised when the obliged entities have the flexibility to achieve their obligation through a large number of routes (and choose the most cost effective options). Consider pros and cons of trading (spot market, bilateral and temporal), only one of the **flexibility mechanisms**, while the number of standardized measures, the number of eligible and obliged entities, the number of eligible measures and sectors are others. **The limiting factors here are administrative burden and costs** for the regulator.

A cost-effective scheme ensures additional and genuine savings. This can be achieved by **ensuring that actual cost-effectiveness of a measure resembles the cost-effectiveness this measure has for the obliged/eligible entities**. The challenge is to achieve this while keeping transaction costs, for the obliged entities, and administrative burden, for the regulator, low. Well understood measures can therefore be standardized, which can ensure this dual goal, though experiences have shown subsidies or skewed saving values can distort this cost-effectiveness.

A final consideration deals with **paying the bill**. End-users, governments, municipalities and the implementing entities could all have costs. If no provisions are made than probably the bill will be divided among all consumers or tax payers, which would result in savings for some, and increased expenditures for others. Equity issues, however, can be handled through sub obligations.

Lessons Learned

Standardized Measures

- If annual savings are used within a scheme, ensure that measures with long lifetimes are also fully rewarded for their savings. Italian experiences show that initial focus was very much on low hanging fruit, leaving potential for cost effective, long lived measures untapped.
- Standardized saving values (the ex ante approach) are considered to be very useful for well understood measures, reducing transaction and administrative costs.
- A limited number of standardized savings and high certification thresholds restricts flexibility and can lead to a lower degree of economic efficiency (Di Santo, et al. 2011) (Oikonomou 2010).

- The simplicity and effectiveness of these standardized savings have the consequence that the obliged entities (naturally) choose those options most cost effective in the scheme: these measures are usually quite mature and any market transformation or innovations due to the schemes of the UK, France and Italy have been limited (Eyre, Bodineau and Pavan 2009). Other policy instruments would need to be put into place for this goal.
- For additional and cost-effective savings ensure that correctly calculated saving values would not have occurred without the scheme
- The differences in saving values and methodologies of the standardized measures make a direct comparison, and possible harmonization, more difficult.

Trade off between trading and not trading

- Trading costs money, but can save money if enough incentives, transparency and cost heterogeneity for compliance exists
- Obligations have been successful without trading
- If trading is an element of the scheme, (other) design modalities must ensure liquidity and possibilities to achieve savings in various manners (cost heterogeneously).

Compliance

- Legal backing and governmental backing/support enables the regulator to face any legal challenges.
- Adaptability of the regulator is required and ensures streamline of scheme
- Develop a long term vision and make this clear to stakeholders. This will result in commitment from the side of the obliged entities and make the obligation part of their business.
- Besides penalties, transparency and support enhances rates of compliance

Learning

- Learn from 'own' experiences
- Find 'own' optimal path between often mentioned characteristics as (cost) effectiveness, transaction costs, administrative burden, economic efficiency, transparency and accountability.
- Adequate reporting, M&V and information flows prerequisite for accountability and learning

6. Interactions and Considerations for a Distributors' Obligation on Electricity Savings in India

A possible DOES scheme would be implicitly linked to the Indian (electricity efficiency) background. This chapter discusses various interactions and explores possibilities on explicitly accounting for some of these interactions.

6.1. Linkages to Programs Implemented by the Bureau of Energy Efficiency

The linkages and interactions of a future DOES scheme to programs from the Bureau of Energy Efficiency are very relevant. First of all, such programs can have be a supportive element in a future DOES scheme. Though currently not the case, an extensive and accurate standards and labelling program would be ideal to combine within a DOES scheme. For example, annual sales could indicate which electricity efficient appliances have limited sales (compared to less electricity efficient types) and these could therefore become eligible in a DOES scheme. Such eligibility or additionality criteria would need to be reviewed regularly. The Energy Building Conservation Code scheme would probably be of limited use in a DOES scheme, as the buildings targeted are commercial buildings. The commercial sector is a subsidising sector and therefore utilities would loose revenue when achieving savings within this sector.

Related to Bachat Lamp Yogana and the BEE-DSM projects (ESCO mode) there should be some clear rules. If these Bureau of Energy Efficiency's DSM projects would not have been implemented without an obligation on the utility, they can supposedly be considered additional. Nonetheless initial difficulties remains: "Would measures have been implemented without the obligation?" And: "What to do with projects in the pipeline?"After the initial phase of the obligation this concern is less relevant when the target is carefully considered and when it is stated to what extent such projects from the Bureau of Energy Efficiency may be eligible in the new obligation. As most utilities are public utilities it would seem wasteful not to allow such ready-made projects. This is especially the case considering that to date few utilities have implemented such programs.

6.2. Linkages to the PAT Scheme

The first cycle of the PAT scheme commenced on the 1st of April, 2012 and will last three years (BEE 2012a). The target of the DOES scheme could be linked to the duration of a future cycle of the PAT scheme. Bertoldi and Rezessy (2009) mention two different cases in which the targets of such schemes could be related. In the first case, surplus energy use in PAT could be offset by certified energy saving reductions from a DOES scheme. In the second case, a fraction of the set cap is reserved for certified energy savings, i.e. the possession of a limited amount of possible DOES certificates would allow a Designated Consumer to consume all energy reserved in the cap, while the absence of such certificates would lead to a more stringent cap. Both cases can provide a stimulus for savings (and certification) within a DOES scheme. In the first case, however, the actual energy use of the Designated Consumers might be unaltered, possibly undermining some (sub) goals of the PAT scheme (additional efficiency improvements in industry). The second case reserves a fraction of the initial cap for savings resulting from a DOES scheme. The compliance with this set-aside fraction could be voluntary or obligatory. Possible demand and offsetting would then be limited.

Obviously, a DOES scheme does not need to be related to the PAT scheme directly. Results from Europe have shown that a White Certificate scheme or an Energy Saving Obligation can also function on a stand alone basis (no explicit ties). Savings achieved in such a scheme would be additional to the savings in the PAT scheme when:

- The obliged parties of the DOES scheme are not allowed to implement projects within the plants of the obliged parties of the PAT scheme.
- Savings in electricity use due to a DOES scheme does not (indirectly) result in a less stringent cap for the power sector (included in the PAT scheme). This is currently the case, as the PAT scheme sets energy intensity targets.

Related to the above, the obliged parties of the DOES scheme should not be allowed to implement projects within the plants of the obliged parties of the PAT scheme. In case of an explicit one way linkage between PAT and a DOES scheme, costs for achieving obliged savings within a DOES scheme could differ to the 'original' compliance costs within the PAT scheme. This could lead to enlarged demand for the savings within the DOES scheme (and reduced demand for savings within the PAT scheme). From an economic point of view this will be the most cost effective option for saving energy, though it might be unattractive from a societal point of view because industry pays for savings achieved outside their sectors and does not necessarily improve own energy efficiency. An initial set up could be two separate schemes with limitations on this one way exchange. Another, perhaps more practical point, is that direct linkages allow possible 'errors' within the design of either scheme to spill over. Learning phases would be able to identify such errors and strengthen the independent schemes, before linking them.

6.3. Linkages to CDM funding

Future demand might be limited for Indian Certified Emission Reductions as the EU ETS will focus on the Least Developed Countries post 2012. Besides this issue CDM projects have to prove additionality, which will make it difficult for DOES measures to become eligible, when obligations exist. In any case, the author believes that additional CDM funding can be allowed. The CDM executive board and the Designated Operational Entities (the independent auditors) will test each project on additionality and in the case of a project which is (partly) due to an Indian DOES scheme the CDM administration will only be satisfied if is shown that additional (over and above the obligation in this case) savings are to be realised. Not setting an obligation is another option, though this is not recommended as savings are considered to be unnecessary limited in case of voluntary (possibly CDM funded) measures and, moreover, this study researches an obligation as a mean to achieve more savings (section 3.1).

