Renewable Energy in Some Selected Islamic Countries

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Abstract: - Presently, the demand of energy is met by fossil fuels. Combustion of fossil fuels has caused negative impacts to the environment globally. To overcome it, sustainable, clean and safe energy policies that would satisfy the energy demand of the 21st century have to be implemented. Renewable energy resources should therefore be key energy sources for the future. This paper is to study the renewable energy in 2005 and its implementation strategies for some of the selected Islamic countries.

Key-Words: - Renewable energy, Islamic countries, strategies

1 Introduction

Energy is a key factor in economic development and in providing vital services that improve quality of life. Presently, the demand of energy is met by fossil fuels (i.e. coal petroleum and natural gas). It is a well know fact that 8 countries have 81% of all world crude oil reserves, 6 countries have 70% of all natural gas reserves and 8 countries have 89% of all cost reserves [1]. More than half of Asia, Africa and Latin America import over half of all their commercial energy. This problem is worsened by the fact that demand on power generation is continuously increasing in these countries. In addition, at the current rate of production the world production of liquid fossil fuel (petroleum and natural gas) will decline by the year 2015.

Scientific assessment based on the available instrumental observational records from the industrial era to the present day showed that

(a) Global mean temperature has increased by between 0.3-0.6^{o}C since the 19th century, while mean sea level has risen between 10-25cm over the same period

(b) night-time minimum temperature over land have generally increased more than the daytime temperatures and

(c) Recent years have been among the warmest since 1860, despite the cooling effect of 1991 Mount Pinatubo volcanic eruption.

The occurrences of these phenomena are due emissions of greenhouse gases arising from human activities, especially those related to the use of fossil fuel, agricultural practices and land-use management have many side effects. Their combustion products produce pollution, acid rain and global warming. In fact the last two decades have been the warmest on record with 1998 being the warmest even with the cold La Nina conditions that dominate the year 1999. Increasing global temperature is expected to cause sea level to raise, an increase in the intensity of extreme weather events, and significant changes to the amount and pattern of precipitation. Other expected effects of global warming include changes in agricultural yields, modifications of trade routes, glacier retreat, species extinctions and increases in the ranges of disease vectors.

To overcome these global effects, sustainable, clean and safe energy policies that would satisfy the energy demand of the 21st century have to be implemented. Renewable energy resources should therefore be key energy sources for the future. This paper is to study the renewable energy in 2005 and its implementation strategies for some of the selected Islamic countries. There were 39 selected countries and were as shown in Table 1. All the relevant data were obtained and compiled from [2]-[6].

2 Renewable Energy in Selected Islamic countries

2.1 Energy Supply

Fuel mix in energy supply of most of the selected Islamic countries is not yet well diversified. Coal and other clean renewable energy sources share very low percentages in total primary energy

supply (TPES). Bahrain, Kuwait, Oman, and Turkmenistan get their energy sources for TPES 100% from fossil fuels. The TPES per capita ranges from 0.3 - 20 toe/capita. Countries with TPES per capita higher Table 1. Some selected Islamic countries for this study

	Selected countries		
1.	Algeria	21.	Kazakhstan
2.	Benin	22.	Kyrgyzstan
3.	Cameroon	23.	Tajikistan
4.	Cote d'Ivoire	24.	Turkmenistan
5.	Egypt	25.	Uzbekistan
6.	Gabon	26.	Albania
7.	Libya	27.	Turkey
8.	Morocco	28.	Bahrain
9.	Mozambique	29.	Iran
10.	Nigeria	30.	Iraq
11.	Senegal	31.	Jordan
12.	Sudan	32.	Kuwait
13.	Togo	33.	Lebanon
14.	Tunisia	34.	Oman
15.	Bangladesh	35.	Qatar
16.	Brunei Darussalam	36.	Saudi Arabia
17.	Indonesia	37.	Syria
18.	Malaysia	38.	United Arab Emirates
19.	Pakistan	39.	Yemen
20.	Azerbaijan		

than 10 toe/capita were Bahrain, Kuwait, Qatar and United Arab Emirates. Except Bahrain, these countries are OPEC members, the main exporters for petroleum products and had high dependency on fossil fuels as energy sources where energy from crude oil or/and natural gas shares more than 70% of the TPES.

