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Comparative Study of Polices and Related Best Practices in the Asia-Pacific Region for Promoting the Adoption and Utilization of Renewable Energy Technologies

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This report was prepared by Mr. Sridhar Samudrala, President & CEO, International Energy Consulting Co, USA under a consultancy assignment from the Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

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EXECUTIVE SUMMARY

The increased demand and surge in energy prices in the Asian energy markets has renewed the concerns of governments, businesses, and individuals regarding the rapidly depleting fossil fuel resources and expensive methods of generating electricity to meet the growing demand.

The world is changing and has to utilize its resources in a more efficient and environmentally friendly manner while providing its customers with affordable power. This transition towards a more efficient low-carbon economy may change both the way power is produced, transmitted, distributed and consumed. With the new policies already introduced in the United States and Europe to incorporate the abundant renewable resources, Asia may be keen to consider and tailor some of the successful methodologies.

Renewable energy sources have grown to supply approximately 17 % of global energy consumption in 2011. By 2011 total renewable power capacity worldwide was approximately 1400 GW an increase of 8 % over 2010. In 2013 and onward renewable energy is expected to grow strongly in the end use sectors: power, heating, cooling and transport.

The top seven countries China, United States, Germany, Spain, Italy, India and Japan accounted for 70 % of total capacity world wide. The top five countries for investment are China, United States, Germany, Italy and India. Of all these countries China is the fastest growing regarding renewable energy with the most growth in renewable capacity (282 GW). By region, the EU was home to nearly 44% of global non-hydro renewable capacity at the end of 2011, and the BRICS nations accounted for almost 26%; their share has been increasing in recent years, but virtually all of this capacity is in China, India, and Brazil.

Global new investment in renewables rose 17% to a record USD 257 billion in 2011. India displayed the fastest expansion in investment of any large renewables market in the world, with 62% growth. Developing countries had their share of total global investment decrease after several years of consistent increases; developing countries accounted for USD 89 billion of new investment in 2011, compared with USD 168 billion in developed countries.

Most of the world's electrical infrastructure was built when energy was relatively inexpensive. There have been many upgrades to meet the growing demand, however the Asian energy industry still operates like it did over a century ago (with coal being the major fuel) – energy is produced in large central power stations and flows over the inefficient grid to customers. The reliability is limited prompting businesses to generate their own electricity at a higher cost and passing it on to the customers. Additionally, there has been an increased demand resulting in an inefficient and environmentally wasteful system emitting environmental gasses, consuming large quantities of fossil fuels (diesel), and essentially not well suited to take advantage of the new distributed/renewable energy technologies developed.

Many Asian countries are still developing targets for renewable electrification that integrate into the grid. The use of new technologies in PV and wind is attracting new investment into the much needed sector. Renewable energy utilization is well poised to capture a fair share of the generation mix to meet this growing demand while adhering to the stringent regulatory mechanisms developed to utilize renewable energy technologies. Renewable energy may be an essential element to facilitate the transformation of the Asian electric industry in the near future.

The renewable generation policies remain the most common type of support (Feed in Tariffs, Renewable Portfolio Standards and Renewable Energy Technology) are the key drivers to accelerate the sector.

In 2013, the United Nations wanted to review the potential for renewable energy integration into the energy mix in Asia and Asia pacific countries. This document will

1. Review the policies and practices for enhancing affordability of sustainable energy options and sustainable building technology options thru promotion of local production (manufacturing) and provisioning (services thru South- South Cooperation) and renewable energy policies

2. Develop a draft Roadmap to enhance sustainable energy and sustainable building technologies and business environments for the following Countries:

   1 **Least Developed Countries**

Kingdom of Cambodia		Lao PDR

   2 **Developing Countries**

China	India	Malaysia
Pakistan	Philippines	Thailand
Vietnam		

   3 **Pacific Island Countries**

   Fiji Islands

   4 **Developed Countries**

Australia	South Korea

This document will discuss the total primary energy supply, renewable energy policies, stakeholders, scope for electricity, and develop a generic draft road map for accelerating and implementing renewable energy. This document may assist incapacity building and promotion of best practices in the area of renewable, energy, environment, and energy security. To this end, the Overall Objective of this document is:

1 Improve and promote the economic and social development through the efficient delivery of sustainable, economic and secure electricity using Renewable Energy;

2 Transform the energy generation from a fossil fuel based system to a more complete energy mix through the enhancement and capacity addition of renewable energy (solar, wind, biomass, biogas, etc…);

3 Increase the awareness of the private and public sector organizations in introducing and promoting renewable energy thereby contributing to the national development goals in the area of environment, climate change and energy security;

4 Increase the understanding of renewable energy integration into the existing electricity grid;

5 Support policies and regulatory frameworks for the adoption of Renewable Energy systems;

6 Develop the understanding of relevant government agencies on the application of renewable Energy Systems;

7 Support capacity building, knowledge management and institutional development for Renewable Energy Systems;

8 Discuss an appropriate Roadmap for the countries to follow in a systematic manner to promote and integrate renewables into the grid.

The success of the above will depend on the countries to implement a variety of policies which will encourage renewable energy generation and integration in the existing electricity grid. These assumptions are categorized below:

1. Recognition by the Asian government of the economic importance in approving and implementing renewable energy projects and allow them to export electricity into the existing grid for environmental sustainability and economic security;

2. New renewable energy technologies and equipment installed for generation and incorporation into the grids with some regulatory intervention;

3. The Governments and the relevant agencies are willing to review the existing renewable policies and grid procedures and compare them to the new process;

4. Government officials volunteer to partner with each other to enhance the electricity grid using best practices in other countries and avoid timely policy mistakes that waste money;

5. Key stakeholders from the government, corporate and private sector, and individuals and are interested to utilize the information and knowledge gathered. The stakeholders participate in the workshops and implement the processes to accommodate the renewable energy systems.

Summary

A well designed renewable energy policy may assist in reducing the greenhouse gas emissions while optimizing the use of existing infrastructure by controlling the power flows and meeting demand. The electricity grid if properly engineered, can also allow the injection of distributed/renewable energy into the grid at economical rates. This integration into the grid may improve efficiency of the electrical power system by managing the consumption patterns of new and existing users who are connected to the grid (note: renewable power can only be an economical option if new transmission and distribution resources are not required and the injection of renewable power will offset the distribution and transmission losses of existing fossil generation).

The major benefits include reduction of carbon emissions leading to environmental sustainability and lower tariffs/prices to the customers. By implementing renewable energy into the existing grid systems, the utilities and customers may be able to generate and distribute electricity at lower rates, which in turn could stimulate greater economic activities in communities and activities that may lead to more productivity of, and benefits to, women and children.

The renewable energy policies coupled with reduction of inefficient and costly fossil energy may result in decreased CO2 emissions of up to 12% (as done in the US). During 2007-12, in the US, substantial amounts of inefficient coal and petroleum generation were displaced by natural gas and renewables such as wind, solar and hydroelectric power. The U.S. (largest emitter of CO_2 until 2006 when China passed it) emissions from the consumption of fossil fuels peaked in 2007 and declined significantly over the past five years (12 %). Of total added renewables power increases, wind power clearly was the most significant and Solar PV grew by over 600% contribution towards total U.S. power generation.

The Asian energy sector may benefit in developing positive business cases with a precise indication of how investments are paid for, reflecting the benefits for the wide range of stakeholders including consumers, utilities, information technology (IT) providers, manufacturers and the environment. New innovative mechanisms to finance these investments are a necessity if renewable energy is to become a reality. This document validates the need for additional outreach, education and policy change at the provincial and national levels in the developing countries.

LEAST DEVELOPED COUNTRIES

A. Kingdom of Cambodia

Introduction

Cambodia is officially known as the Kingdom of Cambodia, a member of the Association of the Southeast Asian Nations (ASEAN) and Greater Mekong Sub region (GMS). Cambodia has a total population of about 15 million, of which approximately 80 % live in rural areas, with a total area of 181,035 Km$_2$.

Cambodia is one of the poorest countries in the SA region. Cambodia's electricity sector has developed in the past decade, however the development has not been at the same rate as the economic development and the electrification rate in remains low. The vast majority of the population is still not connected to grid and electricity cost remains high. Electric power is supplied throughout the country and sourced from three organizations;

1. State-owned Electricite du Cambodge (EDC)
2. Independent Power Producers (IPPs), and
3. Rural Electricity Enterprises (REEs) REEs.

Currently, Cambodia imports electricity from neighboring countries and recently this has increased. However electricity shortages are abundant and reliability is suffering. In 2010/11 electricity imports from Thailand and Vietnam made up over 42% of the country's total supply. Various sources also indicated the main source of power across the country are utilizing diesel which is imported from abroad making the electricity tariff very volatile. In 2010/11, diesel was estimated to account for almost 90% of the total power sources used to generate electricity.

It has been estimated that approximately only 22% of Cambodians have access to electricity. Also, Phnom Penh, which has 10 % of the population, uses more than 85% of total electricity.

The overall energy strategy in Cambodia covers four main categories: 1) Electricity, 2) Renewable energy, 3) Power and 4) Wood energy. In 2006, the government approved the Rural Electrification by Renewable Energy Policy. The main objective was to create a framework for renewable energy technologies to increase access to electricity in rural areas. The policy was linked to a master plan for the implementing projects.

Electricity Capacity

The Electricity Authority of Cambodia (*EAC)*reported total electricity consumption in 2008 as 1859 GWh. EAC also projected an annual growth of 12% per year until 2024. Additionally, EAC is projecting that by 2020 most of the electricity (65-70%) will be generated by Hydro, 15% by coal fired power plants and the rest (15%) by Alternative energy sources (hydropower, natural gas and solar, with renewable resources) in general considered to be relatively abundant.

According to the EAC, consumers' demand for electricity increases every year;
Hence, the demand for electricity-producing capacity installed must also be increased. In 2002, the number of consumers was only 182,930. Consumer numbers increased about 268% to reach 672,709 in 2010. In the meantime, installed capacity edged up around 310% from 614.03 million kilowatt-hour (kWh) in 2002 to 2,515.67million kWh in 2010. Within the next 15 years, the demand of power in the country is expected to increase by as much 500% reaching about 3,000 Megawatts (MW) in 2025(Phnom Penh Post (PPP), 2012).

Blackouts are a norm in Cambodia, especially in Phnom Penh municipality as the supply capacity reaching peak level, particularly in the dry season. Phnom Penh currently requires up to 400 MW per day, and current supply is only 290 MW (1/2 imported from Vietnam (PPP, 2012)).

Projected Electricity Capacity Additions in Cambodia

Hydropower	8,000 to 10,000 MW
Biomass	1,500 MW
Solar	49,023 units
Bio Gas Digesters	15,000 units (Feb. 12, 23,000 units by 2016).

An Asian Development Bank (ADB) study indicated, the number of households supplied with electricity from the main electricity grid was 633,123 in 2008 and expected to increase to 1,131,190 by 2013(ADB, 2011). Cambodia is on track to achieve a target of increasing the length of high-voltage transmission network by 100 Km from 2005 to 2010 and increasing per capita use of electricity from 54 kWh in 2005 to 89 kWh in 2010 in terms of improving access to a reliable and affordable power supply.

The Tariff is high in Cambodia since it is based on the full-cost recovery principle. The tariff levels vary from area to area and, there is a huge discrepancy between urban and rural customers. Rural customers generally pay higher tariffs than their urban counterparts. The electricity tariff rates range from US¢9-25 per kWh for EDC grid and US¢40-80/kWh for rural areas. The average electricity prices for industrial consumers ranges from US¢11.71 to US¢14.63 which is the highest among the ASEAN economies. This large gap is due to various factors such as differences in supply capacity, economy of scale, load factor, fuel transportation cost, cost of capital and financing, power supply losses, and risk premium for rural customer's low capacity to pay the bill.

Key Stakeholders

Electric power is supplied throughout the country is sourced from three organizations;

1. Ministry of Industry, Mines and Energy
2. State-ownedElectricite du Cambodge (EDC)
3. Electricity Authority of Cambodia (EAC)

Ministry of Industry, Mines and Energy

As set out in the Law on Electricity, the MIME has the following roles:

1. Responsible for setting and administrating the government policies, strategies and planning in the energy sector;

2. Providing the EAC information on policies, strategies, planning of energy sector and its decision on;

3. Planning and agreements on the export and import of electricity;

4. Investments in the rehabilitation and development of the energy sector in the short, medium and long term;

5. Promotion of the use of indigenous energy resources in the generation of electricity;

6. Restructuring, private sector participation and privatization of public utilities;

7. Promotion of efficiency in generation, transmission, distribution and consumption of electricity and action taken to create a comprehensive electricity conservation program for Cambodia; and

8. Electricity sector emergency and energy security strategies.

Electricite Du Cambodge

According to the EDC Annual Report 2007, the EDC, the state-owned public utilities entity, has the following functions and responsibilities:

1. Develop, generate, transmit and distribute electric power;

2. Build, own, finance, lease and operate power generation substations, transmission lines, distribution networks;

3. Maximize the output and reliability of the assets, customer satisfaction with higher quality and better services.

Electricity Authority of Cambodia

The EAC is a legal public entity, being granted the right from the RGC to be an autonomous agency to regulate electricity services and to govern the relation between the delivery, receiving and use of electricity. The Law on Electricity regulates the roles of the EAC as follows:

1. Issue and monitor licenses for the supply of electricity services;

2. Approve tariff rates and terms and conditions of electric power services of licensees, except where the authority (EAC) consider those rates or charges and terms and conditions are established pursuant to a competitive, market-based process;

3. Implement guidance procedures and standards for investment programs by licensees;

4. Enforce the performance standards for licensees;

5. Evaluate and resolve consumer complaints and contract disputes involving licensees, to the extent that the complaints and disputes relate to the violation of the condition of licenses;

6. Require the electric power services and the customers to obey the rules relating to the national energy security, economic, environment and other government policies.

Conclusion

Cambodia is rich in energy sources and can maximize its potential if proper energy policies and investment signals are constructively created. The main source of fuel for power generation is diesel and HFO. The electricity sector requires extensive redesign. There is a capacity to introduce greater renewable energy into the mix. Currently there is seems to be no positive renewable energy policy for Cambodia that may attract investors to develop the electric sector.

Demand for electricity may keep increasing as the economy develops and more pressure will be put on the people and government to obtain electricity. The government seems to prefer large projects in the energy sector and may want to consider the small scale renewable energy projects for the energy mix. Cambodia is embarking on an improved investment environment for energy and renewable energy may be a key sector for investment.

B. Lao People's Democratic Republic

Officially known as the Lao People's Democratic Republic (Lao PDR), is a landlocked country in Southeast Asia, bordered by Burma and China to the northwest, Vietnam to the east, Cambodia to the south, and Thailand to the west. Its population was estimated to be around 6.5 million in 2012. Laos' "strategy for electricity development is based on generating electricity from its rivers and selling the power to Thailand, China, and Vietnam.

The economy depends heavily on investment and trade with Thailand, Vietnam, and China. The Asian Development Bank (ADB) and other multinational banks have made substantial contributions towards creating energy infrastructure in the Lao People's Democratic Republic (Lao PDR). Total ADB energy sector assistance from 1988 to 2009 has been over $300 million for projects and $20 million for technical assistance. Energy sector assistance since the late-1980s has focused on hydropower projects, high-voltage grid extension, rural electrification, and capacity building to manage power sector infrastructure and utility operations.

During the sector assistance program evaluation (SAPE) period (2000–2009), ADB approved support for two energy sector projects: the Nam Theun 2 Hydropower Project and the Northern Area Rural Power Distribution Project (NARPDP). ADB's total energy sector assistance approvals during the SAPE period comprised $100.0 million in loans and $5.6 million in TA support. Seventy percent of loans and more than 50% of TA approvals were linked directly to the Nam Theun 2 project.

The government's energy objectives have been consistent since the 1990s and through the SAPE period. The key objectives are to:

1. Bring electricity to 90 % by 2020;
2. Improving the main grid;
3. Off-grid electrification; and

4. Developing projects (i.e. earning foreign exchange by setting up export-oriented hydropower projects) and exporting electricity.

The government has learned of taking the necessary precautions and steps up front to manage environmental and social impacts and preempt serious erosion of financial gains from all large hydropower projects (upwards of 50 MW).

The interest from international developers and investors over the past few years to sign memoranda of understanding for developing large hydropower projects has reinforced the government's convictions on the importance of mitigating environmental and social impacts.

The ADB along with other donors has contributed to building capacity to manage the environmental and social impacts of large hydro power projects. The Nam Theun 2 project is one of the best examples for Lao PDR and has peaked interest from the investor community to acquire and institute a wide array of expertise in environmental and social disciplines.

Renewable Energy Stakeholders

At present, there is no comprehensive renewable energy policy and strategy in Lao PDR. Projects implementations were carried out by various sectors which lead to gaps in the management and promotion of the development of renewable energies. Although there are some Private sector investments in fuel crops plantation, but facing significant obstacles due to lacking appropriate management mechanism

In recent years, several public organizations and stakeholders have been involved in the development of renewable energy:

1. Ministry of Energy and Mines has been actively involved in various renewable energy activities, particularly in the development of solar energy, micro hydropower, bio-energy, and bio-fuel

2. Ministry of Agriculture and Forestry has been piloting project with small family seized biogas digester and carried study on the plantation of fuel crops (Jatropha, and other);

3. Ministry of Science and Technology has carried out research projects on renewable energy utilization in Lao PDR.

Other organizations and institutions, such Organic Production Promotion Association, Agricultural and Handicraft Promotion Association, Plantation Promotion Association, Lao State Fuel Company, Kolao company, Sunlabob Renewable Energy Co., Ltd, Luangprabang Teak Tree Import-Export Co, Ltd (Kao Oil Tree Protection Promotion Plant and Development Project) and Bio-diesel Company are also involved in the energy sector.

Renewable Energy Development Status in Lao PDR

Lao PDR has setup a policy to promote renewable energy:

1. Promote biofuels production and use, particularly from Jatropha and other appropriate energy (Biodiesel development from Jatropha, Vernicia Montana, Animal Fat, used tires and City wastes have been piloted by private sector. Fuel crops plantation for biofuels production has also progressed, especially Jatropha, Vernicia Montana, Palm, Sugarcane, Cassava plantation);

2. Install small solar home systems (20,000 households electrified);

3. Larger PV systems installed (capacity up to 40-100 kWp) have also been piloted within cooperation project between MEM and NEDO (Japan), as a component of a hybrid power system;

4. Develop micro hydropower to supply electric power to households in off-grid remote rural areas (Upto now, installed capacity of small scale hydropower projects (capacity less than 15 MW) have reached 23 MW).

The total domestic energy demand is anticipated to increase by 3.6 percent per annum, increasing from 1.8 million TOE in 2005 to 3.9 million TOE in 2025. Despite the fact that the overall demand of energy in various economic sectors will remain high until 2025, the share of household sector declines from 77.8 percent in 2005 to 48.5 percent in 2025. Energy demand in the industrial sector is increasing at around 8 percent per year or from 6.1 percent share to 16.9 percent during the period 2005 to 2025, while the transportation sector grows at 6.8 percent per annum during that period.

Electricity generation is predicted to increase at 11 percent annually for the period 2005 to 2025. Most of produced electricity are for export to neighboring countries and only 10 percent is used domestically. The domestic demand for electricity will increase from 425 megawatts in 2006 to 2,863 megawatts in 2025. This increase will be covered mainly by development of hydropower and coal-fired power plants.

The demand for transportation fuel is predicted to increase by 5 percent per year. By 2025, the total demand for refined petroleum products will reach 1,174 million liters, of which 45 percent is for gasoline (528 million liters) and 55 percent is for diesel (645 million liters).

Policy

The promotion and development of renewable energies has increased in priority and is one of the most important policies of the Government to stabilize energy supply and assist in the social and economic improvement of the country. The Government supports domestic and foreign entrepreneurs and investors to invest in energy projects at the village level.

Policies on the promotion and development of renewable energies in Lao PDR focus on small power development for self sufficiency and grid connection, biofuels production and marketing, and development of other clean energies in the country.

The government defines priorities for development as follows:

1. Provide financial incentives to investors who aim to produce clean energies to meet domestic demand and, who take socially and environmental corporate responsibility in order to increase investments in renewable energy projects;

2. Prioritization of policies which facilitate private sector investments in rural electrification such as provision of incentives and financing;

3. Development of small power systems, biofuels, solar and biomass energy at the village level to provide electricity and energy to rural and remote communities;

4. Generation of electricity for productive uses at the village level using waste materials from agriculture, biogas, hydropower or other local resources. People in rural areas will be encouraged to use renewable energy to enhance self-sufficiency and the GoL will seek cooperation with private sector, NGO and development partners to encourage investment support for processing equipment and necessary machinery adjustments.

Financial Incentives

Investments in renewable energy projects in Lao PDR, whether on biofuels production, grid connected or isolated systems, off-grid projects, and individual systems, are entitled to investment incentives under the Investment Law of Lao PDR, update in 2009. The financial incentives include the following:

1. Import duty free on production machinery, equipment and raw materials;

2. Import duty free on chemical materials necessary for biofuels production within 7 years;

3. Profit tax is divided in to 3 categories: 20%, 15% and 10%. Profit tax exemption is possible for a certain period depending on activities, investment areas and size investment;

4. Subsidies on unit product price depending on energy type and times period. Additionally, the investors can obtain also non-fiscal incentives, such as:

5. Up to 75 years leasing term (for enterprise construction land);

6. Permission to expatriate earnings to home or third countries;

7. Right to employ foreign workforce (not more that 10% of the enterprise's total labors).

The Government will also provide support by seeking assistance from international organizations, commercial banks and low interest loans sources for funding renewable energy projects; to encourage private commercial banks in understanding and interests to investment into renewable energy projects. The Government will establish a one-stop service center for disseminating information and facilitate investments on renewable energies.

The Government will establish a Renewable Energy (REN) Fund as sub-account to the existing Rural Electrification (RE) Fund. The Fund will be used for the following:

1. Financial assistance for the development of renewable energy and biofuel industry and market in Lao PDR;

2. Finance barrier removal activities such as resource assessment; research, development, and demonstration activities; project preparatory studies, etc;

3. Fund capacity building activities, promotional activities, dissemination of knowledge on effective renewable energy use, etc.

The Fund will be sourced from the following:

1. Government budget;

2. International organizations and donor countries, international financial organizations and NGOs;

3. Financial contribution or investment from social organizations and from domestic and foreign investors.

Renewable Energy Potential

Lao PDR lacks conventional energy resources (e.g., Oil or Natural Gas) and has limited coal. It does have vast renewable energy resources, such as Biomass, hydropower, solar and limited wind. Hydropower is the most important energy resources in Lao PDR, and estimated around 26,000 MW. There is an estimated 2,000 MW of small scale (below 15 MW) potential.

Solar has a large potential if harvested properly. It is estimated that Lao PDR has sunshine 1800-2000 hrs/year. With such potential, if photovoltaic technology was used (overall efficiency of 12-15%), it would generate 146 kWh/m2/year, or 1.5x108 kWh/km2/year (13 MTOE/km2/year).

