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Drastic Revolution in Supply of Renewable Energy and Astonished Energy Performance Technologies

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ABSTRACT

Electricity consumption will comprise an increasing share of global energy demand during the next two decades. In recent years, the increasing prices of fossil fuels and concerns about the environmental consequences of greenhouse gas emissions have renewed the interest in the development of alternative energy resources. In particular, the Fukushima Daiichi accident was a turning point in the call for alternative energy sources. Renewable energy is now considered a more desirable source of fuel than nuclear power due to the absence o frisk and disasters. Considering that the major component of greenhouse gases is carbon dioxide, there is a global concern about reducing carbon emissions. In this regard, different policies could be applied to reducing carbon emissions, such as enhancing renewable energy deployment and encouraging technological innovations. Two main solutions may be implemented to reduce CO2 emissions and overcome the problem of climate change: replacing fossil fuels with renewable energy sources as much as possible and enhancing energy efficiency. In this paper, we discuss alternative technologies for enhancing renewable energy deployment and energy use efficiency. JEL Classification: D61, D62, H23, N50, O13, Q52, Q55

Keywords: *Energy Resources; Renewable Energy; Energy Use Efficiency; Generation Technology; Carbon Emission; Green Employment.*

1.0 Introduction

Considering that the major component of greenhouse gases (GHGs) is carbon dioxide, thereis a global concern about reducing carbon emissions. In this regard, different policies could be applied to reduce carbon emissions, such as enhancing renewable energy deployment and encouraging technological innovations. In addition, supporting mechanisms, such as feed-intariffs, renewable portfolio standards and tax policies, are employed by governments to develop renewable energy generation along with implementing energy use efficiency for saving energy .Many countries have started to install facilities that use renewable energy sources for power generation. The importance of alternative energy sources comes together with climate change challenges associated with the excessive use of fossil fuels. There are three primary motivators that stimulate the growth of renewable energy technologies: energy security, economic impacts and carbon dioxide emission reduction. The term "alternative energy" refers to any form of energy other than the conventional sources of energy, including hydropower. In recent years the focus has been on renewable energy sources.

IEA (2012d) refers to two significant global trends that should characterize the deployment of renewable technologies over the medium term. First, as renewable electricity technologies scale up, from a total global supply of 1,454 gigawatts (GW) in 2011 to 2,167 GW in 2017,they should also spread out geographically. Second, the more recent years of high fossil fuelenergy use has led renewable technologies to become increasingly competitive on a cost basiswith their alternatives in a number of countries and circumstances. According to IEA calculations, wind is the most competitive type of renewable energy technology among the other options, if local conditions such as financing, CO2 emission levels and fossil fuel prices prove favorable (OECD, 2010). When talking about clean technologies, there are two primary concepts of energy technologies: energy supply technologies, which refers to alternative

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sources of renewable energy (e.g., wind and solar power), and energy efficiency technologies, or those technologies which are hired to enhance energy use efficiency, (e.g., combined heat and power (CHP), virtual power plants (VPP) and smart meters). It should be noted thattransforming the energy sector and replacing conventional energy with renewable energy isevolutionary associated with technological change and forming markets. Jacobson andBergek (2004) indicate that the transforming process for certain forms of renewable energy,such as wind and solar, will happen after 2020, even if the growth rate of consumption isstrongly increasing over the next decade. Also, renewable energy markets are not easilyformed due to cost disadvantages and the subsidizing of fossil fuels.

The remainder of this study proceeds as follows. In Section 2 we present the differentrenewable energy supply technologies including solar, wind and hydro power, geothermaland other sources. In Section 3 different energy use efficiency technologies are discussed. These include electric vehicles, combined heat and power, virtual power plants and theapplication of smart meters. The final section provides a summary and concludes.

