Asia-Pacific
Economic Cooperation

EWG 05 – 2015A: Workshop on experiences and plans to double renewable energy utilization by 2030 in the APEC region

Daegu, Republic of Korea

November 10 – 11, 2015

Energy Working Group

August 2016

APEC Project: EWG 05 – 2015 A

Produced by

Dr. Anil Pahwa (**Project Overseer)**
Professor and Logan-Fetterhoof Chair
Jefferson Science Fellow (U.S. Department of State 2014-15)
Electrical and Computer Engineering
Kansas State University
Manhattan, KS 66506 United States
pahwa@ksu.edu

Dr. Gilsoo Jang
Professor
Korea University
School of Electrical Engineering
Anam-dong, Seongbuk-gu, Seoul 136-713, KOREA
gjang@korea.ac.kr

For

Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

[**APEC#216-RE-01.9**]

Contents

Executive Summary

There is worldwide interest in increasing the share of renewal energy in electricity generation and energy consumption for enhancing sustainability, as evidenced both by the United Nations' Sustainable Energy for All (SE4ALL) initiative and the APEC Leaders' 2014 commitment to double renewable energy in APEC's energy mix by 2030 (over 2010 levels). The energy ministers reiterated this commitment at the energy ministerial in the Philippines in October 2015. With over 40% of the world population and more than 60% of global energy consumption, it is especially important for the APEC economies to accelerate the deployment of renewable energy.

The workshop targeted best practices and next steps to help APEC economies develop roadmaps for increasing the share of renewable energy in power generation and end-use technologies. By promoting the exchange of experience gained and best practices in implementing policies and plans focused on renewable energy, the workshop has the potential to significantly influence the rate at which renewable energy is adopted across the member economies and thus increase the overall share of renewable energy in electricity generation and energy consumption. Through this workshop, APEC set an example for international cooperation on renewable energy development.

Six international expert speakers and 17 delegates representing 10 APEC economies attended the workshop. The expert speakers addressed various topics related to renewable energy including global projections for renewable energy, projections and consequences for the APEC region, system integration and flexibility issues, renewable energy for buildings, and green technologies. Delegates from China, Chinese Taipei, Japan, Korea, Malaysia, Papua New Guinea, Peru, the Philippines, Thailand, and Viet Nam made presentations on their plans and experiences on renewable energy. These were followed by breakout sessions to address the following issues.

1. **Currents trends and barriers**: policy, technical, and social to advancing renewable energy
2. **Opportunities and strategies** for strengthening renewable energy implementation: emerging technologies, innovative financing, public-private partnership, and business cases
3. **Best practices** for advancing renewable energy: training for capacity building, reducing soft costs, resources for information sharing, stakeholder engagement

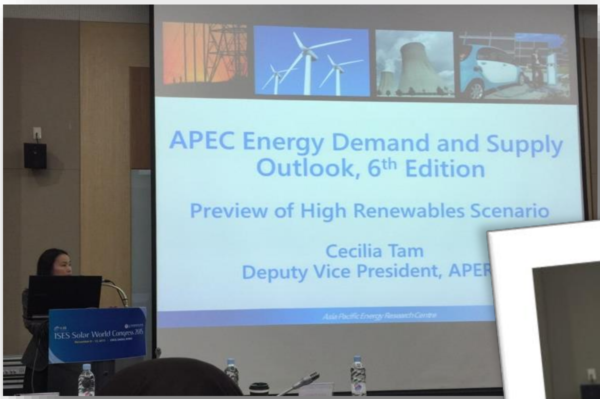
The workshop concluded with an interactive panel session to develop a summary of best practices, identify gaps, prepare guidelines to accelerate growth of renewable energy in the APEC region, and provide recommendations for future activities and workshops to sustain the efforts towards meeting the goals of doubling renewable energy in the energy mix. Specific issues in priority order for future consideration identified by the workshop attendees are

- Education, training, collaboration, and information exchange
- Policies and keeping policymakers informed
- Market reforms and cost of renewable energy
- Leverage advances in smart grid and storage technologies
- Strategic and innovative financing for bankable projects

Session 1

Chair – Tom Key

9:00 to 9:30	Christine Lins, Executive Secretary, Renewable Energy Policy Network for the 21st Century (REN21), France - "Global Status and Outlook on Renewable Energy".
9:30 to 10:00	Cecilia Tam, Deputy Vice President, Asia Pacific Energy Research Centre (APERC), Japan - "APEC Energy Demand and Supply Outlook 6th Edition: Preview of High Renewables Scenario".



1-1. Global Status and Outlook on Renewable Energy

Christine Lins
Renewable Energy Policy Network for the 21st Century (REN 21), France

The evolution of renewable energy over the past decade has surpassed all expectations. Most renewable energy technology saw significant cost reductions, and support policies have spread throughout the world. Renewable energy provided an estimated 19.1% of global final energy consumption in 2013; the share of modern renewable energy increased to 10.1% while the share of traditional biomass was 9 %, the same as in 2012. Renewable energy comprises 27.7% of global power generation capacity and 22.8% of global electricity demand was produced from renewable energy. The most significant growth occurred in the power sector, with global renewables power capacity exceeding 1,712 GW, an increase of more than 8.5 % over 2013. In 2014, renewables made up an estimated 59% of net additions to global power capacity and represented far higher shares of capacity added in several economies around the world. Variable renewables are achieving high levels of penetration in several economies. Regionally, Asia installed the most generating capacity–led by China, which added the most wind power, solar PV, and hydropower capacity of any economy in the world. The share of renewables in transportation remains small, and renewable energy accounted for an estimated 3.5% of global energy demand for road transport in 2013, up from 2% in 2007. Also, job creation has come to the forefront of the policymaking debate. According to analysis from IRENA, globally an estimated 7.7 million people worked directly or indirectly in the renewable energy sector. Solar PV is the largest employer with 2.5 million jobs, most of which are concentrated in China due to its undisputed lead in manufacturing as well as a rapidly expanding domestic market. Japan, the United States, and Bangladesh have also boosted their solar PV employment. Solar power and wind were the leading technologies by far in terms of dollars committed, with solar power (mostly solar PV) accounting for more than 55% of new investment in renewable power and fuels (not including hydro >50 MW), and wind power taking 36.8%. Feed-in policies in many economies evolved further towards premium payments in the power sector, and continued to be adapted for use in the heating sector. Trends and developments related to feed-in policies vary from one income group and region to the next. Consequently, for a global transition to renewables a concerted and sustained effort is needed to achieve four objectives: First, establishing and strengthening institutional, financial, legal, and regulatory support mechanisms for renewable energy deployment. Second, building awareness about the challenges posed by a lack of access to sustainable energy sources (DRE and the potential increasing energy access has in terms of education and health is key). Third, long-term and differentiated stable policy frameworks to sustain and increase investment levels (in DRE and all over the board). Last, greater attention to the heating and cooling and the transport sector.

1-2. APEC Energy Demand and Supply Outlook 6th Edition: Preview of High Renewables Scenario

Cecilia Tam
Asia Pacific Energy Research Centre (APERC), Japan

Looking at where energy demand is going in the APEC region, APERC forecasts about 33% increases in energy consumption in 2040, led by higher demand in transport and also stronger growth in industry demand. If we look regionally at final energy demand, we find that today the U.S is second largest energy consumer globally and at the top is China. Further, China and South East Asia account for nearly 90% of all additional energy consumption expected to 2040.

Based on APERC's business as usual (BAU) scenario energy supply rises by 30% from 2013 to 2040 as the share of fossil fuels declines from 86% to 82%. It is interesting that shares of oil and coal being used in the region are declining rapidly as shares of gas as well as and renewables are rising. In this edition of the Outlook, we have developed three alternative scenarios. The first is the improved efficiency scenario in which APEC's target of reducing energy intensity by 45% will be reached by 2032. All sectors will need to contribute to achieve this rapid reduction in energy intensity. The second scenario considers an alternative power mix with emphasis on cleaner coal including carbon capture and storage, gas and nuclear. High nuclear and gas leads to the lowest CO_2 emissions level. The final scenario is the high renewables scenario which outlines how APEC can achieve its doubling renewables goal by 2030 compared to 2010 levels. In this scenario, we assume that government targets are fully met and additional renewables capacity needed to meet the goal is developed based on a least cost approach for the APEC region.

China and U.S have the largest estimated potential for renewable energy in the APEC region. The potential is estimated by considering several factors, such as the government policies, targets, plans and projections. Additionally, costs of renewable technologies have been declining in different economies, but they vary widely. For example, hydro in Viet Nam has the lowest Levelized Cost of Electricity (LCOE) and offshore wind costs are highest in Peru. Under the high renewable scenario, renewable's share will be 33% by 2030 and continues to rise to about 36% in 2040. Most of the increase in renewable capacity will come from solar and wind as much of the remaining economic hydro power potential is already developed in the BAU. China and U.S together will provide about 70% and 71% of the total renewable generation in the region in 2030 and 2040, respectively. In transport we have estimated the potential for additional biofuels supply potential through the use of unutilized agriculture land as well as enhancing productivity per cultivated land. Thirteen economies have potential for bioethanol and 11 economies for biodiesel production. However, almost all economies will have possibilities of increasing biofuels use in the transport sector. Since there is a mismatch between biofuels demand and production in the APEC region, trade of biofuels among APEC members would help to address this imbalance.

Session 2

Chair – Christine Lins

10:30 to 11:00	Tom Key, Senior Technical Executive, Electric Power Research Institute (EPRI), United States - "An Integrated Grid Path for Distributed Solar".
11:00 to 11:30	Nick Schlag, Managing Consultant, Energy+Environmental Economics (E3), United States - "Renewable Integration in the Western United States: Challenges and Opportunities".
11:30 to 12:00	Bing-Chwen Yang, Division Director, Green Energy and Environment Research Laboratory, Industrial Technology Research Institute (ITRI), Chinese Taipei - "Low Carbon Technology for Green Energy Implementation".

2-1. An Integrated Grid Path for Distributed solar

Thomas Key
Electric Power Research institute, United States

Power systems are changing and this change is dominated by Distributed Energy Resources (DER), which are devices at the edge of the power system in distribution systems. Many innovations in electricity generation and end use are on the distribution end of the system. For example, advancement in technologies such as solar PV, electric vehicles, power electronics, and energy storage provide distributed and customer sited resources.

Renewable technologies are a big driver, there is currently ~70 GW of wind power and more than 20 GW of solar. Growth rates are high in these areas. PV for example took ~20 years to reach 1 GW, and is now doubling every 2-3 years. Further, electric vehicles are gaining popularity, bring a new concept of "mobile" electrical load and generator. Currently, U.S. has 180,000 electric vehicles on the road and the adoption rate is increasing. Demand Response also has already become a significant resource and load connectivity enabled by smart phones will continue to make this resource easier to acquire as customers manage their electricity use with smart apps. In the future, if natural gas remains affordable and plentiful, we can see greater penetration of gas based distributed generation and as technology drives the cost of energy storage, we may also see more deployment of distributed energy storage in customer premises.

These changes are not fully planned or integrated with the power system. In many cases, the distribution system operators do not have visibility of how much electricity is being produced by the distributed generators and neither are they aware of bids for demand response within their system on the wholesale market. This lack of integration, either during planning or during operation of the power system, results in unintended consequences when the penetration of renewable resources increases. In Germany, where in a decade 60 GW of distributed wind and solar were added to the system with peak load of 80 GW, the consequences are well known. These experiences are a valuable lesson to consider for other economies like U.S. which are in the early stages of deploying distributed energy resources.

Among many kinds of renewable energy sources, solar PV will be a key driver of the change. The Department of Energy "SunShot" Vision Study, released in February 2012, forecasted that U.S. will have 302 GW of PV by 2030. The impact of Germany's high penetration level to electricity prices can help figure out whether U.S. power grid is ready for this amount of penetration level or not. Germany is in the position that they can trade energy with other economies and even with Germany's relatively well connected infrastructure, they occasionally have negative market prices on the weekend when the market is not able to absorb excessive amount of energy from solar.

Solar output variability brings a grid operating challenge, which has significant differences from season to season or day to day, affected by irradiance conditions. A single PV module can have the output variability up to 9.1% per second. To measure the impact of weather conditions, daily variability can be categorized into 5 terms based on Sandia's Variability Index (VI) and the Clearness Index (CI) as shown by the limits on the chart. VI is the ratio of the length of the measured irradiance curve to the length of the clear sky irradiance curve based on 1-minute average data. CI is the ratio of the area under the measured irradiance curve to the area under the sky irradiance curve. Categorizing variability in this way allows one to quickly compare the variable resource across seasons and at different locations.

Potential Grid issues with PV variability will be voltage control, equipment operation, demand and energy, system protection and power quality. The main concerns which also usually work as a limiting factor is voltage of the feeder. EPRI has been conducting research on integrating PV in distribution system, especially on determining feeder hosting capabilities. EPRI's approach is to determine how much PV can be accommodated before adversely impacting a feeder with various scenarios including PV technology, PV size and location, feeder construction and operation. As a research outcome, EPRI provided an analytical approach for determining impact of distributed energy sources on feeder depending on their size and location. Advanced inverters for PV also have significant upside with respect to increasing hosting capacity. In many cases, use of smart inverters can be the least cost solution for mitigating voltage related issues caused by PV. EPRI is providing utilities with better understanding of how to use inverters by developing recommended settings and methods for better integration.

To achieve high penetration of PV, several options can be suggested. Leveraging hosting capacity of the existing grid will make solar a better match to the available capacity and energy demand. Changing requirements for distributed generator to provide grid support, especially for island grids, can also contribute to high PV integration. Distribution upgrades and reinforcements like AMI, smart protection and control system have proven their applicability in European power systems. For the bulk two-way transmission grids, flexibility of resources and DG ride-thru requirements will increase possible penetration capacity.

2-2. Renewable Integration in the Western United States: Challenges and Opportunities

Nick Schlag
Energy and Environmental Economics Inc. (E3), United States

Multiple studies have established the central role that the electric sector must play in meeting economy-wide carbon reductions goals. It is not just investing in renewable energies but also includes transition of non-electric system to electricity as well such as increasing electric vehicles, which will make the power systems to play more important roles. Multiple de-carbonization options of the U.S. generation fleet include dependence on wind, solar, CCS technologies, and nuclear power. In the United States most of the renewable energy development are driven by "Renewables Portfolio Standards" (RPS). Many states have implemented the RPS to require certain percentage of loads be delivered by renewable energy. Most of the set targets range between 10 to 20%. Earlier in 2015, California passed legislation to establish the renewable energy target to 50% by 2030 and this will require the California power system to transit to different levels in next ten to fifteen years.

Many renewable resources are variable and uncertain, which means that output from these generation changes from minute to minute or second to second and cannot be predicted perfectly in advance. Outputs from solar or wind are concentrated during specific times of day and year, which significantly impacts the bulk power system operation. These characteristics require a transition to an electric system that is more flexible. More reserve are required in order to meet minute to minute changes with fast responses. At low penetrations of renewables, existing plants and conventions can accommodate incremental changes. At high penetrations level, however, impacts of renewables are transformational and nonlinear. To comply with anomalous impact, market structures and scheduling processes should allow efficient system dispatch and paradigms for resource planning and procurement should shift from capacity to flexibility. Also, contractual structures should ensure proper economic signals are provided to renewable energy developers.

California has already reached a high level of penetration by having 23% of loads served with renewable energy sources in 2013. Utilities of California are on track to meet or exceed 33% of renewable energy by the year of 2020, and California has recently established an RPS target of 50% by 2030 to accelerate the transfer and development of renewable energies in the states. At the moment California does not have operating experience at 33% penetration, but there are other states or economies that have experience in operating at reasonable high penetration, but none of them have achieved a penetration above 50% or even 30%. These challenges indicate the need for new tools and understanding of system operation. California utilities and regulators are now working on institutionalizing the questions about flexibility and needs of flexibility to integrate renewables.

Considering the RPS target of 50% in California several challenges can be addressed about operating the system with high renewable integration. The first one is of peaking capability, which requires the system to meet the highest peak loads with sufficient reliability. The second problem is the ramping capability of thermal resources that need to be ramped downward, and potentially shut down, to make room for a significant influx of solar energy after the sun rises and then needs to be ramped up quickly shortly after sundown to meet a high net peak demand. In addition, over generation may occur during hours with high renewable energy production even if thermal resources and imports are reduced to their minimum levels. Flexible capacity is also needed to meet sub-hourly ramping needs.

Balancing large amounts of solar generation in California will be more challenging as their penetration increases. Over generation increases rapidly above 33% and is very high on some days with 50% penetration even with fossil generation reduced to the minimum levels possible. Therefore, renewable curtailment is a critical strategy to maintaining reliability. Operating coal resources flexibly will help integrate renewables by mitigating over generation but may result in increased cycling costs and reduced equipment lifetimes. Geographic and technological diversity facilitates renewable integration by distributing production across more hours of the year, which also leads to lesser over generation. Regional coordination between markets or states offer substantial benefits since renewable integration is easier on larger systems. Currently initiatives are underway to encourage regional coordination.

Introduction of variable renewables has shifted the capacity planning paradigm. The new planning problem consists of two related questions which are (1) how many dispatchable resources are needed to meet load and flexibility requirements on various time scales, and (2) what is the optimal mix of new resources, given the characteristics of the existing fleet of conventional and renewable resources? Procurement decision for new investments and programs should consider the value each option provides to renewable integration.

California's experience is not unique but can be achievable with its technological feasibility. High penetrations of renewable generation require us to reconsider how decisions are made in the electric sector across all time scales. In daily time scales, market structures and scheduling processes must be organized to allow efficient dispatch across a boarder range of conditions. Across years, decision making frameworks for procurement must consider impacts of renewable generation on the system. Diversity and regional coordination are low hanging fruit that mitigate many of the challenges of achieving high penetrations. Additional investments may be necessary under some circumstances to facilitate renewable integration.

2-3. Low Carbon Technology for Green Energy Implementation: Challenges and Opportunities

Bing-Chwen Yang
Green Energy & Environment Research Laboratories
Industrial Technology Research Institute, Chinese Taipei

If the global temperature rises 2 degrees, 2 billion people will suffer from water scarcity and 20% of the world population will be affected by the floods. If the sea level continues to rise, the future of island regions, including Chinese Taipei, will be threatened. Energy related measures across all sectors should be taken to achieve the global goal of reducing annual carbon emission levels by 2050 to half of those in 2011. To achieve this scenario, strong policies will be needed from governments worldwide. Many approaches are needed to cope with climate change. A variety of low carbon technologies can be integrated such as green buildings, smart grid, and demand management system. As an effort towards integration of these technologies, Chinese Taipei government plans to transform the Penghu Island into the economy's first model of a low carbon community. In Penghu Island, renewable energy supplies 56% of total energy consumption as of 2015, and carbon emission have been reduced from 5.4 tons/cap-yr (2008) to 2.1 tons/cap-yr (2015). Infrastructure of this island, including PV system, wind power, LED street lamps, electric scooters and charge stations, contribute to lowering carbon emissions. Additionally, all new public buildings and major private constructions must obtain green building certification.

Green Energy and Environment Research Laboratories (GEL) is one of the research laboratories of the Industrial Technology Research institute (ITRI) in Chinese Taipei. GEL is working on providing energy policy and industry development support, recommendations based on industrial insight, robust economic models and analyses, and focus on research and development for renewable energy and energy conservation technology with low carbon emission and high energy efficiency.

There are various major research projects on low carbon technology to which GEL has contributed.

PV technology with flexible non-vacuum Cd-free CIGS and 14.6% efficiency has achieved 0.4USD/Wp module cost and this will lead the PV industry towards grid parity. GEL also has developed ButyFix™, a bio butanol technology that feeds on a cellulose polymer and has theoretical carbon footprint of zero. Ocean energy and geothermal energy are other renewable resources for ITRI's research projects. Effectively capturing wave energy with long term reliability is a key issue. ITRI is focusing on High Efficiency Wave Energy Converter and offshore installation technology with underwater power transmission. For geothermal energy, anticorrosion coating technology to endure highly acid geothermal corrosion is on the research track. To acquire best drilling sites and strategies, geothermal database and data fusion systems are being implemented in the field. Waste heat of the industry can be utilized using subcritical ORC system for which demo units are in operation. Carbon capture is an intuitive low carbon technology that re-utilizes carbon for chemical processes. Smart green building is an integration of high insulation paint, renewable energy, smart grid and AMI (Advanced Metering Infrastructure), and demand management and storage technologies. Optimal energy control of building is based on integrated information of the real time environment, human activities and electricity tariff. ITRI's green campus project employs different new low carbon technology, such as green building, LED, smart grid, and energy management system shows 6-10% electricity savings. High efficiency lightning, centrifugal chiller with active magnetic bearing, and external rotor brushless DC motor are the major energy saving technologies pursued by GEL. Al-ion battery is a low cost and has low flammability with high capacity energy storage to promote power system's reliability with renewable energy sources. In order to operate power system more efficiently, smart grid is monitoring most of high voltage transmission lines with AMI and applying smart meters to distribution sites. A virtual power plant has been constructed in the new Taipei city to conduct research on dispatch algorithms for controlling distributed energy resources and load shedding.

In response to global climate change, Chinese Taipei has been continuously supporting energy research to provide superior technologies and promote green energy industry. For green energy development, ITRI strategically focuses on renewable energy technologies, higher energy efficiency equipment and standards, and intelligent energy management. ITRI will keep on assisting governments to play significant roles on energy policy, technology development and industry promotion.

Session 3

Chair – Cecilia Tam

1:30 to 2:00	Shicong Zhang, Deputy Director, Research Center for Development Strategy, China Academy of Building Research, Peoples Republic of China - "Renewable Energy Utilization Towards Net Zero Energy Building".
2:00 to 2:30	Dave Renne, President, International Solar Energy Society (ISES), Germany - "The Future of Solar".
2:30 to 3:00	Open Discussions

3-1. Renewable Energy Utilization Towards Net Zero Energy Building

Shicong Zhang
Research Center for Development Strategy
China Academy of Building Research, Peoples Republic of China

During the next two decades, over 80 billion m^2 of new and rebuilt buildings will be constructed in urban areas worldwide. The residential and commercial sectors of energy consumption in the United States have been increasing consistently from 1950 to 2011; and in 2011, it was 1.33 times higher than that in 1990. So, APEC launched the Nearly Zero Energy Building Program that requires planning for new federal buildings to include design specifications that achieve Zero-Net-Energy use by 2030. The program, which started in July 2013, was proposed by China with co-sponsoring economies of Hong Kong-China, Singapore, Canada, Japan, Thailand, New Zealand, and the United States. Objectives of the program are 1) Net Zero Energy Building Definition and Policy, 2) Research Program Outcomes and Technology Roadmap, 3) Pilot Projects among APEC Economies, and 4) Liaison with Related Associations and Alliances. In 2013, a Net Zero Energy Building Workshop was conducted in Beijing with a focus on Section 1 (Policy & Overview), Section 2 (Codes & Standard), and Section 3 (Technologies). Also, policy, definition, key technologies and pilot project were discussed by 15 economies and 80 experts in a 2014 workshop. For example, Korea's national goal for 2020 is reducing GHG emission in the building sector by 26.9%. The United States has a goal of 100% of all new federal buildings achieving NZE by 2030, and by 2020 all planning for new federal buildings requires design specifications that achieve Zero-Net-Energy use by 2030. In Canada, there are five topics for NSERC Smart Net Zero Energy Buildings Strategic Research Network. They are 1) Integrated solar and HVAC systems for buildings, 2) Active building envelope systems and passive solar technologies, 3) mid-to long-term thermal storage for buildings and communities, 4) Smart building operating strategies, and 5) technology transfer, design tools and input to national policy. Japan also enacted energy efficiency standards for residential building.

Some APEC economies have already issued policies and set up clear and aggressive long-term goals for NZEB to address energy self-sufficiency, environment protection and pressure of climate change. Some definitions of zero energy to address design and operation of buildings to achieve the zero energy targets are not very clear. They are also related to the government policies and incentives. Potentially, some definitions with similar content among APEC economies need to harmonize in the future. "Building codes and Standards" are the most fundamental and effective measures to promote NZEB development. "Energy codes and Standards" play a vital role by setting minimum requirements for energy-efficient design and construction. Since 1970s to now, the building energy codes have already helped in achieving 50%-70% energy savings and still there is a 70%-90% energy saving potential in the future. Major institutes, societies and alliances have all established NZEB or similar targets, most of them are more stringent than the federal national goal. "Obstacle & Barriers" to promoting

NZEB are 1) Long term targets together with a clear near objective is needed in some economies, 2) significant funding is still needed for the technology research and building codes upgrading to make NZEB widespread by 2030, 3) incremental cost needs to be balanced with the government subsidy in the near future and with technology promotion, industry growth and marketization in the long term, and 4) best practice projects needs more attention to show the direct energy reduction results and verify the latest research achievements, which is the most effective way to call the interest of officers and experts to expand the project's influence. These contents that are relevant to Nearly Zero Energy Building are uploaded to APEC website. NZEB Best Practices and Energy Reduction Results Comparative Study will be conducted for professional in-depth comparative research with the detailed information collected on the best practices of NZEB pilot buildings among APEC economies. The study will showcase how tremendous energy savings could be achieved by integrated design, advanced technology utilization and NZE oriented management and commissioning of buildings. With 80%-90% energy reduction, building are becoming easier to achieve NZE if integrated with renewable energy, but it needs definition as well as codes and standards. Zero Energy Building is strongly linked with renewable energy development.

3-2. The Future of Solar Energy

Dave Renne
International Solar Energy Society (ISES), Germany

The purpose of this presentation is to discuss the future of solar with relevant technologies. Already 2000 Gt CO_2 has been emitted since the beginning of the industrial revolution (around the middle of the 18th century) with about half of this occurring in the last 40 years. The increase in greenhouse gases in the atmosphere resulting from fossil fuel burning and land use changes has resulted in an increase in global mean temperature of 0.85 ^{0}C since reliable records first began around 1850. To stabilize climate change at today's level by 2100, cumulative CO_2 emissions must not exceed 1000 Gt $C0_2$ between now and 2100. However, emission *rates* have actually been increasing over the past two decades and are now around 30 Gt CO2/year. Furthermore, the carbon burning infrastructure already in place can produce all of the balance of the allowable emissions at the present rate. The IMAGE modeling team of the PBL Netherlands Environmental Assessment Agency developed various scenarios CO_2 concentrations to address various climate change goals. Scenario RCP2.6, which requires substantial reduction in greenhouse gas emission starting by mid-century, is our best opportunity to limit global warming to below 2.0 degree in the long term.

Looking into the growth of the solar industry, global PV capacity by the end of 2015 was at least 200 GW, which represents approximately 1% of global electricity supply. Also by the end of 2015, renewables comprised an estimated 26.4% of the world's power generating capacity. This was enough to supply an estimated 22.1% of global electricity with hydropower providing about 16.4%. While renewable capacity continues to rise at a rapid rate from year to year, renewable electricity's share of global generation is increasing more slowly. This is in large part because overall demand keeps rising rapidly, and also because much of the renewable capacity being added is variable.

Three pillars of successful growth of any technology such as PV are reliable and efficient technologies, financing with private capital, and policies for an enabling market environment. These three factors work together to produce positive feedback resulting in robust economic activity.

There are several types of PV technologies currently in use. For example, Concentrating Photovoltaic (CPV) fills a small market that saw less than 0.2GW growth in 2015. Thin Films technologies are composed of Amorphous Silicon, CdTe/CIGS, and Organic materials. The main technology is Crystalline Silicon, and is considered to be the workhorse of the solar industry.

The PV market has seen 22% cost reduction for every doubling of capacity. This is due to effective government R&D programs which have stimulated commercial market with continuous improvements in cell efficiencies. By 2020, some estimates project that 7% of global electricity generation will be supplied by PV. In the future, the price of modules should continue to drop, which will further expand the market, so projections by Navigant Research estimate 321 to 430 GW cumulative PV by 2018. This forecast is based on the assumption that PV module prices and installation costs will continue to decline at a much more conservative rate of 3% to 8% per year from 2013 to 2020 compared to the dramatic price declines in the previous years. By 2020, solar PV systems will have installed costs in the range of $1.50 per watt to $2.19 per watt throughout the world. If this price range is realized, solar PV will largely be at grid parity without subsidies in all but the least expensive retail electricity markets. IEA's PV Roadmap Projections to 2050 expect a shift from residential to large-scale PV over time.

Several other organizations including Greenpeace, GEA, IEA ETP, IEA, and WEO have done their own projections for renewable energy. The projections of Greenpeace and GEA are at the higher end with renewable energy share of total global energy at 80% and 70%, respectively by 2050.

To keep solar energy secure, the projects must be "Bankable". Solar projects must be based on good policy decisions, site and technology studies, and appropriate feasibility studies. Due diligence is a critical step in this sequence, which comes when the project feasibility is shown to be favorable and financing commitments are ready to be made.

Studies have shown that over a longer period of time the standard deviation of solar irradiation at a given location is low. This means that the 90% probability level of solar irradiation over a 1-year period can be lower than the 90% probability level of solar irradiation over a longer period of 10 years. In other words, while fluctuations can be expected in aggregate annual solar irradiation from year to year, over a longer period of time these fluctuations will tend to offset each other.

In conclusion, solar energy has achieved commercial success, but must now become a mainstream energy source. Specifically, 1) good policies will reduce risk and uncertainty, 2) continued technology R&D will improve efficiencies and reduce costs, 3) capital (and especially private capital is available for bankable projects, and 4) a workforce is needed to support the growth of these technologies. Price drops, expanded RE targets, low-cost storage, management of the demand side, and utility acceptance will play the most important role in the future growth of renewable energy.

Open Discussions

The delegates engaged in open discussions on the following topics:

PV penetration level of each economy

- U.S. expected to achieve 30% of renewables including 10% of PV in 2030
- Hydro and thermal penetration analysis need to be supplemented

Efficiency and life cycle of PV production

- As PV system decrepit, efficiency also drops
- Recent products have very small efficiency drop
- In past ten years, life cycle and fault prevention technologies have improved significantly

Provide guarantee to cover risks

- Manufacturer cannot give permanent guarantees
- Newly started company may not survive when markets change steeply

Local policy or market to promote penetration

- Involve local community to be a part of projects
- Provide business opportunities
- Protecting local market too much will make electricity price rise

Program policy for joint development of training program for students and engineers

- Number of programs exist in universities in U.S.
- International Solar Energy Society (ISES) has good training programs
- ISES webinar

Strategies for strengthening renewable energy

- Installing PV on the polluted areas which are covered with chemical waste from nearby factories

Session 4

Chair – Nick Schlag

3:30 to 3:50	China – Xu Zhao, Asia Pacific Sustainable Energy Research Center (APSEC) - "Renewable Energy Experiences and Plans in China".
3:50 to 4:10	Chinese Taipei - Chun-Li Lee, Bureau of Energy - "Strategy and Roadmap for Renewable Energy in Chinese Taipei".
4:10 to 4:30	Japan - Takao Ikeda, The Institute of Energy Economics - "Policy and Current Status of Renewable Energy in Japan".
4:30 to 4:50	Peru - Sol García-Belaúnde, Territory and Renewable Energies Energizing for Development - "Implementing Renewable Energy Technologies in Rural Peru".

4-1. Renewable Energy Experiences and Plans in China

Xu Zhao
Asia Pacific Sustainable Energy Research Center (APSEC), China

This report shows Chinese experiences in the context of a timeline of installed renewable energy power generation capacity (2005-2014), a timeline of renewable energy power generation (2005-2014), and the share of RE/non-fossil power in energy consumption (2010-2014). In addition, it presents China's renewable energy targets and emphasizes the Energy Development Strategy Action Plan. Plans for achieving the "15% by 2020" target are also included.

Cumulative installed RE power generation capacity in China has increased gradually in the last 10 years. In particular, solar PV (on-grid) starts at almost zero percentage of total capacity in 2005, but a cumulative 30 GW of solar PV (on-grid) has been installed by 2014 inclusive, and PV installation speed is far faster than that of total renewable energy. Wind power also increased to 96 GW in 2014 from just 1 GW in 2005. Biomass saw 9.5 GW installed by 2014. But geothermal and ocean resource power capacity witnessed reasonable growth during the 10-year period.

The annual growth rate of annual RE power generation has fluctuated, and the current ratio of RE power in the total power generation is about 20%. The ratio of non-fossil energy to total energy consumption is around 10% based on the information from 2010 to 2014.

China aims to raise the share of non-fossil (dominantly renewables) energy in primary energy consumption to 10% by 2010, 11.4% by 2015, 15% by 2020, and 20% by 2030 to achieve the "doubling". Moreover, China published "Energy Development Strategy Action Plan (2014-2020)", which puts forward an "Economical, Clean and Safe" strategy and accelerated construction of clean, efficient, safe and sustainable modern energy systems. Three Highlights of the Energy Development Strategy Action Plan (2014-2020) are (1) Control over Total Consumption – total coal consumption of 4.2 billion tons by 2020, a 100 million ton reduction for Beijing, Tianjin, Hebei and Shandong and a negative growth for Yangtze and Pearl River Deltas; (2) Optimized Energy Structure – ratio of primary energy forms by 2020 (non-fossil fuel reaches 15%, natural gas is more than 10% and coal is less than 62%), and (3) Institutional Energy Reform – drive energy pricing reform, accelerate electricity system reform, and toughen energy regulation.

To achieve the 15% by 2020 target, RE will be intensively developed as per the plan, which will see 350 GW of hydroelectric power's installed capacity and 200 GW wind power's installed capacity by 2020. Solar energy generation will be developed by establishing photovoltaic bases, and by 2020 installed capacity should reach 100 GW. Geothermal energy, biomass energy, and ocean energy will also be actively developed. To enhance the penetration of RE into the energy consumption mix, improving the integration of renewable energy into the grid, power system management and energy storage is necessary.

4-2. Strategy and Roadmap for Renewable Energy in Chinese Taipei

Chun-Li Lee
Bureau of Energy, Chinese Taipei

This presentation mainly consists of the New Energy Policy of Chinese Taipei, Renewable Energy Development Act, and Development Strategy. Looking at the chronology of energy policy development, we see Taipei launched a framework for sustainable energy policy in 2008. Before the sustainable energy policy, the Taipei government focused on fossil fuels and nuclear power. After the new policy, it switched its focus to renewable energy. One year later, the Taipei government passed the Renewable Energy Development Act, which provides subsidies to promote renewable energy.

When the big nuclear disaster happened in Japan in 2011, the Chinese Taipei government was shocked because Chinese Taipei is so close to Japan, an economy with which it shares technology. Therefore, Taipei announced a new energy policy--"Steadily reduce nuclear dependency and gradually move towards a nuclear-free homeland and create a low-carbon green energy environment"-- which will increase its renewable energy capacity step by step.

The core strategy of the Renewable Energy Development Act is a feed-in tariff (FiT) system. A committee was formed to decide the calculation formula and feed-in tariffs. The formulas and tariffs, which are very important for technical advancement, cost variation and goal achievement statistics, are reviewed and evaluated annually. Tariffs shall not be lower than the average cost for the fossil-fired power of domestic power utilities. In the current mechanism only solar PV tariff rates are currently set on date when generating equipment installations are completed. Other technologies have tariff rates set on the Power Purchasing Agreement (PPA) signing date. PPA is an important credit for banks to provide project financing. In Taipei, almost 80% of PV systems get their money from the project financing. The government offers a PV capacity quota every year. The installed capacity of PV systems has increased more than 60 times in the 5 years after the implementation of FiT.

Five principles which have been considered for expanding Chinese Taipei's renewable energy development to its maximum potential are (1) subject to technological maturity and feasibility, (2) cost effectiveness – if the current cost is too high the government cannot promote it, (3) development in phases, (4) acceptable increase in electricity prices, and (5) facilitating the development of related industries.

The Ministry of Economic Affairs raised the renewable energy target to 17,250 MW for 2030 (It was 10,858 MW in 2010.). Taipei is focusing on off-shore wind energy and solar PV energy based on a strong solar cell industry, and the total capacity of renewable sources will be up to 17,250 MW by 2030. On the other hand, people who live in Taipei do not like hydro power because of the frequent earthquakes, so hydro power is not the main target. In addition, the currently non-existing commercial geothermal power plant leads to a low capacity target for geothermal energy. Because Taipei is a small island, on-shore wind power is unsuitable for installation.

To prompt solar PV and offshore wind power, the Thousand Wind Turbines and One Million Solar Rooftop PVs promotion programs were approved in 2012. Strategies for offshore wind are (1) feed – in tariff, (2) offshore Demonstration Incentive Program, (DOP) (3) Directions of Zone Application for Planning (ZAP), and (4) Offshore Zonal Development. Three demonstration wind farms, a project that subsidizes 50% of the cost of the demonstration turbines and provides NT$ 250M for preparatory expense, was officially announced in January 2013. The goal of the solar PV projects is to develop 8,700 MW by 2030 (3000 MW roof-top and 5,700 MW ground) and to apply the feed-in tariff strategy for achieving annual targets for installations. A cap quota is decided annually and a PV-ESCO mechanism encourages banks to participate in project financing and to provide soft loans to PV-ESCO players. Sixteen banks now provide PV system financing support, and green energy investment funds have grown from USD 1.6 to 222 million from 2011 to 2013. The PV-ESCO capacity ratio increased from 48% to 80% from 2012 to 2014.

4-3. Policy and Current Status of Renewable Energy in Japan

Takao Ikeda
The Institute of Energy Economics, Japan

This presentation focuses on the long term energy outlook in Japan and RE deployment status with an examination of current issues and related actions to address the issues. Japan regularly publishes its energy strategy. The previous plan for 2030 was established in June, 2010, but it was revised after the Fukushima accident in 2014. Following that a long term energy outlook was published in July 2015, but the Japan government still is not fully sure of the numbers and targets for the future. So the percentage for nuclear energy and renewable energy can be revised corresponding to the evolving situation. However, according to present estimate of the energy outlook, the renewable energy share will be 22-24% in 2030 with hydro around 9% and PV around 7%.

As a part of RE Deployment Promotion Scheme, RPS (Renewable Portfolio Standard) was launched in 2003 and it includes wind, solar, small hydropower, biomass power generation, and binary geothermal. In 2009, a FIT (Feed-in tariff) was introduced for small scale facilities of less than 500 kW to buyback surplus PV electricity based on a voluntary Net-Metering system. A FIT policy with a premium rate for the investors during first 3 years started from July, 2012. Utilities hold the rights to disconnection of renewable energy facilities for up to 30 days without compensation in order to maintain the grid electricity quality. A new disconnection guideline for the new application of PV and wind was implemented this year. In the new guidelines the disconnection duration was changed from 30 days to 360 hours and for wind a disconnection duration of 720 hours was implemented. The premium FIT was discontinued this year, but a new FIT scheme with new disconnection rules are under consideration for diversification of renewable energy technologies. It is important to have an appropriate FIT policy as it has helped Japan increase its RE capacity by more than 10 times since 2003.

A current issue for Japan is unbalanced RE deployment with too much reliance on PV. In the future, a more balanced approach is needed with higher diversification for more stable growth of RE. There are additional issues that need to be addressed. For example, East Japan power system is 50Hz and on the other hand West Japan is 60Hz, which makes it difficult to operate the whole Japan as one grid. Many PV projects are born in rural area where they don't have enough consumption. Therefore, establishment of wide area grid utilization system and strengthening of transmission lines, including energy storage system, in and out of utilities' area are needed. RE cost is expected to decrease due to cost reduction based on R&D, and standardization of project contract and construction. Additionally, capacity building for better opportunity for project finance is under consideration.

Upon implementation of new FIT in 2012, the new PV capacities accounted for 96.3% of the total renewable energy capacities installed in the first three years. Non-residential PV facilities alone accounted for 80.9% of the total. Also, new PV Application reached 70 GW in 2014 due to FIT. Initially the disconnection rule was applied only for big PV projects over 500 kW, but the new rule can be applied not only to big plants but also to residential roof top systems.

Utility scale batteries projects for grid stability supervised by Hokkaido Electric power, Tohoku Electric Power, and Kyushu Electric Power are on-going. A big challenge for the future is disposal of PV waste, which will keep growing after completing the operating life of 25 years.

4-4. Energizing for Development: Implementing Renewable Energy Technologies in Rural Peru

Sol García-Belaúnde
Territory and Renewable Energies, Peru

The Institute for the Sciences of Nature, Territory and Renewable Energies (INTE) was created on 7 March 2011 as part of the PUCP's Vice-Rectorate for Research. Its vision is that by using an interdisciplinary approach with ethics and social responsibility, it seeks to be internationally recognized for its contributions to science, education, technological innovation and sustainable development. The goals of this institute are to (1) be at the forefront of knowledge and scientific research in terms of ecological, territorial, socio-environmental and renewable energy concerns, (2) support, promote and generate value for the environment in Peru, (3) provide training in environmental issues with ethical responsibility, (4) develop proposals and alternatives in the fields of innovation, technology transfer, development and sustainable management and (5) provide information and monitor environmental practices of government offices and civil society.

Peru, located in western South America on the Pacific Rim, is a mega-diverse economy, as more than 88% of climates in the world can be found here. This also places it as third in the world at risk from the effects of climate change. Energy policies in Peru are designed to provide all Peruvians with an energy system that satisfies the national energy demand in a regular, continuous and efficient way while promoting sustainable development. It is supported by planning and with continuous research and innovation. Final energy consumption by energy sources in 2014 was 29% diesel, 19% electricity, 12% natural gas, and 40% other sources. Of these 42% was consumed is transportation, 26% in residential and commercial sector, 28% in mining and industry, and 4% other. The Peruvian energy mix is as follows: 60% are traditional fuels (diesel, natural gas, coal, and wood) and 40% is hydro energy.

Renewable energies can be transformed into three types of usable energy: heat, electricity and mechanical energy. Traditional biomass (wood, dung, etc.) are sources that are used for cooking and water heating. Solar thermal energy is also used for heating (water, heating systems) and cooking processes. Hydro power has been the main source of renewable energy for electricity generation in both the grid (interconnected system) and in the off-grid systems. Wind energy is applied at the small scale level (as part of the grid), in off-grid systems, and demonstration projects.

Photovoltaic solar energy currently has applications through small systems for telecommunications, distance education and medical centers (either as part of the grid or in the off-grid systems). There are also facilities for rural electrification projects and pilot projects for productive use. Biomass, bagasse and biogas from landfills are also used to produce electricity. Liquid biofuels such as anhydrous ethanol and biodiesel are used to generate mechanical energy.

The current status and prospects of RE in Peru are summarized in the National Energy Plan. According to the Peruvian National Energy Plan 2014-2025, Latin America, as a region, has great potential for renewable energies and is currently the region of the world with the greatest use of traditional energy sources, reaching more than 90% in electricity production in past years. Although this includes hydro energy, it is considered a traditional energy source, so non-traditional energy sources only account for 2%. This number, however, should reach 5% by 2020, thus diversifying the energy mix with clean energies.

National electricity production, by 2013, was as follows: 52% hydro energy and 46% thermal energy (oil, coal and gas). INTE is developing and implementing appropriate technologies using renewable energies to satisfy domestic and productive demands for the rural sector. The appropriate technologies must be accessible for rural inhabitants, do minimal harm to the environment and have low cost. For example, the appropriate technologies are (1) improved kitchens, (2) solar heating systems, (3) hydraulic wheels, (4) solar cookers, (5) solar panels, (6) Trombe walls, (7) solar pumps, (8) hydraulic ram pumps, (9) wind pumps, (10) solar cooling, (11) wind turbines, (12) solar dryers, (13) sewage water treatment (14) thermo kitchens, and (15) overshot river pumps.

Current projects include the Energy Connection System with PUCP River Pumps in Andean Rural Communities, which was financed by the European Union and implemented by the PUCP and the Warm, Clean House Project, which includes the technologies of improved kitchens, warm wall/Trombe walls and insulation systems. These projects improve the quality of life of the population of the Andes who every year face the hardships of cold weather and lack of resources with which to protect themselves. Together, these technologies reduce the incidence of acute respiratory infections and related high child mortality rates. They are also environmentally friendly and sustainable as the materials employed are easy to find for the communities.

Session 5

Chair – Bing Chwen Yang

9:00 to 9:20	Malaysia - Azah Ahmad, Sustainable Energy Development Authority (SEDA) - "Updates on Renewable Energy Development in Malaysia".
9:20 to 9:40	Thailand - Karnnalin Theerarattananoon, Department of Alternative Energy Development and Efficiency (DEDE) - "Renewable Energy Development in Thailand".
9:40 to 10:00	Viet Nam - Ninh Hai Nguyen, Ministry of Industry and Trade (MOIT) - "Economy Report on Renewable Energy - Viet Nam".

5-1. RE Development in Malaysia – Updates

Azah Ahmad
RE Technology Department, SEDA, Malaysia

Installed electricity generation in Malaysia was 29,748 MW until 2013, and the mix of renewable energy in total generation is 2% now. The target energy mix of the Malaysia power plan consists of 53% coal, 29% gas, 15% large hydro and 3% renewable energy by 2020. Target renewable energy capacity will be 2,080 MW under a feed-in tariff (FiT) policy. A national renewable energy policy and an action plan were launched in 2010, and SEDA Malaysia was formed as the main implementing agency. FiT payments come from the RE fund, and the quota to be offered depends on the renewable energy funds collected.

The source of renewable energy funding is additional charges imposed on electricity bills. In 2011, the Cabinet of Malaysia approved in principle a 2% additional charge on electricity bills. However, only 1% charge was imposed at the start of FiT, which later increased to 1.6% starting 1st January 2014. The size of the renewable energy fund determines the renewable energy targets for Malaysia. This is partially a "polluters pay" concept and will encourage renewable energy developers. Before the introduction of the Renewable Energy Act (RE Act) in 2011, there was a small renewable energy producer program, which resulted in about 68 MW of grid-connected RE generation by 2011. The RE Act relies entirely on the FiT to achieve the national renewable energy targets.

Important observations such as the competitive use of fuel and transportation costs were also taken into consideration in deriving the targets and projections. Grid parity occurs when the cost of generating renewable electricity is equivalent to or cheaper than the cost of generating electricity from conventional fossil fuels. When this happens, renewable energy would be competitive as it would be the cheaper choice and becoming the economical choice for power generation.

Approved FiT projects at the end of 2015 will number 7,280 with a cumulative capacity of 1,137MW. Of these, Solar PV will be around 321 MW, which corresponds to 28% of the total capacity. Cumulative capacity of operational projects has so far reached 319 MW. To come up with more renewable energy development, SEDA Malaysia introduced PV-related standards and guidelines, solar PV courses, and a PV service provider registration program.

Challenges faced by renewable developers will be related to benefits. Getting a steady and assured supply at a reasonable price will become an issue. Grid connection is another issue and it includes distances from the grid, technological concerns related to voltage rise, and the lack of local load. Some pioneers are suffering from financial issues too, which are making long term projects riskier. Government also needs to cooperate with developers without delaying the projects or creating difficulties in getting permits. FiT for solar PV will stop after 2017 due to constraints on the renewable energy fund to allocate more quota. Other RE quota will continue until 2025.

5-2. Renewable Energy Development in Thailand

Karnnalin Theerarattananoon
Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand

The total energy consumption of Thailand in 2014 reached 75,804 MW. Energy consumption has been growing at 2.4% per year, and renewable energy accounts for 10% of consumption. In 2014, renewable energy accounted for a total of 9,025 ktoe or 11.9% of consumption. The transportation and industrial segments account for 72% of Thailand's energy consumption, and since 2010 the industrial sector has overtaken the transportation sector as the largest source of demand. Industry and transportation both account for ~36% of total energy consumption. Thailand spent almost 1,400 billion baht for energy imports in 2014.

Thailand's renewable energy sources are a combination of electricity, fuel and heating from solar PV, wind or waste-burning energy. In 2008, Thailand set up the Renewable Energy Development Plan (REDP). A modified version of the REDP, the Alternative Energy Development Plan, was developed in 2015 to achieve energy security, cost effectiveness and environmentally sustainable energy. AEDP set a timeline for the plan to match with other national energy plans and promote the development and deployment of WTE and bio-based energy as its first priorities.

The AEDP will also promote PV and wind energy for power generation once their development costs can compete with LNG cost. Conventional incentive schemes have been replaced with a feed-in tariff scheme for very small renewable energy power generation projects. The AEDP uses a competitive bidding scheme in conjunction with the FiT scheme for the RE power generation sector. The AEDP's target is to increase the share of renewable energy to 30% in 2036.

The renewable energy share in Thailand's power generation sector was around 9% in 2014; it is now planned to increase to 20% by 2036. For the renewable energy share in the heating sector, 17% of the current value will be increased to 30-35% target share by 2036. The transportation sector share has the same renewable energy doubling plan, which corresponds to a 20-25% target in 2036 compared to a 7% share in 2014. The Ministry of Energy employs several tools to incentivize renewable energy development, including feed-in tariff.

5-3. Economy Report on Renewable Energy – Viet Nam

Nguyen Ninh Hai
Renewable Energy Department, Ministry of Industry and Trade General Directorate of Energy, Viet Nam

The total energy consumption of Viet Nam in 2014 was 128.4 GWh of which 53.9% was consumed by the industry and construction sector. The second largest energy consumers were residential loads, which corresponded to 35.6% of the total energy. Power generation consisted of 41%, hydro, 25% coal fired power plant, and 30% gas turbine and others. Since 2008 Viet Nam's power market and power sector have been reformed into several power companies and regrouped again. A roadmap for introducing and developing an electricity market in Viet Nam was approved by the prime minister in 2013. This roadmap from 2015 to 2021 will reform the power market from the current competitive generation market to include an electricity wholesale market an electricity retail market by 2021.

The potential wind power in Viet Nam is concentrated in the low speed region. The approximate megawatt potential of total wind power is 2,209 MW. The solar radiation level of Viet Nam is above 3.4kWh/m2/day, and it reaches 4.8kWh/m2/day in the southern, central highlands and south central coastal regions. Renewable energy targets, which were issued in 2011, include increasing the share of RE generation to 4.5% of total power generation in 2020 and to about 6% in 2030. The wind power targets are 1,000 MW in 2020 and 6,200 MW in 2030. Biomass has a 500 MW target in 2020, which will increase to 2,000 MW in 2030. Renewable targets also include electrifying the remote, high mountain areas by renewable energy to supply power to 231,000 households by year 2020.

The renewable energy policies of Viet Nam include cooperate tax exemptions for the first four years, which are reduced to 50% over the next nine years. Import taxes will also be exempted. Biogas and ocean energy such as tide hydro are now being considered for new types of renewable energies to be developed in the future power system of Viet Nam. FiT for wind power plants will be reviewed and revised. The Renewable Portfolio Standards (RPS) are another example of renewable future directions. Establishing renewable energy funds is also being considered including environmental fees, carbon taxes and others. To make renewable integration move forward, assessment of renewable energy potential nationwide and the establishment of a database will be necessary.

Session 6

Chair – Shicong Zhang

10:30 to 10:50	The Philippines - Rico R. Velasco, Department of Energy - "National Renewable Energy Program of the Philippines".
10:50 to 11:10	Papua New Guinea - Rebecca Kiage, Department of Public Enterprises - "Sustaining the Development of Papua New Guinea's Renewable Energy Sector – Opportunities and Challenges".
11:10 to 11:30	Korea - Sang-keun Gavin Yu, Korea Energy Agency (KEA) - "New and Renewable Energy in Korea - Best Practices in Policy and Deployment".

6-1. National Renewable Energy Program of the Philippines

Rico R. Velasco
Solar & Wind Energy Management Division, Renewable Energy Management Bureau, Department of Energy, The Philippines

The development and utilization of renewable energy in the Philippines are governed by two landmark laws. The Renewable Energy Act of 2008 or the RE Law which aims to accelerate the development of the economy's renewable energy resources by providing fiscal and non-fiscal incentives to private sector investors and equipment manufacturers/suppliers, and the Biofuels Act of 2006 which mandates the use of bio-fuel blended gasoline and diesel fuels. The Biofuels Act also provides fiscal incentives to encourage investments in the production, distribution and use of locally-produce biofuels.

The policy directions under the RE Law mainly supports the three major pillars under the energy reform agenda of the current administration. (a) Ensure energy security; (b) Achieve optimal energy pricing; and, (c) Develop a sustainable energy plan. It supports the business environment conducive to RE business by providing non-fiscal and fiscal incentives. Non-fiscal incentives include Renewable Portfolio Standard (RPS), Off-Grid development, Feed-in Tariff (FiT), Net Metering, and Green Energy Options.

The National Renewable Energy of the Philippines (NREP) of the Philippines aims to increase the RE-based capacity by 200% within the next 20 years (2011-2030). The goal is to increase the RE capacity from about 5-MW in 2010 to 15-MW by 2030. The NREP Roadmap is divided into different milestones and sets out indicative interim targets for the delivery of renewable energy within the said timeframe.

The challenges in the development of renewable energy in the Philippines include: full implementation of policy mechanisms under RE Law; streamlining of administrative process; awareness and social acceptance; and high upfront cost. To address these challenges, the full implementation of RE Law is needed, which include finalization and approval of guidelines on other renewable energy policy mechanisms (RPS, green energy options, etc.). An energy investment coordination center and linkages with other government regulatory agencies should be established. Additionally, intensify the nationwide IEC campaigns on renewable energy to increase awareness and acceptance on RE projects and develop an internationally-accepted education and training strategies. Lastly, to reduce the cost and time of RE developers in conducting resource assessment, an RE database should be established and more resource inventory and investment mission should be initiated.

6-2. Sustaining the Development of Papua New Guinea's Renewable Energy Sector – Opportunities and Challenges

Rebecca Kiage
Department of Public Enterprises, Papua New Guinea

Papua New Guinea (PNG) is the last Asian economy to be a member of APEC. Its population is 7.4 million, and its total area is about 462,840 km^2. PNG's GDP growth rate was 8% from 2002 to 2014, but in 2015 it doubled to 15%. PNG has a 14% energy sector contribution to GDP and is a net exporter of energy. The installed electricity capacity of PNG is about 580 MW.

Because of the economy's geographical characteristics, the PNG power grid is divided into a three islanded grids (Ramu, Port Moresby, and Gazelle). In addition, PNG has 19 provincial centres which are powered by thermal generation. But 87% of PNG's population experiences a lack of access to electricity, whilst the 13% with access to electricity face the challenges of frequent unreliable power supply.

Currently, the main renewable source of PNG is hydro power. The installed capacity of hydro is about 432 MW and 4,560 MW capacity is planned for development. Other renewable energy resources include geothermal, solar, wind, biomass, and gas. Gas energy capacity is 85 MW, which is the second largest capacity, an additional 50MW is planned for development in 2016. The first LNG project was developed as 9 TCF, and the second project will be constructed in 2017 as 10 TCF.

PNG electricity demand increases with constraints to electricity supply annually due to the boom in economic activities from the PNG LNG, mining and non-mining sectors. Another challenge is connectivity. For 2050, PNG's Vision 2050 states that the PNG's economy should attain 100% of its power supply from renewable and sustainable energy sources. Greenhouse emissions must be reduced by 90% to 1990 levels. Last, all PNG households should have access to a reliable and affordable energy supply. For reducing greenhouse gas emissions, the development of biofuels, an alternative to fossil fuels, is the best way. For PNG's national sustainable and renewable development strategy, the promotion of green energy investment in the renewable resources sector is necessary.

6-3. New and Renewable Energy in Korea - Best Practices in Policy and Deployment

Sang Keun YU (Gavin)
New & Renewable Energy Center (NREC), Korea Energy Agency (KEA)

When we define new and renewable energies, new energy (NE) includes fuel cells, hydrogen, and coal liquefaction or gasification. Renewable energy (RE) includes nine sources: PV, solar thermal, wind, waste, bio, hydro, geothermal, marine, and hydro thermal. In Korea's new and renewable energy (NRE) supply by sources, the waste source is the largest component (81%). Currently, the NRE industry is growing rapidly. Compared to 2007, the number of NRE manufacturers have increased more than double by 2013. Furthermore, the NRE share of total primary energy supply (TPES) was 4.08% in 2014 and supply was increased to 16.78% (2013-2014) while the annual average of TPES growth is 0.98%. Korea is the first economy in the world to support a fuel cell market by RPS (133,719 kW generation capacity in 2013).

According to the 4^{th} Renewable Energy Basic Scheme in Korea, NRE share targets in 2035, based on primary energy and power generation capacity, are 11% and 13.4%. While the ratio of waste energy would be decreased significantly, the shortfalls are expected to be replaced with solar PV and wind.

In Korea, there are several best practices in NRE's deployment and infrastructure program. These programs are (1) home subsidy program, (2) building subsidy program, (3) FiT, (4) financial support program, (5) RPS, (6) regional deployment program, (7) combined support program, (8) PV rental program, and (9) independent energy island program etc. The home subsidy program subsidizes a portion of the installation costs of an NRE facility. Korea's best practice was installed in the Energy Independent Village with NRE in 2012.

Sessions 7-8

Chair – Anil Pahwa

Breakout roundtable discussions on following topics

Current Trends and Barriers

- Current trends and barriers including policy, technical and social to advancing renewable energy

Opportunities and Strategies

- Opportunities and strategies for strengthening renewable energy implementation: emerging technologies, innovative financing, public-private partnership, and business strategies

Best Practices

- Best practices for advancing renewable energy: training for capacity building, reducing soft costs, resources for information sharing, stake-holder engagement

Group 1

Discussion leaders: Christine Lins, Cecilia Tam

Discussion members: Sang-keun Yu (Korea), Chun-Li Lee (Chinese Taipei), Xu Zhao (China), Azah Ahmad (Malaysia), Sol Garcia-Belaunde (Peru), Soottisak Singkul (Thailand)

1. **Current trends and barriers including policy, technical and social to advancing RE**
   - Carrot & stick (only carrot does not work)
   - RE act addresses technical barriers (esp. local capacity)
   - Capacity building important
   - RE fund comes from end-users – awareness raising was important to inform consumers (regular information days, information at schools etc.)
   - Tightening/improving the rules over time to give fair & transparent access to funds
   - Malaysian banks: RRI should be at least 12 %, below they are not interested to invest in RE
   - Slow reaction from government to correct market failures
   - Large RE industry is doing well, SMEs more averse to taking up opportunities to go abroad
   - Consumers are interested in renewables but not so prepared to make themselves investment in renewable energy
   - Low electricity price for industry
   - Backbone in RE: hydro, wind and solar
   - Hydro & wind are mature, solar is booming
   - PRC swiches from export oriented market to domestic market
   - Implementation of RE policy at local level should be encouraged (local governments need to realise the importance of RE)
   - Promotion of feed-in tarriffs by central government, only part of local governments provide similar incentives
   - Government puts much emphasis on R&D
   - Chinese population has strong support for RE as a means to mitigate environmental problems
   - Focus on large utility-scale projects
   - Curtailment still an important issue / integration of RE a priority for the government
   - Stronger policy focus on diversification of energy mix (currently a lot of focus on biofuels)
   - Lack of financial incentives
   - Weak relationship between academia, industry and government (PPP)
   - Poor communication between different ministries
   - No incentives for solar energy devices (only off-grid)
   - Lack of availabilty of resources to finance projects
   - Need for continuous training of workforce (few training opportunities)
   - Need to create more awareness about the positive impact of renewable energy
   - Language barrier (native language vs. Spanish/English)

- RE goal of 5 % by 2013 is not being reached (currently at 2%)
- Regular change of Minister causes disruption in the policy framework
- Need to import technologies & expertise from abroad – not enough capacity in the economy
- Electricity grid needs to be more expanded to integrate renewable energy sources
- Lack of awareness (e.g. misbelief that solar panels chase away the rain)

2. Opportunities and strategies for strengthening RE

- Scheme by government providing soft loans (not yet existing in Malaysia)
- Government provides interest subsidies, project developers still need to find conventional funding, banks are often reluctant to finance RE projects (slowly getting better)
- Setting-up of SEDA (dedicated agency to facilitate RE deployment)
- Energy storage is a key enabler for RE deployment to stabilise the grid
- Focus on service of generating electricity rather than incentive
- Promoting new energy demonstration zones (e.g. on town or city level are granted special rights as test zones such as New Energy Demonstration Cities Programme)
- Distributed PV demonstration parks/zones Programme
- Electrical vehicles
- Graphene for innovative battery technologies
- Energy generation through nano carbon tubes (new marine energy technology)
- Innovative PPP financing
- Training of staff to implement projects
- Creation of awareness about benefits of renewable energy (e.g. through ecomarkets in Lima)
- Awareness campaigns in schools and universities
- Incentives for companies investing in environmental measures
- Best practise: promotion of RE in rural areas

3. Most important issue APEC should address in future

- Electricity market reform (remove subsidies from conventional fuels)
- Education to facilitate reaching doubling of RE goal
- More coordinated approach in achieving the doubling goal
- APERC could work on reporting on progress towards the RE doubling target
- More collaboration among different APEC working groups

Group 2

Discussion leaders: Tom Key, Shicong Zhang

Discussion members : Ikeda Takao (Japan), Rebecca Kiage (Papua New Guinea), Karnalin Theerarattananoon (Thailand), Nguyen Ninh Hai (Viet Nam), Rico Velasco (The Philippines)

1. **Current trends and barriers including policy, technical and social to advancing RE**
   - In China, due to historical reason, some people worked in the coal plant company or government organizatiobn have strong influence on goverment's policy
   - In Thailand, continuity of national energy plan is problem
   - High cost of renewable energy in unattractive to industry association
   - In Papua New Guinea, renewable energy is not the first priority
   - PV integration is hard to achive above certain level of penetration.
   - Some economies have poor grid infrastrucuture, which make it hard to construct renewable energies in remote areas.
   - Social and cultural issues

2. **Opportunities and strategies for strengthening RE.**
   - Energy storage system with smart grid
   - Financial support by government to the renewable developer
   - Better understanding of risk and opportunity of renewable investment

3. **Best practices for advancing renewable energy RE.**
   - In Thailand, government build biogas fascility on the community and train local people to maintain the system by themselves
   - In the Philippines, government train local dsitribution utility to maintain the offgrid island area
   - Harmonize test procedure of renewable energy equipment for fast permission

4. **Most important issues that APEC needs to address in the future.**
   - Foothold of fossil fuels industry in the economy
   - Policy instablity/lacking
   - Renewables are not priority
   - Social/clutural issues
   - Classification of the doubling renewable target into by sector
   - Integration of renewable energy in both buldings and in the grid is challenging
   - Technical advancement in smart grid and energy storage
   - Availability and access of land for renewables energy development

<u>Group 3</u>

Discussion leaders: Nick Schlag, Bing-Chwen Yang

Discussion members: Yong Sun (China), Cathy Koloa (PNG), Shevena I Jumin Jeffrey (Malaysia), Alexi Kabalinskiy (Japan), Gilsoo Jang (Korea)

1. Currents trends and barriers including policy, technical, and social to advancing RE.

- Cost of renewable energy : for consumer or developers/investors
- Lack of continuity in government policy
- Inconsistencies among central and local government
- Lack of specific renewable energy policy
- Lack of technological maturity, potential and diversity
- Attracting capital for investments
- Challenge meeting specific goals thru FIT
- NIMBY phenomenon
- Lack of technical expertise
- Not learning from mistakes
- Lack of public understanding
- Necessity of international standard

2. Opportunities and strategies for strengthening renewable energy implementation.

- Keep policymakers informed
- Creating “Bankable” projects (success stories)
- Lengthening manufacturing chain
- Need for technical training
- Nurture emerging technologies
- Smart metering and controls
- Low cost government financing
- Shortening supply-demand chain

3. Best practices for advancing renewable energy.

- Encourage international and interregional information exchange : (1) Technical, (2) Policy, (3) Academic
- Eliminate up-front costs thru innovative financing
- Maintain compliant and licensed service providers
- Develop unified electrical standards, gridcodes, testing procedures
- Improve PR and Engage at a grassroots level (Road shows)
- Production continuous information dialog for stakeholders

Conclusions

Group leaders of the breakout sessions presented a summary of the discussions within their respective groups, which was followed by further discussions and voting by all participants to select the top five issues that need to be addressed in the future. Each participant was given five votes to select top five items from the combined list of issues prepared by the breakout groups. The following are observations, challenges and recommendations, in priority order, for future consideration identified by the workshop attendees.

- **Education, training, collaboration, and information exchange (24 votes)**
  - Need for education and training (10)
  - Encouraging international and interregional information exchange (7)
  - APERC could work on reporting of progress towards RE goals (4)
  - More collaboration among different APEC working groups (3)
- **Policies (23 votes)**
  - Keeping policymakers informed (7)
  - Policies are unstable or lacking (7)
  - Classification of doubling RE targets by sector is needed (4)
  - More coordinated approach to achieving doubling RE goal (2)
  - Renewable are not a priority (3)
- **Market reforms and cost of renewable energy (18 votes)**
  - Cost of renewable energy for developers and consumers (9)
  - Subsidy removal in the electricity market (8)
  - Foothold of fossil fuels industry (1)
- **Technology (13 votes)**
  - Leveraging advances in smart grid and energy storage (6)
  - Integration of RE both in buildings and the grid is challenging (3)
  - Maintaining compliant and licensed service providers (3)
  - Lengthening local manufacturing chain (1)
- **Strategic and innovative financing (7 votes)**
  - Creating bankable projects (4)
  - Eliminating upfront costs (3)

Since the sample size of delegates was small, the priority order should not be given too much importance. The results were influenced by the background of the delegates voting and different group of delegates would likely provide a different order. Therefore, all the issued identified by the delegates must be considered as important for meeting the renewable energy goals by 2030.

Appendix A – Agenda

EWG 05 – 2015A: Workshop on Experiences and Plans to Double Renewable Energy Utilization by 2030 in the APEC Region

in conjunction with
The International Solar Energy Society (ISES) Solar World Congress

Daegu, Republic of Korea
November 10 – 11, 2015

Venue: EXCO, Daegu
Room: 320A

Agenda

Tuesday, 10 November

8:00 to 8:30 Registration

8:45 to 9:00 Opening Remarks and Workshop Expectations – Anil Pahwa

Session 1: Chair – Tom Key

9:00 to 9:30 Christine Lins, Executive Secretary, Renewable Energy Policy Network for the 21st Century (REN21), France
Global Status and Outlook on Renewable Energy

9:30 to 10:00 Cecilia Tam, Deputy Vice President, Asia Pacific Energy Research Centre (APERC), Japan
APEC Energy Demand and Supply Outlook 6th Edition: Preview of High Renewables Scenario

Group Photo

10:00 to 10:30 Break

Session 2: – Chair – Christine Lins

10:30 to 11:00 Tom Key, Senior Technical Executive, Electric Power Research Institute (EPRI), United States
An Integrated Grid Path for Distributed Solar

11:00 to 11:30 Nick Schlag, Managing Consultant, Energy+Environmental Economics (E3), United States
Renewable Integration in the Western United States: Challenges and Opportunities

11:30 to 12:00 Bing-Chwen Yang, Division Director, Green Energy and Environment Research Laboratory, Industrial Technology Research Institute (ITRI), Chinese Taipei
Low Carbon Technology for Green Energy Implementation

12:00 to 1:30 Lunch Break

Session 3: – Chair – Cecilia Tam

1:30 to 2:00 Shicong Zhang, Deputy Director, Research Center for Development Strategy, China Academy of Building Research, Peoples Republic of China
Renewable Energy Utilization Towards Net Zero Energy Building

2:00 to 2:30 Dave Renne, President, International Solar Energy Society (ISES), Germany
The Future of Solar

2:30 to 3:00 Open Discussions

3:00 to 3:30 Break

3:30 to 3:50	**Session 4: Chair - Nick Schlag**
	China – Xu Zhao, Asia Pacific Sustainable Energy Research Center (APSEC) Renewable Energy Experiences and Plans in China
3:50 to 4:10	Chinese Taipei - Chun-Li Lee, Bureau of Energy *Strategy and Roadmap for Renewable Energy in Chinese Taipei*
4:10 to 4:30	Japan - Takao Ikeda, The Institute of Energy Economics *Policy and Current Status of Renewable Energy in Japan*
4:30 to 4:50	Peru - Sol García-Belaúnde, Territory and Renewable Energies *Energizing for Development: Implementing Renewable Energy Technologies in Rural Peru*
4:50 to 5:00	First Day Wrap Up

Wednesday, 11 November

	Session 5: Chair - Bing-Chwen Yang
9:00 to 9:20	Malaysia - Azah Ahmad, Sustainable Energy Development Authority (SEDA) *Updates on Renewable Energy Development in Malaysia*
9:20 to 9:40	Thailand - Karnnalin Theerarattananoon, Department of Alternative Energy Development and Efficiency (DEDE) *Renewable Energy Development in Thailand*
9:40 to 10:00	Viet Nam - Ninh Hai Nguyen, Ministry of Industry and Trade (MOIT) *Economy Report on Renewable Energy*
10:00 to 10:30	Break
	Session 6: Chair - Shicong Zhang
10:30 to 10:50	The Philippines - Rico R. Velasco, Department of Energy *National Renewable Energy Program of the Philippines*
10:50 to 11:10	Papua New Guinea - Rebecca Kiage, Department of Public Enterprises *Sustaining the Development of Papua New Guinea's Renewable Energy Sector – Opportunities and Challenges*
11:10 to 11:30	Korea - Sang-keun Gavin Yu, Korea Energy Agency (KEA) *New and Renewable Energy in Korea - Best Practices in Policy and Deployment*
11:30 to 11:50	Open Discussions
11:50 to 1:30	Lunch Break

1:30 to 3:00 **Session 7:**

Breakout roundtable discussions on following topics

1. **Currents trends and barriers** including policy, technical, and social to advancing renewable energy
2. **Opportunities and strategies** for strengthening renewable energy implementation: emerging technologies, innovative financing, public-private partnership, and business strategies
3. **Best practices** for advancing renewable energy: training for capacity building, reducing soft costs, resources for information sharing, stakeholder engagement

Group 1: Orange
Discussion leaders: Christine Lins and Cecilia Tam
Location: Room 320 A
Group 2: Green
Discussion leaders: Tom Key and Shicong Zhang
Location: Room 320 B
Group 3: Yellow
Discussion leaders: Nick Schlag and Bing-Chwen Yang
Location: Room 307

3:00 to 3:30 Break

Session 8: Chair – Anil Pahwa

3:30 to 4:15 Short reports on Group 1, 2, and 3 findings by group leaders

4:15 to 5:00 Brainstorming and Open Discussions to define a pathway for the future

5:00 to 5:10 Workshop Evaluation

5:10 to 5:20 Closing Remarks

Questions for the Breakout Sessions:

1. **Currents trends and barriers** including policy, technical, and social to advancing renewable energy

    1. What are the policy barriers for advancing renewable energy?
    2. What the technical barriers for advancing renewable energy?
    3. What the social barriers for advancing renewable energy?

