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Current status on potential and policy for the development of renewable energy in Vietnam

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Abstract
In the context of increasing energy demand in Vietnam, the ability to supply domestic energy resources is limited (expected to import coal for electricity after 2015) while the potential of renewable energy sources in Vietnam Very large men with high demand for electricity and heat for production, considering the availability of renewable energy sources available for electricity production, cogeneration (both electricity and heat) is very feasible. about technology and economic efficiency and environment. In order to meet demand while energy supply is and will face many problems & challenges, especially the gradual depletion of domestic fossil fuels, oil prices fluctuate with increasing trend and Vietnam will depend more on world energy prices ... Therefore, considering the exploitation of renewable energy sources in the coming period will have a very important meaning both in economy and society. Assembly, energy security and environmental protection.

Keywords: renewable energy, technology application, policy, solution

1. Introduction

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.[3] Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services [1-4]. Based on REN21's 2017 report, renewables contributed 19.3% to humans' global energy consumption and 24.5% to their generation of electricity in 2015 and 2016, respectively. This energy consumption is divided as 8.9% coming from traditional biomass, 4.2% as heat energy (modern biomass, geothermal and solar heat), 3.9% hydroelectricity and 2.2% is electricity from wind, solar, geothermal, and biomass. Worldwide investments in renewable technologies amounted to more than US$286 billion in 2015, with countries such as China and the United States heavily investing in wind, hydro, solar and biofuels[5]. Globally, there are an estimated 7.7 million jobs associated with the renewable energy industries, with solar photovoltaics being the largest renewable employer. [6]. As of 2015 worldwide, more than half of all new electricity capacity installed was renewable [7]. Renewable energy resources exist over wide geographical areas, in contrast to other energy sources, which are concentrated in a limited number of countries. Rapid deployment [8] of renewable energy and energy efficiency is resulting in significant energy security, climate change mitigation, and economic benefits [9]. The results of a recent review of the literature [10] concluded that as greenhouse gas (GHG) emitters begin to be held liable for damages resulting from GHG emissions resulting in climate change, a high value for liability mitigation would provide powerful incentives for deployment of renewable energy technologies. In international public opinion surveys there is strong support for promoting renewable sources such as solar power and wind power [11]. At the national level, at least 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond [12]. Some places and at least two countries, Iceland and Norway generate all their electricity using renewable energy already, and many

other countries have the set a goal to reach 100% renewable energy in the future. For example, in Denmark the government decided to switch the total energy supply (electricity, mobility and heating/cooling) to 100% renewable energy by 2050 [13].At least 47 nations around the world already have over 50 percent of electricity from renewable resources, with Iceland generating all its electrical power from renewable energy [14][15][16] though this does not include non-electrical energy (e.g. transport and heating). While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas and developing countries, where energy is often crucial in human development [17][18]. As most of renewables provide electricity, renewable energy deployment is often applied in conjunction with further electrification, which has several benefits: Electricity can be converted to heat (where necessary generating higher temperatures than fossil fuels), can be converted into mechanical energy with high efficiency and is clean at the point of consumption [19][20]. In addition to that electrification with renewable energy is much more efficient and therefore leads to a significant reduction in primary energy requirements; because most renewables do not have a steam cycle with high losses (fossil power plants usually have losses of 40 to 65%) [21].

Renewable energy includes: wind, solar, hydropower, geothermal, biomass (firewood, rice husk, agricultural and forestry by-products), biogas, biofuels, and tidal / oceanic energy / wave. The use of renewable energy mainly for cooking, hot water supply and lighting has existed for a long time. However, the development of renewable energy technology to serve electricity generation and fuel transport is implemented in Recently, mainly hydroelectric, solar, wind, geothermal and biofuel. The improvement of technology and knowledge of materials, the reduction of costs combined with the state's support policies have contributed to promoting the strong development of renewable energy. In the world, the main motivation for renewable energy development is due to the oil crisis in 1973 and 1979-1980, followed by environmental factors, energy security, and diversification of energy sources. For Vietnam, the development of renewable energy is essential to ensure energy security, contribute to improving public health, environmental protection, responding to climate change, creating jobs ... To In doing so, Vietnam will need to have coordinated and sustainable policies at the national and territorial level to expand the renewable energy market; promote and deploy new technologies; provide appropriate opportunities to encourage the use of renewable energy in all important areas of the energy market. Although renewable energy (except hydroelectricity) is a small part of the total energy supply worldwide and in Vietnam, projects of renewable energy generation in Vietnam have increased more than double from 2000 to 2010, although the current purchase price from renewable energy projects is not attractive to investors. By the end of 2010, renewable energy accounted for about 3.5% of the total installed capacity of the electricity system, however, according to experts, many small and extremely small hydroelectric plants are inactive, while others The biomass power plant operates in moderation or on a seasonal basis. Excluding small hydroelectricity, in 2010 the installed capacity of renewable energy is about 790MW, mainly from biomass, wind and solar. Growth rate in the biomass power industry has strongly shifted the source structure. The total installed capacity of biomass power is 150 MW, and there are already a number of power plants on the grid and plans to expand. The main barrier for renewable energy development is production costs. Many new technologies of renewable energy - including wind, solar and biofuels have been and will soon be economically competitive with fossil fuels and can meet part of Vietnam's energy needs. Technologies with relatively competitive costs are hydro, wind, biomass and geothermal. Although solar cells are expensive, this cost is steadily declining due to advances in technology. In Vietnam, through the research projects in the General Energy Development Plan of the Institute of Energy, the cost for producing renewable electricity is as follows (see Table 1).