2.0 Renewable Energy Supply Technologies

The renewable energy supply is continuously increasing. A large amount of investment hasbeen made during recent years and the advancement of technology has enabled countries toproduce renewable energy more cost effectively. It is forecasted that the number of countriesproducing above 100 megawatts (MW) of renewable energy will increase significantly by2017 (IEA, 2012d). Due to some negative and irreversible externalities coming withconventional energy production, it is necessary to promote and develop renewable energysupply technologies. These technologies may not be comparable with conventional fuels interms of production cost, but they could be comparable if we consider their associatedexternalities, such as their environmental and social effects. Also, it should be noted thateconomies of scale could play a key role in reducing the unit production cost. Transmissionand distribution costs, as well as technologies, do not differ much among the conventionaland renewable energies. Below we present facts about the development of the mainrenewable energy supply technologies.

1-Hydro power
2-Wind Power
3-Solar Power
4-Geothermal
5 -Other renewable sources

3.0 Energy Efficiency Technologies

As previously mentioned, there are two main solutions to reducing CO2 emissions and toovercoming the climate change problem: replacing fossil fuels with renewable energy sourcesas much as possible and through enhancing energy efficiency. We discussed the state of the art methods for technical and economic feasibility of expanding the use renewable energysources and the possibility of substitution in the first part of this review. In this part thatfollows, we discuss energy efficiency technologies.

Energy efficiency for an electricitynetwork could be considered in different stages, such as the power generation, transmission,distribution and consumption. The different technologies that are currently available includeelectric vehicles (EV), combined heat and power (CHP), virtual power plants (VPP) andsmart grids, each of which are given below:-

1-Electric Vehicles
2-Combined Heat and Power
3-Virtual Power Plant
4-Smart meter

4.0 Main Drivers for Using Renewable Energy Technologies

1- Energy security
2- Economic impacts
3- CO_2 emission reduction

4.1. Results and discussions

Ongoing concerns about climate change have made renewable energy sources an importantcomponent of the world energy consumption portfolio. Renewable energy technologies couldreduce carbon dioxide emissions by replacing fossil fuels in the power generation

industryand the transportation sector. Due to negative and irreversible externalities in conventionalenergy production, it is necessary to develop and promote renewable energy supplytechnologies. Power generation using renewable energy sources should be increased in orderto decrease the unit cost of energy and to make them compatible with a competitivealternative to the conventional energy sources. Two main solutions may be implemented toreduce CO2 emissions and to overcome the problem of climate change: replacing fossil fuelswith renewable energy sources as much as possible and enhancing energy efficiencyregardless of type. In this review, we considered hydro, wind, solar and geothermal sources,because of their significant contribution to power generated by renewable sources.Renewable energy production and supply is continuously increasing on the global level.

The drastic increase in oil price and its impacts on both coal and gas prices, a largeamount of investment has been made over recent years in renewable energy. Theseadvancements in technology have enabled countries to produce renewable energy in larger quantities and more cost effectively. Due to negative and irreversible externalities associated with conventional energy extraction and consumption, it is necessary to promote and develop renewable energy supply and consumption. The IEA forecasts positive developments inrenewable energy sources. They act as substitutes for fossil fuels and reduce emissions. In the short term, some renewable technologies may not be comparable to conventional fuels in the scope of production costs and transmission, but they could be comparable if we consider their associated positive externalities, such as their environmental and social effects.

Also, it should be noted that economies of scale could play a key role in reducing the unit cost of production. Transmission and distribution costs and technologies do not differ much among the conventional and renewable energy sources. In this review we have presented detailed facts about the main renewable energy supply technology developments, including hydro, wind, solar, and geothermal in detail and other sources such as biomass, ocean waves and tides in brevity. The emphasis has been on current production capacity and the estimated capacity, as well as development costs which are sunk. We have also presented empirical findings from comparative studies of alternative energy technologies.