Considering the administrative hassles and timescales required, the fact that CDM funding always occurs after implementation, the low prices of today and the expected low demand for the future, CDM funding might be limited, though additional savings and funding should be allowed and accounted for in a DOES scheme. There are other options for (international) funding, such as bilateral funding, funding through the Carbon Finance Unit of the World Bank, voluntary carbon markets and funding through Nationally Appropriate Mitigation Actions. Utilities cannot be expected to search for such funds though. This would require substantial effort and transaction costs. Timescales could also be greater than the timescales of the obligation. At the central level though, these options could be investigated.

6.4. Linkage to Renewable Purchase Obligation and Renewable Energy Certificate Trading

In PAT and Renewable Energy Certificate trading documentation possibilities of making the two respective certificates (Renewable Energy Certificates and Energy Saving Certificates) eligible in both schemes are mentioned (BEE 2011) (CERC 2010). The following discussion on linking a DOES scheme to the Renewable Purchase Obligation and REC trading framework could also be seen as a discussion on linking the PAT scheme to the Renewable Purchase Obligation and REC trading framework.

The units of possible certificates of a DOES scheme could be compared with Renewable Energy Certificate units through at least one technical conversion as a unit of end use electricity saved corresponds to approximately 2-4 units of primary fossil energy (depending on conversion efficiencies at thermal power plants). However, the real issue is not whether energy saving certificates can be fungible for compliance towards the RPO, but whether they should be. Fungibility of certificates increases flexibility for obliged entities. However, a drawback is that one of the schemes could achieve less of stated goals. The initially cheaper certificates (which are likely to be the energy saving certificates) would limit actual certification (and hence achievement) within the other, linked scheme. The author personally finds it inappropriate to link RECs and possible certificates of a DOES scheme. This because a lot of (policy) effort has been put into the specific goals of generating renewable power and enhancing electricity efficiency. This has resulted in, or is aimed to result in, (sub) benefits such as, but not limited to, cheaper supply of technologies, development of knowledge and variety of possibilities to reduce fossil energy consumption. Full compatibility would ensure the most cost effective options, but especially these side effects and sub benefits would then be limited. Another indirect effect gains importance if the Renewable Purchase Obligation and DOES targets would both be very ambitious. In this case the obligation within a DOES scheme would limit primary energy consumption and hence the absolute value of the Renewable Purchase Obligation, which is set as a percentage of electricity supplied. This should be recognized and accounted for once it becomes important. Currently, India is experiencing strong growth in electricity consumption and has to deal with power shortages. Initial targets could therefore be determined without such considerations.

6.5. Subsidies

Barely any subsidies for electricity efficiency have been found. Subsidies reduce end-users' costs for electricity efficiency. Considerations on this topic are very much related to cost recovery. Consumers or end- users, the utility (hence all consumers), the government (hence all tax payers) or 'other parties' can financially contribute to an eligible measure within a DOES scheme. The choices involved here are how the financial burden of the measures should be shared. If substantial increases in tariffs are considered unwanted then this means that the government, the specific consumer or other parties will have to pay the largest share of costs. In the first case this means that India states need to develop subsidies (or tax rebates) related to electricity efficient measures and that obliged entities have the primary role of awareness raising and coordinating installations. The second case means that specific, individual reimbursements through tariffs should be possible. The obliged utilities (or other implementing entities, such as an ESCO) could act as a loan-provider, reducing initial costs. The third option would include possibilities for international funding or discounted prices for consumers through arrangements with suppliers of electricity efficiency measures.

In the case of subsidies, risks are windfall profits and unfair competitive advantages for certain supplying industrial sectors. For instance, in the case of subsidizing the CFL sector, this sector would gain compared to other suppliers of electric efficient products. Overlapping subsidies or tax arrangements might limit the effectiveness of these instruments. In a country as large, heterogeneous and decentralized as India it is recommended that possibly subsidies or other financial incentives should be determined at the state level. The electricity tariffs for end-users, rates for the Value Added Tax and specific demand for certain electricity efficiency measures are state dependent and financial incentives should therefore be a state affair. It should be noted that such state dependent subsidies have a drawback in case a national, harmonized DOES scheme is envisioned. The central level might lack overview of all state dependent subsidies and financial instruments. In case trading and standardized measures are introduced this unknown heterogeneity could lead to the fact that certain measures will be very attractive and much implemented, resulting in oversupply of these measures, an artificial low trading price and high costs for that specific state (which had provided subsidies/tax rebates). Nonetheless subsidies, or tax rebates, are recommended at the state level. Another point is that many states do subsidize electricity consumption for some end-users. It would seem rational that electricity efficiency would then also, to a degree, be subsidised within these end-use sectors.

6.6. Geographic and Distributional Effects

In case of a nationwide scheme, geographical and distributional effects, already shortly mentioned in the previous section, should not be ignored. A nationwide scheme means that customers from utility A could pay for measures implemented by customers from utility B, hundreds of miles away. Though this can be technically cost effective, the areas in which the measures are implemented profit from such a framework, while other areas (which have previously focussed on energy efficiency and have no 'low hanging fruit' anymore) pay the bill. Another drawback is that the local benefits of a DOES scheme (such as more reliable electricity supply, less peak power purchases for utility, employment) will not arise in some states. These issues are especially relevant in a nation in which many distribution utilities already have a poor financial situation. For sake of comparison, the European Commission has assessed the possibility to unify European White Certificates schemes into one community–wide scheme, but their research concluded that this would not be appropriate (European Commission 2011), even though national White Certificates schemes were considered useful for promotion of energy efficiency.

Related to potentials for electricity the current situation is believed to be rather uniform, though an area as Mumbai has had years of DSM projects. In any case the potential for electricity efficiency will not be as heterogeneously spread across the nation as is the case for the potential for renewable power production. This can justify a target (range) set at the central level. Other harmonization efforts can create increased transparency and overview, which would make inter state comparisons and learning easier. Moreover, if for the future the creation of a national scheme or trading possibilities is envisioned, harmonized schemes will make such a task much less problem prone. Harmonization should not be the rule though. Climate, use of appliances, availability of financial resources, etc. vary across states. There should be possibilities to account for these differences.

6.7. Conclusion

A DOES scheme would be able to fit within the Indian energy sector and background. Most important is that linkages are made explicit. It should be clear what is and what is not allowed under the obligations. An important issue here are the differences between various states, and the state and central level. Subsidies set at state level could support priorities within that state. Ideally, programmes and efforts from the Bureau of Energy Efficiency will be useful in a DOES scheme. However, there are currently limited possibilities as only 4 appliances are obligatory to have labels and commercial buildings are likely to be playing a minor role in a DOES scheme.

Inter state trading and direct linkages of a DOES scheme with other Indian trading schemes is possible, but, for the time being, not recommended. This because distributional effects would result in some form of geographic cross-subsidization, money could flow from one state or utility to another, reducing the local benefits of a DOES scheme. Funding of measures within a DOES schemes could be partly through CDM projects, though this will probably be only for the part of savings which goes over and above the obligation. Considering low demand, administrative burden and future expectations there could be a (central) focus on other funding possibilities.