Biomass - includes energy crops and organic wastes. Energy crops comprise Oily crop (Palm, Jatropha, Vernicia Montana, Sun flower, Beans, coconut, etc), sugar and starch (sugarcane, Cassava, corn) and quick growing trees and aquatic cultures. Organic wastes include residues of agriculture-Forestry production, By-products of agro-forestry industry(sawdust, wood chips, rice husk, corn cobs, livestock manures...) and municipal wastes (Households' wastes, communal wastes, food processing wastes...). It was estimated that utilizing of livestock wastes for biogas production could generate around 2.8x108 m3 of biogas per year, or equivalent to 5x108 kWh electricity(about 216 MTOE).

Wind - There is limited data on wind energy potential. According to international data sources, potential exists in central provinces of Lao PDR, especially up of high mountains along Lao-Vietnam border (Savannakhet and Khammouane provinces) where at a height 50 m and above, wind speeds reach 5.8 m/s 4. At the present Ministry of Energy and Mines is ongoing installation wind data logger in four sites in these province and plan to install in other provinces. The potential for wind energy in Lao PDR is estimated to be more than 2,800 MW.

Challenges

Electricité du Laos (EdL) is today facing a challenge of meeting the government’s 90% electricity access target by 2020. In order to meet this 90 % by 2020 there are many changes required.

Currently, exports remain confined to dedicated high-voltage transmission lines that enable power interchange between, e.g., the Lao PDR and Thailand. In order to increase the exports of the vast potential, the connecting grids from Lao PDR must be stabilized and meet the international grid codes and metering arrangements.

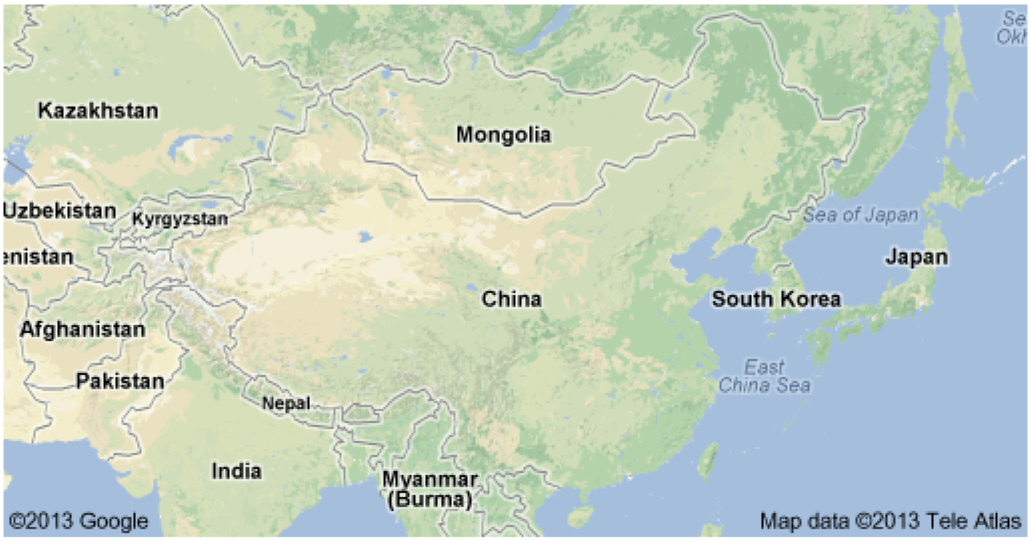
The government has formulated a hydropower policy that calls for sustainable hydropower development. A renewable energy law is under preparation. However, there is no integrated energy policy.

Conclusion

Lao PDR has vast potential in the renewable energy sector. With the government promoting renewable energy, energy efficiency and energy conservation policies private sector participation is bound to increase. The Lao PDR aims to increase the share of renewable energies to 30% of the total energy consumption by 2025. To reduce the importation of fossil fuels, the Lao PDR already outlined a vision to reach 10% of the total transport energy consumption from biofuels. The government is also facilitating appropriate incentives and risk guarantee for investments in the renewable energy sector. Investments in 2025 is projected to reach around USD 1,799 million , of which USD 17 million is from the public sector, USD 36 million from domestic investors and USD 1746 million from foreign investors. With these incentives the renewable energy sector is set to increase in Lao PDR.

Developing Countries

C. CHINA



China is the world's most populous country and largest energy consumer in the world. This has made them extremely influential in the world energy markets. China's rapidly growing economy has driven the country's overall energy demand and the quest for securing new energy resources.

The top seven countries for non-hydro renewable electric capacity are China, United States, Germany, Spain, Italy, India, and Japan and they have accounted for about 70% of total capacity worldwide. By region, the EU was home to nearly 44% of global non-hydro renewable capacity at the end of 2011, and the BRICS nations accounted for almost 26%; their share has been increasing in recent years, but virtually all of this capacity is in China, India, and Brazil. Global new investment in renewables rose 17% to a record USD 257 billion in 2011.

The top five countries for total investment were China, which led the world for the third year running, followed closely by the United States, and by Germany, Italy, and India. India displayed the fastest expansion in investment of any large renewables market in the world, with 62% growth. Developing countries had their share of total global investment decrease after several years of consistent increases; developing countries accounted for USD 89 billion of new investment in 2011, compared with USD 168 billion in developed countries.

Coal still supplies the majority (70 percent) of China's total energy. Oil is the second-largest source, accounting for 19 percent of the country's total energy consumption. China has made an effort to diversify its energy supplies, however hydroelectric sources (6 percent), natural gas (4 percent), nuclear power (2 percent), and other renewables (0.3 percent) account for relatively small shares of China's energy consumption mix.

The Chinese government set a target to raise non-fossil fuel energy consumption to 11.4 percent of the energy mix by 2015 as part of its new 12th Five Year Plan. EIA projects coal's share of the total energy mix to fall to 59 percent by 2035 due to anticipated higher energy efficiencies and China's goal to reduce its carbon intensity (carbon emissions per unit of GDP). However, absolute coal consumption is expected to double over this period, reflecting the large growth in total energy consumption.

China Energy and Renewable Energy Policy

The National Development and Reform Commission (NDRC) is the primary policymaking and regulatory authority in the energy sector, while four other ministries oversee various components of the country's oil policy. The government launched the National Energy Administration (NEA) in July 2008 to act as the key energy regulator. The NEA, linked with the NDRC, is charged with approving new energy projects in China, setting domestic wholesale energy prices, and implementing the central government's energy policies, among other duties. The NDRC is a department of China's State Council, the highest organ of executive power in the country.

China is now second only to the United States in total wind capacity. China’s wind turbine manufacturing industry became the largest in the world in just four short years, with three Chinese producers now in the top 10 globally, according to the latest BTM report: Sinovel, Goldwind. More than 80 domestic manufacturing firms now exist and most Chinese turbines are now in the 1.5–2 MW class, in comparison with earlier years when sub-1 MW models still accounted for a large proportion of turbine production.

China is now also the largest manufacturer of solar PV, supplying almost 40% of all solar PV worldwide in 2009. About 4 GW/year of manufacturing capacity existed by the end of 2009 and more than 500 solar PV firms were established. The top-three Chinese producers were Suntech (704 MW in 2009), Baoding Yingli (525 MW), and Jingao (JA) Solar (524 MW). Installations of grid-connected solar PV also accelerated from 2009to ‘12 as the first beginnings of a true domestic market emerged. In addition, there were small capacity amounts existing for both geothermal, at 34 MW, and marine energy with some 4 MW. Also added in 2009 were 22 GW of new hydro, 0.4 GW of new biomass power, and 160 MW of additional grid-connected solar PV.

The solar hot water market has increased from 31 million m^2 (22 GWth) added in 2008 to 42 million m^2 (29 GWth) added in 2010, partly as a result of a new rural energy subsidy programme for home appliances, for which solar hot water qualifies. The total existing solar hot water capacity increased to 145 million m^2, or enough for 60 million households (assuming 2.5 m^2 of absorber each). The period 2008–2009 also saw the beginning of offshore wind power development, with bidding underway for at least one 70 MW project and several hundred megawatts planned across a number of other projects.

Looking to the future, the government's current draft plan calls for 300 GW of hydropower, 150 GW of wind power, 30 GW of biomass power, and 20 GW of solar PV, for a total of 500 GW of renewable power capacity by 2020. This would be almost one-third of China's expected total power capacity of 1600 GW by 2020.

500 GW of renewable power capacity by 2020 is implied by existing renewable energy portfolio standards for major utilities, based on calculations by the China Renewable Energy Industries Association. Those portfolio standards require utilities to achieve 8% of capacity and 3% of power generation from non-hydro renewables by 2020.

Many of these market developments can be traced back to the enactment of the landmark 2005 Renewable Energy Law, which took effect in 2006 with the passage of detailed implementing regulations. A provision for renewable portfolio standards (also called 'mandated market share') was a key element of that law, along with feed-in tariffs for biomass, 'government-guided' prices for wind power, an obligation for utilities to purchase all renewable power generated, new financing mechanisms and guarantees, and other market-enhancing provisions. Complementing the law was a wind-power 'concession' programme which was in place during 2003–2007 and which added 3.4 GW through annual competitive project bidding. And other R&D policies have been ongoing.

Recent changes to renewables policy in China, including 2009 amendments to the 2005 Renewable Energy Law and a number of other new policies enacted during 2008–2009, are outlined below.

An update to the original 2005 renewable energy law was adopted by the National People's Congress in December 2009 and took effect 1 April, 2010. This update contained three main provisions:

1. More detailed planning and co-ordination is to be required, including co-ordination of renewables with overall electric power sector development and transmission planning, and co-ordination of local- (provincial-) level development with national development plans. In addition, the roles and responsibilities of electric power companies are to be further elaborated in relation to grid-interconnection of renewable energy generators and definition of different classes of renewable generators (including small-scale generators with positive net power production). The law revisions also address areas such as energy storage and smart grids.

   One reason for these grid-related provisions was that the renewables sector has been growing so fast, especially wind power that the process of transmission planning and interconnection was falling behind wind turbine installations. Although not widespread, some completed wind capacity lacked transmission access, mostly in the cases of 'rogue' or unapproved projects not coordinated with national planning.

Transmission bottlenecks to seven designated geographic 'bases' for wind power may become a significant issue in the future. The bases are Gansu/Yumen, East Inner-Mongolia, West Inner-Mongolia, Xinjiang/Hami, North Hebei, West Jilin, and Jiangsu Coastline. In addition, many sources are now reporting time lags in the operational status of completed turbines due to the time required for interconnection, testing, certification, and final approvals. These time lags are mostly related to personnel and administration bottlenecks rather than infrastructure issues, and do not appear to be serious obstacles.

2. Provisions were strengthened to guarantee that electric utilities purchase all renewable power generated. Previously, utilities were only obligated if there was sufficient power demand on the grid. Now, utilities must buy the power in all circumstances, but can then transfer the power to the national grid company for use elsewhere. The revisions to the law also add deadlines and economic penalties for utilities failing to comply with this guaranteed-purchase requirement.

3. A renewable energy fund under the Ministry of Finance as part of the 2005 law was strengthened and consolidated. Previously, the fund was collecting a 0.4 fen/kWh (0.06 US cents/kWh) surcharge on electric power sales nation-wide (with some customer classes exempt). The Ministry applies those funds to the costs of government-supported renewable energy projects and the costs of feed-in tariffs.

Many other policy changes have occurred recently. Among them, the target for the share of renewable energy was changed. In 2006, China adopted a target for 15% share of primary energy to come from renewables by 2020, up from 8% in 2006. This target has now been revised in two respects. Firstly, the new target is for a 15% share of final energy consumption. This change puts China's target on the same accounting footing as the European Union, which adopted a target in 2008 for a 20% share of final energy by 2020. In general, a 15% final energy target implies a larger quantity of renewables than a 15% primary energy target. However, the second revision to the China target changed the scope from 'renewables' to 'non-fossil-fuel sources', which includes nuclear. Nuclear power currently provides less than a 0.3% share of final energy in China, but will increase by 2020, so the net impact on total renewables by 2020 of the target change is complicated to assess.

Meanwhile, there was also a new carbon intensity target. China announced in December 2009 that it would reduce the carbon intensity of GDP by 40%–45% by 2020, relative to 2005 intensity levels. China historically has targeted energy-intensity in many sectors individually as part of its energy-efficiency improvement plans, and the carbon-intensity target can generally be viewed as a variation and aggregation of these existing energy-intensity targets.

Additionally, the country's Eleventh Five Year Plan for 2006–2010 aimed to increase energy efficiency by 20% over the five years, including increases in efficiency of pumps, fans, and boilers, and lower energy intensities for materials like steel and cement.

The government also changed wind power feed-in tariffs. The 2005 Renewable Energy Law authorized feed-in tariffs for wind power based on 'government guided' prices, which evolved year-by-year as competitive bidding for wind power capacity resulted in standardized or 'approved' prices, generally on a province-by-province basis. In August 2009, a new feed-in tariff regime was established for wind power. Four specific tariffs were established nationwide, to be applied on a regional basis based on geographic wind resources.

The lowest tariff is RMB0.51/kWh (7.5 US cents/kWh), for the best resource regions of Inner Mongolia and parts of Xinjiang. The second and third levels are RMB0.54/kWh (7.9 US cents/kWh), and RMB0.58/kWh (8.5 US cents/kWh) for more average regions throughout large sections of the country such as parts of western, central and north-eastern China.

Finally, the fourth level is RMB0.61/kWh (9.0 US cents/kWh) for the least-favourable resource regions. The tariffs were established to be consistent with prices from previously approved projects in these provinces/regions over the past three years. However, the tariffs apply to onshore wind projects only as the tariffs for offshore wind projects have not yet been established.

The biomass feed-in tariff has also been amended. The previous feed-in tariff for biomass, established under the 2005 law, was a RMB0.25/kWh (3.7 US cents/kWh) premium added to a province-specific coal power generation price. The new premium was increased to RMB0.35/kWh (5.2 US cents/kWh).

Another significant change has been the elimination of the wind turbine domestic content requirement. China previously required wind turbines installed in China to have at least 70% 'domestic content' in terms of the value of incorporated materials and components. This requirement was dropped in 2010 as no longer necessary, as virtually all turbine installations were Chinese-produced products.

Another recent change exempts renewable energy projects from local (provincial) income taxation. However, this may have the effect, perhaps unintended, of reducing the incentives for provincial governments to support renewable energy projects, unless local manufacturing enterprises also benefit.

The so-called ‘Golden Sun’ programme was initiated in 2009, providing capital subsidies for solar PV installations through 2011 on a project-by-project basis. Off-grid (stand-alone) installations receive 70% capital subsidies while grid-connected installations receive 50% subsidies. Qualifying grid-connected installations must have a peak capacity of 300 kW or larger. There are also programme caps, which limit the overall quantity of systems installed – under the terms of the programme installations in any given province are limited to 20 MW total.

Almost 300 projects have been proposed under the Golden Sun programmetotalling 640 MW and entailing about RMB20 billion ($2.9 billion) of investment. As a separate part of the programme, the Ministries of Finance and Construction are providing subsidies of RMB15/watt ($2.20/watt) for grid-connected solar PV and RMB20/watt ($2.90/watt) for building-integrated PV. Eligible installations must be 50 kW or larger, and must utilize solar PV modules of minimum efficiency levels (16% for mono-crystalline, 14% for poly-crystalline, and 6% for amorphous). In 2010, the subsidy levels were reduced to RMB13/watt ($1.90/watt) for grid-connected and RMB17/watt ($2.50/watt) for building-integrated.

There is also a new solar PV bidding programme. Similar to the early development of the wind power industry, the government initiated a competitive bidding programme for solar PV projects. This programme is creating new benchmark tariffs for solar PV (so-called ‘approved price levels’) on the basis of competitive bidding. One example was a bidding process in Dunhuang, in Gansu Province in 2009 for two 10 MW projects. Bid prices ranged as low as RMB0.69/kWh (10.1 US cents/kWh), and resulted in an approved price of RMB1.09/kWh. Another approved price was RMB1.15/kWh (16.9 US cents/kWh) in April 2010 for four projects in Ningxia totalling 40 MW.

Finally, there are new provincial-level solar PV preferential tariffs. The provinces of Zhejiang and Jiangsu have established province-wide preferential tariffs for solar PV. In Zhejiang, the tariff was set as a premium of RMB0.70/kWh (10.3 US cents/kWh) added to the province-average coal power generation price which was RMB0.46/kWh in 2009 (6.8 US cents/kWh), thus producing a total tariff of RMB1.16/kWh (17 US cents/kWh). Jiangsu set preferential tariffs significantly higher than Zhejiang, and also established a range of tariffs depending on technology type: RMB2.1/kWh (31 US cents/kWh) for ground-based systems, RMB3.7/kWh (54 US cents/kWh) for roof-top, and RMB4.3/kWh (63 US cents/kWh) for building-integrated (all 2009 levels). Jiangsu also slated tariffs to decrease progressively, to 1.7/3.0/3.5 in 2010 and to 1.4/2.4/2.9 in 2011, respectively. However, the Zhejiang and Jiangsu preferential tariffs were not considered ‘approved’ prices at the national level in principle, which means the money to cover the tariffs comes from provincial budgets rather than national funds.

Energy Demand

China's energy consumption will continue to grow steadily for a long time. China's economy will grow more modestly from 2030 to 2050 than it did in the past decade. Given the industrial structure and energy demand during the equivalent development phase in developed countries; current and future energy needs; and international pressure on climate change, social sustainable development and energy conservation, China's final energy consumption is more likely to reach 4.5 to 5.0 btce (3.15 to 3.50 btoe) by 2020, 5.5 to 6.0 btce (3.85 to 4.20 btoe) by 2030, and about 6.5 btce (4.55 btoe) by 2050. With significant energy conservation efforts, energy demand could be further reduced. With respect to electricity demand, economic and social development will continue to increase electrification of communities.

The electric power demand growth rate will be higher than the growth rate of overall energy demand. China's final power consumption is likely to reach 8 000 TWh by 2020, 10 000 TWh by 2030 and 13 000 TWh by 2050. While electric power demand is increasing in middle and western areas, demand in eastern areas is increasing even more rapidly, so electricity transmission from north to south and from west to east will remain significant in the coming 40 years.

China's Low-Carbon Energy Strategy

The government has stated that China's future energy strategy will no longer be based on coal but on "domestic sources, with diversified development and with a focus on environmental protection" – a more sustainable energy supply strategy. The 12th Five-Year Plan for Economic and Social Development (2011-15), published in March 2011, proposed that "a modern energy industry in China will be based on:

1. Energy conservation;
2. Domestic development; and
3. Diversity and environment protection

To promote these changes, the Chinese government is vigorously encouraging renewable energy (solar, bio gas, wind, mini hydro, etc), hydropower, nuclear power and other non-fossil energy development, and has recently introduced official mid-term development goals.

In September 2009, the Chinese government proposed that by 2020 non-fossil energy sources contribute 15% in total primary energy consumption. The 12th Five-Year Plan proposed three binding targets for 2015: that non-fossil fuels in primary energy consumption increase to 11.4% in 2015 (from 8.3% in 2010); and that energy consumption and CO2 emissions per unit of GDP be reduced by 16% and 17% respectively. Although a longer-term target has not been announced, China is vigorously promoting its low-carbon energy strategy, and wind power will continue to be one of the main technologies to achieve the low-carbon strategy.

The NEA said the overall goal is for total renewable energy consumption to reach 478 million mt of coal equivalent, representing 9.5% or more of the overall energy consumption mix by end 2015.

Total installed hydropower generation capacity is targeted to reach 290 million kilowatts, while wind power will total 100 million kW. Solar power capacity will total 21 million kW. Total biomass energy consumption will be 50 million mt of coal equivalent. China will establish:

1. 100 new energy model cities
2. 200 green counties and
3. 30 new energy demonstration projects.

China has pledged to increase its non-fossil fuel energy consumption to 11.4% of the energy mix during the 12th five-year plan, compared with 9.6% during the 11th five-year plan. It also aims to reduce its energy consumption per unit of GDP by 16% and achieve a 17% cut in its carbon emissions by 2015 from 2010 levels.

In order to meet these targets, China plans to fund/spend 2.37 trillion yuan (US $380 billion) from 2010-2015 on such measures, and the nation plans to reduce energy consumption per unit of GDP by 16 percent and carbon intensity by 17 percent over that period.

China ended 2011 with more renewable power capacity than any other nation, with an estimated 282 GW; one-quarter of this total (70 GW) was non-hydro. Of the 90 GW of electric capacity newly installed during the year, renewables accounted for more than one-third, and non-hydro renewables were more than one-fifth.

Wind

Wind power capacity increased by 20% in 2011 to approximately 238 GW by year-end, seeing the greatest capacity additions of any renewable technology. China accounted for almost 44% of the global market (adding slightly less capacity than it did in 2010), followed by the United States and India; Germany remained the largest market in Europe.

China's economic development will still be an important strategic task over the next 20 or 30 years. Wind energy is one of the renewable energy sources most likely to be developed commercially on a large scale – and hence support China's economic development – because of its cost effectiveness and low environmental impact. Between 2006 and 2009, China's wind power growth rates were more than 100% on average. At the end of 2010, installed wind power capacity in China was more than 40 GW and the grid connected operation capacity was more than 30 GW. Wind power can and should play a much greater part in China's sustainable energy and electricity supply in the future.

2012 was the country's first ever decline in new installations. The NEA issued around 29GW of wind farm permits last year, up 8% on 2011, which saw a tightening of wind farm approvals. The country is also planning the wind energy counterpart of its massive Three Gorges dam after the Government gave the green light on a 1.4GW wind complex in Inner Mongolia comprising seven wind farms.

The end of 2012 also saw China Longyuan Power Group Corp. Bring its 150MW offshore wind farm on line, now the country's largest. However, China's ability to meet its target of 5GW offshore wind capacity by 2015 may be under threat, following news that the State Oceanic Administration (SOA) intends to tighten up the rules governing the use of offshore and coastal areas further due to environmental considerations. SOA regulations have already delayed the launch of China's second offshore wind licensing round, and the four projects awarded in 2010 totaling 1GW are yet to start construction due to access constraints.

Solar (PV) & Solar Thermal Heating and Cooling

Solar PV saw another year of extraordinary market growth. Almost 30 GW of operating capacity was added, increasing total global capacity by 74% to almost 70 GW. China has rapidly emerged as the dominant player in Asia. Although 2011 was a good year for consumers and installers, manufacturers struggled to make profits or even survive amidst excess inventory and falling prices, declining government support, slower market growth for much of the year, and significant industry consolidation. Module manufacturing continued its marked shift to Asia, mainly at the expense of European firms.

Solar heating capacity increased by an estimated 27% in 2011 to reach approximately 232 GWth, excluding unglazed swimming pool heating. China remained dominant in the global solar heating industry, a position that it has held for several years, and export of Chinese products has increased considerably in recent years. Solar hot water collectors are used by more than 200 million households (over half of them in China). The majority of renewables jobs worldwide are located in a handful of major economies, namely China, Brazil, the United States, and the European Union, in particular Germany.

