

## Prospect of Vietnam's New and Renewable Energy

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**Key words** : New and renewable energy, barriers, policies,

**Abstract** : Vietnam is endowed with multiform new and renewable energy resources. However, potential of new and renewable resources in Vietnam has not been completely assessed. Although the Government has embarked several programs to expand the use of these resources, the share of new and renewable energy in total commercial energy is still insignificant. The purpose of this study is to summarize potential and current development status as well as the prospect of new and renewable energy. Identification of barriers that are the hindrances in the development of new and renewable energy would suggest measures to future commercialization of new and renewable energy.

### Nomenclature

CDM : Clean Development Mechanism  
Wp: Watt-peak  
TOE: Ton of oil equivalence

### Subscrip

EVN : Electricity of Vietnam  
MP VI: Master plan for power development in the period of 2006-2015 with prospect to 2025  
RE: New and renewable energy  
MOIT: Ministry of Trade and Industry of Vietnam  
PPCs: Provincial People's Committee  
IE: Institute of Energy  
NEDO: New Energy and Industrial Technology Development Organization

### 1. Introduction

In 1986, Vietnam embarked on a path of reform, known as "Doi moi", a comprehensive changed by restructuring the economy from a planned economy to a market economy. Since then, the Vietnamese economy had shown a remarkable performance as one of the fastest growing economies in the world. With the average annual GDP growth of Vietnam was about 7.75 percent over the period of 1990 to 2007, living standard has improved substantially. Vietnamese market-led economy relies heavily on industry, trade, services, tourism and agriculture. In

2007, Vietnam has a population of 85.2 million, GDP of US\$ 70.02 billion, and an income per capita of US\$835. High economic growth rate of Vietnam led to high energy demand. To meet energy demand in the future, while energy supply and energy prices are facing with big challenges, new and renewable energy development has an important meaning in the socio-economic, energy security and environment protection. Vietnam government has realized the importance of new and renewable energy development and has issued some documents as legal foundation for new and renewable development. However, the share of RE in total commercial energy consumption is insignificant, not proportional to its potential. In 2005, electricity output from RE is 265.57 Gwh, approximately 0.5% total electricity production. The share of RE capacity over total generating capacity reduced from 3.1% in 2002 to 2.5% in 2005.

This study is to summarize current development status as well as prospect of RE, identify barriers and address these hindrances in order to accelerate RE in Vietnam

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## 2. Resources Assessment

Vietnam is relatively endowed with multiform renewable energy resources which are distributed through-out the country. They can be exploited for production of energy to meet rapidly increasing energy demand as well as environmental protection. Main new and renewable energy in Vietnam are small hydro power, biomass energy, wind energy, solar energy and geothermal energy

### 2.1 Small and Micro Hydroelectric Power

Total installed capacity of small hydroelectric power in Vietnam is about 1600-2000 MW (account for the stations have installed capacity under 10MW), takes 7-10% total theoretical reserve of national hydroelectric power. The technique-economic reserve of small hydroelectric power as follows:

- 1) Installed capacity ranges from 0.1-5kw per station included: 1 millions places with total installed capacity from 50 MW to 100 MW
- 2) Installed capacity ranges from 5-100kw per station included: 2500 places with total installed capacity from 100 MW to 150 MW
- 3) Installed capacity ranges from 100-10000kw per station included: 480 places with total installed capacity approximate 738 MW, located in 23 provinces

Furthermore, Vietnam has significant micro hydroelectric power potential, at flumes with the height of water column is about 0.7-0.8m. In 2006, Ministry of Industry and Trade conduct an official study about small hydro power. Technical potential of small hydro in Vietnam with capacity range from 0.1MW to 30 MW per station is about 4015 MW and 1050 stations, takes 10-12% total hydro power resources. Small hydro power potential locates mainly in Northend Mountain, South of Central Region and Tay Nguyen area.

