Asia-Pacific
Economic Cooperation

Utility-based Financial Mechanisms For Renewable Energy and Energy Efficiency

APEC 21st Century Renewable Energy Development Initiative (Collaborative VIII): Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency (EWG 02/2007)

Energy Working Group
Expert Group on New and Renewable Energy Technologies

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Report prepared for the APEC Expert Group on New and Renewable Energy Technologies by:

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APEC Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency

Honolulu, Hawaii
Sheraton Waikiki Hotel
March 30-April 1, 2009

March 30, 2009

8:30	Registration
9:00-9:30	Official Welcome The Honorable Hermina Morita Hawaii House of Representatives
9:30-10:30	Workshop overview and introduction to utility based financial mechanisms that support renewable energy and energy efficiency Dr. Cary Bloyd Argonne National Laboratory, and APEC Expert Group on New and Renewable Energy Technologies
10:30-11:00	Break
11:00-11:30	Overview of renewable energy support policy in Japan/historical development, buy back rate system of electric utilities, RPS, and green power. Dr.Hiroshi Asano Senior Research Scientist Central Research Institute of Electric Power Industry (CRIEPI) Tokyo, Japan
11:30-12:00	California's Experience with feed-in tariffs and renewable energy portfolio standards Dr. Terry Surles Senior Advisor California Institute for Energy & Environment Office of the President University of California Board Member Pacific International Center for High Technology Research
12:00-2:00	Lunch

2:00-4:00 Hawaii's Experience in Grid Connected Renewable Energy Systems: Regulatory, Government Energy Office, and Utility Perspectives

2:00-2:30 Regulators perspective on Renewable Energy Portfolio Standards
Mr. Carlito Caliboso
Chairman
Public Utilities Commission
State of Hawaii

2:30-3:00 Hawaii State Government Experience: Renewable Energy Portfolio Standard and Hawaii Clean Energy Initiative
Mr. Theodore "Ted" Peck
Energy Administrator
Department of Business Economic Development & Tourism
State of Hawaii

3:00-3:30 Electric Utility Perspective on financing Grid Connected Renewables
Mr. Dave Waller
Vice-President for Customer Solutions
Hawaiian Electric Company

3:30-4:00 Break

4:00-4:30 Mexico's current financial mechanism that support the implementation of utility based renewable energy and efficiency
Dr. Jorge Huacuz
Director
Non-conventional Energy
Electrical Research Institute
Cuernavaca, Mexico

4:30-5:00 Malaysian current financial mechanisms and future directions (including feed in tariff plans and their evaluation).
Ir. Ahmad Hadri Haris
Head of Renewable Energy
Malaysia Energy Centre (PTM)
Kuala Lumpur, Malaysia

March 31, 2009

9:00-9:30 Efficiency certificate trading in Australia & in the context of renewable energy certificate energy certificate in the APEC region
Dr. Hugh Outhred
School of Electrical and Engineering & Telecommunications
University of New South Wales
Sydney, Australia

9:30-10:00 China's current financial mechanisms that support the implementation of utility based renewable energy and efficiency
Mr. Wang Zhongying
Director
Center for Renewable Energy Development (CRED)
Energy Research Institute
National Development and Reform Commission
Beijing, China

10:00-10:30 Break

11:00-11:30 Grid connected renewable energy in New Zealand
Dr. David Natusch
Managing Director
Resource Development Limited
Lower Hutt, New Zealand

11:30-12:00 Financing grid connected renewable energy in Vietnam
Mr. Vu Van Thai
Deputy Director General
International Cooperation Department
Ministry of Industry and Trade
Ha Noi, Viet Nam

12:00-2:00 Lunch

2:00-2:30 Financing grid connected renewable energy in Chinese Taipei
Dr. H. (Tom) Lee
Senior Researcher & Deputy Director
New Energy Technology Division
Energy & Environment Research Labs
Industrial Technology Research Institute
Chinese Taipei

2:30-3:00 Thailand's current financial mechanism that support the implementation of utility based renewable energy and efficiency
Dr. Paritud Bhandhubanyong
Senior Advisor
National Science and Technology Development Agency
Bangkok, Thailand

3:30-4:00 Break

4:00-4:30 Financing grid connected renewable energy in Indonesia
Dr. Andi Novianto,
Chairman, Alternative Energy Technical Team
Coordinating Ministry for Economic Affairs
Deputy Ministry for Energy, Mineral Resources, and Forestry
Jakarta, Indonesia; and

Mr. Ario Senoaji
State Electric Company, PT PLN
Jakarta, Indonesia

4:30-5:00 The Philippines' current financial mechanisms that support the implementation of utility based renewable energy and efficiency
Dr. N.A. Orcullo,Jr.
De La Salle University-Dasmarinas
Cavite, Philippines

April 1, 2009

9:00-9:30 Financial Aspects and Potential of Small Grid Connected Hydropower in Vietnam
Mr. Nguyen Duc Cuong
Director, Center of Renewable and Clean Development Mechanism
Institute of Energy
Ha Noi - Viet Nam, and

Mrs. Phan Thi Thuy Tien
Director, Science Technology and Environment Department
Vietnam Electricity (EVN)
Ha Noi - Viet Nam

9:30-10:30 Roundtable discussion of the recommendation for APEC Energy Working Group on Utility RE/EE Finance Priorities

10:30-11:00 Break

11:00-11:30 Workshop Next Steps Cary Bloyd

1. Introduction

Continued strong growth in electricity demand in the APEC region highlights the linkage between the energy needed to support sustainable development and concerns over the contribution of the electric utility sector to both global and local environmental issues. As APEC economies account for over 50% of the world energy demand, it is important that new energy production be based on best practices in the use of new and renewable energy technologies as well as cost effective energy efficiency measures. The electric utility sector is particularly important due to the size of investment that will be needed in the future. The electric utility sector is expected to account for about 49% of the projected $3.4 to $4.0 trillion investment needed for APEC's energy sector over the next two decades.[1]

Electric utilities across the APEC region have shown an increased interest in implementing grid-connected renewable energy systems as well as implementing various energy efficiency programs. The motivating factors for these activities include efforts to reduce green house gas emissions, increase energy security in their economies, improve the local environment, increase local employment, and for the economic benefits of using domestic energy resources.

Several policies and measures have been implemented globally targeted to promote greater use of renewable energy and energy efficiency. Financial mechanisms such as rebates and subsidies from utilities as well as various tax incentives from the governments have long been adopted. As many countries have liberalized their electric utility sectors, new approaches have been developed to find more effective means to promote renewable energy and energy efficiency activities.

In the US, each state implements its own electricity policies. Renewable Portfolio Standards (RPS) have been adopted widely in the US. RPS is projected to increase the use of energy from renewable sources in the US significantly in the future (projected at 60 GW by 2025). However, this will still be only 15% of projected electricity demand growth in that year.[2] The US thus needs to find other policies to accelerate renewable energy growth in addition to an adoption of RPS. Most states are adopting combinations of mechanisms to achieve their goal of increasing renewable energy generation.

Feed-in tariffs have been implemented widely in Europe and have proven to be effective renewable energy schemes that drive growth in renewable energy markets in several European countries—especially Germany and Spain. Net metering has some similar characteristics with feed-in tariffs. Both allow consumers to produce and supply their renewable electricity to the grid and be paid for it. One main difference is that net metering pays generators based on the retail rate or, more often, wholesale or "avoided cost" price, while feed-in tariffs normally pay the generators a pre-specified rate above the retail rate of electricity. The US has more experience with

[1] "APEC Energy Demand and Supply Outlook 2006", Asia Pacific Energy Research Center, Institute of Energy Economics, Tokyo, Japan, 2006, page 66. See wwww.iiej.or.jp/aperc

[2] Wiser, R. and Barbose. G., "Renewable portfolio standards in the United States: A status report with data through 2007", (LBNL-154E), Berkeley, CA: Lawrance Berkeley National Laboratory, 2008.

net metering than feed-in tariffs. Forty-four US states have currently adopted a net metering policy.

Renewable energy certificates and white certificates are market-based instruments that are tradable and are used to guarantee that certain amounts of electricity are generated from renewable energy sources, and certain amounts of electricity have been saved, respectively. White certificate markets have developed just recently and there is not much experience in the market at present.

This paper examines recent advances in utility-based financial mechanisms that support renewable energy and energy efficiency activities. The utility-based financial mechanisms reviewed here include renewable portfolio standards, feed-in tariffs, net metering, rebates and loan programs, renewable energy certificates, and white certificates. These mechanisms can be classified into four groups: quota schemes, performance-based incentives, capital payments, and market-based instruments. Some countries have more success with one mechanism over the others. This paper provides a discussion of policy effectiveness as well as some principal similarities and differences among these financial mechanisms.

2. Renewable Portfolio Standard

A Renewable Portfolio Standard (RPS) is a regulatory policy which places an obligation on electric utilities to produce a specified fraction of their electricity from renewable energy sources. Some states also allow energy efficiency measures to be counted as part of their RPS. Presently, a total of 28 US states are implementing an RPS and 5 states have a renewable energy goal (see Table 1). The targets of RPS are different in each state, for example, varying from 8% (in Illinois) to 25% (in New York) by 2013. Some states have set a target of using any combined qualified renewable energy resources to meet their RPS while others states have separated qualified renewable energy resources into different classes (or tiers) and set a certain target for each resource class to be utilized to meet the RPS. Wind, photovoltaics, biomass, hydroelectric, and land fill gas are the most common renewables that are qualified in the RPS of most states. Geothermal is also widely included in the states' RPS. In general, the qualified geothermal utilization is geothermal for electricity production. Arizona and Hawaii, however, have allowed both geothermal electric and geothermal heat pumps, and Nevada has included geothermal electric and geothermal hot water district heating systems, in their RPS. Most states clearly stated that fuel cells to be qualified in their RPS must use renewable energy fuels. However, Connecticut, District of Columbia, Maine, New York and Pennsylvania counted any fuel cells (using renewable or non-renewable fuels) in their RPS. Several states — including Colorado[3], Connecticut, Hawaii, Illinois, Nevada, North Carolina, Pennsylvania, and Vermont—have also allowed energy efficiency technologies to be counted as part of their RPS.

Pennsylvania is implementing an "Alternative Energy Portfolio Standard" (AEPS) instead of RPS, and established two categories of energy sources. Tier I sources include (new and existing) photovoltaic energy, solar-thermal energy, wind, low-

[3] Only in the Fort Collins.

impact hydro, geothermal, biomass, biologically-derived methane gas, coal-mine methane and fuel cells. Tier II sources include (new and existing) waste coal, distributed generation systems, demand-side management, large-scale hydro, municipal solid waste, wood pulping and manufacturing byproducts, and integrated gasification combined cycle (IGCC) coal technology. The AEPS calls for utilities to generate 8% of their electricity by using Tier I energy sources, and 10% using Tier II sources by May 31, 2021.

The RPS relies on the private market for its implementation as electric utilities buy electricity from private generators. With an obligation to meet RPS requirements, electric utilities have to make sure that sufficient amounts of electricity are purchased from certified renewable energy generators. Certified renewable energy generators earn certificates (Renewable Energy Certificates) for every unit of electricity they produce and can sell these along with their electricity to electric supply companies. Supply companies then pass the certificates to the state or regulators to demonstrate their compliance with their RPS obligation.

Table 1: Renewable Energy Portfolio Standards in the US

States	Wind	PV	Solar Thermal	Bio-mass	Geo-thermal	Hydro electric	Fuel Cells	Land fill gas	Tidal/ Ocean	Wave	CHP/ Cogen	Anae Robic digestion	MSW	Bio diesel	Etha-nol	Co firing	Hy-dro gen	EE1/
Arizona	X	X	X	X	X2/	X	X	X			X	X						
California	X	X	X	X	X	X	X	X	X	X		X	X	X				
Colorado	X	X		X	X	X	X	X				X						X3/
Connecticut	X	X	X	X		X	X	X	X	X	X		X					X
Delaware	X	X	X	X	X	X	X	X	X	X		X						
District of Columbia	X	X	X	X	X	X	X	X	X	X			X			X		
Florida	X	X		X				X					X					
Hawaii	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Illinois	X	X	X	X		X		X						X				X
Iowa4/	X	X		X		X		X				X	X					
Maine	X	X	X	X	X	X	X	X	X		X		X					
Maryland	X	X	X	X	X	X	X	X	X	X		X	X					
Massachusetts	X	X	X	X			X	X	X	X								
Michigan	X	X		X		X		X										
Minnesota	X	X	X	X		X		X				X	X			X	X	
Missouri	X	X	X	X	X	X		X										
Montana	X	X	X	X	X	X	X	X				X						
Nevada	X	X	X	X	X5/	X	X	X	X			X	X	X				X
New Hampshire	X	X	X	X	X	X		X	X	X		X		X	X		X	
New Jersey	X	X	X	X	X	X	X	X	X	X		X						
New Mexico	X	X	X	X	X	X	X	X				X						
New York	X	X		X		X	X	X	X	X		X		X	X			
North Carolina	X	X	X	X	X	X		X	X	X		X					X	X
North Dakota	X	X	X	X	X	X		X									X	
Oregon	X	X	X	X	X	X		X	X	X		X					X	
Pennsylvania6/	X	X	X	X	X	X	X	X	X		X	X	X					X
Rhode Island	X	X		X	X	X	X	X	X	X		X		X				
South Dakota	X	X	X	X	X	X		X				X	X				X	

Table 1: Renewable Energy Portfolio Standards in the US (Continued)

States	Wind	PV	Solar Thermal	Bio-mass	Geo-thermal	Hydro electric	Fuel Cells	Land fill gas	Tidal/ Ocean	Wave	CHP/ Cogen	Anae Robic digestion	MSW	Bio diesel	Etha-nol	Co firing	Hy-dro gen	EE
Texas	X	X	X	X	X	X		X	X	X								
Vermont	X	X	X	X		X	X	X				X						X
Virginia	X	X	X	X	X	X			X	X		X	X					
Washington	X	X	X	X	X	X		X	X	X		X		X				
Wisconsin	X	X	X	X	X	X	X	X	X	X								

Notes: 1/ Energy Efficiency
2/Include both geothermal electric and geothermal heat pump
3/ Energy efficiency is included only in the RPS of the Fort Collins and is not applied to other cities in Colorado.
4/ Iowa called it "Alternative Energy Law".
5/ Include geothermal electric and geothermal hot water district heating systems
6/ Pennsylvania called it "Alternative Energy Portfolio Standards" and included "waste coal, coal mine methane, coal gasification, and other distributed generation technologies in its standards.

Source: Database of State Incentives for Renewable & Efficiency, see www.dsireusa.org

It has been argued that RPS mechanisms have tended to be most successful in the US in stimulating new renewable energy capacity where they have been used in combination with federal Production Tax Credits (PTC).[4] In periods where PTC have been withdrawn, the RPS alone has often proven to be an insufficient stimulus to provide incentives for large volumes of renewable generating capacity.[5]

There is also an argument that RPS creates "limited" long-term markets for renewable energy. The RPS is achieved by obligating electric suppliers to deliver to consumers a portion of their electricity from renewable energy sources. RPS is one of the quota scheme mechanisms, which generally do not create long-term certainty. A quota is set either for a period of time or for a quantity of power. Once that goal is reached, there is nothing to make electric suppliers obtain more renewable energy power, or keep renewable power producers from becoming uneconomic. In addition, RPS depends on competitive bidding and limits participation to only participants with high power in the market. This leads to the concentration of renewables into the hands of powerful generators.

3. Electricity Feed Laws

Electricity Feed Laws permit the interconnection of renewable sources of electricity with the electric-utility network and specify how much the renewable generators are paid for their electricity. Electricity Feed Laws are also known as Feed-in Tariffs, Renewable Tariffs, or Renewable Energy Producer Payments, and, in Ontario, Canada, Standard Offer Contracts. The modern version of Electricity Feed Laws is called Advanced Renewable Feed-in Tariffs.

Feed-in tariffs are payment per kWh for electricity generation fed back into the electricity grids from designated renewable electricity generation sources like solar PV systems or wind turbines. Investors receive a long-term contract, i.e., 20 years, from utilities to buy electricity from them at a guaranteed fixed price, assuring them a return on their investment. The payments are generally at a higher rate than retail prices of grid electricity to provide an incentive to the investors. In Europe, these fixed prices are structured either in the form of long-term payments based on generation cost plus a reasonable profit (as in Germany) or in the form of a fixed premium on top of the spot market price for electricity (as in Spain).[6] Feed-in tariffs offer equitable opportunity to all willing participants in the market.

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[4] Companies that generate wind, geothermal, and "closed-loop" bioenergy are eligible for the federal production tax credit (PTC), which provides a 1.9-cent per kWh benefit for the first ten years of a renewable energy facility's operation. Other technologies, such as "open-loop" biomass, incremental hydropower, small irrigation systems, landfill gas, and municipal solid waste, receive a lesser value tax credit. See the Union of Concerned Scientists, http://www.ucsusa.org/clean_energy/solutions/big_picture_solutions/production-tax-credit-for.html

[5] http://en.wikipedia.org/wiki/Renewable_Portfolio_Standard

[6] Ragwitz and Huber, "Feed-in systems in Germany and Spain and a comparison," (2005) from "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions", a white paper prepared for the Heinrich Boll Foundation, by Wilson Rickerson and Robert C. Grace, February 2007.

A feed-in tariff can be a net feed-in tariff or a gross feed-in tariff. A net feed-in tariff, also known as export metering, pays the system owner only for surplus energy he produces to the grid after his consumption, whereas a gross feed-in tariff pays for each kWh produced to a grid-connected system.

Feed-in tariffs have been claimed to be the most effective way to stimulate rapid growth of renewable energy market. After investment subsidies, feed-in tariffs are claimed to be the most widespread means of promoting renewable energy uptake in Europe. At present, feed-in tariff regulations for renewable energy exist in over 40 countries around the world including 18 European Union countries.[7] In 2006 Ontario became the first government in North America to establish a set of European-style feed-in tariffs, called the Standard offer Contract.[8]

Advanced Renewable Feed-In Tariffs (ART) is the modern version of Electricity Feed Laws. ART use a tiered system. For example, with wind energy, the price per kWh in each tier reflects the price needed for incentives in different regions during the first few years. During later years, wind power generators in areas with strong winds are paid less than those in low-wind zones. The actual price in later years is a function of the amount of electricity generated. Wind power generators producing more than a certain amount, reflecting a windy site, are paid a lower rate per kWh than the norm. Wind power generators producing less than the standard, reflecting a less windy site, are paid a higher rate. Germany and France are adopting ART for wind, and solar energy. Both set fixed prices during the first five years. Germany sets two tiers that apply across the entire country, and France sets three different tiers and different prices depending on location—metropolitan France, its old colonies (DOM-TOM) and Corsica. Germany paid all onshore wind projects beginning operation in 2004 at 0.087 €/kWh for the first five years of operation. After five years, the payment level at windy sites drops to 0.055 €/kWh. For generators at less windy sites, the higher payment level is extended for longer periods of time depending on the weakness of their wind resource.[9] France pays 0.03 €/kWh for windy sites, 0.08 €/kWh for less windy sites, and 0.06 €/kWh at sites between the two extremes.[10]

Feed law systems have resulted in the installation of eight times more wind capacity worldwide than quota systems. Neither net metering, renewable portfolio standards, tax credits, nor even PURPA (the US Public Utilities Regulatory Act), have produced more wind-generated capacity than the feed laws used in Europe.[11]

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[7] http://www.energymatters.com.au/government-rebates/feedintariff.php

[8] Ontario Power Authority, 2007

[9] Wilson Rickerson and Robert C. Grace (2007), "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions," a white paper prepared for the Heinrich Boll Foundation.

[10] Paul Gipe, "Electricity Feed Laws Power Renewable Energy," http://www.fuelandfiber.com/Athena/ElectricityFeedLawsNewAthenum.doc

[11] Bernard Chabot, an economist with France's Agency for Environment and Energy Management.

Germany

Germany is credited with implementing the most successful feed-in tariff laws. The Electricity Feed Act was introduced in Germany in 1991 to guarantee interconnection of renewable energy power with electricity grids. This 1991 Act required utility companies to purchase electricity generated from renewable resources at set rates (feed-in tariffs) at a percentage of the average retail rate, which varied from year to year. Wind and solar projects received 90% of the retail rate. Hydropower, biogas, and biomass plants under 500 kW received 80%, and over 500 kW but under 5 MW received 65% of the retail rate.[12] The ratepayers of each utility were responsible for the cost burdens within their utility territory. Total generation was capped at 10% of each utility's portfolio.

In the late 1990s, the retail rates began to fall which resulted in slow growth of renewable markets. The 1991 original scheme was amended and expanded in 2000, and has been responsible for the dramatic growth in Germany's renewable energy market, particularly the solar photovoltaic industry.

Under the new feed-in tariffs, power from renewable energy sources is paid at fixed price premium rates, targeting specific technology types. The 20-year long-term contracts are offered to renewable generators to secure a reasonable profit for their investment. The feed-in tariffs are differentiated based on costs of generation of individual technology plus a reasonable profit. Each technology is eligible for a different feed-in rate so that each renewable energy resource type can be profitably developed. The resource-specific feed-in tariffs are further differentiated by system size, installation type, and/or resource availability. Wind generators are differentiated by wind resource such that projects in better wind regimes received lower payments than those in lower wind regimes.

The 2000 feed-in tariffs were amended in 2004. The 2004 law adjusted the payments for biomass, PVs, and geothermal generators to more accurately reflected generation costs and to target specific applications, such as facade-integrated PVs; fuels such as manure and energy crops for biogas; and conversion technologies, such as fuel cells and organic Rankine cycles. The rates for some technologies were adjusted again in 2008.

The average level of feed-in tariff in 2005 was €0.0953 per kWh (compared to an average cost of displaced energy of €0.047 kWh). The total level of subsidy was €2.4 billion, at a cost per consumer of €0.0056 per kWh (3 % of household electricity costs).[13]

Under the German feed-in tariffs, the renewable generators receive a fixed payment for 20 years, but payment streams decline over time such that a generator beginning

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[12] International Energy Agency (2008), "Global Renewable Energy Policies and Measures Database: Electricity Feed Law", see http//www.iea.org/textbase/pm/?mode=re&id=1057&action=detail

[13] HM Treasury (2006), *Stern Review on the Economics of Climate Change*, p. 367, Retrieved from http://en.wikipedia.org/wiki/Feed-in_tariffs_in_Germany

production in 2006 will receive a lower payment stream than a generator beginning production in 2005. This declining payment structure is designed in order to account for improved efficiencies from economies of scale and encourage cost reductions over time. In 2005, for example, the annual reductions are 1.5% for electricity from biomass and landfill gas; 5% for electricity from PV; 1% for electricity from geothermal; and 2% for electricity from wind. There is no decrease in the incentive for hydropower. In addition, the prices are revisited by parliament every four years to allow for adjusting the program to changes in the economy. German feed-in tariffs by technology and payment reduction rates, with installed capacity and output in 2005 are shown in Table 2.

Table 2: German Fixed Payments (2005)

Resource	Max Size	Payment (€cent/kWh)	Decrease in incentive (% per annum)	MW (2005)	GWh (2005)
Hydropower	500 kW	9.67	0.0%	4,680	21,524
	5 MW	6.65			
Landfill gas, sewage gas, mine gas	500 kW	7.67	1.5%	2,192	13,444
	5 MW	6.65			
Biomass	150 kW	11.5	1.5%		
	500 kW	9.9			
	5 MW	8.9			
	20 MW	8.4			
Geothermal	5 MW	15	1.0%	0.2	0.2
	10 MW	14			
	20MW	8.95			
	Above 20 MW	7.16			
Onshore wind	First 5 years	8.7	2%	26,500	18,428
	Up to 20 years	5.5			
Offshore wind	First 12 years	9.1	2%		
	Up to 20 years	6.19			
Photovoltaics	Ground mounted	45.7	5%	1,508	1,000
	Building mounted (30 kW)	57.4			
	Building mounted (<100 kW)	54.6			
	Building mounted (>100 kW)	54			

Source: Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit (2004) and Staiss et.al (2006) from "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions", a white paper prepared for the Heinrich Boll Foundation, by Wilson Rickerson and Robert C. Grace, February 2007, p7.

The German feed-in tariffs have resulted in significant expansion of renewable energy markets during the past decade, and Germany is now the world's largest market for photovoltaic systems and wind energy. In 2005, 10% of electricity in Germany came

from renewable sources of which 70% was supported by feed-in tariffs. Germany more than doubled its national supply of renewable electricity between 2000 and 2007, and met its 2010 target of 12.5% renewable electricity three years ahead of schedule.[14] As a consequence of this success, Germany recently increased its renewable energy target to 27% of all electricity generation by 2020.

Spain[15]

Spain is another country where feed-in tariff policy has driven rapid growth of renewable energy markets. Spain was the first country to include a specific solar thermal feed-in tariff. In 2007, there were only 10 MW of solar thermal systems installed in the country, but as of March 2008, 270 MW additional capacity of solar thermal systems are under development.

The current feed-in policy in Spain is a result of various amendments to renewable energy policies and legislation. In 1997, Spain established a special regime for renewable energy targets that allowed generators to choose either a feed-in tariff, similar to Germany's, or a premium payment on top of the electricity market price. Both the tariffs and the premium payments were based on generation costs and differentiated by technology, and, for some resources, by size. Both the tariffs and the premium payments were adjusted annually by the government to take into account changes in the market. The payment burdens were distributed nationally. Generators over 10 MW would need to forecast their generation 30 hours in advance.

In 2004, the regime was amended to further differentiate resources by size, including an increase in the PV system size eligible for the most generous tariff from 5 kW to 100 kW. The annual tariffs were tied to the average annual retail price, rather than set by government. A full review of tariffs was scheduled for every 4 years. The contract length was set at the life of the system. More incentives were added for generators to choose the premium payment option. Unlike the German feed-in tariff, the Spanish feed-in tariff included capacity goals for each technology that would trigger a policy revision by the government when reached. The goals for each resource are 13,000 MW for wind, 3,200 MW for biomass, 2,400 MW for hydro, 200 MW for solar thermal, and 150 MW for PV.[16]

The tariff scheme was revised again in 2007. After the 2004 amendment to increase incentives for the premium payment option, the majority of renewable generators opted to take this option, rather than the tariff payment. Spot market prices increased more than the government projected. To control costs, the law removed the incentive for choosing the premium payment and established a floor and a ceiling value for the premium payment option. The annual adjustment in tariff was changed to tie it to the

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[14] Bohme et al. (2008), "Development of Renewable Energies in Germany in 2007", Berlin, Germany: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit.

[15] Grace, Robert C., Rickerson, Wilson and Corfee, Karin (KEMA), "California Feed-in Tariff Design and Policy Options," California Energy Commission, Publication number: CEC-300-2008-009D.

[16] Del Rio Gonzalez, P. (2008) "Ten Years of Renewable Electricity Policies in Spain: An Analysis of Successive Feed-in Tariff Reforms", Energy Policy, 36 (8), 3345-3350.

consumer price index instead of average retail price.[17] The capacity goals for certain resources were raised. Biomass was further differentiated by fuel type and biomass tariffs were increased. Different incentives were offered for on-peak and off-peak generation. A generator received 104.62% of the payment for on-peak power, and 96.70% of the payment for off-peak power.

In 2008 the Spanish PV market increased four times larger than its capacity goal. The government thus introduced a cap of 300 MW on annual solar installations (200 MW for rooftop systems, and 100 MW for ground-mounted systems) and reduced the incentives to between 65% and 75% of their previous levels.[18]

There are several similarities between German and Spanish feed-in policies. Both schemes provide long-term contracts and fixed-price payments that encourage investor security. Both schemes provide payments based on generation costs for a specific technology. Both Germany and Spain evenly distributed the cost of their feed-in tariff policy nationally.[19] Several differences, however, are seen between these two schemes. Some of the key components of the feed-in policies in Germany and Spain are compared in Table 3.

[17] Held A., Ragwitz, M., Huber, C., Resch, G., Faber, T. and Vertin, X. (2007), "Feed-in systems in Germany, Spain and Slovenia: A comparison", Karlsruhe, Germany: Fraunhofer Institut für Systemtechnik und Innovationsforschung.

[18] "Spain to cut subsidies for solar PV, not solar thermal", SustainableBusiness.com News (July 22, 2008), www.sustainablebusiness.com/index.cfm/go/news.display/id/16449

[19] Germany initially limited its feed-in tariff cost distribution within each utility service territory but eventually switched to a broader socialization system due to problems with cost imbalances and their effect on competition in the electricity market.

Table 3: Comparison of German and Spanish Feed-in Tariffs

Design Issue	Germany	Spain
Contract length	20 years	Project life
Tariff structure	Fixed payment	Fixed payment or fixed premium
Incentive basis	Generation cost	Generation cost
Differentiation		
Technology	Yes	Yes
Size	Yes	Yes
Resource quality	Yes	No
Tariff adjustment	Tariffs locked in for 20 years, applicable to a generator coming online in a particular year; for each subsequent year, the fixed 20-year rate declines according to a schedule that tracks experience curves	Annual tariff and premium rates pegged to CPI; Payment revised periodically by government; Premium payment sits atop variable wholesale electricity market price, but total remuneration is bounded by floor and ceiling
Tariff revision	4 years	4 years, or by capacity triggers
Policy caps	None	Technology-specific capacity triggers, with grid access deposits
Forecast obligation	No	Yes
Voltage support incentive available to generators	No	Yes
Peak generation differentiation	No	Voluntary

Source: KEMA, Inc.

Australia

Feed-in tariff legislation has been enacted by several State governments in Australia. Several States have also proposed solar photovoltaic feed-in tariffs schemes. There is no nationalized feed-in program, only State-run schemes.[20] A uniform federal scheme to supersede all State schemes has been proposed, but not enacted. Two state governments—including Western Australia (WA) and the Australian Capital Territory (ACT)—have enacted a gross feed-in tariff. Other State Government, including Victoria (VIC), South Australia (SA), Tasmania (TAS), Northern Territory (NT), and Queensland (QLD) have enacted net feed-in tariff schemes, meaning that

[20] The Federal Parliament of Australia has not yet enacted a national gross feed-in tariff scheme for renewable energy. However, a capital grant/rebate is offered of up to AUD 8,000 per household for domestic installations and 50% for school installations.

homeowners are only paid for the electricity exported to the grid minus what is consumed in the home at the time of generation.

Tariff rates vary among States. Victorian households with solar power systems will be paid a feed-in tariff starting in 2009 at AUS$0.60 per kWh for every unused kWh of power fed back into the state electricity grid, which is almost four times the current retail price for electricity and the highest feed-in tariff offered in Australia. South Australian residents will receive AUS$0.44 per kWh. Not all electricity companies in South Australia may choose to offer contracts and those that do may add to this incentive. The Australian Capital Territory's gross feed-in tariff pays around AUS$0.50 per kWh, almost four times the normal retail price. The current feed in tariff rate for Tasmania is AUS$0.20 per kWh. In Northern Territory, Alice Springs residents can receive a net feed in tariff rate of AUS$0.45 per kWh produced while other areas of the Northern Territory receive the rate of AUS$0.1438 per kWh. The feed-in schemes in Australia among states are shown in Table 4.

Table 4: Australia Feed-in Tariff schemes

State	Current Status	Max Size	Rate Paid AUS$ Per kWh	Program Duration (Years)	Model
VIC	Commences 2009	2 kw	$0.60	15	Net
SA	Commenced July 2008	10 kw	$0.44+	20	Net
ACT	Commences March 2009	30 kW	$0.5005 up to 10kW; $0.4004 up to 30 kW	20	Gross
TAS	Commenced	tbc	20c	tbc	Net
NT	Incentive is available for 225 rooftop PV systems in Alice Springs	tbc	$0.4576, capped at $5 per day; then reverts to $0.2311/kWh	tbc	Net
WA	Little activity since election commitment	tbc	Expected to be up to $0.60	Likely 2-9 years	Gross
QLD	Commenced July 2008	10 kW	44c+	20	Net
NSW	Under review, to commence in 2009	tbc	Not yet specified; expected $0.60	tbc	tbc

Note: "tbc"refers to "to be confirmed."
***Source*:** http://www.energymatters.com.au/government-rebates/feedintariff.php

Canada

North America's first electricity feed law was implemented in Ontario, Canada. The feed-in tariff mechanism in Ontario is under the name Standard Offer Contracts (or also known as Advanced Renewable Tariffs). The contracts became available in Fall 2006, and included existing systems from January 1, 2000. The Standard Offer Contracts include many of the characteristic elements of European feed laws. The tariff paid for each kilowatt-hour generated is different for each renewable energy technology. Contracts are open to all parties and for 20 years—so it will be sufficient time to payback the investment. Ontario tariffs for wind, hydro, and biomass are adjusted for 20% inflation (compared to the 60% adjustment in France). There is no inflation adjustment for PV. Contracts under Ontario's Standard Offer Program are

limited to 10 MW (while German's project size is limited to 20 MW). However, there is no limit of the program's total size (same as the German feed law).[21]

Ontario's prices under the Standard Offer Program are normally less than tariffs paid in Europe. In the case of solar energy, Ontario's price is US$0.3336 per kWh as compared to US$0.7217 per kWh in France or US$0.6057 per kWh in Germany. Table 5 compares Ontario's Standard Offer Contract Tariffs with feed-in tariffs in other countries.[22]

Table 5: Ontario's Standard Offer Contract Tariffs as Compared to Feed-in Tariffs in Other Countries (First year Renewable Tariffs in US$/kWh)

	Wind	PV	Hydro	Biogas	Program Duration
Ontario	0.0877	0.3336	0.0877	0.0877	20 years
Austria	0.0978	0.5960		0.2196	
Brazil	0.0715		0.0505	0.0631	
Czech Republic	0.1117	0.6002			
France	0.1062	0.7217	0.0711	0.1166	15 yrs for wind and biomass; 20 yrs for solar and hydro
Germany (2008)	0.1040	0.6057	0.0955	0.1403	20 years
Italy		0.7126			
Portugal	0.1024		0.1062		12 years
Spain (2007)	0.0981	0.5897		0.1750	
Turkey	0.0713				

Note: Tariffs were conversed from Euro.
Source: www.wind-works.org/FeedLaws/RenewableTariff.xls

Only recently, Prince Edward Island has established feed-in tariffs. The rate is $0.043 per kWh for wind, biomass, and solar with a $0.013 per kWh adder tied to the consumer price index. Systems in Prince Edward Island must be larger than 100 kW. Saskatchewan is also in a process of implementing a standard offer contract.[23]

[21] "North America's First Electricity Feed Law: Standard Offer Contracts in Ontario, Canada" by P.Gipe and B.Chabot, DEWI Magazin Nr. 29, August 2006; www.dewi.de/dewi/fileadmin/pdf/publications/Magazin_29/04.pdf

[22] www.wind-works.org/FeedLaws/Canada/Q&AonStandardOfferContracts.html

[23] Wilson Rickerson and Robert C. Grace (2007), "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions," a white paper prepared for the Heinrich Boll Foundation.

United States[24]

The United States implemented a law called the Public Utilities Regulatory Act (PURPA) in 1978. PURPA permitted interconnection of renewable energy generators with the grid but did not specify the price—only the means for calculating the price. Electric Feed Laws are equivalent to PURPA with tariff prices being specified.

Six US states have introduced feed-in tariff legislation including California (CA), Michigan (MI), Illinois (IL), Minnesota (MN), Rhode Island (RI) and Hawaii (HI). In addition, eight states are surveying the idea of adopting feed-in tariffs in their states to increase renewable energy generation including Florida, Main, Massachusetts, New Jersey, New York, Vermont, Wisconsin, and Oregon. Feed-in tariff schemes vary among states as shown in Table 6.

Table 6: US Feed-in Tariff Schemes

	Current Status	Max Size	Program Duration (years)	Model[1/]
CA	Commenced in 2006 and expanded in 2007	1.5 MW- system cap 478.4 MW-program cap	10, 15, or 20 years	Gross or net
MI	The bills were passed by the House; now in committee in the Senate	20 MW	20 years	Gross
IL	Opposed in the legislature, and amended to PV net metering bill	20 MW	20 years	Gross
MN	Referred to Committee on Finance (2/28/2008)	20 MW Generators must be majority-owned by Minnesotans.	20 years	Gross
RI	Referred to House Corporations (2/26/2008). The bill is being negotiated.	20 MW	20 years	Gross
HI	Not passed out of committee and will have to be reintroduced next session	20 MW Nameplate capacity = 5% of utility peak demand	20 years	Net

Note: [1/] "Gross" refers to 100% generation to utility, and "Net" refers to surplus of energy after consumption

Source: Feed-in Tariffs and Renewable Energy in the USA—a Policy Update, Rickerson, Bennhold and Bradbury (May, 2008)

[24] Rickerson, Bennhold, and Bradbury (2008), "Feed-in Tariffs and Renewable Energy in the USA—a Policy Update", North America Solar Center, Heinrich Boll Foundation (Washington DC), and WorldFuture Council.

California was the first state to develop feed-in tariffs, which were introduced in 2006. The program was for systems with a capacity of 1.5 MW and below, capped at 250 MW total statewide and limited to facilities sited at wastewater and water treatment facilities. The contracts are offered to generators for 10, 15 or 20 years. Generators can choose to sell either 100% of the total power or sell only their excess electricity after their own use. Unlike German feed-in tariffs, California's feed-in tariffs are based on time-of-delivery, not generation cost of individual technologies. All technologies are offered the same price, but this price varies depending on whether the electricity is generated during peak or off-peak times. In Southern California, peak payments can be up to $0.31 per kWh in the summer. In 2007 the program was extended to all customer-types and the cap was expanded to 478.4 MW. A recent bill (AB 1807 of 2008) is seeking to increase the system capacity limit to 20 MW and shift to a payment structure that is based on individual technology generation costs.

In addition to California, other state legislatures have introduced feed-in tariffs. These states designed their feed-in tariff structures similar to Germany with tariffs based on technology-specific payments. Michigan offers technology-specific payments for wind, hydropower, biomass or biogas, landfill gas, PV and geothermal in a sliding scale of capacity. Minnesota offers technology-specific payments similar to Michigan but does not cover geothermal. Illinois proposed a similar feed-in tariff structure to Michigan but it was opposed in the legislature and thus amended to be a PV net metering bill with a project cap at 2 MW, and pays all gross kWh PV generated through net metering at 200% of the retail price. The current feed-in tariff schemes in the US are compared in Table 7.

In addition to feed-in tariff bills at the state level, there is a significant effort to introduce national feed-in tariffs in the US. A national feed-in tariff bill, called a renewable energy payment (REP), was introduced to the Congress in May 2008. The bill includes three main design elements: 1) guaranteed interconnection through uniform minimum standards (e.g., the priority interconnection and transmission of power from new renewable energy facilities, which include renewable energy facilities 20 MW or less); 2) a mandatory purchase requirement through fixed-rate 20-year contracts (e.g., national REP rates at levels designed to provide for full cost recovery plus a 10% internal rate of return on investment; REP rates would be differentiated on the basis of energy technology, the size of the system, and the year that the system was placed in service.); and 3) rate recovery through a regionally partitioned national system benefits charge on every electric customer in the US.[25]

[25] Rickerson, Bennhold, and Bradbury (2008), "Feed-in Tariffs and Renewable Energy in the USA—a Policy Update," North Carolina Solar Center, World Future Council, and Heinrich Boll Foundation.

Table 7: Feed-in Tariffs in the US

	Michigan	Illinois	Minnesota	Rhode Island	Hawaii
Wind	$0.105 (<700 kWh/$m^2$/year) Linear in between 700 to 1,100 kWh/m^2/year $0.08 (>1,100 kWh/$m^2$/year) $0.25 (2000 sq ft swept area)	None	$0.105 (<700 kWh/$m^2$/year) Linear in between 700 to 1,100 kWh/m^2/year $0.08 (>1,100 kWh/$m^2$/year) $0.25 (1000 sq ft swept area)	$0.115 (<20 MW) $0.105 (20MW to 50 MW)	None
Hydro	$0.10 (<500 kW) $0.085 (500 kW to 10 MW) $0.065 (>10 MW, <20 MW)	None	$0.10 (<500 kW) $0.085 (500 kW to 10 MW) $0.065 (>10 MW, <20 MW)	$0.10 (<500 kW) $0.085 (500 kW to 10 MW) $0.065 (>10 MW, <20 MW)	None
Biomass/ Biogas	$0.145 (<150 kW) $0.125 (150 kW to 500 kW) $0.115 (500 kW to 5 MW) $0.105 (5 MW to 20 MW)	None	$0.145 (<150 kW) $0.125 (150kW to 500 kW) $0.115 (500 kW to 5 MW) $0.105 (5MW to 20 MW) (60% or greater efficiency)	$0.145 (<150 kW) $0.125 (150kW to 500 kW) $0.115 (500 kW to 5 MW) $0.105 (5MW to 20 MW)	None

Table 7: Feed-in Tariffs in the US (Continued)

	Michigan	Illinois	Minnesota	Rhode Island	Hawaii
Landfill Gas	$0.10 (<500 kW) $0.085 (>500 kW) (or sewage treatment gas)	None	$0.10 (<500 kW) $0.085 (>500 kW) (60% or greater efficiency, or sewage treatment gas)	$0.10 (<500 kW) $0.085 (>500 kW) (or sewage treatment gas)	None
PV	$0.71 (façade cladding < 30kW) $0.68 (façade cladding 30 kW to 100 kW) $0.67 (façade cladding >100 kW) $0.65 (rooftop < 30kW) $0.62 (rooftop 30 kW to 100 kW) $0.61 (rooftop >100kW) $0.50 (ground mounted)	All gross kWh generated through net metering at 200% of the retail price	$0.71 (façade cladding < 30kW) $0.68 (façade cladding 30 kW to 100 kW) $0.67 (façade cladding >100 kW) $0.65 (rooftop < 30kW) $0.62 (rooftop 30 kW to 100 kW) $0.61 (rooftop >100kW) $0.50 (ground mounted)	$0.54 (rooftop < 30kW) $0.52 (rooftop 30 kW to 100 kW) $0.44 (rooftop >100kW to 2 MW) $0.48 (ground mounted)	$0.45

Table 7: Feed-in Tariffs in the US (Continued)

Technology	Michigan	Illinois	Minnesota	Rhode Island	Hawaii
Geothermal	$0.19 (<5 MW) $0.18 (5 MW to 10 MW) $0.115 (10 MW to 20 MW) $0.09 (>20 MW)	None	None	$0.19 (<5MW) $0.18 (5MW to 10 MW) $0.115 (10MW to 20 MW) $0.09 (>20 MW)	None
Other	None	None	None	Avoided cost times 1.15	None

Source: Rickerson, Bennhold, and Bradbury (2008), "Feed-in Tariffs and Renewable Energy in the USA—a Policy Update," North Carolina Solar Center, World Future Council, and Heinrich Boll Foundation.

Several states in the US have passed Community-Based Energy Development (C-BED) legislation, and thus a C-BED policy similar to feed-in tariffs is being considered. Minnesota is an example of a state considering C-BED feed-in tariffs. The C-BED structure is similar to that of feed-in tariffs in that utilities are required to develop 20-year contracts for renewable generators. However, utilities are not required to enter into C-BED contracts, and the contracts are negotiated rather than standardized. The C-BED policy in Minnesota covers wind and other technologies but did not establish technology-specific rates.

Japan

Japan had the largest number of solar photovoltaic units installed in homes until fiscal 2005 when Germany surpassed this record due to the implementation of its feed-in tariff policy. Japan wants to implement a feed-in tariff system in fiscal 2010 where electric power companies are obligated to purchase surplus electricity generated by household solar cells. Feed-in tariffs in Japan focuses only on solar power and on the surplus electricity generated after home or factory usage. At present the utilities purchase electricity only voluntarily for about 23 to 25 yen ($0.243 to $0.264)[26] per kWh The feed-in tariff rate paid to investors will be guaranteed for 10 years at 50 yen (about $0.528) per kWh, about double current retail prices. The guaranteed price may come down when mass usage of solar panels reduces related costs.

The additional cost to electric power companies of introducing the system would be offset through slightly higher electricity rates, resulting in a rise in electricity price per family of up to 100 yen a month.

It costs about 2.5 million yen to install solar cells in a typical home. About 500,000 yen of this amount is covered by government subsidies.

Japan's industry ministry reinstated subsidies of household solar cell installations (repealed in fiscal 2005), starting in April 2009, at 70,000 yen ($740) per kW of solar panel to foster use of solar panels in homes.[27]

4. Net Metering

Net metering has some similar characteristics with feed-in tariffs. Both net metering and feed-in tariffs are a performance-based renewable energy incentive scheme. Both allows consumers to produce and be paid for renewable electricity that they supply to the grid. However, net metering schemes are not backed up by the special rules needed to achieve the price and access objectives of a feed-in tariff law.

Under net metering, consumers can offset the cost of electricity they buy from a utility by selling renewable electric powered they generate back to the utility. A consumer's electric meter can run both forward and backward in the same metering period, and the consumer is charged only for the net amount of electricity consumed. By definition, true net metering calls for the utility to purchase power at the retail rate and

[26] Use an exchange rate of $1 equals 94.59 Yen

[27] www.asahi.com/english/Herald-asahi/TKY200902260086.html

use one meter.[28] However, net metering rules vary significantly by country, state, and province. Dual metering is adopted in some states and countries, allowing the price paid by utilities for surplus power to be at a different rate from the price paid by consumers for using the power from utilities. From the point of view of a consumer, dual metering is less attractive than net metering as any surplus is often bought at a low price per unit, such as at the wholesale or "avoided cost" price, which is lower than the retail prices of electricity.

In the US, as part of the Energy Policy Act of 2005, all public electric utilities are required to make available upon request net metering service to any electric consumers that the electric utility serves. Currently, net metering is available in 44 US states and Washington DC.[29] New Jersey and Colorado are considered to have the best net-metering policies in the US as both have no limit on overall enrollment (but limit system size to be less than 2 MW each), roll over month to month and pay annually for excess generation at avoided-cost rate (New Jersey) or incremental cost (Colorado).[30]

As an example of net metering in other economies, Ontario allows net metering for up to 500 kW. Credits can be carried for 12 consecutive months. Any unused credits remaining at the end of 12 consecutive months are cleared at the end of that billing.[31] Areas of British Columbia serviced by BC Hydro are allowed net metering for up to 50 kW. At each annual anniversary, the customer is paid 5.4 cents per kWh if there is a net export of power. Systems over 50 kW are covered under the Standard Offer Program.[32]

There are several advantages associated with implementing net metering. Net metering is considered a low-cost, easily-administered mechanism for encouraging investment of small-scale renewable energy systems. Net Metering gives customers more flexibility, allows them to maximize the value of their production, and increases the value of the electricity produced by renewable generation. Net metering allows customers to "bank" their energy and use it at different times than it is produced. Renewable energy such as wind and solar energy is an intermittent resource and customers may not be using power as it is being generated and with net metering, consumers can receive full value for the electricity they produce without having to install battery storage systems—which directly affects the economics and pay-back period for the investment. Utilities also benefit from net metering because when

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[28] http://apps1.eere.energy.gov/states/alternatives/net_metering.cfm

[29] Details on net metering policy in each US state can be found at http://www.dsireusa.org/library/includes/seeallincentivetype.cfm?type=Net&currentpageid=7&back=regtab&EE=0&RE=1

[30] Interstate Renewable Energy Council, http://www.irecusa.org/index.php?id=88

[31] "Net Metering in Ontario" http://www.energy.gov.on.ca/english/pdf/renewable/NetMeteringBrochure.pdf

[32] http://www.bchydro.com/planning_regulatory/acquiring_power/net_metering.html

customers are producing electricity during peak periods, the system load factor is improved.[33]

5. Renewable Energy Certificate

Renewable Energy Certificates (RECs) are also known as Green tags, Green Certificates, Renewable Energy Credits, or Tradable Renewable Certificates. RECs are tradable environmental commodities. One certificate represents proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource. About 25% of US utilities offer a green power program.

RECs can be sold, and the owner of the REC can claim to have purchased renewable energy. The consumer of RECs receives only a certificate. The energy associated with an REC is sold separately and is used by another party. Because RECs can be traded separately from electricity, that makes it possible for anyone to buy green power anywhere regardless of whether or not his/her utility offers green power.

In states with an REC program, a renewable energy generator is credited with one REC for every 1 MWh of electricity he/she produces. A certifying agency gives each REC a unique identification number to make sure it doesn't get double-counted. The renewable electricity is then fed into the electrical grid, and the accompanying REC can then be sold on the open market.

There are two main markets for RECs in the US—compliance markets and voluntary markets. Compliances markets are in US states with Renewable Portfolio Standard policies. Electric utilities in those states have a mandate to sell certain quantities of electricity that are generated from renewable energy sources. These utilities can then purchase RECs at the equal amounts to their requirement of electricity sales from renewable energy sources. Voluntary markets are ones where customers choose to buy power from renewable energy sources voluntarily. Renewable energy generators located in states that do not have an RPS can sell their RECs to voluntary buyers, usually at a cheaper price than compliance market RECs.

There is a long list of power generators that generate power from renewable energy sources and sell RECs.[34] However, there is no national registry or database of RECs issued at present. Several certification and accounting organizations attempt to ensure that RECs are correctly tracked and verified and are not double-counted. The leading certifiers are, for example, Green-e[35], and Environmental Resources Trust, Inc.[36]

Prices of RECs can fluctuate significantly. REC prices depend on many factors, such as the location of the facility producing the RECs, supply/demand situation, and the type of power produced. Some organizations sell as many RECs as possible and then

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[33] http://apps3.eere.energy.gov/greenpower/markets/netmetering.shtml

[34] http://www.green-e.org/base/re_products?cust=r#res

[35] http://www.green-e.org/

[36] http://www.ert.net/

use the funds to guarantee a specific fixed price per MWh generated by a future wind farm, for example, making the building of the wind farm a financially viable prospect. The income provided by RECs, and a long-term stabilized market for tags can generate the additional incentive needed to build renewable energy facilities. Table 8 shows wholesale prices of RECs in the voluntary market in the US Midwest, West, and the national average in 2006.

Table 8: Wholesale/ Large Commercial Voluntary REC Prices in 2006

Unit: $/MWh

Generation Type	Midwest	West	National
Biomass		$3-10	$1-5
Solar		$18-21	$21
Wind	$1-4	$3-7	$1-4
Geothermal		$1-7	

Source: Evolution Markets. From Lori Bird, "Overview of Renewable Energy Certificate (REC) Markets," National Renewable Energy Laboratory, presented at the FTC Workshop, January 8, 2008.

Technologies qualified for RECs vary from one trading scheme to the other trading scheme. In general, the following generation technologies qualify as producers of RECs: solar electric, wind, wave and tidal, geothermal, lo impact-hydropower (such as small-run-of-the river facilities), biomass, biofuels, landfill gas, and fuel cells (that are powered by hydrogen produced by one of the above approved generators, not from fossil fuels).

Prices for RECs are set by supply and demand. A renewable energy production or consumption target is set, and the consumer purchases renewable energy from whoever provides it the most competitively. In principal, this system delivers the cheapest renewable energy, since the lowest bidder will win.

RECs are currently in use in several countries including Poland, Sweeden, the UK, Italy, Belgium, and the US.[37]

One advantage of RECs is that it allows consumers to support renewable energy even when their utilities do not provide green power options. However, critics point out a flaw in this system is that it does not require any proof of displaced power from polluting sources. Since some renewable energy sources, most notably wind power, are intermittent and variable, their production does not displace an equivalent amount of other sources, diminishing the effective value of the RECs. There is also an argument concerning "additionality" with RECs. When there are voluntary REC purchases, it is difficult to prove that these purchases result in new renewable energy onto the electricity grid or they are simple payments to a project that would have existed even in the absence of the REC sales.

[37] For more information about REC in the US, see http://www.epa.gov/greenpower

7. White Certificate

White certificates are also known as Energy Savings Certificates, Energy Efficiency Credits or White Tags. Similar to RECs which are used for renewable energy electricity trading, White Certificates represent a specific, verified quantity of reduction in energy use. Each certificate is a unique and traceable commodity guaranteeing that additional 1 MWh of energy is saved and that the benefit of these savings has not been accounted for elsewhere. White certificates are given to the producers whenever an amount of energy is saved. The producers can use the certificate for their own target compliance or sell to other parties who cannot meet their required targets.

Australia was the first nation that commenced tradable energy efficiency certificates, starting in New South Wales (NSW) on January 1, 2003 and in the Australian Capital Territory (ACT) on January 1, 2005. The certificates are created as part of a larger baseline-and-credit emissions trading scheme called the Greenhouse Gas Reduction Scheme (GGAS). GGAS applies in NSW and the ACT which are part of a wholesale electricity market operating across a total of six jurisdictions of Australia. GGAS aims to reduce GHG emissions associated with the generation and use of electricity through project-based activities to offset the production of emissions. The GGAS legislation imposes benchmarks targets for GHG emissions on the electricity sector as a whole. These overall targets are implemented by setting individual benchmark emissions levels for certain obligated parties, principally electricity retailers. The obligated parties have to control their GHG emissions at their pre-set benchmark level. The obligated parties have an option of purchasing certificates called New South Wales Greenhouse Abatement Certificates (NGACs) to offset their excess emissions and surrender these certificates to the Scheme's Compliance Regulator. NGACs are transferable and tradable between parties. One NGAC represents one abated tonne of cabon dioxide equivalent. NGACs are created by accredited "Abatement Certificate Providers" undertaking several types of project-based activities that reduce or offset emissions. One of these activities, called "demand side abatement" includes energy efficiency projects. NGACs created as a result of energy efficiency project are white certificates. By the end of 2006, nearly 10 million energy efficiency certificates were created under GGAS.[38]

White Certificates have been used to some extent in Europe but not very much in the US at present. Three states—Connecticut, Nevada and Pennsylvania, however, allow white certificate trading. These states have adopted Renewable Energy Portfolio Standards that allow regulated utilities to meet a certain percentage of their projected power needs through energy efficiency. Utilities must meet their obligations by either reducing their consumers' energy usage, or by purchasing energy efficiency certificates (white certificates). The White Certificate markets are still very new in these states, and offer no experience to date.[39]

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[38] David J Crossley, "Tradeable Energy Efficiency Certificates in Australia," Energy Futures Australia Pty Ltd, Sydney, Australia, email: crossley@efa.com.au

[39] Matthew Brown (2008), "White certificates for Energy Efficiency in the United States," InterEnergy Solutions, January 30, see http://www.interenergysolutions.com/blog/?p=85

Pennsylvania allows white certificate trading, but there have been few trades at this point. Energy efficiency can be used to meet what the state calls Tier II standards for the advanced energy portfolio standard, but it must compete with small hydro, waste coal and other more traditional resources. Nevada allows energy efficiency to meet up to 25% of the renewable energy portfolio standard and also allows trading. Regulations have been developed but programs have not yet existed, nor have trades been placed. An innovative feature in Nevada is that reductions that occur during peak periods receive double credit — providing greater incentive to these reductions.