Table 1: Costs for electricity production from renewable energy

Cost	Small hydropower	Wind	Rice straw	Baggage	Waste	Solar	Geothermal energy
VND	300-1000	1200-1800	900-1600	700-1200	1600-1800	3600-6000	1100-1600

In addition to the high cost of production, some other barriers to the development of renewable energy include: lack of policies and organizations to support IR development; lack of information and databases for planning and policy making; auxiliary technology and services for renewable energy have not been developed; It is difficult to access capital to develop RE projects

2. Renweable energy in Vietnam

Solar energy (solar radiation) is an extremely important resource in Vietnam. On average, total solar radiation in Vietnam is about 5kWh / m2 / day in the central and southern provinces and about 4kWh / m2 / day in the northern provinces. Currently, there are two types of solar applications in Vietnam:

- Solar heat: Transfer of solar radiation into thermal energy, used in water distillation systems, drying systems, solar cookers and solar water heating systems, ... The most popular application form today is household solar water heater and industrial scale.

- Solar electricity (DMT): For Vietnam, the solar power system is using SPV photovoltaic technology (Solar Photovoltaic or PV). Some of the most popular application models today are:

+ Independent solar power generation system: household scale, street light system and electric grid connected to the local grid.

+ Solar power generation system connected to the national grid. Currently, in Vietnam this model is still small scale, the largest DMT station generates electricity on the national grid with capacity from 100kWp to 154kWp, large-scale projects are only formed at the stage of investment preparation.

In 2001, the World Bank funded the construction of wind maps for four countries (Cambodia, Laos, Thailand and Vietnam), to support the development of wind power for the region. This study, with wind data from the hydrometeorological station and data from MesoMap

model, gives a rough estimate of wind potential in Vietnam at an altitude of 65m and 30m from the ground and soils. corresponding to the shaft height of large grid-connected wind turbines and small wind turbines installed in areas with independent mini nets. Hydrometeorological data provided by the National Institute of Meteorology and Hydrology (VNHM) and the US National Oceanographic and Meteorological Administration (NOAA). NOAA, since 1994 has connected with 24 hydro-meteorological stations in Vietnam to collect hydrological data. The World Bank study shows that Vietnam is the country with the largest wind potential among the four countries in the region: over 39% of Vietnam's total area is estimated to have a large annual average wind speed. more than 6m / s at a height of 65m, equivalent to a total capacity of 512GW. In particular, more than 8% of Vietnam's ranked area has very good wind potential. However, the World Bank's wind map is considered by many experts to be too optimistic and may cause some serious errors due to the wind potential evaluated based on the simulation program. Indeed, comparing actual wind measurement data conducted by Electricity of Vietnam (EVN) is generally much lower than corresponding figures from the World Bank's wind map. EVN's study on "Assessing wind resources for electricity production" is the first official study of Vietnam's wind energy resources. Accordingly, wind data will be measured for a number of selected points. It will then extrapolate into regional representative wind data, by omitting the impact of surface roughness, obstruction caused by objects such as the whole house and the influence of the terrain. This regional wind data is then used to calculate wind data at another point by applying the same process, but in the opposite direction. Based on that data, the project also considers the influencing factors (distance of connection to the electrical system, topography, equipment transport capacity, community acceptance and related issues). to land use and environment ...). By doing so, the study has identified suitable points for wind power production, equivalent to a capacity of 1,785MW. Central Vietnam has the largest wind potential, with 880MW concentrated mainly in Quang Binh and Binh Dinh provinces, followed by the South, with Ninh Thuan and Binh Thuan provinces.