### 2.2 Solar Energy

Located in the tropical and monsoon zones, Vietnam has access to year-round solar energy sources, particularly in the northwestern, central country. Average radiance per year ranges from 2.8 kWh/m<sup>2</sup>.day (Lao Cai-Northern Vietnam) to 5.4 kWh/m<sup>2</sup> day (Kon Tum-Southern Vietnam) and average sunlight is from 1400 hours (Yen Bai-Northern Vietnam) to 2800 hours (Ham Tan-Southern Vietnam). In fact, radiance and sunlight are higher and higher from the North to the South of Vietnam. According to a study conducted by Institute of Energy [5], feasible potential of solar energy application in Vietnam as follows:

- 1) Total solar panels which can be applied at households are 114107 units and communities are 1167 units
- 2) Unvented solar water heaters: To 2015, if most of the urban households use unvented solar water heaters, total unvented solar water heaters will be 3 814 065 units and total saved electricity will be 3,398 billion kWh.

### 2.3 Wind Energy

There are several studies which assessed wind energy resource of Vietnam. However, the data of wind energy measure for the whole country is not available; consequently, there are big differences in those studies. According to the MP VI, wind power potential of 12 provinces in the North and Middle of Vietnam is 600 MW and wind power potential of 5 provinces in the south of Vietnam included Lam Dong, Tra Vinh, Ben Tre and Soc Trang is up to 1600 MW. Wind power could generate 800-1400 kwh per sq.m per year on certain islands, 500 -1000 kwh per sq.m per year the coastal areas of the central region, Tay Nguyen (the Central Highlands) and the Southern region, and 500 kwh per sq.m per in other parts of the country

### 2.4 Geothermal Energy

There is a potential for geothermal energy in Vietnam since it has more than 300 hot-water areas, with a surface water temperatures ranging from 30°C to 105°C in North-West and North and South of Centrals. Up to now, there is no geothermal energy using for power generation. According to MP VI, there are 29 geothermal fields have prospects of exploiting at industrial scale. Moreover, only 12 of them can be used for constructing geothermal power stations. An American company (Mineral & Ormat) have conducted feasibility study at some areas included Bang, Nghia Thang, Mo Duc, Hoi Van, Tu Bong and Thanh Danh to develop 112,7 MW geothermal power. However, those projects have been cancelled due to low profitability potential. Primary estimation of total Vietnam geothermal potential is about 340 MW.

### 2.5 Tidal Energy

Base on geographical and geological features, 18 places which have potentiality for tidal energy have been specified. However, prospect of tidal energy potential of Vietnam is not very promising and there are only some appropriate places for small tidal power plants. Moreover, It is suggested that some areas need surveying in more details.

### 2.6 Biomass Energy

Main biomass sources are wood and by-products of the cultivated crops. According to the evaluation of Institute of Energy, biomass energy potential is shown table 1 and table 2. The potential of biomass resources in Vietnam is huge, only agriculture by-products are 70 million tons (approximately 20 million TOE). However, there are four types of biomass energy can be used for power generation: husk in rice husk plants, sugar refuse cane in sugar mills, coffee shells and wood refuses.

**Table 1 Biomass Energy Exploitation**  
Unit: Million tons

Sources	2005	2010
Wood energy exploitation	23.67	27.60
By-products from agriculture plants	60.8	72.37
By product from cattle-breeding	54.72	60.72

Source: Institute of Energy, Vietnam  
Bio-fuel :Ethanol potential of Vietnam is estimated as follows:

**Table 2 Ethanol Potential**

Sources	Potential Mil. l/year	Oil equivalent Mil. TOE
Starch	17	10.56
Treacle	70	46.20
Total	87	57.42

Source: Institute of Energy, Vietnam

### 3. Status of Current Development

#### 3.1 Small and Micro Hydroelectric Power

Vietnam has built and operated over 500 small hydroelectric stations of which capacity type ranged from 5kw to under 50kw are 362 stations with total capacity of 4709 kW; from 50 kW to under 100 kW are 28 stations with total capacity of 1681 kW; capacity type from 100 kW to under 10 000 kW are 117 stations. Moreover, there are stations and units which are very small and their capacity from 0.2 kW to less than 5 kW has been used at remote area. The number of this type is about 150 000 units with estimated capacity of 60 MW. There are 49 hydropower plants connected to the national grid with total capacity of 64 MW and over 300 small hydropower plants which are not connected to the national grid with total capacity over 70 MW. To 2006 total small hydropower capacity is about 135 MW and electricity production reached 172 million kWh.

