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# Experience of Policy Instruments used to promote renewable energy

Case study of Maharashtra, India

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Supervisor

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# Abstract

Policy instruments are used to support the introduction and diffusion of renewable energy technologies as the cost of renewable energy is generally higher than fossil-based energy. The commonly used policy instruments for supporting renewable electricity are quota-based system and the price based feed-in system. While quota based systems specify minimum targets for renewable electricity procurement by electricity suppliers, price based systems provide fixed selling price for the entire renewable electricity generation over a long time frame.

This research attempts to study the influence of policy instruments on the renewable sector in Maharashtra, an Indian state. In Maharashtra, "Renewable Purchase Obligation" (RPO), a policy instrument similar to feed-in system was operational for two years, from 2004 to 2006. Thereafter, RPO was replaced by a new instrument called "Renewable Purchase Specification" (RPS) in year 2006, which was similar to quota based system.

The renewable sector experienced two different development patterns during the regime of the two policy instruments. While capacity growth rate increased rapidly under RPO regime, the same declined sharply under RPS regime. This study looks into the various issues that influenced the developments in renewable sector during the regime of these policy instruments.

The results of the study show that the provision of penalty under the RPS for non-achievement of targets was one of the most significant issues that affected the renewable sector. While the purpose of penalty was to support renewable growth by ensuring compliance among the electricity consumers for meeting targets, it instead created barriers to capacity growth. As the supply of renewable electricity was much lower than what was required to meet the targets specified under RPS, the price of renewable electricity registered a sharp increase and the market started favoring the generators. The substantial gap between demand and supply of renewable electricity indicates that the market was not mature enough to support competition based RPS system. Based on the findings, it is felt that price based system would be better than quota based system in such markets which are yet to mature.

Key words: renewable policy, renewable electricity, feed-in, quota based

# Executive Summary

The energy sector has been recognized as one of the key contributors to the process of environmental degradation. While a large part of electricity generation comes from fossil fuel based power stations, the associated green house gas emissions make the sector significant from environment point of view. The environmental issues of this sector are even more prominent in developing countries, which primarily rely on fossil based power generation for meeting their growing energy needs. India, one of the rapidly growing economies, has almost 70% of its generation capacity based on fossil fuels. It is against this background that promotion of renewable electricity has risen in importance.

Various types of policy instruments have been used to promote renewable electricity across the world, with the most popular ones being quota based instruments and price based instruments. While the relative merits and demerits of both the instruments have been at the centre of discussion, it is felt that proper design and time of introduction of these instruments, with respect to the maturity of electricity market, has got a significant influence on the growth of renewable electricity sector.

This research attempts to analyze the experience of an Indian state, Maharashtra, with regard to the influence of policy instrument on the development of renewable sector. As part of the research, the influence of policy instrument on growth of renewable sector has been analyzed and significant issues that influence the development of renewable sector have been identified.

In India, the Central Government introduced special provisions for promotion of renewable electricity in the Electricity Act 2003 (EA 2003), wherein the states were supposed to formulate their own policy instruments and set up minimum targets for purchase of renewable electricity by the electricity distribution companies or licensees.

**Policy instruments introduced in Maharashtra**

Maharashtra Electricity Regulatory Commission (MERC) introduced "Renewable Purchase Obligation" (RPO) in year 2004, to address the immediate requirement of allocating responsibility among distribution licensees[1] for purchase of renewable electricity, before preparing a long-term policy instrument as per the requirement of EA 2003. Under RPO, fixed tariff was to be offered to renewable generators, and the entire renewable generation was to be purchased by distribution licensees. The financial burden of renewable electricity was to be shared by all distribution licensees. The basic features of RPO resembled price based "feed-in" policy used to promote renewable electricity.

In 2006, a long-term policy instrument called "Renewable Purchase Specification" (RPS) was introduced by replacing the RPO. Under RPS, targets were earmarked for distribution licensees regarding procurement of renewable electricity through competitive bidding. Thus, the basic features of RPS resembled the "quota based" policy used for promotion of renewable electricity.

**Growth pattern observed in renewable electricity sector of Maharashtra**

[1] Distribution companies are referred to as Distribution licensees or licensees

The growth in renewable sector has shown distinctly different patterns during the regimes of the two policy instruments, i.e., RPO and RPS. As the renewable electricity sector is largely dominated by wind power, the performance of the entire sector is reflected through the performance of wind power sector. While the capacity growth in wind sector rapidly increased under the RPO regime, the same declined sharply under the RPS regime.

**Significant issues that influenced renewable development during RPO and RPS regime**

Under RPO regime, the capacity addition rate increased rapidly in wind power sector. This may be attributed to the assurance provided to wind power generators about the sale of their entire generation at fixed price, which provided them higher degree of certainty about their earnings and resulted in higher capacity growth rates. The distribution licensees were given the mandate to buy the entire renewable generation from the generators in their respective areas at fixed price.

Under RPS regime, the capacity growth rate suffered due to several issues. Only one out of the four distribution licensees in the state is expected to meet the target in year 2007-08. TPC[2], the only distribution licensee which has got adequate renewable generation capacity within itself, is expected to meet the targets. Other distribution licensees who rely on independent renewable generators for meeting their renewable targets, are not likely to meet their respective targets in 2007-2008.

Analysis of the developments in Maharashtra during the two regimes revealed that the major issues that influenced the development of renewable sector, are mainly organizational, regulatory and market related in nature.

Among the regulatory issues, provision of penalty in RPS has constrained the growth of renewable sector in a significant way. The study reveals that the penalty applicable on distribution licensees in case of failure to meet renewable targets, has been largely responsible for increase in land acquisition problems. The renewable developers are not able to afford buying land for the new projects, because the private land owners have increased the price to a level which seriously affects the financial viability of new projects. The increase in land price is driven by the presumption that distribution licensees would buy renewable power at any price in order to meet their targets and avoid penalty. This would make renewable electricity generation a highly profitable business, which in turn, would encourage the renewable developers to pay any price for purchasing land to set up new projects. This presumption among private landowners encouraged them to demand exorbitant price for their land.

The slowdown in capacity growth due to land related issues, coupled with the high demand for renewable electricity from distribution licensees to meet renewable targets, has provided the existing renewable generators with the opportunity to sell their generation at substantially higher prices under RPS regime as compared to RPO regime. As the price of renewable electricity is passed on to consumers, they are burdened to a larger extent under RPS regime than under RPO.

Further, the existing generators are enjoying higher selling price whereas the new generators are finding it difficult to set up projects. Therefore, members within the same stakeholder group are affected differently under RPS regime.

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[2] TPC stands for Tata Power Company Ltd.

The consumers of the state are facing severe power shortage in light of the rapidly rising electricity demand. Consumers, in almost the entire state are subjected to load shedding, wherein they have to spend few hours almost on a daily basis without any power supply. The potential of renewable sector in addressing the problem is constrained by the slowdown in capacity growth under RPS regime.

As all independent renewable generators lie in the geographical area of MSEDCL, they are dependent on MSEDCL for grid connectivity and metering services. In order to ensure reliability of these services, the generators prefer to sell their power to MSEDCL instead of other distribution licensees. In the recent years, renewable power has become economically more attractive than conventional[3] power imported from other states at higher prices to meet peak power requirement. Due to this economic reason, MSEDCL purchased almost the entire renewable generation by leveraging its geographical advantage of covering all renewable generators. This hardly left any scope for other distribution licensees to buy renewable power from the market in order to meet their targets.

Additionally, organizational issues like performance of MEDA in implementing policy instruments has influenced the renewable sector in a significant way. Need for capacity building in MEDA is keenly felt to improve the functioning of the policy instruments, with regard to coordination and monitoring.

In view of the experience of renewable sector, it is felt that the RPS regime has not been able to promote growth in an effective way. In case of Maharashtra, the market demand for renewable electricity, induced by the penalty provision, was much higher than the supply. The fulfillment of such demand required rapid growth in renewable generation capacity, which was constrained by quite a few barriers. The most significant barrier relates to land acquisition issues, like increase in land prices, which has affected the capacity addition plans of new renewable generators as well as distribution licensees in the state. Moreover, as all renewable generators are located in the area of MSEDCL, the entire generation is purchased by MSEDCL, leaving hardly anything for other distribution licensees to buy for meeting their targets. Some renewable generators are ready to sell their generation to other distribution licensees, like REL and BEST, but at a price which is much higher than the price they would get from MSEDCL. Further, the distribution licensees are not allowed to import renewable power from other states to meet their targets. In all, the quota based RPS system has not provided alternative and flexible options to meet the targets in a cost effective way.

**Way forward**

Given the power shortage scenario in the market, it is felt that the RPS should be replaced by a price based feed-in system, similar to RPO. Such a system would help in restricting the escalation in price of renewable electricity thereby lessening the financial burden on consumers. Additionally, as the RPO doesn't have the provision of target and penalty, the problems associated with these provisions, like, land acquisition, may reduce after RPS is replaced by RPO. Overall, it is expected that RPO would help in accelerating renewable capacity growth rate and lessen the financial burden on consumers.

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[3] Conventional power mainly comprises power from non-renewable sources

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# 1 Introduction

## 1.1 Background

**International energy scenario**

Energy has held the central stage for social and economic development. Whether it is for industrial development or growth in any sector of economy, energy issues invariably occupy a place of prominence. As 2 billion people around the world still use traditional fuels for cooking and an almost similar number lack supply of electricity, the role of energy as a catalyst for development has become even more significant (Johansson and Goldemberg 2002;UNDP 2004).

While developed countries mainly drove the growth in energy demand in the past, the developing countries are likely to drive this demand in the future. The global electricity generation is projected to increase at an annual rate of 2.4% between the years 2004 and 2030, and will reach 30.36 trillion Kwh in year 2030 (EIA 2007). While this increase in demand for electricity is understandable, driven by rapid economic growth particularly witnessed in developing countries, what causes concern is the environmental burden of the way this demand is met (Khanna and Zilberman 1999; Kroeze et al. 2004 and IEA 2007). As fossil fuel continues to be main source for generating electricity at global level, associated carbon emissions from combustion processes continue to pose serious challenge to the health of environment.

In light of the above, relevance of renewable electricity generation is felt more closely than ever before. The United Nations conference on Human settlements HABITAT II stresses on the need to develop renewable technologies and emphasizes its role in achieving the goals of sustainable development (Reddy et al. 1997). It is therefore imperative to create enabling mechanisms in order to support renewable based projects, particularly in developing countries, which are registering rapid growth in their energy consumption.

**Indian Energy scenario**

India, a developing country has been witnessing steep economic growth in the recent years. While the GDP is growing at a rate of around 8% per annum, it is putting a huge pressure on the power sector of the country (Varun and Singal 2007). On one hand, the power sector is obliged to meet the spiraling demand owing to rising economic activities, on the other hand, it has to meet the commitment of extending power supply to all non-electrified households in the coming years. Almost 56% of rural households and 44% of non-rural households in India don't have access to electricity (Reineberg 2006). The National Electricity Policy aims to provide reliable and quality power to all households at an affordable price by the year 2012 (MOP 2005). This is particularly important for narrowing social gaps and improving the standard of living (Audinet 2002). The annual per capita consumption of electricity in India is 553 Kwh, which is about half of the corresponding Chinese consumption and about twenty five times lower than that of US. Almost 600 million citizens of India don't have access to electricity (PC 2006). Hence, accessibility to energy and energy services has been made a key element of the national development policy (MOEF 2007).

The gap between demand and supply in the power sector has been increasing due to inadequate pace of capacity addition as compared to growth in demand (IPIDC 2004). During the year 2006-07, the overall generation in the country was 662429 MU, which was 7.3%

higher than the previous year. In spite of this growth, the shortfall in energy was around 9.6%. Similarly, the peak demand met was 86818 MW, with a shortfall of 13.8% during 2006-07(CEA 2007). The following figure shows the trend of demand supply gap in the last couple of years (Sharma 2006).

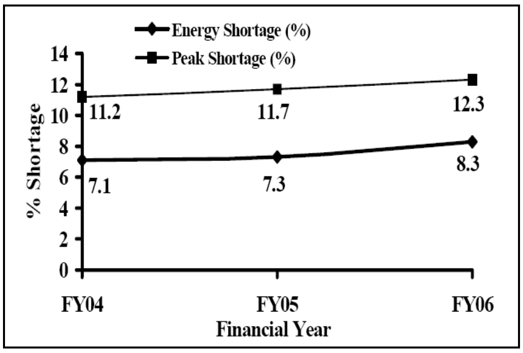


*Figure 1-1 Trend of demand supply gap in Indian electricity sector*

(*Source: Sharma 2006*)

While the power sector is struggling to keep pace with the demand, most of the capacity addition is observed in fossil based generation. The Integrated Energy Policy of India predicts coal to remain the mainstay of electricity sector at least until 2031-32 (PC 2006). As almost 70% of the generating capacity is based on fossil fuels, the generation sector is exerting enormous pressure on the environment. While it is essential to meet the growing energy needs of the economy, it is also essential to minimize the causes of climate change for promoting sustainable development (Asif and Muneer 2007). In light of the above, the role of renewable electricity in energy planning has risen in importance, not only for bridging the demand supply gap, but also for ensuring better environmental performance. Usage of renewable energy technologies can help in reducing sulfur control cost by at least two-thirds in India, and thereby contribute to the cause of environmental air quality (Boudri et al. 2002).

### Renewable energy policy

As the cost of renewable electricity[4] (RE) is generally higher than electricity from fossil based sources, RE requires additional supporting policies till it becomes commercially competitive against conventional[5] electricity (IPCC 2007). Internationally, different types of policy instruments have been implemented for promotion of Renewable electricity technologies.

The usual approach followed across the globe is to create a market for renewable generation, by introduction of appropriate policy instruments (LIPP 2007). For instance, the EU directive on "Promotion of electricity produced from renewable energy sources in internal electricity market" introduced in 2001 (2001/ 77/ EC), requires the member states to progressively increase the contribution of renewable sources in their electricity generation (EC 2001). Different types of renewable policy instruments have been implemented across the world, based on different systems like, price, quota, tax and tender (Munoz et al. 2007). Presently, around 60 countries in the world have implemented renewable instruments, including 23 countries from the developing world (REN21 2007). These policy instruments have shown

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[4] Renewable electricity is referred to as RE

[5] Conventional power refers to electricity generated from non-renewable technologies

marked degree of difference in their influence on renewable sector in terms of growth of renewable capacity as well as cost of renewable generation.

## 1.2 Problem statement in Indian Context

India comprises of 28 states with most of them following the path of rapid economic development. Given the condition of Indian power sector as discussed in section 1.1, renewable power is being increasingly seen as an option to address the issues related to demand supply gap and associated environmental concerns (Garg and Adhikari 1998; Bakshi 1997; Gupta 1999). The Central Government, through the Electricity Act enacted in 2003 (EA 2003), set guidelines for the states to formulate and implement renewable energy policy instruments, to increase the penetration of renewable electricity in power sector (Chaurey et al. 2004). Accordingly, some states formulated policy instruments which differed not only in their structure and operational framework, but also in terms of their contribution to the growth of renewable electricity sector (WISE, 2008 March.PC).

Maharashtra, an Indian state, introduced a policy instrument called RPO[6] in 2004 and then replaced it with another instrument called RPS[7] in 2006, in accordance with the EA 2003. While renewable growth rate increased rapidly during RPO regime, it declined sharply during RPS regime. In view of the contrast in renewable growth observed during the regime of the two instruments, need is felt to analyze the experience of renewable sector under the regime of these instruments, in order to improve the future performance of the sector.

## 1.3 Objective and Research Question

The objective of the thesis is to develop an understanding of the various issues that influenced the performance of renewable electricity sector in Maharashtra, under the influence of the two renewable policy instruments and explore ideas for improving the performance in future. As the current policy instrument, i.e., RPS will be reviewed in the year 2010 (MERC 2006a), the outcome of this research could provide useful inputs to the review process. Moreover, many Indian states are in the process of implementing renewable policy instruments, and their power sector situation is similar to that of Maharashtra. Hence, the finding of this research is expected to serve as a general reference for other states. Towards achieving the above-mentioned objective, this study intends to focus on the following research questions.

- What are the significant issues influencing the development of renewable electricity sector, under the regime of renewable policy instruments in Maharashtra?
- What has been the influence of renewable policy instruments on key stakeholders, viz., distribution licensees[8], consumers and renewable generators, in Maharashtra?
- What type of intervention is needed with regard to renewable policy instruments, in order to improve the performance of renewable electricity sector in Maharashtra?

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[6] RPO stands for “Renewable Purchase Obligation”

[7] RPS stands for “Renewable Purchase Specification”

[8] Electricity distribution companies/utilities are referred to as Distribution licensees or licensees.

## 1.4 Scope of thesis

As the objective of the thesis is to mainly focus on the performance of renewable policy instruments, the scope is limited to only such technologies, which are covered under the policy instruments in Maharashtra, India. Accordingly, only grid connected renewable electricity projects are considered for the study excluding the stand-alone ones as they do not supply electricity to the grid. Though renewable projects generating only heat are not considered in the study, cogeneration projects generating combined heat and power have been included in the scope of study as they are covered under the renewable policy instruments.

Further, this research analyses the developments in renewable sector during the regime of two policy instruments, namely, Renewable purchase obligation (RPO) and Renewable purchase specification (RPS). The first policy instrument, i.e., RPO was introduced in year 2004, which was replaced by the RPS, in the year 2006 (MERC 2004a; MERC 2006a). Therefore, the period from year 2004 to 2008 has been considered for analysis. The research also looks into the experience of renewable sectors in UK and Germany under the influence of Renewable Obligation (RO) and Feed-in tariff (FIT) system respectively. These renewable policy instruments are studied to develop a deeper understanding of the underlying concepts before proceeding with the case of Maharashtra. Some of the learnings from UK and Germany are considered while developing recommendations for the case of Maharashtra.

## 1.5 Methodology

The research has been developed as a study of the influence of policy instruments on the performance of renewable electricity sector in Maharashtra, an Indian state. The research is divided into the following tasks and subtasks.

**Task 1: Review of prominent renewable policy instruments aimed at promoting renewable electricity**

**Subtask 1.1**: *Literature Review of international renewable policy instruments and factors influencing their performance.*

**Methodology:** This part of research involves study of the design features and operational experience of two prominent policy instruments, namely feed-in (price based) systems and quota-based systems. The purpose of this sub-task is to develop an understanding of the theoretical frameworks and operational issues of these policy instruments and study their impact on the growth of renewable electricity in the respective regions. In order to study the instruments in operational context, the "Renewable Obligation" of UK and "Feed-in tariff" of Germany have been studied, which serve as examples for quota based and price based instruments respectively. As these instruments in UK and Germany have already gathered considerable experience, they have been selected for study to get a good insight into the associated issues and concerns.

The task is carried out by extensive literature survey of official documents, peer reviewed articles, databases and discussion papers published by the DTI, DEFRA and OFGEM (UK), BMU (Germany), European Union (Directives, consultation papers), IPCC, IEA and UNEP.

**Subtask 1.2**: *Literature Review of Renewable sector development in India.*

**Methodology:** This part of research involves studying the development of policy support to renewable sector in India and analyzing the underlying concepts. This part of research looks into the provisions available in the national policies, like the "Electricity Act 2003", "National Electricity policy" and "National Tariff Policy", for promotion of renewable sector at national level. The idea is to develop an understanding of regulatory and policy support extended to renewable sector at national level, within the context of electricity sector restructuring.

This subtask is carried out through survey of policy documents of Ministries of Power (MOP), Ministry of Non Conventional Energy Sources (MNES), Indian Renewable Energy Development Agency (IREDA), Central Electricity Authority (CEA), Maharashtra Electricity Regulatory Commission (MERC) and Maharashtra Energy Development Agency (MEDA).

**Subtask 1.3:** *Study of electricity scenario in Maharashtra*

**Methodology**: In this subtask, the general electricity scenario of Maharashtra is studied, covering issues like, demand-supply gap and capacity addition in the power sector. Thereafter, the status of renewable electricity scenario in Maharashtra is reviewed to get an idea about the progress made in different renewable sources.

This subtask is carried out through survey of documents of Ministries of Power (MOP), IREDA, Central Electricity Authority (CEA), Economic survey of India, Planning commission of India, Maharashtra Electricity Regulatory Commission (MERC) and Maharashtra Energy Development Agency (MEDA).

Additionally, primary data is collected through interviews with officials of MEDA, NPC and WISE.

**Subtask 1.4:** *Study of renewable policy instruments in Maharashtra*

**Methodology**: This sub-task focuses on the structural and operational framework of renewable policy instruments introduced in Maharashtra, which are framed in line with the requirements of renewable policies at national level. The Renewable Purchase obligation (RPO) and Renewable Purchase Specification (RPS) are the policy instruments introduced in Maharashtra since the year 2004. The tariff policies, which were operational before the introduction of renewable policy instruments in Maharashtra, are also briefly reviewed, to understand their relationship with the policy instruments. Additionally, the main stakeholders within the context of renewable policy instruments are identified and their inter-relationships are studied, so as to develop an understanding of the role of these stakeholders in the development of renewable sector.

This subtask is carried out through survey of publications and documents of Central Electricity Authority (CEA), IREDA, Economic survey of India, Planning commission, Maharashtra Electricity Regulatory Commission (MERC), Maharashtra Energy Development Agency (MEDA), PRAYAS , TERI, GEF and World Bank. Additionally, primary data is collected through interviews with officials of MEDA, TERI, NPC and WISE.

### Task 2: Analysis of developments in renewable electricity sector of Maharashtra

**Subtask 2.1:** *Overview of renewable development in Maharashtra under the influence of renewable policy instruments*

**Methodology**: In this subtask, the overall growth in renewable sector as well as growth in prominent sectors like wind is studied under the regime of the two policy instruments, viz., RPO and RPS. Further, the power purchase mechanism adopted by distribution licensees is studied, in order to understand the implications of this mechanism on the cost-competitiveness of renewable electricity.

As the performance of the renewable sector with regard to growth of renewable generation is largely reflected in the performance of distribution licensees, hence, the achievement of renewable targets by distribution licensees under the regime of the two policy instruments is studied in this subtask.

This subtask is carried out through primary data collection and interviews with officials of MEDA, ABPS, and main distribution licensees, including MSEDCL, TPC, REL and BEST. Additionally, tariff petitions of these distribution licensees before Maharashtra Electricity Regulatory Commission (MERC) , Orders of MERC and performance statements by MEDA, were referred to.

**Subtask 2.2:** *Identification and analysis of important issues that influence the development in renewable sector*

**Methodology**: This task involves analysis of developments in the renewable sector of Maharashtra to identify the significant issues influencing them under the regimes of RPO and RPS, in the background of the experience of UK and Germany from Subtask 1.1. The issues are categorized into organizational, regulatory and market related issues, depending on their relevance.

This subtask is carried out through interviews with officials of MEDA, ABPS, NPC, REDAM, WISE, Suzlon and distribution licensees including MSEDCL, TPC, REL, BEST. Additionally, published literature in leading journals like Energy Policy, Powerline and Businessline, were referred to.

**Subtask 2.3:** *Analysis of outcomes during the regime of the two policy instruments*

**Methodology:** The criteria for analysis of outcome during the regime of two policy instruments is established and is followed by analysis of outcomes using the criteria. Based on the analysis in subtask 2.2, the influence of the two policy instruments on key stakeholders, i.e., consumers, renewable generators and distribution licensees is analysed. Thereafter, the drivers contributing to the growth of renewable sector are identified with a view to develop recommendations for future consideration.

The analysis carried out in this section is mainly qualitative in nature aimed at capturing the bigger picture of renewable development, and is supported by facts and details collected from the field.

This subtask is carried out by using the output of previous sub-tasks and by referring to the documents and publications from MEDA, PRAYAS, TERI, GEF and World Bank. Additionally, the officials of ABPS, TERI, NPC, REL and BEST were consulted for this subtask.

**Task 3: Conclusion and Identification of options for future interventions**

**Methodology:** Based on the above analysis, conclusion was drawn about the respective influence of the two policy instruments on the renewable sector in Maharashtra. The prominent issues affecting development of renewable sector were identified, while giving due consideration to the impact on stakeholders under the regime of each policy instrument. This formed the basis for recommending future interventions aimed at improving the performance of renewable sector while considering the interests of key stakeholders. This task focused on developing recommendations along two pathways;

- Identifying areas for improvement in the operation of current renewable policy instrument, i.e., RPS.
- Exploring the option of reverting back to the earlier policy instrument, i.e., RPO, after modifications.

Both the pathways were explored while considering the larger interest of renewable development in the state of Maharashtra. Some key points observed during the study of policy instruments in Germany and UK are considered while developing recommendations for future interventions.

This task was carried out through primary data collection and interviews with officials of ABPS, TERI, NPC, REDAM, WISE, Suzlon REL and BEST. Additionally, the documents and discussion papers published by the DTI, DEFRA and OFGEM (of UK), BMU (of Germany), and UNEP were referred to.

## 1.6 Limitations and assumptions in the study

For the purpose of study, views of significant stakeholders have been considered. While every effort has been made to give uniform representation to views of all stakeholder groups, there may be a slight possibility of over-representation of views of a particular group of stakeholders. This may be attributable to the number of responses received from the different group of stakeholders during the study period. It may be worth mentioning at this stage that the field study was primarily carried out during the period of January'08-March'08, which was close on the heels of closure of financial year April'07 to March'08, and had a bearing on the availability of people for interview given their busy schedule during this part of the year.

Renewable Purchase Specification (RPS) was introduced in August 2006. Therefore, the period considered for studying the influence of RPS is August'06-April'08. Although the time frame considered for analyzing the impact of RPS appears to be a bit short, the findings of the study are expected to contribute meaningfully when the RPS would be taken up for review in year 2010.

The Electricity Act 2003 (EA 2003) was introduced with the broad objective of addressing the requirements of electricity sector in the context of electricity sector restructuring. In this research, only those provisions of EA 2003 which are explicitly mentioned for renewable sector , have been considered. There may be few other provisions in the EA 2003, which are likely to have a bearing on the renewable sector indirectly. Such provisions are not considered in this research owing to the limitation of time for the study.

The gap between demand and supply in the electricity sector of Maharashtra has a significant influence on the renewable sector. At present this gap is widening and is expected to show similar trend in the future, based on the viewpoint of significant stakeholders interviewed during the study. Hence the analysis is based on the present trend of demand supply gap.

While assessing the performance of the distribution licensees with regard to fulfillment of renewable targets, data collected from them is used for the purpose of analysis due to non-availability of data from the nodal agency, MEDA.

Data for capacity growth of wind power sector was available for the last 10 years. However, data for other renewable sources was not available from official agencies for such duration. Considering that wind power sector contributes a major share of renewable capacity in the state (MERC 2006a), it is assumed that the growth of entire renewable sector is adequately reflected in the performance of the wind power sector.

## 1.7 Outline of the study

The study is structured on the following lines:

Chapter 1: Starting with the general background about the impact of electricity sector on the environment this chapter sets out the objective, research question, scope and limitation of the study, followed by the methodology adopted for the study.

Chapter 2: This chapter gives an over view of Feed-in tariff of Germany and Renewable Obligation of United Kingdom. As part of the overview, the structure and operational framework of these instruments are discussed along with their influence on renewable development in the respective countries. This chapter provides the theoretical understanding of the two policy instruments.