Fig. 2: The modes of RE in Vietnam

Vietnam territory is located in the tropics, with an average annual rainfall of about 1,800 - 2,000mm. With the northern topography and high mountainous western border, the East is a coastline of more than 3,400 km, so our country has a quite dense river system, with more than 3,450 systems. And with such favorable natural conditions, the hydropower potential of our country is relatively large. According to theoretical calculations, the total hydropower capacity of our country is about 35,000MW, of which 60% is concentrated in the North, 27% is distributed in the Central and 13% in the South. Technical potential (potentially feasible to exploit) is about 26,000MW, equivalent to nearly 970 planned projects, can annually produce more than 100 billion kWh, of which small hydroelectricity comes in particular 800 projects, with a total power of about 15-20 billion kWh /year. It can be said that up to now large hydropower projects with capacity of over 100MW have almost been exploited. Projects with favorable locations and low investment costs have also been constructed. Remaining in the near future, small capacity hydropower projects will be invested for exploitation. In recent years, in addition to large projects invested by EVN, with capital and plans to implement on schedule, small and medium projects due to investors outside the power sector are often behind schedule, or stopped. The reason for the slow progress or being stopped by projects is: (1) The economy of our country has been facing difficulties in the past time. (2) Projects that are inefficient and inadequate as in planning and feasibility studies, or investment costs are too high, difficult to pay back. (3) The project owners are not financially capable, or the project owner has no experience in project

management, self-construction leads to poor work quality and long time. (4) Some projects seriously affect the ecological environment, deforestation on a large scale, affecting downstream ... recovered, temporarily removed from the planning. In Vietnam, hydroelectricity accounts for a high proportion in the electricity production structure. Currently, although the electricity industry has developed a diversified power source, hydropower still accounts for a significant proportion. In 2014, hydropower accounted for about 32% of total electricity production. According to the forecast of VII Power Plan (PDP VII), hydropower proportion is still quite high in 2020 and 2030, equivalent to 23%. In addition to the goal of power generation, hydropower plants also have the task of cutting and preventing floods for downstream in the rainy season, and at the same time supplying water for production and people's needs during the rainy season.

3. Policy and Solutions

Characteristics of renewable energy are a lot of dependence on natural conditions (water, sun, wind, geographical position ...), technology and production costs. Therefore, to promote renewable energy development, Vietnam needs support policies such as quota mechanism, fixed price mechanism, bidding mechanism and certification mechanism.

Quota mechanism (norm norm): The Government stipulates that the production units (or consumers) must ensure a part of the electricity produced / consumed from renewable energy sources; rate set by rate. This mechanism has the advantage that it will create a competitive market between renewable energy technologies, thereby reducing the cost of renewable energy production. This mechanism helps the Government only set quotas to achieve the target for renewable energy, while the price will be decided by the competitive market. The penalty price is calculated and given as the ceiling limit for the total cost that affects consumers. The downside of this mechanism is that the production unit will be exposed to great risks and costs beyond its control. Moreover, this mechanism will prioritize the development of the lowest cost technologies, thus will not promote the development of less competitive technologies.

Fixed price mechanism: The government sets the price per kWh produced from renewable energy, which may vary for each different renewable energy technology. Normally, this price norm is higher than the electricity price produced from fossil fuel types, thus encouraging and ensuring economic benefits for renewable energy. The Government financed a fixed price mechanism from state capital or forced production and transmission units to buy all electricity from renewable energy sources. This mechanism minimizes risks for renewable energy investors. With fixed prices set differently for renewable forms, the Government can encourage investment in renewable energy technologies that need to be developed with different objectives. However, this mechanism has limitations that the fixed price for a long time will be difficult to control the profitability of investors. Decreasing fixed prices may apply, however, it must be clearly stated to minimize risks to investors. Applying this mechanism, the Government could not foresee how many RE projects will be invested, so it is impossible to know the total cost of this mechanism in the short and long term. Another limitation is to increase the costs for moderation and to generate technical problems for the electrical system because grid managers are forced to receive renewable energy.

