

Biomass utilisation in selected Asian countries: policy, R&D and status

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Summary

Energy is essential to economic and social development and to improve quality of live. A cheap and stable energy supply is a prerequisite. However, to ensure the sustainability of energy consumption and production is a very difficult task. Generally, national sustainable policy targets and strategies are defined according to what is prescribed by Conventions and Protocols. For the international level, Kyoto Protocol has been established. This paper is deal with the use of biomass as a source of energy including policy, R&D and status in some selected Asian countries i.e. Indonesia, Malaysia, Thailand, India, China, Japan and Turkey at the recent position based on the published data available in the literatures. The sustainable potential of biomass resources both from non-plantation and plantation in some Asian countries has been reported. Attractive use of biomass as a source of energy in commercial scale has been shown in target countries and it seem that the mostly use is for fuel in heat and power generation.

Keywords: Biomass utilisation; Renewable energy; heat and power generation

Introduction

Biomass utilisation is driven by many factors; among them are increase in oil price, energy supply security, climate change and environmental issues, waste minimisation, economic considerations, technological improvement, existence of renewable energy (RE), carbon market, and government policies, support and incentives. And some the reasons why we chose the biomass as an alternative energy are producible in large quantities, environmentally benign, cost-competitive, etc. Further, lifecycle assessment on biomass shows that its net energy balance (NEB = energy output – energy input) is positive. It means that the biomass is a source of energy, even the cost for biomass-based electricity production is little higher than hydropower and wind energy. Meanwhile, energy cost for biomass power generation with plant size 1-20 MW of about 5-12 US cents/kWh is considerably lower than rooftop solar PV with peak capacity 2-5 kWp as about 20-80 US cents/kWh. Biomass heating system and biomass gasifier for rural energy also exhibit a reasonable cost of 1-6 and 8-12 US cents/kWh. Moreover, NEB ratio of electricity from biomass of 6.40 is considerably higher than NEB ratio of ethanol from corn grain of 1.25 and biodiesel from soybean of 1.93. In addition, NEB ratios for ethanol and synfuel from biomasses of 5.69 and 10.66, respectively are also relatively higher [1,2]. Based on NEB ratio, it is evident that use of biomass as a source of RE especially for electricity generation, biofuel and synfuel productions seems has an advantage and profitable.

Bhattacharya et al [3] wrote that the main reasons for utilisation of biomass as a modern energy source include: (i) recent developments relating to the conversion technology and biomass production that have made bioenergy competitive with fossil fuel based energy generation in

some situations, (ii) environmental benefits provided by the modern biomass energy, (iii) enhancement of energy security and diversity of energy supply, (iv) employment generation and rural development, and (v) restoration of degraded lands as a result of plantation and possibility of increase in biodiversity.

In order to intensively promote the RE development, a number of actions have been taken by the governments in selected countries. Among the actions are addressed to stimulate technological progress, to trigger learning effects with respect to investment costs, to minimise administration and transaction costs, to maintain public acceptance regarding renewable energy sources (RES) technologies, increasing R&D activities, etc. Within the Asian countries, Japan is the largest contributor to R&D. Other countries with a substantial contribution to Asian RE R&D are China and India. Moreover, some pilots and commercial projects have been developed and some others are being installed. All the countries have also established the policies, planning and regulations on energy efficiency improvement and RE development including portfolio, investment or finance, tariff and tax. Asian countries with explicit mandates on RE for rural electrification include Bangladesh, China, India, Indonesia, Nepal, the Philippines, Sri Lanka, Thailand, and Vietnam. In overall, share of primary and final energy from RE in the selected countries are still limited.

