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Case Studies on the Best Practices of Wind Energy Development in APEC Region

Ha Noi, Viet Nam
4 – 5 October 2016

Summary Report

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Summary Report

I. Introduction

On 4 and 5 October 2016, the **Seminar on Best Practices of Wind Energy Development in APEC Region**, initiated by Viet Nam and co-sponsored by China; Chinese Taipei; and the United States, was held in Ha Noi, Viet Nam. Speakers and participants came from 12 APEC member economies (Chile; China; Indonesia; Japan; Malaysia; New Zealand; the Philippines; Peru; Chinese Taipei; Thailand; the United States; and Viet Nam). Most of the Seminar participants were from the public sector, academic institutions and from the private sector related to wind energy.

The project sought to undertake five case studies in selected APEC economies to explore good practices in wind energy development and raise understanding on various aspects of wind energy development, including, the role and forms of legislations and regulations, how stakeholders (the public sector, investors, NGOs, local communities, etc.) react to environmental and social impacts of wind energy development. It also aimed at conducting information sharing during the 2-day Seminar to increase awareness and share lessons of wind energy development in the Asia Pacific Region. These information shall be practical and pragmatic, and will also cover the government's laws and regulations, the corporate strategies, among other things. Last but not least, it is expected to acquire recommendations from APEC economies on the way forward to develop wind energy.

II. Background

This project is designed to implement Leaders' notes in 2011 that "We are committed to advancing our shared green growth objectives. We can and must address both the region's economic and environmental challenges by speeding the transition toward a global low-carbon economy in a way that enhances energy security and creates new sources of economic growth and employment." The APEC Leaders, once again, are committed to strengthening APEC Energy Security, clearly state in the 2012 Declaration: "Promote technology development and deployment of a low-emission energy supply including carbon capture, storage and use, and renewable energy sources such as bioenergy from sustainable wind sources". Through undertaking five case studies in selected APEC economies and a 2-day Seminar to explore good practices in wind energy development and raise understanding on various aspects of wind energy development, including, the role and forms of legislations and regulations, etc. the project would contribute directly to the commitments of APEC Leaders to "speed up the transition toward a low – carbon economy", and "promote

development and deployment of a low – emission energy supply" that "enhance energy security and create new sources of economic growth and employment".

This project also contributes to the APEC Energy Security Initiative (ESI) as it is the principal mechanism through which the EWG addresses the short and long term energy security challenges in a sustainable manner. In particular, this project is one of the long-term measures (including renewable energy). In addition, this project is in line with EWG Strategic Plan during 2014-2018 as it contributes to EWG's pillars of strengthening energy security, promoting energy efficiency as well as developing cleaner energy sources.

Themes covered during the 2-day event include: *(i) Outcomes of 4 case studies on wind energy development in New Zealand; Thailand; the United States and Viet Nam; (ii) Panel discussions on 4 case studies; (iii) Case Studies of Promoting the Wind Energy Development in other APEC Member Economies; (iv) Promoting Wind Energy Development in the APEC region: Challenges and Recommendations; (v) The Way Forward.*

III. Discussion

Outcomes

The **Seminar on Best Practices of Wind Energy Development in APEC Region** included two days for presentations and discussions on the outcomes of 4 case studies on exploring good practices in wind energy development and raise understanding on various aspects of wind energy development, including, the role and forms of legislations and regulations, how stakeholders (the public sector, investors, non-governmental bodies, local communities, etc.) react to environmental and social impacts of wind energy development. The Seminar also focuses on the benefits, challenges, financing and development issues of future wind energy development in the APEC region. In addition, the Seminar included other case studies and detailed examination in wind energy development in other APEC member economies as well as difficulties and impediments that prevent wind energy development in the APEC region. Overall, the Seminar achieved its main objectives as described in the project proposal. Moreover, all participants considered that it afforded many chances for valuable networking among representatives from the policy community, academics and private-sector actors in wind energy sector from within and outside the APEC region.

Key Issues Discussed

Opening remarks

In his opening remarks, **Mr Luong Hoang Thai (Director General, Ministry of Industry and Trade of Viet Nam)** stressed the need to look for energy sources that

have the ability to regenerate quickly or immediately, such as solar energy, wind energy, water energy, biofuels etc as these energy sources are clean and sustainable, with an acceptable cost. He highlighted that regarding energy security, wind power is an enormous energy source which is always available. In recent years, wind energy is the fastest growing energy source with an average growth of approximately 29% per year worldwide.