The voluntary market for white certificates, where consumers may purchase energy efficiency certificates to reduce their carbon footprints, is still developing. There is still a lack of a good and widely accepted measurement and verification processes for trading White Certificates.

In Europe, several countries have implemented white certificate schemes or are seriously considering doing so. Italy started a scheme in January 2005. France started it in 2006. UK has combined its obligation system for energy savings with the possibility to trade obligations and savings. Denmark and the Netherlands are seriously considering introduction of a white certificate scheme in the near future.

Under the French White Certificates Trading program, suppliers of energy (electricity, gas, heating oil, LPG, heat, refrigeration) must meet government-mandated targets for energy savings achieved through the suppliers' residential and tertiary customers. Suppliers are free to select the actions to meet their objectives. They may, for example, inform customers how to reduce energy consumption, run promotional programs, or provide customers with good incentives. The suppliers who exceed their energy saving requirements can trade energy savings certificates. Energy suppliers who do not meet their obligation over the period (2006-2008) must pay a penalty of euro 0.02 per kWh. The first experimental phase of the scheme will run for three years from July 1, 2006 to June 30, 2009. It is expected that during this time, the scheme will result in 54 TWh of cumulated energy savings.[40]

The market for white certificates in the US can be expected to grow larger than the renewable energy certificate market because it requires less government approval and expense to install energy efficiency measures in factories and commercial buildings than to construct most renewable energy projects. One important issue is how to ensure that customers are not double counting their white certificates with other incentive programs for energy efficiency.

8. Capital Payment Incentives

Utilities offer various capital payment incentives to consumers for obtaining renewable energy systems or energy efficiency improvements. The typical incentives from utilities in the US include rebates and loans. A rebate, or up-front subsidy, is a direct payment to consumers to refund part of the installation costs of renewable energy systems, or buy down costs of energy efficiency equipment. Programs are available for both residential customers and non-residential customers such as

[40] http://www.iea.org/textbase/pm/?mode=pm&action=detail&id=2613

schools, non-profit organization, commercial and industrial customers. For example, utilities may offer rebates to their residential customers for the installation of energy efficient heat pumps and geothermal heat pumps, for insulation upgrades in their homes, or offer rebates for the purchase of Energy Star qualified household appliances (i.e., clothes washers, dishwashers, refrigerators). Some utilities offer low interest rate loans to its customers for a variety of energy efficient improvements ranging from replacement thermal windows and insulation upgrades to improving heating and cooling system installations. This will make the new equipment or home improvement project more affordable, and allow them to be paid over a period of time.

Buy-back programs are being offered to customers by some utilities. Buy-back programs for inefficient equipment such as old refrigerators, air conditioners, or back-up diesel generators will increase capital stock turnover for inefficient equipment. Such programs will help subsidize the replacement of inefficient equipment with newer and more efficient ones.[41]

It is argued that good public policy pays only for performance. Thus payments should be coupled with generation. Rebates or up-front subsidies pay based on nameplate capacity of the installed system and are independent of the actual power generated over time. They also provide no incentive for proper maintenance, which can lead to a shorter system lifetime. More and more US states have moved toward performance-based incentives (payment for generation) and away from up-front capital subsidies.

There are currently debates over the issue of capital payments (i.e., rebates or up-front subsidies) and performance-based or production incentives (i.e., feed-in tariffs and net metering). California's solar program is one example.[42] The California solar program provides up-front capital payments to new solar system installations, and there was a proposal to convert the program to production payments. There are both proponents and opponents on the issue. The solar industry was also split over the issue. Some manufacturers and dealers wanted to maintain the up-front capital payment, while other manufacturers and dealers wanted to move toward production payments.

California's buy-down program puts a solar premium of $2.50-$2.80 directly in the pockets of dealers and installers. Market prices for installed solar systems in California are approximately $2,500 per kW—more costly than in Germany. This "California premium" is likely due to the buy-down program's up-front subsidy. The buy-down program's proponents argued that the buy-down encourages homeowners to buy solar to take advantage of the subsidy while the production incentive requires homeowners to invest in solar, and that discourages residential solar sales. The performance-based incentive's advocates argued that without a production payment, there is no incentive to actually install systems that work. Indeed, California does not

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[41] The list of financial incentives offered by utilities, and by federal government and state, in each US states can be found at http://www.dsireusa.org/summarytables/financial.cfm?&CurrentPageID=7&EE=1&RE=1

[42] www.wind-works.org/FeedLaws/USA/Performance-BasedIncentivesorRenewableTariffsforPhotovoltaicsintheUSA.html

know how well the solar systems currently operating in the state are performing. They have only estimates.

The conversion of California's entire solar program to performance payments hinged on how the transition would be made from the existing buy-down subsidy. The mix of incentives in the current program is the result.

Participants in the California process warn that new programs should be designed to avoid buy-down payments from the start. Once capital subsidies have been put in place, it is very difficult to wean dealers from them and substitute performance payments.

The issue of capital payments versus performance-based incentives (PBI) was addressed directly in the California Solar Initiative, which began in January of 2007. In this initiative, the state defined a capital payment called the Expected Performance-Based Buydown (EPBB) to pay for small solar systems (less than 50 kW in size) and a PBI to pay for larger solar systems (equal to, or greater than, 50 kW). The current payments for EPBB are set at $2.50 per watt for residential and commercial users, and $3.25 per watt for government and non-profit users. A PBI payment of $0.39 per kWh is paid to residential and commercial customers, and $0.50 per kWh to government and nonprofit customers. The maximum payments for both EBPP and PBI will decrease over time as more systems are installed. The stated goal of the overall initiative, known as the Go Solar California campaign, is to install 3,000 MW of new grid-connected solar power by 2017.[43]

9. Concluding Remarks

Different renewable energy policies have been adopted to date and there are continuous debates over the merits and success of each policy scheme. The utility-based mechanisms mentioned in this paper are compared in Table 9. Renewable Portfolio Standards (RPS) are widely implemented in the US and Europe. More recently, feed-in tariffs have been implemented in Europe and claimed to be the principal policy driving renewable energy markets for several countries in Europe at a faster rate than seen with RPS. Due to the success of Germany in expanding its renewable energy market by adopting feed-in tariffs, feed-in schemes in various versions (i.e., advanced renewable feed-in tariffs, renewable energy producer payments, or standard offer contracts) have been adopted in other countries and it is considered the world's most widespread national renewable energy policy.

[43] California Solar Initiative Program Handbook, January 2009, see www.gosolarcalifornia.org

Table 9: Comparisons of the Utility-based Mechanisms

	Type of Mechanism	Process	Price	Participants	Issue
RPS	Quota system	Use bidding tender system; Quantity of capacity is determined politically, and price is derived from bidding	Competitive price to meet defined target	Large corporation	Quota system for large corporation
Feed-in tariffs	Performance-based/ production incentives	Price is determined politically, and the amount of capacity that results is a function of an open market	Non-market price mechanism; Fixed payment above retail price	Small consumers	Difficult to determine "right" tariff rate
Net metering	Performance-based/ production incentives	Utilities use avoided cost to determine payment rate.	Wholesale or avoided cost prices; below retail rate	Small consumers	Not enough incentive to invest
Rebates/ Loans	Capital payment Incentives	Utilities set up the programs and determine the payment rate	Determined by utility	Small consumers	No incentive to maintain the system
Renewable Energy Certificates	Market-based Mechanism	Production or consumption target is set, consumers purchase from the lowest bidder.	Determined by demand and Supply	Small/large consumers	Argument on additionality
White Certificates	Market-based Mechanism	Producers of energy saving receive the certificates for their own compliance or sell to others who can't meet their required targets	Determined by demand and Supply	Small/large consumers	Double counting with other programs

RPS vs Feed-in tariffs.

RPS is a bidding or tendering system. A quantity of capacity is determined and the price per kWh is derived from bidding among would be developers. In the tendering system, a regulatory agency issues a call for tender of a specified amount of generating capacity. Companies then propose projects and submit bids to provide that capacity at a certain price. The agency typically selects the lowest bidders. In comparison, prices for feed-in tariffs are first determined, and the amount of capacity that results is a function of an open market. Feed laws are simple, offer transparency, and provide a stable policy framework on which manufacturers and developers can build businesses. Engineers and economists calculate the price per kWh needed to spur development for various technologies. They report their findings to a legislative assembly that determines the final price. Prices can thus be tailored to technologies and to regions.[44]

An advantage of feed-in tariffs is that they can be structured to create incentives for renewable energy where the resource is comparatively weak, e.g., pay more for wind power in less windy areas.

With feed-in tariffs, the financial burden falls upon utility ratepayers. Feed-in tariffs reward the number of kWh produced over a long period of time. Because the rate is set by the authorities, getting the price right can be challenging. If the price is too high, it will introduce the risk of overpaying and overstimulating the market. As this high tariff paid to the owner of the system is charged across the board to utility ratepayers, too high of rate adds more burden to customers. If the price is set too low to provide adequate returns to eligible projects, it will have little effect on stimulating development of new renewable energy generation.

It is often argued that feed-in tariffs, which are fixed price policies, are inherently more costly than RPS because they do not encourage renewable energy competition. A competition between renewable energy generators under RPS brings down renewable energy certificate (REC) prices, which create an efficient incentive that supports renewable energy capacity at a minimum cost to society. The counter argument for feed-in tariffs is that the fixed price payment of feed-in tariffs create low risk, stable investment climate while investors under RPS face risks from a volatile electricity market and a volatile short-term renewable energy credit market. The risks raise the cost of capital used to finance renewable energy projects and renewable energy policies, and make RPS more costly than feed-in tariffs.

A study by the Commission of the European Communities (CEC) in 2005 which compared the effectiveness and efficiency of different policies found that risk played an important role in policy efficiency.[45] The study concluded that feed-in tariffs are more efficient and less costly than RPS policies due to the higher risk premium requested by investors and the high administrative costs under RPS policies as well as

[44] Paul Gipe, "Unlike tax credits, feed laws don't lead to the boom and bust cycle common to the North American Wind Industry," see www.sustainablebusiness.com/index.cfm/go/news.feature/id/1060

[45] Commission of the European Communities (2005), "The Support of Electricity from Renewable Energy Sources," Brussels.

the still immature REC market. CEC found that the incentive level payments for wind projects, for example, were typically higher in countries with RPS markets than they were in countries with feed-in tariffs, and wind generators typically receive greater windfall profits under RPS than under feed-in tariffs.[46]

One study on best practices for feed-in tariffs concluded that successful feed-in tariffs have the following characteristics, and Germany has been cited as the basis for many of these best practices.[47]

- Long-term guaranteed payments that adequately reflect generation costs and profit
- Incentive levels that decrease over time, i.e. "tariff digression"
- Incentive levels that are specific to certain renewable energy technologies (i.e. PV, wind, biomass, etc.)
- Incentive levels that are tailored to achieve specific policy goals, i.e. development in different wind regimes, use of certain conversion technologies, etc., i.e. "stepped tariff"

European analysts have concluded that RPS have not been as effective in Europe as feed-in tariffs have been. Many countries in Europe are adopting feed-in tariffs in combination with RPS. Most of the US states that are proposing feed-in tariff policies also adopt RPS policies. Rather than viewing feed-in tariffs as a competing policy with RPS, states and countries can view feed-in tariffs as another tool to be adopted to reach existing RPS goals. The countries with proven success in feed-in tariffs like Germany and Spain have undergone several amendments before reaching their present success. APEC economies would be well advised to study the existing feed-in polices and tailor them to fit their renewable energy markets.

[46] Wilson Rickerson and Robert C. Grace (2007), "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions," a white paper prepared for the Heinrich Boll Foundation.

[47] Klein, et.al., "Evaluation of different feed-in tariff design options: Best practice paper for the International Feed-in Cooperation", Karlsruhe, German and Laxenburg, Austria: Fraunhofer Institut fur Systemtechnik and Innovationsforschung and Vienna University of Technology Energy Economics Group.

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APEC Energy Overview and Workshop Introduction

APEC Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency

March 30-Aprl 1, 2009

Honolulu, Hawaii USA

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Argonne is America's First National Laboratory and one of the World's Premier Research Centers

- Founded in 1943, designated a national laboratory in 1946
- One of 17 DOE National Laboratories
- Managed by the University of Chicago for the Department of Energy
  - About 3,200 employees and 4,000 facility users
  - About $500M budget
  - 1500-acre site in Illinois, southwest of Chicago
- Broad research and development portfolio
- Numerous sponsors

Presentation Overview

- APEC Energy Working Group (EWG)
- APEC Expert Group on New and Renewable Energy Technologies (EGNRET)
- Workshop motivation and overview
- Review of electric utility finance mechanisms
- Concluding thoughts

What is APEC?

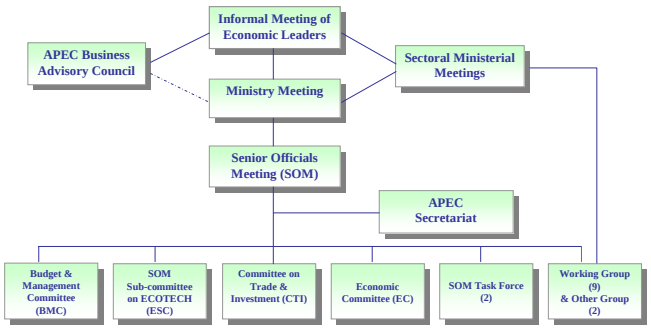
- Asia-Pacific Economic Cooperation (APEC) was created in 1989
- Objective: Promote trade liberalization, trade facilitation and technical assistance
- APEC Economies account for more than one third of the world's population, 60% of world GNP and 50% of world trade
- Implements its activities through 11 working groups including the Energy Working Group

(http://www.apec.org)

APEC Member Economies span the Pacific

- Australia
- Brunei Darussalam
- Canada
- Chile
- Peoples Republic of China
- Hong Kong China
- Indonesia
- Japan
- Republic of Korea
- Malaysia
- Mexico
- New Zealand
- Papua New Guinea
- Peru
- Republic of the Philippines
- Russia
- Singapore
- Chinese Taipei
- Thailand
- United States
- Vietnam

Asia Pacific Economic Cooperation



APEC Energy Working Group (EWG)

- The EWG was launched in 1990
- The EWG seeks to maximize the energy sector's contribution to the region's economic and social well-being, while mitigating the environmental effects of energy supply and use
- Australia has been the EWG Lead Shepard since its inception
- The Energy Security Initiative (ESI) is the principal mechanism through which the EWG addresses the short and long term energy security challenges in APEC in a sustainable manner
- The APEC Energy Ministers (EMM8) last met in Darwin, Australia in September 2007 under the theme “Strengthening our Community, Building a Sustainable Future”

(www.ewg.apec.org)

The Energy Working Group is supported by 7 sub-fora groups

- Expert Group on Clean Fossil Energy (EGCFE) – Chair: USA *(www.egcfe.ewg.apec.org)*
- Expert Group on Energy Efficiency & Conservation (EGEEC) – Chair: New Zealand (www.egeec.apec.org)
- Expert Group on Energy Data & Analysis (EGEDA) – Chair: Japan (www.ieej.or.jp/egeda/)
- Expert Group on New and Renewable Energy Technologies (EGNRET) – Chair: USA (www.egnret.ewg.apec.org)
- APEC Biofuels Task Force- Chair: USA (www.biofuels.apec.org)
- Asia Pacific Research Center (APERC) *(www.ieej.or.jp/aperc/)*
- Energy Business Network- Chair: New Zealand (www.ewg.apec.org)

Projects are conducted by writing proposal to the APEC Secretariat in Singapore

- APEC funds about $8 million/year of projects across all working groups
- In 2008, 120 projects were submitted for APEC support with 32 being from the Energy Working Group
- Proposals go to one of three funds
  - APEC Operational Account
    - *The most general fund used to address APEC priorities*
  - APEC Support Fund
    - *Directed at capacity building in development APEC economies*
  - APEC Trade Investment and Liberalization Fund (TILF)
    - *Donated by Japan, and directed at projects directly related to trade, such a equipment standards*

The EWG Secretariat has led the development of comprehensive project overview reports

- Overview of APEC Energy Working Group Projects, April 15, 2007*
  - Identifies and categorizes 250 EWG projects conducted since 1992
- Overview of APEC Energy Working Group Projects
  Stage 2: Project Outcomes
  Report 1: Energy Efficiency and Conservation, Energy Data and Analysis and Promoting Energy Trade and Investment (May 16, 2008)*
- Overview of APEC Energy Working Group Projects: Stage 3, is the subject of a current EWG project proposal and will look at project outcomes for clean fossil energy and new and renewable energy technologies including alternative transport fuels

*Available from: http://www.ewg.apec.org

The APEC Renewable Energy Expert Group's Activities are Diverse and Complementary

- Lead and work with EWG major initiatives
  - APEC 21st Century Renewable Energy Development Initiative
  - EWG led Energy Security Initiative (2001)
  - Ministerial Level Financing Initiative (2004)
  - Ministerial Level Hydrogen Initiative (2004)
  - Ministerial Level Biofuels Initiative (2006)
- Organize workshops
- Conduct research projects
  - 43 have been completed since 1992
  - 7 are being implemented in 2008-2009

Current APEC EGNRET Projects (1)

- APEC 21st Century Renewable Energy Development Initiative (Collaborative I):Workshop on Best Practices in Energy Efficiency and Renewable Energy in Commercial Buildings (EWG 02/2007A) Mexico
- APEC 21st Century Renewable Energy Development Initiative (Collaborative VI): Best Practices in New and Renewable Energy Technologies in Urban Areas in the APEC Region (EWG 04/2008) USA
- APEC 21st Century Renewable Energy Development Initiative (Collaborative IX):Alternative Transport Fuels Policy Options for APEC Economies (EWG 04/2007A) New Zealand
- APEC 21st Century Renewable Energy Development Initiative (Collaborative VI): Successful Business Models for New and Renewable Energy Technology implementation in APEC Economies (EWG 03/2008) New Zealand

Current APEC EGNRET Projects (2)

APEC 21st Century Renewable Energy Development Initiative (Collaborative IX) : Workshop and Report on Implications of Bio-refineries for Energy and Trade in the APEC Region (EWG 05/2008A) Chinese Taipei

- Addressing grid-interconnection issues in order to maximize the utilization of new and renewable energy sources (EWG 02/2009) Japan
- 2008 APEC Photovoltaic Conference (EWG Self funded) Chinese Taipei, October 7-8, 2008 (http://www.apecpv.itri.org.tw)
- **APEC 21st Century Renewable Energy Development Initiative (Collaborative VIII): Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency (EWG 02/2007) USA**

Utility finance project motivation: APEC economies account for over 50% of the world energy demand

- APERC has estimated US$ 5.95-7.55 trillion total investment is needed in the energy sector through the year 2030*
- The electric utility sector will require 60.4% of this as it expands from 2,138 TW in 2002 to 4,207 TW in 2030
  - New and Renewable Energy Challenge: Instead of constructing 2000 large (1,000 MW facilities), construct 2,000,000 small (1 MW facilities)
- It is important that new energy production be based on best practices in the use of new and renewable energy technologies as well as cost effective energy efficiency measures

*APEC Energy Demand and Supply Outlook 2006, Asia Pacific Research Center, Tokyo, Japan (www.ieej.or.jp/aperc)

Electric utilities across the APEC region are embracing NRET for many reasons

- Reduce green house gas emissions
- Improve the local environment
- Increase local employment
- Economic benefits of using domestic energy resources
- Increase energy security in their economies

Utility Finance Project Summary Report

- Six basic financial mechanisms were reviewed under four broad categories
  - Quota schemes
    - *Renewable portfolio standards*
  - Performance-based incentives
    - *Feed-in tariffs*
    - *Net metering*
  - Capital payment incentives
    - *Rebates and loan programs*
  - Market-based instruments
    - *Renewable energy certificates*
    - *White certificates (energy efficiency)*

A principal goal of the summary report is to be a starting point for understanding the current state of the art in financing utility based renewable energy and energy efficiency

- The report discusses policy effectiveness as well as some principal similarities and differences among these financial mechanisms
- A note of caution: terminology is not standardized and the state of knowledge is rapidly changing

A principal goal of the workshop is to share experiences and explore how APEC can best assist member economies in increasing the implementation of utility based renewable energy and energy efficiency programs

- The agenda is based on bringing together different perspectives
  - Government energy policy decision makers
  - Electric utility representatives
  - Researchers and practitioners

Renewable portfolio standards

- A Renewable Portfolio Standard (RPS) is a regulatory policy which places an obligation on electric utilities to produce a specified fraction of their electricity from renewable energy sources
  - A total of 28 US states are implementing an RPS
  - The targets of RPS are different in each state, varying from 8% in Illinois to 25% in New York by 2013
  - Resources utilized vary across states and are associated with local characteristics
  - Eight states allow energy efficiency to be counted towards RPS goals

RPS issues

- RPS mechanisms have tended to be most successful in the US in stimulating new renewable energy capacity where they have been used in combination with federal Production Tax Credits
- There is an argument that RPS creates “limited” long-term markets for renewable energy
  - Once that goal is reached, there is nothing to make electric suppliers obtain more renewable energy power
  - RPS depends on competitive bidding and limits participation to only participants with high power in the market
- Many states are starting to examine combining RPS and feed-in tariffs

Feed-in laws specify how much the renewable generators are paid for their electricity

- Feed-in laws go by many names
  - Feed-in tariffs
  - Renewable tariffs
  - Renewable energy producer payments
  - Standard offer contracts (Ontario)
  - Advanced renewable feed-in tariffs

World Feed-in tariffs have similar prices

First year Renewable Tariffs in US$/kWh

	Wind	PV	Hydro	Biogas	Program Duration
Ontario	0.0877	0.3336	0.0877	0.0877	20 years
Austria	0.0978	0.5960		0.2196	
Brazil	0.0715		0.0505	0.0631	
Czech Republic	0.1117	0.6002			
France	0.1062	0.7217	0.0711	0.1166	15 yrs for wind and biomass; 20 yrs for solar and hydro
Germany (2008)	0.1040	0.6057	0.0955	0.1403	20 years
Italy		0.7126			
Portugal	0.1024		0.1062		12 years
Spain (2007)	0.0981	0.5897		0.1750	
Turkey	0.0713				

Similarities and differences between German and Spanish feed-in policies are instructive

- Common elements
  - Both provide long-term contracts and fixed-price payments that encourage investor security
  - Both provide payments based on generation costs for a specific technology
  - Both evenly distribute the cost of their feed-in tariff policy
- Differences
  - Forecast obligation
  - Voltage support incentives
  - Peak generation differentiation

Successful feed-in tariffs have the common characteristics

- Long-term guaranteed payments that adequately reflect generation costs and profit
- Incentive levels that decrease over time, i.e. “tariff digression”
- Incentive levels that are specific to certain renewable energy technologies (i.e., PV, wind, biomass, etc.)
- Incentive levels that are tailored to achieve specific policy goals, i.e., development in different wind regimes, use of certain conversion technologies, etc., i.e. “stepped tariff”

Net metering is a critical first step in supporting renewable energy production on the "customer side" of the meter

- Under net metering, consumers can offset the cost of electricity they buy from a utility by selling renewable electric power they generate back to the utility
- Both net metering and feed-in tariffs are a performance-based renewable energy incentive scheme
- True net metering calls for the utility to purchase power at the retail rate and use one meter
- Net metering rules vary significantly by country, state, and province
- Interconnection rules needed for net metering are important but have been defined and are available
- In the US, as part of the Energy Policy Act of 2005, all public electric utilities are required to make available upon request net metering service to any electric consumers that the electric utility serves

Net metering has a number of advantages

- It is considered a low-cost, easily-administered mechanism for encouraging investment of small-scale renewable energy systems
- It allows customers to "bank" their energy and use it at different times than it is produced
- Utilities can benefit from net metering because it can improve system load factor by producing electricity during peak periods
- Net metering is needed to properly credit consumer based renewable energy production for local and global environmental benefits

The US is developing a number of innovative business models based on net metering

- Power Purchase Agreements (PPAs)
- Installation aggregation
- "Solar options" on new home constructions

Solar Purchase Power Agreements coupled with net metering allow for turn key solar installations

- Sun Edison will provide turn key solar PV for eight Wal-Mart stores, four in California and four in Hawaii
- The solar photovoltaic systems will be deployed with the SunEdison Power Purchase Agreement (PPA) model, whereby customers purchase solar electricity, rather than solar equipment
- SunEdison will finance, install, operate and maintain the photovoltaic power plants for Wal-Mart
- Under the PPA model, SunEdison only charges customers for electricity produced at rates equal to, or below the customer's existing retail prices

Capital payment incentives can take a number of forms

- A rebate, or up-front subsidy, is a direct payment to consumers to refund part of the installation costs of renewable energy systems, or buy down costs of energy efficiency equipment
- Utilities may offer rebates to their residential customers for the installation of energy efficient appliances
- Utilities may offer low interest rate loans to its customers for a variety of energy efficient improvements ranging from replacement thermal windows and insulation upgrades to improving heating and cooling system installations
- Buy-back programs are being offered to customers by some utilities. Buy-back programs for inefficient equipment such as old refrigerators, air conditioners
- There are currently debates over the issue of capital payments (i.e., rebates or up-front subsidies) and performance-based or production incentives (i.e., feed-in tariffs and net metering)

Renewable energy certificates are tradable environmental commodities

- Renewable Energy Certificates (RECs) are also known as Green tags, Green Certificates, Renewable Energy Credits, or Tradable Renewable Certificates
- One certificate represents proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource
- The US has two main markets for renewable energy certificates
  - Compliance markets are in US states with Renewable Portfolio Standard policies
  - Voluntary markets are ones where customers choose to buy power from renewable energy sources voluntarily
- One advantage of RECs is that it allows consumers to support renewable energy even when their utilities do not provide green power options

Prices of renewable energy certificates are a function of supply and demand

Unit: $/MWh

Generation Type	Midwest	West	National
Biomass		$3-10	$1-5
Solar		$18-21	$21
Wind	$1-4	$3-7	$1-4
Geothermal		$1-7	

Source: **Evolution Markets.** From Lori Bird, "Overview of Renewable Energy Certificate (REC) Markets," National Renewable Energy Laboratory, presented at the FTC Workshop, January 8, 2008.

White certificates are the most recent financial mechanism to be developed

- White certificates are also known as Energy Savings Certificates, Energy Efficiency Credits or White Tags
- White Certificates represent a specific, verified quantity of reduction in energy use. Each certificate is a unique and traceable commodity guaranteeing that additional 1 MWh of energy is saved and that the benefit of these savings has not been accounted for elsewhere
- Australia was the first nation that commenced tradable energy efficiency certificates, starting in New South Wales (NSW) on January 1, 2003 and in the Australian Capital Territory (ACT) on January 1, 2005
- Three US states—Connecticut, Nevada and Pennsylvania, allow white certificate trading
- Italy started a scheme in January 2005. France started it in 2006. UK has combined its obligation system for energy savings with the possibility to trade obligations and savings

There is a growing world-wide interest in white certificates

- The market for white certificates in the US can be expected to grow larger than the renewable energy certificate market because it requires less government approval and expense to install energy efficiency measures in factories and commercial buildings than to construct most renewable energy projects
- One important issue is how to ensure that customers are not double counting their white certificates with other incentive programs for energy efficiency
- There is still a lack of a good and widely accepted measurement and verification processes for trading White Certificates

Concluding thoughts

- Different renewable energy policies have been adopted to date and there are continuous debates over the merits and success of each policy scheme
- An advantage of feed-in tariffs is that they can be structured to create incentives for renewable energy where the resource is comparatively weak, e.g., pay more for wind power in less windy areas—but, the problem is getting the price right
- Rather than viewing feed-in tariffs as a competing policy with RPS, states and countries can view feed-in tariffs as another tool to be adopted to reach existing RPS goals
- The countries with proven success in feed-in tariffs like Germany and Spain have undergone several amendments before reaching their present success
- APEC economies would be well advised to study the existing feed-in polices and tailor them to fit their renewable energy markets

APEC utility finance workshop next steps

- Each speaker will be asked their thoughts on how to best move ahead in the concluding session of the workshop
  - Which financial mechanisms do you think would be most useful to your economy?
  - What are the constraints that you see to applying the financial schemes that have been discussed to your economy?
  - What is most needed to help your economy adopt the financial mechanisms that have been discussed?
  - Are there specific lessons learned in your economy on financial mechanisms you can share?
- Your comments will form the basis of a new project that the APEC Expert Group on New and Renewable Energy Technologies will propose for implementation in 2009-2010

Thank you for your attention!

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Overview of Renewable Energy Support Policy in Japan

Dr.Hiroshi Asano
Senior Research Scientist
Central Research Institute of Electric Power Industry
and Research Fellow, Lecturer, the University of Tokyo

1. Current status and future targets of RE in Japan

2. Various Renewable Energy Support Scheme

3. RPS

4. Summary and remaining issues

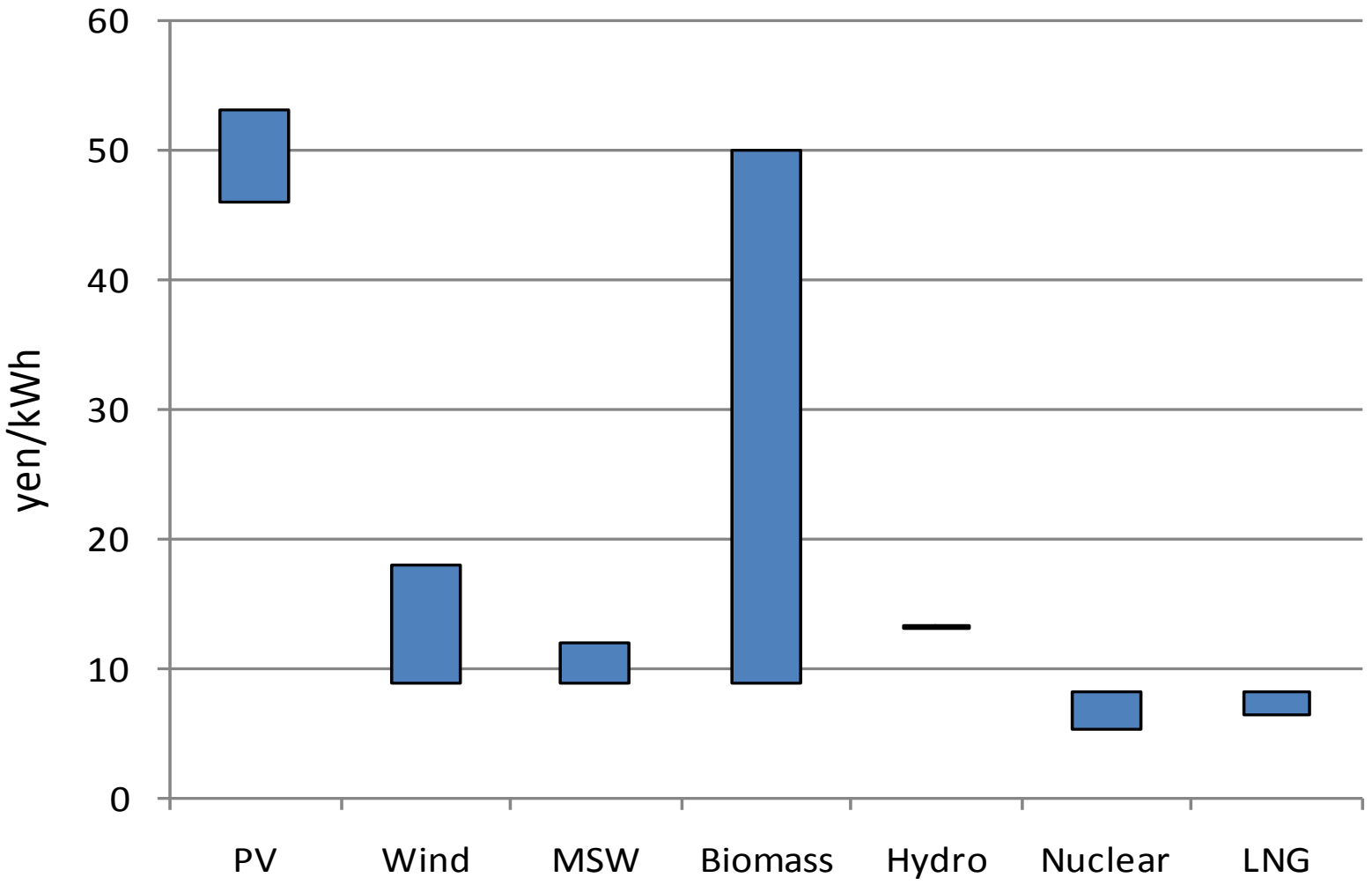
Acknowledgement: I appreciate cooperation from Dr.Tagashira and Mr.Nishio, CRIEPI.

Share of Renewable Energy Generation in Total Generation

Country	% of RES in total generation
Japan	10.0
US	9.3
Germany	11.2
UK	4.6
Italy	16.5
Spain	17.2

IEA, Energy balances of OECD countries, 2005-2006

Costs of RES-E and electricity from conventional power plants (1 USD=100 yen)



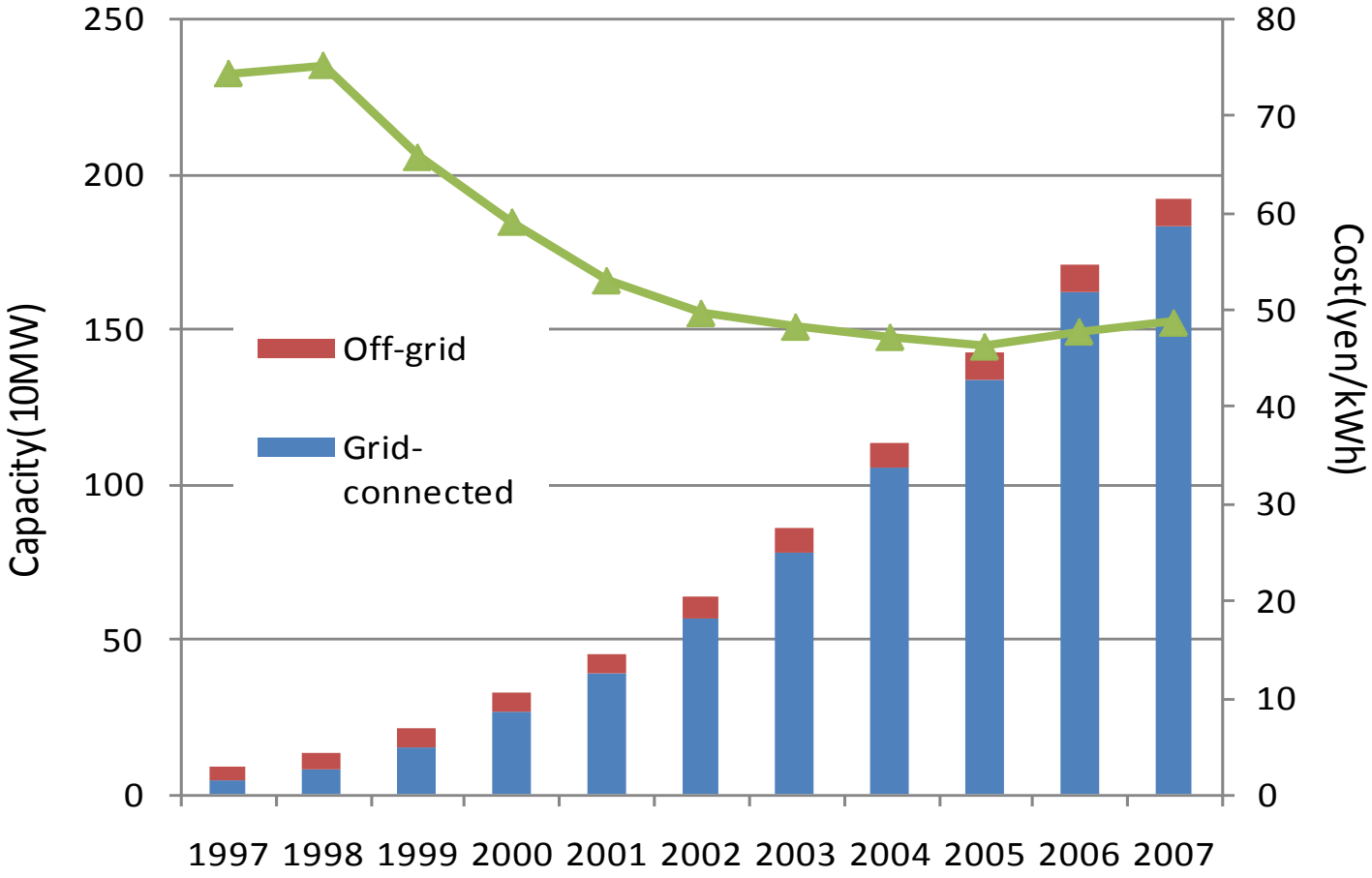
◆Wind power: 1680 MW in December 2007

- ➢Wind power is favorable in Hokkaido, Tohoku and Kyushu.

◆PV: 1920 MW in March 2008

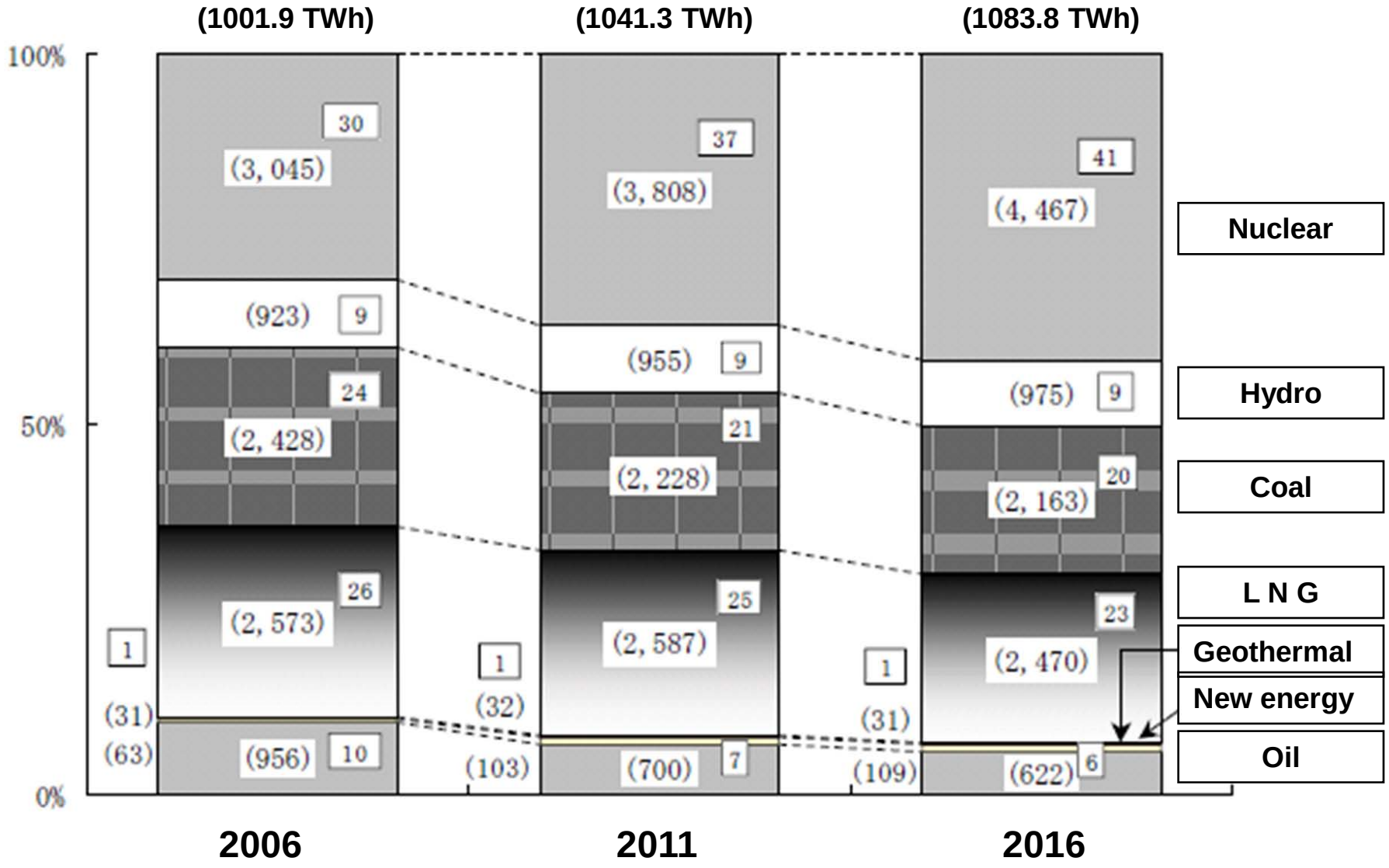
- ➢Outcome of various support mechanism

Change in production costs and accumulated capacity of PV



Sources: NEF and IEA-PVPS

Generating output by fuel type in Japan: 10 year supply plan



Electricity production by sources towards 2030

	2005	2010	2020	2030
Total Electricity(TWh)	984.5	1013.1	1005.0	890.8
LNG	233.9	251.2	201.3	146.3
Coal	252.9	221.8	200.6	148.1
Oil	107.2	65.0	56.0	38.9
Nuclear	304.8	366.4	437.4	437.4
Hydro	81.3	95.4	84.6	85.6
Geothermal	3.2	3.2	3.3	3.3
Others(PV,Wind,MSW,etc)	5.6	10.2	21.7	31.2
Unknown	−4.4	0.0	0.0	0.0
Only electricity fed into the grid				

Targets of RES in Governmental Energy Outlook in 2008

Fiscal Year	2005		2010		2020	2030	remarks
	10^4kl of crude oil equivalent	MW	10^4kl of crude oil equivalent	MW	10^4kl of crude oil equivalent	10^4kl of crude oil equivalent	
PV	35	1422	118	4820	350	1300	2007:1919(MW)
Wind power	44	1078	134	3000	200	269	2007:1675(MW)
Biomass (+ Waste) power	252	2100	586	4500	393	494	
Biomass heat	142		308		330	423	
Others	687		764		763	716	
Total	1160		1910		2036	3202	

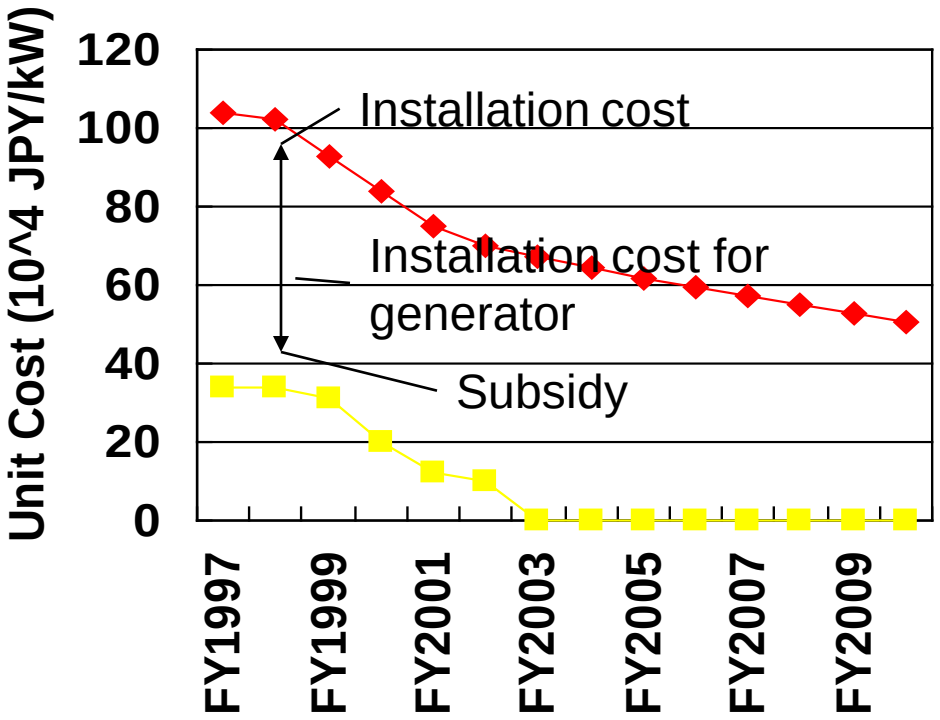
Others include solar thermal, black liquel, waste heat, etc.

Overview of Utility Based Financial Mechanisms that Support Renewable Energy in Japan

- **Utility based voluntary buy-back rate scheme from 1992: surplus electricity generated at end-users.**
- **standard offer contracts: historically for large wind power generators**
- **RPS（Renewables Portfolio Standard）**
- **Green power fund from 2000**
- **Green certificates from 2001; Japan Natural Energy Company Limited.**

- **Complimentary with the governmental support schemes**
  - **Subsidy for installation**
  - **RPS**
  - **Investment tax credits**
  - **Low rate loan**

Installation Cost Reduction and Subsidy for PV



◆Revival of subsidy from FY2008 (Jan. 2009)

◆70 thousand JPY/kW by the METI

◆Additional subsidy by local government: e.g. Tokyo

Support Policy（1）

- **New energy is promoted by the government; by definition. Not competitive with conventional energy technologies.**
- **Support for R&D：the “Sunshine Project” of New Energy Development Organization (NEDO) from 1985.**
- **Subsidy, Low rate loan, tax credits for installation of RE**
  - **PV：New Energy Fund(NEF)’s subsidy program for residential PV until FY 2005.**
  - **Some local governments provide subsidy to PV and EE appliance such as HP water heater.**

Support Policy（2）

- **Voluntary buy back rate for green power**
  - **By technology: for PV the same rate with the purchased power from the local utility**
  - **optional TOU rate: peak , off-peak period**
  - **PV：23 JPY/kWh for standard flat rate, 31 JPY/kWh for TOD rate**
- **RPS（Renewables Portfolio Standard）**
- **Voluntary green power programs**
  - **Utility base green fund**
  - **Green Power Fund: local NPO, wind in Hokkaido, PV in Yokohama**

Proposed new regulatory buy-back tariffs for PV

- **Transform the current voluntary buy-back rate scheme to regulatory buy-back tariffs regulated by the Ministry of Economy, Trade and Industry (METI) under discussion.**
- **METI will submit a new law called by "Law on promoting non-fossil energy sources and efficient use of fossil energy sources by energy suppliers" to the Diet.**
- **Not feed-in tariff. Only surplus electricity is qualified.**
- **with favorable rate, say, 0.5$/kWh.**
- **Additional cost for customers : Less than US$1 per month estimated**
- **Decreasing rate level in years**

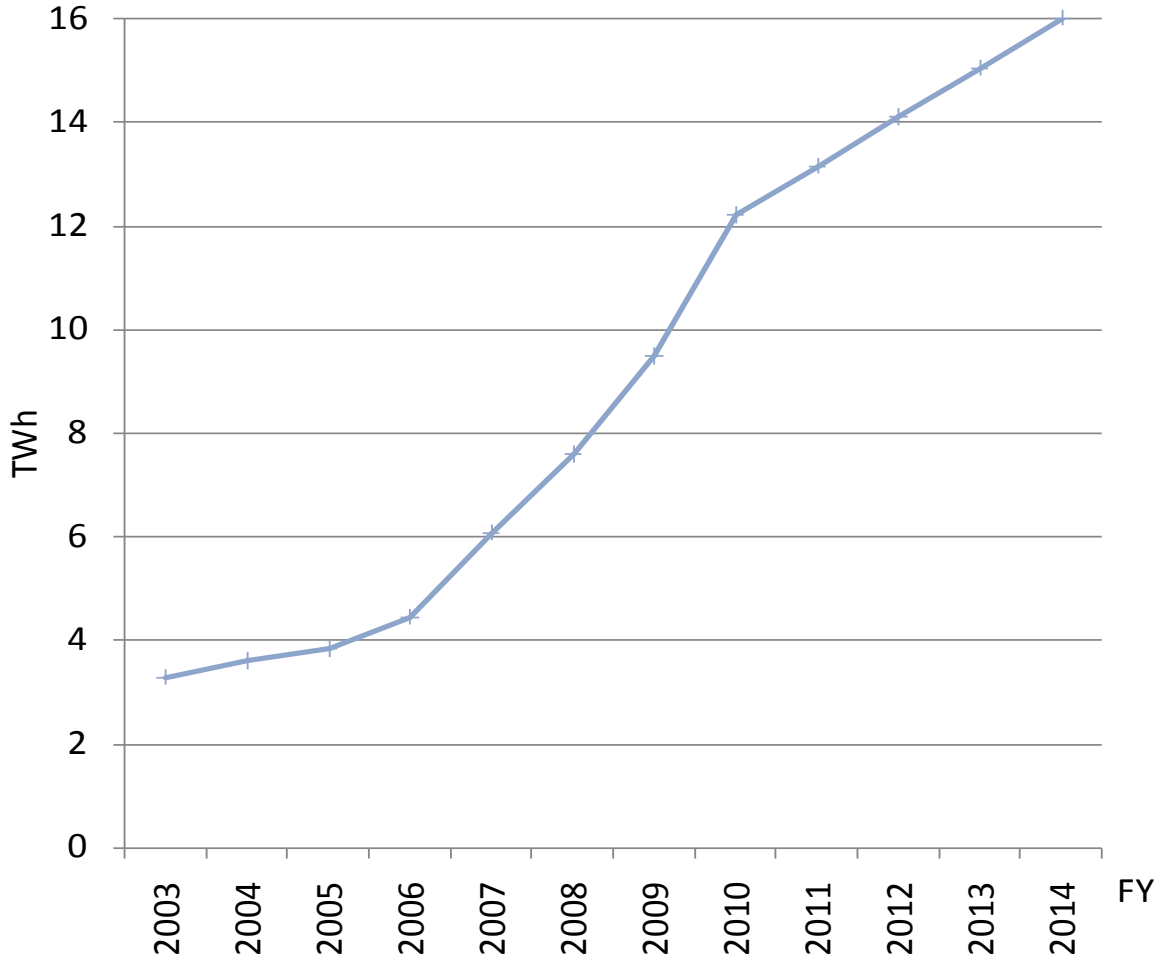
Renewables portfolio standard in Japan

- Electricity retailers are required to source a certain percentage of their total electricity from eligible RES every fiscal year.
- Trade of RES-E certificates
- Banking and borrowing. Maximum certificate price = 11 JPY/kWh.
- It has been implemented since April 2003
- Liable electricity retailers
  - Thirty retailers must meet targets in 2008
  - Ten utilities incur the most of total amount of obligation.

Eligible sources of the RPS

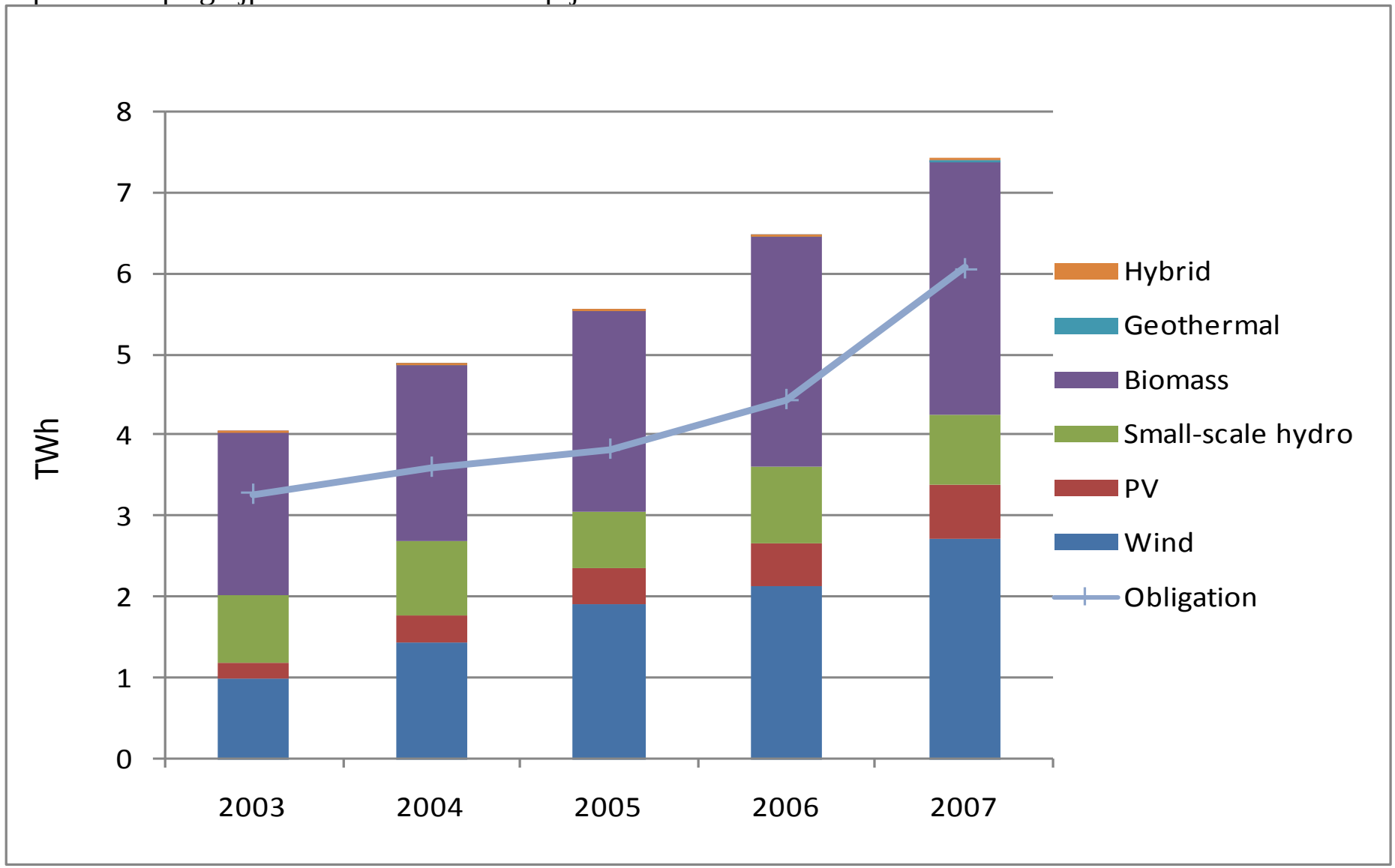
- Eligible sources:
  - PV
  - wind
  - biomass including municipal solid waste combustion (estimated electricity only from biomass components)
  - small–scale hydro(<1MW)
  - geothermal(only advanced technologies)
- All existing facilities are included.
- Self consumption is ineligible.
- Issuing unit of credits= 1MWh

Changes in obligation levels of RPS



Achievements to date

http://www.rps.go.jp/RPS/new-contents/top/joholink-kiroku.html



Issues of RES-E in Japan -PV-

- Japan had been a leader in the world in terms of PV manufacturing and installation.
- Who bears following costs related to the installation of PV facilities?
  - Balancing cost caused by intermittent generation
  - Cost of reinforcing the additional capacity of the grid
- Continuation of voluntary net metering system by utilities
  - Utilities have a right to stop purchasing electricity from PV at any time.
- So regulatory buy-back rate systems?