In the future, there are two ways for small hydropower development: Small hydroelectric connected to the national grid or building hybrid systems. Main problem with small and micro hydroelectric power development of Vietnam is the depletion of resource. To 2020, most of small hydroelectric powers will be exploited.

#### 3.2 Solar Energy

Up to 2005, Vietnam has about 2300 small unvented solar water heaters which were installed at households. Each heater is estimated to save 600-1000 kWh per year. In the last three year, using solar energy for heating water has grown rapidly. According to Institute of Energy in 2008, there are about 61000 unvented solar water heaters in Vietnam, 50% in the South, 42% in the North of Vietnam. Therefore, total saved electricity is over 36.6 GWh.

Solar battery equipments were applied in Vietnam

in early 1990s. From 1992, solar battery panels were used for households at remote areas. So far, solar battery panels are mainly imported. There are four types of systems that define Vietnamese solar energy market:

1) Individual home systems: The capacity of the system depends on each area and actual needs of households. However, because the price of the systems is still high, the capacity relies on the price and the designer's imposition. The capacity of the each system is about 50-75 Wp

2)Village facilities (common lighting, audio, television): The capacity of these systems is from 200-2000 Wp

3) Solar battery systems combined Diesel: This kind of system uses power generator as complement source when there is not enough electricity from solar battery system

4)Solar battery systems which independently connected to grid: This is boosted solar battery systems.

Currently, there are about 800 systems in the South of Vietnam, mainly at households, 165 systems at households in the Middle of Vietnam included Gia lai, Quang Nam, Binh Dinh, Quang Ngai, Khanh Hoa provinces and 25 systems for village centers. Moreover, Vietnam has two solar cell hybrid:

1)Solar battery project (100Kw + small hydro power 25kw) in Gia Lai province. This project began operation in 1999 funded by NEDO organization of Japan.

2)Solar battery project (7kw + wind power generation 2Kw) in Kon Tum province funded by Tokohu Electricity Company – Japan. This project began operation in 2000 supplies electricity for 42 householders.

3)Solar battery station 154kWp at National Conference Center which has been operated since 2006.

Total solar battery for power generation is about 1,25 MW

In the last decades, although Vietnam has gained significant results on studying and applying solar energy resource, studies on solar energy are spontaneous, have no long-term orientation and have no specific support policies. The price of solar facilities are still high compared with people's income, cannot be socialization, especially in agriculture, mountainous areas, islands. Currently, solar cell installations have two main barriers: The first one is high investment cost. Generally, solar panels are imported with the cost of 8.0-8.5 US/Wp, plus transportation cost from 5-7%. The second barrier is the capacity of the solar cell. Low average capacity of solar cell makes it overloaded or damaged when high electricity demand happened. Solar energy development might be better if some measures are implemented: (i) Reduce investment cost by develop domestic production with financial support from the Government; (ii) Develop technology to increase the capacity of solar cell.

### 3.3 Wind Energy

Wind power application has not been developed, only at the preparation phase. Not many regions have good wind power potential which can install wind motor with large capacity. Currently, Vietnam only installed 1000 wind motors, mainly with capacity up to 200 kW and 120 wind motors for water pump. Vietnam also has some projects for wind power which can be connected to national grid. However, most of them only stop at investment report stage because of the shortage of development policy for wind power. The biggest wind power station in Vietnam is 800 kW of capacity in Bach Long Vi island. However, its operation came to a halt due to technological transfer problems. Total capacity of wind power in Vietnam is 1.23 MW

According to the MP VI, total 170 MW of wind power will be installed to 2020. However, at the moment, Vietnam does not have the data of wind measure in the whole country therefore wind power assessment has large differences.