7. An Indian DOES scheme: Considerations, Recommendations and Proposed Steps

This chapter starts with a section reflecting on the Indian electricity sector and especially highlights to what extent differences between the Indian and European backgrounds are relevant. The second section lists considerations and input form stakeholders, before the attention is turned to the more-to-the-point recommendations for the short term and proposed steps. The third section discusses and proposes the various design modalities of a DOES scheme. This chapter finishes with an identification of challenges and a summary.

7.1. Reflections on Indian Electricity Sector

One difference between the Indian DSM regulations and the White Certificate schemes and Energy Saving Obligations of the UK, France and Italy is that the Indian DSM schemes also stipulate cost effectiveness for the utility, which is not automatically the case when there is an obligatory energy saving target for cost effective savings (end-user perspective). Less electricity sold, especially in off peak periods, will in general reduce revenue for electricity suppliers. Therefore, potential for Indian DSM savings are in theory smaller compared against the overall potential from an end use perspective. This cost-effectiveness is considered important as it seems a win-win solution: no incremental costs for consumers and increasing financial health for distribution utility. However, utilities cannot always find incentives in such explanation. This is understandable as

- Sales of electricity should be responsible for their income
- In cases of loss on a per unit basis (peak power costs>tariff for end users) there is a theoretical benefit at that moment, but during off peak power sales this might not be the case. There is uncertainty in projections on what is cost effective for the utility.
- Most utilities are publicly owned and feel no incentive without an obligation and clear guidelines.

Another important difference relates to the fact that the White Certificate schemes and Energy Saving Obligations of the UK, France and Italy have been designed to work with obliged, mostly private, utilities. Moreover, there are no severe issues with cross subsidization and financial health of distribution utilities. Mentioned barriers (Chapter 4) irrelevant in Europe are very relevant for an Indian DOES scheme and hence an Indian DOES scheme would need to account for these.

Thirdly, electricity use in Europe is not growing as rapidly as in India. Projections such as the one in the Government of India's Integrated Energy Policy state that within the next 20 years electricity consumption will increase with a factor of three to four. This means that the major share of this future electricity consumption will be due to appliances not yet installed. In Europe, the White Certificate schemes and Energy Saving Obligations of the UK, France and Italy focus on current building stock, as within this sector there is a large energy saving potential. For India, it would make sense to focus on new appliances, as a substantial energy saving potential is likely to be found within these yet to be installed measures.

Finally, current action and effort on electricity efficiency (DSM programs and other policies) must obviously not be wasted. An instant DOES scheme would have little effect as some supportive policies

and guidance are not 'ready' and because existing and planned DSM programmes are so similar. Therefore the following sections distinguish between the short term and the long term. Short term refers to current situation and provides considerations and recommendations for the following years, whereas long term considerations and recommendations refer to an actual DOES scheme.

7.2. Considerations and Recommendations for the Short Term

Some useful comments, specifically relevant for a DOES scheme, were provided through stakeholder consultation. The comments below, as well as lessons learned identified in the previous chapters have been taken into account in the following sections (recommendations, proposed steps and options for design modalities).

- Increasing tariff is politically difficult.
- An obligation is most important
- A lot depends on perception and willingness of consumers, which is very low in agricultural sector.
- Grey market ensures that appliances stay in use, not reducing demand.
- Proper metering is absent
- Small ESCO market.
- Cost sharing rather than cost minimization should be the design philosophy
- M&V critical, though transaction costs should be kept minimal
- Involve manufacturers of energy efficiency appliances

In order to have a starting point, some design philosophies are provided. The proposed path is to build upon utility based DSM projects, which, in the long run, can become a national DOES scheme. The subjective design philosophies will influence the trade-offs which will be encountered when designing a DOES scheme.

Determining Goal and Design Philosophies

- Electricity efficiency, load shifting and awareness raising through additional and cost effective measures.
- Supported by other policies instruments.
- Obligations with supplementary incentives for economic efficiency.
- Costs should be mainly recovered from end-users who have installed measures, through governments and through arrangements with suppliers. This is an equitable way which will allow for more savings and which does not require substantial hikes in tariffs.
- Simplicity of scheme is considered important as there are many state-dependent factors and issues. Possible loss of effectiveness is hoped to be limited due to less administrative burden/transaction costs.

Recommendations for the Short Term

Recommendations for the short term include:

- Build upon the current DSM regulations implemented in some states. Start with few utilities, work towards full inclusion. **Work towards a national obligation** and communicate this towards

and with stakeholders. Express national obligation in final energy units and ensure a minimum target so that every state develops experience and achieves comparable savings.

- Reflect on successes and failures of the DSM regulations. **Learn from experiences**. National level should offer (harmonized) support. Communicate successes and address failures/ identified barriers.
- Additional effort for **tariff rationalization**: tariff rationalization would give the (former) subsidised end-users incentives to save electricity, whereas it would make the (former) subsidising sectors a more attractive option to the distributor utility for implementation of electricity saving measures.
- **Experiment with incentive framework (tariffs) and third party inclusion (but no trading)**. This could prove to have additional value in the states with private distribution utilities (Delhi, Mumbai, and Orissa). In any case, utilities should be able to contract third parties under the obligation. This is also especially relevant in states which already have public bodies working on electricity efficiency or in states where the utilities have limited resources.
- **Evolve standardized measures**. Expand (obligatory) standard and labelling scheme and other supportive programs. Standardized measures will be valuable for inter state comparisons and possible harmonization. Furthermore, costs (transaction costs, M&V costs) will be reduced. Standard measures could differ dependent on climate and other external factors, but issues related to baselines and lifetimes should be determined by a knowledgeable body. This would mean that additionality (besides cost-effectiveness) is more likely.
- **BEE to provide adequate technical guidelines, FOR to communicate lessons and harmonize schemes, SERCs to be the central/state regulators.**
- Initial focus could be on awareness raising and capacity avoidance (lower costs for utility).
- No explicit linkages with the Renewable Energy Certificate trading and PAT schemes recommended.
- The actual obligation should be kept within state boundaries: distribution utilities are to implement measures at their own customers, with no initial cross-state exchanges or trading. Preferably state governments indicate state priorities and provide (financial) support for measures.
- CDM and other **funding possibilities** (such as National Appropriate Mitigation Actions) should be allowed and **further investigated**.

7.3. Proposed Design Modalities for the Long Term

Once initial steps have been taken and guidelines, documentation and standardized measures have been prepared the road is paved for a (more) harmonious national obligation. This section outlines various design modalities and proposes some options. The section summarises with Table 12, in which an overview of the proposed is provided.

The obligation

After initial obligations from the SERCs a national order should stipulate action from all states. A target should be set in units of electricity savings. The central level could specify a target range as potential for energy efficiency (within eligible sectors) would be quite uniform across the states. The amount of

savings to be realized is recommended to be a percentage of sales to the eligible sectors (energy units). Due to high growth rates the exact amount could be based on (increasing) sales of previous years. Such a uniform target would also create possibilities for inter state comparisons, learning and possible future linkages (if deemed appropriate). Obliged entities will be distribution licensees who deliver electricity, above a certain threshold, to the eligible sectors. Failure to comply would have to be penalized. Whether utility is public or private, utility should feel need for implementing measures at end-users. The target and compliance period could be linked to the multi year tariff frameworks: target achievement within the DOES scheme would then become part of the regular distribution business and would have a fixed place within the dealings between utility and regulator. Combined with ambitious electricity saving targets this will ensure utility stays within/ gets used to a 'DOES mode' and will aim for cheapest kWh reductions. The mindset can be switched to (subsidised) kWh saved/unit of expenditure. Regulators should communicate that 'obligations are here to stay'. An obligation is without doubt the most important step to take.