Chapter 3: In the context of India, this chapter gives a broad overview of policy support available to the renewable electricity sector in India. Starting with the background of previous renewable promotion policies, this chapter discusses the main features of currently operational regulations and policies like Electricity Act 2003, National Electricity Policy and National Tariff Policy.

Chapter 4: This chapter covers the general electricity scenario in Maharashtra and gives an idea of the current status of renewable electricity potential and generation in the state.

Chapter 5: This chapter deals with the different policies aimed at development of renewable electricity in Maharashtra. Starting with tariff policies, this chapter presents the design and operational framework of two policy instruments, viz., Renewable purchase obligation (RPO) of 2004 followed by Renewable purchase specification (RPS) of 2006. This chapter also presents the main stakeholders in the renewable electricity sector of Maharashtra and elaborates on their roles.

Chapter 6: This chapter analyses the development in the renewable sector under the influence of the two policy instruments. Starting with the overview of renewable generation in the state under the regime of RPO and RPS, it looks into the performance of distribution licensees in terms of achievement of renewable targets. Thereafter, the significant issues influencing the performance of renewable sector are identified and analyzed. This is followed by analysis of outcome due to the application of two policy instruments, RPO and RPS on renewable sector. Thereafter, the influence on key stakeholders is analyzed and the drivers for renewable growth are identified.

Chapter 7: This chapter presents the conclusion of the research followed by recommendations aimed at improving growth of renewable electricity sector in Maharashtra.

# 2.0 Renewable energy policy instruments

As renewable based electricity is generally costlier than fossil based electricity, supporting policies play a vital role in promoting them in a market dominated by fossil based generation (Ringel 2006). The renewable policy instruments aim to induce the demand of renewable electricity in the market through various mechanisms, which may vary in their design and operational framework. The instruments are generally based on a wide range of systems, the prominent ones being, price based, quota based, tender based and credit based systems (Mendonca 2007).

The most commonly used renewable energy instruments are based on either quota system or price system (REN21 2004). Among the EU member states, close to 18 countries follow price based systems, also known as feed-in tariff systems. On the other hand, quota based system, also known as green certificate system is followed in 5 member states (Mendonca 2007). Most of the developing countries are implementing renewable policy instruments, which are based on either quota system or price system (REN21 2007).

While the importance of renewable policy instruments has been well recognized by many countries, yet the significance of economic efficiency and ecological effectiveness of the different options has been a matter of debate (Ringel 2006). And it is precisely due to this reason that the policy makers debate the comparative merits and demerits of these instruments. The choice of instrument is generally driven by national policies, regional renewable potential and technological maturity (Patrik 2008). These instruments vary significantly in terms of their objective and operational framework, while their performance is influenced by regional potential and priorities (Reiche and Bechberger 2004). In view of the above, it is felt relevant to analyze the characteristics of these instruments in a regional context to develop an understanding of their performance. It is with this purpose that the following sections look into the structure and performance of price based system and quota based system, in Germany and United Kingdom respectively. While the German system is called Feed-in tariff (FIT), the one in UK is called Renewable Obligation (RO) (Mitchell et al. 2006).

## 2.1 Salient features of Feed-in tariff (price based) and Renewable Obligation (quota based)

### 2.1.1 Feed-in tariff (FIT) in Germany

FIT was introduced by the German government in year 1990, as "Electricity feed-in law" or Stromeinspeisungsgesetz (StrEG)". The instrument was revised in year 2000, and came to be known as Renewable Energy Sources Act (RESA) (Runci 2005).

Under FIT, the renewable electricity generators are assured sale of their entire generation to grid operators at prices which are pre-determined by regulatory authorities or the Government. However, the amount of renewable generation is determined by the market, which is based on economic attractiveness of renewable projects. Under the law, the electric companies have to enter into long term power purchase agreements, usually ranging from 20 to 30 years, with renewable generators, to buy electricity at fixed price (Mitchell et al. 2006). This system aims at reducing the risk of renewable generators by providing them guaranteed market and fixed price for their generation (Lipp 2007).

Considering that renewable based electricity is generally costlier than conventional[9] electricity, the extra burden incurred by the electric companies in fulfilling the mandate of renewable electricity purchase, is passed on to consumers, which allows the entire system to be operated without depending on state subsidy (Lipp 2007).

**Tariff setting:** Under FIT, the role of Government assumes considerable significance as it is responsible for fixing the price of renewable electricity. If the price is fixed too high, then it would result in windfall profits for renewable generators at the cost of consumers. On the other hand, if the price is too low, the renewable generators would desist from making fresh capacity addition, which will ultimately affect the purpose of the policy instrument (BMU 2007a). Hence, factors like assessment of site-wise renewable potential, rate of technological maturity and generation cost of various technologies, need to be considered carefully for arriving at an optimum price of RE, while balancing the interests of renewable generators and consumers (Mendonca 2007).

**Tariff differentiation**: The generation cost from renewable sources depends on many factors, significant among them being plant capacity, location, technology and fuel type. These factors not only affect capital cost, but the associated operating cost as well. Hence, the tariff setting mechanism under FIT, factors in these aspects to ensure optimum returns for all types of renewable generators (Mendonca 2007). The factors considered for differentiating tariff under FIT are presented below.

**Tariff differentiation based on renewable source**: Under the German FIT, electricity generated from Wind, Photovoltaics, Geothermal, Hydroelectric (below 20 MW), biomass and landfill/ sewage/ mine gases is considered eligible (BMU 2007b). As the generation cost varies with the renewable sources, the tariff for renewable electricity is differentiated based on the type of source used. Example of resource based tariff differentiation in FIT is presented in appendix- 6.

**Tariff differentiation based on location of project**: Generation also depends on the geographical location of project, especially in case of wind projects. A wind project located in a place with better wind profile, represented by higher full load hours per annum (FLH), will have better capacity utilization and would generate more electricity than a similar turbine located elsewhere (Mendonca 2007). Thus, wind projects located in favorable sites are likely to make substantially higher profits than those located in other regions, if uniform tariff is provided for all projects. To address this issue, the German FIT uses stepped tariff mechanism, wherein tariff is differentiated on the basis of wind potential at different sites. Tariff is progressively reduced with increase in full load hours, with an aim of providing uniform profit margin to all wind projects (Klien et al. 2007). The figure 2.1 explains the mechanism.

[9] Conventional electricity refers to electricity from non-renewable generation sources

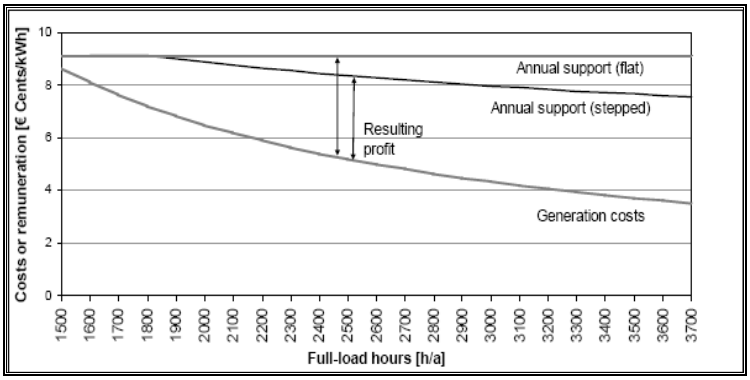


*Figure 2-1: Stepped tariff schemes in Germany*

*(Source: Klein et al. 2007)*

In the figure above, locations with high values of full-load hours (FLH) represent favorable locations. Accordingly, the tariff offered through stepped annual support, is lowest for sites with full-load hours (FLH) of 3700 hours. As against this, the tariff offered to sites with FLH of 1500 to 1800 hours, is the highest at 9 €cents/ kwh. Thus, stepped annual support mechanism prevents excessive profit making by projects operating in better locations (Klien et al. 2007). Further, higher tariff for projects located in areas with lesser wind potential helps in promoting uniform growth.

**Tariff digression with time**: Experience suggests that cost of renewable generation reduces with technological learning, economy of scale and market expansion, which in turn are a function of time (Mendonca 2007). Thus, to pass on the benefits of declining generation cost to consumers, tariff digression is adopted, wherein projects commissioned at a later date are offered lesser tariffs than the ones constructed earlier (Mendonca 2007). The figure showing tariff digression for wind power projects is presented in appendix- 6.

**Burden sharing by network operators**: As network operators are mandated to purchase entire generation of all renewable projects connected to their networks, the operators covering areas with higher renewable potential are obviously obliged to buy higher amount of renewable generation, which subjects them to higher degree of financial burden. Under FIT, the burden of renewable purchase is shared equitably among all operators to ensure level playing field among them (BMU 2007c).

### 2.1.2 Renewable Obligation (RO) in United Kingdom

Renewable obligation (RO) was introduced in UK in year 2002 on the lines of quota based system (DTI 2006). In this system, the regulator determines the minimum quantum of generation target and allows the market to determine the price. The regulator mandates the electricity companies to purchase a minimum share of their total energy transaction from renewable sources at least cost through competitive bidding. The underlying principle of RO is to have a market based instrument which will promote competitiveness as well as increase penetration of renewable electricity (Mitchell et al. 2004).

Under the RO in UK, the electric suppliers are obliged to buy renewable obligation certificates (ROC) corresponding to a certain percentage of their total electricity sales as specified by the regulator, OFGEM[10]. The following figure shows the operational mechanism of the certificate system in UK.

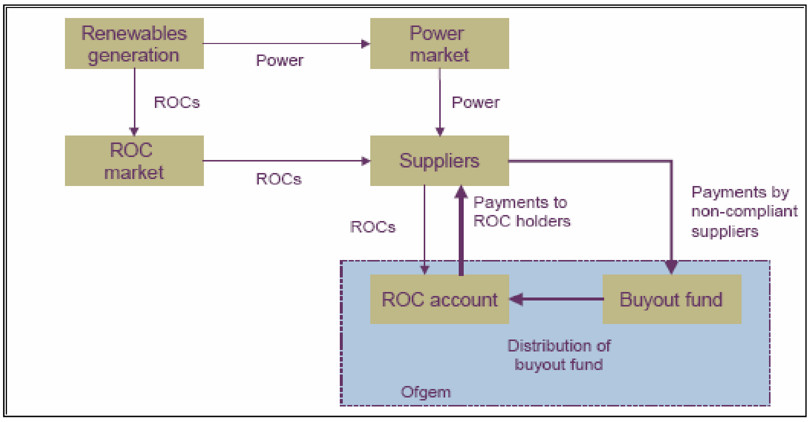


*Figure 2-2 Working of Renewable Obligation system in UK*

*(Source : Oxera 2005b)*

In the above system, renewable generators produce electricity and sell them in power market to electric companies at market price. As renewable based generation is generally costlier than conventional sources, hence, the renewable generators need additional income streams to recover their costs. This is provided by the certificate mechanism wherein, the renewable generators sell green certificates, which are allotted to them, in proportion to their generation (Oxera 2005b). The renewable generators are allotted a certificate (ROC) for each MWh of renewable electricity generated. They can sell these certificates in the certificate market (ROC market) to either electric suppliers or traders. Thus, renewable generators have two main revenue streams; sale of electricity, and sale of certificates (ROC). The traders may hold the certificates and later sell them to electric suppliers at a premium, based on demand supply situation. Thus market determines the cost of renewable electricity in this system. As cost of renewable electricity is generally higher than conventional, the electric companies will expectedly limit their purchase to just fulfill their obligation at lowest cost (Oxera 2005b). Thus the target or obligation imposed by regulator on electric suppliers, places a restriction on the market size of certificates.

**Targets for renewable purchase**: The targets are progressively increased to allow phasewise growth of renewable electricity. Targets start with 3% for the year 2002 and go up to 15.4% by year 2015 and stay at that level until year 2027. The tenure of RO has been set for 25 years in order to provide long term policy support assurance to renewable generators (Wordsworth and Grubb 2002).

**"Buy-out" route**: While targets have been specified for electric companies, there is a possibility that some electric suppliers would not be able to fulfill their targets. Hence, the RO provides an option for these companies to fulfill their targets by paying "Buy out price" to the regulator, corresponding to the shortfall in achieving their targets, at a rate based on Retail price index (RPI) (LEK 2006). The amount collected by regulator through "buyout price" is distributed among electric suppliers in proportion to the quantum of certificates purchased by

[10] OFGEM stands for "Office of Gas and Electricity Markets"

them, to facilitate renewable promotion (Toke 2007). This allows the supplier with the highest certificate ownership to get maximum share in recycled buyout fund.

**Cost of green certificates:** The size of market for certificates is dependent on the number of certificates to be purchased by electric companies to fulfill their targets. This may however lead to a situation wherein the electric companies may choose between purchasing certificates and pay Buy out price, to fulfill their obligation, based on the cost competitiveness of each option (Smith and Watson 2002). While the cost of certificate is determined by the market, the Buyout price is based on retail price index (RPI). The additional cost of electricity due to this mechanism is passed onto consumers, but limited to the extent of €cents 4.68 /kwh[11] up to 10% of total electricity consumption (Toke 2007).

As this mechanism is based on the concept of least cost generation without according any preference to a specific technology, the certificates from different generators are sold through common auction route. Hence, renewable generators offering certificates at least price are likely to sell all of their allotted certificates. Emphasis on least cost generation obviously favors adoption of well established technologies ahead of the emerging ones (Menanteau et al. 2003).

## 2.2 Performance of Renewable policy instruments

While the policy instruments have shown considerable contribution in terms of promotion of renewable generation in both UK and Germany, analysis of various aspects underpinning their functioning is vital to develop an understanding of their performance. The following sections elaborate on some of the significant aspects influencing the performance.

### 2.2.1 Risk exposure

The perception of risk exposure by renewable developers affects the overall performance of renewable sector, both in terms of capacity addition as well as growth in renewable electricity generation (Mitchell et al. 2006).

**Risk exposure in FIT**: Under FIT, renewable generators are assured of a market to sell their entire electrical output, without any upper limit, at predetermined prices which are set above market prices. This removes the price risk which is generally found in competitive markets due to fluctuation in prices. Price fluctuations in a competitive market may come from introduction of new technologies which are capable of generating power at a lower price (Lipp 2007; Mitchell et al. 2006).

Additionally, volume risk, i.e., risk associated with the uncertainty of finding a sizeable market to sell entire generation may also pose considerable problems for the renewable generators. As the earning potential of renewable generators is dependent on their capacity utilization, hence, any fall in their generation on account of a lower market size will adversely affect their earning potential. Unless the electric companies are mandated to buy the entire RE generation, they might avoid buying renewable electricity because of its higher price (Mitchell et al. 2006).

**Risk exposure in RO**: Under RO, the electric companies may limit their purchase of renewable electricity to just fulfill their minimum specified targets, owing to its higher cost as compared to conventional electricity. In such case, the renewable generators face the possibility of getting exposed to volume risk and lower capacity utilization, especially if there is

[11] 1 UK pound has been considered equivalent to € 1.56

overcapacity in renewable generation sector. Hence, restriction in the market size due to quotas, may lead to a drop in their revenue earning potential (Mitchell et al. 2006).

The renewable generators are also exposed to price risk, as price of renewable electricity is likely to decline due to technological learning, as well as increase in number of renewable generators (IMECHE 2007). As a result, the electric companies may be reluctant to enter into long term power purchase contracts with renewable generators in the hope of taking advantage of falling prices in forthcoming years. This, in turn creates problem for new renewable generators, as they need to show long term power purchase contracts to financial institutions in order to get loans at favorable interest rates (Toke 2007; Hain et al. 2005).

### 2.2.2 Effectiveness in terms of Renewable growth

**Renewable growth under FIT**: In Germany, the renewable electricity generation grew from 3.4% of total consumption in 1990 to 12% in 2007, equivalent to 74 TWh. The renewable target of 12% of total generation was achieved in year 2007 itself, three years ahead of its scheduled time of 2010 (BMU 2007a). The performance with respect to target achievement also depends to a large extent on the estimation of target, which is done by the Government. Proper estimation of renewable potential, realistic growth rates and optimum level of tariff for the renewable generators are some of the crucial factors key to achievement of targets (Klein et al. 2007).

**Renewable growth under RO**: In UK, the renewable generation grew from 1.8% of total consumption in 2002 to 4% in year 2005, equivalent to 16919 GWH (OFGEM 2005 b). The figure representing the growth in renewable capacity in UK is presented in appendix-7 .However, the renewable sector could not achieve the targets. Against a target of 4.9% in year 2005, the achievement was 4% of total electricity consumption (OFGEM 2005a). This underachievement of target may be explained by the fact that there is a perverse incentive associated with under-generation, in order to maintain the price of certificates at a high level. If renewable generators continue to generate in excess of minimum market requirement, this may lead to decline in price of certificates (Mitchell et al. 2006). In essence, the minimum target for renewable procurement specified under RO, acts as a ceiling on the market size of renewable electricity, in case excess renewable capacity is available.

### 2.2.3 Cost Effectiveness

**Cost effectiveness under FIT** : In Germany, the average cost impact for renewable on consumer was 0.7 €cents/ KWh in year 2006, out of a total of 19.4 € cents/ Kwh, which is around 3.6% of the total cost. This impact of renewable on power cost is expected to decline, with advancement in renewable technology and corresponding reduction in generation cost as these are factored in while specifying tariff under FIT (BMU 2007a).

FIT has been pointed out for promoting renewable electricity at a higher cost, as it is not based on the concept of least cost generation (Toke 2007). By providing fixed tariff to renewable generators, the FIT moves away from the principle of competition in the market, which may hamper the process of innovation and the need to reduce costs. However, it is also felt that fixed tariff actually encourages the renewable developers to go in for technological development so as to reduce their production cost and improve profit margin. Hence, the tariff setting process under FIT should be dynamic, to maintain consistency with the ongoing technological developments (Meyer 2003).

**Cost effectiveness under RO:** Under RO, the cost of renewable power is determined by the market, based on the size of target vis-à-vis supply of renewable power. The idea of having market based structure in RO is to ensure that the renewable sector is promoted in the most cost effective way and the burden on consumers is kept at the lowest possible level (Toke 2007; Linden et al. 2005). As electric companies procure renewable power from least cost generators, therefore the prices are expected to decline in case supply exceeds demand (Toke 2007). Further, price is also influenced by the magnitude of penalty imposed on electric companies for not fulfilling the targets. The electric companies may choose to pay through buy-out route instead of purchasing renewable certificates, if that turns out to be more economical (Smith and Watson 2002).

The buyout price is linked to the Retail price index (RPI) of the country (Oxera 2005a). Therefore, the impact of renewable purchase on the overall electricity price is dependent on both certificate price as well as RPI. The cost of certificates was about €62.5/ MWh in year 2006, and the buyout price was around €49/ MWh. As the payment made in the "buy-out" fund to the regulator is recycled back to the electric companies, in proportion to their certificate procurement, the resulting impact of renewable on cost of electricity is determined by two factors; the proportion of target met through certificates and the proportion met by payment in buy-out fund. The RPO has however been pointed at for its operational complexity (LEK 2006).

### 2.2.4 Growth in multiple renewable source options

**Growth in multiple renewable source options under FIT**: Cost of renewable electricity generation is significantly influenced by the source used for harnessing power, which is addressed under FIT through tariff differentiation. Accordingly, emerging RE technologies are assured higher tariff as compared to established RE technologies, which addresses the risk concerns of renewable developers towards investing in emerging technologies (Lipp 2007). This mechanism coupled with appropriate supporting policies, have promoted growth in multiple renewable sources (Mitchell et al. 2006). For example, the "100000 roof program for solar cells" in Germany aimed at promoting solar photo voltaic, has resulted in considerable capacity addition (Hoffmann 2006; BMU 2007a).

**Growth in multiple renewable source options under RO**: As discussed, the RO is based on the concept of promoting least cost generation to make the entire system cost effective (Toke 2007). While it is aimed at reducing burden on consumers, the least cost approach literally comes in the way of capacity addition in emerging technologies, whose generation cost is higher than established technologies (Menanteau et al. 2003). In UK, the renewable growth has been mostly concentrated in land fill gas segment and onshore wind power projects. As landfill sector has been exploited close to its fullest potential, there is an enhanced interest in wind sector (Oxera 2005a). As in year 2004-05, close to 70% of total annual capacity addition was in onshore wind sector and 12% in landfill gas sector, which shows concentration of renewable growth in select few renewable options (BERR 2007).

## 2.3 Importance of design of policy instrument

The German Feed-in tariff (FIT) has been credited with providing the renewable developers protection against risk exposure, which has contributed in a big way in promoting renewable electricity. The relatively better performance of wind power sector in Germany in comparison to UK, in-spite of UK having the best wind potential in Europe is generally cited as one of the examples to justify the better performance of price based system (Meyer 2003). On the other hand, the German FIT system has been pointed out for reducing the need to cut down generation costs by providing fixed tariff, which reflects on its cost effectiveness (Toke 2007). In this regard, quota based RO in UK, with the underlying concept of least cost generation, strives to make the system most cost effective (Lipp 2007).

Given the difference in performance of the two systems, as discussed in section-2.2, the role played by design of the policy instrument becomes prominent. As per Dinica,V. (2006), well designed policy is crucial to the growth of renewable sector. The performance of a renewable policy, whether price based or quota based, is significantly influenced by its ability to address the risk and profitability concerns while factoring in regional realities. The variability in risks associated with factors like, resource availability, reliability of technology, approval of plans, regulatory stance and interest rates, can significantly influence the rate of renewable growth (Dinica 2006). Even with same kind of public financial support, difference in risk exposure can produce different type of results. Improvement in power supply systems like grid extension for connecting renewable projects and addressing the local resistance of people are also factors which influence the growth of renewable capacity significantly (Reiche and Bechberger 2004). Hence, there is a need to take holistic view of the issues specific to the region while designing policy instrument for that region.

## 2.4 Relevance of policy instruments at various stages of market development

Midttun and Gautesen (2007), while elaborating on the role of different renewable promotion schemes, highlighted their relevance in various stages of market transformation. As the renewable market passes through different stages of maturity, specific renewable policies are required for each stage. The following figure depicts the different stages of market development along with the applicability of policies at each stage.

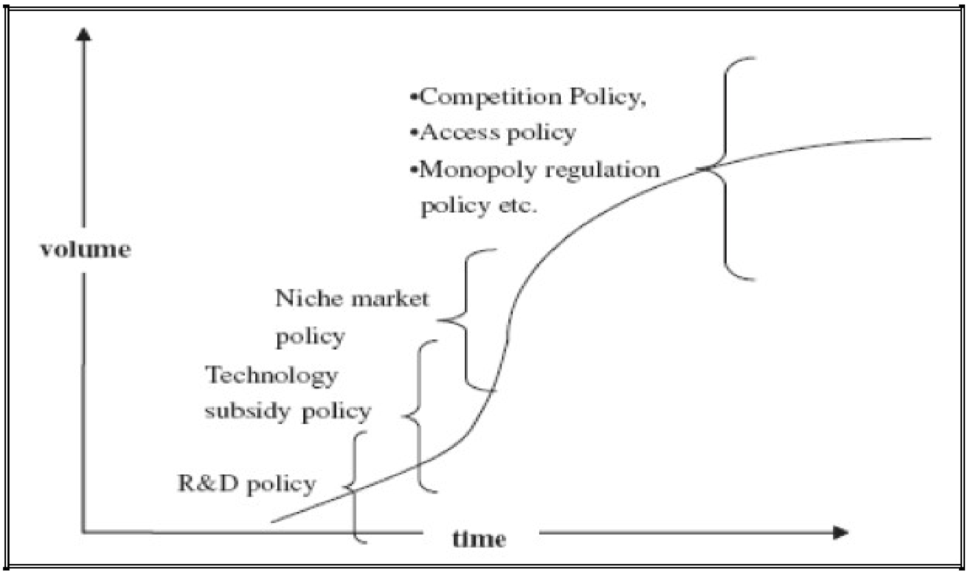


*Figure 2-3: Policy instruments applicable in various stages of policy cycle*

*(Source: Midttun and Gautesen 2007)*

While research and development (R&D) policies are required during the early innovation stage of market development, feed-in tariff (FIT) policies could be employed in the subsequent stage to continue the momentum generated in the initial innovation stage. As FIT supports various technological pathways through targeted measures, like separate tariffs for each technology, it could be helpful in bringing them to an uniform level of competitiveness(Midttun and Gautesen 2007). During FIT stage, some of the technologies are expected to mature to an extent, whereby they could start operating in niche markets supported by certificate-based systems. At this stage, FIT policies could be followed up by certificate/quota based policies, wherein renewable technologies would be allowed to compete among themselves, which would further accelerate their commercialization. This cross-technology competition would prepare the renewable technologies for the next stage wherein they would be able to compete with conventional technologies in regular energy markets without any policy support, under open competition policies (Midttun and Gautesen 2007).

Therefore, different policy instruments have a specific role to play in taking the renewable market through various stages of development, which make them complementary to each other. The policy instruments need to be designed in a way such that they address the specific requirements of the stage they are intended for (Lipp 2007). Further, the timing of introduction of the policy instruments with respect to maturity of renewable technologies needs to be carefully worked out, to ensure consistency in various stages of market development (Midttun and Gautesen 2007).

# 3.0 Policy support for Renewable electricity in India

## 3.1 Development of policy support for Renewable initiatives

Realizing the need of renewable energy, the Government of India set up a dedicated department called "Department of Non-Conventional energy sources" (DNES) within the central Government in 1982. Later, the Indian Government upgraded the DNES to the "Ministry of Non-conventional Energy Sources" (MNES[12]) in the year 1992. The MNES is responsible for the overall planning, program formulation and overseeing the implementation of various renewable programs (Boparai 1998).

The initial programs for renewable energy promotion were designed to address the energy needs arising out of the rural energy crisis. The focus of these programs was on off-grid renewable electricity promotion based on supply-push concept (Ghosh et al. 2002), wherein, cash subsidies were extended for promotion of renewable technologies. However, various factors like budget limitations and poor selection of technologies, led to failure of many of these programs. With the onset of economic liberalization process in India, the MNES in 1993-94, re-oriented these programs from subsidy based approach to commercial based approach. These programs were aimed at improving the performance of renewable projects. Accordingly, combination of fiscal and financial incentives like, tax concessions, duty waivers, better repayment schedules and attractive interest rates, were used to promote renewable technologies (Iniyan and Jagadeesan 1997; Deo and Modak 2005). As per commercial based approach, the MNES set the price of renewable electricity from various renewable sources at an uniform rate of €cents 3.75 per KWh, considering 1994-95 as the base year (Deo and Modak 2005). This was the price at which the state owned distribution licensees had the option to buy power from renewable generators. Further details of the tariff are presented in appendix-1.

Considering the high initial costs associated with the renewable technologies, the Government of India set up a financial institution called Indian Renewable Energy Development Agency (IREDA), with the exclusive aim of financing and developing renewable energy projects in the country (Garg and Adhikari 1998). IREDA tied up with international financial institutions like, The World Bank, to offer program specific financial and technical assistance to a broad range of stakeholders including project developers, equipment manufacturers and suppliers, in sectors like wind, solar photovoltaic and small hydro. Financial support was extended to renewable developers in the form of loans at favorable interest rates. For implementing the renewable promotion programs of MNES at state level, nodal agencies were created in the states (Bakthavatsalam 1999). Details of fiscal benefits for renewable sector are presented in appendix- 1.