### 3.4 Geothermal Energy

In Vietnam, geothermal survey works as energy resource only was conducted formally in last decades. There is no geothermal plant in Vietnam now and no master plan for geothermal development

### 3.5 Tidal Energy

The completion of survey work on tidal energy has not finished. At the moment, Vietnam does not have tidal power plant. However, some potential places are far from center, the cost for transmission line will lead to higher electricity price and , the negative impact of tidal power plants on environment has not been studied in Vietnam.

### 3.6 Biomass Energy

1)Thermal energy: Biomass is an important energy resource of Vietnam, there are about 70% agricultural people using biomass to cook every day. Biomass is also using as combustible in some local industries such as brick, ceramic production, food processing, electricity and steam production. The current biomass energy consumption are collected, analyzed and aggregated as follow:

Wood: Currently, about 20% of total wood consumption is dealing in the market, the remainder is available. Wood is used for producing construction materials, food processing, and cooking. Total wood consumption is about 24.5 million tons.

Straw: Used as combustible for households in agricultural Northern region. In the South and Middle of Vietnam, the people burn straw away and it causes some environmental problems. Straw used as combustible is estimated about 7.8 million tons (24% total straw).

Husk: Used as for brick production in the South of Vietnam and combustible for households. Husk is used as combustible about 2.7 million tons (42% total husk)

Others by-products: Manioc, coffee shells, peanut shells, sugar-cane refuse, corn-cultivated by-products.... also use as combustible. Currently, these biomass types only are exploited and used about 40% of total potential. Total of these biomass types consumption is about 2.688

TOE

Totally, biomass consumption for heat energy in Vietnam is about 38 million tons, equivalent to about 13.5 million TOE, about 38% total final energy consumption. Biomass energy using in agricultural areas has low efficiency (8-15%) because of the traditional burning stove, causes air pollution.

**Table 3 New and Renewable Energy in 2005**  
Unit: KTOE

Sources	Consumption	%
Commercial energy	21800	61.7
Heat energy from RE	13 515.8	37.6
Biomass	13513	99.9
Solar energy	0.645	0.01
Biogas	0.160	
Total	35 315.8	100.0

Source: Institute of Energy, Vietnam

2)Biogas :There are about 80 000 units in Vietnam now, of them 95% for cooking and 5% for light and those units can produce about 500 KTOE per year. Biogas technology in Vietnam is being commercialized. Actually, there are several households which invested to build stations for their own use, and concurrently some private groups can build the stations has been formed. However, there are some problems happened with the development of biogas energy : Market for biogas has not been managed yet, the development and the organization of network and are not complete, narrow and uncomfortable service is another disadvantage; the main obstacle of biogas development is that low people's income and the lost of State management. Therefore, incomplete biogas technology was sometime applied which has limited success and ineffective investment. Biogas energy mainly develops in plane areas, not well developed in remote areas.

3)Bio-fuel: Currently, resources to produce bio-fuel (ethanol) are mainly from sugar, cane juice and cassava. For spirit production from sugar, the efficiency of this process is not high, the cost of spirit price is more expensive that of other countries. Vietnam is also planning to produce domestic ethanol with 6 projects each of which has capacity about 100 million liters per year from cassava. Ethanol gasoline has been used in test programs.

4)Power generation: Biomass used for power generation reached 150 MW of capacity. Currently, Electricity is mainly produced from 43 sugar mills. Some sugar mills are selling electricity to the national grid, the highest price is about 4.04 US cent/kWh. Waste is also used to produce methanol and electricity. There is one power station with capacity of 750 kW and the selling price is 4 US cent /kWh. Vietnam has about 130 husk rice plants and some of them have used husk to generate electricity. However, electricity output only meet the electricity demand of plants and no grid connectivity.

