

Renewable Energy Based on Deregulated Electricity Market

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Abstract— This paper shows that the penetration of renewable energy in deregulated electricity markets is changing the behavior of wholesale electricity costs. Electricity markets work fine when the penetration of renewable energy is low, but they are interrupted when the penetration is significant. Renewable technologies have a cost structure that disrupts the traditional formation of wholesale electricity prices in liberalized markets — they have zero or near zero marginal costs. The poor design of liberalized electricity markets is the cause of two inconsistencies:

- Although renewable energy results in lower prices, this is not the result of a decline in long-run full-cycle costs.
- The returns earned by renewable energy arise from the marginal costs set by fossil fuel technologies. Therefore, if fossil fuels were displaced from the market, current liberalized market rules would deny these returns.

Renewable energy is a sustainable and clean source of energy derived from nature. Power industry is moving rapidly from regulated conventional setup to a deregulated environment. In the deregulation environment, generation, transmission, and distribution are independent activities. There is a competition among generators for managing different customers. Main benefits from the deregulation include cheaper electricity, efficient capacity expansion planning, cost minimization, more choice, and better service.

Keywords- Renewable Energy (RE), Renewable energy resources (RES), Deregulated Electricity Market (DEM).

I. INTRODUCTION

Today power industry all around the world is switching from monopoly traditional setup to a deregulated approach. In the DEM, generation, transmission, and distribution are independent authorities. There is stiff competition among generators for attracting clients. The major advantages of the deregulated approach include economical generation, rate minimization, plenty of choices and better service. The electric service providers all over the world are opting to change their way of operation and business, from vertically integrated mechanism to open market system. According to Central Statistics Organization (CSO) and International Monetary Fund (IMF), India has emerged as the fastest growing major economy in the world; simultaneously it is facing the global threat of climate change. India has immense potential for renewable energy resources (RES). The future sustainable development of the nation to a great extent depends on harnessing these sources. Voracious utilization of conventional energy sources degrades environmental traits, human health and society. The

traditional approach is a challenge for future global security. So there is indispensable obligation to promote renewable energy in present Indian restructured power sector to attain sustainable and eco-friendly development. There is a substantial gap between the power demand and power generated in India. Hence there is the need to establish more generation plants. This should be achieved preferably from renewable sources by governmental as well as various private sectors. Electricity generation from renewable is assuming increasing importance over large negative environmental externalities caused by electricity generation from fossil fuels based energy.

II. RENEWABLE ENERGY

A. Renewable energy

RE is energy that is generated from natural resources that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed.

Alternative energy is a term used for an energy source that is an alternative to using fossil fuels. Generally, it indicates energies that are nonconformist and have low environmental influence. The term alternative is used to in contrast with fossil fuels according to some sources. By most definitions alternative energy doesn't cause any harm to the environment, a distinction which separates it from renewable energy which may or may not have significant environmental impact.

B. Current status of RES India

For India to become the world's economic powerhouse, it must first broaden the tax base and bring more of India's rural communities into the formal economy. As on 31 March 2017 summit its determined 2022 targets, as wind power was more than halfway towards its goal, whilst solar power was below 13% of its highly determined target, although expansion is expected to be dramatic in the near future.

During April-September 2016, renewable energy sector added 3,164 MW as against 1,629 MW added during April-September 2015. Bio energy was at just above 80% mark whilst small hydro power was already 85% of the way to meet its target. Overall India was at 33% towards summit its 2022 renewable installed power capacity target of 175 GW.

Solar power maintains its lead over wind in bringing new capacity to the grid. During the first half, solar energy sector added 1,750 MW while the wind segment added 1,305 MW, according to the Union Ministry of New and Renewable Energy (MNRE).

As on September 30, 2016, total grid connected installed renewable power capacity in India stood at 45,917 (MW). Total capacity of wind power stood at 28,083 MW. Solar's capacity was 8,513 MW. Biopower segment had a total capacity of 4,882 MW. Small hydro and waste-to-power accounted for 4,323 MW and 115 MW respectively. New deployment of renewable energy has gathered considerable pace. The ambitious targets are now further backed by India's global commitment under a formal multinational agreement.

According to the MNRE, a total renewable energy capacity of 42.6 gigawatts (GW) is to be added to the grid between April 2017 and March 2019. The capacity addition target, quite understandably, is dominated by solar power. Wind energy targets have also been increased steadily, although in the very likely scenario of withdrawn incentives these targets may prove hard to achieve. The aim is to generate 16,725MW of clean and renewable energy in 2016-17 (Apr-Mar), of which 12,000 MW would come from the solar power sector. Clean and renewable energy capacity addition through wind, biomass and small hydro projects is expected to be of 4,000MW, 500MW and 225MW, respectively, to meet the target for the ongoing financial year. For 2017-18, the government's aim is to add 20,450MW of renewable and clean energy, which includes 15,000MW of solar energy, 4,600MW of wind energy, 750MW of biomass energy, and 100MW of hydro power.

The government has set a target of 175,000MW capacity addition for renewable energy by 2022.

India's energy requirements are enormous and the demand is growing but our resources are limited both in physical and financial terms. The capital expenditure per watt of solar energy produced has fallen to Rs 60.6 in 2015-16 from Rs 79.7 in 2013-14, and is further projected to fall to Rs 53 in 2016-17. Still, lowering the cost of debt and equity for capital expenditure will accelerate growth in solar energy. Solar energy is a capital-intensive industry and if the initial cost of setting up the plant is high, the cost of solar energy is pushed up. Solar energy, the backbone of India's renewable energy targets, is, on average, still more expensive than coal-based energy -- between Rs 4.5 and Rs 5.5 per kilowatt hour for solar compared to between Rs 2.5 and Rs 3.5 for coal. For wind the rates have fallen to a record (low) of Rs.4 a unit for solar and Rs.5, it is still costlier than conventional and spot power prices. For non-solar, the targets range from 8.75 per cent to 10.25 per cent of the total power purchased; solar is 2.75-6.75 per cent. The target is to procure RE of at least 17 per cent of the total power purchased by 2019.