Biomass, CHP, & Transport

The growing use of biomass for heat, electricity, and transport fuels has resulted in increasing international trade in biomass fuels in recent years; wood pellets, biodiesel, and ethanol are the main fuels traded internationally. Biomass, in the form of both solid and gaseous fuels, continues to provide the majority of heating produced with renewable energy sources. Biogas produced from domestic-scale digesters is used increasingly for cooking, and to a smaller extent for heating and lighting, in China, India, and elsewhere.

Hydropower

China continued with significant additions in 2011, installing 12.3 GW of new capacity, followed by Vietnam, Brazil, India, Canada, and Malaysia.5 (See Figure 10.) China ended the year with 212 GW of total installed hydropower capacity, and with 18.4 GW of pumped storage capacity.6 The country's 12th Five-Year Plan envisions hydropower capacity reaching 300 GW by 2015, and pumped storage capacity of up to 80 GW.7

Geothermal

In China, due to a low market threshold, a large number of manufacturers have entered the market for direct geothermal energy, resulting in a vicious price war. Geothermal integrators and builders with mixed levels of expertise often face high operating costs, which can result in constructing units with weak heating or cooling.34

Projects

The country's new capacity targets for 2013 show the growth in its domestic renewables market. China is also investing in other countries renewable energy markets. The Government appears to be encouraging renewable energy manufacturers and developers to seek growth opportunities abroad in an attempt to keep businesses alive in the face of supply chain consolidation, grid capacity constraints and protectionist measures from the West.

In December 2012, the Government selected projects eligible for capital grants under its Golden Sun program. Around 2.9GW of capacity was awarded across some 100 developers, generating a potential cost to the Government of up to US$2.5b if the projects are completed by June 2013. The Government also wants to encourage Chinese citizens and businesses to install more rooftop panels, and recently approved a subsidy range of CNY7.5–CYN9.0 (€0.9–€1.1) per watt for a batch of 126 approved projects.

In January, the National Energy Administration (NEA) announced that China intends to install at least 49 GW of new renewables capacity in 2013.

21 GW from hydropower
18 GW from wind and
10 GW from solar.

12th Five-year Plan 2011-2015

In January 2012, as part of its 12th Five-year Plan, China published a report *12th Five-year Plan on Greenhouse Emission Control (guofa [2011] No. 41)*, which establishes goals of raising carbon intensity by 17% by 2015, compared with 2010 levels and raising energy consumption intensity by 16%, relative to GDP. More demanding targets were set for the most developed regions and those with most heavy industry, including Guangdong, Shanghai, Jiangsu, Zhejiang and Tianjin. China also plans to meet 11.4% of its primary energy requirements from non-fossil sources by 2015.

The plan will also pilot the construction of a number of low-carbon Development Zones and low-carbon residential communities, which it hopes will result in a cluster effect among businesses and consumers.

Conclusion

China still faces many challenges in expanding renewable energy, including training of skilled engineers, expanding research and development institutions, improving the operational experience and performance of wind turbines, reducing transmission bottlenecks for wind power, addressing time lags in testing and certifying new wind turbine installations, conducting more detailed resource assessments, aggregating biomass resource collection, integrating renewables into overall power sector planning and design at both macro and distributed levels, and continued policy development and adjustment. Also, grid-based electricity storage and smart-grid operation will become important. Nonetheless, China's renewables industries have hardly suffered from the recent global economic problems, and the period 2010–2020 looks promising.

There is encouraging progress regarding the use of electricity in China: according to World Watch Institute, about 17% of China's electricity came from renewable sources in 2007, led by the world's largest hydroelectric generators.

China is also quickly realizing that coal will no longer be able to support the growth of its economy. Its reliance on fossil fuels in general and coal in particular, is unsustainable and will put pressure on its abilities to continue a rapid growth trajectory in the long run. Moreover, there is also the fact that China is recorded as the third consumer of coal and peat in the world, generating up to 77% of the total electricity in 2010, after Brazil and India.

The China Renewable Energy Law of 2005 is still the key driver of renewable energy development in China. By prioritizing the renewable energy sector, it presents China with an opportunity for global leadership. China's driving policy doctrine, referred to as the "Five Year Plan", is in its 12th issuance for the period from 2011 – 2015 and has a distinct and new focus on adjusting the country's economic growth model with a specific focus on energy.

The development of renewable energy in China has been nothing short of rapid, and this can be seen by the increased amount of investment in renewable energy technologies and installations that have shown a significant rise throughout the 2000′s in China. However, while all this significant interest and rapid growth are encouraging, the consequences of rapid infrastructure building out such poorly aligned integration points (wind turbines to smart grid, for example) must first be dealt with before China can realize any of the aggressive targets it has set for itself.

China has shown leadership with its continued efforts to promote and develop renewable energy not only in China but around the world. The targets set forth even if they are marginally achieved, are more significant than most countries energy infrastructure.

D. INDIA

India is the fourth largest energy consumer (United States, China, and Russia) and has one of the fastest economic growth rates (7% or higher since 2000). India along with China account for the largest share of Asian energy demand growth. Growth in the energy sector has been high due to foreign investment and the aggressive GOI policy. However, utilization rates in Indian power plants have fallen steadily since 2004 because of insufficient fuel supplies. Significant parts of the country still do not have reliable access to electricity. The GOI indicates that over 90 % of urban households had electricity, and 60 % of rural households had access, however, many parts have rolling blackouts for 4-10 hrs per day due to electricity shortage.

The top five countries for total investment were China, which led the world for the third year running, followed closely by the United States, and by Germany, Italy, and India. India displayed the fastest expansion in investment of any large renewables market in the world, with 62% growth. Developing countries saw their relative share of total global investment slip back after several years of consistent increases; developing countries accounted for USD 89 billion of new investment in 2011, compared with USD 168 billion in developed countries.

India has changed rapidly over the past 10 years that it is difficult to monitor the changes. The Government of India (GOI) is adapting to the changing atmosphere and the energy policy focuses on securing energy sources to meet the needs of its growing economy. It has been estimated that approximately 20-25 % of the population lacks access to electricity. Also, cities and surrounding electrified areas suffer from rolling blackouts. The GOI is trying to balance this by producing more electricity by both conventional and renewable means while taking into account environmental concerns. This is a monumental task as India is a true Democracy which has a multi-faceted legal system and many traditional norms that must be accommodated.

The GOI has been unable to meet the growing demand despite it valiant attempts. There are many obstacles which prevent the GOI from acting (fuel subsidies, increasing import dependency, and slow energy sector reform).

Parts of the energy sector, such as coal production, remain closed to private and foreign investment. Despite having large coal reserves and a healthy growth in natural gas production over the past two decades, India like many countries remains dependent on imported crude oil. In early 2013, the GOI announced that they will work on an action plan to make India energy independent by 2030 through increased hydrocarbon production, unconventional resources such as coal bed methane and shale, foreign acquisitions by domestic Indian companies, and reduced subsidies on motor fuels. These actions either increase India's energy supply or lower demand. It did not mention many details of renewable energy.

India is the only country with dedicated ministry for renewable energy (Ministry of New and Renewable Energy (MNRE)) and every state has a coordinating department for advancing renewable energy. India's largest energy source is coal, followed by petroleum and traditional biomass (e.g., burning firewood and waste). The industrial sector is the largest energy consumer, representing over 40 % of India's total primary energy demand in 2009, and is mostly fueled by traditional biomass. The power sector is the fastest growing area of energy demand, increasing from 23 percent to 38 percent of total energy consumption between 1990 and 2009.

Electricity

According to the Central Electricity Authority (CEA), India has approximately 211,000 MW of installed electricity capacity, mostly in coal-powered plants. Because of insufficient fuel supply, the country suffers from a severe shortage of electricity generation, leading to rolling blackouts.

Total Installed Electricity Capacity (2012): 211,766 MW

Coal:	57.4%	Hydro-electric:	18.6%
Renewable:	12.2%	Natural Gas:	8.9%
Nuclear:	2.3%	Oil:	0.6%

Over 327 GW of power is projected by 2020 and MNRE expects renewable capacity to double to 65 GW by 2020. MNRE had a capacity addition of 14,000 MW is targeted during the 11th Plan period that would take the renewable power generating capacity to nearly 25,000 MW by 2012. As of 2012, current installed renewable capacity was 24,503 MW. This momentum is likely to be sustained and it is envisaged that the renewable power capacity in the country will cross 87,000 MW by 2022.

KEY Stakeholders

Ministry of Power: The Ministry of Power is the main organization responsible for planning and implementing all of India's power sector policy, with various departments handling different parts of the sector, including thermal, hydropower, and distribution.

Ministry of New and Renewable Energy (**MNRE**): MNRE is the Ministry of the government of India for all matters relating to new and renewable energy and the administrative ministry for policies and programs in this area. The Ministry is organized into several divisions dealing with different technologies and applications.

The Solar Energy Centre serves as the technical focal point for solar energy development.

1. The Centre for Wind Energy Technology, an autonomous organization under the administrative control of the MNRE, has been established in Chennai, Tamil Nadu, and serves as the technical focal point for wind power development.
2. The Sardar Swaran Singh National Institute of Renewable Energy is an autonomous institution to serve as the technical focal point for the development of bio-energy, including bio-fuels, and synthetic fuels.
3. The Indian Renewable Energy Development Agency (IREDA) was established in 1987 to promote, develop, and extend loans and financial assistance for renewable energy and energy efficiency/conservation projects. IREDA is a nonbanking financial institution under the administrative control of the MNRE.

The MNRE and the state development agencies have been critical in the increased deployment of alternative energy facilities in India and have very ambitious plans. The MNRE is encouraging the state agencies to double the energy from renewable energy projects in cogeneration, biomass and small hydro in the next five years.

Planning Commission: The Power and Energy, Energy Policy and Rural Energy Division of the Planning commission guides the energy policies of the country.

Central Electricity Authority (CEA): The Central Electricity Authority (CEA) advises the central government on long- and short-term policy planning. The CEA assists the Ministry of Power and others in all the techno-economic matters.

The Central Electricity Regulatory Commission (CERC): The CERC provides the tariff for generation and State Electricity Regulatory Commissions (SERC) set generation and transmission policies. India's electricity regulatory framework is the based on the 2003 Electricity Act, which reformed the state electricity boards, provided open access to transmission and distribution networks, and created SERCs to manage electricity on a regional basis. The GOI implemented many parts of the Act however the electricity sector continues to face challenges in distribution.

In order to meet the growing demand and losses, the CERC is encouraging more generation from renewable energy sources, such as hydropower, wind, and solar.

Generation, Transmission & Distribution: The major generators of energy are the National Thermal Power Corporation (NTPC), the National Hydroelectric Power Corporation (NHPC) and the Nuclear Power Corporation of India Limited (NPCIL). The largest transmission provider is the Power Grid Corporation of India (POWERGRID). They own/operate the largest transmission owner and operator, controls five regional electricity grids and state transmission utilities (with some private sector participation) operate the transmission and distribution segments. The distribution is handled by the states (some have given it to the private sector).

The central government also assists in financing electricity development projects thru the Power Finance Corporation and delivering electricity to customers falls on state governments or distribution companies.

Bureau of Energy Efficiency (**BEE**)

The BEE, established under the Energy Conservation Act of 2001, has introduced labelling requirements and building codes to reduce the energy intensity of GDP growth. For instance, the Energy Conservation Building Code (ECBC) is aimed at maximising energy utilization in commercial buildings, by using Leadership in Energy and Environmental Design (LEED) certification standards, and customising buildings based on location temperatures. The BEE is comprised of ministers from Central and State energy-related agencies. The BEE is working with key industries, including cement, aluminium, and paper and pulp, to establish voluntary EE practices. It is also drafting standards for energy-labelling, building codes, and certification programs, among other initiatives.

In February 2011, India's Bureau of Energy Efficiency (BEE) adopted new quality standards for solid state lighting, a process greatly accelerated as a result of SEAD, facilitated technical exchange between BEE and the United States Department of Energy. These standards are in the process of being notified through the Bureau of Indian Standards. In March, India also launched new internationally harmonized efficiency labels for laptops, drawing from the Energy Star programme.

National Mission

Recognizing the importance of addressing issues related to climate change, as well as considering economic and social developmental as priorities, India outlined domestic actions towards climate change mitigation in its National Action Plan for Climate Change in 2008. The National Action Plan contains 8 National Missions that represent multi-pronged, long term and integrate strategies for achieving key goals in the context of climate change. These Missions are:

- National Solar Mission,
- National Mission on Enhanced Energy Efficiency,
- National Mission on Sustainable Habitat,
- National Water Mission,
- National Mission for Sustaining the Himalayan Eco-system,
- National Mission for a Green India,
- National Mission for Sustainable Agriculture and
- National Mission on Strategic Knowledge for Climate Change.

Each National Missions is institutionalized by a respective Ministry. The National Mission for Enhanced Energy Efficiency (NMEEE) operates under BEE. The Prime Minister's Council on Climate Change approved draft principles of the NMEEE on August 2009 and the Union Cabinet approved its implementation framework on 24th June 2010, with dedicated funds to the tune of Rs. 235.35 crores (USD53 million).

The energy sector is covered in extensive detail, beginning with the achievements of the 11th Plan, including the total number of electrified villages increasing to 560,000, capacity additions of 54,964 MW, and the installation of a further 70,286 circuit km of transmission lines. A total capacity addition of 118,536 MW is planned for the 12th Plan period, including 30,000 MW of grid-connected renewable capacity, comprising of 15,000 MW wind, 10,000 MW solar, 2,100 MW small hydro and 2,900 MW of biomass/fuels. In addition, the 12th Plan targets the creation of a National Grid, through the development of a HVDC connector to the country's Southern electricity grid, as well as increasing HVDC and 765 kV links throughout the grid to improve capacity. Extensive energy policy reforms are recommended in the 12th Plan, including the strengthening of provisions for increasing renewable energy capacity, and incentives for low-cost transmission development to connect new renewable capacity. Finally, the plan sets notable new targets for energy efficiency in all sectors of the economy, with a projected yearly energy saving of 11,430 ktoe, compared to a business-as-usual scenario, as of 2016-17.

Issues regarding the Power Sector

The growing economy and increasing population are a major concerns for the nation's energy security. India is dependent on foreign fuels making it vulnerable to, foreign energy supplies. Power distribution in India is unevenly dispersed with a mismatch in supply and demand in different regions. The transmission and distribution (T&D) system is a three-tier structure comprising of distribution networks, state grids, and regional grids.

The central transmission utility, PowerGrid India, operates approximately 98,368 km of transmission lines at 800/765kV, 400kV, 220kV & 132kV, as well as at over 500kV HVDC. Below are the different regional grids and the states in each of the grids.

- Northern region: Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttarakhand and Uttar Pradesh.
- Eastern region: Bihar, Jharkhand, Orissa, Sikkim, and West Bengal.
- Western region: Dadra and Nagar Haveli, Daman and Diu, Chhattisgarh, Goa, Gujarat, Madhya Pradesh and Maharashtra.
- Southern region: Andhra Pradesh, Karnataka, Kerala, Puducherry and Tamil Nadu.
- North-eastern region: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

Over 327 GW of power is required by 2020. The 12th Five Year Plan (2012-2017) projects major increases in energy imports, with import dependence on coal and oil set to increase to 22.4% and 78% respectively. Renewable capacity is also projected to increase to 54,503 MW by the end of the 12th Plan.

The State electricity boards (SEBs) have financial problems due to non payment and theft. Additionally, farmers across India are provided with free (or very low cost) electricity.

Renewable Energy

Renewable energy sources accounted for only 12.2% of India's overall power generation capacity in 2012. The Ministry of New and Renewable Energy (MNRE) estimates that there is a potential of around 90,000 MW for power generation from different renewable energy sources in the country (48,561 MW of wind power, 14,294 MW of small hydro power and 26,367 MW of biomass).

Hydropower: The hydropower installed capacity is approximately 37,367.4 MW. The estimated small hydro power potential in India is around 15,000 MW. Only 16% has been developed so far for power generation. There are over 5415 small hydroelectric sites with a capacity of 14,305.47 MW. The largest numbers of sites have been identified in Arunachal Pradesh with a total capacity of 1333.04 MW. Himachal Pradesh has the highest potential with 547 sites of total capacity 2268 MW.

Wind Energy: India's wind resources have been mapped by the Centre for Wind Energy Technology (CWET). As of August 31, 2011 the installed capacity of wind power in India was 14,989.89 MW, Tamil Nadu (6286.02 MW), Maharashtra (2400.05 MW), Gujarat (2337.31 MW), Karnataka (1773.25 MW), Rajasthan (1678.62 MW), Madhya Pradesh (275.89 MW), Andhra Pradesh (199.15 MW), Kerala (35.30 MW), and West Bengal (1.1 MW).

During the 2010-11 financial year, India added only 2350 MW of wind capacity for a total installed capacity of 14,156 MW. India's domestic market has transformed the Indian wind industry into a significant global player.

Solar Energy: The annual solar radiation over India ranges from 1,200 to 2,300 kWh/m2, with most of the country having radiation greater than 1900 kWh/m2/year, with about 300 clear sunny days. For comparison, in Germany, annual solar radiation ranges from 800 kWh/m2 to 1200 kWh/m2. The area required to meet India's power energy needs (620 billion kWh in 2005) with solar photovoltaics (at an efficiency of 10%) is about 3,000 km2 (60 km by 50 km) which is 0.1% of the land area of the country.

The amount of solar energy produced in India is less than 1% of the total energy demand. The grid-interactive solar power as of December 2010 was merely 10 MW. In 2009, solar power contributed approximately 27 GWh to the national electricity supply. If harnessed properly, India can become the largest provider of solar energy.

Biomass Energy: Being an agrarian nation, India has considerable potential to use many forms of biomass. The total potential for biomass-based power generation is estimated to be 21,000 MW. Current utilisation amounts to approximately 2,735 MW, with various technologies and projects currently in development to increase this. For example, Singapore-based All Green are investing in 10 biomass gasification plants in the country.

Geothermal Energy: The geothermal resources in India have not been exploited commercially for heat or power generation. The geothermal resources have been mapped and the Geological Survey of India estimates the power generation potential may be around 10,000 MW.

Thermal: Coal-fired power plants are the main source of power for India's electricity generation sector and account for over 50 % of installed capacity. Fuel supply and quality are the main problems to the power plants. Recent upgrades to power stations and fuel linkages have decreased shutdowns and reliability problems.

Energy Policy and Laws

Electricity Act (2003) - It consolidates the laws relating to generation, transmission, distribution and trading, and use of electricity. It also promotes rural electrification through renewable energy sources stand alone systems.

- **National Action Plan on Climate Change (2008)**

It addresses the critical concerns of the country through directional shift in the development pathway, including the enhancement of both current and planned programmes.

- **Jawaharlal Nehru National Solar Mission (JNNSM) (2009)**

The programme goals include creating an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.

- **National Mission for Enhanced Energy Efficiency**

Apart from creating an energy efficiency market, the mission aims to cut down the country's annual energy usage by 5% by 2015, and carbon dioxide emissions by 100 million tonnes every year. The goal of the mission is to reduce energy usage of 10,000 MW by 2012.

- **India Energy Policy (IEP)**

The IEP, adopted by the Indian government in 2006, is India's comprehensive energy road map. Prepared by the Planning Commission of India, the IEP identifies multiple energy challenges, including meeting energy demands, securing supply, mitigating climate change, and promoting renewable and alternative energy. The IEP sets forth several policy choices to address these challenges.

The government is making efforts to increase renewable energy supply. It has launched over 2000 RE projects under the CDM. The government has also adopted policies to promote RE. The government has established specialised centers on technology development to promote solar and wind energy projects. It has also been advised by the National Biofuel Coordination Committee and the Biofuel Steering Committee to achieve at least a 20% ethanol blend in petroleum and diesel by 2017.

New Programs and Projects

India is setting up a company with initial capital of 20 billion rupees (approximately USD406 million) to build federal solar projects and help the country reach a target of 20GW of solar energy capacity by 2022. The decision comes at a time when some solar and renewables companies and experts are worried about funds and a relative lack of interest by commercial companies.

India is planning major road shows in the U.S. and Europe, to attract investment in renewables, especially the solar energy sector, for the next phase of the solar program, which is scheduled to be launched in the financial year that begins April 1, 2013. The country aims to add 4-7 GW of solar capacity in that phase, which ends in 2017.

In the solar energy sector, many large projects have been proposed, and a 35,000 km2 area of the Thar Desert (Rajasthan), has been set aside for solar power projects, sufficient to generate from 700-2100 GW. India is ready to launch its Solar Mission under the

National Action Plan on Climate Change, with plans to generate 1000 MW of power by 2013. India is planning to generate 1000 MW of solar power every year by 2013. A complete package has been proposed to propel the power sector into ‘solar reforms’ that could lead to annual production of 20,000 MW by 2020. The country currently produces less than 5 MW every year.

In the first phase, between 2010 and 2013, the government is also proposing to generate 200 MW of off-grid solar power and cover 7 million m2 with solar collectors. By the end of the final phase in 2022, the government hopes to produce 20,000 MW of grid-based solar power, 2000 MW of off-grid solar power and cover 20 million m2 with collectors.

Regulatory

The GOI is encouraging investment in non-conventional energy sources and proposed a financial outlay of approximately $44.79 million on R&D in the wind energy sector. The GOI is focusing on developing small projects in remote areas and setting pilot projects.

Wind energy power projects are capital intensive and hence investors have to be provided continuous support. The average pay back period for wind power projects is 25 years, however, technology changes very slowly in this area, hence manufacturers do not have to worry about technological changes. The GOI is giving income tax holidays, concessional custom duty, duty free import, and accelerated depreciation, to investors. The various State Governments are providing support in the form of energy buy back, power wheeling and banking facilities, sales tax concession benefits, electricity tax exemption and capital subsidy.

The GOI has an incentive program named a Generation Based Incentive (GBI) Scheme. The incentives are as follows:

1. All grid integrated projects of capacity of more than 5 MW are eligible for this scheme. The project has to be synchronized with the grid and certified by the utility.

2. Wind site has to be validated by C-WET.

3. Electricity generated from the project should be sold to the grid.

4. The MNRE will provide the GBI of Rs. 0.50 per unit for a period of ten years to the eligible project promoters through IREDA. This scheme is currently valid for wind farms installed before March 31, 2012. This incentive shall be in addition to the tariff determined by the State Electricity Regulatory Commission (SERC).

5. IREDA will disburse the generation based incentive to the generator on half yearly basis through e-payment.

6. Not applicable for those who have set up capacities for captive consumption, third party sale, or merchant plants.

7. The component of the scheme will be reviewed when projects aggregating to 49 MW, which are estimated to generate around 0.9 billion units of electricity, will get registered by IREDA.

Conclusion

The GOI intends to promote RE, however its efforts are hampered by inconsistent policies at the state level and by the lack of a central RE law. Some States have set relatively high renewable portfolio standards (RPS – renewable energy targets) however many are not monitored.

Solar panels, wind turbines, micro-CHP plants and micro-grids are a reality growing and India still require industrial-strength grids and large power plants. Over 80,000 villages are yet to be electrified and India has had a negative Energy Balance. The renewable energy policies if properly employed can harness the much needed energy and bring India out of the deficit. The total estimated potential of renewable Energy is over 152,000 MW and can be harnessed and distributed at reasonable rates.