**Table 4 New and Renewable Electricity in 2006**

Sources	Capacity MW	share %
Traditional	11360	97.47
RE	287.48	2.53
Biomass	150	1.32
Solar energy	1.25	0.011
Small hydro	135	1.18
Wind electricity	1.23	0.008

Source: Institute of Energy, Vietnam

The potential for electricity production from biomass is estimated about 250-400 MW, the electricity surplus can be supplied to the national grid. However, all plants will have to reach an agreement with EVN. It may become an obstacle to develop this kind of plant in Vietnam. Moreover, Vietnam needs to have specific plant and overcome barriers to develop power generation from biomass. The sugar-cane supply is not stable because of the low sugar-cane price and the competition of sugar imported from Thailand and Cambodia. On the other hand, all husk rice plants is at small scale and disperse. The cost for collecting husk become expensive and make electricity price higher.

#### 4. Policy for New and Renewable Energy Development

Vietnam government has realized the importance of new and renewable energy development and has issued some documents as legal foundation for new and renewable development. This section is to summarized some main contents of these issues.

1)The National Energy Strategy of Vietnam to 2020 and vision up to 2050 (2007) with main objectives for new and renewable energy as follows: (i) Strive for increasing the share of new and renewable energy to 3% of total primary commercial energy in 2010; 5% in 2020 and 11% in 2050 (ii) Complete agricultural and mountainous energy programs. The number of households use commercial energy for cooking will be 50% in 2010 and 80 % in 2020; to 2010, 95% agricultural household will access to electricity, to 2020 nearly 100% of them will use electricity (iii) Consider to form energy development fund in order to support the investment in new and renewable energy. Moreover, the orientation for new and renewable energy also stipulated: (i)New and renewable energy resources have not completely assessed, therefore it is necessary to have plan and investment for further surveying the data, establishing master plans, zoning types of new and renewable energy in order to suitably exploit and invest the resources. Establishing special organizations from different economic sectors in order to investigate and make plan. Carrying out propaganda programs, making studies, trial-manufacture and expanding new and renewable energy technology (ii) Using new and renewable energy concurrent with

energy savings programs as well as other national goal programs such as rural electrification, afforest...(iii) Encouraging companies to produce, assemble, repair new and renewable energy devices such as hot water appliances, small hydroelectric, wind engines, biogas tunnels. Cooperating to buy technology of developed countries in order to assemble high-tech devices such as solar cell, electricity wind... gradually develop domestic technology (iv) Supporting the investment for survey work, research, trial-manufacture programs, building typical centers using new and renewable energy; Making preferential import tax of devices, new technology, production tax and distribution tax; copyright protection for invents and improvement patents (v)Allowing individuals, institutions from home and abroad to cooperate in investment and exploitation new and renewable energy based on mutual benefit

2)The Master plan for Power development 2006-2015 with prospect to 2025 (2007) outlines some goals: (i) Continue to implement investment program to develop agricultural electricity which was approval by the Prime Minister, strive for accessing to electricity of 95% communes in 2010 and 100% in 2015 (ii) Develop small hydroelectric power, new and renewable energy for remote, bordered, mountainous, island areas (i) Install 2451 MW of capacity of renewable electricity in 2015 and to 2025 the increment capacity is 1600 MW which are connected to the national grid.