2. **Opportunities and strategies** for strengthening renewable energy implementation: emerging technologies, innovative financing, public-private partnership, and business strategies

    1. What are the opportunities and strategies for strengthening renewable energy implementation?
    2. What are the emerging technologies for advancing renewable energy?
    3. What are the business strategies for innovative financing and public-private partnership for advancing renewable energy?

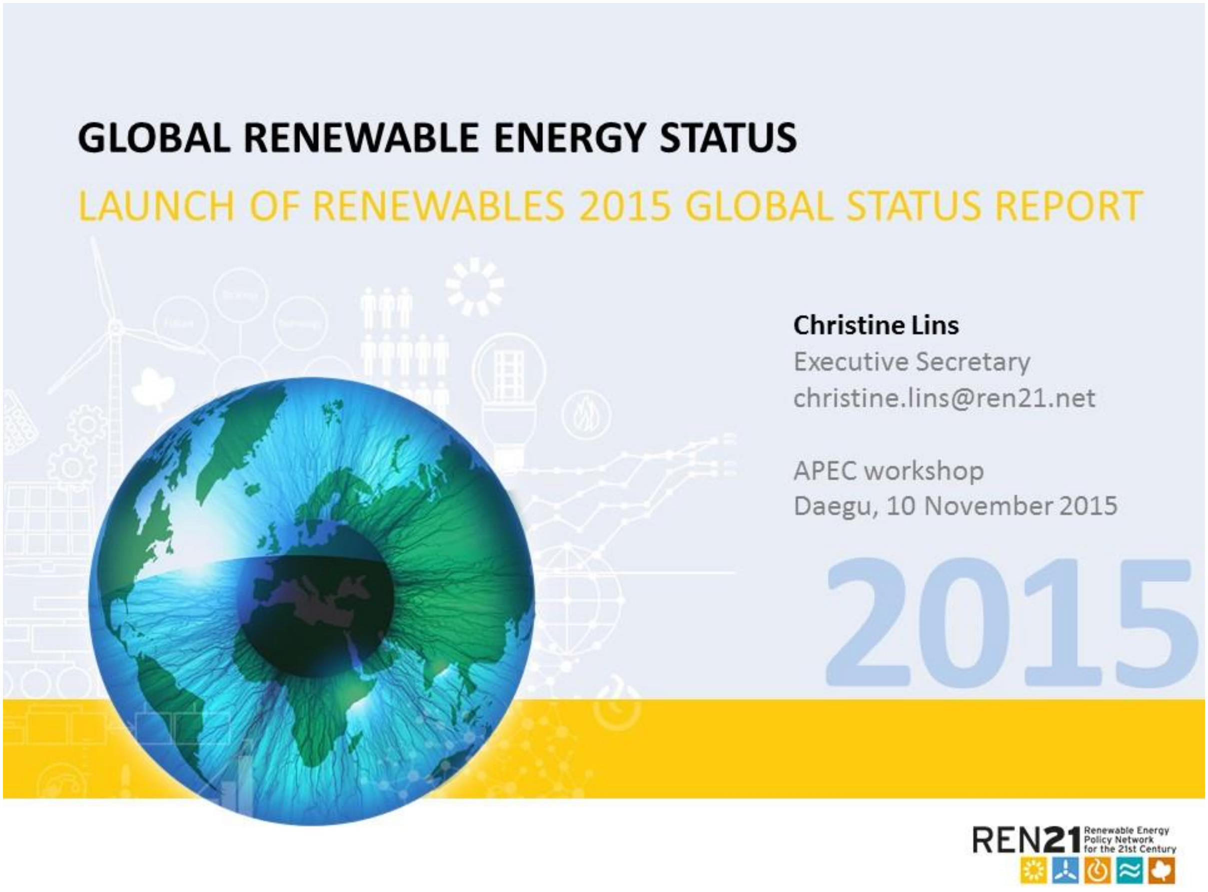
3. **Best practices** for advancing renewable energy: training for capacity building, reducing soft costs, resources for information sharing, stakeholder engagement
    1. What are the best practices for training and capacity building to advancing renewable energy?
    2. What are the best practices for reducing soft (non-hardware) costs for renewable energy?
    3. What are the best practices to build resources for information sharing?
    4. What are the best practices to improve stakeholder engagement?

4. In light of above questions, what are the most important issues that need to be addressed in the future to allow APEC economies to prepare a roadmap to double renewable energy in the energy mix by 2030?

Appendix B – Presentation Slides

1-1. Global Status and Outlook on Renewable Energy

Christine Lins
Executive Secretary, Renewable Energy Policy Network for the 21st Century (REN 21), France



REN21 is a **multi stakeholder network dedicated** to the rapid uptake of **renewable energy worldwide.**

Science & Academia:
IIASA, ISES, SANEDI, TERI, Fundacion Bariloche, NREL

NGOs:
CURES, GFSE, Greenpeace, ICLEI, ISEP, JREF, RCREEE, WCRE, WFC, WRI, WWF

Industry Associations:
ACORE, ARE, CEC, CREIA, EREF, GWEC, IGA, IHA, IREF, WBA, WWEA

International Organisations:
ADB, EC, ECREEE, GEF, IEA, IRENA, UNDP, UNEP, UNIDO, World Bank

National Governments:
Brazil, Denmark, Germany, India, Norway, South Africa, Spain, UAE, United States of America

REN21 Renewable Energy Policy Network for the 21st Century

REN21 Renewables 2015 Global Status Report

www.ren21.net/gsr

Launched at Vienna Energy Forum on 18 June 2015

Network of over 500 contributors, researchers & reviewers worldwide

The report features:

- Global Overview
- Market & Industry Trends
- Investment Flows
- Policy Landscape
- Distributed Renewable Energy for Energy Access
- Feature: Using Renewables for Climate Change Adaptation

The report covers:

- All renewable energy technologies
- The power, heating & cooling, and transport sector
- Energy Efficiency

Economy data available under new REN21 Renewables Interactive Map **www.ren21.net/map**

REN21 Renewable Energy Policy Network for the 21st Century

A Decade Of Renewable Energy Growth Surpassing Expectations

The evolution of renewable energy has surpassed all expectations.

Global installed capacity and production from all renewable technologies **have increased substantially.**

Significant cost reductions for most technologies.

Supporting policies spread throughout the world.

		START 2004	2013	2014
INVESTMENT				
New investment (annual) in renewable power and fuels	billion USD	45	232	**270**
POWER				
Renewable power capacity (total, not including hydro)	GW	85	560	**657**
Renewable power capacity (total, including hydro)	GW	800	1,578	**1,712**
Hydropower capacity (total)	GW	715	1,018	**1,055**
Bio-power capacity	GW	<36	88	**93**
Bio-power generation	TWh	227	396	**433**
Geothermal power capacity	GW	8.9	12.1	**12.8**
Solar PV capacity (total)	GW	2.6	138	**177**
Concentrating solar thermal power (total)	GW	0.4	3.4	**4.4**
Wind power capacity (total)	GW	48	319	**370**
HEAT				
Solar hot water capacity (total)	GW_{th}	86	373	**406**
TRANSPORT				
Ethanol production (annual)	billion litres	28.5	87.8	**94**
Biodiesel production (annual)	billion litres	2.4	26.3	**29.7**

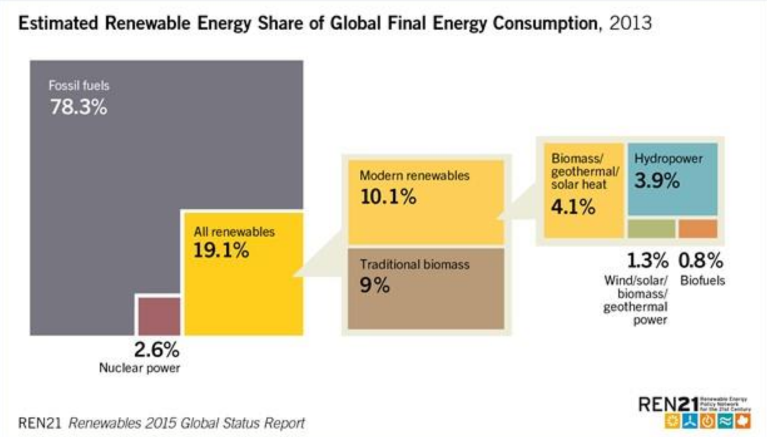
REN21 *Renewables 2015 Global Status Report*

Renewable Energy in the World

Renewable energy provided an estimated **19.1%** of global final energy consumption in 2013.

The share of **modern renewable energy** increased to 10.1%.

The share of **traditional biomass** was of 9%, same as in 2012.



Renewable Energy "Champions" - annual investment/capacity additions

ANNUAL INVESTMENT / NET CAPACITY ADDITIONS / PRODUCTION IN 2014

	1	2	3	4	5
Investment in renewable power and fuels (not including hydro > 50 MW)	**China**	United States	Japan	United Kingdom	Germany
Investment relative to annual GDP[1]	**Burundi**	Kenya	Honduras	Jordan	Uruguay
Geothermal power capacity	**Kenya**	Turkey	Indonesia	Philippines	Italy
Hydropower capacity	**China**	Brazil	Canada	Turkey	India
Solar PV capacity	**China**	Japan	United States	United Kingdom	Germany
CSP capacity	**United States**	India	–	–	–
Wind power capacity	**China**	Germany	United States	Brazil	India
Solar water heating capacity[2]	**China**	Turkey	Brazil	India	Germany
Biodiesel production	**United States**	Brazil	Germany	Indonesia	Argentina
Fuel ethanol production	**United States**	Brazil	China	Canada	Thailand

REN21 *Renewables 2015 Global Status Report*

REN21 Renewable Energy Policy Network for the 21st Century

Renewable Energy "Champions" – total capacity

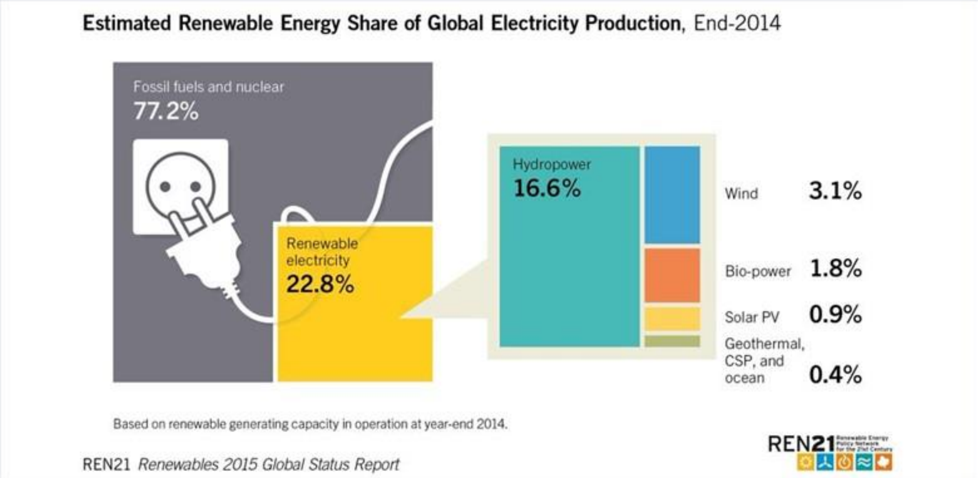
TOTAL CAPACITY OR GENERATION AS OF END-2014

	1	2	3	4	5
POWER					
Renewable power (incl. hydro)	**China**	United States	Brazil	Germany	Canada
Renewable power (not incl. hydro)	**China**	United States	Germany	Spain / Italy	Japan / India
Renewable power capacity *per capita* (not incl. hydro)	**Denmark**	Germany	Sweden	Spain	Portugal
Biopower generation	**United States**	Germany	China	Brazil	Japan
Geothermal power capacity	**United States**	Philippines	Indonesia	Mexico	New Zealand
Hydropower capacity[4]	**China**	Brazil	United States	Canada	Russia
Hydropower generation[4]	**China**	Brazil	Canada	United States	Russia
Concentrating solar thermal power (CSP)	**Spain**	United States	India	United Arab Emirates	Algeria
Solar PV capacity	**Germany**	China	Japan	Italy	United States
Solar PV capacity *per capita*	**Germany**	Italy	Belgium	Greece	Czech Republic
Wind power capacity	**China**	United States	Germany	Spain	India
Wind power capacity *per capita*	**Denmark**	Sweden	Germany	Spain	Ireland
HEAT					
Solar water collector capacity[2]	**China**	United States	Germany	Turkey	Brazil
Solar water heating collector capacity *per capita*[2]	**Cyprus**	Austria	Israel	Barbados	Greece
Geothermal heat capacity[5]	**China**	Turkey	Japan	Iceland	India
Geothermal heat capacity *per capita*[5]	**Iceland**	New Zealand	Hungary	Turkey	Japan

REN21 *Renewables 2015 Global Status Report*

REN21 Renewable Energy Policy Network for the 21st Century

Power Sector



- Renewables accounted **27.7%** of global power generation capacity and **22.8%** of global electricity demand.
- Renewables made up for **59%** of net additions to global power capacity.
- Total RE power capacity: **1712 GW,** an increase of more than 8.5% over 2013.

REN21 Renewable Energy Policy Network for the 21st Century

Heating & Cooling

Energy use for heat accounted for about half of total world final energy consumption in 2014.

Small but growing modern renewable energy share of final global heat demand: **approx. 8%.**

Asia uses the largest amount of modern renewable energy in the heating sector overall, driven primarily by the amount of industrial bio-heat used in India and other Asian economies.

REN21 Renewable Energy Policy Network for the 21st Century

Transport

Renewable energy accounted for an estimated **3.5%** of global energy demand for road transport in 2013, up from **2%** in 2007.

Trends in the development of **gaseous fuels** and electricity continued to create pathways for the integration of renewables into transportation.

As of early 2015, China was home to 97% of the world's 235 million electric two wheelers and 79% of the world's 46,000 electric buses**.**

REN21 Renewable Energy Policy Network for the 21st Century

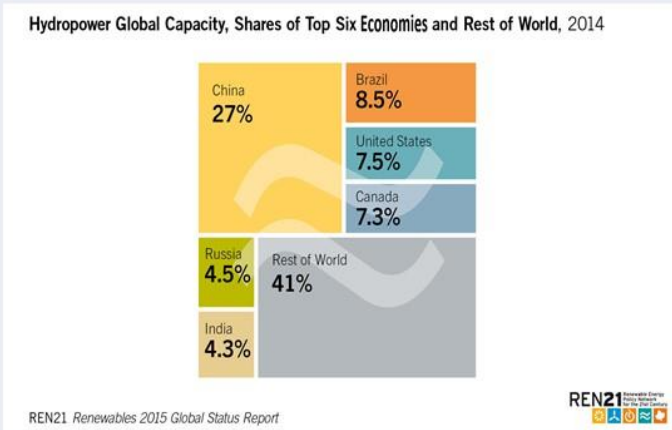
Hydropower - global capacity

Total global hydropower capacity: **1,055 GW**

37GW of **new capacity** were commissioned in 2014, presenting a **3.6%** increase (out of which 22 GW in China)

Steady industry growth, driven by:

- China's expansion
- modernisation of ageing hydropower facilities



REN21 Renewable Energy Policy Network for the 21st Century

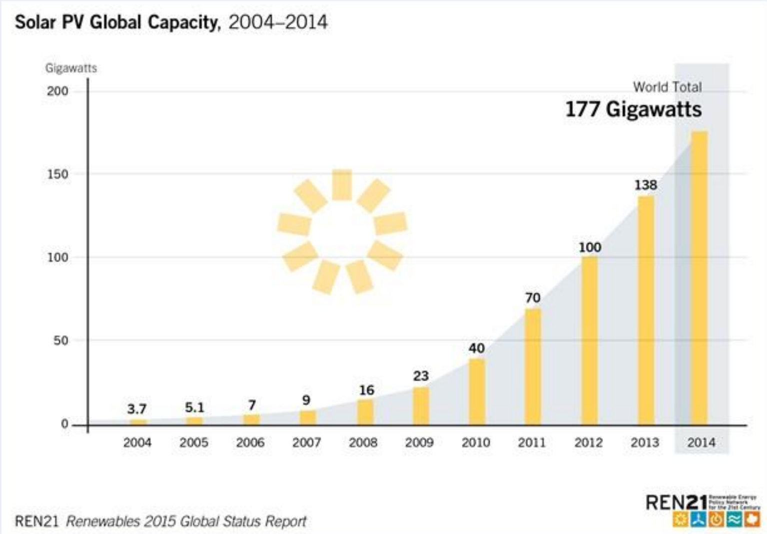
Solar Photovoltaics (PV) – total global capacity

Solar PV:

- **+40 GW** added (10.6 GW in China)
- Total capacity: **177 GW**

More than 60% of all PV capacity in operation worldwide at the end of 2014 was **added over the past three years.**

Asia accounted for almost **60%** of global additions.



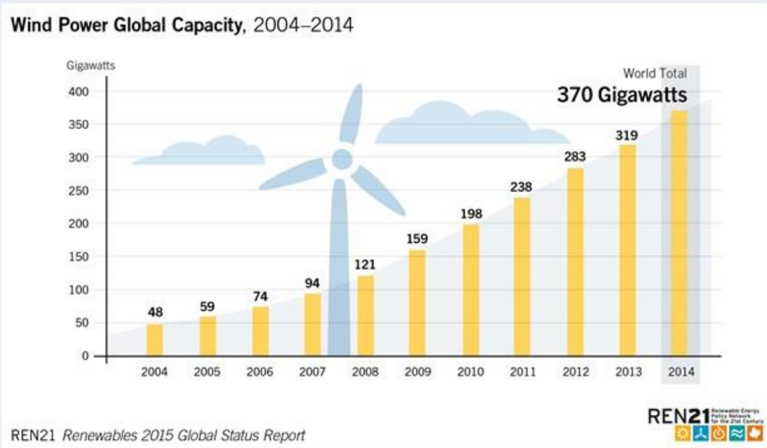
REN21 Renewable Energy Policy Network for the 21st Century

Wind Power – total world capacity

51 GW of capacity were added (out of which 23.2 GW in China)

Total capacity: **370 GW** (out of which 115 GW in China generating 2.8 % of China's total electricity consumption)

Offshore, an estimated **1.7 GW** of grid-connected capacity was added in 2014, for a world total exceeding **8.5 GW**



REN21 Renewable Energy Policy Network for the 21st Century

Concentrating Solar Power (CSP) – global capacity

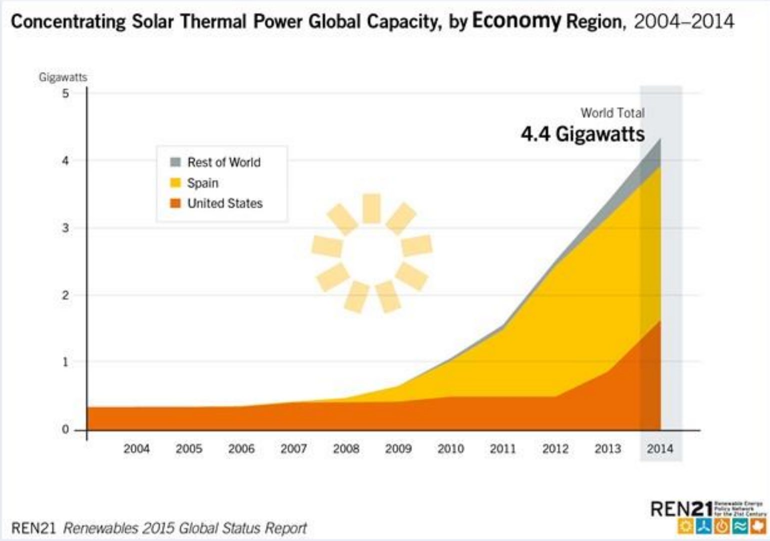
Total CSP capacity: **4.4 GW**

With **+0.9 GW** added, this represents an increase of **27%.**

Trends:

Markets continue to shift to **developing economies.**

China started construction on its first commercial CSP project: the 50 MW Qinghai Delingha plant



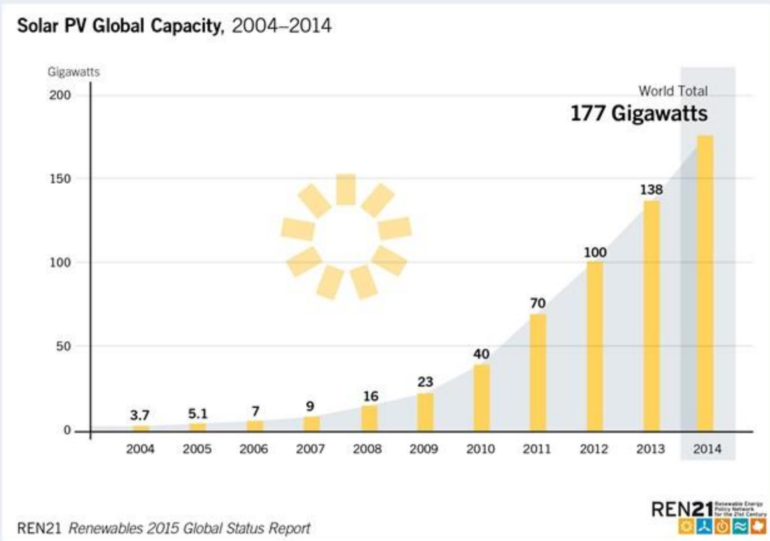
REN21 Renewable Energy Policy Network for the 21st Century

Solar Thermal Heating & Cooling

Cumulative capacity of all collector types in operation rose by a net **44 GWth** for a year-end total of **374.7 GWth**

China again accounted for about 80% of the world market for solar water collectors.

The slowdown in market growth continued in 2014.



REN21 Renewable Energy Policy Network for the 21st Century

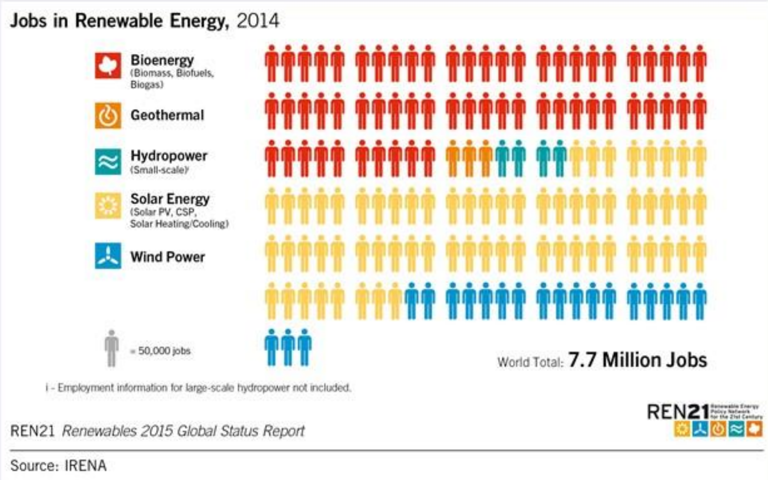
Jobs in Renewable Energy

Global employment continued to increase

An estimated **7.7 million direct or indirect jobs** in the renewable energy industry

Solar PV: 2.5 million jobs, global wind 1 million jobs in 2014

South Korea: approx. 7.500 solar PV jobs in manufacturing in 2013



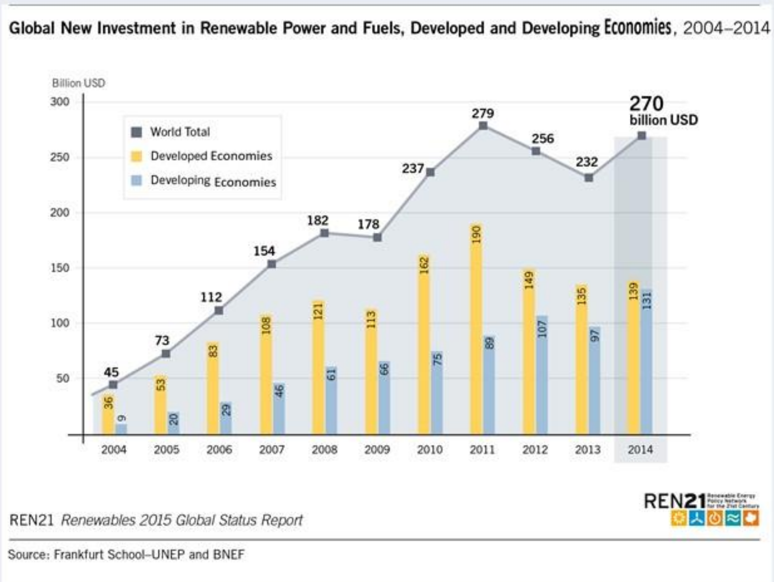
Global Investment in Renewable Energy

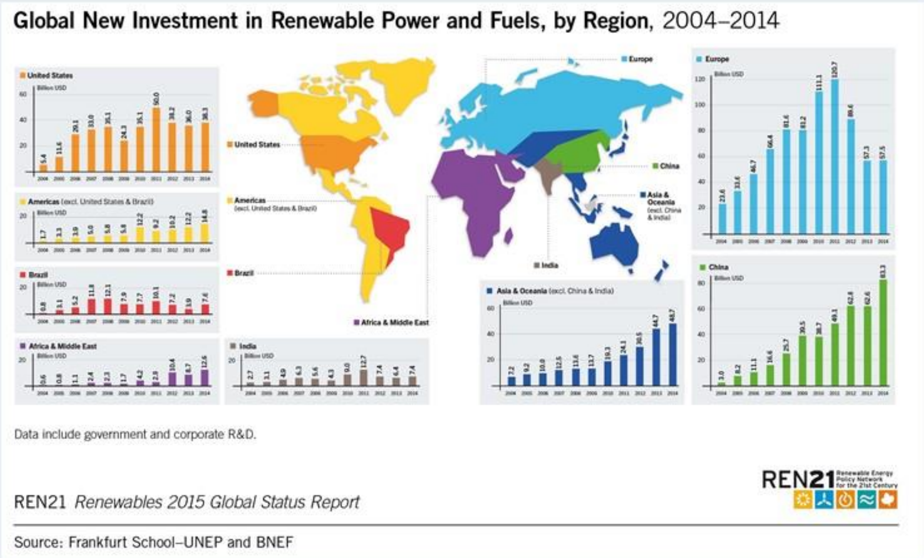
Global new investment estimated **USD 270.2 billion in 2014**

(including hydropower USD 301 billion)

Reasons for the increase:

- Increase in solar power installations in China and Japan
- Investment in solar power up **25%**
- Record investment in offshore wind projects in Europe





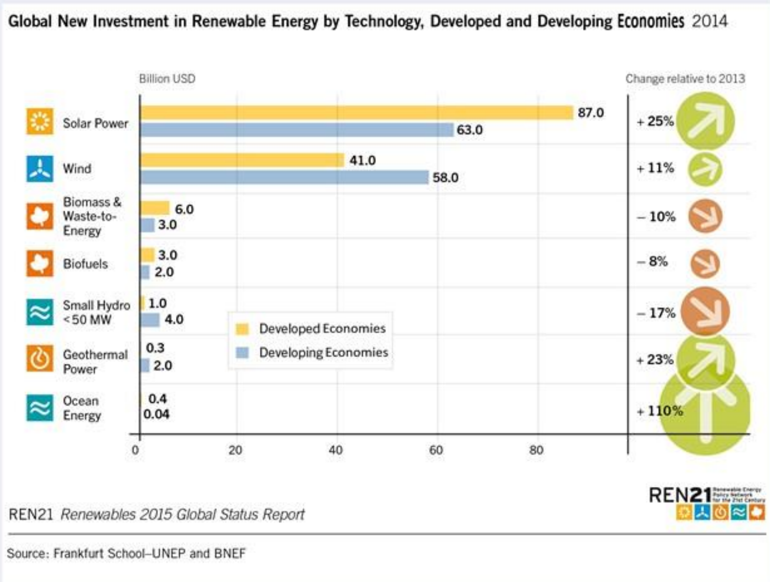
Developed Economies: Annual investment in 2014: **USD 138.9 billion** (increase of 3 % compared to 2013)

Developing Economies: annual investment in 2014: **USD 131.3 billion** (increase of 36% compared to 2013)

Global Investment in Renewable Energy by Technology

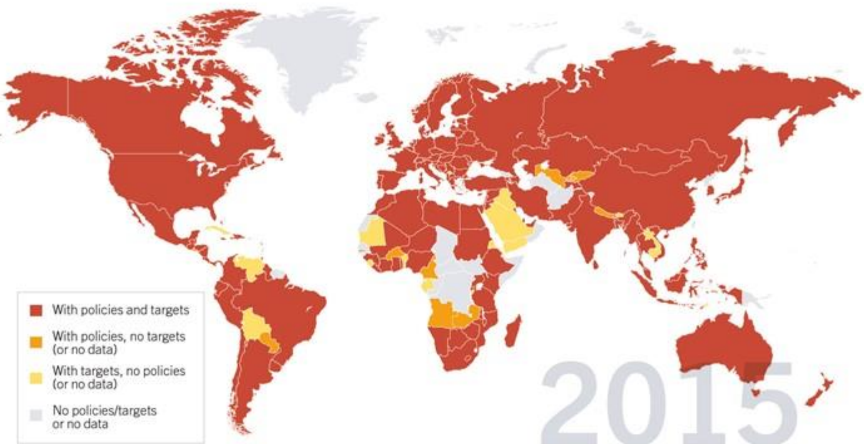
Solar power - leading sector for money committed during 2014, receiving more than **55% (USD 149.6 billion)** of total new investment in renewable power and fuels

Wind power followed with **USD 99.5 billion**



Renewable Energy Policy Landscape

Economies with Renewable Energy Policies and Targets, Early 2015



Economies are considered to have policies when at least one national or state/provincial-level policy is in place.

REN21 *Renewables 2015 Global Status Report*

REN21 Renewable Energy Policy Network for the 21st Century

REN21 Renewable Energy Policy Network for the 21st Century

Renewable Energy Policy Landscape

POLICIES		START 2004[1]	2013	2014
Economies with policy targets	#	48	144	**164**
States/provinces/Economies with feed-in policies	#	34	106	**108**
States/provinces/Economies with RPS/quota policies	#	11	99	**99**
Economies with tendering/ public competitive bidding[5]	#	n/a	55	**60**
Economies with heat obligation/mandate	#	n/a	19	**21**
States/provinces/countries with biofuels mandates[6]	#	10	63	**64**

REN21 *Renewables 2015 Global Status Report*

At least **164 economies** had **renewable energy targets**.

At least **145 economies** had **renewable energy policies** in place.

Most policies focus on power: mainly feed-in-tariffs and renewable portfolio standards.

Recent trends: Merging of components from different policy mechanisms.

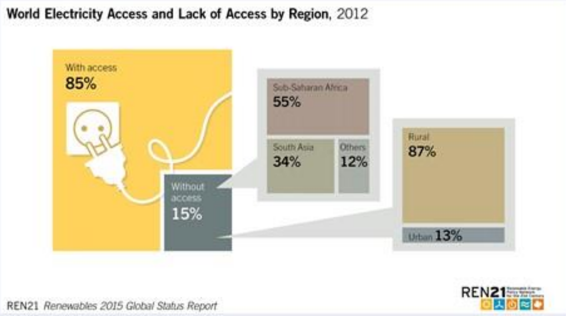
REN21 Renewable Energy Policy Network for the 21st Century

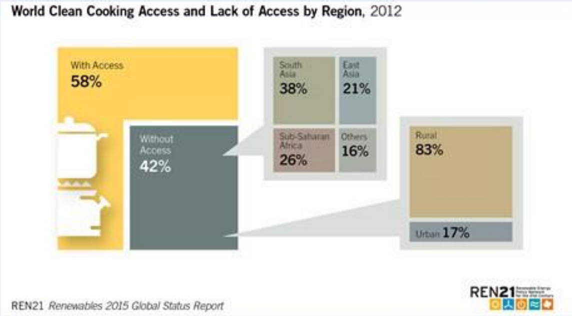
Distributed Renewable Energy in Developing Economies

15% of the global population still lack electricity access

In developing Asia, the share of population with access is 83% and the number of people without access to electricity in 2012 was 620 million.

Little quantitative information on DRE markets, but information available indicates that **markets are significant,** e.g. **off-grid solar PV** attracted approx. **USD 64 billion of investment in 2014**.





REN21 Renewable Energy Policy Network for the 21st Century

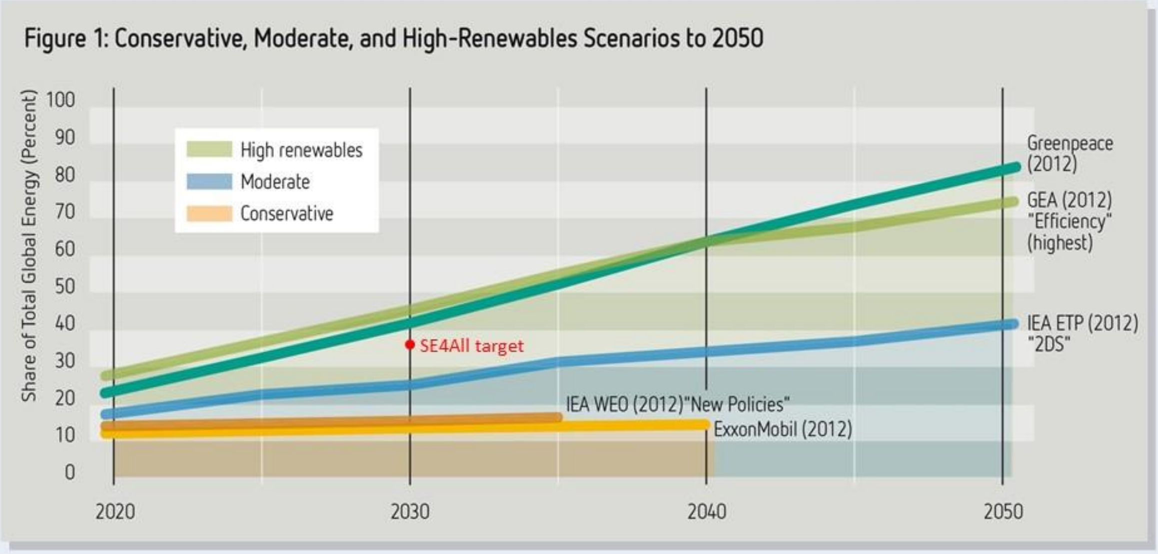
The future of renewable energy – what is in the cards?

"The future of renewable energy is fundamentally a choice, not a foregone conclusion given technology and economic trends."

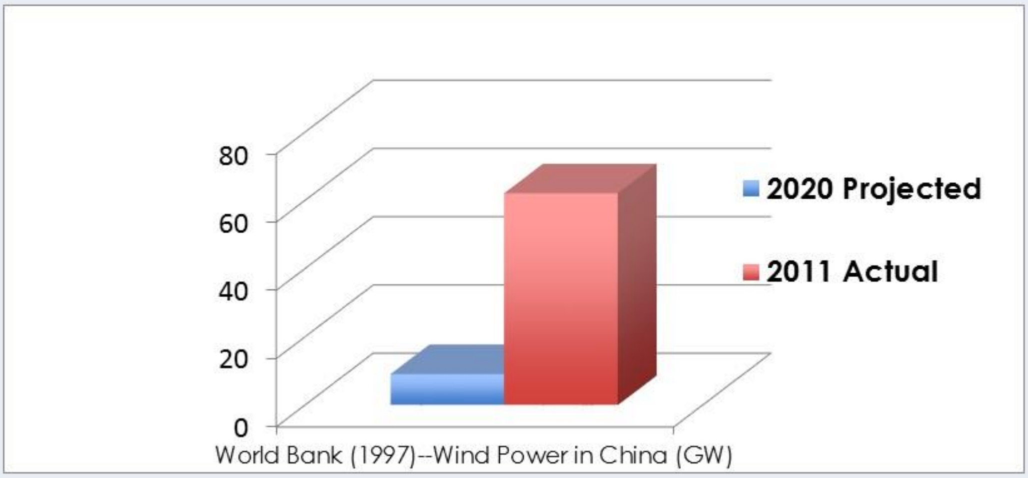
RENEWABLES
GLOBAL FUTURES REPORT

REN21 Renewable Energy Policy Network for the 21st Century

Future outlook – what is in the cards?



Historic Projections Fall Short…



In 1997, the World Bank predicted about 6 GW of wind in China for 2020, nearly ten times of this amount was reached nearly a decade earlier with close to 60 GW installed wind capacity in China in 2011.

Global Renewable Power Capacity by 2030

Table 4: Global Renewable Power Capacity by 2030 in Recent Scenarios

	Hydro	Wind	Solar PV	CSP	Biomass	Geothermal	Ocean
	GW						
Actual 2006 Capacity for Comparison	–	74	8	0.4	45	9.5	0.3
Actual 2011 Capacity for Comparison	970	238	70	1.8	72	11	0.5
IEA WEO (2012) "New Policies"	1,580	920	490	40	210	40	10
IEA WEO (2012) "450"	1,740	1,340	720	110	260	50	10
IEA ETP (2012) "2DS"	1,640	1,400	700	140	340	50	20
BNEF GREMO (2011)	—	1,350	1,200		260	30	—
IEA RETD (2010) "ACES"	1,300	2,700	1,000	120	340	—	—
Greenpeace (2012)	1,350	2,900	1,750	700	60	170	180

Sources: See Annex 2. Actual 2006 and 2011 from REN21 (2008, 2012).
Notes: CSP stands for solar thermal power. Figures for 2030 are rounded to nearest 10 GW or 50 GW from original sources. Hydropower figure for 2011 excludes pure pumped hydro capacity; a comparable figure for 2006 is not available, see REN21 (2012), notes to Table R2, and note on hydropower on page 168.

RENEWABLES
GLOBAL FUTURES REPORT

REN21 Renewable Energy Policy Network for the 21st Century

Conclusions

Renewable energy continued to grow in 2014 against the backdrop of increasing global energy consumption, and a dramatic decline in oil prices during the second half of the year.

For the first time in 40 years, economic and CO_2 growth has " decoupled" – marking a record year for renewables.

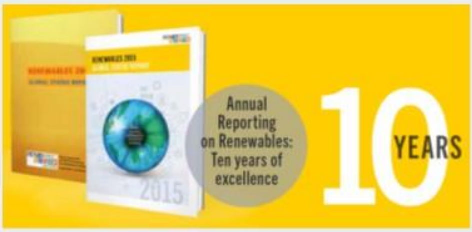
The past decade has set the wheels in motion for a global transition to renewables, but a concerted and sustained effort is needed to achieve it:

- Long-term and stable policy frameworks, which can adapt to changing environment, to sustain and increase investment levels
- Greater attention to the heating and cooling and the transport sector and "energy system thinking"
- Improve information on distributed renewable energy markets in developing economies and improve access to up-front finance

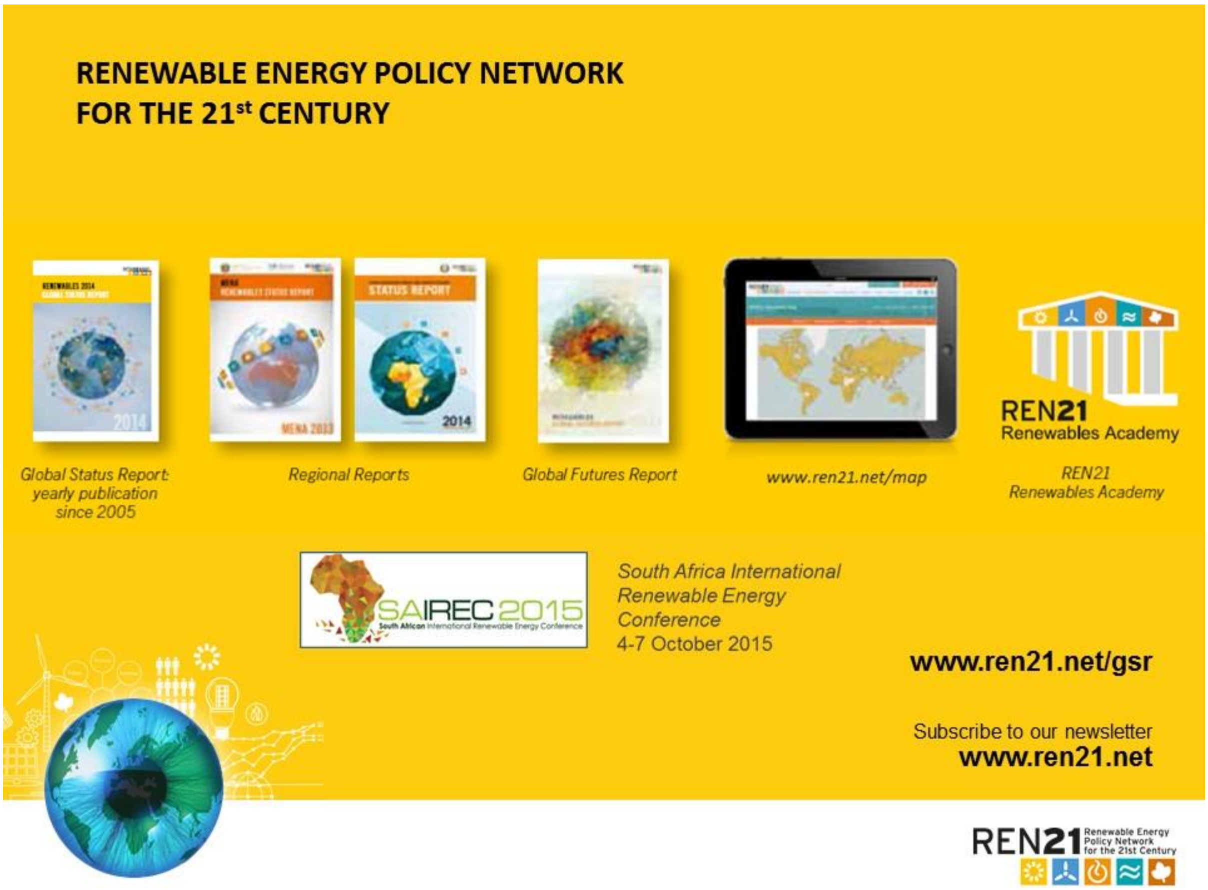
See you at SAIREC 2015

Cape Town, 4-7 October 2015

SAIREC 2015 South African International Renewable Energy Conference

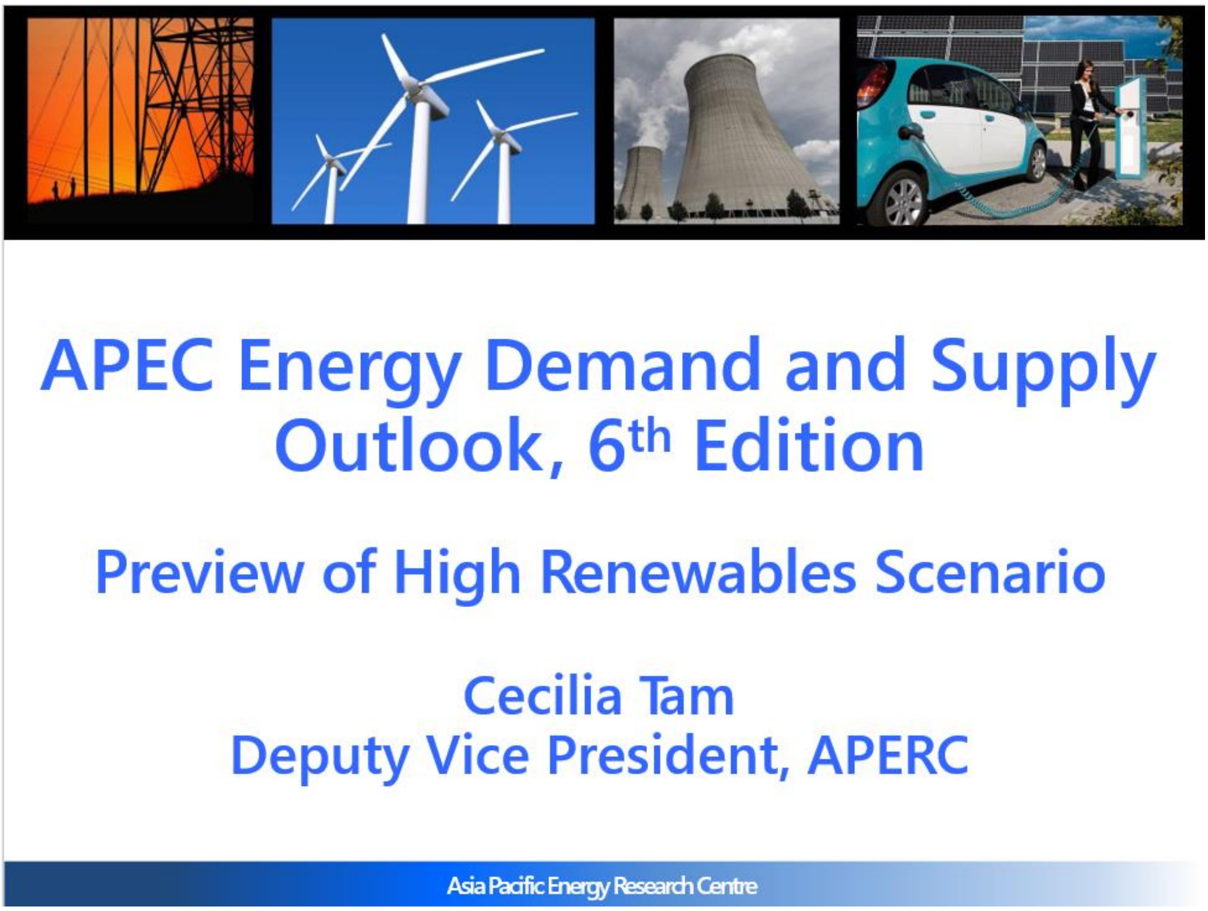


REN21 Renewable Energy Policy Network for the 21st Century


RENEWABLE ENERGY POLICY NETWORK
FOR THE 21st CENTURY
Global Status Report: yearly publication since 2005
Regional Reports
Global Futures Report
www.ren21.net/map
REN21 Renewables Academy
South Africa International Renewable Energy Conference
4-7 October 2015
SAIREC 2015
www.ren21.net/gsr
Subscribe to our newsletter
www.ren21.net
REN21 Renewable Energy Policy Network for the 21st Century

1-2. APEC Energy Demand and Supply Outlook, 6th Edition

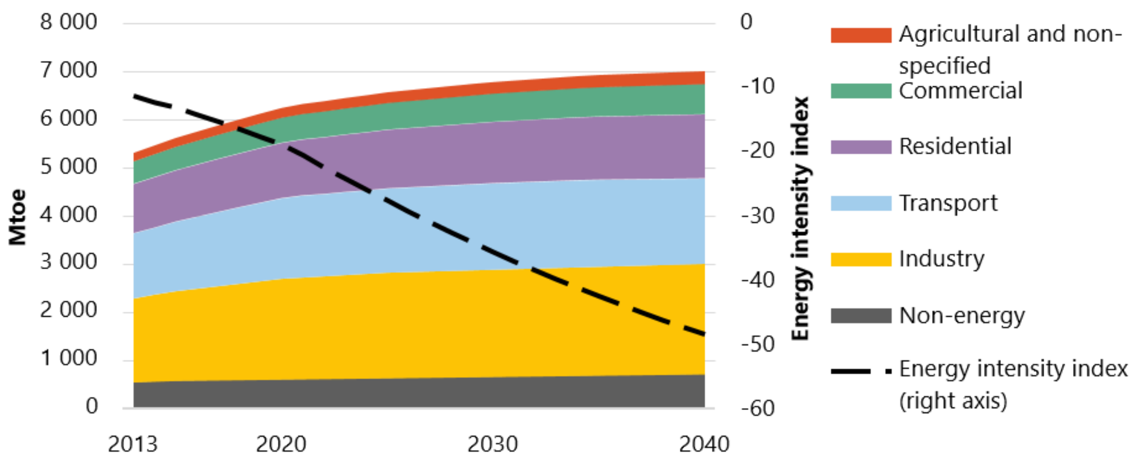
Cecilia Tam
Deputy Vice president, Asia Pacific Energy Research Centre(APERC), Japan



Business as Usual (BAU) Scenario

2

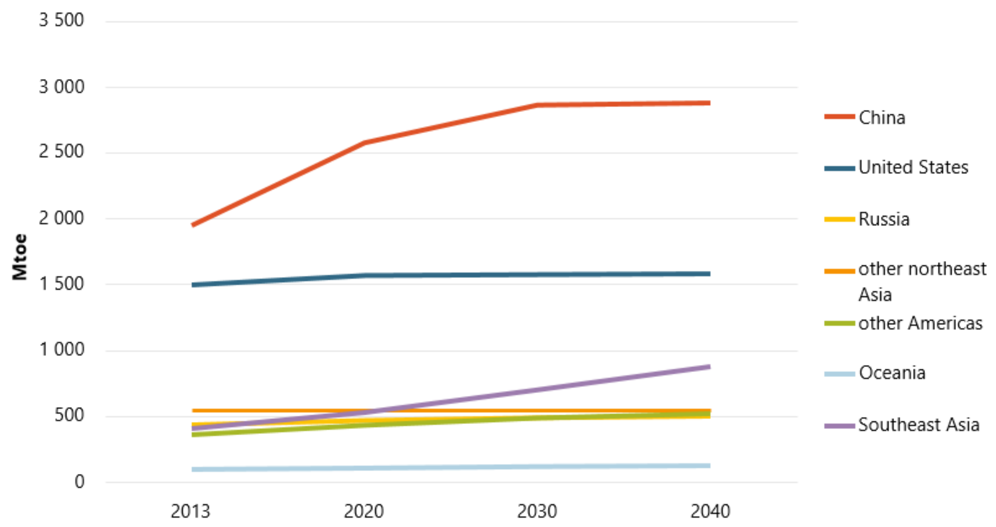
APEC Total Final Energy Demand



Final energy demand rises 32% from 2013 level by 2040. APEC's energy intensity reduction target of 45% cannot be met by 2035 in the BAU scenario.

3

Final Energy Demand Growth by Region



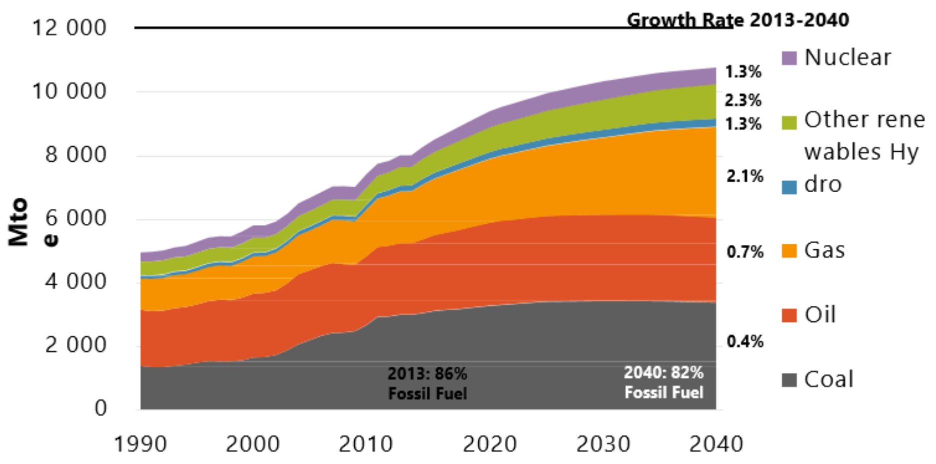
Energy demand for China and South East Asia increases 50% and 110%, respectively.

Note: **Oceania** (Australia, New Zealand and PNG), **Other Americas** (Canada, Chile, Mexico and Peru), **Other Northeast Asia** (Hong Kong, Japan, Korea and Chinese Taipei), **Southeast Asia** (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam)

4

Fossil-Fuels Continue to Dominate

Total primary energy supply by fuel, 1990 - 2040



Source: IEA statistics 2015 and APERC analysis

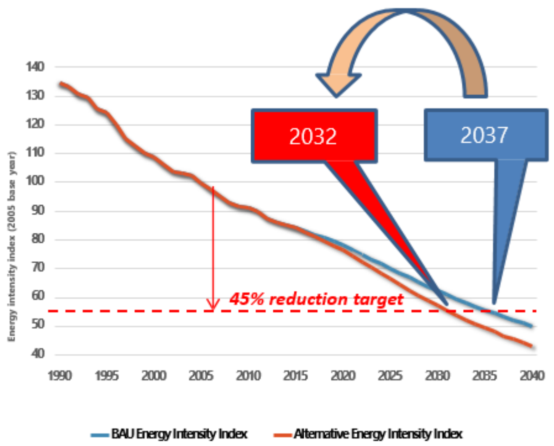
Energy supply in APEC region will more than double by 2040 from 1990 level.

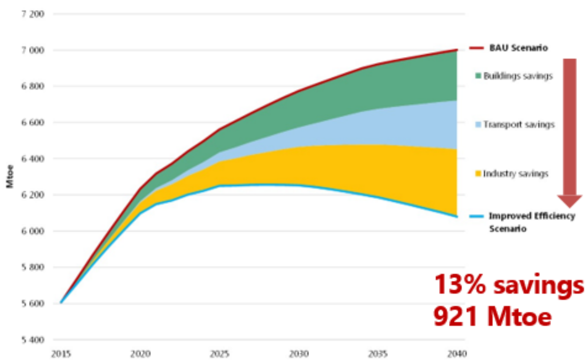
5

Alternative Scenarios

6

Improved Efficiency Scenario



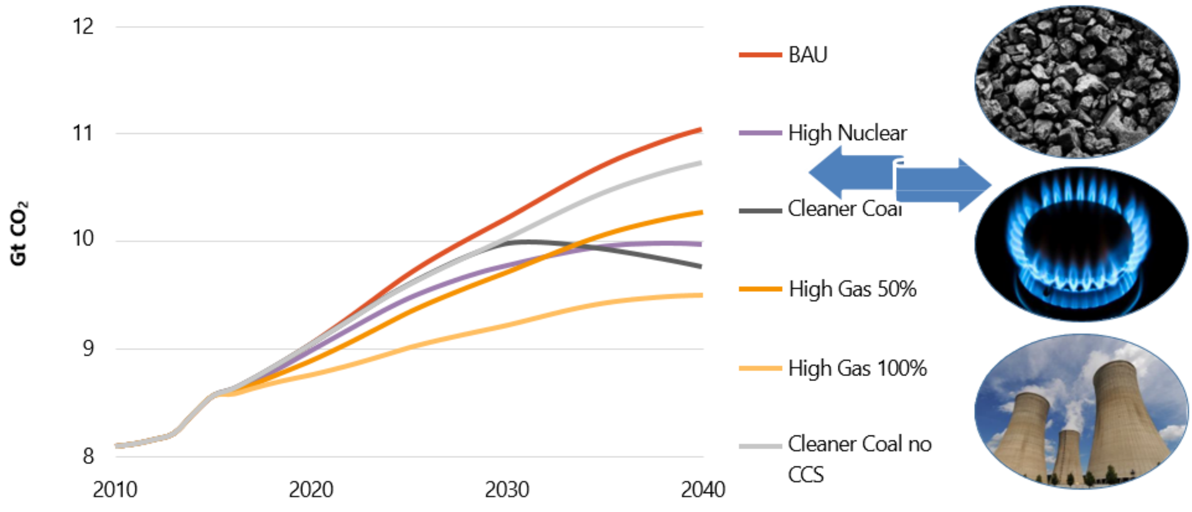


APEC's target in 2035 can be met earlier under the Improved Efficiency Scenario

7

Alternative Power Mix Scenario

Trade off between cleaner coal, gas and nuclear



High Gas and Cleaner Coal leads to the lowest CO_2 emissions level

8

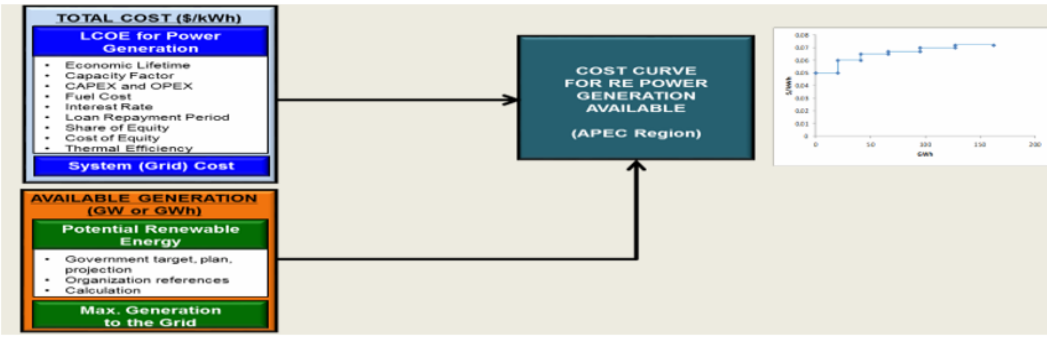
High Renewables in Power Sector

Asia Pacific Energy Research Centre

General Assumption and Methodology

<High Renewable Scenario – Power Sector >

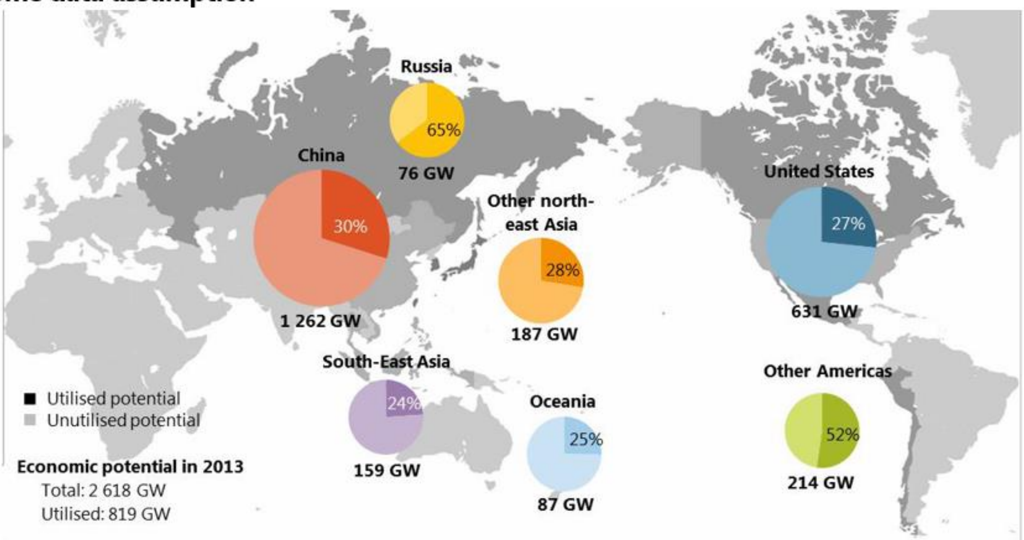
- Projection assumes government targets are fully met and the additional renewables cap acity needed to meet the APEC doubling goal is developed based on a least cost appro ach for the APEC region. Additional renewable power is identified by considering the LC OE per technology and per economy, and the economic potential per technology and p er economy.
- For macroeconomic and general assumptions, all data and information for inputs to L COE are solicited from many sources and references (e.g. the economy data, report fr om international energy organizations, international financing institutions).



10

Estimated Potential of Renewable Energy

The potential is estimated by considering many factors, such as the government policies, tar gets, plans, and projections; and estimations using other pertinent sources or references wit h some data assumption



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

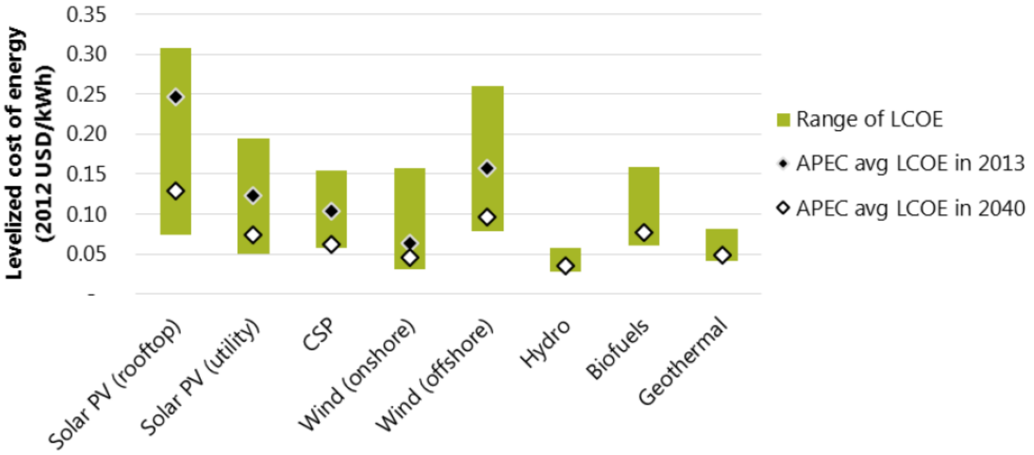
Note: **Oceania** (Australia, New Zealand and PNG), **Other Americas** (Canada, Chile, Mexico and Peru), **Other North East Asia** (Hong Kong, Japan, Korea a nd Chinese Taipei), **South East Asia** (Brunei Barussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam)

11

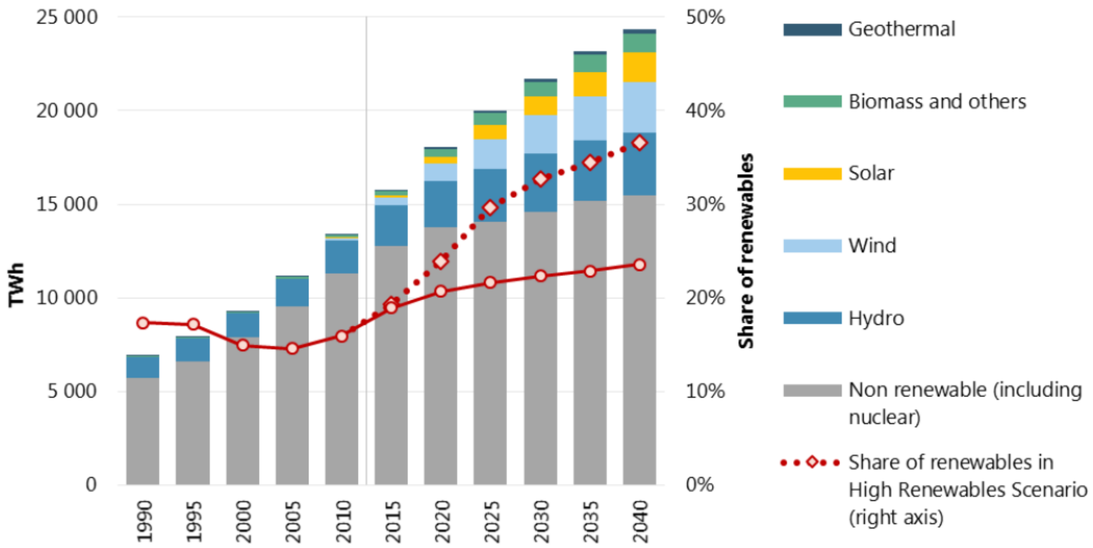
Declining Electricity Cost from Renewables

<Renewable in Power Generation>

- Costs of RE technologies (solar and wind) have been declining from 2013 to 2040 in different economies where the lowest Levelised Cost of Electricity (LCOE) is hydro in Viet Nam and the highest is offshore wind in Peru.

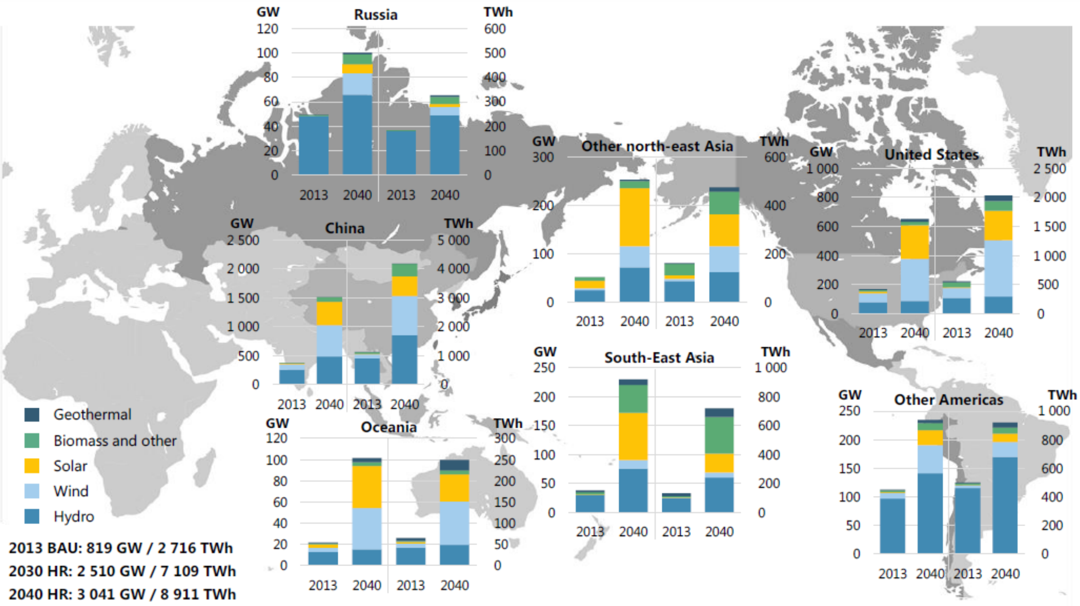


Solar and Wind Growing at the Fastest Rates



Solar and Wind have the highest annual growth rates due to abundant untapped economic potential, declining costs and government targets in some economies.

High Renewables Scenario



Renewables mix varies across APEC

Variable Renewable Integration

Economy	Share of variable renewables in total power generation 2030	2040
Australia	42%	49%
Brunei Darussalam	8%	8%
Canada	8%	8%
Chile	21%	18%
China	12%	16%
Hong Kong, China	2%	2%
Indonesia	3%	12%
Japan	10%	12%
Korea	8%	10%
Malaysia	3%	3%
Mexico	8%	9%
New Zealand	21%	23%
Papua New Guinea	6%	4%
Peru	1%	1%
Philippines, the	7%	6%
Russia	2%	3%
Singapore	1%	1%
Chinese Taipei	9%	12%
Thailand	7%	6%
United States, the	21%	25%
Viet Nam	4%	7%

Variable renewables — Other — Total renewables

<Variable Renewable Energy (VRE) Integration>

- Mostly APERC economies can be categorized as "Low Share", except for several economies such as Australia and United States.
- According to IEA:
  - "Low Share", No a big technical challenge to operate a power system under categorized "Low Share" (IEA,2015).
  - "Large Share", The system-wide integration needs to be transforming in order to increase flexibility.

Note:

- *"Low Share" means that the share of VRE is 5-10% of annual generation.*
- *"High Share" means that the share of VRE is 20-45% of annual generation.*

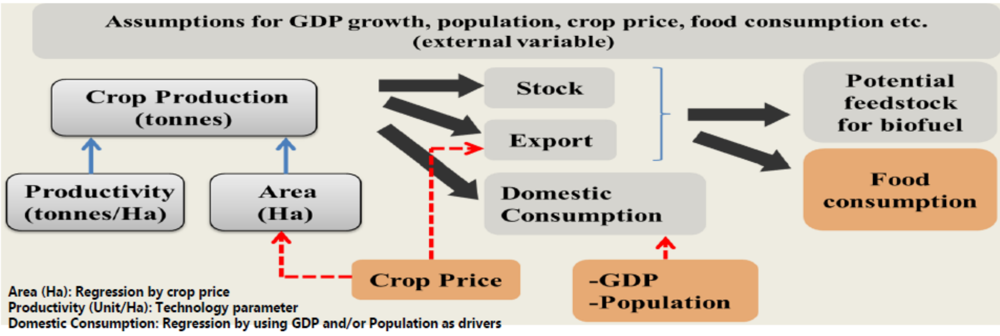
High Renewables in Transport Sector

Asia Pacific Energy Research Centre

General Assumption and Methodology

<HIREN Scenario – Transport Sector>

- **Supply Potential-** The projection is based on maximising the unutilized agricultural land and enhancing productivity per cultivated land. Expansion of agricultural land is considered through improvement in cultivation structure by crops (energy crops) and maximising arable land. Those economies with higher productivity levels per cultivated land will serve as benchmarks for increasing productivity of other economies on the assumption that such could be shared and transferred to others.
- **Demand -** The projection of blend rate is based on the minimum blend rate and/or target on biofuels by considering the biofuels supply potential availability.