## 3.2 Development in regulatory frameworks and its influence on Renewable sector

The electricity sector in the country has been undergoing significant transformation since the early 1990s with the aim of improving the commercial viability of distribution utilities (Singh 2006). This started in year 1991 with the modification of the Electricity Supply Act of 1948, whereby the private sector entities were allowed to build power plants or Independent Power Projects (IPPs) (Banks et al. 1998). This was followed by the introduction of Electricity

[12] MNES is presently known as Ministry of New and Renewable Energy (MNRE).

Regulatory Commissions Act, in 1998, which mandated formation of regulatory commissions[13] at Central and state Government levels. Thereafter, Electricity Act 2003 (EA 2003), was introduced which consolidated the policy instruments of most segments of power sector, including generation, transmission, distribution, trading and usage (Kulkarni and Mukherjee 2006). The significant aspects of EA 2003 including its relation to renewable sector are discussed in the following sections.

### 3.2.1 Electricity Act 2003

In continuation of the restructuring exercise, the Government introduced Electricity Act 2003 (EA 2003) in year 2003, which primarily focused on unbundling of the power sector by separating and segmenting different parts of power sector and setting rules for commercial interface between them (Bhattacharyya 2007). Among the various areas that were addressed, those pertaining to competition, protection of consumer interests, rationalization of tariff, promotion of renewable electricity and constitution of regulatory commissions[14] were given prominence (MOLJ 2003).

Understandably, this Act aimed at unbundling of power sector through bifurcation of generation, transmission and distribution segments, and introduction of competition by providing more supply options to consumers (Deo and Modak 2005). This Act also aimed at promoting and sustaining private investment in the electricity sector, including renewable generation (MOLJ 2003). Under EA 2003, the generation business was de-licensed, which meant that any party could set up a conventional/ renewable power plant without a license, except for hydro sector (Deo and Modak 2005).

### 3.2.2 Provision of renewable promotion in EA 2003

As is evident from the above, the Act promotes least cost power generation, which could have gone against the interests of renewable developers, owing to their higher cost of generation when compared with conventional power sources. Hence there was a need for special treatment of renewable based generation, which was addressed by the Act through separate principles for promotion of grid-connected renewable based electricity. Under Section 86 (e) of EA 2003, the functions of State Electricity Regulatory Commissions are stated as

> *"promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution license."*

(Source: MOLJ 2003)

As can be seen from the above excerpt, the Act, while stressing on the promotion of renewable energy does not specify quantitative targets and leaves it to the respective state regulatory commissions to establish targets, based on regional considerations, like renewable potential, technological maturity and grid connectivity (Kulkarni and Mukherjee 2006). As per

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[13] Regulatory bodies are referred to as regulatory commissions

[14] Regulatory bodies or commissions were to be created both at Central and State level. Accordingly, at central level, the commission was named as "Central electricity regulatory commission (CERC)". In Maharashtra, at state level, the commission was named as "Maharashtra Electricity Regulatory Commission" or MERC.

the Act, the targets for renewable electricity procurement for a distribution licensee[15] could be specified as a percentage of its total electricity consumption, which underlines its similarity to "quota based" renewable policy instrument discussed in section-2.1.

### 3.2.3 National Electricity policy and National Tariff policy

Based on the principles outlined in EA 2003, the National Electricity Policy (NEP) was introduced in year 2005, followed by National Tariff Policy (NTP) in 2006. The NEP and NTP specify guidelines for overall development of power sector while ensuring safeguard of consumer interests through reasonable user charges. As part of the NEP, National Electricity Plans will be made every five years. While making the plans, due consideration would be given to economic, environmental and energy security performance of various alternatives (MOP 2005). NEP and NTP are based on EA 2003 and therefore complementary in nature. The significant features of both the policies in the context of renewable sector are presented below:

**Targets for renewable procurement:** The state level regulatory commissions are supposed to specify targets for distribution licensees for procurement of renewable electricity, as a percentage of their total consumption. The targets would be based on the renewable potential in the state and its impact on retail price of electricity chargeable to consumers (MOP 2006). Thus the policy addresses the variability in renewable potential across different states of the country.

**Stress on improving competitiveness of renewable electricity:** Emphasis is laid on reduction in capital cost and generation cost of renewable projects through competition among renewable generators in order to improve the competitiveness of renewable sector against conventional fossil based sector. Further, the policies stress on using the concept of "competitive bidding" by distribution licensees for procurement of power from renewable generators (TERI 2007; MOP 2006).

**Tariff for supporting renewable electricity:** Recognizing the need to support renewable electricity till it becomes competitive in comparison to conventional electricity, the policy allows for introduction of appropriate differential in prices between renewable electricity and conventional electricity by providing preferential prices for renewable electricity. The state regulatory commissions are supposed to specify preferential tariffs for renewable electricity in their respective states (MOP 2006). This is significant in view of the fact that renewable generation from most of the technologies is still not in a position to compete with conventional power on price front in many states. The operational significance of preferential price is elaborated in section- 5.4.4.

**Safeguard of consumer interests and reduction in regulatory risks:** The policy aims to protect the interest of consumers by ensuring reasonable and competitive price of electricity. Towards this, the policy suggests that return on investment of the generation companies should be balanced such that it addresses consumers' interests as well. Additionally, it specifies that benefits arising out of lower cost of generation after the assets have fully depreciated, should be passed on to consumers by way of reduced tariff (MOP 2006). Further, the policy aims to bring in transparency in regulatory processes and promote consistency in the policies to minimize risk perceptions about regulatory approach (Thakur et al. 2004).

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[15] Distribution utility or distribution company is referred to as distribution licensee.

**Benefits of competition in electricity market:** The NTP appreciates the fact that potential benefits of competition among renewable generators could be realized only when the markets are mature enough to support them. This would require adequate number of renewable generators in the market along with ample supply of renewable power (MOP 2006). In case of power shortage scenario, open markets will favor the power generators and will be unable to support competition in the practical sense.

**Support services for renewable generation:** The state level regulatory bodies are supposed to ensure supporting services for renewable generators, like grid connectivity and open access of networks, so that the generators could exercise the option of selling power to such consumers who offer them the best deals (MOP 2005). The concept of Open Access is detailed in the following paragraph.

**Provision for Open Access (OA) among consumers and generators:** The NEP stresses on providing Open access in transmission and distribution networks for both generators and consumers, in order to promote competition. The consumer and the generator may be connected to different electricity networks, yet they can buy or sell power by using the intervening electricity networks under the Open Access system. This facility is provided to the consumers and generators under the provision of “third party sale” and “open access” of transmission/ distribution lines (MOLJ 2003; MOP 2005; MOP 2006).

The open access system is expected to provide wide range of options to consumers as well as power generators, for buying or selling of power, on better economic terms. This is expected to open up options for renewable generators for choosing between distribution licensees to sell their generation (Thakur et al. 2004). Previously, the renewable generators were restricted to sell their power to that distribution licensee, who provided them with grid connectivity. However, in order to avail open access of networks, either the generator or the buyer has to pay for the wheeling charges and losses[16] occurring in the intervening networks (MOP 2006).

[16] When electricity is transmitted through transmission/ distribution network, the network operators levy charges for using their network in the form of transmission/ wheeling charges (fixed charges). Further, some amount of electricity is lost as heat depending on the actual amount of energy transmitted (variable charges). The combination of wheeling charges and energy losses are to be borne by either the generator or buyer of electricity.

# 4.0 Electricity scenario in Maharashtra

Maharashtra, with a population of about 96 million[17], accounts for almost 9% of the country's population and occupies a place of prominence in the economic and political landscape of the country (DES 2007). With a land area of 308000 square kilometer, it is the third largest state in the country. It is also known as the industrial power house of India accounting for almost a quarter of the gross industrial output of the country (MMRDA 2007). Mumbai is the capital of Maharashtra and is located on the western coast of the state as can be seen in the map presented in appendix- 8. With a population of around 12 million, it is one of the biggest cities of the country (MMRDA 2007).

## 4.1 Electricity demand and supply

Given the burden of growing population on one hand and high economic growth rate on the other, the power sector has been strained to meet the growing demand. The gap between supply and demand of electricity has been rising continuously due to rapid growth in electricity demand and decline in public sector investments in power sector with the onset of market liberalization since the early 1990s (DES 2008).

The figure 4.1 shows the decline in capacity addition rate in power generation sector.

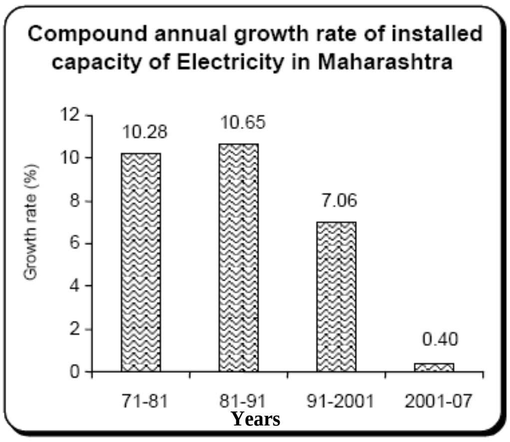


*Figure 4-1 Capacity addition trend in Maharashtra*

*(Source: DES 2008)*

The electricity consumption of the state in the year 2006-07 was around 62085 GWh, an increase of around 4.7% over the previous year (DES 2008). In 2006-07, against a demand of 110005 GWh, the availability was 89138 GWh indicating a shortfall of around 19% on energy. The shortfall in meeting peak demand during the same period was 27.4% against a peak demand requirement of 17455 MW (CEA 2007). The figure- 4.2 shows the rising trend of gap between demand and supply in Maharashtra.

[17] As per population census carried out in year 2001. Population census is carried out once in 10 years.

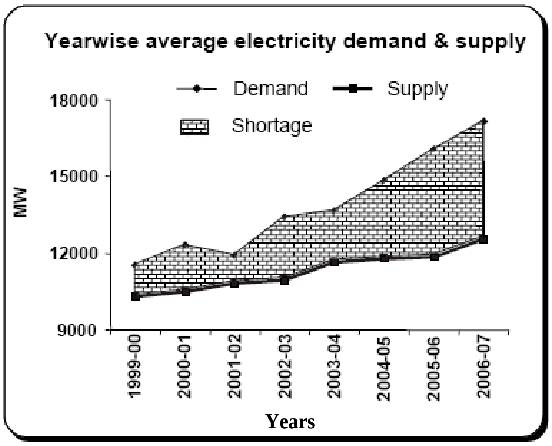


*Figure 4-2 Electricity demand and supply*

*(Source: DES 2008)*

While the state is trying to meet its burgeoning demand by importing power from other states, it is also resorting to power cuts on consumers to quell the demand (MERC 2007 l). Given the drop in capacity addition rate, as presented in figure-4.1, the role of renewable sector in meeting the growing electricity needs of the state becomes even more significant.

## 4.2 Renewable electricity scenario in Maharashtra

The renewable energy sector in Maharashtra has grown considerably in the last decade, owing to favorable central Government policies and consistent efforts of the MEDA[18] at state level. The total installed grid connected renewable generation capacity was around 1980 MW in September 2007 (MEDA 2008b). The table 4.1 presents the renewable electricity potential in Maharashtra.

*Table 4-1 Renewable electricity potential from grid connected sources in Maharashtra*

*(Source: MERC 2006 a)*

| S. No. | Renewable source | Available Potential (MW) - As per MNES | Installed capacity as on July 2006 (MW) |
|---|---|---|---|
| 1 | Wind | 4138 | 1001 |
| 2 | Small Hydel plants (SHP)* | 599 | 206 |
| 3 | Co-generation | 1250 | 74 |
| 4 | Biomass | 781 | 14 |
| 5 | MSW** and liquid waste | 287 | 0 |
| 6 | Industrial Waste | 350 | 6 |
| | Total | 7405 | 1301 |

* Below 20 MW capacity, ** Municipal solid waste

[18] MEDA stands for Maharashtra Energy Development Agency

As can be observed from the above table, wind sector is the biggest contributor in terms of installed capacity. The wind sector accounts for about 77% of the total renewable generation capacity in Maharashtra as in July 2006. In terms of balance potential available, wind sector alone has a potential of around 3137 MW which is about 51% of total balance potential in the entire renewable sector of Maharashtra (MERC 2006a).

In the cogeneration sector, the state has a substantial renewable generation potential in sugar industries. There are almost 185 sugar industries in the state, with a combined generation potential of 1250 MW. Against an installed capacity of 74 MW in July 2006, the capacity increased to 159 MW by December 2007 from 18 projects (DES 2008). In the year 2007-08, the capacity addition was 60.5 MW (MEDA 2008c).

Biomass sector offers a potential of 781 MW in the state. While the installed capacity of biomass based project was around 14 MW in July 2006, it grew to about 333 MW by January 2008 (MEDA 2008d). The issues concerning development of Cogeneration and biomass sectors are discussed in section-6.3.2.3.

Given the higher potential available in wind sector as well as its technical maturity over other sectors, renewable developers have shown more interest in wind sector as compared to other sectors (TERI 2006c; CTA 2007; Maurya, 2008 March PC). Considering the lead role played by wind sector in capacity addition, the functioning of wind sector has been analyzed in greater detail in chapter 6.

## 4.3 Main institutions involved in regulation and promotion of renewable electricity sector

### 4.3.1 Maharashtra Electricity Regulatory Commission (MERC)

MERC was set up under the Electricity Regulatory Commission Act 1998, to oversee the reform in power sector and decide upon issues related to electricity pricing and economic management of the power sector in a transparent manner (Deo and Modak 2005). Apart from introducing various tariff policies for different renewable sources, MERC introduced the renewable policy instrument, called Renewable purchase obligation (RPO) in year 2004 followed by Renewable Purchase Specification (RPS) in year 2006 (MERC 2004a; MERC 2006a).

### 4.3.2 Maharashtra Energy Development Agency (MEDA)

MEDA, a body under the Government of Maharashtra, was created in the year 1986 with the objective of promoting renewable energy sources and undertaking energy conservation initiatives in the state, under the aegis of the MNES[19] (Zagade, 2008 March PC). With regard to the promotion of grid connected renewable electricity sources, the agency is responsible for implementation of the policy instruments introduced by the MERC. MEDA was entrusted with the responsibility of developing operating and compliance mechanisms and facilitating interaction between different stakeholders, for implementing the policy instruments (MERC 2006 b; MERC 2007b).

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[19] MNES is the apex controlling body of MEDA. ( http://www.mahaurja.com/ )

# 5.0 Policies for promotion of renewable electricity in Maharashtra

The policies for promotion of grid connected renewable electricity in Maharashtra underwent a series of changes in consonance with changes in the policies of MNES, since 1990s. The promotional policies initiated by MNES at the centre were executed by the nodal agency, "Maharashtra Energy Development Agency" (MEDA) at state level (Zagade, 2008 March PC).

The following sections start with the discussion of tariff policies followed by renewable policy instruments introduced by MERC. The tariff policies specify the tariff for renewable electricity from different renewable sources. The renewable policy instruments draw the tariff values from different tariff policies/ orders to decide upon the selling price of electricity from different renewable sources. An example of the relationship between tariff policy (wind tariff policy) and renewable policy instruments is given in appendix- 5.

## 5.1 Tariff policies for renewable electricity

As discussed in section- 3.1, the MNES fixed a common price for renewable electricity from all sources, taking 1994-95 as the base year (Deo and Modak 2005). While most of the state regulatory commissions in the country adhered to the tariff of renewable electricity set by the MNES at central Government level, very few state regulatory bodies, which included MERC, opted to modify the renewable tariff by factoring in the regional characteristics of renewable sector. The MERC issued separate tariff policies/ orders for electricity from main renewable sources, starting with tariff policy on "Non-fossil fuel based cogeneration", in year 2002 and "Wind energy" in year 2003 (WII 2005; MERC 2003). Details about the validity of tariff policies for various renewable sources are given in appendix- 2.

In the Wind energy tariff policy, tariff rates and time length of tariff policy was differentiated based on the date of commissioning of wind projects. The wind projects were accordingly categorized into three different groups; Group-1 for projects commissioned before 27$^{th}$ December 1999; Group-2 for projects commissioned between 27$^{th}$ December 1999 and 31$^{st}$ March 2003; and Group-3 for projects commissioned after 31$^{st}$ March 2003. The tariff was differentiated for the groups in order to factor in technological improvements and variance in tax benefits available to the projects belonging to different groups (Deo and Modak 2005). Details about grouping or classification of wind projects are presented in appendix- 3.

## 5.2 Renewable policy instruments in Maharashtra

According to the EA 2003, the State electricity regulatory commissions (SERC) are supposed to devise long term plans for facilitating development of renewable projects in their respective states, by specifying targets to the distribution licensees with regard to purchase of renewable electricity as percentage of their total consumption (MOLJ 2003). The MERC decided to take a complete view of the existing contractual agreements of energy purchase by the licensees and other policies related to renewable energy purchase, before working out a long term policy instrument. As this could have taken considerable time, the MERC started by introducing "Renewable Purchase Obligation" (RPO) in 2004, which addressed the immediate concern of allocation of responsibility among the distribution licensees pertaining to purchase of renewable electricity (MERC 2004a). In a way, the RPO served as a temporary policy instrument till a long term instrument was prepared.

Thereafter, in year 2006, the MERC replaced the RPO with "Renewable purchase specification" (RPS), after working out the long term requirements of renewable sector (MERC 2006a). The salient features of these instruments and underlying principles are elaborated in the following sections.

## 5.3 Renewable purchase obligation (RPO), 2004

The following sections present the significant features of the RPO.

### 5.3.1 Applicability of RPO

Under the RPO, the distribution licensees are obliged to buy the entire renewable electricity (RE) produced by the generators located in their respective coverage areas. The cost of RE purchase would be shared among all licensees at the end of the accounting year, through financial settlement (MERC 2004a). The settlement process would involve allocating the cost of renewable electricity to each licensee in proportion to the total energy purchased by the respective licensee, during the accounting year (Rao, 2008 March PC).

### 5.3.2 Tariff for different renewable options

The price at which the distribution licensees would purchase renewable electricity from the generators is fixed according to the tariff mentioned in existing tariff policies applicable for different technologies (Rao, 2008 March PC; Rokade, 2008 Feb. PC). For example, the tariff for wind power given in the Wind Energy Tariff order, 2003, would be used for setting the price for wind power under the RPO. The relationship between the wind tariff policy of 2003 and the RPO is presented in appendix- 5. The cost of renewable purchase by distribution licensees is supposed to be passed on to the consumers, through sale of electricity (Rokade, 2008 Feb. PC).

### 5.3.3 Operating mechanism of RPO

RPO required the distribution licensees to purchase the entire renewable generation from all renewable generators coming under their respective service areas. As the amount of renewable electricity purchased by distribution licensees could vary depending on the concentration of renewable generators in their respective areas, the RPO required the licensees to share the total cost of renewable electricity purchased by them in proportion to their respective energy consumption, at the end of the accounting year (Rao, 2008 Feb. PC; Rokade, 2008 Feb. PC).

The driver for renewable growth under RPO is the fixed price offered to renewable generators and also the mandate of purchase of their entire generation by the distribution licensees (Rokade, 2008 Feb. PC). This provides renewable generators higher degree of certainty about the sale of their generation.

The figure-5.1 illustrates the operating mechanism of RPO:

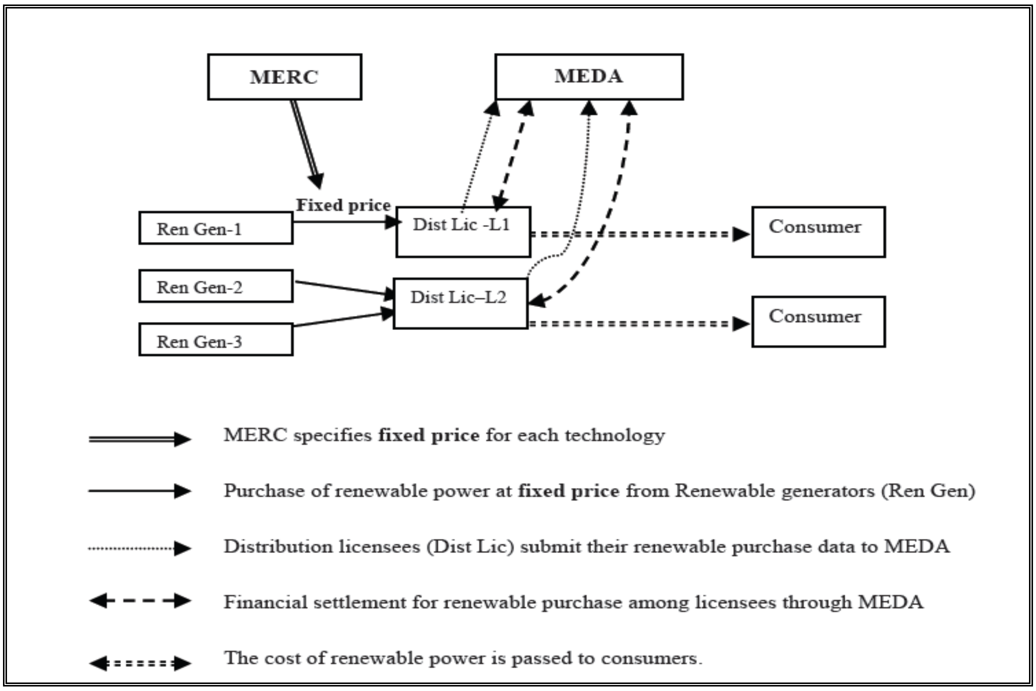


*Figure 5-1 Schematic diagram of operating mechanism of RPO*

*(Source: Rao, 2008* Feb. PC*)*

In the above figure, the distribution licensees (shown as Dist Lic) purchase renewable power from the renewable generators (shown as Ren Gen), located in their respective areas, at a fixed price. The MERC fixes the price based on the existing tariff orders, as discussed in section 5.3.2. As distribution licensee L2 has two renewable generators in its area, it buys renewable power from both of them. Similarly, L1 buys from one generator located in its area. At the end of the accounting year, the licensees report the data of RE[20] purchase and total energy purchase[21] to MEDA. Thereafter, MEDA calculates the total cost of RE purchase of all licensees and distributes the cost to each licensee in proportion of their total energy purchase. Thus, the cost of renewable purchase in the state is distributed among the licensees at the end of the accounting year (Rao, 2008 Feb. PC).

The RPO considers renewable electricity produced by generators located within the state, for sharing the cost of renewable electricity among the licensees (MERC 2004a).

### 5.3.4 Sources of renewable electricity

The distribution licensees are mandated to purchase renewable generation from such grid connected renewable sources, which are approved by the MNES. Accordingly, generation from renewable sources like wind, biomass, small hydro, bagasse based cogeneration and solar energy are eligible under the RPO system (MERC 2004a).

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[20] RE stands for Renewable electricity

[21] Total electricity purchase means summation of purchase from various sources including renewable and non-renewable.

### 5.3.5 Support infrastructure and consistency with previous policies

In line with the previous tariff policies for wind and cogeneration based projects, the cost of erecting new power evacuation facilities on transmission system for providing grid connectivity, is to be borne by the respective transmission network operator, which may be recovered through the cost of service provided by them (MERC 2004a).

## 5.4 Renewable purchase specification (RPS), 2006

The RPO was replaced by the RPS in year 2006, to introduce target based renewable purchase specification, as required under The Electricity Act 2003. The RPS specifies targets for purchase of renewable electricity by consumers, corresponding to a certain percentage of their total energy input from recognized sources of grid connected renewable electricity (MERC 2006a). The RPS emphasizes on growth of renewable electricity at a competitive cost to consumers, and therefore stresses on least cost generation in the renewable sector (MERC 2006a). The details of consumers, who are required to fulfill the mandate of RPS, is presented in section- 5.4.1 and details of renewable sources, covered under the RPS is given in section- 5.4.2.

The significant features of RPS instrument are presented below:

### 5.4.1 Applicability of targets for "Eligible persons"

The electricity consumers who are supposed to fulfill the mandate of renewable procurement under RPS are termed as "eligible persons" or consumers. Electricity consumers can be broadly categorized into three different categories, depending on their mode of purchasing electricity (MERC 2006b; Rao, 2008 Feb. PC; Rokade, 2008 Feb. PC).

- **Distribution licensees**: Most of the consumers buy power from distribution licensees; and the distribution licensees buy power from generators. Therefore, the distribution licensees act as consumers for the generators.

- **Open access (OA) consumers**: These consumers buy power directly from the generators without going through the distribution licensees. As these consumers use the intervening networks / grid for getting the power transmitted from the generator to their premises, they are called open access (OA) consumers.

- **Captive consumers**: These consumers have their own captive generation units and meet their power requirement, either fully or partially, through self generation. The generation units could be fossil based or renewable based.

The consumers who purchase power from licensees, automatically pay for green power, if the licensees include green power in their portfolio. On the other hand, the Open access consumers, or OA consumers, generally buy power directly from fossil based independent power generators (Pandit, 2008 Feb. PC). Therefore their power portfolio usually does not contain green power. Unless it is specifically mandated for OA consumers to buy green power, they would avoid including green power in their portfolio, as renewable power is generally costlier than conventional power. Similarly, the captive consumers, who generate power from fossil based sources for their own consumption, could avoid buying green power unless it is specifically mandated for them (MERC 2006b; Rao, 2008 Feb. PC).

Hence, in order to ensure that OA consumers and captive consumers also include green power in their portfolio, the RPS mandates these consumers to procure green power corresponding to the targets specified under the instrument (Pandit, 2008 Feb. PC).

### 5.4.2 Sources of renewable electricity

The renewable sources for grid connected electricity as approved by Ministry of Non-conventional energy sources (MNES), Government of India, has been considered eligible for fulfilling the renewable targets under RPS instrument. Accordingly, renewable generation from wind, biomass, small hydro, municipal solid waste and cogeneration (non-fossil fuel including bagasse) are recognized for meeting RPS targets (MERC 2006b).

The RPS also specifies that renewable electricity from only grid connected projects would be considered. Off-grid projects or stand alone systems have not been considered at this stage, as they are located in remote places which pose problems for metering and verification (MERC 2006b).

### 5.4.3 Targets under RPS

The exercise of target setting for renewable procurement by eligible persons/consumers is key to the smooth functioning of RPS. The target setting exercise may need to consider various factors like, annual renewable generation potential, total electricity demand and impact of renewable purchase on the tariff paid by consumers.

Realistic assessment of annual renewable generation potential plays a vital role in the target setting exercise (Sharma, 2008a Feb. PC). As part of target setting, annual renewable generation of previous years, i.e., 2004-05 and 2005-06 were considered to establish annual renewable generation potential for forthcoming years, i.e., from 2006-07 onwards (MERC 2006a; MERC 2006b). The parameters considered for this exercise included annual capacity addition, capacity utilization factor (CUF) or plant load factor (PLF), auxiliary consumption and losses due to transformation, and their values are presented in appendix- 4. The values for the above parameters were considered by the MERC after factoring in the comments of prominent stakeholders, like, renewable generators, consumer representatives, MEDA and distribution licensees through a participatory process (MERC 2006a).