Eligible measures

Studies should identify eligible measures. Load shifting measures, which cannot be expressed in terms of energy saved, can be included but need different approval/cost recovery processes. Eligible measures could shift from initial focus on demand side measures (cost effective for utility, reducing peak demand) towards the inclusion cost effective electricity efficiency measures (cost effective for end users, reducing energy demand). This would increase saving potential. This could gradually occur as more experience with cost recovery and funding has been gained. More research is required for the determination of saving values of these standardized measures. Standardized measures can be effective and ensure cost-effectiveness for a scheme as a whole, but only if they correctly represent additional savings and when the number of measures is not too limited. There could be a focus on new appliances as much of future electricity requirements (and capacity additions) will be due to appliances not yet in use.

Eligible sectors

The eligible sectors are recommended to be the residential, possibly municipal and agricultural sectors. There are separate schemes for industry and utilities would be reluctant to invest in electricity efficiency within the industrial and commercial sectors anyway. This is because they are, in many states, the subsidising sectors. The agricultural sector is recommended to put out of focus despite its potential and cost-effectiveness for the utilities, because experience, positive results and incentives for the end-users are limited.

Eligible entities

Eligible entities will be restricted to the obliged entities, which are the electricity distributors. The regulators have experience and authority to deal with them, and not with other parties. However, the obliged entities should be allowed to make use of third parties and arrangements with third parties to comply. One can think of bulk procurement agreements, ESCO involvement, agreement with sales points, etc. In other schemes, these third parties have had a substantial role and utilities have made (long term) agreements with them for compliance towards targets. Competitive bidding could be made obligatory if public utility has little resources for own implementation.

Trading

After an initial non-trading period, trading could be considered. However, trading

a) will introduce additional transaction costs and administrative burden.
b) would probably be of limited effectiveness due to small ESCO market, limited number of measures, limited experience of regulators with market players and public nature of utilities.
c) could possibly result in geographical cross- subsidising.

Trading is a flexibility mechanism that can ensure economic efficiency and can minimise compliance costs within a scheme. Alternatives to attain economic efficiency within a DOES scheme are:

a) Possibilities for utilities to make use of subcontracting and competitive bidding for ESCO involvement.
b) New tariff structure rewarding overachievement of obligation (actual financial gain: not just cost recovery). This can refer to overachievement in terms of target or overachievement in terms of cost effectiveness of realised savings.
c) Providing flexibility through other options (e.g., number of eligible and standardized measures, compliance routes, and eligible end-use sectors).

As mentioned in Section 7.1 a major difference between the Indian and European utilities is the fact that most Indian utilities are public, whereas most European utilities are private. Public utilities are less motivated by economic incentives. Therefore a clear obligation and a clear and sufficiently severe penalty are required within the Indian DOES scheme. However, economic efficiency can and should be relevant within this scheme. The following subsection details further on this issue.

Cost effectiveness

BEE would be responsible for appropriate guidelines and standardized measures on behalf of cost effectiveness. The need for a substantial number of these measures (ensuring flexibility) and need for updating these measures (ensuring additionality) could mean that besides utilities and SERCs, BEE should also have a DOES cell/department. As mentioned in Chapter 5, societal cost effective measures should be aimed to be equally cost effective for obliged entities within the DOES scheme.

Standardized measures should be researched and preferably used as soon as possible for well understood measures. Benefits are reduced M&V costs for utility, reduced administrative burden for regulators and synchronisation of value of savings. Furthermore, an appropriate entity is determining the saving values, rather than involved utilities or SERCs.

Additionality

Even researched cost-effective measures are simply expensive if they achieve non additional savings within a scheme. The standardized and non standardized measures should reflect additional savings. Changing market sales, behaviour and other relevant factors should be reflected in the regular updates on (standardized) measures and M&V guidelines. Such guidelines should include clauses on additionality. Additionality coefficients would need to be updated on a regular basis.

M&V

For the well understood, standardized measures monitoring and verification can be reduced to (random) checks to control whether measure has been actually installed. Ex ante saving values can be attached to

these measures. For larger and non standardized measures, with a necessity for monitoring, BEE should develop guidelines, which are to be followed. SERCs should conduct verification procedures themselves, though they could make use of external (BEE accredited) verifiers, which have experience through implementation of other schemes (PAT, Energy Conservation Building Code).

Cost recovery

SERCs would still need to pre-approve estimated costs and allow costs made to be recovered. To this end also, guidelines and support from BEE and Forum of Regulators would be useful. It would be up to the SERC to determine whether cost-recovery would suffice or whether an incentive framework will be useful. Some (private) utilities will not be triggered, some might be. This would then be an additional benefit. The incentive framework could be based upon the framework used to reduce the distribution losses (as in Delhi). Tariffs will have to be increased if the costs of the distribution utility are substantial. If this is considered inappropriate other parties have to (indirectly) cover some of the costs. Consumers who do not benefit from a DOES scheme should not pay towards the obligation, whereas those consumers who do benefit can pay, though these costs could be smaller than compared to the situation without a DOES scheme. Options for cost-reductions could relate to governmental tax rebates (or subsidies), bulk procurement and agreements with suppliers, competitive bidding for ESCO involvement or new tariff mechanisms, such as an utility acting as a loan provider and charging the specific consumer a monthly surcharge until this consumer has (partly) paid for distributor's expenses made related to the electricity saving measure implemented in his dwelling. Measures installed in the (heavily) subsidised sectors or measures reducing peak power consumption have the additional benefit that they can be cost-effective for the utility. These options would need to be researched more. It would be useful if there would be room to experiment with, and learn from, such cost recovery options.

International Funding

Besides possible eligibility with the CDM framework of the measures implemented by the obliged parties, other funds could be used within an Indian DOES scheme. Studies could investigate possibilities for international funding or support. Preferably, this would occur prior to the actual first cycle of the obligation.

Interactions with other schemes

One way eligibility with PAT would be possible: DOES savings would be certified as (type II) Energy Saving Certificates in PAT and could offer additional incentives to measures within the DOES scheme. A Designated Consumer might be offered a cheaper possibility to comply with PAT target. Such one way eligibility could reduce investment in industrial energy efficiency. In this case, a limit would be required. Such a linkage would require certification of electricity savings and therefore additional efforts from (new) institutions within the DOES scheme. Explicit linkages with Renewable Energy Certificate trading are not recommended.

Institutional framework

A new act or amendment would need to stipulate the necessary actions from the stakeholders. An amendment to the Energy Conservation Act would seem most practical, as this act already has a clause