He observed that despite such advantages and the geographical position of the APEC economies, in developing economies including Viet Nam, wind energy is still a relatively new, undeveloped field and accounts for a modest proportion in the total energy supply of the economy. For example, concerning the construction of small wind power stations for the economic development of rural regions, 41% of the rural areas of Viet Nam can use this form of energy supply. These numbers in Cambodia, Laos and Thailand are respectively 6%, 13% and 9% of the rural areas. However, this geographical advantage has not been taken thoroughly and efficiently. According to Mr Luong, this is due to the fact that the majority of developing APEC members share these same weaknesses: lack of infrastructure and expertise, poor practical and inexperienced management and operation of the machines, limitation of resources, especially technological and financial ones. Furthermore, since wind energy depends on natural conditions, risks are high volatility, investment and maintenance costs as well as difficulties in supply chains in the market, commercial development of wind energy etc. This fact has posed many challenges for APEC members, especially developing economies in promoting the development of wind energy.

The Director General expressed hope that with the active participation of scholars, policy makers, representatives from organizations and the private sector in and out of the Asia Pacific region, the Seminar participants would be able to identify and to propose many useful and feasible initiatives, aiming to maximize the effectiveness of the wind energy in order to ensure social security and sustainable development.

Seminar's sessions

Experts provided presentations on the following topics:

1/ During Session 1 on "Case Studies' Outcomes – New Zealand", ***Mr Eric Pyle (Chief Executive, New Zealand Wind Energy Association)*** gave an overview about the New Zealand power system which has the total installed generation capacity up to 10.5GW and the peak load is 6.4GW. According to the speaker, New Zealand has huge advantage~~s~~ to develop the wind industry. It has good wind data, passionate and technically competent individuals, modern electricity market, cost effectiveness of wind generation. Besides, it has supportive government policies for the industry and a strong industry association to support businesses. About the disadvantages, the speaker listed out some issues that has not helped the industry including uncertainty in the electricity industry, limited support from government for renewable energy, support for geothermal generation, lack of a price on carbon, mis-information about wind

generation, limited Power Purchase Agreement (PPA) market for independent power producers -*only 2 generation companies have become expert in wind*, and difficulties in gaining environmental permits. At the end of the presentation, Mr Pyle provided some recommendations: local engineering companies will make a significant contribution to the wind industry; there is a tendency to "think big" when considering wind-farms; develop a set of planning and management tools for wind-farms and the roles of wind industry association. To the lessons learned, the speaker emphasized important issues such as the need for a good and high quality data, support new projects, grid integration studies, environmental protection framework and internationalization.

During the discussions, Seminar participants commented that data from the case study is high-quality and the study focused on on-shore wind farms. Mr Eric Pyle shared that New Zealand is a thin economy and the case study included information on off-shore wind projects as well. On the members of New Zealand's Wind Energy Associations, Mr Pyle affirmed that members are companies (with strong Government support such as Siemens, Vestas etc.), consultants, and other interested stakeholders. On sustainable development, the speaker reiterated that New Zealand gives priority to environmental protection and clean energy development.

2/ During Session 2 on "Case Studies' Outcome - Thailand". ***Dr Worajit Sethapun (Dean of Asian Development College for Community Economy and Technology, Chiang Mai Rajabhat University, Thailand)*** focused on three main issues: Thailand renewable energy policy and status; wind energy development in Thailand; stakeholder roles in wind energy development. The speaker shared that Thailand secures the energy supply through some practical actions such as exploration and production of natural gas and crude oil both in the sea and on land, building more new power plant(**s**) by government agencies and private organization, increase the use of renewable energy, develop international energy cooperation. Thailand also conducted fair energy pricing in which the energy price was restructured, tax is applied at suitable rate for different type of oil. Dr Worajit presented briefly the Thailand integrated energy blueprint, the alternative energy development plan and some of its highlights. About the wind energy development of Thailand, the speaker introduced the history of wind development of Thailand, its wind mapping and showing some demonstration sites and examples of turbine evaluation. Dr Worajit provided information on some obstacle(s) in wind energy development which are landscape of the areas that have wind energy; cost of producing and installing the wind turbine and the appropriateness of the site grid connection; and environment related obstacles. The speaker concluded that Thailand has high opportunities for wind energy industry development. Wind energy development under alternative energy development plan concentrates on providing power generation if the investment cost would be able to compete with the power generation – need suitable site and appropriate technology.