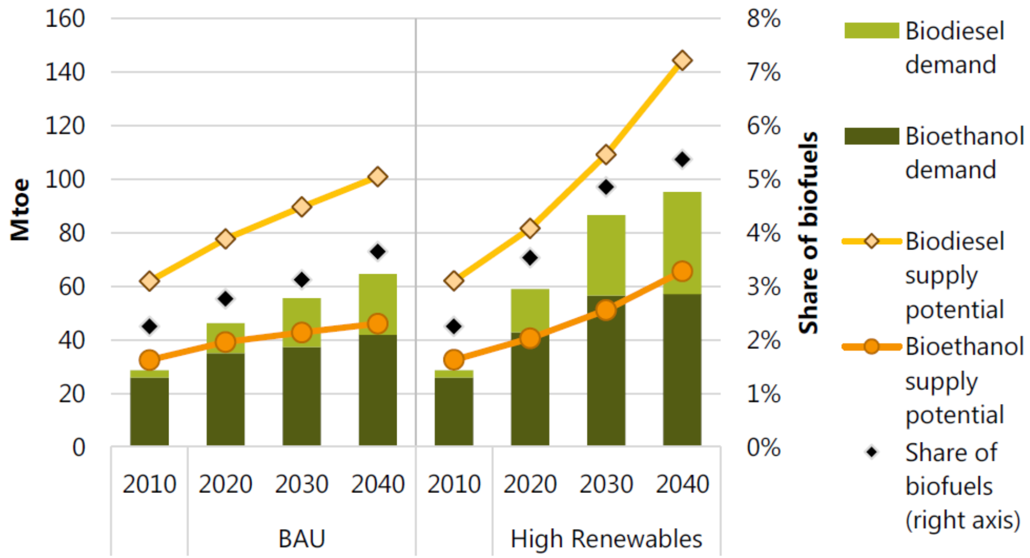


APERC Asia Pacific Energy Research Centre 17

Biofuels in APEC

Economy	Regulation	Blend rate mandate		Blend rate target		Incentives, subsidies and taxation
		Bioethanol	Biodiesel	Bioethanol	Biodiesel	
Australia	√	√*	√*	E4/E5*	B2*	√
Brunei Darussalam	-	-	-	-	-	-
Canada	√	up to E8.5**	up to B4**	E5	B2	√
Chile	-	-	-	-	-	-
China	-	E10**	-	10 Mt (2020)	2 Mt (2020)	√
Hong Kong	√	-	-	-	-	√
Indonesia	√	E3	B10	E20 (2025)	B30 (2025)	√
Japan	√	√	-	0.5 million Loe (2017)		Y
Korea	√	-	B2	-	B5 (2020)	√
Malaysia	√	-	B7	-	B10	√
Mexico	√	E2	-	√	-	√
New Zealand	-	-	-	-	-	-
Papua New Guinea	-	-	-	-	-	-
Peru	√	-	-	E7.8	B5	√
The Philippines	√	E10	B2	E20 (2020)	B20 (2025)	√
Russia	√	-	-	-	-	-
Singapore	-	-	-	-	-	-
Chinese Taipei	√	-	-	-	-	√
Thailand	-	-	B7	4 billion L/yr	5 billion L/yr	√
The United States	√	up to E15**	up to B10**	136 billion L/yr (2022)**		√
Viet Nam	√	E5	***	E10 (2017)	-	√

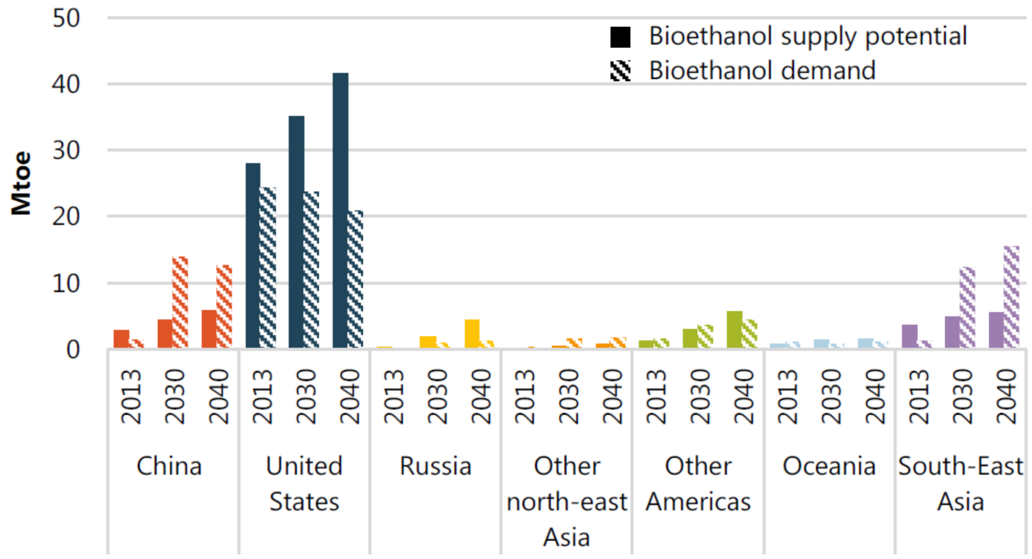
Lack of Bioethanol Supply Potential



Almost all economies can increase biofuels use in the transport sector.

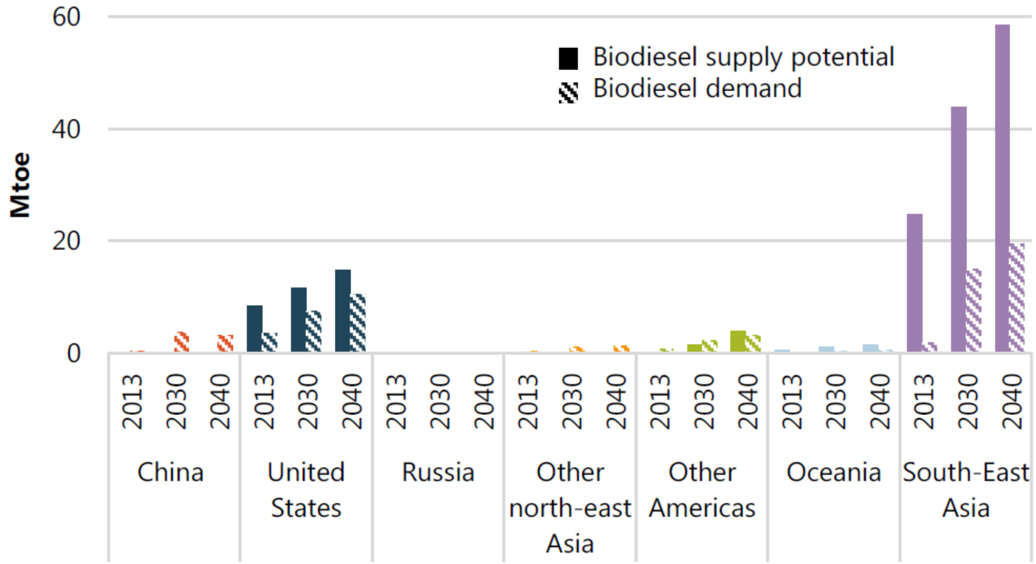
Advanced biofuel technologies needed, as higher supply potential based only on 1st generation biofuels is insufficient to meet growing demand

US Leads APEC Bioethanol Production



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Southeast Asia Dominates Biodiesel Production



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Biofuels Trade Needed in Short- and Medium Term

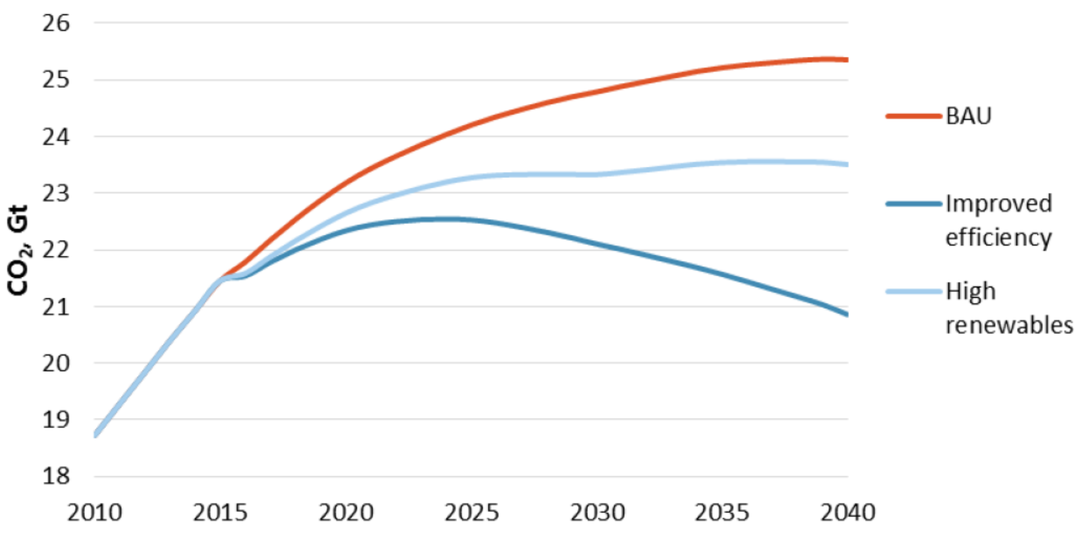
<Biofuels Trade>

- There is a mismatch between biofuels demand and production in the APEC Region.
- Biofuels trade among APEC member for short- and medium-term period is one of solutions.
- Developing and deploying advanced biofuels technologies in the long-term period.

Economy	Net bioethanol balance		Net biodiesel balance	
	2030	2040	2030	2040
Australia	592	774	- 50	- 140
Brunei Darussalam	0	0	0	0
Canada	- 635	- 365	- 731	- 917
Chile	0	0	0	0
China	-9 456	-6 634	-3 735	-3 072
Hong Kong, China	0	0	- 19	- 25
Indonesia	-7 255	-8 678	13 212	20 854
Japan	- 992	- 948	0	0
Korea	52	65	-1 088	-1 175
Malaysia	0	0	18 859	22 603
Mexico	278	2 026	705	2 609
New Zealand	- 20	- 25	146	132
Papua New Guinea	7	13	609	1 011
Peru	- 289	- 383	- 818	- 999
Philippines, the	- 919	-1 423	- 553	- 827
Russia	1 067	3 200	57	126
Singapore	0	0	0	0
Chinese Taipei	- 77	- 69	0	0
Thailand	620	299	-1 484	-1 895
United States	11 501	20 831	4 059	4 199
Viet Nam	76	- 209	-1 091	-1 791

APERC *Asia Pacific Energy Research Centre* 22

Total CO_2 Emissions in APERC Scenarios



APERC *Asia Pacific Energy Research Centre* 23

Opportunities for Policy Action

<Renewable Power Generation>

- Continue to improve business environment for renewables development as "doing business" in some APEC economies are still cumbersome.
- Strengthen and improve the economy's electricity system to facilitate greater VRE integration.

<Renewable Transport>

- For enhancing biofuels trade among APEC member economies:
  - Implement the guidelines for the development of biodiesel standard in the APEC region which was established in 2007 by EGNRET.
  - Establish similar standard for bioethanol.
  - Establish biofuels blend rate standard for vehicles which can meet the standard of auto-manufactures.
- Introduce the development and deployment of advanced biofuels to promote greater utilisation of biofuels.

Thank you for your attention!

APEC Energy Demand and Supply Outlook Release 11 May 2016

available for download from http://aperc.ieej.or.jp/

2-1. An Integrated Grid Path for Distributed solar

Thomas Key
Electric Power Research institute, USA

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

An Integrated Grid Path for Distributed Solar

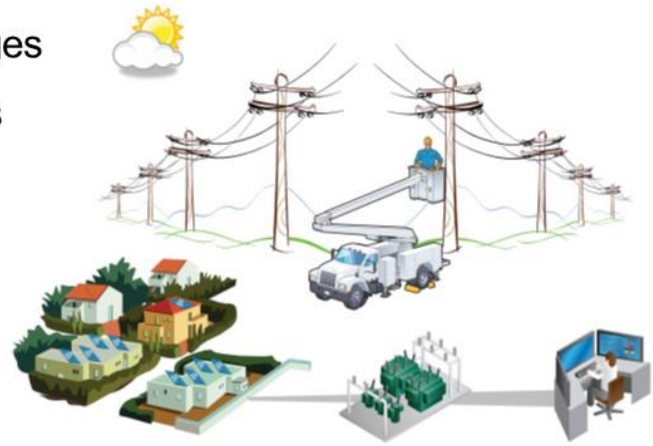
Thomas Key
Senior Technical Executive

Asia-Pacific Economic Cooperation

Daegu, Republic of Korea
November 10 – 11, 2015

Outline

1. Who is EPRI?
2. What is "*The Integrated Grid*" idea?
3. Lets talk about solar PV
4. Integration Challenges
5. Research Learnings
6. Smart Inverters
7. Recommendations for the grid
8. Conclusions



2

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Who is the Electric Power Research Institute (EPRI)?

Independent
Objective, scientifically based results address all aspects of electricity

Nonprofit
Chartered to serve the public benefit

Collaborative
Bring together scientists, engineers, academic researchers, and industry

3

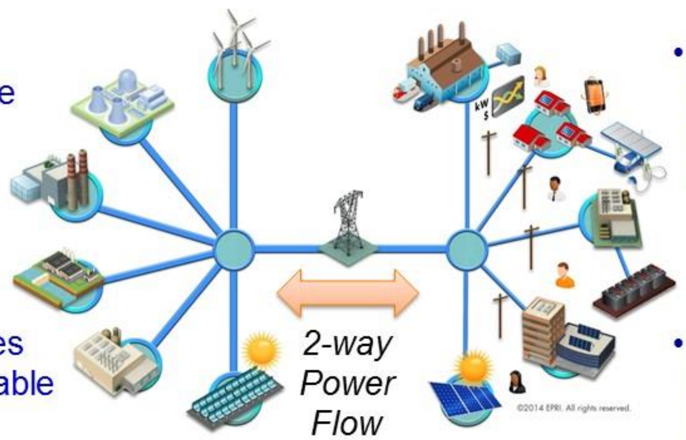
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Changing Landscape: An Integrated Grid is a Better Grid

Operating the Grid – *Looking Forward*

More *Use of* Distributed Energy Resources (DER)

- Generation Becomes More Flexible
- T & D Becomes More Controllable and Resilient

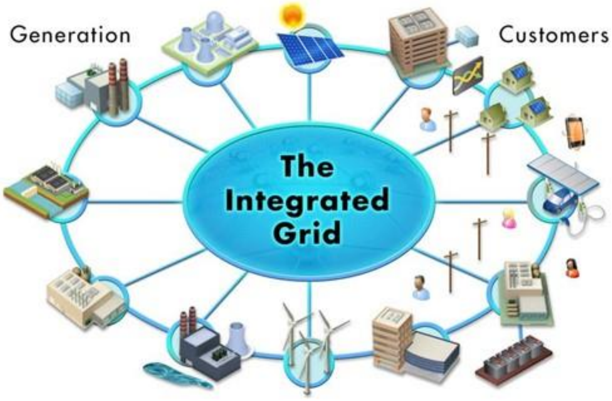


- Consumers Become Energy Producers
- Loads Become More Interactive and Dynamic

A More *Dynamic* End-to-End Power System

What are needed *Elements* for a more Integrated Grid?

1. Grid Modernization
2. Communication Standards and Interconnection Rules
3. Integrated Planning and Operations
4. Informed Policy and Regulation



Grid's role in Achieving full Value from All Resources

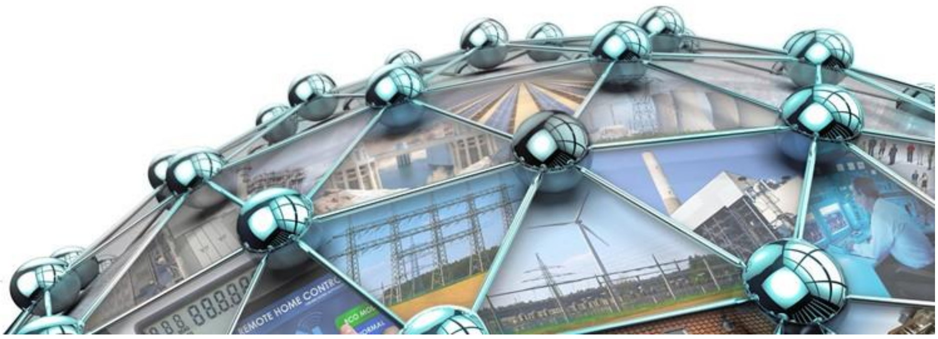
ELECTRIC POWER RESEARCH INSTITUTE

ELECTRIC POWER RESEARCH INSTITUTE

THE INTEGRATED GRID

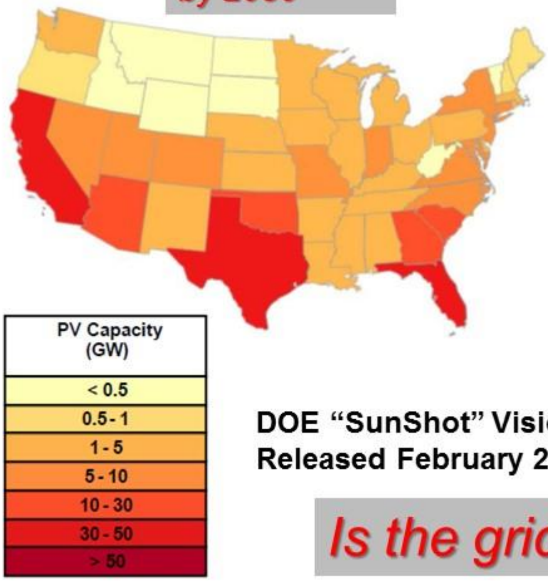
REALIZING THE FULL VALUE OF CENTRAL AND DISTRIBUTED ENERGY RESOURCES

Go to ***integratedgrid.epri.com*** for all materials

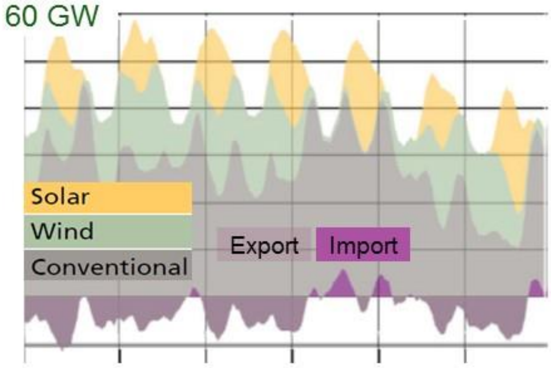


Let's talk about Solar PV, a key driver of change

US Future?
302 GW PV
by 2030



Germany Now – Power Demand for one week in May 2015



DOE "SunShot" Vision Study, Released February 2012

Is the grid ready for PV?

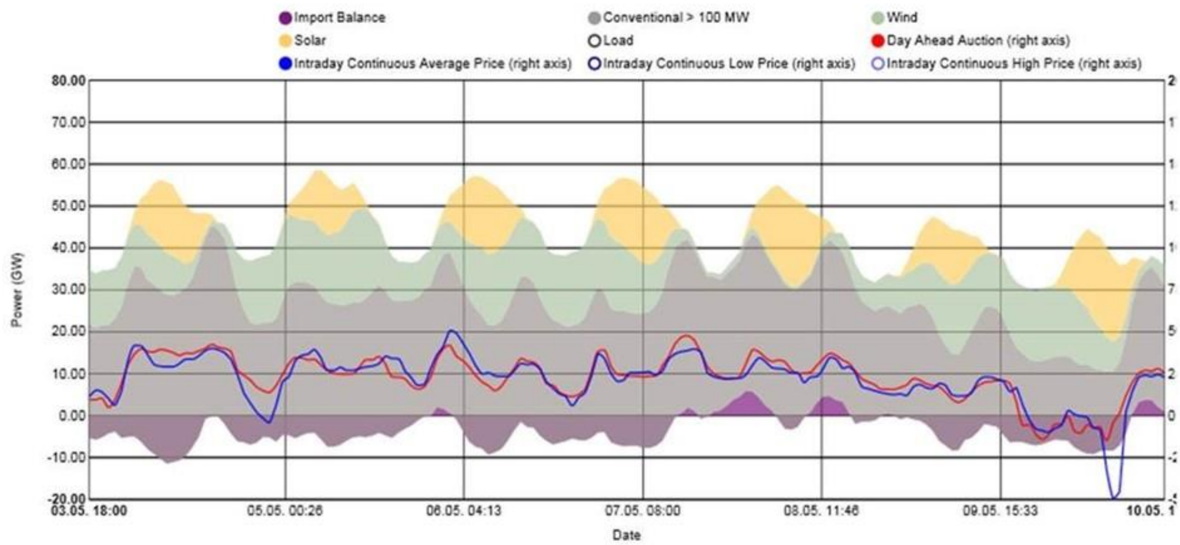
EPRI ELECTRIC POWER RESEARCH INSTITUTE

Renewables do Impact Electricity Prices

ENERGY CHARTS

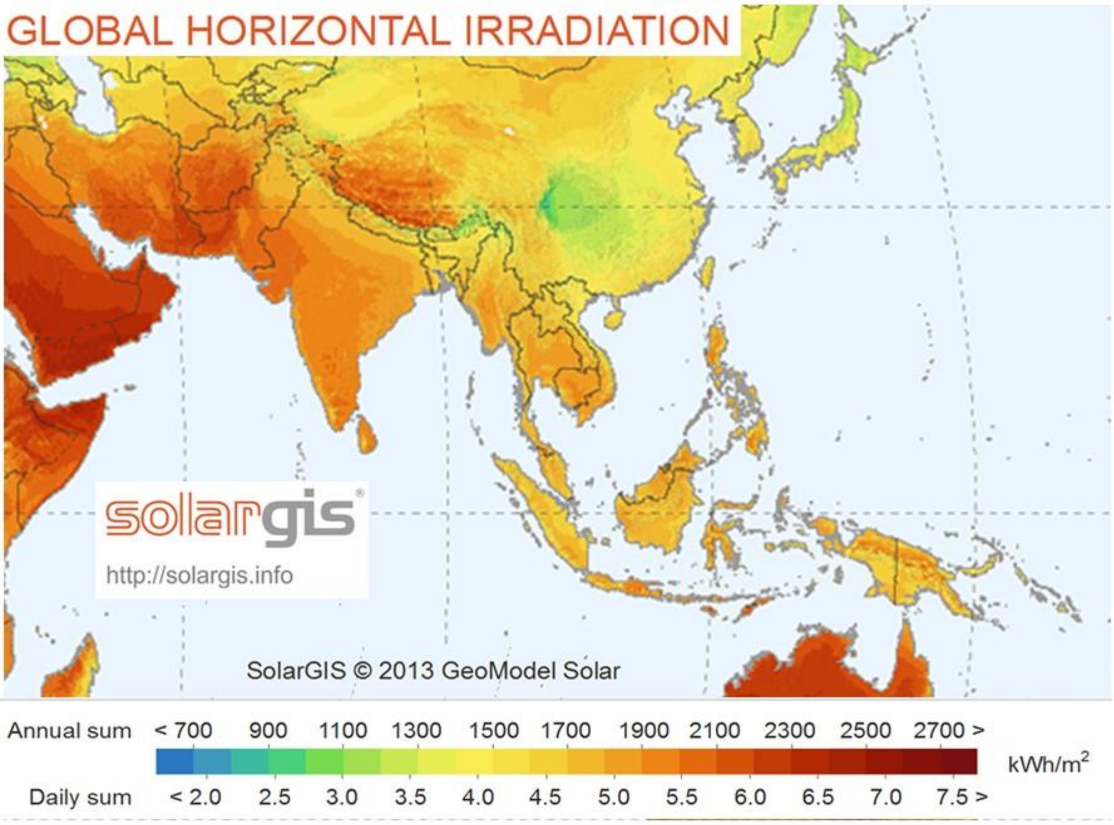
Fraunhofer ISE

Electricity production and spot prices in week 19 2015



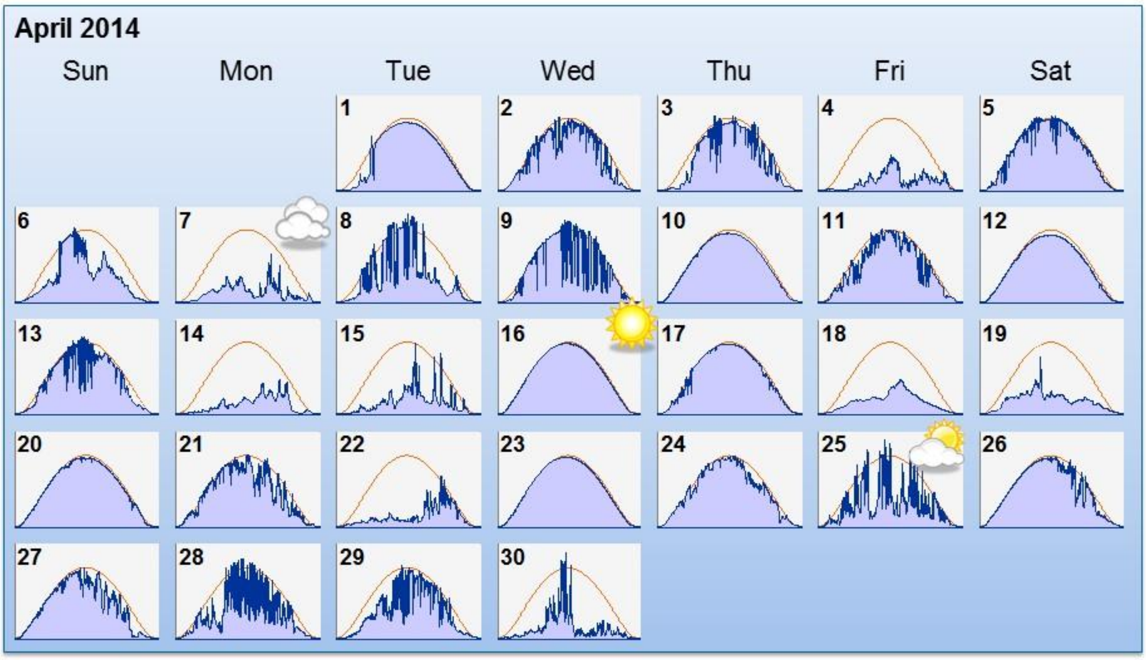
Datenquelle: 50 Hertz, Amprion, Tennet, TransnetBW, EEX, EPEX
Last update: 06 Oct 2015 02:52

EPRI ELECTRIC POWER RESEARCH INSTITUTE



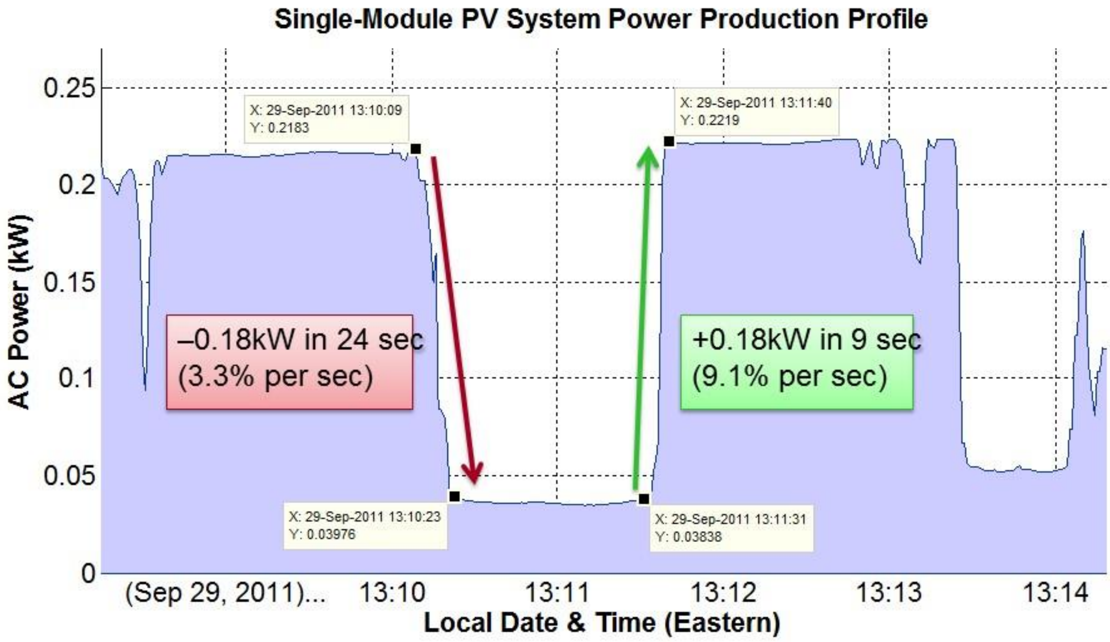
Interconnection Challenge: Solar output variability

Calendar based on irradiance, 1-min averages at 30° fixed tilt, Knoxville



Single-Module Ramp Events on 1-MW Site in TN

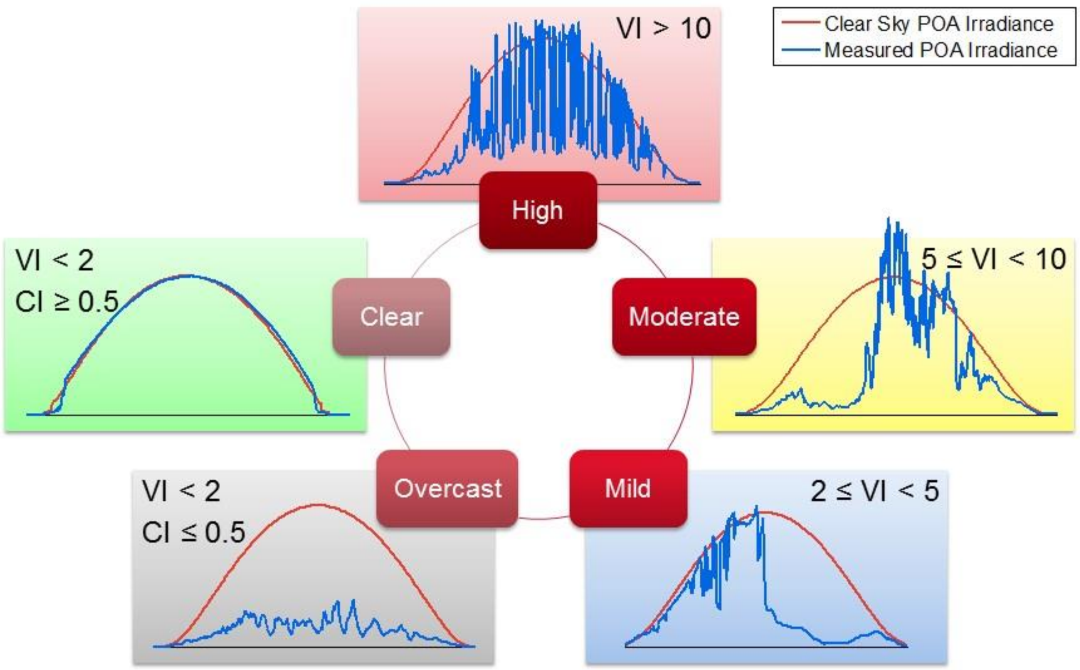
Measured 1-sec output from a 224-W module with micro-inverter



EPRI ELECTRIC POWER RESEARCH INSTITUTE

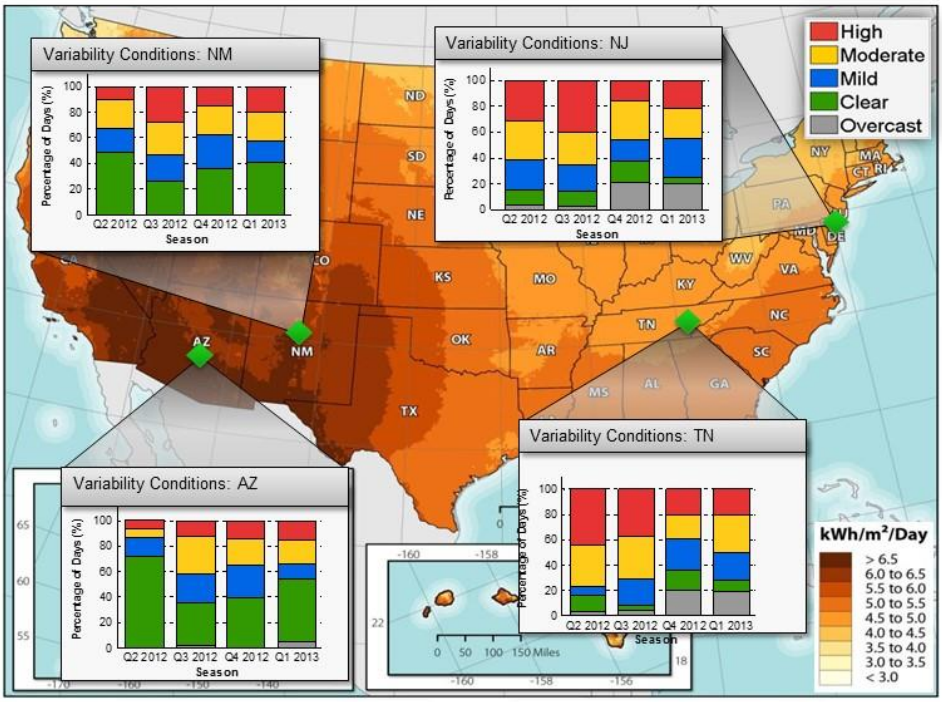
Categories for Daily Variability Conditions

Applied Sandia's variability index (VI) with clearness index (CI) to classify days



EPRI ELECTRIC POWER RESEARCH INSTITUTE

Categories for Daily Variability Conditions

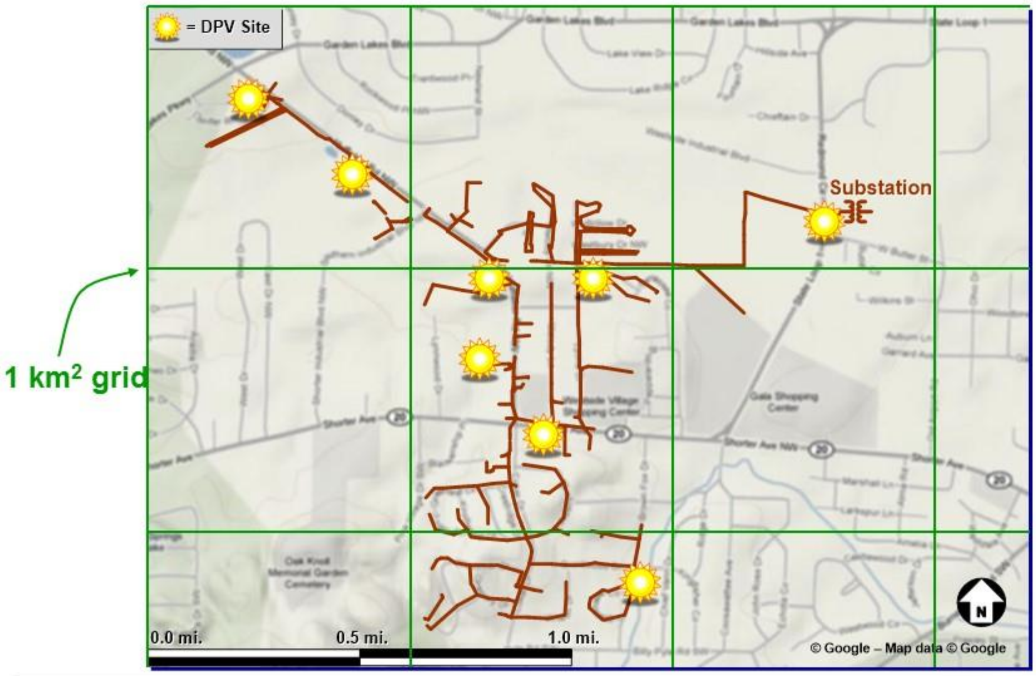


Using a clearness index (CI) and a variability index (VI) and to classify days

EPRI ELECTRIC POWER RESEARCH INSTITUTE

PV variable output on distribution feeder

Circuit map showing locations of pole-mount systems in Rome, GA



EPRI ELECTRIC POWER RESEARCH INSTITUTE

Potential Grid Issues with PV Variability

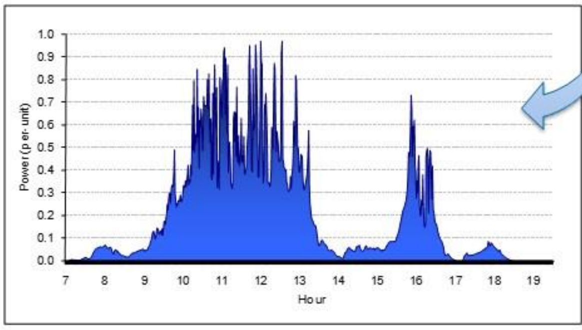
Voltage Control
- Overvoltage
- Voltage variations

Equipment Operation
- Feeder regulators,
- Load tap changers
- Switched capacitor banks

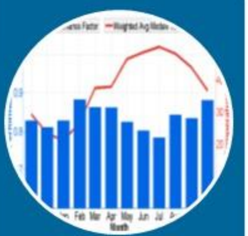
Demand/Energy
- "Masking" peak demand
- Unbalancing supply and demand

System Protection
- Relay desensitization, networks
- Breaker reduction of reach
- Unintentional islanding

Power Quality
- Harmonic generation
- Flicker worries

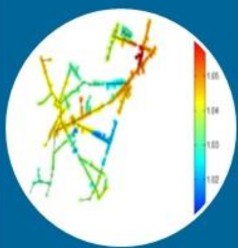


EPRI Research Steps for Integrating PV in Distribution?



Understanding PV Plant Performance

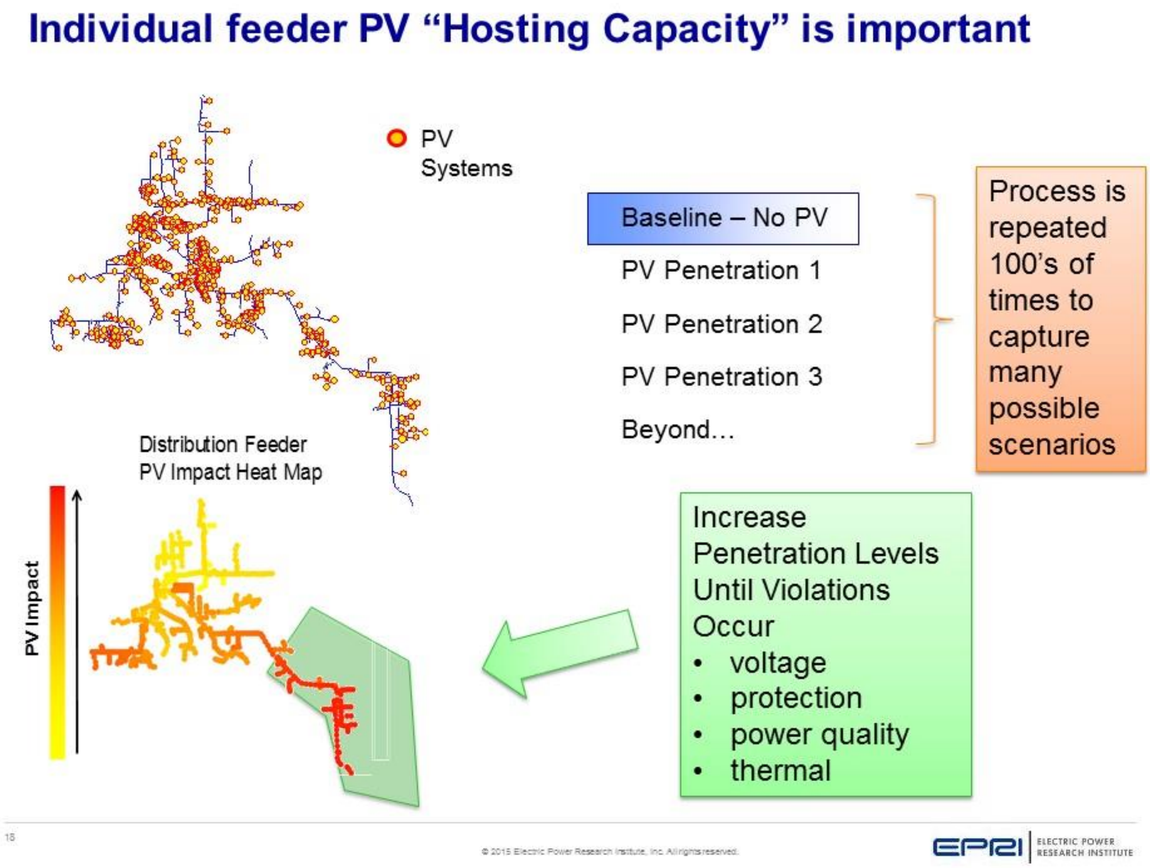
Determine Feeder Hosting Capabilities



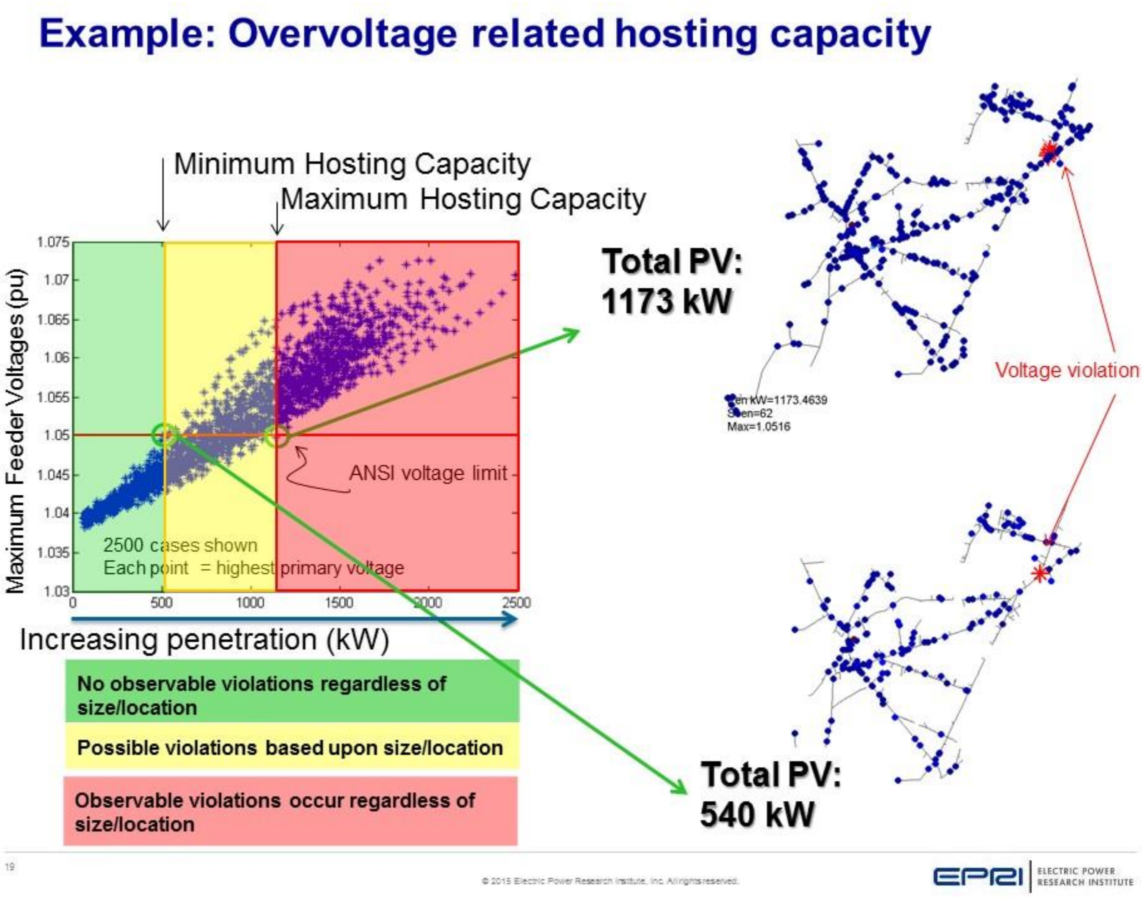
Develop Improved Methods for Analysis

Deploy Inverter-Grid Support

Current Research Activities



Individual feeder PV "Hosting Capacity" is important
PV Systems
Distribution Feeder PV Impact Heat Map
PV Impact
Baseline – No PV
PV Penetration 1
PV Penetration 2
PV Penetration 3
Beyond…
Process is repeated 100's of times to capture many possible scenarios
Increase Penetration Levels Until Violations Occur
• voltage
• protection
• power quality
• thermal
18
© 2015 Electric Power Research Institute, Inc. All rights reserved.
EPRI ELECTRIC POWER RESEARCH INSTITUTE



Example: Overvoltage related hosting capacity
Minimum Hosting Capacity
Maximum Hosting Capacity
Maximum Feeder Voltages (pu)
1.075
1.07
1.065
1.06
1.055
1.05
1.045
1.04
1.035
1.03
0
500
1000
1500
2000
2500
ANSI voltage limit
2500 cases shown
Each point = highest primary voltage
Increasing penetration (kW)
No observable violations regardless of size/location
Possible violations based upon size/location
Observable violations occur regardless of size/location
Total PV: 1173 kW
Total PV: 540 kW
Voltage violation
19
© 2015 Electric Power Research Institute, Inc. All rights reserved.
EPRI ELECTRIC POWER RESEARCH INSTITUTE

How much PV can the existing grid host?

EPRI's approach is to determine how much PV (hosting capacity) can be accommodated before adversely impacting a feeder

Distribution Feeder Hosting Capacity: What Matters When Planning for DER?

April 2015

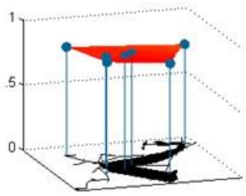
What matters most?

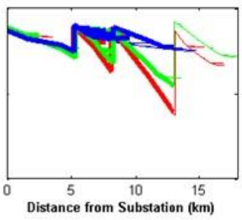
- **PV technology**
- **PV size and location**
- **Feeder construction and operation**

EPRI White Paper summarizing ~ 5 years of research on the Integration of DER.

*Search "**EPRI and 3002004777**"*

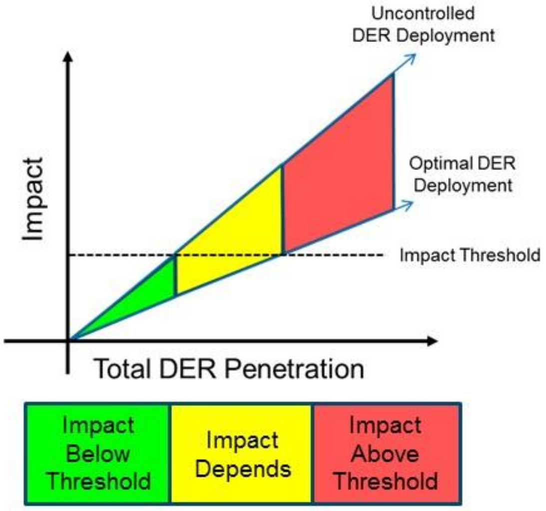
S mo

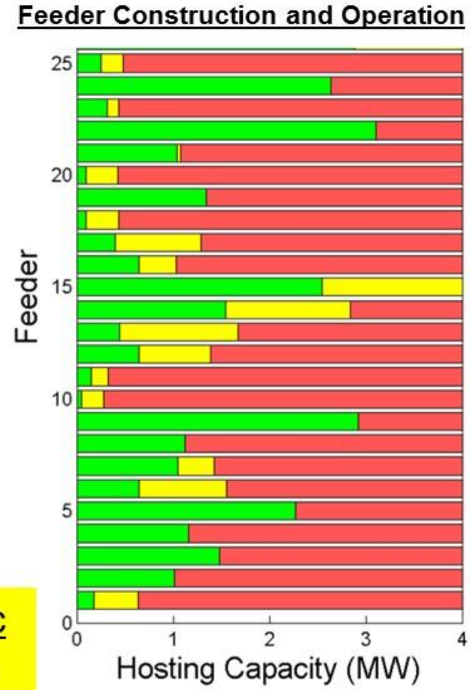




Search: "Youtube Epri Pv Penetration"

Learning: Each Feeder has unique response





EPRI supports **"OpenDSS"** a public software for research and education

Inverter – Role in PV Plants

PV inverter converts DC energy from solar modules in to AC energy and interface the PV system with electricity grid

Traditional Inverter

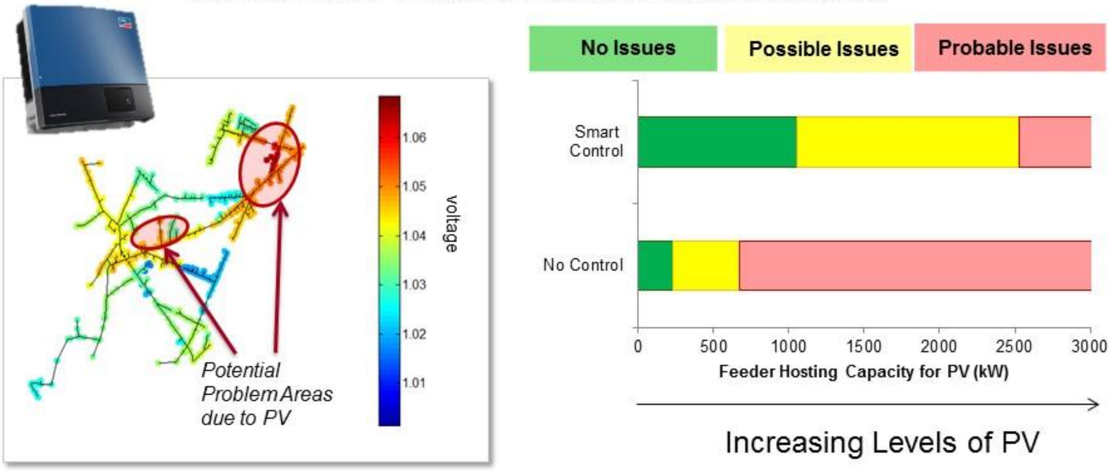
- Matching PV output with grid voltage and frequency
- Providing safety by providing unintentional islanding protection
- Disconnect from grid based on over/under voltage/frequency

Smart Inverter Functionality

- Voltage Support
- Frequency Support
- Fault Ride Through (FRT)
- Communication with grid

With and without Inverter Grid Support

How Much PV Can a Feeder Accommodate?



Smart Inverters and Control Increase PV Feeder Hosting Capacity

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Planning with DER - Mitigation

Analytics

- Screening
- Hosting Capacity
- Reliability
- DER/Grid Modeling

Tools

- Advancing commercial tools
- Open-source (OpenDSS)

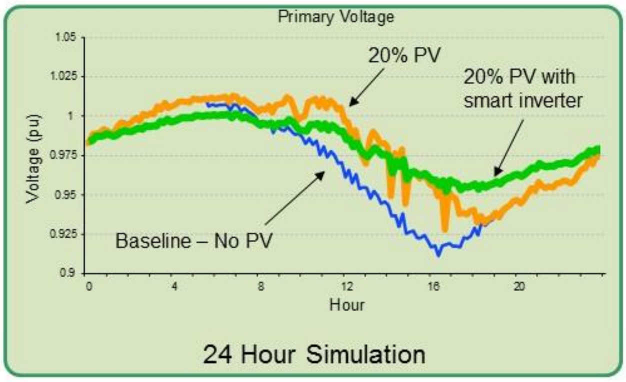
Mitigation

- Smart inverters
- Grid-side enhancements

Training

- Engineering Guidelines
- Planning with DG

Improved Integration with

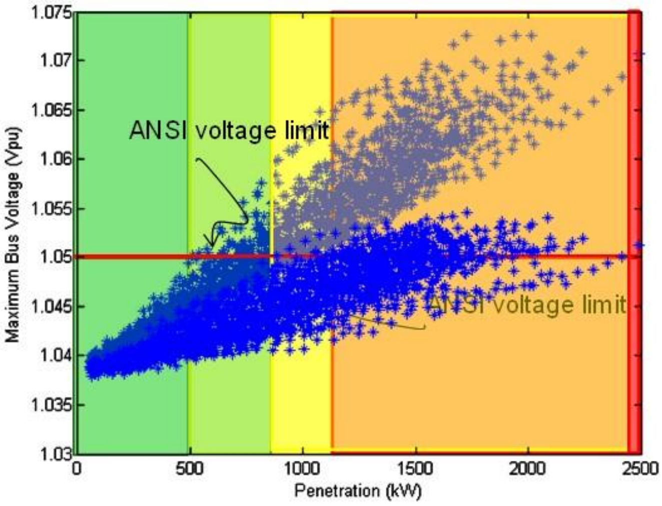


- Often least-cost solution
- Increased hosting capacity

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Advanced Inverters Have Significant Upside

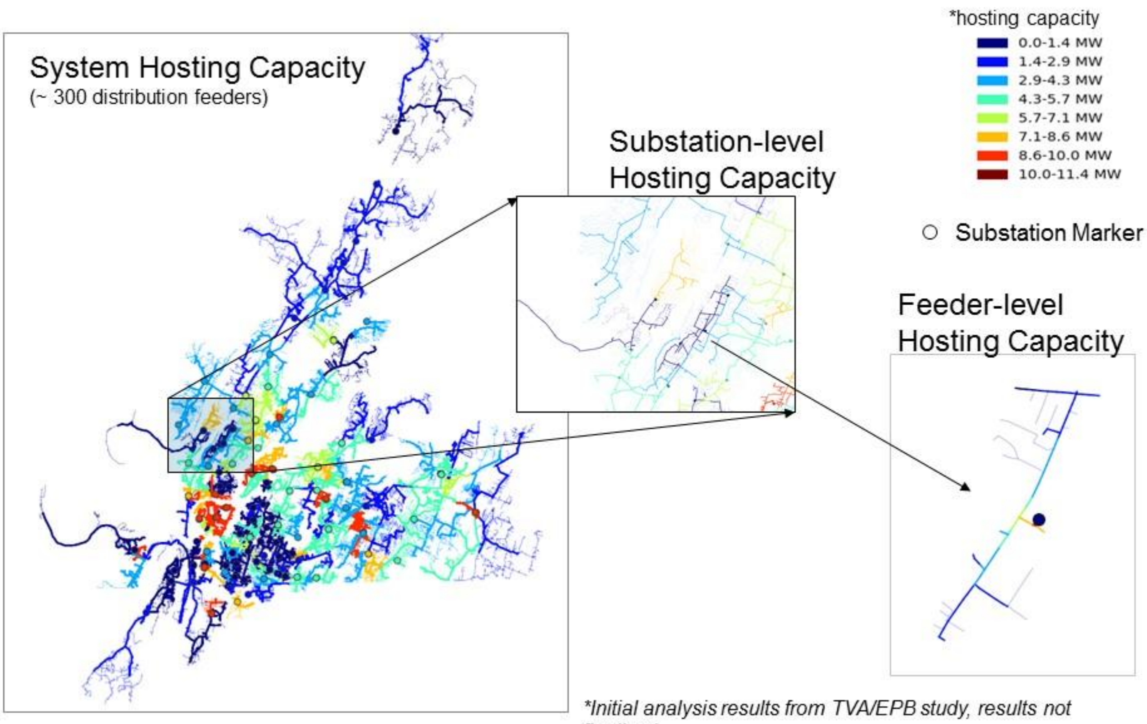
- Voltage issue
  - Voltage-related issues often the most limiting issues regarding integrating DER
- Least-cost solution
  - In many cases, use of smart inverters can be the least cost solution for mitigating voltage related issues due to DER
- Increased hosting capacity
  - EPRI has shown smart inverters can increase hosting capacity significantly



26

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Mapping Feeder Hosting Sample Chattanooga, TN, USA

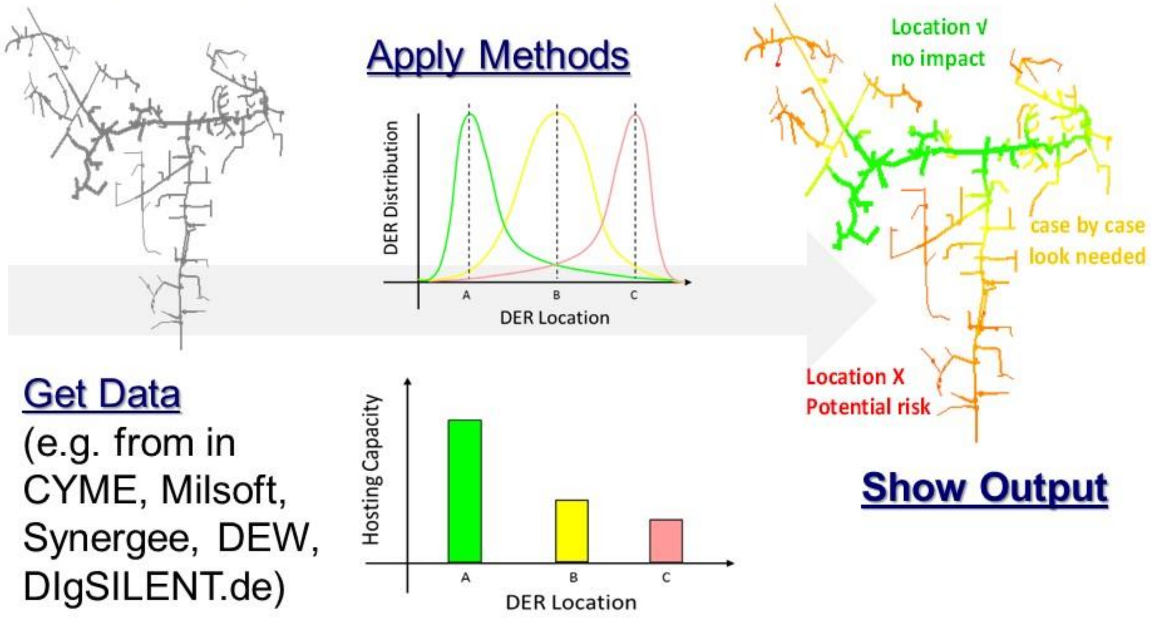


**Initial analysis results from TVA/EPB study, results not finalized*

27

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Moving from research methods to everyday utility analysis tools



Details on Streamlined Method: EPRI Report 3002003278

Recommendations: So what are some high penetration integration options?

1. ***Leveraging existing grid "hosting capacity" (matching solar to available capacity and energy demand)***
2. ***Changing requirements for DG to provide grid support, especially for island grids (Smart Inverters...optimal setting)***
3. ***Pinpointing distribution upgrades and reinforcements (AMI, smart protection and control, wires, see PVGrid)***
4. ***For the bulk two-way transmission grid, provide levers for operators (flexibility of resources, DG ride-thru requirements, forecasting, etc)***

Also see EPRI public white papers

Conclusions: Key Takeaways

- ***An integrated approach is needed to transform the power system***
- ***EPRI utility member's current research for PV integration can help and is ready use***
- ***Industry, policy, and regulatory leaders need to coalesce and make changes to enable the transformation***

Integrated
The Whole is Greater than the Sum of its Parts

Transforming the Power System will be a *Journey* not a Destination

30

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

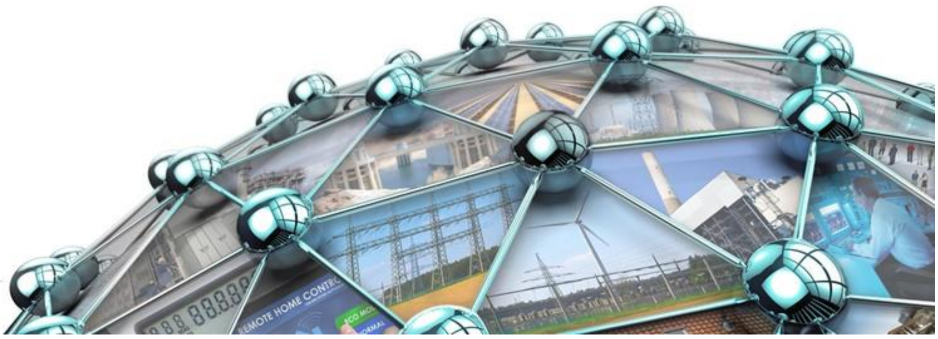
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Questions?

Tom Key, tkey@epri.com
www.epri.com

Together...Shaping the Future of Electricity

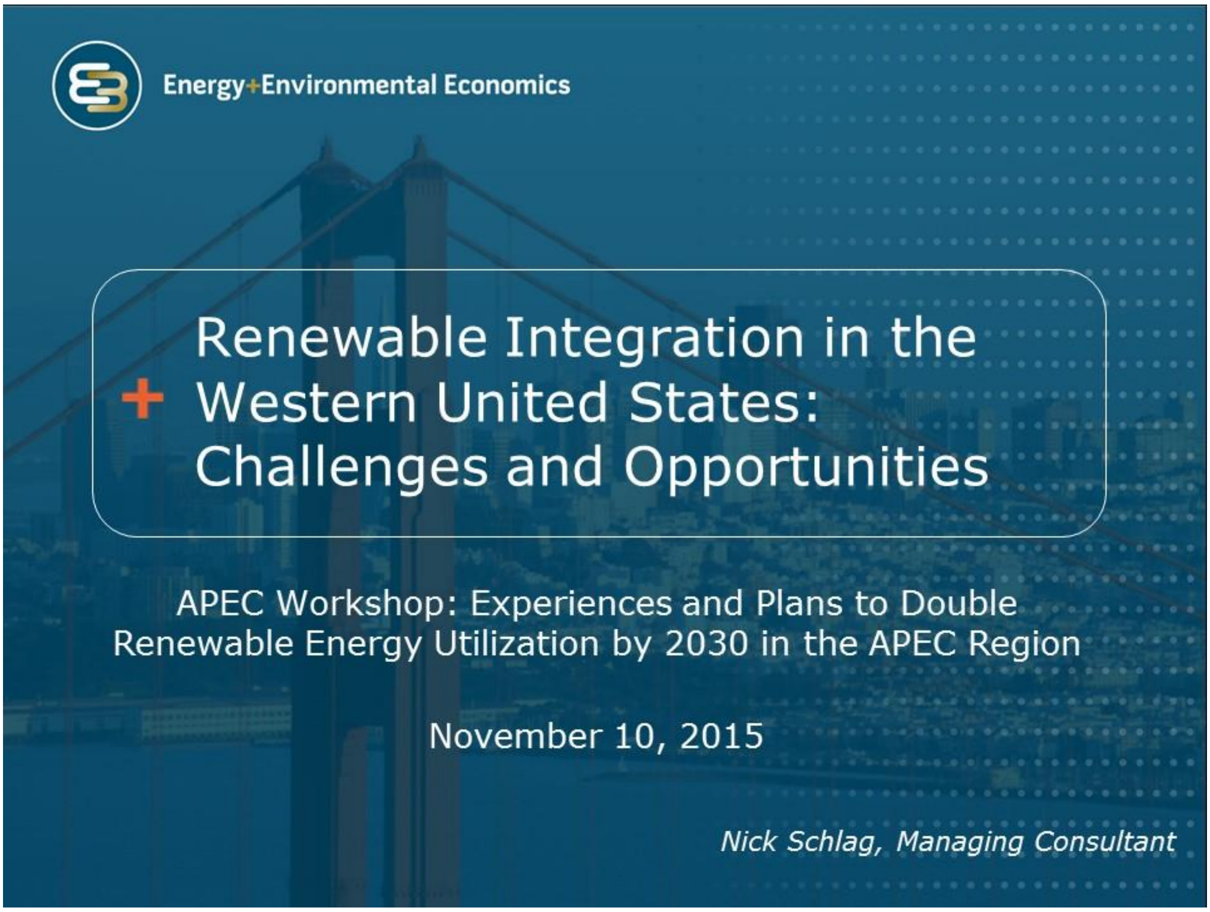
The Integrated Grid Online Community
http://integratedgrid.epri.com



31

2-2. Renewable Integration in the Western United States : Challenges and Opportunities

Nick Schlag
Managing Consultant
Energy and Environmental Economics Inc. (E3), USA



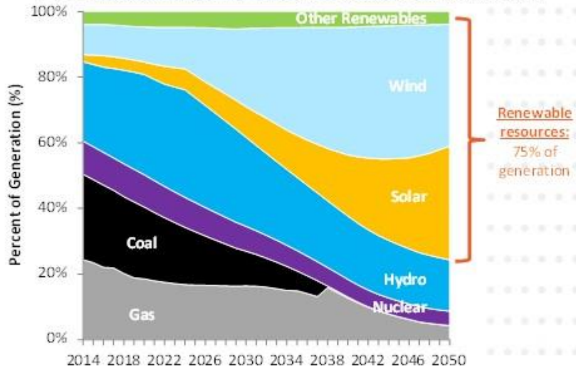
Energy and Environmental Economics, Inc. (E3)

- **Electricity sector specialists, founded 1989**
- **Offices in San Francisco and Vancouver**
- **Rigorous analysis on a wide range of energy issues for utilities, regulators, gov't agencies, power producers, technology companies, and investors**
  - Resource planning, asset valuation, cost of service, rate design, EE/DR/DG cost-effectiveness, NEM cost shifts, renewable procurement, renewable integration, transmission development, deep decarbonization pathways

Renewables Play a Key Role in Achieving Deep Decarbonization

- **Multiple studies have established the central role that the electric sector must play in meeting economy-wide carbon reductions goals**
- **Multiple options for decarbonizing the electric sector exist:**
  - Renewables
  - CCS technologies
  - Nuclear

Decarbonization of US Generation Fleet via Investment in Renewable Generaiton



Data source: E3 PATHWAYS High Renewables Case

Renewables Portfolio Standards Drive Development in the U.S.

+ **Many US states have implemented "Renewables Portfolio Standards" (RPS) targets to encourage renewable development**

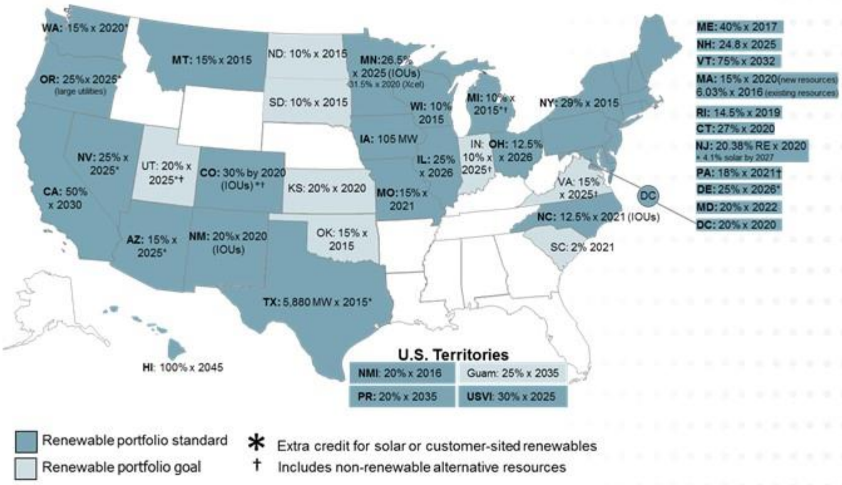
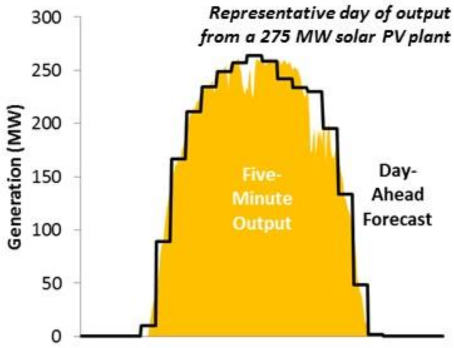


Image source: Database of State Incentives for Renewables and Efficiency (DSIRE)

Qualities of Renewable Generation

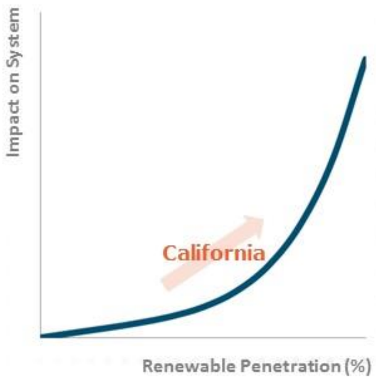
+ **Many renewable resources are:**
  - **Variable:** output changes from minute to minute, second to second
  - **Uncertain:** output cannot be predicted perfectly in advance
  - **Concentrated:** output is concentrated during specific times of day and year



+ **These characteristics imply a transition to an electric system that is more flexible:**
  - Can adjust output quickly with limited notice

Institutions Should Adjust to Allow Renewable Integration

- **At low penetrations, impacts of renewables are modest**
  - Existing institutions and conventions can accommodate incremental changes
- **At high penetrations, impacts of renewables are <u>transformational</u>**
  - Market structures and scheduling processes should allow efficient system dispatch
  - Paradigms for resource planning & procurement should shift from capacity to flexibility
  - Contractual structures should ensure proper economic signals are provided to renewable developers



Impact of renewables on electric system is nonlinear

California's Renewable Energy Achievements To Date

- **Today:**
  - **23% RPS achieved** by IOUs in 2013
  - **15% reduction in electric sector GHG emissions** relative to 2005
- **By 2020:**
  - **On track to meet (or exceed) 33% RPS** by 2020
    - ≈ 50% if counting rooftop PV (5%) and large hydro (13%)
  - **20% reduction in electric sector GHG emissions** relative to 2005
  - **6-8% rate increase** due to 33% RPS
- **By 2030:**
  - **50% RPS target** recently established by SB350

50% RPS is a New Challenge

- **California still does not have operating experience at 33% RPS**
- **No other economy or state has achieved an equivalent RPS above 30% anywhere in the world**
  - Germany: 22% renewables in 2012
    - 7.4% wind, 4.5% solar
  - Spain: 24% renewables in 2012
    - 18% wind, 4% solar
  - Denmark: 30% wind in 2012
    - Assisted by interconnections with Germany & Norway
  - Norway, New Zealand & British Columbia achieve higher renewable penetrations with large hydroelectric resources which do not count towards RPS in California

Energy+Environmental Economics 8

Renewable Integration Challenges

1. **Downward ramping capability**

   Thermal resources operating to serve loads at night must be ramped downward and potentially shut down to make room for a significant influx of solar energy after the sun rises.

2. **Minimum generation flexibility**

   Overgeneration may occur during hours with high VER production even if thermal resources and imports are reduced to their minimum levels. A system with more flexibility to reduce thermal generation will incur less overgeneration.

3. **Upward ramping capability**

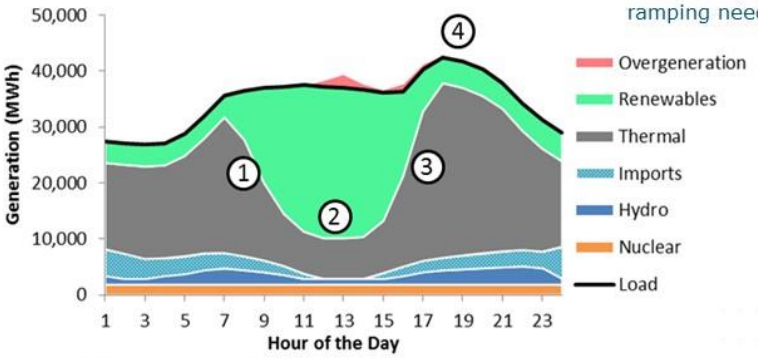
   Thermal resources must ramp up quickly from minimum levels during the daytime hours and new units may be required to start up to meet a high net peak demand that occurs shortly after sundown.