Bidding mechanism: The Government will set competitive bidding criteria, which can be specific to each type of RE technology. The list of renewable energy projects will be selected from low to high until satisfying the development objectives set for each type of renewable energy and published. Then the Government, or authorized management agency, will force units to produce power output from winning projects (with price subsidy support). The advantage of this mechanism is that competition reduces the minimum cost compensation cost. The government can completely control the number of selected projects, which means controlling the cost of losses. In addition, fixing prices for winning projects is also a guarantee for long-term investors. But this mechanism also reveals some disadvantages that when winning the bid, investors may delay the implementation of the project due to many reasons: waiting for the opportunity to reduce investment costs, accept loss bidding. only for the purpose of hoarding the project to prevent other units from competing and not to implement loss projects ... the Government can issue sanctions to limit these disadvantages.

Certification mechanism: With this mechanism, it can be a production certificate, or investment certificate, operating on the principle of allowing units investing in renewable energy to be exempt from production tax per kWh, or withholding into other investment projects. This mechanism has the advantage of ensuring high stability, especially when this mechanism is used in combination with other mechanisms to increase efficiency. However, this stability must be clearly stated in the document on the time of certification. Another drawback is that this mechanism is in favor of large, potential units and many investment projects to easily deduct taxes into it.

Currently, Vietnam does not have a mechanism to support IR development overall, in addition to the separate price support mechanism for wind power approved in 2011. In some research projects conducted by the Institute of Energy in over the past time, a number of other mechanisms such as bidding mechanism or quota mechanism have also been shown to be appropriate, along with proposing a number of institutions to promote IR development. In addition, to support small and independent renewable energy projects (off-grid), the above studies also show that a "mechanism for direct credit to consumers" is appropriate in Vietnam's conditions. However, the application of any mechanism should also apply additional sanctions or other support mechanisms to maximize efficiency of supporting RE development.

In the period 2005 - 2030, Vietnam's energy demand will increase 4 times. Electricity demand of Vietnam increased by 10% / year by 2025. Therefore, the Government of Vietnam recognized the importance of Renewable Energy and established the Long-term Renewable Energy Development Plan. In addition, the development of renewable energy in Vietnam also brings many benefits such as stimulating rural development and creating job opportunities, improving rural roads, reducing thermal power, thus reducing environmental costs. schools from fossil fuel projects. In the case of wind power development, Vietnam has a high wind potential compared to other

countries in Southeast Asia. The total wind energy potential is 1,750MW. The average wind speed in the area with good wind is 6m / s at a height of 60m. The wind potential is higher in the central and southern parts of the country (especially in the Central Highlands, islands and coastal areas), corresponding to 880MW and 855MW respectively. In the North, the potential is about 50MW. Currently there is a wind farm with a total capacity of 30 MW in operation and a wind farm with a capacity of 90 MW under construction. The government and people expressed their support for wind power development; especially wind power will meet the rapidly increasing electricity demand. The institutional framework for developing renewable energy is under construction. The goal of wind power development in Vietnam is 5% of the total electricity output in 2020 and 11% in 2050. A key component of the approved incentive mechanism to promote wind power development is the regulated electricity price (FIT). FIT is 7.8 US cents / kWh. In particular, EVN (Vietnam Electricity Group) is obliged to buy electricity from wind power projects at the price of 6.8USc / kWh. Compensate the price from the state budget for investors of wind power project are 0.1UScent / kWh (from Vietnam Environment Protection Fund). In addition, this support mechanism also includes reduction and exemption of corporate income tax, import taxes, land use fees, VAT and environmental fees.

4. Conclusion

In general, spilled oil can affect animals and plants in two ways: direct from the oil and from the response or cleanup process. There is no clear relationship between the amount of oil in the aquatic environment and the likely impact on biodiversity. A smaller spill at the wrong time/wrong season and in a sensitive environment may prove much more harmful than a larger spill at another time of the year in another or even the same environment.Oil penetrates into the structure of the plumage of birds and the fur of mammals, reducing their insulating ability, and making them more vulnerable to temperature fluctuations and much less buoyant in the water. Animals who rely on scent to find their babies or mothers cannot due to the strong scent of the oil. This causes a baby to be rejected and abandoned, leaving the babies to starve and eventually die. Oil can impair a bird's ability to fly, preventing it from foraging or escaping from predators. As they preen, birds may ingest the oil coating their feathers, irritating the digestive tract, altering liver function, and causing kidney damage. Together with their diminished foraging capacity, this can rapidly result in dehydration and metabolic imbalance. Some birds exposed to petroleum also experience changes in their hormonal balance, including changes in their luteinizing protein. The majority of birds affected by oil spills die from complications without human intervention. Some studies have suggested that less than one percent of oil-soaked birds survive, even after cleaning, although the survival rate can also exceed ninety percent, as in the case of the Treasure oil spill.

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