Summary

- **Feed in tariff should be evaluated from the cost-effectiveness including incentives for large cost reduction.**
- **Japan has adapted policy mix for RE historically.**
- **Wind power and biomass energy have technical constraints to supply energy. Not good natural conditions. Environmental regulation of land use, e.g. National Parks**
- **Coordination among manufactures, housing makers, builders, utilities , financial institutes and government is key.**

Next Step

- **Long-run priority is on PV in Japan.**
- **Council on Economic and Fiscal Policy, March 2009: 1 trillion JPY market and 110 thousand of employment in solar industry in 2020**
- **In addition to utility-based support programs, Mega Solar power plants are planned. 140 MW towards 2020**
- **Japanese intelligent grid technology:**
- **TIPS: Triple I (Intelligent, Interactive and Integrated) Power Systems support large penetration of intermittent RE generation smoothly.**

TIPS core technologies

in Jap

Over 50% penetration of renewable energy(PV) in distribution system.

Operation/control under demand/supply integration

◆Efficient practical application of DG and ADAPS technologies

◆Demand/supply integrated control of customer‘s equipment for interconnection of renewable generation and benefit analysis

500/275kV

275/66kV

66/20(30)/6.6kV

6.6kV/100,200V

◆Demand/supply integrated emergency control technologies

◆Autonomous appliance control to enhance inherent self -healing characteristics of power system

➢Development of operation and control technologies to realize demand/supply integration in TIPS. Evaluation of its benefit from customer’s viewpoint.

References

- Nishio and H.Asano(2006), Supply Amount and Marginal Price of Renewable Electricity under the Renewables Portfolio Standard in Japan, Energy Policy, 34, pp.2373-2387
- H.Asano, Supply potential of electricity from renewable energy sources through 2014 under the Renewables Portfolio Standard in Japan, RPS Subcommittee, the Advisory Committee for Natural Resources and Energy, Dec.2006(in Japanese)

Mahalo!

Thank you!

Hiroshi Asano

http://criepi.denken.or.jp/

http://www.hes.t.u-tokyo.ac.jp/

Comments on California Renewable Portfolio Standards, Feed-in Tariffs, and Net Metering

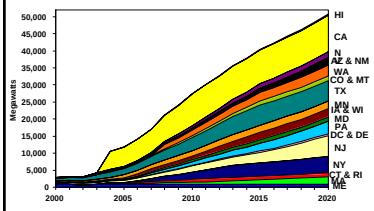
Terry Surles,
PICHTR, CIEE, and UH/HNEI
and
Ken Krich, CIEE

Outline of Presentation

- Progress toward 20% RPS
- Transmission process and progress
  - Grid issues related to as-available renewables
- Key policy choices for 33% renewables
- Feed-in Tariffs
- Net Metering

What is Possible for Renewable Electricity

Renewable Energy From State Standards



Total Estimated Solar Capacity Driven by State RPS Set-Asides

2010: 400 MW to 500 MW
2015: 1,200 MW to 1,400 MW
2020: 2,800 MW to 3,200 MW
2030: 3,700 MW to 4,300 MW

Western Governor's Association 2015 Goal

Clean Energy – 30,000 MW

- Solar – 8,000 MW
- Wind – 5,000 to 9,000 MW
- Geothermal – 5,600 MW
- Energy Efficiency – 40,000 MW

California's RPS Policy Required All Retail Energy Sellers to Procure 20% Renewable Energy by 2010

- Original legislation (SB 1078, 2002) was 20% by 2017. Accelerated target to 2010, effective January, 2007 (SB 107, 2006). ***Began at around 14% in 2003.***
- All RPS-obligated retail sellers must procure an incremental 1% of retail sales per year until 2010
- 20% obligation continues post-2010, growing with California's energy use
- RPS procurement compliance is measured in terms of electricity deliveries (GWh), **not signed contracts**

Current Contracting Status: The Good News

California Public Utility Commission (CPUC) has approved 112 contracts for almost 7,000 MW of new and existing RPS capacity

- Of these, 73 are projects with new capacity, totaling 5,245 MW
  - Were all this capacity to come online by 2010, we would more than achieve our RPS target
- Recent RPS solicitations have been robust:
  - Increased participation from larger and more experienced developers
  - Utilities shortlisting 10x their incremental procurement targets
  - California renewable market is maturing
- **Procurement process is working**
  - Due to complexity of program, took time to coordinate across agencies and implement; process now hitting its stride

Renewable Power Delivery Status: Not So Good News

- 21 contracts for over 800 MW of new capacity have come online
- RPS generation has not kept pace with overall load growth
- Utilities likely to hit 20% by ~2013

		2003	2004	2005	2006	2007	2008 (estimate)
PG&E	RPS Eligible GWh	8,828	8,575	8,543	9,111	9,047	10,275
	RPS GWh as % of bundled sales	12.1%	11.6%	11.7%	11.9%	11.4%	12.9%
SCE	RPS Eligible GWh	12,613	13,248	12,930	12,706	12,465	12,754
	RPS GWh as % of bundled sales	17.9%	18.2%	17.2%	16.1%	15.7%	16.0%
SDG&E	RPS Eligible GWh	550	678	825	900	801	1,071
	RPS GWh as % of bundled sales	3.7%	4.3%	5.2%	5.3%	5.2%	6.3%
TOTAL	RPS Eligible GWh	21,991	22,500	22,298	22,719	22,393	24,100
	RPS GWh as % of bundled sales	14.0%	13.9% ♣	13.6% ♣	13.2% ♣	12.7% ♣	13.7% ♣

Numbers in red represent year-on-year decreases in GWh or % terms

California's IOUs Served 12.7% of 2007 Retail Electricity Sales with Renewable Power

- Pacific Gas and Electric (PG&E) - 11.4%
- Southern California Edison (SCE) - 15.7%
- San Diego Gas & Electric (SDG&E) - 5.2%
- ESPs served 4.7% and small and multi-jurisdictional utilities served 6%.
- 2007 renewable energy by resource type:
  - Geothermal - 47.93%
  - Wind - 19.04%
  - Biomass - 14.32%
  - Small Hydro - 11.12%
  - Biogas - 4.73%
  - Solar - 2.86%

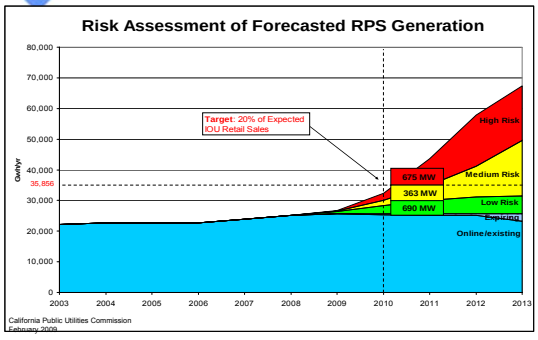
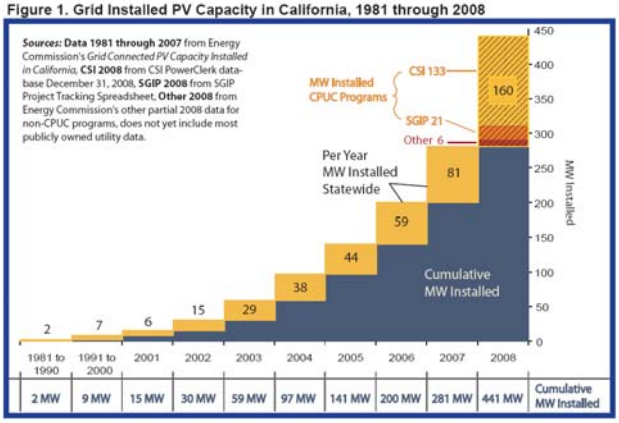
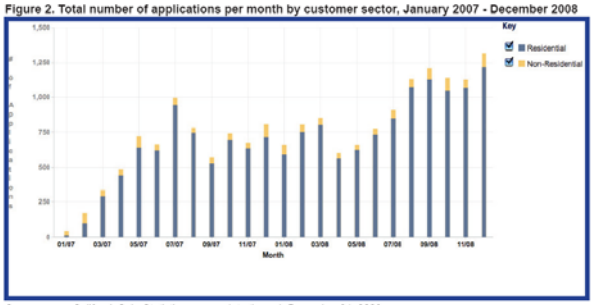


Figure 1. Grid Installed PV Capacity in California, 1981 through 2008



PV Applications Over the Past Two Years

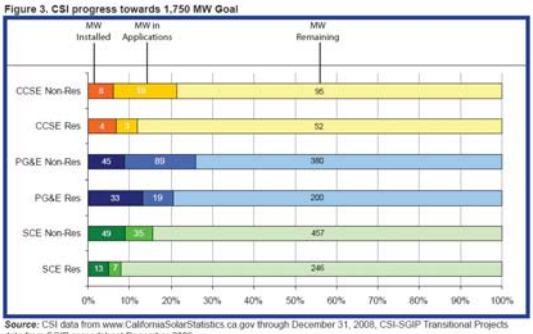
Figure 2. Total number of applications per month by customer sector, January 2007 - December 2008



Source: www.CaliforniaSolarStatistics.ca.gov, data through December 31, 2008.

California Solar Initiative

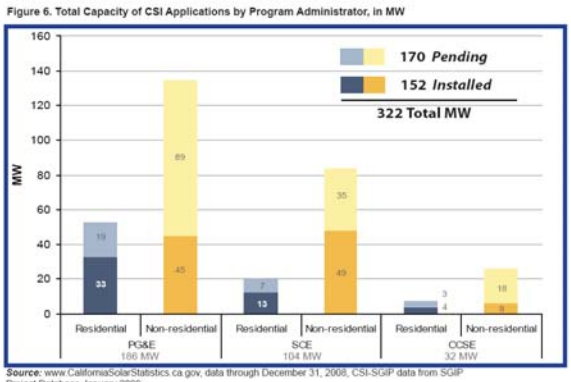
Figure 3. CSI progress towards 1,750 MW Goal



Source: CSI data from www.CaliforniaSolarStatistics.ca.gov through December 31, 2008, CSI-SGIP Transitional Projects data from SGIP spreadsheet December 2009.

Clean Solar Initiative Progress

Figure 6. Total Capacity of CSI Applications by Program Administrator, in MW



Source: www.CaliforniaSolarStatistics.ca.gov, data through December 31, 2008, CSI-SGIP data from SGIP Project Database January 2009.

CPUC Developing Multi-Agency Solutions to Facilitate 20% RPS

- **Transmission planning and permitting**
  - See forthcoming slides
- **Site control and permitting**
  - Working with relevant federal (BLM), state agencies (CEC), and local agencies
- **Project Viability**
  - Attempting to evaluate non-performing contracts
- **Generation permitting**
  - California Energy Commission (thermal facilities)
  - County agencies (wind, thermal <50 MW)

Transmission for 20% RPS Can Be an Issue in Certain Regions

- CPUC ordered Edison to build Tehachapi; segments 1-3 are under construction, segments 4-11 are under review
- CPUC implemented Public Utilities Code Section 399.25, which allows for backstop rate recovery for transmission built for renewable purposes
- CPUC approved Sunrise Powerlink for SDG&E in December 2008
- **With these actions, available transmission will be sufficient to reach 20% renewables**

Effective Transmission Planning Is Critical in Reaching 33% Goal

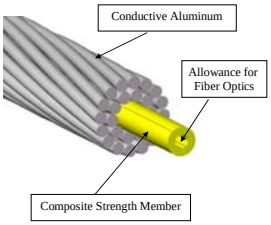
- Initiated Renewable Energy Transmission Initiative
  - with California Independent System Operator (ISO) and Energy Commission, plus investor-owned and publicly-owned utilities
- Purpose is to identify and rank competitive renewable energy zones (CREZs) for transmission development
  - To solve “chicken and egg” problem of which comes first: transmission or generation (similar issue in Hawaii linking load on one island with renewable resource on another island)

Transmission Permitting

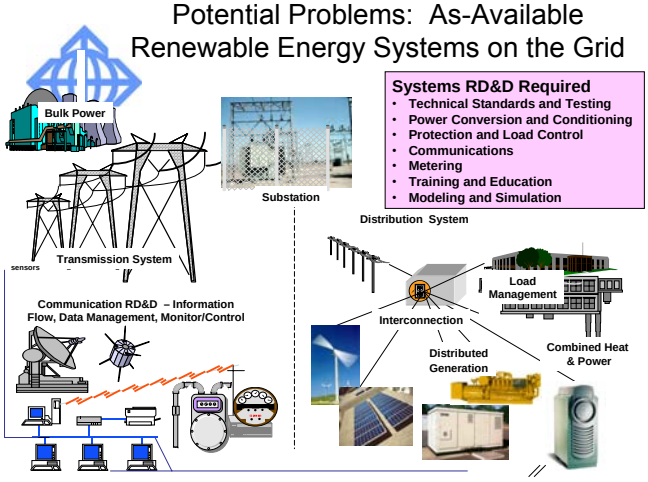
- Transmission pathway identified for CPUC-jurisdictional entities:
- Utility submits to ISO for approval – IPP must also do study for ISO
- CPUC and ISO working to collaborate on determination of “need” to streamline timing
- Utility simultaneously conducts initial environmental assessment
- Utility files application, with proposed route, alternatives, and environmental assessment, at CPUC
- CPUC conducts California Environmental Quality Act (CEQA) review or CPUC is a co-lead with a federal agency on CEQA/National Environmental Policy Act review – includes extensive public input and outreach
- CPUC issues certificate of public convenience and necessity (CPCN) or permit to construct (PTC): aka “permit”

Improved Transmission Performance with Composite Reinforced Aluminum Conductors

- transmission lines Performance Improvements:
  - Ampacity increases by 200%
  - Operating temperature increase by 146%
  - Tension is reduced by 35%
- Contractor's plan is to gain a 5-10% market share of new ACSR equivalent sales within 5 years.
  - $800 million – yearly sales for overhead conductor cable in California
  - $2 million – cost per mile to build new transmission line
  - 31,321 –total circuit miles of California overhead
- Conductor (for double layer stranded sizes) can be ready for large-scale production in 6-8 months.



Potential Problems: As-Available Renewable Energy Systems on the Grid



Systems RD&D Required
- Technical Standards and Testing
- Power Conversion and Conditioning
- Protection and Load Control
- Communications
- Metering
- Training and Education
- Modeling and Simulation

Power Quality and Reliability: A Necessity in a Digital Society

Outage Costs for U.S. Industry estimated at $79 Billion Annually in a recent study by Joe Eto, LBL

Total U.S. Cost of Electricity $250 Billion Annually

Momentary Interruptions (<5min) are More Costly than Sustained Interruptions

From Imre Gyuk, DOE, 2007

Transmission and As-Available Renewables: Examining "What-if" Scenarios

What if 1MW of wind power were added to an island grid?

	Fuel Use		Emissions (tons)		
	GWh	MMBtu	NOx	SOx	CO_2
Combined Cycle	-2.1	-15545	0	-2	-1352
Combustion Turbine	-1.3	-13905	-1	-2	-1245
Diesel	0.0	-341	0	0	-29
Puna Geothermal	0.0	0	0	0	0
Small Hydro	0.0	0	0	0	0
Steam Oil	-0.6	-7582	-1	-1	-726
Wind	4.1	0	0	0	0
Solar	0.0	0	0	0	0
Grand Total	0.1	-37374	-2	-6	-3352

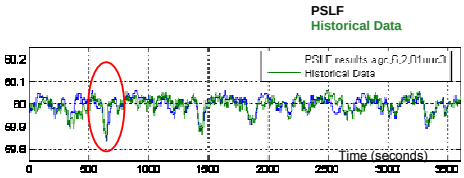
HELCO Cost

HELCO	IPPs
	↓↓↓ CC
↓↓↓ CT	
↓ Diesel	
↓↓ Steam Oil	
Wind ↑↑ …?	

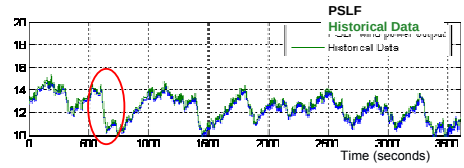
- With no other changes to the system, an increase in wind power offsets fossil fuel generation and reduces emissions
- From a cost of energy perspective, the price paid to wind producers matters - currently avoided cost of oil
- Additionally, HELCO must maintain their system frequency at 60Hz and sudden changes in wind power will affect the frequency - need for spinning reserve and/or new technology

Significant Wind Fluctuations Can Have Significant Impacts on Voltage and Frequency

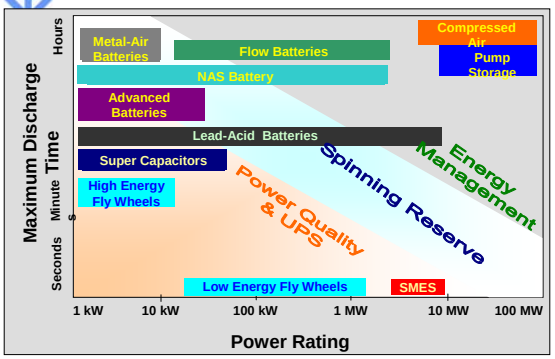
Frequency (Hz)



Apollo Windfarm (MW)



Storage Technologies Used to Address As-Available Impacts



California's Future Storage Technology Portfolio Must Address Certain Issues

Industrial

- **Need for increased reliability**
- **Need for improved power quality due to increased use of digital controls in industry**

System Support

- **Manage transmission and distribution instability caused by congestion**
- **Overcome transmission bottlenecks caused by limited transmission capacity**

Distributed Generation

- **Improve dispatchability and reliability of intermittent renewables**
- **Create load-following capability for fuel cells**

Getting Stakeholders Together: Level of Consensus

What we expected: What we got:

Lessons Learned from 20% Goal Drive Policy Options for Meeting 33% Goal by 2020

- 20% RPS legislation was detailed and prescriptive - 33% statute should be as **simple and flexible** as possible, to allow responsiveness to market conditions
- 20% RPS legislation focused on the procurement process (now working) – 33% should focus on **statewide coordination** needed to facilitate more efficient and timely project development
- Consider recognizing **different characteristics and starting points**
- Current **cost containment mechanism** (market price referent – MPR or benchmark) should be phased out in favor of a more dynamic approach to **utility portfolio planning and procurement**

Cost Containment

- MPR (or any replacement benchmark) problematic
  - May actually increase costs to MPR level
  - Does not contain costs or help assess contracts
- Reasonableness should be assessed by CPUC just like any procurement costs, as part of utility portfolio
- In 2015-16 timeframe, possible to compare against other GHG-emissions mitigation strategies under AB 32 and related laws

Feed-in Tariffs Based on AB 1969 (for Renewables) and AB 1613 (for CHP)

What is a Feed-in-Tariff (FiT)?

- Standard offer contract for the sale of electricity from a qualifying Distributed Generation facility to the utility grid
- California experience with Qualifying Facilities (QFs)
- Public Utilities Regulatory Policy Act (PURPA) of 1978 established QFs and outlined their payment according to the avoided cost of power
  - PURPA is no longer relevant in developing Power Purchase Agreements (based on avoided costs)
- QF is currently defined as non-utility generator with less than 80 MW capacity that utilizes cogeneration and/or renewable fuels (for bioenergy, ≥ 50% biomass)

Feed-in Tariffs

- In February 2008, the CPUC made new Feed-in Tariffs available for the purchase of up to 480 MW of renewable generating capacity from small facilities throughout California.
- New Feed-in Tariffs are a simple means for small renewable generators to sell power to utilities at predefined terms and conditions, without contract negotiations.
- Power sold to the utilities under the feed-in tariffs will contribute to the utilities ability to meet their Renewables Portfolio Standard goals.
- AB 1969 authorized Feed-In Tariffs for small renewable generators (<1.5 MW) owned by public water and wastewater facilities and facilitates a streamlined interconnection process
- Statewide cumulative capacity is now up to 228 MW for total of 478 MW
- Rate is determined by Market Price Referent with Time of Delivery adjustments

Feed-in Tariffs

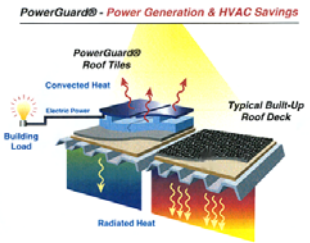
- Feed-In tariff approach complements RPS and other programs to promote procurement of renewable energy, while avoiding overlap
- Allows for generation above on-site demand
- Streamlined approach
  - Standard Terms and Conditions
  - Renewable Energy Certificatess transfer to utilities with sale of electricity
  - Helps utilities meet RPS requirements
  - 10, 15, or 20 year fixed base price contracts

Net Metering Is Another Program Designed to Increase the Penetration of Renewable Resources

- Net metering laws, as amended, allow for up to 1 MW systems
  - Up to 10 MW for biogas digesters
- Eligible technologies are photovoltaic systems, wind, fuel cells, and biogas
  - PV "in" and "out" prices are the same
  - Biogas digesters only allowed to recoup generation costs
- Limited to 2.5% of Investor Owned Utilities (IOUs) peak demand
- Net excess generation is carried forward for one year with any remaining given to the utility

PowerLight's PowerGuard

While California is known for its hot dry summers, that same solar resource provides a clean, safe and reliable way to generate electricity



PowerLight's insulated 30 year roof system reduces building air conditioning loads while it's PV surface generates electricity during hot and expensive peak summer hours

The Yolo County Success

Accomplishments

- **Is opening the way for landfill gas electricity systems to be more widely used in California**
  - **Accelerates gas production from over 30 years to less than 10 years, making landfill electricity more competitive**
  - **Reduces volume of landfill which can extend landfill life by 20 percent**
  - **Significantly reduces the chance for groundwater pollution from leachate release**
- **Has become the leading bioreactor project within EPA's XL Program and will strongly influence landfill regulations across the country**

Control cell without bioreactor

Enhanced bioreactor cell

33% Renewables Target Has Multiple Benefits

- Greenhouse gas emissions reduction
  - AB 32 California Air Resources Board Scoping Plan as key driver, along with other related laws
- In-State economic and environmental benefits
  - Job creation
  - Fuel diversity
  - In-state air quality
- Orderly progress toward a higher percentage renewable portfolio at reasonable costs
  - Different starting points implies potential for different end points
  - Acknowledgement of customer-owned rooftop photovoltaics helping to meet statewide goals (similar issue in Hawaii)?

APEC Workshop on Recent Advances in Utility Based Financial Mechanisms that Support

Renewable Energy and Energy Efficiency

Honolulu, Hawaii

March 30, 2009

REGULATOR'S PERSPECTIVE

ON

RENEWABLE ENERGY PORTFOLIO STANDARDS

AND

ENERGY EFFICIENCY

Carlito P. Caliboso

Chairman

Public Utilities Commission

State of Hawaii

Background
Regulatory Authority

- *General supervisory power over public utilities under Chapter 269, HRS. HRS §269-6(a).*

- *"The public utilities commission may consider the need for increased renewable energy use in exercising its authority under this chapter." HRS §269-6(b). Act 177 (SLH 2007).*

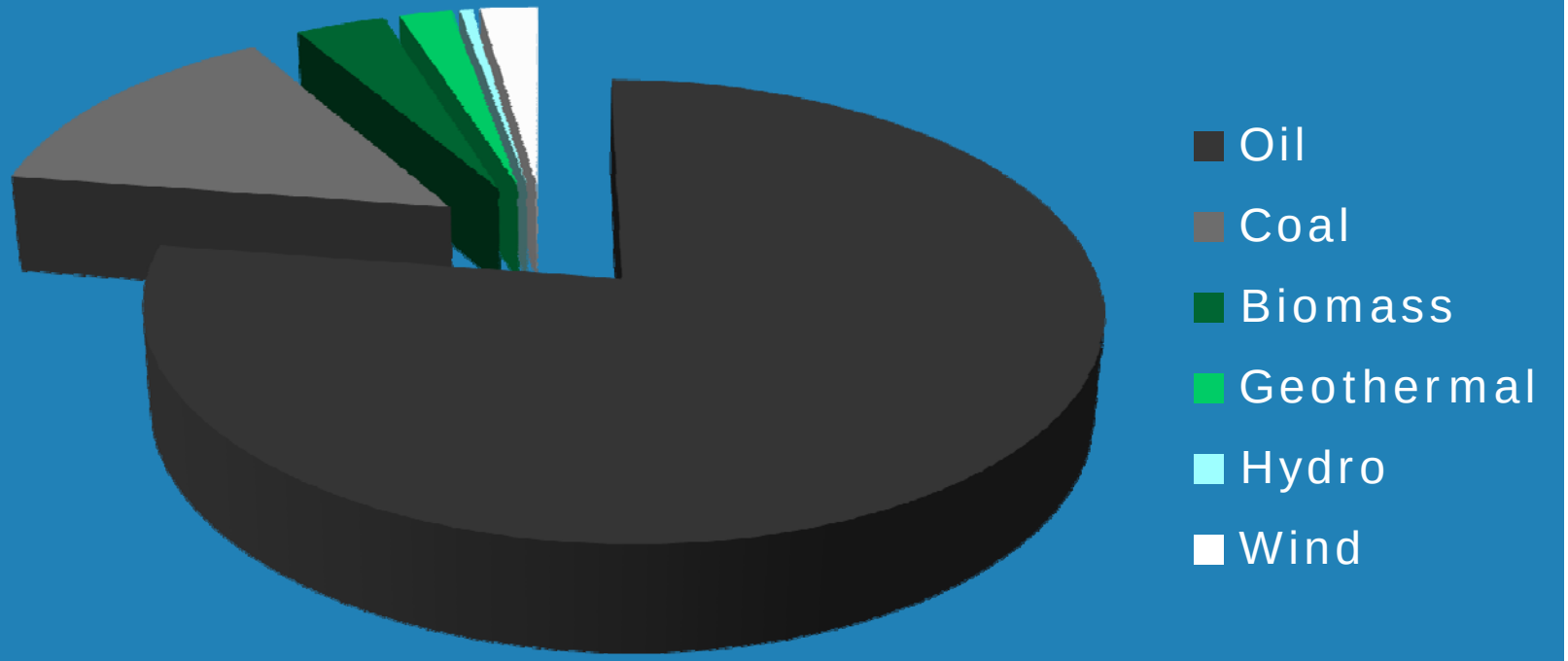
Traditional Regulatory Objectives, Ch. 269 HRS

- *Reliable Electricity Service*
- *Just and Reasonable Rates*
- *Fair Opportunity to Earn Reasonable Rate of Return*

Balancing Traditional Regulatory Objectives

Hawaii's Dependence on Oil
Hawaii Fuel Mix

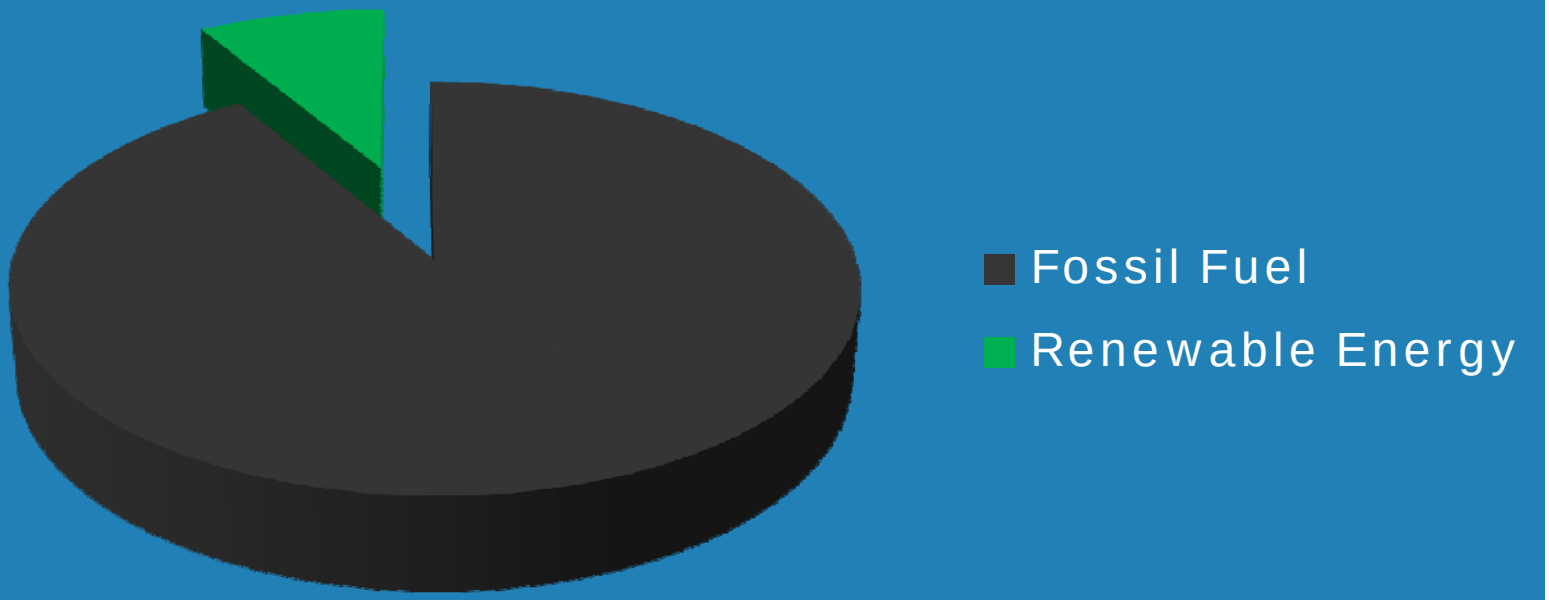
Percent of Fuel Used for Electricity Generation by HECO in 2007



Data Source: www.heco.com

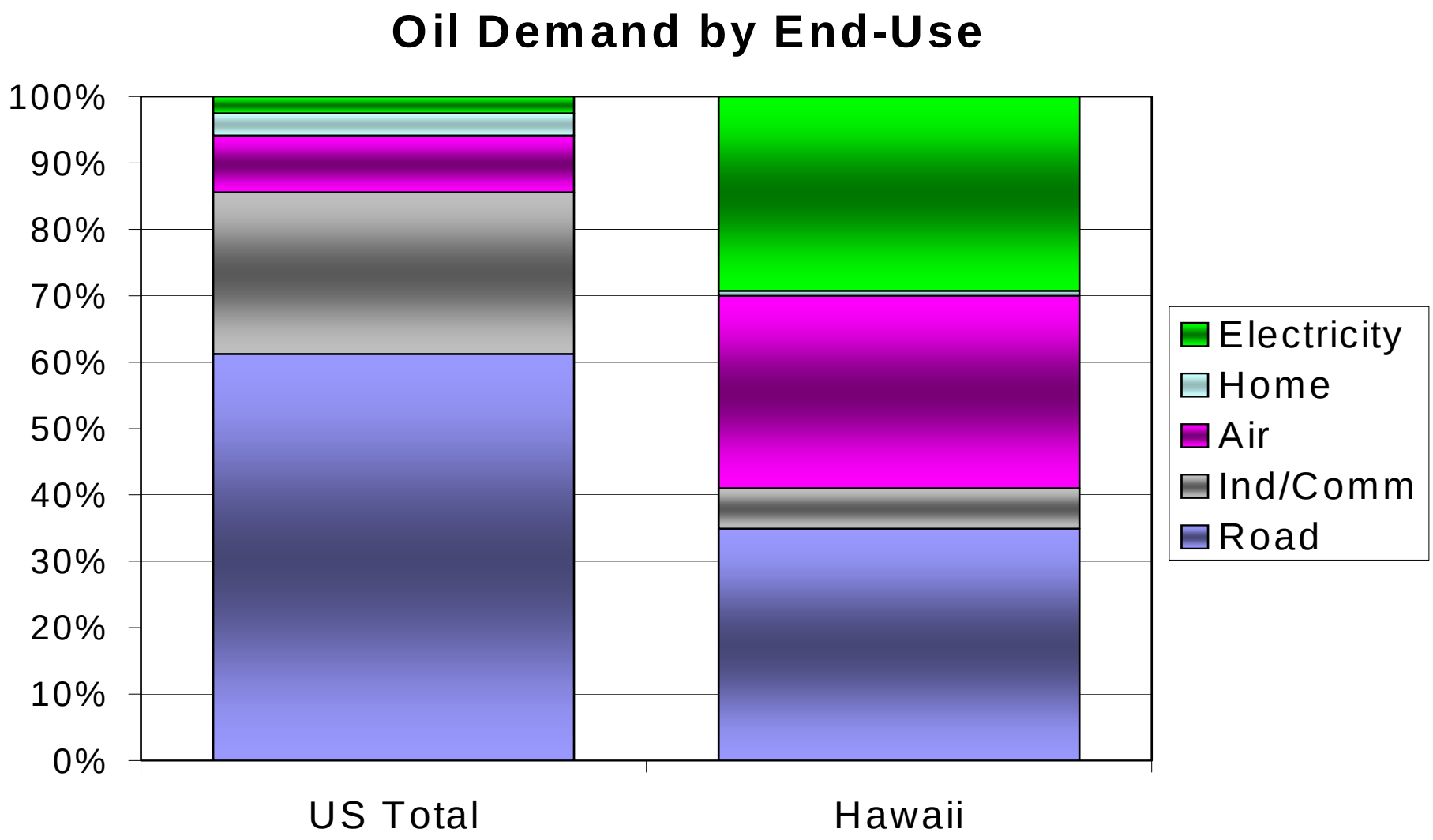
Hawaii's Fossil Fuel Dependence

Percent of Fossil Fuel and Renewable Energy Used in Electricity Generation
2007



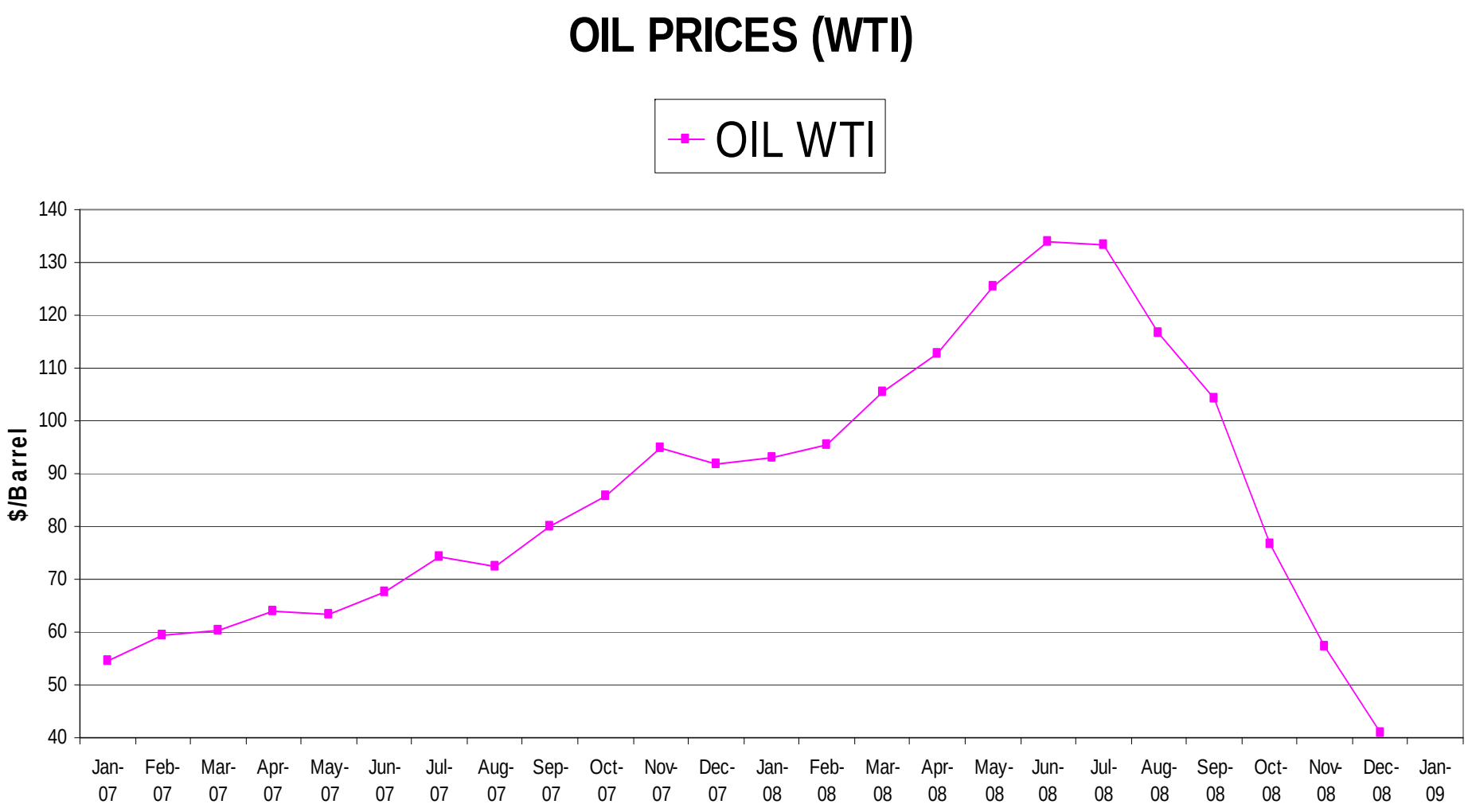
Data Source: www.heco.com

Comparison of US and Hawaii Oil Demand



Source: HNEI

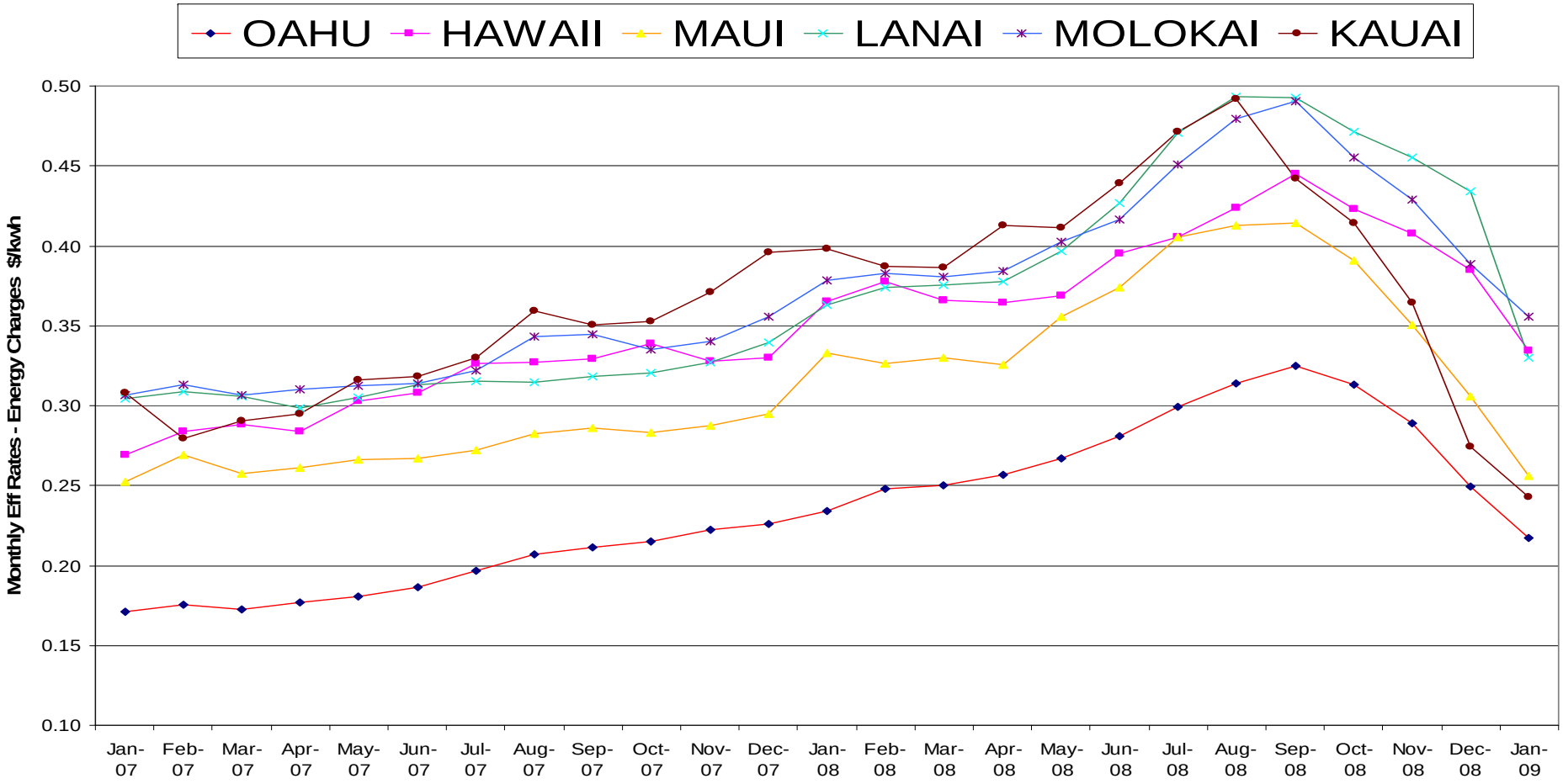
Oil Price Volatility



Data Source: U.S. DOE Energy Information Administration
http://tonto.eia.doe.gov/dnav/pet/pet_pri_spt_s1_m.htm

Vulnerability to Oil Price Volatility

EFFECTIVE RATES

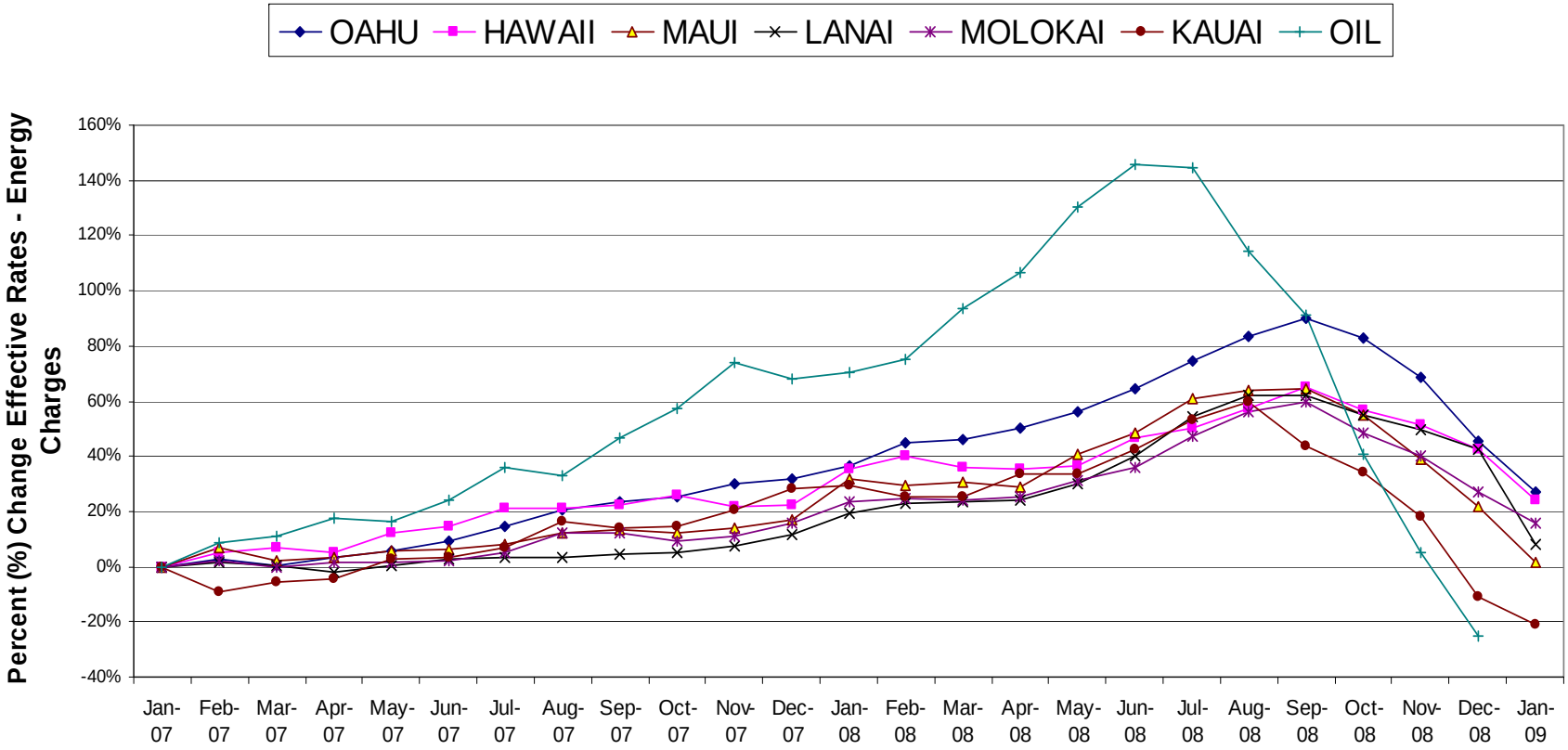


Data Source: HECO Companies' "Effective Rate Summaries" Reports
KIUC Fuel and Purchased Power Rate Adjustment Reports

Vulnerability to Oil Price Volatility

EFFECTIVE RATES AND OIL PRICE CHANGES

SINCE JANUARY 1, 2007



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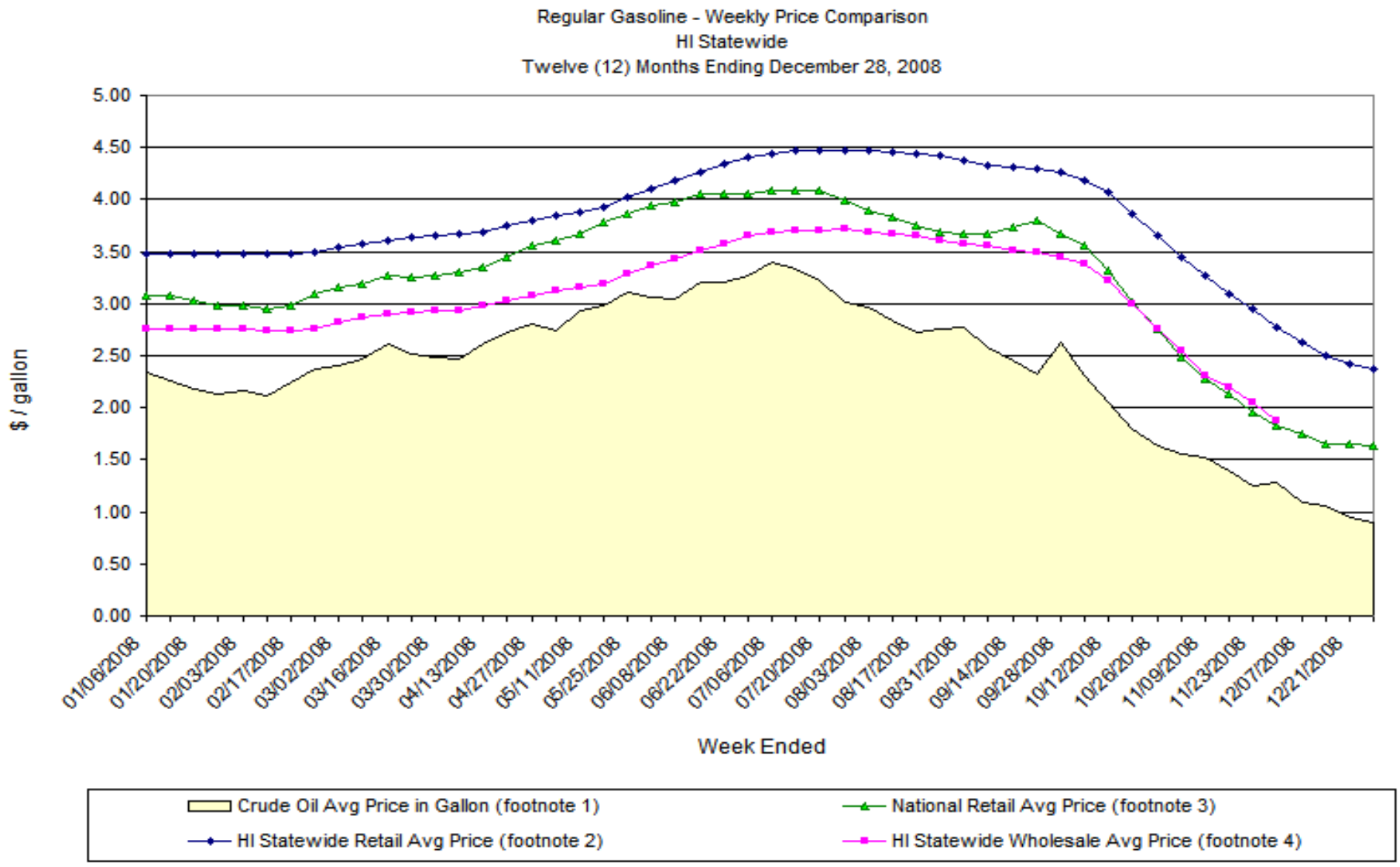
Vulnerability to Oil Price Volatility



Price of Oil Since 1980s

Climate Change
(Global Warming)

Priority Policy and Regulatory Objectives

- *Energy Security*
  - *Reduce Imported Oil Dependence*
  - *Price Stability*
  - *Supply Security*
- *Climate Change (Global Warming)*
  - *Reduce Green House Gas Emissions*
  - *Reduce Fossil Fuel Use*

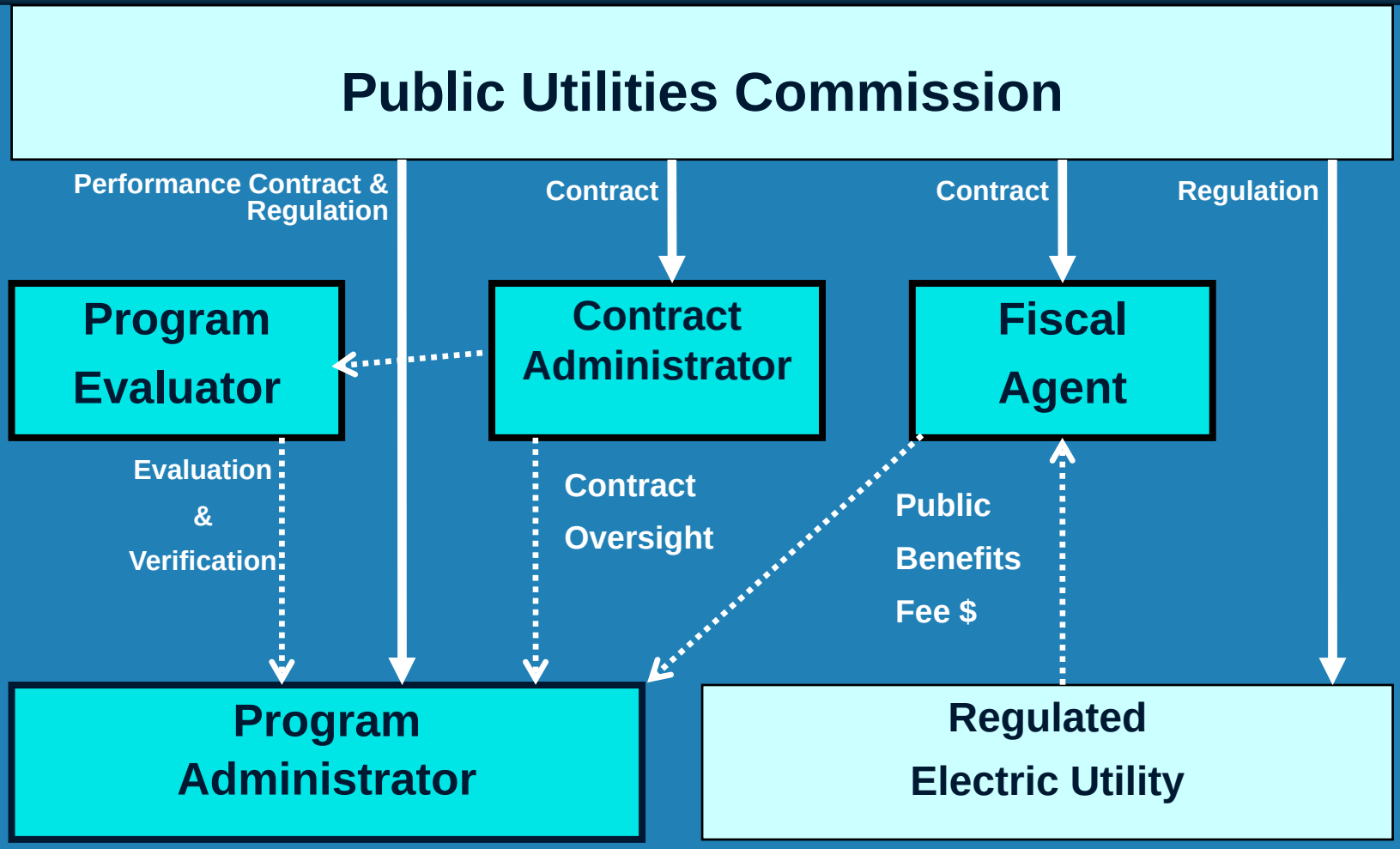
Primary Energy Strategies

- *Energy Efficiency:*
  - *Maximize Cost-Effective Energy Efficiency Programs*
- *Increase Renewable Energy Generation*
  - *Wind*
  - *Solar*
  - *Geothermal*
  - *Wave, OTEC, Biofuels, & Others*