4. **Peaking capability**

   The system will need enough resources to meet the highest peak loads with sufficient reliability

5. **Sub-hourly flexibility (not shown in chart)**

   Flexible capacity needed to meet sub-hourly ramping needs



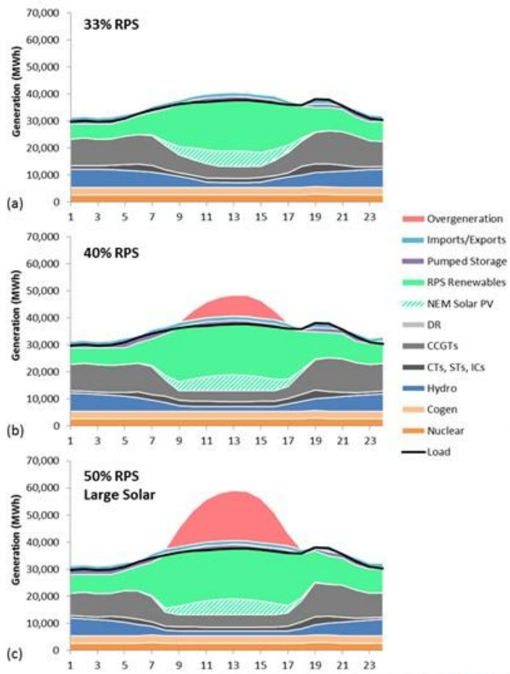
Energy+Environmental Economics 9

New Tools are Needed to Assess Impacts of Renewable Energy

+ **In order for information to remain useful in decision-making processes, modeling tools must be capable of capturing the full impacts of high penetrations of renewables**
+ **E3's REFLEX, a stochastic production simulation model, has been tailored to analysis of high renewable penetrations**
  - **Simulates electric dispatch to balancing generation with load** at an hourly level
  - **Captures wide distribution of operating conditions** through Monte Carlo draws of operating days
  - **Illuminates the significance of the operational challenges** by calculating the likelihood, magnitude, duration & cost of flexibility violations

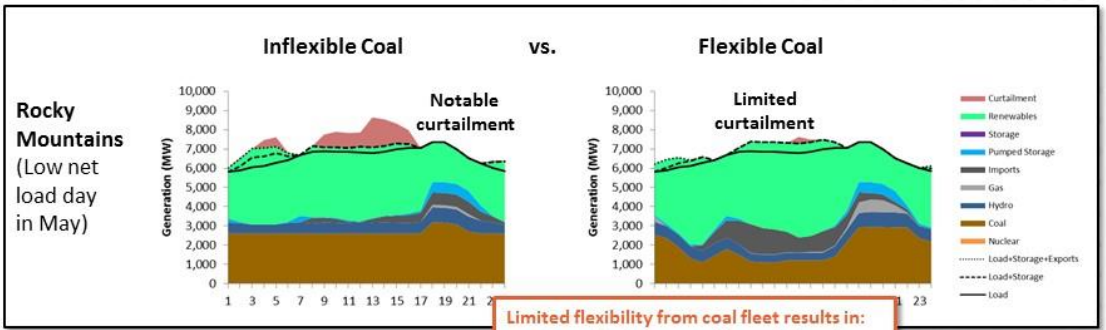
California's Challenge: Balancing Large Amounts of Solar Generation

+ **Overgeneration increases rapidly above 33%**
  - Overgeneration is very high on some days under at 50% RPS
  - Fossil generation is reduced to minimum levels needed for reliability
+ **Renewable curtailment is a critical strategy to maintain reliability**
  - Reduces overgeneration
  - Mitigates ramping events



Operating Coal Resources Flexibly Helps Integrate Renewables

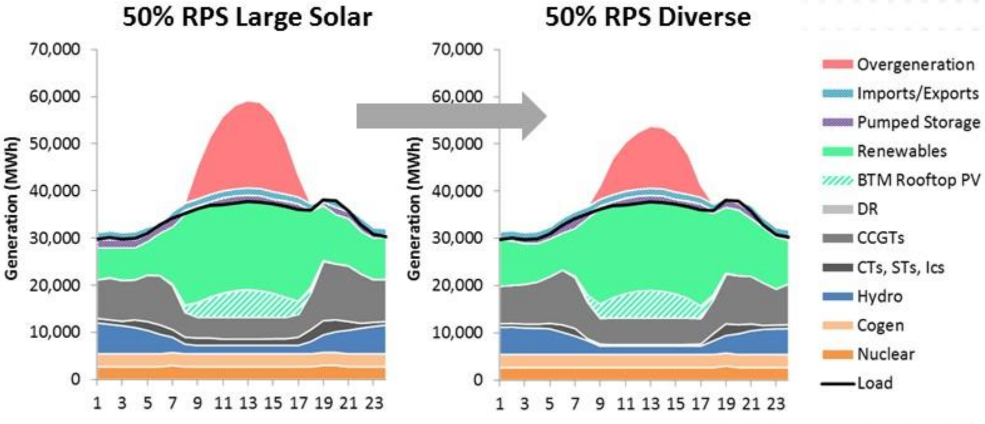
+ **In systems with a heavy reliance on coal generation, ease of renewable generation depends on how flexibly coal can be operated**
  - Operating coal in a traditional "baseload" capacity exacerbates renewable curtailment
  - Operating coal more flexibly mitigates curtailment but may result in increased cycling costs and O&M and reduced equipment lifetimes



Limited flexibility from coal fleet results in:
- Exacerbated renewable curtailment
- Increased use of coal generation
- Decreased use of gas generation

Renewable Diversity Reduces Integration Challenges

+ **Geographic and technological diversity facilitates renewable integration by distributing production across more hours of the year**



Procuring a Least-Cost Portfolio of Renewables

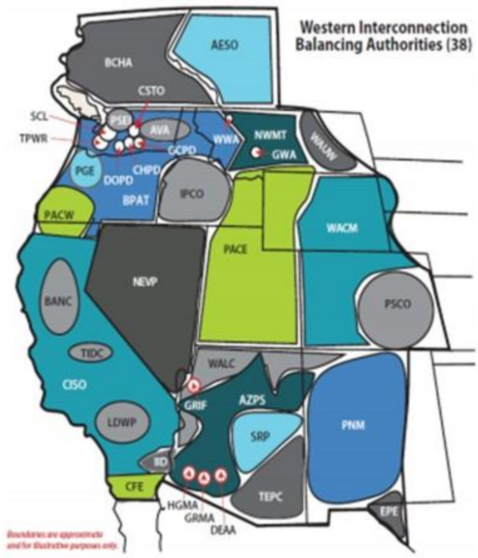
- **California's "Least Cost, Best Fit" procurement framework is designed with the intent to allow utilities to procure a least cost portfolio by considering both cost and value**
- **Costs and values must adjust over time as:**
  - Renewable technologies mature
  - Incentives and financing environments change
  - System characteristics change

Net Market Value Framework

\+ Levelized Cost of Energy
\+ Transmission Cost
− Capacity Value
− Energy Value
\+ Curtailment Cost
\+ Integration Cost
= Net Resource Cost

Regional Coordination Offers Substantial Benefits

- **Renewable integration is challenging on small systems, easier on large systems**
- **Historically, WECC BAs have operated largely independently**
  - No centralized market
  - Bilateral energy trading
- **Current initiatives underway to encourage regional coordination:**
  - Energy Imbalance Market (EIM)
  - Balancing authority consolidation (CAISO & PacifiCorp)

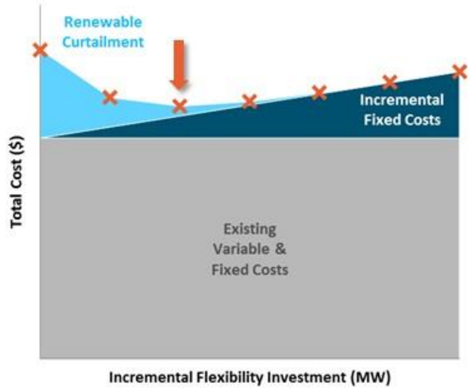


Defining a New Planning Paradigm

- **Introduction of variable renewables has shifted the capacity planning paradigm**
- **The new planning problem consists of two related questions:**
  1. How many MW of <u>dispatchable</u> resources are needed to (a) meet load, and (b) meet flexibility requirements on various time scales?
  2. What is the optimal mix of new resources, given the characteristics of the existing fleet of conventional and renewable resources?

Portfolio Planning Provides Least-Cost Pathway

- **Many supply & demand side procurement options:**
  - Flexible natural gas (CCGT, CT, ICE)
  - Energy storage (pumped storage, batteries)
  - Demand response
  - Flexible loads, retail rate design
- **Procurement decisions for new investments & programs should consider the value each option provides to renewable integration**



There is a direct tradeoff between the value provided by flexible resources and their cost

California's Experience is Not Unique

+ **Achieving high penetrations of renewable generation is technically feasible**
+ **High penetrations of renewable generation require us to reconsider how decisions are made in the electric sector across all time scales**
  - **In day-to-day operations:** market structures and scheduling processes must be organized to allow efficient dispatch across a broader range of conditions
  - **Across years:** decision-making frameworks for procurement must consider impacts of renewable generation on the system
+ **Diversity and regional coordination are low-hanging fruit that mitigate many of the challenges of achieving high penetrations**
+ **Additional investments may be necessary under some circumstances to facilitate renewable integration**

Relevant E3 Projects & Studies

+ **RPS Calculator development & program support**
  - Developed model currently used by California Public Utilities Commission (CPUC) to create plausible renewable scenarios for planning purposes
+ **Investigating a Higher Renewables Portfolio Standard in California**
  - Conducted study for five California utilities to examine impacts of moving from 33% to 50% RPS
+ **WECC Flexibility Assessment**
  - Performed analysis for Western Electricity Coordinating Council (WECC) to examine impacts of high renewables penetrations on regional electric operations
+ **PATHWAYS: Long-Term Greenhouse Gas Reductions Scenarios**
  - Conducted study for California state agencies to examine potential pathways to 2050 carbon reduction targets
+ **Pathways to Deep Decarbonization in the United States**
  - Conducted study as part of the Deep Decarbonization Pathways Project led by Sustainable Development Solutions Network (SDSN) and the Institute for SustainableDevelopment and International Relations (IDDRI)


Energy+Environmental Economics
Thank You!
Energy and Environmental Economics, Inc. (E3)
101 Montgomery Street, Suite 1600
San Francisco, CA 94104
Tel 415-391-5100
Web http://www.ethree.com
Nick Schlag, Managing Consultant (nick@ethree.com)

2-3. Low Carbon Technology for Green Energy Implementation

Bing-Chwen Yang
Deputy General Direction
Green Energy & Environment Research Laboratories,
Industrial Technology Research Institute, Chinese Taipei

Contents

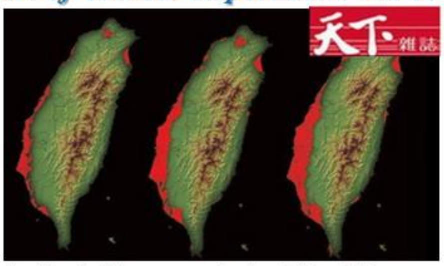
Why Green Energy

– Grand Challenges Globally

Climate Change Impact

Arctic

If the sea level continues to rise, the future of Chinese Taipei Island will be…



Sea level rising scenario: 6 m/ 15 m/ 25 m

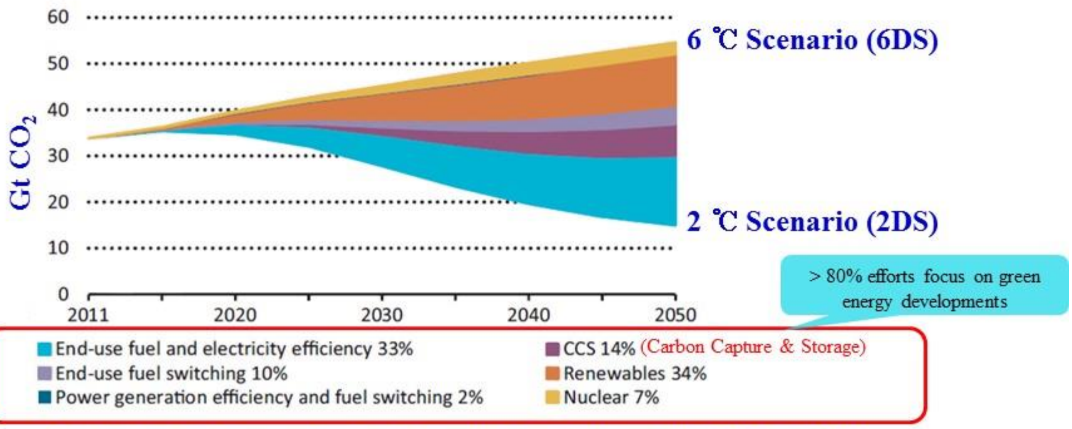
Source: National Geographic magazine / 天下雜誌369期

If the global temperature raises 2℃：

- 2 billion of people will suffer from water scarcity
- 20-30% of species might face extinction
- 20% of the population will be affected by the floods

It Needs Many Approaches to Cope with Climate Change

- Energy related measures across all sectors should be taken by 2050 to achieve the global goal of reducing annual CO_2 emission levels to half of those in 2011
- To achieve the 2DS scenario, strong policies will be needed from governments worldwide



Contributions to annual emissions reductions between the 6DS and 2DS

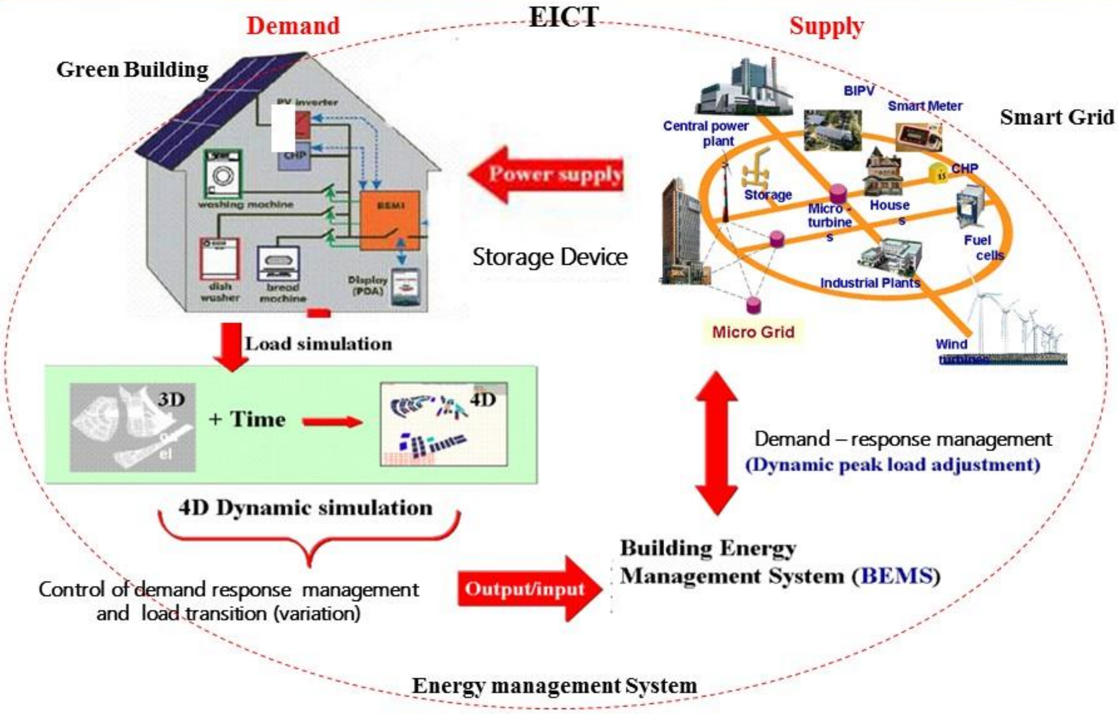
Source: IEA-ETP 2014

Technology Integration for Low Carbon Environment

– Technology Integration
– Penghu Low carbon Island
– ITRI Campus

ITRI Industrial Technology Research Institute

Integration of Low Carbon Technology



ITRI Industrial Technology Research Institute

Penghu Low Carbon Demo Project

- The **Penghu Low Carbon Island** project was carried out from 2011 to 2015. **(97 Islands, 128 km², Population ~ 101,000)**
- **Target :**
  - Renewable energy supplies **56%** of total energy consumption in 2015
  - Reduce CO_2 emission from **5.4 tons/cap-yr** (2008) to **2.1 tons/cap-yr (2015)**

Installed 20 PV system (**1.56 MW**) and subsidized **1,893 m²** solar water heaters (by March 2015)

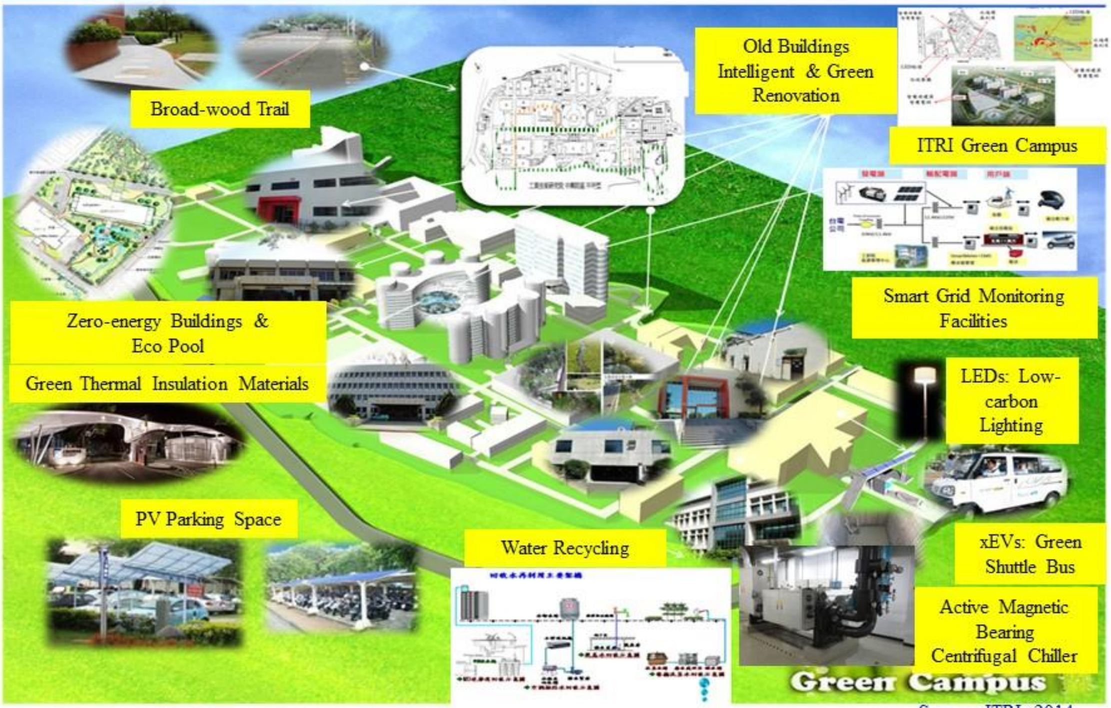
Established **5,309 LED** street lamps and subsidized **12,028 energy-saving appliances** (by March 2015)

Established **612 charge stations** and subsidized **3,561 electric scooters** (by March 2015)

All new public buildings and major private constructions should obtain **green building certification**

ITRI Industrial Technology Research Institute

Demo-Program – ITRI Green Campus



Source: ITRI ,2014

ITRI's R&D in Green Energy

– ITRI Picture
– Renewable Energy
– Energy Conservation

 APEC-Daegu-10

Industrial Technology Research Institute

ITRI Industrial Technology Research Institute

– A non-profit R&D institution founded in 1973

- Lead the development of emerging high-tech industry
- Enhance the competitiveness of industries in the global market
- Create economic value through technology R&D

Total Staffs: 5,610
Ph.D. : 1,333 (23.8%)
Master : 3,057 (54.5%)
Bachelor : 1,220 (21.7%)
Alumni : 23,582

Total Patents : 23,213

Startups & Spinoffs (2014) : 260

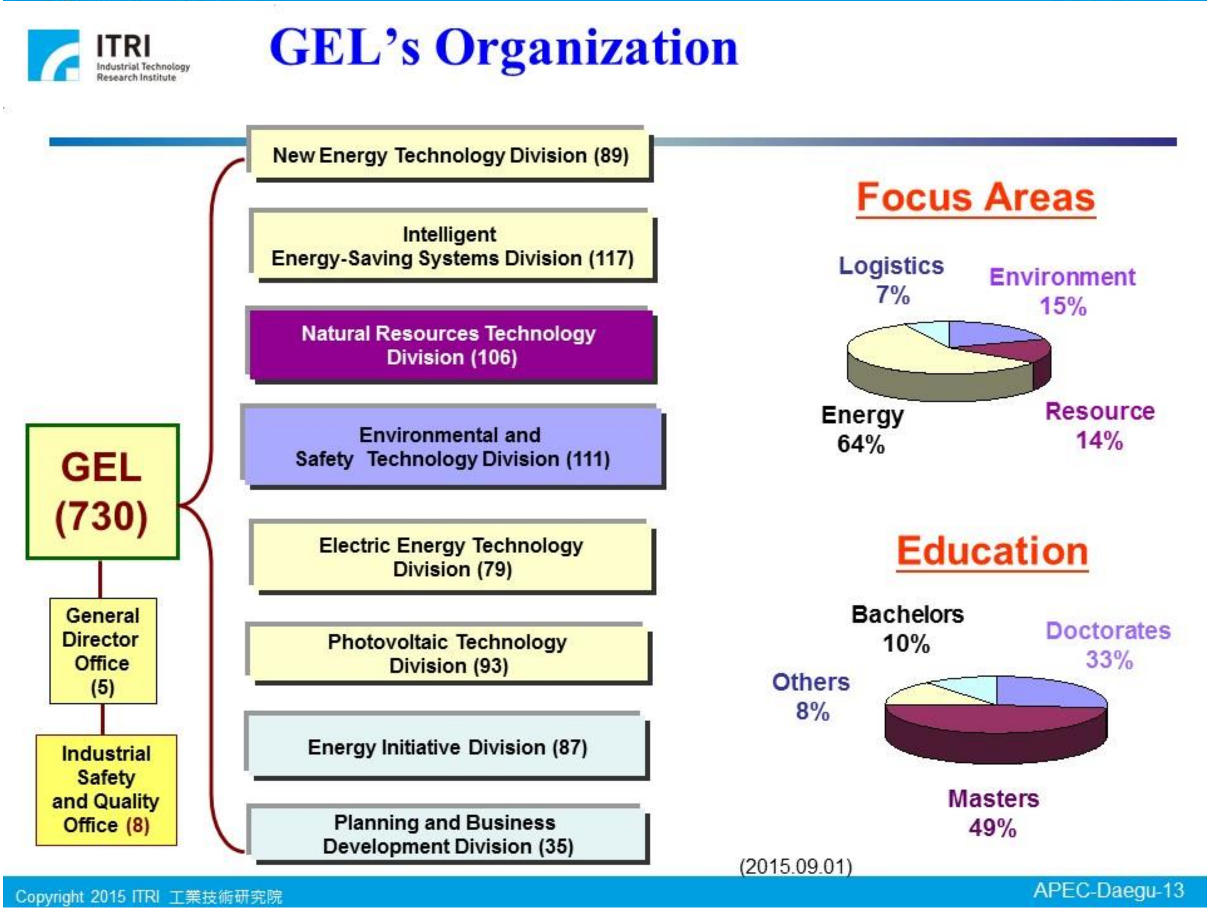
Industry Services (2014)
Provided Services : 15,086

Transferred Technologies : 626

2015.09.01

 APEC-Daegu-11


ITRI Industrial Technology Research Institute
Organization of ITRI
ITRI
Industrial Technology Investment Corporation
ITRI College
Technology Transfer Center
Commercialization and Industry Service Center
ITRI International Center
Office of Strategy and R&D Planning
Office of Marketing Communications
Administrative Service Center
Accounting Resource Center
IT Service and Development Center
Human Resources Office
ITRI Southern Region Campus
ITRI Central Region Campus
Biomedical Technology and Device Research Laboratories
Green Energy and Environment Research Labor
Material and Chemical Research Laboratories
Mechanical and Systems Research Laboratories
Information and Communications Research Laboratories
Electronics and Optoelectronics Research Laboratories
Center for Measurement Standards
Display Technology Center
Service Systems Technology Center
Industrial Economics and Knowledge Center
Knowledge-based Economy and Competitiveness Center
Computational Intelligence Technology Center
Machine Tools Technology Center
2015.09.01
Copyright 2015 ITRI 工業技術研究院
APEC-Daegu-12


ITRI Industrial Technology Research Institute
GEL's Organization
GEL (730)
General Director Office (5)
Industrial Safety and Quality Office (8)
New Energy Technology Division (89)
Intelligent Energy-Saving Systems Division (117)
Natural Resources Technology Division (106)
Environmental and Safety Technology Division (111)
Electric Energy Technology Division (79)
Photovoltaic Technology Division (93)
Energy Initiative Division (87)
Planning and Business Development Division (35)
Focus Areas
Logistics 7%
Environment 15%
Energy 64%
Resource 14%
Education
Bachelors 10%
Doctorates 33%
Others 8%
Masters 49%
(2015.09.01)
Copyright 2015 ITRI 工業技術研究院
APEC-Daegu-13

ITRI's Energy R&D Strategies and Focus

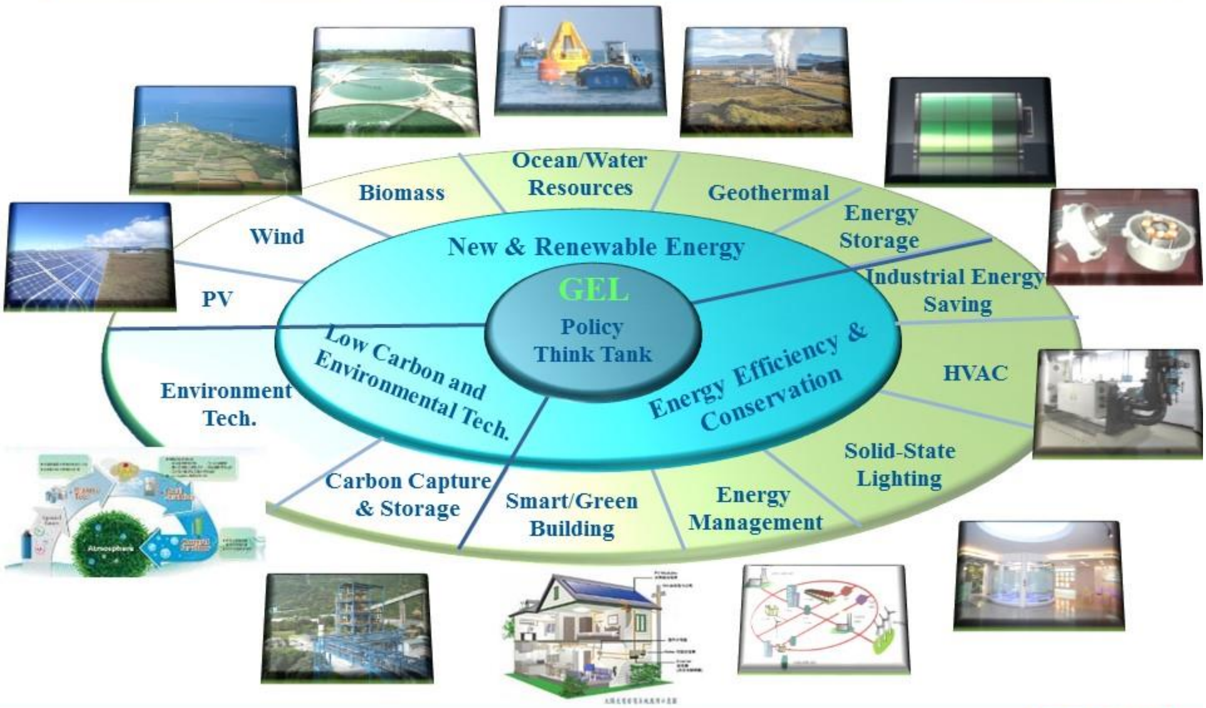
Strategies:

- **Provide energy policy and industry development support and recommendations based on industrial insight and robust economic models and analyses**
- **Emphasize on energy security and industrialization utilizing future application scenario methodologies**

R&D Focus:

- **New and Renewable Energy**
  - **Environmental friendly and low cost**
  - **Enhancing industry competitiveness**
- **Energy Efficiency & Conservation**
  - **Superior technologies and higher standards**
  - **Promoting incentives plans for broader adoption**
  - **Energy management**

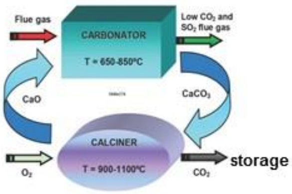
GEL's Research Fields

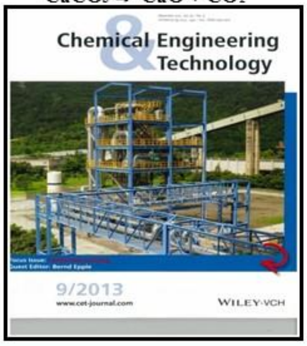


ITRI Industrial Technology Research Institute

R&D 100 Awards

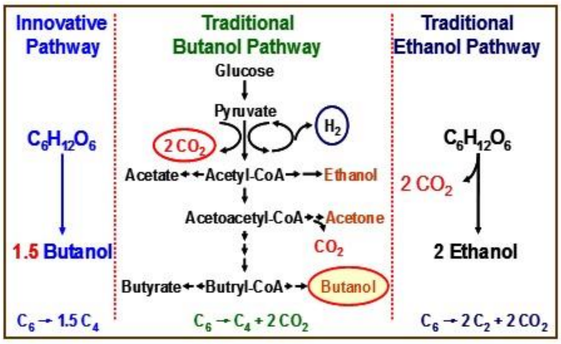
HECLOT — 2014 R&D 100 Winner



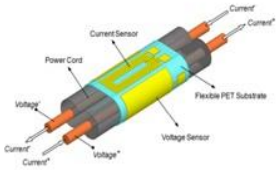


ButyFix — 2013 R&D 100

鼎唐能源科技 Green Cellulosity Corporation



AVA clamp — 2012 R&D 100

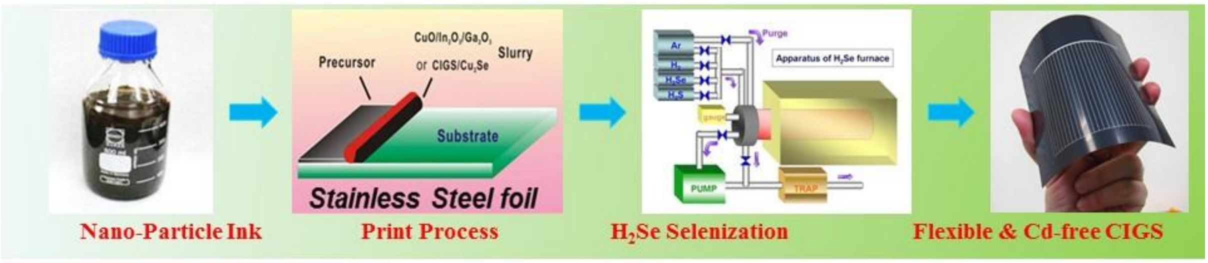


ITRI Industrial Technology Research Institute

PV Technology

CIGS Solar Cell

- Flexible non-vacuum Cd-free CIGS with 14.6% efficiency (η_{cell}=13.98%@200 cm^2 is world 1st) and 0.4 USD/Wp module cost, can lead PV industry to grid parity

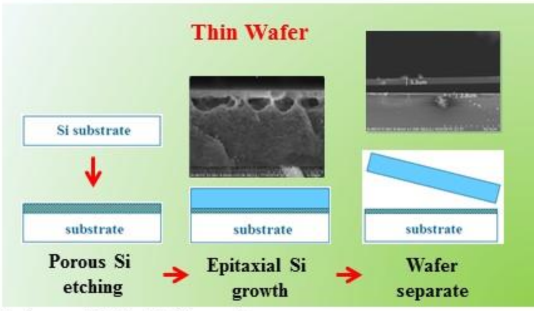


Thin Wafer Si Solar Cell

- Thin wafer Si solar cell (≦50um; from TCS to Wafer) halves the wafer cost (from 1USD to 0.5 USD)

New Structure & Material

- New structure & material (HIT, Perovskite)
- BOS Integration



BOS: Balance of System, HIT: Heterojunction with Intrinsic Thin layer, TCS: trichlorosilane

ITRI Industrial Technology Research Institute

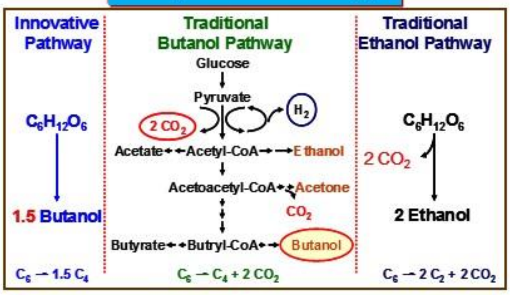
Bio Energy

ITRI R&D focuses

鼎唐能源科技 Green Cellulosity Corporation

- **ButyFix technology - Innovative carbon loss-free pathway**
  - 50% increase in feedstock utilization
  - Theoretical carbon yield is 100%
  - Spun-off Green Cellulosity Corporation
- **Eco cellulose hydrolysis technology**
  - Environmentally-friendly process conditions using ionic solution
  - Total sugars yield >90%
  - Processing time is about 1/16 of enzymatic hydrolysis process
- **Demo plant:**
  - ButyFix: 5,000L fermenter pilot verification completed
  - Eco cellulose hydrolysis: 1,000L pilot verification completed

ButyFix technology



Cellulose Hydrolysis Technology

	NREL	Arkenol	ITRI
Technology	enzymatic hydrolysis	strong acid	ionic solution
Corrosion	weak	strong	medium
Feedstock flexibility	less	more	more
Enzyme / catalyst recovery	no	yes	yes
Feed concentration (wt.%)	20	14.6	25
Reaction time (hr)	84	6	5
CO_2 emission (g/kg sugar)	612	500	334
Water consumption (kg/kg biomass)	4.26	19.9	2.2
Cost (US cent/kg)	23.46	33.03	16.05

ITRI Industrial Technology Research Institute

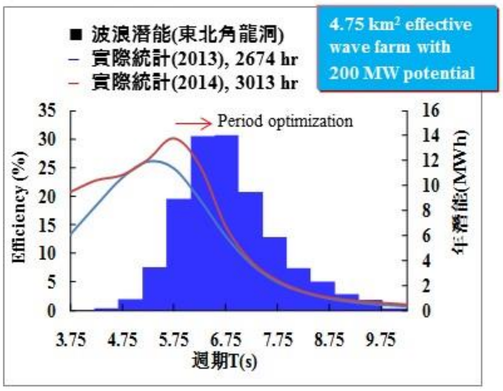
Ocean Energy

Key issues

- Effectively capture wave energy
- Long-term WEC reliability
- Underwater power transmission
- Marine engineering

ITRI R&D focuses

- High efficiency WEC
- System kinetic control and optimization
  - 3,000hr full load power generation, capacity factor > 33%
- Design and development of dynamic cable
- Offshore installation technology



WEC: Wave Energy Converter

Geothermal Technology

Key issues

- Highly acidic geothermal corrosion
- Best drilling sites and strategies
- Site scale geothermal potential assessment

ITRI R&D focuses

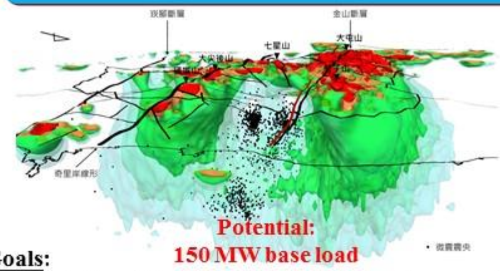
- Anticorrosion coating technology (ITRI south campus)
  - 50% cost reduction compared to TiO_2
- Time-lapse 3D fluid flow tomography technique
- Geothermal database and data fusion system

Thermal valley test: > 4000 hr

SS 304 without coating

SS 304 with coating

3D airborne inversion result combine with microseismic events



Goals:

- Analyzing distribution direction of underground hot dry rock
- Verifying geothermal resources

Waste Heat Utilization - ORC

ITRI R&D focuses

- **Subcritical ORC System:**
  - Large capacity turbine development
  - Demo units in operation
  - Levelized COE around 1 NTD/kWh
  - 1/2 -1/3 price compared with current products
- **Durability and long term test**

Manufacturers	Capacity (kW)	Price (USD/kW)
Tuboden(歐洲)	500	2,500
UTC(美國)	280	1,500
Tri-O-Gen(歐洲)	150	3,000
GE(美國)	125	3,000
Kobe (日本)	70	2,500
ElectraTherm(美國)	50	3,000
BEP(歐洲)	55	2,400
	250	1,750
Chinese Taipei	30~500	800~1,000

COE: Cost of Energy

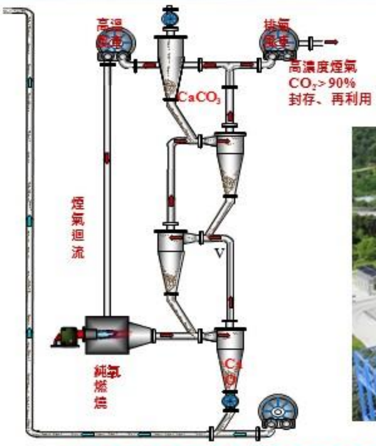
200kW screw ORC
(Formosa Chemicals & Fibre Corporation)
(500 hrs operation)

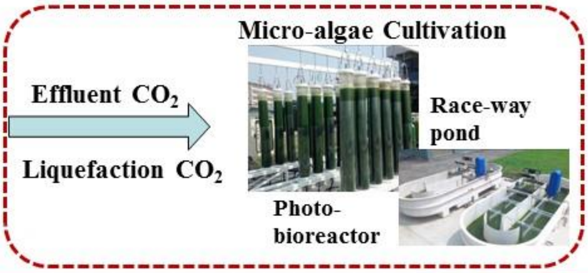
ORC price competitivity

Carbon Capture, Utilization & Storage

ITRI R&D focuses

- High-efficiency calcium looping technology (HECLOT) : advanced oxy-fuel calcination and CO_2 capture efficiency > 90%
- Engaging cement industry for synergy (1.9 MW pilot is operating)
- Zero adsorbent cost and low energy consumption reducing the capture cost from 45 USD to 26 USD per ton of CO_2
- The integration of carbon capture with industrial processes and CO_2 re-utilization to lower the capture cost and to create market incentives

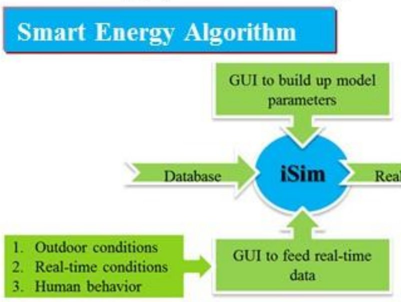




Smart Green Buildings

ITRI R&D focuses

- Integration of high insulation paint, renewable energy, smart grid & AMI, demand management & storage technologies
- Optimized energy control based on integrated information of the real-time environment, human activities, and electricity tariff
- From ITRI green campus demo to stores and shops with 6-10% electricity saving
- Hsinchu Science Park Hub gets EEWH-RN Diamond Certification and is the first case in HSP (Hsinchu Science Park)
- Apply the technologies to TPC & Hua-Nan Bank

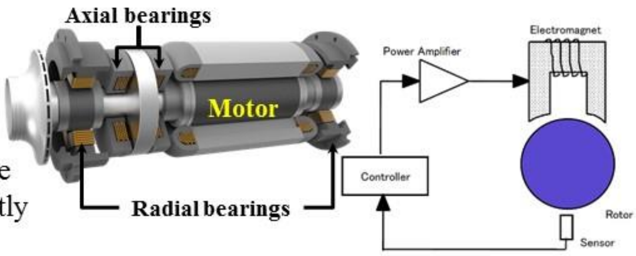


TPC: Taiwan power company
EEWH: Ecology, Energy Saving, Waste Reduction, Health

Active Magnetic Bearing Chiller

Benefits

- High efficiency (COP up to 6.5) and quiet (~70dB)!
- >25% energy saving potential
- Compared to conventional chillers, size (5.28: 1) and weight (4: 1) can be greatly reduced
- ROI < 5yrs



ITRI 180RT AMB

ITRI R&D focuses

- Unbalance force rejection control (UFRC) algorithm to reduced rotor displacement
- Higher efficiency variable speed AMB centrifugal chiller at partial-load
- Soft-switching control of IGBT power electronics

High Efficiency Lighting – LED Par38

ITRI R&D focuses

- **Develop high efficient (>90%) optics, drive circuit and heat dissipation technology**
- **Fixture efficiency reaches 80%, surpassing the US DOE 2020 target**

	Efficiency	ITRI 2012	DOE 2012 target		
			2013	2015	2020
Heat dissipation	86%	95%	87%	88%	90%
Drive circuit	85%	90%	87%	89%	92%
Optics	86%	94%	87%	89%	92%
Fixture	63%	80%	66%	69%	76%

90W Halogen lamp

- Replace halogen lamps
- 88% power consumption reduction

11W LED PAR38

- Replace commercially available LED lights
- 22% power consumption reduction

13.5W LED PAR38

ITRI Industrial Technology Research Institute

External Rotor Brushless DC Motor

Market-driven technology

- Rare earth magnet is controlled by China and the cost is unstable
- Key driver ICs are supplied by only few companies
- No world class BLDCM and driver suppliers in Chinese Taipei

Advantages

- Energy saving up to 70%, specially, under low speed applications
- Chinese Taipei first 32bits MCU and 100W IGBT. IC price is as low as $ 2USD
- Soft start (less vibrating)
- Much more thinner, lighter, and even quieter

ITRI Focus

Rare-earth magnet free BLDC motor

32 bits MCU (HV &LV IGBTs)

New company and new products

CHINASTEE 瑞智精密 RECHI SHARP SANYO 台灣三洋

: DynaRECHI 瑞智動能

BLDCM: blushless DC motor, MCU: Microcontroller Unit

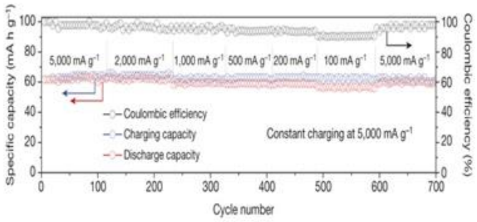
ITRI Industrial Technology Research Institute

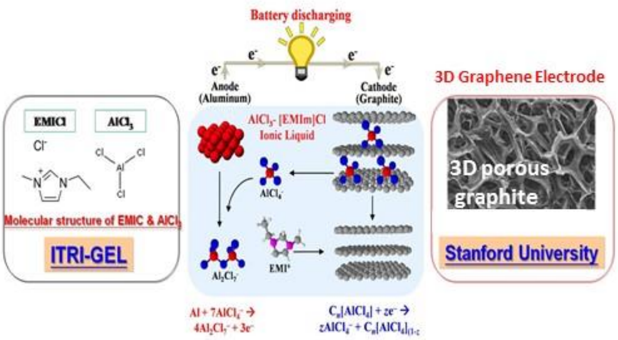
Innovative Al-ion Battery

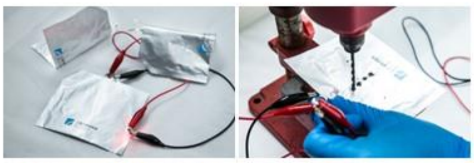
Published in Nature, Vol. 520, April 2015

Unique Feature

- Rechargeable aluminum-based batteries offer the possibilities of low cost and low flammability and high capacity
- High safety ionic liquid electrolyte (EMIC+$AlCl_3$)
- 3D porous graphite foam cathode (cooperated with Stanford University)
- Full Charge/discharge Cyclelife > 7,500
- Super Fast Charging: <1 min (70°C)



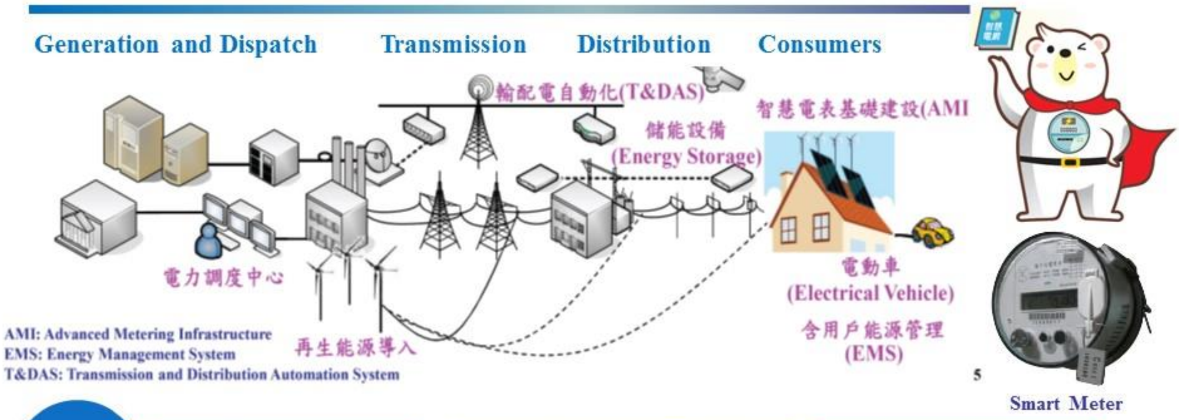




Thin and flexible Al-ion battery made from stable materials, even if drilling doesn't explode.

ITRI Industrial Technology Research Institute

Smart Grid Program



Schedule

- Demonstration (2011~2015)
- Promotion & Deployment (2016~2020)
- Overall Application (2021~2030)

Six Aspects

- Smart Generation and Dispatch
- Smart Transmission
- Smart Distribution
- Smart Consumers
- Development of Industries for Smart Grid
- Establishment of Environment for Smart Grid

ITRI Industrial Technology Research Institute

Virtual Power Plant

Key issues

- Growing power demand
- Higher penetration and intermittencies of renewable energy
- Local bottlenecks of power distribution

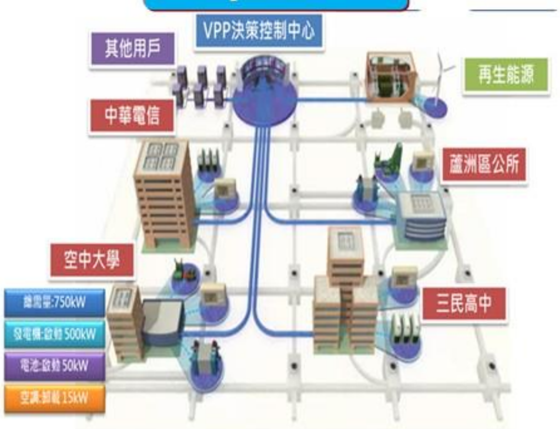
ITRI R&D focuses

- Dispatch algorithm to control distributed energy resources (DER) and load shedding

Pilot Site Test & Results

- Load shedding test in YS26 feeder line in Luchou substation, New Taipei City
- Precision short term load forecasting with 2.47% MAPE
- 0.2% peak-cut achieved by load shedding
- Future target: 1-2% peak-cut

Concept of VPP



Performance benchmark on day ahead short term load forecasting:

	NY ISO	ITRI	SCI Paper
MAPE (%)	3.55	2.47	2.84

MAPE : Mean Absolute Percentage Error

Concluding Remarks

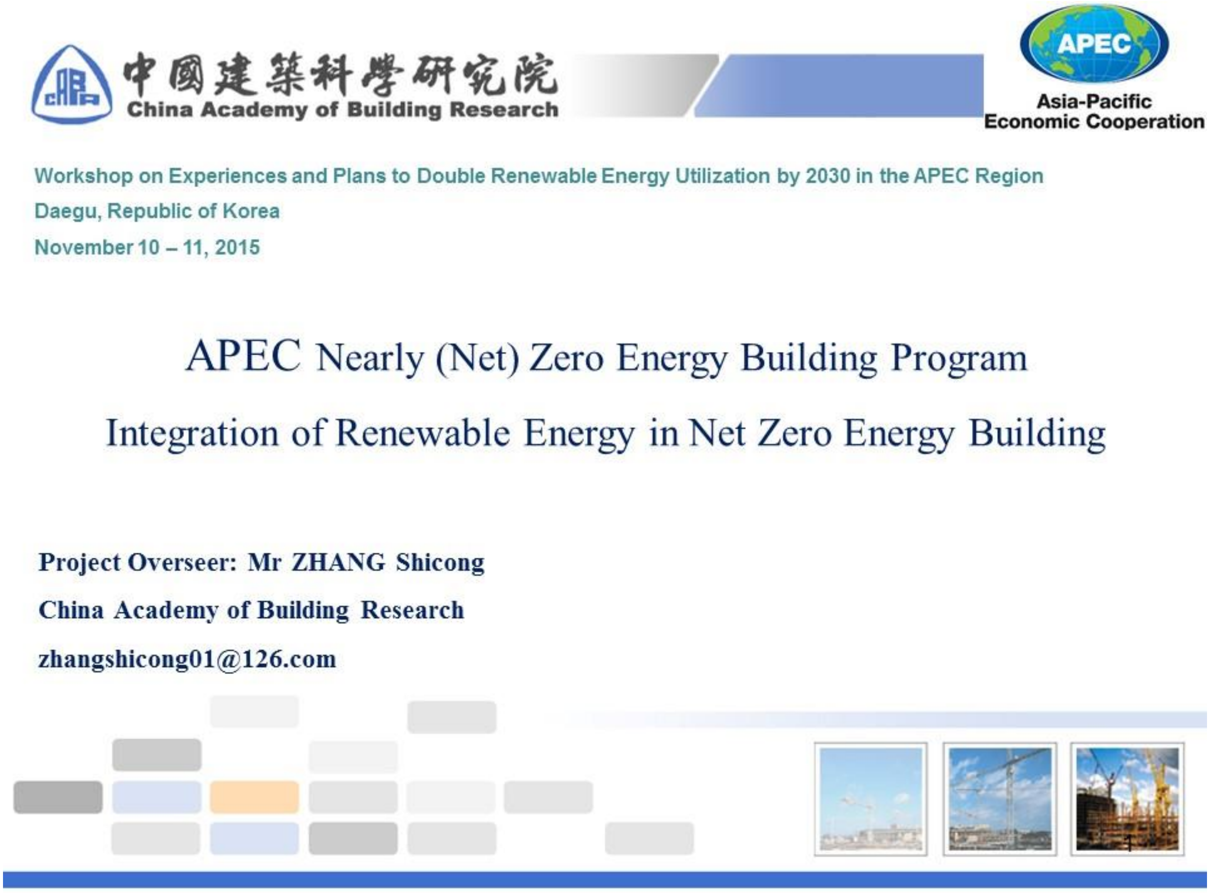
- In response to global climate change, Chinese Taipei has been continuously supporting energy research to provide:
  - Superior technologies, and
  - Promote green energy industry
- For green energy development, we strategically focuses on:
  - Renewable energy technologies
  - Higher energy efficiency equipment and standards
  - Intelligent energy management
- ITRI will keep on assisting MOEA to play significant roles on energy policy, technology development and industry promotion

 APEC-Daegu-30

THANK YOU FOR YOUR ATTENTION

3-1. Renewable Energy Utilization Towards Net Zero Energy Building

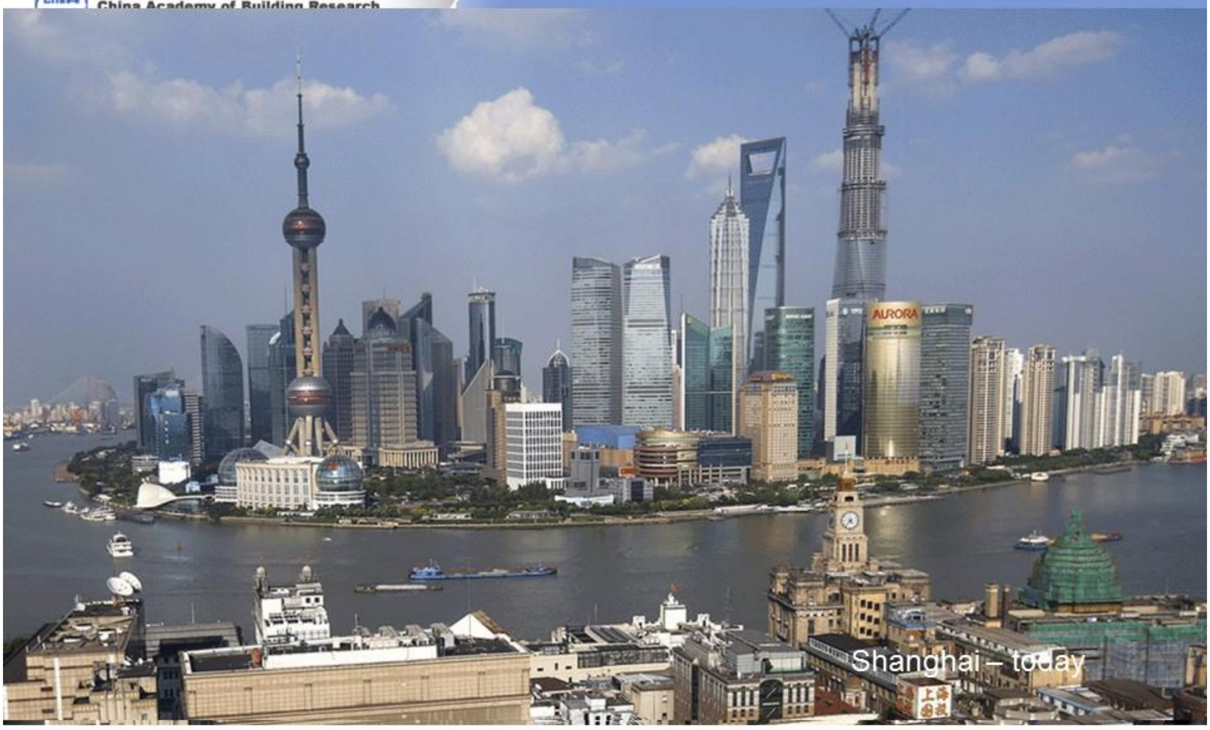
Shicong Zhang
Deputy Director
Research Center for Development Strategy, China Academy of Building Research, Peoples Republic of China



中國建築科學研究院
China Academy of Building Research

China Academy of Building Research

中國建築科學研究院
China Academy of Building Research



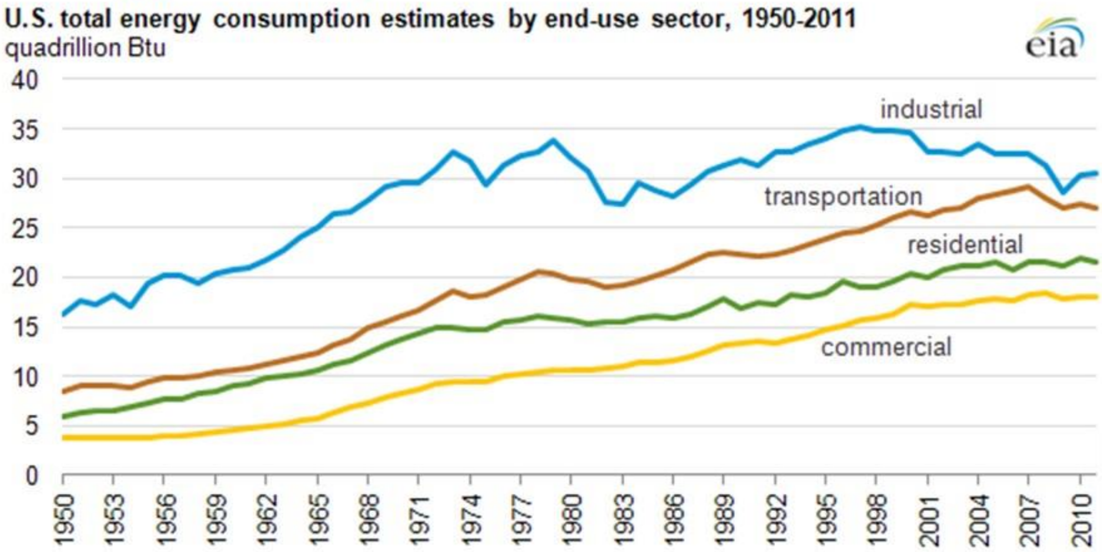
China Academy of Building Research

During the next two decades, over **80 billion m²** (900 billion ft²)

of new and rebuilt buildings

will be constructed in urban areas worldwide.

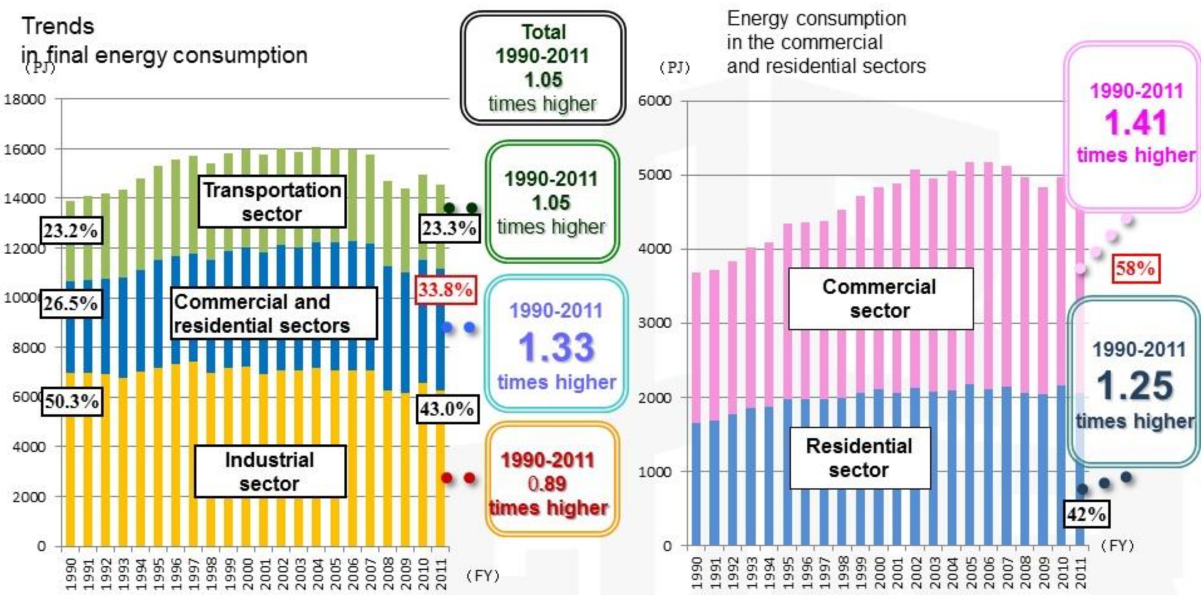
Energy consumption in the U.S.



Source: EIA

中國建築科學研究院
China Academy of Building Research

Transition of Final Energy Consumption
and energy consumption in Buildings



China Academy of Building Research 6

中國建築科學研究院
China Academy of Building Research

APEC Program-- Nearly (Net) Zero Energy Building

Project Background

（1）Policy: the federal government enacted the Executive Order 13514

- As of 2020, all planning for new Federal buildings requires design specifications that achieve Zero-Net-Energy use by 2030.
- Large government buildings have to start showing progress by 2015.

（2）Networks: Smart Net Zero Energy Buildings Strategic Research Network

- Researchers
- Industry
- Government

（3）Pilot Projects are booming.

China Academy of Building Research

APEC Program--Nearly (Net) Zero Energy Building

APEC- EWG – EGEEC - 41 XC

11-12 April 2013

North Star Continental Grand Hotel

Beijing, China

中國建築科學研究院
China Academy of Building Research

APEC Program-- Nearly (Net) Zero Energy Building

Proposing APEC economy: China

Co-sponsoring economies: Hong Kong-China, Singapore, Canada, Japan ,Thailand，New Zealand，USA.

Start date: July 2013

Completion date: December 2014

Total Budget: 204,400 USD. APEC funding:120,000USD, Self-funding:84,400

China Academy of Building Research

APEC Program-- Nearly (Net) Zero Energy Building

Focus Area:

- Net Zero Energy Building Definition and Policy
- Research Program outcomes and Technology roadmap
- Pilot projects among APEC economies.
- Related associations and alliances

中國建築科學研究院
China Academy of Building Research

APEC Program-- Nearly (Net) Zero Energy Building

APEC-Net Zero Energy Building workshop (Oct 2013 Beijing. China)

APEC-Net Zero Energy
Building Workshop
Beijing. China.
30-31,Oct,2013

China Academy of Building Research

APEC Program-- Nearly (Net) Zero Energy Building

.APEC-Net Zero Energy Building workshop (Oct 2013 Beijing. China)

Section 1: Policy & Overview

- China
- IEA-SHC-Task40
- US
- Canada

Section 2: Codes & Standard

- Japan
- Indonesia
- China

Section 3: Technologies

- US
- Canada
- Korea
- China

Participating economies:

- Chile
- Mexico
- Peru
- HK-China
- Indonesia
- Malaysia
- Thailand

APEC Program-- Nearly (Net) Zero Energy Building

APEC-Net Zero Energy Building workshop (Oct 2014 Beijing. China)

APEC-Net Zero Energy Building Workshop

Beijing. China.

22-23, Oct, 2014

中國建築科學研究院
China Academy of Building Research

APEC Program-- Nearly (Net) Zero Energy Building

APEC-Net Zero Energy Building workshop (Oct 2014 Beijing. China)

Section 1: Policy & Overview

- Canada
- China
- Japan
- Korea
- US

Section 2: Definition & Key Technologies

- Canada
- China
- Japan
- Korea
- US

Section 3: Pilot project

- Canada
- China
- Korea
- US (2)

Participating economies:

- HK-China
- Japan
- Russia
- Thailand
- US

EGEEC Delegates:

- Brunei Darussalam
- Australia
- Canada
- China
- HK-China
- Japan
- New Zealand
- Russian
- Thailand
- The Philippines
- USA

China Academy of Building Research

中國建築科學研究院
China Academy of Building Research

	Speaker Participants	Economy Delegates & Experts	Invited NGO	Total
2013 workshop	USA, China, Japan, Korea, Indonesia, Canada 6 Economies:13 Experts	HK-China, Mexico, Peru, Indonesia, Chile, Thailand, Malaysia 7 Economies：9 Experts	IFC, UNDP, World Bank, WWF	13 Economies 60 Experts
2014 workshop	USA, China, Japan, Korea, Canada 5 Economies:15 Experts	HK-China, Thailand, Indonesia, Russia, USA, New Zealand, Australia, The Philippines, Brunei Darussalam, Taiwan-China 11 Economies：20 Experts	IFC, UNDP, World Bank, WWF, APERC, ICA 7 Organizations	15 Economies 80 Experts

China Academy of Building Research 15

JAPAN

- Building Research Institute
- Nikken Sekkei Research Institute
- Nagoya University
- National Institute for Land and Infrastructure Management

PARTNERS

CANADA

- NSERC Smart Net-zero Energy Buildings Strategic Research Network
- Concordia Centre for Zero Energy Building Studies
- Carleton University
- S2E Technology

CHINA

- Ministry of Housing and Urban-Rural Development
- National Energy Administration
- China Academy of Building Research

KOREA

- Ministry of Land, Infrastructure and Transport
- Korea Institute of Civil Engineering and Building Technology
- Kongju National University

USA

- Architecture 2030
- Energy Foundation
- Lawrence Berkeley National Laboratory
- Sustainable Energy Partnerships
- The Bullitt Foundation

中國建築科學研究院
China Academy of Building Research

APEC Program--Nearly (Net) Zero Energy Building

POLICY: APEC Economies Progress – Korea – National Goal

Reducing 26.9 % of GHG Emission in Building Sector until 2020

APEC Program-- - Nearly (Net) Zero Energy Building

POLICY: APEC Economies Progress -- USA

- **US federal NZE, High Performance Green Buildings, Executive Order 13514**

-- -- At least 15% of existing federal buildings and leases meet Energy Efficiency Guiding Principles by 2015

-- A goal of 100% of all new federal buildings achieving NZE by 2030

-- As of 2020, all planning for new Federal buildings requires design specifications that achieve Zero-Net-Energy use by 2030.

President Obama issued on October 5, 2009

中國建築科學研究院
China Academy of Building Research

California goals and stakeholder

- **California's goals**

-- 100% of new commercial buildings are ZNE/NZE by 2030

-- 50% of existing commercial buildings are ZNE/NZE by 2030

-- 100% of new residential buildings are ZNE/NZE by 2020

Source: The California Efficiency Strategic Plan (Sep 2008)
californiaenergyefficiency.com/docs/EEStrategicPlan.pdf

- **Key Stakeholder**

-- California air resource board (CARB)

-- California Energy Commission (CEC)

-- California Public Utilities Commission (CPUC)

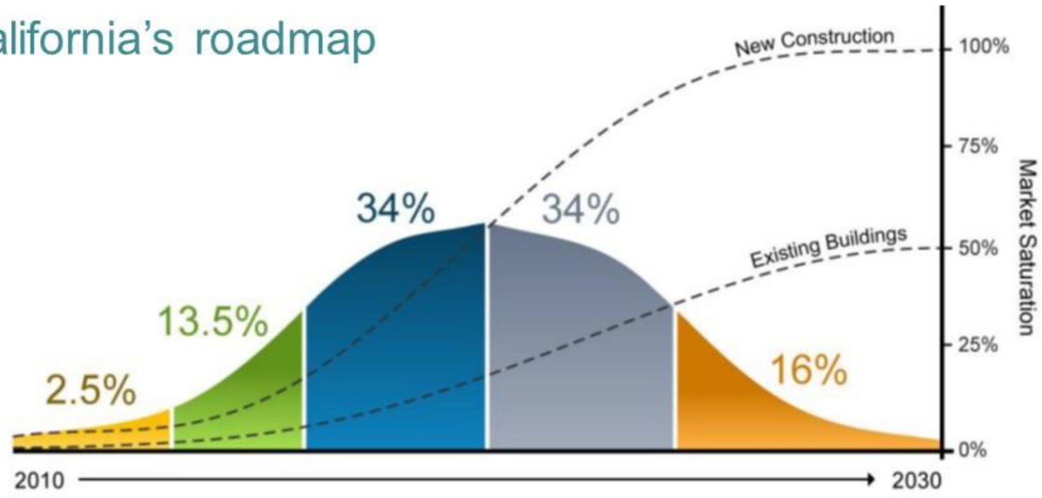
-- Cal EPA

-- Utilities (PG&E, SCE, SDGE)

-- California Independent operator (CAISO)

中國建築科學研究院 China Academy of Building Research

California's roadmap



Innovators
1-4/1-5: Innovative Finance Tools & Incentives

Early Adopters
1-3: Path to Zero/ZNE Pilots
1-6: Integrated Design
2-6: Existing Building Finance Tools
2-8: Plug Loads

Early Majority
2-1: Lead by Example
2-4: Benchmarking
2-5: Business case
2-7: Integrated Energy Management

Late Majority
2-2: Codes for Existing Buildings

Laggards
1-1: ZNE Codes
1-2: T24 and T20
2-3: Code Compliance

China Academy of Building Research 20

中國建築科學研究院 China Academy of Building Research

APEC Program--Nearly (Net) Zero Energy Building

RESEARCH: APEC Economies Progress – Canada

NSERC Smart Net Zero Energy Buildings Strategic Research Network

Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
Integrated solar and HVAC systems for buildings	Active building envelope systems and passive solar technologies	Mid-to long-term thermal storage for buildings and communities	Smart building operating strategies	Technology transfer, design tools and input to national policy

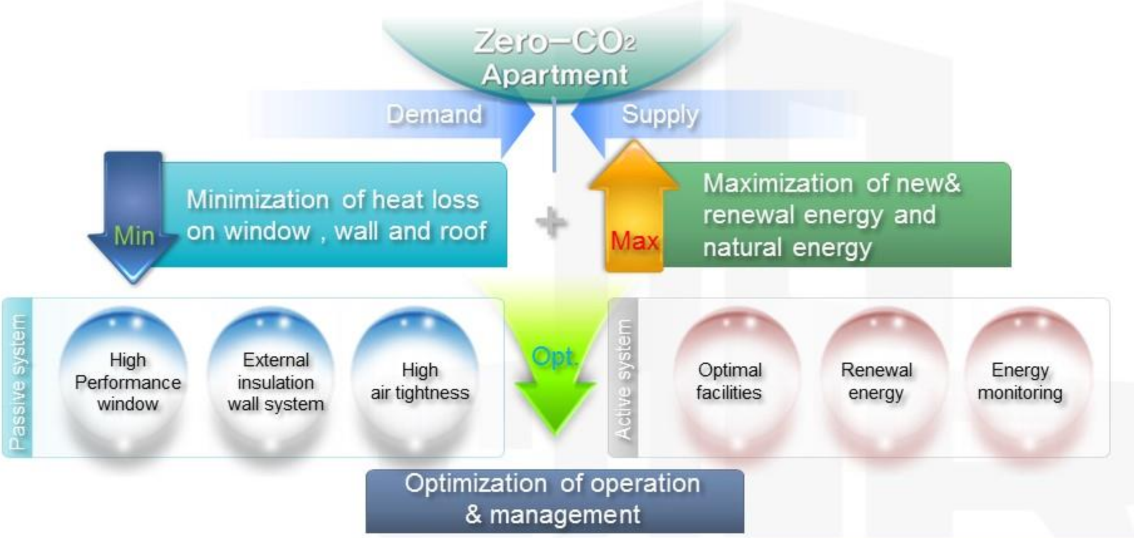
- 15 Canadian Universities
- Partners: NRCan, utilities, CMHC, building industry, PV industry, controls
- Build partnerships across industry sectors and disciplines

China Academy of Building Research 21

中國建築科學研究院
China Academy of Building Research

Objectives of the Research

Nearly Zero carbon emission house through minimization of heat loss on building envelope maximization of new & renewal energy, and optimization of operation & management



中國建築科學研究院
China Academy of Building Research

Ministry of Economy Trade and Industry

■Workshop on Realization and Popularization of ZEB

【ＺＥＢに至る様々な省エネ技術とその省エネ量】

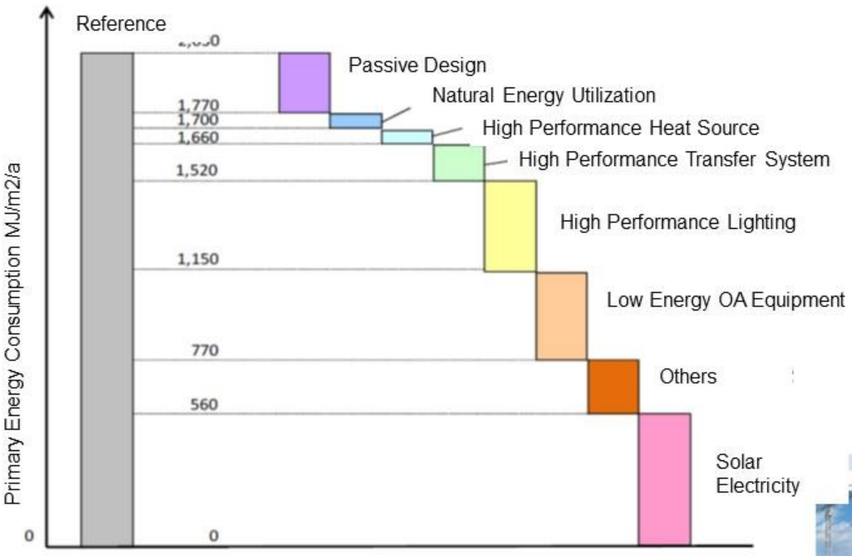


Fig. Primal energy saving for each technology to realize ZEB

APEC Program--Nearly (Net) Zero Energy Building

BUILDING CODES: APEC Economies Progress – JAPAN

Japan-Energy Efficiency Standard for Residential Building :

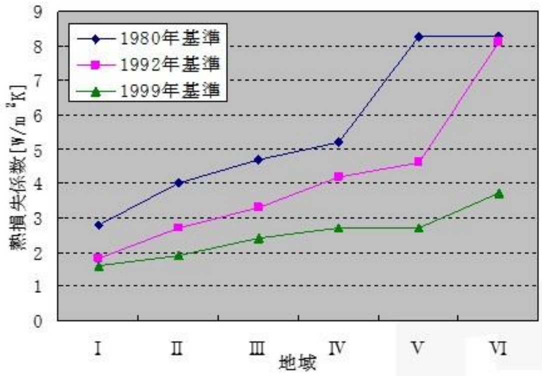
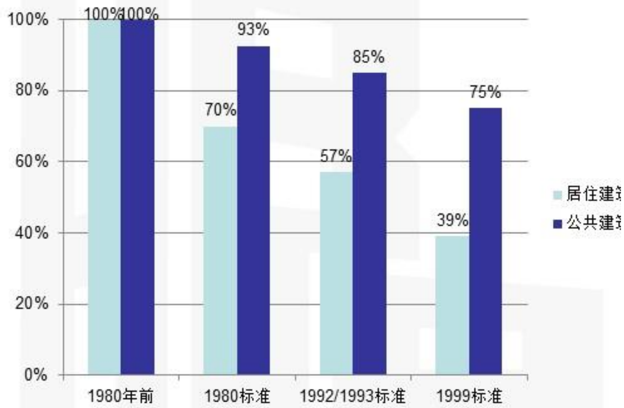


Fig. Standard value of heat loss coefficient for houses



APEC Program--Nearly (Net) Zero Energy Building

NETWORK : APEC Economies Progress – Canada

APEC Program--Nearly (Net) Zero Energy Building

NETWORK & ALLIANCES: APEC Economies Progress – China

China Nearly Zero Energy Building Alliance

中國建築科學研究院 China Academy of Building Research

APEC Program--Nearly (Net) Zero Energy Building

Program Conclusion:

- (1) Policy and Objective

With regards to energy self-sufficiency, environment protection and pressure of climate change, some APEC economies had already issued policies and set up clear and aggressive long-term goals for NZEB.