The table-5.1 presents the renewable targets based on projected values of electricity demand and annual renewable generation. Year 2005-06 has been considered as the base year for working out the projected values.

*Table 5-1 Establishment of renewable targets under RPS*

*(Source: MERC 2006 b)*

| **Parameters** | **2005-06** | **2006-07** | **2007-08** | **2008-09** | **2009-10** |
|---|---|---|---|---|---|
| Total electricity demand of State (GWh) | 85207 | 93925 | 96817 | 99804 | 102889 |
| Annual Renewable generation (GWh) | 1704 | 2818 | 3873 | 4990 | 6173 |
| RPS target (%) | 2% | 3% | 4% | 5% | 6% |

### 5.4.4 RPS Operational mechanism and preferential price

Under RPS, the distribution licensees buy renewable power from the generators through competitive bidding. The following figure shows the significance of preferential tariff in the RPS system.

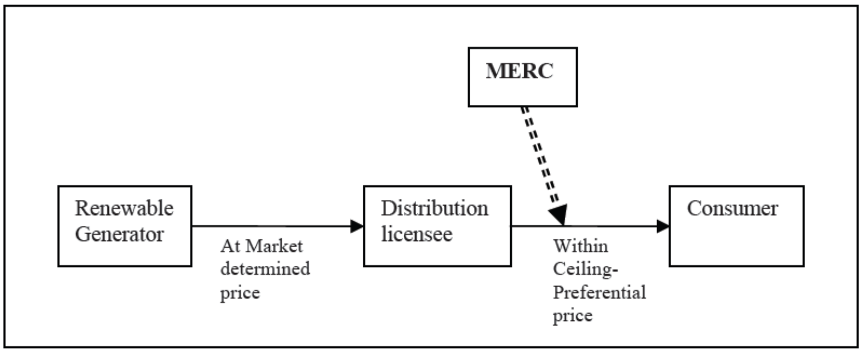


*Figure 5-2 Operating mechanism of RPS*

*(Source: Rao, 2008* Feb. PC*)*

In the above figure, the distribution licensee is supposed to buy renewable power from the generators at market determined price to ensure that renewable power is promoted at least cost (MERC 2006a). This aspect of RPS which involves competitive bidding process is similar to the concept of quota based system of UK, discussed in section- 2.1.2. However, when the distribution licensee passes-on the cost of renewable power to the consumers, through sale of electricity, such cost should be within the preferential price, which acts as a price ceiling (Rao, 2008 Feb.PC). The regulatory commission, MERC, ensures that the distribution licensee complies with the price ceiling while selling power to the consumer. The idea of preferential price is to put a limit on the cost burden that will be passed on to consumers due to renewable electricity. However, if the distribution licensee purchases power at a cost lower than preferential price, then the benefits of lower price is passed on to consumers. The preferential price therefore acts as a price ceiling in the transaction between distribution licensee and consumer.

The preferential price is set by the regulatory commission, based on the existing tariff policies for different renewable options (Patil, 2008b Feb.PC; Rokade, 2008 Feb.PC). The relationship between the Wind tariff policy and renewable policy instruments like RPO and RPS is presented in appendix-5. MEDA, the state nodal agency, is responsible for coordinating the overall implementation of RPS, which includes monitoring of eligible consumers with regard to their achievement of renewable targets (MERC 2006a).

**Consistency with previous tariff policies**: If the tariff rates are changed frequently by the regulatory body, then it may give rise to uncertainty among renewable project developers regarding the selling price of their generation. Therefore, to avoid such regulatory uncertainty, the MERC decided to extend the validity of existing tariff policies for wind and cogeneration sector until 2010 (MERC 2006b). As original tariff policies of small hydro and biomass, were valid until 2010, it was decided to continue with the same before revisiting them for revision (MERC 2006a). One of the arguments in favor of postponing the re-determination of tariff, is that longer experience gained in terms of operational issues, like, capacity utilization factor, would help in making appropriate modifications later (Pandit, 2008 Feb.PC). The applicability of the previous tariff orders within the context of RPS instrument is presented in appendix-2.

### 5.4.5 Balanced growth in all resource options

The RPS order intends to stimulate growth in all renewable options in order to harness the renewable sources to the maximum possible extent (MERC 2006b). Concentration of growth in a select few renewable options may lead to neglect of other renewable options, in terms of lower research activities, which may ultimately delay their commercialization.

Considering the above, MERC evaluated the option of developing technology specific targets for renewable electricity (Pandit, 2008 Feb.PC). However, MERC also appreciated the fact that technology specific targets will increase the complexity of the system, and also increase the administration and compliance costs. Considering that the RPS is in its initial phase of implementation, the MERC felt that technology specific targets may be avoided at this stage (MERC 2006a).

### 5.4.6 Enforcement and Provision of penalty

The RPS mechanism entails procurement of renewable electricity by the "eligible persons" in order to meet their targets. As renewable power is generally costlier than conventional power, there is a possibility that some eligible consumers would avoid buying renewable power. Therefore, to improve the compliance level of eligible consumers, provision of penalty was introduced in RPS (MERC 2006b). The penalty rates corresponding to shortfall in procurement of RE against the targets is presented below.

*Table 5-2 Penalty in RPS*

*(Source : MERC 2006a)*

| **Year** | **Penalty rate**[22] | |
|---|---|---|
| | €cents/ KWh | INR/ KWh |
| 2007-08 | 8.33 | 5 |
| 2008-09 | 10 | 6 |
| 2009-10 | 11.67 | 7 |

**Penalty on renewable generator**: In case eligible consumers had entered into contracts for purchase of such amount of renewable electricity which was sufficient to meet their targets, but could not get the contracted amount of RE due to issues attributable to suppliers/ renewable generators, then the eligible consumers are exempted from penalty (Pandit, 2008 Feb.PC). If it is established that the shortfall in supply of contracted RE is due to poor maintenance of equipments or lack of planning in arranging fuel supply by the generator, then the penalty will be applicable on the renewable generator (MERC 2006b). The penalty amount is supposed to be utilized by MEDA in promoting renewable technologies through research and development activities and capacity building programs in the state (MERC 2006a).

### 5.4.7 Operating period and review of the order

[22] INR stands for Indian Rupees. 1 € has been considered equivalent to INR 60.

The MERC decided to have the RPS valid from year 2006-07 to year 2009-10 and take up the performance review of the policy instrument one year prior to the completion of its tenure, i.e., from the beginning of 2009-10. Experience gained during the intervening period is expected to provide useful inputs, which would help in deciding the future of the policy instrument (MERC 2006a).

## 5.5 Main stakeholders in the renewable electricity sector

The main stakeholders in the renewable electricity sector in the context of renewable policy instrument are identified as the renewable generators, distribution licensees, consumers, the state regulatory commission (MERC) and nodal agency (MEDA) (Rao, 2008 Feb.PC; Rokade, 2008 Feb.PC). The following figure shows the relationship between the stakeholders.

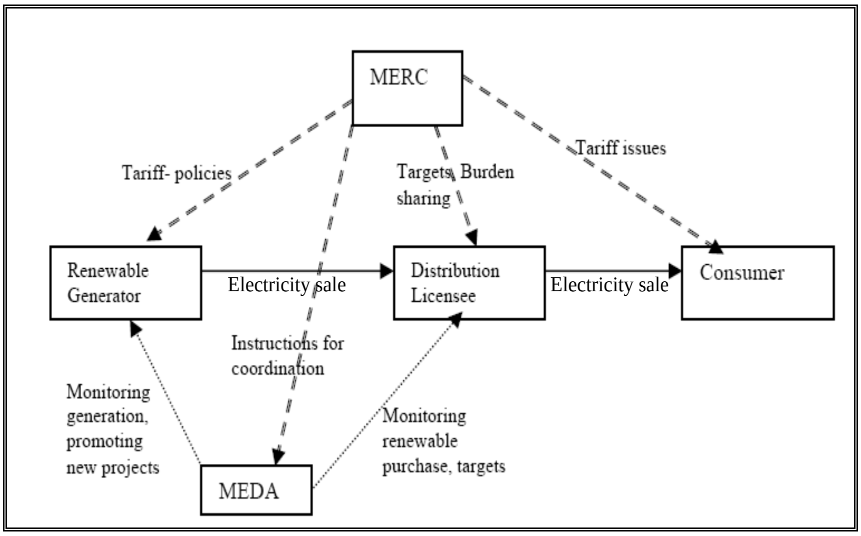


*Figure 5-3 Main Stakeholders in renewable electricity sector*

*(Source: Rao, 2008 Feb.PC)*

The performance of the entire renewable sector is reflected mainly in terms of growth of renewable capacity and the cost for supporting such growth. The distribution licensees buy electricity from several sources including renewable generators. While selling electricity to the consumers, the licensees pass on the cost of RE to consumers. Hence, the consumers bear the financial burden of supporting renewable sector, and the extent of burden is influenced by the performance of renewable generators and distribution licensees (Pise, 2008 March.PC; Rokade, 2008 Feb.PC).

The functioning of generators, licensees and consumers is influenced by the MERC and MEDA in a significant way. While MERC sets the provisions of policy instrument, MEDA performs the role of a facilitator/ coordinator for policy implementation. The following paragraphs elaborate on the roles of MERC and MEDA.

As can be seen from figure 5.3, MERC issues orders covering various aspects of the renewable electricity sector. For the renewable generators, MERC specifies the tariff either in the form of fixed tariff or preferential tariff, depending on the requirement of policy instrument. For distribution licensees, MERC issues orders on associated aspects like grid connectivity and metering provisions. Under the RPO, the distribution licensees were asked to share the burden of renewable purchase, whereas under RPS, the licensees are given targets for renewable procurement. MERC takes into consideration the burden of renewable purchase that would be passed on to the consumers. Further, MERC gives instructions to MEDA about the coordination and implementation of renewable policy instruments (Pise, 2008 March.PC; Rokade, 2008 Feb.PC).

MEDA coordinates with the distribution licensees and renewable generators for implementing policy instruments. MEDA develops operational framework for policy implementation, monitors the renewable procurement by licensees and helps renewable generators in various ways including technical support for new projects, like micrositing studies in case of wind projects (Pise, 2008; Rao, 2008). MEDA also implements the renewable promotional policies of the MNES at state level.

In light of the role played by MERC and MEDA in formulating and implementing the policy instrument, it is felt that the influence of policy instrument on renewable sector is reflected through the influence on key stakeholders, viz., renewable generators, distribution licensees and consumers.

# 6.0 ANALYSIS OF DEVELOPMENTS IN RENEWABLE SECTOR OF MAHARASHTRA

The developments in renewable sector of Maharashtra, under the influence of renewable policy instruments can be categorized into two distinct phases, i.e., from year 2004 to 2006 and from 2006 onwards. The RPO was operational from the year 2004 to 2006, and was replaced by the RPS in year 2006 (MERC 2004a; MERC 2006a). As these policy instruments are structurally different, the developments in renewable sector have been analyzed during their respective regimes.

This chapter starts with the overview of developments in renewable electricity sector in Maharashtra under the regimes of RPO and RPS. This is followed by overview of achievement of renewable targets by the distribution licensees. Thereafter, significant issues that affect the development of renewable sector are analyzed. This is followed by analysis of outcomes resulting from the application of RPO and RPS on renewable sector. Based on the above, the influence of policy instruments on key stakeholders is discussed and the drivers for renewable growth are identified.

## 6.1 Overview of developments in Renewable electricity sector

This sub-chapter starts with the brief overview of renewable electricity generation under the regimes of RPO & RPS, and is followed by analysis of wind power development in the state. Thereafter, power purchase mechanism of distribution licensees is discussed for analyzing the competitiveness of renewable power.

### 6.1.1 Generation of renewable electricity under RPO and RPS

The overall renewable electricity generation in Maharashtra covering all renewable sources during the regime of RPO and RPS, is presented in the following table-6.1.

*Table 6-1 Renewable electricity generation in the state*

*(Source: MEDA 2005; MEDA 2006; MERC 2007g; REL 2008; MERC 2007i ; MERC 2007k ; Deshpande, 2008 Feb.PC)*

| Year | Total Renewable generation (GWh) | Total energy consumption (GWh) | Renewable as % of total energy consumption | Renewable target (% of total consumption) | Renewable Policy instrument |
|---|---|---|---|---|---|
| 2004-05 | 639 | 82207 | 0.78 | *Not applicable | RPO |
| 2005-06 | 925 | 84280 | 1.09 | *Not applicable | RPO |
| 2006-07 | 2127 | 88591 | 2.4 | 3 | RPS |

* Renewable targets were not applicable for the years 2004-05 and 2005-06, as this period was covered under RPO regime.

As observed from the above table, the generation during the period 2004 to 2007, has been increasing in terms of percentage of total energy consumed. While no targets were set under RPO regime, a target of 3% of total energy consumption was set for RE procurement for the year 2006-07, under the RPS regime (MERC 2006a). The achievement was 2.4% against a target of 3% in 2006-07, as can be observed from the above table 6.1.

It is worth noting here that the target of 3% was set by the regulator for the year 2006-07, after consulting various stakeholders like, distribution licensees, renewable generators and MEDA, regarding their views on anticipated renewable capacity addition in the future. During this consultative process, the wind power generators and MEDA opined that these targets could be achieved (MERC 2006a). However, non achievement of targets in year 2006-07, indicates that these stakeholders did not anticipate the issues that could have caused non-achievement of targets (Rao, 2008 March, PC).

Before discussing the issues influencing the achievement of renewable targets under RPS regime, it is felt useful to study the pattern of capacity addition in renewable sector. As discussed in section-4.2, wind sector had a share of 77% of renewable generation capacity in July 2006 and is expected to drive capacity addition in future as well (MERC, 2006a; Maurya, 2008 March, PC). As wind sector has been at the forefront of capacity addition, the following section elaborates on the development in this sector.

### 6.1.2 Wind power development

Generally, sites with mean annual power density of more than 200 Watts/ $m^2$ are considered to be potential sites for wind power projects (DES 2008). Favorable supporting policies by the Government and attractive tariff for wind generation by regulatory agencies have contributed to the growth of this sector (Maurya, 2008 March.PC). The following figure shows the trend of capacity addition in the wind sector.

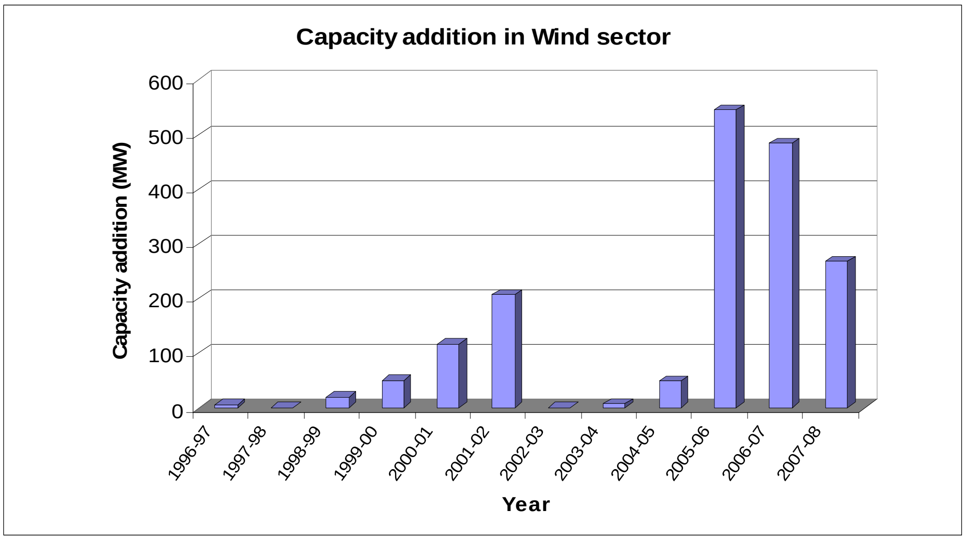


*Figure 6-1 Capacity addition in wind power sector*

*(Source: MEDA 2008a)*

As is observed from the above figure, capacity addition grew at a considerable rate between years 1996 and 2002. However, between year 2002 and 2004, the rate of capacity addition dropped, which may be attributable to the withdrawal of sales tax exemption benefits by the Government (WISE, 2008 Feb.PC).

**Capacity growth trend during RPO regime (2004-06)**: The capacity growth rate started increasing from 2004-05 upon introduction of "Wind energy" tariff order/ policy in November 2003 followed by introduction of RPO in 2004 (WISE, 2008 Feb.PC). While the wind tariff policy provided new tariff rates for wind projects commissioned after March 2003, the RPO provided assurance to the renewable developers about sale of their entire generation at new tariff rates, which minimized the risks related to availability of markets for selling their generation (MERC 2003; MERC 2004a).

The assurance of sale of entire renewable generation is especially significant in view of the incidents, wherein wind turbines had to shut down due to preference of non-renewable generators during conditions of lean power demand. For example, the wind turbines in Tamil Nadu, a neighboring state were asked to shut down, for a few hours every day between April and September due to fall in demand in the grid. During this time period, the fossil based generating plants were kept operational, which shows the preference for fossil based generation over wind based generation (Kamat 2007). As economic viability of renewable projects is closely related to availability of market, the RPO, by assuring market for entire electrical output addressed such concerns and contributed to the growth of wind capacity in the period 2004-06 (WISE, 2008 Feb.PC).

**Capacity growth trend during RPS regime (from 2006 onwards)**: From figure-6.1, it is observed that the rate of capacity growth started declining from the year 2006-07, after RPO was replaced with RPS in August 2006.

### 6.1.3 Overview of power purchase arrangement of distribution licensees

#### 6.1.3.1 Options for power purchase by distribution licensees

The distribution licensees need to purchase power from various power generating stations for meeting the demand of their consumers. However, if the generation capacity available in the state is not able to cope with the demand, the licensees resort to either importing power from utilities outside the state or buying from power traders. In either case, they purchase such power at considerably higher rates, to meet their peak demand (Rao, 2008 March, PC). Broad overview of the various routes available with the distribution licensees for purchasing electricity is presented in the following figure:

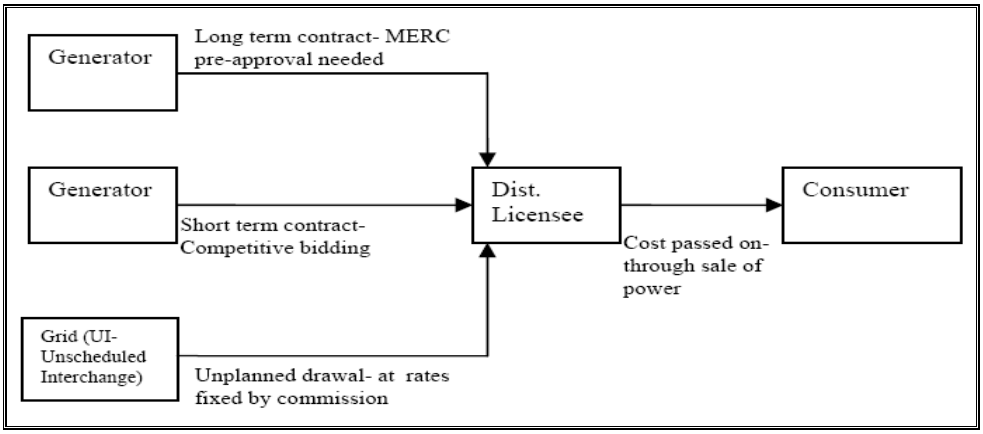


*Figure 6-2 Power purchase options for distribution licensees*

*(Source: Rao, 2008 March.PC)*

**Long term energy contracts**: In the above figure, the long term power purchase agreement (PPA) or long-term energy contracts with the power generators within the state is generally the most economical option for the distribution licensees. The time duration of long term contracts is above 1 year and the cost at which electricity is purchased under this type of contract by the distribution licensee is to be pre-approved by the regulatory commission, i.e., MERC, so that the cost could be passed on to the consumers through sale of electricity. As power purchased through long term contracts is generally the cheapest option for distribution licensees, they generally try to source their maximum requirement of electricity through long term contracts (Rao 2008 Feb.PC).

**Short term energy contracts:** As electricity demand profile is not uniform and difficult to predict over long time frames, it becomes difficult for the distribution licensees to meet their entire power requirement through long term contracts. Thus, they enter into short term contracts with power generators to meet their peak demand requirements. The duration of short term contracts is less than one year, and the cost of power from these contracts is generally higher than cost of power purchased through long term contracts. If the distribution licensee follows the process of competitive bidding for entering into short term energy contracts with power generators, the cost of such purchase need not be pre-approved by the MERC (Rao 2008 Feb.PC). The significance of short term contract through competitive bidding in the context of renewable electricity purchase is further discussed in section- 6.3.1.1, in connection with the approach followed by BEST in meeting renewable targets.

**Unscheduled Interchange (UI)**: As it is difficult to predict the electricity demand accurately over the year, there are instances when the total power purchased through long term and short term contracts is not able to meet the peak demand. During such instances, the distribution licensees draw power from the grid, which is called UI power drawal (MERC 2008d). This power drawal is also referred to as unplanned power drawal as purchase of this power was not contracted beforehand. Ideally, the distribution licensees should avoid drawing UI power as it is unplanned and costly. The cost of UI power is fixed by the Central Electricity Regulatory Commission (CERC), and is generally higher than the cost of power purchased through long term contracts (Dharaskar, 2008 Feb.PC). As CERC sets the cost of UI power, its purchase need not be pre-approved by the MERC (Rao 2008 Feb.PC).

**6.1.3.2 Competitiveness of Renewable power:** With the rise in gap between demand and supply of electricity in the state, the cost of power purchased through short term contracts and UI is becoming costlier than renewable power. If renewable power could be used to even partially replace the power purchased through short term contracts or UI drawal, for meeting peak demand or marginal demand, it would help the distribution licensees in reducing their overall expenditure for power purchase. However, in order to use renewable power for meeting peak demand, renewable power should be available whenever peak demand arises. In other words, the generator should be able to schedule its generation in response to the demand. Biomass and cogeneration based renewable projects are some of the schedulable generators who can partially meet peak demand (Dharaskar 2008 March PC). As nearly 70% of the generation from wind turbines in Maharashtra is during high demand time blocks, the wind sector also contributes in meeting peak demand to a limited extent, though they are not schedulable in nature (TERI 2004).

Thus the rising gap between demand and supply in power sector is improving the competitiveness of renewable power against conventional power bought at margin[23]. In 2004, when RPO was being introduced, MSEDCL had requested the MERC that the burden of renewable power be distributed among all licensees to ensure equity (MERC 2004a). Obviously, the cost of renewable power was higher than the cost of conventional power

[23] Power bought at margin refers to power bought for meeting peak demand.

purchased through either long term or short term contract in 2004. However, by the year 2006, the MERC while introducing RPS instrument noted that renewable power had become economically more attractive than conventional power bought at margin (MERC 2006a). For example, MSEDCL in year 2006-07, planned to buy 3504 GWH at the rate of €cents 6.67/ kwh from power trading companies for meeting peak demand, while the weighted average cost of power from renewable sources was around €cents 5.53/ kwh(MERC 2006a). Given the economic attractiveness of renewable power, there is a growing interest among distribution licensees to increase the share of renewable in their power portfolio (Rao, 2008 Feb.PC).

## 6.2 Overview of achievement of renewable targets by main distribution licensees

The electricity supply sector in Maharashtra is served mainly by four distribution licensees. The performance of these licensees in procuring renewable electricity since the introduction of renewable instruments in year 2004 is discussed as follows:

### 6.2.1 Reliance Energy limited (REL)

REL caters to the electricity requirements of about 2.69 million consumers in Mumbai. It mainly sources power from its own power generation facility at Dahanu (250MW x 2) and the generating stations of Tata Power Company (TPC) (MERC 2007h). In addition to these sources, the balance power requirement is met through bilateral-short term power purchase contracts with other generators and Uninterrupted Interchange (UI) drawal (Rao, 2008 Feb.PC). The performance of REL with respect to its obligation under Renewable policy instruments is presented below.

*Table 6-2 Performance of REL in meeting renewable targets*

*(Source: MEDA 2005; MEDA 2006 ; REL 2008 ; MERC 2007 h)*

| Year [24] | Total electricity consumption (GWh ) | RE[25] procured (GWh) | RE as % of total electricity consumption | Target[#] (%) |
|---|---|---|---|---|
| 2004-05 | 7456.75 | 58.01 | 0.78 | - |
| 2005-06 | 7918.74 | 86.89 | 1.09 | - |
| 2006-07 | 8643 | 0 | 0 | 3 |
| 2007-08 | *9009 | **NA | NA | 4 |

* Projected value, **Data not available (NA), [#]For the period 2004-06, no targets were mentioned under RPO

As is evident from the above table-6.2, the renewable purchase was 0.78% and 1.09% of its total electricity consumption, in 2004-05 and 2005-06 respectively, while RPO was operational. However, after RPO was replaced with RPS in 2006-07, REL's renewable procurement registered a sharp fall and came down to zero (Rao, 2008 Feb.PC). Discussions with REL personnel revealed that it would not be able to reach renewable targets even in 2007-08. The performance of REL, along with the performance of other distribution licensees is discussed in section 6.2.5.

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[24] Year 2004-05 refers to the one year duration from 1st April 2004 till 31st March 2005. Same concept holds good for other years as well, unless otherwise specifically mentioned.

[25] RE refers to Renewable electricity

### 6.2.2 The BrihanMumbai Electric Supply & Transport Undertaking (BEST)

BEST, one of the oldest distribution licensees supplying power in Mumbai, serves around 0.94 million consumers. It doesn't have any generation facility of its own and sources its power from the generating stations of Tata Power Company (TPC). As the power sourced from TPC is not sufficient enough to meet its entire requirement, BEST sources its balance power needs through bilateral short term power purchase contracts with other producers and UI power (MERC 2007j; MERC 2007k). The performance of BEST with respect to its obligation under Renewable policy instruments is presented below.

*Table 6-3 Performance of BEST in meeting renewable targets*

*(Source: MEDA 2005; MEDA 2006 ; MERC 2007 j ;MERC 2007 k; Rokade, 2008* Feb.PC*)*

| Year | Total electricity consumption (GWh ) | RE procured (GWh) | RE as % of total electricity consumption | Target (%) |
|---|---|---|---|---|
| 2004-05 | 3962.12 | 30.78 | 0.78 | - |
| 2005-06 | 4155.52 | 45.6 | 1.09 | - |
| 2006-07 | 4408 | 0 | 0 | 3 |
| 2007-08 | 4547.23* | # 2.4 | 0.05 | 4 |

* Projected value, # Estimation based on 0.6 GWh / month for 4 months from December 07 to March 08

As in the case of REL, the renewable purchase of BEST was 0.78% and 1.09% of its total electricity consumption, in 2004-05 and 2005-06 respectively, while RPO was operational. However, after RPO was replaced with RPS in 2006-07, its renewable procurement reduced to zero. In the year 2007-08, BEST is expected to procure only 2.4 GWh amounting to around 0.05% of its total consumption, as against the target of 4% in 2007-08 (Patil, 2008a Feb.PC; Rokade, 2008 Feb.PC). Obviously, BEST is not expected to reach the targets even after two years of RPS regime. The performance of BEST, along with the performance of other distribution licensees is discussed in section 6.2.5.