Maximize Energy Efficiency Aggressively

- *2004 HECO Rate Case 04-0113 DSM Application Bifurcated*
- *Energy Efficiency Docket 05-0069*
- *Public Benefits Fee, Act 162 (2006) , HRS §269-121.*
- *Energy Efficiency Program Administrator Docket 2007-323*

Hawaii Energy Efficiency Program Administrator July 1, 2009

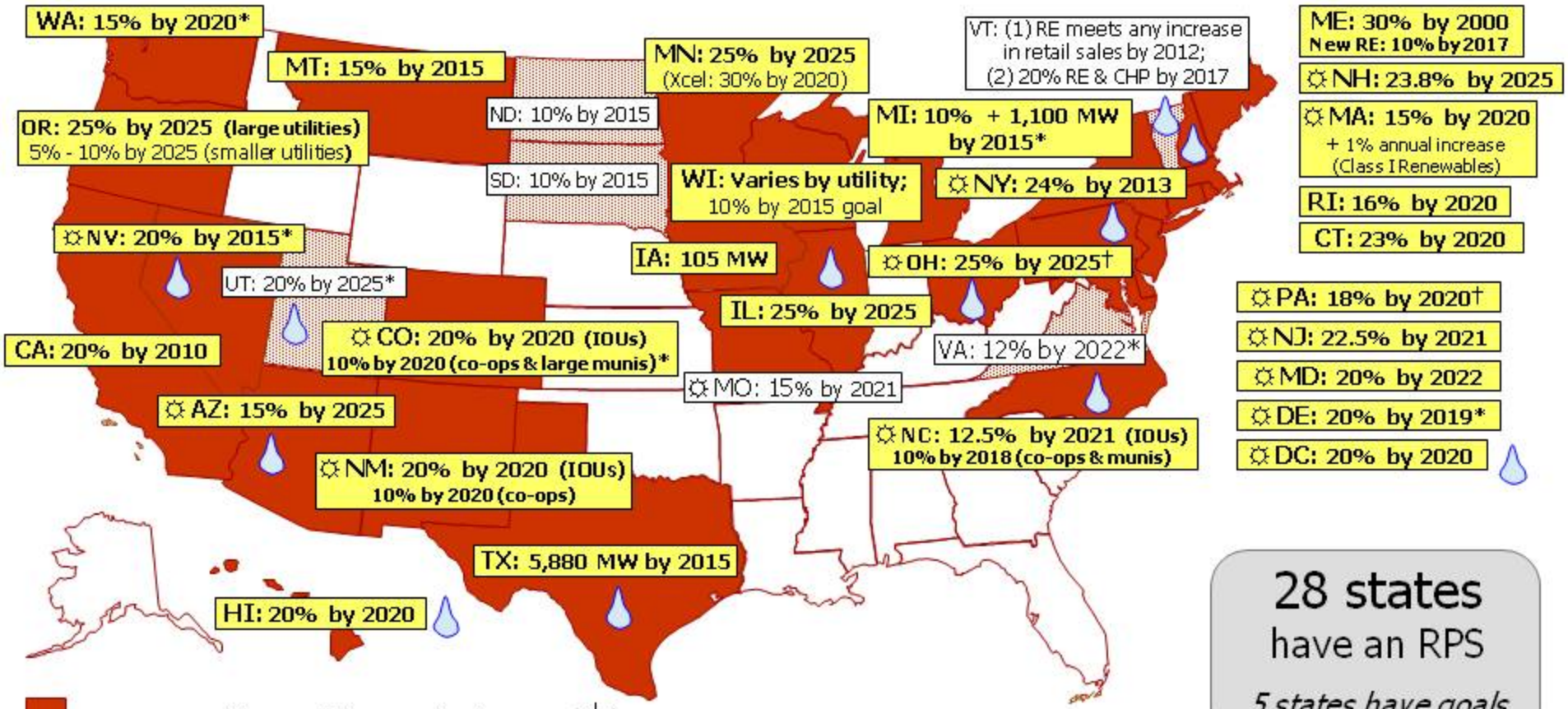


Establishing Energy Policy to Increase RE Generation

- *Renewable Portfolio Standards*
  - *Standards*
  - *Goals*
- *Broad Policy Tool (Weapon)*
  - *Requires % of RE Generation*
  - *Communicates Policy to Change*

Renewable Portfolio Standards

www.dsireusa.org / March 2009

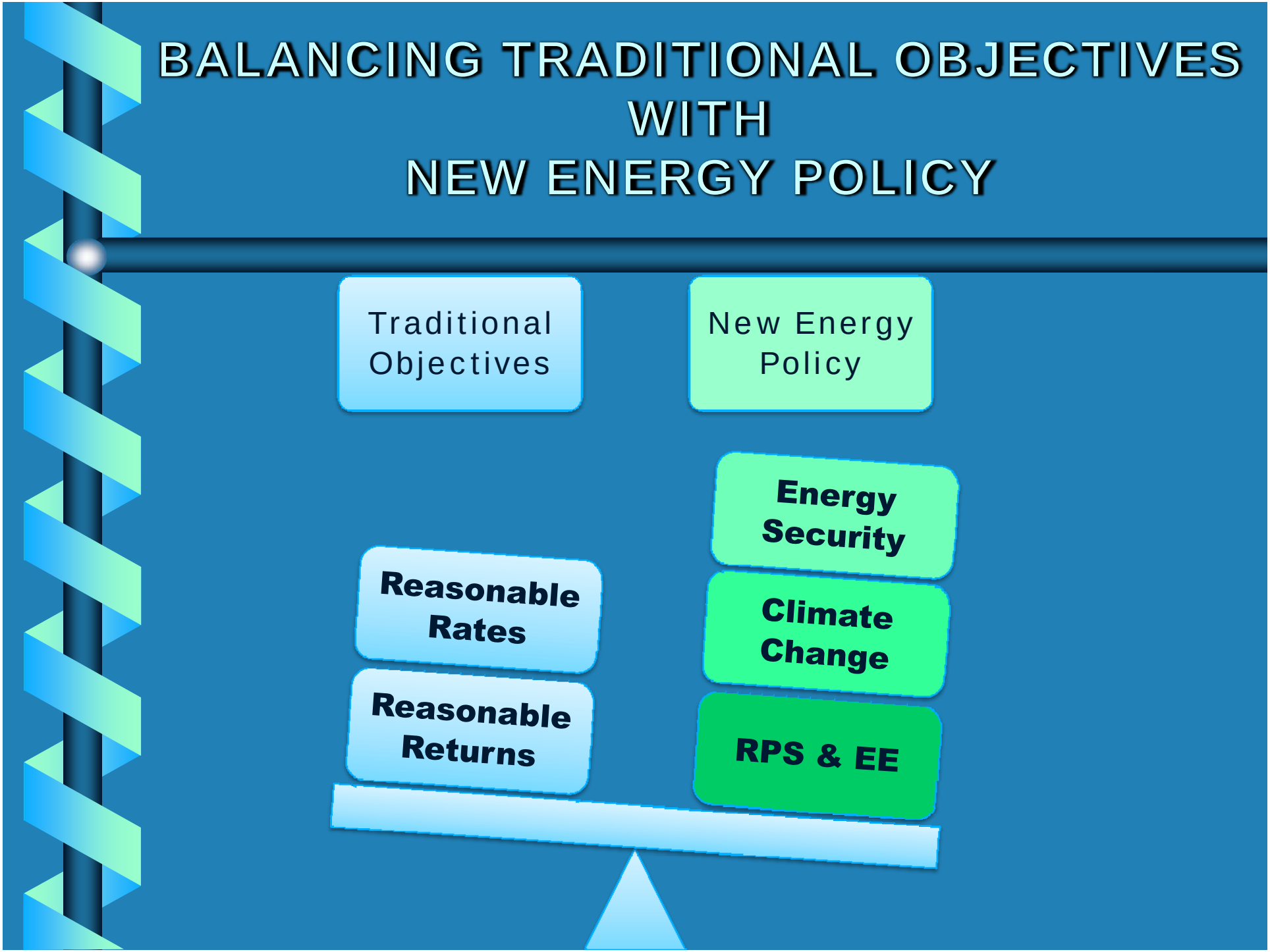


Establishing Policy to Increase RE Generation: RPS

- *RPS (includes EE), HRS §269-92*
  - *10% Renewable Energy by 2010*
  - *15% Renewable Energy by 2015*
  - *20% Renewable Energy by 2020*

- *Penalties Established for RPS at $20 per MWh of deficiency. (Order 12/19/2008 Docket 2007-0008)*

BALANCING TRADITIONAL OBJECTIVES WITH NEW ENERGY POLICY




Kaheawa Wind
Maui


Kaheawa Wind
Maui
03/11/2009

Hawi Wind
Big Island

Hawi Wind
Big Island


La Ola Solar Farm
Lanai
03/13/2009

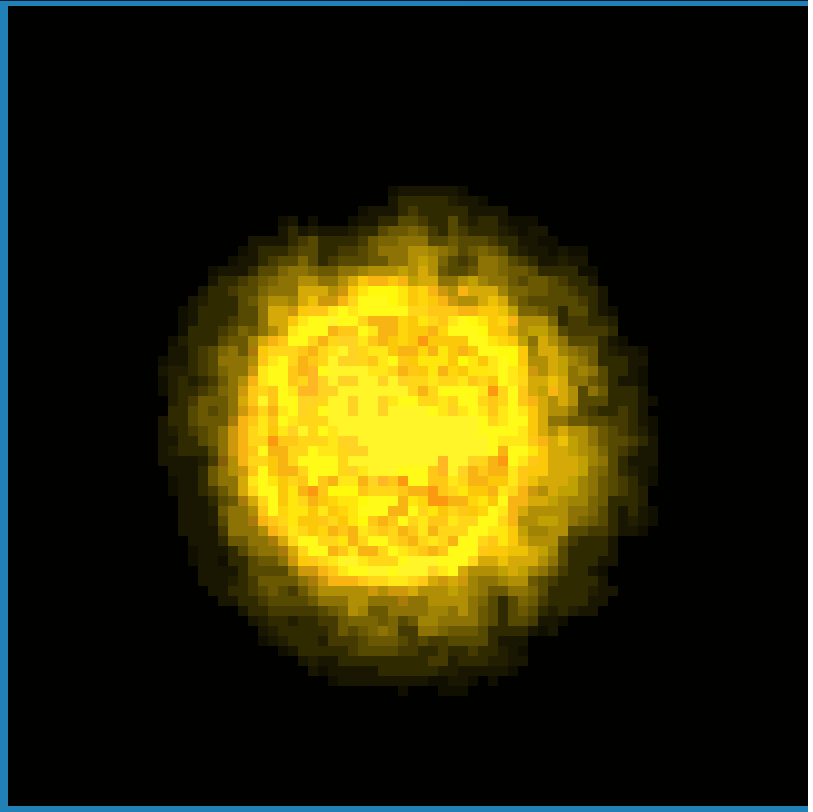
La Ola Solar Farm
Lanai

La Ola Solar Farm
Lanai

Renewable Energy Progress
Others on the Horizon

- *Sea Water Air Conditioning*
- *Ocean Thermal Energy Conversion (OTEC)*
- *Biomass*
- *Biofuels*
- *Wave*
- *Others TBA*

ALOHA



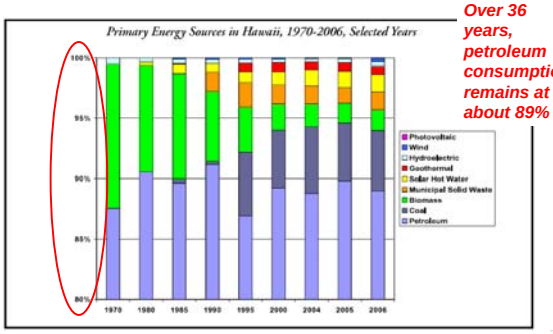
Renewable Energy Opportunities

March 30, 2008

Department of Business, Economic Development & Tourism

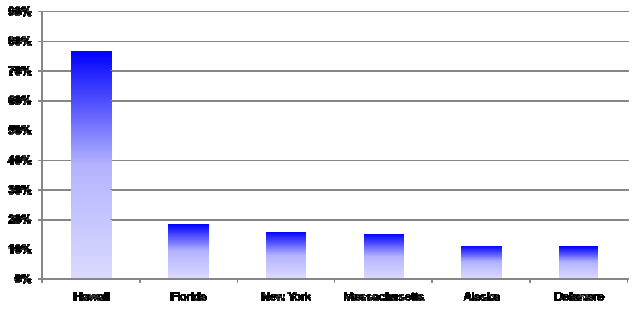
Contents

Hawaii's Dependence on Fossil Fuels



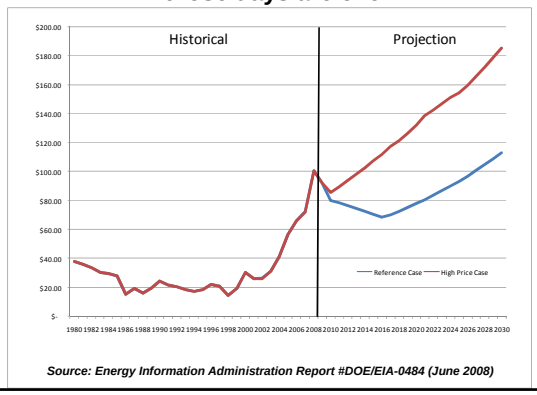
Over 36 years, petroleum consumption remains at about 89%

Hawaii is the most petroleum dependent state



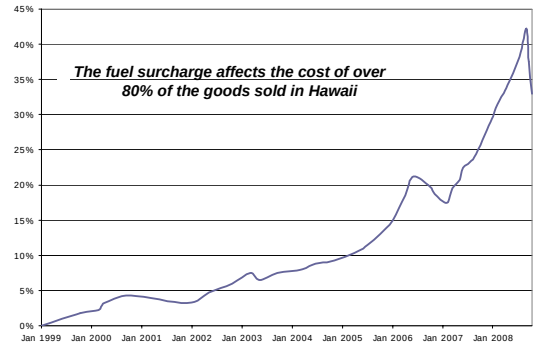
Petroleum dependence for electricity – top six states

Hawaii's energy system was based on $20/barrel oil: those days are over



Source: Energy Information Administration Report #DOE/EIA-0484 (June 2008)

High energy costs multiply throughout the economy



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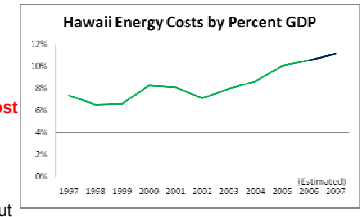
Economic impact of dependence on expensive energy

- Household fuels and utilities **costs rose 36.4 percent**, year-over-year, in the Honolulu CPI during 2Q'08
- Mainland energy costs are 4% of a state's Gross Domestic Product; in Hawaii, it approaches 11%, **almost 3 times as much**
- Between 2007 and 2008, State Government **consumption** of electricity has **decreased 1.17%**, but **expenditures** have **increased 19.55%**



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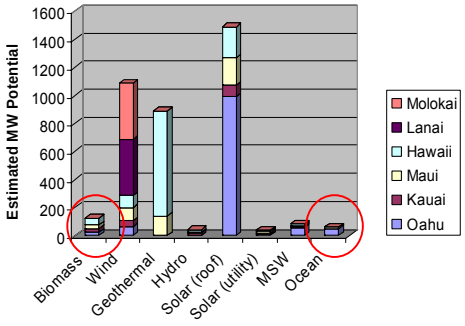
Energy Security is One Priority

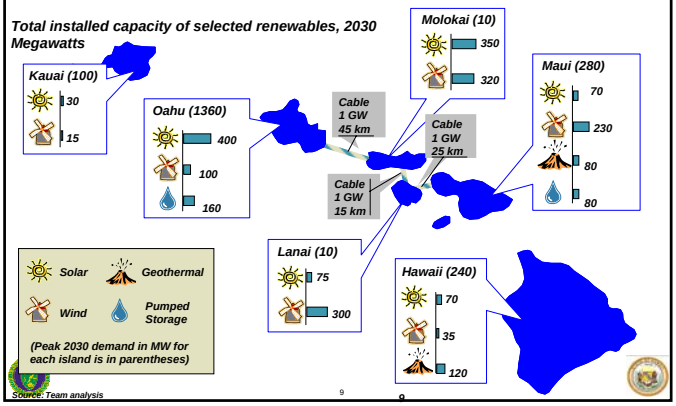
Hawaii typically has a *14-21 day supply* of oil

Hawaii's Renewable Resources
Estimated @ 150% of Current Installed Capacity



Hawaii's Wealth of Renewables

Total installed capacity of selected renewables, 2030
Megawatts



Source: Team analysis

Contents

- Hawaii's Energy Picture
- Hawaii's Energy Future: 70% Clean Energy by 2030
- A Key Role: Efficiency
- New Technologies and Systems

The Hawaii Clean Energy Initiative was launched on January 28, 2008 with the signing of a Memorandum of Understanding between the State of Hawaii and the U.S. Department of Energy

"…the Department of Energy will help Hawaii lead America in utilizing clean, renewable energy technologies."

Governor Lingle

"Hawaii's success will serve as an integrated model and demonstration test bed for the United States and other island communities globally..."

Assistant Secretary Karsner

Hawaii Clean Energy Initiative

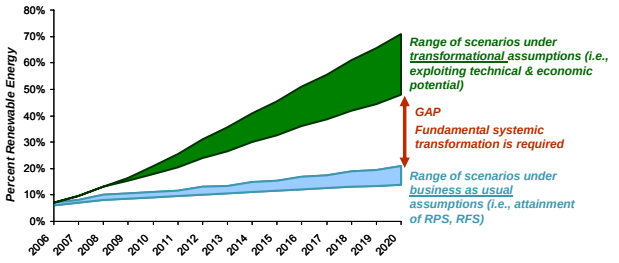
National Partnership to Accelerate *System* Transformation

The goals are:

- *Achieve a **70% clean energy economy** for Hawaii within a generation*
- *Increase Hawaii's **security***
- *Capture **economic benefits** of clean energy for all levels of society*
- *Foster and demonstrate **innovation***
- *Build the **workforce** of the future*
- *Serve as a **model** for the US and the world*

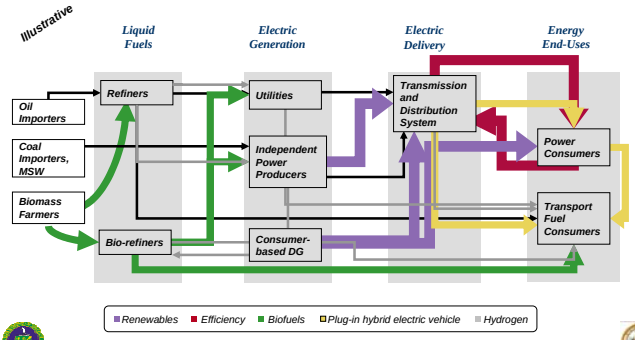
Hawaii's transition to an economy powered by clean energy, instead of imported foreign oil

In 2004, Hawaii's RPS included 6% renewables, which would increase only incrementally



…will require a substantive transformation of regulatory, financial, and institutional systems

The Hawaii Energy Ecosystem provides a level of complexity in systemic transformation that is instructive to larger systems



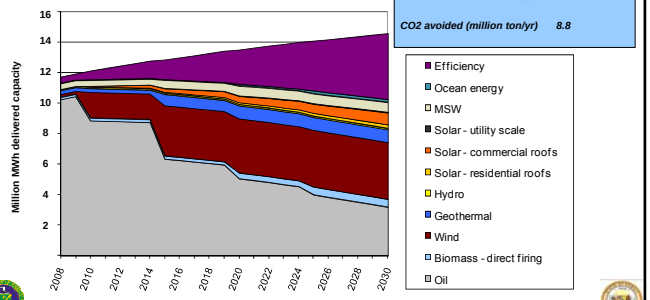
HCEI Scenarios: Analytical Path Toward 70% Clean Energy End-State

- First cut at order of magnitude requirements and impacts
- Evaluated sensitivity to several factors
- No absolutes defined in this evaluation
- Most work on electricity, some on transportation, little on jet fuel
- **Based on *current commercially viable technologies*; potential game changers like OTEC and algae to energy are not considered**
- **All scenarios are presented *without imported biofuels*; all scenarios can hit the goals with imported biofuels**
- Follow-up economic and cost/benefit impacts, refinements in progress.

Scenario 8 Electricity

Hawaii could reach 70% clean energy in the electricity sector and reduce oil imports by 20 MM bbl/year by 2030

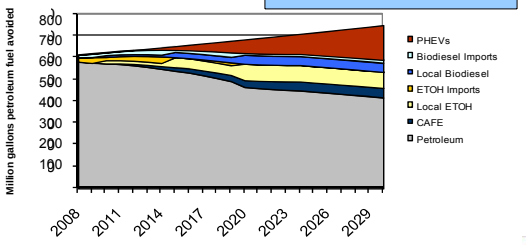
Summary of 2030 Electricity Results	
Clean energy achieved	70%
Oil reduction (million bbl/yr)	17.3
CO2 avoided (million ton/yr)	8.8



Scenario 8 Transportation

High PHEV penetration, local biodiesel and ethanol production

Summary of 2030 Transportation Results	
Clean energy achieved	63%
Oil reduction (million bbl/yr)	9.9
CO2 avoided (million ton/yr)	4.2



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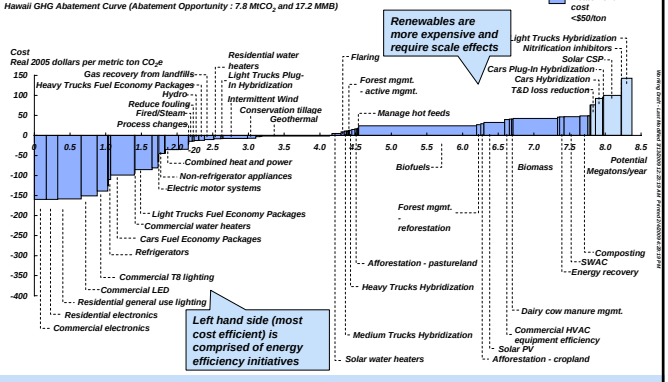
Energy efficiency (EE) initiatives are most economical and could drive down overall cost of energy in Hawai'i

ANALYSIS BASED ON $60/BBL OIL

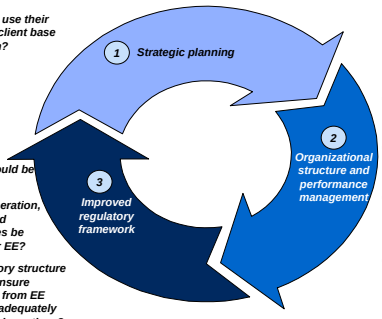
Hawaii GHG Abatement Curve (Abatement Opportunity : 7.8 MtCO$_2$ and 17.2 MMB)



Source: Team analysis

As the energy efficiency landscape evolves, the State of Hawai'i and energy utilities will need to build out three core aspects of its efficiency program

- *Where to play?*
- *How to play?*
- *How can utilities use their capabilities and client base to drive adoption?*



- *How should the EE programs be managed and measured?*
- *What is the most effective organizational structure?*
- *How should incentives within EE and between EE and other divisions be aligned?*
- *How can effectiveness be ensured as the organization grows?*

- *What targets should be set?*
- *How should generation, transmission, and efficiency utilities be compensated for EE?*
- *How can regulatory structure be designed to ensure loss of rate base from EE programming is adequately compensated by incentives?*

SOURCE:McKinsey analysis

Negawatt - the cheapest watt of energy is the one never used.

- Fastest-growing U.S. energy source (~2.5-3.5%/yr)
- Energy efficiency has tremendous potential to reduce greenhouse gas emissions
- The U.S. Department of Energy estimates that increasing energy efficiency throughout the economy could cut national energy use by 10% or more in 2010 and about 20% in 2020
- A comprehensive set of policies for advancing energy efficiency could lower national energy use by 18 percent in 2010 and 33 percent in 2020.
- These policies, along with policies to advance renewable energy, could dramatically lower U.S. carbon dioxide emissions while saving consumers and business $500 billion net during 2000-2020.
- Policy Approaches to Advancing Energy Efficiency
  - Framework – Priorities, benchmarks, mandates
  - Resources – Fees, funding, financing mechanisms for projects
  - Green Buildings (72% of electricity consumption) – Codes, standards, energy use labeling

Contents

Hawaii National Marine Renewable Energy Test Center Program Objectives

- **Objectives:**
  - Facilitate development & implementation of commercial wave energy systems for use in Hawaii and elsewhere
  - Target – one or more of these system to supply energy to grid at >50% availability within 5 years
  - Move Ocean Thermal Energy Conversion (OTEC) to pre-commercialization and conduct long-term testing

Hawaii Natural Energy Institute
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

Hawaii National Marine Renewable Energy Test Center Current Test Sites

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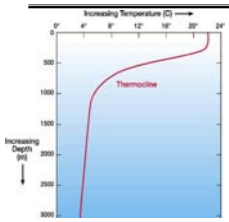
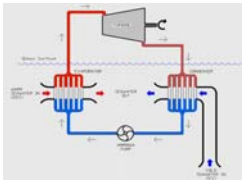
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

Ocean Thermal Energy Conversion





Using the temperature difference between: DEEP OCEAN WATER ~5°C And SHALLOW OCEAN WATER ~25°C

Closed -cycle

1. *Warm ocean surface seawater boils a refrigerant liquid at high pressure (130 psi).*
2. *Refrigerant vapor spins a turbine-generator, becomes low pressure (80 psi).*
3. *Cold deep ocean seawater condenses refrigerant to a liquid again.*
4. *Cycle continues -- similar to steam turbine but lower temperature.*

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University of Hawaii at Manoa

Makai Ocean Engineering

OTEC Challenges:

- Technical challenges
  - Large diameter and long pipelines
  - Low cost, efficient heat exchangers
  - Large, stable platform and mooring design
  - Dynamic power cable to shore
- Cost Challenge:
  - Low cost must be achieved with new materials, better engineering, innovative designs, while taking advantage of economy of scale and current offshore technology.

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University of Hawaii at Manoa

Makai Ocean Engineering

Hawaii Center for Advanced Transportation Technologies

HCATT

- Develop and demonstrate zero emission and low emission transportation technologies.
- Establish infrastructure to support zero emission vehicle operations.
- Create business opportunities to attract vehicle technology companies to Hawaii.
- Facilitate growth of transportation technology industry in Hawaii.
- Secure new funding sources to expand scope of operations in Hawaii.

Hawaii Center for Advanced Transportation Technologies
531 Cooke Street, Honolulu, HI 96813
Thomas L. Quinn 808-594-0100 tquinn@htdc.org www.htdc.org/hcatt

Electric, Hybrid, and Fuel Cell Vehicles

Neighborhood Electric Vehicles

Fuel Cell Bus

Plug-in Hybrid

Hybrid electric-fuel cell bus for Hickam Air Force Base

Phycal: Algae to energy

Land

Nutrients

Waste paper

Water-
Brine & Fresh

CO_2

Sunlight

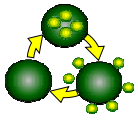
Algal Oil

Methane Gas

Phycal: Strategic Energy Products

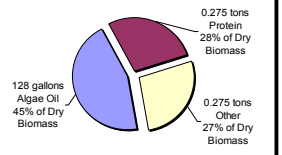
Phycal Hawaii R&D

- Objective: Grow algae for energy products
  - Algal lipids (oil), methane, hydrogen
- Major innovation: Non-destructive extraction
  - Extract lipid from cell without dewatering or killing algae
  - Recycle algae to ponds
  - Reduced dewatering, nutrient, CO_2 costs
  - Higher lipid and biomass growth rates
- Inputs: CO_2 from flue gas, wastewater, wastepaper
- Pilot plant in Q1, 2010
- Production by late 2012



"Refocusing" Agriculture: The base for a sustainable, economic and secure Hawaii ("back-of-the-envelope" estimates)

One metric ton of algae



Cane as an Algae "Feedstock"

- ***1.0 acre cane at 50 tons per acre***
  - ***1025 gallons ethanol ($2480)***
  - ***5500 kwh of power ($979)***
  - ***Revenue total = $3459***
- ***50 tons of cane/acre produces 15.2 tons CO2/acre on processing***

15.2 tons CO2 produces 5 tons of algae

- ***5 tons of algae/acre***
  - ***640 gallons of oil ($4/gallon)***
  - ***1.3 tons of protein ($700/MT)***
  - ***1.3 tons of biomass (=4.3 tons whole cane = 573 kwh or power = $84)***
  - ***Revenue total = $3554***
- ***5 tons algae require 0.07 acres of algae ponds***
  - ***(7% reduction in land available for cane)***

Increasing Land Productivity through Innovation and Integration ("per **acre** back of the envelope estimates")

Current Sugar Focus	Current Energy Focus	Future Energy Focus with advanced crop varieties and advanced processing	Future Energy Focus with advanced crop varieties and advanced processing integrated with algae
• 7-8 tons sugar • 5000 kwh power • 1x CO_2	• 1025 gallons ethanol • 5500 kwh power • 1.5x CO_2	• 2500 gallons ethanol • 9,000 kwh power • 2.5x CO_2	• 2500 gallons ethanol (or other advanced fuels) • 10,000 kwh power • 1000 gallons oil • 2 tons protein • 0.1x CO_2
	• revenue $3460 • land "footprint" = X per gallon fuel		***•revenue >$10,000 •land footprint = 1/3X per gallon fuel***

We Invite Your Attention and Partnership

Working as partners, we achieve together what none of us could do alone

"Our performance will be measured by the successful transition of the energy systems globally to clean and secure sources with stable costs, healthy and strong economies and environmental sustainability."

DBEDT
STATE OF HAWAII

Demand Response: A Reliability Tool Today; A Renewable Integration Tool Tomorrow

Dave Waller, VP Customer Service
Hawaiian Electric Company

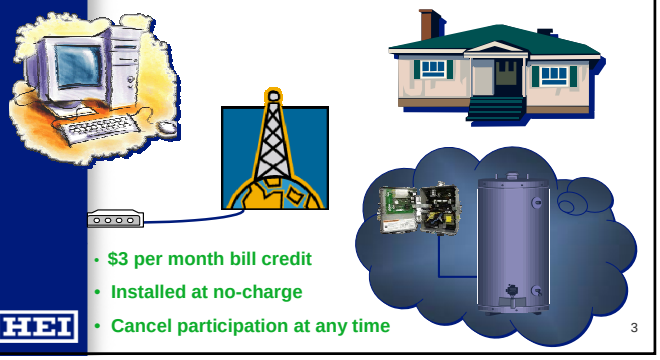
EnergyScout Programs

HECO's Direct Load Control programs designed to provide immediate, automated customer response to unplanned system-wide emergencies

- **EnergyScout for Business**
- **EnergyScout for Homes**

Residential Direct Load Control

How RDLC Works



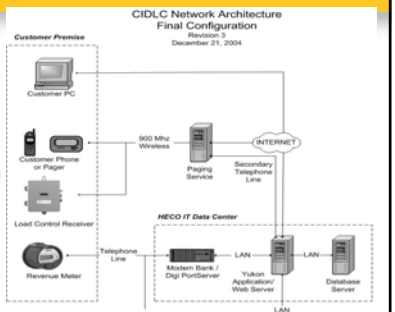
- **$3 per month bill credit**
- **Installed at no-charge**
- **Cancel participation at any time**

Commercial & Industrial DLC

Back-up Generators

Interruptible Loads

- Heat Pumps
- Chillers
- Pumps
- Lights
- Industrial Processes



Incentives:

Demand Reduction $5-$10/kW

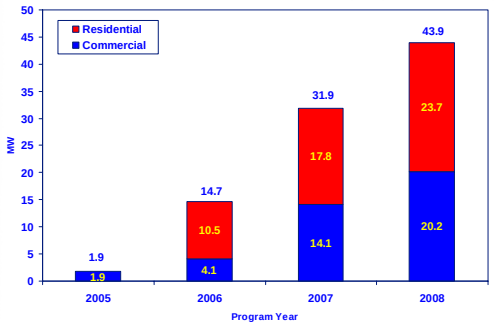
Energy Reduction $0.50/kWh

Energy Scout for Businses

- Incentives to curtail use during critical peak periods
  - Identify non-essential interruptible loads
  - Utilize customer emergency generators
- Applies to customers with 200 kW to 10 MW of interruptible demand
- 41 Oahu Commercial Customer enrolled today

5

EnergyScout Curtailable Load



6

EnergyScout Programs

- Residential EnergyScout customers contribute over 23 MW!
- Commercial EnergyScout customers contribute over 20 MW!
- At 43 MW, that's nearly half the size of HECO's new power plant

7

Hawaii Clean Energy Initiative

- Prospect to be stable financially with new 'regulatory compact'
- Focus on service & efficiency, not sales
- Committed to
  - RPS 40 percent/2030
  - 1,100 MW of new RE energy
  - Feed-in tariff, NEM

Renewable commitment

Large & mid-size wind projects

Biofuels

- **Waste-to-energy; biomass; land crops & algae**

Solar power

- **Customer sited & utility scale**

Geothermal

Ocean power

- **Seawater A/C**
- **Wave Energy**
- **OTEC**

'Big Wind' agreement

Oahu has largest population & power demand but few renewable Resources

On Lanai, Castle & Cooke planning, 200+ wind farm MW

On Molokai, First Wind Hawaii planning 200+ MW wind farm

State to build inter-island cable to bring power to Oahu

10

Implications of Wind Expansion

- **Load profiles & wind generation usually do not align**
- **Forecasting wind generation uncertain**
- **Mitigation measures include:**
  - **Develop wind forecasting techniques**
  - **Place constraints on wind power facilities**
  - **Increase regulating reserves**
  - **Expand Direct Load Control**

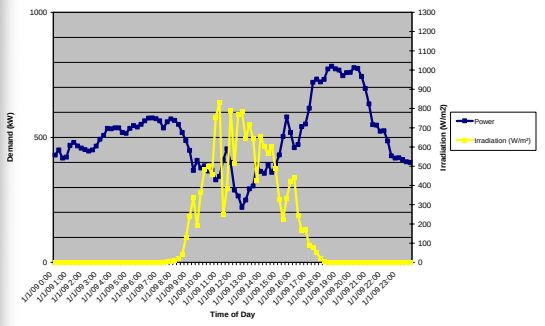
11

Putting the February 2008 ERCOT Events into Perspective

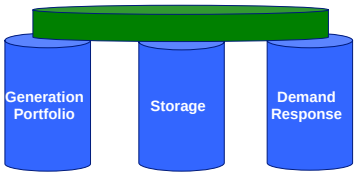
- Geographic diversity limit the speed that wind events propagate.
  - February 26, 2008 - three hours to drop 1,500 MW.
  - February 24, 2007 - two hours to drop 1,500 MW.
  - AES Truewind reports that ERCOT can expect:
    - less than one 2,800-MW, 30-minute drop per year - 15,000-MW wind
    - 2-4, 1,300-MW, 30-minute increases or decreases
  - Experience in Other Regions
    - Denmark: 2000 MW (83% of capacity) decrease in 6 hours - 1/8/05
    - Germany: 4000 MW (58% of capacity) decrease in 10 hours – 1/24/04
    - Portugal: 700 MW (60% of capacity) decrease in 8 hours – 6/1/06
    - Spain: 800 MW (7%) increase in 45 minutes
- Conventional generation contingencies require dedicated spinning reserves and immediate response (2300 MW of ERCOT Responsive Reserve Service).
- Multi-hour wind ramps give the system operator time to utilize **load response**, supplemental reserves, or non-spinning reserves.

12

Variability of PV



Renewable Energy Integration



- Quick Start Units
- Fast Ramping
- Wider Operating Range
- Regulation capability

- Shift Energy from off-peak to on-peak
- Mitigate Over Generation
- Voltage Support
- Regulation capability

- Price sensitive load
- Responsive to system dispatches
- Frequency Responsive
- Responsive to Wind Generation Production

Electrify transportation

- **EVs are key to reducing fossil fuel use**
- **Plug-in Electric Vehicles; more efficient, cleaner & less expensive than ICE vehicles using gasoline**

- **Ideal Demand Response candidate**

Demand Response
Key Link for Renewable Integration

- Capabilities of Demand Response to improve reliability well proven
- Should be considered as option for as available renewable integration
- Plug in hybrids and EV's
  - Off Peak Load for as available renewables
  - Demand Response well suited for EV

Hawaiian Electric Company, Inc.

Thank you!

Further questions:
dave.waller@heco.com

HEI

17

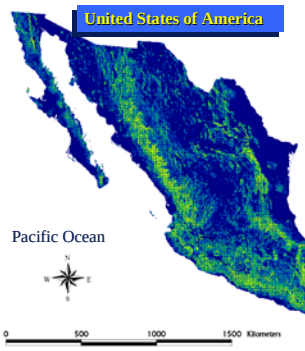
APEC Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency

Honolulu, Hawaii, March 30-April 1, 2009

Current Legal and Regulatory Framework for Renewable Energy in Mexico

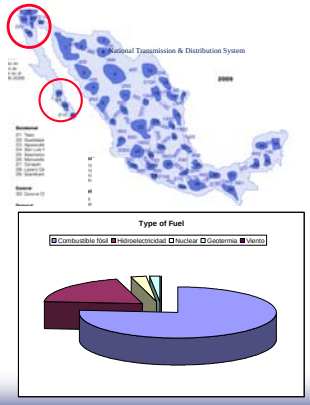
Jorge M Huacuz
Non-Conventional Energy Unit
Electrical Research Institute
Mexico

Mexico: General Information



- Total land area: 1,964,375 Km^2
- Population: 104 Million (2008)
- Arid Land: About 65%
- US-Mexico Border 3,152 Km
- Centralamerican Border: 1,149 Km
- Coast Line: 11,122 Km
- Official language: Spanish

The Mexican Electrical System



- Two State-owned utilities (CFE, LFC)
- Other main actors:
  - IPPs
  - Self-suppliers
  - Small generators (under 30 MW)
  - Co-generators (heat & electricity)
  - Electricity exporters
- Over 55 GW of capacity installed
- Demand growth rate at 5% per year
- Additional generating capacity soon to be required
- Fossil fuels supply 76.5% of primary energy for power generation
- Large hydro & geothermal in second place
- Very low contribution from wind, solar and other renewables

Legal Framework for the Electrical Sector

- **Self Supply**
  - ✓ Electricity for the generator's own usage
  - ✓ No sell to third party allowed
  - ✓ Self-supplier association with third parties allowed
  - ✓ Surplus electricity can be sold to the national utility (CFE)
  - ✓ Banking of electricity with CFE allowed
- **Co-generation**
  - ✓ Simultaneous production of heat and electricity
  - ✓ Production of electricity from waste heat included

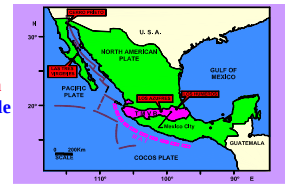
  } For self supply only
- **Independent Power Production**
  - ✓ No limitation in the amount of power produced
  - ✓ Electricity produced only for sale to CFE
  - ✓ Must fit capacity expansion plans of CFE
  - ✓ Long-term contracts by CFE awarded on levelized least costs basis (US$/kWh)
- **Small Generation**
  - ✓ Generating capacity under 30 MW
  - ✓ Electricity only for sale to CFE
  - ✓ Free choice on location, building schedule and type of technology
  - ✓ Purcchase price slightly under CFE´s short term marginal cost
- **Electricity for Export**
  - ✓ No main constraints

Bottom Line of Legal Framework

- No electricity sells to third parties allowed
- Electricity for sell to the national utility must compete with conventional alternatives on levelized per kWh cost over the plant useful life
- Economic competitiveness of electricity for self-generation depending on the tariff system
- No direct money incentives of premiums over and above short term avoided costs allowed

Mexico's RE Resource Potential

Average solar irradiance:
5 kWh/m2-día
Widely available



Wind: ~5,000 MW proven
15,000 MW estimated

Geothermal
- **High Temp. >250°C: >2,000 MWe**
- **Low Temp. <250°C: >40,000 MWt**
- **Waste heat from geothermal fields under exploitation: N/C**
- **Geopressurized: N/C**

N/C: Not quantified

Mexico's RE Resource Potential

Bioenergy (early estimates):
- **Total potential: (>3,000 MW)**
- **Forest residues and energy plantations: (>600 MW)**
- **Cattle manure and agriculture residues: (ca 1,330 MW)**
- **Solid urban waste: ca 1,000MW**
- **Sugarcane bagasse: ca 250 MW**

Small & mini hydro:
- **Total potential: N/C**

(At least 3,500 MW)

Ocean energy
Total potential: N/C
>11,000 km coastline

N/C: Not quantified

Current RE Installed Capacity

Wind:
185 MW installed
250 MW under construction
100 MW contract awarded
~2,000 MW in generating permits by CRE

Peak-shaving PV: ~500 kW
Projects underway for larger capacity

Small hydro: ~80 MW under development

210 MW
Cogeneration from sugarcane bagasse

7.4 MW with biogas from sanitary landfills
85 MW under development
Trash-to-electricity projects under development

Recently Approved Bills

Law for the Promotion and Development of Biofuels (early 2008)

- Aims at the production of biofuels as an element of energy diversification and sustainable development
- Seeks to open new business opportunities for farmers
- Emphasizes production of ethanol and biodiesel
- Creates the National Biofuels Commission
- Trust fund has been created to support building of support infrastructure, development of clean technology to increase productivity and to foster R&D

Recently Approved Bills

Law to Foster the Use of Renewable Energy (late 2008)

- Creates the Consulting Council for Renewable Energy
- Seeks to foster local development of efficient technology
- Seeks to foster commercial application of all renewables
- Defines renewable energy as a tool for mitigation of climate change
- Mandates the Energy Regulatory Commission to establish regulations for electricity production from RE
- Mandates the National Electricity Dispatch Center to develop rules for the dispatch of renewable energy
- Mandates the Secretariat of the Environment to set methodologies for environmental valuation of renewables
- A special renewable energy program must be established which will set the share of renwable energy in the production of electricity
- Creates facilities for R&D and technological innovation
- Mandates RE resource assessment and mapping at the national level
- Creates a Trust Fund to facilitate financing of renewables and efficient use of energy

Additional Existing Regulations

- ***Project of Ecological Norm for Wind Farms*** Will prevent and mitigate negative environmental impacts from wind farm projects in the national territory. In approval process.
- ***Net Metering for Commercial and Domestic Applications***

  Applies for grid-connected photovoltaic generators under 30 kW for commercial and 10 kW for domestic systems. CFE banks electricity for up to one year on a one-to-one kWh basis
- ***Green Mortgages***

  Financing from the National Institute for Housing available for new house buyers who want to install solar water heaters. Under negotiations for expansion to finance photovoltaic systems

Additional Existing Regulations

- ***Accelerated Depreciation for Environmental Investment***

  Investments in renewable energy technology can be depreciated 100% in one year.
- ***Zero Import Duty***

  Applies to environmentally friendly equipment purchased abroad
- ***New Law for Science and Technology***

  Assigns fiscal incentives to private companies who invest in renewables R&D

Additional Existing Regulations

- ***Grid interconnection contract for renewable energy***
  Self-suppliers can inject surplus electricity to the grid for use at a later time. The value of electricity in either direction is calculated by a set of formulas established in the contract terms.
- ***Wheeling Service Agreement for electricity from renewable energy sources***
  Establishes a fee for service according to the type of interconnection contract between the self-supplier and the utility.
- ***Methodology to determine service charges for transmission of renewable electricity***
  Establishes a predictable, transparent and flexible regime to avoid overcharges to the producer.

Programs in Place

Large Scale Renewable Energy

- Objective: to prime the market for renewable energy IPPs in Mexico
- Technology of choice: grid-connected wind farms
- Operational scheme: Complementary fund with seed money from the GEF to provide incentives on per kWh basis
- Status: Contract already awarded for the first wind farm (101 MW) under this modality

Programs in Place

Measures for the efficient use of electricity

- Buy-back old hardware mechanisms and soft financing to lower electricity consumption in the domestic sector
- Users payback loans through their electricity bills from their monthly savings in electricity
- Technologies of choice:
  - Thermal insulation of roofs in critical weather regions to lower air conditioning loads
  - Switching old domestic appliances for new modern and more efficient ones (including air conditioners)
  - Replacing incandescent light bulbs with high efficiency compact fluorescent ones

Concluding Remarks

- Mexico, an oil producing and exporting country, is (finally!) including renewable energy as important element of its energy policy
- Regulatory and institutional mechanisms are being put in place to facilitate mainstreaming of renewable energy, but it is only the beginning. A lot remains to be done in other areas, such as industrial infrastructure and human resource development, so that most of the value from renewables remains in the country
- Many such mechanisms are *ad hoc* instruments adapted to the national conditions, considering the limitations imposed by the supreme law regarding the types of incentives renewable energy producers can receive


Electrical Research Institute
(IIE)
Thank you for your attention.....

Pusat Tenaga Malaysia

Sustainable Energy Development

Malaysian Financial Mechanisms for Renewable Energy (RE) & Future Direction

Ir. Ahmad Hadri Haris
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Malaysia Energy Centre (PTM)

APEC Workshop
30th March – 1st April 2009, Honolulu Hawaii

Malaysia

- Population: 27.7 million (2008) (Malay, Chinese, Indian, others)
- Land size: 330,000 km2
- GNI per capita: US$7,479 (GDP: 6% - 0.1%)
- Maximum electricity demand:
  - 13.8 GW (2005)
  - 20 GW (2010)
- Installed electricity capacity:
  - 19.2 GW (2005)
  - 25.3 GW (2010)
- Electricity generation mix:
  - 2005: 70% NG; 22% coal; 6% hydro; 2% oil
  - 2010: 56% NG; 36% coal; 6% hydro; 0.2% oil; **1.8% RE**

Malaysian Electricity Supply Industry

Cabinet

Ministry of Energy, Water & Communications (MEWC)

Economic Planning Unit (EPU)
Prime Minister's Department

Ministry of Finance

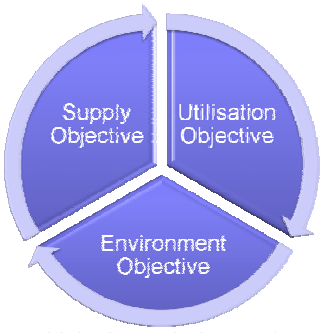
Malaysia Energy Centre (PTM)

Energy Commission (ST)

Tenaga Nasional Berhad (TNB)
Sabah Electricity Sdn Bhd (SESB)
Sarawak Energy Berhad (SEB)
Independent Power Producers (IPPs)
Co-generators

Malaysia Energy Policy

To ensure provision of adequate, secure and cost-effective energy supplies by developing indigenous energy resources , both non-renewable and renewable, using the least-cost options and diversifying supply resources within and outside the economy



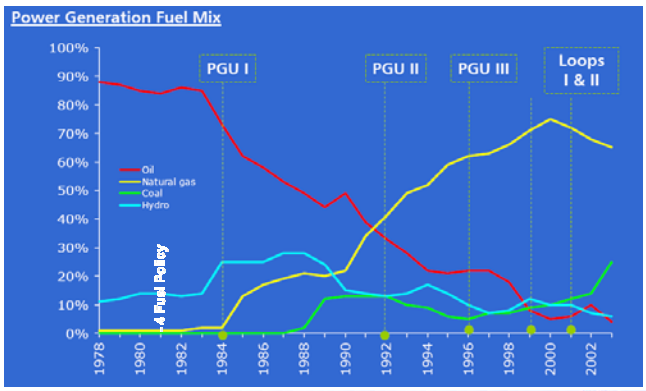
To promote the efficient utilisation of energy and the elimination of wasteful non-productive patterns of energy consumption

To minimise the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment

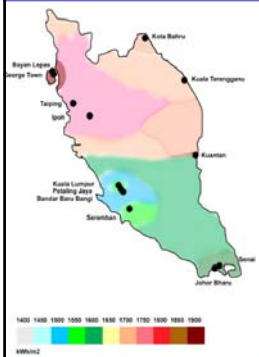
Malaysia Energy Policy

- National Petroleum Policy (1975)
- National Energy Policy (1979)
- National Depletion Policy (1980)
- 4th Fuel Diversification Policy (1981) => Natural Gas, Hydro, Coal, Oil
- 5th Fuel Policy (2001) => Natural Gas, Hydro, Coal, Oil, **RE**

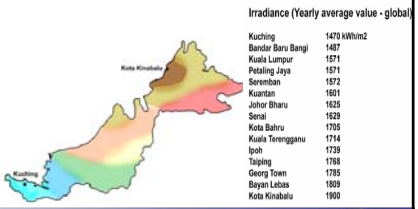
Trends of Fuel Sources for Power Generation



Untapped Potential: Solar Power



- Suitable building roof surfaces*
  >65 million m² x 100 Wp/m² = **>6,500 MWp**
  * 2.5 million houses (40%) + 40,000 commercial buildings (5%)
- PV covering 0.6% (786 km2) land of Peninsular Malaysia can provide enough electricity supplied by TNB in 2007 (86.5 TWh)



Irradiance (Yearly average value - global)

Kuching	1470 kWh/m2
Bandar Baru Bangi	1487
Kuala Lumpur	1571
Petaling Jaya	1571
Seremban	1572
Kuantan	1601
Johor Bharu	1626
Senai	1629
Kota Bahru	1705
Kuala Terengganu	1714
Ipoh	1739
Taiping	1768
Georg Town	1785
Bayan Lebas	1809
Kota Kinabalu	1900

5th Fuel Policy: RE Potential & Status Quo





Solar PV	Biomass	Biogas	Small Hydro	MSW
Potential: > 6,500 MW Status: 1 MW -MBIPV Project (SURIA 1000, Demo, Showcase Incentives & SURIA for Developers) -yearly average irradiance 1,400-1,900 kWh/m²	**Potential:** 1,340 MW by 2030 Status: Total 53 MW under construction as of end Dec'08 -13 MW to be commissioned by end March -BioGen Project -Palm oil waste (EFB), other agricultural waste (woodchips, paddy husks, etc)	**Potential:** 410 MW by 2028 Status: Total 3.75 MW under construction as of end Dec'08 -500 kW to be commissioned by end March -Palm oil mill effluents (POME), cassava waste, livestock, agro, industrial waste water	**Potential:** 490 MW by 2020 Status: Total 17.8 MW under construction as of end Dec'08 -Run of the river with minimum impounding -Capacity < 30 MW	**Potential:** 360 MW by 2022 Status: 8 MW (5 MW to be exported to grid) to be commissioned end Mar'09 -waste collected in Malaysia approximately 21,000 tonnes/day

RE Support & Promotion Mechanisms

Support Mechanism
- Approvals & licenses
- REPPA: RM/kWh 0.21 (biomass, biogas); 0.17 (hydro), net-meter (PV)

Promotion Mechanisms
- Pilot projects & case studies
- Capacity building & lessons
- Financing & policy developments

SREP (Small Renewable Energy Power) Programme
- Launched in 2001
- Objectives: To encourage production of RE by small power generators (10MW) and allow the sale of generated electricity to utilities
- Status: 10 MW grid-connected power from Biomass; 2 MW grid-connected power from Biogas

UNDP-GEF Biomass Power Generation & Demonstration (Biogen) Project
- Launched in 2002
- Objectives: To demonstrate biomass and biogas grid-connected power generation projects
- Status: 13 MW (export 10 MW) and 500 kW (FELDA Sorting) power plants will be grid connected and commissioned in April 2009. ~700 MW off-grid electricity produced by private palm oil millers.

UNDP-GEF Malaysia Building Integrated Photovoltaic (MBIPV) Project
- Launched in 2005
- Objectives: To reduce unit cost of solar PV technology by 20% and increase capacity by 350% via PV applications in buildings
- Status: ~ 1MW of cumulative grid-connected PV installations; PV system unit cost has dropped by 16% average.