The GOI can accelerate and build grid interactive plants, provide a reasonable feed-in tariff, and incentivize low interest loans, and mandate domestic procurement for renewable projects paid through the National Clean Energy Fund. With some of these mechanisms employed, clean energy will assist in meeting the energy needs. RE is clearly one of the answers.

E. MALAYSIA

Malaysia is a federal constitutional monarchy in Southeast Asia, consisting of thirteen states and three federal territories and borders with Thailand, Indonesia, and Brunei. Malaysia has one of the best economic records in Asia, with GDP averaging almost 7.0%. Malaysia energy production is dependent on oil and natural gas. Power generation capacity for the Malaysian National Grid is approximately 27,000 MW.

Total installed electricity capacity: 27,000 MW

Natural gas:	**58.0%**	**Coal:**	**32.4%**
Diesel:	**2.2%**	**Biomass:**	**1.2%**
Fuel oil:	**0.1%**	**Others:**	**0.1%**

Malaysia is estimated to only have 30 years of natural gas reserves, and 15 years of oil reserves. The Malaysian government is reviewing the energy policy and expanding its renewable energy sources for the future. The oil and gas industry in Malaysia is currently dominated by state owned Petronas and the energy sector as a whole is regulated by Suruhanjaya Tenaga, a statutory commission who governs the energy in the peninsula and Sabah.

The electricity system covers the Malaysian Peninsula, connecting electricity generation stations owned TNB and Independent Power Producers (IPPs) to energy consumers. A small number of consumers, mainly steel mills and shopping malls also take power directly from the National Grid. The national grid: Tenaga Nasional Berhad (TNB) owns and operates the Transmission system. There are two other electrical grids in Sabah and Sarawak operated by Sabah Electricity Sdn Bhd and Sarawak Electricity Supply Corporation respectively.

Malaysia has one of the most intricate transmission system linked by approximately 11,000 km of transmission lines. The 500 kV transmission system is the single largest transmission system to be developed in Malaysia.

Phase 1 (1995) involved the design and construction of the 500kV overhead transmission lines from Gurun, Kedah in the North along the west coast to Kapar, in the central region and from Pasir Gudang to Yong Peng in the south of Peninsular Malaysia.

International Connections

The transmission is connected to Thailand and Singapore which can transfer over 1000 MW to Thailand and Singapore via Submarine cables. The distribution system of 33 kV, 22 kV, 11 kV, 6.6 kV and 400/230 connects the transmission system to the customers.

Energy Policy

The Malaysia Government is encouraging the development of renewable energy in the economy through policy and various strategies. Malaysia has a Five-Fuel Policy (oil, coal, gas, hydro, and renewables) that has made renewable energy one of the components in the fuel mix for power generation. The Small Renewable Energy Power Program encourages production of renewable energy by small power generators allowing the sale of generated electricity to utilities. The Ninth Malaysia Plan specified a target for electricity grid-connected renewable energy generation—300 MW in Peninsular Malaysia and 50 MW in Sabah.

The **Tenth Malaysia Plan 2011-2015** has changed its focus on green technology including short term goals vested in National Green Technology Policy and new renewable energy feed-in tariff mechanisms. It details on the strategy to restructure the energy subsidies the country has been providing on natural gas and electricity used by the industry sector as well as the discounted energy pricing mechanism for selected industrial users.

The 10th MP also includes a plan to achieve 985 MW by 2015 contributing to 5.5% of Malaysia's total electricity generation mix. In order to achieve its target, the National Renewable Energy Policy 2010 has been launched.

Malaysia's energy sector has the following objectives:

- Secure cost-effective energy supplies by developing indigenous energy resources, both non-renewable and renewable;
- Diversify supply sources;
- Promoting efficient utilization of energy and the eliminating wasteful and non-productive energy consumption; and
- Environmental protection in the production and use of energy.

The government is formulating various strategies to promote RE, including an action plan to assist RE project developers, especially Small Renewable Energy Plan (SREP) projects. The plan includes:

- a review of the Renewable Energy Power Purchase Agreement (REPPA) to recommend how the terms and conditions can be simplified and differentiating between larger projects and smaller and rural projects;
- new targets for RE utilization by the type of RE source and by region;
- economic support through fiscal and financial incentives improvement.

The Small Renewable Energy Program allows renewable projects with up to 10 MW of capacity to sell their electricity output to TNB, under 21-year license agreements. Numerous applications for the program have been received, mainly involving biomass, and over half are for palm oil waste. In 2005 alone, 28 biomass projects were approved totaling 194 MW, four 9 MW of landfill gas projects, and 70 MW of mini hydro-electric projects. The government is also giving priorities in the following areas:

- Energy Efficiency
- The Malaysian Energy Commission has set up energy efficiency programs. Industrial consumers use about 40% of primary energy, as well as about 55% of the electricity (which consumes about 38% of primary energy) used in Malaysia. This means that industrial consumers use about 60% of the total energy used in Malaysia.

Wind

Studies are being conducted to utilize off shore wind. Studies have shown that offshore sites exhibit exploitable conditions for power generation, with average annual wind speeds of 4.1 m/s being recorded in the eastern Peninsula region of the country. Utilization in the country is currently at the pilot project stage, with an estimated installed capacity of 0.2 MW (off-grid).

Hydropower

Hydropower potential is approximately 29,000 MW and 85% of potential sites are located in East Malaysia. The role of hydropower in the generation fuel mix will be more prominent. Though most of the potential sites in Peninsular Malaysia have already been developed, there is still untapped potential in the states of Pahang, Kelantan and Perak. The Bakun Hydroelectric Project, which is currently under development, has the greatest potential. The Bakun project will add 2,400 MW to hydro-electric generation capacity. The government has also approved the Peninsular Malaysia – Sarawak interconnection link via submarine cable to channel the power generated from the Bakun project. The government is also studying the possibility of developing more hydropower at the Rejang Basin in Sarawak.

Solar

Solar PV potential is estimated at 6,500 MW. Despite the abundant resource, with an average daily insolation of 4.5 kWh/m2/day across the majority of the country, solar PV applications in Malaysia are limited to mainly stand-alone PV systems, especially for rural electrification where the systems receive a significant subsidy. Currently, roughly 1 MW of grid-connected solar PV systems are installed in the country, with a further 6.1 MW of grid-connected PV.

Biomass

The main focus for RE is on biomass, especially from palm oil and wood wastes and estimated to be as high as 30,000 MW. Being the largest palm oil producer in the world, the Malaysian economy has abundant sources of palm oil biomass. The various projects are being implemented and harvested for electricity production.

Geothermal

The potential for geothermal power generation exists in the country. There is an estimated 200 + MW of potential, particularly at the Tawau geothermal field. The location on Sabah has been observed as having temperatures of 220 to 236 degrees Celsius. RM1.5 million has been allocated for research into the site, and plans for its development have been included in the 10th Malaysian Plan.

The target of contribution towards the total electricity generation mix from RE is 10% by 2010, after which this ratio is envisaged to be maintained.

Conclusion

Malaysia is rich in biomass particularly from palm oil and can maximize its conversion to electricity potential if proper energy policies and investment signals are constructively created. As they move away from the depleting fossil fuels, they are meeting the demand with Renewable energy from Biomass. Malaysia is moving towards aggressive Renewable Energy Policy which may bring in extensive foreign investment.

Demand for electricity will keep increasing as the economy develops. They also have an interconnection with Thailand and Singapore which can transfer power as needed via the upcoming ASEAN Grid.

F. PAKISTAN

Pakistan, officially the Islamic Republic of Pakistan is a sovereign state in South Asia. Strategically, Pakistan is located in a position between the important regions of South Asia, Central Asia and the greater Middle East. With over 170 million people, it is the sixth most populous country in the world and has the second largest Muslim population after Indonesia.

Pakistan will continue to face chronic power shortages for the next decade, despite aggressive pledges and plans announced by government officials and aid promised by various foreign organizations. System inefficiencies similar to other countries in Asia prevent plans of the international organizations from being effectively implemented. Also, the poor fiscal position sends the wrong signal as private producers are discouraged from increasing investment given the lack of promptness in payment.

Hydro power and renewable energy sources are available, however remain as alternatives that the government struggles to tap, due to the high capital outlays.

Load shedding across the country is a norm due to shortfall, faulty generators, lack of fuel (oil and gas) and low levels of rain. However, with the general elections in Pakistan due in 2013, the government has raised PKR 82bn from debt issuance in September2012 to pay its delayed dues (US$4.2bn) to private electricity producers to encourage electricity production.

Iran has initiated discussions with Pakistan in November 2012 on an agreement that would see Iran export 1,000 MW of electricity. Pakistan's neighbour has further pledged to complete the gas pipeline by 2014, a move which could alleviate the fuel shortages faced by certain states as well as its neighbor India.

The Central Power Purchase Agency has requested the National Electric Power Regulatory Authority to approval a power tariff hike of PKR39 in January 2013 as the cost of generating continued to rise in October due to the shortage of gas. This comes after a recent tariff increase granted in October, and this trend is likely to continue as fuel prices continue to raise the cost of electricity production.

Progress of talks between India and Pakistan regarding the sale of electricity and petrol continue but remain slow, with Indian officials. Worsening energy shortage in Pakistan may push Pakistani authorities to push ahead with negotiations, although imports from neighbors are unlikely to exceed supplies from Kuwait.

During 2013-2021, Pakistan's overall power generation is expected to increase by an annual average of 3.86%, reaching 136 TWh. Driving this growth is an annual 6.39% rise in hydroelectric generation and a 4.14% increase in gas-fired generation. Growth in coal fired generation is likely forecasted to remain at a more subdued pace of an average of 2.17%while oil-fired generation is estimated to suffer an average annual contraction of 0.13%.

A government planning commission has warned in 2005 energy security plan that 143 GW will be required by 2030. Pakistan is looking for US $8 bn of private power project investment to meet its target.

Renewable Energy

The government has allotted approximately 39,000 acres of land and increased the rate of return for investors in wind power projects to 17%, which implies a tariff rate of 14.6 cents per kilowatt-hour. Approximately half of these projects are projected to be completed by June 2013, and could potentially add 1.8GW of power in the summer, when electricity demand is at its highest. Although these incentives and guarantees could help bolster the success rate of these projects compared to previous attempts, there remains a possibility that global economic woes could delay financing from foreign companies and push back the completion dates.

In 2012, the GDP was 3.7%, and the BMI forecasts the economy to grow at a speed of approximately 4.1% between 2013 and 2021. Net power consumption looks to increase from 77.09 TWh to 110.26 TWh. This brings puts the annual growth rate for electricity demand to an average of 3.8%.

Although Pakistan is expected the have a rise in net generation over the coming years, they will likely maintain import for energy. The Pakistan transmission and distribution has increased in efficiency and A falling percentage of transmission and distribution losses and this will likely provide minor supply improvements.

Power Sector Reforms

Government of Pakistan (GoP) initiated structural reforms in the power sector under the Power Sector Reform Plan (2010) finalized by Cabinet Committee on Restructuring (CCOR). Implementation of Power Sector Reform Plan 2010 has been expedited and upgraded under the Power Sector Recovery Plan 2011.

The plans are based on the following key pillars:

- Improved governance structure;
- Supportive legal framework;
- Financial sustainability;
- Supply side management;
- Demand side management and
- Promote private sector participation in the sector.

Power Sector Subsidy

During 2011-12, energy outages in Pakistan continued to be the dominant constraint in its growth. By 2011-12, electricity and gas shortages are considered to be the primary cause of constrained production activities in a number of industries. Energy intensive industries (Petroleum, Iron and Steel, Engineering Industries and Electrical) shaved off 0.2 percentage points from real GDP growth in 2010-11 and in 2011-12.

The GoP is also making the timely payment of tariff differential subsidy (TDS) and ensuring it along with subsidies for KESC and FATA on monthly basis. All subsidy claims till December 2011 (Rs.56 billion) have been disbursed. GoP started 2012 with no outstanding claims against any power sector company. For 2012, overall subsidy is estimated to be Rs.91– 125 billion. Monthly financial planning is being implemented for smooth financial flow. General Sales Tax (GST) exemption withdrawn for lifeline and agriculture consumers (Rs. 10 billion budgeted by GoP for 2012). GoP aims to phase out subsidies to power sector which have cost rupees one trillion in the last 4 years.

Also, the estimated cost of power crises to the economy is approximately Rs.380 billion per year, around 2 percent of GDP, while the cost of subsidies given to the power sector to the exchequer in the last four years (2008-2012) is almost 2.5 percent of GDP, (Rs. 1100 billion). The liquidity crunch in the power sector has resulted in under utilization of installed capacity of up to 4000 MW. It has also affected investment in power sector. Floods were one of the factors which caused electricity and gas shortage as it damaged the distribution network (i.e., 90 percent of distribution transformers to the petroleum and gas fields). "The total damage to the energy sector was of Rs 1.2 billion (US$ 14.2 million) according to Asian Development Bank Report, "2011 Pakistan Floods; Preliminary Damage and Needs Assessment".

To ensure energy security and sustainable development in the country, the government is also taking all possible measures to diversify its energy mix. In this the regard government has given maximum attention to fast track the development of Alternative / Renewable Energy (ARE) resources in the country.
The Alternative Energy Development Board (AEDB) has updated the Renewable Energy (RE) Policy, 2006, in consultation with the provinces and other stakeholders. The policy includes all (Alternative Renewable Energy (ARE) technologies including Wind, Solar, Hydro, Biogas, Cogeneration, Waste-to-Energy, and Geothermal; providing extremely attractive financial and fiscal incentives to both local and foreign investors while offering

them a level playing field. It is expected that with the approval of the policy and government's keen interest in energy sector, the situation will improve significantly in near future.

The National Electric Power Regulatory Authority is exclusively responsible for regulating the electric power services and safeguarding the interests of investors and consumers. NEPRA grants licenses for generation, transmission and distribution of electric power; determines tariff rates, charges and other terms and conditions for supply of electric power; prescribes and enforces performance standards and addresses the complaints of electricity consumers.

Conclusions

The GoP has been giving maximum support to fast track the development of Alternative / Renewable Energy (ARE) resources in the country. In May 2010 the government gave the Alternative Energy Development Board (AEDB) the mandate to implement Alternative / Renewable Energy (ARE) commercial projects on its own or through joint venture or partnership with public or private sector entities in addition to its mandates under the ordinance. Solutions to the power shortages remain out of sight for Pakistan unless the renewable energy sector is tapped.

Along with the AEDB, the Pakistan Council of Renewable Energy Technologies (PCRET) has also been promoting Renewable Energy Technologies in Solar, Micro-hydel, Wind etc.

AEDB initiated a number of supportive measures that were required to be taken for laying a strong foundations of the ARE sector in Pakistan. In this regard:

- New wind corridors in areas outside Sindh also been identified. New wind measuring masts are being installed in all four provinces.
- National Grid Code for wind power projects has been amended. Grid Integration Plan 2010-2015 for wind power projects is developed by AEDB to support National Transmission and Dispatch Company (NTDC).
- Asian Development Bank has been taken onboard to provide guarantee to the wind power project developers in order to mitigate the country risk.
- Local manufacturing of micro wind turbine has been started. Manufacturing for large wind turbines is also being initiated. The turbine towers for the first project are being manufactured in Pakistan.
- Issues related to financing of projects have been resolved and now leading financing agencies like International Finance Corporation (IFC), Asian Development Bank (ADB), and Organization of the Petroleum Exporting Countries (OPIC) and Economic Cooperation Organization (ECO) Trade Bank etc. are offering financing to wind power projects in Pakistan.

With the appropriate incentives and increases in tariff for the renewable projects, Pakistan may see a vibrant increase over the next decade.

G. PHILIPPINES

The Philippines, officially known as the Republic of the Philippines, is a country in Southeast Asia in the western Pacific Ocean. Its location on the Pacific have endowed the country with natural resources and made it one of the richest areas of biodiversity in the world. An archipelago comprising 7,107 islands, the Philippines is categorized broadly into three main geographical divisions: Luzon, Visayas, and Mindanao.

Philippines has a growing energy demand, tight energy supply, limited foreign investments and critical power development issues, and the Department of Energy is set to release the Philippine Energy Plan highlighting the plans and programs of the energy sector to fuel support for the economic growth of the country for the period 2009-2030. 1n 2010, the generation capacity was 16,359 MW and the growth has exceeded supply.

Renewable energy (RE) has become a critical component of the government's strategy to provide energy supply for the country. The generation from geothermal and hydro resources has increased lessening the country's dependency on imported fuels. The government is also accelerating its rural electrification efforts by generating more from solar, micro-hydro, wind and biomass. Well aware of the deficiencies in the power system, the government is preparing to introduce a wide-ranging initiative aimed at improving energy security that has at its core a focus on renewable sources. The Energy Plan 2012-13is to expand the use and production of renewable energy, while also driving forward hydrocarbons exploration and overhauling the electrical network.

The Department of Energy (DOE) is projecting renewable energy to provide up to 40 percent of the country's primary energy requirements over the next ten-year period. RE-based capacity is foreseen to reach 9,147 MW by 2013, a dramatic increase from its current level of 4,449 MW. Biomass, micro-hydro, solar and wind will remain to be the largest contributors to the total share of renewable energy in the energy mix

The DOE’s long-term goals:

- Increase RE-based capacity by 100 percent by 2013;
- Increase non-power contribution of RE to the energy mix by 10 million barrels of fuel oil equivalent (MMBFOE) in the next ten years. In support of these general goals, the government aims to:
    a. be the number one geothermal energy producer in the world;
    b. be the number one wind energy producer in Southeast Asia;
    c. double hydro capacity by 2013; and
    d. expand contribution of biomass, solar and ocean by about 131 MW. These goals serve as concrete benchmarks for government to advance its vision of a sustainable energy system with RE taking a prominent role in the process.

With increased private sector investments as well as the adoption of modern and innovative technologies in exploration and development, the DOE is targeting the installation of an additional 1,200 MW of geothermal capacity by 2013, resulting an increase of about 60 percent from the 2002 level of 1,931 MW.

Finally, the DOE will push for the installation of up to 417 MW from wind-based power and another 131 MW sourced from solar, ocean and biomass.

Philippine Energy Plan 2009-2030

The over-arching theme of PEP 2009-2030 is ensuring the best energy choices for a better quality of life

The plans and programs of PEP 2009-2030 are to overcome the challenges that are confronting the energy sector at present and usher the change in the landscape of the country's energy future. In simple terms, the plan will see to it that public policies on energy are at par with the changing needs of the energy sector.

The economy's Six-point National Energy Sector Strategic Directions

- Promote green and clean energy;
- Ensure responsive, comprehensive, integrated, and consistent energy policy;
- Identify and achieve the optimal (or best) energy mix;
- Strengthen energy research and development program;
- Develop manpower and institutional capacities;
- Continue the implementation of social mobilization and monitoring mechanisms at the local and economy-wide levels

To realize these policy thrusts, the energy sector will see to it that necessary action plans will be set to motion within the 20-year planning period. The overall objectives are to:

- Accelerate the exploration and development of oil, gas and coal resources
- Intensify development and utilization of renewable and environment-friendly alternative energy resources/technologies

- Enhance energy efficiency and conservation
- Attain nationwide electrification
- Put in place long-term reliable power supply
- Improve transmission and distribution systems
- Secure vital energy infrastructure and facilities
- Maintain a competitive energy investment climate

Renewable Energy

The target is to double the RE-based installed capacity for power generation at the end of the planning horizon from its 2008 level of 5,300 MW. The ERC has implemented mechanisms on Feed-in-tariff, Renewable Portfolio Standard and Net Metering. ***FiT***refers to the RE policy that offers guaranteed payments on a fixed rate per kwh for RE generation, excluding any generation for own use; ***RPS*** is market-based policy that requires electricity suppliers to source an agreed portion of their energy supply from eligible RE resources; ***Net Metering*** a system in which a distribution grid user has a two-way connection to the grid and is only charged for his net electricity consumption and is credited for any overall contribution to the grid. Green building technology will also be promoted with our partners in the construction and real estate sectors. Other programs for implementation are the monitoring of efficiency performance of power generation utilities and electric distribution facilities, promotion of aviation fuel efficiency enhancement, retrofit of commercial and industrial establishments and voluntary agreement program on the rationalization of tricycle operation.

Philippines – RW energy Targets Renewables in general Triple 2010 renewable power capacity by 2030

- Wind 2,378 MW by 2030
- Solar 285 MW by 2030
- Hydro 8,724.1 MW by 2030
- Geothermal 3,461 MW by 2030
- Biomass 315.7 MW by 2030
- Ocean 70.5 MW by 2030

Currently, among the major islands, Visayas has the highest installed capacity with 964 MW. Given the targets of the geothermal sector, there will be a continuing conduct of PECR to secure geothermal investments (there are 21 geothermal prospects under PECR). Existing service contractors will also be encouraged to undertake expansion and optimization projects. R&D efforts, on the other hand, will be exerted to develop low enthalpy geothermal resources as well as the non-power applications of geothermal.

Biodiesel

The country has made significant strides on the use of alternative energy for transport. With a favorable policy environment in place, the Plan targets to increase biodiesel blend from 2 percent to as high as 20 percent at the end of the planning horizon. This would result to significant fuel displacement of 102 million liters in 2009 to 1,885 million liters in 2030.

Bioethanol

For bio ethanol, the targeted blend is 20 percent from the existing 5 percent or the accelerated E10 that can be seen in the pumps. This will displace 1,340 million liters in 2030 from the current 169 million liters of fuel displacement. The realization of the biofuel target blends will consider factors such as supply availability (but not in conflict with food security targets), infrastructures availability and competitiveness and rational pricing.

Compressed Natural Gas

The government's program on CNG is covered under the Natural Gas for Vehicle Program for Public Transport. Under its pilot phase, the target is to have all of 200 buses commercially operating. By 2030, about 10,000 buses nationwide will be fuelled by natural gas. With the onset of the required policy support in the medium-term and the coming on stream of the critical infrastructure facilities, CNG buses are seen to increase commercial operation in Luzon and Visayas by 2015 and 2020 in Mindanao. Over 7.000 units are projected to run in the entire Luzon within the planning horizon.

Rural Electrification

The legacy of the Arroyo administration is to attain 100 percent barangay electrification. This is close to full realization as the country's barangay electrification level now stands at 99.5 percent. To date, there remains 22 areas yet to be energized which are either in far-flung locations, hard to reach or the last mile areas or there are incidence of peace and order. Majority of these problematic areas are in Mindanao.

Within the planning horizon, the PEP envisions a 90 percent household electrification level through the DOE and the National Electrification Administration-led Expanded Rural Electrification Program which also includes other attached agencies of DOE such as the Philippine National Oil Company, National Power Corporation and industry players.

A drive to reduce electricity shortages in the Philippines will see the country set out to become the largest geothermal energy producer in the world in line with efforts to increase its focus on renewable energy sources.

The need for the Philippines to develop its energy sector was highlighted recently by the World Bank, which raised its 2013 forecast for the country on the back of prudent economic policies and political stability, but also pointed to key issues requiring action. Electricity distribution stands at 70.18% of households but access in rural areas is particularly low.