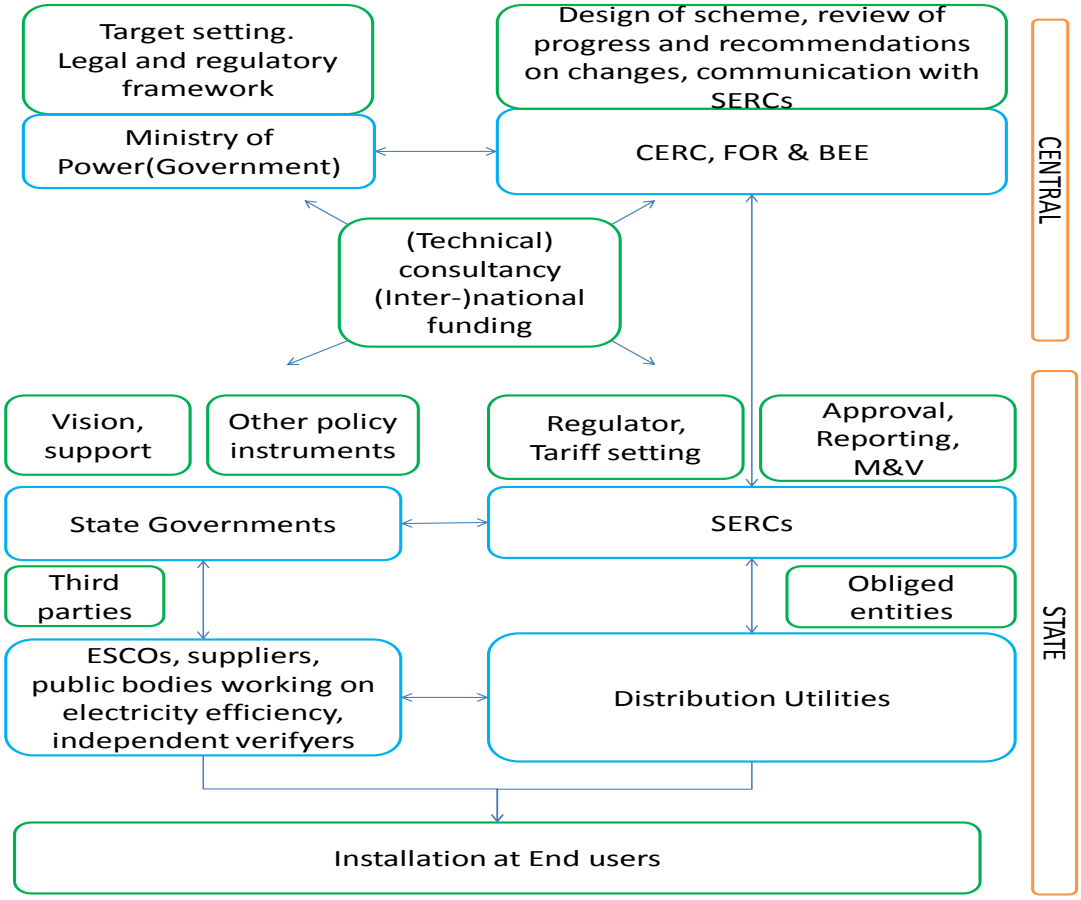
stating that electricity distributors could become designated consumers and would hence have to oblige to any (specific) stipulations within this Act.

However, the respective SERCs are to issue regulation on obliged utilities (determined at national level) and to deal with approval of plans, monitoring and verification, (new) cost recovery options, penal structure and reporting to central level. The issued regulations from the SERCs will be state specific; though certain design modalities should be fixed at the central level. State governments have several important roles and responsibilities within the electricity sector of their state. Historically, regulating electricity distribution was purely a state affair. State governments should develop a long term vision for electricity efficiency and savings at end-users together with supportive policy instruments. This will guide SERCs and will help utilities attaining their targets.

The amendment or act would stipulate what is to be fixed within the regulations. State governments, which have supportive and guiding functions related to the SERCs, should communicate relevant state policies and priorities, so that SERC regulation could possibly stipulate actions within that sphere. The FOR could issue draft regulations in which the central obligations and intra state flexibility options are noted. The resulting SERC regulations would then be composed of the national stipulations (by act or amendment within current acts) and the state's priorities, in a framework established through communication with and support by the FOR.

Utility should have flexibility to chose between standardized measures, BEE ready made projects, subcontracting ESCOs, agreements with (bulk) contracts with manufacturers/stores, own projects, etc. BEE and CERC are to inform SERCs on (technical) guidelines and utilities from national level. BEE being the 'technical regulator' should design standardized measures and constantly monitor and communicate (publicly) on savings/changes. The CERC can be the overall regulator and communicate with SERCs. A DSM cell is already required in the first DSM obligations and it is indeed recommended that both utilities and regulators (CERC, SERCs and BEE) have dedicated persons working on the challenges of the DOES scheme. The national level (CERC, FOR, BEE) should receive reports from the SERCs on a regular basis, and during FOR meetings changes, failures or successes can be communicated between the various SERCs. Figure 5 provides a graphical representation of the proposed institutional framework.

Figure 5: Institutional framework DOES scheme



7.3.1. Overview of the Proposed Framework

Table 12 shows the proposed framework, repeats main points made previously in this section and provides an overview.

Table 12: Proposed values for selected design modalities for a future Indian DOES scheme

Aspect	Recommended choice	Comments
Goal	Cost effective additional measures	Current focus is very much on cost effectiveness. Additionality is another aspect which should be included.
Duration of scheme	Multi-year	Link with multi year tariff framework if possible
Overall Target Characteristics overall target	Percentage form of electricity supplied; to be determined Lifetime savings for	An obligation with a target in energy units is most important. Lifetime savings ensure that all

and savings Energy/Carbon savings discounted	standardized measures; Discounting not necessary	savings are accredited within a scheme. Focus on appropriate annual savings and lifetimes
Possible sub targets	Possible awareness target Competitive bidding (e.g., ESCO involvement)	As this is considered large barrier As this would involve and evolve market parties and could reduce costs for utilities
Obliged parties Threshold and Target appointment Eligible implementers	Distribution Utilities Threshold to be determined , target appointment based on electricity sales within the eligible sectors Utilities, ESCOs, public bodies and subcontractors	In similar schemes third parties have played substantial roles
Eligible measures Eligible end-use sectors	Standardized savings, measures approved by BEE. Recommended sectors: focus on residential	To be further researched and determined (BEE) To be further researched and determined (Government)
M&V	SERC to verify savings, possibly through accredited verifier.	Supportive guidelines from BEE
Certificate Trading Certificate size and price Banking	Use of trading is considered limited NA NA: Overachievement rewarded within multi-annual cycle	First look if incentives work Obligation more important. Trading has risk to be expensive, little used Not really applicable within India's tariff setting context
Non- compliance	Penalty	Should be clearly set and communicated
Costs	Costs should be limited for non participants in scheme.	Delivery routes should focus on: possible subsidies, ESCO participation, bulk procurement/deals with shops/manufacturers Reducing peak loads/expensive power purchases
Cost recovery	Incentive framework should be developed.	There are some private utilities. If this can also incentivise public utilities this would an additional bonus.
Institutional framework	As in Figure5	

7.3.2. Challenges

The scheme proposed above addresses, to an extent, barriers (as identified in Chapter 4) related to successful implementation of a DOES scheme. It can be observed that the crux will be the issues related to costs and cost recovery. Table 13 lists the barriers identified in Chapter 4 and discusses to what extent the proposed DOES scheme addresses these barriers.

Table 13: Barriers for a DOES scheme

Barriers	Barrier Addressed	Comments
Lack of interest and motivation, lack of capacity utilities	Partly, through obligation and through additional incentives	DSM cells should be constituted within all the distribution utilities and regulators.
High initial costs	partly	Barrier depends on states' involvements, restructuring of tariff by SERCs and on ability of distributors to successfully tie up with third parties.
No (clarity on) financial incentives	To a large extent	Recovery of costs through tariff structure plus an additional incentive framework
Lack of clarity about obligations on Distribution Utilities Absence of Regulations/guidelines for DSM implementation	yes	This work considers an obligation a necessity. Guidelines to be drafted at national level.
Poor financial health of DISCOMs and cross subsidization. Lack of investment capability/ project financing.	no	Tariff restructuring remains very important for electricity efficiency.
No proper load research/evaluations; Inadequate measurement and verification of DSM processes, lack of load data (uncertain results)	Partly	Standardized measures and BEE guidelines could partly address this barrier.
Non availability of efficient equipment	Not specifically addressed	Certainty of demand (obligation) could raise supply.
Lack of public awareness/participation/confidence	Not specifically addressed	Supportive action necessary. A sub-obligation on awareness raising could be put within a DOES scheme
Lack of M&V understanding	To a large extent	Clear guidelines and standardized savings from BEE

Table 13 shows that challenges will remain. Learning by doing and learning by sharing information would be valuable in respect to the mentioned challenges. Some barriers, such as tariff structures and slow implementation rates of regulation are not addressed specifically within a DOES scheme and could reduce effectiveness of such a scheme. Energy Saving Obligations and White Certificate schemes are dynamic schemes which need to regularly update, communicate and learn in order to be effective. This will require some effort. The challenges deemed most relevant are shortly discussed below.