Hydro power is the largest renewable energy source for power generation around the world. Despite its large energy generation contribution, its development is difficult due to a high initial fixed investment cost and environmental and population relocation costs. Hydro power is attractive due to a combined supply of water for agriculture, household, recreation and industrial use. Additionally, it can store water and energy that can be used for both base and peak load power generations. The availability of funding, political and market risks, resource allocation priorities and local environmental concerns are considered to be barriers to the development of hydro power capacity. The installed wind power capacity has also been increasing, especially in countries like China, the US, Germany and Denmark. Advantages of wind power plants include the installation as turnkey contracts within a short period, a lower investment compared to nuclear and hydroelectric plants, economies of mass production, an absence of fuel costs and low operation and maintenance costs. The problems associated with the use of wind power include intermittency of wind energy and an added cost for power transmission to users. Generation cost is dependent on location, feasibility and the minimum required speed for wind turbines. China has developed its own solar power capacity, decreasing the cost of generation due to the availability of cheap labor and public subsidies.

Another source of the reduced costs is in advances and the high efficiency in concentrated solar power technologies in the US. The negative effects include land, material and chemical use and impacts on buildings' esthetics. The performance is dependent on location. Geothermal energy has been used throughout history for bathing, heating and cooking. The geothermal gradient and permeability of rocks determines its economic implementation feasibility. Unlike wind and solar power, geothermal is continuously available through the year, although technology has some negative environmental effects. Improved energy efficiency is an important way to reduce energy use, and thereby CO2 emissions, and to overcome the climate change problem. We discussed state of the art methods for the technical

and economic feasibility in the implementation of renewable energy sources, as well as the possibility of their combined use and substitution in the first part of this review. In the latter part we discussed energy efficiency technologies. Energy efficiency for electricity networks can be considered in different stages, such as power generation, transmission, distribution and consumption. For this purpose, different energy 30 efficiency technologies are available, including electric vehicles, combined heat and power, virtual power plants and smart grids. Each of these technologies were discussed in detailed and their performances compared.Electric vehicles have the potential to be used for both power generation and storage. Giventhe fact that transportation is a main contributor to the problem of emissions, improving fuelefficiency with the adoption of electric vehicle technology on a large scale will enable greaterenergy savings and CO2 reductions. Advances in smart grid technology impact the large scaleuse of electric vehicles and enhance the efficiency of the technology. However, managingload and supply fluctuations is a challenge. Combined heat and power technologies providesubstantial gains in efficiency. The technology offers an efficiency use of fuel by preventingthe discarding energy as waste heat. A significant part of waste heat can be transformed into aproduct for heating buildings, adding to its economic value and improving energy efficiency.

A virtual power plant is a cluster of distributed energy resources controlled and managed by acentral control unit, allowing for the possibility to control home appliances to optimize loadreductions. It helps to combat the energy waste problem due to distance and transmissionlosses.The driving force for using renewable energy technologies are energy security, economicimpacts, and CO2 emission reduction. The level of insecurity is reflected by the risk of supplydisruption and the estimated costs of security itself.

The emphases for the economic impactsare job creation, industrial innovation and balance of payment. Renewable energytechnologies could enable countries with good solar or wind resources to implement these energy sources to meet their own domestic demand. Moreover, the cost of importing fuels can affect economic growth. If these countries could reduce their balance of payment byproducing their own renewable energy to replace their dependence on fossil fuels, they couldexpand their capacity for investment in other sectors. Renewable energy technologies couldreduce carbon dioxide emissions by replacing fossil fuels in the power generation industryand transportation sector. Life-cycle CO2 emissions for renewable energy technologies are much lower than fossil fuels.

5.0 Conclusions

This review of renewable energy generation and efficiency technologies has provideddetailed and useful information that can be used in the decision making of differentstakeholders in the rapidly developing market. Each technology has both advantages anddisadvantages that vary by location, availability, the technological capability of producers,financial limitations and environmental considerations.

Each municipality, region or countryhas different initial conditions that determine the energy mix that can be produced at thelowest cost while minimizing the harm done to the environment. Thus, there is no singlesolution to every energy need and problem, but rather an optimal location specific solutionamong a set of possible renewable solutions.

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