In contrast to countries that had very low TPES per capita (below 0.5 toe/capita) such as Benin, Mozambique and Togo, the main energy source for energy supply was combustible renewables and wastes. Mozambique had the highest renewable energy share of 94.7% in TPES from two sources, i.e. hydro and, combustible renewables and wastes in 2005. Among the renewable energy sources for TPES, combustible renewables and wastes are the dominant for most of the selected Islamic countries except for few. Azerbaijan, Kazakhstan, Kyrgyzstan, Syria, Tajikistan and Uzbekistan used hydro as their main renewable energy sources while in Jordan the main renewable energy sources for TPES are geothermal and solar.

2.2 Energy Consumption

Petroleum products and natural gas were the dominant energy consumed. However, countries with total final consumption of energy (TFC) per capita below than 0.5, such as Cameroon, Cote d'Ivoire, Mozambique, Sudan and Togo, were actually consuming energy from combustible renewables and wastes more than 65% of TFC. Combustible renewables and wastes are the major renewable energy sources in TFC for all almost the selected Islamic countries except Jordan, where the main RE sources are geothermal and solar that was about 96% of total RE in TFC. However, countries such as Bahrain, Kuwait, Oman, Tajikistan, Turkmenistan and Uzbekistan totally consumed energy from fossil fuel sources at end use stream.

In 2005, countries such as Iraq, Nigeria and Uzbekistan had shown relatively high final energy consumption per GDP, whereas Bangladesh and Tunisia had recorded final energy consumption per GDP less than 100 toe/Million 2000 US$ PPP. These indicate that the former group of countries demand more energy for end users to produce 1 unit of final goods or services as compare to the latter group of countries. In term of electricity, Iraq, Kyrgyzstan and Tajikistan had relatively high final electricity consumption per GDP. Whereas countries that had per unit GDPPPP of final electricity consumption lower than 0.1kWh/2000US$ were countries that have electrification rate lower than 33%. Bangladesh is one of the nations with low coverage of electrification. This might be one of the possible reasons for Bangladesh to have lower final energy consumption per GDP. However, Tunisia and Algeria which also had relatively low value of per unit GDP of final energy and electricity consumptions have electricity coverage as high as 98-99%, indicating that they consumed energy more efficiently in socio-economic activities. In contrast, though Iraq is one of the largest energy exporters and has the longest depletion period of crude oil, it had recorded high value of per unit GDP of final energy and electricity consumptions which indicate poor energy efficiency in socio-economic activities.

2.2 Electricity generation and consumption

There are some countries that have very low accessibility to electricity especially Mozambique (6%) and Togo (17%) that accounted for 18.6 and 5.1 million populations without electricity, respectively [6]. The study found that the energy sources for countries that have low electrification coverage are mainly dependent on combustible renewables and wastes

which might be traditional biomass such as charcoal, wood, straw, agricultural residues and dung. Inefficient burning of biomass can be a major cause of indoor smoke pollution. The World Health Organization (WHO) estimated that, each year, 1.6 million women and children in developing countries are killed by the fumes from indoor biomass stoves [7]. Albania, Cameroon, Mozambique and Tajikistan depended nearly 100% of renewable sources to generate electricity. On the other hand, this study also found that countries that have electrification rate higher than 90%, 85 - 100% of the electricity was generated from fossil fuels. Bahrain, Brunei Darussalam, Kuwait, Libya, Oman, Qatar, Saudi Arabia and United Arab Emirates, which are also net energy exporters, generated electricity 100% from fossil fuels sources.

In term of renewable energy in electricity generation, hydropower is the main energy source. Geothermal, solar, wind, tide, wave and other RE sources had also been utilised by Indonesia, Egypt, Morocco, Senegal and Tunisia for electricity generation.

3 Strategies for implementing renewable energy programmes

The widespread application of renewable energy technology can be enhanced by employing several strategies namely (a) establishing education and capacity building programmes (b) creating renewable energy market and financing mechanism (c) improving appropriate energy policies and (d) establishing database and international collaboration

3.1 Educational and Capacity Building Programmes

Educational programmes are able to provide the technical knowledge and improve the level of competency of service providers, engineers, architects, technicians and academia. Other capacity building programmes can enhance the awareness level of the rationales for renewable energy technology among the public, policy makers, investors and financial institutions. Hence, the understanding of renewable energy technology would be raised to the point that they understand the technology, are aware of its true benefits and ecological significances, understand the purpose and appreciate the functions of the technology.

Educational programmes on renewable energy should be implemented as part of the education agendas and well structured in all levels of education system. For instance renewable energy should be included as a chapter in science or physics subject at schools level, undergraduate and post-graduate programmes at university level. Thus, the people would be provided with basic knowledge of renewable energy at primary and secondary levels and would have mastered the subject at tertiary level.