Economy	Department	Year	Policy	Objective
Japan	MLIT,METI,MOE	2008	Action plan of ZEH and ZEB	Realizing ZEH and ZEB on average for all new buildings by 2030
Korea	MLIT and other 7 Ministry	2014	The Activation Plan of ZEB Corresponding to Climate Change	All new buildings are mandatory design to achieve NZE by 2025
The United States	Federal government	2007	Executive Order 13514	Buildings that enter the planning process in 2020 must be designed to achieve NZE by 2030
	Department of Energy	2007	Energy Independence and Security Act	Marketable NZEH by 2020; Commercial NZEB at low incremental cost by 2025

Program Conclusion:

(2) Definition

The zero energy definition determines how to design and operate buildings to achieve the zero energy targets. It is also related to the government policies and incentives. Potentially, some definitions with similar content among APEC economies need to harmonize in the future.

Economy	Definition
Canada	Net zero energy housing, net zero energy building, A net-zero energy (NZE) home, A net-zero energy ready (NZER) home, A net-zero energy verified (NZEV) home
China	Nearly Zero Energy Building
Japan	Net Zero Energy Building, Zero-Energy Housing
Korea	Zero Energy Building: Low-rise Zero Energy Building, High-rise Zero Energy Building, Zero Energy Building Town
The United States	Zero-Net-Energy (site or source) Building, Net-Zero Energy (cost or emission) Building, Net Zero Energy Home, Energy Free Home

中國建築科學研究院
China Academy of Building Research
APEC Program--Nearly (Net) Zero Energy Building

Program Conclusion:

(3) Building codes and standards

Building codes and standards are the most fundamental and effective measures to promote NZEB development. Energy codes and standards play a vital role by setting minimum requirements for energy-efficient design and construction. Since 1970s to now, the building energy codes already make 50%-70% energy savings and still have a 70%-90% energy saving potential in the future. ASHRAE 90.1 and Title 24 of California in the United States have already set up goals to move to NZE step by step till 2020 and 2030.

APEC Program--Nearly (Net) Zero Energy Building

Program Conclusion:

(4) NGOs

•Major institutes, societies and alliances have all established NZE or similar targets, most of them are more stringent than the federal (national) goal

Economy	Goal by institutes, societies and alliances
Canada	SNEBRN：facilitate widespread adoption of NZEB in Canada by 2030
China	Nearly Zero Energy Building Alliance: 30-30-30
The United States	AIA: carbon neutral buildings by 2030; ASHRAE: Vision 2020- net zero energy usage for all types of facilities by 2020

中國建築科學研究院
China Academy of Building Research

APEC Program--Nearly (Net) Zero Energy Building

Program Conclusion:

(5) Obstacle &Barriers.

- **Long term NZEB target** together with a clear near objective is needed in some economies.
- Significant funding is still needed for the **technology research and building codes upgrading** to support NZEBs become widespread by 2030.
- **Incremental cost** needs to be balanced from the government subsidy in the near future and from technology promotion, industry growth and **marketization** in the long term view.
- **Best practice projects** needs more attention to show the direct energy reduction result and verify the latest research achievements, which is the most effective way to call the interest of officers and experts to expand the project influence.

APEC Program--Nearly (Net) Zero Energy Building

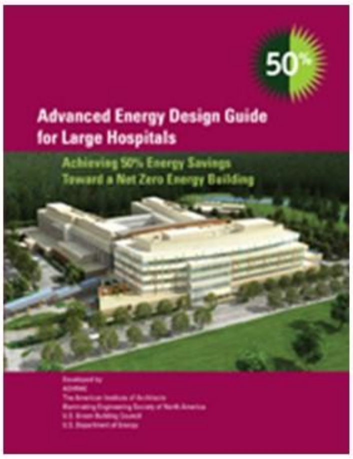
Nearly (Net) Zero Energy Building

PUBLICATION NUMBER	APEC#214-RE-01.19
YEAR	2014
PUBLISHED DATE	December 2014
TYPE OF PUBLICATION	Reports
PUBLICATIONS UNDER	Energy Working Group (EWG)
PAGES	248
ACCESSED	2391

Here's the URL: http://publications.apec.org/publication-detail.php?pub_id=1595

APEC Program--Nearly (Net) Zero Energy Building

Program Impact: China NZEB Guideline



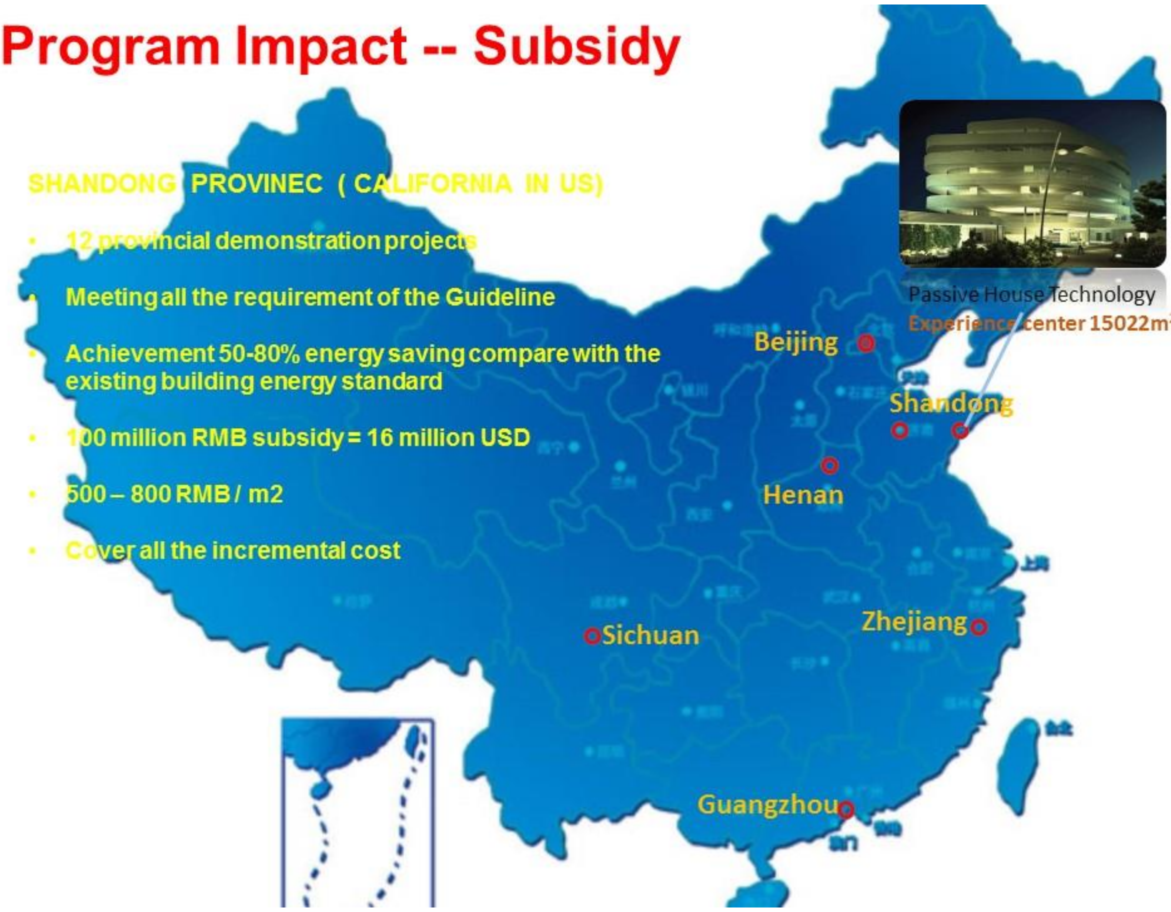

被动式超低能耗绿色建筑技术导则
（居住建筑）
2015年3月

34

Program Impact -- Subsidy

SHANDONG PROVINEC（CALIFORNIA IN US)

- 12 provincial demonstration projects
- Meeting all the requirement of the Guideline
- Achievement 50-80% energy saving compare with the existing building energy standard
- 100 million RMB subsidy = 16 million USD
- 500 – 800 RMB / m2
- Cover all the incremental cost



APEC Nearly (Net) Zero Energy Building Program Phase II

"One building off by itself has zero impact on the world's climate, but a building that is influential and begins to change the way that architects, engineers, contractors, developers and financial institutions shape the built environment, that's a building that was worth building."

- Denis Hayes, President, CEO, Bullitt Foundation

Founder of Earth Day

Coordinator for the First Earth Day in 1970. Founded the Earth Day Network that was expanded to more than 180 nations.

EWG 02-2015A: NZEB Best Practices and Energy Reduction Results Comparative Study

Project Background

- 25th APEC Ministers Meeting and 21st APEC Economic Leaders' Declaration, to reduce APEC's aggregate energy intensity by 45 percent by 2035, using 2005 as a base year.
- Building energy consumption takes 30% to 40% of total primary energy in APEC economies and has a fast increasing trend in the developing economies due to the urbanization rate increase and living standard improvement.
- **Successful demonstration projects are the most powerful way to promote NZEB in building sector.** Successful demonstration projects could achieve 75%-90% energy reduction compared with the ordinary building.

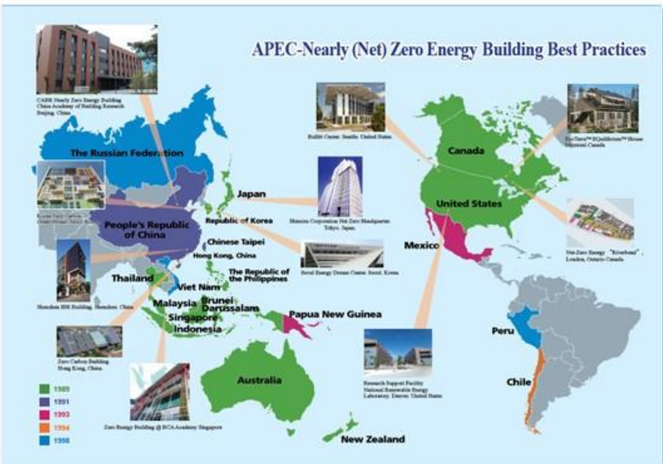
● Program Objective

- Carry out professional in-depth comparative research with the detail information collected of best practices of NZEB pilot buildings among APEC economies, to showcase how tremendous energy savings could be achieved by integrated design, advanced technology utilization and NZE oriented management & commissioning in buildings.
- To prepare a report <APEC Nearly (Net) Zero Energy Building Best Practices>, as a guidebook of NZEB design to support of NZEB development and marketization in APEC regions.
- Accelerate the NZEB technologies, systems, and equipment trading among APEC economies.

● Program Content

(1) Best Practice collection and comparison

- Building Basic Information
- Climate Zone
- Energy Reduction Goal
- Specific technology
- Design VS operation
- Metrics



(2) Two workshops

(3) Information analysis

● Work plan

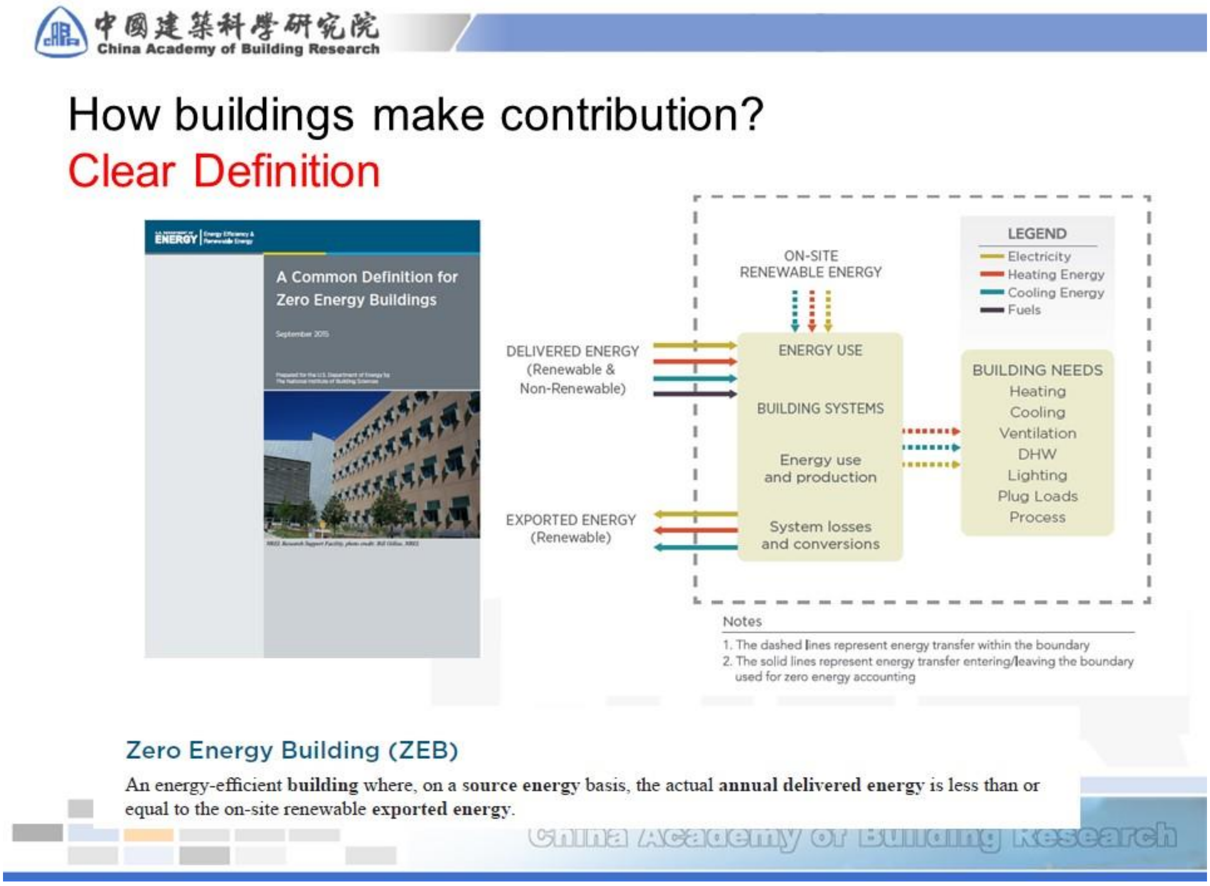
June 2015	Step 1: Project planning and expert group establishment
July 2015	Step 2: Investigate existing NZEB demonstration collecting forms and establish APEC NZEB best practices information collection template
August 2015	Step 3: 1st Workshop: NZEB Case Studies, Best Practices, Policies Education Issues & Enabling Technologies Location: Montreal, Canada
September 2015-March 2016	Step 4: Collection information of NZEB demonstration projects
April 2016	Step 5: 2^{nd} workshop preparation
May 2016	Step 6: 2^{nd} workshop: NZEB Best Practice in Tropical Areas Location: Chinese Taipei
June-November 2016	Step 7: Final report

● Implementation Status

Workshop: NZEB Case Studies, Best Practices, Policies and Education Issues & Communities and Enabling Technologies

- Aug 20-21 Montreal, Canada.
- Local organizer: Concordia University. Centre for Zero Energy Building Studies.
- 95 Participants, 4 keynote speeches and 35 presentations
- 11 APEC invited speakers and 5 economy delegates (Chile, Thailand, China, Mexico, Indonesia)

● Montreal Workshop



How buildings make contribution?

Definitions

In addition to establishing a definition for ZEB, shown below, it was clear that definitions were needed to accommodate the collections of buildings where renewable energy resources were shared. To meet this need, the team provided variations on the ZEB definition. The bold text represents key terms that are further addressed in the nomenclature and guidelines.

Zero Energy Building (ZEB)

An energy-efficient **building** where, on a **source energy** basis, the actual **annual delivered energy** is less than or equal to the on-site renewable **exported energy**.

Zero Energy Campus

An energy-efficient **campus** where, on a **source energy** basis, the actual **annual delivered energy** is less than or equal to the on-site renewable **exported energy**.

Zero Energy Portfolio

An energy-efficient **portfolio** where, on a **source energy** basis, the actual **annual delivered energy** is less than or equal to the on-site renewable **exported energy**.

Zero Energy Community

An energy-efficient **community** where, on a **source energy** basis, the actual **annual delivered energy** is less than or equal to the on-site renewable **exported energy**.

How buildings make contribution?

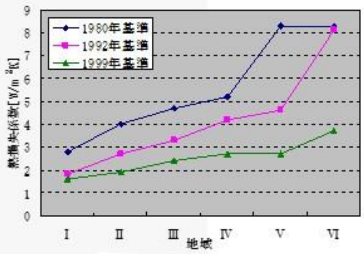
Renewable energy technology goes into building codes

Photovoltaics

Solar Water Heating

Solar Vent Air Preheat

Ground Source Heat Pump



Standard value of heat loss coefficient for houses

中國建築科學研究院
China Academy of Building Research

How buildings make contribution?

Advanced Technologies and demonstration

BIPV as multi-functional building component:

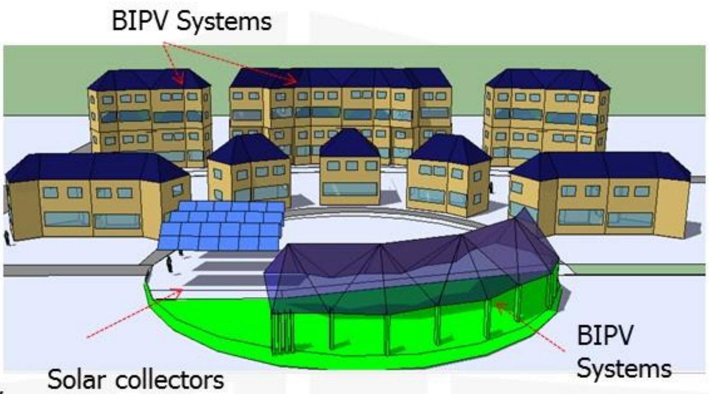
- -electricity generation
- -shading devices
- -weather protection
- -noise protection
- -thermal insulation
- -daylighting controls

中國建築科學研究院
China Academy of Building Research

How buildings make contribution?

Towards Net-zero Energy Community

NREL Research Support Facility



Electricity generation 85%-110% of the total energy use of the neighborhood

Design: C. Hachem

How buildings make contribution?

Towards Renewable Energy City

- ZHANGJIAKOU in HEBEI Province
- 2022 The winter Olympics in Beijing and Zhangjiakou
- By 2020, 55% of the electricity will come from renewable energy; 100% of the public transportation, 40% of the residential building energy and 50% of the commercial building energy will come from renewable energy; 40% of the industry will achieve zero carbon.

中國建築科學研究院
China Academy of Building Research

Conclusion

- With the 80%-90% energy reduction, building are becoming easier to achieve NZE if integrated with Renewable energy, but we needs Definition, Codes & Standards.
- Leadership in advanced technologies and demonstrations.
- Look at the community and city level

China Academy of Building Research

COP Paris
巴黎联合国气候大会

- Buildings Day 建筑日
- Cities Day 城市日
- “How to get to zero emissions” forum 如何达到零碳排论坛

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

中國建築科學研究院
China Academy of Building Research

Thank you

Contact:

Mr ZHANG SHICONG

China Academy of Building Research

86-10-84270181

zhangshicong01@126.com

3-2. The Future of Solar Energy

Dave Renne
President
International Solar Energy Society (ISES), Germany

The Future of Solar Energy

Dave Renné
President, International Solar Energy Society
Dave Renné Renewables, LLC
Boulder, Colorado USA
drenne@mac.com

Presented at the
Workshop on Experiences and Plans to Double Renewable Energy Utilization by 2030 in the APEC Region
Daegu, South Korea

9 November 2015

ISES
International Solar Energy Society

Outline

- The Climate Challenge
- The Response – The Growth of the Solar Industry
- What the Future Holds: Prices drop and markets expand
- Technical Challenges

The Climate Challenge

~2000 $GtCO_2$ emitted since 1750 (~1/2 of this in past 40 years); leading to +0.85 ^0C since 1850

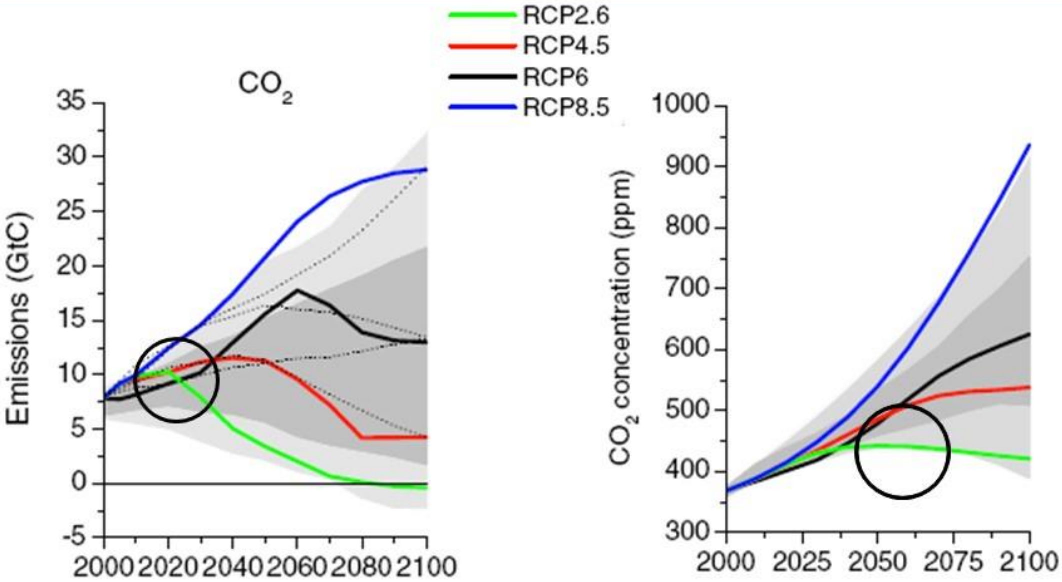
To stabilize climate change at today's level by 2100, cumulative CO_2 emissions must not exceed ~1000 $GtC0_2$ between now and 2100

However…emission rates are *increasing* (currently ~30 $GtCO_2$/yr)

The *listed reserves* of top 100 fossil companies = 745 $GtCO_2$

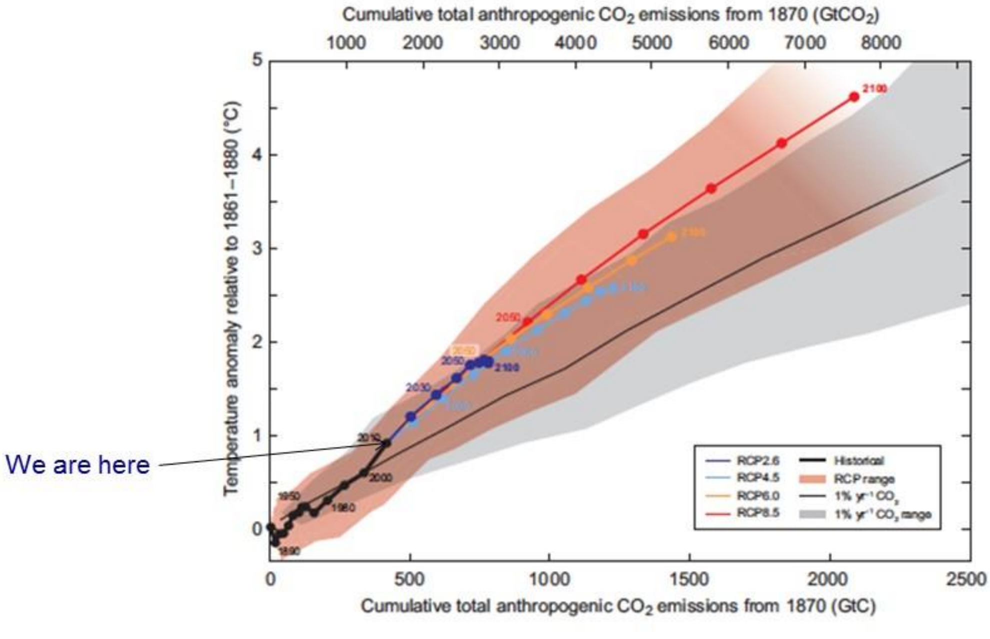
…and current carbon-burning infrastructure alone can use up these listed reserves.

IPCC Representative Concentration Pathway (RCP) Scenarios

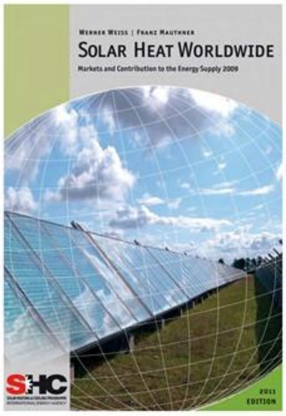


RCP 2.6 is our best opportunity to limit global warming to <2.0 ^{0}C in the long term

Where will we be by 2100?



A Response - the Growth of the Solar Industry



APEC Workshop: 9 November 2015

Est. Global PV Capacity by end 2015

~ 200 GW

Approx. 1% of global electricity supply

APEC Workshop: 9 November 2015

Central Station PV

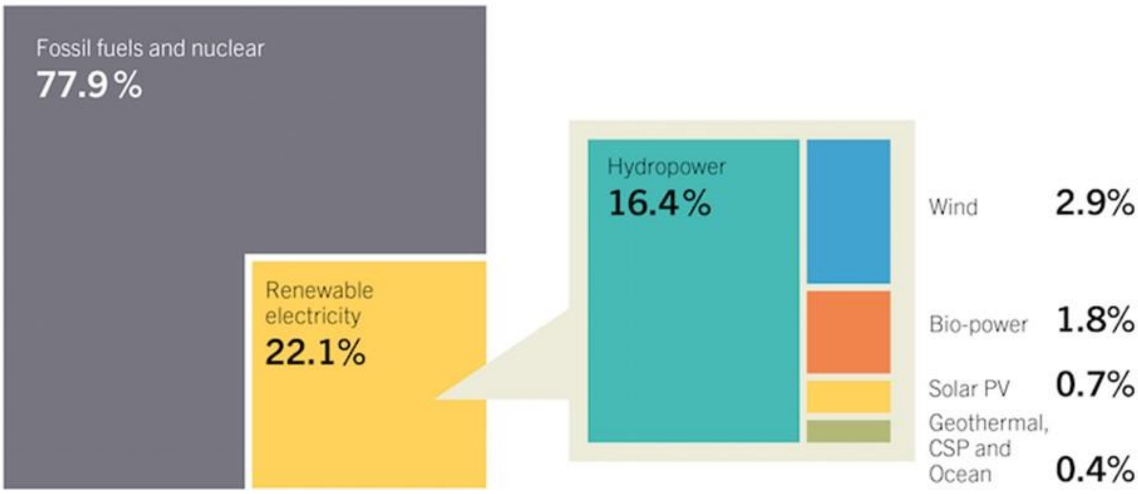
By 2015…at least 70 >50 MW systems worldwide

At least 17 came on-line in 2014 and early 2015

…but Rural, Off-Grid and Distributed PV also continue to grow

APEC Workshop: 9 November 2015

RE Share of Global Electricity Production

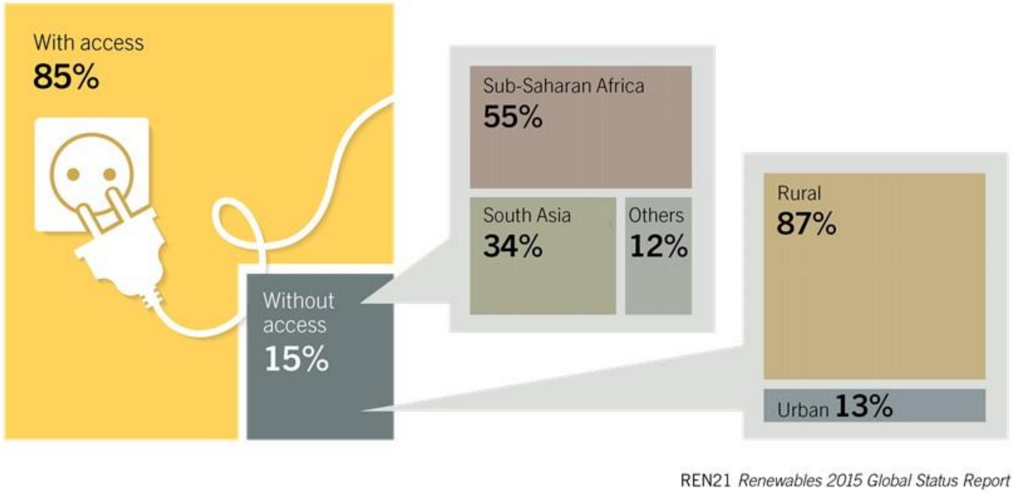


Source: REN-21 2014 Global Status Report

APEC Workshop: 9 November 2015

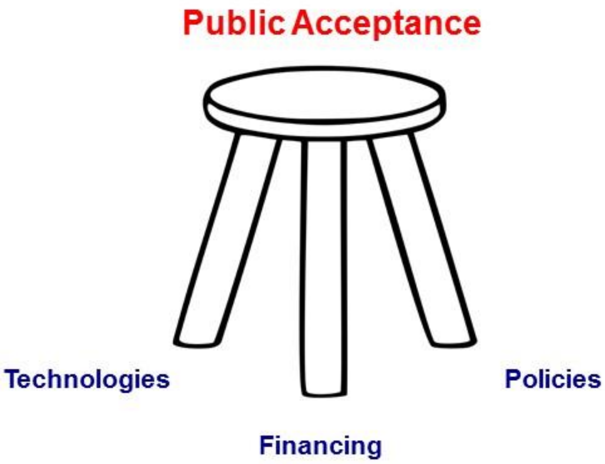
Status of Electricity Access

World Electricity Access and Lack of Access by Region, 2012



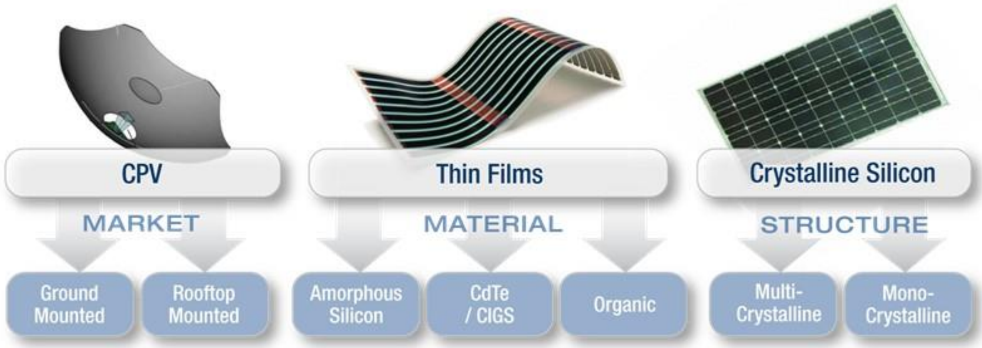
Source: REN21 Global Status Report 2015, Figure 35

Successful Technology Growth



ISES International Solar Energy Society

PV Technologies



Production in 2013…

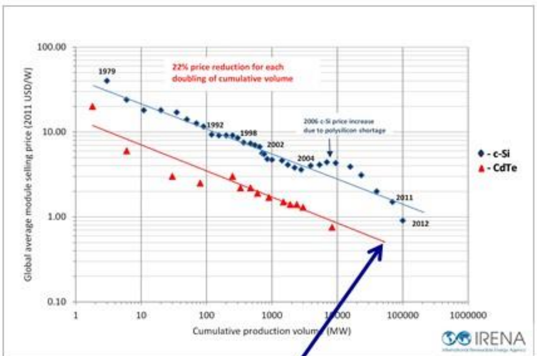
<0.2 GW | 4.9 GW | 47 GW

APEC Workshop: 9 November 2015

ISES International Solar Energy Society

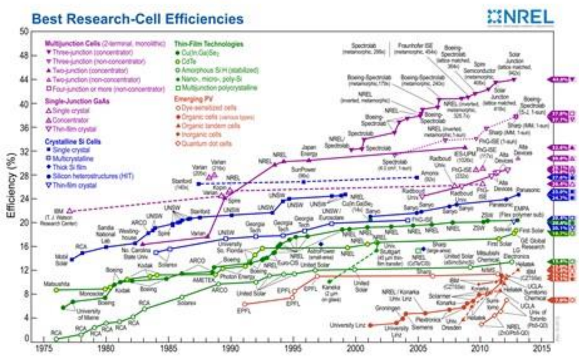
The Growth of Solar…

~22% Module Learning Curve



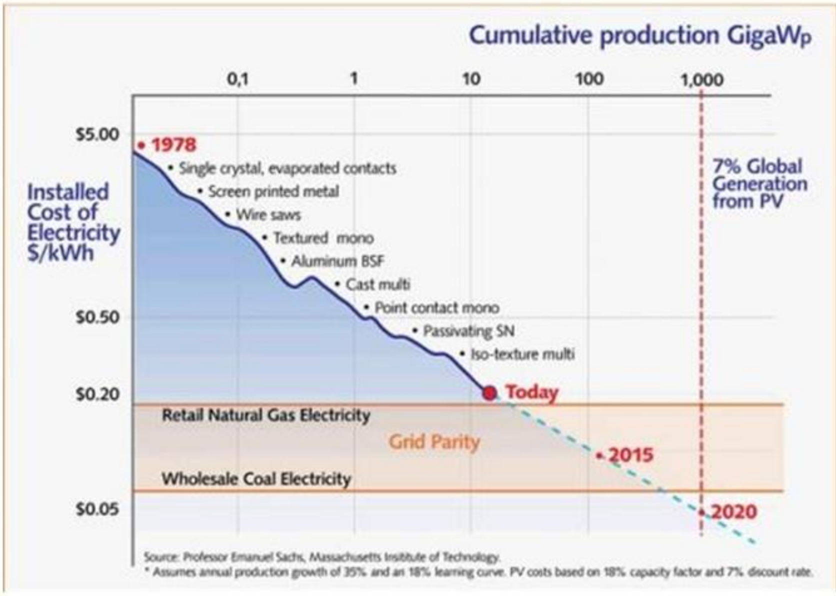
$0.50/Watt U.S. SunShot Goal

Cell efficiencies are improving



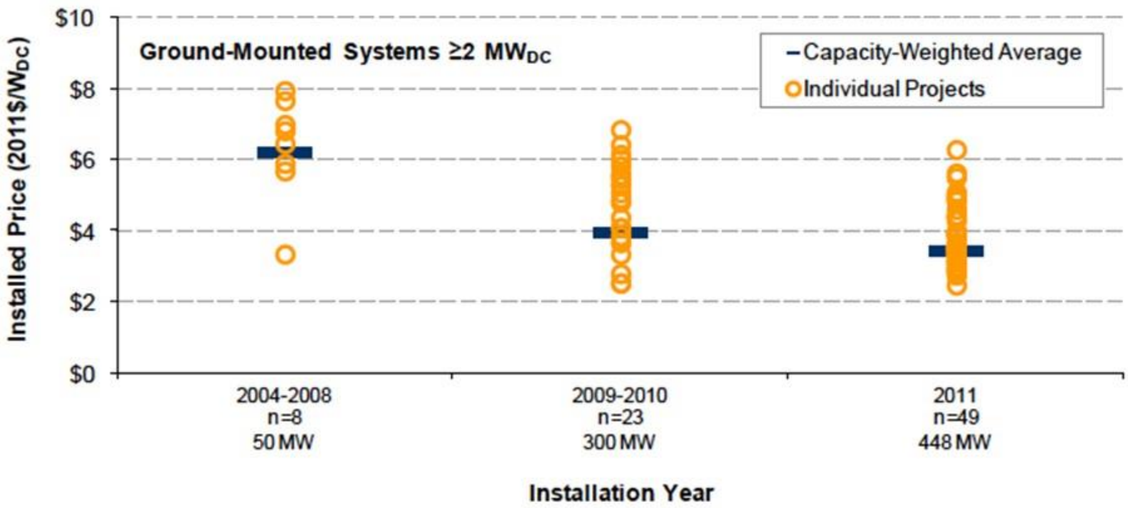
APEC Workshop: 9 November 2015

…is Leading to Grid Parity



Source: MIT

Utility Scale Prices are also Dropping



Source: NREL Publication #56776, Nov. 2012

Growth in Other Solar Technologies Significant

Solar Thermal capacity in 2013: 374.7 GW_{th}

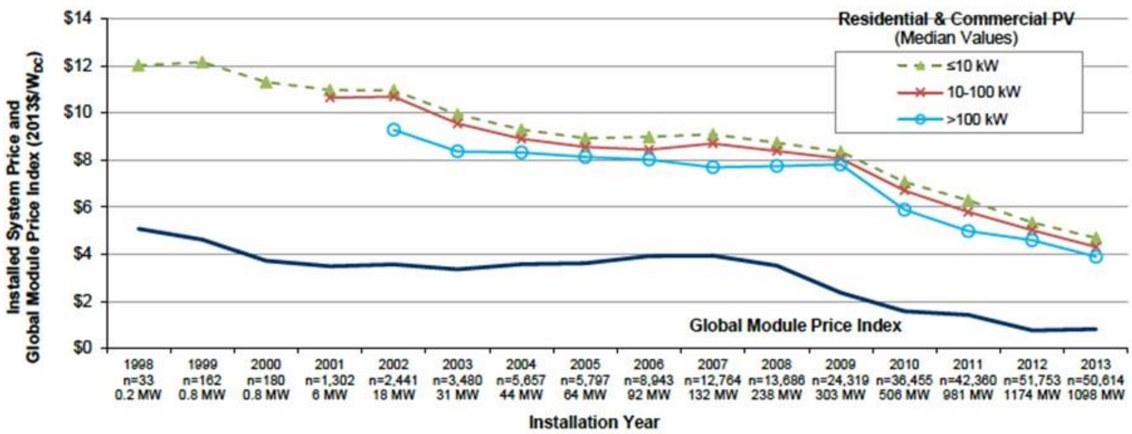
Solar Heat Worldwide, 2015

CSP capacity estimates, 2014: ~4.4 GW (up from 1.1 GW in 2010)

REN-21 2015 Global Status Report

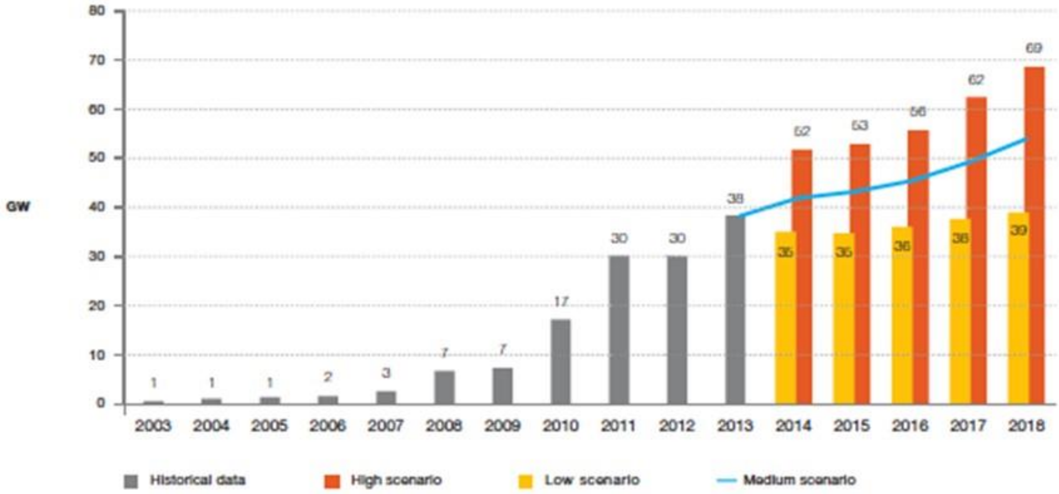
Photo Credits: NREL

The Future: Prices Drop and Markets Expand



Source: LBNL, SunShot Initiative Report, 2014

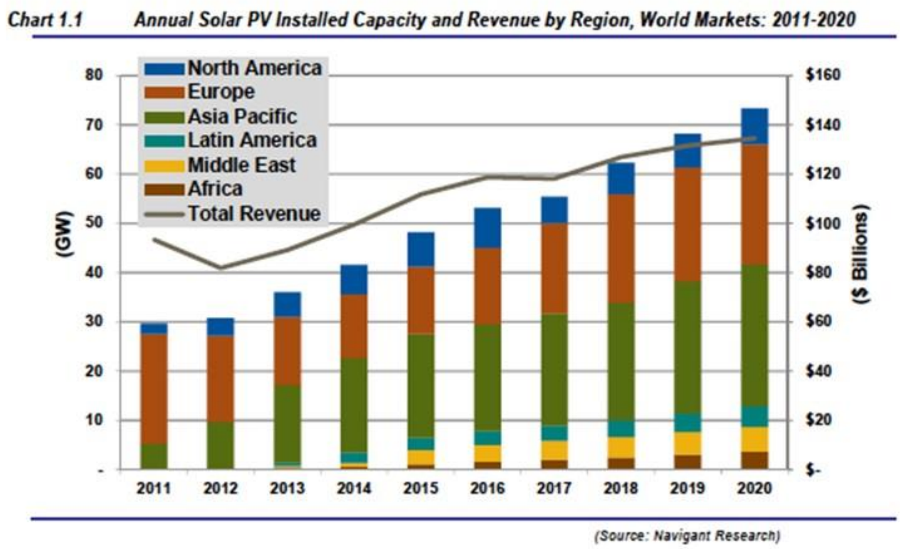
PV Capacity Projections to 2018



Projections are 321 to 430 GW Cumulative PV by 2018

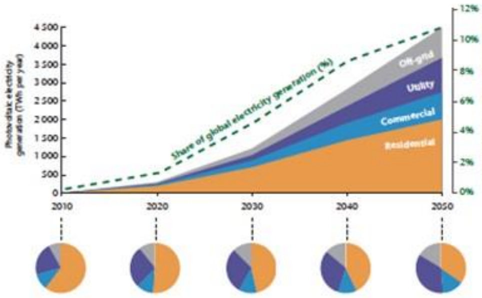
Source: EPIA 2014

Navigant Projections to 2020

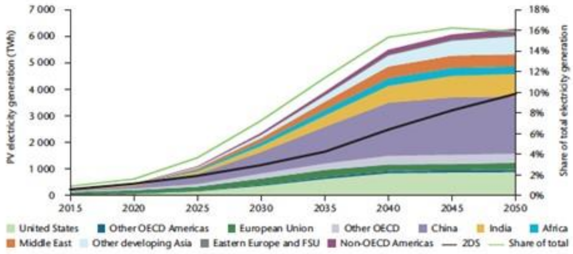


IEA's PV Roadmap Projections to 2050

Source: IEA PV Roadmap, 2010 and 2014



2010: ~11% of total electricity supply by 2050

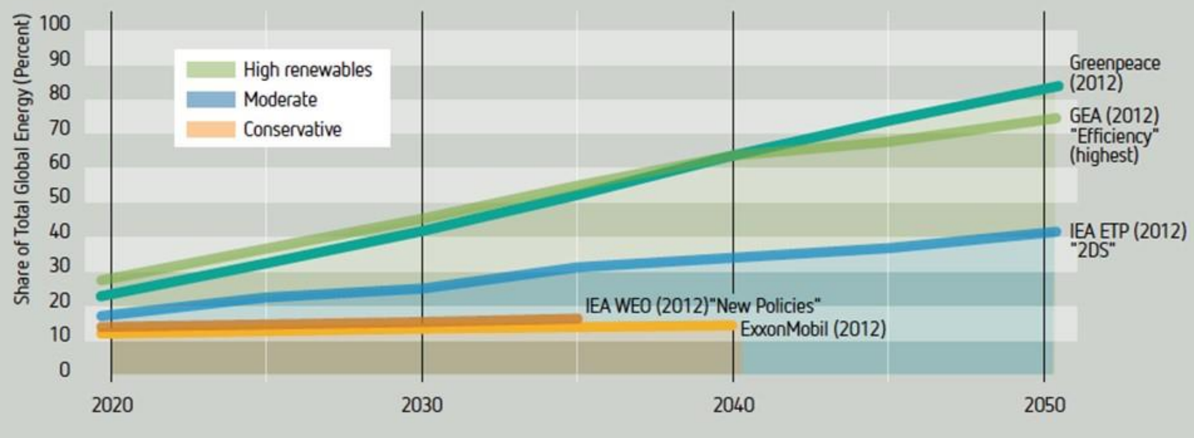


2014: ~16% of total electricity supply by 2050

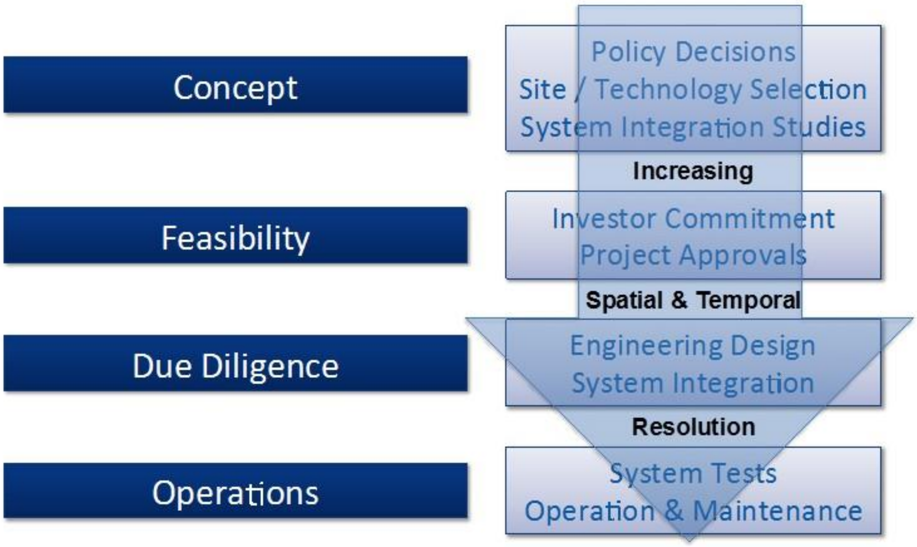
Note: Shift from residential to large-scale PV over time

REN 21 Global Futures Report Summarizes Several Scenario Analyses

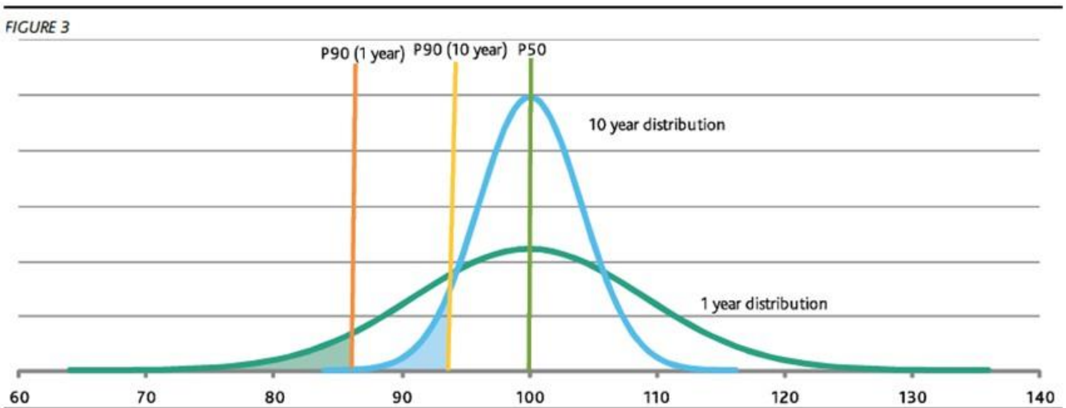
Figure 1: Conservative, Moderate, and High-Renewables Scenarios to 2050



Creating “Bankable” Projects



Reducing data uncertainty reduces finance risk



Source: Moody’s Investors Services, July 28, 2010

Summary Points

- Yes, we can 100% RENEWABLES !
- Solar energy has achieved commercial success, but must now become a mainstream energy source.
  - Good policies will reduce risk and uncertainty
  - Continued technology R&D will improve efficiencies and reduce costs
  - Capital is available…bankability will improve its access
  - Workforce is needed to support the growth of these technologies
- Price Drops, Expanded RE targets, low-cost storage, management of the demand side, utility acceptance, will all be Game Changers!

APEC Workshop: 9 November 2015

Thank You!

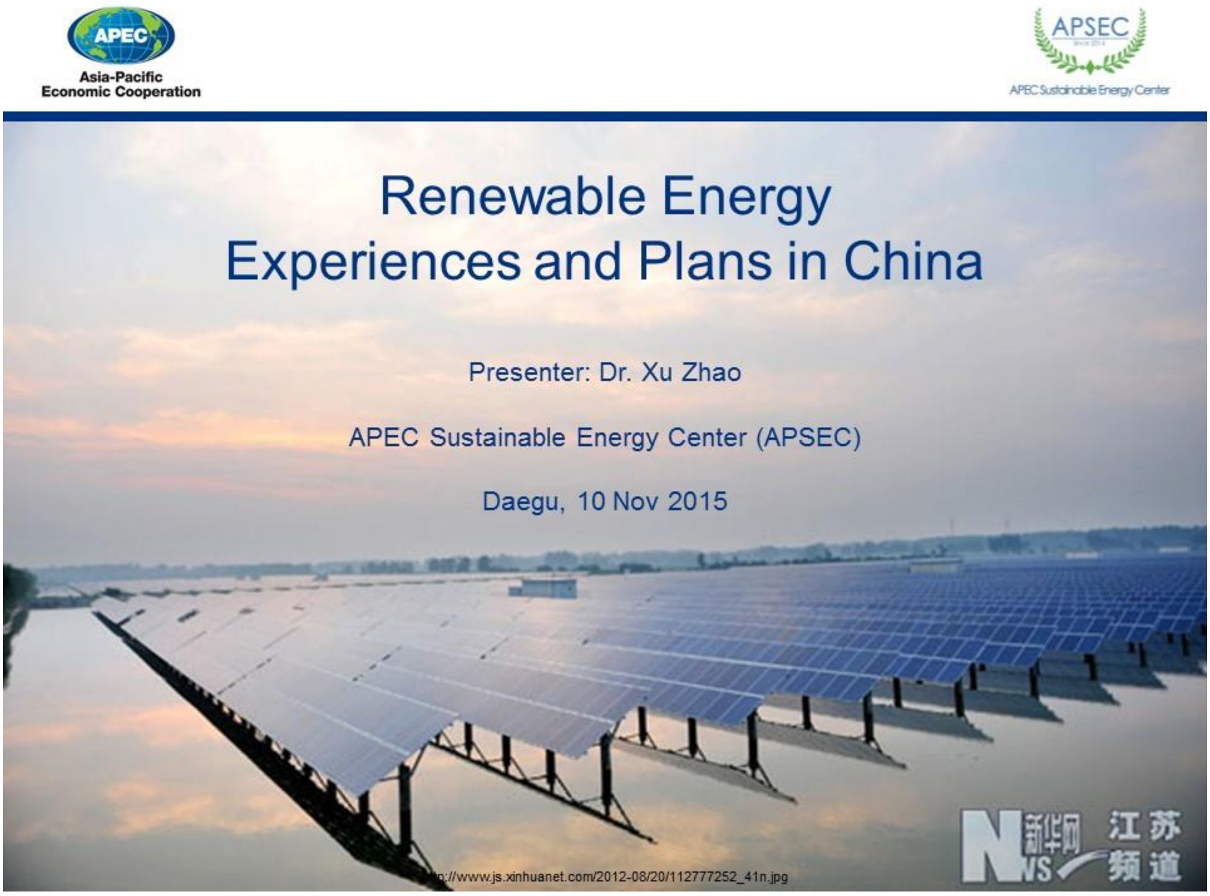
Dave Renné
drenne@mac.com

APEC Workshop: 9 November 2015

4-1. Renewable Energy Experiences and Plans in China

Xu Zhao

Asia Pacific Sustainable Energy Research Center (APSEC), China



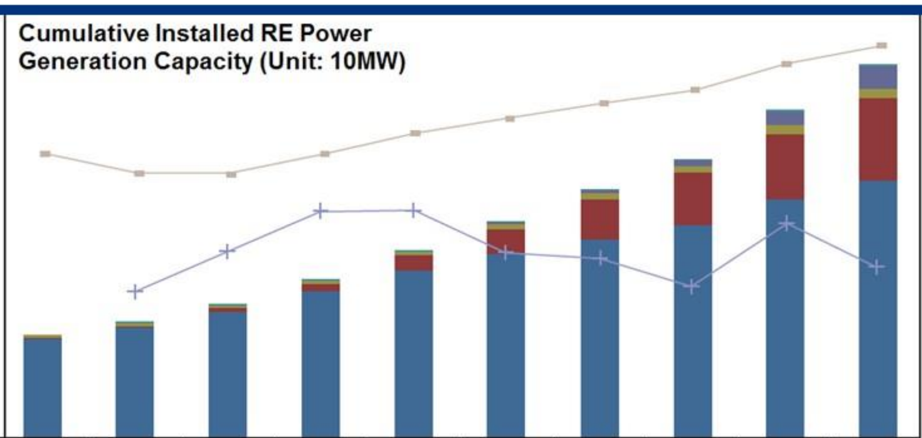
Experiences

- Timeline of installed RE power/electricity capacity (2005-2014)
- Timeline of RE power generation (2005-2014)
- Share of RE/non-fossil in energy consumption (2010-2014)

Plans

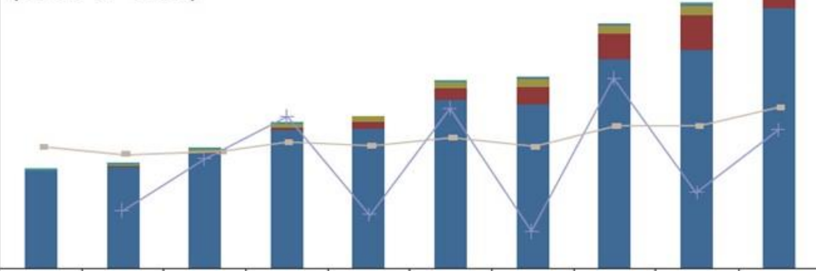
- China's RE target
- Highlights of Energy Development Strategy Action Plan (2014-2020)
- Plans on achieving the "15% by 2020" target

The key reference & Thanks.



Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Geothermal & Ocean	2.5	2.5	2.5	2.81	2.81	2.81	3.02	3.02	3	3
Solar PV (on-grid)	7	8	10.1	14	28.4	86.4	293	650	1745	2805
Biomass	200	250	300	327	460	550	700	770	868	948
Wind (on-grid)	106	207	420	839	1760	2950	4623	6142	7656	9637
Hydro	11739	13029	14823	17260	19629	21606	23298	24947	27975	30183
Total	12055	13497	15556	18443	21880	25202	28917	32512	38247	43576
Annual Growth Rate (%)		12.0	15.3	18.6	18.6	15.2	14.7	12.4	17.6	13.9
Percentage of the Total Capacity (%)	23.3	23.3	21.7	23.3	25.0	26.1	27.4	28.5	30.6	32.1

RE Power Generation
(Unit: 10^8 kWh)



Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Geothermal & Ocean	1	1	1	1	1	1.46	1.46	1.46	1.50	1.50
Solar PV (on-grid)	0.42	0.48	0.61	0.84	1.70	5.18	17.60	41	85	250
Biomass	52	70	97	147	207	248	315	315	383	416
Wind (on-grid)	16	28	57	114	249	490	715	1028	1393	1534
Hydro	3964	4149	4714	5655	5717	6867	6681	8540	8906	10643
Total	4033	4247	4870	5918	6176	7611	7730	9925	10769	12845
Annual Growth Rate (%)		5.3	14.7	21.5	4.4	23.2	1.6	28.4	8.5	19.3
Percentage of the Total Power Generation (%)	16.1	14.9	14.9	17.1	16.8	18.0	16.4	20.0	20.1	23.2

Asia-Pacific Economic Cooperation

APEC Sustainable Energy Center

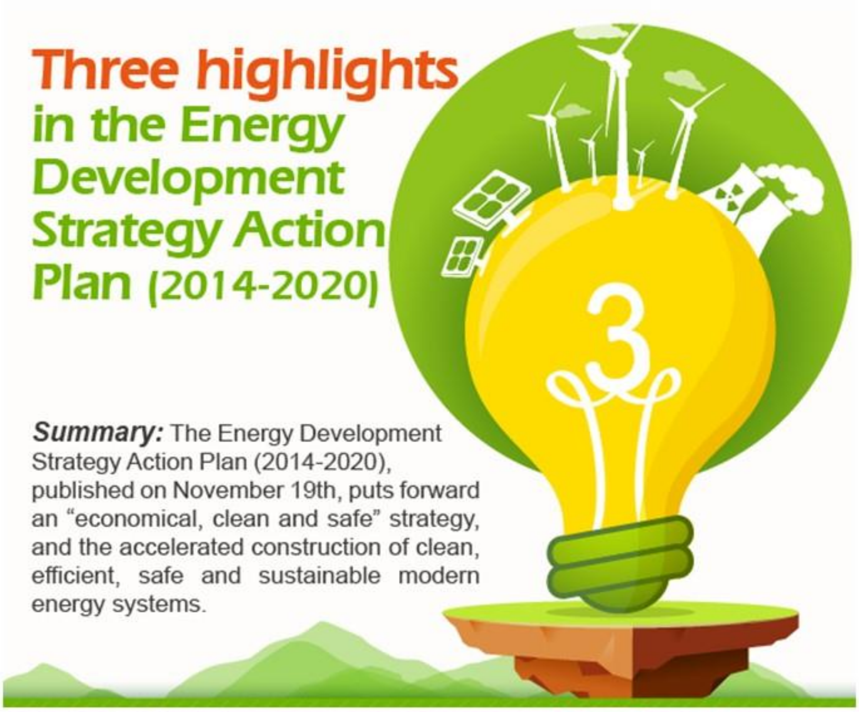
Unit: 100Mtce

Year	2010	2011	2012	2013	2014
RE Power	2.529	2.537	3.219	3.449	4.077
Hydro	2.287	2.198	2.776	2.859	3.384
Wind	0.163	0.235	0.334	0.447	0.488
Biomass	0.077	0.097	0.096	0.115	0.125
Solar	0.002	0.006	0.013	0.027	0.080
Geothermal & Ocean	0.000	0.000	0.000	0.000	0.000
Nuclear Power	0.233	0.269	0.300	0.336	0.396
Biogas	0.102	0.111	0.112	0.112	0.112
RE Heating	0.301	0.358	0.405	0.465	0.509
Biofuels	0.039	0.041	0.056	0.055	0.055
Total Energy Consumption	36.065	38.704	40.214	41.691	42.600
Total of RE (i.e. RE Power, Biogas, RE heating & Biofuels)	2.971	3.047	3.793	4.081	4.753
Total of Non-Fossil Energy (i.e. the above Total of RE + Nuclear Power)	3.204	3.315	4.093	4.417	5.150
Ratio of Non-Fossil Energy to Total Energy Consumption	8.79%	8.46%	10.05%	10.4%	11.9%

China aims to raise the share of non-fossil (dominantly renewables) energy in primary energy consumption to

- 10% by 2010[1]
- 11.4% by 2015[2]
- 15% by 2020[1,4,5]
- 20% by 2030[3,5] (i.e. to achieve the "doubling")

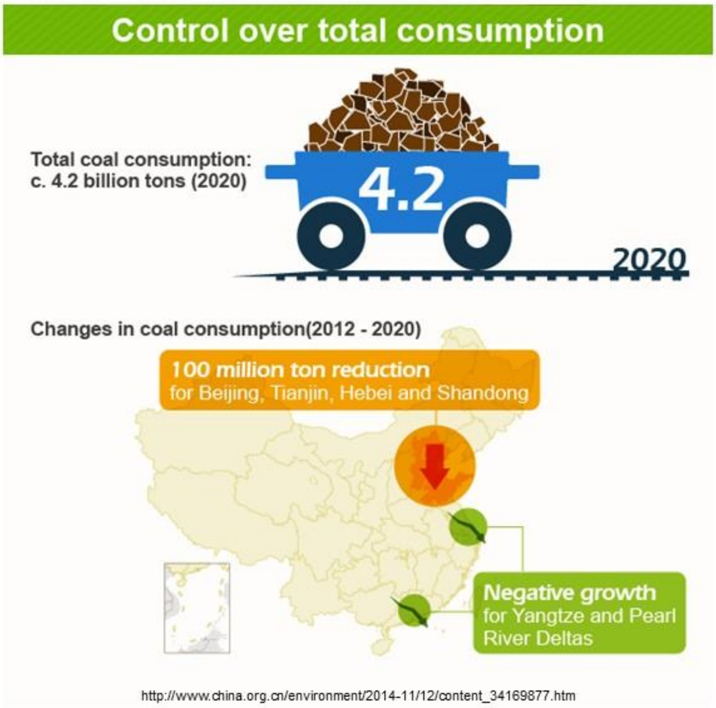
[1] National Development and Reform Commission, 2007. Medium and Long-Term Plan for Renewable Energy Development. Aug 2007 (in Chinese). See also: (http://www.ndrc.gov.cn/zcfb/zcfbghwb/200709/W020140220601800225116.pdf).
[2] State Council, 2013. The 12th Five-Year Plan of Energy Development. Jan 2013 (in Chinese). See also: (http://www.gov.cn/zwgk/2013-01/23/content_2318554.htm)
[3] Office of the Press, State Council, 2014. U.S.-China Joint Announcement on Climate Change. 12 Nov 2014 (in Chinese). See also: (http://www.scio.gov.cn/xwfbh/xwbfbh/wqfbh/2014/20141125/xgzc32142/Document/1387124/1387124.htm)
[4] State Council, 2014. **Energy Development Strategy Action Plan (2014-2020)**. 19 Nov 2014 (in Chinese). See also: (http://www.gov.cn/zhengce/content/2014-11/19/content_9222.htm)
[5] National Development and Reform Commission, 2015. Intended Nationally Determined Contribution (INDC). Submitted to UNFCCC on 30 Jun 2015 (in Chinese & English). See also: (http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf)



http://www.china.org.cn/environment/2014-11/12/content_34169877.htm

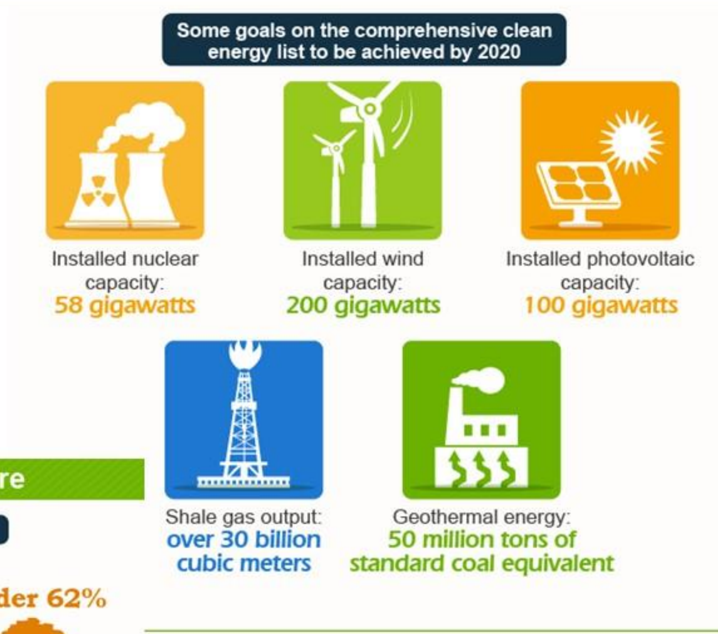
Asia-Pacific Economic Cooperation

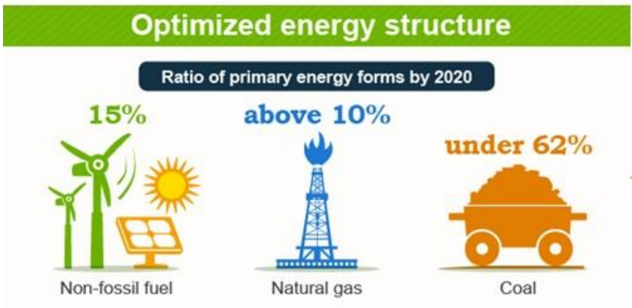
APEC Sustainable Energy Center



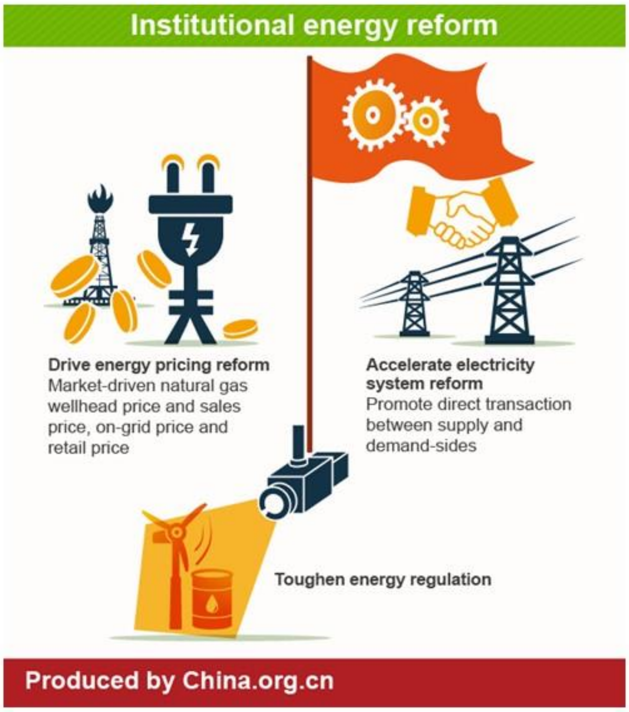
Asia-Pacific Economic Cooperation

APEC Sustainable Energy Center





http://www.china.org.cn/environment/2014-11/12/content_34169877.htm



http://www.china.org.cn/environment/2014-11/12/content_34169877.htm

Asia-Pacific Economic Cooperation
APSEC APEC Sustainable Energy Center

To achieve the 15% target, RE will be intensively developed as per the ***plan***.

- By 2020, hydroelectric power's installed capacity should reach 350GW.
- By 2020, wind power electricity generation's installed capacity is to reach 200GW. Nine wind power electricity generating bases will be built at Jiuquan, western Inner Mongolia, eastern Inner Mongolia, norther Hebei, Jilin, Heilongjiang, Shandong, Hami, and Jiangsu.
- Solar energy electricity generation will be developed by establishing photovoltaic bases. By 2020, photovoltaic installed capacity should reach 100GW.
- Geothermal energy, biomass energy, ocean energy will be developed. By 2020, the scale of geothermal energy use is be equivalent to 50 million tons of standard coal.
- To enhance the penetration of RE into energy consumption mix, e.g. through improving the integration of RE power into the grid, power system management, energy storage etc.

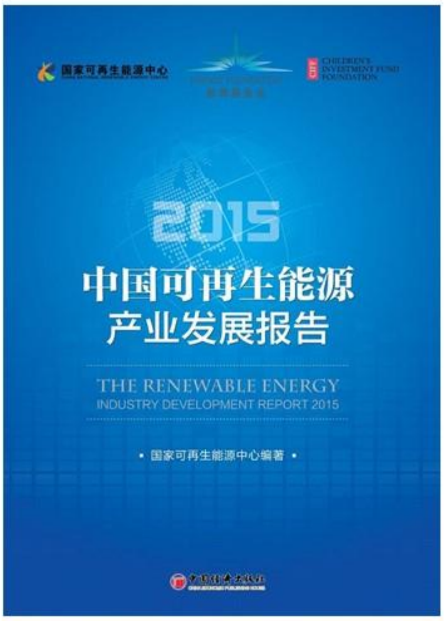
Special thanks to CNREC for all the energy statistics.

China National Renewable Energy Center (CNREC), 2015. The Renewable Energy Industry Development Report 2015. Sep 2015 (in Chinese). See also: (http://www.cnrec.org.cn/cbw/zh/2015-10-23-488.html)

THANK YOU!

Claimer: All non-DIY materials used in this presentation belong to their rightful owners. I don't hold any rights.