The Centre is working on a \$3.1-billion worth package to encourage companies to set up solar cells and modules manufacturing industry. Under the project, which will be dubbed as 'Pradhan Mantri Yojana for Augmenting Solar Manufacturing,' the government will not only fulfill the domestic needs of clean energy equipment but also create an export industry.

It is a long term imperative that these resources are exploited optimally. India is attracting significant attention from major overseas project developers, equipment suppliers and financiers. – Looking at the larger picture to enhance productivity at various levels through renewable energy thereby contributing to the national aspirations of social and economic growth. The productive use of energy will cut across livelihood systems (both farm sector and non-farm sector), employment generation, social infrastructure (health centers, educational institutions, panchayats etc.) and so on.

TABLE I. GRID CONNECTED RE AS MARCH 2017

Sources	Total installed capacity (MW)	2022 Target (MW)
Wind Power	32279.77	60,000.00
Solar Power	12288.83	100,000.00
Bio mass Power (Biomass & Gasification and Bagasse Cogeneration)	8182.00	10,000.00
Waste to power	114.08	
Small Hydropower	4379.85	5,000.00
Total	57244.23	175,000.00

TABLE II. GRID CONNECTED INSTALLED CAPACITY FROM ALL SOURCES AS FEBRUARY 2017

Source	Installed Capacity (MW)	Percentage
Coal	189,047.88	59.93%
Renewable energy	50,018.00	15.86%
Hydropower	44,413.43	14.08%
Gas	25,329.38	8.03%
Diesel	837.63	0.27%
Nuclear	5,780.00	1.83%
Total	315,426.32	100%

III. DEM

DEM is the process of changing rules and regulations that control the electric industry to provide clients the choice of electricity sellers who are either sellers or traders by allowing competition. Due to competition in the electric industry, the power costs are likely to come down which profits the clients.

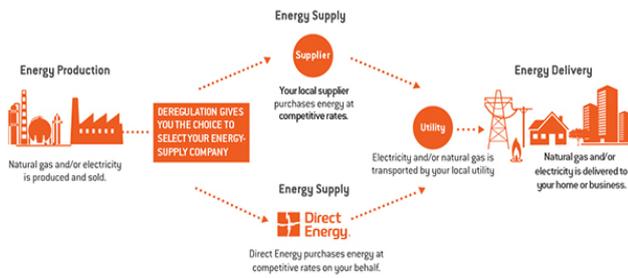


Figure 1. Deregulated Electricity Market

A. Comparison between regulated and deregulated electricity market

In a regulated market, vertically-integrated utility own and control the whole stream of flow of power from generation all the way to your meter. In this model, clients are forced to pay a set cost set up by the service organization—no different alternatives.

- Single authority or few producers
- Costs are controlled by single commission
- Costs passed to customers
- Small incentive for efficiency

In a deregulated market, utility corporations working in a deregulated electric market are still able to set their own costs, however should buy power during its generation stage before selling to end-clients. However, the main difference between regulated and deregulated electricity is found at the most micro level—the customers.

- Several Producers
- Prices represented by advertise market device
- Potential for market power

B. Advantages of Deregulated Electricity Market

- **Electricity price will reduce:** It is a common understanding that the competitive prices are lesser than the monopolist prices. The producer will try to sell the power at its marginal cost, in a perfectly competitive environment.
- **Choice for consumers:** The consumer will have choice for its retailer. The retailers will compete not only on the price offered but also on the other facilities provided to the customers. These could include better plans, better reliability, better quality, etc.
- **Customer-centric service:** The retailers would provide better service than what the monopolist would do.
- **Innovation:** The regulatory process and lack of competition gave electric utilities no incentive to improve or to take risks on new ideas that might increase the customer value. Under deregulated environment, the electric utility will always try to innovate something for the betterment of service and in turn save costs and maximize the profit.

IV. RENEWABLE ENERGY IN DEM

Deregulated markets have opened up generation for competition from independent power producers in 24 states, such as California, Texas and most states in the Northeast. 18 of these states and Washington D.C. have also introduced retail choice, which allows residential and/or industrial consumers to choose their own electricity provider. Customers benefit from more competitive rates and generation options, including renewable energy.

It is important to note that the market is not split clearly between regulated and deregulated states. Some states, like California, are partially regulated markets. This is due to the nature of the grid, historic reasons and the geographic boundaries of utility territories in neighboring states.

The profits associated with deregulation are:

- Systems capacity will be used efficiently.
- Optimization of energy supply will take place.
- Price of the electricity will become clearer.
- Consumer choice will be improved.
- Use better technologies in place of bad technologies.
- Electricity costs are reduced.
- The usage efficiency is improved due to restructuring in price signals.
- Power flow will take place from surplus areas to shortage areas.
- The charge of additional services is reduced by reserve sharing.

V. CONCLUSION

Several new policies and reforms are in progress to enhance the financial health of the power sector. As per new Acts the setting up of independent regulators and the government separating itself from tariff matters, the state distribution utilities would be able to attain financial viability. Most of the state electricity boards are being unbundled into three distinct corporations namely Generation, Transmission and distribution. The distribution system are being horizontally broken down into convenient Discos with independent accountability and privatized for better efficiency in metering, billing and revenue collection. Government is even subsidizing private DISCOMS. Electricity reform in India is already in never before pace.

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