The DOE is optimistic that the Philippines will manage to secure the $3bn-$5bn investment needed to reach its goal, citing the considerable potential for developing geothermal energy resources. Several private sector players have already stepped up their involvement in the geothermal energy segment, including Philippines-based Basic Energy Corporation, which plans to invest $1bn in geothermal projects once a partnership with a Chinese corporation is secured.

One component is the rural electrification program, which has an objective of achieving 90% household electrification by 2017.

Conclusion

The Philippines currently has the highest electricity retail tariffs in Asia (average of $0.18/kWh). In order to bring down this rate, the Philippines must change from fossil fuels to RE and allow private sector participation. RE development across the Philippines has increased and will continue to increase in the next decade.

H. Thailand

Located in Southeast Asia, with over 70 + million people, Thailand has the highest electricity demand, compared to other countries in Southeast Asia. They have approximately plan for increasing imports from neighboring countries such as Laos, Myanmar, and China.

The current installed capacity is 31,447 MW, with the majority of energy sources from natural gas (66%) and coal (20%) (EPPO, 2011). Non-hydro renewable energy contributes a minor (around 5%) but increasing share of total electric power generation (DEDE, 2010).

Thailand is one of the first Asian countries to implement a feed-in tariff (FiTs) program. This program was initiated in 2006 called the "adder" program, because it ensures guaranteed purchases and attractive tariff rates to eligible grid-connected renewable power project. As of December 2011, Thailand has about 8,000 megawatts of renewable energy projects in the pipeline seeking adder and about 1,000 megawatts already connected and selling power to the grid.

Thailand's Renewable Energy Policy

Thailand's electricity sector has evolved from a government monopoly to a semi-unbundled structure called the "Enhanced Single Buyer" model. Thailand major power players consist of the following:

- Electricity Generating Authority (EGAT) of Thailand;
- Independent Power Producers (IPPs);
- Small Power Producers (SPPs);
- Very Small Power Producers (VSPPs);
- Metropolitan Electricity Authority (MEA);

- Provincial Electricity Authority (PEA);
- Energy Regulatory Commission (ERC); and
- Ministry of Energy (MoE)

Electricity Generating Authority (EGAT) of Thailand owns about 50% of generation assets and 100% of transmission assets. Independent Power Producers (IPPs), Small Power Producers (SPPs), and Very Small Power Producers (VSPPs) own the other 50% of generation assets. They produce and sell power to the high-voltage transmission system owned by the single buyer EGAT. VSPPs also sell power through the two state-owned distribution systems. Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA) are the state owned distribution entities. The Ministry of Energy is responsible for the energy policies, including electric power and renewable energy policies. The ERC regulated the electric power and natural gas transmission in the country.

As of January 2012, Thailand had five separate long-term energy plans, each of which corresponds to a single or a group of energy sources and is prepared by different government divisions. The energy policy is carried out by different government departments, depending on the functions of the departments and there has been little co-ordination between these departments to assess how the plans can contribute to meet joint goals.

The five plans include:

- Power Development Plan (PDP 2010-2030);
- 15-Year Renewable Energy Development Plan (REDP 2009-2022);
- 20-Year Energy Efficiency Development Plan;
- Natural Gas Plan; and
- Natural Gas Vehicle Roadmap

Of particular relevance to this paper are the PDP and the REDP since they contain renewable energy targets. The PDP and the REDP can be seen as competing rather than complementary. The PDP specifies, 20 years into the future, a forecast of load growth, the additional capacity of power plants to be built to meet the forecasted load growth, the types of energy sources for new generation capacity, and the share of investment by EGAT and IPPs. The REDP seeks to bring renewable energy to 20% of final energy consumption by 2020 and sets targets for different forms of renewable energy. The two plans were prepared by different government departments and motivated by different policy drivers. As a result, the plans have set diverging targets for renewable power generation.

Between 2009 and early 2010, the early drafts of the PDP specified relatively low renewable energy targets and did not at first include the REDP as part of the inputs. In the process of finalizing PDP, two rounds of public hearings were held, from which members of the public pointed out the lack of consistency between the renewable energy projections in the REDP and the draft PDP (PDP Documents, 2010a; PDP Documents, 2010b). The PDP calls for much lower

Renewable Energy Status

Renewable energy accounts for about 8.2% and the government puts it in the "others" category, and industrial co-generation (combined heat and power) accounts for about 10% of total electricity supplied to the grid.

The PDP plans for high levels of conventional generation including new coal, natural gas, nuclear, and large-scale hydropower. The relatively high share of conventional generation, which is planned twenty years into the future, can potentially erode the need for decentralized and renewable energy in the country's generation mix. The REDP depends upon IPPs, VSPPs and other private sector organizations that require support from the government. The REDP has set goals to achieve specified capacity for different types of renewable energy, Table 1 shows 500 MW of solar power, 800 MW of wind, 324 MW of hydro power, 3,700 MW of biomass power, 120 MW of biogas power, 160 MW of MSW power, and 3.5 MW of hydrogen power by 2020. Table 2 shows that the achievement of these targets has been mixed, with on-grid capacity exceeding short-term targets for solar and biogas, and capacity far below targets for other types of renewables.

The share of renewable energy to the total electricity production of 153,392 GWh was 8.2% in 2011 (DEDE, 2012).

Table 1

Energy Type	Technical Potential	Capacity 2008	2008-2011 Targets		2012-2016 Targets		2017-2002 Targets	
(Electric power)	MW	MW	MW	Ktoe	MW	Ktoe	MW	Ktoe
Solar	50,000	32	55	6	95	11	500	56
Wind	1,600	1	115	13	375	42	800	89
Hydro	700	56	165	43	281	73	324	85
Biomass	4,400	1,610	2,800	1,463	3,220	1,682	3,700	1,933
Biogas	190	46	60	27	90	40	120	54
MSW	400	5	78	35	130	58	160	72
Hydrogen	0	0	0	0	0	0	3.5	1
Total	57,290	1,750	3,273	1,587	4,191	1,906	5,607.5	2,290

Table 2

Type of RE	15-Year Target (until 2022), MW	2008-2011 Target	Actual On-grid Capacity (SPP+VSPP) as of Dec 2011	Difference (+ = above target - = below target)	% difference (% above target or below target)
Solar	500	55	110.97	55.97	+101.76%
Wind	800	115	0.38	-114.62	-99.67%
Small/Micro Hydro	324	165	13.28	-151.72	-91.95%
Biomass	3,700	2,800	724.72	-2,075	-74.12%
Biogas	120	60	98.69	38.69	+64.49%
MSW	160	78	37.33	-40.67	-52.14%
Hydrogen	3.5	0	0	0	n/a

A comparison of Thailand's renewable energy targets and 2011 status

The Thailand power sector continues to outperform other countries in Renewables:

- On-grid solar energy capacity is 101% more than the target by government until 2011, i.e. 110.97 MW
- Biogas plants generated 64.5% more than target of 60 MW as of December 2011
- Small and micro scale hydro plants and wind generation have current capacity of about 13.28 MW and 0.38 MW against the set target of 165MW and 115MW till 2011 respectively

A case of REDP is considered for the analysis of the strategy of implementation by the government bodies in Thailand Ministry of Energy established the roadmap as strategy to promote renewable and alternative energy development for 25 percent in 10 years (AEDP: 2012-2021) through the following six strategic issues:

- Promoting the community to collaborate in broadening production and consumption of renewable energy
- Adjusting the incentive measure on investment from private sector appropriated with the situation
- Amending the laws and regulations which do not benefit to renewable energy development
- Improving the infrastructure as system of transmission line, power distribution line, including a development towards Smart Grid System

- Public relations and building up comprehensive knowledge for the people
- Promoting the research work as mechanism to develop the integrated renewable energy industry (Source: DEDE (2012))

Thailand is also one of the leading ASEAN countries to establish policies to promote biofuel production to reduce its dependency on oil imports and to capitalize on its supplies of feedstock from vast agricultural production. These Principles to the 'Energy policy of Thailand' are built as follows:

- To establish sustainable energy security
- To expedite and promote alternative energy
- To monitor energy prices and ensure appropriate levels, in line with wide and investment situation
- To effectively save energy and promote energy efficiency
- To support energy development while simultaneously protecting the environment

Bio Fuels Policy

Renewable energy consumption is expected to grow from 10.7% in 2011 to 14.1% in 2022 and the share of alternative energy consumption (including the NGV) is expected to grow from 15.6% in 2011 to 20.3% in 2022 respectively

Biofuels have an important role to play as their contribution in the renewable energy mix is expected to grow up to 4.1% by 2022

Year	No. of approved/registered Bio-ethanol plants			No. of approved/registered biodiesel plants		
	No. of biorefineries	Combined production capacity (Million Liters/Day)	Capacity in use (%)	No. of biorefineries	Combined production capacity (Million Liters/Day)	Capacity in use (%)
2006	5	0.78	48	3	0.6	1
2007	7	0.96	54	5	1.3	16
2008	11	1.6	58	9	2.3	68
2009	11	1.7	65	14	5.4	38
2010	19	2.9	40	13	5.4	41
2011	19	2.9	50	13	5.4	42
2012	24	4.8	42	13	5.4	50

(Source: Preechajarn and Prasertsri, 2011. Data for 2011 and 2012 are post estimates)

Thailand's renewable energy policy is not yet the central part of Thailand's long-term energy policy. This is one of the major impediments to Thailand's renewable energy development. The somewhat vague support for the Adder program has created a high level of uncertainty for investors.

Incentives

Besides FiT, the Thai government has put in place various low-interest loan options for different target groups, including large-scale investors and small-and-medium sized enterprises (SMEs). The major source of low-interest funding comes from the Energy Conservation Promotion Fund (ENCON Fund), which is collected from a tax per liter on all petroleum products sold in Thailand through Thailand's Revolving Fund Program. Large-scale investors in renewable energy projects can receive financial assistance in the form of low-interest loans with an interest rate ceiling of 4%.

Smaller-sized investments can receive financial assistance from the ESCO Fund in the form of equity investment (up to 50 million Baht or 1.7 million USD), venture capital, equipment leasing, and CDM project development.

In addition to financing options provided by the Thai government, the renewable energy projects in have received funding from international lenders, Asian Development Bank (ADB) World Bank's International Finance Corporation (IFC). The ADB's Solar Energy Initiative provided funding for two Bangchak Petroleum solar power plants totaling 34.5 MW and 9.3 MW respectively, as well as for the 73 MW Natural Energy Development solar electric power plant. IFC and the Clean Technology Fund are also financing two 6-MW solar power projects in Thailand.

In the case of biomass, most grid-connected power plants are owned by large agro-businesses with strong balance sheets, such as sugar mills, rice mills, and palm oil production plants. In the case of solar farms, companies that have been able to secure loans are often associated with other well-established businesses, including a television channel, a plastic surgery hospital, a solar manufacturing company, a petroleum company, and an Independent Power Producer (IPP). Financing for grid-connected renewable energy projects remains a challenge for developers in Thailand and Asia.

Issues and Potential Solutions

Thailand's renewable energy framework can still prosper from minor improvements to the following four areas: (1) planning and strategy (2) policy and regulatory framework for FiT (3) financing options, and (4) the technical environment:

Planning and Strategy: It may be important to consider having one plan. Unify the PDP and the 15 year REDP. One plan will make the energy policy simpler and easier for the expansion of RE. Thailand's FiT program is not backed up by a renewable energy law, it may be beneficial to integrate the RE and incentivize it in the FiT.

Policy and Regulatory Framework: RE can be characterized by a slow and cautious policy and regulatory framework. Challenges are still being worked out in the application process for adder support. The planning process for an updated FiT scheme should take lessons of successful FiT schemes in other the US and European countries and practice light-handed regulation wherever possible.

Financing options: Financial support does exist from both the private and public sector, both domestically and from international financers. The credit rating of the investors has played a key role in influencing the banks. In order for the market for RE to expand in a continuous and sustainable manner, there is a need for an increase in capacity building in private and public financial institutions to evaluate risks and opportunities in renewable energy

Supportive technical environment: Technical limits must be planned for and established by the transmission and distribution utility. Thailand may want to review the strategic planning of the grids in Europe and the US, this will open the many possibilities for the ASEAN Grid and integration of DE and RE.

Conclusions

Thailand has the foundation for a good renewable energy program. Barriers still remain but short term goals have been reached by solar and biogas energy.   The REDP has been replaced by a more ambitious Alternative Energy Development Plan (AEDP 2012-2021), which set higher targets for most types of RE, effective implementing mechanisms become even more important.

Thailand's renewable energy framework is still supply-side oriented. The energy policy is considering energy efficiency measures and policy enforcement with emphasis on creating demand for renewable energy. Renewable energy will move Thailand as the forerunner in the South East Asian Countries.

I. VIETNAM

Vietnam is one of the most challenged nations for electricity development. The electricity capacity of Vietnam system is 14,000 MW, of which hydroelectricity accounts for approximately 40%, and thermal electricity (including coal, FO oil, and gas turbine) 60%. Renewable energy is a small fraction and is now being explored to be a greater mix of the energy solutions. Changes in power generation proportion and form have remarkably reduced the dependence on hydroelectricity in the recent years.

In recent years, electricity sector has been put in the lime light and highly appreciated. The electricity sector in Vietnam has increased significantly. The number of households in rural areas using electricity has risen from 50% in 1996 to 88% in 2004 and to approximately 95% in 2007. The current distribution system has over 125,000 km medium voltage lines, 220,000 km low voltage lines and over 700 intermediary transformer stations with total capacity of 3,500 MVA and 160,000 distributing transformer stations with total capacity of more than 36,000 MVA.

EVN has significantly improved its infrastructure and is meeting the demand for electricity, which has risen significantly over the last decade and maintained basic services to the customers as well as kept relatively low cost in comparison with that of the world. Vietnam's rural electrification programs are one of the most successful in the world.

The electricity sector has developed at the rate of approximately 10-12.5%, however, it still cannot catch the demand of 20% annually. Vietnam government has encouraged investment in developing the electricity infrastructure in a proper way. In the coming time, a series of new plants will be put into operation; however, demands for electricity still remain a big challenge for Vietnam's development.

Major Stakeholders:

Electricity of Vietnam (EVN) is the state- owned entity responsible for developing, managing and operating state electricity assets. EVN is managing most power stations. EVN has control of 77% the total generated electricity and 79% the entire country's total electricity output. (EVN) is the largest power company in Vietnam having an installed electricity generation capacity of 8,860 MW and a distribution network of 19,396 kilometres (12,052 mi). According to 2007 UNDP report on the 100 largest enterprises in Vietnam, EVN came in at 3rd position after Agribank and VNPT.

EVN is also the sole manager of the national electricity network in operating the electricity transmission system, and at the same time owning all electricity companies which sell electricity from the national network to users.

The biggest electricity companies are:

- Electricity company No. 1 (in the North)
- Electricity company No. 2 (in the South)
- Electricity company No. 3 (in the Central area); and
- Companies managing the distribution system in Hanoi, Ho Chi Minh city, HaiPhong and Dong Nai provinces.
- Other important members of EVN include 4 transmission companies, 4 consulting companies, a national power system moderated center and some companies producing equipment.

The Prime Minister of Vietnam approved the national power development plan for the 2011-2020 period with the vision to 2030 (the "Power Master Plan VII") on 21 July 2011. The Power Master Plan VII puts strong emphasis on energy security, energy efficiency, renewable energy development and power market liberalization. The Power Master Plan VII sets out six key directions and four specific targets for Vietnam's power development in the next 20 years:

Six Key Directions

1. Integrate the development of the power sector into the socio-economic development strategy of Vietnam and ensure sufficient supply of electricity for the national economy and social life.

2. Combine the efficient use of domestic energy resources with the reasonable import of electricity and fuels and diversify the primary energy resources for power generation and fuel conservation and ensure energy security for future.

3. Improve the quality of electricity and electricity services step by step and adjust the electricity tariffs according to the market mechanism to encourage investment in power sector and efficient use of electricity.

4. Develop the power sector in parallel with the protection of natural resources and the eco-environment to ensure sustainable development of the country.
5. Create a competitive power market by diversifying the form of investment and trading of electricity. The State shall hold monopoly only in the power transmission network in order to ensure security of the national energy system.

6. Develop the power sector based on reasonable and efficient use of primary energy resources in each region and continue the promotion of rural electrification to ensure sufficient, continuous and safe supply of electricity to the whole country.

Four Specific Targets:

1. Increase the aggregate output of imported and produced electricity from 194-210 billion kWh by 2015 to 330-362 billion kWh by 2020 and 695-834 billion kWh by 2030.

2. Give priority to the development of power generation from the renewable energy so that the proportion of electricity generated from the renewable energy will be increased from the present 3.5% of the total electricity production to 4.5% in 2020 and 6% in 2030.

3. Reduce the average energy elasticity ratio (the ratio between the growth rate of energy consumption and the growth rate of GDP in the same period) from the current 2.0 to 1.5 in 2015 and 1.0 in 2020.

4. Promote the rural electrification program in rural, mountainous and island areas so that most of the rural households will have access to the electricity by 2020.

National Power Development Plan

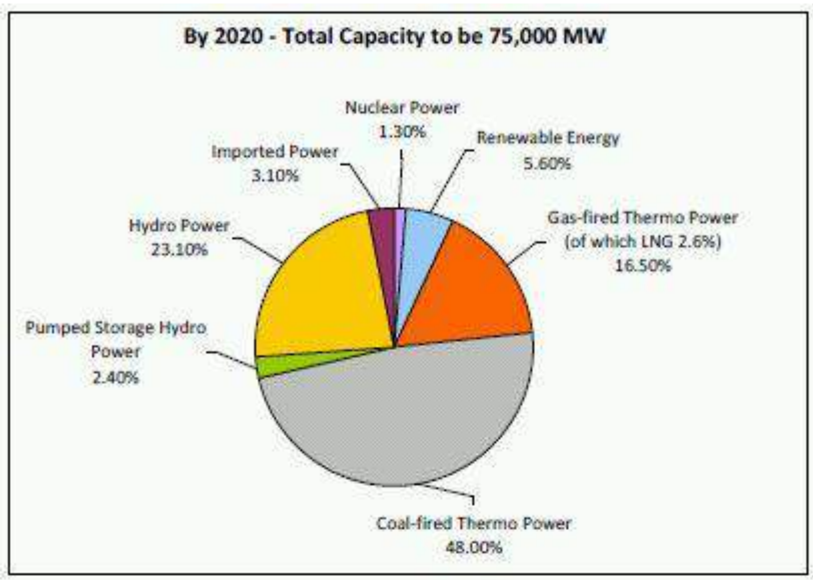
The Power Master Plan VII sets out high-level strategies for the national power development in four main areas:

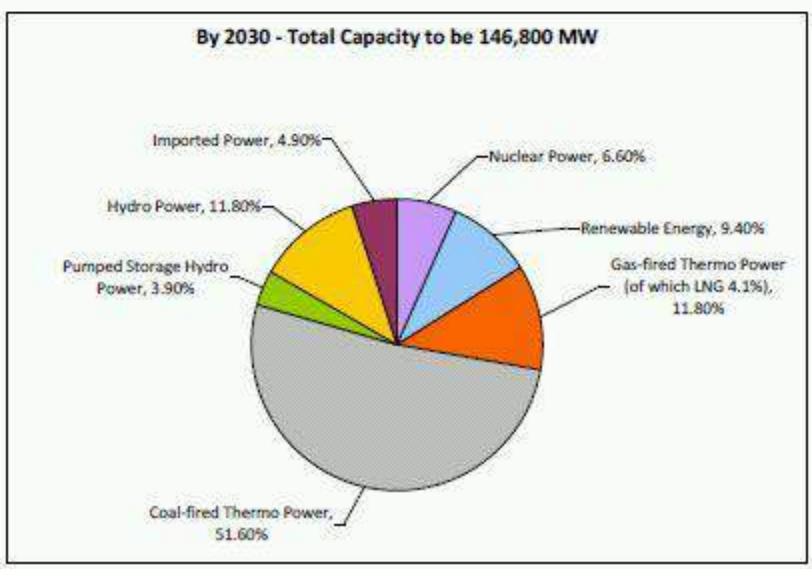
1. Development of power sources;
2. Development of power transmission grid,
3. Interconnection of power networks with other regional countries, and
4. Electricity supply to rural, mountainous and island areas.

1. Development of Power Sources

The Power Master Plan emphasizes a balanced development of power sources in each region of the country (North, Central and South Vietnam) to ensure the power source reserve capacity is shared effectively. It envisages that the aggregate power generation capacity of all the power plants in Vietnam will be increased to about 75,000 MW by

2020 (with produced and imported electricity reaching 330 billion kWh) and 146,800 MW by 2030 (with produced and imported electricity reaching 695 billion kWh). The charts and table below show the targeted capacity of plants that generate power from each of the hydropower, pumped storage hydropower, coal-fired thermo power, gas-fired thermo power and renewable energy by 2020 and 2030 and their respective percentage in the total capacity under the Power Master Plan VII:





	Targeted Capacity by 2020	Targeted Capacity by 2030
Wind Power	1,000 MW	6,200 MW
Biomass Power	500 MW	2,000 MW
Hydropower	17,400 MW	/
Pumped Storage Hydropower	1,800 MW	5,700 MW
Gas-fired Thermal Power	10,400 MW (with electricity production of about 66 billion kWh)	11,300 MW (with electricity production of about 73.1 billion kWh)
Coal-fired Thermal Power	36,000 MW (with electricity production of about 156 billion kWh)	75,000 (with electricity production of about 394 billion kWh)
Nuclear Power	First nuclear power plant to be put into operation.	10,700 MW (with electricity production of about 70.5 billion kWh)
LNG Power	2,000 MW	6,000 MW

Coal-fired power plants will still remain the most important source of electricity in Vietnam. To secure the supply of coal, Vietnam will speed up its negotiations with other nearby countries to import coals from them on a long-term and stable basis. On the other hand, the State will give its top priority to the development of power sources from renewable energies such as hydropower, wind power, solar power and biomass power in the next decade, especially hydropower projects with multiple functions (e.g., flood control, water supply, power production). Financial incentives will also be given to enterprises that develop new and renewable energy from agricultural wastes and garbage of the cities. The State targets to put the first nuclear power plant into operation in 2020 and develops more nuclear power plants going forward with the hope that electricity generated from nuclear energy will account for about 10.1% of the total power output by 2030.

2. Development of Power Transmission Grid

The State will make further investment in the national power transmission grids to bring their development in line with the national and local power development plans, increase the reliability of power supply, reduce power losses during transmission and ensure favourablemobilization of power sources in the rainy season and dry season and in all operation regimes of the power market in Vietnam. The national power transmission grids will be improved to comply with N-1 criterion. Whilst voltage level of 500kV will remain the main super-high voltage for power transmission in Vietnam, the State will carry out further research on the development of power transmission networks at voltage levels of 750kV, 1000kV and by high voltage direct current transmission system after 2020.

3. Interconnection of Power Network with Regional Countries

The State will also implement cooperation programs with other countries in the ASEAN such as Laos, Cambodia and China and the Greater Mekong Sub-region for inter-connection of Vietnam's power networks with the respective countries via power transmission networks at voltage levels of 110-220- 500 kV.