Presenter: Dr. Xu Zhao
Researcher at APEC Sustainable Energy Center (APSEC)
Email: xu_zhao@tju.edu.cn



4-2. Strategy and Roadmap for Renewable Energy in Chinese Taipei

Chun-Li Lee
Bureau of Energy, Chinese Taipei

Outline

1. New Energy Policy of Chinese Taipei
2. Renewable Energy Development Act
3. Principles of Renewable Energy Development
4. Renewable Energy Targets
5. Development Strategy :
   - Thousand Wind Turbines Program
   - Million Solar Rooftop PVs Program

1. New Energy Policy of Chinese Taipei

Chronology of Energy Policy Development

2015.01.15-16	Held the 4th National Energy Conference
2011.11.03	Announced New Energy Policy to "Steadily Reduce Nuclear Dependency, Gradually Move Towards a Nuclear-free Homeland, and Create a Low-carbon Green Energy Environment"
2010.05	Approval of the National Master Plan on Energy Conservation and Emission Reduction
2010.01	Establishment of the Committee on Energy Conservation and Emission Reduction
2009.07.08	Promulgation of Renewable Energy Development Act Amendment of Energy Management Law
2009.04.15-16	Held the 3rd National Energy Conference
2008.06.05	Launched Framework of Sustainable Energy Policy

2. Renewable Energy Development Act

- In order to systematically promote renewable energy, in July of 2009, Chinese Taipei promulgated the ***Renewable Energy Development Act***. **The core strategy of the Act is a Feed-in-Tariff system**.
- A Committee is formed to decide the calculation formula and feed-in tariffs. Tariffs and formula should be **reviewed annually**, referring to **technical advancement, cost variation, goal achievement status**, etc.
  ➔ **no degression system in place**
- Tariffs shall not be lower than the average cost for fossil-fired power of domestic power utilities.

Strategy and Roadmap for Renewable Energy in Chinese Taipei

Mechanism of Feed-in Tariffs

- Current, only Solar PV tariff rates are set on date when generating equipment installations are completed. Other technologies have tariff rates set on the Power Purchasing Agreement (PPA) signing date.
  ➔ **tariffs applied for 20 years**
  ➔ **PPA being a very important credit for banks to provide project financing**
- **BOE announces PV capacity quota every year.** PV systems > 50 kW are subject to a bidding procedure to decide tariffs. Developers proposing higher discount rates receive the priority to get the quota.
- **The installed capacity of PV systems has been increased by more than 60 times in 5 years after the implementation of FIT.**

All rights reserved.

3. Principles of Renewable Energy Development

- **Five principles which have been considered to expand Chinese Taipei's renewable energy development to maximum potentials：**

1. Subject to technological maturity and feasibility
2. Cost effectiveness
3. Development in phases
4. Acceptable increase in electricity price
5. Facilitating development of related industries

4. Renewable Energy Targets

- The Ministry of Economic Affairs raised the renewable energy target to 17,250 MW for 2030 (was 10,858 MW set in 2010), which is its third-time upward adjustment for the renewable energy target.

	Capacity of Renewable sources (MW)						Electricity generated from renewable sources (GWh)					
Year	2013	2014	2015	2020	2025	2030	2013	2014	2015	2020	2025	2030
On-shore Wind	614	637	737	1,200	1,200	1,200	1600	1500	1800	2900	2900	2900
Off-shore Wind	0	0	0	520	2,000	4,000	0	0	0	1800	6800	13600
Hydro Power	2,081	2,081	2,089	2,100	2,150	2,200	5400	4300	4600	4700	4800	4900
Solar PV	392	620	1,115	3,615	6,200	8,700	300	600	1400	4500	7800	10900
Geothermal	0	0	0	100	150	200	0	0	0	600	1000	1300
Biomass	741	741	741	768	813	950	3400	3500	5400	5600	5900	6900
Total	3,828	4,079	4,682	8,303	12,513	17,250	10800	9900	13200	20100	29200	40500
Share of Total System	7.8%	8.4%	9.6%	15.0%	20.6%	27.1%	4.3%	3.8%	5.0%	7.0%	9.5%	12.6%

Chinese TAIPEI

5. Development Strategy

◆ To prompt solar PV and offshore wind power, Thousand Wind Turbines and Million Solar Rooftop PVs promotion programs were approved in 2012.

Chinese TAIPEI

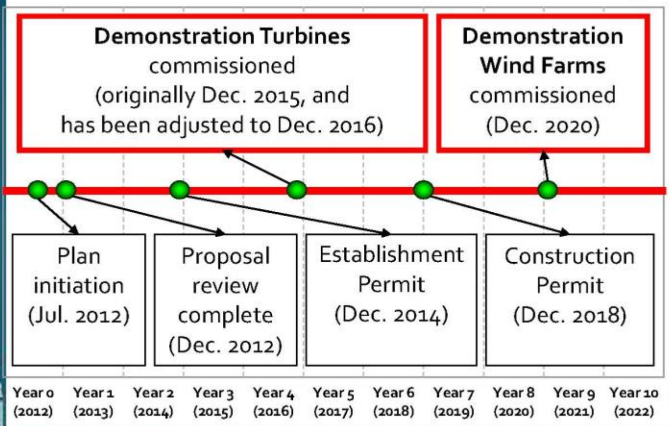
Strategies for Offshore Wind

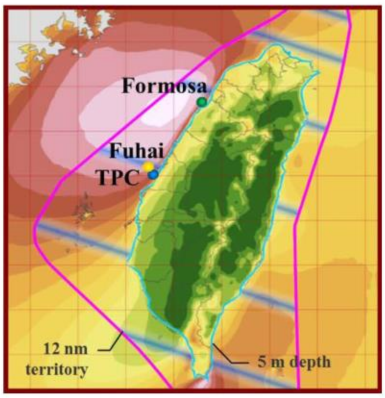
- **Feed-in Tariff** (tariffs for 2015 as below)
  - **Option #1:** US$ 0.1794 / kWh for 20 years
  - **Option #2:** US$ 0.2221 / kWh for the first decade and US$ 0.1081 / kWh for the second
    (assuming exchange rate: US$ 1 = NT$ 32)
- **Offshore Demonstration Incentive Program (DIP)**
  - **4 Demonstration Turbines by 2016, 3 Demonstration Wind Farms by 2020**
  - **Government provides subsidy for both equipment & developing processes.**
- **Directions of Zone Application for Planning (ZAP)**
  - **36 Zones of Potential revealed for preparation in advance of Zonal Development**
  - **Applicants must acquire EIA consent by 2017 and Preparation Permit by 2019.**
- **Offshore Zonal Development**
  - **To be announced by 2017 while SEA is currently in progress**
  - **Commercial scale for cost reduction**

Offshore Demonstration Incentive Program

3 Demonstration Wind Farms

- **Winners (Fuhai, Formosa & TPC) officially announced on 9th January 2013**
- **To subsidize 50 % cost of the Demonstration Turbines** (FIT advances/interest-free loan)
- **To subsidize NT$ 250M for preparatory** (wind mast, EIA, etc.) **expense**
- **To confirm feasibility in terms of administration, technology and finance**





5-1. Thousand Wind Turbines Program
Strategy and Roadmap for Renewable Energy in Chinese Taipei

Potential Zones → ZAP → Zonal Development

Siting for Zones of Potential (ZoP)

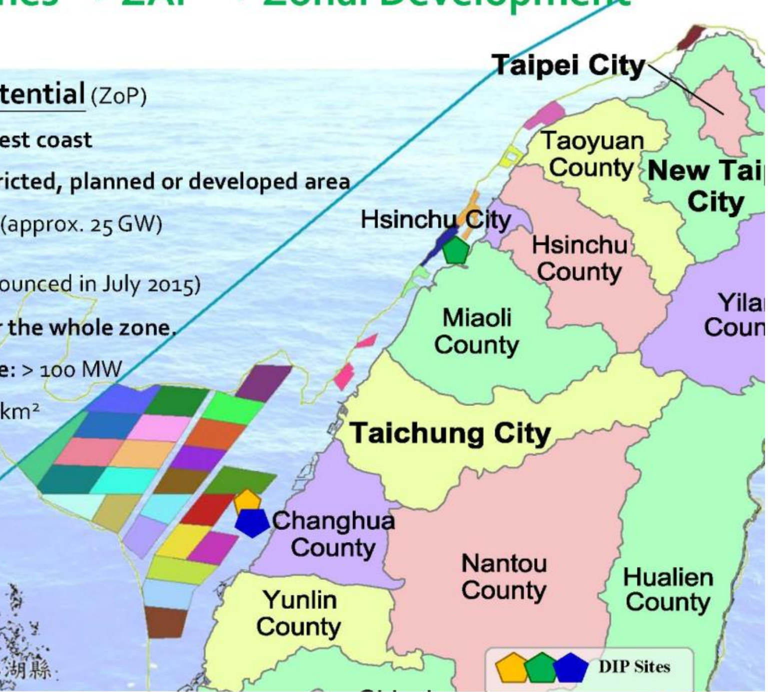
- **Within 50 m isobath off west coast**
- **Excluding protected, restricted, planned or developed area**
- **36 ZoP: total 3,084.5 km²** (approx. 25 GW)

Directions of ZAP (announced in July 2015)

- **Applicants should plan for the whole zone.**
- **Total capacity of each case:** > 100 MW
- **Capacity density:** > 5 MW/km²

Zonal Development

- **SEA & inter-department negotiation will be conducted based on 36 ZoP.**



Chinese TAIPEI

5-2.Million Rooftop PVs Program

Strategy and Roadmap for Renewable Energy in Chinese Taipei

Goal and Strategy of Solar PVs

➢ Goal

- 8,700 MW developed by 2030
  - A. Roof-top (3,000 MW)
  - B. Ground (5,700 MW)
    Priority placed to contaminated agricultural farmlands and severe land subsidence areas, with 6.5% open to PV installation as the current target

➢ Strategy

- The Feed-in Tariff as a strategy to achieve annual targets for roof-top and ground installations
- A cap quota is decided annually, while expecting large scale expansion after grid-parity is reached.
- PV ESCO

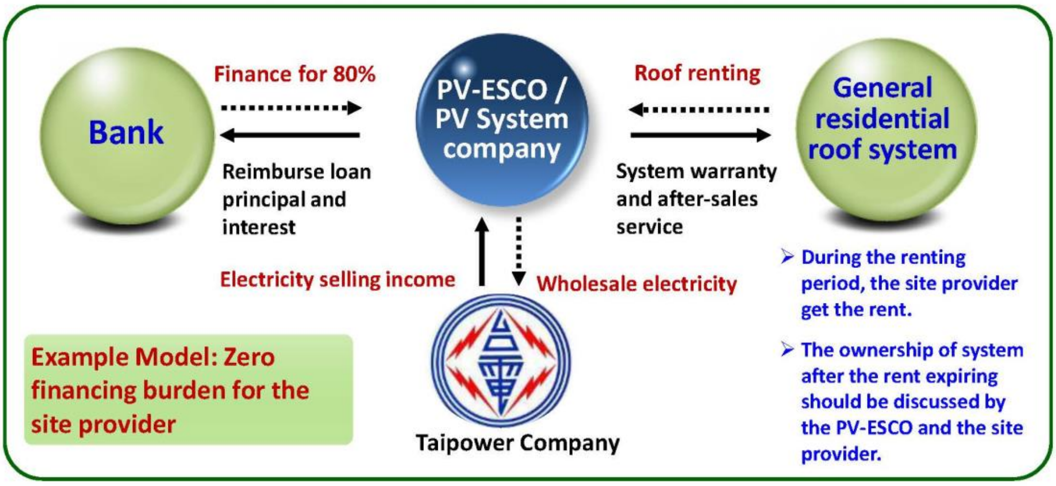
Chinese TAIPEI

5-2.Million Rooftop PVs Program

Strategy and Roadmap for Renewable Energy in Chinese Taipei

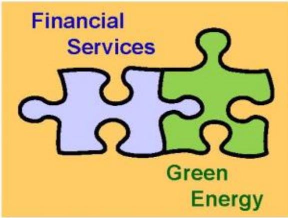
Establishment of PV-ESCO Mechanism

Encouraging banks to participate in project financing and to provide soft loans to PV-ESCO players



Achievements of PV-ESCO: Green Financing

- 16 banks now provide PV system financing support, green energy investment funds grows from USD 1.6 to 222 million from 2011 to 2013.
- USD 222 million funds could generate USD 317 million in system installation value, about 170 MW of domestic demand, and create more than USD 0.5 billion in industry chain value.
- PV-ESCO assists in installations for all buildings including solar community, public roof, solar farm, solar terminal, solar factory, solar rail, solar MRT, solar campus, etc.
- ESCO model plays an important role in Chinese Taipei PV installation. PV-ESCO capacity ratio increase from 48% (2012), 63% (2013), and up to 80% (2014).



Chinese TAIPEI

Chinese Taipei, Your Best Partner !

LIGHT YOUR FUTURE

Thank you for your attention

Chinese TAIPEI

4-3. Policy and Current Status of Renewable Energy in Japan

Takao Ikeda
The Institute of Energy Economics, Japan

Workshop on Experiences and Plans to Double Renewable Energy Utilization by 2030 in the APEC Region

Policy and current status of Renewable Energy in Japan

November 10-11th, 2015

Takao Ikeda
The Institute of Energy Economics, Japan
(IEEJ)

1. Long term energy outlook

2. RE deployment status

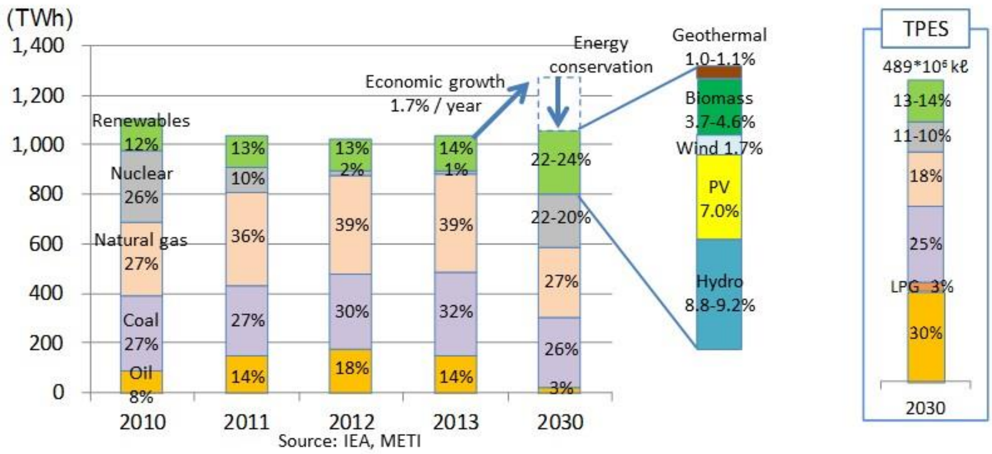
3. Current issues

4. Action to the issues

2

Long term energy outlook for 2030

- In 2015, Japanese government has published “Long-Term Energy Supply and Demand Outlook” (for 2030).
  - The previous plan was completely revised after Fukushima accident.
- Renewable electricity share will be 22-24% in 2030.
- This outlook can be revised corresponding to the situation.



3

1. Long term energy outlook

2. RE deployment status

3. Current issues

4. Action to the issues

4

RE Deployment Promotion Scheme

2003

RPS (Renewable Portfolio Standard)

- wind, solar, small hydropower, biomass power generation , binary geothermal
- 8-year target set by every 4 years
- Finish in July 2012 as FIT started

2009

Buyback system surplus PV electricity

- Started from November, 2009
- Developed from Utilities' voluntary Net -Metering system
- Only for small scale facilities up to 500 kW

2012

Commencement of FIT

- Started from July 1, 2012
- Premium FIT rate for the investors during first 3 years
- Utilities hold the rights to disconnection the renewable energy facilities up to 30 days without compensation in order to maintain the grid electricity quality

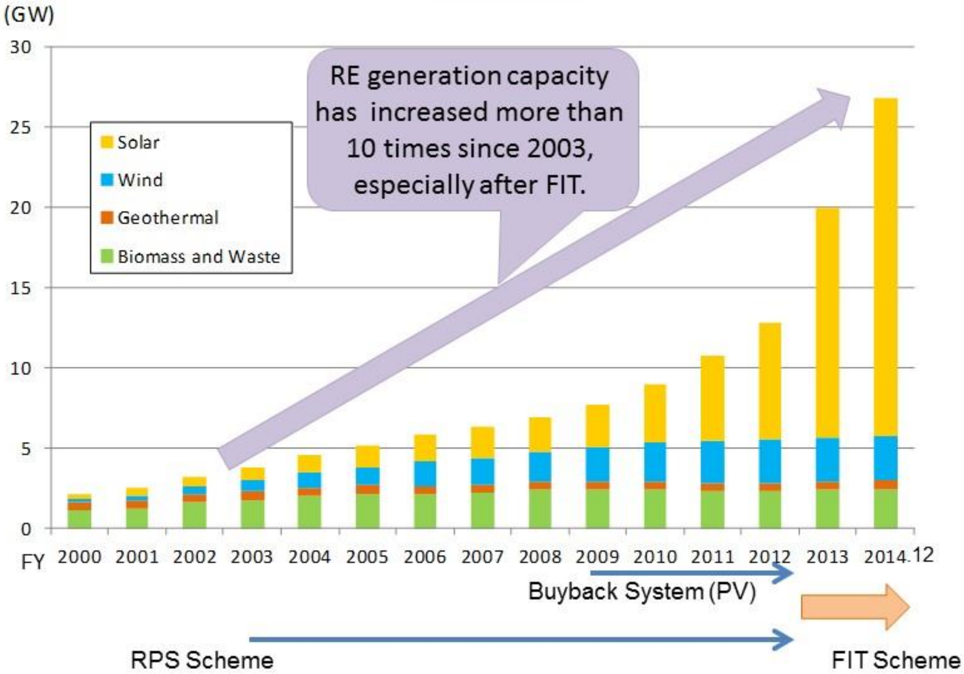
2015

Expiration of premium period of FIT

- New disconnection guideline for the ***new*** application of PV and wind.(Jan)
  PV:360 hours changed from 30days/ Wind: 720 hours can be disconnected without compensation from the Utitlities
- 3 years FIT premium rate period is finished (July)
- Currently, New FIT scheme is under consideration for diversification of renewable energy technologies

5

Transition of RE installation



Source: The Energy and Data Modeling Center (EDMC) of IEEJ,
The Federation of Electric Power Companies of Japan (FEPC) (before 2010),
METI (after 2011)

6

1. Long term energy outlook

2. RE deployment status

3. Current issues

4. Action to the issues

7

Issues on PV under rapid expansion of deployment

IEE JAPAN

Current Issues

- Unbalanced RE deployment (Too much rely on PV)
- RE deployment with national cost consciousness
- Stabilized electricity output in a low cost way
- Establishment of wide area grid utilization system and the rule

Current Discussion

- Strengthen the transmission lines in and out of utilities' area
- FIT rate setting and revision of the connection rule
- Cost reduction through
  - (1)R&D
  - (2)standardization of project contract and construction etc.
- Capacity Building for better opportunity of project finance

8

Need diversification in renewable energy

IEE JAPAN

◆PV capacities account for 96.3% of the total renewable energy capacities installed during first 3 years of FIT

◆ Non residential PV facilities alone account for 80.9% among total

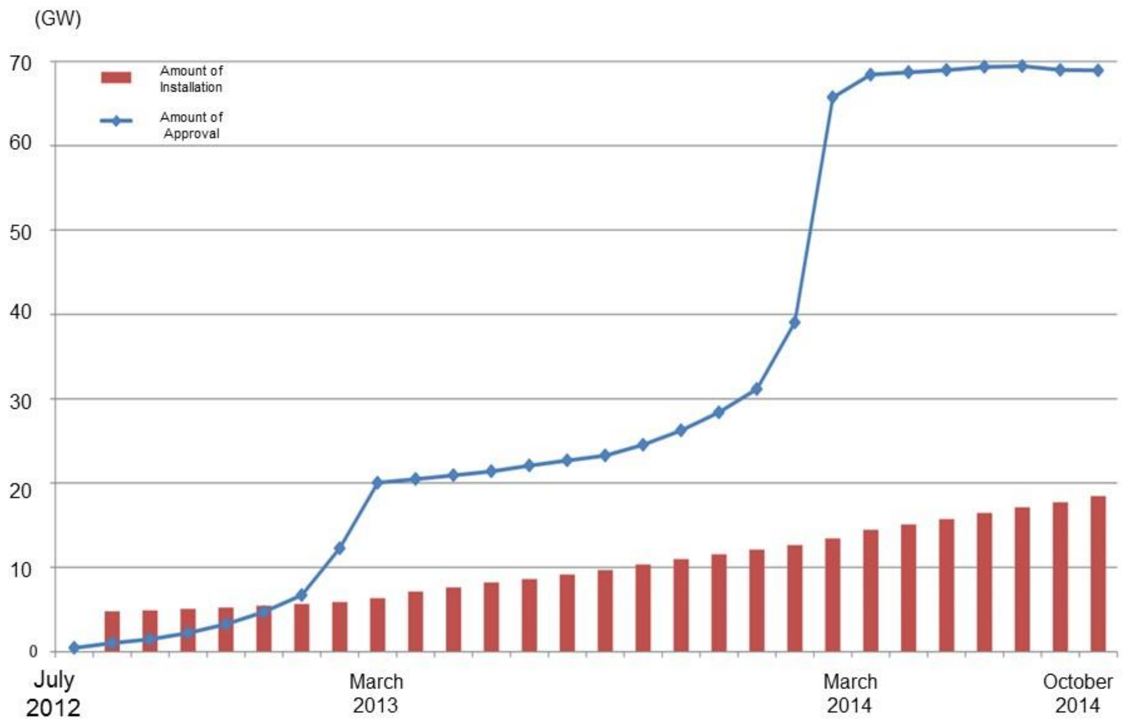
(MW)

	Cumulative Capacity as of June 2012 Before FIT started (MW: Approx)	Capacity start operation from July 2012 to June 2015
PV (Residential)	4,700	3,320 (96.3% of Total After FIT)
PV (Non Residential)	900	17,450
Wind	2,600	350
Middle and Small Hydro (Less than 30MW)	9,600	110
Biomass	2,300	320
Geothermal	500	10
Total	20,600	21,560

Source: METI

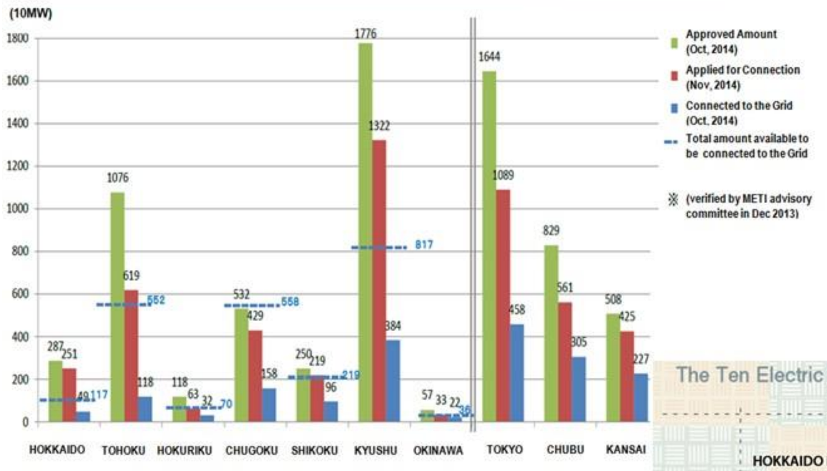
9

Approved PV application and installation



10

PV connection to the grid by utilities



11

IEE JAPAN

1. Long term energy outlook

2. RE deployment status

3. Current issues

4. Action to the issues

12

New rule for PV disconnection

IEE JAPAN

The Rule when FIT is started

- The disconnection rule is applied only over 500kW PV plant
- Utilities can disconnect the PV power plants from the grid up to 30 days without any compensation.

New Rule for New Applied Facilities

* Starting date varies based on the plant scale and the utility area.

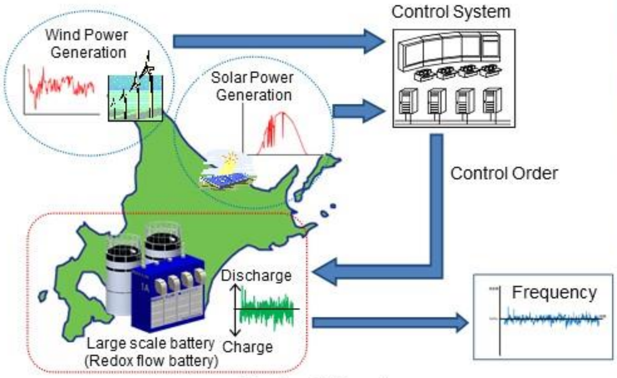
- This rule can be applied all plants including residential roof top system (Except small plants under 50kW in Tokyo, Chubu and Kansai Area.)
- Utilities can disconnect PV plants up to 360 hours and Wind power plants (over 20kW) up to 720 hours without any compensation.

- Geothermal and Small Hydro Power Plants have no limits to the grid connection.

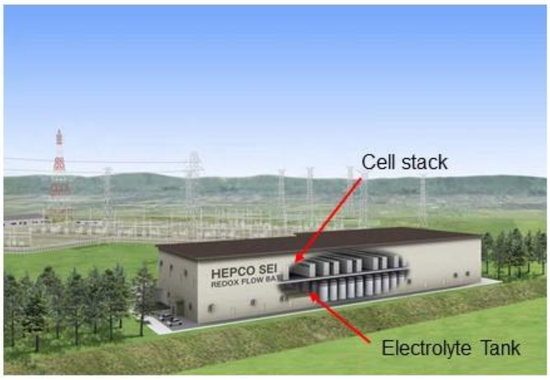
13

Utility scale batteries for grid stability(1)

Hokkaido Electric Power Co.,Inc.
(Demonstration Project :FY2013-FY2017)



Overview of battery system
(Sumitomo Electric Industries)



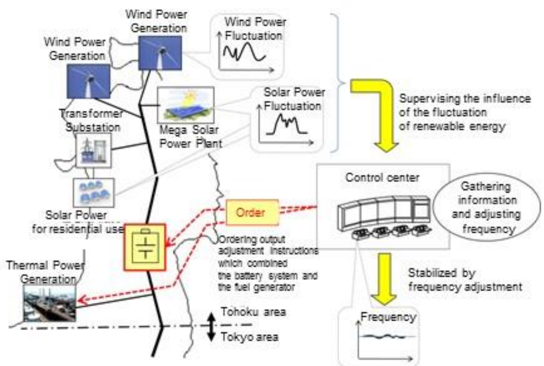
Conceptual drawing

Subsidized Company	Battery type	System Capacity	Location
Hokkaido Electric Power Co., Inc. Sumitomo Electric Industries Ltd	Redox Flow battery	60 MWh	Minami Hayakita Substation

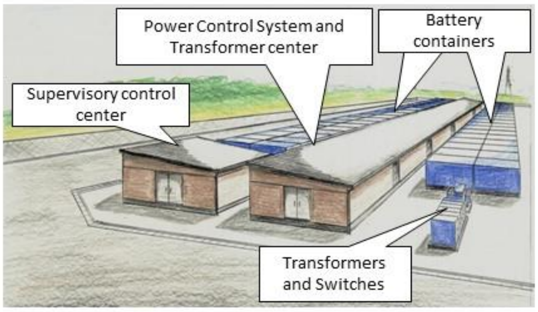
*(**Source**) NEDO.*

Utility scale batteries for grid stability(2)

Tohoku Electric Power Co.,Inc.
(Demonstration Project:FY2013-FY2017)



Overview of battery system
(Toshiba)



Conceptual drawing

Subsidized Company	Battery type	System Capacity	Location
Tohoku Electric Power Co., Inc.	Toshiba Lithium ion Battery	20 MWh	Nishi Sendai Substation

*(**Source**) NEDO.*

Utility scale batteries for grid stability(3)

Tohoku Electric Power Co.,Inc.
Demonstration Project :FY2015

Subsidized Company	Battery type	System Capacity	Location
Tohoku Electric Power Co., Inc.	Lithium ion Battery	40 MWh	Minami Soma Substation

Kyushu Electric Power Co.,Inc.
Demonstration Project :FY2015

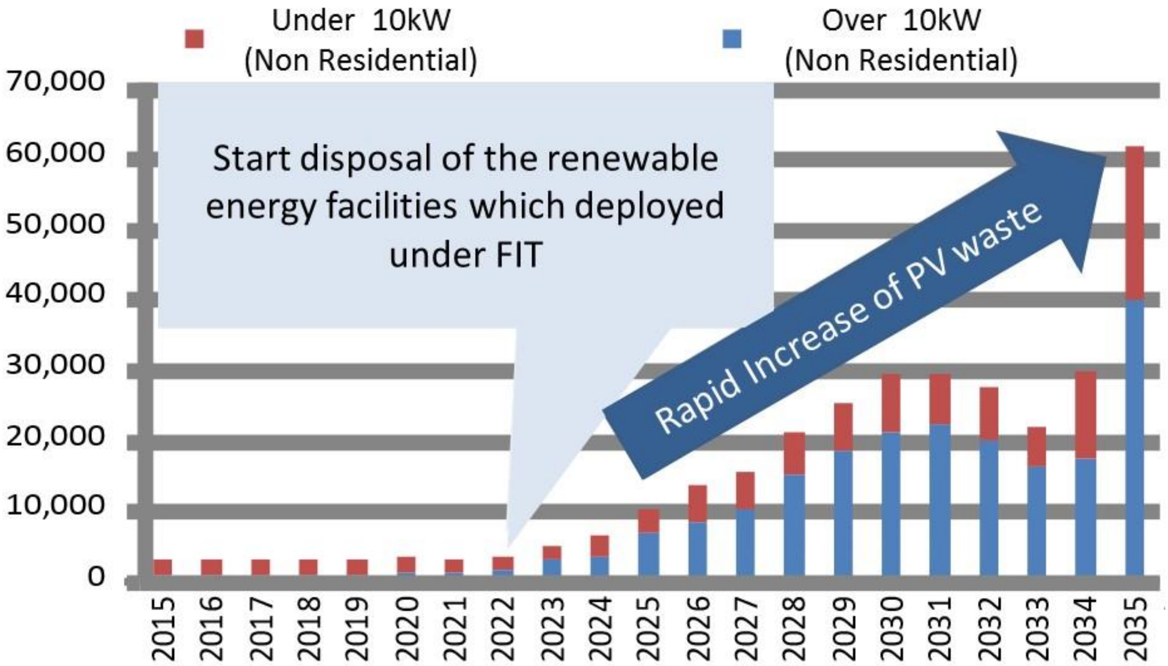
Subsidized Company	Battery type	System Capacity	Location
Kyushu Electric Power Co., Inc.	NAS Battery	300 MWh	Buzen Oil Thermal Power Plant

*(**Source**) New Energy Promotion Council.*

16

Challenges to be anticipated in the future

Anticipated PV disposal in the future (PV operating life = 25 years)



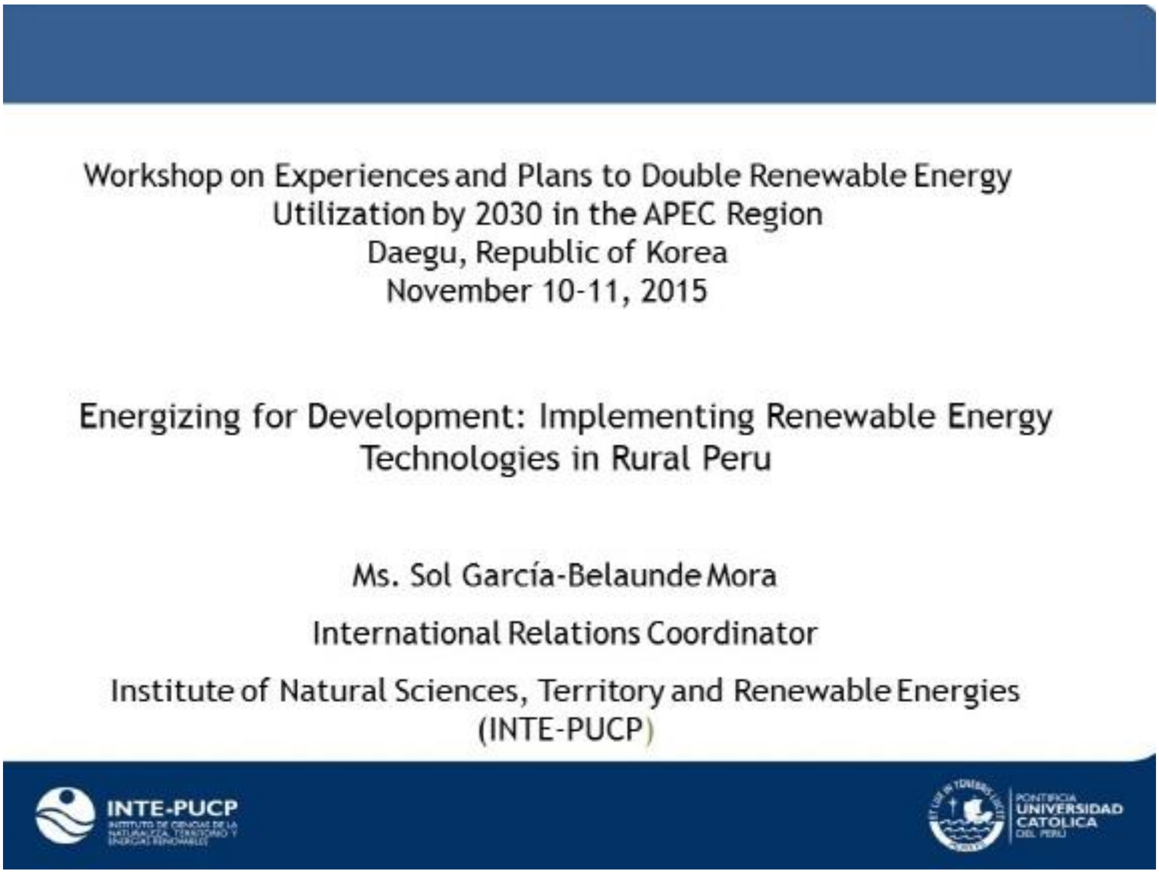
17

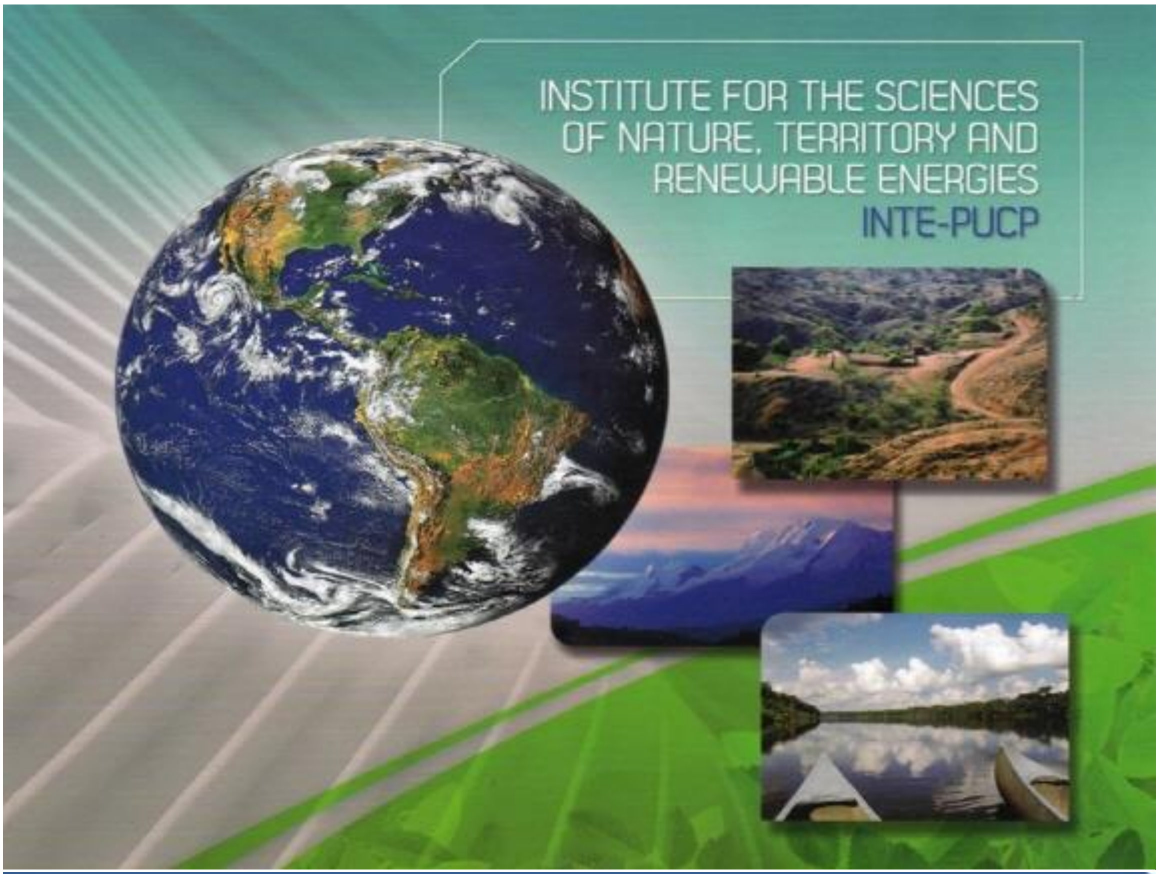
IEE JAPAN

Thank you for your attention !

4-4. Energizing for Development : Implementing Renewable Energy Technologies in Rural Peru

Sol García-Belaúnde
Territory and Renewable Energies, Peru





INSTITUTE FOR THE SCIENCES OF NATURE, TERRITORY AND RENEWABLE ENERGIES OF THE PONTIFICAL CATHOLIC UNIVERSITY OF PERU, INTE-PUCP

The Institute for the Sciences of Nature, Territory and Renewable Energies (INTE) was created on 7th March, 2011, as part of the PUCP's Vice-Rectorate for Research.

Vision:

Using an interdisciplinary approach, with ethics and social responsibility, it seeks to be internationally recognized for its contributions to science, education, technological innovation and sustainable development.

Goals:

- Be at the forefront of knowledge and scientific research in terms of ecological, territorial, socio-environmental and renewable energy concerns.
- Support, promote and generate value for the environment in Peru.
- Provide training in environmental issues with ethical responsibility.
- Develop proposals and alternatives in the fields of innovation, technology transfer, development and sustainable management.
- Provide information and monitor environmental practices of government offices and the civil society.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Peru: A Biodiverse Country

Peru, located in Western South America, on the Pacific Rim is a mega-diverse economy, as more than 88% of climates in the world can be found here. We are also third in the world to be at risk from the effects of climate change.

"Diversity not only sustains life, but also the economy. Peru knows that sustainable management will generate wealth for all. It is time to chart a new course in the development of mankind. And the economy has everything to make it so. " (Ministry of the Enviroment. (2010). PERU: ECONOMY AND BIODIVERSITY.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Public Policies on Energy

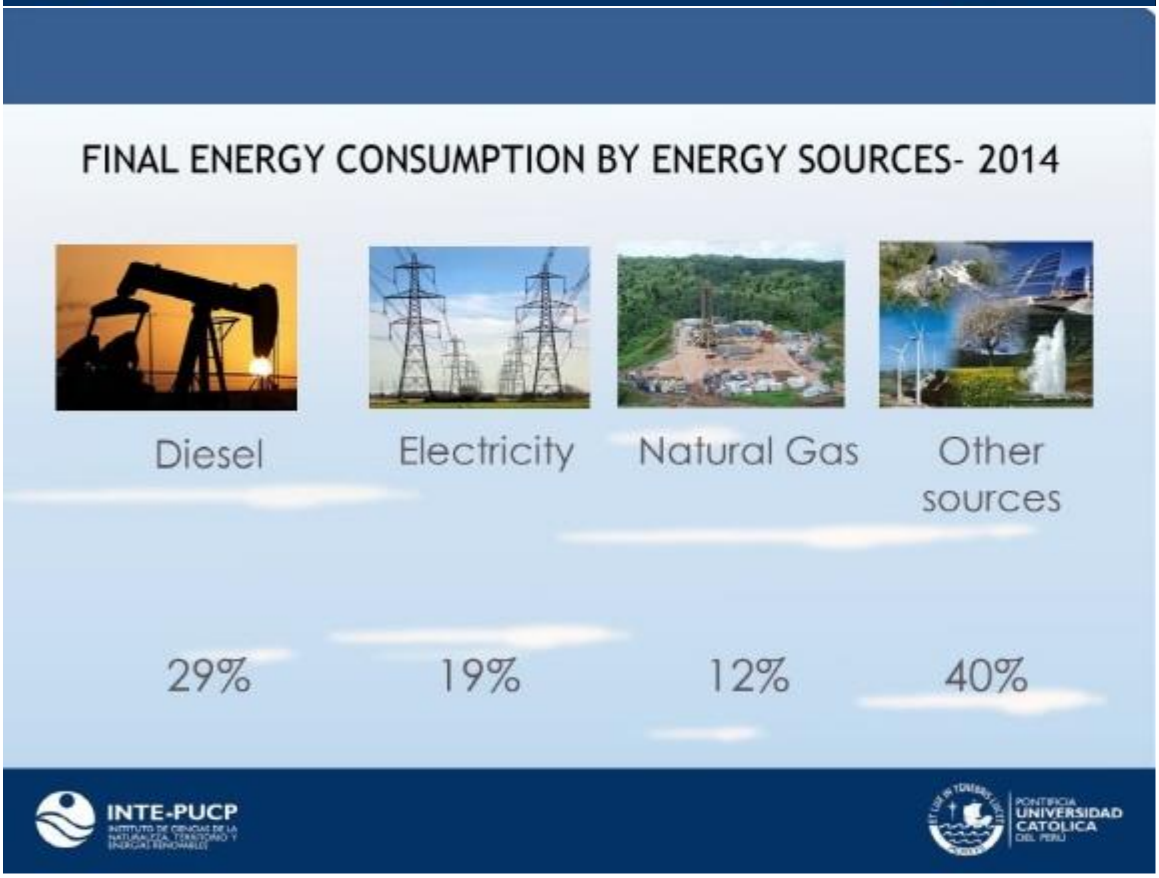
The Vision:

To provide all Peruvians with an energy system that satisfies the national energy demand in a regular, continuous and efficient way; that promotes sustainable development, and is supported in planning and in continuous research and innovation.

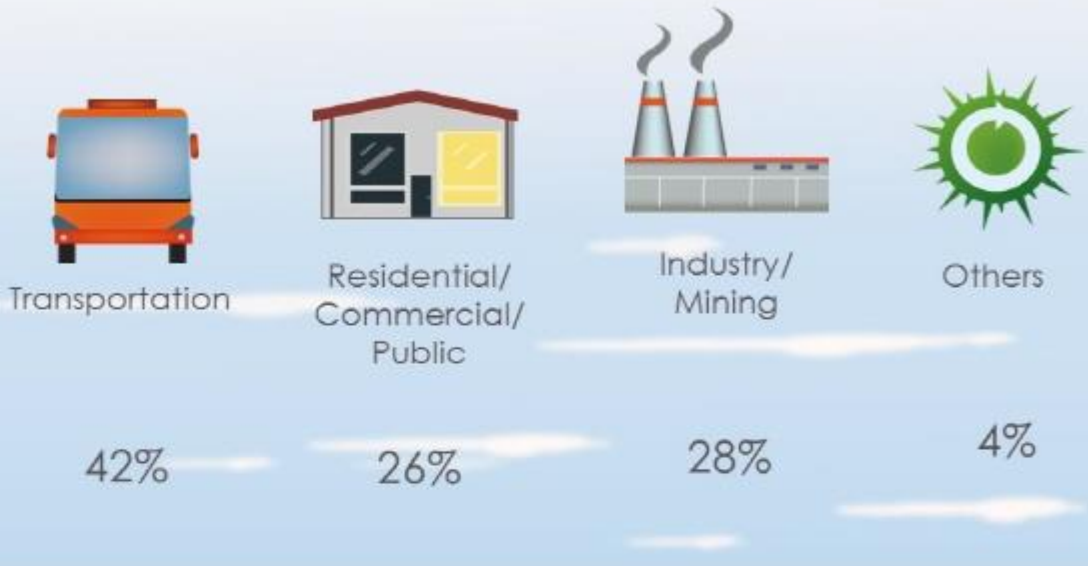
INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ


Public Policies: Goals towards2040
Diversified energy mix, with an emphasis on renewable energies and energy efficiency
Energy supply for sustainable develop-ment
Universal access to energy supply
Greater efficiency in energy use (supply and demand)
Self-sufficiency in energy production
Minimal environmen-tal impact
Develop the natural gas industry
Institutio-nal strengthe-ning
Be part of the regional energy markets
INTE-PUCP
PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ


FINAL ENERGY CONSUMPTION BY ENERGY SOURCES- 2014
Diesel
Electricity
Natural Gas
Other sources
29%
19%
12%
40%
INTE-PUCP
PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

FINAL ENERGY CONSUMPTION BY ECONOMIC SECTOR- 2014



The Peruvian energy mix is made up as follows: 60% is traditional biofuels (diesel, natural gas, coal, wood) and 40% is hydroenergy.

Peru has great renewable energy sources that can and should be used to diversify the energy mix and so help mitigate the effects of climate change. This is therefore part of our national strategy to face climate change.

Renewable energies can be transformed into 3 types of usable energy:

Heat, electricity and mechanical energy.

Generation of heat

Generation of electricity

Generation of mechanical energy

Heat generation:

- **Traditional biomass** (wood, dung,etc) are sources that are used for cooking and water heating.
- We also have **solar thermal energy** for heating (water, heating systems) and cooking processes.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Electricity generation:

- **Hydropower** has been the main source of renewable energy for **electricity generation** in both **the grid (interconnected system) and in the off-grid system.**
- **Wind energy** is applied at the small scale-level (as part of the grid) and on off-grid systems and demonstration projects.
- **Photovoltaic solar energy** currently has applications through small systems for telecommunications systems, distance education and medical centers (either as part of the grid or in the off-grid system). There are also facilities for rural electrification projects and pilot projects for productive use.
- **Biomass,** bagasse and biogas from landfills are also used to produce electricity.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

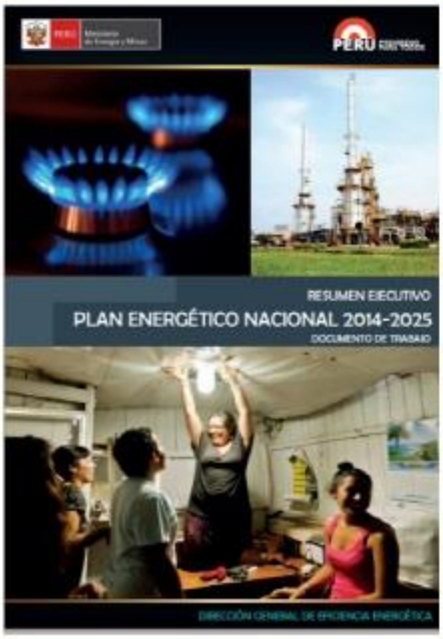
Generation of mechanical energy

- **Liquid biofuels** such as anhydrous ethanol and biodiesel are used to generate mechanical energy.

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Current Status and Prospects of Renewable Energy in Peru



National Energy Plan

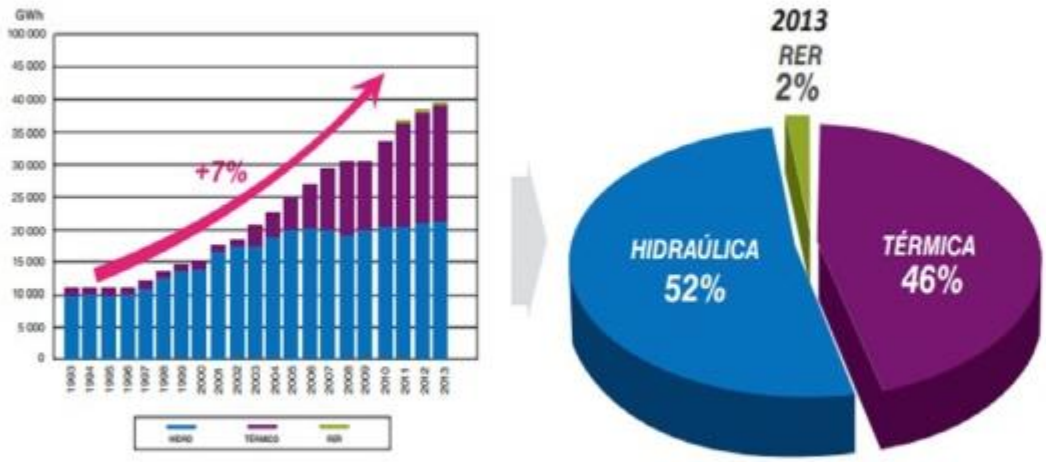
2014-2025

http://www.minem.gob.pe/minem/archivos/2ResEje-2014-2025%20Vf.pdf

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

DEVELOPING RENEWABLE ENERGY RESOURCES



Fuente: MINEM

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

DEVELOPING RENEWABLE ENERGY RESOURCES

Tecnología	Potencia (MW)
Hidroeléctricas < 20 MW	391
Eólicas	232
Solares	96
Otros	27
Total	746

Fuente: MINEM

In addition, the **auction of 500,000 off-grid photovoltaic systems** was completed. These have a 50 MW capacity and will be **installed in rural areas of the economy. By 2020-2021, the renewable energy supply will be of 200 MW hydroelectric plants.**

Regarding the RER, it is estimated to reach the 5% foreseen in the law for non-hydro technologies. Among the projects under consideration there are off-grid hybrid systems (diesel / PVS), photovoltaic, wind zones and biomass for domestic off-grid and interconnected systems. It is estimated to reach in the short term no less than 200 additional MW of new non-conventional renewable generation. **These measures will help us have a stake greater than 60% of renewable energies in the energy mix.**

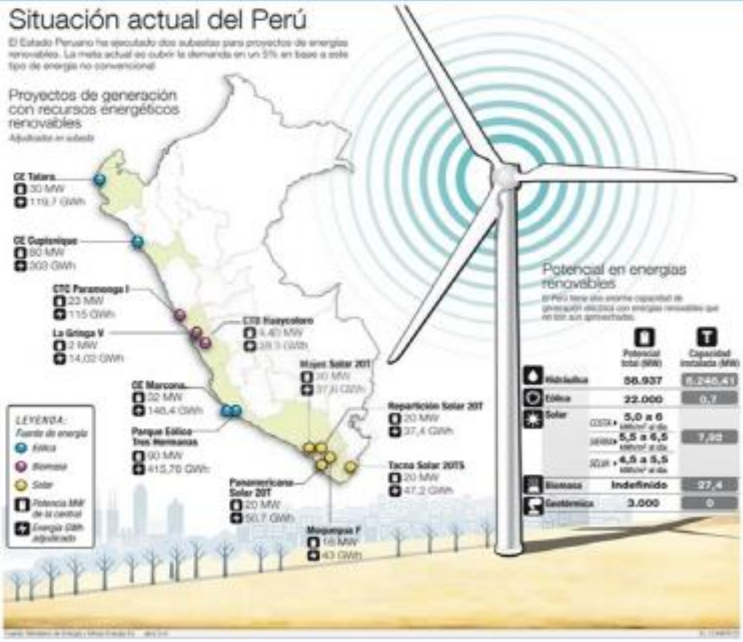
INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

NON-TRADITIONAL RENEWABLE ENERGY SOURCES IN PERU

This grapic shows the location of power plants of non-traditional renewable energy sources (eolic, biomass, solar). These are auctioned projects to generate electric energy from RER.

Geographic and weather conditions favor the installation of these power plants.



INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

How is INTE- PUCP Participating in Projects on Renewable Energy for Rural Areas?

INTE is developing and implementing appropriate technologies using renewable energies to satisfy domestic and productive demands for the rural sector.

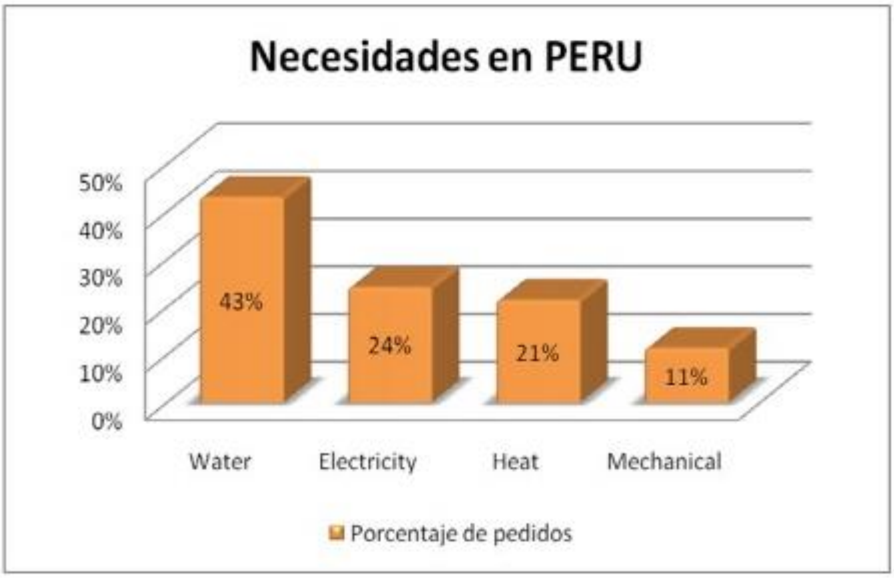
What are appropriate technologies?

- It is the design, development, implementation and management of technology directed at solving social and environmental problems, generating social and economic dynamics aimed towards social inclusion and sustainable development.
- Problem-solving is based on a systemic approach rather than on the resolution of specific issues.
- Social technology reaches a wide variety of tecnology production: the product, the process, the services and the organization for different issues: food, housing, energy, safe water, transportation, communications, etc.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

ENERGY NEEDS IN PERU



INTE-PUCP

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

Collaborative Development of Technology (DPT)

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

Appropriate Technologies

- They satisfy a necessity (water, health, agriculture, energy, agroindustry, biodiversity)
- Low cost
- Accesible for the rural inhabitant
- Minimal harm to the environment
- The population can acquire the technological knowledge
- Easy to replicate and have growth potential

Examples....

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Appropriate Technologies

Improved Kitchen

Solar Heating Systems

Hydraulic Wheel

Solar Cooker

Solar Panels

Trombe Wall

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ


Appropriate Technologies
Solar Pumps
Hydraulic Ram Pumps
Solar Cookers
Windpumps
Solar Cooling
Wind Turbines
INTE-PUCP
PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU


Appropriate Technologies
Solar Dryers
Sewage Water Treatment
Thermo Kitchens
Overshot River Pumps
INTE-PUCP
PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

Projects

Proposals for Research, Development, Innovation and Transfer of Technological Knowledge

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

Where? Rural Areas of Peru

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

PROJECTS

"Energy Connection System with PUCP River Pumps in Andean Rural Communities"

Electricity and Water Pumping with Clean Energies

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

PUCP RIVER PUMPS

- Hydraulic Pumps to Generate Electricity
- Project financed by European Union, implemented by PUCP.
- 6 of the 32 wheels installed so far, project ends in 2 years

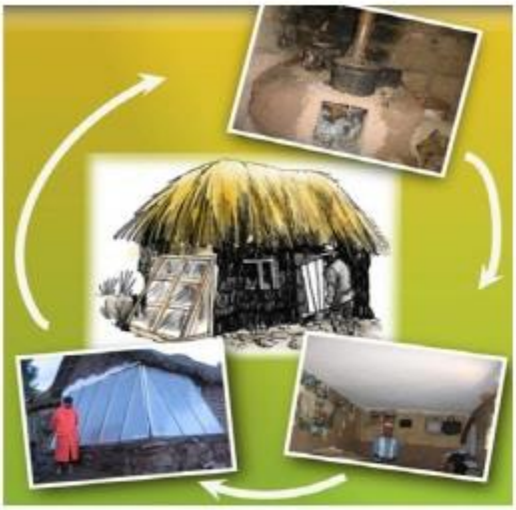
INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

IMPACT OF THE PROJECT

- Over 6500 Andean people will get electricity
- 32 communities will receive water for watering in highland areas
- Less use of batteries, candles and kerosene
- 64 Yachachiqs (teachers) become experts in PUCP River Pumps

PUCP WARM CLEAN HOUSES



The PUCP Warm Clean House Project includes the following technologies:

- Improved Kitchen: Expells the fumes
- Warm wall/Trombe wall: rises temperature
- Insulation system: maintains heat

Problems

- Every year, over 500 people die due to the low temperatures in the highlands of Peru. (MINSA)

Low Temperatures

Poor Infrastructure

In-house Pollution

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

PUCP´s Response to the Problems

- PUCP has developed a number of appropriate technologies: Trombe wall, improved kitchen and roof insulation system.
- These packages have been implemented in Canas, Cusco and in Puno, both located over 4000 mts a.s.l.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Heat Generation

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Heat Generation

Improved Kitchen: built with clay and a metal sheet that is used for cooking; the amount of wood or dung used is reduced. The chimney expels the fumes, reducing pollution inside the house.

Trombe Wall and Insulation System:
The Trombe wall or warm wall is built on the side of a wall that is painted black to attract and maintain heat. The insulation system in the roof prevents the heat from leaving the house.
These technologies rise the temperature by 10° C and reduce the risk of Acute Respiratory Infections.

INTE-PUCP
INSTITUTO DE CIENCIAS DE LA NATURALEZA, TERRITORIO Y ENERGÍAS RENOVABLES

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

IMPACT OF THE PROJECT

The Warm Clean House Project improves the quality of life of the population of the Andes who every year face the hardship of cold weather and lack of resources to protect themselves.

As the insulation system is set up, the house construction is examined and improved; the new kitchen reduces in-house pollution and the warm wall guarantees higher temperatures inside the house, over 10° C.

Together, these technologies reduce the incidence of Acute Respiratory Infections and related high child mortality rates.

They are also environmentally friendly and sustainable, as the materials employed are easy to find for the communities.

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Thank You!

INTE-PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

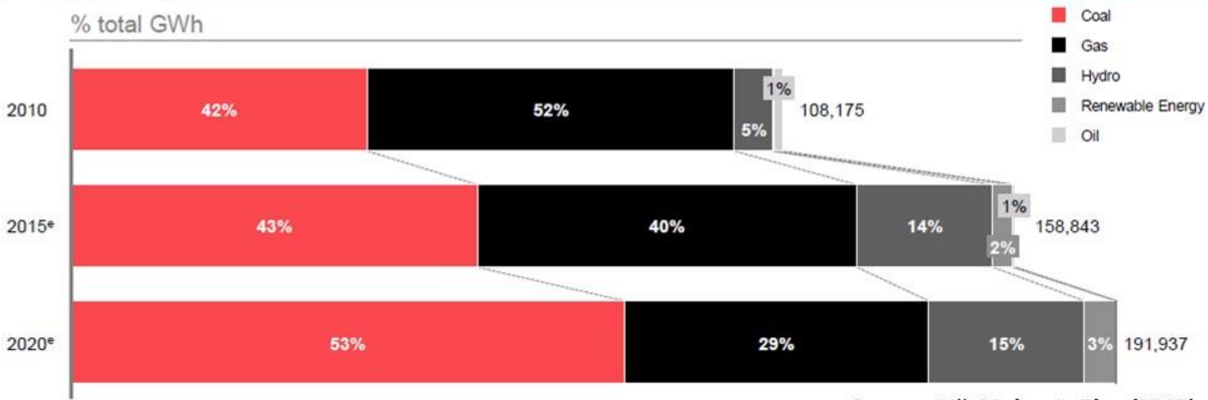
5-1. RE Development in Malaysia – Updates

Azah Ahmad
RE Technology Dept, SEDA, Malaysia

Background on RE development

2

Malaysia: Electricity Generation Mix



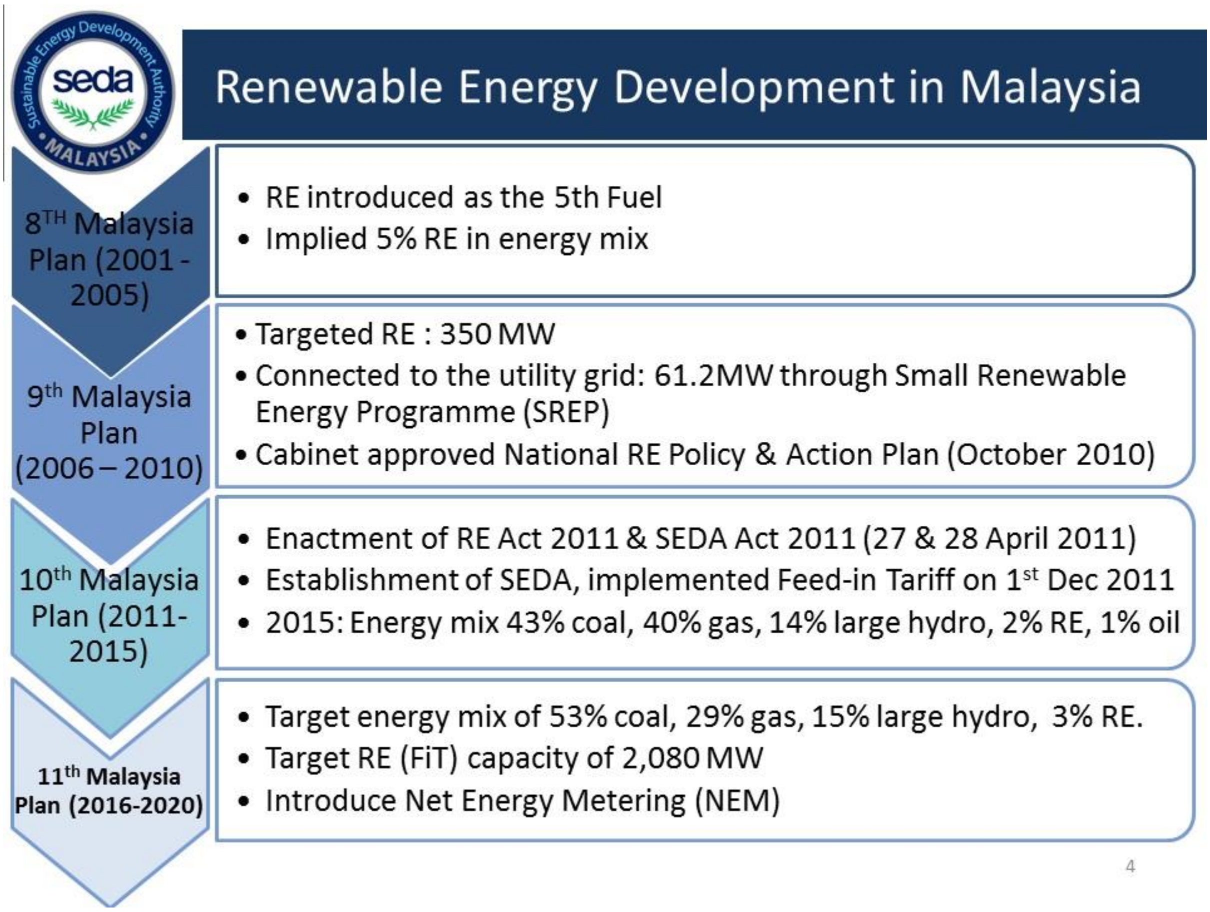
Source: 11th Malaysia Plan (2015)

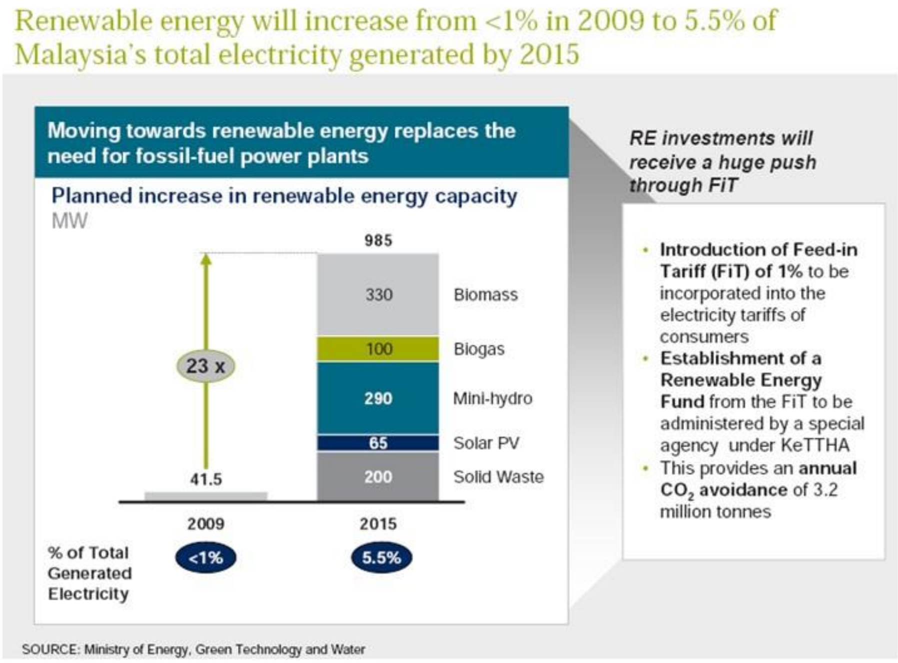
Population (2015) : 31mil

Area : 329,847 km²

Installed electricity generation capacity (2013): 29,748MW

3





- National RE Policy & Action Plan (REPAP) launched in 2010
- RE Act gazetted in June 2011 (FiT mechanism)
- SEDA Malaysia was formed as the main implementing agency
- Fit payments come from RE fund, quota to be offered depends on RE fund collected

Source of RE Fund for FiT

Source of RE Funding – from additional charge imposed on electricity bills

Cabinet in 2011 principally approved **2 %** additional charge on electricity bills

- 1st December 2011- **1.0 %**
- 1st January 2014 – **1.6 %**
- The size of the RE fund determines the RE target for Malaysia

Benefits

- Partial "polluters pay" concept
- encourages EE and DSM

6

Malaysian National RE Targets (set in 2010)

Year	Cumulative RE Capacity	RE Power Mix (vs Peak Demand)	Cumulative CO_2 avoided
2015	985 MW	5.5%-6%	11.1 mt
2020	2,080 MW	11%	42.2 mt
2030	4,000 MW	17%	145.1 mt

- Before the introduction of the RE Act in 2011, there was the Small RE Producer (SREP) program and Suria 1000, which resulted in about 68 MW of grid-connected RE generation by 2011
- The RE Act relies entirely on the FiT to achieve the National RE targets

7

RE Policy: Projected RE Growth (2010)

Year	Cumulative Biomass (MW)	Cumulative Biogas (MW)	Cumulative Small-Hydro (MW)	Cumulative Solar PV (MW)	Cumulative Biomass (Solid Waste) (MW)	Cum Total RE, Grid-Connected (MW)
2011	110	20	60	9	20	219
2015	330	100	290	65	200	985
2020	800	240	490	190	360	2,080
2025	1,190	350	490	455	380	2,865
2030	1,340	410	490	1,370	390	4,000
2035	1,340	410	490	3,700	400	6,340
2040	1,340	410	490	7,450	410	10,100
2045	1,340	410	490	12,450	420	15,110
2050	1,340	410	490	18,700	430	21,370

Assumptions, RE Technical potential:

Biomass (EFB, agriculture): 1,340 MW will be reached by 2028.
Biogas (POME, agriculture, farm): 410 MW will be reached by 2028.
Mini-hydro (not exceeding 30 MW): 490 MW will be reached by 2020.
Solar PV (grid-connected): unlimited.
Solid waste (RDF, incineration, sanitary landfill): projection of 30,000 tonne/day of Solid Waste as projected by KPKT, followed by 3% annual growth post 2024

8

Feed-in Tariff Rates

Technology / Source	FiT Duration	Range of Basic FiT Rates (USD/kWh)	Annual Degression
Biomass (palm oil waste, agro based)	16	0.084 – 0.118	0%
Biomass (Solid waste)	16	0.084 – 0.148	0%
Biogas (landfill / agri waste)	16	0.088 – 0.145	0%
Small Hydro	21	0.072 – 0.075	0%
Solar PV (individual)	21	0.309 – 0.480	10%
Solar PV (non-individual)	21	0.191 – 0.427	10%
Geothermal	21	-	-

- **USD1 = MYS3.21**

9

Bonus rate for local contents

Technology / Source	Additonal bonus on top of base rates
Biomass	For locally manufactured assembled gasification
Biogas	For locally manufactured/ assembled gas engine
Solar PV	For locally manufactured PV modules For locally manufactures inverter

10

FiT Implementation & Outcome

11

Cumulative Approved FiT projects (30 September 2015)

No	RE Sources	No, of projects	Capacity (MW)	% of total capacity
1	Biogas	90	158.18	13.90%
2	Biomass	37	348.79	30.65%
3	Small Hydro	36	279.64	24.58%
4	Geothermal	1	30.00	2.64%
5	**Solar PV**	**7,116**	**321.29**	**28.24%**
	Solar PV (Individual)	6,536	60.55	5.32%
	Solar PV (Community)	132	2.78	0.24%
	Solar PV Non-Individual (<500kW)	338	61.01	5.36%
	Solar PV Non-Individual (>500kW)	110	196.94	17.31%
	Total	**7,280**	**1,137.89**	**100.00%**

12

Cumulative Operational Projects (30 September 2015)

No	RE Resources	No of projects	Capacity (MW)
1	Biogas	9	17.23
2	Biomass	7	74.90
3	Small Hydro	5	18.30
4	Solar PV (Individual)	4,180	41.05
	Solar PV (Community)	51	0.80
	Solar PV Non-Individual (<500 kW)	206	31.91
	Solar PV Non-Individual (>500kW)	64	135.35
	Total	**4,522**	**319.55**

13

FiT implementation Outcome – Up to 2018 (30 September 2015)

CDM baseline 2012
Pen M'sia – **0.741 ton/ MWh**
Sabah & Labuan- **0.546 ton/ MWh**
(Source: Study on Grid Connected Electricity Baselines in Malaysia Year:2012, MGTC)

	No of jobs create	RE generation (MWh)	Installed capacity (MW)	FiTCD capacity (MW)	Co2 reduction (tonnes)	Total investment (RM)
Biogas (palm oil waste, ago based & farming)	3,562	998,013.31	142.49	17.23	719,065.81	1,148,957,283.11
Biomas (palm oil waste, ago based & farming)	7,675	1,531,516.74	257.99	74.90	1,026,072.15	1,565,727,407.84
Mini hydro	4,100	1,704,289.30	273.34	18.30	1,220,830.17	2,500,193,863.65
Solar PV	7,442	399,928.90	297.69	209.1	288,371.47	3,157,595,059.78
Geothermal	450	236,520.00	30.00	0.0	129,139.92	0.00
TOTAL	23,229	4,870,268.25	1,001.51	319.55	3,383,480	8,372,473,614

Quality - standards and trainings

15

PV related standards and guidelines

- Power system study – determine point of connection by national utilities
- MS 1837: 2010 (1st rev)- Installation of grid-connected PV Sytsem – outlines the standards required for PV modules,inverter, electrical components, etc.
- Guideline for interconnection of PV system to LV and MV network
- IEC 61727-PV Systems Characteristics of the utility interface
- RE (Technical and Operational) rules 2011
- Procedure for Testing and Commissioning


MALAYSIAN STANDARD
MS 1837:2005
INSTALLATION OF GRID - CONNECTED PHOTOVOLTAIC (PV) SYSTEM
© Copyright 2005
DEPARTMENT OF STANDARDS MALAYSIA

T&C Procedures

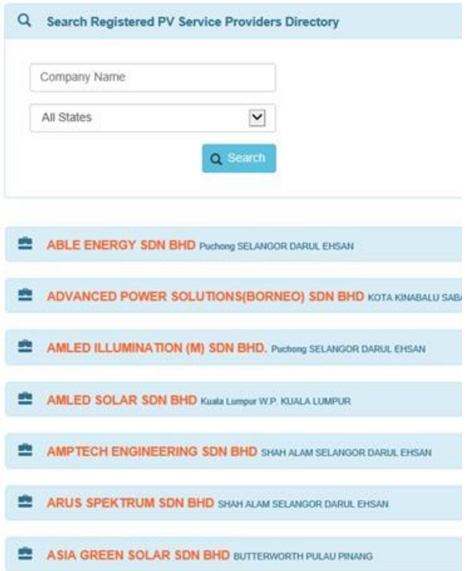
- T&C for biomass, biogas and small hydros
- Available/ downloadable at www.seda.gov.my
- Download→guidelines→

1. OVERVIEW AND REFERENCE STANDARDS	PDF
2. PART 1 - a. SYSTEMS LESS THAN OR EQUAL TO 12 kWp	PDF
b. SYSTEMS LESS THAN OR EQUAL TO 12 kWp (USE OF MICROINVERTER IN THE PV SYSTEM) - NEW	PDF
3. PART 2 - SYSTEMS GREATER THAN 12 kWp AND LESS THAN 72 kWp	PDF
4. PART 3 - SYSTEMS EQUAL TO OR GREATER THAN 72 kWp AND UP TO 425 kWp	PDF
5. PART 4 - SYSTEMS GREATER THAN 425 kWp	PDF
6. INVERTER SITE TESTS - PV PLANTS CONNECTED AT MEDIUM VOLTAGE	PDF

17

Registered PV *Service Providers*

- FiT was started – free market, anyone can be an installer—caused much problems ie quality of systems, closed business after secured projects, no continuity, etc.
- Started in 2014 - All installations under FiT programme only by Regstered PV Service Providers as listed at SEDA's website
- 118 registered companies, application online
- Annual renewal –expired every 31st Dec, abide by the terms & conditions and code of ethics

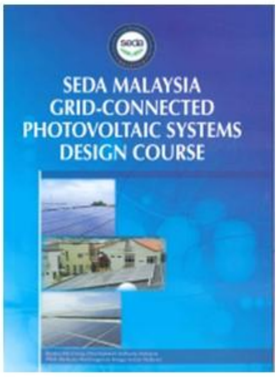


18

Solar PV Courses

1. Grid-Connected Solar PV Systems Design

- Started with Institute of Sustainable Power Quality (ISPQ) in 2007, the first country in ASEAN certified with ISPQ programme
- Training providers:
- Min req: Diploma in Engineeirng or Degree in Physics
- Duration : 8 days (including exam both theory and practical), set a very high standard, competent person is responsible in the design of solar PV projects performance.
- Hold trainings for ASEAN, participated by 8 countries in 2013



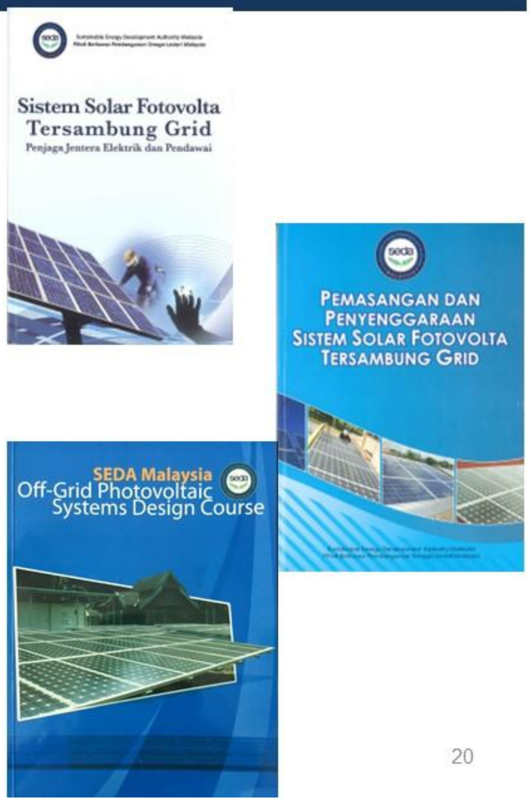
19

Solar PV Courses

2. Grid-Connected Solar PV for Wireman & Chargeman
   - Min req: Wireman/chargeman cert holder
   - Duration : 5 days (including exam)

3. Installation and maintenance of Solar PV system
   - Min req: Secondary high school cert
   - Duration : 2 mths (classroom & practical) + 2 to 4 OJT

4. Off-Grid Solar PV Systems Design
   - Min req: Diploma in engineering or Degree in Applied Physics
   - Duration: 10 days (including exam)



20

Way forward

21

Challenges Faced by RE Developers

Feedstock issues

- Getting a steady and assured supply of EFB, padi husk, MSW, etc., at a reasonable price (biomass)

Grid connection issues

- Distance from Grid (small hydro and biogas)
- Technical issues like voltage rise and lack of local load due to remote location of RE plants, as well as high fault current
- Delays and other problems with utility connection at local level

Finance

- Some pioneer failed and failing biomass and small hydro plants give a negative perception of RE
- Long lead time and security of feedstock issues, leading to higher risk

Permits

- Delays and difficulties in getting State Government, Forestry Dept., DOE, and other agencies (small hydro)

Many of these issues are not faced by PV developers!