Fiscal incentives (<2011): Pioneer Status or Investment Tax Allowance; import duties and sales taxes exemption

Key Issues Affecting RE

Needs for a New RE Policy & Action Plan

Reason 1	To address current market failure
Reason 2	To provide long term sustainability (avoid start and stop policy)
Reason 3	To stimulate a new growth industry
Reason 4	To recognise the importance of the environment as an economic growth contributor
Reason 5	To develop human capital resources particularly in the field of R&D in RE technologies
Reason 6	To improve the coherence of current policy

New RE Policy & Action Plan

Vision

Enhancing the utilisation of indigenous renewable energy resources to contribute towards national electricity supply security and sustainable socio-economic development

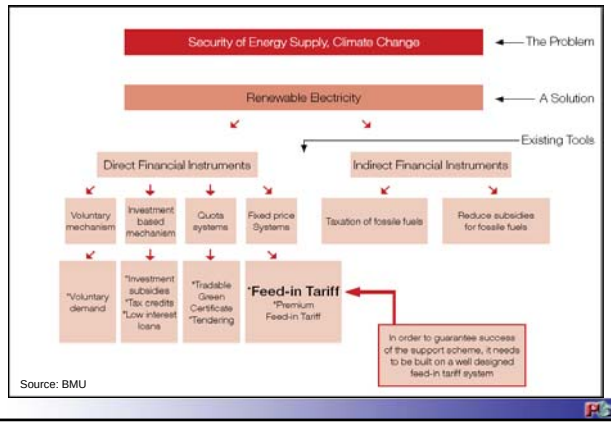
Objectives

1. To increase RE contribution in the national power generation mix;
2. To facilitate the growth of the RE industry;
3. To ensure reasonable RE generation costs;
4. To conserve the environment for future generation; and
5. To enhance awareness on the role and importance of RE.

Strategic Thrusts

Thrust 1: Introduce and Implement Appropriate Regulatory Framework
Thrust 2: Introduce Conducive Stimulus Package for RE Businesses
Thrust 3: Intensify Human Capital Development
Thrust 4: Enhance RE Research and Development
Thrust 5: Design and Implement an RE Advocacy Programme

Choices: RE Support Mechanism



Source: BMU

Feed-in Tariff (FiT): The Choice for RE Regulatory Framework

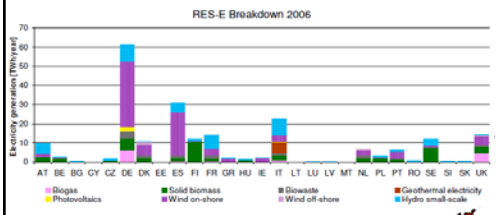
- A mechanism that allows electricity that is produced from RE resources to be sold to power utilities at a fixed premium price and for specific duration.
- Provides a conducive and secured investment environment which will make financial institutions to be comfortable in providing loan with longer period (> 10 years).
  - Provides fixed revenue stream for installed system
  - Only pays for electricity produced – promotes system owner to install good quality and maintain the system
  - With suitable degression rate, manufacturers and installers are promoted to reduce costs while maintaining quality
  - Disadvantage: does not address first cost barrier

Verifications of FiT Effectiveness (selected)

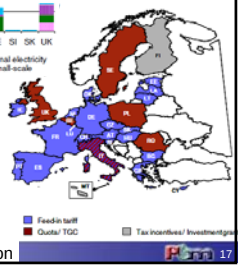
- Stern Review Report:
  - Sir Nicholas Stern stated that "Comparisons between deployment support through tradable quotas and feed-in tariff price support suggest that feed-in mechanisms achieve larger deployment at lower costs."
- UNDP-GEF Report: Promotion of Wind Energy - Lessons Learned From International Experience and UNDP-GEF Projects
  - "Feed-In tariff policies have been very effective in Germany, Spain and Denmark, leading to the world's first, second and fifth installed wind energy capacities."
- International Energy Agency: Deploying Renewables - Principles for Effective Policies
  - "Feed-in Tariffs are more effective and cheaper than quotas for Renewable Energy"
- Ernst & Young Report: Renewable Energy Country Attractiveness Indices:
  - "Feed-in Tariffs are cheaper than Trading System"

Evidences of FiT Effectiveness

Breakdown of RES-E generation in the EU-27 Member States in 2006



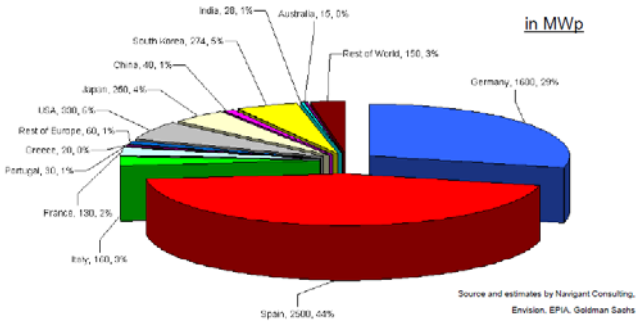
Source: Fraunhofer



- Germany revolutionised RE deployment with the implementation of EEG (RESA) in 2000
- Germany records exponential RE growth since 2000 (due to no limit of annual capacity)
- By 2007, Germany's FiT model replicated by 20 EU Member States
- By 2007, EEG generates national economic benefits equivalent to Euro 9.4 billion VS cost of Euro 3.3 billion

FiT Effectiveness: Example of Solar PV

Total installed PV capacity in 2008: ~5.6 GWp > 80% in Feed-in Tariff markets



Critical Factors for an Effective FiT Mechanism

- Access to the grid must be guaranteed. Utilities must be legally obliged to accept all electricity generated by RE private producers.
- FiT rates must be high enough to produce a return on investment plus a profit (not excessively) to act as an incentive.
- FiT rates must be fixed for a long enough period (typically 20 years) to give certainty and provide businesses with clear investment environment.
- There must be adequate "degression" for the FiT rates to promote cost reduction to achieve "grid parity", where an annual stepwise reduction in tariffs by a certain percentage is mandated.
- Adequate fund is created to pay for the FiT rates (or the incremental cost) and guarantee the payment for the whole FiT contract period.
- There must be constant monitoring and progress reporting.

Please refer to **www.onlinepact.org** (World Future Council)

Determining FiT Rates (Malaysia)

Biomass	▪ Capex (investment cost) ▪ Loan: rates (8.8%), period (15 years) ▪ Fuel: requirement (250,000 t/yr), prices, transport charges ▪ Costs: O&M, depreciation, insurance ▪ Revenue: FiT rates, duration (16 yrs), capacity factor (70%), other revenue ▪ Annual cost increment (3%): fuel, transport, O&M, insurance ▪ IRR, SPB, cash-flow
Solid waste	▪ Capex (investment cost) ▪ Loan: rates (8.8%), period (15 years) ▪ Fuel: requirement (1,000 t/day), prices, transport charges ▪ Costs: O&M, depreciation, insurance ▪ Revenue: FiT rates, duration (21yrs), capacity factor (70%), other revenue (tipping fee, recycling) ▪ Annual cost increment (4%): fuel, transport, O&M, insurance ▪ IRR, SPB, cash-flow
Solar PV	▪ Capex (investment cost – RM22/Wp avg) ▪ Loan (80%): rates (6%), period (15 years) ▪ Costs: O&M, depreciation, insurance ▪ Revenue: FiT rates, duration (21yrs), capacity factor (13%) ▪ Annual cost increment (3%): O&M, insurance ▪ SPB, (IRR), cash-flow

FiT Rates = Empirical Values

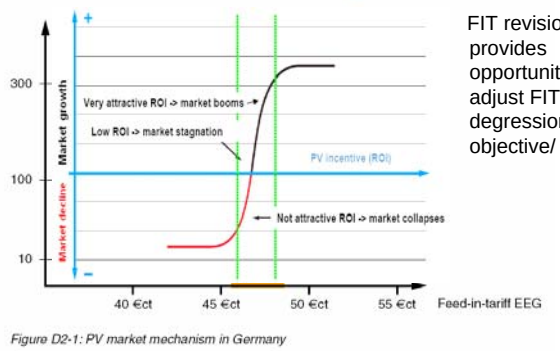


Figure D2-1: PV market mechanism in Germany

FIT revision: provides opportunity to adjust FIT prices & degression towards objective/ target

Source: BMU

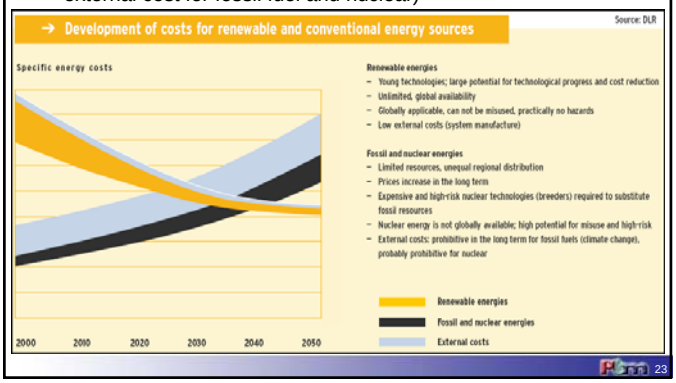
FiT Rates: Comparison

RE Technologies	FiT Rates		
	Germany 2007	Italy 2009	Malaysia 2009/2010
Retail Electricity Tariff (average)	0.28 US$/kWh	0.24 US$/kWh	0.08 US$/kWh **(Subsidised)**
Solar PV	2.4 x retail	2.7 x retail	5.5 x retail
Wind	0.4 x retail	1.7 x retail	1.1 x retail
Biomas	0.5 x retail	1.2 x retail	1.1 x retail
Biogas	0.4 x retail	1.0 x retail	1.1 x retail
Mini-hydro	0.5 x retail	1.2 x retail	0.8 x retail
Cost to consumers (% of retail tariff)	4.8%	7.8%	2% (proposed)

Source: BMU, GSE

Grid Parity

- FiT changes to net-metering when grid-parity is achieved (real cost + external cost for fossil fuel and nuclear)



Important to prepare local RE industry prior to start of FiT regulatory framework

Towards benefiting local industry
Promotes quality & cost reduction
Meeting expectation
Healthy growth

MBIPV Project (2005 - 2010)
Objective: To reduce GHG emission by reducing long-term cost of BIPV technology via development of a sustainable BIPV market

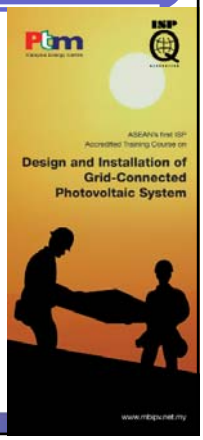
- Component 1: BIPV information services, awareness and capacity building programme
- Component 2: BIPV market enhancement & infrastructure development programme
- Component 3: BIPV policies and financing mechanisms programme
- Component 4: BIPV industry development and technology localisation programme

Competency Training

- ISP accredited training
- 10 days: theory, practical, exam







Approved Service Provider Scheme

- License valid for 1 year with annual review.
- Only for companies.
- Staff passed ISP training.
- Use certified electrician.
- Company shall be financially sound.
- Company shall have workers insurance and public liability insurance.
- Company shall follow APVSP Industry Best Practice Guidelines.
- Company shall abide by the APVSP Code of Conduct.

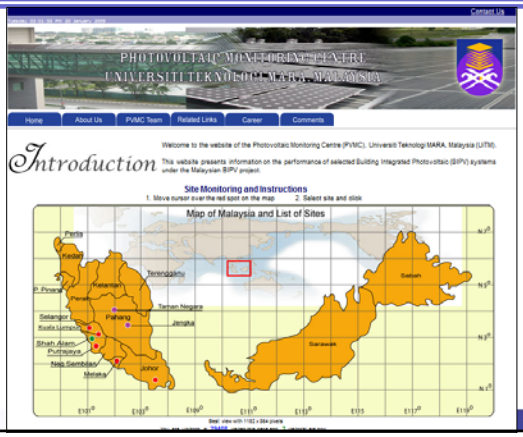
Complemented by Quality Assurance Scheme

Quality Control Centres

Inverter Quality Control Centre

Mounting Structure Quality Control Centre

Performance Monitoring

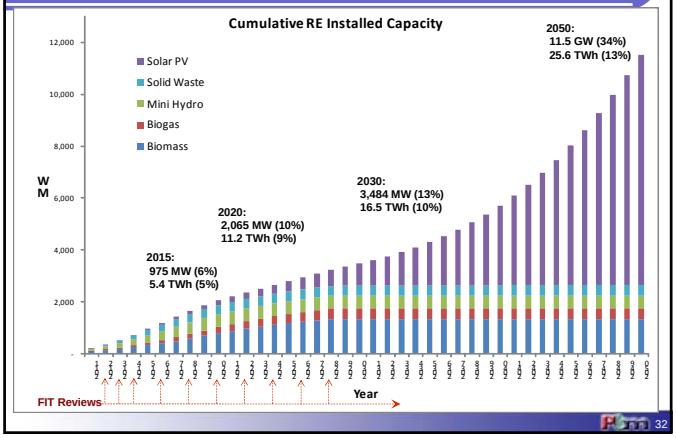


Communicate Internationally

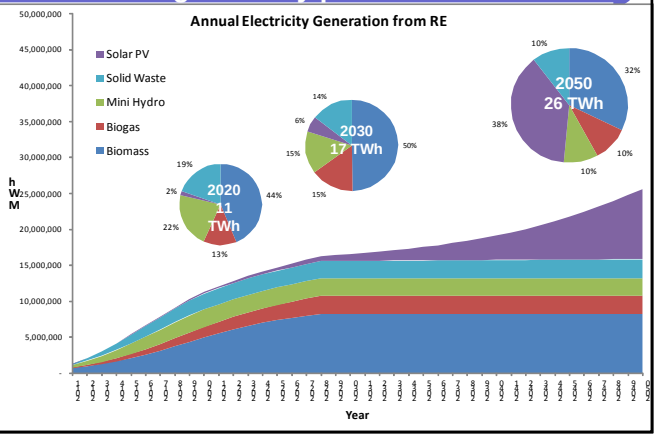
- Exchange of knowledge & lessons learned
- Accelerate learning process & minimise mistake
- Friendship

Awareness & Understanding – Most Critical

Towards achieving RE Targets



RE Generation Mix: PV expected to contribute significantly post 2030



Thank you

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43650 Bandar Baru Bangi, Malaysia

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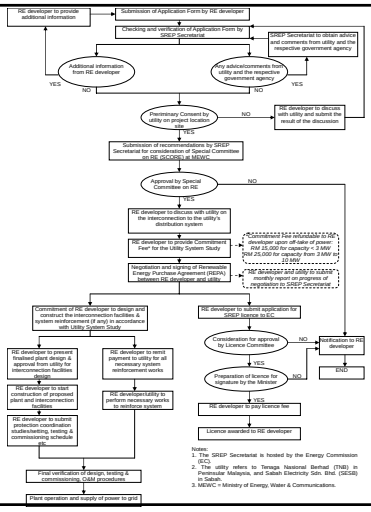
Comparison between FiT and Quota System

Feed-in Tariff (FIT)	Renewable Portfolio Standards (RPS)
▪ Proven to be the cheaper option ▪ Performance based incentive - encourages reliable operation ▪ Provides long-term investment security and returns ▪ Creates stable and predictable revenue to pay for cost of investment ▪ Degression and periodic reviews allow and stimulate price reductions due to technological advances (e.g. solar PV) ▪ Simple to implement – specific RE developments and FiT costs can be pre-determined and planned in advance ▪ Encourage smaller and distributed power producers and new industries – greater number of jobs	▪ Less successful in achieving targets (e.g. UK, Sweden) ▪ Involves tradable green certificates which are unpredictable in prices ▪ Must have a penalty system ▪ Requires strong enforcement mechanisms ▪ No clear identification of source of funds to meet additional costs ▪ Unpredictable RE prices and costs because of bidding and trade ▪ Usually only one RE technology would be promoted ▪ Usually only bigger company (with resources) would be interested to become developers



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Renewable Energy & Energy Efficiency Certificate Trading: the Australian Experience

Hugh Outhred, Former Presiding Director, CEEM, UNSW

APEC Workshop on Recent Advances in Utility-Based Financial Mechanisms that Support Renewable Energy & Energy Efficiency
Honolulu, Hawaii, 30 March – 1 April 2009

What is technology?
(www.iiasa.ac.at)

Software & orgware are critical in complex technological systems such as electricity industries

The Art of Knowing and Doing

The study of **technology** concerns *what* things are made and *how* things are made. Technology, from the Greek *science of* (practical) *arts,* has both a *material* and an *immaterial* aspect.

Technology = Hardware + Software + "Orgware"




Hardware:	Manufactured objects (artifacts)
Software:	Knowledge required to design, manufacture, and use technology hardware
"Orgware":	Institutional settings and rules for the generation of technological knowledge and for the use of technologies

Technology's most important characteristic: ***Continuous change >>***

Making decisions about technology

- Decision-making (DM) is a characteristic behaviour of all animals and of humans in particular
- Technology is a specific result of human DM:
  - A result of accumulated, path-dependent decision-making
- A technological system is a complex collection of technological components
  - An electricity industry is a technological system
- A Decision-making framework for an electricity industry is a tool for analysis or design:
  - For example, the issues involved in integrating renewable energy or improving end-use efficiency

Decision-making framework for an electricity industry

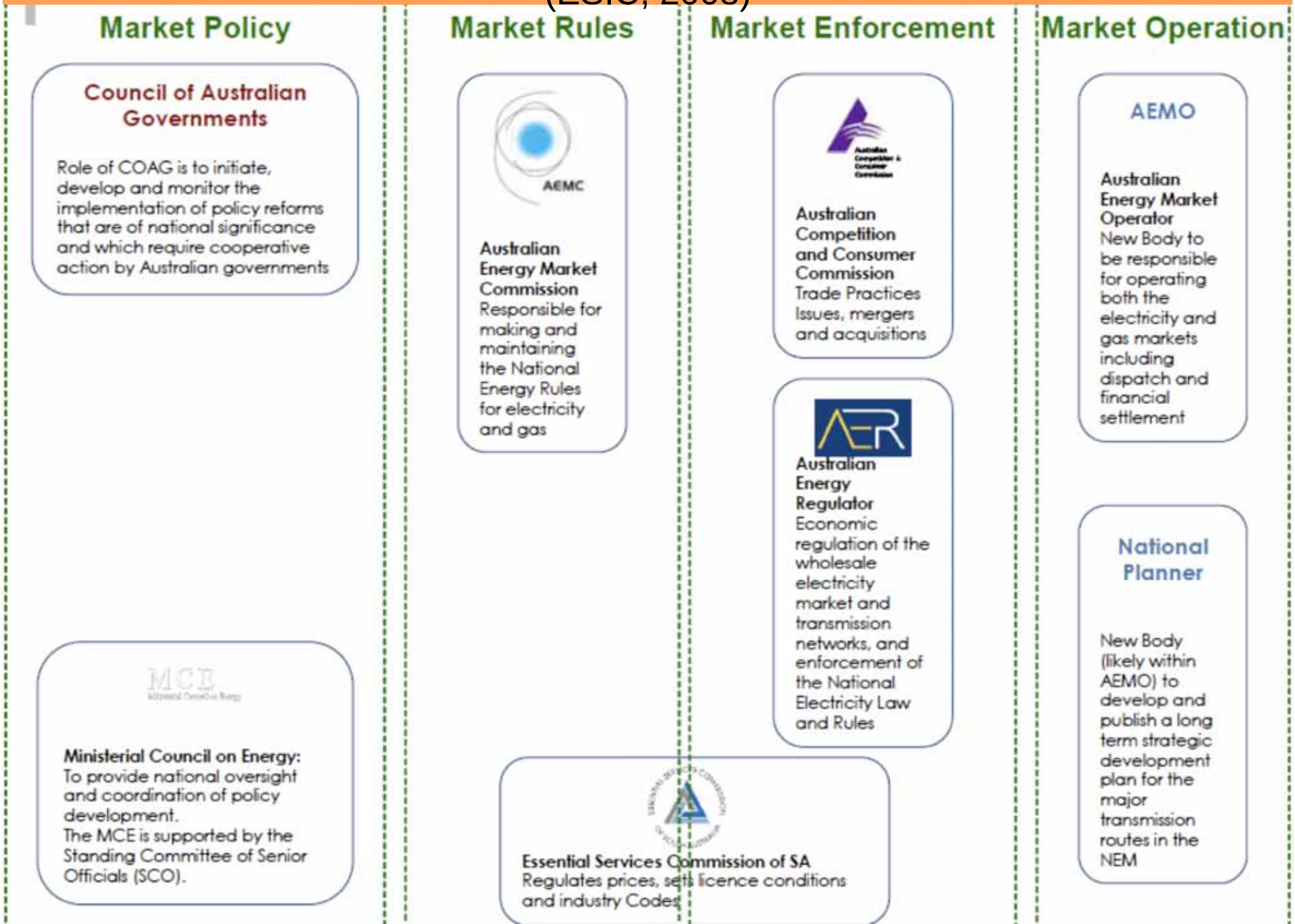
Governance regime	▪ Formal institutions, legislation & policies ▪ *Informal social context including politics*
Security regime	▪ Responsible for core integrity on local or industry-wide basis, with power to override
Technical regime	▪ To allow connected industry components to function as industry-wide machine
Commercial regime	▪ To coordinate decentralised decision-making according to commercial criteria ▪ Includes formally designed markets

Broad governance issues for an electricity industry

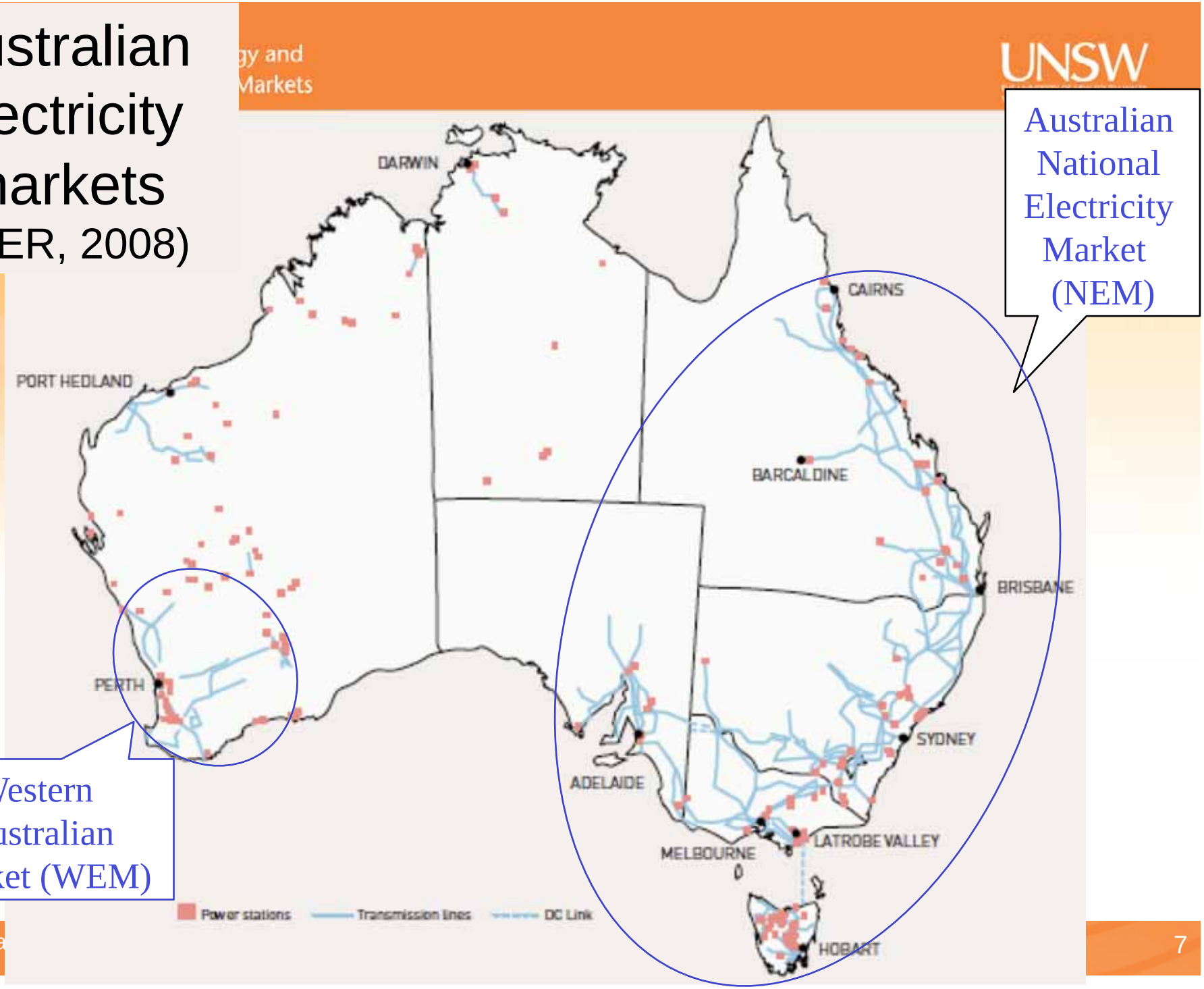
- Social issues - electricity as an *essential good:*
  - How can we secure access to primary energy resources?
  - How can we make essential residential energy services affordable?
  - Commercial & industrial energy services:
    - What is the appropriate role of subsidised electrical energy in regional, industry and corporate development?
- Environmental issues - local, regional & global:
  - What level of environmental impacts are acceptable?
  - How can adverse impacts be minimised?
  - Should we be more frugal in energy use?

Stationary energy sector governance in Australia

(ESIC, 2008)



Australian electricity markets (AER, 2008)



Australian National Electricity Market (NEM)

Western Australian Market (WEM)

Centre for Energy and Environmental Markets

Scope of the National Electricity Market

Participating jurisdictions:

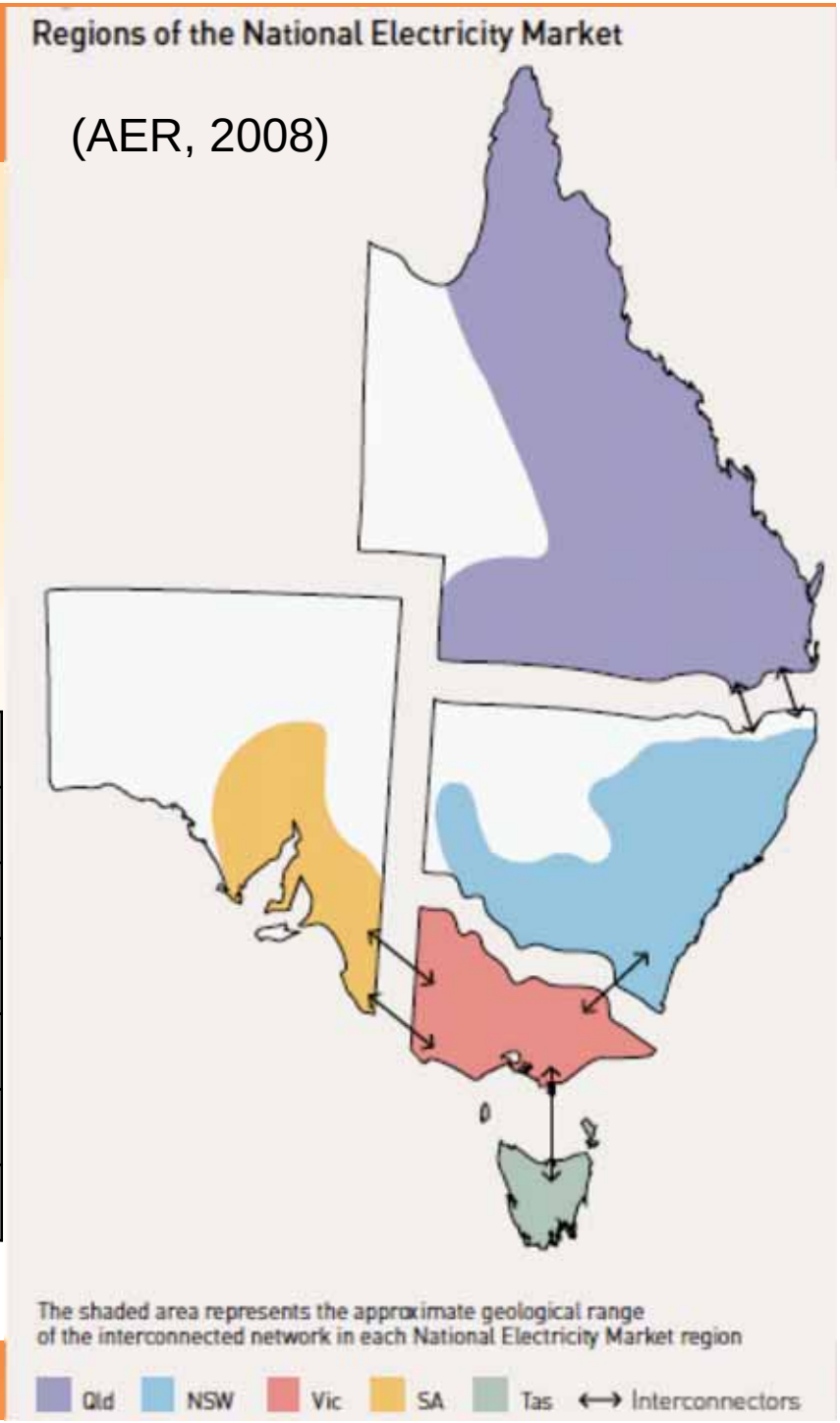
- Qld, NSW, ACT, Vic, SA, Tas

NEM market regions:

- Qld, NSW, Vic, SA, Tas

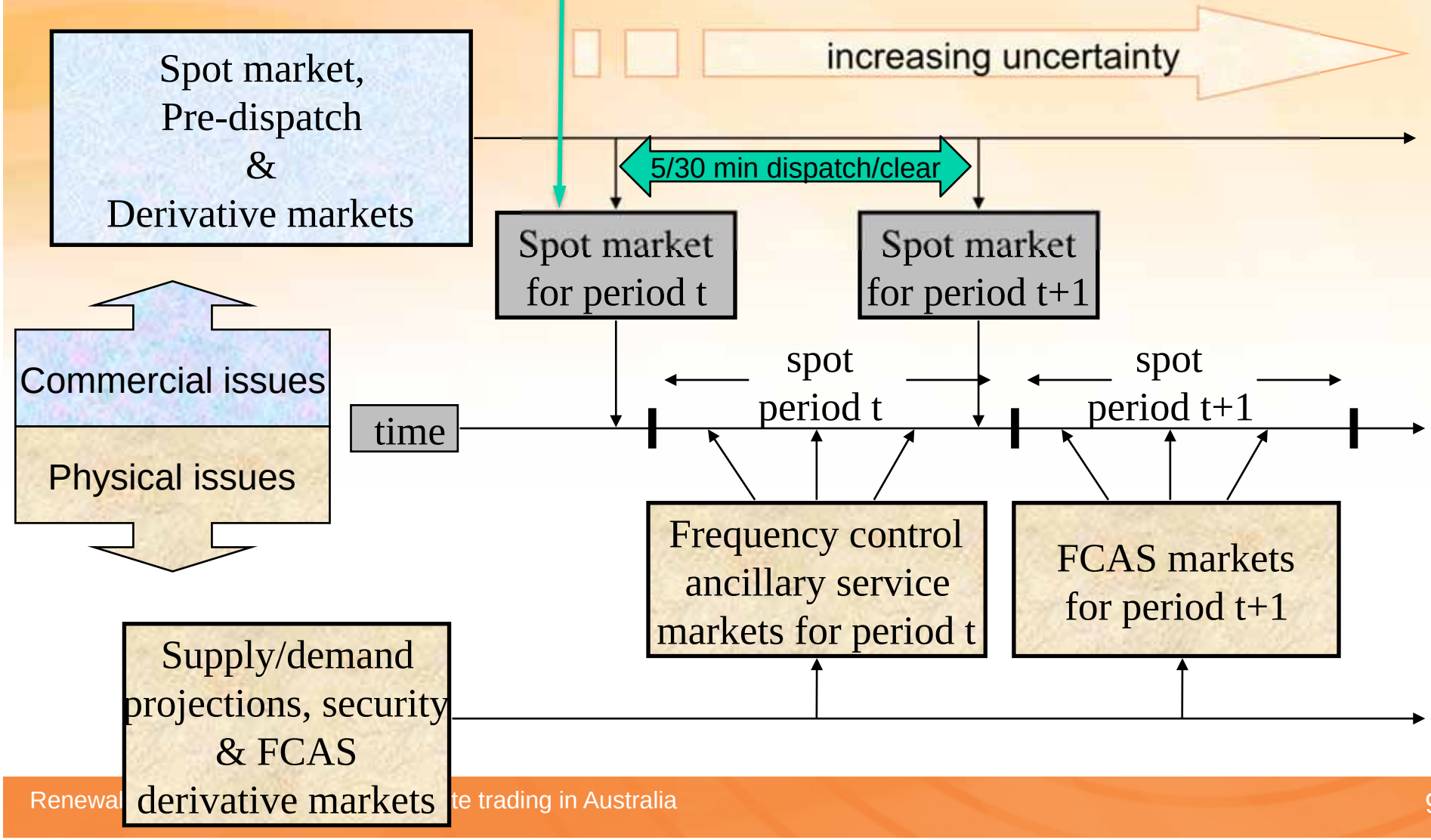
Registered gen capacity (2008)	44390 MW
No. of registered generators	275
No. of end-users	8.7 million
NEM turnover 2007-08	$11.1 billion
Energy generated 2007-08	208 TWh
Max winter demand (18/7/08)	34 GW
Max summer demand (14/1/08)	32 GW

(based on AER, 2008)

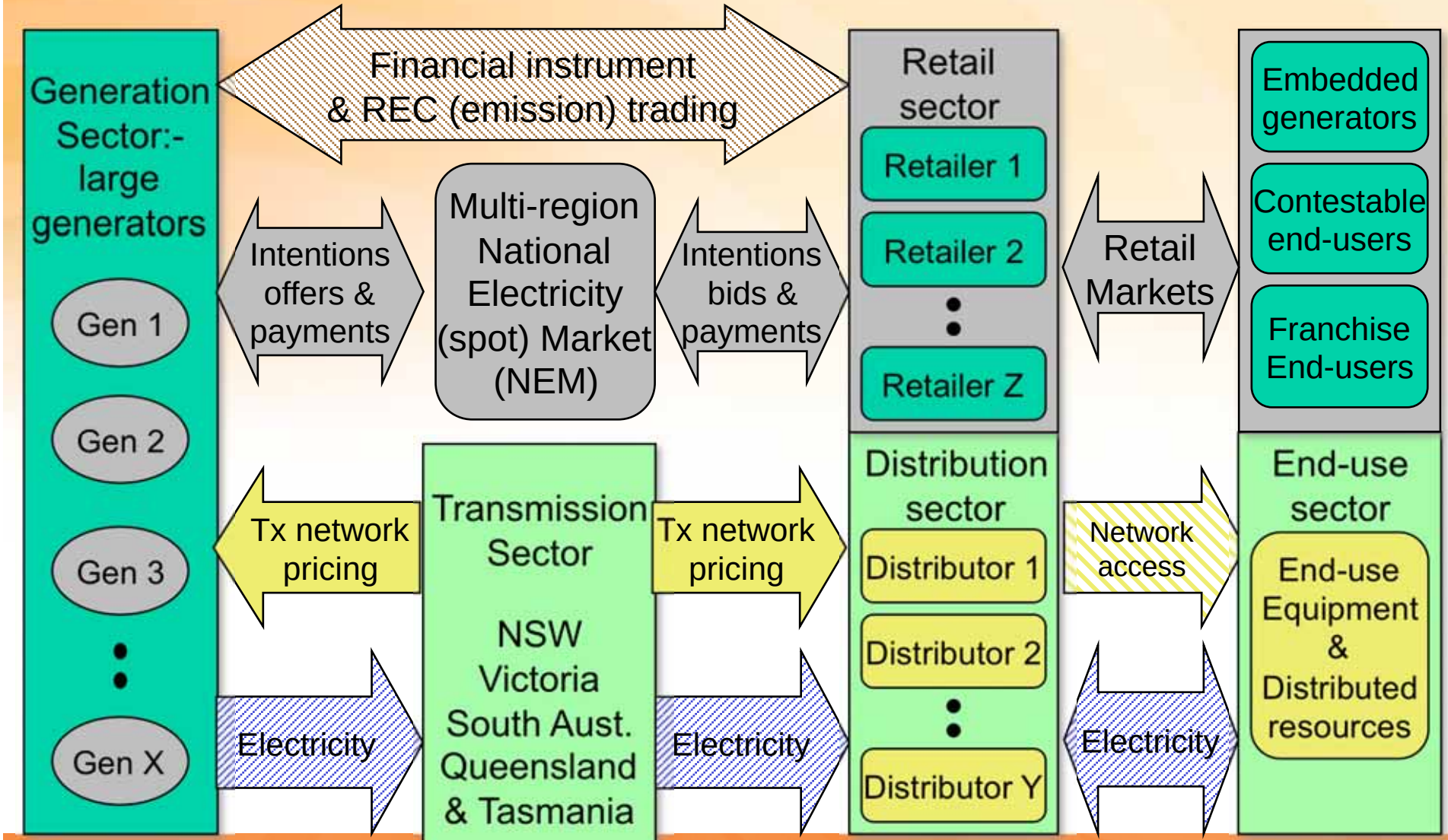


Spot market implements security-constrained dispatch

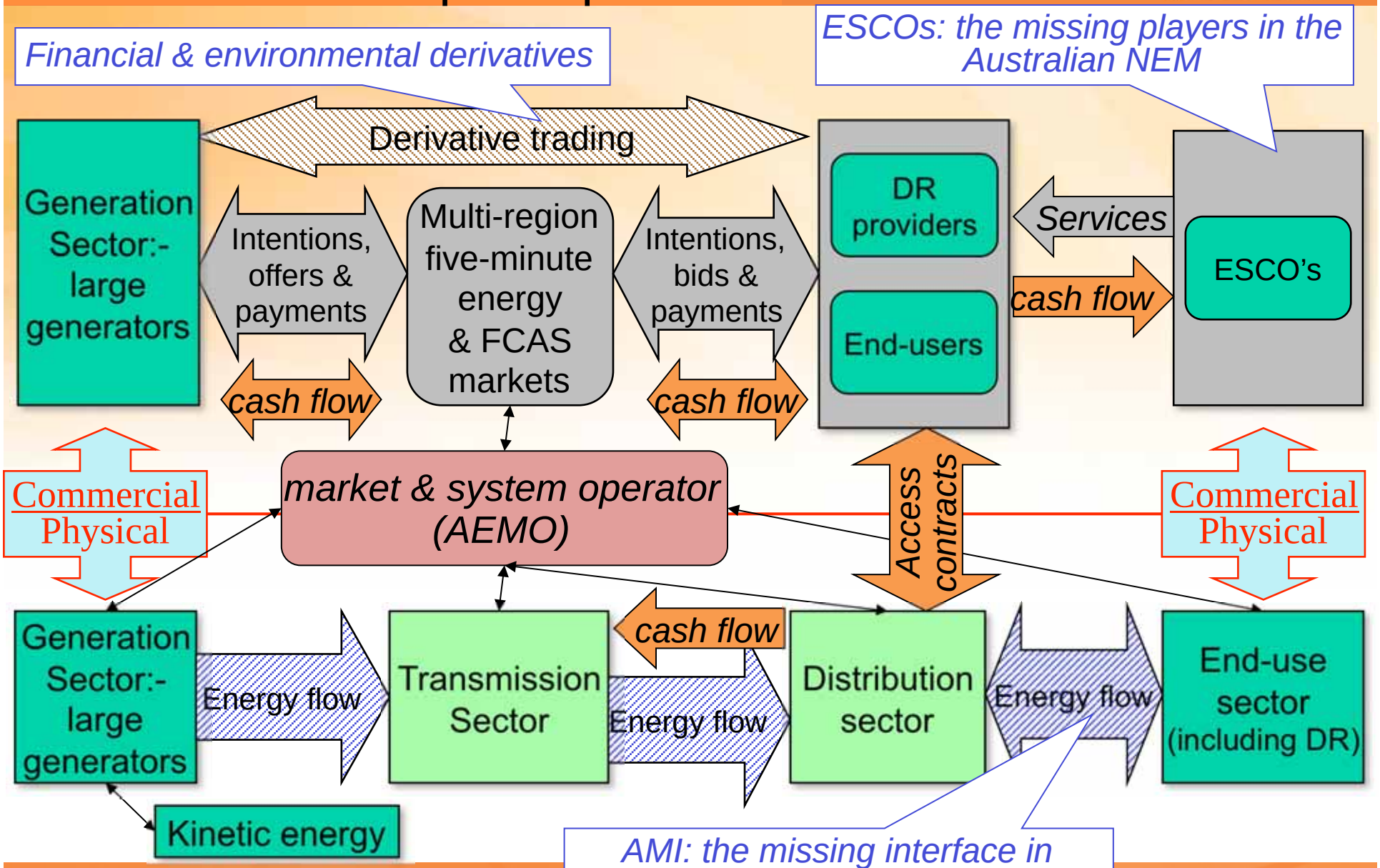
Managing supply-demand balance in NEM



Structure of the Australian National Electricity Market

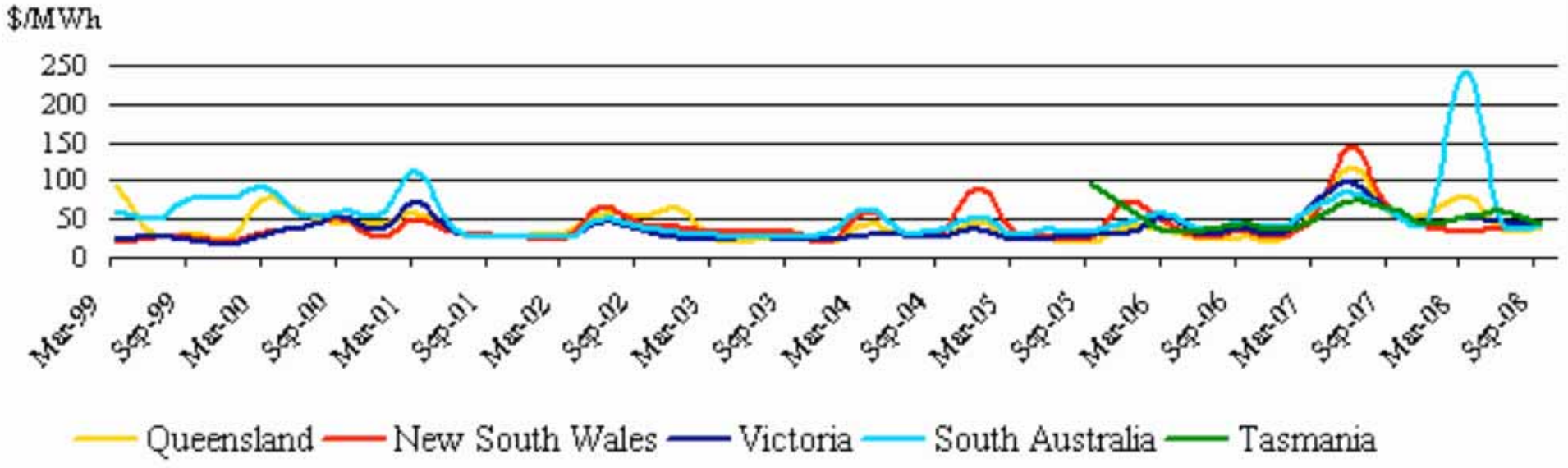


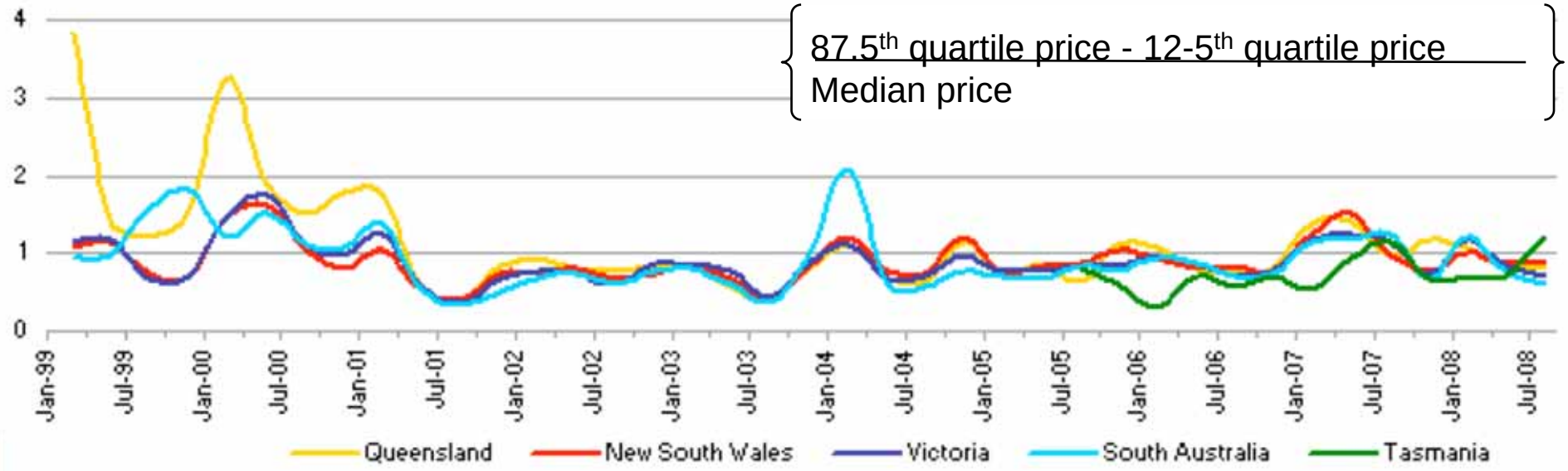
Enhanced NEM structure with active end-user participation



NEM quarterly spot energy price & peak-period price volatility index since market start

(AER long term analysis)





$$\frac{87.5^{th}\text{ quartile price} - 12\text{-}5^{th}\text{ quartile price}}{\text{Median price}}$$

AEMC Review of energy market frameworks in light of climate change policies (2008-2009) #1

The Review is to:

- examine the potential impacts of the CPRS and expanded RET on both the electricity and gas markets across all jurisdictions;
- determine what adjustments may be necessary within the existing energy market frameworks, having regard to the National Electricity and Gas Law objectives – to deliver efficient, safe, secure and reliable energy supplies in the long term interests of consumers; and
- provide detailed advice to the MCE on implementation of any amendments required.

The AEMC is to have regard to:

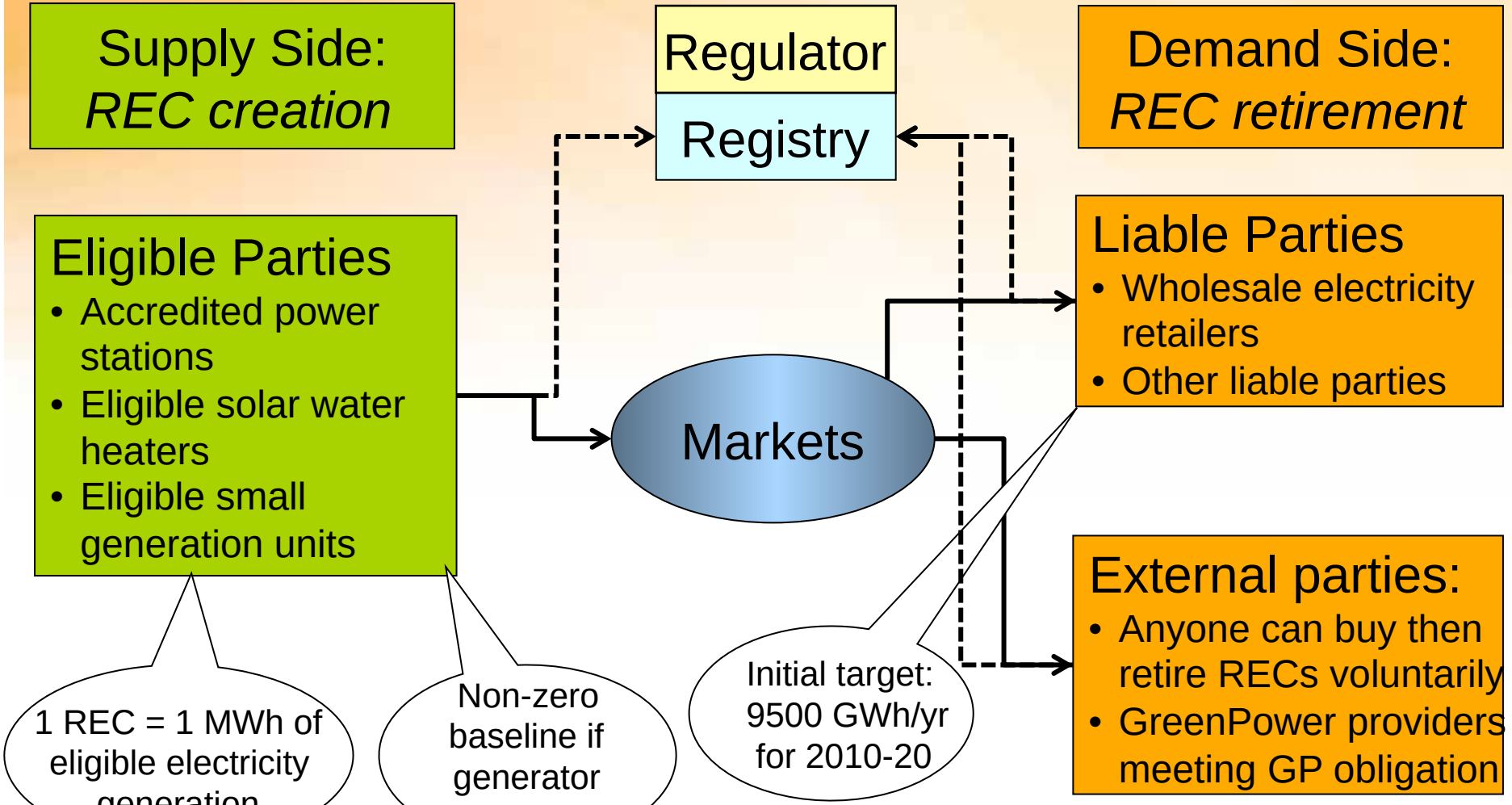
- the MCE's requirement that amendments will only be supported if they contribute to the energy market objectives;
- the need for amendments to be proportionate;
- the value of stability and predictability in the energy markets regulatory regime; and
- any other AEMC Reviews, Rule changes or MCE reforms that may relate to this Review.