### 6.2.3 Tata Power Company Limited (TPC)

The distribution area served by TPC, like BEST and REL is limited to the city of Mumbai. TPC sources a part of its power requirement from its own fossil based generation plant of 1770 MW capacity. TPC meets the balance power requirement through its wind power projects, hydro power projects, bilateral contracts with other producers and UI power (Anvekar, 2008 Feb.PC). The performance of TPC with respect to its obligation under Renewable policy instruments is presented below.

*Table 6-4 Performance of TPC in meeting renewable targets*

*(Source: MEDA, 2005; MEDA, 2006 ; MERC, 2007 g ; TPC, 2008; Anvekar, 2008 Feb.PC)*

| Year | Total electricity consumption (GWh ) | RE procured (GWh) | RE as % of total electricity consumption | Target (%) |
|---|---|---|---|---|
| 2004-05 | 3361.36 | 26.12 | 0.78 | - |
| 2005-06 | 2563.37 | 28.12 | 1.09 | - |
| 2006-07 | 2788* | 27.24 | 0.97 | 3 |
| 2007-08 | 3180** | ˄128 | 4 | 4 |

* From ARR order of 2006-07, ˄ Expected RE procurement as per discussion, ** Projected value.

As in the case of REL and BEST, the share of renewable in the total electricity consumption of TPC was 0.78% and 1.09%, for the years 2004-05 and 2005-06 respectively, under RPO regime. In the year 2006-07, TPC was able to procure renewable power corresponding to 0.97% of its total consumption, mainly because of its own wind projects. However, this was still lower than the 3% target for 2006-07. For the year 2007-08, TPC is expected to fulfill its renewable target of 4%, because of commissioning of additional wind power capacity (Anvekar, 2008 Feb.PC).

### 6.2.4 Maharashtra State Electricity Distribution Company Limited (MSEDCL)

MSEDCL is the biggest distribution licensee operating in the state. It covers the entire distribution area in the state excluding the city area of Mumbai, which is served by the other three distribution licensees, namely, REL, BEST and TPC. The energy requirement of MSEDCL is met by the generating stations of state owned utilities, central utilities and private power producers (MERC 2007i). All the independent renewable generators are located in the area of MSEDCL. The performance of MSEDCL with respect to Renewable policy instruments is presented below.

*Table 6-5 Performance of MSEDCL in meeting renewable targets*

*(Source: MEDA, 2005; MEDA, 2006; MERC, 2007i; Deshpande, 2008* Feb.PC*)*

| Year | Total electricity consumption (GWh ) | RE procured (GWh) | RE as % of total electricity consumption | Target (%) |
|---|---|---|---|---|
| 2004-05 | 66874.81 | 519.62 | 0.78 | - |
| 2005-06 | 69030.84 | 757.51 | 1.09 | - |
| 2006-07 | 72752.19 | 2100 | 2.89 | 3 |
| 2007-08 | 84900.16* | NA** | NA | 4 |

* Projected consumption. ** NA- Data Not Available

The share of renewable power in total energy consumption for MSEDCL was 0.78% and 1.09%, for the years 2004-05 and 2005-06 respectively, under RPO regime. In the year 2006-07, it could achieve 2.89%, against a renewable target of 3% (Deshpande, 2008 Feb.PC). Further, discussions revealed that targets would be very difficult to achieve in the forthcoming years, due lack of growth in renewable capacity and rise in targets (Deshpande,2008 Feb.PC; Wangikar, 2008 Feb.PC).

### 6.2.5 Discussion on achievement of renewable targets by distribution licensees

**Performance of licensees under RPO**: As long as RPO was in force from 2004 to 2006, the licensees used to share the entire renewable energy purchased among them. As all the renewable developers are located in the license area of MSEDCL, the entire renewable generation from independent renewable generators was bought by MSEDCL. At the end of the year, the financial burden of RE purchase on MSEDCL was shared among all distribution licensees, in proportion to their respective total energy consumption[26]. Therefore, the performance of all distribution licensees during 2004 to 2006 is uniform in terms of

[26] Total energy consumption of a licensee is the sum of its conventional and renewable energy consumption.

percentage of renewable electricity in their total consumption. Under RPO, no separate target was specified for the licensees for purchase of renewable electricity (MERC 2004a).

**Performance of licensees under RPS**: After RPO was replaced by RPS in the year 2006-07, targets were specified for the licensees for renewable procurement (MERC 2006a). From the sections – 6.2.1 to 6.2.4, it is evident that none of the licensees, except TPC, are expected to meet their targets in the forthcoming years. While MSEDCL increased its procurement from 757 GWh to 2100 GWh, between the years 2005-06 and 2006-07, the procurement of BEST and REL was reduced to zero (Deshpande 2008 Feb.PC). It is obvious that MSEDCL procured the entire generation of renewable generators located in its distribution area and did not share it with other licensees. In-spite of trying to purchase RE at preferential price from independent renewable generators, REL and BEST were not successful in buying any amount of RE during RPS regime at preferential price (MERC 2007c). BEST has bought 2.4 GWh in 2007-08, but at a price higher than preferential price.

**Geographical advantage for MSEDCL**: As discussed in 6.2.4, all renewable generators are located in the geographical area served by MSEDCL. Discussions with REL and BEST revealed that if same price is offered for purchase of RE by all licensees, the renewable generators would prefer to sell their electricity to MSEDCL, as they are dependent on MSEDCL for services like grid connectivity and metering. However, the renewable generators are ready to sell power to REL and BEST if they offer a price higher than that offered by MSEDCL (Rao 2008 Feb.PC; Rokade 2008 Feb.PC). MSEDCL is offering preferential price to the renewable generators, which is the highest that can be offered under long term contracts (Deshpande 2008 Feb.PC). Therefore, REL and BEST cannot buy power from these generators unless their offer exceeds preferential price, which is not possible under long term contracts (Rao 2008 Feb.PC; Rokade 2008 Feb.PC). Thus, the natural advantage of MSEDCL with respect to its geographical coverage is enabling it to purchase the entire renewable generation.

## 6.3 Identification and analysis of significant issues influencing the performance of renewable sector

As discussed in section- 6.1.3.2, the cost competitiveness of renewable power has been improving with respect to conventional power bought at margin, especially during the RPS regime starting from 2006. While the improvement in cost competitiveness of renewable power is expected to result in higher capacity growth rate in renewable sector, reverse trend has been observed in capacity growth rates during the RPS regime. The following sections analyse the major issues that influenced the growth of renewable sector.

### 6.3.1 Organizational issues

#### 6.3.1.1 Approach of distribution licensees towards meeting renewable targets under RPS regime

Growth in capacity of renewable power projects is crucial to the achievement of targets set under RPS regime. Problems associated with land acquisition affected the capacity addition plans of not only independent renewable developers but also distribution licensees. While the RPS aims at increasing the contribution of licensees towards capacity addition for meeting renewable targets, interaction with the distribution licensees indicate that two out of four major distribution licensees have no definite plans, to go in for self generation for meeting RPS targets (Anvekar, 2008 Feb.PC; Sharma, 2008a Feb.PC). The following sections discuss the issues associated with capacity addition plans of licensees.

### Approach adopted by REL for meeting renewable targets of RPS

REL attempted to meet its target by purchasing power from independent renewable power producers as well as by investing in creation of renewable power generation capacity. However, the price quoted by the renewable generators was substantially higher than the preferential price specified by the regulator, MERC, which prevented REL from entering into power purchase contract with any of the independent renewable generators in 2006-07(MERC 2007c).

REL recognized the need to create renewable generation capacity with a long term view of fulfilling their targets. As part of its renewable strategy, it decided to set up 150 MW of wind capacity in 2007-08. However, due to land acquisition problems, REL could commission only 45 MW capacity by 2007-08 (Rao 2008 Feb.PC). Due to the above problems, REL requested the MERC to waive off targets for the year 2006-07 and relax targets for the year 2007-08 (MERC 2007c). As is obvious from above, REL has explored the route of capacity addition for meeting its renewable targets during RPS regime. However, considering that capacity addition by licensees was emphasized under the RPO policy of 2004 (MERC 2004a), it may be inferred that REL made a delayed start in setting up renewable generation capacity, after the introduction of RPS in 2006 (Pandit, 2008 Feb.PC).

### Approach of TPC for meeting renewable targets of RPS

TPC took the initiative of setting up renewable generation capacity before the introduction of RPS instrument in 2006. Additionally, TPC has stated before the MERC that the shortfall in achievement of target for the year 2006-07 can be made up during the year 2008-09, consequent to the commissioning of its 100MW wind project (MERC 2007c). This will enable TPC to meet its renewable targets for the forthcoming years, i.e., up to 2010, from its own renewable generation facilities (Anvekar, 2008 Feb.PC). It is worth noting here that, pro-active planning of TPC to set up renewable capacity even before the introduction of RPS instrument in year 2006, has enabled it to be in a position to meet its renewable targets until year 2010 (Pandit, 2008 Feb.PC).

### Approach of MSEDCL for meeting renewable targets of RPS

MSEDCL has no definite plan for taking the path of self generation. All independent renewable generators are located in the distribution area of MSEDCL and are dependent on MSEDCL for availing grid connectivity and metering services. Therefore they are more likely to enter into power selling contracts with MSEDCL to ensure satisfactory grid services. With this geographical advantage, MSEDCL is relying on capacity addition by independent renewable generators in order to meet its future renewable targets, instead of adding capacity itself (Rokade, 2008 Feb.PC). However, dependence on renewable generators for capacity addition exposes MSEDCL to the risk of non- attainment of targets, in the event of inadequate capacity addition rate by independent renewable developers.

### Approach of BEST for meeting renewable targets of RPS

BEST does not have any plan of setting up renewable generation capacity. According to BEST, its distribution area is limited to the urban areas of Mumbai city and it is practically not possible to find land in Mumbai for commissioning renewable projects. Hence, BEST has opted to source its RE requirement from independent renewable generators. However, BEST was unable to find any generator who would sell power within the preferential price fixed by regulator. The renewable generators offered to sell power to BEST at a cost higher than the preferential price (Patil, 2008a 2008 Feb.PC; Rokade, 2008 Feb.PC).

As discussed in section- 5.4.4, the renewable power purchase should be through long term contract at a cost which should be within the preferential price, so that such purchase could be approved by MERC. However, as discussed in section- 6.1.3.1, if renewable power is bought through short term contract using competitive bidding route, then such power purchase need not be pre-approved by the commission, even if the cost is higher than preferential price (Rao, 2008 Feb.PC).

The following figure shows the options available with the licensee to buy renewable power at different prices.

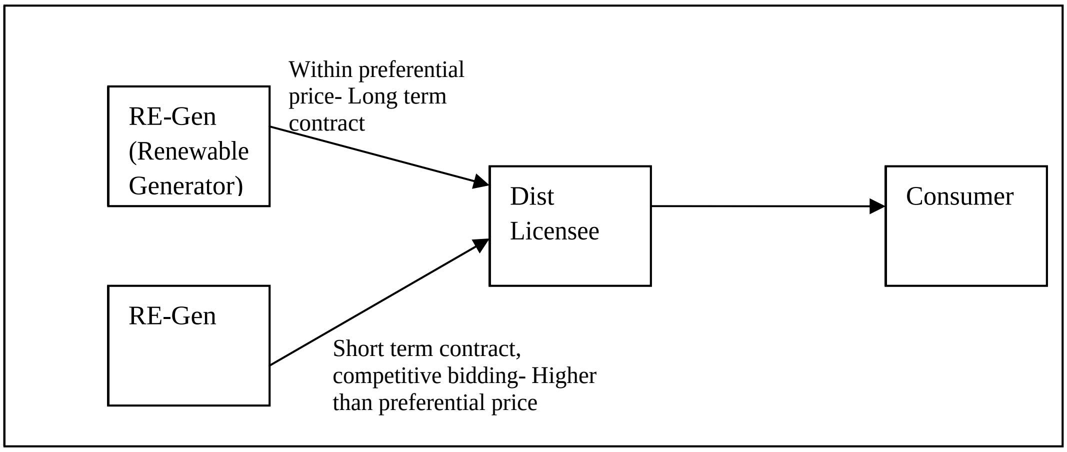


*Figure 6-3 Options for purchasing renewable power*

*(Source: Rao, 2008 Feb.PC)*

BEST used the option of short term purchase through competitive bidding, to buy about 3MW power from a cogeneration plant since January 2008, at the rate of 7.5 €cent/ kwh, which was considerably higher than the preferential price of 5.08 €cent/ kwh (Dharaskar, 2008 Feb.PC).

**Influence of BEST approach on renewable power market**

As discussed in 6.2.5, some renewable generators are ready to sell their generation to BEST & REL if prices higher than preferential prices are offered (MERC 2007c). BEST, in order to avoid penalty, decided to buy RE from such renewable generators at a cost higher than preferential price through short term contract using competitive bidding. However, it is felt that this type of approach allows the distribution licensees to ignore the need of creating capacity for renewable generation and also allows them to buy renewable power at higher than preferential price, and pass on the burden to consumers (Dixit, 2008 Feb.PC). Further, this type of renewable purchase arrangement will encourage other renewable generators also to charge prices which are higher than preferential prices. While on one hand, it will increase the average cost of electricity for consumers, on the other hand, it will not contribute to growth in renewable capacity (MERC 2007c). As higher cost of renewable purchase will be passed on to consumers, this approach of licensees will result in windfall profits for renewable generators at the expense of consumers (Dixit, 2008 Feb.PC).

**Impact of uncertainty about penalty on approach of licensees:** As discussed in 6.3.1.1, two of the licensees, MSEDCL and BEST are not interested in setting up renewable capacity. The lack of initiative on part of the two licensees could be partly attributed to the uncertainty surrounding the imposition of penalty, in case they fail to meet their renewable targets (Suzlon, 2008 Feb.PC).

As results of RPS compliance for the first year of RPS regime, i.e., 2006-07, are yet to be officially published by MEDA, the MERC hasn't been able to sort out the issues that might arise due to imposition of penalty (Doshi, 2008 Feb.PC). The issues related to penalty clause may come up for deliberation after results of non-compliance by licensees are reported by MEDA. Some of the probable issues related to penalty are discussed in section 6.3.3.3.

#### 6.3.1.2 Analysis of MEDA's contribution in implementation of renewable instruments

In the year 2004, MEDA was given the responsibility of implementation of RPS in the state, which involved responsibilities concerning development of operating and compliance mechanisms and initiation of monitoring and reporting mechanisms on the progress of RPS in the state (Rane, 2008 March.PC; MERC 2006a). Additionally, MEDA was also entrusted with the responsibility of facilitating interaction and financial settlement between different stakeholders. In line with its responsibilities, MEDA did a commendable work by actively participating in the deliberations leading to formulation of policy instrument, its implementation and coordination between stakeholders (MERC 2007b; MERC 2007e).

However, the achievement of distribution licensees with regard to RPS targets for the year 2006-07 was not officially published by MEDA till 1st April 2008. This delay in reporting the progress of RPS implementation in the first year of RPS regime is affecting the performance review of distribution licensees, and delaying the process of initiating new measures to facilitate effective implementation of RPS (Doshi, 2008 Feb.PC).

Further, MEDA as an institution responsible for promoting renewable energy in the state, took the initiative of doing wind potential survey for the benefit of project developers. As wind sector offers a huge potential for renewable development in the state, MEDA plans to carry out further site surveys to offer around 50 potential sites to renewable developers by the end of year 2007-2008 (Pise, 2008 March.PC). However, the confidence level of the project developers regarding quality of site assessment by MEDA was not sufficient enough to motivate them to directly take up such sites for project development (Suzlon, 2008 March.PC). The developers again repeat the site surveys for assessment of wind potential before proceeding with the installation of machinery, which invariably adds to the time and cost requirements of the project.

#### 6.3.1.3 Monitoring compliance of Open access and captive consumers

As discussed in section- 5.4.1, three categories of consumers, namely, distribution licensees, Open access (OA) consumers and captive consumers are obliged to fulfill their RPS targets by procuring renewable power corresponding to the targets set under the instrument. Under, the Electricity Act 2003, OA consumers are allowed to use the intervening grid network by payment of suitable charges, to get the power transmitted from the generator to their premises (MERC 2006a). As OA and captive consumers do not purchase electricity from distribution licensees, hence, information about the amount of power consumed by these consumers is generally not available with the licensees. However, this information is available with the grid operators who allow their network to be used by these consumers (Rokade, 2008 Feb.PC).

This information is essential for monitoring the compliance of OA consumers and captive consumers as targets are linked to their consumption. Scheme for identification and monitoring of these consumers is yet to be effectively implemented.

### 6.3.1.4 Process of generation metering

As discussed in section -6.2.5, all renewable generators are located in the distribution area serviced by MSEDCL. As a result, metering of net electricity generation is jointly done by representatives of renewable generator and MSEDCL. The cycle time required for metering exercise followed by transmission of data to the buyer licensee, through the "State load dispatch centre" (SLDC), is considerable. While it usually takes about a fortnight for some licensees like TPC, to get the information (Anvekar 2008 Feb.PC), the time requirement may vary depending on the remoteness of the project and the number of stages through which information has to travel (Wangikar, 2008 Feb.PC). The duration for this process has a direct bearing on the time required for the renewable generators to get paid for their generation and also affects the monitoring and verification process by nodal agency.

### 6.3.1.5 Dependency on MSEDCL

Even though Electricity Act 2003 allows the generator to sell power to any consumer, the renewable generators are usually reluctant to sell their power to consumers other than MSEDCL. As MSEDCL is responsible for providing grid connectivity and metering services, hence the renewable generators are dependent on MSEDCL for the smooth functioning of their projects. In the present context, MSEDCL is the natural partner of the renewable generators (Rao, 2008 Feb.PC). The renewable generators harbor inhibitions that the quality of services that they get from MSEDCL would suffer if they don't sell their generation to MSEDCL, which could affect their business (Suzlon, 2008 March.PC).

### 6.3.1.6 Interpretation of RPS

There have been situations wherein difference in interpretation of rules by different stakeholders has affected the operation of RPS instrument. As already mentioned- 3.2.3, renewable developers are free to sell their generation to any consumer in the state. Some of the Group-2[27] wind power projects had power purchase contracts of 8 years with MSEDCL, which were effective until the end of the year 2007-08. Accordingly, these wind projects were supposed to receive payments for the energy supplied by them to MSEDCL. However, MSEDCL stopped payment to these wind projects from April 2007 itself, as it misinterpreted the validity of the contract period (MERC 2007f; MERC 2008a). As a result, the affected wind power projects were not paid for their generation for close to 8 months (Suzlon, 2008 Feb.PC). This, along with similar other incidents indicate misinterpretation of the provisions of RPS which is causing significant hardship to renewable generators (MERC 2007d). Further, it also creates doubt among renewable generators about the quality of cooperation[28] that they would get from MSEDCL, if they decide to sell power to other distribution licensees.

[27] Wind power projects commissioned between 27th December 1999 and 31st March 2003 (MERC 2003)

[28] RE generators are dependent on MSEDCL for services like metering and grid connectivity.

### 6.3.2 Market related issues

#### 6.3.2.1 Cost competitiveness of renewable power

As discussed in section 6.1.3.2, renewable power is progressively becoming cost competitive as compared to conventional power bought at margin. This provides the distribution licensees an opportunity to reduce their expenditure for power purchase by increasing the amount of renewable power in their portfolio. As a result, licensees like MSEDCL would like to procure the entire renewable power generated in its area even if it exceeds the targets (Rao 2008 Feb.PC; Rokade 2008 Feb.PC). This would hardly leave any renewable power for other licensees to purchase from the market, even if the renewable supply exceeds MSEDCL's target. Consequently, the other licensees, except MSEDCL, might face the prospect of penalty.

As discussed in 6.2.5, the geographical advantage of MSEDCL is enabling it to purchase the entire RE generation. Thus, the cost competitiveness of renewable power and geographical advantage of MSEDCL has created barriers for other licensees to procure renewable power from independent renewable generators.

#### 6.3.2.2 Land acquisition issues

As discussed in section- 4.2, fresh capacity addition has been observed to be substantially higher in wind power than in other renewable options. While requirement of land is a cause of concern for all renewable electricity projects, it is more relevant to wind projects, which generally require vast tracts of land. In recent times, Maharashtra has witnessed various problems associated with acquisition of land for developmental projects. Whereas some of these problems are attributable to the lack of clarity on guidelines from clearance authorities, most of the current problems are on account of local conditions prevailing in the areas proposed for setting up renewable projects (Trivedi, 2008 Feb.PC; Pise, 2008 Feb.PC).

For example, in Sangli district, around 44 wind turbines with an installed capacity of 74 MW, were shut down in April 2007, due to protests from the local populace who wanted more money from renewable developers for their leased land (Wadke 2007). Additionally there were problems related to acquisition of land for construction of access roads and power lines. The impact from the protests were so significant that it affected the execution of new projects in Sangli and Dhule districts, and resulted in shifting of some projects to neighboring states. New wind projects of about 200 MW capacity (Suzlon, 2008 Feb.PC) are being shifted from Maharashtra to neighboring states like Gujarat and Karnataka, owing to steep hike in land prices charged by owners, which sometimes went as high as 20 times the usual cost (Trivedi, 2008 Feb.PC). Incidents like these are posing a serious problem in the commissioning of new projects.

In the recent past, problems related to clarification from the Government have come to the fore. The recent example is that of M/s Suzlon Energy Ltd., who were working on a 105 MW wind project for REL. After having employed their resources for survey of wind profile, for almost 6 months at Gudepanchgani site, work had to be stopped on account of the site being a declared a bird sanctuary. While the whole episode not only resulted in monetary loss for the project developer, but also affected schedule of the project, which in turn had a bearing on the achievement of renewable target for the licensee (Sharma 2008b Feb.PC).

In Dhule district of Maharashtra, about 340 hectares of land was earmarked for wind power projects to be developed by M/s Suzlon Energy Limited. However, with the introduction of

"Recognition of Forest Rights Act 2006", the aspirations of tribal people living in the area, about regularization of land they had been tilling for years, became a reality. This led to a conflict of interest between local tribal population and project developers over diversion of forest land for wind power projects, resulting in uncertainty about the fate of the proposed projects (Menon, 2007).

While the rights of local tribal population as provided by the Act is well appreciated, speedy clearance of issues related to allocation of sites and clarity on areas coming under forest coverage will help in avoiding confusion and prevent time and cost overruns for the projects (Trivedi, 2008 Feb.PC).

### 6.3.2.3 Growth in a select few technological segments

As discussed in section 4.2, the trend of capacity addition in renewable projects indicates that most of the development has taken in place in the wind sector. The following sections look into the possible reasons for higher growth in wind sector as compared to other renewable sectors.

**Availability of high potential and modern technology in wind sector**

While indigenization of manufacturing facilities along with partnership of Indian wind turbine manufacturers with leading European firms played a major role in ensuring penetration of modern technology in Indian market, the relatively higher potential available in wind sector, played a major role in attracting investors towards this sector. In Maharashtra, the wind sector offers the highest potential amongst all renewable sources (MERC 2006a). Internationally, India holds 4$^{th}$ position in terms of installed wind power capacity (CII 2004 and Hauber 2007).

**Preference for wind sector by distribution licensees**

As discussed in section 6.3.1.1, TPC and REL have invested in capacity addition in wind sector. Though REL is facing problems related to land acquisition for its wind power projects, yet they prefer to invest in wind ahead of other options like biomass or small hydro, as the latter options are remotely located and the size of installations are also small, which pose a major challenge in managing such projects. Hence, the distribution licensees are generally averse to the idea of entering into small-scale power generation projects. So far as cogeneration option is concerned, these power plants are not stand-alone units and are generally attached to another industry, like sugar industry in Maharashtra. Hence, to plan for renewable power generation through cogeneration route essentially means venturing out into a completely new industrial sector, like sugar, for the distribution licensees. As this requires significant reorientation of business strategies, distribution licensees like REL don't consider cogeneration as an option for capacity addition (Rao, 2008 Feb.PC; Sharma, 2008b Feb.PC). Because of the above issues, the licensees prefer capacity addition in wind sector.

**Challenge faced by biomass and cogeneration based renewable projects**

**Fuel supply issues**: In case of biomass and bagasse based renewable power, fuel supply linkages play a crucial role in their success in long run (UNEP 2004). Apart from growth in demand for biomass for non-power generation purposes, issues like collection of biomass from distributed sources have become major barriers in the smooth functioning of these projects (Virendra, 2008 March.PC). When competing users of biomass offer better price to biomass producers than renewable generators, the issue of fuel supply security becomes significant (UNDP 2005). As per MEDA, usage of biomass in particle board manufacturing, brick kilns and other steam raising purposes, reduce the availability of biomass for power generation (Patil, 2008b). Further, increase in capital cost of project and variation in agro-climatic conditions also pose a major risk for the project developers (MERC 2007a). Lack of a well organized biomass market also induces uncertainty in fuel supply and increases transaction cost, like transportation of fuel from different locations (Debyani et al. 2006). So far as bagasse based cogeneration is concerned, the usage of bagasse for paper making has been on the rise in neighboring states like Tamil Nadu which is affecting the availability of biomass for power generation (Smouse and Staats 1998).

**Quality of fuel**: The variation in quality of fuel influences the power generation cost of the project. Uncertainties associated with fuel quality, with respect to calorific value and moisture content, affect the earning potential of the project. The common preferential price offered for power generated from various types of biomass fuels, affects the cost recovery period of the projects (Debyani et al. 2006).

**Uncertainty about capital cost**: As per Cogeneration Association of India, the capital cost considered for calculating tariff / selling price of power from cogeneration units, was about €0.5 million/ MW in year 2002 (MERC 2006a). However, this cost increased by about 33% to €0.67 million/ MW by the year 2006. While this situation may necessitate reconsideration of tariff, it may be worth mentioning here that lack of accurate data about capital cost of projects posed a significant challenge to the regulator in working out the tariff for these projects. The MERC received wide range of figures of capital cost ranging from €0.231 million / MW to €0.8 million/ MW from the studies instituted for this purpose (Deo and Modak 2005). Therefore, as per MEDA, the selling price provided for cogeneration units, needs to be reconsidered after duly considering the escalation in capital cost (Patil, 2008b March.PC), to improve the commercial viability of these projects.

**Size of projects**: The small size of plants deters the large project developers from investing in this sector, who are generally interested in investing in big projects (Rao, 2008 Feb.PC). Based on data from MEDA, out of a total number of 33 biomass based projects in Maharashtra in January 2008, 26 projects had capacity rating of up to 10 MW with the maximum capacity being 25 MW (MEDA 2008d).

**Challenge faced by small hydro sector**

In this sector, the small size of plants leads to higher investment cost on a per MW basis. Moreover, potential sites for these projects are mostly in remote areas and dispersed in nature. This increases the cost of extending grid supply for evacuation of power from these sites. Additionally, the seasonal variation in availability of water and dependence on the planning[29] of irrigation agencies makes it difficult to schedule generation as per power demand profile. In case of maintenance requirements, the remoteness of these projects makes accessibility an additional issue to deal with. Additionally, the small size of these projects deter large project developers from taking active interest in investing in this sector (Debyani et al. 2006).

[29] If the hydro project is installed on irrigation canal, power generation depends on water release plans of irrigation agency.

