Renewable Energy Market Participants In The United States

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The purpose of this paper is to discuss the emerging of renewable energy in the US energy market and the effects on the behavior of the market participant.

I. Renewable energy in the U.S. competitive Market

Due to the competitive nature of the U.S. energy market, and the confort on producers to become more efficient in terms of production and prices, the renewable energy market faces a big challenge due to their high initial capital costs [A]. However, competitive markets are still the richest environment for the growth of clean energy sources [A]. In order to realize the economics benefits of the renewable market, time has to be factor in on a long term prospective. The fact that renewable energy sources are generally capital investment and have no running costs has an interesting consequence [7]. As an example, If we build a renewable power station today, we are providing free electricity to its users for the next 40 years, while if we build a coal-fired power station today, we meet the capital costs now but leave it to our inheritors to meet the large fuel costs and the external costs associated with the plant's pollution over its 40-year life [7]. Clearly, the major driver nowadays for renewable energy is the capital cost, however, according to the U.S Energy Information Administration (EIA), these costs decline through "learning by doing", where many technologies are developed and enhanced to reduce the capital investment Purdon on the renewable energy [A]. Another angle that can shed lights on the benefits of renewable energy to the U.S market and its participants is the verity of sources for energy especially renewable. Such diversity will immunity the market from any price fluctuating in the fossil fuel and fix the prices in the market pool [A].

As well as energy market, ancillary services market is affected by the renewable energy. In very short words, any investment in renewable energy, solar or wind as an example, will demand an additional enough on-line capacity to provide the necessary ancillary services [2-I]. The market operator needs a backup capacity for when the sun doesn't shine or the wind doesn't blow. However, up to date, this intermittency of solar and wind power has not been a major issue for renewable market [7]. Most of these disparities are compensated by the premium placed on renewable power via the RPS "Renewable Portfolio Standards" requires by many states [7]. As more investment in the renewable energy take place, the concern of ancillary services will increase as well, but, with the new technologies improvements in power storage, then these intermittency and concerns will be overcame. Tell that day comes; there will be a continuing need for fossil fuel as source of continuous base load power [7].

II. Renewable energy Presence in the US power sector

More than 446 billion kilowatt-hours since 1997 generated from electric utility and non-utility power producers every year, 13% of that comes from renewable generating sources. Utility producers are all the electric power companies that generate, transmit and distribute electricity for sale. Non-utility producers includes a corporation, person, agency, authority, or other legal entity that owns generating capacity, but unlike electric utilities, it is without a franchised service area or an obligation to serve retail customers [A]. Both producers are participating heavily in the US energy sector. As in 2009, the total production of energy in the US was 3,949,667 gigwatts-hour, 39% of that was generated by the non-utility producers compared to 61% from the utility producers [A]. However,

the non-utility producers are dominating the renewable energy field by owning 83% of the wind projects in the US in 2010 as shown in the next figure [A website].

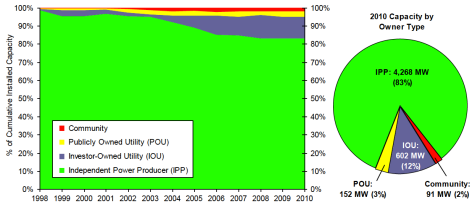

Fig.1: Producers ownership share in 2010 for wind projects

Also, the above figure illustrates the growth of investment by the utility producers in the wind energy projects. These investments support the U.S. strategy in the utilization of renewable energy and the expected forecast of the green power production. According to the US Energy Information Administration (EIA), the production of the renewable energy will increase up to 16% of the total power in the year of 2035 compared to what it was in 2010 with only 10% out of the total energy [k]. As an example for such investment, New York Independent System Operator (NYISO) is working with General Electric Company (GE) as well as with Automatic Weather Stations Incorporation (AWS) to increase the wind capacity production by 20% for the New York area by 2020. According to AWS, such investment can provide at least 10% of system peak load in that area [K]. Which is in the direction of the U.S government for 20% by 2030 [11].

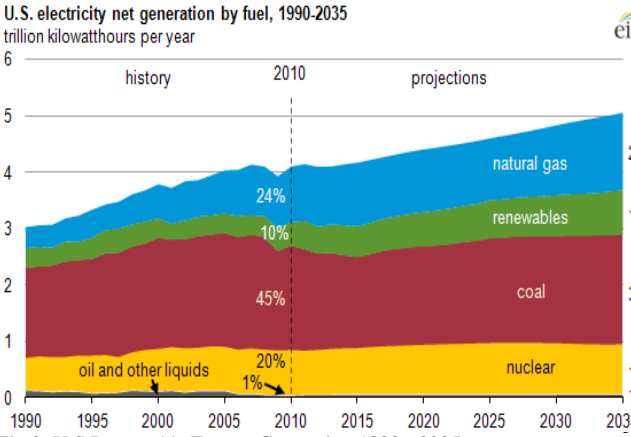

Fig.2: U.S Renewable Energy Generation 1990 - 2035

Generally, the hydroelectric power plants are the major renewable energy source for electricity production in the United States, where they contributes to 81% of the total renewable energy production. Biomass is the second source with 75 % of the generated power. Followed by geothermal with 19 % and finally, the wind and solar plants which account for the rest 6 % [7].