During the discussions, Seminar participants commented that New Zealand has advantages of high speed wind as well as financial and policy incentives while Thailand has limited wind resources and fewer incentives. The floor also commented that there have been public and private investment in big machines.

To reply to a questions from the floor on the expensive costs of small wind turbine, the speaker explained that it is due mainly to high installation cost. However, the speaker also stated that most investors focus on payback rather than installation costs. Moreover, Dr Worajit also informed that hybrid network is Thailand's direction to move forward and there have been 15 MOU with communities to install hybrid system. Regarding pricing for land and land requirement, the speaker provided information that the land is rented from the Government with cheap price as the projects are clean and renewable energy; some Communities even provided free land as the projects create jobs for local laborers. At this stage, there is difficulty due to new regulation that wind farm should be located far from the community.

Dr Worajit also mentioned about Government's incentives through various programs such as tax free for 8 years if investors are investing in renewable energy projects. The Energy Blueprint of Thailand targets to reduce electricity consumption by 20%. The speaker also stated that Feed in Tariff (FIT) will be given for 20 years. The Government of Thailand also establishes special funds such as Green Climate Fund for renewable energy projects. Thailand's Department of Energy has visited 1,400 out of 7,000 communities to assess man-power and renewable energy potentials.

3/ During Session 3 on "Case Studies' Outcome – The United States". ***Professor Terry Surles (Lead for Clean Energy Solutions, Hawaii University, United States)*** made a presentation on "The United States (US) Wind Energy Review - With Three State-Based Case Studies for Wind Development". He mentioned that sea-level rise would become a major problem for San Francisco Bay/delta region and the Mekong delta and the US energy policy will not be changed in the near future. However, Department of Energy has launched $3.5B grid modernization initiative with bi-partisan support. The speaker shared some information about the US primary energy consumption, US electricity generation consumption, renewable energy consumption, new production tax credits through 2018 and wind power installation. Regarding wind energy development, Professor Surles informed that wind grew to 40% of new capacity in 2015, cumulative wind capacity was over 75 GW, turbine prices continue to decrease, power purchase agreement prices continue to trend downward. Turbines designed for lower wind regimes have gained market share and the first US off-shore wind, 50 MW project off Rhode Island has just come on-line. The speaker said that individual states within the US are more effective in developing new policies, programs, and addressing (or forcing) changing utility business models. He emphasized better modeling and forecasting capabilities are critical to ensure that variable renewable energy systems will be profitable. About the study, Professor Surles discussed projects in three different states including California, Hawaii and New York. The speaker showed the

similarities and dissimilarities between California and Viet Nam in which he demonstrated an example about Hatchet Ridge wind farm. About the case study of Hawaii, he mentioned some wind energy policies of Hawaii and project Kaiwaloa Wind Farm on Oahu. The last case study was New York State case study, which was an example of aggressive government support. On lessons learned, the speaker reiterated some main issues that affect the wind industry and said it might be true for similar situations in Viet Nam.

During discussions, to reply to a comment that the costs of grids of Hawaii is twice of those of California, Professor Surles considered that those are reasonable as costs of land and labor in Hawaii are more expensive. Regarding a question on energy policies of US states, the speaker informed that the federal government does have a Production Tax Credit (PTC) policy in place for wind energy. However, individual states have different tax policies and research and development funding. The three examples were shown to illustrate a very aggressive renewable energy policy with considerable tax credits (Hawaii), an aggressive policy of tax credits coupled with state-based R&D (California), and a policy for co-funding projects to create new opportunities for renewable energy systems (New York). As pointed out in the meeting, other states such as Iowa (very low cost wind electricity prices) and Texas (semi-autonomous from the rest of the continental grid) would led to and be the result of different energy and tax policies.