Capacity building activities are such as seminars, workshops and short courses in renewable energy technology and policy. Key personnel especially would have the opportunities to understand and hence apply the technology in the economic sectors. Engineers and architects for example might consider renewable energy technology in building designs.

3.2 Renewable Energy Market and Financing Mechanism

The technical feasibility and economic viability of renewable energy technology can be addressed by implementing a number of demonstration projects. These projects will further provide a wider level of acceptance and better understanding of the technology and its benefits. The demonstration projects will also pave the way for providing first hand experiences for improvements in the training and skills of the stakeholders as well as increased efforts in R&D activities. For example solar energy technology in Malaysia, BIPV demonstration projects (500 kWp) and a national kick-off roof-top programme (>1 MWp) similar to many programmes implemented in Japan and Germany will provide adequate knowledge and experience to architects, engineers, project developers, policy makers and other stakeholders for subsequent follow-up programme. Besides, several demonstration projects such as solar hot water heating system for hospitals, hotels and catering services should be implemented. Others include solar industrial process heat in the drying, food and textile industries.

To initiate any renewable project, funders and investors play crucial roles in term of financing the project. Funders need to support infrastructure projects by providing loans to project developers. The government may provide soft grants, incentives and lower taxes to reduce the capital investment cost and hence encourage

more renewable energy projects. Another financial aid is through the trade of carbon credit. Developing countries such as Malaysia is eligible to benefit through the Clean Development Mechanism (CDM).

Apart from that, attracting the manufacturers to invest locally can reduce the cost of renewable energy technology components where import taxes would be avoided. In Malaysia, the future of solar energy technology is promising. Four manufacturers of solar modules have decided to locate their factories in Malaysia due to educated workforce, attractive tax incentives and availability of silica oxide. They are First Solar, a manufacturer of solar modules from United States, German solar cell manufacturer Q-Cells AG, SunPower Corporation and Solarif Sdn Bhd [8].

These investments will create job opportunities for the local people and would help in economic growth. There will be demand for more human resource capacity in R&D and manufacturing. Partnership and/or joint ventures with international companies will upgrade local companies. R&D institutions and the technical infrastructure for testing and certification facilities will be established to ensure only high quality commercial renewable energy products are produced for the local and international markets. Therefore, investment taxes and incentives strategy need to be well formulated to attract more international manufacturers and encourage local industries utilizing the renewable energy technology.

The outcome of these strategies will strengthen the industry, consumers and policy/decision makers. These will ensure the increase of renewable technology installed capacity and the long-term cost reduction of the technology via the increase in demand, economies of scale and competitive local manufacturing.

3.3 Renewable Energy Policy

Appropriate, proactive and integrated plans and policies will facilitate the development of conducive business environments and thus enhancing further cost reduction of the renewable technology. A good renewable energy policy needs comprehensive studies to formulate appropriate, effective and financial efficiency action plans.

Research activities are the foundation to understand the strengths and barriers of the technology from technical, financial, social and environment impacts point of views. Thus, through the research activities, a compilation of policy, legal, institutional, financial and fiscal measures could be proposed to the government. Studies such as potential of implementing the renewable energy in the country could be proposed as national targets to be achieved in a given period. Achievable targets are important to create confidence and hence encourage more renewable energy projects in the subsequent development plans.

A Feed-in Tariff (FiT) or Feed-in Law (FiL) or solar premium, is an incentive structure to encourage the adoption of renewable energy through government legislation. The regional or national electricity utilities are obligated to buy renewable electricity (electricity generated from renewable sources such as solar photovoltaic, wind power, biomass, and geothermal power) at above market rates set by the government. It is also called the renewable energy payment. The higher price helps overcome the cost disadvantages of renewable energy sources. The rate may differ among various forms of power generation.

Schemes such as quota incentive structures (renewable energy standards or renewable portfolio standards) and subsidies create limited protected markets for renewable energy. The supply of renewable energy is achieved by obliging suppliers to deliver to consumers a portion of their electricity from renewable energy sources. In order to do this they collect green electricity certificates. Hence a market is created in green electricity certificates which, according to the theory, generates downward pressure on the prices paid to renewable energy developers. This is based on the theory of perfect competition where there is a multiplicity of buyers and sellers in a market where no single buyer or seller has a big enough market share to have a significant influence on prices. Although, in practice, markets are very rarely perfectly competitive, the assumption is still that a relatively competitive market will produce a more efficient use of resources compared to a system where prices are set by Government fiat.