4. Electricity Supply to Rural, Mountainous and Island Areas

New investments will be made in improving and upgrading the national power grid and developing local power sources from renewable energy for power supply to the rural areas with a view that 100% of the communes and 98.6% of the rural households will have access to electricity in 2015 and almost all rural households will have access to electricity in 2020. Rural electrification will continue to be carried out to speed up agricultural and rural industrialization and modernization.

Capital Investment Required

To implement the Power Master Plan VII, approximately USD 48.8 billion is required for 2020, of which two-thirds will be used for power generation development and one-third for power network development, and up to approximately. Another USD 75 billion for the period from 2021 to 2030, of which 65.5% will be used for power generation development and 34.5% for power network development.

In view of the huge capital requirements (estimated to be a total of USD123.8 billion) for developing the power sector in the next two decades, the Power Master Plan VII sets out various policies to attract foreign investment including diversifying the form of investment, reducing the capital raising costs for power projects and forming local and overseas joint ventures in construction and development of power projects.

To address one of the root problems in attracting foreign investment, the State will raise the electricity tariffs step by step to 8-9 US cents per kWh by 2020 in order to bring the electricity tariffs closer to the market price to ensure reasonable returns for the investors. The State will also gradually eliminate its monopoly on electricity distribution in order to create a competitive power market and only holds its monopoly on power transmission to ensure national energy security.

New Hopes under the Power Master Plan VII

The most obvious change in the Power Master Plan VII is a breakaway from catching up with the national electricity demand at all costs. The Power Master Plan VII sets the total additional capacity source for the 2016-2025 period at 61,283 MW, far below the figure of 121,524 MW as forecasted in the Power Master Plan VI. The latest plan focuses instead on upgrading the power network and technologies used for power generation and energy efficiency so that power can be generated and consumed more efficiently. The reduction of energy elasticity ratio from the current 2.0 to 1.0 by 2020 as highlighted as a specific target in the plan will also considerably cut the investment required to accelerate the power generation after 2015 and help solve the problem of coal supplies to thermal power plants. The State's attitude to gradually abolish the price subsidies on electricity tariffs will also exert a considerable pressure on household consumers and companies in Vietnam to use electricity more efficiently. With a combination of efforts on balanced development of power sources, investment in energy efficiency and power market liberalization, the Power Master Plan VII will hopefully show a higher possibility of satisfying the power need of the fast-growing economy of Vietnam.

Renewables

The Vietnam government's Decision No. 1855/QD-TTg (2007) presents the Vietnam energy development strategy up to 2020: The vision targets for a share of

3% by	2010
5% by	2020
11% by	2050

The government plans additional capacity of renewable electricity in the future to consist of 241 MW/year in the period 2006 to 2015 and 160 MW/year in the period 2016 to 2025, equalling a total 4050 MW renewable electricity capacity by the year 2025.

Additionally, the Vietnamese government presents a scheme on the development of biofuels up to 2015 with a vision to 2025. It aims for an annual output of 100,000 tons of E5 and 50,000 tons of B5 by 2010 in order to satisfy 0.4% of the whole country's gasoline and oil demand by that time.18 By 2015, ethanol and vegetable oil projection is planned to reach 250,000 tons (enough for blending 5 million tons of E5 and B5), satisfying 1% of the whole country's gasoline and oil demand. By 2025 the ethanol and vegetable oil output should reach 1.8 million tons, satisfying some 5% of the whole country's gasoline and oil demand.

A Renewable Energy Master Plan is finished and in the first announcement of the Renewable Energy Master Plan, it is stressed that the plan will give priority to low cost renewable energy sources such as:

- small scale hydropower
- sugarcane bagasse
- municipal solid waste
- geothermal power
- wind, rice husk
- renewable heat, and
- bioenergy.

Priority will also be given to off-grid projects related to rural electrification in remote areas with a focus on developing RE for areas where costs of RE are lower than diesel electricity or connection to the national grid.

Status of Power Sector and Renewables

Hydro: The hydro energy economic potential is estimated at 84 TWh/yr, which is more than the electricity consumption of 46 TWh in 2005.

Hydro Pump Storage: Vietnam's economic potential is over 10,000 MW of hydro pump capacity. These resources are mainly located in the northern and southern areas of the country.

Geothermal: With more than 300 hot streams from 30 °C to 148 °C, Vietnam is preliminarily estimated to have 1, 400 MW that could be developed for direct use and producing electricity. In which, 400 MW geothermal capacity could be developed for producing electricity up to 2020.

Biomass: Biomass resources that could be used for generating electricity include rice husk, paddy straw, bagasse (sugar cane, coffee husk, and coconut shell), and wood and plant residue with a potential of 1000-1600 MW.

Solar: Vietnam lies from 23° to 8° North latitude and has good constant solar sources. In the southern and central areas, solar radiation levels range from 4 to 5.9 kWh/m2/day uniformly distributed throughout the year. The solar energy in the north estimated to vary from 2.4 to 5.6 kWh/m2/day.

Wind: Vietnam has approximately 513 GW of theoretical capacity. Excluding restrictions on the exploitation of the potential, 120.5 GW of wind power capacity, about 10 times the peak load demand in 2005 is estimated economically feasible for producing electricity.

To meet the rapid increase in electricity demand forecast for 2010-2030, Vietnamese organizations are considering different economic alternatives for expanding the electricity generation system. Fuels considered economically viable for producing electricity are domestic fossil fuel resources and imports, including imported electricity. The availability of domestic fuels supply is based on exploiting estimation scenarios of natural gas and coalmining industries locally. The possibilities for importing fuel or electricity sources have been estimated depending on their availability and national financial resources. The electricity import is mainly from hydro sources via ASEAN power interconnection system projects that have been concurred or negotiating with neighbor countries such as China, Lao, and Cambodia. The success of these projects depends on involved countries' economic development, impacts of international market pricing level, national strategy on bilateral and multilateral cooperation, etc....

Issues and Barriers

Financial and Infrastructural Issues: EVN, the single-buyer of electricity, has no obligation to buy from renewable energy projects. There is a lack of commercial business and infrastructure to provide renewable electricity-generation equipment and services, and a limited access to finance for customers, businesses and project developers. This sends the wrong signal to investors in the renewable sector.

Information and Technical Capacity: There is insufficient awareness/information on renewable technologies and data on the national potential of renewable energy sources. The estimates for renewable energy in Vietnam are varied from different reports. There is insufficient (R&D) which leads to unreliable national estimates of renewable energy sources and their technological development, and makes it difficult for planning programs. There is also a lack of access to technology, skilled manpower, training facilities and R&D facilities are so far hindering the promotion of renewable energy technologies in Vietnam.

Institutional and Legislative Concerns: The Government sectors that oversee the renewable energy require training and understanding of the new approaches available in the market to deploy renewable energy technologies into the grid. The government is one of the largest barriers to the successful adoption of these technologies. Specially, the current policy and regulatory framework for promoting the usage of renewable energy is inadequate to drive its development.

Conclusion

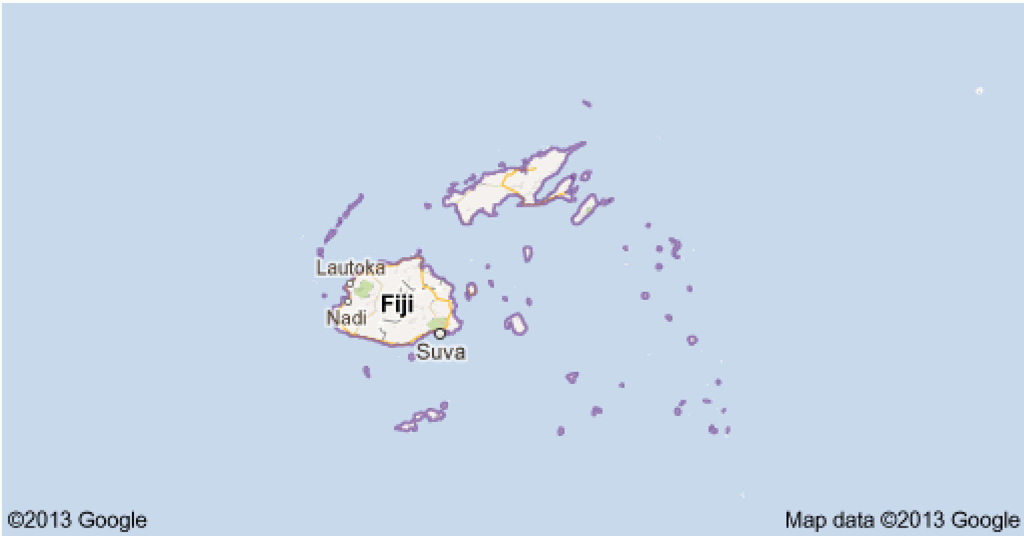
The barriers are still playing a major role in Renewable Energy development. RE has a large potential in Vietnam and could have an impact in the near future as part of the national plan to generate electric power in Vietnam. The grid can accommodate small renewables. The demand for electricity services from 2013-2030 may exceed the domestic fuels supply sources for generating electricity in Vietnam. The country, thus, need to import electricity energy, coal and natural gas from 2015 and 2016.

At a moderate assumption level of fossil fuels prices, 4.4 GW of the renewable energy capacity potentially available could now become cost-effective for replacing conventional fuel-generating capacities to produce electricity in Vietnam. Of the capacities that could operate cost-effective, small hydro energy accounts for 45.5%, geothermal accounts for 31.8%, and biomass energy (bagasse, rice husk, and paddy straw) accounts for the remaining 22.7%. With the contribution of renewables capacities, the share of electricity generation provided by coal fuel could be reduced by 5%. This would reduce the total cumulative CO2, SO2, and NOX emissions by 8.2%, 3%, and 4%, respectively during the period 2010-2030.

The electricity production of small and mini hydro energy would be increasingly exploited up to its maximum potential of 4 GW to meet the requirement of energy independence and energy security over the specified period. Vietnam's available renewable energy sources are vast and could potentially contribute to energy mix, security and independence by 2030.

PACIFIC ISLAND COUNTRIES

J. Republic of Fiji



Republic of Fiji is one of the most developed economies in the Pacific island. It is comprised of more than 332 islands, of which 110 are permanently inhabited, and more than 500 islets, amounting to a total land area of circa 18,300 square kilometres (7,100 sq mi). The two major islands, VitiLevu and Vanua Levu, account for 87% of the populations (850,000).

Fiji is different to other countries in the region that rely on diesel-based electricity generation for their power supplies. Between 2002-2008, oil imports rose from approximately 5% to 12% of Gross Domestic Product (GDP) which meant a negative impact on Gross National Income of 7 per cent, and may have contributed to a week economic performance. In Fiji, energy security has been of vital concern and used to support a range of investments in renewable energy technologies. Fiji Electricity Authority (FEA), the monopoly provider of grid based electricity in Fiji, had stated that over the next 10 years, its goal will be to implement renewable energy projects while reducing its fuel consumption and decrease its exposure to oil price volatility. The FEA has also established a goal of generating 90 per cent of its electricity using renewable energy technologies by 2011(100 % 2013).

Fiji has a peak load of 138 MW. The main sources of electricity in Fiji are hydro-power and oil-based generation. The VitiLevu grid, known as the VitiLevu Interconnected System (VLIS) the largest of these grids represents over 94 per cent of FEA generation. It also accounts for almost all electricity produced by renewable technologies, with most electricity generation in the three small grids produced using oil-based generators. In2009, the FEA supplied a record 777 GWh of electricity, which represented a 47 per cent increase on generation in 1999.

The FEA operates four electricity grids:

1. Island of VitiLevu;
2. Islandof Vanua Levu(the Labasa and Savusavu grids);
3. Ovalau Grid.

Depending on various weather rainfall patterns, hydro-power generates between 48 and 65 per cent of Fiji's grid supplied electricity and the remaining is Oil-based generation. Independent power producers provide about 3 per cent of Fiji's electricity (generating power from bagasse (in the sugar industry) and biomass (in the timber industry)), which is sold to the FEA. Wind and solar technology provide less than 1 per cent of FEA power.

Policy Initiatives

Fiji is initiating new policies to advocate renewable and decentralized energy and the following targets are set forth:

1. Review/Reorganization of the State Owned Utility;

2. Regulatory overhaul to set the tariff rates in the country (based on the various customer types) – Increase IPP tariffs to around 23 cents;

3. Review Net Metering and Feed in Tariffs;

4. 90% Renewables for the Electricity Sector in 2015;

5. Restructure the Regulation (all currently handled by the Fiji Commerce Commission (for all public utilities; telecom, water, energy (petroleum & electricity));

6. Major Fiscal Incentives for Renewables;

7. Incentives for biodiesel (diesel used for blending with biodiesel has a duty of only $0.05/L compared to $0.18/L. Concession of $0.13/L is provided);

8. 10 year tax holiday is available to a taxpayer undertaking a new activity in processing agricultural commodities into bio-fuels as approved by the Commissioner from 1 January 2009 to 31 December 2014. To qualify, the taxpayer must have:
    a. Minimum level of investment of $1,000,000; and
    b. Employ 20 local employees or more for every income year.

Prevailing Major Fiscal Incentives for Renewables Industry	**Items**	**Fiscal**	**Vat**

Bio – Fuel Projects – Companies involved in the production of Bio-Diesel and Ethanol	Plant, machinery and equipment for initial establishment of the factory Chemical required for bio-fuel production	Free	15%
Renewable Energy Goods	Wind, Solar, Hydro, Geothermal and Biomass (Items include turbines, panels, batteries, cogeneration plants etc.)	Free	15%

Projects:

The FEA has also continued to purchase electricity from the Fiji Sugar Corporation and has begun buying electricity from a 9.3 MW biomass plant operated by Tropik Wood. These measures have decreased the use of fuel oil and diesel.

The FEA is constructing a 40 MW hydro-power plant in Nadarivatu with a concessionary loan from China (expected to generate about 101 GWh of electricity per year, or a little more than one-fourth of power production at Monasavu). The Nadarivatu hydro-power scheme,will be the second largest hydro scheme built in Fijian history (FEA 2007a, 2008a). Other investments in Fiji include the Butoni wind farm, installation of co-generation plants in the timber and sugar industries, and various smaller hydro-power schemes.

Conclusion

As Fiji is embarking on a new policy of 100 renewable, there will be multiple opportunities for IPP to invest and generate electricity. The visionary move to 100% renewable is the first of its kind in Asia. This measure is a costly measure as major loans are being taken. Fiji has an abundance of renewable (hydro, solar & biomass) resources which may be utilized to increase electricity generation. The power grid may be small but can accommodate the various decentralized/renewable generation and may not require a major redesign of the transmission and distribution sectors. Fiji is embarking on an improved investment environment for energy with renewables as the key source. This policy should lead the way to attract more investment in the sector.

DEVELOPED COUNTRIES

K. Australia

Australia is abundant in high quality/diverse energy resources (34% - uranium resources, 14% black coal, and up to 2% natural gas of world's energy resources). Australia also has large wind, solar, geothermal, hydroelectricity, ocean energy and bioenergy resources.

Gross electricity generation is projected to grow by around 49 per cent (1.1 per cent a year) to reach 377 terawatt hours by 2049-50 and a significant amount of this growth is expected to come from expansion of renewables and gas-fired electricity generation. The use of renewable energy resources in electricity generation is projected to rise by 4.8 per cent a year, from 13 per cent of total generation in 2012-13 to 50 per cent in 2049-50.

Australia is the world's ninth largest energy producer, accounting for around 2.4 per cent of the world's energy production (IEA 2012a). The main fuels produced in Australia are coal, uranium and gas. The following is the list of Energy Production:

Coal	60%
Uranium	20%
Gas	13 %
Crude oil & LPG	6%,
Renewable energy	2 %

About half of Australia's electricity is expected to be generated by renewables by 2049-50. The use of renewable energy resources in electricity generation is projected to rise by 4.8 per cent a year, from 13 per cent of total generation in 2012-13 to 50 per cent in 2049-50. Wind is expected to be the largest source of renewable electricity generation (21 per cent by 2049-50). Solar is projected to be the second largest contributor (16 per cent by 2049- 50), and is the fastest growing of all sources over the projection period.

The strong growth in renewable electricity generation is a result of the increased competitiveness of renewable technologies under carbon pricing, as well as expected advances in technologies and a decline in their capital cost.

Australian production of renewable energy is dominated by bagasse, wood and wood waste, and hydroelectricity, accounted for 80 per cent and Wind and solar energy accounted for the remainder 20 % of renewable energy production in 2010-11. Australia's energy resources are expected to last for many more decades. In addition, many of Australia's renewable energy resources are largely undeveloped.

Energy policy

Australia has an integrated energy policy which is developed and implemented through the state and territory governments. The main objective of the national energy policy is to deliver secure, reliable, clean and competitively priced energy to consumers and build national wealth through the safe and sustainable development of Australia's energy resources. Central to this is the commitment to competitive and well-regulated markets operating in the long-term interests of consumers and the nation (Australian Government 2012).

Renewable Energy Target (RET)

Australia has adopted a policy to deliver at least 20 per cent of Australia's electricity from renewable sources by 2020. The RET of 20% by 2020 provides support for renewable energy investment and industry development in the transition period to more mature carbon prices and technology costs.. The RET, which commenced in 2010, expands on the previous Mandatory Renewable Energy Target (MRET) which began in 2001.

The RET creates a guaranteed market for renewable energy deployment, using a mechanism of tradable certificates created by large-scale renewable energy generators and owners of small-scale solar panel, wind, and hydro systems. Demand for these certificates is created by placing a legal obligation on entities that buy wholesale electricity (mainly electricity retailers), to source and surrender certificates to the Clean Renewable Energy Regulator.

The certificates are created by:

1. Installation of solar water heaters, solar panels and small-scale wind and hydro systems under the Small-scale Renewable Energy Scheme (SRES). These are known as Small-scale Technology Certificates (STCs); and
2. Renewable energy power stations under the Large-scale Renewable Energy Target (LRET). These are known as Large-scale Generation Certificates (LGCs).

Certificates can be traded directly between power stations, RET liable entities, small-scale system owners, and other traders, through a self-regulated open market, where the daily price is set by market supply and demand.

STCs may also be traded for a Government-guaranteed $40/STC via the STC Clearing House. The Clean Energy Regulator does not set the price of certificates (unless they are purchased through the STC Clearing House), nor does the Clean Energy Regulator receive any money from certificate sale, purchase, or surrender.

The RET commenced in 2010 aims to have 45,000 gigawatt hours of electricity come from renewable energy sources by 2020. In January 2011, the RET was split into the voluntary Small-scale Renewable Energy Scheme (SRES) and the mandatory Large-scale Renewable Energy Target (LRET). The LRET's target for electricity to be sourced from renewable sources is 41,000 gigawatt hours by 2020. And SRES is 4,000 gigawatt hours by 2020. The cost of integrating renewable energy into electricity grids is dependent on the overall mix of generation technologies. It is estimated that wind/solar and other RE integration costs associated with balancing may increase the overall cost of electricity by as much as $9/MWh.

The IEA (2011) has also identified methods and opportunities to reduce integration costs through the use of 'flexible resources'. These flexible resources - which already exist in electricity grids to varying degrees - include quickly dispatchable conventional power plants (e.g. hydro power, OCGT), storage facilities (e.g. pumped hydro), demand side management and response, strengthened grid interconnection, wind forecasting and market design (e.g. intra-hour trading). Several of these flexible resources (e.g. increased OCGT capacity, improved wind forecasts, intra-hour trading) are already being utilized in Australian electricity markets.

Solar roof-top PV was not included as a separate technology in the current projections which are confined to network generation. Nonetheless, following AEMO (2012), roof-top estimates are explicitly added to the electricity generation projections.

Conclusions

The energy consumption will continue to grow over the next decade and this growth is expected to come from renewables. Australian has vast renewable resources which the government is prepared to use and exploit. Renewable energy is projected to have the strongest growth prospects. Solar, wind and geothermal have the highest growth prospects over the next decade. The share of fossil fuels is forecasted to decline from 87 % in 2012-13 to 50 % of total electricity generation by 2050.

Wind is expected to be the largest source of renewable electricity generation (21 per cent by 2049-50). Solar is projected to be the second largest contributor (16 per cent by 2049-50), and is the fastest growing of all sources over the projection period.

This strong growth in renewable electricity generation is a direct result of the increased competitiveness of renewable technologies and decreased capital cost of renewable technology.

L. Republic of Korea

South Korea is the world's 10th largest energy consumer and imports up to 97% of its energy sources. The power sector in South Korea accounts for approximately five - six percent of the Asia Pacific regional power generation.

The energy mix is as listed:

1.	**Oil:**	**43 %**
2.	**Coal**	**24 %**
3.	**Liquefied natural gas (LNG)**	**15 %**
4.	**Nuclear**	**15 %**
5.	**NRE**	**3 %**

As the economy grows and market size increases, the South Korean power sector is expected to have a moderate growth up to 2015. South Korea has one of the most solid economies in the world and requires stable environmentally friendly power at reasonable tariffs.

1st National Basic Energy Plan (2008-2030)

In 2008, as a support for its "Low-carbon Green-growth" initiative in the energy sector, Korean government announced the nation's first 20-year long-term energy plan which is a guideline for other energy-related government plans such as the Basic Plan for Long-term electricity supply and demand. The plan indicates that the energy intensity will be decreased from 0.341 to 0.185 by 2030, and the NRE (New & Renewable Energy) will be expanded from 3% to 11% of total energy supply by 2030, while reducing the fossil energy ratio (based on the primary energy level), including oil, to 61% by 2030 from 83% at present.

In order to decrease the energy dependency on foreign fossil-fuels, the Republic of Korea Government (ROKG) has developed mechanisms to promote new and renewable energies (NRE). ROKG new National Energy Plan (2008) is dubbed the "Low Carbon, Green Growth Plan," and the first long-term energy plan to serve as the major policy for energy generation and use up to 2025.

ROKG aims to increase the NRE generation from 3% to 11% by 2030. More specifically:

1. Photovoltaic power will increase - from 80 MW to 3,504 MW (44 times);
2. Wind energy - from 199 MW to 7,301 MW (37 times);
3. Bio energy from 1,874 KGcal to 36,487 KGcal (19 times); and
4. Geothermal energy from 110 KGcal to 5,606 KGcal (51 times).

Renewable energy still is at a disadvantage due to the high costs and low returns compared to conventional power generation, however NRE is based dependant on the government's policy to make it viable. ROKG's is providing some incentives to for NRE:

1. Providing financial incentives such as subsidiaries, low interest loans, tax reduction/exemption, and feed-in-tariffs to power generation companies using NRE.
2. Mandating government owned entities must use NRE to supply a growing portion of their needs.
3. From 2012, Renewable Portfolio Standards (RPS) is to be applied to major power generators. A certain portion of their supply of electricity is to be generated by renewable energy.

NRE

• Waste-to-energy	77%
• Small hydro covers	13.9%
• Bio	6.6%
• Wind	1.4%
• Solar Thermal/PV	0.8%
• Geothermal	0.2%.