4/ During Session 4 on "Case Studies' Outcome – Viet Nam", ***Mr Nguyen Quoc Khanh (an Independent Consultant)*** presented on behalf of the researcher. His presentation was titled "Near – shore Wind Project Development in Viet Nam". To start the presentation, Mr Nguyen briefed about the economic profile of Viet Nam regarding emission and energy. According to the speaker, Viet Nam's overall emissions would increase fivefold, per capita emissions four fold, and the carbon intensity of GDP by 20% between 2010 and 2030. He shared that electricity consumption demand increased with average rate of 12%/year during 2006-2015 (from 51.3 TWh in 2006 to 143.4 TWh in 2015). Mentioning targets and policies, the speaker affirmed that the research was done to develop the offshore wind power source and over the continental shelf after 2030. He listed out some incentives from government including electricity purchase price incentive, tax preferential incentive, incentives for infrastructure, land use, fees, loan etc. For the near-shore cases, the speaker said that out of some limitations due to density of population and overlap use of land, Viet Nam has more than 3,000 km long coastal line and is expected to have a good potential for wind energy. The coastal areas, especially the near-shore, experience shows that higher wind speed than the onshore by around 0.5 to 2 m/s (at the same level). The first near-shore wind power plant in a sub-merged coastal area located in Bac Lieu city in the Mekong River Delta of Viet Nam. The wind farm has an estimated electricity output of 300 GWh per annum, purchased by Electricity of Viet Nam group (EVN) at a price of 9.8 US cents/kWh. Approximately 150,331 tons of CO2 emissions are expected to be offset annually. Mr Nguyen also referred to some

difficulties in phase I and phase II of the project, from that he fingered out some lesson learn. After providing some information on current status of wind near-shore development of Viet Nam, the speaker highlighted the need to develop wind energy through financial support, transparent mechanism and some technical in-depth studies.

During the discussions, to reply a question on Viet Nam's preference to use FIT instead of auctions like Brazil or South Africa, the speaker mentioned that FIT was introduced during 2009 – 2010 when Viet Nam started developing renewable energy. FIT was introduced by Germany and was useful at the beginning as there were few competitors at that time. At the moment, it is essential to learn about the actual costs of wind farms to make the necessary adjustment about the supporting mechanism. A Seminar participant also commented that FIT in Viet Nam is too low compared to that of the Philippines.

5/ Session 5 was the panel discussion with the participation of four speakers: ***Mr Dale Andrew, Independent Expert, former Head of Environment Division, OECD Trade and Agriculture Directorate; Mr Chih-Wei Wu, Deputy Division Directorate, Bureau of Energy, MOEA, Chinese Taipei; Professional Wirachai Roynarin, Director of Energy Research Centre Faculty of Engineering, Rajamangala University of Technology Thanyaburi, Thailand and Mr Vu Quang Dang, Project Manager, Quang Trung International Energy Consultancy Ltd, Viet Nam.***

Mr Vu Quang Dang began his presentation by providing some information regarding wind power in Viet Nam and Thailand. He made a table of comparison between Viet Nam and Thailand through some parameters including population, area, system power capacity, average wind speed, wind farm installation, incentives, financial indicator etc. The speaker also shared the wind power target and progress of Viet Nam and Thailand. He commented that Viet Nam and Thailand have similar progress at the moment but target of Viet Nam in the future is very high which was evaluated to be too optimistic. From the comparison, Mr Vu concluded that if Viet Nam FiT is not increased, wind power investors will come to Thailand (and the Philippines) and Viet Nam's high target remains on paper.

Professor Dr Wirachai Roynarin presented the combination of small and megawatt wind machine in wind farm design for low wind speed zones. Firstly, he introduced the conditions that are suitable for small wind power machine. Most of the wind machines in the market in a small or megawatt size are designed for high wind speed resources. The speaker illustrated the testing site and machine installation of projects in Krabi Green Park, Island. Dr Wirachai concluded that the combination wind park design gained higher in plant performance by approximately 5 %, and capture wind energy at high and low pressure zones. The combination small and MW wind machine is easier for wind farm development. He also stated that it is more suitable, more effective and more flexible for low wind speed zones for wind resource average of 5-6 m/s.

Mr Chih-Wei Wu emphasized on two important issues to have successful wind projects: (i) stakeholder commitment and (ii) technical and industry support. Stakeholder commitment will depend on the policy maker, the development of electric sector, investment sector, local government support, residents and nature. For the technical and industry support, it is important to have wind resource information (windy or windless); equipment supplier technical feasibility (onshore or offshore); supplier chain (include maintenance technique) and other power technology integration (e.g. solar, biogas, diesel).