Adequate support from central level

To date there is no central obligation and as this largest democracy faces many challenges this could take some time. Prior to this, effort would be required from the future (technical) regulators at national level (BEE and Forum of Regulators) and the Ministry of Power, which would need to provide a clear long term vision and which would have to research options related to a DOES scheme.

Adequate state support

Possible tax rebates or partial funding through states' energy conservation funds are uncertain. Experiences have shown that, in practice, regulations are not always in place or implemented. Some states perform better than others. This could lead to a skewed situation.

Functioning of SERCs

For many SERCs the role as electricity *efficiency* regulator is new and would require certain change in mindset. Additional effort and adaptation is required as they would need to deal with different cost recovery options (such as an incentive framework) and verification protocols. Guidance from national level (Forum of Regulators) would be required.

Cross subsidisation and cost related aspects This remains an (additional) barrier within a DOES scheme. Utilities would prefer not to sell less electricity to the commercial and industrial and sectors, as in most cases these are the subsidising sectors. Utilities cannot, or are restricted to, simply pay for all measures. End-users might be reluctant to invest. Hence, without supportive measures or cost recovery mechanisms achieving an obligation could be very difficult.

7.4. Conclusion

Independent of the exact design philosophies or values for parameters within a DOES scheme electricity saving can be achieved. The first and foremost step is to put an obligation in place. However, the cost-effectiveness of total savings due to an obligation would be benefitted by numerous and well designed eligible (standardized) measures. Furthermore, transparency and communication between the various regulative bodies would make learning and harmonization easier, hence improving the scheme.

The scheme would also only yield results if the implementing and coordinating bodies are capable and motivated to achieve these (cost effective) electricity savings. Therefore, communication, capacity building, support, as well as the obligation and penalty are necessary. Challenges remain and a DOES scheme will not spontaneously result in electricity savings.

8. Conclusion and Future Research Needs

This work has investigated aspects of the Indian electricity and electricity efficiency sector and has provided a comparative analysis between a number of trading schemes. This formed the input for recommendations on a future DOES scheme. After the Introduction and Methodology Chapter, the actual research questions have been answered in chapters four to seven. This chapter reflects on the posed questions and concludes. Furthermore, data gaps are identified and suggestions for future research are made.

Which policy instruments to encourage energy efficiency have been used in India and which success and failure factors can be identified?

There are several policy instruments in India which address electricity efficiency, though implementation can be somewhat slow. Voluntary aspects lead to limited action, which may indicate need for more awareness raising or obligations. For DSM measures, increased number of guidelines and effort from the national level could reduce burden and transaction costs at the state level.

What are the similarities and differences between the PAT scheme, (idealised) White Certificate schemes and other trading schemes; which success and failure factors can be identified and which (success) factors and experiences might be applicable to the PAT scheme?

Many differences have been found. More often than not these differences could be justified within the (national) context in which the scheme was /is operating. Nonetheless, there seem to be some fairly universal lessons learned. Flexibility is a prerequisite for a trading scheme and enhances compliance and cost effectiveness. This flexibility refers to options for the obliged entities, and to capacity of the regulators. Another important aspect is to let the regulators regulate, let the government set targets and goals and provide (legal) backing, whereas appropriate institutions can set saving values.

How effective are the current White Certificate schemes in terms of costs and achievements, which changes have influenced this effectiveness and to what extent are trading schemes compatible/do interactions occur?

Can the standardized measures, within the White Certificate schemes of the European countries, be compared to each other and can possible differences be explained?

The researched schemes show substantial differences on effectiveness and additionality, which are linked to the saving values and methodologies related to the dominant (standardized) savings used. In general, the schemes are considered cost-effective. An obvious rule for effectiveness, though seemingly broken on a number of occasions, is that the actual cost effectiveness must be reflected in the cost effectiveness these measures have in the eyes of the obliged entities. Another lesson is that without harmonization processes these measures can be barely compared to one another and this hence hinders the creation of a single scheme. This shows that harmonization is important if India aims for such a single Indian wide scheme.

What are recommendations, based on this research, for introducing a DOES scheme to the Indian electricity policy framework?

Interactions, possible synergies, unwanted overlaps and effects which might occur when a DOES scheme will be initiated within India have been analysed. Inter state trading or explicit linkages with other trading schemes are not recommended. There should be some room to experiment with, and learn from, options for economic incentives and cost recovery. In short, for a future DOES scheme, the current DSM frameworks seem a good start, though learning, supportive measures, explicit obligations and well researched standardized saving values are considered to become of added value.

Future Research Needs

For a future Indian DOES scheme it would be useful if a number of topics would be further investigated. Appropriate target setting, well-researched standardized measures and levels of compliance are very relevant for the effectiveness of a DOES scheme. Therefore, research on standardized measures (baselines, market uptake of electricity efficient appliances, and additionality of measures), potential for savings within a DOES scheme (eligible measures/sectors/actors, target setting), enforcement mechanisms and methods for learning and capacity building would be important. Moreover, there might be external funding possibilities (e.g. Nationally Appropriate Mitigation Actions). This work has not focussed on these issues, though insights on these topics would be very useful.

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Appendix A: Retail Tariffs for State of Haryana (2012-2013)

Distribution & Retail Supply Tariff for FY 2012-13 Approved by Haryana Electricity Regulatory Commission (effective from 01.04.2012)									
Sr. No.	Category of consumers	Tariff for 2011-12				Tariff for 2012-13			
		Energy Charges (Paise / kWh)	Fixed Charge (` per kW per month of the connected load / per kVA of sanctioned contract demand in case supply is on HT)	FSA (Paise / kWh)	MMC (` per kW per month of the connected load)	Energy Charges (Paise / kWh or/ kVAh)	Fixed Charge (` per kW per month of the connected load / per kVA of sanctioned contract demand (in case supply is on HT) or as indicated	FSA (Paise / kWh)	MMC (` per kW per month of the connected load or part thereof)
1	**Domestic (LT)**								
	Upto 40 units per month	263	Nil	15	` 80 upto 2 kW and ` 70 above 2 kW	270/kWh	Nil	15	` 80 upto 2 kW and ` 50 above 2 kW
	41 - to 250 units per month	380	Nil	29		450/kWh	Nil	29	
	251 to 400 units per month	380(for units 251-300) 465(for units 301-400)	Nil	37		525/kWh	Nil	37	
	401 and above units per month	465(for units 401-500) 499(above 500)	Nil	37		560/kWh	Nil	37	
2	**Non Domestic**								
	Upto 5 kW (LT)	450	Nil	31	180	525 /kWh	Nil	31	` 180 upto 5 kW and ` 160 above 5 kW upto 20 kW
	Above 5 kW and Up to 20 kW (LT)	450	Nil	31	160	550 /kWh	Nil	31	
	Above 20 kW upto 50 kW (LT)	470	115	31	Nil	550 /kWh	130 /kW	31	Nil
	Existing consumers above 50 kW upto 70 kW (LT)	470	115	31	Nil	575 /kWh	150 /kW	31	Nil
	Consumers above 50 kW	470	115	31	Nil	525 /kWh	130 /kW	31	Nil
3	**HT Industry (above 50 kW)**								
	Supply at 11 KV	415	120	31	Nil	470/kVAh	130 /kVA	31	Nil
	Supply at 33 KV	403	120	31	Nil	460/kVAh	130 /kVA	31	Nil
	Supply at 66 KV or 132 KV	391	120	31	Nil	450/kVAh	130 /kVA	31	Nil
	Supply at 220 KV	383	120	31	Nil	440/kVAh	130 /kVA	31	Nil