Policy, R&D and status of biomass utilisation in selected Asian countries

Indonesia

Talking about RE in Indonesian, the country right now has instituted a number of policies to promote RE power generation through "green energy policy" for maximum utilisation of RE and energy efficiency, small power distributed generation using RE to support small enterprises with capacity less than 1 MW, and medium-scale power generation program supports businesses with capacity under 10 MW (Indonesia has revised feed-in tariff to cover plants up to 10 MW in size, from a previous limit of 1 MW). For further increase the utilisation of RE, Indonesia is taking some actions which includes formulating a directive policy on investment and financing, creating incentives through policy to include tax and fiscal incentives, depletion premium, and increasing R&D activities. Indonesian sustainable energy development policies and strategies are formulated in Blueprint for National Energy Management 2005-2025. In 2004, just one year before the blueprint is established; Indonesia has installed electricity generation capacity as about 21.4 GW in which 13% coming from RES. At this point, the contribution of RE in final energy consumption (FEC) was only 1.3%. According to the blueprint, RE targeted in primary energy to meet the level of 15% and to supply 4% of country's electricity need by 2025 [2,4].

R&D activities on RE, of course including biomass are performing by Agency for Assessment and Application of Technology (BPPT) and some universities/institutes. The government through the Ministry of Research and Technology (MRT) provides the funding for the research projects on palm oil that also cover solid waste biomass which proposed by the universities or research institutes. Meanwhile, the Ministry of Energy and Mineral Resources (MEMR) is taking the responsibilities on the planning and policy. Several grants and funds for biomass gasification studies come from international agencies/developed countries too. About 50 gasifiers were installed and about 10 were intended as commercial units. Among them, power gasifiers are about 10-120 KWe and thermal gasifiers are 400-900 KWth. One of the pilot projects on electricity generation from rice husk gasification can be found in BPPT Laboratory with the capacity of 18 KWe. Kyoto Protocol has been ratified as well; Clean Development Mechanism (CDM) projects begin to growth slowly even though there is no registered biomass projects on CDM yet [5,6]. Only a theoretical investigation on CDM potential from bagasse cogeneration has been conducted by Restuti and Michaelowa in 2007 [7].

On the country policy, alternative energy roadmap in range of 2006-2025 is focused on geothermal, biofuel including biomass, solar and coal. Biomass potential in Indonesia right now is 49.81 GW, whereas installed capacity is 302 MW ($\pm 6\%$ of the potential). And about eight new biomass-fueled power plants with total capacity of 127.5 MW are under evaluation [5,7,8,9]. Biomass potential particularly comprises of saw mill, plywood mill, sugar mill, rice mill, palm oil mill solid wastes and others agriculture solid wastes. Further, a commercial rice husk gasification-based power plant was installed in Haurgeulis, West Java in 2003 with the capacity of 100 KWe, funding support by Directorate General of Electricity and Energy Utilization (DGEEU) MEMR. Mostly biomass-based power plants in Indonesia are a direct combustion type which is set up in almost all palm oil and sugar mills in Sumatera, Java and Kalimantan. Biomass-based electricity generation in 2025 is projected to reach a level of 810 MW.

Malaysia

The country's Ninth Plan (2006-2010) strengthens initiatives for energy efficiency and RE focused on better utilisation of energy resources. Six years before this plan, the fuel diversification policy has announced RE as the fifth fuel in the energy supply mix. All RE areas are of interest to the country including biomass wherein Malaysia has an abundant resource from palm oil solid waste. RE is being targeted to be a significant contributor to the country's total electricity supply. With this objective in mind, greater efforts are being undertaken to encourage the utilization of renewable resources for energy generation. The government provides also various tax incentives for new investments, such as 100% tax exemption for pioneer status business models for a 10 year period and 60% tax allowance on capital expenditure for improving energy conservation. Country's promotion on RE utilisation goes through following programs: small renewable energy producers (SREP) program, biomass based power generation and cogeneration (BioGen) and RE power purchase agreement (REPPA). Thereafter, many companies are already taking advantage of RE technologies to begin reaping energy cost savings and revenue now.

Major R&D activities are attempted by universities and research centers. Works on R&D in Malaysia are almost same to Indonesia. Funding for RE development is supported by government such Malaysia Electricity Supply Industry (MESITA) and RE Business Fund (REBF) and certainly by international agencies and developed countries. Malaysia is considerably active in CDM with the number of registered biomass projects is 15 [6].