### 6.3.3 Regulatory issues

#### 6.3.3.1 Setting of renewable electricity targets

Target setting is very crucial to the success of any renewable instrument, especially when it involves provision of penalty for non-fulfillment of targets (Dinica 2006). The annual targets set for licensees under RPS for renewable procurement are based on the anticipated annual capacity addition and estimated generation from renewable projects. The estimated generation from a renewable project is dependent on the "plant load factor" (PLF[30]) of the project. The PLF of a project increases proportionally with the increase in electricity generation from the project. Therefore, estimation of PLF and annual capacity addition play a crucial role in the process of target setting. If target is set at a very high level, there is a possibility of exposing the distribution licensees to penalty even if their performance has been average (Rao, 2008 March.PC). On the other hand, if the target is set at a very low level, there will not be adequate push for promoting renewable growth.

As most of the new capacity addition is in the wind sector, the following sections look into the underlying concepts of target setting in the wind sector.

**Basis for estimation of PLF in wind power sector**

As discussed in 5.4.3, targets were set after factoring in the experience of prominent stakeholders, like renewable generators and MEDA, for setting the targets. While the MERC calculated the targets based on common value of PLF for the entire state, it differentiated the PLF based on the date of commissioning of projects. For example, the wind projects that were commissioned before 1st April 2003 are considered to have a PLF of 18% and those commissioned after this date are considered to have a PLF of 20% (MERC 2003). This differentiation in PLF with respect to time is based on the understanding that PLF improves with improvement in technology, and technology improves with time (Deo and Modak 2005). However, common value of PLF for the entire state indicates that variation in wind profile with respect to geographical location of project was not considered while calculating PLF.

**Influence of geographical location on PLF of wind projects**

Generation data available from similar wind turbines indicates that PLF varies with the geographical location of the project. For example, in the year 2002, PLF ranged from 8.5% to 21.9% for 371 machines, located in different places, each with a capacity of 350 KW (Deo and Modak 2005).

**Relation between technology improvement and PLF of wind project**

PLF of wind projects is dependent on various factors, like wind potential at the project site and technological maturity (Mabel and Fernandez 2007). Discussions with renewable developers indicate that sites with highest wind potential are generally exploited before the ones with lower potential (Trivedi, 2008 Feb.PC). Accordingly, with the passage of time, gains due to improvement in technology may be offset by lower wind potential of new sites. In other words, new projects equipped with better technology but located in areas with lower wind potential, may result in lower generation and consequently lower PLF. The following

[30] Plant load factor (PLF) is also referred to as Capacity utilization factor (CUF)

figure-6.4 justifies this inference, wherein PLF doesn't increase consistently with respect to time.

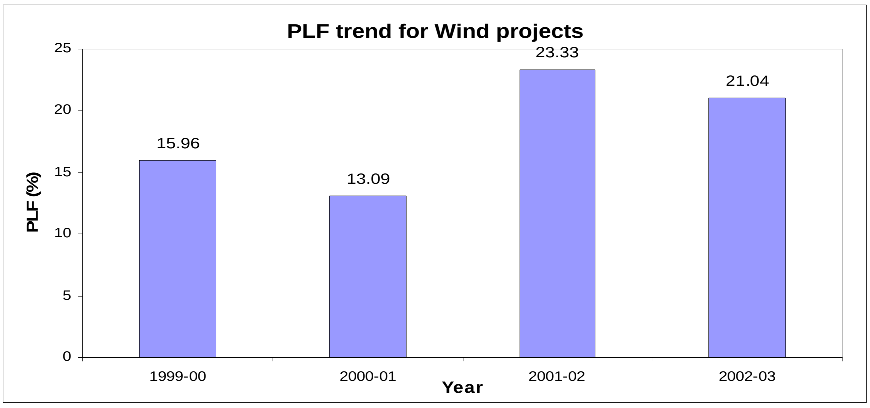


*Figure 6-4 Annual variation in Plant Load Factor (PLF)*

*(Source: MERC 2003)*

In the above figure, PLF decreases between years 1999-00 & 2000-01 and again between 2001-02 & 2002-03 (MERC 2003). Therefore, it can be inferred that technological improvement with respect to time may not result in increase in PLF.

**Influence of weather conditions on PLF**

Seasonal variations in weather condition also influence electricity generation of wind projects (Mabel and Fernandez 2007). Studies have indicated that wind energy generation in the neighboring western coastal region of India is significantly influenced by wind profile, temperature and humidity (Trivedi 1999 Feb.PC). Generation from wind sector was found to drop substantially by around 21% from 470 MU to 371 MU for the projects located in Satara, between years 2004-05 and 2005-06 (Pandit, 2008 Feb.PC). The reason for this drop in generation was attributed to bad weather condition by MEDA (MERC 2008 b).

Considering the above, it is felt that the process of target setting should give due consideration to factors like location of project and weather conditions apart from technological improvements. Similarly, for other renewable sectors, there is a need for reassessment of PLF and targets, while considering various associated issues like fuel availability, etc.

### 6.3.3.2 Time period of preferential tariff and renewable power cost

Under the RPS, the tariff support for wind power projects is applicable for a certain period of time, during which, the renewable developers are expected to recover their capital costs and also earn reasonable return on their investment by selling power at preferential tariff. After the completion of the tariff support period, or maturity of tariff period, the assets of the project are supposed to be fully depreciated, i.e., the capital costs are fully recovered. Hence, generation cost after maturity of tariff period, should be lesser than the generation cost during the tariff period. As per the National Tariff Policy, benefits of reduced tariff after the assets have fully depreciated should be passed on to consumers (MOP 2006). Since the burden of providing price support to renewable projects was borne by the consumers during tariff support period, hence the benefit of lower generation cost after maturity of such tariff period should be passed onto the consumers.

Presently, the renewable developers are free to sell their generation at market prices, after completion of their tariff period till the end of their economic life. This means that Group-2 wind projects, after completion of 8 years of tariff support period, will have the option to sell their generation at market price for the remaining life of 12 years, provided its economic life is 20 years (Dixit, 2008 Feb.PC). As there is a shortage of renewable power in the market, the market prices may be higher than preferential prices (Tripathy, 2008 March.PC). Even if they sell power at preferential price, they are able to earn high profits[31]. Thus, wind power generators get an opportunity to earn high profits, because tariff support period is kept shorter than their economic life.

**Reason of keeping time length of tariff support shorter than economic life of project**

The philosophy behind keeping the time length of tariff support shorter than economic life of the project is that if the renewable developers are able to recover their fixed cost earlier than the economic life of project, it will allow them to invest in technology upgrades, which may contribute to additional renewable generation (Deo and Modak 2005). For example, a 350 KW wind turbine when replaced by a 1 MW turbine would generate more electricity from the same site. On the other hand, if the renewable generator is tied up in tariff period for a longer time, then they would require longer time to recover their fixed cost, which would delay their investment for modernization of their projects (Deo and Modak 2005).

However, based on interaction with stakeholders, it is observed that wind generators are more interested in making higher profits from old projects, whose tariff period is already matured, rather than invest in upgrades of technology (Parvathirathnam, 2008 Feb.PC). Hence, the purpose with which the tariff period was set is not fulfilled to the extent desired.

**Cost saving potential**

A scenario analysis was carried out to analyze the potential of cost savings that could be passed on to consumers, if tariff period for Group-2 wind projects is extended up to the end of their economic life. The results show that there is a cost saving potential of about €14.1 million by the year 2010-11, which would translate into a reduction in the overall power cost for consumer by about 1.29%. This is significant because one of the consumer representatives, PRAYAS is demanding for a ceiling on the share of renewable cost at 2% of the overall power cost (PRAYAS 2006). Details of the scenario analysis are presented in appendix- 9.

### 6.3.3.3 Penalty related issues

The RPS instrument has the provision of penalizing the eligible consumers, if they fail to fulfill their yearly RE procurement targets (MERC 2006a).

Discussions revealed that MSEDCL, REL and BEST would fall short of meeting the targets in 2007-08 (Deshpande, 2008 Feb.PC; Rao, 2008 Feb.PC; Rokade, 2008 Feb.PC). In this situation, it becomes imperative to look into the issues that may crop up upon imposition of penalty.

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[31] Preferential tariff is meant for recovering capital cost and earn reasonable return on investment. On maturity of tariff period, capital cost is fully recovered. After this, if preferential tariff is still continued, the generators get paid for the capital cost which they have already recovered during tariff period. This allows them to earn high profits. If generators charge market price, which are higher than preferential price, they earn even higher profits.

## Effect of penalty on capacity addition

With the above background, it is worth taking a look at the effectiveness of the penalty provision on capacity addition in the state. While TPC had initiated setting up of renewable projects prior to introduction of RPS order, REL started the same after introduction of RPS instrument, but was caught up with problems concerning land acquisition. After this incident, REL decided to install 25 MW wind power project in Gujarat, a neighboring state, despite being aware of the fact that RE generated in other states would not qualify for meeting renewable targets in Maharashtra (Rao, 2008 March.PC). Based on discussion, it is understood that the idea of capacity addition by TPC and REL is driven by commercial interests, rather than the penalty provision of RPS.

Further, penalty provision has not proven effective in inducing either MSEDCL or BEST to plan for self generation. As discussed in 6.3.1.1, their approach is to procure power from independent renewable generators. As for the independent renewable generators, their capacity addition plans are affected due to land acquisition problems.

The above developments indicate that while penalty hasn't been able to promote capacity addition among licensees, it has slowed down capacity addition rate of independent renewable generators. The capacity addition observed in the state is mainly driven by commercial interests rather than the penalty provision under RPS.

## Effect of penalty on cost of power to consumer

Based on experience of REL and BEST it is observed that renewable generators are fully aware of the shortage of renewable power and the applicability of penalty on licensees in case of non-achievement of renewable targets (MERC 2007c). Hence, they are charging prices in excess of preferential tariff specified by the regulator. If the licensees agree to pay such higher prices, using short term contracts and competitive bidding, as has been observed with BEST in section- 6.3.1.1, the additional costs will be passed on to consumers, without a corresponding growth in actual renewable generation. If however, the licensee does not buy such high cost renewable power and instead pays penalty, the resulting financial burden would be quite heavy, which has even been acknowledged by a consumer representative, PRAYAS. (MERC 2006a).

Considering the above, it is felt that the penalty provision could result in making renewable electricity costlier to consumers.

## Collection and utilization of penalty

MERC has earmarked the responsibility of collecting penalty to MEDA, from those eligible consumers who fail to accomplish the renewable targets. However, the process of identification and monitoring of some of the eligible consumers, viz., open access and captive consumers is yet to be properly established by MEDA (MERC 2007b). Additionally, the methodology for utilization of penalty amount has to be elaborately worked out. MERC has stated that the funds accrued through penalty should be used to promote renewable energy in the state (MERC 2006a). However, there is need of an elaborate plan on utilization of fund, for supporting emerging renewable options, demonstration projects and capacity building programs.

## Imposition of penalty on renewable generators

As discussed in 5.4.6, penalty would not be imposed on "eligible consumers" if it is established that they were unable to meet their renewable target because of unsatisfactory performance of the renewable generators. Further, if it is established that the performance of renewable generator was unsatisfactory due to inadequate upkeep and maintenance of machinery, the penalty would be imposed on the generator (MERC 2007a). The provision for penalty could significantly affect the interests of renewable generators, especially the biomass based projects, which are exposed to fuel supply uncertainties. In case of problems in fuel supply linkages, the biomass based generators would run the risk of paying penalty apart from incurring losses due to drop in electricity generation.

## 6.4 Analysis of outcome due to application of policy instruments-RPO and RPS

The criteria considered for analyzing the outcome of RPO and RPS is discussed below.

**Criteria for analysis**

The developments in renewable sector, under the influence of renewable instruments can be analyzed using a broad range of criteria depending on the context of the study. The objectives of a policy could be used as a measure for analyzing its outcome. In this research, the criteria used for analysis is based on the objectives set out under the RPO and RPS, and the criteria used by Nichols and Martinot (2000) in a study on "Measuring results from climate change programs".

**Objectives of RPO and RPS**

**Objectives of RPO**: As discussed in 5.2, the Electricity Act 2003 required the states to design and implement long term framework for development of renewable sector. To address this requirement, MERC started with the introduction of RPO in year 2004, before developing a long term framework which required elaborate preparation (MERC 2004a). As RPO was expected to be replaced by a long term framework later, the objective of RPO was limited to the extent of allocating responsibility of renewable power procurement among the distribution licensees.

**Objectives of RPS:** By year 2006, RPS was designed and introduced, after factoring in the viewpoints of various stakeholders, like consumers and renewable generators. The main objectives of RPS are as follows (MERC 2006b):

- The policy should be cost effective and flexible, to address changing requirements.
- The policy should be socially beneficial in terms of improvement in environmental performance and increased diversity in energy supply.
- The policy should be predictable over long time frame to provide market stability and reduce the regulatory risk for stakeholders.

- The policy should be compatible with other policies at both state and national level.

- The policy should be non-discriminatory in nature for all stakeholders.

**Criteria considered in "Measuring results from climate change programs".**

In a study on "Measuring results from climate change programs" conducted under the auspices of Global Environmental Facility (Nichols and Martinot 2000), the following criteria were used for evaluating the performance of renewable promotion policies pertaining to grid connected renewable energy clusters :

- Growth in renewable generation and installed capacity of renewable projects.

- Development in business, in terms of availability of equipment manufacturers and service firms.

- Policy and regulatory frameworks addressing key issues like, tariff, etc.

**Criteria considered for analysis**

As both RPO and RPS were introduced to fulfill the requirements of Electricity Act 2003 and both of them are in line with the various renewable energy tariff policies at state level, hence, both the policy instruments can be considered compatible with the national and state level policies.

Based on the criteria used by Nichols and Martinot (2000) and the objectives of RPO and RPS, the following criteria are drawn up for analyzing the development in renewable sector:

- Effectiveness in terms of cost of renewable power

- Effectiveness in terms of growth of renewable capacity

- Non-discrimination among stakeholders

- Growth of associated business services

The above criteria are in line with the National Electricity Policy, discussed in 3.2.3, which stresses on the competitiveness of renewable electricity. Further, non-discriminatory aspect of renewable instrument is vital for ensuring level playing field among all stakeholders (Tripathy, 2008 March.PC). In order to ensure sustained growth, development in associated business services, like manufacturing ability and availability of skilled manpower, is of vital importance. Hence, the above has been included in the criteria for analyzing the development of renewable sector under RPO and RPS.

### 6.4.1 Effectiveness in terms of cost of renewable power

**RPO regime**: Under the RPO regime, i.e., between years 2004 and 2006, the entire renewable power was bought at fixed price by the distribution licensees, which was based on the tariff values given in various tariff orders[32].

**RPS regime**: Under the RPS regime, in the first year of operation, i.e., 2006-07, the entire generation from independent renewable generators was purchased by the MSEDCL at preferential tariff, which was based on similar tariff values as were used during the RPO regime as fixed price (Deshpande, 2008 Feb.PC). So, cost effectiveness of both the instruments is of similar order, if cost of renewable electricity in RPO regime is compared with the corresponding cost in the first year of RPS regime.

However, in the second year of RPS regime, i.e., 2007-08, some of the renewable generators started demanding higher than preferential prices to distribution licensees, owing to shortage of renewable power in the market. As discussed in 6.3.1.1, BEST even started purchasing renewable power from such generators at a cost which was higher than the preferential tariff mentioned in tariff policies. This market development wherein, the licensee is paying higher than preferential price in order to avoid penalty is making renewable electricity costlier in RPS regime than during RPO regime, wherein the entire generation was bought at fixed price. Thus, from the second year of RPS regime, i.e., 2007-08, the cost effectiveness of RPS seems to have reduced as compared to the RPO regime.

The cost effectiveness of RPS is expected to further decrease if more renewable power is bought by distribution licensees at prices which are higher than preferential prices, in order to avoid penalty. Thus, it can be inferred that the cost effectiveness of RPS is lower than that of RPO under the present circumstances in Maharashtra.

### 6.4.2 Effectiveness in terms of growth of renewable capacity

The growth of renewable electricity sector in Maharashtra is predominantly reflected in the capacity addition observed in wind sector, as has been discussed in section- 4.2. As can be

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32 The MERC had specified preferential tariff for power from Wind, biomass and cogeneration separately, through various tariff orders.

seen in figure 6.1, during the period 2004-06, when RPO was in effect, the capacity addition rate in wind sector accelerated from 48.75 MW in year 2004-05 to 545 MW in year 2005-06 (MEDA 2008a).

However, following the introduction of RPS in year 2006, the capacity addition rate steadily declined from 484.5 MW in 2006-07 to 268.15 MW in 2007-08 (MEDA 2008a). As a result, the overall performance of distribution licensees also suffered in terms of achievement of targets under the RPS regime. Thus, it can be inferred that the effectiveness of RPO in terms of growth of renewable power is better than that of RPS.

### 6.4.3 Non-discrimination among stakeholders

**Under RPO regime from year 2004-2006**

Under the RPO regime, the entire renewable electricity was purchased by MSEDCL and the burden of such purchase was financially settled at the end of the accounting year among all distribution licensees. This ensured equity among all licensees so far as burden of renewable procurement was concerned (MERC 2004a). So far as consumers are concerned, the sharing of renewable energy among all distribution licensees ensured that the burden or benefit arising out of such sharing was distributed among all consumers in an equitable manner. As regarding renewable generators, the entire power generated by them was assured for purchase by licensees at fixed prices earmarked for each technology. Hence, all generators, existing as well as the prospective ones, got a uniform treatment with regard to selling price.

**Under RPS regime from year 2006 onwards**

As discussed in section- 6.2.5, renewable power has become competitive with respect to conventional power bought at margin to meet peak demand in the RPS regime. MSEDCL procures the entire renewable generation available from independent power producers in its area without sharing with other licensees. Further, MSEDCL will continue to consume the entire renewable generation, even if they exceed their target, because of the cost competitiveness of renewable power (section 6.3.2.1). Therefore, under RPS regime, only one distribution licensee is enjoying the advantages of renewable power, which is exposing other licensees to the prospect of paying penalty for not achieving target (Rokade, 2008 Feb.PC). As the cost of renewable power is passed on to consumers, the benefit of low cost renewable power is in essence, passed on to consumers connected to MSEDCL network only.

Further, BEST has started procuring renewable power at prices higher than preferential price, which will eventually be passed on to the consumers. This has resulted in a situation wherein, consumers served by different licensees are subjected to different levels of financial burden (Rokade, 2008 Feb.PC).

As far as renewable generators are concerned, the existing generators are getting the opportunity of making high profits due to the scarcity in the market and penalty applicable on distribution licensees. However, new renewable generators are unable to commission their projects owing to problems associated with land acquisition (Parvathirathnam, 2008 Feb.PC). So, on one hand, while existing generators have the opportunity to make higher profits, the prospective ones are not able to enter the market.

### 6.4.4 Growth of associated business services

Associated business services ranging from research to manufacture and servicing of machineries have grown substantially over the past decade. However, as capacity addition has been higher in wind sector compared to other sectors, growth in business services has mostly been seen in wind sector. Quite a few wind technology providers have commercial and research tie ups with leading European companies, which have resulted in indigenization of almost 80% of the components of wind power sector. Additionally, some wind power companies like Suzlon have started serving overseas markets of China and US in the recent years (Suzlon, 2008 March.PC).

As both RPO and RPS has been operational for 2 years each, it is difficult to predict the extent of contribution of each of these regimes in the growth of associated business services. However, as progress is generally dependent on demand, it can be inferred that rise in capacity addition during RPO regime contributed to the growth of associated business services. On the contrary, drop in capacity growth rate during RPS regime may affect the associated services in the long run.

## 6.5 Influence on key stakeholders

As discussed in section 5.5, the influence of renewable instruments on the development of renewable sector is reflected through the influence on the following key stakeholders:

- Renewable generators
- Distribution licensees
- Consumers

The other significant actors in the renewable sector like, MERC, MEDA and IREDA promote the growth of renewable sector through various initiatives, like, policy intervention, policy implementation and financial assistance, as per the provisions of policy instrument. The influence of policy instruments on key stakeholders, based on the analysis in preceeding sections, is discussed below.

### 6.5.1 Distribution licensees

- **Contribution to capacity addition**: Both RPO and RPS have been partly successful in inducing the distribution licensees into capacity addition. While TPC started building capacity in renewable generation during the RPO regime itself, REL started the same after imposition of targets under RPS regime (Pandit, 2008 Feb.PC).

- **Impediments in capacity addition**: During RPS regime, from year 2006 onwards, the licensees started facing serious problems in land acquisition for new projects (Suzlon, 2008 March.PC). However under the RPO regime, i.e., from 2004 to 2006, problems related to land acquisition were not encountered.

- **Risk of penalty**: Under RPO regime, there was no target of renewable purchase and hence no penalty (Rao, 2008 Feb.PC). However, under RPS regime, slow growth rate in renewable capacity coupled with rising renewable targets exposed the distribution licensees to the risk of penalty.

- **Escalation in cost of renewable power**: Under RPO, fixed price was offered to renewable generators, due to which there was no possibility of any price rise. In RPS regime, the market experienced shortage of renewable power as compared to the quantity required to fulfill the renewable targets of licensees (FV 2007), which led to an increase in cost of renewable electricity, exceeding the preferential tariff specified by the MERC (MERC 2007c).

- **Using short term contract option**: Under RPO regime, power purchase was done through long term contracts at fixed price. However, under RPS regime, BEST started using short term power purchase option to purchase renewable power at higher than preferential costs, in order to avoid penalty (Rokade, 2008 Feb.PC). This will affect the consumers in the form of higher cost of electricity.

- **Sharing of renewable power**: In RPO regime, all licensees had the opportunity to buy RE at preferential tariff by sharing the total financial burden at the end of the year. In RPS regime, MSEDCL is using its geographical advantage by purchasing the entire generation at preferential tariff without sharing it with other licensees, which is forcing other licensees to buy RE at prices higher than preferential prices.

- **Complexity of the system**: Under RPO regime, only MSEDCL had to procure renewable generation from all generators at fixed price (MERC 2004a), which avoided the need of competitive bidding. In RPS regime, all licensees have to follow competitive bidding, and enter into multiple power purchase contracts with renewable generators. These requirements add to the operational complexity for licensees.

### 6.5.2 Renewable developers

- **Favorable condition for existing renewable developers**: Under RPS, existing renewable generators are able to charge higher price to licensees on account of shortage of renewable power in the market and applicability of penalty on licensees. This gives them the opportunity to make windfall profits. Under RPO, fixed price prevented the generators from making windfall profits.

- **Unfavorable condition for new renewable developers**: In RPS, the new developers are finding it difficult to set up projects, mainly due to land acquisition problems. Under RPO, new renewable generators did not face such problems.

- **Option of Open access of networks**: Under RPO, generation was to be bought by the licensee which gave grid connectivity. So, MSEDCL used to purchase the entire generation at fixed price. Under RPS, the option of open access is used by some renewable generators to sell power to non-MSEDCL[33] licensees at prices which are higher than preferential prices. Thus the option of Open access provided in EA 2003 is being used to make high profits by some renewable generators.

- **Fuel supply linkages and penalty clause**: In RPS regime, biomass based projects are exposed to the problems of fuel supply linkages, which affect their generation (Virendra, 2008 March.PC). The RPS instrument provides for transfer of penalty from licensees to renewable generators, if the latter fails to supply power as contracted in the agreement. Thus the provision of penalty is posing a major problem for biomass based generators. On the other hand, though the biomass based generators used to face fuel supply problems during the RPO regime as well, they were not exposed to the additional problem of penalty (Rao, 2008 Feb.PC).

### 6.5.3 Consumers

[33] Non-MSEDCL licensees mean BEST, TPC and REL. Under RPS, MSEDCL buys power at the maximum cost possible under preferential price. The renewable developers, in order to get higher than preferential price, want to sell power to non-MSEDCL licensees.

- **Higher burden for consumers**: Under RPS, if all licensees follow the path of BEST of purchasing renewable power at higher cost through short term contract, it would result in higher burden for consumers, and allow the renewable generators to make windfall profit. The fixed price system of RPO doesn't entail windfall profit for generators at the cost of consumers.

- **Benefits of depreciated assets**: As discussed in section-6.3.3.2, the consumers do not get the benefit of lower generation cost due to depreciated assets after completion of tariff support period, under RPS regime. Under RPO, there is a possibility of passing on the benefits of depreciated assets to consumers by specifying fixed tariff for generation from such projects.

- **Reliability of service**: The rising gap between demand and supply in electricity sector has led to frequent power-cuts/ non-availability of power, causing inconvenience to consumers (Narayana, 2008 Feb.PC). Under RPS regime, decline in capacity addition rate has restricted the extent of contribution from renewable sector that could have helped in mitigating the problem.

- **Lost opportunity for consumers**: Renewable electricity has become cost competitive against conventional electricity bought at margin, as discussed in section- 6.1.3.2. Decline in capacity addition rate in renewable sector during RPS regime has prevented the consumers from enjoying the cost advantage of renewable power.

## 6.6 Drivers for renewable growth

The renewable sector has been affected by various issues as discussed in the previous sections. In order to devise future interventions for accelerating growth in renewable sector, it would be useful to identify the drivers which have contributed, to the growth of renewable sector during the regime of the two policy instruments.

### 6.6.1 Drivers at institutional level

**Regulatory body:** Maharashtra was only one of the two states in the country, wherein the state regulatory commission (MERC) took the initiative of working out the tariff separately for each renewable option (Deo and Modak 2005). Further, MERC showed its proactive approach in introducing the RPO in 2004 and RPS in 2006 as per the requirements of EA 2003. With a proactive regulator in the state, the renewable sector stakeholders can look forward to appropriate policy interventions in the future, which would drive renewable growth.

**Promotional agency**: The state has the advantage of having a separate nodal agency, MEDA which functions exclusively for the promotion of renewable energy in the state (Pise 2008 March PC). On the strength of its experience in RE sector, and supported by capacity building programs, MEDA can play a bigger role in promoting renewable electricity sector.

**Financial institution**: The presence of IREDA, a financial institution dedicated solely for financing renewable projects has made a major contribution to the renewable sector.

### 6.6.2 Drivers at Market level

**Renewable developers**: The rising interest among big corporate bodies for investment in renewable sector is a positive sign for the development of the sector. Big corporate groups, like National Thermal Power Corporation (NTPC) and Oil and Natural Gas Corporation Ltd. (ONGC), have shown keen interest in wind power sector (Sasi 2007).

**Technology providers**: As discussed in section- 6.4.4, growth of manufacturing capabilities in renewable technologies, especially in the wind sector helped in reducing the project cost by indigenization of production. Technological tie ups with leading European manufacturers have helped in localization of the technologies and easy availability of associated services.

**Overall Power scenario**: As discussed in section 6.3.2.1, the growing gap between demand and supply in the overall power scenario has made renewable power reasonably competitive against conventional power bought at margin. This trend could increase the demand for renewable electricity and contribute to the growth of renewable capacity in the state.

### 6.6.3 Drivers at policy level

**Policies at Central level**: Electricity Act 2003, National Electricity Policy 2005 and National Tariff Policy 2006, aimed at addressing the requirements of renewable sector sends clear signals about the support from Central Government for renewable electricity sector.