AEMC Review of energy market frameworks in light of climate change policies (2008-2009) #2: *The energy market decision-making context*

Renewable energy, efficiency & emission trading in Australia

- Australia-wide (tradable instruments):
  - Mandatory renewable energy target - MRET (since 2001)
  - Carbon pollution reduction scheme (proposed for 2010)
- New South Wales (tradable instruments):
  - Greenhouse gas reduction scheme – GGAS (since 2003)
  - NSW energy savings scheme - NEET (from 2009)
- Victoria (tradable instruments):
  - Victorian energy efficiency target – VEET (from 2009)
- South Australia (NOT tradable instruments):
  - Residential energy efficiency scheme – REES (from 2009)

MRET Scheme – Renewable Energy Certificate (REC) Market (ORER, 2008)

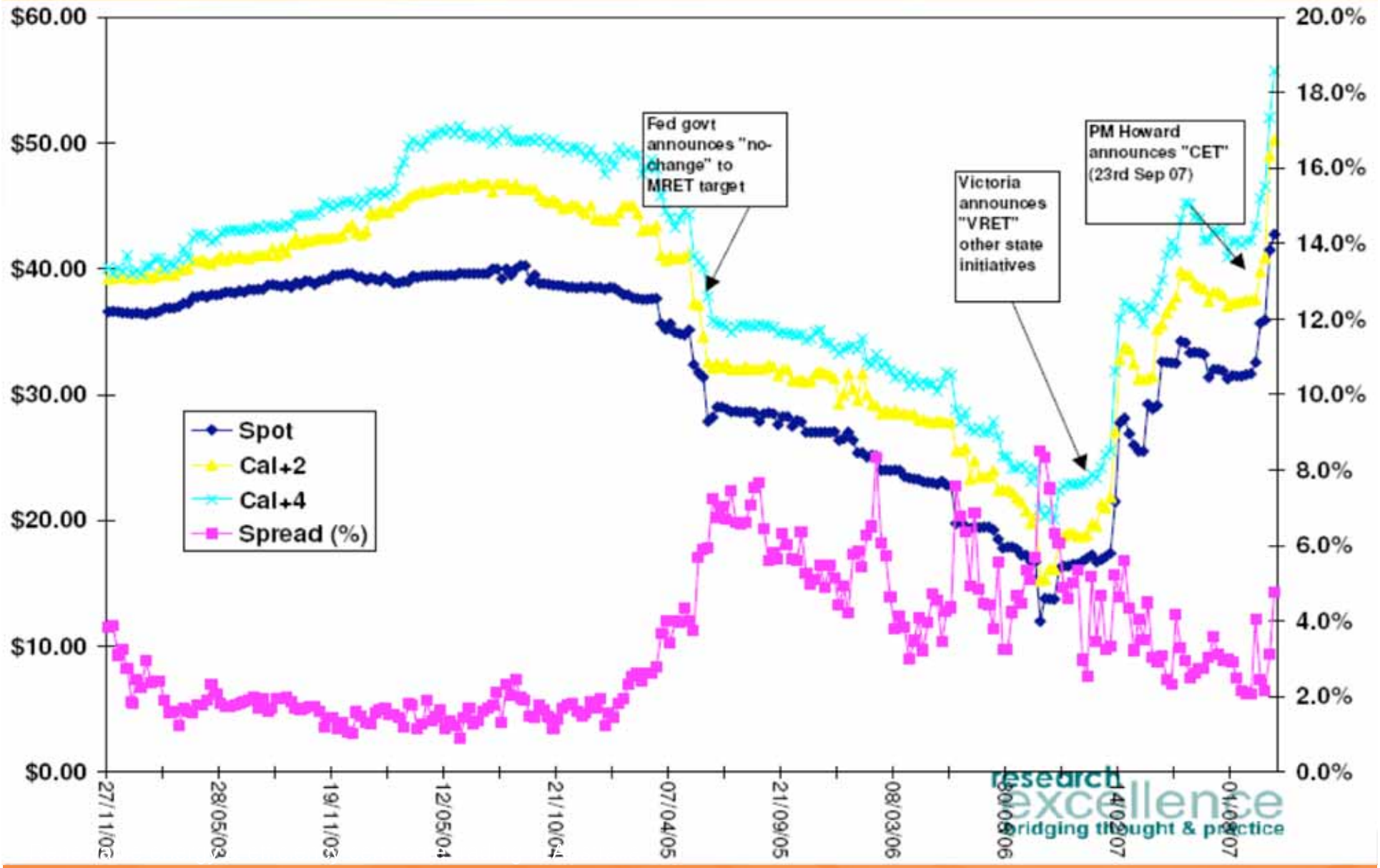


MRET performance to date

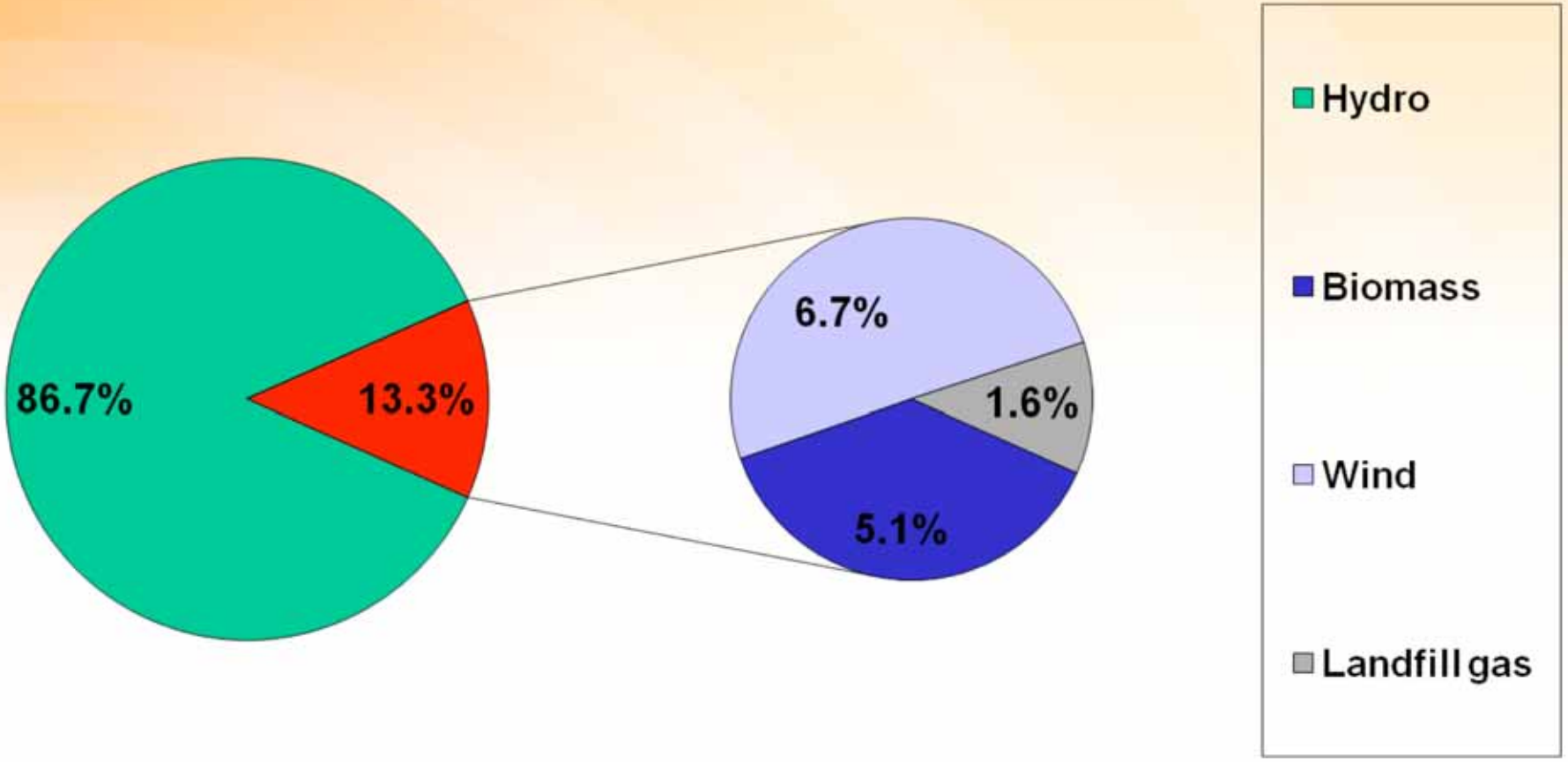
- Strengths:
  - Investment in new renewable energy generation:
    - About half income from energy and half from RECs
    - REC target easily met
  - Reasonable efficiency – low cost by international standards
  - Technology flexibility valuable:
    - Biomass less than expected but wind + others more
- Weaknesses:
  - Windfall gains for ‘old hydro’
  - Boom-bust cycle due to policy uncertainty & early scheme end-date (2020)

REC spot & derivative market prices

(Nolles, Garnaut Review Presentation, 2007)



Renewable energy generation in Australia, 2004-05 (18.7 TWh or ~ 9%) (NGF, 2007)

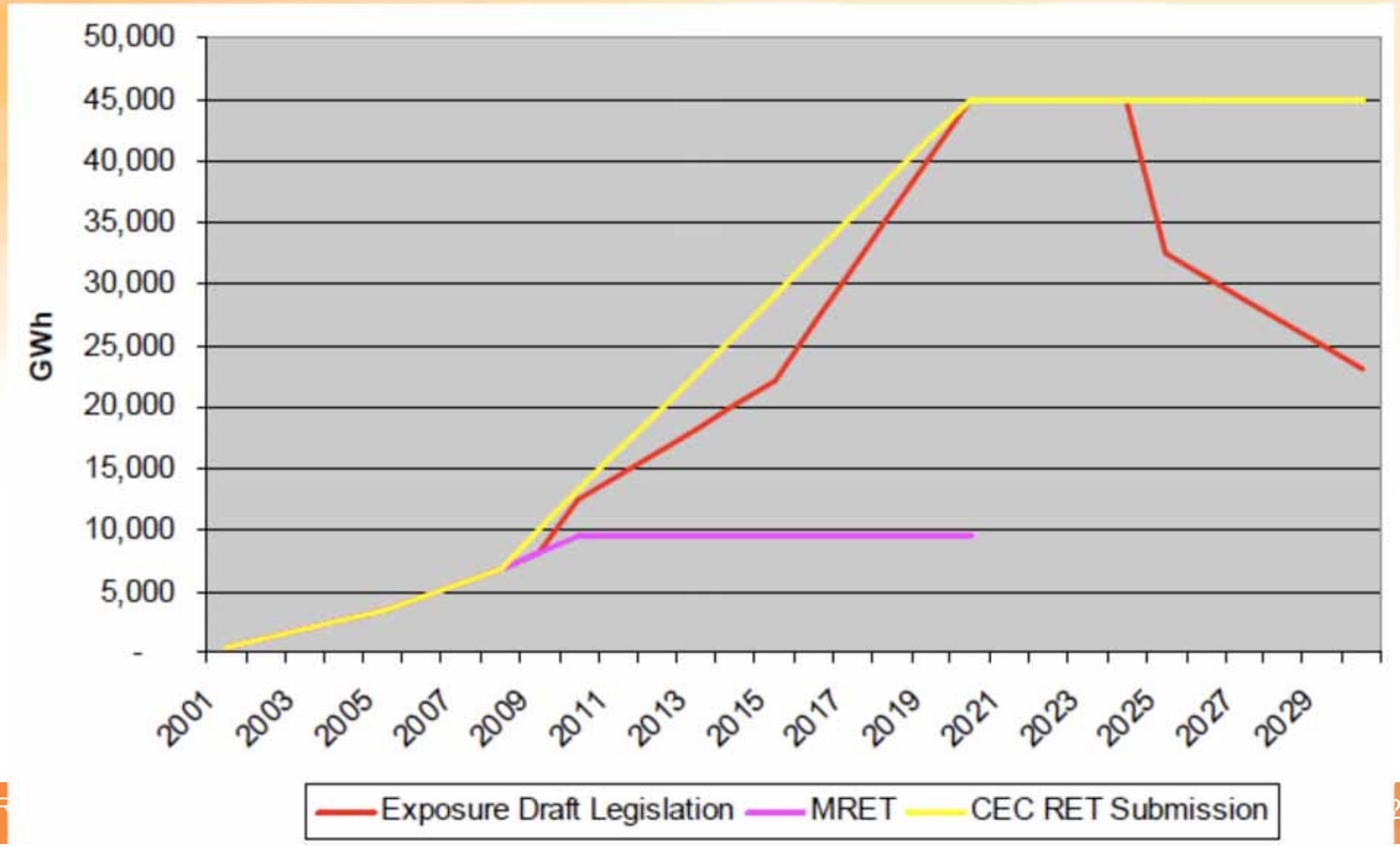


Investment to November 2008 (ORER, 2008)

Eligible Renewable Energy Source	Investment $M	Estimated RECs GWh/year
Wind	2530	3500
Hydro	300	1600
Solar Water Heaters	710	1210
Wood Waste	50	450
Landfill Gas	160	510
Bagasse	600	600
Other	450	300
TOTAL	4800	8650

MRET target: existing & proposed expansion

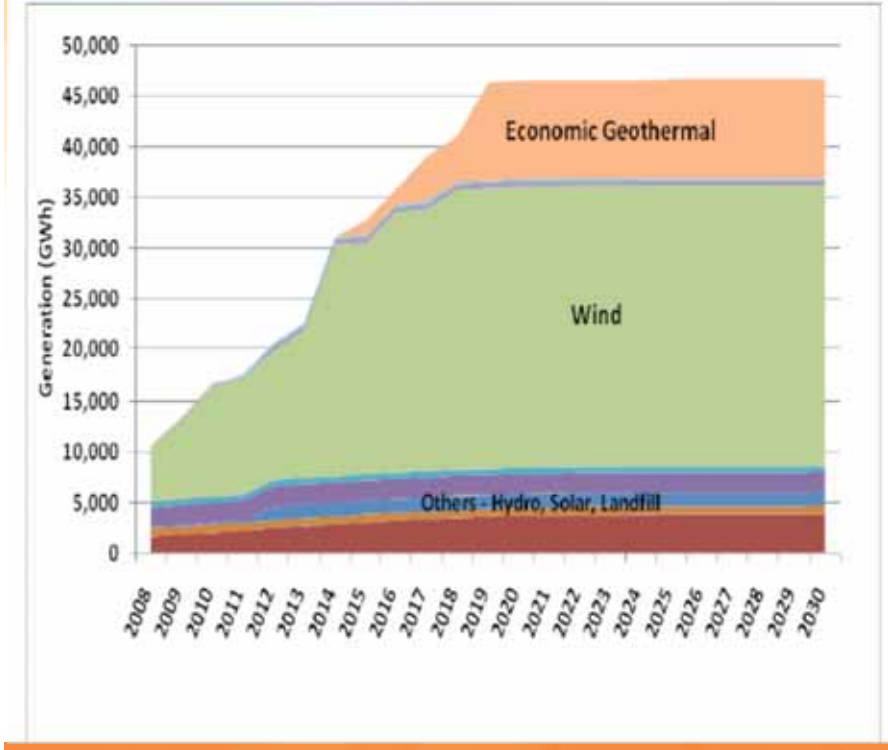
(CEC, 2009)

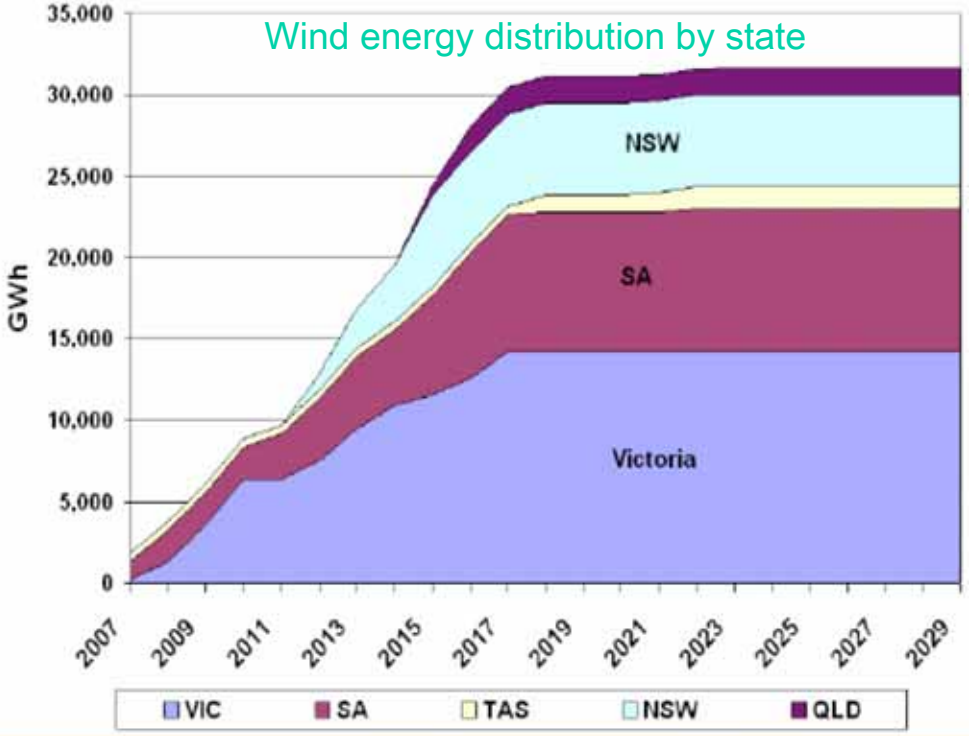


Expanded MRET target of 20% or 45 TWh by 2020

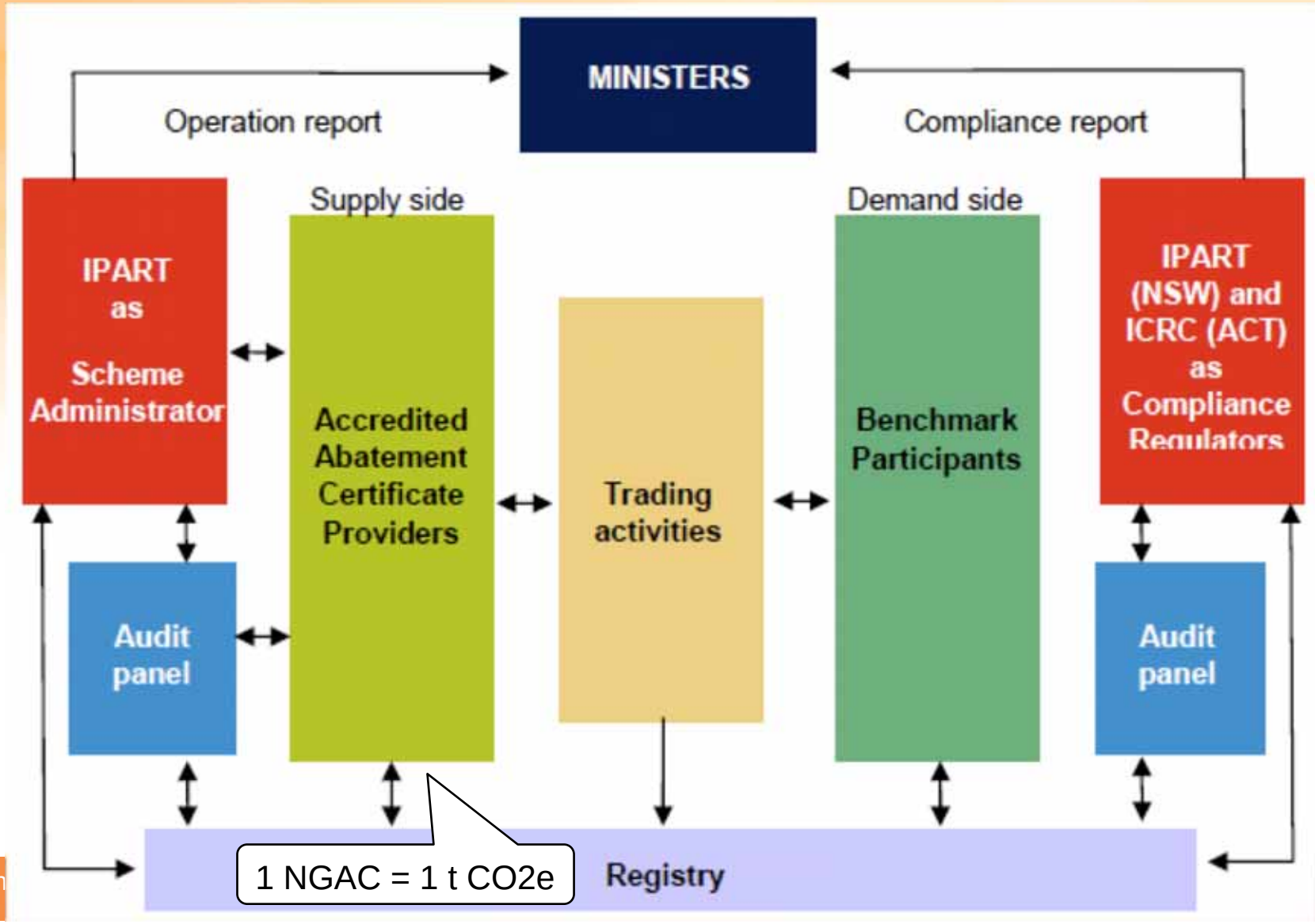
- Rules still to be finalised
- A scenario for resulting renewable energy generation shown below
- Possible high wind penetration in SA + Vic

(IES, *NSW Privatisation Conference*, 2008)

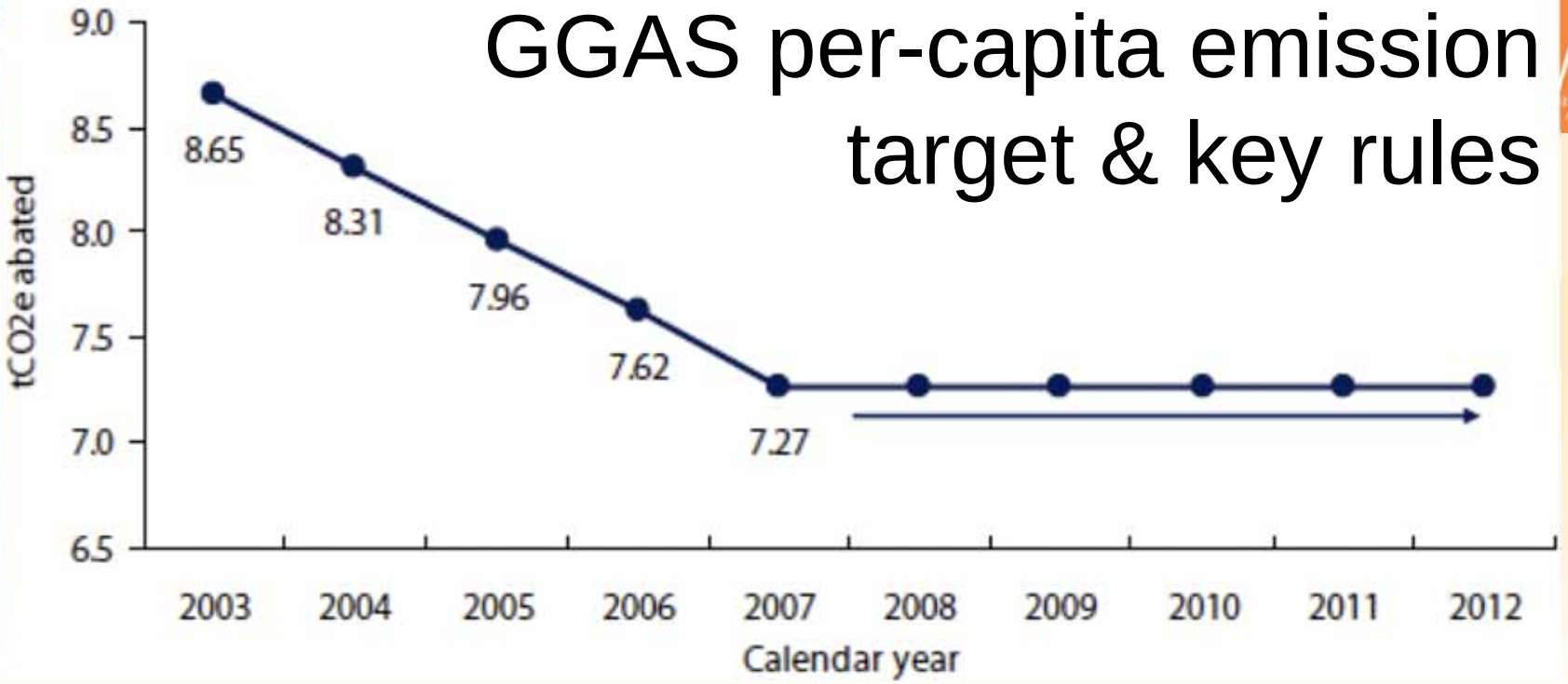


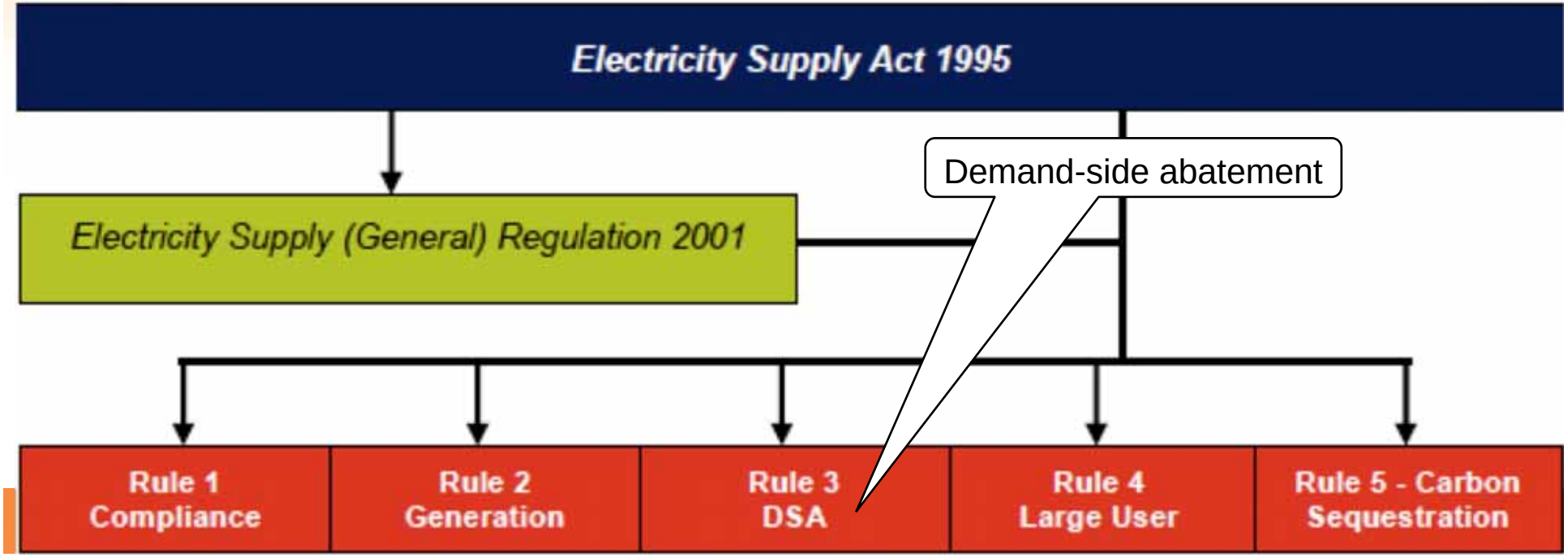


NSW Greenhouse Gas Reduction Scheme (at Sept 08)



GGAS per-capita emission target & key rules



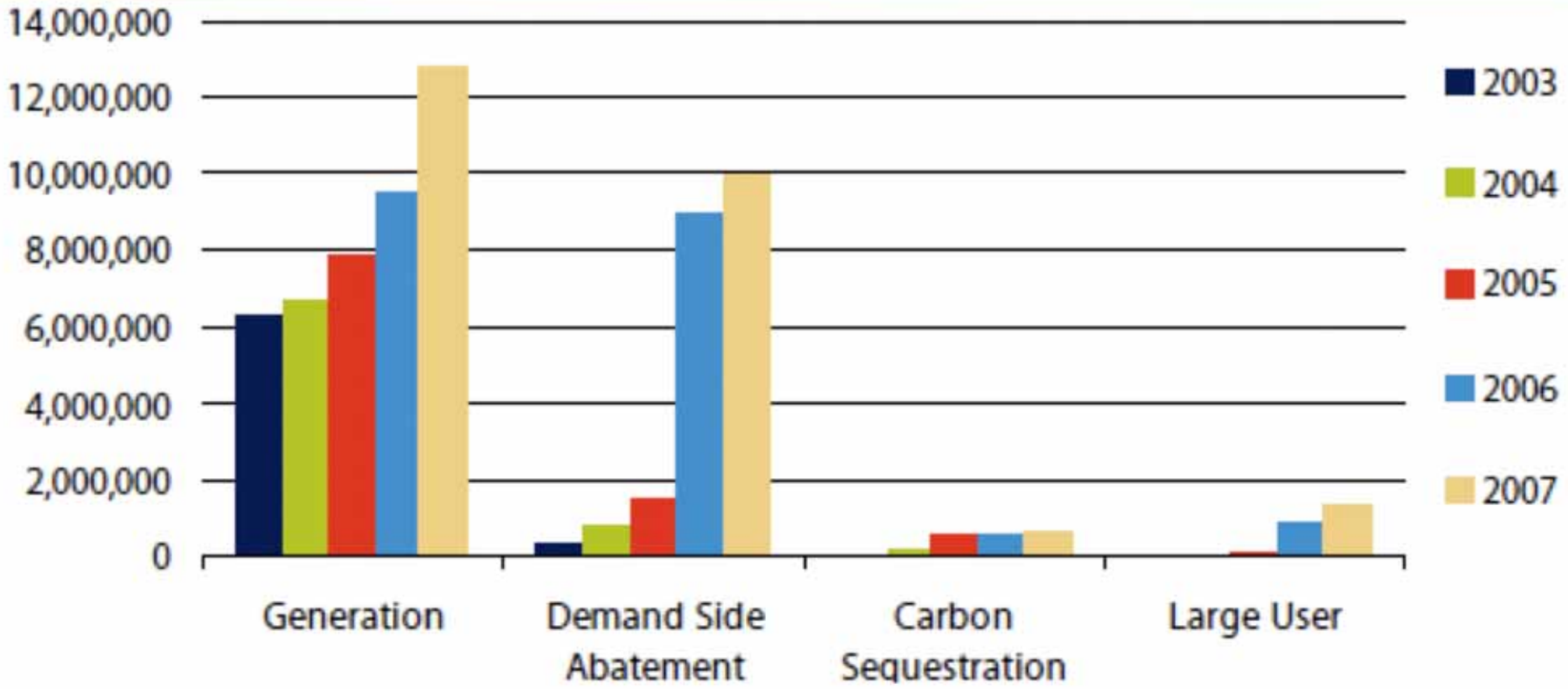


Default DSA NGACs (Crossley,08)

Gas hot water system replacing an electric one	20
Compact fluorescent lamp rated at 8000+ hours	0.5
Compact fluorescent lamp rated at 5000+ hours	0.3
AAA showerhead connected to an electric hot water system	4.0
AAA showerhead connected to a hot water system with an unknown energy source	3.1
Refrigerator 3.5 to 6 star rating	0.1 to 2.5
Clothes washer 2.5 to 6 star rating	1.3 to 3.5
Clothes dryer 3 to 6 star rating	0.3 to 1.2
Dishwasher 4 to 6 star rating	0.1 to 0.5

Sources of NGACs & LUACs to June 2008

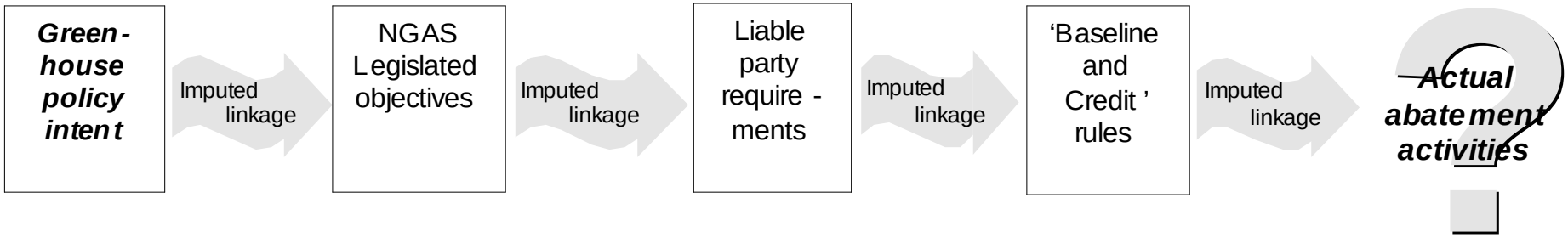
(Introduction to GGAS, Sept 08)



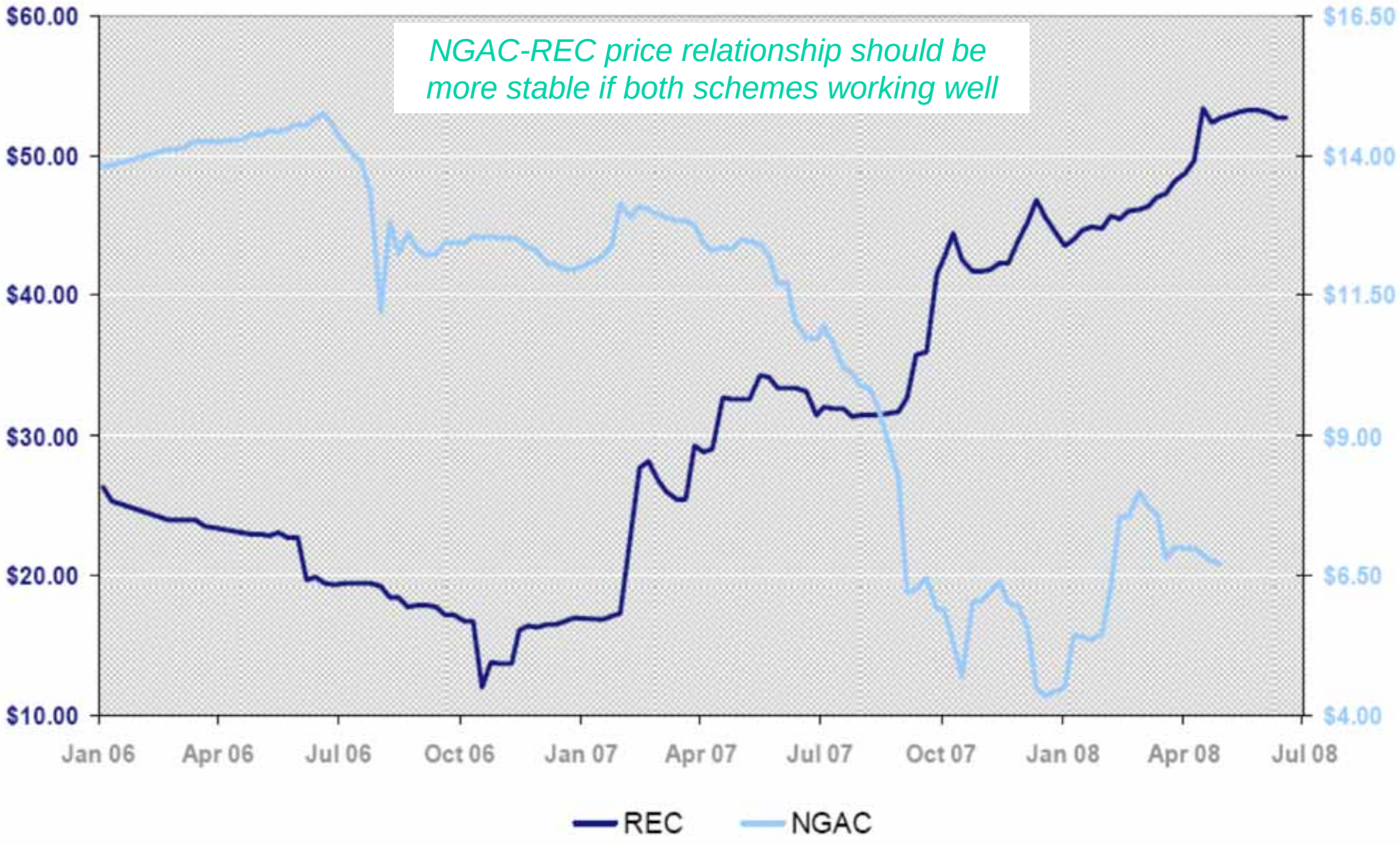
DSA primarily give-away CFLs in 2006, for which the regulator later reduced NGAC value from 0.5 to 0.2

Challenges of GGAS design

- Degree of abstraction:
  - Large gaps between policy objectives, commercial arrangements + physical outcomes
- Broad scope
  - Adds complexity, dilutes accountability
  - Risks creating a 'market for lemons'
    - eg. give-away CFLs & showerheads



Price history – NGAC & REC (ANZ, 2008)



Emerging global carbon markets (ANZ, 2008)

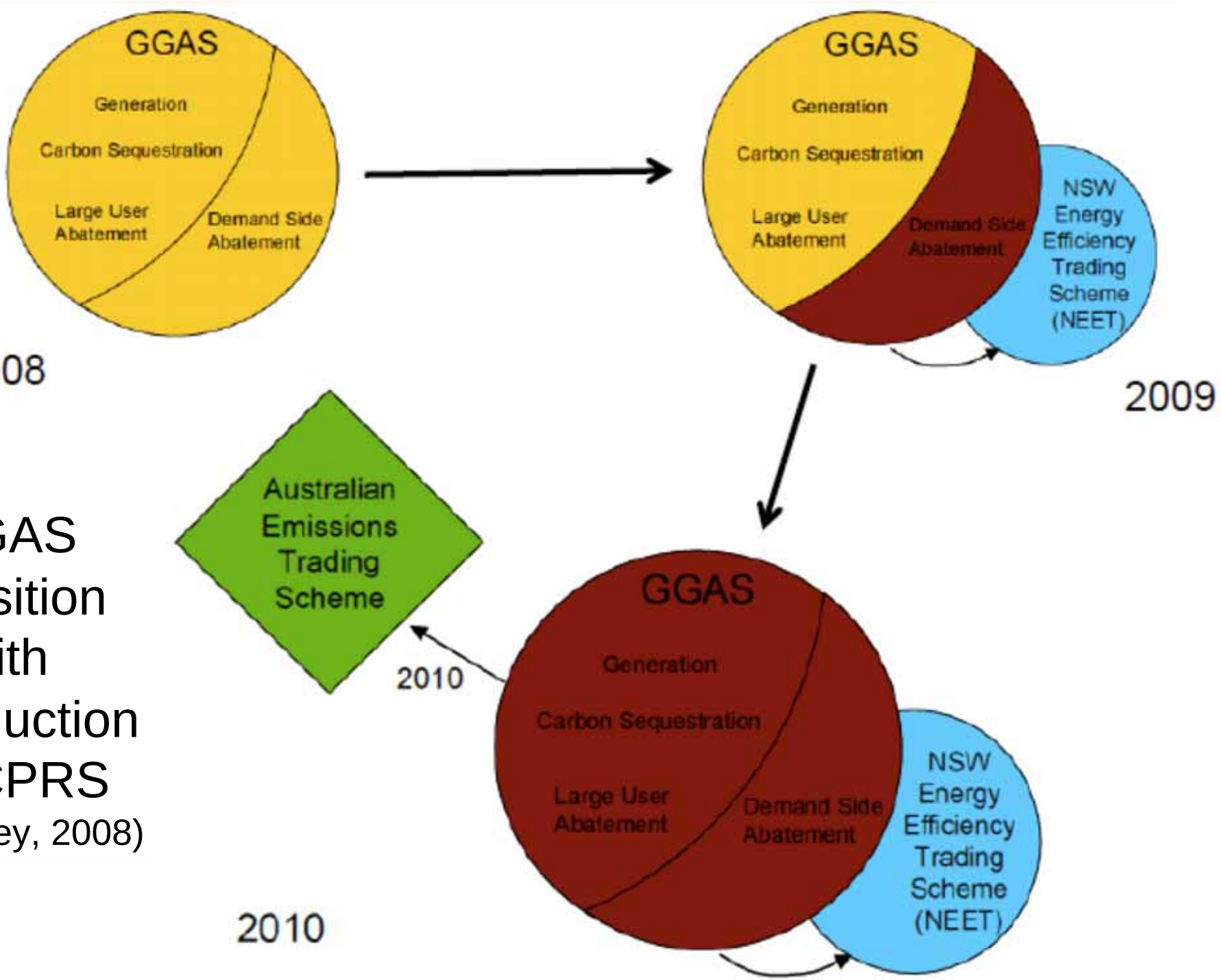
Carbon Credit	Schemes	2006		2007	
		Volume (MtCO2e)	Value (US$M)	Volume (MtCO2e)	Value (US$M)
EUA	EU ETS	1101	$24,357	2061	$50,097
NSW	NGAC	20	$225	25	$224
CER and ERU	CDM and JI under the Kyoto Protocol	508	$5,477	832	$13,376
CFI	Chicago Climate Exchange	10	$38	23	$72
VER/VCU's	Voluntary	33	$146	42	$265
Total		**1,745**	**31,235**	**2,983**	**64,035**

- Turnover doubled from 2006 to 2007

Source: State and Trends of the Carbon Market 2008 – World Bank

GGAS transition with introduction of CPRS

(Crossley, 2008)



NSW Energy Savings Scheme from July 2009

- To replace DSA feature of existing NGAC scheme
- To operate alongside national ETS (CPRS)
- An entity that improves efficiency of electricity use in NSW can create equivalent NEET certificates
- Liable parties: elec retailers & non-trade-exposed direct end-users (annual certificate obligation)
- Target: ramp from 0.4% to 4% of elec sales by 2014
- Terminate in 2020 or before if national NEET starts
- IPART to be NEET scheme regulator

Victorian efficiency (VEET) scheme (www.dpi.vic.gov.au/energy)

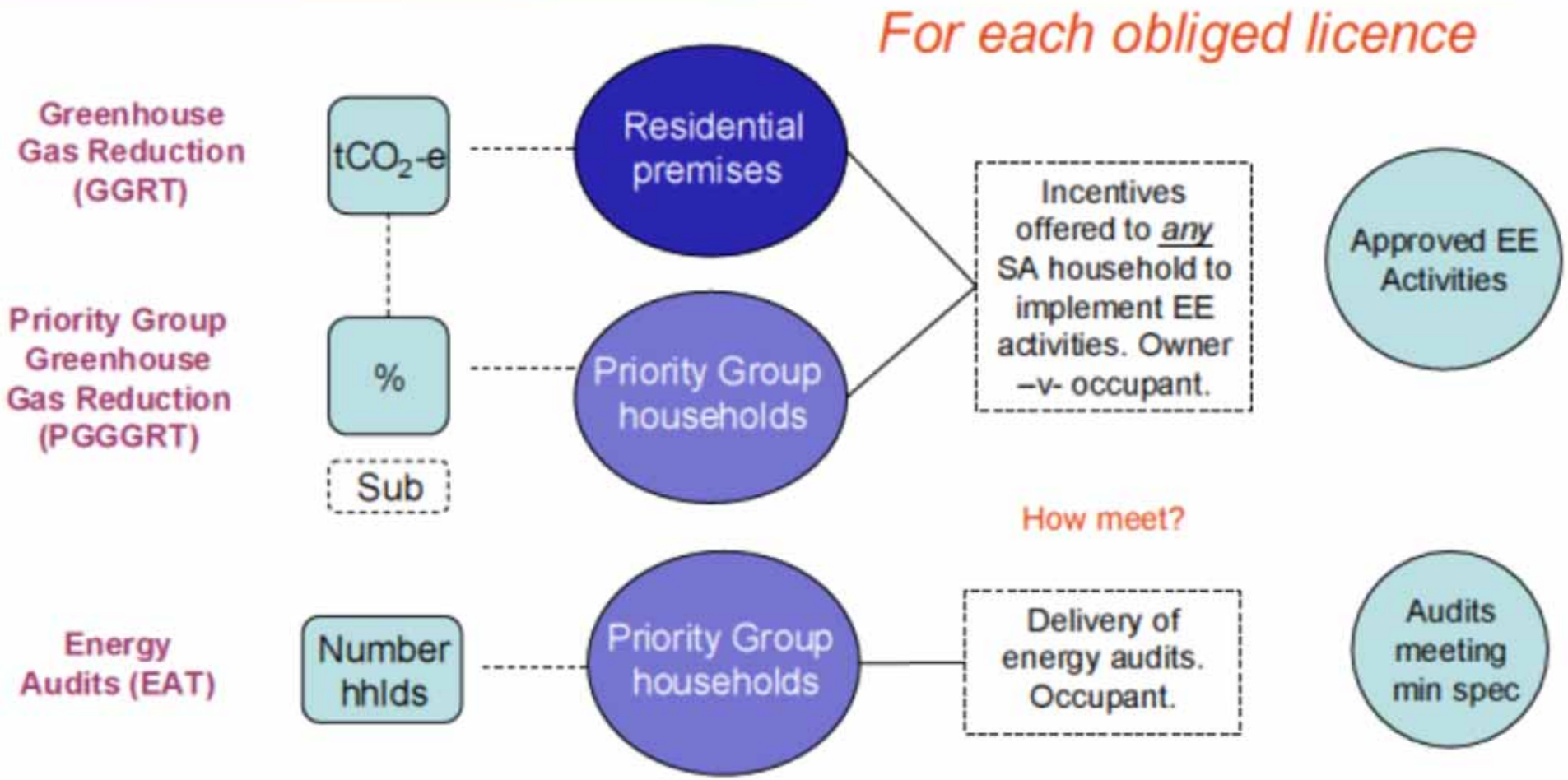
- Modelled on UK energy efficiency trading scheme
- Liable parties will be energy retailers (elec & gas)
- To commence in 2009 & operate in 3-year phases, may run for 20 years, will use tradeable certificates:
  - 1 VEEC = 1 tonne CO_2-e;
  - Initial target = 2.7 Mt CO_2e reduction per year
- Eligible activities prescribed in regulations:
  - 25 in initial list all in household sector
  - List to be reviewed every 6 months

Initial list of VEET eligible activities (Crossley, 2008)

Gas/LPG storage water heater replaces an electric resistance water heater
Gas/LPG instantaneous water heater replaces an electric resistance water heater
Electric boosted solar or heat pump hot water heater replaces an electric resistance water heater
Solar retrofit kit fitted to an existing electric resistance water heater
Gas/LPG boosted solar hot water heater replaces electric resistance water heater
Gas/LPG boosted solar hot water replaces gas/LPG water heater
Solar pre-heater for an existing gas/LPG water heater
Installation of high efficiency ducted gas heater to replace existing gas ducted heater
Installation of high efficiency ducted gas heater to replace existing central electric resistance heater
Installation of ducted air-to-air heat pump to replace existing ducted air-to-air heat pump (non gas reticulated areas only)
Installation of ducted air-to-air heat pump to replace existing central electric resistance heater

Installation of gas/LPG space heater
Install high efficiency space air-to-air heat pump (non gas reticulated areas only)
Installation of ceiling insulation in existing home with uninsulated ceilings
Installation of under floor insulation in existing home with uninsulated floors
Installation of a thermally efficient window
Retrofit of existing single glazed window with a fixed attachment which raises thermal efficiency of existing window
Air sealing
Installation of low energy GLS lamp
Installation of low energy small decorative lamp
Installation of low energy reflector lamp
Installation of low energy downlight
Installation of low flow shower rose replacing conventional shower rose
Destruction of refrigerator purchased before 1996
Purchase of high efficiency refrigerator
Purchase of high efficiency freezer

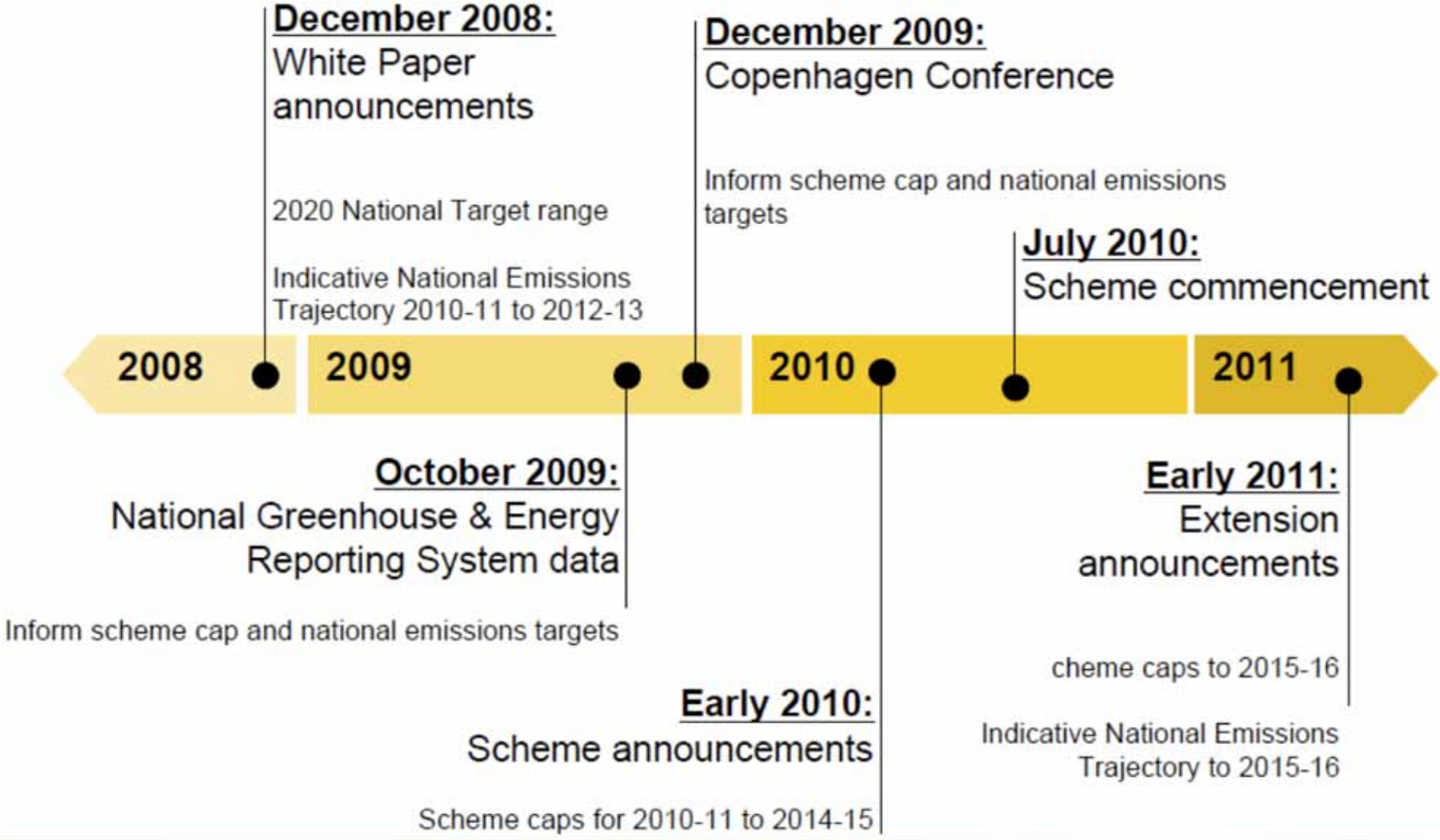
SA REES components (Crossley, 2008)



Carbon Pollution Reduction Scheme (CPRS)

- Australia-wide emission-trading cap & trade scheme
  - All Kyoto gases – CO_2, CH_4, N_2O, SF_6, HFCs & PFCs
  - Entities with facilities that emit ≥ 25,000 CO_2-e pa (~1000)
  - Entities that supply certain fuels & synthetic GHGs
- Target: 5-15% reduction from 2000 level by 2020
- Permits & allocations:
  - 1 Australian Emission Unit (AEU) = 1 tonne CO_2-e
  - Up to 131 million AEUs allocated to coal-fired generators
  - Assistance to Energy Intensive Trade-Exposed Industries
  - Price cap of AUD 40 with 5% pa increase

Timeline for key CPRS decisions (Hatfield-Dodds, 2008)



Conclusions from the Australian experience

- In the Australian context (may not be transferrable):
  - A competitive electricity industry shown to work well
  - A Tradeable Renewable Energy Certificate Scheme can work well for low-cost RE such as wind, hydro & biomass
- Less certain that in the Australian context:
  - Tradeable Energy Efficiency Certificate Scheme & an Emissions-Trading Scheme are good policy options:
    - Unlikely to act fast enough to avoid dangerous climate change
- PV remains expensive for grid-connected use:
  - Promoting PV may simply subsidise middle-class households for little emission reduction

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Many of our publications are available at:

www.ceem.unsw.edu.au

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Renewable Energy & Energy Efficiency Financial Mechanisms: *Recommendations*

Hugh Outhred, Former Presiding Director, CEEM, UNSW

APEC Workshop on Recent Advances in Utility-Based Financial Mechanisms that Support Renewable Energy & Energy Efficiency
Honolulu, Hawaii, 30 March – 1 April 2009

www.ceem.unsw.edu.au

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Recommendations based on Australian experience #1

- In the Australian context (may not be transferrable):
  - The National Electricity Market works well
  - The Tradeable Renewable Energy Certificate Scheme has worked well for low-cost RE: wind, hydro & biomass
  - Grid-connected PV still uncompetitive:
    - FiTs used instead but are a form of middle-class welfare
  - Tradeable Energy Efficiency Certificate Schemes are not yet working well (very abstract & need strong regulation)
  - Emissions Trading Scheme yet to be implemented:
    - Very broad coverage may create uncertainty & be easy to game
    - Unlikely to act fast enough for Australia to make an equitable contribution to avoiding dangerous climate change

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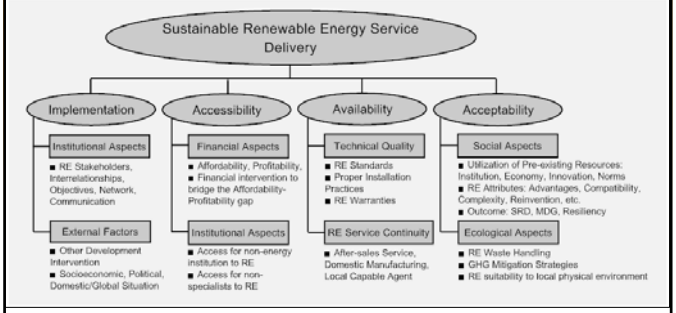
UNSW

Recommendations based on Australian experience #2

- Introducing new RE technology involves *diffusion of innovation* & requires *social capital:*
  - *Can be either organic or government-led (accelerated)*
  - *Government-led should take a holistic approach*
- Government-led strategy for RE introduction:
  - Consider both tech. components & tech. systems:
    - Analyse using Decision Making (DM) & I3A Frameworks
  - Consider what *energy services* you wish to promote
    - eg on-grid vs off-grid; RE resources; local manufacture vs import
  - Develop appropriate orgware, software before hardware:
    - Design using DM & I3A frameworks within the cultural context
  - Deploy RE hardware within macro-economic constraints

The I3A Sustainable RE Service Delivery Framework
(Retnanestri, 2008)



Implementation: Institutional aspects & external factors affecting RE service delivery
Accessibility: Financial, Institutional, Technological accessibility
Availability: Technological, Institutional aspects to maintain service quality & continuity
Acceptability: Social & ecological dimensions

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Role of financial mechanisms - conclusions

- Choice of mechanism depends on context, eg:
  - On-grid or off-grid; RE deployment maturity
  - RE hardware: local manufacture or import
  - Orgware & software (O&S) status (education & training, institutions) *develop prior to hardware deployment*
- To deploy technically proven hardware after O&S:
  - FiT, RPS, tradeable instruments etc. as appropriate
- For hardware RD&D:
  - Innovation support policies & institutions
- Education & training (O&S):
  - Scholarships, apprenticeships, courses, RD&D funding

Recommendations for RE & EE financial mechanisms 5

Centre for Energy and Environmental Markets UNSW

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Many of our publications are available at:
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Renewable Energy: Finance Measures or Regulations?