Malaysia is well positioned to take advantage of its enormous output of biomass from oil palm residues and wood wastes. Malaysia is the main of palm oil producing countries in the world besides Indonesia and Thailand. Biomass potential is accounted as 2,700 MW and contributes to $\pm 16\%$ of the energy consumption in the country, out of which 51% comes from palm oil biomass and 22% from of wood waste. The resources are widely used in Malaysia for heat and power generation through combustion process. The excess power from this combined and heat power plant can be connected to the national grid system. Currently, total generated power from palm oil residues for internal consumption is about 211 MW [10]. Mostly, biomass power plants in palm oil mills in Malaysia run by cogeneration system. TSH Bio Energy is the first biomass RE project using palm oil empty fruit bunches for a 14 MWe cogeneration system power plant in Sabah. The 2 MWe with the same type/system and fuel source can be found in Kedah [6].

Thailand

Thailand's Energy Policy on RE was outlined by the government earlier 2008 is to develop and promote research in all forms of RE inline with the "sufficiency economy philosophy" and sustainable development. Ministry of Energy has identified a goal to increase the share of RE to 8% of total final energy demand by 2011 to meet the RE-based electricity target of 3,276 MW.

This will result in total emission savings of at least a million tonnes of CO₂ per year. Existing RE-based electricity is 1,621 MW ($\pm 44\%$ of target). Therefore, the program and regulation framework in order to push the RE utilisation such as small power producers (SPP) program, very small power producers (VSPP) program and renewable portfolio standard (RPS) are on going now. Additional actions are provided in financial sector such incentives and funding supports in promotion projects and R&D. Thailand adopted a new feed-in policy for biomass, wind, solar, and micro-hydro. Further, the country has also established Thailand Green House Gas Management Organisation (TGO), an autonomous government organisation, active in the promotion of CDM projects and use clean energy by giving importance to the management of Green House Gasses (GHGs). The number of registered biomass projects on CDM is 5 [6].

Activities on R&D are conducted specially by universities in which supporting funds come both from government through Energy Conservation Promotion Fund (ENCON Fund) and international agencies/developed countries. In fact, Thailand has been financing small power producers from public funds, with over 1,500 MW of renewable capacity installed by mid-2006—mostly biomass and biogas projects (average capacity about 20 MW) [2].

Existing biomass potential and installed biomass-fuelled power plant capacity recently are 7,000 and 560 MW, respectively [10]. A 53 MWe cogeneration system of bagasse-based power plant has been constructed in Suphanburi. Some others power plants can be found in Nakornrachasima using rice husk as a fuel and in Rayong by using biogas from MSW. In 2011, potential agriculture waste in Thailand is estimated as much as 2,075 MWe and biomass-based power generation is projected to reach up to 1,040 MW. Share of biomass in RE at that state is set up at 62% [11]. Since Thailand is the second top sugar producers in the world after Brazil, use of bagasse in Thailand is significant compare to other resources such as palm oil solid waste or rice husk [12].

India

Recognising the importance of RES as the best alternative to conventional fuels, the Government of India, as far back as in 1981, sets up a Commission for Additional Sources of Energy in the Department of Science and Technology. Later on this was followed by the setting up of a full fledged independent department, the Department of Non-conventional Energy Sources in 1982, converted into the Ministry of Non-conventional Energy Sources (MNES) in 1992. In line with the government policy the Prime Minister of India has announced on March 3, 2001, a goal of increasing the share of renewable to 10% of the additional planned capacity in the next 10 years that is 10 GW. Right now, existing capacity of renewable electric power in India has reached up to 10 GW (excluding large hydro). Share of primary energy from renewable at this point is 31%. To promote renewable power generation India announced a new national tariff policy in early 2006 that covers quotas, preferential tariffs, and guidelines for pricing “non-firm” power [2,13]. Financial assistance is available in various forms, such as direct installation subsidy, feed-in tariffs, tax rebates and low interest loans.