Mr Dale Andrew explained he would step back and make some remarks about how wind energy development fitted in with the energy and climate policy landscapes. The four case studies underscored the variety of economies' and regional situations affecting the development of wind. Not all of these are technical such as the quality of wind. The importance of consulting all stakeholders was demonstrated in the New Zealand example, where after an initial failure wide-based consultations contributed to the success of later wind projects. The amount and duration of feed-in tariffs (FIT) also vary. Several participants emphasized that FITs are not the only way to incentivize wind development - other means include auctions, bids for tender, tax credits and accelerated depreciation rates. European experience is that initial FITs can be set at too high a level and many have now been reduced significantly. Recent auctions or bids for tender in the developing world, such as in Brazil and South Africa, have resulted in favorable outcomes for the government and the consumer. Finally Mr. Andrew showed some photos of the floods last week in the streets of Ho Chi Minh City. These were the worst in 40 years and were due in part to increased frequency and severity of extreme weather events and also the extensive building of high rise buildings which have not allowed for sufficient storm and sewage drains in view of the reduced capacity of land to absorb water. Therefore climate policy is also an important criterion for renewable energy development. The UNFCCC COP21 held in Paris in December 2015 led to a successful international consensus to keep global warming to less than 2 degrees C. Sea-level rise due to climate change is becoming a major problem as pointed out in the presentation in the US case study which will affect the Mekong Delta. In US regional initiatives, such as the one between nine Northeast and Mid-Atlantic States a broad approach has been taken to reduce GHG by offering offsets from power sector emissions reductions to combat sources of other greenhouse gases, such as methane from ruminants and landfills.

6/ During Session 6 on "Case Studies of Promoting in the Wind Energy Development in other APEC Member Economies", there were three speakers: ***Mr Chih-Wei Wu, Deputy Division Director, Bureau of Energy, MOEA, Chinese Taipei; Dr Veena Jha, Maguru Consultants Limited, India; Mr Daisuke Seki, Deputy Director, New and Renewable Energy Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Energy, Japan.***

Mr Chih-Wei Wu started his presentation by introducing the potential resources of off-shore and on-shore wind power of Chinese Taipei. For the on-shore wind power, it

is reported to produced 329 WTs/647MW accounted for 15.6 % of all renewable energy and first batch of offshore wind turbines scheduled to be installed by 2016. In terms of wind power development strategy in Chinese Taipei, he briefed about the Renewable Energy Development Act since 2009 and its developments in the years after. Up to now, FIT is effective for 20 years to all electricity from renewable resources; 3.6 % extra bonus till 31 December 2019 for PPA of onshore turbines completed before 31 December 2019; 15 % extra bonus for PPA of turbines located at islands without any seabed cables to the main grid. Through the wind power development process, Chinese Taipei had to face with many obstacles and challenges. They were doubt from local residents and environmentalists, current regulations regarding nearby residents, community involvement becomes crucial for wind power development. The speaker shared that there were some demonstration incentive programs for off-shore wind and three companies got the incentive. He also mapped potential zone for wind development in Chinese Taipei. To conclude the presentation, Mr Wu said that benefits from wind resources could be shared with all the residents and local government plays an important role to communicate with community residents and the wind developers. The most important thing is to create a triple-win situation for the community, the wind developers, and the government.

The presentation of **Dr Veena Jha** focused on the supply chain issue of wind energy in India. From the beginning, Dr Jha observed that competition in the fast-moving renewable energy (RE) sector is fierce. The supply chain of solar wind energy offers interesting opportunities for developing economies to be a part of the RE drive. She shared information about current status of Indian wind energy firm in the supply chain. With supply chain bottlenecks a constant threat, many of the large wind firms have responded by buying out suppliers of critical components such as blades, generators, and gearboxes. Dr Jha noted that there is a move in India to indigenize wind turbine component production. This could lead to significant opportunities for suppliers of raw materials that go into the production of these components. She also mentioned about the accessing raw materials and components, Local Content Requirement (LCR) incentive, component manufacturing, services along the supply chain. Dr Jha used part of her presentation to introduce about the India wind power industry about the capacity, market share, global presence, MW installed worldwide. Moreover, she insisted the support from government from tariff to grid integration that help wind power firm develop. The speaker shared her survey of seven firms in the wind industry identified the following crucial bottlenecks in the wind industry; main finding of wind industries in China, Germany, India, Japan, and the United States, from which she made a comparison of policy strategies for the on-shore wind industries and the resulting performance. Dr Jha concluded that the supply chain of the wind industry is incredibly complex and offer several opportunities in both products and services for developing economies to participate.