	Arc furnaces/Steel Rolling Mills	415+15	120	31	Nil	470+18 Paise per kVAh if	130 /kVA	31	Nil

Distribution & Retail Supply Tariff for FY 2012-13 Approved by Haryana Electricity Regulatory Commission (effective from 01.04.2012)									
Sr. No.	Category of consumers	Tariff for 2011-12				Tariff for 2012-13			
		Energy Charges (Paise / kWh)	Fixed Charge (` per kW per month of the connected load / per kVA of sanctioned contract demand in case supply is on HT)	FSA (Paise / kWh)	MMC (` per kW per month of the connected load)	Energy Charges (Paise / kWh or/ kVAh)	Fixed Charge (` per kW per month of the connected load / per kVA of sanctioned contract demand (in case supply is on HT) or as indicated	FSA (Paise / kWh)	MMC (` per kW per month of the connected load or part thereof)
4	**LT Industry - upto 50 kW**								
	Up to 20 kW	440	Nil	32	150	535/kWh	Nil	32	` 150 /kW
	Above 20 kW upto 50 kW	440	75	32	Nil	510/kWh	150 /kW	32	Nil
	Existing consumers Above 50 kW upto 70 kW	440	75	32	Nil	498 /kVAh	150 /kW	32	Nil
5	**Agriculture**								
	Metered: (i) with motor upto 15 BHP	25	Nil	Nil	` 200 / BHP per year	25 /kWh	Nil	Nil	` 200 / BHP per year
	(ii) with motor above 15 BHP	25	Nil	Nil		20 /kWh	Nil	Nil	
	Un-metered (` / Per BHP / Month): (i) with motor upto 15 BHP	Nil	35	Nil	Nil	Nil	35	Nil	Nil
	(ii) with motor above 15 BHP	Nil	35	Nil	Nil	Nil	30	Nil	Nil
6	**Public Water Works**	425	145	30	Nil	510 /kWh	150 /kW	30	Nil
7	**Lift Irrigation**	430	120	30	Nil	510 /kWh	150 /BHP	30	Nil
8	**MITC**	430	120	30	Nil	510 /kWh	150 /BHP	30	Nil
9	**Railway Traction**								

	Supply at 11 KV	455	125	30	Nil	530 / kWh	125 /kVA	30	Nil
	Supply at 33 KV	443	125	30	Nil	520 /kWh	125 /kVA	30	Nil
	Supply at 66 or 132 kV	431	125	30	Nil	510 /kWh	125 /kVA	30	Nil
	Supply at 220 kV	423	125	30	Nil	500 /kWh	125 /kVA	30	Nil

Distribution & Retail Supply Tariff for FY 2012-13 Approved by Haryana Electricity Regulatory Commission (effective from 01.04.2012)

Sr. No.	Category of consumers	Tariff for 2011-12				Tariff for 2012-13			
		Energy Charges (Paise / kWh)	Fixed Charge (` per kW per month of the connected load / per kVA of sanctioned contract demand in case supply is on HT)	FSA (Paise / kWh)	MMC (` per kW per month of the connected load)	Energy Charges (Paise / kWh or/ kVAh)	Fixed Charge (` per kW per month of the connected load / per kVA of sanctioned contract demand (in case supply is on HT) or as indicated	FSA (Paise / kWh)	MMC (` per kW per month of the connected load or part thereof)
10	**DMRC**								
	Supply at 66 kV	395	125	30	Nil	450 / kWh	125 /kVA	30	Nil
	Supply at 132 kV	380	125	30		450 /kWh	125 /kVA	30	Nil
11	**Bulk Supply**								
	Supply at LT	440	130	31	Nil	525 / kWh	130 /kW	31	Nil
	Supply at 11 kV	430	130	31	Nil	515 /kWh	130 /kW	31	Nil
	Supply at 33 kV	418	130	31	Nil	505 /kWh	130 /kW	31	Nil
	Supply at 66 or 132 kV	406	130	31	Nil	500 /kWh	130 /kW	31	Nil
	Supply at 220 kV	398	130	31	Nil	495 /kWh	130 /kW	31	Nil
12	Bulk Supply Domestic (70 kW and above at 11 kV or above voltage)	360	50	31	Nil	390 /kWh	50 /kW	31	Nil
13	**Street Lighting**	415	Nil	31	150	495 /kWh	Nil	31	150 /kW
14	**Independent Hoarding / Decorative Lightning**	650	120	31	Nil	695 /kWh	150 /kW	31	Nil
15	**Temporary Metered supply**	1.5 times the tariff of relevant category for which temporary supply has been sought							

Notes:

1. 80% of the connected load shall be taken into account for levying fixed charges where leviable in case of LT industrial

Supply

2. Energy charges for HT industrial and existing LT industrial consumer categories having load above 50 kW to 70 kW are in Paise / kVAh
3. Fixed charges for unmetered AP consumers,MITC and lift irregation category are in Rs. / per BHP / Month.
4. Fixed charges for HT industrial supply category, are in Rs. kVA of Contract Demand. For Railways and DMRC, the fixed charges are in Rs/kVA of the billable demand. For all other consumer categories (except Bulk Suply Domestic), the fixed charges are in Rs. / kW of the connected load or part thereof per month
5. Fixed charges for Bulk supply Domestic are in Rs. / kW of the recorded demand.
6. Supply charges in case of Domestic consumer category are telescopic in nature

Source: http://herc.gov.in/mainpages/tarif.html

Appendix B: Clean Development Mechanism and Project Requirements

The Clean Development Mechanism allows countries who need to limit or reduce their GHG emissions under the Kyoto Protocol to offset some of their emissions through investing in carbon reduction projects in developing countries. This flexibility mechanism ensures that the donor countries are not forced to achieve their Kyoto target through costly measures within their own borders. Furthermore, this mechanism gives an opportunity for funding sustainable development in the host countries. The certificates from the CDM (Certified Emission Reductions) are eligible for the EU ETS: in case the (individual)allocated cap cannot be effectively achieved through reductions, CDM may offset the surplus emissions. A single Certified Emission Reduction ensures that one tonne of CO_2 equivalent has not been emitted, which would have been the case in absence of the CDM project. As an offsetting mechanism, a CDM project do not represent actual carbon savings on a global level. In the best case (100% additionality in host country), the extra emissions in the donor country are offset and hence this mechanism does not result in any increase of global emission reductions. In case of limited additionality global emissions will actually increase.

CDM in India

India has been very active in registering CDM projects and various programmes and policies try to make use of this funding possibility. In the pipeline report of February 1st, 2012 it is estimated that at the end of 2012 the 1865 Indian projects will receive a total of approximately 407 million Certified Emission Reductions. To date, 15.6% of all issued Certified Emission Reductions have been issued to Indian projects, amounting to a total of approximately 133 Mton CO_2 eq reductions (UNEP Risoe 2012a). The future may experience less demand for Indian CDM projects as new changes within the EU ETS prevent the use of Certified Emission Reductions due to Indian projects registered after 2012. From then onwards, only CDM projects from the so called Least Developed Nations will be eligible within the EU ETS. There could be demand from non EU-ETS firms and nations (EU's effort sharing commitment, carbon trading Australia, voluntary actions), but the EU ETS was a large source of demand.