According to the 11th New and Renewable Energy five-year plan 2008-2012, about 15 GW of RE will be added to the present installed capacity. Henceforth, the strategic goals for Energy Independence by 2030 would thus call for a shift in the structure of energy sources. Firstly, fossil fuel imports need to be minimized and secure access to be ensured. Secondly, maximum hydro and nuclear power potential should be tapped. The Ministry of New and Renewable Energy has also provided funds for town and city level RE planning. RPS policies, also called renewable obligations or quota policies for RE promotion exist at provincial/state level in India, at least in six states. It should be noted that India is one of the largest country shares of renewables annual investment besides Germany, China, the United States, Spain, and Japan [2,13].

R&D is running fast in India and it seems that India is a largest contributor, after Japan, in RE R&D in Asian now. As the mentioned above countries, R&D is in general performed by universities/institutes and government research centers. Fortunately, India has a national public source of funds for RE development i.e. India's Renewable Energy Development Agency (IREDA) in addition to international agencies. IREDA has so far extended financial support for 35 projects with installed capacity of 461 MW for power generation out of which 369 MW are commissioned. Further, a 6.5 MW biomass-based (rice husk) power generation by M/s Indian Acrylics in the state of Punjab was financed by banks. CDM activities in India are significantly higher with the number of registered biomass projects is 25. Moreover, a study on CDM potential of bagasse cogeneration has also examined by Purohit and Miclaelowa in 2007 [6,14].

Small-scale thermal biomass gasification is a growing commercial technology in India. Total capacity of gasifiers was estimated at 35 MW. In India, projects adopting biomass gasification in silk and other textile production and processing have been demonstrated on a commercial basis, involving local entrepreneurs. The economic payback period is as short as one year. Applying to drying of rubber also offers payback times of less than one year. Gasifiers are also used to dry bricks before firing in a kiln. By 2006, India had achieved 70 MW of small-scale biomass gasification systems for rural (off-grid) power generation. An example of gasifier technology is RR Bio Projects 12.5 MW IGCC Plant of wood in Andhra Pradesh. Overall existing capacity of electric from biomass is 1,500 MW, while the potential is 24,700 MW including bagasse co-generation and waste-to-energy. The estimated total biomass energy potential in 2010 is 8.76 EJ and biomass energy is expected to add more than 500 MW of additional capacity by 2012. Of the current total installed RE-based, wind constitutes 69%, followed by small hydro (19%), biomass (co-generation, 11.5%), waste-to-energy (0.42%), and solar (0.03%) [2,13,15,16,17].

China

In February 2005, China passed a groundbreaking law to promote RE. Implementing of the law started January 1, 2006. The law provides a feed-in tariff for some technologies and establishes grid feed-in requirements and standard procedures. It establishes cost-sharing mechanisms so the incremental cost will be shared among utility consumers. It also creates new financing mechanisms and supports rural uses of RE. The law also provides for a long-term development plan, R&D, geographic resource surveys, technology standards, and building codes for integrating solar hot water into new construction. Therefore, China's government through National Development and Reform Commission (NDRC), Ministry of Construction and Ministry of Finance takes a responsibility in RE policies and regulations. Many regulations and policies in RE such as regulation and management measure of RE power, regulation on renewable power pricing and cost sharing, guided catalog of RE industry, standard for solar building, geothermal heat pump, fund earmarked for RE, RE surcharge, national middle and long-term plan for RE development, etc. have been issued in 2006.

China's RE target is 15% of primary energy by 2020 from the current status of 8%, and there are individual technology targets as well, including 300 GW of hydro, 30 GW of wind, 30 GW of biomass, and 1.8 GW of solar PV [2]. In addition, in late 2007 China announced RPS mandates that are part of its existing policy framework for supporting renewable. Especially, to support the development on biomass-based power, China adopts the subsidy price in the first 15 years and develops bi- and multi-fuel biomass power projects [18]. Government represented by NDRC and the Ministry of Science & Technology (MOST) offers the funds for R&D projects. MOST has supported the R&D through two national high-tech R&D programs during tenth five-year plan period: 863 programs supported the commercialisation of new technologies, and 973 programs supported the research of basic science. Additionally, there are some subsidies for demonstration projects and training courses from the

Ministry of Finance (MOF), and Ministry of Agriculture (MOA). About 11 biomass CDM projects have been registered in China now [6].