3)The Decision of the Prime Minister about some mechanism and policies of CDM projects: (i) Preferential receives: taxes, land utilization, land lease, depreciation of fix asset; investment credit of State according to regulations (ii) Consider to have price support of the products of CDM projects (in preferential areas) (iii) Consider receiving financial support when establishing, building projects according to the regulation of current law

4)The Decision of the Prime Minister about the approval of "Master plan for bio-fuel development to 2015, with prospect to 2025" (2007): (i)To 2010, building and developing the tested production models and using at scale of 100 000 tons E5 and 50 000 tons B5 per year; ensuring to satisfy 0.4% domestic gasoline demand of Vietnam (ii)To 2015, ethanol production and vegetable oil reach 250 000 tons (can mix 5 million tons E5, B5), satisfying 5% total gasoline demand of the country

4)Electricity law which came into force from 01/07/2005: (i)Intensifying new and renewable energy exploitation and utilization in order to produce electricity (ii) new and renewable project in electricity production will receive preferential investment, electricity price, taxes...(iii) Encouraging organizations and individuals to invest in building grid or power stations using new and renewable energy

5)The Decision of Prime Minister about "Strategy for power development of Vietnam 2004-2010 period and orientation to 2020" (2004): (i) Identifying development research new and renewable energy to

satisfy electricity demand, especially for remote areas (ii) Promoting agricultural electricity program, strive for the access to electricity of 90% agricultural households in 2010 and 100% in 2020 (iii) Developing new and renewable energy plants: Using new and renewable energy resource to generate electricity for remote areas

6) Circular No 58/2008 which regulates the price support for the products of CDM projects: (i) Electricity produced from wind energy, solar energy, geothermal energy and tidal energy (ii) Electricity produced by methanol recapture from refuse disposal sites and coal production tunnels

7) The Decision "Regulation on price list of avoidable cost and electricity sales and purchase contracts (2008): (i) Regulation on the conditions, construction procedures, modification, complements and cancellation the tariff applied for small power plants connected to the national grid (ii) Applied for organizations, individuals selling and purchasing electricity of small power plants.

## **5. Barriers to New and Renewable Energy Development**

### **5.1 Policy and Institutional Barriers.**

National energy policy and legal framework are not strong enough for promoting exploitation and use of renewable energy, especially production of electricity from renewable energies where there are least costs of grid connected renewable power supply. Vietnam need an institution with complete authorities to manage RE development. In 2001, Vietnamese government launched the "Action plan for new and renewable energy development" known as REAP. However, their efforts is mainly to develop legal framework for the grid connected projects. Over the last ten years, there are only 67 MW of small hydroelectric connected to the national grid. The rural electrification by off-grid power projects has not reached its goals. Some projects were stagnant at early stage. Totally, the number of successful projects in Vietnam may not exceed 30. Whereas, in the "Service providing energy project" funded by World Bank in Sri Lanka, 101 systems has completed and 46 others are building. In Nepal, 87 systems has been operated within one year in a UNDP's program. Rural electrification using RE will only success if there exist standard models which can be applied for each of power resource (pico-hydro electric, solar cell, hybrid systems) and then, they can be applied for hundreds or thousands households. One of the biggest challenges of rural electrification policy is that off-grid projects have to be designed in such a way as to be feasible to connect to the national grid even if the grid is expanded to selling electricity on daylight. More over, non-existence of an unified institution for off-grid projects management also is an barrier for its development. Actually, many models were failed due to the lack of studies and analysis of specific characteristics of each region (custom and habits, public models). The top-down approach method in off-grid rural electrification is not efficient. In this case, an approach method with the participation of local

government and people may be more appropriate. Increase the awareness of public included the awareness of disbursement duty. In fact, some many projects in Vietnam have operation difficulties because the shortage of money.

Generally, RE policies in Vietnam are too general to be adopted by enterprises. Usually, they need to negotiate with the government, especially about the price. Actually, Vietnam is now lack of an adequate policy and regulations to purchase power from small power producers. Studies carried out showed that the stand alone bagasse of rick husk fuelled power plant were uneconomical. Although EVN is purchasing electricity from several private power companies, up to now, the regulations to purchase electricity from private power producers are not issued. Power purchasing contracts between EVN and the private power companies are negotiated case by case basis. The policies, regulations and procedures for encouraging renewable energy are required to level the playing field with conventional generation