III. Renewable energy Participants Prospective

A. Producers Prospective:

Power producers, either utility or non-utility, are the main players in the renewable energy market. With the high initial capital cost of renewable energy projects, investments turn to be unfavorable. In addition to the capital cost, producers are faced with the aggressive competition from the fossil fuel energy market, which offer much cheaper rates. As a result, most if not all the investment in renewable energy nowadays is based on purchasing agreements. However, with the advance in the technologies of renewable energy and with the removal of certain barriers in the market with the help of the government, the renewable energy would become competitive with the hydroelectric energy. This section of the paper discusses the policies and incentives offered by the US government to develop the grown renewable energy businesses. Also, it talks about the development of green energy selling rates.

B. Governmental Policies:

The reduction in cost of renewable technology has been aided by the dramatic increase in private investment as highlighted before, which increased from $50 billion in 2005 to $70 billion in 2006 [6].

However, it is a fact that most renewable technologies, excluding wind energy, are still in the developmental stage, and to guarantee the further growth in this industry, the government are deciding some policies and incentives to investors to put their money into renewable energy technology; namely, Production Tax Credit (PTC), Renewable Portfolio Standards (RPS), Public Benefits Fund and Net Metering.

According to the EIA *"Renewable portfolio standards (RPS), or referred to as renewable electricity standards (RES), are policies designed to increase generation of electricity from renewable resources. These policies require or encourage electricity producers within a given jurisdiction to supply a certain minimum share of their electricity from designated renewable resources. Generally,*

these resources include wind, solar, geothermal, biomass, and some types of hydroelectricity, but may include other resources such as landfill gas, municipal solid waste, and tidal energy." [1-A] Currently, 29 states plus D.C are mandating the RPS initiatives [9], and every one of these states has a specific benchmark to achieve within a period of time. For example, in 2015 New Your state is required to generate 30% of its total energy sale (MWh) from renewable energy. Where in D.C area only 20% is required by 2020 [9]. Such policy would drive the renewable markets further in investment. Verifying the compliance with the RPS limits can also be achieved by buying traceable Renewable Electricity Credits or (REC) which will encourage non-utility producers to participate more in renewable energy.

Production Tax Credit (PTC) provides an income tax credit of 2.2 cents per kilowatt-hour for the production of electricity from utility-scale turbines [11]. It has been created under the Energy Policy Act of 1992 [11]. It has been and still an effective factor in fostering the growth of renewable energy market. With the benefits of the PTC, the wind industry has been able to reduce the cost of wind power by more than 90% since 1980 [10]. As a result, the wind industry saw a 27% increase in capacity in 2006 and a 45% increase in capacity in 2007 [1]. Unfortunately, the PTC is set to expire at the end of 2012, and it is very crucial to extended it immediately. Falling in approving the extension will have a huge impact on the great progress and the investment in the wind industry. Figure 22 shows the historical impacts that occurred because of the expiration of the PTC in the wind power.

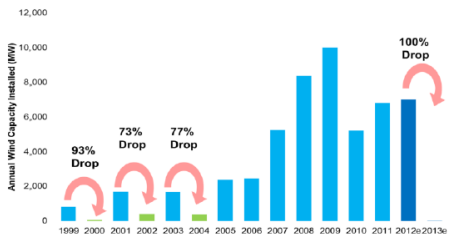

Fig.3: Historical Impact of PTC Expiration

Public Benefits Fund (PBF), it is a funding mechanism for energy efficiency and renewable energy investment. PBF is collected by applying a fee on customers' utility bills on the basis of their consumption of energy. Currently, 30 states and the District of Columbia are benefiting from the PBF system. As such policy is very encouraging to the renewable energy investors, it my be resisted by the large consuming costumers such as the industry sector, calming that it would increase the operation cost and minimize the revenue in their operation. The current fee for the PBF is calculated as an increment of 1-mill per kilowatt-hour, which is equal to $0.001 per kilowatt-hours. It would take one million kWh to reach $1,000 [12].

Net Metering program services is another important tool in the investment motivation in renewable energy, especially for non-utility producers. It is a two ways meter that allows consumers who are investing in renewable energy generation to sell any excess power than their consumption back to the eclectic gird with the market retail price. At the same time, the meter charges the costumers for their consumption from the grid. Such program allows the investors to maximize the value of their production which in turns maximize their benefits. Also, power generators may benefit from this program because when customers are producing electricity during peak hours, they system load factor improved [13-website].