Similar to India, small-scale thermal biomass gasification is becoming a growing commercial technology in China recently. In a few provinces, biogas from thermal biomass gasification is also provided as cooking fuel through piped distribution networks. The main biomass resources in China are agricultural residues, animal manure, fuelwood and municipal solid waste (MSW). So far, China has one of the world's largest installed capacities of small-scale wind and biomass renewable applications. Existing capacity of biomass power plant is ± 3 GW and the sustainable biomass energy potential in China is estimated to be about 8.9 EJ by 2010 [19].

Japan

Japan initiated a *Sunshine Project* in 1973 after the first oil crisis as a project to develop and commercialize new energy technologies, including renewables. The New Energy and Industrial Technology Development Organization (NEDO) was established by the Japanese government in 1980, and the *Sunshine Project* was updated to the *New Sunshine Program* in 1993. The government's budget for RE development has been rising sharply. There is still no comparison to the government's overwhelming outlay for nuclear power, but Japan's RE budget is by no means insignificant at 100 billion yen (± 865 million US\$) annually. A significant budget is provided for photovoltaic systems and Japan is a global front runner in terms of their penetration, but the penetration of power generation from other RES such as wind and biomass energy pales in comparison.

Japan Renewable Energy Policy Platform (JREPP) was launched on July 1, 2008, taken the initiatives by eight groups involved in RE including the Institute for Sustainable Energy Policies (ISEP). The platform aims to study and suggest proposals for RE policies. Prior to the inception, the eight groups presented the Year 2050 RE Vision with an interim report on their policy proposals to implement the policies for the Vision. The report states that over 60% of domestic electricity demands in 2050 could be covered by making best use of the natural energy in Japan. It also estimates that more than 75% of carbon dioxide emissions arising from domestic energy use can be reduced. In the Vision, projection of the electricity substitution by renewable energy in 2050 would be 10% for wind power, 18% for solar energy, 14% for biomass, 10% for geothermal heat and 14% for hydraulic power. RPS exists at the national level. In 2007, Japan has revised its RPS policy on share of electricity from RES to 1.63% by 2014 (previously 1.35% by 2010), for an expected 16 terawatt-hours (TWh) by 2014 (initially 12.2 TWh by 2010) [2,20].

In order to fulfill the Vision, the JREPP thereafter suggested the following factors and policies would be necessary: national and local governments' initiatives in setting clear numerical targets for RE over the medium- and long-term, public understanding and agreement about the use of RE, appropriate strategies to lower barriers to entry and substantial expansion of RE markets. Japan allocated 15 billion yen (± 130 million US\$) in 2006 for R&D, pilot projects, and market support. The world's first commercial wood-to-ethanol plant began operation in Japan in 2007, with a capacity of 1.4 million liters/year. Japan is the only a developed country in Asia which provides the funds in carbon market. Japan's Green Power Certification system sold 58 GWh of certificates in 2006, primarily to corporate, non-profit, and municipal customers, with a small share to individual households.

In December 2002, the Japanese government decided upon "Biomass Nippon Strategy" at the cabinet meeting. The strategy sets three types of goals, i.e. technical, regional and national. The basic strategies include those for production, collection and transportation, conversion technologies, and stimulation of demand for energy use or material use. This is the first national project for Japan to utilize biomass as valuable resource. "Biomass Nippon Strategy" has started

with the reflection of the past unsuccessful experiences and the unique situation of biomass utilisation that the use of waste or by-products precedes energy crops. Total biomass resource available in Japan is 1.44 EJ per year or 7% of Japanese primary energy supply and existing biomass power generation is about 0.1 GW. The quantity of domestic biomass in Japan is not large, but for the purpose of 6% reduction of GHG by 2010 decided in the Kyoto Protocol, this could be a large contribution [2,21,22].