Low electricity prices: Normally, EVN purchases electricity from the private power companies with prices less than their average tariffs. The low selling price of generated power leads to longer payback period of new and renewable projects. This will also not attract the investment of the private power producers. Moreover, some new and renewable energy resources of Vietnam have not been completely done the survey work. Therefore, the estimation of some new and renewable energy potentials are not exact

### **5.2 Financial Barriers**

Underdeveloped capital and financial markets in Vietnam have limited the enterprise's access to capital; The legal framework is uncompleted and sometime inconsistent with the lending policy; Lending mechanism are unsynchronized; Lack of regulatory framework for promoting grid-connected renewable power development such as power purchase agreement as well as electricity tariffs; Lending conditions and procedures are complicated and often changed; Bank/financial organizations lack the necessary capacity to evaluate RE projects; Banks also face high transaction costs due to the smallness of potential RE projects; Credit institutions are hesitant to lend to RE projects due to high risks and long time to recover the investment cost; Lack of RE Promotion Fund; There is shortage of good, bankable project proposals, mainly because of the lack of capacity and technical support ; Cost of RE devices is still high (imported solar battery is about 6.5 US/Wp) while income of rural households is low.

In the circular No 58/2008, Ministry of Natural Resources and Environment stipulated financial support for some of RE projects. The financial support do not include Small hydroelectric and biomass energy, that is this regulation is only for wind power projects, solar energy project, tidal power plants. The most important features of this mechanism is that support will be given based on electricity output, not for investment cost. It is opposite to the other countries' experience. For example, in India the government support the investment cost for

RE projects and those project commercially operated. Actually, this mechanism make wind power projects less efficiency: (i) The regulation does not stipulate the ceiling support or solve allocated support procedures in case support demands excess the fund as well as the competition on prices and does not encourage efficient projects with lower cost price;(ii) This regulation also does not encourage RE plant to maximize its revenue from CER (Certified Emission Reduction) because the Government will support for all unequal part between cost plus benefit and net revenue

### **5.3 Market-related Barriers**

Currently, electric power sector in Vietnam has undergone market reform. That will lead to setting up of an electricity market with competitive and reliable power supply tariff rationalization and elimination of subsidies and grants may bring down the penetration of RE. For biomass-based technologies, the barriers are unsustainable biomass supply and non-existence of a fuel market, unreliable supply of biomass and frequent price fluctuation.

### **5.4 Technological Barriers**

Vietnam is lack of complete technologies manufactured within the country. Promulgation of equipment standards is not sufficient. Auxiliary devices, control units locally manufactured have quality lower than available systems imported from foreign countries. Even for unvented solar water heaters, with not complicated manufacturing technology, proper for domestic science and technology level, wide range of application do not have industrial production. Domestic invented solar water heater production has low quality due to insignificant investment. Moreover, its efficient operation also low because of the designers do not take into account the quality of water in Vietnam which contains  $\text{CaCO}_3$ .

There is shortage of consulting and technical services for renewable energy technology, especially maintenance and repair services after installation and commercial enterprises supplying renewable energy electric equipment and services. Import of high quality equipment or joint venture investment to improve domestic equipment quality is needed to support rural electrification program, especially renewable electricity projects. Vietnam also do not have enough technical knowledge and skills man powers to implement new and renewable energy projects. Currently, wind power units with capacity smaller than 200W are the most competitive and the most applicable. However, the unstable quality of equipment causes by the single production, manual sections with low precise. Some large wind power units (>500W) only had experimental production, the quality of products is low, the electricity system of the wind engine is not complete.

### **5.5 Information and Social Barriers**

Compared with other countries, Vietnam has insignificant performance on new and renewable energy development. Although most of projects were supported by foreign organizations, there are so many difficulties in application, especially people's

awareness. Community awareness of renewable energy technologies and services, social and environmental benefits from renewable energy power projects are still limited. Some people consider that investing in renewable energy would be risk and therefore they don't want to invest, expect projects invested by Government. Another problem always emerges is that management of the projects after construction. The efficiency of many systems declined because people with lack of knowledge changed the design of the systems. Besides that, Vietnam must have a strong human resource for this sector and build a service network for project areas so that some accidents of the systems can be solved in time.