CDM Project Requirements

The two main requirements that any project must meet in order to receive Certified Emission Reductions are sustainability and additionality. Sustainability is defined at the national level, as the host country's Designated National Authority decides whether the project meets the country's sustainable development criteria and goals. Additionality literally means that the savings would not have occurred in the absence of the CDM. There are several steps involved in the project design process that should ensure that the savings due to registered projects are truly additional. Though the exact requirements vary between the different types of CDM projects, though every project must determine a baseline, for which alternative scenarios, barriers preventing spontaneous implementation and investment analyses are investigated. 'Demonstration of additionality' should be included and looks at the spread of similar projects in the region. Besides the baseline methodology, an approved monitoring methodology must be followed and environmental issues and stakeholders' comments must be reported. It must also be confirmed that the proposed project is a voluntary action from the project participants.

Appendix C: Renewable Purchase Obligation and Renewable Energy Certificate Trading

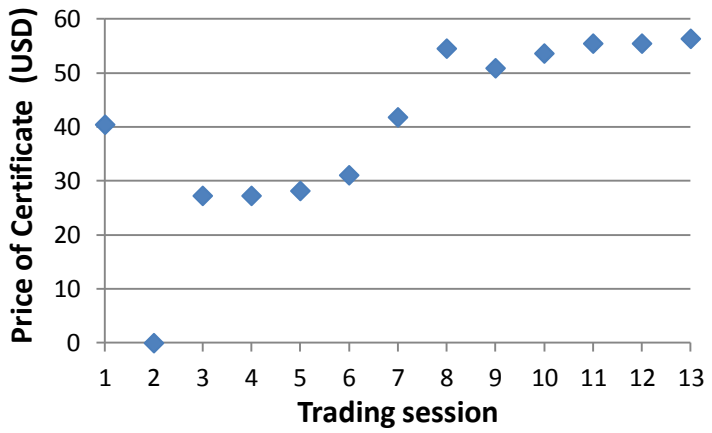
The SERCs impose a Renewable Purchase Obligation on obliged entities within their state, which are the electricity distributors and, in some states, also captive users and open access consumers (large consumers purchasing power directly from generator/market). This Renewable Purchase Obligation is expressed as a percentage of electricity sold (ABPS 2009). For renewable energy sources a tariff has been determined at the state level, which is to be paid by the obliged entities. This tariff is higher than the average power purchase costs and therefore power from renewable sources was barely contracted once the obliged entities meet their Renewable Purchase Obligation. In other states, with a shortage of renewable power supply, the obliged entities cannot even reach their obligation. The Renewable Purchase Obligations of the various states differ and obliged entities could only buy renewable power from suppliers within their state. A large share of the (national) untapped potential for increased renewable power lies within states which already have high Renewable Purchase Obligations. A (inter-state) trading scheme has been set up in order to overcome this geographical constraint and is to diminish risks related to over- and under- supply within a state. The scheme is expected to offer additional benefits, such as an increased flexibility for obliged entities to meet their obligation and increased competition between suppliers of renewable power.

Due to this new scheme (trading activity started in 2011) renewable power generators can sell their electricity at preferential tariff or sell their electricity and issued Renewable Energy Certificates separately (Soonee, Garg and Prakash 2010). The units of trade at the national level are these Renewable Energy Certificates, which have a denomination of 1 MWh.

The Tariff Policy 2006 announced and outlined that SERCs are to fix a percentage, which distribution licensees must purchase from such (non-conventional and cogeneration) sources before a certain date. The act does mention the punishment in case of non-compliance (art. 142), but the enforcement mechanisms in many states have been found to be inadequate (ABPS 2009). The penalty described in Article 142 is not very high in terms of costs, especially considering the costs of the obligation for some obliged entities. The act leaves a lot of (regulation/implementation) room available, to be filled in by the SERCs. Some states have booked good results, but some states have experienced underachievement. Regulation varies between the states.

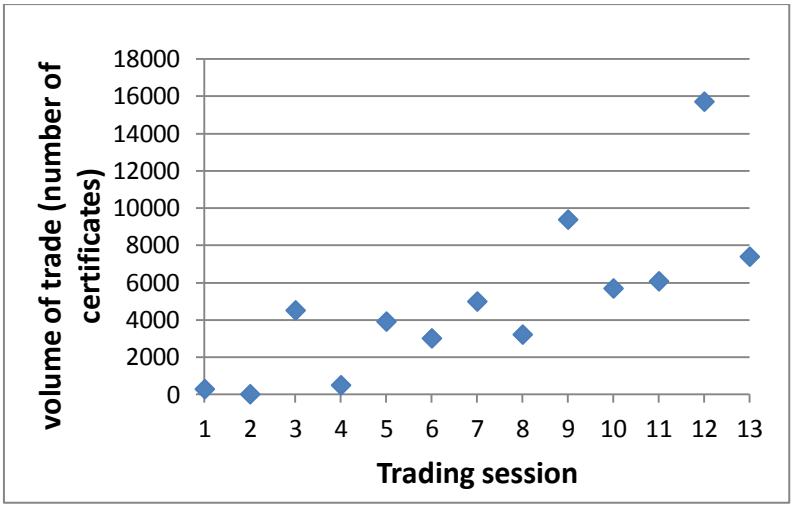
The National Load Despatch Centre has been designated as the central agency for registration, administration and implementation of the Renewable Energy Certificate trading. Regulation states that certificates are only to be traded through the power exchanges (NLDC 2010). The trading is primary intended for the generators, in order that they can sell green certificates (if they are not able/willing to sell their electricity at preferential tariff). Trading experiences are limited. Up to March 2012, there have been monthly trading sessions at Power Exchange India Limited (PXIL). Figure A and Figure B show prices and volumes of the Renewable Energy Certificates traded, since March 2011 (first session).

Figure A: Market clearing prices of Renewable Energy Certificates trading sessions



(PXIL 2012)

Figure B: Volume of trade during Renewable Energy Certificates trading sessions



(PXIL 2012)

Initially trading was limited, the more recent trading sessions have seen an increase in volume traded. Though prices are determined through bidding processes, CERC has set a floor and forbearance price, which is USD 26.4 and USD 68.7 respectively (CERC 2010). It should also be noted that the above refers to non-solar Renewable Energy Certificates. The second type of Renewable Energy Certificates, solar Renewable Energy Certificates are more expensive and have not been traded within these trading sessions. There have been a limited number of buy bids, but no sell bids. The absence of solar Renewable Energy Certificates has not been explained, but could relate to risks generators feel and hence to non-harmonised Renewable Purchase Obligation for solar energy (certificates) specifically.

Co-generation and biomass with up to 15% coal are also eligible for Renewable Energy Certificates issuance (CERC 2010). Some states have made several separate obligations, for development of specific

renewable sources. Some of these generators would hence have more difficulty selling on the market (higher costs) and remain dependent on state set obligations and tariffs.

The trading was not set up for the (mainly public) entities with a Renewable Purchase Obligation. There is no incentive for them to achieve these costs as efficiently as possible; there is an obligation, and a pass through of costs. The scheme is mainly to ensure that national potential, heterogeneously spread, can be tapped. The scheme is a result of obligations and verifications at state level, with certification and trading at central level. This is possible, though success will depend on national overview and harmonisation. No information was found on the type of bidders (whether these were public or private utilities) or which renewable energy source was dominant.