Turkey

There is a multi dimensional need for studying the energy situation in Turkey. First, Turkey is a candidate for becoming an EU member in the near future and preparation for membership can work as a stabilizer for the Turkish economy. Second, Turkey has a strategic position as a gas and oil transit country. Finally, the Turkish economy has had a boom-bust structure in the recent past and it is interesting to study their development performance. Regarding the RE, there exist various kinds of incentives in the Law on the Utilization of RES for the purpose of generating electricity. The Law mainly includes support mechanisms and further incentives to encourage investments, through feed-in tariff mechanism, investment allowances, and tax-free applications. Indirectly transfer of modern energy technologies is also being promoted. Free of charge delivery of land and investment allowance is supplied by Ministry of Finance as well. Cogeneration applications are attached high importance in line with the general strategy of increasing the resource utilization, while decreasing the system losses and environmental hazards. In 2010, renewables is projected to contribute 26% of electricity generation.

Efforts to promote increased research and development of various energy technologies on RE, energy efficiency, advanced energy technologies, etc are on going. Priority R&D areas are determined in a way to address the needs in the energy sector. The Scientific and Technical Research Council of Turkey-Marmara Research Center (TÜBITAK-MAM) coordinates the activities regarding energy technologies related R&D. One interesting work that has been done is the study on evaluation of biomass such as hardwoods, softwoods, grasses and wood bark as feedstock for the production of phenol-rich phenolic neutrals. The source of the feedstock does have some impact on the quality of the resins or plastics; softwoods and grasses appear to be attractive feedstocks [23].

The annual biomass potential of Turkey is approximately 32 million tonnes oil equivalents (MTOE) correspond to about 380.8 TWh. Biomass is the major source of energy in rural. Biomass is used to meet a variety of energy needs, including generating of electricity, heating of residences, fueling of vehicles and providing heat for industrial facilities. Biomass potential mainly consists of wheat straw, wood and woody materials, cocoon shell and hazelnut shell. Among the biomass energy sources, fuelwood seems to be the most interesting because its share of the total energy production of Turkey is high as 21%. Biomass production is projected as much as 7.32, 7.52, 7.81 and 8.205 MTOE for the period 2015, 2020, 2025 and 2030, respectively including classic and planned modern biomass [23,24].

Biomass power plants use the technology that is very similar to that used in coal-fired power plants. The average capacity is about 20 MW in size, with a few dedicated wood-fired plants in the 40–50 MW size range in 1983. A number of biomass-fuelled electricity generating technologies, such as modern wood-fired plant, whole tree energy system, biomass co-firing, biomass integrated gasification combined cycle (BIGCC) and stirling engine, etc., are currently available. Meanwhile, gasification technologies also applied to produce biogas from biomass. The biogas is then used to drive a high efficiency combined cycle gas turbine in combined heat and power technology (CHP). Turkey's first biomass power project is under development in Adana province, at an installed capacity of 45 MW. Two others, at each capacity of 30 MW are at the feasibility study stage in Mersin and Tarsus provinces. A US firm will establish a 10 MW capacity BOT power plant in Ankara-Mamak, which will use landfill gas generated by garbage.

The electricity production from usable biomass (about 17 MTOE/year) has a net impact of 4.4 billion US\$ in personal and corporate income and represents more than 160,000 jobs [23].

Brief Analysis

Traditionally biomass used as a domestic energy source for cooking and electricity generation in some plentiful resources countries such in sugar mills, palm oil mills, etc. through direct burning, a very inefficient process. Meanwhile, modern biomass energy plants using traditional materials are usually built in situ, provide extra revenues to local businesses, development of large-scale commercial biomass energy plants involves particular logistical issues such as the difficulty in amassing biomass from dispersed sources. For the short of biomass resources and developed country like Japan, the contribution on biomass utilisation should be provided by technology development.