**Policies at state level**: MERC introduced RPO and RPS in line with the central policies. The strong sense of commitment at state level for the renewable sector is reflected in these policies (MERC 2004a; MERC 2006a).

### 6.6.4 Drivers at consumer level

**Positive attitude among consumers**: Realizing the significance of environmental concerns, the consumer representatives have expressed their support for renewable electricity, even at the cost of bearing additional financial burden, provided that the share of renewable cost in the overall electricity cost is within 2% (PRAYAS 2006). The supportive attitude of consumer representatives towards the promotion of renewable electricity would augur well for the development of renewable sector.

# 7.0 CONCLUSION AND RECOMMENDATION

## 7.1 Conclusion

As per the Electricity Act 2003 (EA 2003), the states were supposed to formulate their own renewable promotion policy instruments, which would include setting up of targets for procurement of renewable electricity by the distribution licensees. To begin with, the MERC introduced “Renewable Purchase Obligation” (RPO) in year 2004, as a temporary measure before introducing long term policy instrument as required under EA 2003. The RPO addressed the immediate requirement of allocating responsibility among the distribution licensees for purchase of entire renewable generation by offering fixed tariff to renewable generators. In year 2006, RPO was replaced with “Renewable Purchase Specification” (RPS) which provided a long term framework as required by EA 2003, wherein targets were earmarked for distribution licensees regarding procurement of renewable electricity.

The growth in renewable sector has been markedly different during the regimes of RPO and RPS. The performance of wind sector, the largest contributor to renewable sector, has a significant influence on the entire sector. While capacity addition rate in wind sector sharply increased under the regime of RPO, it experienced a sharp decline under the RPS regime. My first and second research questions would be answered in the following sections.

Analysis of the developments in renewable sector during the two regimes revealed that organizational, regulatory and market related issues influenced the sector considerably. Among these, problems related to land acquisition, one of the market based issues, has affected rate of capacity addition in a significant way. The provision of penalty in the RPS has to a large extent been the cause of land acquisition problems. The private land owners, being aware of the penalty imposable on distribution licensees in case of shortfall in achievement of targets, have increased land prices to very high levels. On the contrary, during RPO regime, the renewable sector didn’t face major land related problems.

Land related issues have impacted renewable generators, one of the key stakeholders, in various ways. The land related issues have created hurdles for the project developers in setting up new projects, which has slowed down the overall capacity growth rate. This slow down in capacity growth rate has provided the existing renewable generators with the opportunity to demand higher prices for their generation, due to shortage in supply of renewable electricity in comparison to the demand induced by penalty on distribution licensees.

As the existing generators are demanding higher price for their generation, a distribution licensee has started making use of the short term power purchase route, for buying renewable power, at a price higher than preferential price. The short term power purchase route allows the distribution licensee to pass on the higher cost of renewable power to the consumer, without any corresponding rise in renewable generation. Under RPO regime, as the selling price of renewable power was fixed at preferential price, the generators couldn’t make windfall profits due to which the consumers were spared from any additional financial burden. Therefore, in terms of cost effectiveness, RPO seems to better placed than RPS.

Further, issues concerning time duration of tariff regime could influence electricity cost significantly. Analysis of projected scenario indicates that extension of tariff regime for wind projects, to cover their entire economic life could reduce the financial burden on consumers. RPO, through its fixed tariff mechanism, would enable the eligible consumers to buy renewable electricity at fixed price even after the tariff regime has matured, which is not possible under the present RPS regime.

Organizational issues like, performance of MEDA in implementing the policy instruments has influenced the developments of renewable sector considerably. The higher level of complexity associated with RPS in comparison to RPO, has necessitated the need for major capacity building in MEDA.

The RPS regime has impacted the distribution licensees in various ways. The natural advantage enjoyed by MSEDCL in geographically covering all renewable generators in the state, is obvious through its performance under RPS regime. While MSEDCL purchased the entire renewable generation from independent generators in the state in 2006-07, other licensees like REL and BEST were not left with any renewable power to buy. However, under RPO regime, the entire renewable generation was shared by all distribution licensees. Thus the economic benefits of renewable power, as discussed in section-6.3.2.1, would be shared more equitably under RPO than under RPS.

In view of the above, it is observed that RPO has been relatively more effective than RPS in terms of capacity addition as well as cost effectiveness. As discussed in sections-2.3 and 2.4, the policy instrument needs to be designed and introduced to target a particular stage of market development. Accordingly, different stages of market development need different types of instruments. In the case of Maharashtra, it seems that the renewable market was not mature enough to support a market based pricing system, when the RPS was introduced in 2006. As price of electricity is determined by the market in RPS, shortage in supply of renewable electricity would expectedly drive up the renewable prices, which would ultimately affect the consumers. The fact that 3 out of 4 distribution licensees are not expected to meet renewable targets even in 2007-08, shows that there is a scarcity of renewable electricity supply in the market as compared to the amount required to meet the targets. Therefore rise in price of renewable electricity and drop in capacity addition rate, during the RPS regime, could be attributed to the mismatch between the market condition and choice of policy instrument. On the other hand, the rapid growth in renewable capacity during the RPO regime indicates that the market conditions were actually suited for “feed-in” type instrument.

In response to my third research question about the type of intervention needed for improvement in renewable sector performance, I would suggest reverting back to the RPO regime after certain modifications would be the best option under the present market situation. Under the Recommendation (section 7.2), various interventions are suggested, which aim at improving the performance of both RPO and RPS. However, in the given market conditions, it is felt that recommendation in section 7.2.4, which talks about reverting back to RPO regime is the most appropriate option.

## 7.2 Recommendation

As per methodology, the first part of recommendation, from 7.2.1 to 7.2.3, elaborates on the measures which can help in addressing the issues affecting the performance of renewable sector in RPS regime. These recommendations look into the possibilities of improving the renewable sector performance while remaining in the RPS regime.

In 7.2.4, the option of reverting back to the RPO regime is discussed to address the issues that are likely to be prevalent even after the previous recommendations (7.2.1 to 7.2.3) are implemented. The recommendations from 7.2.5 to 7.2.9 are aimed at improving the performance of renewable sector under both RPO and RPS regime.

### 7.2.1 Land acquisition issues

As discussed in section 6.3.2.2, lot of problems have been observed in the recent past, regarding land acquisition for renewable electricity projects. While some of these problems relate to exorbitant rates charged by private land owners, there are instances of large projects being scrapped / delayed due to non-clearance of land from Government (Trivedi, 2008 Feb.PC). Therefore need was felt to establish a mechanism which would improve the clarity of the whole process.

**Special provision for renewable projects**

As promotion of renewable energy is in the larger interest of public and environment, the Government may consider special provisions for land acquisition for renewable projects on lines similar to those applicable for acquiring land for building roads and railways. For example the Government is considering introduction of an ordinance for facilitating speedy acquisition of land for important railway projects, which are in the larger interests of public (PIB 2008). The Government is considering this initiative as important railway infrastructure development projects are facing major hurdles in acquiring land (Chanda 2007). There is also a need for transparency regarding the status of land coming under the control of forest department, so that there would be clarity as to whether such land could be used for renewable projects, which would help in avoiding unnecessary delays in project execution.

**Clearances for site:** The process of getting clearance or permits for development of sites could be streamlined if MEDA, the nodal agency, plays a lead role in coordinating with various Government agencies, local revenue authorities and stakeholders in this regard. As securing clearance for sites takes up to two years in some cases, as against project commissioning time of 3 to 6 months in case of wind power projects, this part of project development needs to be streamlined by clearly earmarking the role of nodal agency and renewable developers (Parvathirathnam, 2008 Feb.PC). MEDA being a Government body, is ideally placed to develop an integrated approach, simplify the procedures and facilitate single window clearance system.

Experience of renewable sector in Greece highlight the role played by regional development agencies in facilitating renewable projects through their involvement as an intermediary between local municipal corporations and project developers (Polatidis and Haralambopoulos 2007). On similar lines, MEDA can play a lead role in facilitating clearance for renewable projects.

**Leasing of land**

Discussions revealed that land acquisition could be facilitated through benefit sharing with the land owners. While cooperative sector can participate in this process, options for using free space in wind project sites for agricultural purpose could be explored. This would allow the local population to carry on with their agricultural activities without hindering the functioning of wind projects (Pise, 2008 Feb.PC). However, this requires proper understanding between the wind developers and local populace for functioning of this concept. The tribal land owners who are not willing to sell their land to renewable developers could be extended the option of leasing out their land for 30 years to the developers. While this approach would meet requirement of renewable developers, it will help the land owners in retaining ownership of their land, which has been the subject of contention.

**Involvement of MIDC**: Maharashtra Industrial development corporation (MIDC), a state Government body responsible for promotion of industrial development in the state, could be involved to address land related issues[34]. Additionally, cooperative sector involving local population could be encouraged to participate in the commissioning of renewable projects (Pise, 2008 Feb.PC). All relevant stakeholders could be involved in formalizing the shape and scope of the schemes, which could help in facilitating land acquisition for setting up new renewable projects.

**Role of MEDA:** MEDA needs to take a leading role in facilitating land acquisition process for renewable projects. As discussed, MEDA needs to coordinate with MIDC, local administrative bodies and mining department for seeking clearance of sites, apart from creating a platform between renewable developers and forest land owners to sort out problems associated with leasing of land. Being a Government body, MEDA is expected to enjoy higher confidence among people while devising solutions for land acquisition as compared to private developers.

### 7.2.2 Import of renewable electricity from other states

The basic objective of renewable policy is to promote renewable sources, address environmental concerns and energy security issues. While it is important to develop renewable projects within the state, it is also important to realize the broader goal of increasing the share of renewable in the state, which underlines the need of sourcing renewable power from any source irrespective of its geographic location.

**Import of Renewable electricity (RE) from other states:** As gap in demand and supply in power sector is continuously increasing, the licensees of Maharashtra are compelled to import conventional power from other states at substantially high cost. RE is not generally imported as it cannot be used to offset the renewable targets under RPS. In view of the rising import of conventional power, it is felt that the licensees should be encouraged to import RE in the larger interest of environment. This could be promoted by making imported RE eligible for meeting renewable targets under RPS. A case in point could be the example of Delhi, which is

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[34] One of the main activities of MIDC is to procure land in Maharashtra for industrial purposes under Chapter 6 of MID Act 1961. (http://www.midcindia.org/inv_dest/midc_brief/objectives.php#TOP)

planning to import RE from wind power projects located in Rajasthan (GreenEnergy 2007). Import of renewable electricity could help in reducing the gap in its demand and supply in the state and consequently its price as well.

However, there are a number of issues that need to be sorted out for facilitating import of RE. The pricing mechanism of RE varies from state to state. Hence, the economic viability of import option would depend on the price of RE in the exporting state. Additionally, there are issues associated with operational procedures, like accounting for transmission and distribution losses. Different states have different levels of transmission and wheeling charges applicable for renewable generators, which need to be factored in while evaluating the cost effectiveness of import option (WISE, 2008 Feb.PC). Further, there may be issues related to metering, reporting and verification protocols for RE generators in the exporting state. For addressing these issues, MEDA may be required to liaison with its counterpart organizations in the exporting states.

Addressing the administrative and technical complexity may have an impact on the economic attractiveness of this option. However, this route could still help in increasing the penetration of RE in the state.

### 7.2.3 Estimation of renewable targets

Setting the size of target is an important aspect of the policy instrument as it influences the burden that the consumers would be subjected to. Further, target setting becomes a vital issue especially if the policy instrument specifies penalty for non achievement of targets (Mukherjee 2006). As targets are based on availability of renewable potential, it is felt that reassessment of RE potential in the state may be useful for sustaining growth in a cost effective way, which has been discussed in section 6.3.3.1. The assessment of renewable potential may factor in the following ground realities associated with the renewable sources.

**Consideration of local conditions for wind projects**

Proposed location of new capacity addition and PLF at proposed location need to be considered in order to work out the RE generation potential with higher degree of accuracy, against the present practice of using state-wide average values of PLF. Experience indicates that error in estimating PLF for wind power projects could affect the capacity addition rates, as was observed in 1996-98 (CWET 2004b)[35].

For estimating the PLF at proposed locations, one of the options could be to consider the annual PLF reported by various projects in the state, which would give an idea about the PLF that could be expected in the respective locations. PLF of projects in an area is reflective of the wind condition and generation potential specific to that area/ region. Therefore, consideration of actual PLF of projects from different regions would help in better estimation of RE generation potential in the state.

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[35] The promoters assumed a PLF of 20%, whereas the actual figures in most cases were lower. This resulted in actual generation being lesser than estimated, and impacted the revenue earning of the projects.

Additionally, factors like turbine design and grid connectivity[36], need to be considered for better assessment of generation potential (CWET 2004a). The exercise would be further useful if it could also indicate the potential at different heights like 50 meter, 75 meter and 150 meter, so as to provide a comprehensive idea of the potential available with different technologies (Hossain 2007). Issues like site calibration and long term assessment of select sites need to be looked into (Kumar and Beurskens 2007).

**Consideration of local conditions for biomass and bagasse based projects**

As discussed in section- 6.3.2.3, fuel supply linkage in biomass sector is the one of the crucial aspects for smooth functioning of the projects. Therefore, availability and cost of biomass for power generation purpose needs to be considered for estimating the available potential.

In case of cogeneration sector, some co-generation units may sell power directly to power traders who are ready to pay prices higher than preferential prices of RPS. The power traders are able to offer high prices, as they sell this power at even higher prices to cater to the peak demand of some consumers[37], in the backdrop of power shortage in the entire region[38] (Rao, 2008 Feb.PC; Anvekar 2008 Feb.PC). As the power traders are not required to fulfill the mandate of renewable power procurement under RPS, they do not need to report such purchase from cogeneration units as green power purchase. This leads to a situation wherein, renewable power generated by some cogeneration units is not used to offset the targets under RPS.

Because of purchase of renewable power by traders, the amount of renewable power left in the market for eligible consumers to meet their RPS targets, reduces. Hence, a thorough assessment of potential for different renewable pathways needs to be undertaken, to work out realistic targets for eligible consumers.

As the distribution licensees have to follow competitive bidding for sourcing power from renewable generators (MERC 2006a), the scarcity of renewable power in the market, created by power traders, led to an escalation in renewable prices thereby burdening consumers. Therefore there is a need to determine a ceiling on the financial burden that may be imposed on consumers due to renewable targets, in consultation with the consumer representatives.

**Role of MEDA**

MEDA as the nodal agency may facilitate the process of target re-assessment, through a detailed study, while factoring in the issues described above. While undertaking the exercise, there is a need to ensure that the technology and methodology used for the exercise should be mature enough to earn the confidence of renewable developers. Presently, some developers repeat the micro-siting exercise to assess wind potential, even after the site has been previously assessed by MEDA (Suzlon, 2008 March.PC). The credibility of MEDA's micro-siting exercise may be improved if MEDA coordinates with leading institutions, like CWET and renewable developers, to work out a standard methodology for estimation of RE generation

[36] As per CWET, the technical potential of wind in India is 13000 MW against an estimated potential of 45000 MW if grid penetration is considered to be 20%. Hence, grid connectivity should also be considered while evaluating RE potential.

[37] These are generally big industrial consumers.

[38] Maharashtra as well as neighboring states are suffering from shortage of power.

potential. This may avoid the necessity of repeating micro-siting by renewable developers, all over again.

### 7.2.4 Relevance of penalty in RPS and reverting back to RPO

Penalty of RPS has given rise to quite a few significant issues in the renewable sector. It is felt that penalty, which was meant to facilitate compliance among eligible consumers, may not have contributed in a way as desired for promotion of renewable electricity. While on one hand, there has been a decline in the growth rate of capacity addition, on the other hand, the price of renewable electricity has risen up on account of widening demand supply gap. Hence, there is a need to critically review the effect of penalty on renewable sector.

**Concept of competition and penalty in RPS**

Conceptually, RPS is based on the principle of competitive bidding, wherein, renewable power is to be purchased from least cost generator. This concept is likely to succeed in matured markets wherein demand and supply are reasonably balanced, i.e., the buyers and sellers have range of options to do business with, based on the price of RE. Therefore the concept of competition between generators would be appropriate only when sufficient generation capacity is available (TERI 2006a and TERI 2006b). However, in case of Maharashtra, availability of renewable power is much lesser than the amount required to meet the targets. In such situation, the market turns into a seller's market, wherein, renewable generators start demanding higher than preferential price to the licensees (Rokade, 2008 Feb.PC). This leads to increase in power cost for consumers, without corresponding growth in renewable generation. Thus the very purpose of promoting renewable power at least cost to the consumers is defeated. Hence, it is felt that competition based RPS has been introduced a bit too early, with regard to the readiness of market.

**Applicability of Green certificate system**

The certificate system would help the renewable generators to sell their certificates to any distribution licensee in the state without having to worry about their relationship with MSEDCL, in case they are connected to MSEDCL network. However, problems related to penalty and land acquisition issues would continue to exist, even with the certificate system. As observed in Renewable Obligation system of UK, the certificate system is burdened with higher degree of operational complexity as compared to the feed-in system of Germany. As pointed out by INWEA, several issues like validity, registration, verification and accreditation of certificates need to be addressed before introducing the certificate model (MERC 2006a). With the present level of maturity observed in implementation of RPS, wherein Open access consumers and captive consumers are not yet identified properly, the issue of introducing green certificate system would most likely add to the complexity of the system. Hence, it is felt that green certificate system may not be a viable alternative in the present situation.

**Proposal for removing provision of penalty**

Given the above situation, it is imperative that the provision of penalty has not contributed in a way as intended. With the modifications suggested in sections- 7.2.1 to 7.2.3, the issues related to land acquisition may partly be addressed by involving MEDA and MIDC. However, the issue of land price may still continue to pose problems in reviving capacity growth rate, which in turn, will influence the demand supply gap of renewable electricity. Even the option of importing renewable power from other states requires many issues to be sorted out, which are discussed in section 7.2.2. In light of the above, it is felt that the provision of penalty may be dropped from the RPS.

**Reverting back to RPO**

Under RPS, without the support of penalty, the targets would have no meaning, as the licensees would not be bound to purchase renewable power from generators. They would buy renewable power as long as it continues to be competitive with respect to power imported from other states, to bridge demand supply gap. However, this cost advantage enjoyed by renewable power may be lost, if new fossil based generation capacity is commissioned in the state in near future, which would obviate the need of importing costly power from other states. In such case, renewable power may not be able to compete with cheap conventional power produced within the state, which may expose them to the risk of not finding consumers for selling their generation.

Therefore, removal of penalty needs to be supported by a feed-in system wherein, the distribution licensees would be mandated to buy the entire renewable generation from their respective coverage areas. To maintain equity among “eligible consumers”, the financial burden of renewable procurement should be shared by all “eligible consumers” at the end of the year. As most of these desired features are already present in the RPO, it could be worth considering reverting back to the RPO, with certain modifications.

**New Feed-in system based on RPO**

Apart from the organizational, regulatory and market related modifications suggested in the preceding sections, additional modifications are felt necessary in the previous RPO in order to improve effectiveness of the system.

**Inclusion of Open access and captive consumers:** The previous RPO instrument mandated only the distribution licensees to share the burden of renewable procurement through financial settlement at the end of the accounting year (MERC 2004a). As discussed in 5.4.1, Open Access consumers and captive consumers, who do not purchase power from the distribution licensees, should also be included in sharing the burden of renewable procurement, to ensure equity among all consumers in the state.

**Tariff differentiation based on location specific characteristics:** In the existing system, tariff is differentiated only on the basis of renewable source used. Regional characteristics, like wind profile specific to the region, was not considered, for determining preferential tariff. For example, wind power tariff is calculated based on an average PLF of 20% for the whole state, instead of considering PLF values for each region separately (Deo and Modak 2005). As a result, preferential tariff for wind power is the same across the whole state, irrespective of the potential available in different regions of the state. As generation cost varies significantly with respect to regional characteristics, the tariff needs to be differentiated accordingly, which would help in maintaining parity in the earning potential of generators located in different regions.

The German Feed-in tariff system (section- 2.1.1) differentiates tariff based on regional characteristics, so as to prevent windfall profits for those generators who are located in sites with better potential. This also helps in passing on the benefits of low cost generation to the consumers, from projects located in high potential areas and thus contributes to the improvement of cost effectiveness of the system.

In order to differentiate tariff, detailed survey of regional characteristics in all technology domains needs to be undertaken, which would involve elaborate planning and involvement of major stakeholders, like technology providers, renewable generators, R&D institutions like CWET, MEDA and meteorological department.

**Tariff differentiation based on time of project commissioning:** As observed in the German FIT system (section- 2.1.1), technological learning with respect to time, leads to reduction in generation costs, wind sector being one of the prominent examples (Mendonca 2007). Hence, tariff needs to be differentiated with respect to time of commissioning to pass on the benefits of low generation cost to consumers. In the present system, tariff offered to the renewable generators in some technologies is kept at the same level for long time frames. For example, the tariff for renewable power from biomass and small hydro plants, which was set in the year 2005 will be valid until year 2010. As substantial changes may be expected in technology and generation cost during this time frame, there is a need for the tariff to be reflective of these changes.

**Improving cost effectiveness by extending the duration of preferential tariff:** As already discussed in section-6.3.3.2, the benefits of reduction in generation cost of renewable electricity after expiry of the preferential tariff period, should be passed on to consumers, in the form of reduced tariff (Dixit, 2008 Feb.PC). As the percentage of renewable in total power is targeted to grow, the share of renewable cost in total electricity cost will become more prominent in the forthcoming years. Extension of tariff period to cover the entire economic life of project would help in reducing the burden of renewable in total electricity cost.

As the existing power purchase contracts of Group-2 wind projects would expire after 8 years, the generators may choose not to enter into fresh contracts at preferential price. Instead, they may prefer to sell power at market price. Therefore, the concept of extension of tariff regime would be workable, only if the entire system is reverted back to fixed tariff system, as provided under RPO. After reverting back to RPO, if some renewable generator evinces interest in modernization of its project, then, fixed tariff applicable for new projects could be offered to such generator. This approach would ensure incentive for modernization of projects as well as transfer of benefits to consumers due to depreciation of assets.

### 7.2.5 Institutional Strengthening

MEDA, the nodal agency responsible for implementation of RPS instrument, has contributed notably in terms of participation in policy formulation stage, analyzing the bottlenecks coming in the way of implementation, framing of operating mechanism and addressing the problems of stakeholders through Technical task force (TTF) meetings. However, as discussed in 7.2.1 to 7.2.5, there are quite a few areas which need attention for improving the functioning of MEDA, with regard to implementation of policy instrument.

**Capacity building in MEDA**

Strengthening of coordinating institution is quite significant for the effective functioning of renewable instrument (Reddy and Painuly 2004). To start with, clarity needs to brought in regarding the roles and responsibilities of MEDA and other stakeholders about the tasks to be performed by them. For example, the delay in publishing the performance of licensees for the year 2006-07, can be attributed to lack of clarity about responsibility for data collection from various sources (Doshi, 2008 Feb.PC). Even during the previous RPO regime, lack of clarity was observed in relation of settlement of accounts, wherein licensees used to share the burden of renewable purchase at the end of year (Rokade, 2008 Feb.PC). Hence, responsibilities are to be demarcated explicitly for data collection, analysis and monthly reporting among the stakeholders, to streamline information flow between the key entities. As the process of reporting, monitoring and compliance involves many actors, like, distribution licensees, transmission licensees, renewable generators, SLDC, OA and captive consumers, it may be too complex a process for MEDA to handle on a regular basis, given its present capacity. Apart from the above, MEDA also needs to facilitate the task of land acquisition issues as discussed in section- 7.2.1. Even the MERC had directed MEDA to engage consultants for facilitating the operation of RPS in the state (MERC 2007b). Hence, need is felt for significant capacity building within MEDA to deal with these issues on an ongoing basis.

**Capacity building among other stakeholders**

As discussed earlier in section 6.3.1.6, functioning of RPS instrument was affected due to misinterpretation of the provisions by stakeholders. MSEDCL had stopped issuing credits to some wind projects, on account of misinterpretation of provisions about validity of "wind" tariff policy and the provisions available under Open Access mechanism (MERC 2007f). Apart from this, there are cases wherein, MSEDCL has charged in excess for transmission and wheeling of renewable power for captive consumers and licensees, due to mis-interpretation of rules (MERC 2008c). As MSEDCL provides network connectivity to almost all renewable generators, hence, it's role in ensuring smooth functioning of RPS instrument has assumed considerable significance. Therefore, it is suggested to initiate capacity building programs among MSEDCL personnel who deal with the renewable generators, and set formal procedures for metering and credit raising for renewable generators. Members of TTF could be given the additional responsibility of conducting regular workshops for key people of their respective organizations to build capacity for dealing with the problems at operational level.

### 7.2.6 Metering and credit transfer procedures

The time required for metering at generator's end and transfer of credits to the RE consumer, varies depending on the connectivity of generator and buyer to the electrical network. The intervening networks used for transmission of renewable power may belong to different entities, who are to be paid transmission and wheeling charges for using their networks. The number of networks that the renewable power has to travel through before reaching the consumer, influences the complexity involved in assessing transmission charges and losses, which in turn influences the amount of credits to be transferred to the consumer. Hence, the number of intervening networks influences the amount of credits as well as the time required for credit transfer. The cycle time of the process can be considerably reduced if online metering using SCADA[39] system is implemented by involving renewable generators and eligible consumers (Kumar and Beurskens 2007). It will allow the SLDC[40] to get online renewable generation data without the need to physically meter the readings after each billing

[39] Supervisory Control and Data Acquisition System- SCADA

[40] SLDC – State Load Dispatch Centre, monitors power flow in the transmission grid

cycle. As of now, the issue of implementation of SCADA at generator's end is not finalized due to lack of clarity about allocating financial responsibility for such modification. This system will also help in migration of the energy settlement mechanism from month end settlement system to 15 minute settlement system. Therefore, consensus needs to be evolved with MEDA in the lead, about cost sharing mechanism between renewable generators, licensees, SLDC and OA and captive consumers, for implementation of online monitoring system.

### 7.2.7 Compliance issues for Open access (OA) consumers and Captive consumers

As with distribution licensees, the performance of OA consumers and captive consumers regarding their RE procurement needs to be monitored on a regular basis. The first step involves identification of these consumers by MEDA in consultation with the distribution licensees, transmission operators and SLDC (State load dispatch centre) (Rao, 2008 Feb.PC). For regular monitoring of these consumers, appropriate reporting mechanism for these consumers needs to be established. This will help MEDA to monitor their compliance on an ongoing basis. Additionally, mechanism for cross-verification of data submitted by these consumers needs to be established. As these consumers are connected to either distribution network or transmission network, their energy transaction is metered by the licensees/ grid operators / SLDC, depending on the voltage level of the connecting grid. Therefore, it is necessary to involve these entities in establishing routines for verification of data submitted by OA and captive consumers. Additionally, representatives from OA and captive consumer groups could be included in the Technical Task Force (TTF), to facilitate effective implementation of the policy instrument.