C. Pricing Green Power [3] [14]
Pricing the energy power in a very simple sense depends mainly on the utility investment cost and the operational expenses. Conventional energy producers employ the concept of economic dispatch to set the price of the produced energy. This concept is based on minimizing the operation cost, which includes fuel cost, maintenance and administration, of electrical power generated to meet the load requiems with the lowest marginal cost. Such concept does not apply to the pricing of renewable energy, because, simply renewable energy has no operation cost which is the main deriver of the economic dispatch. As a result, the pricing will be mainly depending on the capital investment cost of the project. However, producers of renewable energy have another technique to measure and compare the cost across different energy technologies and sources. This technique is called "Levelized Cost of Energy" (LCOE); it is the present value of the total cost of building and operating a generating plant over its financial life. As an example of the utilization of LCOE, every year the EIA measures the levelized cost of all electric generating technologies based on the the National Energy Modeling System (NEMS)

forecast to decide the most economical technology that should be implemented to satisfy each type of demand (base, intermediate, or peaking load).

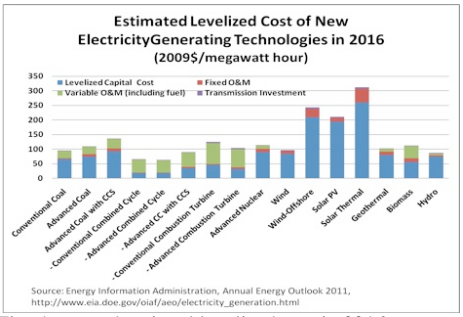

Fig: Averaged national levelized cost in 2016

Levelized Cost of New Generating Technologies, 2016

Plant Type	Capacity Factor (%)	Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	65.3	3.9	24.3	1.2	**94.8**
Advanced Coal	85	74.6	7.9	25.7	1.2	**109.4**
Advanced Coal with CCS	85	92.7	9.2	33.1	1.2	**136.2**
Natural Gas-fired						
Conventional Combined Cycle	87	17.5	1.9	45.6	1.2	**66.1**
Advanced Comined Cycle	57	17.9	1.9	42.1	1.2	**63.1**
Advanced CC with CCS	57	34.6	3.9	49.6	1.2	**89.3**
Conventional Combustion	30	45.8	3.7	71.5	3.5	**124.5**
Advanced Combustion Turbine	30	31.6	5.5	62.9	3.5	**103.5**
Advanced Nuclear	90	90.1	11.1	11.7	1	**113.9**
Wind	34	83.9	9.6	0	3.5	**97**
Wind-Offshore	34	209.3	28.1	0	5.9	**243.2**
Solar PV	25	194.6	12.1	0	4	**210.7**
Solar Thermal	18	259.4	46.6	0	5.8	**311.8**
Geothermal	92	79.3	11.9	9.5	1	**101.7**
Biomass	83	55.3	13.7	42.3	1.3	**112.5**
Hydro	52	74.5	3.8	6.3	1.9	**86.4**

Fig: Averaged national levelized cost in 2016

Based on the levelized cost presented in above figure and table, the conventional combined cycle fire-gas has an advantage compared to the wind energy. So, the base load will be covered by combined cycle, then wind can supply the intermediate load and finally single cycle gas-fired participate as a peaker.

Renewable energy in the U.S. market participates into two forms, either as peak demand relief or just an alternative power sources. Such participation is due to the fact that renewable energy is a variable energy. Pricing the energy of green power during peak demand usually follows the market clearing prices. However, when the renewable energy is considered as an alternative power sources, then, buying that power is on a voluntary basis by the costumers. In this case producers use another tool to price renewable energy called “Green Power Premium”. Green power premium is an increment on the utility bill of the customer who is willing to buy green power. It is based on the difference between the cost of the utility’s least-cost plan and a plan that includes more renewables. There are mainly two steps to determine the premium price.

First step is the generation cost; there are three factors, which contributes to the cost of generating renewable energy. The first factor is quality of the energy source. Investors should seek the location with the highest quality such as high wind speed for wind project and solar radiation availability in solar projects. The more energy that can be generated from a given project, the lower the energy cost. Second factor is technology cost required to convert the source to energy. Third factor is the subsidies offered by the state or federal agencies such as PTC. Looking at those three factors, it is easily can be concluded that they fall under the capital cost of the project.

Second step, after determining the cost that should be included in the price, is the producer has to decide the recovery time of these costs. This step depends on the risk factor that the producer is welling to accept. Because as the recovery time gets shorter, the premium price that must be charged on the costumers increases, which may lead to lower customer participation.

IV. Conclusion

- Governmental polices favored renewable production enhanced the creation of renewable energy market.
- Improvement in electricity storage technology will staplized the renewable energy market.
- Renewable have the advantages of zero marginal cost
- Producers will look in minimizing the cost of production
- Consumer will receive some incentives for using renewable
- Transmission play main role with renewable development

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