22

Where are we in terms of achievement?

RE types	2015 – capacity target under FIT	2015 – FITCD (as at 30 Sept 2015)
Solar	65 MW	209.12 MW
Biogas	100 MW	17.23 MW
Biomass (agri & msw)	530 MW	74.90 MW
Small hydro	290 MW	18.30 MW
Geothermal	0 MW	0.0 MW
Target in 2015	985 MW	**319.55 MW**
		Target of 985MW (Only 32% of target!)

- With 1.6 % contribution to RE Fund, max capacity from FiT by 2020 is 1500 MW – about 72 % of target (2 GW)
- From 1500 MW total FiT capacity, about 500 MW will be from PV since PV FiTs will end in 2017

Life Beyond the FiT

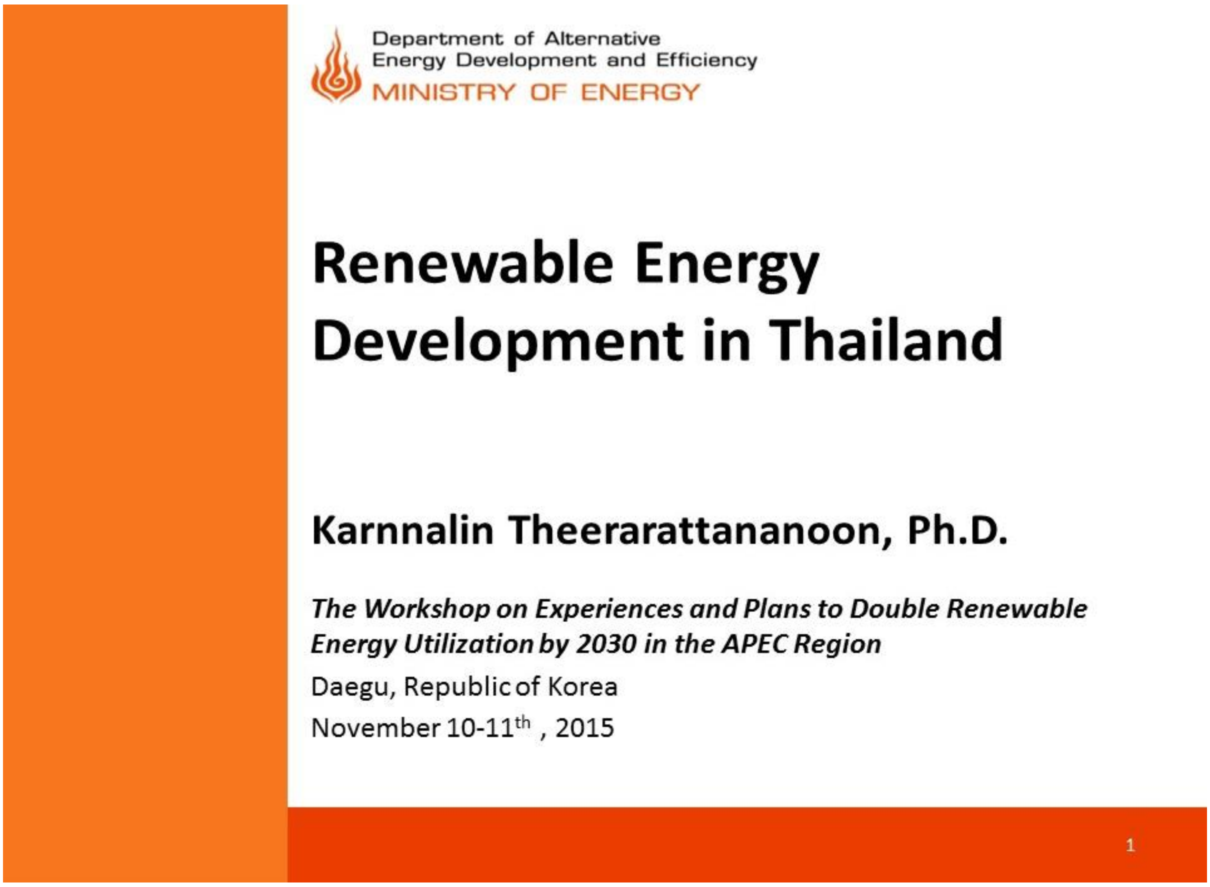
- FiT for solar PV will stop after 2017 due to constrain in RE Fund to allocate more quota
- Other RE quota will continue until 2025
- Continuation for PV:
  - Net energy metering (NEM) quota of 500 MW until 2020 (100 MW quota allocation per year commencing 2016)
  - Proposed **Utility-Scale Solar** (USS) quota of 1,000 MW until 2020 over (200 MW per year commencing 2016) **
  - Total of additional 1,500MW to make up for the shortfall

** Subject to Ministry's approval

24

5-2. Renewable Energy Development in Thailand

Karnnalin Theerarattananoon
Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand



Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Content

1. Thailand's Energy Situation
2. Thailand's RE Policy
3. Current RE Development Progress and Supporting Measures

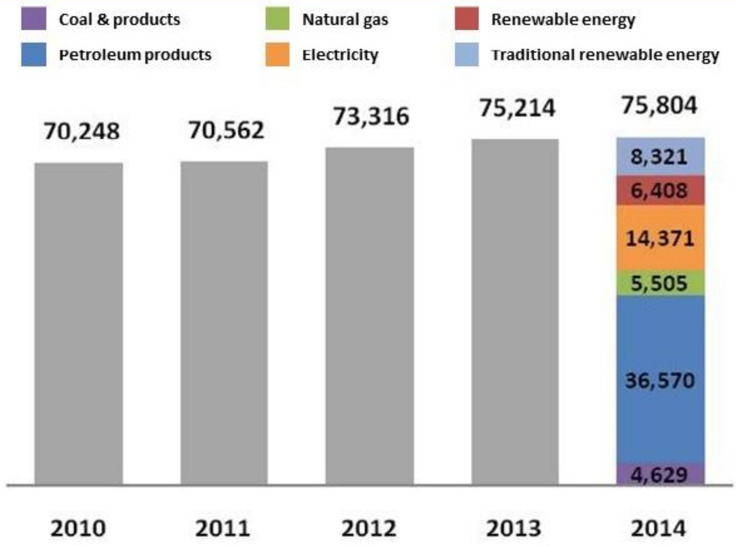
Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Thailand's Energy Situation

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Energy consumption has been growing at 2.4% per year; renewable account for >10% of consumption

Thailand final energy consumption, 2010-2014
Ktoe



- Since 2010, final energy consumption has been growing by ~2.4% per year
- In 2014, renewables accounted for a total of 9,025 ktoe of consumption, or ~11.9 %
  - 5,775 ktoe direct
  - 1,783 ktoe fuel
  - 1,467 ktoe converted electricity

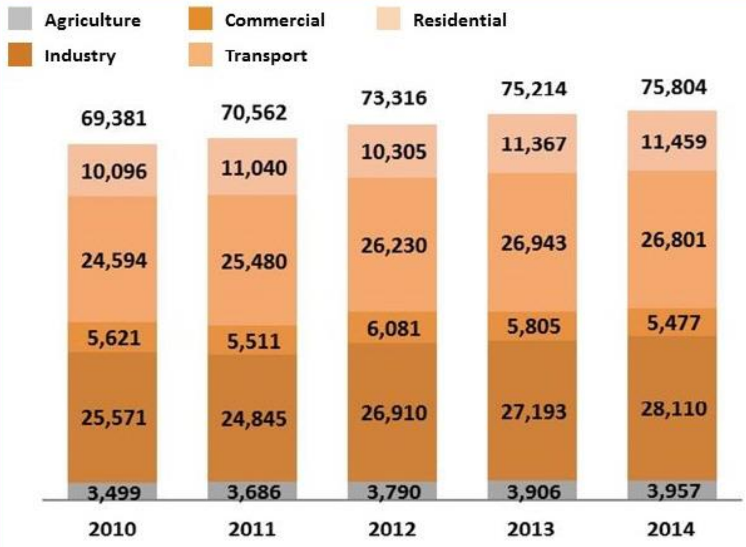
SOURCE: Energy in Thailand – Facts and Figures

4

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

The transportation and industrial segments account for 72% of Thailand's energy consumption

Thailand final energy consumption by industry, 2010-2014
Ktoe



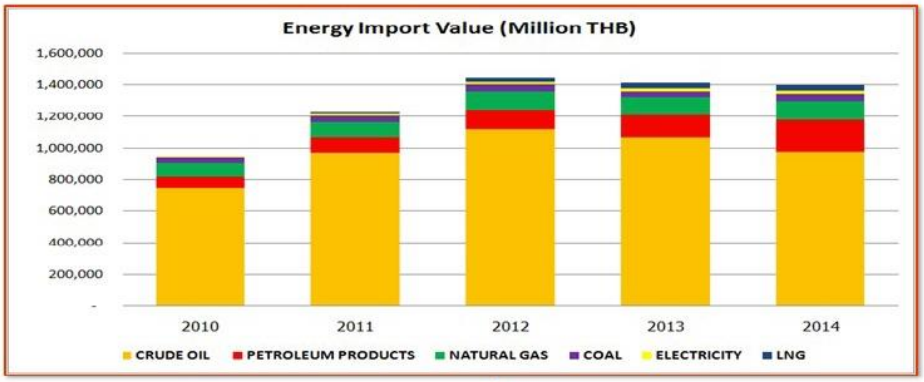
- Since 2010, the industrial sector has overtaken the transportation sector as the largest source of demand
- Industry and transportation both account for ~ 36% of total energy consumption

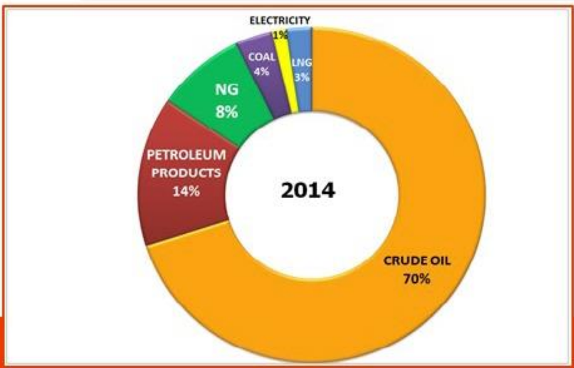
SOURCE: Energy in Thailand – Facts and Figures

5

Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

Thailand spent almost 1,400 Billion Baht for energy import to the country in year 2014





Energy Import Value in 2014
1,397,701 Million Baht

6

Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

Thailand's RE Policies

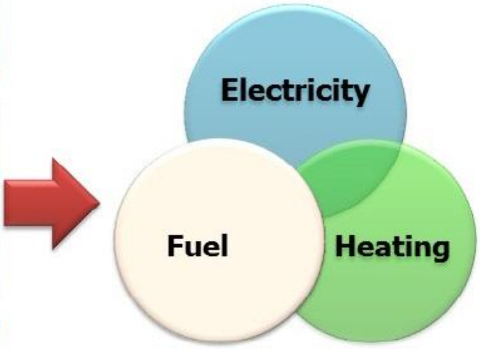
7

Thailand's RE Supply Potential

Natural
- Solar
- Hydro
- Wind

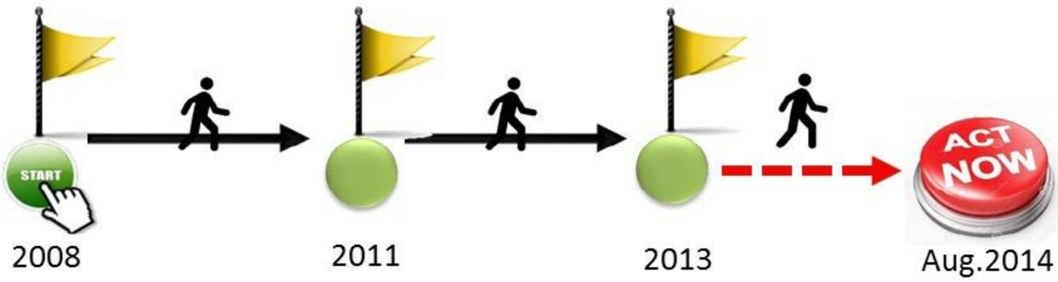
Crop
- Sugar cane (Molasses)
- Cassava
- Palm

Waste
- Agricultural wastes
- Industrial wastes
- Municipal solid waste (MSW)



Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

Revolution of Thailand's RE Plan

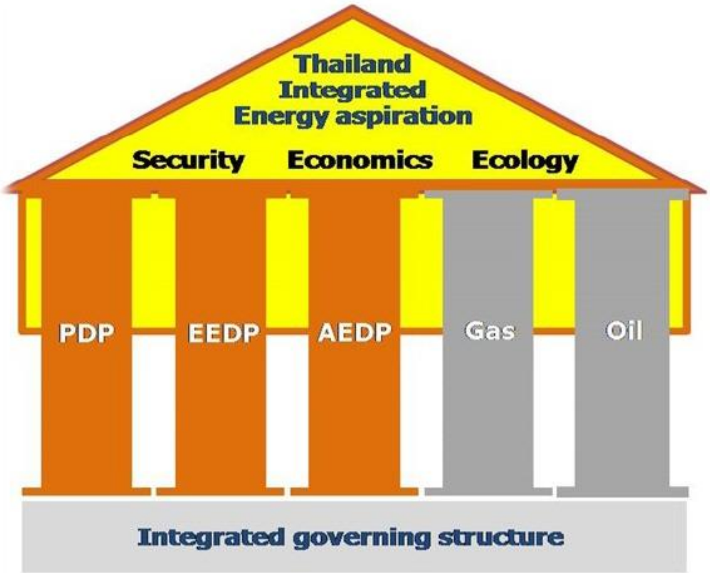


REDP 2008	AEDP 2012	AEDP 2012 Rev.1	AEDP2015
15 yrs (2008-2022)	10 yrs (2012-2021)	10 yrs (2015-2021)	21 yrs (2015-2036)
20.3%	25%	25%	30%

REDP: Renewable Energy Development Plan ; AEDP: Alternative Energy Development Plan

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Thailand's Integrated Energy Blueprint



Objectives

Security

- reliability

Economy

- Affordability
- Cost Competition

Ecology

- Sustainability
- Environmental awareness

Source: The National Energy Policy Council (NEPC)'s resolution on August 15th, 2014

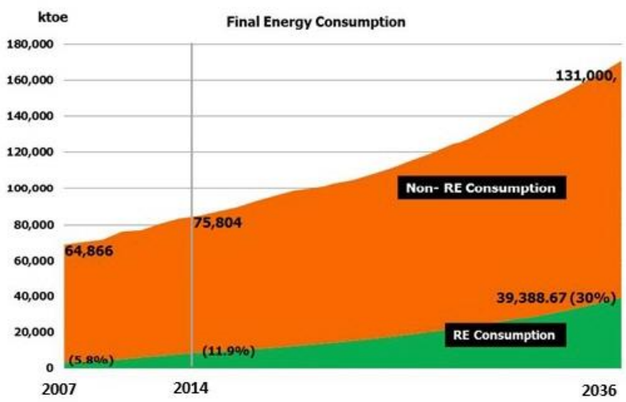
Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Highlight of AEDP 2015-2036

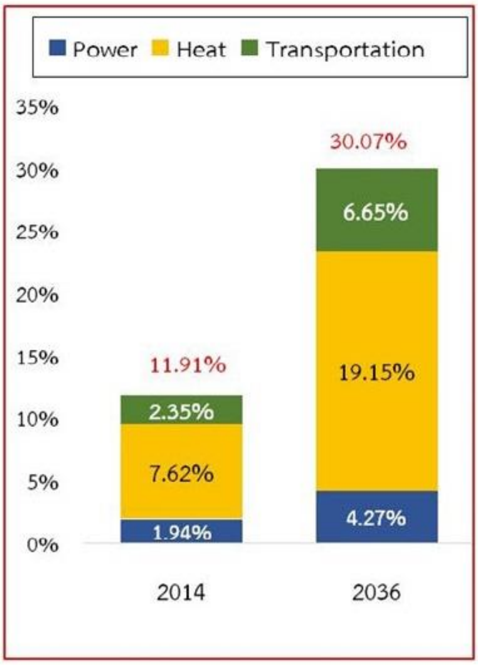
- ✓ Set timeline of the plan to match with other national energy plans
- ✓ Set RE Power Generation Zoning according to remaining RE supply potential in that area (RE Zoning)
- ✓ Promote development and deployment of WTE and biobased energy (biogas, biomass, energy crop) as first priority !
- ✓ Promote PV and Wind energy for power generation once their development cost can compete with LNG cost
- ✓ Replace the ADDER incentive scheme with Feed-in Tariff (FiT) scheme for very small RE power generation project (< 10 MW project size)
- ✓ Use competitive bidding scheme in conjunction with the FiT scheme for RE power generation sector

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Target is to increase share of RE in FEC to 30% in 2036



Energy Consumption in Y2036	ktoe
RE Consumption (ktoe)	39,388.67
Final Energy Consumption(ktoe)	131,000
Share of RE (%)	30%



SOURCE: The National Energy Policy Council (NEPC)'s resolution on September 17th, 2015

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

The Alternative Energy Development Plan is the current roadmap for renewable energy development targets

Foundation: Commitment to the development of a low-carbon society

Facilitator: *Private-led investment*

Alternative Energy Development Plan 2015-2036

Facilitator: *Government funded RD&D*

Goal: Target 30% renewables in Total Energy Consumption by 2036

Bio-Energy

E. Crop	Biogas	Biomass	MSW	Ind.Waste
680 MW	600 MW	5,570 MW	500 MW	50 MW
	1,283 ktoe	22,100 ktoe	495 ktoe	

7,776 MW Power | 23,878 ktoe Heat

Bio-Fuel

Ethanol	Biodiesel	CBG	Others*
~ 11 ML/Day	14 ML/Day	4,800 Ton/Day	~ 10 ktoe

* Other RE sources such as bio-oil, hydrogen, etc.

Solar

6,000 MW
1,200 Ktoe

Wind

3,002 MW

9,002 MW Power | 1,200 ktoe Heat

Hydro

Small Hydro	Large Hydro
376 MW	2,906.4 MW

3,282.4 MW Power

Alternative RE Source*

10 ktoe Heat

* Alternative RE sources such as geothermal energy, etc.

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Current RE Development Progress & Supporting Measures

14

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Power Generation Sector: Status & target

RE Technology	Year 2014 (MW)	Target in 2036 (MW)
1. MSW	65.7	500
2. Industrial Waste	-	50
3. Biomass	2,451.8	5,570
4. Biogas	311.5	600
5. Small Hydro Power	142	376
6. Biogas from Energy Crops	-	680
7. Wind	224.4	3,002
8. Solar PV	1,298.5	6,000
9. Large Hydro Power	-	2,906.4
Total	**4,494**	**19,684.4**
RE Share in Power Sector	**9%**	**20%**

15

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Heat Sector: Status & target

RE Technology	Year 2014 (ktoe)	Target in 2036 (ktoe)
1. MSW	98.1	495
2. Biomass	5,184	22,100
3. Biogas from Wastewater/Animal Manure	488.1	1,283
4. Solar	5.12	1,200
5. Others*	-	10
Total	**5,775**	**25,088**
RE Share in Heat Sector	**17%**	**30-35%**

* Other RE sources such as geothermal energy, etc.

16

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Transportation Sector: Status & target

RE Technology	Year 2014	Target in 2036	
	(ML/day)	(ML/day)	(ktoe)
1. Biodiesel	2.89	14	4,404.8
2. Bioethanol	3.21	11.3	2,103.5
3. Pyrolysis-Oil	-	0.53	170.8
4. Compressed-Biomethane Gas (tons/day)	-	4,800	2,023.2
5. Other Alternative Fuels*	-		10
Total	**6.1**		**8,712.4**
RE Share in Transportation Sector	**7%**		**20-25%**

* Other alternative fuels such as hydrogen, bio-oil, etc.

17

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

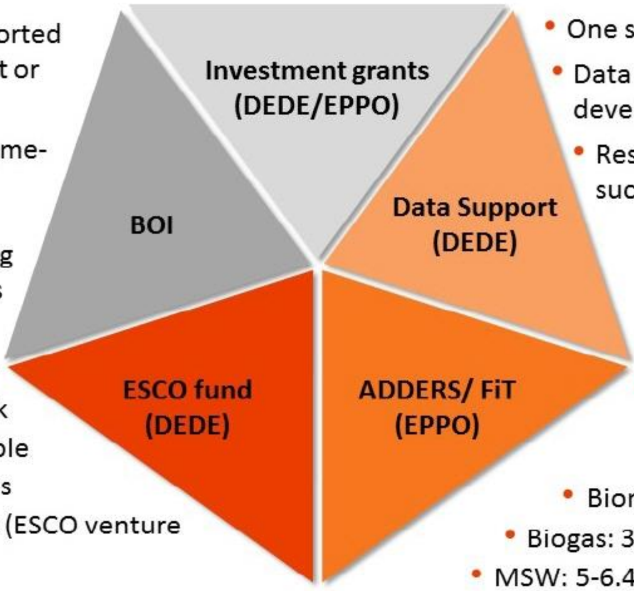
Key success factors

WTE	• Effective waste management/waste sorting system • Effective collaboration among relevant WTE responsible parties
Biomass	• Successful improvement of biomass supply chain system • Successful improvement of biomass logistic/collection system • Successful development of community-scale biomass energy technology
Energy Crop	Successful development of energy crop pilot project that can be used as business model
Solar PV	Advancement of solar PV technology development to the stage in which its LCOE cost can be competitive with fossil fuel cost
Wind	Successful development of wind turbine technology that is suitable for low wind speed potential in Thailand
Smart Grid	Successful development of smart grid system to improve the power demand-supply management via smart technology and thus allow more RE integration into the national grid

18

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

The Ministry of Energy employs several tools to incentivize renewable energy development



- Exemption of imported duty of equipment or machines
- Exemption of income-corporate taxes resulting from Selling RE or saving energy for periods up to 8 years

- One stop service center
- Data on renewable development progress
- Resource data maps, such as solar and wind

- Provides lower risk capital to renewable focused businesses
- Equity investment (ESCO venture capital)
- Equipment leasing
- Credit guarantee facility

- FiT paid for very small renewable power producers
- Biomass : 4.2-5.4 THB
- Biogas: 3.7-5.4 THB
- MSW: 5-6.4 THB
- Wind: 6.06 THB
- Small Hydro: 4.9 THB

19

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

The Ministry of Energy functions as a single source for renewable capacity and development data

One of DEDEs data capabilities is renewable resource mapping; comprehensive solar and wind maps have been developed

20

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Feed in Tariff (FiT) for VSPP scale

Installed Capacity (MW)	FiT (THB/kWh)			Supporting Period (years)	FiT Premium (THB/kWh)	
	FiT_F	(1) $FiT_{V,2560}$	FiT		Biobased Fuel (for the first 8 yrs)	special Southern zones(2) (for project lifetime)
Waste-to-Energy						
≤ 1 MW	3.13	3.21	6.34	20	0.70	0.50
> 1-3 MW	2.61	3.21	5.82	20	0.70	0.50
> 3 MW	2.39	2.69	5.08	20	0.70	0.50
Landfill organic waste	5.60	-	5.60	10	-	0.50
Biomass						
≤ 1 MW	3.13	2.21	5.34	20	0.50	0.50
> 1-3 MW	2.61	2.21	4.82	20	0.40	0.50
> 3 MW	2.39	1.85	4.24	20	0.30	0.50
Biogas from wastewater/manure	3.76	-	3.76	20	0.50	0.50
Biogas from energy crops	2.79	2.55	5.34	20	0.50	0.50
Small hydro						
≤ 200 kW	4.90	-	4.90	20	-	0.50
Wind	6.06	-	6.06	20	-	0.50

(1) FiT_V is subjected to be adjusted by core inflation
(2) Includes 3 Southern provinces (Yala, Pattani, Narathiwas) and 4 districts in

21

FiT for Industrial Waste

Installed Capacity (MW)	FiT (THB/kWh)			Supporting Period (years)	FiT Premium (THB/kWh)	
	FiT_F	$FiT_{V,2560}$	FiT(1)		for the first 8 years	special Southern zones(2) (for project lifetime)
For existing WTE power plant that used incineration technology and had been in operation till February, 16th 2015						
All VSPP size	2.39	2.69	5.08	20	0.70	0.50
For new WTE power plant						
All VSPP size	3.39	2.69	6.08	20	0.70	0.50
For new WTE power plant that uses plasma technology						
All VSPP Size	3.39	2.69	6.08	20	1.70	0.50

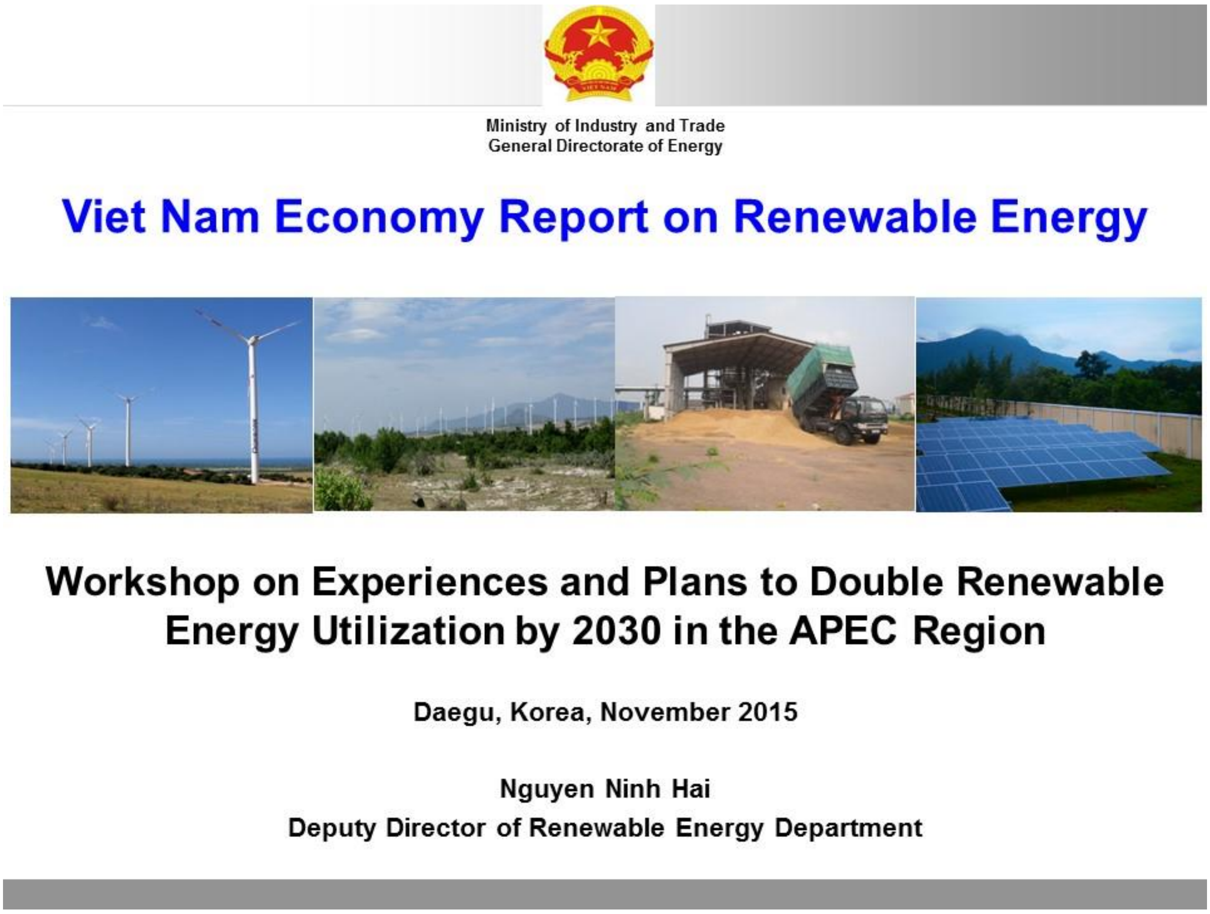
(1) FiT_V is subjected to be adjusted by core inflation
(2) Includes 3 Southern provinces (Yala, Pattani, Narathiwas) and 4 districts in

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Thank you for Your attention

5-3. Viet Nam Economy Report on Renewable Energy

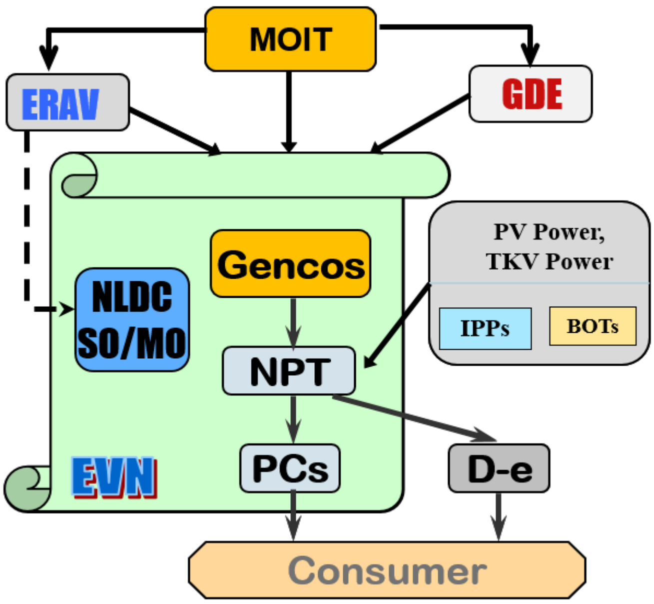
Nguyen Ninh Hai
Deputy Director of Renewable Energy Department
Ministry of Industry and Trade General Directorate of Energy, Viet Nam



Contents

1. Power sector overview: power consumption, power installed capacity, power generation
2. Potential on Renewable energy
3. Current development status on Renewable energy
4. Targets on RE development
5. Summary on RE policies
6. Renewable Energy Future Directions

1. Power Sector Overview – Management Structure



MOIT – Ministry of Industry and Trade

GDE – General Directorate of Energy

ERAV – Electricity Regulatory Authority of Viet Nam

EVN - Electricity of Viet Nam

NLDC– National Load Dispatch Centre

IPP – Independent Power Plant

BOT – Built-Operate-Transfer Power Plant

Gencos – EVN Owned Generation Companies

NPT – National Power Transmission Corporation

PCs – Power Corporations

D-e – Equitized Distribution Companies

1. Power Sector Overview

❖ **Power consumption in period 2010-2014**

No	Consumers	2010		2011		2012		2013		2014		Growth rate
		GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	%
1	Agriculture, Forestry, Fishing	942	1,1	1.079	1,1	1.265	1,2	1.528	1,3	1.893	1,5	19,1
2	Industry, Construction	44.428	51,9	50.085	52,9	55.300	52,4	60.386	52,5	69.185	53,9	11,7
3	Comerces, Hotels, Restaurants	3.896	4,6	4.335	4,6	4.988	4,7	5.403	4,7	6.126	4,8	12,0
4	Residentials	32.150	37,6	34.456	36,4	38.691	36,7	42.144	36,6	45.695	35,6	9,2
5	Others	4.170	4,9	4.703	5,0	5.230	5,0	5.609	4,9	5.535	4,3	7,3
	Total	**85.586**		**94.658**		**105.474**		**115.069**		**128.434**		**10,7**

1. Power Sector Overview

❖ **Installed capacity in period 2010-2014**

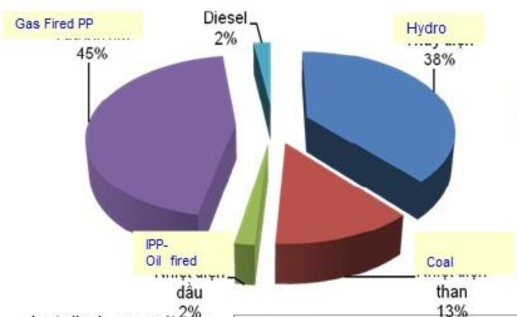
Power sources	2010		2011		2012		2013		2014	
	MW	%	MW	%	MW	%	MW	%	MW	%
Hydro power (>30MW)	8.124	37,7	10.100	41,0	12.009	44,1	13.261	42,5	13.617	39,4
Coal-fired power plant	3.941	18,3	4.451	18,1	4.900	18,0	7.023	22,5	9.843	28,5
FO power plant	575	2,7	574	2,3	574	2,1	537	1,7	537	1,6
Gas-fired power plant	468	2,2	468	1,9	468	1,7	468	1,5	468	1,4
Gas turbine	6.934	32,2	7.434	30,2	7.446	27,4	7.446	12,9	7.446	21,6
Import	1.000	4,6	1.100	4,5	739	2,7	739	2,4	559	1,6
Diesel, small hydro power..	500	2,3	500	2,0	1.078	4,0	1.740	5,6	2.054	5,9
Total installed capacity	**21.542**		**24.627**		**27.214**		**31.213**		**34.524**	

1. Power Sector Overview

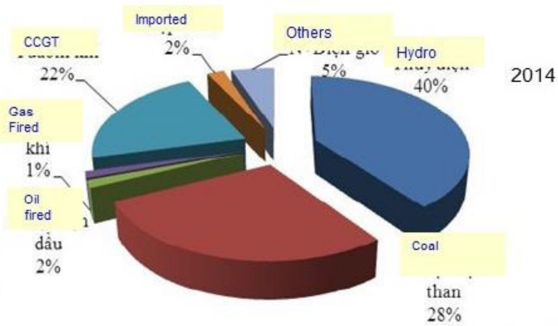
❖ **Power generation in period 2010-2014**

Power sources	2010		2011		2012		2013		2014	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
Hydro power (>30MW)	27.550	27,5	40.924	37,6	52.795	43,9	56.943	43,5	59.840	41,1
Coal-fired power plant	17.562	17,5	20.500	18,9	22.716	18,9	26.863	20,5	37.645	25,9
FO power plant	3.262	3,3	1.721	1,6	43	0,0	52	0,0	104	0,1
Gas-fired power plant	553	0,6	576	0,5	311	0,3	197	0,2	184	0,1
Gas turbine	45.097	45,1	39.967	36,8	41.250	34,3	42.745	32,6	44.896	30,8
Import	5.599	5,6	4.959	4,6	2.676	2,2	3.663	2,8	2.326	1,6
Other (Diesel, small hydro power, wind..)	448	0,4	78	0,1	467	0,4	529	0,4	545	0,4
Total	**100.071**		**108.725**		**120.258**		**130.992**		**145.540**	

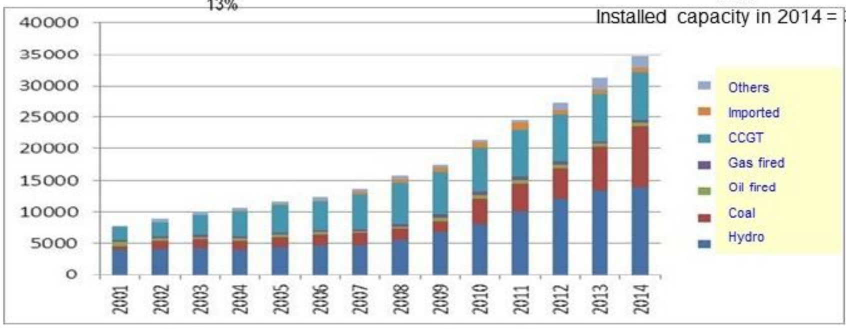
1. Power Sector Overview



Installed capacity in 2005 = 11.6 GW



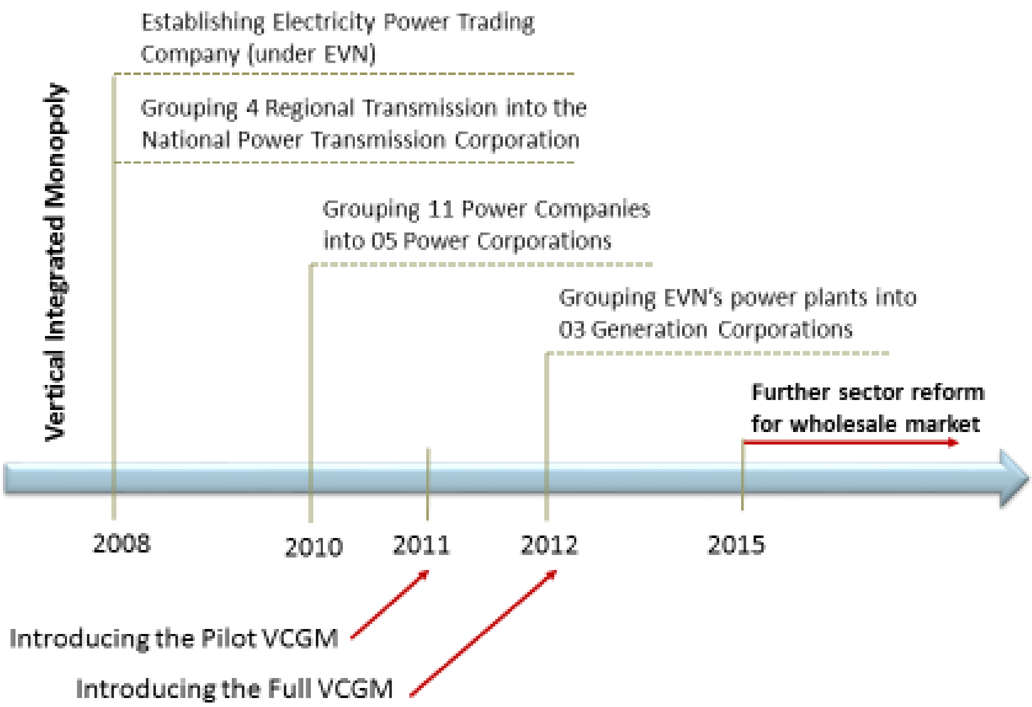
Installed capacity in 2014 = 34.6 GW



➢ ~ 23 GW was put into operation in recent 9 years (growth rate : 13%/year)

1. Power Sector Overview

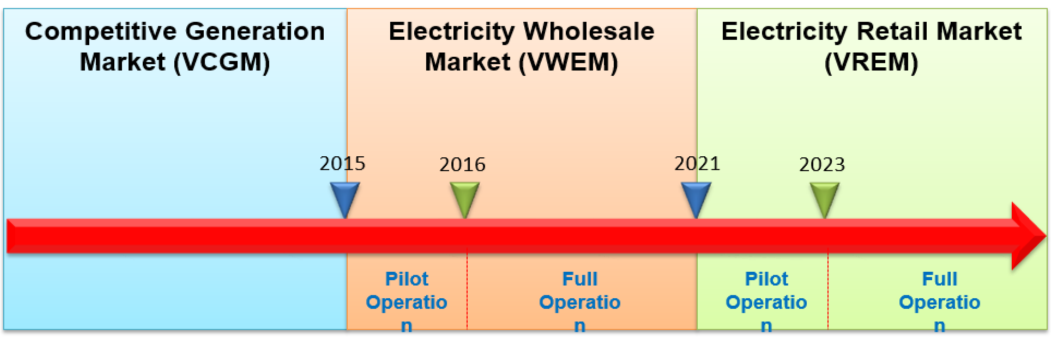
Power Market and Power Sector Reform



1. Power Sector Overview

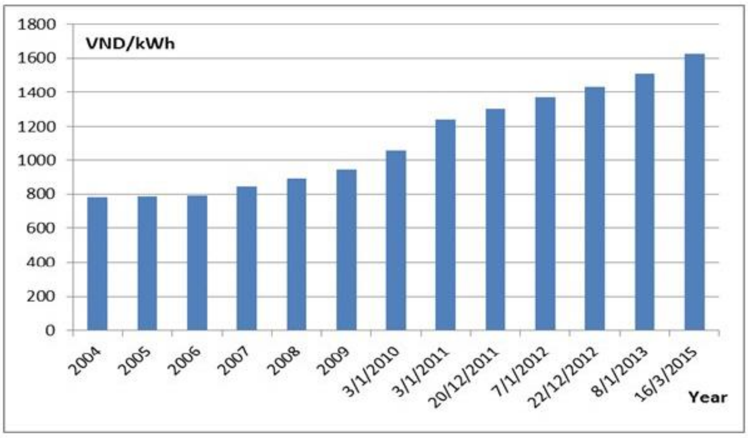
Power Market and Power Sector Reform

- Roadmap for introducing and developing Electricity Market in Viet Nam: approved by the Prime Minister in Decision No 63/2013/QD-TTg



1. Power Sector Overview

Electricity retail tariff (updated March 2015)

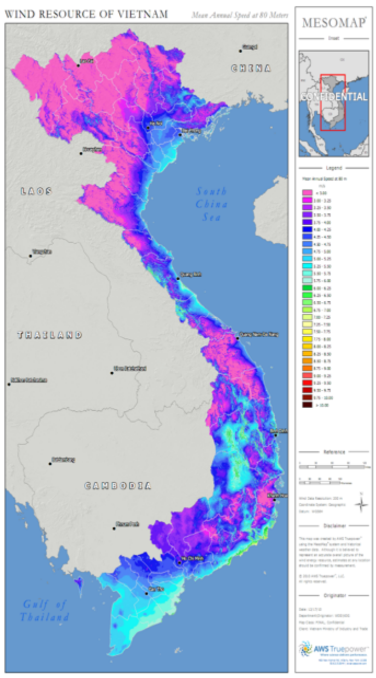


- 2004-2009: increase rate 3.8%/a
- 2010-2015: increase rate: 9.5%/a
- Current price: 1,622VND/kWh ~ 7.3UScent/kWh

2. Potential on RE development - Wind power

Wind energy theoretical potential based on the Wind Resource Atlas of Viet Nam
(assumed an average density of 10 MW/km2)
(Source: WB report 2011)

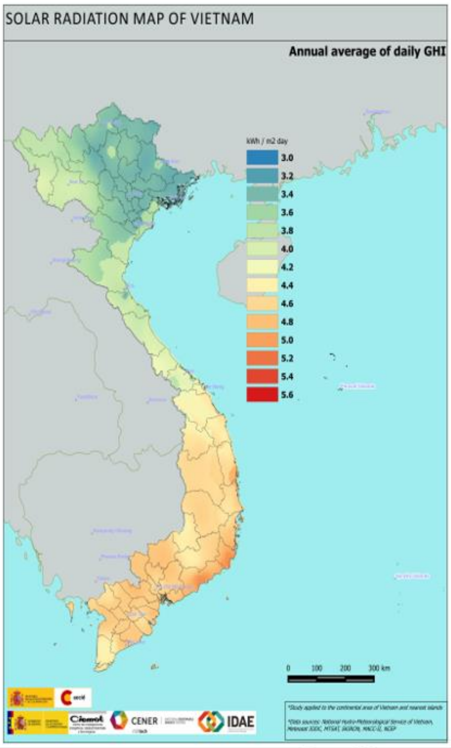
Mean Speed at 80 m Height (m/s)	Estimated Developable Land Area (km²)	Percentage of Developable Land	Approximate Megawatt Potential
<4	95,916	45.7%	959,161
4-5	70,868	33.8%	708,678
5-6	40,473	19.3%	404,732
6-7	2,435	1.2%	24,351
7-8	220	0.1%	2,202
8-9	20	0.01%	200
>9	1	0.00%	10
Total	**209,933**	**100.00%**	**2,099,333**



2. Potential on RE development - Solar power

Solar radiation map of Viet Nam
Annual average of daily Global Horizontal Irradiation
(Source: CIEMAT report, 2014)

Area	Annual average of daily Global Horizontal Irradiation (kWh/m2/day)
North	3.4
North central coast	3.8
South, central highlands and south central coast	4.8



3. RE development – current development status

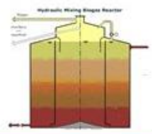
Small Hydro

Potential: ~ 7.000 MW
Present: ~ 1670 MW

Biomass

Potential: ~ 2000 MW
Present: ~ 150 MW

Biogas



Solar energy

Potential: ~ 4-5kWh/m²
Present: ~ 4 MW
(Households, pilot projects)

Wind energy

Potential: ~8,000 MW (>=6 m/s)
Present: 52 MW (46 MW grid-connected, 6 MW off-grid)

Geothermal

M.Solid wastes

Potential: ~ 320 MW
Present: ~ 2.4 MW

Ocean energy

4. RE development - Targets

RE Targets (From PDP 7 issued in 2011)

Increasing share of RE generation to **4.5%** of total power generation in 2020, and about 6% in 2030 (not included hydro power>30 MW).

Wind power: 1,000MW in 2020; 6,200MW in 2030

Biomass: 500MW in 2020; 2,000MW in 2030

Electrifying the remote, high mountain area (no grid) by renewable energy: 231,000 households to year 2020.

5. Summary on RE policies

RE type	Status		Level	Note
	Existing	Proposing		
Small hydro	Avoided cost		By year, by season (about 5 UScents/kWh)	
Wind power	FIT	revising	7.8 UScents/kWh	Under revising
Biomass	FIT		- CHP: 5.8 UScent/kWh - Generation Cost from imported coal power plant	Under studying
MSW	FIT		- Land fill gas:7.28 UScent/kWh - Direct combustion: 10.05 UScent/kWh	
Solar PV	Drafting	FIT	-Solar farm: 11.2 US cents/kWh -Rooftop: 12 US cents/kWh	Planed to submit PM by 6/2016
Biogas		FIT	Under studying	
Geothermal		FIT	Under studying	

5. Summary on RE policies

- ✓Corporate tax exemption for the first four years and reduce to 50% in the next 9 years. CIT rate is 10% (other sectors are 22%)
- ✓Import tax exemption
- ✓Obligation to purchase electricity: EVN must purchase all electricity
- ✓Standard PPA for 20 years
- ✓Tax and land use fee exemption

Page 16

6. Renewable Energy Future Directions

Study price mechanism:

- Other renewable energy types: biogas, ocean, tide
- Review/ revise FIT for wind power
- Renewable Portfolio Standard – RPS. For example: coal-fired power producers with 1000 MW installed capacity must have at least 30MW from Renewable energy.
- Net-metering mechanism
- Establishment of RE Fund: environmental fee, carbon taxes and so on.

Assessment on RE potential

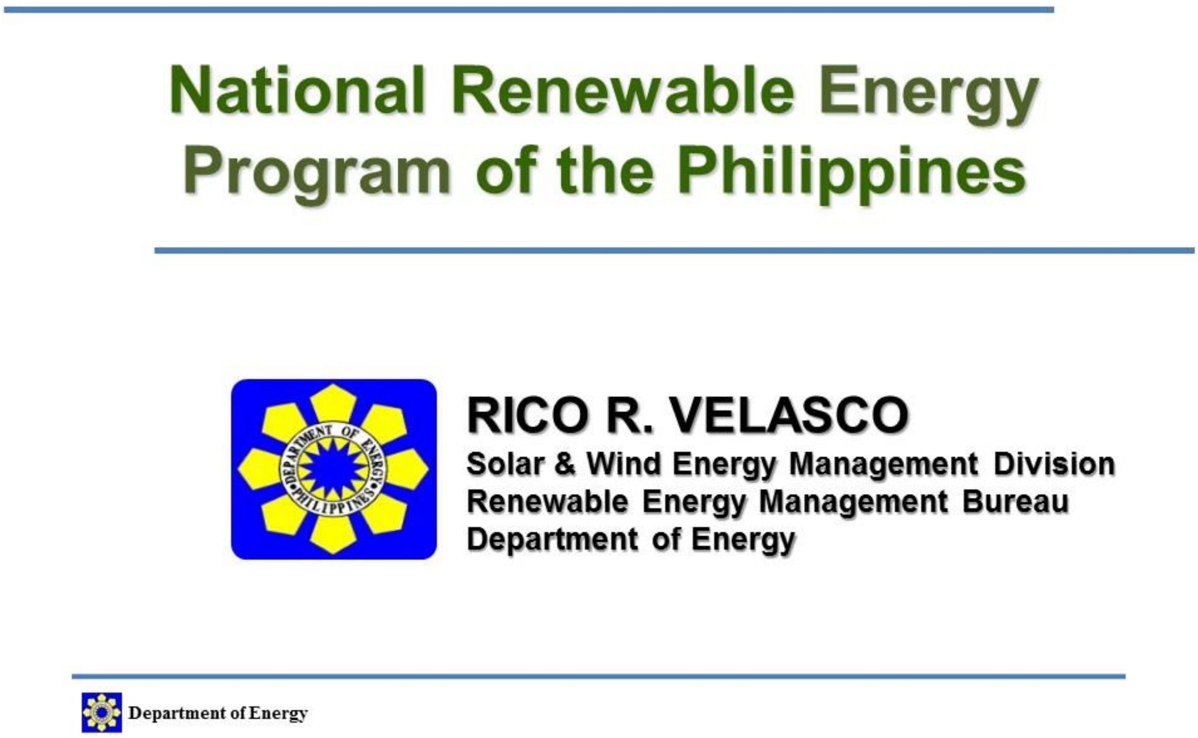
- Study RE potential: wind power, biomass, biogas and so on
- Establishment database on RE

Page 17

Thanks for your attention !

6-1. National Renewable Energy Program of the Philippines

Rico R. Velasco
Solar & Wind Energy Management Division, Renewable Energy Management Bureau, Department of Energy



Outline of Presentation

I. Government Policies

II. Status of Renewable Energy Development

- Renewable Energy Policy Updates

III. Challenges

IV. Way Forward

I. Government Policy

Renewable Energy Act of 2008 (RA 9513)

Accelerate the development of the country's renewable energy resources by providing fiscal and non-fiscal incentives to private sector investors and equipment manufacturers/suppliers.

Biofuels Act of 2006 (RA 9367)

Provide fiscal incentives and mandate the use of bio-fuel-blended gasoline and diesel fuels

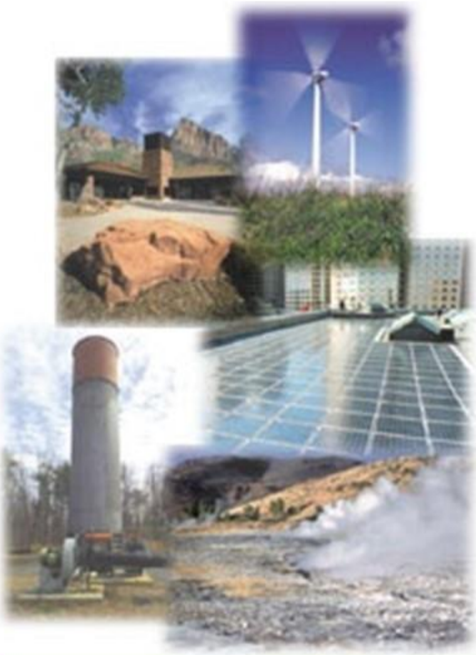
BIODIESEL

- 2008 consumption of 91 million liters (CME)
- 1% biodiesel blend sold in all gasoline stations
- 2% biodiesel blend by Feb. 6, 2009

BIOETHANOL

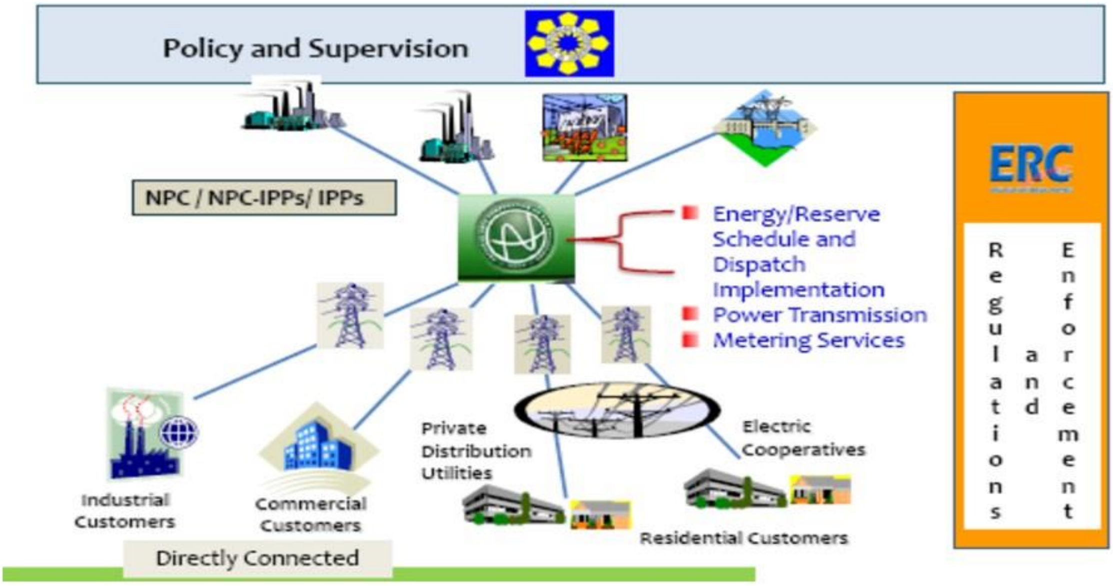
- Start of 5% by total volume mandate on Feb. 6, 2009
- 10% bioethanol blend to all gasoline on Feb. 6, 2012

Renewable Energy



- **Bi** omas/**Bi**ofuels
- **G** eothermal
- **S** olar
- **H** ydropower
- **O** cean
- **W** ind

Electric Power Industry Structure



POLICY DIRECTIONS

- Accelerate the exploration and development of renewable energy resources
  - achieve energy self-reliance
    - to reduce the country's dependence on fossil fuels
    - minimize the country's exposure to price fluctuations
  - adoption of clean energy to mitigate climate change
  - promote socio-economic development in rural areas
- Increase the utilization of renewable energy by providing fiscal and non fiscal incentives.

POLICY MECHANISMS

Non-Fiscal Incentives

- **Creation of RE Market**
  - **Renewable Portfolio Standard (RPS) – mandatory percentage**
  - **Off-Grid Development**
- **Guaranteed long-term fixed price**
  - **Feed-in Tariff**
- **Other Market Options**
  - **Net Metering – off-setting of electricity used**
  - **Green Energy Option**

NON-FISCAL INCENTIVES

- Renewable Portfolio Standards (RPS) – on-grid "RE blend" obligation
- Off-grid RE Development - minimum "off-grid RE blend" obligation
- Net Metering – "consumer RE facility to offset electricity from grid"
- Feed-in Tariff (FIT) - "RE guaranteed fixed price for 20 years"
- Transmission and Distribution System Development – "RE connection facilities in the T/D Development Plan"
- Green Energy Option - "end-users option to choose RE as source of electricity"
- Adoption of Waste-to-Energy Technologies

FISCAL INCENTIVES

- Income Tax Holiday and Low Income Tax Rate
- Reduced Government Share
- Duty-free Importation of Equipment and VAT-zero Rating
- Tax Credit on Domestic Capital Equipment
- Special Realty Tax Rate on Equipment and Machinery
- Cash Incentive for Missionary Electrification
- Exemption from Universal Charge
- Payment of Transmission Charges
- Tax Exemption on Carbon Credits

Department of Energy 10

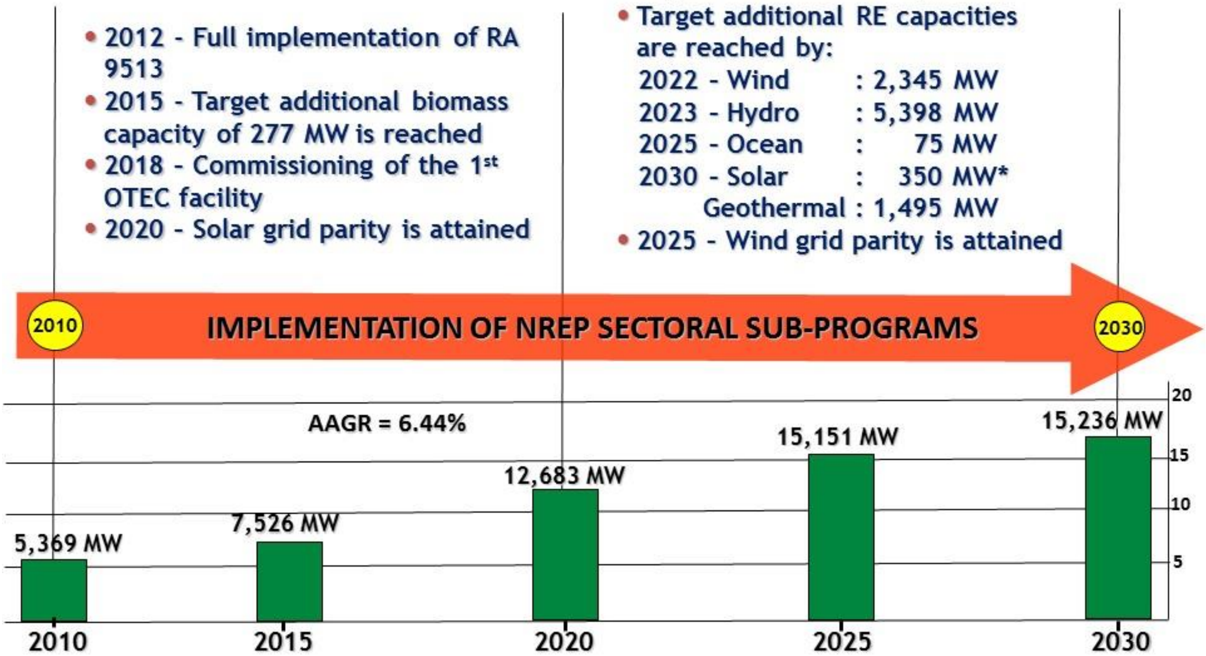
National Renewable Energy Program

Goals

- Increase RE-based capacity by 200% within the next 20 years (2011-2030)
- Increase non-power contribution of RE to the energy mix by 10 MMBFOE in the next ten years
  - Be the number one geothermal energy producer in the world (additional 1,495 MW)
  - Be the number one wind energy producer in Southeast Asia (up to 2,500 MW)
  - Double hydro capacity (additional 5,400 MW)
  - Expand contribution of;
    - biomass - 265 MW
    - solar - at least 350 MW
    - ocean energy – at least 10 MW

Department of Energy 11

NREP ROADMAP (2010-2030)



Note: The National Renewable Energy Program (NREP) is a live document and will be subjected to public consultations. Figures presented may change based on regular updates of the NREP.

NREP TARGETS, 2011-2030

Sector	Short Term	Medium Term	Long Term	Total
	2011-2015	**2016-2020**	**2021-2030**	
Geothermal	220 MW	1,100 MW	175 MW	1,495 MW
Hydropower	341.3 MW	3,161 MW	1,891.8 MW	5,394.1 MW
Biomass	276.7 MW	0	0	276.7 MW
Biofuels	•DC on E10 in 2011 •Mandatory E10 to all Gasoline by 2012 •PNS for B5 by 2014 •DC on B5 by 2015 •Mandatory B5 to all Diesel by 2015	•PNS for B20 & E85 by 2020 •DC on B10 and E20 by 2020	•DC on B20 and E85 by 2025	
Wind	200 MW	700 MW	1,445 MW	2,345 MW
Solar	50 MW	100 MW	200 MW	350 MW
Ocean Power	0	35.5	35	70.5
Total	**1,088 MW**	**5,096.5 MW**	**3,746.80 MW**	**9,931.3 MW**

II. Status of Renewable Energy Development

Updates on RE Policy Mechanisms

Renewable Portfolio Standard (RPS)

- Mandatory (percentage) utilization of RE generation system in on-grid systems
  - *For Department of Energy's finalization*

Renewable Portfolio Standards (RPS) for Missionary Areas

- Mandated minimum percentage of RE generation
  - *For National Renewable Energy Board's finalization*

Green Energy Option Program

- End-users' option to purchase electricity from RE facilities (open access)
  - *For Department of Energy's finalization*

Department of Energy 14

Feed-in-Tariff (FIT)

- Priority connection to the grid
- Priority purchase and transmission of and payment for by grid system operators. Fixed tariff for at least 12 years
- To be applied for generation utilized in complying with RPS
  - *The FIT Rules was promulgated by ERC on August 12, 2010.*
  - *The ERC approved the FIT Rates on July 27, 2012.*
  - *The DOE issued the Guidelines for the Selection Process of RE Projects under FIT System, which took effect on June 2013*
  - *FIT Allowance - FIT-ALL Payment and Collection Guidelines*
    - *The ERC Approved the Guidelines on December 2013*
  - *Amendment of DOE's installation target*
    - *The DOE issued a Certification to amend installation targets of Solar Energy Generation (50 MW to 500 MW) on April 30, 2014 and Wind Energy Generation (200 MW to 400 MW on 07 April 2015)*

Net-Metering Rules and Interconnection Standards

- Connection/sale of customers' RE generation to the grid
  - *The ERC approved the Net Metering Rules last May 27, 2013*
  - *Conducting nationwide IEC for LGUs, DUs, consumers*

Department of Energy 15

Feed-In Tariff (FIT) Rates

RE Technology	FIT Rate (PhP/kWh)	Degression Rate	Installation Target (MW)
Wind	8.53	0.5% after 2 years from effectivity of FIT	400*
Biomass	6.63	0.5% after 2 years from effectivity of FIT	250
Solar	9.68** (8.69)	6% after 1 year from effectivity of FIT	500*
Run-of-River Hydropower	5.90	0.5% after 2 years from effectivity of FIT	250
Ocean	Deferred		10
			1,210 MW

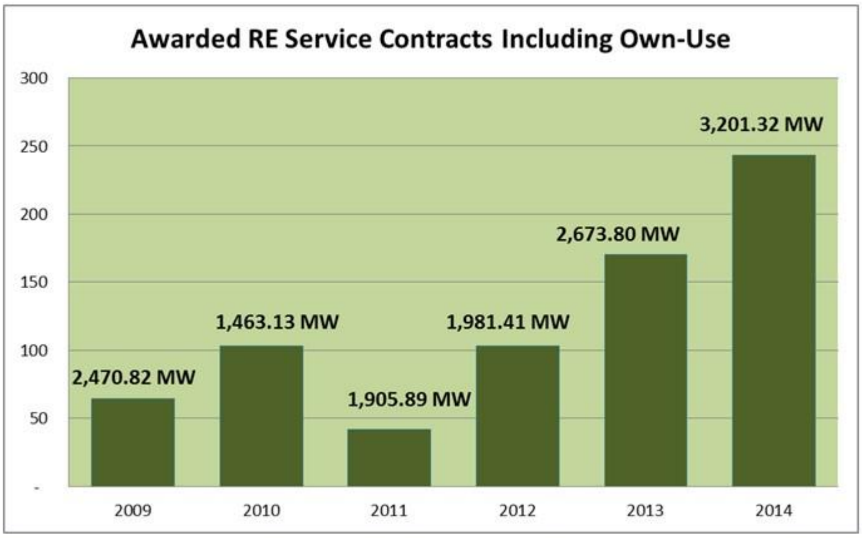
* Amended solar energy installation target from 50 MW to 500 MW and 200 MW to 400 MW for Wind.