### 7.2.8 CDM issues: Improving the viability of wind projects

The distribution licensees have been demanding their share in the CDM benefits enjoyed by wind generators so that the benefits could be passed on to consumers. As per MERC, the renewable projects are developed at the cost of consumer, and therefore, the benefits of CDM should go to the consumers. However, benefit sharing could be implemented for new projects, in accordance with the principle of additionality required for CDM projects.The benefits could be reflected in the tariff charged to consumers (Shah, 2008 Feb.PC; Roy, 2008 Feb.PC). In case of bagasse based cogeneration, the project proponents could make use of the CDM route to set up new projects. With a number of sugar industries yet to go in for cogeneration, CDM support could be used to accelerate the capacity growth rate in the state (Purohit and Michaelowa 2007).

### 7.2.9 Promoting growth in multiple renewable options

As already discussed, growth has been mostly concentrated in the field of wind power generation. Given the supporting policies provided for wind sector along with the huge potential available in the state, the independent renewable developers as well as distribution licensees have shown their preference for wind sector over other renewable sectors. In the following sections, some interventions have been suggested to promote growth in other renewable sectors.

### Supporting policies

Appropriate supporting policies specifically designed for each renewable option could play a significant role in promoting growth of renewable electricity across multiple renewable options. For example, in January 2008, the MNES declared a support scheme specifically targeted for increasing the penetration of grid connected solar photovoltaic (PV) sector (Pandit, 2008 Feb.PC). Under this scheme, the Government would provide financial incentives to renewable generators, up to 20 €cents per kwh for off grid project and upto 16.7 €cents per kwh for grid connected projects (MNRE 2008). This incentive is provided to the renewable developers after accounting for the tariff that the renewable generator gets from sale of electricity to distribution licensees. Considering the high capital cost associated with this sector and its impact on the cost of generation, this scheme will be operational for a period of 10 years. Schemes of this nature are expected to provide the much needed push to the Solar PV sector as has been observed in Germany (section 2.2.4). Similar supporting policies for other emerging renewable options could help in increasing their capacity growth rate.

### Sector specific targets

While promotional policies targeted for emerging renewable options could foster overall development, sector specific targets were considered for the licensees under RPS to promote emerging renewable options (MERC 2006b). Under this, separate targets for RE purchase from different sources were to be given to licensees. However, there was a possibility of increasing the complexity of the system by introducing sector specific targets, which could increase the cost of administrative tasks like monitoring and verification. Additionally, as uncertainties prevailed about accurate projection of potential of various renewable options, introduction of sector specific targets could further complicate the performance of RPS. As the state is still in its initial phase, so far as experience with renewable instruments is concerned, it is felt that sector specific targets could be avoided at this stage. After the renewable markets mature, possibilities could be explored to introduce sector specific targets.

### Addressing requirements of other renewable segments

Apart from the supporting schemes, such as the one available to solar PV sector, there is a need to sort out the hindrances specific to each sector. Some of the prominent issues that need attention are discussed below:

- **Fuel supply linkages in biomass and bagasse based projects**

  In case of biomass and bagasse based projects, continued supply of fuel is key to the success of this sector (Narayana, 2008 Feb.PC). As renewable generators are subjected to penalty, in case of failure in supplying power as per agreement, reliable supply of fuel becomes even more important. Hence, it is felt that the Government can initiate steps for setting up cooperative bio-energy systems, which could involve the farmers of a given area to form cooperatives. The cooperatives would produce biomass for power generators, with the supply chain elements, like transportation and marketing of biomass, being handled by professionals (Virendra, 2008 Feb.PC). This involvement of local community supported by professional expertise would address the issues related to afforestation, harvesting, empowerment, collection and transportation, followed by marketing and pricing of products. In this process, transportation is a key issue and needs to be professional managed as it has a major share in the delivered cost of fuel. Further, pilot plants using different types of conversion technologies using backpressure turbine and condensing turbine need to be commissioned for highlighting the suitability of these options to prospective investors. MEDA being the nodal agency could help in facilitating the process.

- **Community participation in Small hydro projects**

High investment costs, accessibility and transportation issues due to difficult terrains, are some of the major obstacles coming in the way of small hydro projects. Additionally, extension of grid over difficult terrains and providing maintenance services to remotely located projects, makes the sector unattractive for investors. However, experience suggests that some of these problems can be overcome by involving the local community in some segments of the project, which needs adequate capacity building within the local community to take care of day-to-day requirements (Virendra, 2008 Feb.PC). MEDA needs to provide institutional support for research & development (R&D), demonstration projects and training programs for the benefit of community members. Some states like Himachal Pradesh and Kerala have shown active interest in promoting run-of-the river projects, which are to be managed by local communities. In Nepal, Small Hydro Power Program launched in 1996 has been quite successful due to the emphasis on community participation and capacity building among locals.

- **Tariff related issues**

As the tariff for power generation from some renewable sources has been set long time back, there is a need to revise the same based on escalation in capital cost of projects. While the tariff of bagasse-based power was set in the year 2002, the tariff for biomass and small hydro plants was set in year 2005. Given the escalation in capital cost of projects, there is a need to reassess the tariff for these technologies while factoring in various ground realities. For example, in case of biomass-based projects, it may be useful to consider the calorific value of fuel and the cost associated with collection and transportation of fuel. As various types of biomass-based fuels are available, the generation cost varies considerably as per the calorific value of fuels (Virendra, 2008 Feb.PC). Hence, it could be useful to differentiate the tariff based on broad categorization of biomass fuels. Further, there are a host of technologies available for conversion process, like back pressure turbines and condensing turbines. Therefore, it could be useful to further differentiate the tariff based on technology used for power generation.

- **Issues common to all renewable technologies**

The renewable generators / buyers are required to pay transmission and wheeling charges while transmitting power through intervening networks. These charges are made up of two components, fixed and variable. While variable charge is dependent on the actual amount of energy transmitted[41], the fixed component remains constant[42], irrespective of the amount of energy transmitted. Therefore, during lean season, i.e., periods of low generation, the renewable generators/ buyers are obliged to pay at least the fixed component of transmission and wheeling charges (Parvathirathnam, 2008 Feb.PC). As this poses considerable financial burden for generators/ buyers during lean season, it is suggested to remove the fixed charge, as is the case with Group-2 wind projects. Group-2 projects are already enjoying the benefit of not paying any fixed charge. Similar exemption may be extended to all renewable projects.

## 7.3 Suggestions for further research

Presently, different states in India have different policy instruments to promote renewable electricity. Renewable electricity generated in one state cannot be used to meet renewable targets in another state, due to various administrative and technical reasons. It could be interesting to study the regulatory and commercial issues that need to be addressed to facilitate transaction of renewable electricity across states.

MEDA, the nodal agency responsible for promotion of renewable energy in Maharashtra, holds a vital position with regard to implementation of renewable policy instrument and coordinating between various stakeholders in the state. A study can be undertaken to identify the options that could improve the performance of MEDA in implementation of renewable policy instruments, by looking into the inter-relationships between the various stakeholders.

Presently, the settlement of renewable generation among distribution licensees/ eligible consumers is done on a monthly basis. However, in the future, the settlement mechanism for renewable generation is going to migrate to 15 minute billing cycle in Maharashtra. It could be interesting to study the impact of the new billing cycle on different renewable sources in case of both quota based and price based instruments.

*"The new way of doing things may be hard, but continuing in the old way is certain to lead to an impasse".*

*Amulya Reddy*

[41] Variable charges are based on losses in energy during transmission / distribution, which in turn is dependent on the actual amount of energy transmitted.

[42] Fixed charge is dependent on the transmission capacity contracted between the generator and the network operator (transmission/ distribution network operator). The fixed charges remain constant as long as the actual power transmitted through the network remains within the contracted transmission capacity. During lean season, generators earn less revenue due to lower generation, but still have to pay the fixed charges as per contract.

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# Abbreviations

| | | |
|---|---|---|
| ABT | : | Availability Based Tariff |
| BEST | : | The Brihanmumbai Electricity supply and Transport Undertaking |
| CEA | : | Central electricity authority |
| CERC | : | Central Electricity Regulatory Commission |
| CUF | : | Capacity utilization factor |
| DNES | : | Department of non conventional energy sources, India |
| EA 2003 | : | Electricity Act 2003 |
| EPA | : | Energy purchase agreement |
| GHG | : | Green house gas |
| GWh | : | Giga Watt hour |
| IREDA | : | Indian renewable energy development agency |
| IRR | : | Internal rate of return |
| InWEA | : | Indian wind energy association |
| kV | : | Kilo Volt |
| kW | | Kilo Watt |
| KWh | : | Kilo watt hour |
| LRMC | : | Long Range Marginal Cost |
| MERC | : | Maharashtra Electricity Regulatory Commission |
| MNES | : | Ministry of non conventional energy sources, India |
| MNRE | : | Ministry of new and renewable energy, India |
| MEDA | : | Maharashtra Energy Development Agency |
| MU | : | Million units |
| MW | : | Mega watt |
| MWh | : | Mega watt hour |
| MOP | : | Ministry of power, India |
| MSEDCL | : | Maharashtra State Electricity Distribution Corporation Limited |
| MYT | : | Multi year tariff |
| NETA | : | New electricity trading agreement, UK |
| O&M | : | Operation and Maintenance |
| OA | | Open Access |
| PLF | : | Plant load factor |
| PPA | : | Power purchase agreement |
| RE | : | Renewable Electricity |
| RPO | : | Renewable purchase obligation, India |
| RPS | : | Renewable purchase specification, India |
| ROE | : | Return on equity |
| REL | : | Reliance Energy Limited |

| | | |
|---|---|---|
| RE | : | Renewable Electricity |
| REDAM | : | Renewable Energy Developers association of Maharashtra |
| SCADA | : | Supervisory Control and Data Acquisition |
| SLDC | : | State Load Despatch Centre |
| SEB | : | State Electricity Board |
| SRMC | : | Short Range Marginal Cost |
| SERC | : | State Electricity Regulatory Commission |
| TERI | : | The Energy and resources Institute |
| TOD | : | Time of day metering |
| TPC | : | Tata Power Company |
| TWh | : | Terra Watt hour |
| UI | : | Uninterrupted Interchange |

# Appendix

## Appendix- 1: Features of Tariff MNES policy and Fiscal Incentives

**Features of tariff policy by MNES in year 1994** (Deo and Modak 2005)

- A common price of € cents 3.75 per KWh, was fixed for renewable electricity from all renewable sources, taking the year 1994-95 as base year.
- Tariff escalation of 5% was provided per year for the first 10 years.
- No tariff escalation was provided for the next three years, i.e., from 11$^{th}$ to 13$^{th}$ year.
- From 14$^{th}$ year onwards, 5% tariff escalation was provided for the next seven years.
- The annual tariff escalation rate of 5% was provided as per increase in Wholesale price index (WPI).

**Fiscal incentives available to the renewable developers** (Deo and Modak 2005)

The various fiscal incentives to renewable projects is presented as under:

- Subsidy is provided in the capital cost of renewable projects by IREDA, which reduces the burden of capital investment on part of the renewable developers and therefore also reduces the associated fixed cost components in loan repayments like, interest and principal re-payments.
- Loans with lower interest rates are provided by the IREDA.
- Income tax benefits are provided to renewable developers through 100% depreciation of assets in the first year of the project. This helped the renewable developers in reducing their income tax liabilities.
- Sales tax benefits were provided to the renewable developers which allowed them to write-off their sales tax liabilities in main business.

## Appendix-2 : Summary of existing tariff orders

| Renewable Energy Source | Tariff Order date | Target Capacity Addition | Validity period under earlier Orders |
|---|---|---|---|
| Non-fossil fuel (bagasse) based co-generation | 16th August 2002 | 300 MW | 31st March 2007 or target capacity addition, whichever is earlier |
| Non-fossil fuel (bagasse) based Non-Qualifying Co-generation | 25th May 2005 | Incl. above | 31st March 2007 or review linked to review of Qualifying co-generation project cases |
| Wind Energy | 24th November 2003 | 750 MW | 31st March 2007 or target capacity addition, whichever is earlier |
| Biomass | 8th August 2005 | 250 MW | 31st March 2010 or target capacity addition, whichever is earlier |
| Small Hydel | 9th November 2005 | 200 MW | 9th Nov 2010 or target capacity addition, whichever is earlier |
| Municipal Solid Waste | 6th April 2004 | Not specified | 31st March 2007 |

(Source: MERC 2006a)

As can be seen, tariff orders for biomass and small hydel projects were already valid until year 2010. The validity period of the remaining tariff orders were also extended until 31st March 2010, after introduction of RPS in year 2006 (MERC 2006a).

# Appendix-3: Classification of Wind power projects

Classification of Wind power projects (Source: MERC 2003)

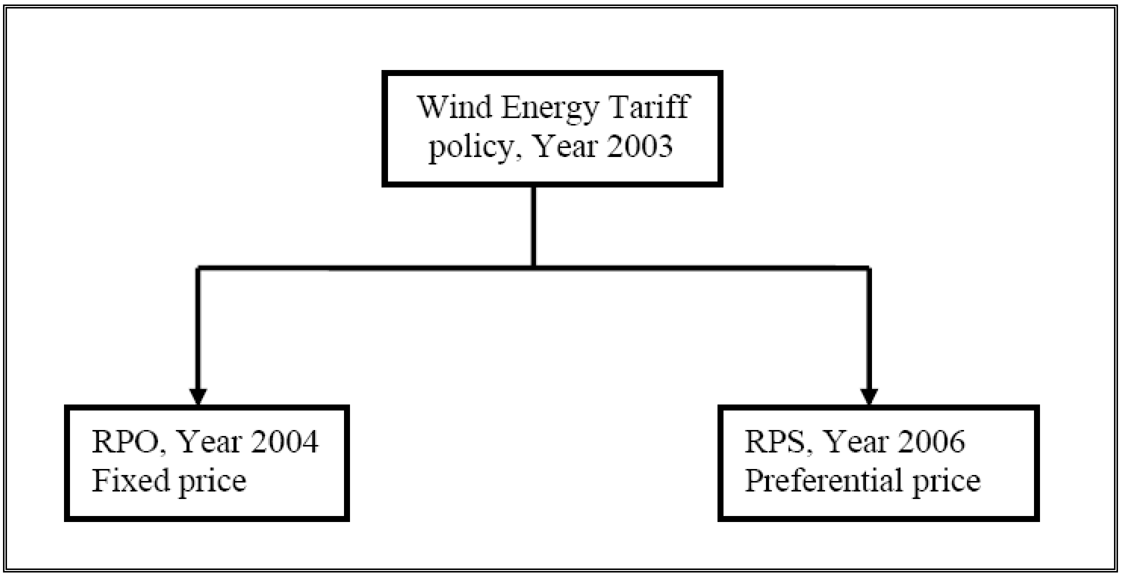
| **Group** | **Project commissioning dates** | **Time duration of Tariff regime** | **Sales tax benefit available** |
|---|---|---|---|
| Group-1 | Before 27th December 1999 | 20 years | Yes |
| Group-2 | From 27th December 1999 to 31st March 2003 | 8 years | Yes |
| Group-3 | From 1st April 2003 | 13 years | No |

# Appendix- 4: Estimation of future renewable electricity potential

Basis for estimating future renewable electricity generation (Source: MERC 2006 b)

| RE Source | Plant load factor (PLF) % | Auxiliary consumption factor (%) | Transformation loss and self consumption (%) | RE capacity addition per annum over RPS tenure | Approximate Annual generation (MU) |
|---|---|---|---|---|---|
| Wind | 20% | 0.5% | 0.5% | 350-400MW per annum | 650 MU |
| Small Hydel | 30% | 0.5% | 0.5% | 30-40 MW per annum | 75 MU |
| Cogeneration | 240 days of operation (season and off-season)~ 59% | 9% | 1% and approx. 30% energy utilization for self consumption | 70-80 MW per annum | 250 MU |
| Biomass | 80% | 10% | 1% | 50-60 MW per annum | 320 MU |

## Appendix-5: Tariff Orders and their relevance to renewable policy instruments




(Source: Rao, 2008)

The Wind tariff policy introduced in year 2003 in Maharashtra, mentioned the tariff values for wind generation. These tariff values were used as **fixed** price under the RPO regime, introduced in year 2004. The same tariff values of Wind tariff policy 2003, are used as **preferential** price, under RPS regime, from the year 2006.

# Appendix-6: Tariff differentiation in FIT, Germany

## Tariff differentiation based on renewable source in FIT of Germany 2006

(Source: Klein et al. 2007)

| Plant capacity | Pure solid biomass | Premium for untreated biomass[1)] | CHP premium[2)] | Premium for innovative technologies[3)] |
|---|---|---|---|---|
| Up to 150 kW | 11.16 | 6.0 | 2.0 | 2.0 |
| More than 150 kW up to 500 kW | 9.61 | 6.0 | 2.0 | 2.0 |
| More than 500 kW up to 5 MW | 8.64 | 4.0 | 2.0 | 2.0 |
| More than 5 MW up to 20 MW | 8.15 | - | 2.0 | - |

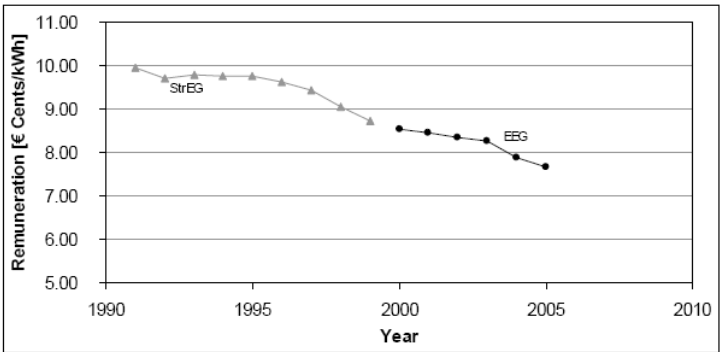
1) The premium for untreated biomass is paid if the electricity is generated from agricultural, forestry or horticultural residues (that were not treated before being used as fuel) as well as from liquid manure.

2) The CHP premium is available, if the electricity is generated in a *combined heat and power* (CHP) plant.

3) The premium for innovative technologies is paid for certain power plant designs, for example *Fuel cells, Organic Rankine plants, Kalina Cycle technologies* or *Stirling engines.*

## Tariff differentiation based on time

(Source: Klein et al. 2007)

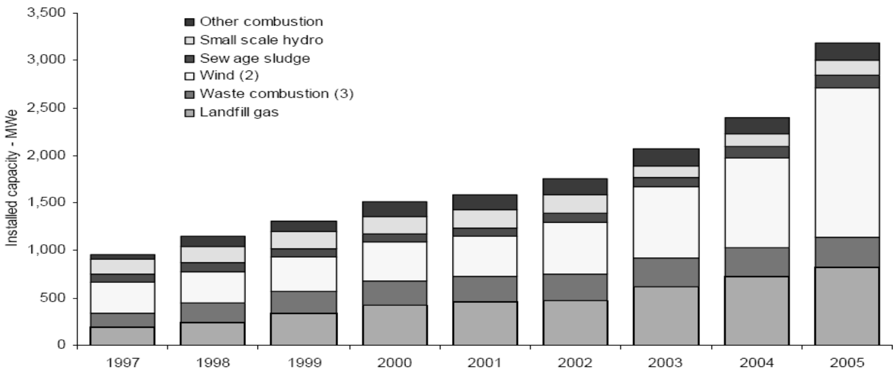



The above figure shows the tariff differentiation for onshore wind projects in Germany.

# Appendix-7: Growth in renewable sector in UK

## Capacity addition in UK (excluding large hydro)

(Source: BERR 2007)




*(1) Large scale hydro capacity was 1,355 MWe in 2005.*
*(2) Wind includes both onshore and offshore and also includes solar photovoltaics (10.9 MWe in 2005) and shoreline wave (0.5 MWe in 2005).*
*(3) All waste combustion plant is included because both biodegradable and non-biodegradable wastes are burned together in the same plant.*

# Appendix-8: Map of Maharashtra

**Map of Maharashtra**

(Source: COI 2001)

## Appendix-9: Consumer benefits by extending time length of tariff regime

For assessing the cost saving potential for consumers, wind power projects under Group-2, i.e., projects commissioned between 27th December 1999 and 31st March 2003, have been considered. As the preferential tariff period of these projects is 8 years, the initial projects in this group will be released from tariff regime[43] starting from the year 2008-09, depending on their date of commissioning (MERC 2007d).

The following table presents year-wise status of wind power capacity from Group-2 projects that will be released from tariff regime after completion of tariff period of 8 years.

Table 1: Status of wind power projects under Group-2 (Source: MERC 2007f)

| Year | Wind capacity released (MW) | Cumulative wind capacity released (MW) |
|---|---|---|
| 2008-09 | 3.04 | 3.04 |
| 2009-10 | 34.01 | 37.05 |
| 2010-11 | 131.7 | 168.42 |
| 2011-12 | 3.6 | 172.02 |

The Group-2 wind generators previously used to sell their power to MSEDCL, as they were having power purchase agreements (PPA) with MSEDCL. Under RPS, after completion of the tariff regime of 8 years, these renewable generators are free to sell their power to any licensee at market rates by entering into new agreements. It has been observed that these wind power generators are aiming to take advantage of the scarcity of renewable power by trying to sell their generation to non-MSEDCL licensees at a price close to penalty rate, which is much higher than preferential price (Tripathy, 2008). On the other hand, the licensees may buy this renewable power at a price close to the penalty rates, as it reflects the avoided cost of penalty for them (Rokade, 2008).

As costly power from Group-2 projects is likely to be purchased by non-MSEDCL licensees, the financial burden will be passed on to the consumers of these licensees. Presently, the consumers of Mumbai buy power from non-MSEDCL licensees like BEST, REL and TPC.

If price based system like RPO is implemented and the time length of tariff regime is extended from 8 years to 20 years, i.e., the economic life[44] of the project, then Group-2 generators would be expected to sell their generation at preferential price. This would help in reducing the renewable purchase cost of the licensees, as preferential tariff is lesser than market based tariff due to scarcity of RE in the market.

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[43] Release of projects from tariff regime is also referred to as maturity of tariff period.

[44] Economic life of wind power projects is generally 20 years.

## Cost saving potential for consumers

A scenario analysis is carried out for assessing the potential of cost savings for consumers if the tariff regime for Group-2 wind power projects is extended from 8 years to 20 years, i.e., to cover the full economic life of the project. This modification will result in cost savings from those Group-2 wind projects, which have already completed 8 years of initial tariff regime and are presently selling RE at market rates.

If the present quota based system (RPS) is continued, the renewable generators would like to sell their generation at a price close to penalty rate. This price has been referred to as "high" price. However, if price based system (RPO) is implemented and the time length of tariff period is extended, the renewable generators may have to sell their power at "preferential" prices, as specified in tariff order for Group-2 projects. Therefore, the difference between "high" price and "preferential" price would represent the cost saving potential for consumers, if RPO is followed instead of RPS. The following table presents the price that the distribution licensees[45] may have to pay, depending on the policy instrument and year of maturity.

Table 2: Selling price charged by Group-2 projects (Source: Rokade, 2008; Rao, 2008 ).

| **Policy instrument** | **Selling rates** | **Selling price for following years** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **2008-09** | | **2009-10** | | **2010-11** | |
| | | **€cents/ kwh** | **INR/KWh** | **€cents/ kwh** | **INR/KWh** | **€cents/ kwh** | **INR/KWh** |
| RPS-Quota based | High | 10 | 6 | 11.67 | 7 | 11.67 | 7 |
| RPO- price based | Preferential | 5.95 | 3.57 | 6.13 | 3.68 | 6.32 | 3.79 |

Based on the above scenarios, the cost saving potential for consumers is worked out and presented in the following figure.

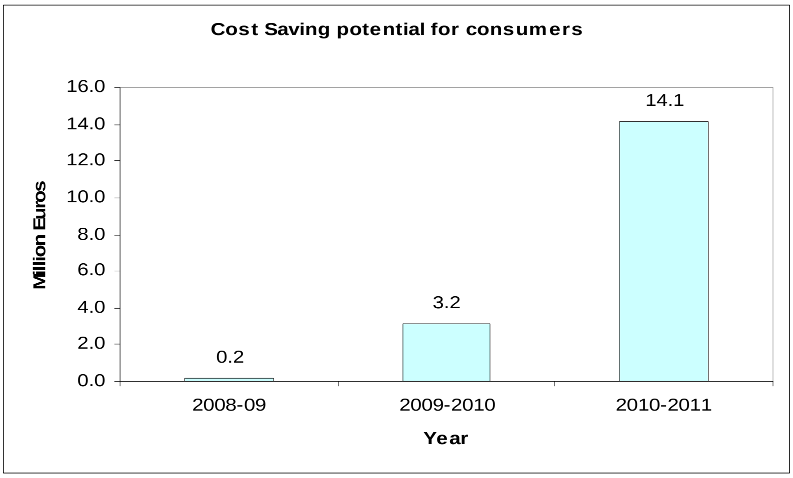


Figure 1: Cost saving potential for consumers (Source: MERC 2007f ; MERC 2006b).

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[45] Based on price quoted by the renewable generators from licensees for sale of renewable power.

In the above figure, the bar graphs indicate the cost saving potential available for consumers after price based system is implemented and tariff regime is extended. The cost saving potential rises from €0.2 million in year 2008-09 to €14.1 million in year 2010-11. The rising trend in saving potential is due to the fact that the capacity of projects released from tariff regime keeps on increasing from 2008 to 2011, as shown in table-1.

The reduction in cost of renewable purchase also reduces the percentage share of renewable cost in total power cost. The following figure shows the cost saving potential as a percentage of total electricity cost.

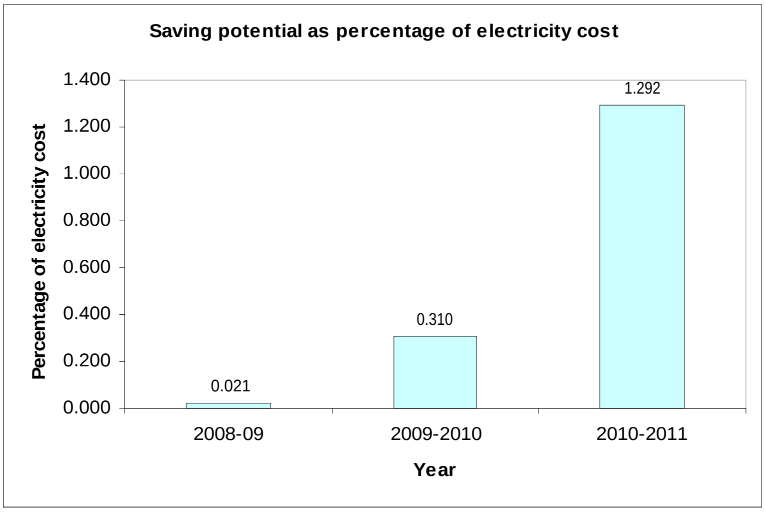


Figure 2: Cost saving potential as percentage of electricity cost (Source: MERC 2007f and MERC 2006b).

In the above figure, the cost saving potential in terms of percentage of electricity cost, increases from 0.02% in year 2008-09 to 1.29% in year 2010-11 (Rao, 2008). This is of special significance because consumer representatives have opined that share of renewable cost in total power cost should be limited to 2% (PRAYAS 2006).

The cost savings are expected to be higher than what has been projected above, if tariff is calculated afresh for these projects for their balance life of 12 years, after excluding the capital cost that has fully depreciated during the initial tariff period of 8 years. This would further help in reducing the financial burden of renewable electricity on consumers.