The fundamental problem with the quota scheme is that there is no long-term certainty. When a quota is set either for a period of time or for a quantity of power, once that goal is reached then

there is nothing to keep the green power producers from becoming uneconomic in the face of power produced from coal fired power stations and hence collapsing as businesses. This inevitability with the quota method means that there is reluctance on behalf of investors to get involved in the first place. Those that do get involved are short-term speculators rather than long-term entrepreneurs and so instability is inherent in this system.

It has been argued that FiT is the most effective way to promote the uptake of renewable energy yet devised. After investment subsidies it is the most widespread means of promoting renewable energy uptake in Europe. A very good example is Germany where FiT has successfully created over 300,000 direct employments and created over 200 companies related to solar energy. Malaysia is looking in to this scheme for its plan to have over 1 MW of building integrated photovoltaics before 2010.

As discussed above, apart from financial aides, enforcement could be one of the options for enhancing renewable energy market. Government could introduce Mandatory Renewable Generation Targets as legislated requirement on electricity retailers to source specific proportions of total electricity sales from renewable energy sources according to a fixed timeframe. This approach allows electricity purchasers to acquire a certain amount of renewable power from the utilities and could be penalised if they fail to do so.

3.4 Institutional and international Collaboration

Institutional and collaboration in education, research and development and information services are important for human development, capacity building and data gathering. Database for energy data and statistics could be established to have better monitoring and assessment on the progress of renewable technology implementation.

One of the attempts could be made is to establish centres of excellent for a particular renewable technology to take up the leading responsibility to share the knowledge, provide training and consultancy services to the members.

For instance, Solar Energy Research Institute (SERI) of Universiti Kebangsaan Malaysia has been recognised by the Islamic Scientific, Education and Cultural Organization (ISESCO) as the Islamic International Centre for Solar Energy Training, Research and Application (ICETRA). SERI has taken up the responsibility to host some of the training programmes on renewable energy. They were Workshop on Renewable Energy Applications for Rural Population held on 22 to 26 October 2007 and the First Asian School on Solar Electricity for Rural Areas was held on 4 to 7 December 2007. The target group of the workshop was local policy makers whereas the Asian School was a short course programme to train the key personal from the selected OIC countries. The Asian School is an annual training programme that the second school is expected to be held in December 2008 by SERI.

4 Conclusion

This study reveals the following conclusions:

1. Some members of the OIC countries are blessed with the wealth of crude oil and gas. The oil and gas industry in these countries has contributed tremendously to the development of their respective countries as reflected in the high values of GDPPPP. Therefore the implementation of renewable energy programs in these countries are very limited indeed.
2. The countries with very much lower GDPPP have to import crude oil and petroleum products. However, the use of renewable energy resources such as biomass, biogas, hydro, solar photovoltaic and solar thermal, wind, tidal and waves, and geothermal is still not fully exploited. Perhaps fire wood accounts for greater use of renewable energy in poorer countries.
3. Mozambique and Togo depended highly on combustible renewables and wastes, and had very low electrification rate. Mozambique had the highest renewable energy share of 94.7% in TPES from hydro and combustible renewables and wastes.
4. Azerbaijan, Kazakhstan, Kyrgyzstan, Syria, Tajikistan and Uzbekistan relied on hydro as renewable source of energy.
5. Geothermal, solar, wind, tide, and wave had also been utilised by Indonesia, Egypt, Morocco, Senegal and Tunisia for electricity generation.

6. Albania, Cameroon, Mozambique and Tajikistan rely more than 95% of their electricity generation from renewable energy resources, mainly hydro.
7. Bahrain, Brunei Darussalam, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Turkmenistan and United Arab Emirates, which are also net energy exporters, generated electricity 100% from fossil fuels sources.
8. Countries that had per unit GDPPPP of final electricity consumption lower than 0.1kWh/2000US$ were countries that have electrification rate lower than 33%.
9. Although some countries were able to generate energy for export, yet they were not able to supply electricity to all areas especially the remote areas, causing groups of population there being deprived of modern energy services.
10. Long term strategies have to be adopted to promote renewable energy technologies especially namely

(a) Establishing education and capacity building programmes
(b) Creating renewable energy market and financing mechanism
(c) Improving appropriate energy policies and
(d) Establishing database and international collaboration

The outcome of these strategies will strengthen the industry, consumers and policy/decision makers.

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