Mr Daisuke Seki's presentation was named "Japan's Renewable Energy Policy and Wind Power Policy Updates". From the first part, he talked about Japan's renewable energy policy and FIT revision in which he shared that in Japan, renewable energy

accounted for approximately 12.2% of power generation in 2014. More specifically, hydroelectric power generated by large-scale dams accounted for 9.0%, PV, wind, geothermal and wind power accounted for 3.2%. Mr Seki showed diagrams about energy demand and primary energy supply electric power demand and power source composition. He explained basic mechanism of the Feed-in Tariff Scheme in Japan, under which if a renewable energy producer requests a government-guaranteed, long-term fixed price electricity purchase contract from an electric utility, the electric utility is obligated to accept this request. The speaker also talked about the goals and measures to realize the RE target (22-24%) in the 2030 energy mix. To the second part, about Japan's wind power policy updates, Mr Seki provided an overview about the wind power industry in Japan with the environmental impact assessment process. He stated that it is difficult to introduce long lead-time energy sources such as wind power, geothermal, small and middle hydropower because power producers have to invest in procedures without guaranteed returns even after the decision to enter the business is made. Generation costs in Japan are twice those in other major economies, and Ministry of Economy, Trade and Industry is making efforts in cost reductions through R&D and in increasing utilization factor through introducing more effective O&M methods. In conclusion, Mr Seki introduced some offshore wind power demonstration projects and offered the possibility of Japan's technologies and experience can promote wind power energy in Asian economies.

During the discussions, to reply a question from the floor on the reasons to introduce FIT after the year 2012 in Japan, Mr Seki explained that the great earthquake in March 2011 affected the then leading party's policy and they decided to introduce FIT to increase renewable energy ratio drastically.

Regarding a comment on business involvement in wind energy power in Chinese Taipei, Mr Wu informed that private companies are encouraged to join building wind power projects and they will be assisted in installation costs and financing in such projects. This incentive is not applied to state-owned enterprises. In Chinese Taipei, at the moment, the capacity of wind project is only 600 MW. Chinese Taipei targets to increase this figure to 1.5 MW by 2025 but land use is a big concern. One solution to land use issue is the greater involvement of local governments and communities in such projects.

7/ During Session 7 on "Promoting Wind Energy Development in the APEC Region: Challenges and Recommendation", there were three speakers: ***Mr Dale Andrew, Independent Expert, former Head of Environment Division, OECD Trade and Agriculture Directorate; Mr Bret Barker, Barker Advisory, in support of US. Department of Energy's Wind Power Technologies Office United States; Mr Takashi Matsunobu, Chief Project Manager Energy Solution Business Management Division, Hitachi Ltd, Japan.***

During the presentation on "Promoting Investment in Wind Energy: Challenges and Recommendations", **Mr Dale Andrew** raised a question about software (services)

needed to make the hardware (goods) work. The speaker said that renewable energy such as solar and wind energy are increasingly competitive. He showed a diagram of world net additions to renewable power capacity, historical and forecast. According to his findings, average import tariffs by category of environmental good are generally very low <1%. Mr Andrew listed some key trends within the wind energy value chain including: global and concentrated wind turbine manufacturing; role of green-field FDI in driving the global integration of wind energy value chain; downstream activities generate more value added than manufacturing activities (only 30% of total jobs in the US). The speaker also mentioned about the role of global value chains in determining trade flows regarding parts and components of wind power energy. Mr Andrew shared some disputed cases in WTO which are related to LCRs and subsidies. The role of policy makers are to mobilize investment in renewable energy(;)support innovation in renewable technologies and to strengthen the domestic enabling conditions for investment. However, he insisted that climate policies cannot be considered in isolation from the broader investment environment. Mr. Andrew also provided some information about investment environment, incentives and climate policies. At the end of the presentation, he addressed some solutions that could help to reform the energy market and make it (to) function properly. He reiterated that climate policies cannot be considered in isolation from the broader investment environment.