——Analysis on China Situations

Wang Zhongying
CRED of ERI, NDRC, China
March 31, 2009

Goals of the RE development in long term (by 2020)

- Increase the ratio of RE in the entire energy mix, to 10% by year 2010, 15% by year 2020
- Take advantages of the local RE resources, to tackle the electricity access issues in remote areas, as well as the fuel shortage issues in rural households
- Promote the RE technology and industrial development, by introducing the global advanced experiences and followed by digestion, innovation efforts etc, to establish the manufacturing capability with own intellectual property rights by 2020

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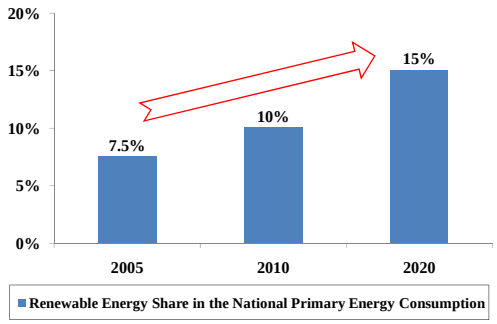
Energy Research Institute National Development and Reform Commission

General targets for REs



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Specific targets

Power targets summary (GW)			
	2005	2010	2020
Hydro	117	190	300
Biomass power	2	5.5	30
Wind power	1.26	5	30
Solar power	0.07	0.3	1.8

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Specific targets

- Non-grain liquid fuel
  - 2010: bio-ethanol 2 million tons, bio-diesel 200,000 ton
  - 2020: bio-ethanol 10 mil. tons, bio-diesel 2mil. Tons
- Solar heat application
  - 2010, accumulated heat collection area 150 mil. m^2; with the other heat application, totally substitute 30 mil. Tons of coal equivalent (TCE)
  - accumulated heat collection area 300 mil. m^2; with the other heat application, totally substitute 60 mil. tce

Biomass targets

	Year 2010	Year 2020
Biomass power generation (10MW)	550	3000
Biogas (100million m3)	190	400
Bio-ethanol(10,000 ton)	200	1000
Bio-diesel（10,000 ton)	20	200
Briquette/pellet fuel (10,000 ton)	100	5000

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Milestones of the RE policy

- Incorporated into the legislation list at June 2003
- 2004 Jun. Bonn Conference, declaration of the RE law and the planning work
- 2005 Feb. release of the *China RE Law* (CRL)
- 2006 Jan. 1st CRL came into force, 10+ regulations afterwards released to help enforce the law
- 2007 Jun. *China National strategy on the Climate Change*, Wind, solar and biomass were prioritized
- 2007 Sep. *China RE Medium- and Long-term Planning*, RE targets identified
- 2007 Dec. White Book on Energy Status and Policy, RE identified as significant part

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RE Strategic Role and Targets

- *CRL* identified the significance of RE
  - Increase the energy supply, improve the energy structure, ensure the energy security, protect the environment, to achieve the sustainable development

International Forum on RE Legislation
2004. May

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Significance for developing RE

- Requirement for sustainable development
- Indispensable for well-off society building and socialism New Rural Countryside development
- Technical options for environment protection and GHG mitigation
- Opportunities to pursue new economic development area
- Security for future energy supply

Major aspects identified by the law

- Establishing national RE general targets and plan
- Grid connection priorities
- Classifying tariffs for Renewable Power
- Sharing cost at national level
- Renewable energy special fund
- Policy on favorable credit and favorable tax treatment

Regulations Progress

- Issued so far
  - Regulation and Management Measure of RE power (Jan. 2006 by NDRC)
  - Regulation on Renewable Power Pricing and Cost Sharing (Jan. 2006 by NDRC)
  - Guided Catalog of RE industry (Jan. 2006 by NDRC)
  - Some national standards (Standard for solar building, Geothermal heat pump by Ministry of Construction, Standard for Solar PV power and wind turbines etc by Standardization Administration of China.)
  - Fund earmarked for RE (May 2006, by Ministry of Finance)
  - 可再生能源发电附加
  - RE electricity surcharge (July 2006, NDRC)
    - 0.1 China Cents
    - 0.2 China Cents (July 2008)

Major points of the new regulations

- Grid must allow the grid connection; mandated to buy all renewable electricity; all the extra costs will be shared by the final users——avoid market competition for RE with conventional energies
- Feed in tariff for Biomass
  - 0.25 Yuan/kWh + local coal fired power price
- Tender price for wind
  - Through a tender processing to determine the regional price standards for wind
- Approval price case by case for other RE projects
  - Project payback price for solar PV, geothermal etc.
- National Earmarked Fund for RE development
- Favorable tax regime to support RE development

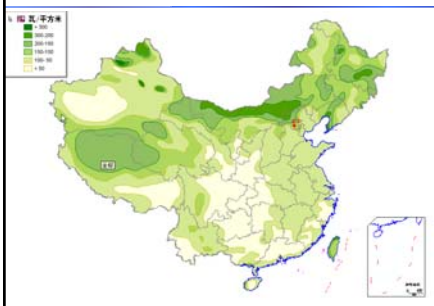
Quota system idea for RE

- MMS policies will be adopted for non-hydro renewable power generation according to the following targets:
  - In areas covered by large scale power grids, non-hydro renewable power generation's share of total power generation will reach 1 percent by 2010 and over 3 percent by 2020.
  - Power generators with self-owned installed capacity of over 5 GW will be required to have a non-hydro renewable energy installed power capacity self-owned that accounts for 3 percent of their total self-owned capacity by 2010 and for over 8 percent of their total self-owned capacity by 2020

RE Market quickly expanded

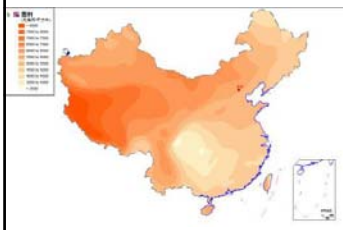
- Release of *CRL*: milestone of RE development (End of 2007), RE saw a unprecedented growth
  - Hydro: newly installed 10GW in 2007, accumulated 148GW, 37% of the economically viable potential

Wind power



- Wind: 12.5GW (2008), exceeding the national wind target by 2010

Solar energy



- Solar water heater: annual production 30 mil m^2, accumulated 130 mil m^2, 60% of the world (2008)
- Solar PV: a record manufacturing capacity 4GW (2008), increased from 3GW, 1nd in the world

Solar PV systems

青海30KW送电到乡光伏电站

Township Electrification PV Power Station 30KW

(Qinghai province)

深圳国际园林花卉博览园1兆瓦并网光伏电站

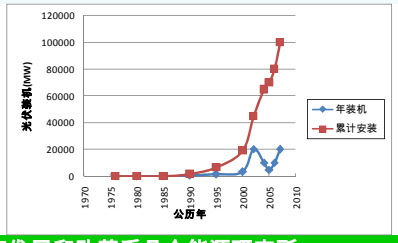
Roof-grid PV power system 1MW

(International flower garden in ShenZhen city)

China's PV market

中国光伏年装机和累计装机统计 (KWp) China's annual and accumulative capacity for PV

年度Year	1976	1980	1985	1990	1995	2000	2002	2004	2005	2006	2007
年装机 Newly installed	0.5	8	70	500	1550	3300	20300	10000	5000	10000	20,000
累计安装 Accumulated	**0.5**	**16.5**	**200**	**1780**	**6630**	**19,000**	**45,000**	**65,000**	**70,000**	**80,000**	**100,000**



Biogas utilization

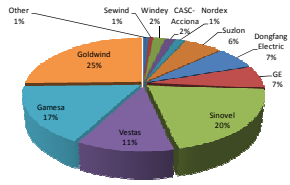
- Biomass: 22 mil household biogas, 3000 large biogas, total volume 10 billion m^3; large livestock biogas plant>800
- Gasification pilot plants > 600 in village level, to supply fuel for 120,000 households

Industry quickly developed

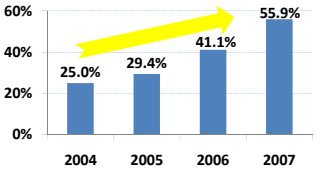
- RE manufacture industry being forming
- Wind industries in China 100+
  - 60+ wind turbine assemblers
  - Capable to produce MW wind turbines in mass production (1MW, 1.5MW, 2MW)
  - Key components: gearbox, blades, generators
- 10+ PV manufacturers with capacity over 100MW
- SWH companies 3000+
  - 10+ revenue over 1billion RMB
- Attract foreign RE giant players
  - GE, Gamesa, Vestas, Suzlon, Repower, Nordex

Wind industry

Market share of domestic turbines in annual increased-market growing



Market share of manufacturer in newly installed capacity (2007)



Market share of domestic turbines in Annual increased market capacity

Solar PV manufacturers

3无锡尚德

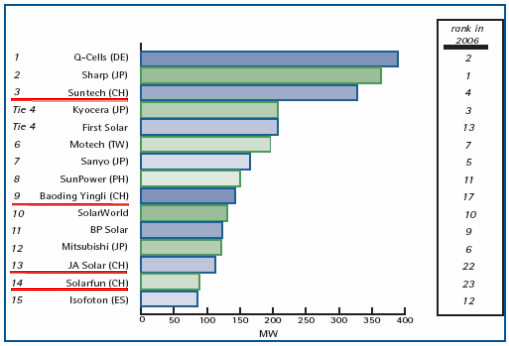
6台湾茂迪

9保定英利

13晶澳太阳能

14浙江林洋

16南京中电 78MW



Common Challenges Faced for RE Development

- General
  - High cost
  - Resource assessment to be strengthened
  - Limited R & D input
  - Weak industry capability
  - Capacity building need to be enhanced

- By technology
  - wind
    - 电网Power grid
  - solar energy
    - 硅材料expensive silicon
    - 成本高，一般为常规电力的10倍 High cost, 10times of the conventional electricity
  - biomass
    - 土地资源limited land
    - 技术瓶颈technical bottleneck
  - geothermal and marine energy
    - 资源评价弱，技术水平不高 weak resource assessment, low level of technology

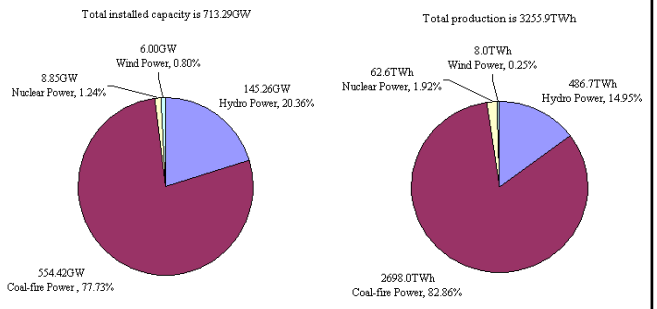
Regulations (law) or Finance Measures for China RE Grid Connection?

China Grid

Wind power ratio

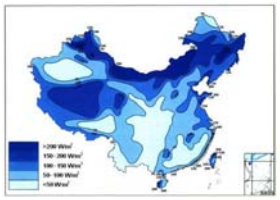
年份	2002	2003	2004	2005	2006	2007
中国总电源装机容量 Total Power（MW）	356,570	391,410	440,000	500,000	600,000	713,290
中国风电总装机容量 Total wind power（MW）	445.0	568.4	763.8	1260.0	2560.0	6050
中国的风电装机比例 Wind power proportion（%）	0.125	0.145	0.174	0.25	0.43	0.84
世界风电总装机容量 Global Total Wind Power（MW）	31,000	40,300	47,317	59,004	73,904	93,849

Capacity and Electricity Mix 2007



Wind resource and grid load ——No balance point

- Wind resource
  - 东北地区，西北地区，华北地区及东南沿海风资源较丰富。
  - Northeast, Northwest and North China areas are with rich wind
- Power grid condition
  - 风资源丰富的"三北地区"电网相对薄弱，风电远离负荷中心。
  - Power grid is weak in 3N areas, wind power is far away from load center.

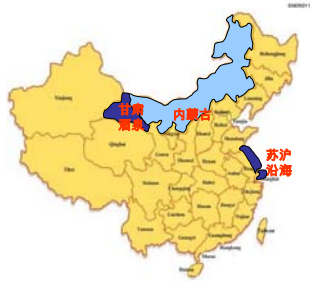


中国风资源分布图
Wind resource distribution

Wind power grid integration status

- 越来越多的大容量风电场（≧100MW）接入220kV甚至是更高电压等级的输电网中。
  - More large scale wind farms (≧100MW) are connected into 220kV transmission network even higher voltage level transmission network.
- 百万千瓦风电基地，千万千瓦风电基地
  - 1000MW wind power base , 10 GW wind power base
- 发展特点：建设大基地，融入大电网。
  - Characteristics: Constructing large wind power base, connecting into large power grid with higher voltage level.

Resource and Load



- **Several 10GW wind farms will be established in Gansu, Inner Mongolia and Jiangsu coast region**

Key Issue for RE grid connection

- How sent electricity from north west to east and south
  - Regional connected
  - Smart grid in region
- Grid company can't make decision
  - Need huge investment
  - Increase subside level

Financing? ——One case on PV

Tenders	Biding price (China Yuan/kWh)	Average level
1	0.69	Exclude the lowest and Highest: Around 1.5 China Yuan/kWh Total investment: Around 250 million China Yuan
2	1.0928	
3	1.16	
4	1.39	
5	1.43	
6	1.4433	
7	1.45	
8	1.486	
9	1.518	
10	1.526	
11	1.658	
12	1.6978	
13	1.9208	

10 MW Project in Gansu

Reasons: reasonable?

- Concession biding
  - Grid connection
  - Feed-in-tariff
  - Land free
- Quota will be launched
  - Most state owned companies
  - Occupied the marked
  - Internal balance
- The scale of the project too small

Conclusion: National strategies and Regulations Plus Finance measures

- Strategy should be made by the state council
  - Regional grids must connected each other
  - Smart grid in the region
  - Quota system should be established
    - Producers and Grids
  - Financing supports
    - Government direct investment
    - Surcharge level to end user should be increased
      - Subside to grid company
- Financing measures
  - Feed-in-tariff
    - PV could be next
  - Net metering
    - PV
  - Adjust the level existed feed-in-tariff
  - Distributed power connected
    - Biogas, Landfill gas, other
  - Resource assessment: National input (already started from wind)
    - Attractive investor and banker

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Utility Based Financial Incentives for Renewable Energy & Energy Efficiency in New Zealand

EGNRET Workshop

Honolulu, Hawaii, USA

30 March – 1 April, 2009

RDL

Coverage

Renewable Energy in New Zealand

Utility based Financial Incentives

Government Incentives

Private Sector Initiatives

Market Solutions

Key Points

RDL

Renewable Energy in New Zealand

Existing:

- **Hydro, Geothermal, Wind, Biofuels,**

Prospective:

- **Wind, Biomass,**

Potential:

- **Solar, Marine**

Lots of Options!

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Installed Electricity Capacity, 2008 (MW)

Renewable Capacity	Hydro	5,023	55.0%
	Geothermal	731	8.0%
	Wind	321	3.5%
	Biomass	46	0.5%
	Total	6,120	67.0%
Non-Renewable Capacity	Gas	2,375	26.0%
	Coal	594	6.5%
	Other	46	0.5%
	Total	3,014	33.0%
Total Capacity		9,133	100.0%

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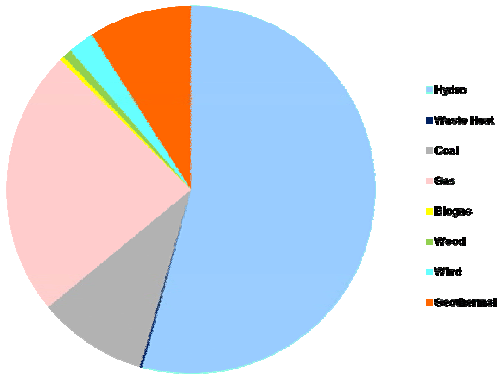
Financial Incentives for NRE Technologies

Electricity Generation Q3 2008



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Financial Incentives for NRE Technologies

Electricity Generation, 2008 (GWh)

Renewable Generation	Hydro	21,944	51.4%
	Geothermal	3,603	8.4%
	Wind	1,037	2.4%
	Wood	467	1.1%
	Biogas	197	0.5%
	Total	27,251	63.8%
Non-Renewable Generation	Gas	10,961	25.7%
	Coal	4,314	10.1%
	Oil	122.3	0.3%
	Waste Heat	57	0.1%
	Total	15,454	36.2%
Total Generation		42,705	100.0%

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Financial Incentives for NRE Technologies

Renewable Energy Introduction in APEC

Mechanisms in Current Use

- Quota schemes,
- Performance based incentives,
- Financial Mechanisms,
- Market based incentives.

Many Options for each Category.

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Financial Incentives for NRE Technologies

Ten Renewable Energy Incentive Types

- Feed-in tariffs,
- Renewable Portfolio Standards (RPS),
- Capital subsidies, grants or rebates,
- Investment or other tax credits,
- Tax rebates,
- Tradable RE certificates,
- RE production payments or tax credits,
- Net metering,
- Investment loans or financing,
- Competitive public bidding,

RDL

Financial Incentives for NRE Technologies

Country	Feed-in tariff	Renewable port-folio standard	Capital subsidies, grants, or rebates	Investment or other tax credits	Sales tax, energy tax, or VAT reduction
Australia		*	*		
Canada	(*)	(*)	*	*	*
Chile			*		
China	*		*	*	*
Indonesia	*				
Japan	*	*	*		
Korea	*		*	*	*
Mexico				*	
New Zealand			*		
Philippines			*	*	*
Russia			*		
Thailand	*		*		
United States	(*)	(*)	*	*	(*)

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Financial Incentives for NRE Technologies

Country	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Australia	*			*	
Canada			(*)	*	(*)
Chile					
China				*	*
Indonesia					
Japan	*		*	*	
Korea				*	
Mexico			*		
New Zealand				*	
Philippines				*	
Russia	*				
Thailand			*	*	
United States	(*)	*	(*)	(*)	(*)

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Financial Incentives for NRE Technologies

Economy	Feed-in tariff	Renewable port-folio standard	Capital subsidies, grants, or rebates	Investment or other tax credits	Sales tax, energy tax, or VAT reduction
APEC (13)	53.8%	30.8%	84.6%	46.2%	38.5%
Europe (19)	68.4%	26.3%	84.2%	73.7%	52.6%

Economy	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
APEC (13)	30.8%	7.7%	38.5%	69.2%	23.1%
Europe (19)	63.2%	15.8%	21.1%	31.6%	26.3%

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Financial Incentives for NRE Technologies

Renewable Energy Incentives, New Zealand

Government Incentives:

- Energy Efficiency and Conservation Authority (EECA),
- Electricity Commission,
- Commerce Commission,

Private Sector Initiatives:

- Electricity Utilities,

Electricity Market Incentives

All operate in New Zealand

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Financial Incentives for NRE Technologies

Government Incentives

Energy Efficiency and Conservation Authority (EECA):

- **Energy Wise Grants - Energy Efficient devices**
  - Building insulation,
  - Solar water heating.
- **Start-up Grants for selected NRE**
  - Micro-Hydro.
- **Energy Labelling**

Primarily promotes Energy Efficiency

RDL

Financial Incentives for NRE Technologies

Government Incentives

The New Zealand Electricity Commission

Provides Energy Efficiency and DSM Subsidies:

- **Efficient Lighting Strategy,**
  - Energy Efficient Light Bulbs
- **Demand Side Management (DSM),**
  - Direct Drive Electric Motors.

Primarily promotes Energy Efficiency

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Financial Incentives for NRE Technologies

Government Incentives

The New Zealand Commerce Commission

Must promote Incentives for DSM in Energy Infrastructure

- **Carrot and Stick regulation**
  - Electricity Lines Companies
  - Promotion of Electric Car infrastructure.

Haven't done much yet – Recent Legislation

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Financial Incentives for NRE Technologies

Government Incentives

The New Zealand Biofuels Obligation:

Not Sustainable!

Cheaper to Import both Ethanol and Biodiesel:

- **Potential Impacts on:**
  - Food supply,
  - land use,
- **Detracts from Energy Security,**
- **Minimal fuel substitution.**

This Mandate has been Repealed!

RDL

The Electricity Market

There are three official markets

- The Wholesale Electricity Market,
- The Reserve Market, 50 MW,
- The Frequency Keeping Market, 50 MW,
- 30 min supply bids 24 hrs ahead at 244 nodes.

About 15% of electricity traded, rest on PPAs.

Most Renewable energy is cost competitive

RDL

Private Sector Initiatives

Electricity Utilities

Power Purchase Agreements (PPA's)

- For Wind, Solar, Hydro – "Weather Energies",
- Electricity generator signs long term PPA,
- PPA used to secure Capital Finance,
- Provides long-term income guarantee

Very effective in promoting RE

RDL

Key Points

- Both Public and Private sector promotion,
- Most aimed at DSM – Energy Efficiency,
- Solar PV not promoted effectively,
- Private sector PPAs, for Wind, Hydro,
- Most Renewable energy is cost competitive.

Financial Incentives limited in New Zealand

RDL

Thank You!

RDL

APEC EGNRET

Energy sector and Financing grid connected renewable energy in Viet Nam

Honolulu, Hawaii, March 30-April 3, 2009

Vu Van Thai
Ministry of Industry and Trade
Viet Nam

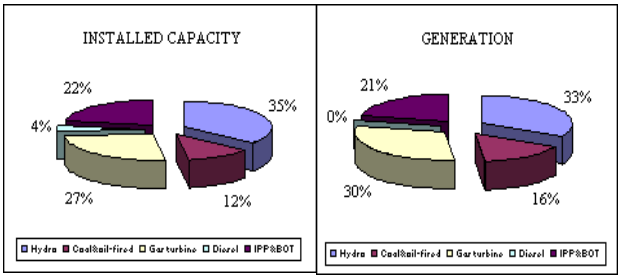
General Information

- Viet Nam has an area of 331,689 km2 and 3,260 km coastline. It has territorial waters with an area approximately three times larger than its mainland territory
- Viet Nam had a population of 85 millions. Current GDP per capita in 2008 $US1050
- Market-oriented reforms since 1986; GDP grew at an average annual rate of 7.9 % over period of 1991-2005, target approved, in June 2006, by National Assembly 2006-2010: 7.5-8.0%.
- Viet Nam is endowed with diverse primary energy resources: Proven reserves of Coal are 3.88 bil.tons (potential 37 bil.tons), Oil - 615-957 mil.tons (potential 2.3 bil.tons), Gas - 600 bil.m3 (potential 1,300 bil.m3). Hydropower potential: 60-80 bil.kWh. Renewable energy and Uranium.

Power Sector in 2006-2007

- **In 2006**, the total installed capacity operated by Viet Nam Electricity (EVN) and IPPs were 9,544 MW and 2,726 MW respectively, making a total of 12,270 MW, from which 37.5 % hydropower, 11.8 % thermal power (coal and oil-fired), 26.6 % gas turbine and 22.2 % non-EVN.
- The generation output was 58,914 bil. kWh, of which hydropower generation 32.4 %, coal-fired & oil-fired 16.0 %, gas turbine 30.4 % and non-EVN 21.1 %.
- **In 2007** estimated total electricity production of EVN was 67,121 bil. kWh, 13,7% higher that was in 2006 of which electricity bought from BOT and IPP was 19,338 bil. kWh, increased by 54,1%. EVN sold 58 billion kWh of electricity, an increase of 1.2 % over the yearly target and 13.4 per cent over 2006. The electricity sales helped bring in total revenue of US$3.5 billion, up 22 %. Electricity consumed by production and household sectors was about 58,19 bil. kWh, of which consumption by industry sector increased by 17,5%.
- The National Power Grid has reached all of cities and provinces.

Power Generation and Installed Capacity Mix by Source in 2006



Domestic Primary Energy Supply

Primary Energy Supply: By 2010, about 47.5-49.5 million TOE and by 2020, about 91-100 million TOE, of which

Hydropower:

- About 35 billion kWh of hydropower in 2010, 60-65 billion kWh in 2020, and 70-80 billion kWh after 2020.

Coal production:

- Coal production will reach 35-40 million tons in 2010, 50-60 million tons in 2010, in which a portion is exploited in Khoai Chau (Hung Yen province), and coal production will be increased to 200 million tons in 2050.

Oil and Gas:

- The oil and gas production in the period 2006-2010 is about 25-30 million tons/year; 31-34 million tons/year in 2011-2015 and about 34-35 million tons/year in 2016-2015.

Nuclear energy:

The Government of Viet Nam has issued "Long term strategy on peaceful utilization of nuclear energy until 2020" as a Prime Minister Decision in January 2006, N*o.01/2006/QD-TTg,* to start operation of the 1st plant by 2020

- ***Renewable energy:*** **the share of renewable energy: 3 % in 2010, 5 % in 2020 and 11 % in 2050**.

Master Plan for Power Development

The Master Plan for Nation Power Development during 2006-2015 with prospect to 2025 (MP No. VI), Decision No. 110/2007/QD-TTg dated 18-7-2007.

- Meet the demand by socio-economic development of the country with annual GPD of approximately 8.5%-9% and higher during 2006-2010, the forecast of annual load demand growth rate at 17% (base scenario), 20% (high scenario) during 2006-2015, in which high scenario is defined to be scenario for management, the scenario of 22% annual growth rate is for unexpected growth.
- Tariff to toward the market direction and to encourage the local and foreign investors to invest on power generation projects.
- Implement rural electrification, try to achieve 95% communes electrified by 2010 and 100% by 2015, 100% households by 2020.
- National Steering Committee for MP VI was established in 2007: with a Deputy Prime Minister as Chairman and Minister of Industry and Trade as Vice Chairman.
- ***Viet Nam will become a Net Energy Importing Country around 2015***

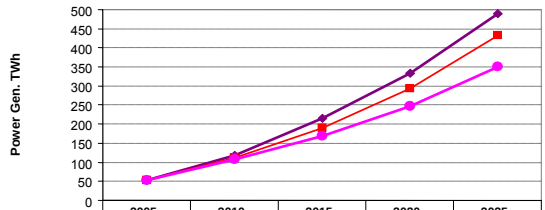
Power Generation in MP No.VI

- Construct hydro power plants of integrated benefits such as: flood prevention, water supply, power production; the gas power shall be reasonably developed to ensure the efficiency; coal fired power plant development shall be intensified; small hydro power plants and new and renewable energy shall be developed for remote, mountainous, bordering and island areas;
- Ensure national energy security and sustainable development, effective exchange of power with countries in the region;
- Complete preparation for investment of nuclear power plant and submit to the PM for approval.
- Properly develop Power centers in various regions of the country to ensure the reliable supply of power locally and reduce the technical power loss in the national Grid as well as to ensure the economic efficiency of the projects, as contribution to the socio-economic development for each region in particular and for the whole country in general.
- Develop new power sources taking in to account those options of in-depth investment and renovation of technology in existing power plants; environment requirements; apply modern technology for new power plants.

Mater Plan for Viet Nam Power Sector Development (MP VI)

Category	Unit	2005	2010	2020
Electricity Generation	TWh	53.4	113.0	294.0
Peak Load	MW	9,255	20,000	50,000
Installed Capacity	MW	11,577	27,000	62,000
500kV	km	3,179	5,000	9,000
	MVA	7,300	11,500	37,500
220kV	km	5,025	11,000	17,000
	MVA	14,765	32,000	86,000
110kV	km	10,290	20,000	-
	MVA	21,100	40,000	-

ELECTRICITY DEMAND FORECAST



	2005	2010	2015	2020	2025
Low Case	53.5	106.7	169.2	247.4	349.4
Base Case	53.5	112.7	190.0	294.0	431.7
High Case	53.5	117.3	215.8	334.2	489.6

National Strategic Program on energy saving & effective use

Decision No.79/2006/QD-TTg on 14-4-2006 for 2006 – 2015

Targets:

- **Saving 3 - 5% for the period of 2006-2010 and 5 - 8% for the period of 2011-2015**
- **Establishing models for energy management**
- **Populating high-efficiency equipment**
- **Implementation Building code (MOC)**
- **Energy Efficiency use in Transport Sector**

- **Complete national regulatory frameworks to EE&C (Energy Conservation Law, Financial Incentives, reasonable energy prices…) and details implementation plan.**
- **Awareness rising and capacity building at government, public, and private sector levels is very important in order to "create a demand" for energy efficiency and to the fast development of EE&C.**
- **Experience sharing is a key issue in energy efficiency and conservation implementation, receiving key information and technical assistant such as "the best practices in energy efficiency and conservation" from more advanced countries like Japan, EU, ASEAN.**

Electricity Saving Program

Decision No.80/2006/QD-TTg for 2006-2010

Target:

-Raise the community's awareness of electricity saving and effective use.

-Ensure the electricity saving and effective use, security and stability electricity supply.

General activities:

- Increasing public awareness
- Encouraging electricity efficiency in generation, transmission, distribution and end-user (government offices: saving at least 10% of yearly electrical consumption).
- Energy controling model for energy saving for at least 40% key enterprises who consume much energy
- The consecutive 3-shift working plan among industrial enterprises which have Pmax/Pmin greater than 2.5 times,

- DSM: encourage using of electricity in off-peak hours (from 22 to 4 am). In the case of power tariff for industrial use (more than 110 kV), tariff of peak hours is three times larger than off peak hours (excluding VAT).

- Instruction No.19/2005/CT-TTg dated 2/6/2005 by the PM on Power Saving.

Electric Power Rate Policy

The electricity prices shall be so determined that

- Investors will get reasonable profits, saving energy resources, using renewable energies which don't make environmental pollution, contributing in socio-economic development, especially in rural, mountainous and island areas;
- Encouraging saving electricity and electricity efficiency;
- Implementing reasonable cross price subsidy between customer classes. Reducing and towards eliminating the cross price subsidy between production costs and electricity prices in residential sector, contributing in promotion of production and increasing competition of the enterprises
- Ensuring self determination rights on electricity buying and selling prices within the tariff schedules specified by the State for sellers and buyers in the electricity market.
- Ensuring legal rights and benefits of electricity units and electricity users.

*Decision 276/2006/QD-TTg dated 4/12/2006 by the PM on tariff shall be continued. Electricity tariff reform, in 2007-2010, is considered as the main method of the funding now. Step by step adjust electricity tariff in order to obtain long-run marginal costs to ensure sustainable development of the sector :*1-1- 2008, average retail *tariff shall be* 842 đ/kWh from 1/1/08 and 890 đ/kWh from 1/7/08. From 1/3/2009 to increase 8% on average by PM decision.

- *From 2010, retail tariff shall be based on market price.*
- *Prices of IPPs shall be based on negotiation/agreement but shall not be 25% higher/lower then the approved tariff frame.*

Renewable Energy Use

- *Renewable Energy Use Relatively Lower against its Potential*
- The most basic use of renewable energy in Viet Nam is biomass for heat. Fuelwood, agricultural residue and animal waste are used as heat source of households. Small hydro and biomass (bagasse…) are used for power generation, though their generation in 2005 was only 265.57GWh, which was approx. 0.5% of the total power generation (51769.68GWh) in Viet Nam
- In 2007, RE accounted for 2.1% of Installed Capacity of Power generation, including:
- Biomass: 1.127%
- Small hydro: 0.921%
- Wind: 0.009%
- PV Solar: 0.008%
- The proportion of renewable energy use is low compared to the potential, although accuracy is not high in evaluating each energy resource.

Small Hydro Power (SHP)

- No accurate number of SHP potential due to lack of data and cost estimation of the projects.
- Recently SHP plants have been built remarkably due to lower investment compared to other RE sources. Estimated 100,000 SHP plants with total capacity about 300MW are in operation.
- According to SHP (from 2 to - 30MW/plant) Master plan prepared by PECC1 SHP resources are concentrated in Lao Cai, Yen Bai, Ha Giang provinces in the North and Lam Dong in Central. Total capacity is 2,925 MW, production about 13,3 TWh, with average load factor of 0,52.

Biomass Resources

Bagasse from 40 sugar factories is being used for production of head and electricity with a capacity of co-generation 150 MW. In 2005, about 2,1 mil tons of bagasse (370 kTOE) was used to produce about 300 GWh electricity.

- In 2007 the first land fill gas plant in Go Cat, Ho Chi Minh city was completed with 3 turbine, total capacity 2.4 MW, electricity sell to PC Ho Chi Minh at 754 VND/kWh. Estimated that this plant could produce 9,000 MWh/year until 2020. Other plants with total capacity of about 200MW land fill gas plants and city waste are under preparation.
- Viet Nam is an agricultural country, and there are huge amount of biomass resources such as bagasse, rice husk and rice straws. Most of biomass resources are used as heat source, and power generation is about 50MW. Potential for power generation: rice husk 100-200 MW; sugar industry (bagasse): 200-250 MW; Others: 100-150 MW
- Bio-Fuel is considered as the most possible measure of effective use of biomass resources.

Wind Energy

- Currently only 1 MW of wind power plants are in operation. On Bach Long Vi island, a plant of 800 kW invested by the Government, started its operation in 2004 but now has to stop due to operational fault (not matching between wind speed and power demand load cure. A 30 kW plant provided by NEDO, Japan. In the end of 2008, AEROGIE.Plus company from Switzerland announced that it has been awarded a license of Vung Tau province to build a wind power plant with designed capacity of 7.5MW on Con Dao island which cost 20mil. Euro, to be put into operation in 2010.
- Wind energy potential is about 17,850 MW of which in the North 502, in theCentral 8,803 and in the South 855 MW. At level of 60m over ground wind speed is about 6 m/s.
- *In BAU case until 2025 registered plant at good wind speed may have a total install capacity of 658,5 MW with production cost 1,226 – 1,891 VND/kWh.*

Government Policies

Electricity Law (2005), Article 61 on investment in development of electricity in rural, mountainous areas and islands if investment is no profitable GOV has policy to support (i) on investment fund, (ii) interest of loan for investment and (iii) tax incentives.

The Master Plan for Nation Power Development during 2006-2015 with prospect to 2025 (MP No. VI), Decision No. 110/2007/QD-TTg dated 18-7-2007: small hydro power plants and new and renewable energy shall be developed for remote, mountainous, bordering and island areas;

Decision No: 1885/QD-TTg dated 27/12/2007 by Prime Minister approving Strategy on National Energy Development up to 2020, and outlook to 2050.

- Main contents of strategies related to promotion of RE development:
  - Encouraging study and use of RE, focus on remote mountainous, island areas. provides funding for survey, study, experimental processing and construction of model stations using RE; exempts import duties, production tax on dissemination of RE equipment and technology.
  - Strive to increase share of RE to about 3% of total commercial primary energy in 2010; 5% in 2020 and 11% in 2050.

Draft Strategy, Master plan on RE Development in Viet Nam for 2010-2015 with a vision to 2025 *(Completed and submitted Government at the end of 2008 for approval)*

Renewable Energy for Power Generation

- The fundamental policy on the introduction and dissemination of renewable energy as power resource is now being formulated as a result that a long term renewable energy development targets as power source is set in the National Energy Policy.
- At present, there are no specific incentives for renewable energy promotion such as advantageous electricity purchase price for renewable energy and obligation of power producers to purchase/produce certain percent of electricity sold from renewable energy power. In addition, when the electricity market is established, which is planned to start from 2009 as part of the electricity sector reform, each power producing companies will be put in a competitive environment. Because renewable energy power is less competitive in price than conventional power, the installation of renewable energy is expected to be low unless effective incentives.

Tax apply to Power plants using Renewable Energy

- Decree 124 dated 11 December 2008, which provides guidance on implementation of the new Corporate Income Tax (CIT) Law effective from 1/1/2009, investment in power plants projects is entitle the following tax incentives: The tax rate of 10% shall apply for 15 years as from the date of commencement of business operation. Within this period, exemption from tax will be granted for 4 years and a 50% reduction of the amount of tax payable for 9 subsequent years. Upon expiry of 15 years (CIT) at the normal rate of 25% has to be paid. Power plants using renewable energy should enjoy these incentives.

Loans for Rural Energy Programs

In the past 10 years, most of Rural Energy programs have been financed from ODA, total loans is about 2 bil.$US, such as Rural Energy (RE I and RE II) and Rural power Distribution (RD) of WB; rural electrification (VSRE) of SIDA, Sweden; SEIER of WB; Renewable projects are focusing on off-grid ones. WB has intention to provide ODA for RE III from 2011 for widen area off-grid .

New loan of ADB for grid-connected projects and rural electrification with total budget: 151mil.$US *(Asian Development Fund-ADF, 32 years, grace period 8 years, interest rate 1-1,5%),*

- Financial Mechanism: apply current on landing terms and conditions (*on landing to EVN 7-27years 2,5%*). When needed special mechanism will be decided by Prime Minister.

Possibility of Renewable Energy exploitation forecast

(Base case)

	2006	2020	2025
Small hydro	255	1988	2454
Biomass	157.7	380.7	395.7
Biogas	0	11	12
Solar	1.65	3.25	3.25
Wind	1.5	443	493
Geothermal	0	214.1	239.1
Tidal	0	5	15
Solid waste	2.4	47.4	97.4
Total (MW)	**418**	**3093**	**3709**
(GWh)	**1.830**	**13.192**	**15.980**

- **Investment capital will be needed about 300$US/year**

Summary and Remarks

- Viet Nam is endowed with diverse primary energy resources such as: coal , oil, gas, hydropower, renewable energy-RE (small hydropower, biomass, wind energy, solar, geothermal…).
- Potential of grid connected RE is considerable. Currently only about 2.3% is in use.
- Encouraging study and use of RE, focus on remote mountainous areas, islands is indicated in Strategy on National Energy Development and in the Master Plan for Nation Power Development during 2006-2015 with prospect to 2025 (MP No. VI).
- But at present, Renewable energy power is less competitive in price than conventional power due to high investments cost and lack of, financial sources, fixed electricity retail tariff by the Government and cross sector / area subsidize... and no specific incentives for renewable energy promotion such as advantageous electricity purchase price for renewable energy and obligation of power producers to purchase /produce certain percent of electricity sold from renewable energy power…

Summary and Remarks

- Renewable Energy and Electricity from RE always link with rural energy program and play an important role in rural electrification, especially off-grid projects.
- RE financial sources are mainly relied on ODA from international financial institutions and foreign assistance for rural energy in general with a portions for renewable energy.
- Financial mechanism for rural energy/renewable energy: Before 1986: almost 100% of budget from the Government (Central Planning Economy). After 1986 until around 2000: jointly financing by Government and people (cooperatives and individuals). Recently: Government (Central and Local) and Public utilities (mainly EVN) and private financing.
- Local investors from various sectors and foreign investors are encouraged to participate in development of power plants and power distribution networks with investment forms in accordance with the laws of Vietnam. Competent local investors are allowed to mobilize all kind of capital sources for investment of power plants and power network with the mechanism of self arrangement for financing and repayment (from MP No.VI).
- No clear separation of public obligation of utilities and their business activities: the Government may order EVN to build power / renewable energy and transmission/distributions facilities to supply energy to curtains areas defined by the Government base on the request of local government.

Summary and Remarks

- Inaccurate Data on RE resources (wind speed higher 30m about ground, hydrological data for SHP...) is making difficulty for evaluation and planning programs, projects.
- No sufficient / Lack of Coordination between relevant ministries, provincial authorities in RE development.
- No large enterprises manufacturing and commercial companies supplying RE equipment and services are on place;
- It is necessary and very important to have:
- Relevant policy / legal frame work strong and efficient legislations and measures (renewable portfolio standards-RPS, feed-in tariffs, tax and investment incentives, power purchase agreement...) to promote RE in general and RE connected projects in particular.
- RE technology transfer and encouraging local manufacturing to reduce RE equipment

Summary and Remarks

Sufficient awareness on RE technologies; Increase Local enthusiastism; Enhancing community's knowledge of social, environmental benefits of RE projects.

- Financing services and capability to assess possible loans from banks by local, private developers.
- Establishnemt of competitive power market with more layers such as public utilities namely EVN, PVPower, Vinaconmin, Song Da, Lilama, foreign and local IPPs, BOT and privates.
- Human resource development in RE.
- External support from international organizations financial institutions and other countries ….
- Encourage investment for renewable electricity by private sectors, cooperatives and entities.
- Invaluable experiences exchange with other countries including APEC member economies.

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APEC Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency

Promoting Grid Connected Renewable Energy System and Recent Activities of Energy Conservation in Chinese Taipei

H. (Tom) Lee, Dr of Eng

March 31, 2009 Honolulu, Hawaii, USA

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Outline

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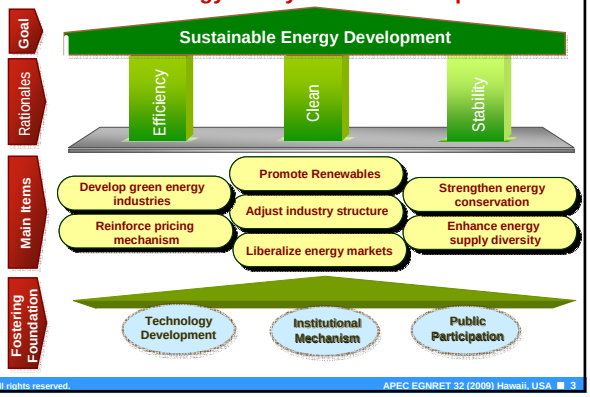
Energy Policy in Chinese Taipei



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Part I. Promoting Grid Connected Renewable Energy System

Targets of Renewable Energy Promotion

➡ Renewable energy shall contribute 15%, in terms of installed capacity by 2025.

Renewables \ year	2008		2025	
	Installed Capacity (MW)	Rate (%)	Installed Capacity (MW)	Rate (%)
1. Hydropower	1,939	5.0	2,500	4.4
2. Wind Power	358	1.0	3,000	5.3
3. Solar PV	4.1	0.0	1,000	1.8
4. Geothermal	-	-	150	0.3
5. Biomass	772	2.0	1,400	2.5
6. Fuel Cell	-	-	200	0.4
7. Ocean Energy	-	-	200	0.4
Total	3,073	8.0	8,450	15.1
8. Solar Thermal Water Heater	1.78 million m^2		4.09 million m^2	

Source: BOE (2009)

Incentives for Renewable Energy in Chinese Taipei

Type	Incentives	Current Status
Electricity Purchase Program	Taipower Renewable Energy Premium Purchase Program	1. Purchase price is US$ 0.063/kWh. 2. The approved purchase capacity has reached 298 MW. 3. Total purchase capacity will be 600 MW.
Solar PV	Solar PV Systems Demonstration Program	1. Subsidy: US$ 4,700 /kW; 50% of installation cost max 382 2. demonstration projects with an installed capacity of 4.099 MW.
Biogas	Biogas Power Generation: Landfills specified	Electricity generated from biogas of landfills being granted with a premium of US$ 0.0156/kWh
	Biogas Power Generation: General	1. Grants up to US$1,000/kW for new generators 2. Installed capacity must exceed 300 kW (could be completed by Nov 30, 2009) 3. Ceased by end of 2008

Source: BOE (2009)

(cont.)

Incentives for Renewable Energy in Chinese Taipei

(cont.)

Type	Incentives	Current Status
Tax Incentives	Statute for Industrial Upgrade	1. Business entities investing in new and clean energy can enjoy a tax credit up to 7% of the equipment cost. 2. Investments in new and clean energy industry can enjoy income tax credits, ranging from 10%~20% of the investments. 3. Two-year accelerated depreciation. 4. Low interest loans：up to the 2-year postal saving floating interest rate, plus 2.45%.
	Business Entities Purchasing Energy Saving Equipment or Using New Energy Equipment or Technology Tax Credits	
	Customs Duty	Duty Exemption for imported equipment without domestic manufacturer.

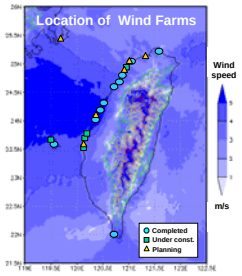
Source: BOE (2009)

Grid Connected Wind Trubines

Status -

- At the end of 2008, 190 wind turbines had been installed, corresponding to a total capacity of 358 MW.
- The First Phase of Development Project on Offshore Wind Energy has been approved by the Executive Yuan (Cabinet)

Targets - 3,000 MW by 2015



Source: BOE (2009)

Grid Connected Solar PV System

Status -

- 382 demonstration projects with the installed capacity of 4.099 MW at the end of 2008.
- Subsidy upto US$ 4,700/kW, 50% of installation cost maximum.

Targets - 1,000 MW by 2015

Fu-Bon Memorial Building, 19.8 kW

Source: BOE (2009)

Grid Connected Solar PV System

Main Stadium for 2009 World Game, Kaohsiung

Installed Cap.: 1 MWp

Generation: 1,100 MWh/year

Source: KOC (2009)

2008 APEC Photovoltaic Conference

October 7~9, 2008 Taipei World Trade Center

Background

- APEC Economies area owns **the biggest capacity** of solar cell production in the world.
- APEC Economies has become the most important sectors of supply chain in the solar energy.

Purpose

- To establish infrastructure for the utilization of PV energy in the APEC region.
- The 2008 APEC PV Conference provides a timely **platform** and **opportunities** for all APEC Member Economies to address PV promotion issues, discuss technology development, exchange information and experience of promotion scheme in the region.

11 APEC Economies represented

- Australia, China, Hong Kong, Japan, Mexico, Malaysia, Singapore, Thailand, USA ,Vietnam and Chinese Taipei

Source: BOE (2008)

2008 APEC Photovoltaic Conference

Conclusions

1 Sharing of information at both government and industry levels to be continued
2 Keeping the APEC PV agenda moving forward
3 Compilation of information and opinions collected from represented member economies to be done and distributed back to allow APEC economies to set common benchmarks
4 Standardization of training materials and certification of PV engineers and technicians; existing lengthy and inconsistent verification processes must be made more efficient
5 Financing issues not adequately explored; requiring more discussion in the future
6 Build on past APEC projects and workshops
7 Report results to the EGNRET 31 Meeting and the 36th EWG Meeting

Source: BOE (2008)

Grid Connected Biogas Power System

Status -

- Operational biogas power generation systems include four landfill sites, three industrial wastewater treatment plants, and some pig farms, with a total installed capacity of 22.4 MW.

Targets -

- It is estimated that there still are six landfill sites with a potential installed capacity of more than 21.2 MW. Biomass energy targets is 1,400 MW by 2015.

Sanzhuku Sanitary Landfill Site, Taipei

Capacity: 6.81 MW
Treatment: 4,256 m^3/hr (1 atm, 25°C)

17.33 Mm^3/yr Biogas (2003)

Photo: TEPA (2001) ; Source: ITRI (2008)

Renewable Energy Development Bill (Draft)

- The Bill has been approved by the Economic Commission of Legislative Yuan and waiting for final approval.
- Obligations: power utilities to grid integrating and buying in of renewable electricity; public constructions to install PV
- Incentives: fixed feed-in tariffs for renewable electricity; installation subsidies for the public using renewables from PV fuel cells and hydrogen
- Deregulation: loosening limitations of land use; unbinding qualification for installing renewable power facilities
- Specific Fund supporting finances: power utilities using fossil and nuclear fuels should render funding as monetary sources of subsidies to reduce the impact to government budget

Renewable Energy Development Bill (Draft)

- Renewable Energy Development Fund—the principle of balancing revenue and expenses based on projected need for subsidies
  - Subsidy for feed-in tariffs (expenses): subsidizing the differences between feed-in tariffs and Taipower's avoided cost
  - Feed-in tariffs: the government establishing a commission consisted of scholars and experts to decide pricing formula, tariffs, and make announcement annually
  - Fund levying (revenue): based on the estimation of subsidizing needs to levy funding from Taipower, IPP and the higher capacity co-generators

Renewable Energy Development Bill (Draft)

- Measures to promote installation—increasing installed capacity, facilitating technological improvement and reducing costs
  - Demonstration subsidy (expenses): those who install PV, fuel cells and hydrogen generators eligible to apply for subsidy
  - Incentive subsidy: those who install solar water heaters eligible to apply for subsidy (alternative to thermal utilization and supported by Oil Fund)
  - Public constructions obligated to be installed with PV systems

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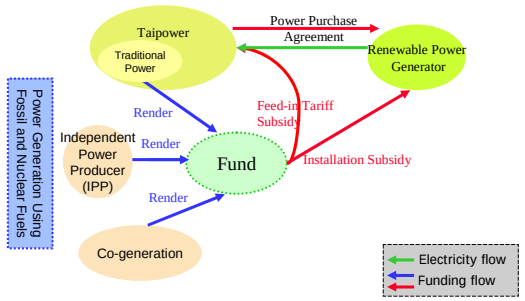
Renewable Energy Development Bill (Draft)



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Chinese Taipei

Part II. Recent Activities of Energy Conservation

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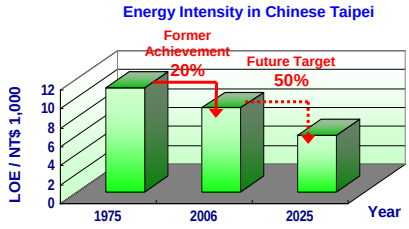
Target for Overall Energy Conservation in Chinese Taipei



- Target: Total energy saving reaches **56.43 MKLOE** by 2025
- APEC Leadership meeting Initiating action to improve energy efficiency by **25%** between year 2005 and 2030.

Source: BOE (2009)

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Action Plan for Energy Conservation in Energy Sector

Raising Efficiency of Transmission: Saving 5.4 MKLOE/yr

- Replacing with high-efficiency generating units for coal-fired power plant (Efficiency raised by 3.5%) by 2025
- Replacing with high-efficiency generating units for gas-fired power plant (Efficiency raised by 5.5%) by 2015
- Improving power patch/transmission facilities (Reducing line lost by 0.5%) by 2015

Taichung Coal-Fired Power Plant (Photo: Chi Po-lin, 2007)

Source: BOE (2009)

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Energy Audit and Incentives for Energy Conservation Technologies

1. Promoting the application of Building Energy Management System
2. Promoting the use of renewable energy
3. Promoting the auditing and benchmarking system to control the building energy consumption
4. Promoting and setting up a incentive mechanism for designers implementing energy efficiency design such as tax deduction, low interest rate loan and multiplying the design fee, etc.
5. Promoting ESCO

Source: BOE (2009)

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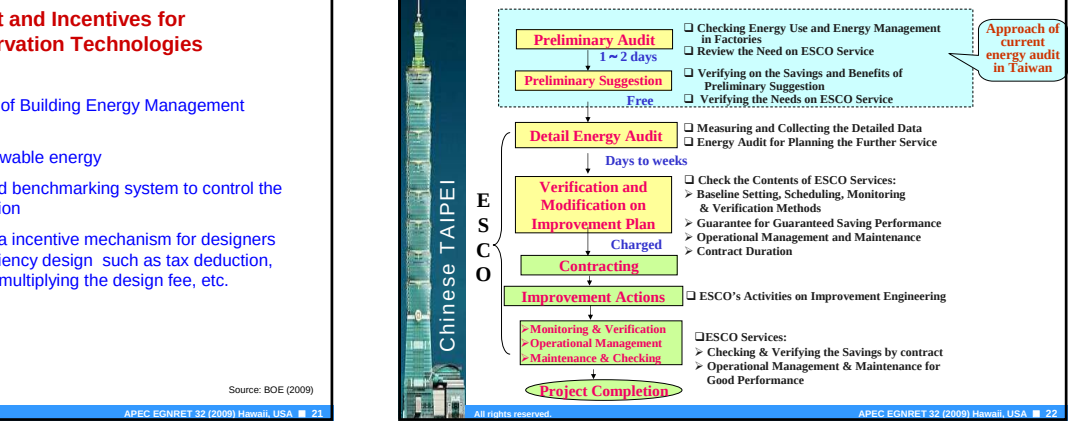

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Other Activities of Energy Conservation

Encourage of Appliance Replacement

- From Oct. 1, 2008, a total budget of NT$ 530 millions is provided by the government to encourage the replacement of old & lower efficient appliances (e.g., air-conditioner, refrigerator, and clothing washer).
- Purchasing the high efficient products with energy conservation label, a total amount of **NT$ 2,000** (~US$ 60) per item cash rebate will be granted.
- The program will be executed for 6 months and only apply to the domestic manufactured products.

Source: BOE (2009)

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Other Activities of Energy Conservation

Energy Conservation & Carbon Reduction

- The government initiates an electricity price privilege program in order to expedite energy conservation.
- Discount electricity bill will be provide to residential sector, and middle and elementary schools, the program started on July 1, 2008.

$$X\% = (A - B) \div A \times 100\%$$

where A= bi-monthly power consumption for the previous year;
B= bi-monthly power consumption for this year

Saving span	Discount rate
0≦ X <5%	95%
5%≦ X <10%	90%
10%≦X	80%

Source: BOE (2009)

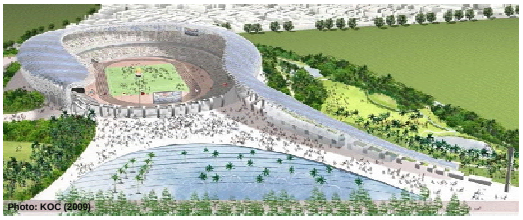
Chinese TAIPEI

Concluding Remarks

- Accelerate the enactment of Renewable Energy Development Bill to establish a sustainable environment.
- Adjust the premium tariffs for renewable energy and rationalize energy prices of fossil fuels taking into account their external costs.
- Remove the obstacles in grid connection and power transmission to promote the power generation from renewables.
- Enhance energy productivity, and stress on energy conservation continuously.

Promoting Grid Connected RE System and
Recent Activities of Energy Conservation in Chinese Taipei

Chinese TAIPEI



Main Stadium for 2009 World Game, Kaohsiung, Chinese Taipei

Thank you for your attention.

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Thailand's current S and T and financial mechanism that support the implementation of utility based renewable energy and efficiency

By... **Paritud Bhandhubanyong**
Advisor to President of NSTDA
Thailand

APEC workshop, Hawaii, USA, March 30-April 1, 2009.