Korea has very strong regulations promoting waste recycling (i.e - energy from wastes). Most solid wastes generated from industry and households are reused, recycled or incinerated for energy (electricity or Combined Heat and Power). The remaining NRE sub-sectors include fuel cells, tidal power, hydrogen power, etc.

One of the most critical parts of ROKG's incentives for market development is the feed-in-tariff (FIT), incentive structure to encourage the adoption of NRE. Under FIT, Korea's electricity utilities are mandated to buy electricity generated using NRE over conventional energy at a ROKG-fixed price. Depending on NRE subsectors, the fixed price can be as high as 10 times that of the market price of traditional electricity cost, a.k.a., System Marginal Price (SMP). ROKG compensates for the cost difference between SMP and the fixed price.

Example: If an electricity utility buys photovoltaic energy at 500 Won per KWh, and the SMP is just 50 Won per KWh, ROKG feeds in 450 won to the utility to offset the cost difference.

ROKG's FIT system has been the key market driver behind NRE in Korea. But ROKG recently noted that FIT makes it difficult for ROKG to forecast electricity generation in the future, and also does not bring in the concept of competition within the industry. To address this issue, ROKG has set a policy to adopt Renewable Portfolio Standard (RPS) that will mandate power companies generate certain amount of electricity using NRE. ROKG plans to adopt RPS to replace existing FIT starting in 2012. The RPS applies to power generators with a capacity of 500MW or more, Korea Water Resources Corporation and Korea District Heating Corporation (Target Generators) – covering 13 publicly-owned and privately-owned power generators.

The RPS does not directly regulate retail suppliers but instead imposes obligations on power generators. Both publicly-owned and privately-owned power generators are subject to the RPS. This is because only one power retail distributor exists in the Korean market and most of the big power generators are still owned by the public sector. The renewable portfolio to be supplied by Target Generators starts from 2% of all power generated (net of power from renewable resources) in 2012, increasing by 0.5% each year up to 2016. Thereafter it will rise by 1% per annum until 2022, by which time the portfolio amounts to over 10%. This ratio may be subject to adjustment based on a review of technology, performance and other circumstances by the MKE every three years. The MKE is responsible for announcing the amount of energy subject to the RPS, as well as the Carve-out-RPS applicable to each Target Generator for a given every year. Target Generators are permitted to borrow up to 20% of the total amount of renewable energy they require for a given year from their renewable portfolios for the following years by submitting the reason for borrowing and quantity to be borrowed.

Photovoltaic power

Korea has seen a drastic growth in solar power generation for the last several years. Its very first solar power plant was built in 2004, which had a generation capacity of 200 KW. Today, Korea has more than 800 solar power plants across the nation, of which total capacity exceeds 292 MW, and there are several hundreds of new solar power plants to be built in a few years. Some of the recently built ones have much greater generation capacity, which include a 24 MW one in Sinan-gun, southwest coastal part of South Korea. The Sinan plant is one of world's largest solar power plants of all, and the largest one equipped with a sun-tracking system, as of today. With ROKG's goal to increase solar power capacity to 3,504 MW by 2030, there will be much more solar power plants to be built, and some of them will have even greater capacity than that of the Sinan plant. Crystalline solar cells have been the dominant form of solar power technology in Korea, but thin-film solar cells is gradually taking up the market and is experiencing significant demand growth in the past year.

Ninety percent of its clean energy investments are in the solar sector. More than 150 MW of solar generating capacity was added in 2011, mostly utility-scale projects.

Wind power

Total wind power generation capacity is 199 MW. The largest wind power plant is located in Pyungchang-gu, in the northeastern part of South Korea and generates 98 MW electricity from 49 wind turbines. The electricity generated is supplied into 50,000 households in the region. Jeju Island on the southwest is also a popular place for wind power plants as it has sustained winds, and its position as the premier Korean vacation destination means it is not well-suited for building polluting, conventional power plants. 50 MW of wind also was added in 2011.

The Korean government plans to invest $8.2 billion into offshore wind farms in order to reach a wind capacity of 2.5 billion kW by 2019. Wind power is one of the most economically viable renewable energies without ROKG incentives.

Fuel Cells

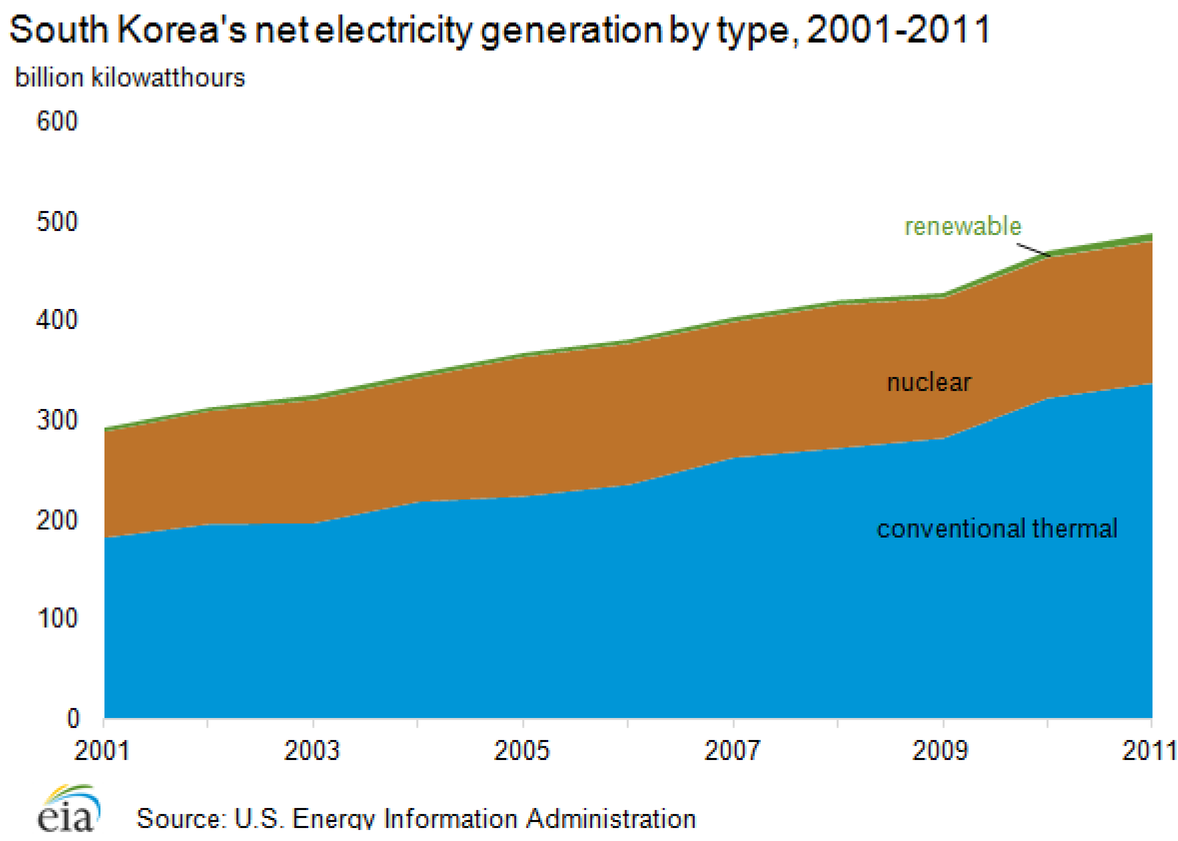
Korea is home to the world's largest hydrogen & fuel cell power plants. Three cities (Pohang, Gunsan, Jeonju) have a hydrogen & fuel cell plant, each of them having a capacity 2.4 MW that can cover electricity needs of about 2,000 households.

The local government of Seoul Metropolitan City just announced that it would have two hydrogen fuel cell power plants in two residential areas, Mokdong and Nowon, of which combined capacity will be 5.2 MW. While photovoltaic and wind energies require vast amount of land, and their efficiency is highly subject to uncontrollable weather conditions, fuel cells is much less limited in this regard. The fuel cells industry is forecast to grow to be one of most rapidly growing NRE sectors in the future.

Marine energy

As a peninsula with 3 coastlines, Korea has easy access to marine energy. Though still in the developmental stage, Korea is very close to fully commercializing such technologies. Construction projects going on alongside the coastal line include a tidal current power plant, in Uldolkmok in southwest of Korea. Tidal current power (a.k.a. tidal stream power) derives energy of moving water like wind power that use moving air. The ongoing, first-phase, test-bed project at Uldockmok plant is going to generate MW electricity, world's largest in its kind. When the last-phase project is completed as planned, it will have a combined capacity of 50 MW.

Tidal power is derived from potential energy between low and high tides. The world's largest tidal power plant is under construction in Sihwa, in the west coast of Korea. The construction is forecast to be completed by 2009 when it will generate 254 MW of electricity. ROKG is very ambitious for the development of tidal power industry, and has plans to build several very large-sized tidal power plants including Saemangum (400 MW), Garorim (520 MW), Chonsuman (720 MW), Gwanghwa (810 MW), Incheonman (1,140MW), all along the west coastline. The cost of electricity generation from tidal power is identified as the lowest among the competing NRE, so the ROKG is actively pushing the further development of the industry.



Stakeholders: Korea Electric Power Corporation (KEPCO)

The state-owned Korea Electric Power Corporation (KEPCO) is the main player for electricity generation, retail, transmission, and distribution. In 2001, KEPCO's generation assets were spun off into six separate subsidiary power generation companies. Although the initial restructuring included plans to subsequently divest KEPCO of these generation companies (excluding the Korea Hydro & Nuclear Power Company), KEPCO continues to wholly own each of the subsidiaries. Furthermore, KEPCO owns majority shares of KEPCO Engineering and Construction, Korea Nuclear Fuel, Korea Plant Service and Engineering, and Korea Electric Power Data Network. According to KEPCO, in 2011 about 81 percent of electricity consumers were residential, 17 percent were commercial and public, and 2 percent were industrial.

Korea Electric Power Exchange (KPX)

The Korea Electric Power Exchange (KPX) is the system operator and coordinates the wholesale electric power market. KEPCO continues to act as the electricity retailer, and controls transmission and distribution. KPX regulates the cost-based bidding-pool market, and determines prices sold between generators and the KEPCO grid. An electricity tariff pricing system, designed to protect low-income residents and industrial consumers, historically has not reflected the true costs of generation and distribution, or provided incentives to conserve electricity. MKE must approve all changes in end-use electricity prices.

A renewable portfolio standard for South Korea became effective in 2012 with a beginning renewable electricity quota of 2 percent of total generation. Renewable sources remain a small share of South Korea's electricity generation, with hydropower being limited to small dams on the Han River, and a 1 billion kilowatt (kW) pumped-storage facility at Yangyang, 120 miles from the capital of Seoul.

Energy Policies for Renewable Energy

The first renewable energy policy was introduced in Korea in 1980 and the government started to give incentives including low interest loans and tax exemption to renewable energy generators. General subsidy program was established in 1994 and according to this promotion act Korean government subsidized renewable energy facilities installation costs. Local renewable energy deployment program was started in 1995 and it required local governments to use a certain amount of renewable energy in public buildings and in remote area residents. In 2004 all public buildings with more than 3000 square meters required to use renewable energy as a portion of their energy consumption. This act revised in 2011 and extended to the buildings with more than 1000 square meters area (Korea Energy Economics Institute, 2011).

The first feed in tariffs law was passed in 2006 and government covered the price difference between renewable energy cost and electricity market price. Feed in tariffs contracts duration was between 15 to 20 years from the first date of subsidization. According to the reports total of 345 MW has been subsidized as of 2006.

The renewable portfolio agreement (RPA) was implemented in 2006 and its main content was voluntary agreement between Korean government and large public utilities to invest 737 million dollars in renewable energy technologies. Also first Renewable portfolio standard (RPS) was introduced in second basic plan for renewable energy deployment in 2003 and in third basic plan for Renewable energy in 2008. The starting year is 2012 and this act will obligate all electricity suppliers to produce a certain portion of electricity by renewable energy. This portion will be 2% in 2012 and will increase to 10% in 2022.

Year	Legislation	Notes
1987	Promulgation of The Promotional Act of NRE Development	Legal basis for NRE R&D activities

1998	Promotional Act of NRE Development, Utilization and Deployment (1stAmendment)	Amendment for legal basis for NRE dissemination
2002/3	Promotional Act of NRE Development, Utilization and Deployment (2nd/3rd Amendment)	Obligation on public bldgs (const. cost), certification, FIT
2003	The 2nd National Basic Plan for NRE Technology Development & Deployment	10 year plan, target: 3%(2006), 5%(2011)
2004	Promotional Act of NRE Development, Utilization and Deployment (4th Amendment)	Including standardization, RESCOs. etc.
2008	The 3rd National Basic Plan for NRE Technology Development and Deployment	Target: 2020(mid), 2030 (long), NRE industry promotion
2009/10	Promotional Act of NRE Development, Utilization and Deployment (5th Amendment)	RPS: 2012(2%) and 2022(10%) Obligation on public bldgs (load)
2011	The 4th National Basic Plan for NRE Technology Development & Deployment (underway)	The 2nd National Energy Basic Plan NRE industrialization, Export

Energy and Climate Policy

Korea is one of the most energy intensive economies in the OECD area. The CO2 emissions in South Korea have been growing fast and are expected to grow much faster than the average for the OECD countries. Korea's GHG emissions accounted for 1.7% of the world total in 2008, making it the 10th-largest emitter in the world with annual CO2 emission of 509,170 (1000 of metric tonnes) according to the US DOE's Carbon Dioxide Information Analysis Centre (CDIAC).

Under the International Energy Agency's (IEA) reference scenario, which assumes that the level of growth in carbon emissions continues from the 2002 level, the Republic of Korea would increase its emissions by close to 35 per cent in 2025, compared to less than 15 per cent for the whole of the OECD countries. In the IEA's low emissions scenario, carbon emissions would grow by slightly less than 25 per cent in 2025, compared to 5 per cent for the whole of the OECD countries. And according to OECD (Jones, 2011), on a per capita basis, Korea's emissions rose by 71.6% over the period 1990 to 2005, far outstripping the OECD average of 2.1.

Low-carbon Green-growth The Korean government has created an institutional framework for a great leap forward toward a green economic power. In 2009, Korea enacted a Framework Act on Low Carbon Green Growth and released a National Strategy for Green Growth and Five- Year Plan for Green Growth. The Strategy has three main objectives and ten policy directions.

The three objectives include mitigation of climate change and the strengthening of the country's energy independence, creation of new growth engines, improvement in the quality of people's lives and enhancement of Korea's international standing. Korea also ranks the lowest among the OECD countries in terms of the renewable energy percentage of the overall energy.

Conclusion

In South Korea, compared to the FIT, the RPS seems to increase the uncertainty for investment in renewable resources. Generators who produce electricity from renewable resources with lower generation may have better market opportunities under the new RPS scheme. ROKG's strong NRE initiatives have increased the investment and growth over the last several years, and the forecast for NRE is strong. ROKG is accelerating the growth of the renewable sector not only in South Korea but all over the world.

RENEWABLE ENERGY ROAD MAP

The method for generation in Asia is based on the centralized approach and is at present time generally unfavorable for renewable energy producers. This is mainly based on the fact that planning was developed on the centralized generation model, with large-scale power stations feeding into large high-voltage power grid systems. Few interconnections are available and each scheme is typically considered on an individual basis as there seems to be no standard interconnection policy.

The following rationale and justifications are there:

First – the renewable energy generator is uncertain of the interconnections and costs. If interconnections are based on the connecting central plants, it may be too costly for small scale generation. Second, it also provides the incumbent utilities that view RE as a threat to their traditional business with the opportunity to restrict the deployment of RE through the imposition of unreasonable authorization requirements.

There has already been a significant amount of work performed on interconnection standardization for RE systems in the United States and Europe. This has occurred both at the State level and more generally through the IEEE. The IEEE P1547 Standard for Interconnecting Distributed Resources with Electric Power Systems is a major document covering a range of technical issues relating to RE interconnection within the context of the US energy market, including RE system testing.

It proposes and specifies the requirements for a series of technical requirements relating to RE interconnection. The primary motivation for the development of this standard was the desire of many market participants to rationalize and simplify the process for interconnecting a device with the electric power system. IEEE P1547 is considered to be a good model that could be developed with a focus to fulfill similar technical and policy requirements to that already achieved by the EU and DOE in the United States.

IEEE P1547 Technical Issues Coverage for RE Schemes

Voltage regulation	Synchronization
Monitoring and Metering	Isolation
Response to voltage disturbances	Response to frequency disturbances
Disconnection for faults	Loss of synchronization
Generator out of synchronism operation	Federer re-closing co-ordination
DC injection	Voltage flicker
Harmonics	Immunity protection
Surge capability	Islanding

In view of this, there is a clear role for Standardization to define the minimum technical performance requirements applicable to new RE systems in terms of their interaction with the host electrical grid network. This will enable much of the technical uncertainty associated with utility authorization to be removed, thus enabling RE Developer’s to perform accurate business cases prior to embarking on lengthy (and otherwise costly) Development programmers.

Standards must fulfill three general high-level objectives:

1. Definition of the electrical network performance within which the RE system must operate both under steady state and dynamic conditions (technical parameter variations such as frequency, voltage, pre-existing harmonic voltages, etc.).

2. Specification of the required performance characteristics of the RE once it is connected to the host electrical network (voltage regulation requirements, response to network faults, voltage fluctuations, protection and control requirements, etc.)

3. Performance type testing that will be required prior to operational acceptance of the RE system by the host network.

Successful implementation of this requirement is the need for current utility generator interconnection practices to be fundamentally review and ensure that the performance requirements for RE schemes are appropriate given their low likely impact on the main interconnected electricity grid (For example, it is likely that many of the technical performance requirements associated with 1000 MW coal-fired power stations will be inapplicable or inappropriate for a 100 kW micro-turbine installation).

Recommendations

Develop a Standard for the electrical interconnection for RE.

For the interim period until a standard is prepared, the Regulatory Commission or Government, in conjunction with the utility generators should review utility generator interconnection practices.

RE System Certification and Permitting

This topic is closely related to the interconnection issue and relates to the various performance verification processes before it can be declared acceptable for operational and commercial use.

Certification and permitting processes for electrical equipment connected to an electrical transmission or distribution network take a number of forms. Tests are required for performance and compatibility to grid. These tests are extensive and are performed in order to confirm that the design of the equipment is sound and that the plant would be expected to perform adequately over its service lifetime within the bounds of the specified operational regime. A much-reduced series of tests would then be performed on all production units of the same design (so-called “routine” testing) in order to confirm that the manufacturing quality of these units is sufficient.

For more complex systems (large centralized power generators) the certification and permitting process is very different, with each plant being subjected to a series of system performance tests as defined by the host electrical network utility. These tests are extensive, and can take significant amounts of time and financial resource. Prior to this, it is usual for detailed electrical system modeling to be performed to determine the expected impact of the new generator on the host grid network and vice versa.

This modeling exercise can also be very time consuming and expensive, but is normally a requirement of the host utility, as well as being an opportunity for the generator to mitigate some of the financial risks associated with the potential technical non-compliance of their equipment when connected into an electrical grid network.

The processes associated with RE certification are very inconsistent and are generally agreed bilaterally between the host utility and the connecting RE system owner. Other certification requirements, such as those relating to emissions performance are also important to adhere to.

A key issue affecting the viability of many RE systems is the cost associated with completing and administering the certification and permitting process, especially as these generally apply each time a new installation is built even if identical systems are being installed. Also, these costs do not generally vary proportionally with power plant size and they therefore tend to have a much greater impact on RE schemes.

In order to promote and enhance the RE schemes, there is a strong case for standardized certification and permitting rules for new RE schemes. Pre-defined technical and other requirements (such as emissions performance, health and safety, etc.), and that the certification process is administered fairly by approved agencies. Alternatively, compliance with some of the technical performance requirements of the RE system specification could be verified through manufacturer "self-certification", reducing the financial burden associated with employing a third party assessor. The legal boundaries between self-certification and the need for certification by third parties, as would probably be required for the health and safety aspects of the installation, would have to be determined generically.

The certification process should also be made legally binding as it would also enable RE Developer's to assess future schemes on the basis of known and defined technical and certification requirements, thus removing some of the uncertainty that currently restricts investment in RE applications. Ideally, with suitable electrical interconnection standardization, the certification of a new design of RE system, either through self-certification or by an independent third party, would validate this design for application at a wide range of host sites without the need for further extensive type and site testing.

Recommendations

Standardized RE system certification and authorization protocols should be Developed and implemented. This would include emissions performance certification.

The certification process for new RE schemes should be administered by an independent, approved agency. RE system manufacturers should also be permitted to "self-certify" certain aspects of the performance of their systems in order to minimize the financial burden associated with the certification process.

Impact of RE on existing network performance

A significant barrier to RE at the present is the uncertainty relating to the impact of large penetrations of RE on the controllability and performance of the host electrical grid networks. This can partly be mitigated through interconnection standardization. This situation is more complex if there are multiple small RE schemes connected within a distribution network. This may create problems in scheduling and wheeling, and if there are multiple RE schemes interconnected to micro-grid systems. Who will be responsible for this management?

In order to gain a clearer understanding of the potential impacts of large penetrations of RE on the main interconnected grid systems, it is important that detailed, scenario-based analysis covering all regions be performed. This analysis requires a long-term study for the future.

Recommendations

In order to gain a clearer understanding of the potential impacts of large penetrations of RE on interconnected grid systems, a scenario-based analyses covering all regions should be done. These studies may determine RE penetration breakpoints at which operational difficulties may and also provide solutions to mitigate these impacts.

Valuation of RE services

The fact that RE is generally located at, or close to, the point of electricity consumption enables it to provide a number of operational and commercial benefits over and above pure power generation. In the current climate of emissions reductions RE may have a commercial advantage. However, with the current market structures and pricing mechanisms, few of the benefits of RE are capitalized to their true commercial value. To ensure a "level playing field" for RE, any benefits that RE provides to the electrical grid system or to the commercial operations of third parties should be fully and fairly reflected in system pricing and other payments to RE systems. The benefits that RE can provide can be summarized as follows:

System Benefits: These relate to the positive contribution that RE can make to the operation of the electrical grid network to which it is connected. Examples of this include voltage support, frequency support (for smaller networks), system reliability and availability enhancements, energy transportation loss reduction, and system response services (eg. spinning reserve).

Commercial Benefits: These are the financial benefits that RE can provide to the different stakeholder groups impacted by the interconnection of a RE scheme. Examples include energy transportation loss reductions which can benefit the host utility if they receive efficiency-related payments through the regulatory regime, emissions savings and resultant tax/levy mitigation, ancillary service provision which can save ancillary service payments for utilities if these services are provided free by the RE scheme, cost-of-downtime savings for customers using RE to mitigate service outages.

The potential technical and commercial contribution of RE, whilst recognized by most stakeholders, has not yet been fully appraised or quantified. It is imperative that this is done to ensure a truly liberalized market environment that reflects the real value of all of the power generation resources within the energy supply system. To make progress towards achieving this, there are a number of significant issues that must be addressed:

The determination of a true market value for the services provided by RE. Whilst the exact value of these services will be case-specific, the general rules and approaches taken in determining the market value for RE should be agreed and implemented.