** Php 9.68 is effective until March 15, 2015, while new rate Php 8.69 was approved by ERC effective until March 15, 2016

Capacity Mix, 2014

FUEL TYPE	PHILIPPINES			
	CAPACITY (MW)		PERCENT SHARE (%)	
	Installed	Dependable	Installed	Dependable
Coal	5,708	5,378	31.81	34.43
Oil Based	3,476	2,692	19.37	17.24
Natural Gas	2,862	2,760	15.95	17.67
Geothermal	1,918	1,607	10.69	10.29
Hydro	3,543	2,982	19.75	19.09
Wind	283	103	1.58	0.66
Solar	108	17	0.13	0.11
Biomass	131	81	0.73	0.52
TOTAL	**18,029**	**15,620**		

Renewable Energy Projects Awarded by Year



Year	2009	2010	2011	2012	2013	2014	TOTAL
No. of RESCs	64	103	42	103	170	243	**725**
Capacity (MW)	2,470.82	1,463.13	1,905.89	1,981.41	2,673.80	3,201.32	**13,696**

Summary of Awarded RE Projects
(As of September 2015)

RESOURCES	AWARDED PROJECTS		POTENTIAL CAPACITY (MW)		INSTALLED CAPACITY (MW)	
	Grid-Use	Own-Use	Grid-Use	Own-Use	Grid-Use	Own-Use
Hydro Power	414	1	8,897.30	1.50	138.19	-
Ocean Energy	8	-	31.00	-	-	-
Geothermal	43	-	750.00	-	1,906.19	-
Wind	51	1	1,168.00	-	426.90	-
Solar	93	12	2,544.81	2.187	131.90	1.90
Biomass	40	23	249.07	6.42	191.55	140.43
Sub-Total	649	37	13,640.18	10.107	2,794.73	142.33
TOTAL	**686**		**13,650.29**		**2,937.06**	

RE Capacity Addition (MW)

RESOURCE	2014	2015	TOTAL
Biomass	77	12.5	89.5
Geothermal	50	10	60
Solar	22	109.9	131.9
Wind	303.9	90	393.9
Hydro	69.6	14.82	84.42
TOTAL	522.5	237.22	759.72

FIT Monitoring Board
(As of September 2015)

RESOURCE	FOR NOMINATION / CONVERSION		WITH CERTIFICATE OF CONFIRMATION OF COMMERCIALITY		WITH CERTIFICATE OF ENDORSEMENT TO ERC	
	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)	No. of Projects	Capacity (MW)
Hydro		-	60	594.49	4	26.60
Wind	6	282.55	5	313.00	6	393.90
Solar	20	693.81	17	638.14	7	131.90
Biomass		-	6	44.37	9	56.75
TOTAL	26	976.36	88	1,590.00	26	609.15

22-MW San Carlos Solar Power Project

Department of Energy

22

150-MW EDC Burgos Power Project

Department of Energy

23

III. Challenges

- Full implementation of Policy Mechanisms under the RE Law
- Streamlining of Administrative Process
- Awareness and social acceptance
- High upfront cost

III. Way Forward

Full implementation of the Renewable Energy Act

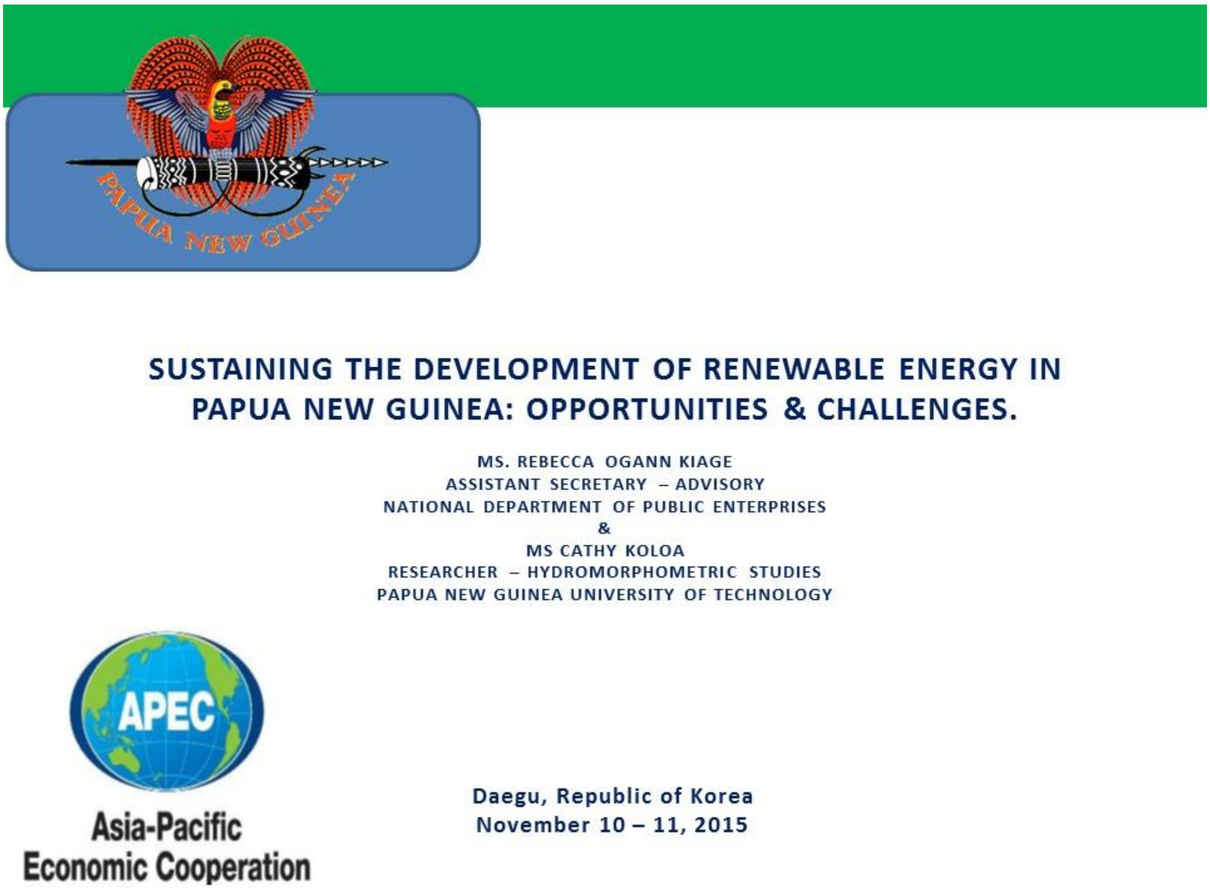
- Finalization / Approval of Guidelines on other RE Policy Mechanisms (Renewable Portfolio Standard (RPS), Green Energy Option, etc.)
- Establish Energy Investment Coordinating Center and Linkages with other Government Regulatory Agencies
- Information, Education and Communication Campaigns / Capacity Building
- Resource Inventory and Establishment of RE Database and more Investment Missions / Business Meetings

MABUHAY

THANK YOU ! ! !

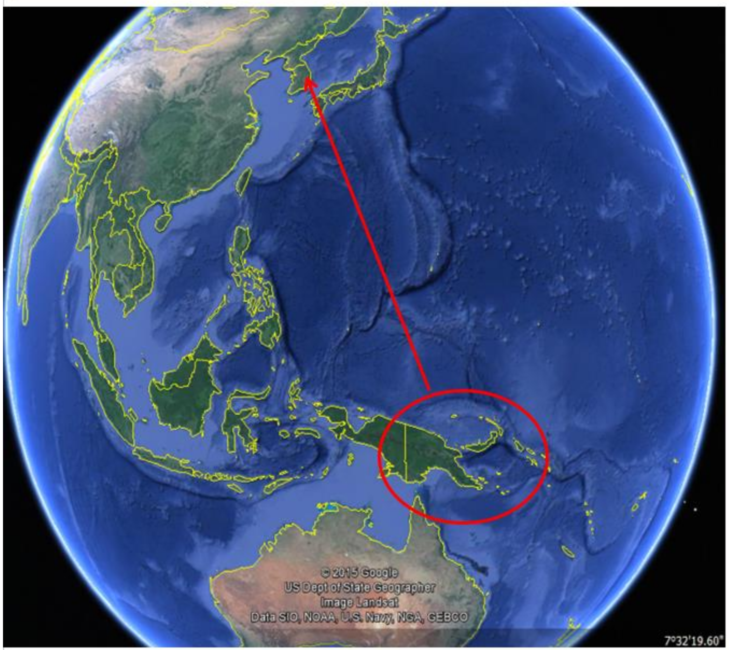
6-2. Sustaining the Development of Papua New Guinea's Renewable Energy Sector – Opportunities and Challenges

Rebecca Kiage
Assistant Secretary – Advisory, National Department of Public Enterprises



PNG PERSPECTIVE

PAPUA NEW GUINEA SOME ECONOMY FACTS



- POPULATION: 7.4 MILLION
- TOTAL AREA: 462,840 km² (KOREA : 100, 210 km²)
- GDP GROWTH: ~8% (2002-2014) ~15% (2015)
- ELECTRICITY: 580 MW (INSTALLED CAPACITY;
- ENERGY SECTOR CONTRIBUTION TO GDP : 14%
- NET EXPORTER OF ENERGY
- MEMBER OF APEC
- OBSERVER ON ASEAN
- "LAST ASIAN ECONOMY"

CURRENT STATUS

a) PNG Power sole national electricity company – 300MW (generation, transmission, distribution & retail)
280 MW (IPPs)

b) 3 Islanded Grid (Ramu, Port Moresby, Gazelle)

c) 19 Provincial Centre powered by thermal generation.

d) 87% Of Population lack Access to Electricity.

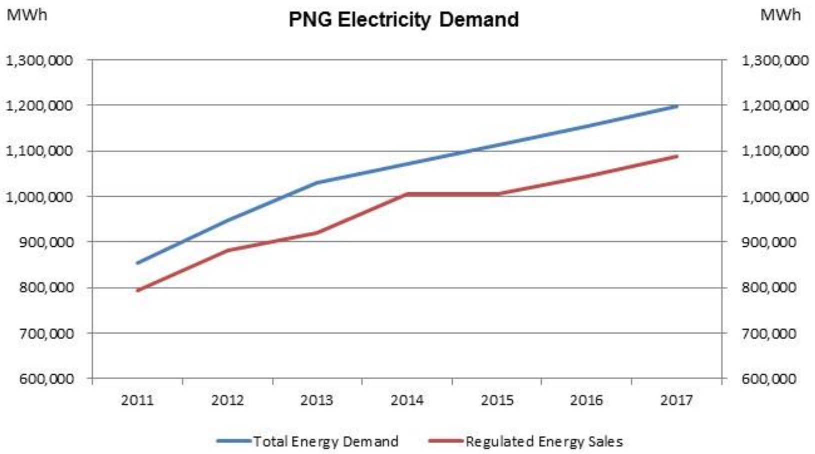
e) 13% Access to Power often unreliable.

PNG Power Ltd, 2014

CURRENT PNG'S RENEWABLE ENERGY MIX

SOURCE	INSTALLED	PLANNED	POTENTIAL
HYDRO	432 MW	4,560 MW (mostly private sector)	~15,000 MW
		Purari (lower) – 2,500 MW (feasibility completed)	
		Purari (upper) – 1,000 MW (feasibility completed, Geotech completed)	
GEOTHERMAL	56 MW	Survey completed (NZ Govt sponsored)	~10, 000 MW
SOLAR		Plan for GIS	
WIND		Resource Mapping Studies (World Bank, completion date 2018.	
BIOMASS	7 MW	69 MW *(eucalyptus, sugarcane, king grass, wood chips)*	
GAS	85 MW	50 MW	~40 TCF
		(First LNG Project, 9 TCF, 2xTRAINS, Developed)	
		(Second LNG Project, 10 TCF, construction 2017)	

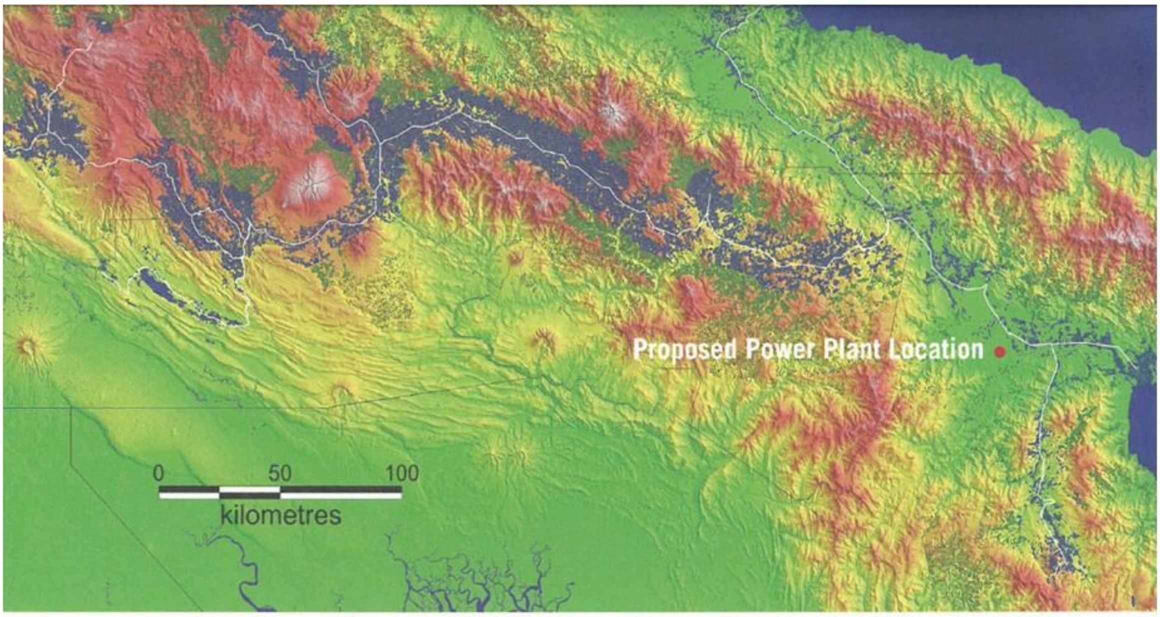
PNG ELECTRICITY DEMAND



ICCC Report, 2013, based on PNG Power Ltd

- **Increase in electricity demand with decrease in electricity supply.**
- **Port Moresby: Supply -130 MW, Demand -150MW with projections to increase to 200MW as the city expands.**
- **Boom in economic activity, PNG LNG, Mining and Non-Mining Sectors.**

CHALLENGES FOR CONNECTIVITY



The figure above shows the location of houses along the Ramu Grid in PNG. The houses within 10 km are shown in blue and the houses between 10 km and 20 km from the grid in yellow. Over 3,000,000 people live within 20 km of the Ramu Grid, and can be connected when reliable power is available.

OVERARCHING NATIONAL POLICY

- PNG'S VISION 2050
  - By 2050 PNG's economy should attain 100% power supply from renewable and sustainable energy sources.
  - Reduce greenhouse emission by 90 percent to 1990 levels;
  - All households should have access to a reliable and affordable energy supply.

- PNG'S STRATEGIC DEVELOPMENT PLAN 2010- 2030
  - By year 2030, 70% of the economy will have access to electricity.
  - Development of biofuels as a renewable source of energy alternative to fossil fuels to grow the economy and reduce or stabilise greenhouse gas emissions.

- PNG'S NATIONAL SUSTAINABLE AND RENEWABLE DEVELOPMEN STRATEGY.
  - Promote Green Energy Investment in the renewable resources sector;

HOW DO WE GET THERE

ENABLING POLICIES AND REGULATIONS

POLICY	PURPOSE	STATUS
NATIONAL ENERGY POLICY	• RESTRUCTURE ENERGY SECTOR • INSTITUTIONAL ARRANGEMENTS • ENCOURAGE PRIVATE SECTOR PARTICIPATION	PREPARATION FOR CABINET
NATIONAL ENERGY PLAN	PLAN ON ENERGY UTILIZATION	PREPARATION FOR CABINET
PUBLIC PRIVATE PARTNERSHIP	• ENCOURAGE PRIVATE SECTOR PARTICIPATION	• ACCEPTED BY GOVERNMENT • LEGISLATION ENACTED (2014)
COMMUNITY SERVICE OBLIGATION	ENCOURAGE COMPETITION AND PRIVATE SECTOR PARTICIPATION	ACCEPTED BY GOVERNMENT (2014)
BIOFUEL POLICY	ENCOURAGE BIOFUEL PRODUCTION & USE	READY FOR CABINET
THIRD PARTY ACCESS CODE	ALLOWS THIRD PARTY ACCESS TO GRID	IN PLACE
GRID ACCESS CODE	TECHNICAL SPECIFICATIONS	IN PLACE
GEOTHERMAL COMMERCIALIZATION	COMMERCIAL EXPLOITATION	DRAFT COMPLETED
RENEWABLE ENERGY	OVERSIGHT ON DEVELOPMENT OF RENEWABLE ENERGY	WILL START SHORTLY
RURAL ELECTRIFICATION	ELECTRICITY PENETRATION TO RURAL AREAS	WILL START LATE-2015
NEROP	ELECTRICITY PENETRATION TO RURAL AREAS	PROJECT TO START JUNE 2015
ELECTRICITY TARIFF REVIEW	NEW TARIFF REGIME TO IMPROVE COMPETIVENESS	CURRENTLY UNDERWAY
RENEWABLE & SUSTAINABLE GROWTH STRATEGY	FROM BROWN GROWTH TO GREEN GROWTH	POLICY APPROVED 2014
LANDOWNER PARTICIPATION	ENABLE LANDOWNER PARTICIPATION	EARLY 2016

POLICY INTENTIONS

- CLEAN AND GREEN
- RELIABLE AND AFFORDABLE
- INCLUSIVE
- ENERGY SECURITY

BEIJING DECLARATION – 2014 APEC ENERGY MINISTERS MEETING

Joining Hands Toward Sustainable Energy Development in the Asia-Pacific Region

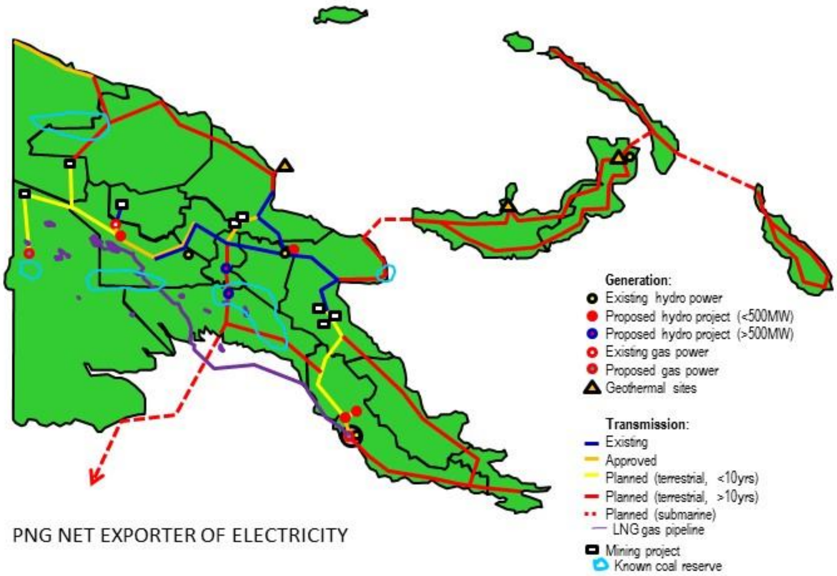
6. We will vigorously facilitate all-round and in-depth cooperation among APEC member economies in renewable energy and seek to eliminate trade protection and restrictive measures that may impede progress in renewable energy technologies and development of this sector. We will encourage innovation, competition and cooperation to promote a sound and sustainable renewable energy sector in the Asia-Pacific and to ensure its energy security, economic growth, poverty eradication and an appropriate response to climate change.

WHAT ARE WE DOING

CHALLENGES vs OPPORTUNITIES

CHALLENGES	OPPORTUNITIES	FUNDING ARRANGEMENTS
GENERATION	Approved 1655 MW	New IPP's to enter generation space.
TRANSMISSION 1) Grid Upgrade 2) Smart Distribution System	a) Tari – Mt Hagen approx. 142km (gas conversion) b) Usino – Kundiawa approx.100km c) Transmission line upgrade d) World Bank interconnection of Ramu and Port Moresby grid 307km.	China Exim Bank Korea Exim Bank JICA World Bank
DISTRIBUTION	Smart Distribution systems installation	Investment opportunities
GEOGRAPHY	Off-grid /micro grid renewable energy technologies.	Investment opportunities
PNG POWER LIMITED	Restructure	

FUTURE NATIONAL GRID



PNG NET EXPORTER OF ELECTRICITY


PAPUA NEW GUINEA
THANK YOU!
MS. REBECCA OGANN KIAGE
rebecca.kiage@publicenterprises.gov.pg
&
MS CATHY KOLOA
cmkoloa@gmail.com

6-3. New and Renewable Energy in Korea - Best Practices in Policy and Deployment

Sang Keun YU(Gavin)
New & Renewable Energy Center(NREC), Korea Energy Agency(KEA)


MOTIE
Contents
I The Status of New & Renewable Energy in Korea
II 4th Renewable Energy Basic Scheme
III Main Policies & Strategies in NRE
IV Best Practices-Deployment & Infrastructure
*NRE: New and Renewable Energy


MOTIE
I
The Status of New &
Renewable Energy in Korea

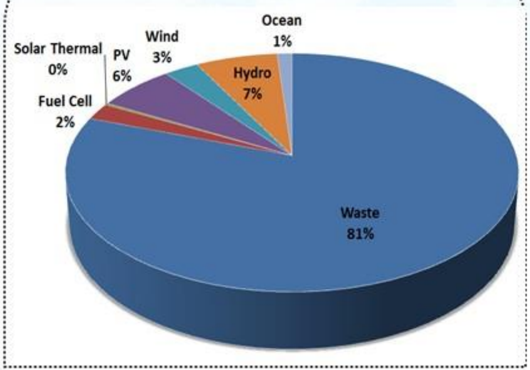
1. The Status of New and Renewable Energy(Tentative)

▶ NRE Share in TPES: 4.08% (2014)
- TPES(283,034 Thousand TOE) vs. NRE Supply(11,537 Thousand TOE)

▶ **NRE** supply has been increased by 16.78% (2013-2014)
(while annual average of TPES growth is 0.98%)

NRE Share in TPES

NRE Supply by Sources



RE : 9 Sources
- PV, Solar Thermal, Wind, Waste, Bio(LFG, Bio-Fuels), Hydro, Geothermal, Marine, Water Thermal

New Energy : 3 Sources
- Fuel-cell, Hydrogen, Coal Liquefaction or Gasification

2. The Status of NRE Industry

▶ Rapid growth of NRE Industry
- Compared to 2007, the number of manufacturers was more than doubled in 2013
☞ 100('07) → 245('13) *Unit: # of manufacturer

- The revenue size was increased by 7 times (2007→2013)
☞ Recovering from the global economic crisis, growth of the industry achieved 6.4 billion dollars of revenue in 2012

* Manufacturers based on 6 Sources(PV, Wind, Bio, Fuel Cell, Solar Thermal, Geothermal)

3. Achievements(PV)

PV — Existing Semiconductor Industry → Establishment of A Complete Value-Chain

With its complete value-chain, Korea is one of the most competitive players in global PV market

	Polysilicon	Ingot/Wafer	Cell	Module	Component /Material	Equipment	Total
Large Enterprises	3	4	7	11	9	5	39
SMEs	1	2	1	13	22	9	48
Total	4	6	8	24	31	14	87

4. Achievements(Wind)

Wind — Existing industrial base: Heavy industries such as Electricity, Shipbuilding → Establishment of Industrial Structure with Huge Potential

Industrial structure has been built with collaboration between SMEs for components & large enterprises for finished goods

Category		Major Companies
Parts	Blade	KM, DACC, Doha Industry, Gwangdong FRP, Hwashim FRP
	Tower	Dongkuk S&C, Unison(Win&P), CS Wind, Speco
	Component	Taewoong, Yonghyun BM, Hyunhin Materials, Mysco, Shillaprecision
system	System	Doosan, Hyundai, Hyosung, Unison, DSME

5. Achievements(Others)

Fuel Cell

- Supporting Fuel Cell market by RPS (1st in the world)
  - * 133,719kW generation capacity ('13)
- Supporting Fuel Cell for house/building through dissemination program ('10~)
- POSCO Power Fuel Cell Stack Plant (100MW/yr) – Construction Completed (Mar. 11)
- Gyeonggi Green Power Plant (58.8MW, MCFC / 2.8MW× 21Units, 2013)

Bio-Diesel

- Rise in supply of Bio-Diesel by Bio-Diesel Dissemination Plan
- Encouraging participation of SME and Large Enterprises

Tidal

- Operating Shi-Hwa Tidal Power Plants (254MW)

II The 4th Renewable Energy Basic Scheme

6. Target

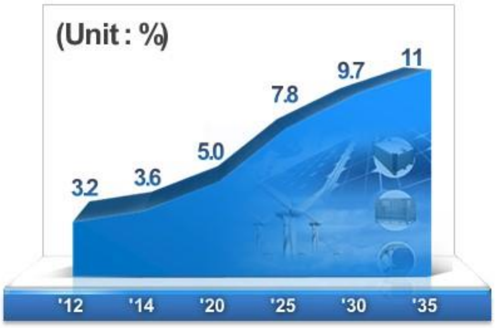
Primary Energy — Target rate: 11.0%(2035)

Annual NRE growth rate between 2014 and 2035: 6.3% ❯ Annual demand rate of primary energy: 0.7%

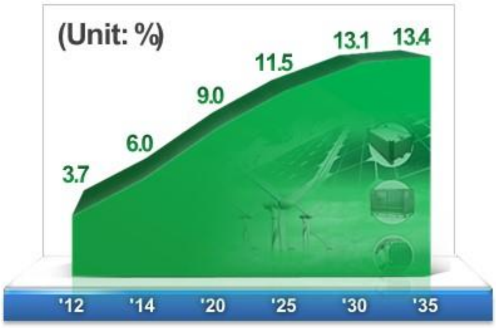
Electricity — Target Rate: 13.4%(2035)

Annual NRE growth rate between 2014 and 2035: 5.8% ❯ Annual demand rate of electricity: 1.8%

NRE share targets based on primary energy



NRE share targets based on power generation capacity



Ref) Deployment Target per Sector and Resource(TPES)

- While **ratio of waste has decreased largely**, the amount of shortfalls are expected to be replaced with Solar PV and Wind

  * Ratio per energy resource(%, '12→'35) : Waste(68.4→29.2), Wind(2.2→18.2), Solar PV(2.7→14.1)

Ratio targets per energy resource compared to primary energy (Unit : %)

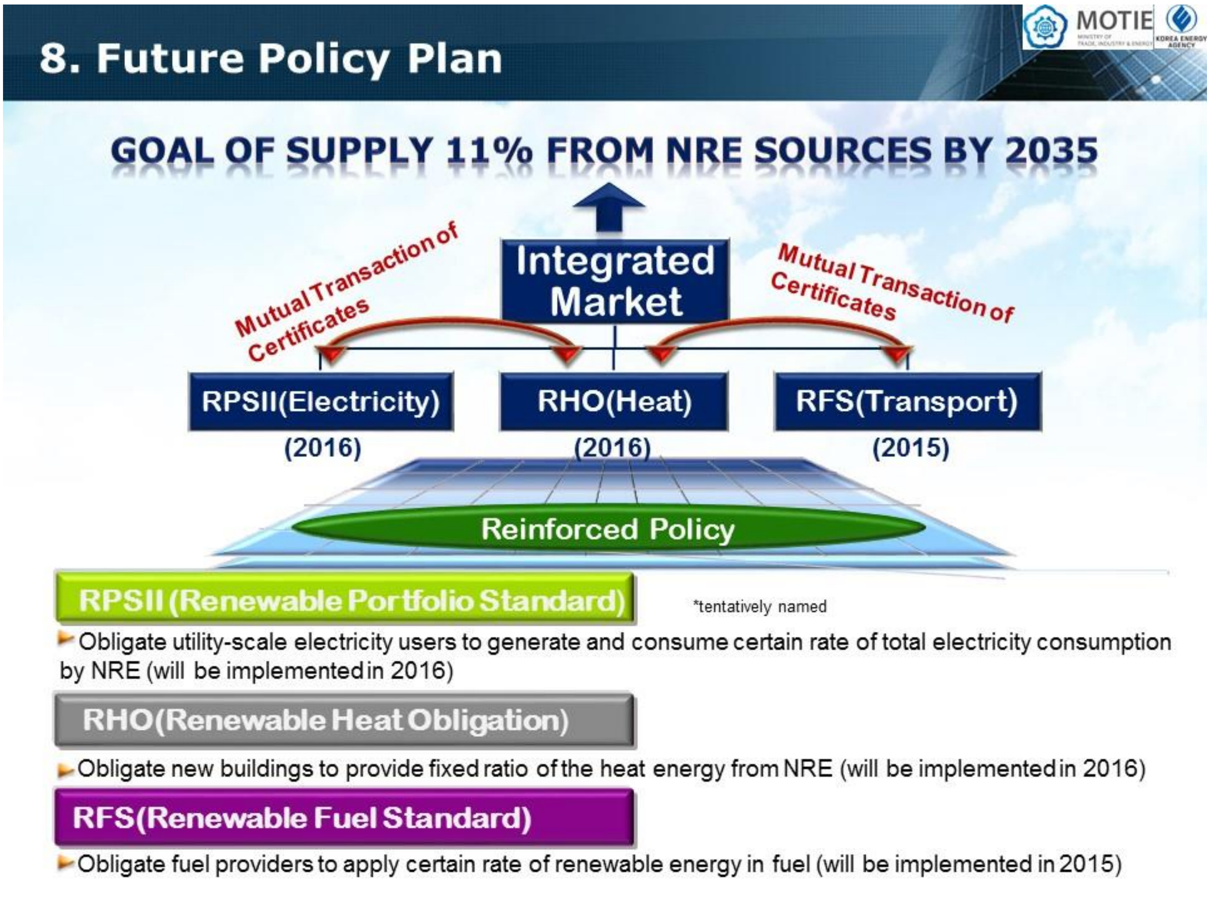
Areas	2012	2014	2020	2025	2030	2035
Solar Thermal	0.3	0.5	1.4	3.7	5.6	7.9
Solar PV	2.7	4.9	11.7	12.9	13.7	14.1
Wind	2.2	2.6	6.3	15.6	18.7	18.2
Bio	15.2	13.3	18.8	19.0	18.5	18.0
Water	9.3	9.7	6.6	4.1	3.3	2.9
Geo Thermal	0.7	0.9	2.7	4.4	6.4	8.5
Ocean	1.1	1.1	2.5	1.6	1.4	1.3
Waste	68.4	67.0	49.8	38.8	32.4	29.2

III Main Policies and Strategies in New and Renewable Energy

7. Main Policies and Strategies in NRE

▶ Budget for 2015 NRE Deployment and Infrastructure: 548.6 million USD
- (Deployment: 542.1 million USD ; Infrastructure : 6.6 million USD)

Function	Object	Method	Program	2014 Budget (Unit: 1 million USD)
NRE Deployment Program	Private Sector	Subsidy	Home Subsidy Program (1 Mil. Homes)	47.4
			Building Subsidy Program	20.0
			Feed-in-Tariffs (FIT)	319.0
			Overseas Business Support	4.5
		Loan	Financial Support Program	115.0
		Mandatory	Renewable Portfolio Standard (RPS)	0.2
	Public Sector	Subsidy	Regional Deployment Program	21.0
			Combined Support Program	10.0
			Establishment of NRE Test-bed	5.0
		Mandatory	NRE Mandatory Use for Public Buildings	-
Infrastructure-building Program	Private & Public Sector	-	Certification, Standardization, and International Cooperation	5.2
			R&D(Policy and Regulation)	1.4
Total				548.7


8. Future Policy Plan
MOTIE
GOAL OF SUPPLY 11% FROM NRE SOURCES BY 2035
Integrated Market
Mutual Transaction of Certificates
Mutual Transaction of Certificates
RPSII(Electricity)
(2016)
RHO(Heat)
(2016)
RFS(Transport)
(2015)
Reinforced Policy
RPSII (Renewable Portfolio Standard)
*tentatively named
Obligate utility-scale electricity users to generate and consume certain rate of total electricity consumption by NRE (will be implemented in 2016)
RHO(Renewable Heat Obligation)
Obligate new buildings to provide fixed ratio of the heat energy from NRE (will be implemented in 2016)
RFS(Renewable Fuel Standard)
Obligate fuel providers to apply certain rate of renewable energy in fuel (will be implemented in 2015)


MOTIE
IV
Best Practices –
Deployment & Infrastructure Programmes

9. Home Subsidy Program (1 Mil. Green Homes)

Overview

- Home Subsidy Program (1 Mil. Green Homes) subsidizes a portion of installation cost of NRE Facility

※Applicable NRE : Solar PV, Solar Thermal, Geothermal, Small Wind, Fuel Cell, Etc.

Goal and Current Status

- Goal : Expand dissemination of NRE supply for around 10% of total households by 2020
- The Status of Home Subsidy Program ('13. 12. 31) *unit: # of households

2004~2007	2008	2009	2010	2011	2012	2013	Total
14,648	10,021	19,193	29,822	35,602	54,663	30,495	194,444

Best Practice

- Energy Independent village with NRE (Jeollabuk-do, Gochang) (2012)
  - Promoted Energy Independency by NRE deployment to the whole village (Total 100 households)
    - 29 (Solar PV, Solar Thermal, Geothermal), 71 (Solar PV)

10. Building Subsidy Program

Overview

- Subsidize a portion of installation cost of NRE facilities in buildings

※Applicable NRE : Solar PV, Solar Thermal, Geothermal, Fuel Cell, etc.

Current Status

- The Status of Building Subsidy Program ('13. 12. 31)

	1993~2007	2008	2009	2010	2011	2012	2013	Total
# of Building	763	166	274	166	229	339	423	**2,360**
Subsidy (1Mil.USD)	101.313	26.639	13.93	13.99	19.04	19.993	21.391	**217.060**

Best Practice

- Masan University (Solar PV 50kW, Subsidized $71,000) (2013)
  - Reduced electricity bills from Solar PV installation on the rooftop of the dormitory building
    - Electricity saving equals to planting 247 young pine trees (27,475kWCO_2)

11. Feed-in-Tariffs (FIT)

Overview

- Provide the difference in between The standard electricity price And System Marginal Price(SMP) for 15-20yrs.
  *Government regulates the standard electricity price

Current Status

- FIT established early deployment foundation by deploying NRE facilities with the capacity of 1,030MW for 2,089 power plants for 10 years (2001-2011)
- FIT subsidy Details (Nov. 2013)

	2002 ~ 2007	2008	2009	2010	2011	Total
Generation (GWh)	2,474	1,183	1,504	2,447	2,521	10,129
Subsidy (million USD)	58.121	119.465	262.652	331.8	368.941	1,140.979

Best Practice

- SudoKwon LFG power plant (Capacity of 50MW, Incheon) (2001)
  - Produces electricity and contributes to reduce Green House Gas emission by utilizing landfill gas
  - Annual generation of 345GWh(in 2012) can supply 96,000 households *(electricity usage of 300kWh/month per household)*

12. Financial Support Program

Overview

- Offers long-term and low-interest loans for NRE consumers and producers in order to reduce the early installation fees and cultivate the industry

Current Status

- Subsidized total amount of 1 billion 428 million USD for 54,493 cases until 2013
- Subsidy and application Details

	'83~2007	2008	2009	2010	2011	2012	2013	Total
Application	54,065	207	31	51	43	40	56	54,493
Subsidy (million USD)	740.675	180.34	130.34	91.34	111.8	89.34	84.206	1,428.041

Best Practice

- Gyeong-ju Wind Farm (2.4MW * 7 turbines, total capacity of 16,800kW) (2012)
  - Electricity Revenue: 40,162MWh/yr. (64.6 million USD)
    ** Reduction of Greenhouse Gas Emission: appx. 26,000CO2/yr. (equals to 3.5 million pine trees)*
  - Cooperation with local government to cultivate tour industry (mountain sports complex)

13. Renewable Portfolio Standard(RPS)

MOTIE

Overview

- Enforces 17 power producers to supply certain amount of the total Power generation by NRE (Implemented in 2012)
  ※ Obligators: power producers with capacity of 500MW or above

Goal and Current Status

- Goal : ('12) 2.0% → ('13) 2.5% → ('14) 3.0% → ('17) 4.0% → ('20) 6.0% → ('24~) 10.0%
- Current Status : RPS achieved 5.6 times of total FIT installed capacity (proceeded for 10 years) in 3 years

RPS('12~'15.Jul)	FIT('02~'11)	Rate of change
5,570MW (Solar PV 2,142MW)	986MW (Solar PV 497MW)	564.9%↑(Solar PV 431% ↑)

Best Practice

- Converting rooftop of the factory and parking lot into Solar PV Power Plant (Busan) (2013)
  - The largest Solar PV Plant for the single factory utilized existing facilities in the world (20MW, Renault Samsung Motors)
  - Generated electricity(26GWh/yr.) provides 7,300 households
    *Ave. usage rate 15%, 1 household uses 300kWh/month

14. RPS – REC & Multipliers

MOTIE

- **Evaluation Criterion**
  ① Economic feasibility
  ② Environmental effect
  ③ Potential
  ④ Industrial promotion effect
  ⑤ Policy priority

Energy Source	Multiplier	Eligible Energy Sources	
		Installation Type	Detail
Solar PV	1.2	On Land	Less than 100kW
	1.0		More than 100kW
	0.7		Exceed 3,000kW
	1.5	On Building & Existing Facilities	Under 3,000kW
	1.0		Exceed 3,000kW
	1.5	Floating on the Water Surface	
Other REs	0.25	IGCC, Byproduct Gas	
	0.5	Waste, LFG	
	1.0	Hydro, Onshore Wind, Bioenergy, RDF Combustion (全焼) Power Generation, Waste Gasification Power Generation, Tidal(潮力) (with Embankment, 防潮堤)	
	1.5	Lignocellulosic Biomass Combustion (全焼) Power, Off shore wind(less than 5km connecting distance)	
	2.0	Fuel Cell, Current Power(潮流)	
	2.0	Offshore Wind(more than 5km connection distance), Geothermal, Tidal(潮力)(without Embankment, 防潮堤)	-
	1.0 ~ 2.5		
	5.5	ESS(with Wind Facility)	2015
	5.0		2016
	4.5		2017

15. Regional Deployment Program

Overview

- Support NRE deployment programs led by local government In order to improve energy provision and regional economy

Current Status

- Subsidized total 2,485 projects with 721.6 million USD in 17 cities and provinces (2013)
- Deployment cases by NRE sources

PV	government offices and other public buildings	**Small Hydro**	filtration plant, reservoir, and etc.
Geothermal	heat and cooling system in government offices, social welfare facilities, and etc.	**Bio**	Pilot program of BDF, Biogas from sewage treatment plant into fuel
Wind	Jeju, Chungbook, Kangwon, Gyongbook, and etc.	**Solar Thermal**	Solar water heating system in social welfare facilities, etc.

Best Practice

- Chang-won Ocean Solar Tower (subsidized 71.8millionUSD) (2013)
  - Total Installed 600kW capacity of solar PV in tower (136m) and Exhibition Center (6,336 ㎡) *[Tower(BIPV): 450kW, Rooftop: 150kW]*
  - Self-sufficient electricity
  - Utilizing local festival (Cherry Blossom), expanding public awareness of NRE

16. Combined Support Program

Overview

- Support partial expense of the project for the facility that combined two or more NRE sources in the same district [large-scale]

Current Status

- Supported total amount of 81million USD with 9 projects in 2013
- Projects

Participants	Energy Source	Participants	Energy Source
Incheon, Ongjin	Solar PV, Wind, ESS	Wanju-gun	Solar PV, Solar Thermal, Geothermal
Chungcheongbuk-do, Cheongwon-gun	Solar PV, Solar Thermal, Geothermal	Geochang-gun	Solar PV, Solar Thermal, Geothermal
Yeongwol-gun	Solar PV, Geothermal	Taebaek, Mine Reclamation Corporation	Solar PV, Solar Thermal
Hadong-gun	Solar PV, Solar Thermal	Haenam-gun, Korea Institute of Energy Research	Solar PV, Wind, ESS
Chungcheongbuk-do, Jincheon-gun	Solar PV, Solar Thermal, Geothermal		

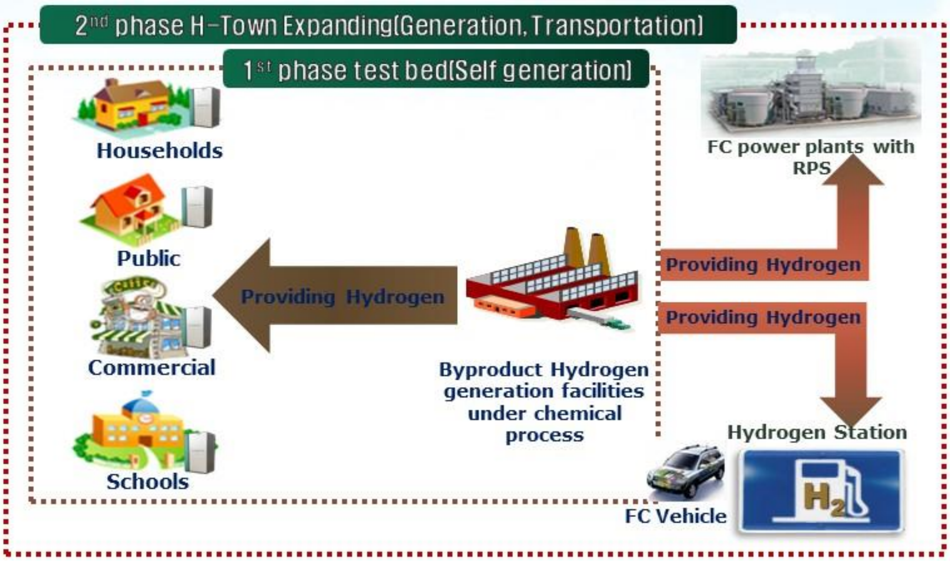
Best Practice

- Ulsan H-town(Hydrogen-town) (140 households, Fuel Cell capacity of 195kW) (2013)
  - Using byproduct hydrogen under chemical process from chemical industry complex
  - Reviewing diversification of fuel energy sources (Biogas from animal waste, Synthetic Natural Gas(SNG), etc.)

17. Combined Support Program

H-Town Pilot Project for Housing

- **Using byproduct hydrogen under chemical process to produce fuel cell (no need for reformers)**
  - -Diversification of energy and reinforcement of fuel cell's price competitiveness
    → Development of hydrogen fuel cell and expansion in the market
  - -Promoting Ulsan consortium (local government, a hydrogen supply company, 4 manufacturing companies, etc)
    - * Facilitate 140 household, 3 public & private buildings, infrastructures, and FC advertisement center
    - ** For the households, installed capacity of 185kW in facilities and invested 8.8mil USD



18. NRE Mandatory Use for Public Buildings

Overview

- For new or renovated public buildings with the floor area of 1,000㎡ or above are obliged to fulfill more than 12% of their total expected Energy usage in NRE

Goal

- Increase NRE mandatory rate for public facilities to 30% by 2020
  - 2,712 public buildings, 136,817 toe (Nov. 2013)
- Annual Mandatory Rate

Year	2011~2012	2013	2014	2015	2016	2017	2018	2019	~ 2020
Mandatory Rate(%)	10	11	12	15	18	21	24	27	30

Best Practice

- Je-Ju International Airport
  - Installed capacity: Solar PV 20kW, Solar Thermal 97㎡, Geothermal 200RT
  - Energy cost saving approx. 100,000USD, Greenhouse Gas Reduction400~500tCO_2

19. PV Rental Program

Overview

- Household owners pay electricity bill as under 80% of ave. Electricity bill, PV Rental companies earn rental fee and benefit from REP selling

  ※ REP: Renewable Energy Point(No Multipliers applied)

2014 PV Rental Program

- Up to 6MW, 2,006 Households

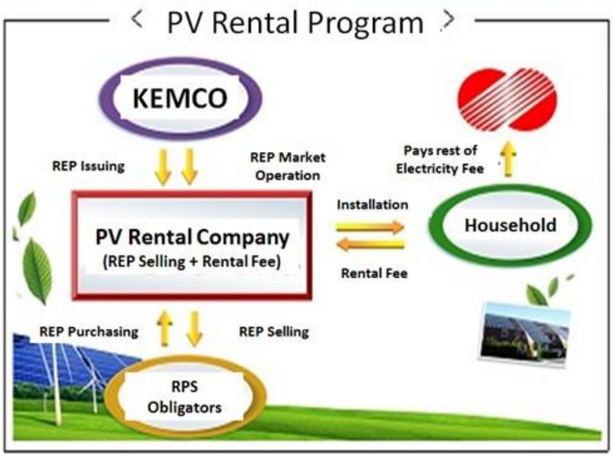
2015 PV Rental Program

- Up to 10.5MW, detached household + apartment household

After 3 years

- Target 22,500 Household

  ** Energy New Business & Core R&D Strategy (Apr. 2015, MOTIE)*



20. Independent Energy Island

Independent Energy Island

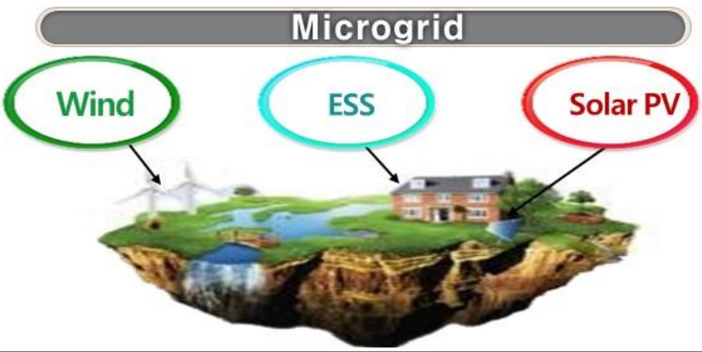
- **Build microgrid in small island areas instead of independent system which is relied on diesel generators with high-expenditure of fuel currently**
- **Pilot project of connection of wind, solar PV, geothermal, ESS etc. in Ulleung Island**

  ** Supply costs of electricity are app. 4 to 14-fold higher than land areas*

  ** 30MWh of ESS installed, NRE ratio: 3.6% →68% (2017)*

- **Expand to more than 9 islands**

* *Energy New Business & Core R&D Strategy (Apr. 2015, MOTIE)*



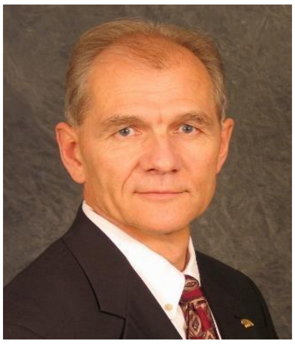

Thank You
New & Renewable Energy
MOTIE
MINISTRY OF
TRADE, INDUSTRY & ENERGY
KOREA ENERGY AGENCY

Appendix C – Speaker Biographies

Anil Pahwa is Professor and holds the Logan-Fetterhoof Chair in Electrical and Computer Engineering at Kansas State University, where he has worked for the past 32 years. His expertise lies in smart grid and renewable energy with a goal to make electric power systems more resilient and sustainable. He was Chair of Power and Energy Education Committee in 2012 and 2013, and presently he is an Editor of IEEE Transactions on Power Systems. He worked in the U.S. Department of State as a Jefferson Science Fellow for a year from 2014 to 2015 providing scientific support for international policies related to energy. His assignments in the Office of Economic Policy in the Bureau of East Asian and Pacific Affairs (EAP/EP) included energy issues, science and technology innovation, infrastructure financing, and urbanization mainly covering the APEC region.

Dr. Christine Lins was appointed as Executive Secretary of REN21, the Renewable Energy Policy Network of the 21st Century, in July 2011. REN21 is a global public-private multi-stakeholder network on renewable energy regrouping international organizations, governments, industry associations, science and academia as well as NGOs working in the field of renewable energy. REN21 has its headquarters at UNEP, the United Nations Environment Programme in Paris/France. Between 2001 and 2011, Ms. Lins served as Secretary General of the European Renewable Energy Council. Previously, she worked in a regional energy agency in Austria promoting energy efficiency and renewable energy sources. Ms. Lins holds a Master's degree in international economics and applied languages. She has more than 19 years of working experience in the field of renewable energy sources.

Cecilia Tam joined the Asia Pacific Energy Research Centre (APERC) as Deputy Vice President in March 2015 and is responsible for managing the research programme at APERC. She is currently leading the development of the 6th edition of the APEC Energy Demand and Supply Outlook. Prior to joining APERC, Cecilia was Head of the Energy Demand Technology Unit at the International Energy Agency (IEA), where she was also responsible for the IEA's Energy Technology Roadmaps Programme. Having joined the IEA in 2006 her work has covered technology roadmaps, finance, deployment and innovation, industry and energy efficiency. She has authored numerous IEA publications including Energy Technology Perspectives, Energy Technology Transitions for Industry, Transition to Sustainable Buildings, and a number of Technology Roadmaps. Cecilia was also a Senior Equity Research Analyst with Dresdner Kleinwort Benson where she covered Latin American electricity companies, working on various privatisations and equity offerings.

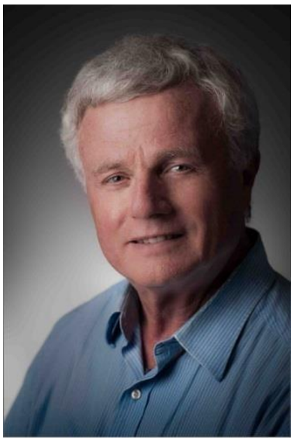


Thomas Key is a Senior Technical Executive at EPRI and is currently responsible for EPRI's research program for integration of distributed resources. He is a fellow of the IEEE for contributions in the area of power systems and power quality. He has also led programs on renewable and distributed generation, and has focused on beneficial integration of PV power systems including early pioneering in this area at Sandia National Laboratory in the 1980's. During his career he has published more than 180 technical publications and reports.

Nick Schlag has worked as a consultant at E3 for six years. At E3, Nick works primarily on long-term resource planning and renewable integration in the electric sector. His work focuses on understanding how renewable policy goals and greenhouse gas reduction targets will affect the electric sector, using scenario analysis to quantify impacts of high renewable penetrations upon electric system operations, supporting infrastructure investment, and retail rates in the future. Nick has contributed to a number of studies investigating the consequences of high renewable penetrations on system operations and the implications of these effects on the feasibility of achieving greenhouse gas reductions through investment in renewable energy.

Bing-Chwen Yang joined the ITRI in Chinese Taipei after he got his Ph.D. degree from the Department of Mechanical Engineering, Pennsylvania State University in 1992. He has accumulated lots of research experience in the field of energy conservation and environmental sustainability. He also leaded more than 10 big research projects in the area of heat transfer, heat exchanger design, HVAC&R system during his service in ITRI from 1992. During that period, he leaded the team to win two golden awards on "Major Contribution Award by the Achievement of Research" from ITRI. He also acts as one of the expert in the think tank of energy policy and strategy for BOE (Bureau of Energy), MOEA (Ministry of Economic Affairs) in Chinese Taipei. He has been the Deputy & Division Director of Residential & Commercial Energy Saving Division in Energy & Environment Research Laboratories from March, 2002 ~ June, 2010. He served as the executive assistant to the General Director of Green Energy & Environment Research Laboratories, ITRI before he moved to Asia Pacific Energy Research Center as a Team Leader in April, 2011. After service in APERC for one year and seven months, he returned to ITRI and became the Division Director of Planning and Business Development division in Green Energy and Environment Research Laboratories from December, 2012 ~ December, 2013 and the Division Director of Green Energy Initiative Division from January 2014 ~ February 2015. Now he is the Deputy General Director of Green Energy and Environment Research Laboratories, ITRI.

Zhang Shicong is Director of China Academy of Building Research and Mayor in Green Building codes and standards, Building Energy Efficiency Codes and Standards, and Commercial Building Energy saving. He participated in the 10th,11th, and 12th Five Year Plan for Building Energy Efficiency Program of China. He is a member of the editorial board of design code for heating ventilation and air conditioning of civil buildings and International building energy codes comparison study. He is a delegate of China in International Energy Agency-Energy Conservation through Energy Storage Implementing Agreement (IEA-ECES) and Program Overseer of APEC Nearly (Net) Zero Energy Program.



David S. Renné has been President of the International Solar Energy Society since 2010. He is also the Operating Agent of an International Energy Agency Solar Heating and Cooling Programme Task 46 titled “Solar Resource Assessment and Forecasting”. He continues to serve as an Associate Editor of the Solar Energy Journal in the field of solar resource assessment. Dr. Renné’s other current professional activities include a Senior Consultant to Clean Power Research, a small U.S. Company that develops resource assessment and analytical software tools to support large-scale grid connected solar energy systems, and a Consultant to the World Bank’s Energy Sector Management Assistance Program’s (ESMAP)’s Resource Mapping Project. From 1991 – until his retirement in 2012 Dr. Renné managed the solar resource assessment activities at the U.S. National Renewable Energy Laboratory (NREL). He also led and participated in a number of international programs. He still retains an Emeritus status at NREL.

Xu Zhao works at Asia Pacific Sustainable Energy Center (APSEC) as a research associate. He obtained his PhD in Civil Engineering from the University of Western Australia in 2014. His current research interests include “Developing Solar-Powered Emergency Shelter Solutions (SPESS) as an Energy-Resilience Tool for Natural Disaster Relief in APEC Community”.

Chun-Li Lee has worked for the MOEA for more than twenty years and is also familiar with Chinese Taipei’s power market, especially in the power market reform and renewable energy. He had participated in the first and second phases of deregulation on power plants, amended the Energy Management Law and promulgated the Renewable Energy Development Act in Chinese Taipei. Mr. Lee has served as the Secretary General, Bureau of Energy, Ministry of Economic Affairs and is responsible for the stabilization of energy supply and the improvement of energy security in Chinese Taipei. He is currently Secretary General, Bureau of Energy, Ministry of Economic Affairs, Chinese Taipei. Prior to that he was Director of the Electricity Division, Bureau of Energy, Ministry of Economic Affairs from 2012 to 2015; Deputy Director of the Electricity Division, Bureau of Energy, Ministry of Economic Affairs from 2009 to 2012; and Specialist of the Energy Technology Division, Bureau of Energy, Ministry of Economic Affairs from 2007 to 2009. He has a Master’s degree in economics from Department of Economics, Chinese Culture University, Chinese Taipei.

Takao Ikeda is Senior Economist in the New and Renewable Energy Group, New and Renewable Energy and International Cooperation Unit at the the Institute of Energy Economics, Japan (IEEJ). As a researcher of IEEJ, he has conducted policy research and current situation covering all renewable energy area and related technologies such as smart grid/smart communities. He also participated in APEC activities including APEC EGNRET and APEC Biofuel Taskforce. He holds the degrees of Bachelor of Engineering and Master of Engineering from Kyoto University, Japan.

Sang Keun Gavin Yu works at New & Renewable Energy Center (NREC) of Korea Energy Agency(KEA). He is in charge of international cooperation with agencies including IRENA, APEC, IPHE, IEA REWP and bilateral Cooperation since March 2011. He represents Korea in the APEC EGNRET (Expert Group on New & Renewable Energy Technologies) and he has been Vice Chair of EGNRET since 2013.

Azah Ahmad obtained her Bachelor of Science Degree in Electrical and Computer Engineering from the Ohio State University, USA 1998 and Master of Science in Energy Technology from UKM in 2004. She has extensive years of working experience in energy efficiency and renewable energy. She was the focal point representing Malaysia for the ASEAN Energy Efficiency & Sub-sector Network from 2003 to 2005 and a Technical Committee member on Performance of Household and Similar Electrical Appliances, SIRIM during her tenure with Pusat Tenaga Malaysia. In 2005, she joined the Malaysia Building Integrated Photovoltaic (MBIPV) Project, a project funded by the Government of Malaysia and UNDP/ GEF. She is a certified ISPQ PV installer by the International for Sustainable Power (ISP). In SEDA Malaysia, in charge of capacity and human capital development in RE as well as RE related projects. Support and facilitate R&D on RE within local research institutions and international organizations. A member of working group of solar PV Systems, appointed by Standards Malaysia since 2010. Serving as the Chairman for the ASEAN RE Awards since 2012.

Karnnalin Theerarattananoon was awarded for the Golden Jubilee Scholarship from the Royal Thai Government in 1998 to pursue her study from Bachelor degree up to Ph.D. She obtained the Bachelor of Applied Science degree in Chemical Engineering from University of Toronto, Canada in 2003; the Master of Science degree in Chemical Engineering from University of Saskatchewan, Canada in 2006; and the Ph.D in Biological and Agricultural Engineering from Kansas State University, U.S.A. in 2012. Her research interest was about bioprocessing production, such as cellulosic ethanol production. She was a member of the Honor Society of Phi Kappa Phi by Election of Chapter at Kansas State University in 2009, and was also a member of the Alpha Epsilon -Honor Society of Agricultural, Food, and Biological Engineering in 2009. Currently, she is working as an Engineer at the Bureau of Energy Research, Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, Thailand. Her work responsibility involves promotion of renewable energy development in Thailand.

Nguyen Ninh Hai is Deputy Director of Renewable Energy Department under General Directorate of Energy under Ministry of Industry and Trade of Viet Nam. Mr. Hai has been working in the renewable sector since 2008. He has been participating in drafting incentive mechanisms to promote development of renewable energy in Viet Nam, such as FIT for wind power, biomass, and municipal waste to energy and solar. He has also worked on other policies related to renewable energy in Viet Nam including National Strategy on promoting development of renewable energy, National Master Plan on Renewable Energy. Mr. Hai is the lead person from Viet Nam in the Renewable Energy Sub-Sector Network under ASEAN Energy Cooperation.

Rico R. Velasco is a Registered Electrical Engineer and currently working as a Science Research Specialist at the Department of Energy (DOE). Mr. Velasco developed an interest in Renewable Energy when he was assigned at DOE - Solar and Wind Energy Management Division. He is involved in the implementation of government-initiated and priority projects such as Household Electrification Program, which entails the provision of household lighting in off- grid areas using Renewable Energy Systems and Wind Resources Assessment Project, which aims to identify viable sites for wind power development in the economy. Further, he is in charge in the administration of Renewable Energy Act of 2008 and all relevant laws, issuances, circular, and regulations particularly the technical evaluation and processing of applications for registration/accreditation of solar and wind (SW) Developers/Fabricators, Manufacturers & Suppliers as well as monitoring and evaluation of SW projects.

Rebecca Ogann Kiage is currently employed with the PNG National Department of Public Enterprise and State Investments (2014 – 2015) as the Assistant Secretary – Advisory overseeing the development of the first PNG National Energy Policy and National Energy Plan. Ms. Kiage's area of research interest are in agriculture and renewable energy policy. Ms. Kiage also has extensive experience in PNG's agriculture policy and has serve with the PNG National Department of Agriculture and Livestock (2001 – 2009). Ms. Kiage holds a Master of Science: Energy & Resources; Policy & Practices from University College London, School of Energy & Resources –Australia, (2011), Master of Public Policy and Management from Monash University, Australia (2006) and a Bachelor Commerce, Business Economics from the PNG University of Technology (2000).

Sol García-Belaúnde Mora is the International Relations Coordinator for the Institute of Natural Sciences, Territory and Renewable Energies of the Pontifical Catholic University of Peru, INTE-PUCP. She acts as the liaison between INTE and other universities, institutes or research centers, aiming to create and strengthen cooperation opportunities in research and promotion of natural sciences, territory and renewable energies. Her work experience includes 7 years as the APEC Focal Point for the Ministry of Education of Peru; as part of her job, she organized the 2008 APEC Education Ministers Meeting and participated in several APEC-funded seminars, both as co-organizer and as speaker. She holds a B.A in Philosophy, studied International Cooperation for Development at the Diplomatic Academy of Peru and is enrolled in the Master's on Public Policy at PUCP.

Appendix D – Workshop Participants

	Name	Gender	Economy	Organization
Project Overseer				
1	Anil Pahwa	M	United States	Kansas State University
	pahwa@ksu.edu			Professor
Invited Experts				
2	Christine Lins	F	France	Renewable Energy Policy Network for the 21st Century (REN21)
	christine.lins@ren21.net			Executive Secretary
3	Tom Key	M	United States	Electric Power Research Institute (EPRI)
	tkey@epri.com			Senior Technical Executive
4	Nick Schlag	M	United States	Energy+Environmental Economics (E3)
	Nick@ethree.com			Managing Consultant
5	Bing-Chwen Yang	M	Chinese Taipei	Industrial Technology Research Institute (ITRI)
	bcyang@itri.org.tw			Division Director, Green Energy and Environment Research Laboratory
6	Shicong Zhang	M	China	China Academy of Building Research
	zhangshicong01@ 126.com			Deputy Director, Research Center for Development Strategy
7	Cecilia Tam	F	Japan	APERC
	cecilia.tam@aperc. ieej.or.jp			Deputy Vice President
Participants				
8	Sang-keun Yu*	M	Korea	Korea Energy Agency
	yusk@kemco.or.kr			Research Associate

9	Chun-Li Lee*	M	Chinese Taipei	Bureau of Energy
	chunlee@moeaboe.gov.tw			Secretary General
10	Ikeda Takao*	M	Japan	The Institute of Energy Economics
	ikeda@tky.ieej.or.jp			Senior Economist
11	Xu Zhao*	M	China	APSEC
	xu_zhao@tju.edu.cn			Research Associate
12	Yong Sun	M	China	APSEC
	sunyong-984@163.com			Research Associate
13	Azah Ahmad*	F	Malaysia	Department of Renewable Energy
	azah@seda.gov.my			Director RE Technology
14	Sol García-Belaúnde*	F	Peru	Sustainable Energy Development
	sol.garciabelaunde@pucp.edu.pe			International Relations Coordinator
15	Rebecca Kiage*	F	Papua New Guinea	Department of Public Enterprises
	Rebecca.kiage@publicenterprises.gov.pg			Assistant Secretary – Advisory
16	Cathy Koloa	F	Papua New Guinea	PNG University of Technology
	cmkoloa@gmail.com			Ph.D. Student
17	Karnnalin Theerarattananoon*	F	Thailand	Department of Alternative Energy Development and Efficiency (DEDE)
	maykarn@hotmail.com			Senior Engineer
18	Soottisak Singkul	M	Thailand	Department of Alternative Energy Development and Efficiency (DEDE)
	soottisak_s@dede.go.th			Engineer
19	Nguyen Ninh Hai*	M	Viet Nam	Ministry of Industry and Trade
	HaiNgN@moit.gov.vn			Deputy Director of New and Renewable

				Energy Department
20	Tran Hoai Trang	M	Viet Nam	Ministry of Industry and Trade
	TungPT@moit.gov.vn			Official of Hydro Power Department
21	Gilsoo Jang	M	Korea	School of Electrical Eng., Korea Univ.
	gjang@korea.ac.kr			Professor
22	Shevena I Jumin Jeffrey	F	Malaysia	Ministry of Energy
	shevena.jeffrey@ kettha.gov.my			Principal Assistant Secretary
23	Rico Velasco*	M	Philippines	Department of Energy
	rrvelasco06@yahoo.com .ph			Science Research Specialist
24	Abdul Matiin Kasim	M	Brunei	Energy Department
	matiin.kasim@jpm. gov.bn			
25	Alexi KABALINSKIY	M	Japan	APERC
	alexey.kabalinskiy@ aperc.ieej.or.jp			Researcher
26	Yeuntae Yoo	M	Korea	School of Electrical Eng., Korea Univ.
	yooynt@korea.ac.kr			Ph.D. Student
27	SungYoon Song	M	Korea	School of Electrical Eng., Korea Univ.
	blue6947@korea.ac.kr			Ph.D. Student
28	Chang Hee Han	M	Korea	School of Electrical Eng., Korea Univ.
	hch0806@korea.ac.kr			Ph.D. Student

Tasks:

The Invited Experts gave a presentation on the first day based on their expertise on a topic relevant to the workshop. They also led the breakout group discussions on the second day. The participants attended all the sessions of the workshop and participated in discussions. Participants identified with * gave a presentation on behalf of their respective economy.


Workshop on Experiences and Plans to Double
Renewable Energy Utilization by
2030 in the APEC Region
APEC
Asia-Pacific
Economic Cooperation
Energy Working Group
Daegu, Republic of Korea
November 10 – 11, 2015

Appendix E – Workshop Evaluation

Survey: APEC Project Evaluation Survey

The objectives of the training were clearly defined		
Strongly Agree	Agree	Disagree
6	12	0

N/A

The project achived its intended objectives		
Strongly Agree	Agree	Disagree
8	8	0

- ✓ **Not a project?**
- ✓ **Despite the fefined objective, we could work more on details of pathways to doubling**
- ✓ **As objective was not fully clear, this question is difficult to answer**

The agenda items and topics covered were relevan		
Strongly Agree	Agree	Disagree
7	11	0

N/A

The content was well organized and easy to follow		
Strongly Agree	Agree	Disagree
7	11	0

- ✓ **1st was focusing a lot on solar, APEC is rich with other RE, more balanced approach needed**

Gender issues were sufficiently addressed during implementation		
Strongly Agree	Agree	Disagree
4	10	0

N/A

The trainers/experts or facilitators were well prepared and knowledgeable bout the topic		
Strongly Agree	Agree	Disagree
4	14	0

- ✓ **All great and informative**

The materials distributed were useful		
Strongly Agree	Agree	Disagree
7	10	1

- ✓ **Bothe printed and PPTpresentations**
- ✓ **Materials wre distributed well**

The time allotted for the training was sufficient		
Strongly Agree	Agree	Disagree
5	11	1

- ✓ **Strongly agree that 2days is enough for this type workshop**
- ✓ **Not Training?**

1. How relevant was this project to you and your economy

Very	Mostly	Somewhat	A little	Not munch
8	8	1	N/A	N/A

- Different economic stituations/ RE resources -> not all topics are relevant to our economy
- High Interest in RE
- APERC always seeks for energy data updates from APEC economies, and networking maeks research easier
- Information presented is useful for my economy; the agreed issues are positive guidelines for policymakers of APEC region
- We have very high target for the impementation of RE in the future
- A lot of examples have been presented
- China now is planning it's 13th "five year planning", and it's share of RE in total energy is forecast to double in 2030
- Understanding the policy and strategies of other apec economies is helpful in terms of RE development
- Focus on agency with focus on RE policy maker(advice) and implement
- S7haring and economy updates or propers at renewable.
- Good information about status of renewable in different economies
- RE is one of the focus of my economy
- Energy policy & regulations on RE development from member economies were well presented

2. In your view what were the project's results/achivements

- Experience is sharing a many economies
- Sharing information with Participants
- Some economies showed great effort in doubling the RE share, and RE devlopment is general. Others learnd a lot
- Identification of issues to work on, common to APEC region; agreement on suggestions to deal with said issues

- Information sharing internationally => good / discuss about important things for RE doubling=>good/one of the point was "info sharing internationally"
- Forward to next cooperation within APEC economies
- Share the information and exchange the experience among economies
- Sharing of information of best practice with economy members and Formulation via group discussion about next step to do.
- Updated situation among APEC economies
- Make different economies know the importance of RE and urge them to make roadmap for RE double by 2030.
- Broaden understanding of apec economies RE initiative (Especially the challenges and strategies for overcoming)
- Improved awareness of program across apec economies to encourage RE development
- Knowledge exchange
- It achieved its objective and identified the need for technologies to cater to the different geographical situation in each economy
- Member economy is key concern on how to achieve the "doublify" goal

3. What new skills and knowledge did you gain from this event

- Experiences from some economies could be applied in our economy
- Better understanding of RE
- More knowledge on RE, APEC economies' situation on RE, policies and positive experience as well as barriers
- Other economies' current situation for doubling RE in APEC
- The indept analyze of each other's barriers of RE deployment
- Yes, learn from other presentations
- Policy tools and measures to promote renewable energy
- New model & best practices from others economies
- Other economies's status and roadmap
- The opportunity to network and collaborate with fellow participants in supporting RE development
- Updates economies RE program/ target
- Good understanding of economy-specific challenges in achieving higher RE penetration
- Contacts information about RE in APEC region
- The different economies have similar issues and agree that a common stand should be proposed to address there issues
- I learned about practices relative to RE development from other economies
- Latest RE policies & measures. Current status and target of RE share

4. Rate your level of knowledge of and skills in the topic prior to participating in the event				
Very	Mostly	Somewhat	A little	Not munch
0	8	6	3	N/A

5. Rate your level of knowledge of and skills in the topic after participating in the event				
Very	Mostly	Somewhat	A little	Not munch
4	10	3	N/A	N/A

- As a part of RE modelling we applied a 'Bulk' approach, some details were emitted, but after the workshop, I understand economies' policy context better
- I have recently started working on the subject, so Iam learning more and more each day
- I realized that what I knew before discuss each other regarding economies issue, I only know only on small part of barrieirs
- A lot of information that I have to study
- Lots of new knowledge on RE policy and status are learned from this workshop
- Involved with the energy sector policy in my line of work
- Most economies shared their experiences in achieving their target
- Comprehensive information
- I have an understanding of what the other economies are facing and possible economies where further knowledge on the technology may be obtained
- Additional knowledge are gained from sharing of experiences
- Improved knowledge of APEC members current status & plans in RE development

6. How will you apply the project's content and knowledge gained at your workplace? Please provide exmaples(e.g. developo new policy initiatives, organise trainings, develop work plans/strategies, draft regulations, develop new procedures/tools etc.)

- Develop new policy iniciatives
- Understanding of individual APEC member situations
- Will improve our BAU and high renewable scenario modelling, as well as have broader range of policy actions to discussed in our report
- Dissiminate information gatered at event and plan organization of another event, maybe an APEC project
- Do more groundworks with SWAT analysis
- It can help me to develoip the new energy policy or strategy in the future
- Review and Develop new policy initiatives
- Work with co-workers
- Develop work plans new policy initiatives
- Develop new policy initiatives for the RE sector
- Use data gained In renewables work follow up with APERC
- Receive work plans strategies
- Try to develop work strategies
- Develop new policy initiatives to increase RE share

7. What needs to be done next by APEC? Are there plans to link the project's outocmes to subsequent collective actions by for a or individual actions by economies?

- Report and follow up
- Engage cooperation on multiple levels, adress financing issues of RE, fund R&D of energing technologies
- These conclusions and agreements should be recommendations for APEC policy makers, both in APEC and in each economy
- understand RE definition of each economies
- Try to share the information through the website
- Conduct capacity building / Training workshop for RE development / How to overcome high investment of RE technology
- Focusing on grid capacity expanded
- To share and establish strong link between different economies on RE technologies.
- Encourage international regional information exchange through technical, policy and academic

- Emphasize sharing of best practices and success stories – provide information to help nascent industriy succeed (The biggest challenge is starting)
- Priority areas were identified & should be followed-up
- Link the project's outcomes to subsequent collective actions
- Consolidate the results and come up with concrete recommendations and action
- Education & Training on RE should be furthered.
- Technical cooperation among members on "Smart Grid" & "Energy Storage" can be advanced

8. What needs to be done next by APEC? Are there plans to link the project's outocmes to subsequent collective actions by for a or individual actions by economies?

- No idea
- Fortify next steps
- Please, invite more ecnomies, sum-up the results to show APEC's overall motives forward doubling, discuss success and failure stories
- Maybe sharing information on previous events that addressed the issue of RE; also sharing inforamtion before the start of the event on what economies have participated in the past on this subject
- Please afford more time for discussion
- Classroom(seat) arrangement should be done in around table form in order to allow more participation from attendants
- Everything is good
- The presentation materials can be shared before the workshop for better understanding and learning
- Increase number of day for workshop to 5 days
- Sharing based on participants need
- Better coordination among expert presenters to link topics to issue facing apec economies / Construct framework among economies for information sharing
- Sharing of list of participants workshop documentation
- Produce a report on the project and distribute to perticipants, ensure the participenting the continuously engaged, continuity ub tge next step
- Needs more coordinated approach
- Seating plan from row to round / face-to-face pattern

APEC#216-RE-01.9