Mr Bret Barker introduced discussion about the difference between centralized and distributed power generation from wind energy technologies. Mr. Barker emphasized that centralized, utility scale wind farms generate wholesale power sent via transmission line to distribution grids for sale to retail power customers. Wind farms primarily compete against fossil fueled power plants. The speaker went on to differentiate that distributed wind energy systems are used to provide power to for remote communities (not connected to a centralized grid) or to offset a portion of energy costs for retail power customers. Distributed wind primarily competes with solar and retail electricity rates.. Small wind technology is the size most commonly used in distributed applications. In 2015 the United States added 28 MW of distributed wind capacity. He also shared some highlights of USA wind market from small wind technology to medium and large wind technology. USA small wind manufacturers see high potential in Asia Pacific markets because there are thousands of islands and remote communities that require electrification, however quality assurance is considered a risk. Mr Barker briefed about the history of R&D cooperation of the US Department of Energy and its previous investment to establish Quality Assurance Framework. New market development for small wind requires policy incentives (e.g. feed-in tariff) and technology quality assurance requirements to protect against untested technologies and unverified claims about technology performance. Regarding next generation technology development, the speaker said that technology development and turbine certification is not easy (or cheap) for small businesses. There were needs to increase energy production, reduce hardware cost and certify turbine performance and safety.

Mr. Takashi Matsunobu divided his presentation into four major parts: *Market Overview; Japanese Industries; Hitachi Technologies; and Conclusion.* First, Mr. Matsunobu introduced the trend of Japanese in wind installation and severe environmental condition in Japan that affect the wind power development. He also listed some recent accident related to the industry in Japan. The speaker said that industrial integration has been able to boost wind business growth. Hitachi wind turbines has tried to employ local components, which have suitable design to East Asian environment. In his view, Japan has some big manufacturers, research institute and organizations working on wind power energy. About Hitachi technologies, the speaker introduced about the downwind solution by which problem (including after tower turbulence) are overcome using analysis-based design techniques and then confirmed by demonstration test. He shared that Hitachi turbines suit all conditions from mountainous to flat and fixed-bottom to floating installations due to difference in design standard. Hitachi also has developed its international cooperation with partners in the region in some programs such as capacity building, technology transfer. To conclude the presentation, Mr. Matsunobu said that Hitachi continuously creates the best solution for Asian wind energy market, which has typhoon, earthquake, lightning requirements, etc.

During the discussions, it was suggested that renewable energy could be further developed by applying higher tax on carbon and tax credit for renewable energy. In addition, some participants reiterated that it is important to discourage fossil fuels and push fossil fuel peer reviews in economies. Dr Jha observed that many APEC economies have used FIT to develop renewable energy; therefore, there should be a comprehensive study on FIT and how to bridge technology gaps. Mr Barker highlighted the importance of continued discussions on technology, grid (nano, micro), decentralized power, (among other topics).

IV/ Conclusions and Recommendations

1/ It is the consensus of the Seminar~~'s~~ speakers, moderators and participants that the project has achieved its intended objectives. APEC should continue to share and discuss more deeply the various knowledge, experience and challenges on wind energy development from various APEC member economies. Participants also said that the Seminar had provided a great opportunity for networking with experts from within and outside the APEC region.

2/ The Seminar participants listed, among others, challenges in wind energy development such as:

- Environmental issues like noise, landscape, etc;
- Wind energy advocates must convince electricity sector operators that wind energy not affect the stability of electricity as new advances in Smart Grid technology and energy storage can effectively address wind variability. New

win turbine technologies will allow for better management of power quality which is a significant issue for some grid systems;

- Problems in investment;
- Government's policies of new and renewable energy development, including FIT. Government policies need to be clear. This resolves issues with investors concerns as they will have a better idea of how to finance wind projects;
- State budget constraints. As shown in the New York State case, a significant infusion of government funds was necessary to have the first major wind farm sited and built in the state. There may be needs of developers in Viet Nam who may require assistance from the government;
- Turbine maintenance;
- Micro-grid and community. For remote areas with good wind resources, this may be a better approach for the development of wind farms to serve specific communities. These micro-grids will require some type of storage or fast-start systems to maintain power;
- Import of technology;
- Geographic and infrastructure conditions;
- Land acquisition;
- Simplifying licenses for wind projects. Governments and their regulators must have mechanisms that have clear pathways for permitting and licensing of projects. This is consistent with the previous bullet on supporting investor confidence;
- Lack of experts;
- Lack of supporting policies and incentives;
- Need for sufficient interest from Central government for encouraging investors and developers to develop wind projects.

3/ The Seminar participants suggested future activities/ topics that APEC should take to promote wind energy:

- Providing a roadmap to access technology and financing for wind energy development;
- Researching and developing a low wind speed turbine;
- Technology transfer on wind turbines;
- Trade aspects of renewable energy; and,
- Matching policies for wind energy development in APEC.