Moreover, the information about the technologies, their costs and effectiveness for the potential investors in grid connected plants, community and household systems, for financing agencies, and for government officials at all levels is inadequate. For example, there are many successful cases of applying biogas tunnels or water heating using solar energy which are not disseminated to others.

## **6 Measures to Overcome the Barriers**

### **6.1 Standardizing Power Purchase Agreement**

The power purchaser holds substantial market power over the RE producer. Further, the negotiation process is inherently complex and expensive when energy is transferred to the intermediary between the producer and ultimate consumer. To solve this problem, a standardized power purchase agreement is necessary. Vietnam should establish the instruction of grid connected RE and standardized trading contract.

### **6.2 Establishing Development Plan for Each Type of Renewable Energy**

Although master plan for solar energy has been stipulated in the decision No 110 of the Primer Minister, the implementation of that has been limited. Currently, potential resource assessments are not adequate and exist differences. IE has finished the new master plan for new and renewable energy development. However, the content of this plan is large and short study period as well as limited budget. Therefore, it is necessary to examine the master plan, add a potential survey project and establishing suitable master plan for each resource in order to create favourable conditions for RE development.

For example, wind power is considered as the most promising RE. However, wind power development in Vietnam is still stagnant. Building master plan for wind power is necessary included the plan of building experimental wind power plant which is connected to the national grid

### **6.3 Efficiently Using Biomass Energy**

Vietnam is still agricultural country and various resources of biomass energy such as sugar refuse cane, straw and husk. All most of biomass energies are used to produce thermal energy or electricity. To efficiently use biomass energy, it is necessary to adopt measures:(i) Stably supply biomass energy resources;

(ii) Develop energy conversion (from biomass energy to electricity, fuel.); (iii) Establish bio-fuel distribution system; (iii) intensify the coordination and cooperation within and between various ministries, agencies, institutes

#### **6.4 Financial System Development**

Assistance in capital mobilization and other assistance are needed to establish and operate renewable energy fund in order to help investment in renewable electricity projects. It is necessary to have laws, transparent operation procedures to monitor and evaluate responsibilities of fund management. To create good conditions to approach commercial credits via partly credit-guaranteeing mechanism and have appropriate resources in terms of level, amount and mechanisms for Government subsidy for rural electrification with RE, for commune power grids and stand-alone power systems.

Proposed financial incentives: VAT and income tax reduction, depreciation increase, reduction of tax or credit interest rate for these investments. Simplify procedures, treated equally between state owner companies and private companies.

#### **6.5 Providing Information and Improving Awareness**

Building awareness for Government officials, financial and business communities and public about RE. Adding and updating data of renewable electricity sources potential as well as market demand to be basis of a national program of renewable electricity development. Issuing necessary regulations of close coordination among MOIT, EVN, PPCs and RE project investors, EVN has responsibility for providing data of plan and amount of communes electrified. Enhancing community's knowledge of social, environmental benefits of RE projects.

Supporting Provincial People's Committees in implementing Plan of RE Development as a part of their rural electrification plans. Training courses for local staff to improve their skills.

#### **6.6 Technical Development**

According to the experience of successful solar cell projects in China, Sri Lanka, quality control, operation standards and device certification are important to build enduring solar energy systems. Therefore, it is necessary for Vietnam to establish standards and instruction discretely for solar cell application.

## **7 Conclusion**

Vietnam has moderate potential for RE even though no completed survey has conducted yet. The current policy environment has been favourable to RE development. The Government also establish set of goal for RE development. However, there still exist several barriers to renewable energy development in the country. Standardized power purchase agreement is necessary, the efficiency improvement of biomass energy utilization and the establishment of master plan for each type of RE source are required. Besides that, Vietnam also should establish financial mechanism, have measures to provide

information and improve awareness as well as develop technology of new and renewable energy..

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