Japan possesses experience in the successful development of compact cars with good mileage, low environmental impact, and low cost. These kinds of technologies should be able to be applied to biomass conversion technologies that allow higher efficiency and reduced impact on the environment even for small scale capacity of biomass feed found in Japan. This kind of small, but efficient plant is then called as "compact plant". By developing compact plants, Japan can contribute the world in terms of enabling the usage of biomass resource with smaller scale of production than today. By using smaller scale of production, total potential of available biomass increase, or "increase in biomass reserve" is enabled. And by supplying this kind of technology, carbon dioxide emission can also be reduced in the world, part of which may be credited to Japanese through the CDM. In comparison with oil exploration, this might be called "preservation of right of biomass mining" by supplying technology. In this chance we exactly agree with the Matsumura and Yokoyama's opinion [22]; for effective uses of biomass with small scale production, gasification and power generation is considered to be suitable. Once gasified, high-efficiency conversion technologies are available like gas engine, microgas turbine, and fuel cell.

For dry biomass conventional gasification technologies are available if efficient tar treatment is developed. For wet biomass, biomethanation is already commercialized, but treatment of fermentation sludge is problematic. We believe that a new technology like supercritical water gasification should be developed in the near future. Of course we do not deny the possibilities of technologies other than gasification to be used for the "compact plant", and agree that all efforts are to be made to commercialize this kind of plant using whatever technologies are available.

To support the biomass utilization, policies and regulations must be established and improved. In some target countries such Indonesia; lack of adequate, well-articulated and strongly implemented policy frameworks can be faced. Policies are half-hearted and inadequate in terms of encouraging investments. Market immaturity and relatively small scale of the local industry; economies of scale not reached, high startup costs and lack of know-how in the industry. There are many financial hurdles; lack of micro-financing options to rural households and project developers, local financial institutions lack knowledge about investments in RE projects, inadequate means to control debt and interest collection which increases the risk of financing. Moreover, high subsidies for oil in some counties reduce the competitiveness of renewable sources.

Inadequate development of local competence in R&D capabilities, operation and maintenance of RE systems can also be found. Small R&D capabilities coupled with an absence of international cooperation in technology transfer means that there is inadequate knowledge and technical know-how to improve on RE technologies in the country; insufficient education and training given to the local people makes the execution of such projects difficult due to a lack of manpower and quality assurance. Economic advantages of RE undermined; tariff settings not sufficiently advantageous to independent power producers, high budgets for grid extension

discourages off-grid systems, high subsidies for oil reduce the competitiveness of renewable sources, insufficient or non-existent tax-breaks and subsidies given to encourage project start-ups, and high import duties discourage import of equipment from overseas suppliers.

Recommendations

1. RE is the obvious solution to raise energy security especially in Southeast Asia. Indonesia, Malaysia and Thailand could in particular be a trendsetter for decentralize biomass use.
2. On Indonesian sides, access on energies for the communities should be widely opened, however the prices of energy should reach their economical values. Since the use of biomass as an energy source is very limit, then development on RE especially biomass should be intensively pushed by among others cutting the oil subsidies, supporting R&D and CDM activities, and establishing the more adequate RE promotion policies such as RPS, capital subsidies, grants or rebates, investment excise or other tax credits, sales tax, energy tax, tradable RE certificates, energy production payments, public investment, loans, public competitive bidding, etc.
3. Expected average annual Certified Emission Reductions (CERs) from registered CDM projects in Malaysia at 2012 is 1.13%, in which almost same to Indonesia about 1.16% [25], therefore Malaysia of course might support the activities on R&D and promotion policies as almost same as Indonesia.
4. Although use of biomass in Thailand seen little higher than Indonesia and Malaysia, and has issued some RE promotion policies such as feed-in tariff, capital subsidies, grants or rebates, net metering, public investment and loans, however the policies still weak to reach the country target of 62% for share of biomass in RE consumption in 2011. CDM efforts are evidently still low.
5. To strengthen biomass utilization in India and China, at least two more RE promotion policies, in addition to the established ones, should be lunched, i.e. tradable RE certificates and net metering policies.
6. Even though Japan is one of developed countries in Asia that engaged actively in promotion of RE, in fact Japan is still leak in policies particularly on sales and energy taxes, energy production payments and public competitive bidding.
7. Transfer and application of biomass technologies in Turkey is going quickly, but in opposite the RE promotion policies more weak than India and China. In addition to India and China, Turkey has to also establish RPS, investment excise or other tax credits, sales and energy taxes, public investment, loans, public competitive bidding, etc.

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