To complement the establishment of a market value for RE services, contractual arrangements that reflect this value must be developed and implemented. These must be applied fairly and consistently to reduce the financial uncertainty that is often associated with new power generation schemes.

Network planning approaches must fully consider the benefits of RE when assessing new infrastructure or power generation options, as in some cases the deployment of RE will provide a more commercially attractive solution than network reinforcement. Indeed, RE has already been shown to provide potential advantages in network security applications[1], but utility practices have shown little sign so far of encompassing RE as an alternative to conventional reinforcement approaches.

Recommendations

Utility network planning procedures should be reviewed to ensure that RE is actively considered within the planning process as an alternative solution to conventional infrastructure reinforcement. This may be achieved through the development and implementation of a set of standardized planning rules and approaches that define the mechanisms by which RE performance should be analyzed.

An assessment of the system operation, commercial and environmental benefits of RE should be conducted. This study should focus on the development of mechanisms for the capitalization of the benefits of RE to enable true through-life economic performance analysis of RE schemes.

New contractual arrangements that reflect the true commercial value of RE should be developed and implemented. These arrangements should be applied consistently to reduce the current financial uncertainties associated with new RE investment.

Net metering and Connection Charges

The concept of net metering is to enable the electricity meters of customers with their own generation facilities to turn backwards when their generators are producing more energy than their own demand. Net metering allows customers to offset their electricity consumption over a long period of time and is of particular interest to the renewable energy community as it effectively increases the economic value of the energy produced.

This is because allowing the meter to counter-rotate means that the generating facility in effect receives the full retail price for the electricity that they generate. This is different from common utility practice where a second meter is installed which measures energy flow back to the grid, and the facility is paid for this export energy at a rate much lower than retail prices.

The widespread introduction of net metering for RE schemes could provide a significant economic incentive that could contribute to the increased deployment of these technologies without the need for a significant financial investment burden in technology development. As the exported energy from on-site generation is considered to have the same value as the retail energy price, it can lower the economic threshold for project implementation. In view of this, some parties are of the view that net metering provides a reasonable replacement for those benefits of RE that can be difficult to capitalize accurately (eg. environmental benefits).

However, the net metering approach described does not necessarily reflect the true market value of energy sales on a time-varying basis as it simply measures net energy transfer without taking account of dynamic price fluctuations. A market-reflective approach is to allow the implementation of "time-varying" net metering, which effectively measures the net financial flow between the RE scheme and the market.

There is significant activity in the United States and Europe looking at net metering. Debateis currently focused on how far eligibility size limits should be extended and how emerging technologies (such as fuel cells) could be included within the current regulations. Similar activities need to be considered and introduced within Asia.

Net metering could be applied to stimulate RE. It would create an environment where RE-generated power is given a fair market value, especially if time-varying net metering is implemented and if consideration is given to those benefits of RE that currently receive no financial credit.

Recommendations

Policy should be reviewed such that the option to adopt simple or time-varying net metering should be considered for all new RE schemes. The size (power rating) of RE schemes to which this policy applies should be made as high as possible to enable a broad range of RE technologies.

Time-varying net metering should be developed and made available for RE schemes (i.e. based on net financial flow between the generator and the market and therefore taking account of the time-varying value of electricity).

Legislation

Currently there is little or no legislation to promote RE in Asia. The policies are limited and there are a number of policy and legislative initiatives that cover a number of aspects related to RE (e.g. renewable energy, combined heat and power, etc). A number of recent legislative measures, such as the Directives on electricity from renewable energy sources, the internal electricity market and on CHP, can generally be expected to increase the levels of RE within the European Union although it is unlikely that this was the original intention.

In some cases, the positive effect on RE is likely to arise from provisions that are specifically designed to promote RE, for instance in the new Electricity Directive or in the Directive on the Energy Performance of Buildings. Other Directives that penalize the inefficiencies of thermal centralized power production or that pose other additional burdens on centralized generation can be expected to have an indirect positive effect on RE through increasing its relative competitiveness. The Directives on Large Combustion Plants and Emissions Trading, and the proposed Directive on the Taxation of Energy products are examples of these.

In view of the fragmented RE technology approach that is currently being implemented, there is a significant risk of incompatible and conflicting development scenarios emerging. Hence, a more coherent view of the features, benefits, problem areas and development paths for RE in the context of the key energy policy goals is required. Such an undertaking must start with very fundamental questions relating the future delivery of electricity.

Recommendations

It should be recognized by policy makers that at the present time there is no coherent approach towards the implementation of RE. Such an approach is urgently needed.

With the assistance of stakeholders in the RE industry, consider taking steps to develop an action plan and associated policy recommendations for the introduction of RE (generically). This will enable the significant benefits of RE to be evaluated and fully realized as a whole. It will also help to stimulate the RE industry.

As an interim measure, current policies and Directives that impact on RE should be reviewed and rationalized to ensure that incompatible and conflicting RE development scenarios are eliminated. This will enable a consistent and rational approach to RE barrier removal.

Incentives and financing

In order to level the playing field for RE, it is important to generate initial interest in order to stimulate RE. The provision of incentives and financing through policy mechanisms is a traditional way of creating such an environment, and this approach has been deployed very successfully. It is important that once the initial market has been stimulated through these mechanisms that technology is commercialized to a degree that it ultimately becomes self-sustainable, i.e. it does not rely on incentives in the long term. This has to be the clear goal for RE.

The installed costs of newer RE technologies (e.g. fuel cells, micro turbines, etc) are currently too high. The higher cost factor is disabling them to achieve a significant market penetration breakthrough without some degree of cost reduction. The countries may offer sufficient incentives to enable developments to take place, whilst ensuring that

RE manufacturers are encouraged to develop genuinely “commercial” systems. Typical incentive mechanisms that could be applied to RE are:

- Grants to offset installation costs;
- Tax incentives and rebates;
- Priority grid access to RE;
- Compensation payments for avoided network infrastructure costs;
- Guaranteed prices or “top-up” payments for exported energy;
- Net metering with guaranteed revenue;
- Appropriate interconnection requirements and standardization;
- Payments to account for system efficiency improvements;

Each of these mechanisms has its merits and potential drawbacks. Furthermore, the use of incentive mechanisms within the energy sector is a complex issue that is impacted by many variables, many of which are very hard to predict and control.

To enable RE incentive scenarios to be reviewed continuously, it is recommended that a detailed (and freely-available) financial model of the Asian energy market is developed for each country. This study does not have to scope to do that. This will enable the impacts of different incentive schemes on the likely penetration of different RE technologies to be analyzed, and will enable a pro-active response to changes in market structure and technology developments by policy makers through changes in incentives and other mechanisms.

Recommendations

A full assessment should be performed to determine appropriate, fair and consistent incentive regimes for RE. These incentives must both encourage the uptake of RE and lead to the commercial development of RE technologies while enabling them to compete and maintain market share in the long term.

Each country should develop a detailed financial model of the Asian energy market, with the purpose of enabling the impacts of different incentive schemes on the penetration of different RE technologies. Such a model will also enable a pro-active response to changes in market structure and technology developments by policy makers through changes in incentives and other mechanisms.

- Co-ordination of RE activities
- There are two key benefits of RE:
- The technical and market-based benefits arising from RE deployment
- The social and wealth-creation benefits of having a thriving RE industry

There is a general lack of cohesion and strategic focus pulling all the research and development activities in RE together as a whole. Without a coordinated approach, it is unlikely that RE will find the widespread market application.

Road Map Policy Issues

Scientists, engineers, and policy makers working on energy, together with industry, are in a position to develop a future with renewables in as a key energy resource. They can adopt and utilize existing resources for the greater demand that is anticipated with growth. This effort will result in creation of decentralized/distributed energy infrastructure, industrial base, specialized research centers, institutional set up, trained and qualified manpower, codes, standards, specifications, regulations, legislations and policy measures, which would facilitate acceptance of RE by consumers. This would require an integrated energy system to be developed and put in place and in turn, require continuous development, demonstration and validation of various technologies related policy issues and other measures. Strong ***Public-Private Partnership Projects*** would be need and implemented to achieve this.

In addition to the technical issues discussed, there are a number of policy issues that have been identified during which at the present time are limiting the uptake of RE. These policy issues must be addressed in conjunction with the technical issues in order to create a fair market place for RE to compete within.

Valuation of RE services
Generator ownership issues
Legislation
Building code requirements
Co-ordination of RE activities
Recommendations implementation timeline
Treatment of stranded costs
Net metering
Incentives and financing
RE industry development
Connection charging

For RE to generate maximum benefit, it is necessary to map out a vision for the timescales within which the implementation of the recommendations in this document could occur in practice.

The timescales are considered to be challenging, but achievable, and necessary for RE implementation to occur to a sufficient degree to enable maximum benefit. Each of the recommendation categories are considered in order to determine a co-ordinated approach to address each of the major issues that are currently restricting RE application.

The following tables are used to provide a relative prioritization of the recommendations. (Include with Scheduling and milestones):

Steps to Consider

Action Item	**Description**	**Milestone Date**
1	Develop an electrical interconnection Standard for RE	2014

2	Review utility practices associated with the interconnection of RE to ensure fair treatment of RE	2014
3	Standardize RE system certification and authorization protocols	2014
4	Develop funding support for new RE projects	2014
5	Co-ordinate RE demonstration and validation through the setting up of a RE test and demonstration facility. This facility could also perform the independent RE certification and standardization role	2015
6	Support R&D for efficiency improvements and cost reductions for "more-established" RE technologies as well as new-generation technologies.	2015
7	Develop analyses of the potential impacts of high levels of RE penetration on interconnected grid systems.	2014
8	Review utility network planning procedures and require RE to be actively considered in the planning process. This may be achieved through the development and implementation of a set of standardized planning procedures.	2014
9	Develop a detailed assessment of the electrical system operation, commercial and environmental benefits of RE.	2015
10	The development and implement new contractual arrangements for the true commercial value of RE.	2014
11	RE schemes and projects to be exempted from stranded cost charges.	2015
12	Market rules ensuring that RE ownership by grid system owners/operators should not be used to adversely affect the market place.	2015
13	Feed-in Tariff – Review the option to adopt simple or time-varying net metering for all RE schemes. The kW rating threshold for RE to qualify for net metering terms should be made as high as possible.	2015
14	A mechanism for time-varying net metering (feed-in tariff) to be developed for RE based on net financial flow between the RE scheme and the market.	2015
15	An assessment of the mechanisms by which net metering could be introduced for RE schemes in ASEAN countries	2015
17	Develop transparent incentives for new RE schemes.	2015

Vision and Road Map

Currently, RE levels are relatively low and targeted at a number of niche applications. Market conditions, policies, rules and utility practices are weighed against RE. The aim is to have a thriving RE manufacturing base, coupled with a genuinely competitive energy market enabling RE to compete on a level playing field with more conventional energy delivery approaches. The target is important both in terms of the future wealth and prosperity of Asia, and in terms of diversity and security of energy supply that is currently receiving significant attention at the global level.

A key constituent of the RE Road Map is the development of Standards for the interconnection of RE systems with electricity grid networks. It is expected that standardized network utility planning procedures, requiring consideration of RE options as alternatives to traditional network reinforcement, would also most likely be completed by 2015. Another key issue to enable increased RE penetration relates to the need for common RE certification protocols enabling increased “type” certification of RE systems by independent third parties. This will reduce the testing demands for RE schemes on individual contracts, and hence will reduce the cost of RE system installation.

At this stage, there are many variables remaining to create a level playing field. Moving on to 2014 and beyond, it would be expected that increasing (and unprecedented) levels of RE installation will occur and realistic market conditions applied. Listed below is the timeline for implementation of some of the major items.

Roadmap Timeline

RESCRIPTION	**YEAR**				
	2014	**2015**	**2016**	**2017**	**2020**
General Policy Timeline					
Develop Initial Roadmap for introduction of RE					
Increase focus within Government for the introduction of RE into the grid					
Make RE and system availability issues integral parts of the building codes and planning process					
Start a “RE Program or Office” -- for assisting the Government, generators, manufacturers, and consumers while providing a platform to distribute information on RE					
Develop a database of power generation and RE statistics to be compiled and made available for all					

interested participants in RE					
Develop funding support for new RE projects					
Develop transparent incentives for new RE schemes.					
Develop analyses of the potential impacts of high levels of RE penetration on interconnected grid systems. Develop a detailed assessment of the electrical system operation, commercial and environmental benefits of RE.					
Review utility procedures associated with interconnection of RE into the grid and develop grid interconnection standard					
Implement RE system interconnection certification and protocols					
Demonstration and validation - Set up a demonstration facility. Facility could perform the RE certification and standardization role					
Develop a system where RE schemes and projects are exempted from stranded cost charges.					
Develop market rules ensuring that RE ownership by grid system owners/operators should not be used to adversely affect the market place.					
Feed-in Tariff – Formulate and adopt simple or time-varying net metering for all RE schemes. The kW rating threshold for RE to qualify for net metering terms should be made as high as possible.					
A mechanism for installing net metering (feed-in tariff) for sale of excess power into the grid.					

Recommendations

Countries listed in this report may/should give consideration to the increase of research and development support for RE technology, and the increased focus of funding for RE barrier removal.

Given the high strategic importance of developing a successful RE, an industry research and development co-ordinating group should be convened to promote the benefits of RE.

It may be considered that the best way to achieve this is by setting up such a group in a dedicated “RE Office”.

The RE Office may:

1. Be a centre of competence and information on RE issues for stakeholders; p
2. Provide a focal point for RE technology and institutional barrier removal;
3. Provide guidance for the co-ordinated and directed support of RE technology development support; and
4. Maintain a database of power generation and RE statistics which may be available to interested parties.

RE can have a great impact and is necessary to properly map out a vision with timelines for implementation. The outline discussed is a roadmap with milestones and time for implementation. The recommendations if followed may result in a more environmentally sound supply of energy all in Asia.

References

Cambodia

1. ADB (2011), *Country Partnership Strategy*. Cambodia: Asian Development Bank.
2. APAEC (2009). *ASEAN Power Grid 2010-2015*. ASEAN Secretariat [online]. Available at: http://www.aseansec.org/22675.pdf.
3. CDRI (2012), *Annual Development Review 2011-2012*. Phnom Penh: CDRI – Cambodia's leading independent development policy research institute. CRCD (2004), *Status and Assessment of the Potential for Clean Development Mechanism Projects*, Phnom Penh: Cambodian Research Centre for Development.
4. EAC (2011), *Report on Power Sector of the Kingdom of Cambodia 2011 Edition*. Phnom Penh: Electricity Authority of Cambodia (EAC).

Lao's PDR

1. http://www.oecd.org/countries/laopeoplesdemocraticrepublic/47180387.pdf
2. http://www.lao-ire.org/data/documents/data_research/general/LIRE-Renewable_Energy_Development_Strategy_in_Lao_PDR.pdf

China

1. http://www.eia.gov/countries/cab.cfm?fips=CH
2. http://www.iea.org/publications/freepublications/publication/china_wind-1.pdf
3. http://www.platts.com/RSSFeedDetailedNews/RSSFeed/ElectricPower/7955459
4. http://www.renewableenergyworld.com/rea/news/article/2013/03/asia-report-china-recommits-to-energy-emissions-goals
5. http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/taxes-incentives-renewable-energy-2012.pdf
6. http://www.ey.com/Publication/vwLUAssets/Renewable_energy_country_attractiveness_indices_February_2013/$FILE/Renewable_energy_country_attractiveness_indices.pdf
7. http://www.renewableenergyworld.com/rea/news/article/2010/07/renewable-energy-policy-update-for-china
8. http://en.wikipedia.org/wiki/Energy_policy_of_China
9. http://www.ecology.com/2013/03/07/renewable-energy-in-china
10. www.martinot.info and www.ren21.net

India

1. http://www.renewableenergyworld.com/rea/news/article/2013/03/indias-off-grid-renewables-initiative-is-changing-lives?page=all
2. http://www.reegle.info/countries/india-energy-profile/IN

3. http://www.mnre.gov.in/http://www.eurasiareview.com/18032013-india-energy-profile-fourth-largest-energy-consumer-in-world-analysis/

Malaysia

1. "National Energy Policy". *Ministry of Energy, Green Technology and Water*. 2008-01-31. http://www.kttha.gov.my/template01.asp?contentid=19. Retrieved 2009-05-25.
2. "Renewable Energy and Kyoto Protocol: Adoption in Malaysia". Publicweb.unimap.edu.my.
3. http://publicweb.unimap.edu.my/~ppkas/home/index.php/news/articles/29-renewable-energy-and-kyoto-protocol-adoption-in-malaysia.
4. Global Energy Network Institute 1-619-595-0139 (2007-06-28). "National Energy Grid of Malaysia - National Electricity Transmission Grid of Malaysia". Geni.org. http://www.geni.org/globalenergy/library/national_energy_grid/malaysia/index.shtml. Retrieved 2010-09-24.
5. http://www.st.gov.my/images/stories/upload/st/st_files/public/st_esim_bi.pdf.
6. "U.S. Energy Information Administration Independent Statistics and Analysis Malaysia". U.S. Energy Information Administration. 2009. http://www.eia.doe.gov/cabs/Malaysia/Profile.html. Retrieved 2010-09-24.
7. "Overview of Energy Commission". St.gov.my. http://www.st.gov.my/index.php?option=com_content&view=article&id=2388&Itemid=1689&lang=en. Retrieved 2010-09-24.
8. Suruhanjaya Tenega. "Suruhjana Tenega Annual Report 2009".
9. http://www.st.gov.my/phocadownload/Laporan%20Tahunan%20Suruhanjaya%20Tenaga%202007.pdf.
10. http://publicweb.unimap.edu.my/~ppkas/home/index.php/news/articles/29-renewable-energy-and-kyoto-protocol-adoption-in-malaysia

Paksitan

1. http://www.marketresearch.com/Business-Monitor-International-v304/Pakistan-Power-Q1-7308747/
2. http://www.finance.gov.pk/survey/chapter_12/14-Energy.pdf
3. http://www.eclareon.eu/sites/default/files/05_solarenergieinpakistan_waqas_bin_najib.pdf

Philippines

1. http://www.oxfordbusinessgroup.com/economic_updates/philippines-energy-plans-target-renewables
2. www.reegle.info/countries/philippines-energy-profile/PH
3. http://www.esmap.org/sites/esmap.org/files/CN_P112371_Renewable%20Energy%20Development.pdf
4. http://www.dfa.gov.ph/index.php/news-from-rp-embassies/7599-workshop-on-renewable-energy-prospects-in-the-philippines-held-in-germany

Thailand

1. DEDE (2011).The Renewable and Alternative Development Plan for 25 percent in 10 years (AEDP 2012-2021)
2. MOE (2011). Thailand 20 year energy development plan (2011-2030).
3. ChuenchomSangarasriGreacen and Chris Greacen (2010). Proposed power development plan (PDP) 2012 and a Framework for improving Accountability and performance of power sector planning. King Mongkut University
4. IEA (2010).Deploying Renewables in Southeast Asia, trends and analysis. IEA. Paris
5. SopitsudaTongsopit and Chris Greacen (2012). Thailand's Renewable Energy Policy: FiTs and Opportunities for International Support. King Mongkut University
6. USAID (2011). Energy trends in developing Asia: Priorities for a low carbon future.
7. PatarapongIntarakamnerd, Pun-arjChairatana and TipawanTangchitpiboon.National innovation System in Less Successful Developing Countries: The case of Thailand .NSTDA. Thailand
8. Yasser M Al-Saleh (2010). Systems Of Innovation As A Conceptual Framework For Studying The Emergence Of National Renewable Energy Industries. Masder Institute of Science and Technology. UAE
9. Professor S. Kumar, Asian Institute of Technology
10. http://ppi-re.worldbank.org/Snapshots/Country/thailand

Vietnam

1. http://www.mondaq.com/x/144632/Renewables/Vietnam+Power+Development+Plan+for+the+20112020+Period
2. http://businesstimes.com.vn/vietnam-electricity/
3. http://www.journals.elsevier.com/energy-policy
4. http://www.iea.org/countries/non-membercountries/vietnam/
5. Economic Potential of Renewable Energy in Vietnam's Power Sector, Nguyen Thanh Nhan+ and Minh Ha-Duong, Ph.D student, Centre International de Recherche sur l'Environnement et le Développement, CIRED-CNRS, Chargé de Recherche, Centre International de Recherche sur l'Environnement et le Développement,CNRS

Republic of Fiji

1. http://new.ren21.net/Portals/0/documents/Resources/GSR2012_low%20res_FINAL.pdf)
2. http://www.irena.org/DocumentDownloads/events/Workshop_Accelerated_Renewable_Energy_Deployment/Session7/S7_2IRENA-RenewableEnergy-Fiji-Final.pdf

Australia

1. ABS (Australian Bureau of Statistics) 2012, *Australian National Accounts: State Accounts, 2011- 12*, *5220.0*, Canberra, November.
2. AEMO (Australian Energy Market Operator) 2012, *Rooftop PV Information Paper, National Electricity Forecasting 2012*, Melbourne, June.

3. Australian Government 2012, *Energy White Paper 2012 – Australia's energy transformation*, Canberra, November.
4. BREE 2011, *Australian Energy Projections to 2034-35*, Canberra, December.
5. Clean Energy Regulator 2012, *About the Renewable Energy Target*, Canberra, April.
6. DNRM (Queensland Government Department of Natural Resources and Mines) 2012, *Fiscal 2011-12 petroleum production and reserves tables*, http://mines.industry.qld.gov.au/mining/ production-reserves-statistics.htm
7. EnergyQuest 2012, *Energy Quarterly August 2012*, August.
8. EPRI (Electric Power Research Institute), 2009, *EPRI technology status data*, September, http://www.ret.gov.au.
9. IEA (International Energy Agency) 2012a, *World Energy Balances*, Paris.
10. Office of the Renewable Energy Regulator (ORER), 2011, *LRET/SRES – the basics*, Canberra, February,
11. RET (Department of Resources, Energy and Tourism) 2012, Energy efficiency, www.ret.gov.au/ energy/efficiency/Pages/EnergyEfficiency.aspx

Republic of South Korea

1. http://www.greenpeace.org/korea/Global/korea/publications/reports/climate-energy/ER_south_korea.pdf
2. http://www.eia.gov/countries/cab.cfm?fips=KS
3. http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Fact_Sheet/G20II_SouthKorea.pdf
4. http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Fact_Sheet/SOUTH%20KOREA_WhoIsWinningTheCleanEnergyRace-REPORT-2012%2049-2.pdf
5. http://eneken.ieej.or.jp/3rd_IAEE_Asia/pdf/paper/110p.pdf
6. http://globalimpactconsulting.com/55/5/2/hot_sectors/renewable_energy/south_korea_.html

Worldwide Resources

1. World Alliance for Decentralized Energy (WADE), http://www.localpower.org/
2. International Energy Consulting Corporation, India, China, Thailand, Malaysia, Vietnam, Philippines, Lao PDR, Indonesia, and worldwide reports
3. Full Advantage Co., Ltd., Resource Center in Thailand and Philippines