A Driving Force for National Science and Technology Capability

Organization & Mandates

National S&T Development Board
Chaired by H. E. Minister of Science and Technology

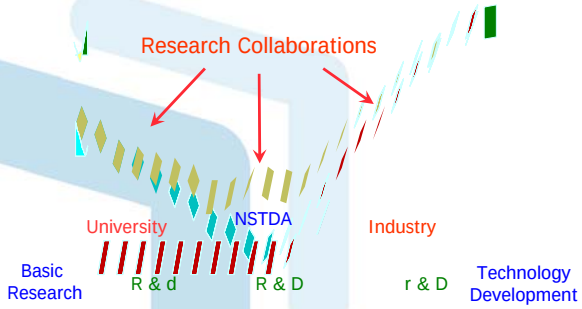
NSTDA President

BIOTEC | TMC | MTEC | NECTEC | NANOTEC

- Research, Development, Design, and Engineering
- Technology Transfer
- S&T Human Resource Development
- S&T Infrastructure Development

A Driving Force for National Science and Technology Capability

Bridging between academic and industry through coordinated S&T programs



A Driving Force for National Science and Technology Capability

NSTDA Strategic Clusters

Foods and Agriculture	Health	Software, Microchips Electronics
Automobiles	Alternative Energy	Textile and Chemical
S&T for society	Environment	Platform Technology

A Driving Force for National Science and Technology Capability

Thailand Science Park at a glance

Area: 80 Acres

Space: 90,000 square metre (200,000 M^2 for the whole project)

National Research Centers : BIOTEC, MTEC, NECTEC, NANOTEC

Space for private sector: incubator units, multi-tenant buildings, long term leased land

Projection in 3 years: 35,000 M^2 available for private sector
- 200 companies
- 4,000 knowledge workers
- turn over of $ 100 million/year

- 61 companies are already operated
- more than 10 companies are in the Pipeline

(as of March 2009)

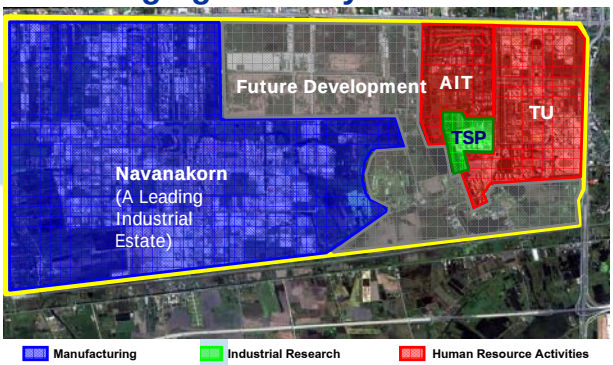
A Driving Force for National Science and Technology Capability

Thailand Science Park Phase 2

1. **Total 124,860 sq. m. gross area**
   - **40,000 sq.m. net for Private Sector**
   - **30,000 sq.m. net for NRCs**
2. **Accelerator for growth of surrounding areas**

A Driving Force for National Science and Technology Capability

An Emerging S&T City of Thailand



Manufacturing Activities | Industrial Research Activities | Human Resource Activities

A Driving Force for National Science and Technology Capability

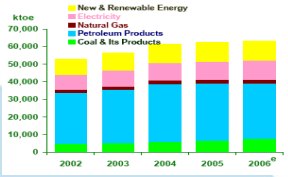
Thailand's Economy in 2007

- 65 Millions Population ~1% of World; Per capita 3,625$
- GDP $245 Billions
- Agriculture: 8.9% of GDP, 39% of Employment
- Manufacturing: 39.3% of GDP, 15.1% of Employment
- 1st Import Item : Crude Oil (15.6% of import bill)

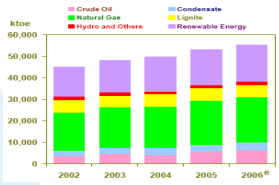
A Driving Force for National Science and Technology Capability

Thailand's Energy Situation

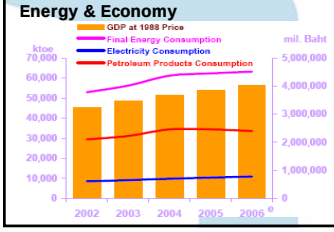
Final Energy Consumption



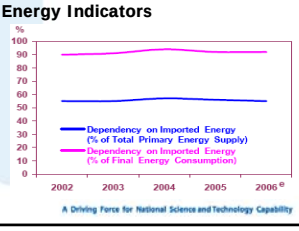
Domestic Production



Energy & Economy

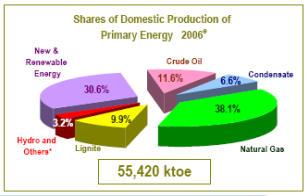


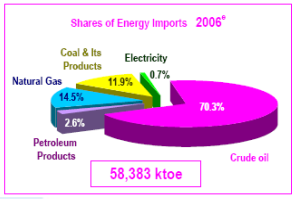
Energy Indicators

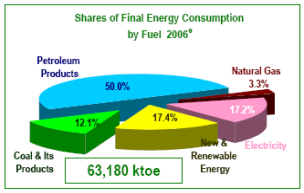


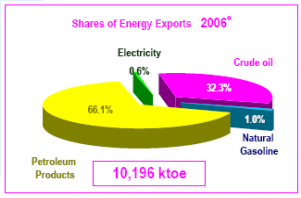
A Driving Force for National Science and Technology Capability

Thailand's Energy Situation 2006









A Driving Force for National Science and Technology Capability

VALUE OF ENERGY IMPORT

UNIT : MILLION BAHT

ENERGY TYPE	2004	2005	2006	2007
CRUDE OIL	486,627	644,933	753,783	715,789
PETROLEUM PRODUCTS	41,533	55,680	62,350	48,317
NATURAL GAS	46,053	62,827	77,843	78,901
COAL	12,275	15,422	18,896	29,656
ELECTRICITY	5,659	7,114	8,294	7,414
TOTAL	592,148	785,976	921,166	880,078

Source: Energy Policy and Planning Office (EPPO), Ministry of Energy

A Driving Force for National Science and Technology Capability

CONSUMPTION AND IMPORT (NET) OF COMMERCIAL PRIMARY ENERGY

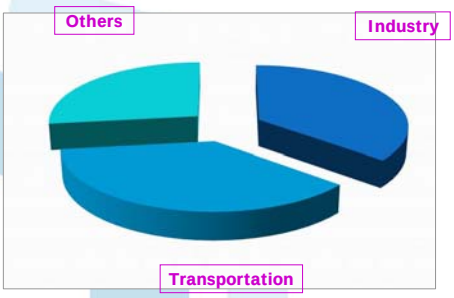
UNIT : BBL/DAY (CRUDE OIL EQUIVALENT)

	2003	2004	2005	2006	2007	2008
IMPORT (NET)	868,283	988,292	979,920	978,121	997,646	941,261
CONSUMPTION	1,346,027	1,450,114	1,519,821	1,547,765	1,606,492	1,623,874
IMPORT/CONSUMPTION	65	68	64	63	62	58

Source: Energy Policy and Planning Office, Ministry of Energy

A Driving Force for National Science and Technology Capability

Share of Final Energy by Sector 2007



Source: Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy

Thailand's Energy Strategies

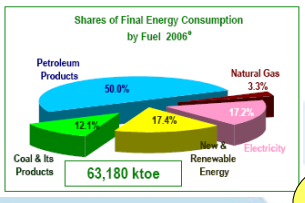
Strategies for Energy Efficiency
Reduce Energy Elasticity from 1.4:1 to 1:1 by 2007

Strategies for Renewable Energy Development
Increase share of RE from 0.5% to 8% of total final energy by 2011

Strategies for Energy Security
Ensure sufficient and reliable energy supply for at least 30 yrs

Strategies for Thailand as a Regional Energy Center
Develop Strategic Energy Land Bridge and Energy Hub

Strategies for Energy Efficiency



Transportation
Private → Public
Improving Logistics

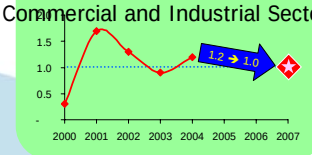
STRATEGIES for ENERGY EFFICIENCY
Energy Elasticity 1.4 → 1.0

Residential
Motivate appropriate energy use

Commercial/ Industrial
Energy Elasticity 1.2 → 1.0

Energy Efficiency (Industrial & Commercial Sector)

Energy Elasticity Commercial and Industrial Sectors

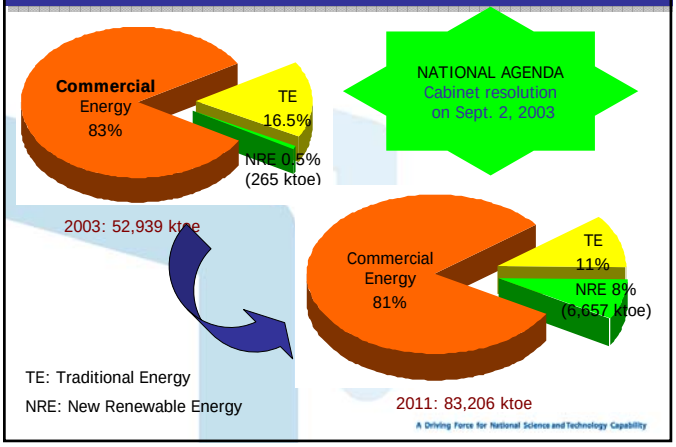


TARGET
Reduce Energy Elasticity from 1.2:1 to 1:1 by 2007

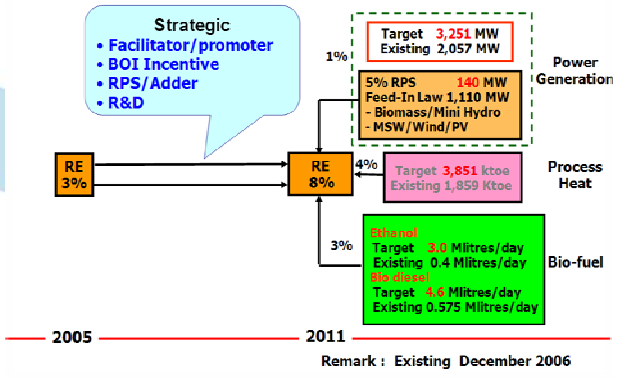
Strategies:
- Restructuring Industrial Sector
  High Energy Intensive → Low Energy Intensive
- Promoting Energy Management in Commercial and Industrial Sector
- Encouraging Supports from Financial Institutions
- Sharing Know-how & Technology

Tools:
1. Tax Incentives
2. Investment Privileges
3. Soft Loans
4. Revolving Fund
5. Energy Efficiency Regulations
6. Technical Support

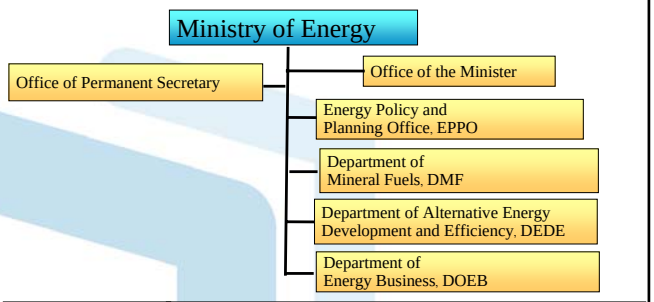
Strategies for Renewable Energy Development



RE Development Target in 2011



Organization



State Enterprise	The Electricity Generating Authority of Thailand, EGAT
Public Company	PTT Public Company Limited, PTT Bangchak Petroleum Public Company Limited, BCP
Public Organization	The Energy Fund Administration Institute, EFAI

Latest Development of Biofuels in Thailand

Gasohol Summary

Target in 2007

- Increase gasohol 95 & 91 market share to substitute ULG95, ULG91

Current consumption

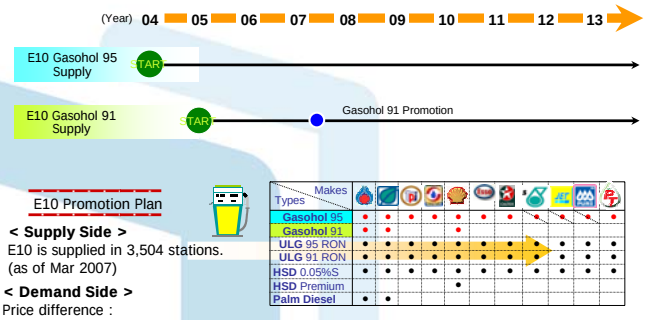
- Gasohol 3.94 million liters/day (Gasohol 95 = 3.52 & Gasohol 91 = 0.42 million liters/day)
- Gasohol service station 3,504 (as of Mar 07)

Current ethanol production

- 7 existing plants with total installed capacity of 955,000 liters/day
- 12 plants under construction with total installed capacity of 1,970,000 liters/day
- Previously, 45 companies approved for licenses
- At present, Free market fuel ethanol industry

BIOFUEL: Ethanol

Ethanol Strategic Plan



< Supply Side >
E10 is supplied in 3,504 stations. (as of Mar 2007)

< Demand Side >
Price difference :
- ULG 95 more expensive than Gasohol 95 by2.50 Baht/liter
- ULG 91 more expensive than Gasohol 91 by2.00 Baht/liter

A Driving Force for National Science and Technology Capability

Status of existing ethanol plants

Companies	Installed cap. (Liters/day)	Raw mat.	Province	Commencing date
1. Pornwilai International Group Trading	25,000	Molasses	Ayuttaya	Oct 03
2. Thai Alcohol	200,000	Molasses	NakhonPathom	Aug 04
3. Thai Agro Energy	150,000	Molasses	Suphanburi	Feb 05
4. Thai Nguan Ethanol	130,000	Cassava	Khon Khan	Nov 05
5. Khon Khan Alcohol	150,000	Molasses	Khon Khan	Jan 06
6. Petrogreen	200,000	Molasses	Chaiyabhum	Dec 06
7. Thai Sugar Ethanol	100,000	Molasses	Kanchanaburi	Apr 07
Total	955,000			

A Driving Force for National Science and Technology Capability

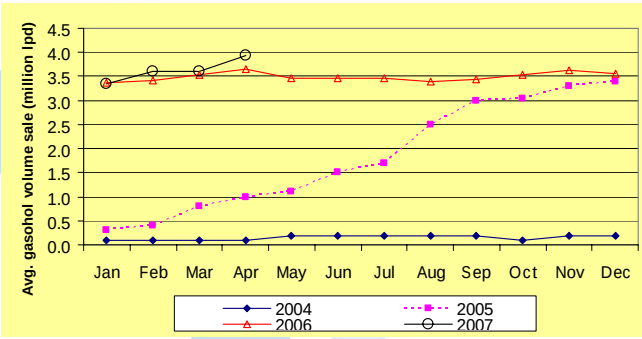
Ethanol plants under construction

Company	Installed Capcity L/d	Feedstock	Province	Expected operation
1. International Gasohol Corp.	150,000	Cassava	Rayong	Q3-Q4 07
2. Farkwanthip Co., Ltd.	60,000	Cassava	Prachenburi	Jun-07
3. Akekarat Pattana Co., Ltd.	200,000	Cassava	Nakhonsawon	Apr-07
4. K.I. Ethanol Co., Ltd.	100,000	Molasses	Nakhonratsima	Jun-07
5. Ratburi Ethanol Co., Ltd.	150,000	Cassava/Molasses	Ratburi	Nov-07
6. Thai Rungruang Co., Ltd.	120,000	Molasses	Saraburi	Dec-07
7. Petrogreen Co., Ltd.	200,000	Molasses	Kalasin	Dec-07
8. ES power Co., Ltd.	150,000	Cassava/Molasses	Sarkaew	Feb.-08
9. Sima Inter Product Co., Ltd.	150,000	Cassava	Chasengsao	Dec-07
10. Sapthip Co., Ltd.	200,000	Cassava	Lopburi	Mar-08
11. P.S.C. Starch Product Plc.	150,000	Cassava	Chonburi	Dec-07
12. TPK Ethanol Co., Ltd.	340,000	Cassava	Nakhonratsima	Early 08
Total	**1,970,000**			

Gasohol service stations

	Jan 06	Jul 06	Dec 06	Mar 07
PTT	1,209	1,197	1,211	1,204
Bangchak	664	698	690	686
Shell	545	552	548	545
Esso	203	366	503	506
Caltex	170	251	296	296
Conoco	77	77	88	88
TPI	39	38	39	36
Petronas	17	48	58	65
SUSCO	11	14	21	23
Paktai	-	-	12	3
Pure	-	-	-	52
Total	2,935	3,241	3,466	3,504

Avg. Gasohol Volume Sale



Gasohol Measures

- **Clear Policy and Target Establishment:**
  - **E10 nationwide** by the end of year 2011
- **Government Support:**
  - **BOI privilege** for fuel ethanol plant
  - **Waiver** on excise tax for the ethanol blended in gasohol
  - **Low rate** of oil fund levy
  - **Market Incentive**: retail price of gasohol95 lower than that of ULG95 of at least 4 c/liter => current price difference
    ULG91 – Gasohol91 = 7 c/liter
    ULG95 – Gasohol95 = 7 c/liter (as of 4 May 07)
- **Enforcement :** all government gasoline fleets must be refueled only gasohol
- **Public Relations:** Create confidence & trust of gasohol use to public via media i.e. TV, press conference, booklets
- **Reformed biofuel organization:** Sub-committee on ethanol under Energy Policy Administration Committee was appointed to direct and manage the development & promotion of bioethanol in Thailand efficiently
- R & D: allocate grant for research & development

Latest Development of Biofuels in Thailand

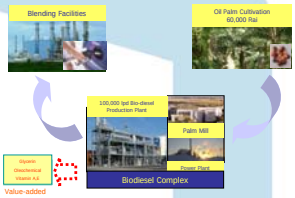
ETHANOL

BIODIESEL

Thailand Policies on Biodiesel

❶ Strategic Plan on Biodiesel Promotion and Development
(Jan 18, 05)

TARGET
Promoting Domestic Production and Use of Biodiesel to Replace 10% of Diesel Consumption in 2012.



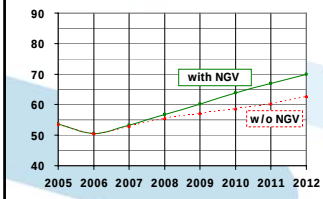
❷ Action Plan on Biodiesel Promotion and Development
(May 17, 05)

- Promote 5-million Rai palm oil cultivation within 2009.
  (6.25 Rai = 1 hectare)
- Promote community-based biodiesel production and use during 2005 – 2006.
- Promote commercial biodiesel production and B5 use from 2007.
- Enforce B5 nationwide in 2011.
- Enforce B10 nationwide in 2012.

April 2, 2007
Due to excess B100 supply,
B2 will be enforced nationwide
in April, 2008, while B5 is still optional.

BIOFUEL: Biodiesel

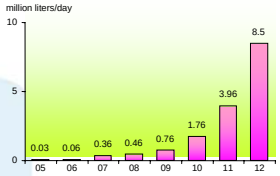
❶ Diesel Demand (Ml/day)



Diesel Demand	2008	2009	2010
with NGV	57	67	70
without NGV	56	60	63

Source: Energy Policy and Planning Office

Bio Diesel Demand



Source : Ministry of Energy and
Ministry of Agriculture and Co-operative

➲ Government policy to ensure sufficient future supply of bio diesel

❶ Increase oil palm plantation area in Thailand to 6,400 million m^2 by 2009

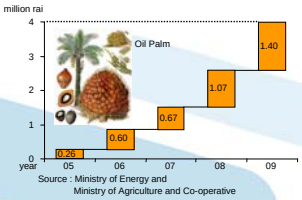
❷ grow another 1,600 million m^2 of oil palm in neighboring countries

Look for alternative raw material

A Driving Force for National Science and Technology Capability

Biodiesel: Feedstock

❶ Oil Palm Plantation Expansion



Source : Ministry of Energy and
Ministry of Agriculture and Co-operative

- Pictured here are typical 18 month old oil palms.
- Harvesting will commence 28 months from planting.

- By age 7 years the young palms have reached full maturity.
- Fruit bunches like these ripen and are harvested throughout the year.

❷ Growing oil palm in neighboring countries

Alternative Raw Material : Jatropha Curcus

- Jatropha curcus is a drought-resistant perennial, growing well in poor soil. It is easy to establish, grows relatively quickly and lives, producing seeds for 50 years.
- Jatropha produces seeds with an oil content of 37%. The oil can be combusted as fuel without being refined. It burns with clear smoke-free flame, tested successfully as fuel for simple diesel engine.

A Driving Force for National Science and Technology Capability

Commercial Biodiesel: Current Status (As of Jun 30th, 2007)

❶ SIX Potential Biodiesel Production Plants

Plant	Capacity (Ml/day)
1. Bioenergy Plus	10,000
2. Suksomboon Energy	50,000
3. Patum Vegetable Oil	80,000
4. Bangkok Renewable Energy	200,000
5. Green Power Corporation	200,000
6. AI Energy	500,000
Total	**1,040,000**

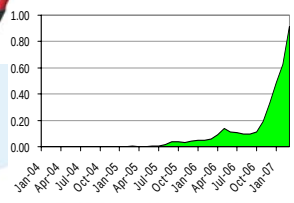
Commercial Biodiesel Standard
Enforcement: October 1, 2006

❷ TWO B5 Sellers:
- Ptt Plc. and
- Bangchak Petroleum Plc.

800 Gas Stations are selling B5 with 0.70 Baht/litre lower price than petroleum diesel. (35 Baht /US$)

❹ 1.5 million litres/day of B5 is sold in Jun 2007.

B5 Sale Volume (Ml/day)



Community-based Biodiesel

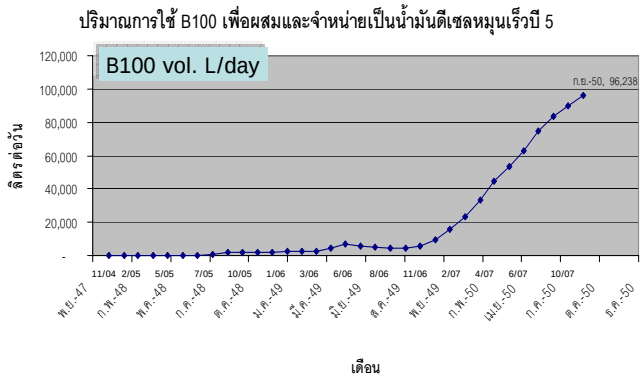
Current Status

Community-based Biodiesel

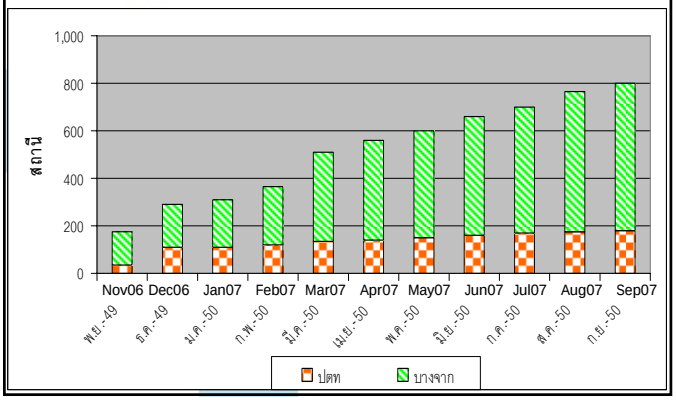
- Objectives:
  - to promote biodiesel production from local raw material
  - to replace diesel use in agricultural machines
  - to deploy sustainability and self-sufficient economy
- DEDE's Roles: Surveying, Providing Technical Support
- Community's Roles: Operating
- 72 communities are running B100 Unit from their local supply for their local use.

Community-based Biodiesel Standard
Enforcement: July 21, 2006

Biodiesel B100 = 100,000 L/d by Sept. 2007



Biodiesel Stations (PTT&BCP) Sept. 2007



Biogas Project for Tapioca Starch Factory

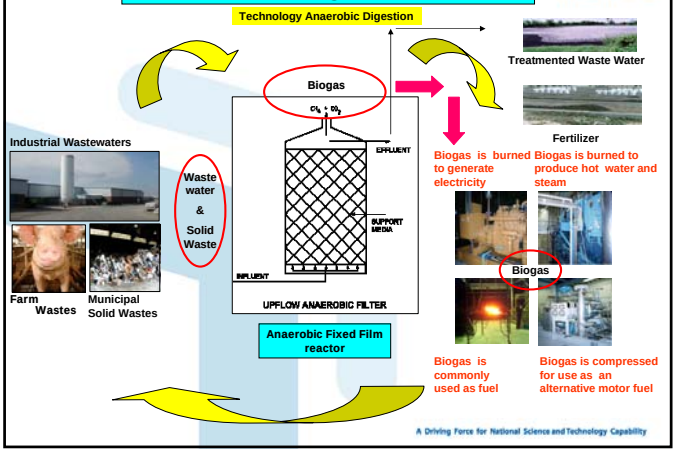
Biogas Potential in Agro-industrial Sector

	Biogas Potential			
	Energy (kTOE/y)	Power (MW_e)	EE Power (GWh/y)	Fuel oil (M. litres/y)
Tapioca starch	142.2	47.9	344.4	143.5
Palm oil	23	7.7	55.5	23
Seafood Canning	8	2.7	19.5	8.1
Fruit & Veg. Canning	1.9	1.1	4.6	1.9
Slaughterhouses	0.7	0.6	1.8	0.7
Sugar Industry	0.5	0.5	1.2	0.5
Total	176.3	60.5	427	177.8

Source: Progress report "TRF", 2006

A Driving Force for National Science and Technology Capability

Biogas



A Driving Force for National Science and Technology Capability

Anaerobic Fixed Film Reactor

- High rate anaerobic
- Single stage
- Less space
- Biofilm on media
- Higher shock load Torrance
- Suitable with high suspended solid wastewater

Total Reactor Vol. (Dia 32m x 7.5m)	12,000	m^3
Organic Loading	55,200	kg COD/d
Biogas Production	17,600	m^3/d
Equivalent to Fuel oil	8,300	litres/d

A Driving Force for National Science and Technology Capability

BIOGAS (AFFR) Project

Biogas Project for Tapioca Starch Factory

Biogas Production in Tapioca Starch Factory

Starch production	240	Ton dry starch/day
Volume of waste water	2,400	m^3/day
COD	23,000	mg/l
Organic loading	55.2	Ton COD/day
Reactor capacity	12,000	m^3
Biogas production rate	17,600	m^3/day
Equivalence to crude oil	8,270	L/day

Project CDM from Biogas in Thailand

1. Korat waste to Energy Project, Thailand Ratchaburi Farms Biogas Project
2. Ratchaburi Farms Biogas Project
3. Wastewater Treatment with Biogas System (UASB) in Starch Plant for Energy and Environment Conservation at Nakorn Ratchasima
4. **Wastewater Treatment with Biogas System (AFFR) in a Starch Plant for Energy and Environment Conservation at Chachoengsao**
5. **Northeastern Starch (1987) Co., Ltd.-LPG Fuel Switching Project**
6. Chumporn Applied Biogas Technology for Advanced Waste Water Management, Thailand
7. Natural Palm Oil Company Limited-1 MW Electricity Generation and Biogas Plant Project

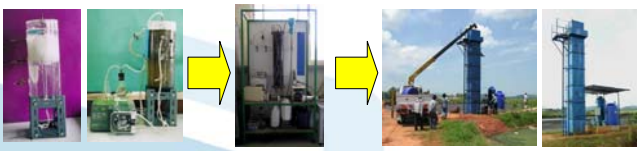
Source : office of Natural Resources and Environmental Policy Planning (8-09-50)

Biogas Project at Sima interproducts 2

Biogas Project at Northeastern Starch (1987)

BIOGAS Project in 2008

Biogas Project for Palm oil factory



5 L lab-scale study | 12.4 L lab-scale study | 6 m3 pilot-scale AHR study

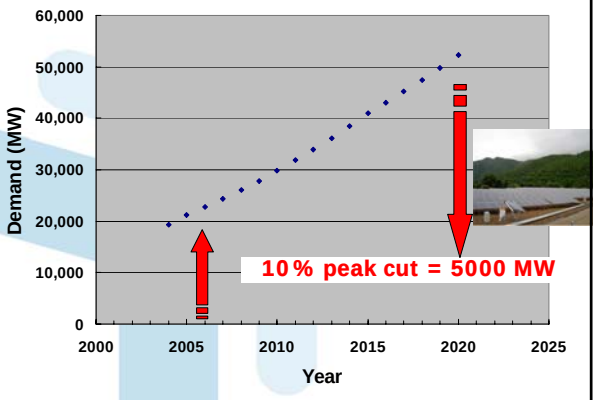
Thachana Palm.

A Driving Force for National Science and Technology Capability

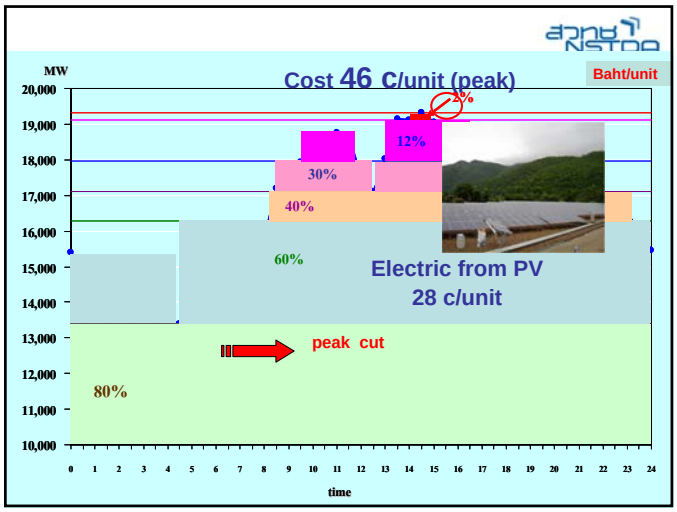
Solar Cell

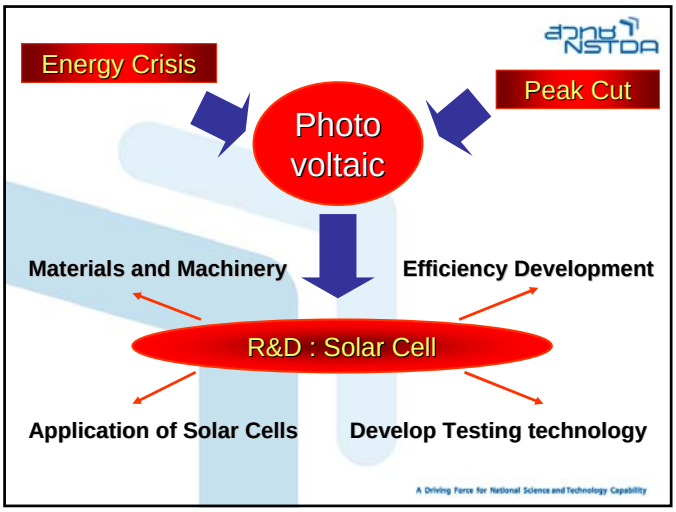
A Driving Force for National Science and Technology Capability

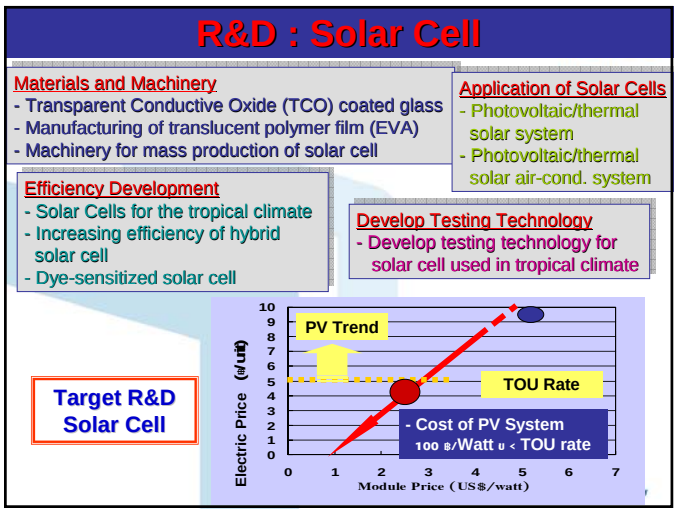
Electricity Demand (2000-2020)

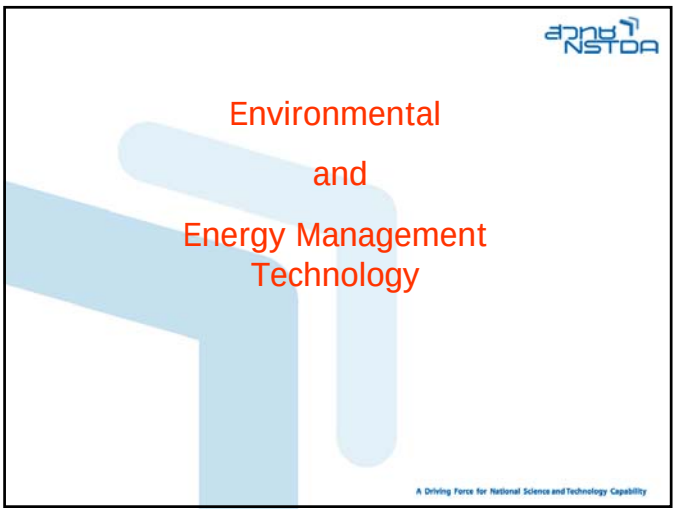


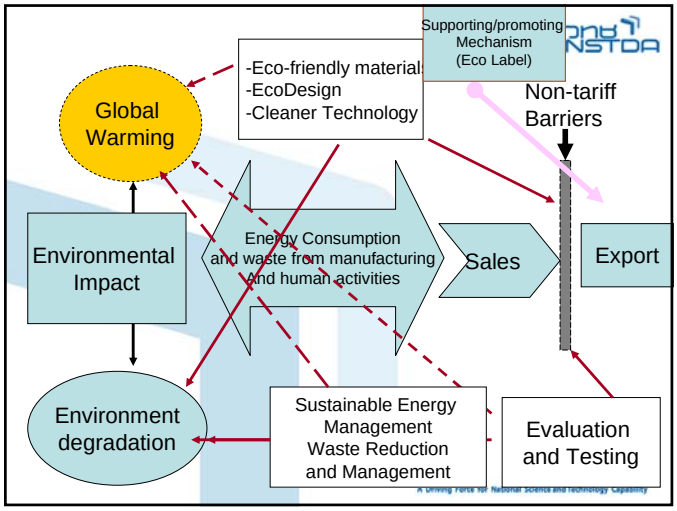
A Driving Force for National Science and Technology Capability

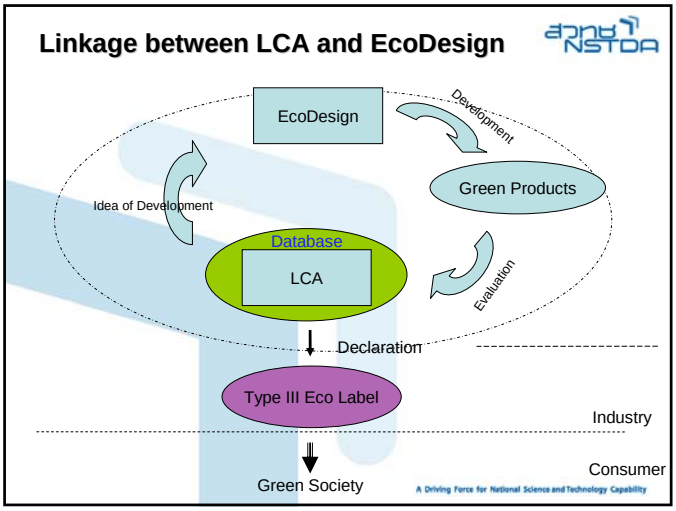

MW
Cost 46 C/unit (peak)
Baht/unit
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
2%
12%
30%
40%
60%
Electric from PV
28 c/unit
peak cut
80%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
time

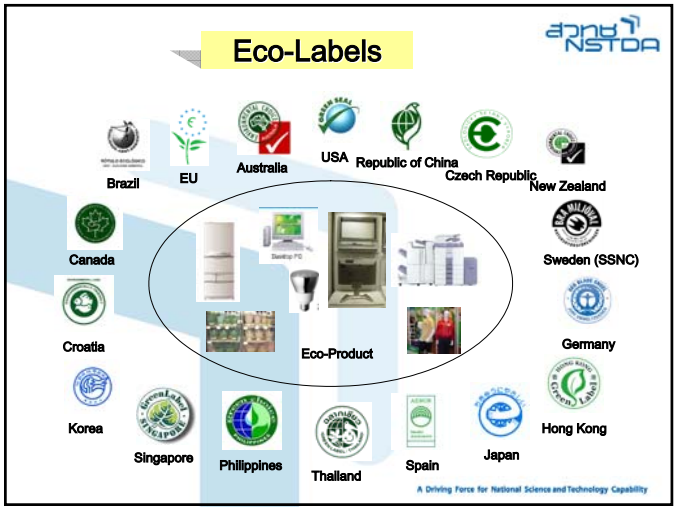

Energy Crisis
Peak Cut
Photo voltaic
Materials and Machinery
Efficiency Development
R&D : Solar Cell
Application of Solar Cells
Develop Testing technology
A Driving Force for National Science and Technology Capability

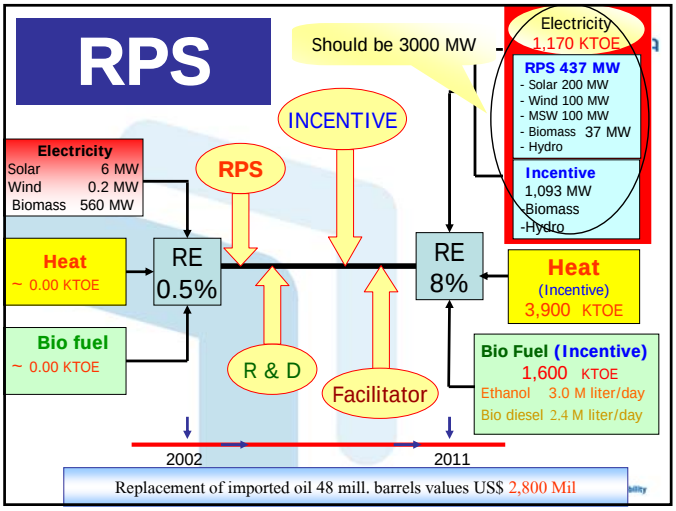

R&D : Solar Cell
Materials and Machinery
- Transparent Conductive Oxide (TCO) coated glass
- Manufacturing of translucent polymer film (EVA)
- Machinery for mass production of solar cell
Application of Solar Cells
- Photovoltaic/thermal solar system
- Photovoltaic/thermal solar air-cond. system
Efficiency Development
- Solar Cells for the tropical climate
- Increasing efficiency of hybrid solar cell
- Dye-sensitized solar cell
Develop Testing Technology
- Develop testing technology for solar cell used in tropical climate
Target R&D Solar Cell
PV Trend
TOU Rate
- Cost of PV System
100 ฿/Watt < TOU rate
Electric Price (฿/unit)
Module Price (US$/watt)


Environmental
and
Energy Management
Technology
A Driving Force for National Science and Technology Capability


Supporting/promoting Mechanism (Eco Label)
-Eco-friendly material
-EcoDesign
-Cleaner Technology
Non-tariff Barriers
Global Warming
Environmental Impact
Energy Consumption and waste from manufacturing and human activities
Sales
Export
Environment degradation
Sustainable Energy Management
Waste Reduction and Management
Evaluation and Testing


Linkage between LCA and EcoDesign
EcoDesign
Development
Green Products
Idea of Development
Database
LCA
Evaluation
Declaration
Type III Eco Label
Industry
Consumer
Green Society


Eco-Labels
Brazil
EU
Australia
USA
Republic of China
Czech Republic
New Zealand
Canada
Sweden (SSNC)
Croatia
Germany
Eco-Product
Korea
Singapore
Philippines
Thailand
Spain
Japan
Hong Kong


RPS
Should be 3000 MW
Electricity 1,170 KTOE
RPS 437 MW
- Solar 200 MW
- Wind 100 MW
- MSW 100 MW
- Biomass 37 MW
- Hydro
Incentive
1,093 MW
Biomass
-Hydro
INCENTIVE
Electricity
Solar 6 MW
Wind 0.2 MW
Biomass 560 MW
RPS
Heat
~ 0.00 KTOE
RE 0.5%
RE 8%
Heat (Incentive)
3,900 KTOE
Bio fuel
~ 0.00 KTOE
R & D
Facilitator
Bio Fuel (Incentive)
1,600 KTOE
Ethanol 3.0 M liter/day
Bio diesel 2.4 M liter/day
2002
2011
Replacement of imported oil 48 mill. barrels values US$ 2,800 Mil

RPS: Renewable portfolio Standard

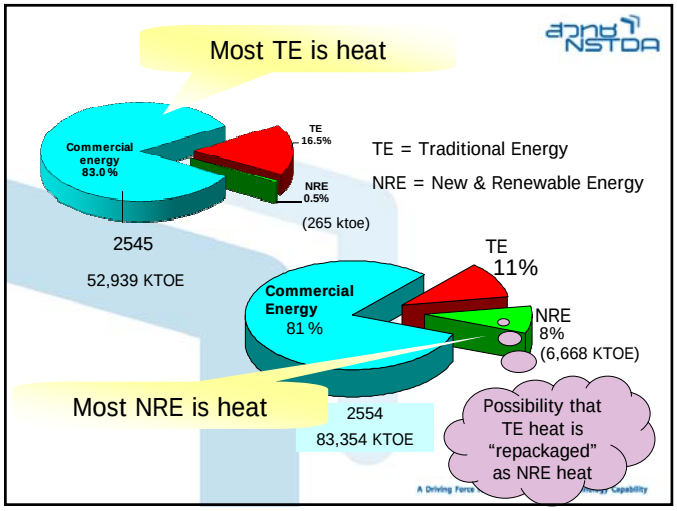
- **Renewable Portfolio Standard (RPS):** obligates each retail seller of electricity to include in its resource portfolio a certain amount of electricity from renewable energy resources.
  - The retailer can either:
    - (a) owning a renewable energy facility and producing its own power, or
    - (b) purchasing power from someone else's facility.
  - RPS rules can allow retailers to "trade" their obligation.

RPS: Renewable portfolio Standard

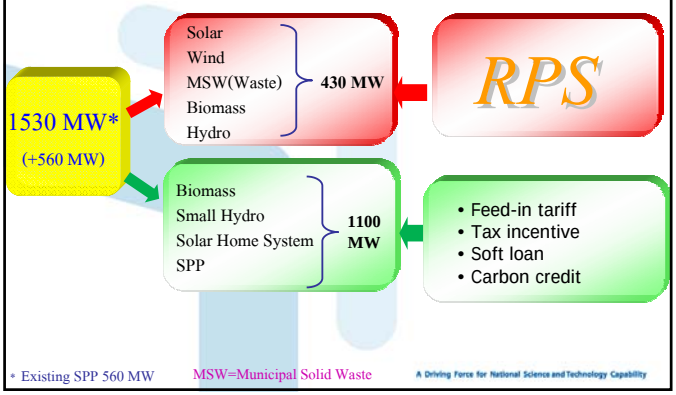
Concerns about Thai RPS

- In other countries, RPS requires functioning wholesale market
- Needs independent regulator
- RPS favors large developers over small
- RPS has mixed track record
- In Thai version, only applies to new fossil generation.
  - Ties new renewable development to development of fossil generation
  - Big hydro exempted from obligations
- In Thai version obligation based on MW rather than GWh encourages gaming

See more at:
http://www.palangthai.org/en/docs/sustain.pdf



RPS: Renewable portfolio Standard



* Existing SPP 560 MW MSW=Municipal Solid Waste

feed-in tariff in Thailand

Paid per kWh of electricity generated

- a guaranteed power sales price
- a guaranteed market (electric utilities must take)
- Favors smaller renewable energy producers
- Simple
- Less prone to cheating

feed-in tariff in Thailand

Feed–in Tariff Mechanism

- The Feed-in Tariff mechanism completed below are based on 2006 estimate load factors and calculate the Feed-in Tariff that would be required if 6% or 8% of delivered energy was derived from RE projects
- The reality is that in 2006 Thailand has only approximately 640 MW which results in only approximately 4500 GWhr of delivered energy to the Thai electricity grids
- On the basis the MoE could employ a step approach to the imposition of the surcharge on delivered energy whether applied to all delivered energy or only on non-RE energy delivered

feed-in tariff in Thailand

Surcharge on delivered energy to support…… RE policy objective

2006 Estimated delivered energy	140,287 GWhr	
Surcharge on delivered energy	*USD 0.0014/KWhr	
Contribution to Feed-in Tariff Fund	USD 197.42 million	
Proposition of delivered energy From RE Projects	8%	6%
Total contribution on RE Projects	11,223 GWhr	8,417 GWhr
Average Feed-in Tariff available	USD 0.017/KWhr	USD 0.023/KWhr

Based on Thailand Load Forecast dated 27 July 2006 by Thailand Load Forecast Subcommittee.
Source: EPPO

*1 USD = 35.53 THB

feed-in tariff in Thailand

Surcharge on non-RE energy to support RE policy objective charged to Non-RE energy generators

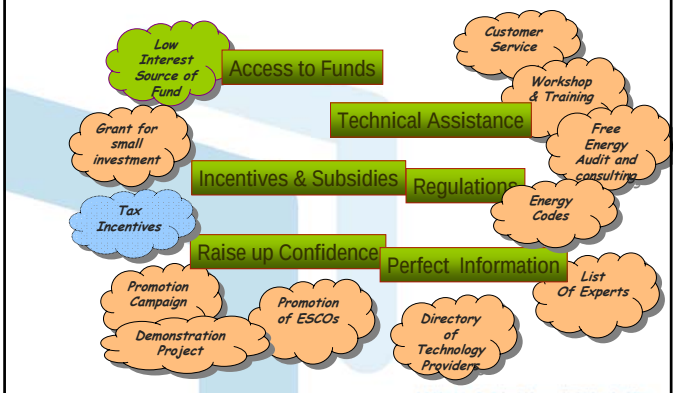
2006 Estimated delivered energy	140,287 GWhr	
Proposition of delivered energy From RE Projects	8%	6%
Total contribution on RE Projects	11,223 GWhr	8,417 GWhr
Total contribution from non-RE Energy	129,064 GWhr	131,870 GWhr
Surcharge on Non-RE delivered energy (Charged to generator)	USD 0.0001/kHhr	USD 0.0001/kHhr
Contribution to Feed-in Tariff Fund	USD 199.55 million	USD 204.05 million
Average Feed-in Tariff available	USD 0.018/kHhr	USD 0.024/kHhr

feed-in tariff in Thailand

	Cost of Energy (USD/kWh)	Feed-in-Tariff (USD/kWh)
Biomass (Empty Fruit Bunch)	0.06	0.08
Landfill Gas (MSW)	0.25	0.22
Incinerator (MSW)	0.48	0.58
Biogas (MSW)	0.37	0.45
Biomass (Gasifier)	0.07	0.09
Biogas (Pig farm)	0.05	0.08
Biomass (Rice Husk)	0.07	0.08
Wind	0.06	0.11
PV	0.31	0.81

Source: Energy for Environment Foundation

Create Conducive Environment for EE Investment



Cooperative Efforts on Energy Management

- Objective: Sustainable energy management through internal cooperative efforts
- Methodologies
  - Educate on concept & method + evaluation
  - Help create and implement EC measures

➢ **Achievement**

- ✓ Implemented 500 facilities
- ✓ Introduced house-keeping measures
- ✓ Energy saving of 5-10% for each facility
  (simple payback of 2.5 yrs)

Revolving Fund for EC Projects

- Budgets allocation from ECP Fund
- Loan approval by Bank
- Technical assistance by DEDE
- Key conditions
  - ✓ Loan size ≤ 1.2 mill USD/project
  - ✓ Interest rate less than 4% (fixed rate)
  - ✓ Repayment in the defined time frame (7yr)

Present Status

- **82 approved and under construction projects with leverage 80 million USD of EC Investment**
- **Average investment 1 mill USD / a project & average payback 2.3 yrs**
- **Annual savings > 250 GWh and 91 mill. liter of fuel oil**

Cost Based Tax Incentive

- 25% Tax Break for the Investment in EE Projects Result in Efficiency Improvement
- Applicable for the First 50 mill baht Investment (1.25 mill USD)
- Incentive Spread Over 5 Years

Performance Based Tax Incentive

- 100% of achieved energy saving will become tax deduction
- Max Incentive of 2 million baht (50,000 USD) / Facility
- Pre and Post Audit will be required

Incentive through ... Board of Investment (BOI)

Import duties and Cooperate tax exemption on new investment in...

Energy conservation business

- High efficiency machine or equipment and renewable energy equipment manufacturing
- Solar PV manufacturing
- Energy Service Company – ESCO

Renewable energy production business

- Alcohol or fuels from agricultural products
- Electricity or steam generation

Incentive last for the max period of 8 years

Promotion of ESCOs

- **BOI – Tax Incentive**
  - Maximum 8 years tax exemption for ESCO projects
  - Cooperate Income tax
- **Access to Revolving Fund**
  - Eligible to borrow the low-interest loan from RF program on project-by-project basis
- **ESCO promotion activities**
  - Website
  - Seminars, workshop
  - Publications
  - Lists of ESCOs and successful cases

Conclusions

- Application of RE and promotion of EE, the two prongs of Thai Government
- Positive trend in liquid biofuel application
- Investment promotion for RE facilities
- RPS and Feed-in tariff for utilities based RE
- IPP, SPP, and VSPP are just starting

Acknowledgement

- **Dr. Boonrod Sajjakulnukit**
  Department of Alternative Energy Development and Efficiency
  Ministry of Energy
- **NSTDA,** Ministry of Science & Technology
- **Energy for Environment Foundation**
- **EPPO**
- **BOI**
- **Ms.Jiratchaya Duangburong, ADO Office, NSTDA**

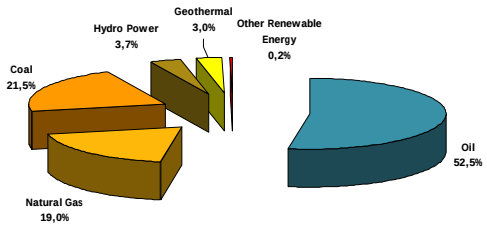
A Driving Force for National Science and Technology Capability

RENEWABLE ENERGY POLICY IN INDONESIA

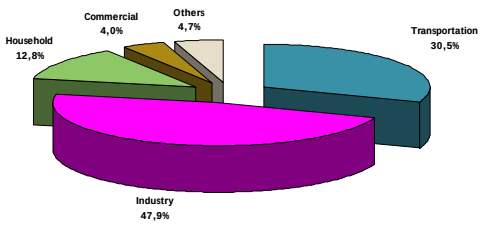
Andi Novianto

Presented at APEC EGNRET Meeting
Honolulu, March 29-April 3, 2009

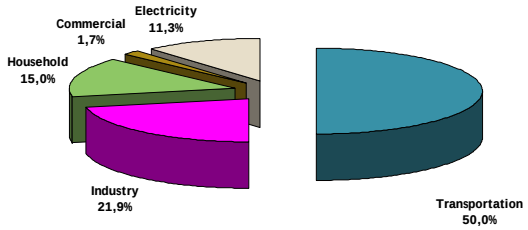
Energy Mix Situation:



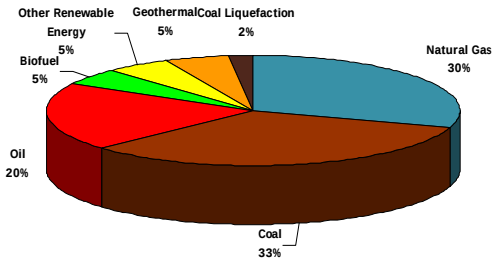
Industry is The Largest Consumption of Energy:



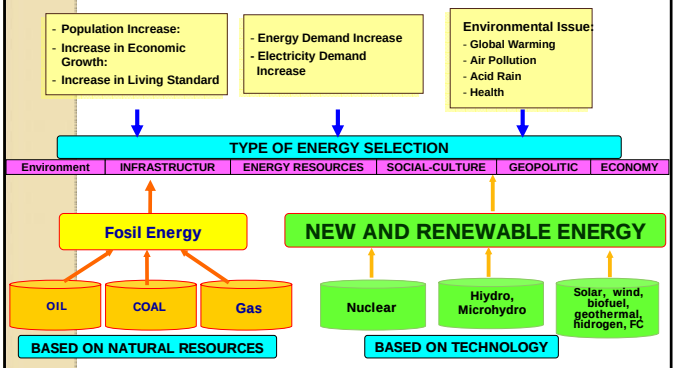
PETROLEUM FUELS CONSUMPTION :



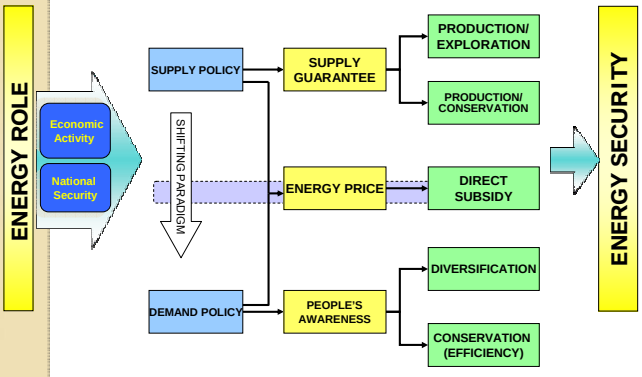
TARGET ENERGY MIX 2025 :



NATIONAL ENERGY PLANNING to 2025:



ENERGY POLICY FRAMEWORK:



RENEWABLE ENERGY POTENCY:

NON FOSSIL ENERGY	RESOURCES	UTILITY CAPACITY
Hydro Power	75,670 MW	4,200 MW
Geothermal	27,000 MW	1,042 MW
Mycro Hydro	450 MW	210 MW
Biomass	49,810 MW	445 MW
Solar Energy	4,80 kWh/m²/day	12 MW
Wind Energy	3-6 m/second	2 MW

New and Renewable Energy Development

TARGET:

- **Short & Medium Term :**
  - Small scale for fulfilling basic energy need for rural area
  - Intensification use of hydro, geothermal, solar and win energy for electricity generation
  - Development of Biofuel
- **Long Term :**
  - Development of new energy (fuel cells, hydrogen)
  - Development of Nuclear Energy
  - Development of Unconventional energy sources (tar/oil sand, biogenic gas, etc)
- **In the year 2025 :**
  At least 15% of the energy mix should be based on renewable energy (Presidential Decree 5/2006)

RENEWABLE ENERGY DEVELOPMENT

1. **Electricity generation**
   - Generated from new renewable energy sources such as microhydro, solar, wind, biomass;
   - Priority for diesel fuel substitution for electricity generation in rural area and for rural electrification
2. **Fuel**
   - Currently, it is generated from biomass;
   - Priority for petroleum-based fuel substitution in transportation sector and kerosene substitution in household sector
3. **Thermal/mechanical energy uses**
   - Can be generated from mostly renewable energy sources;
   - Current applications are for agricultural food processing, water pumping;
   - Technologies are suitable for rural implementation.

RENEWABLE ENERGY PROGRAM (1)

1. **Program on Rural Electrification** : to provide access on electrification for rural communities; since 2005 the government has been decided not to utilize diesel genset and only to implement locally available renewable energy (if the extension of grid is impossible).
2. **Program on Interconnention of Renewable Energy Power Generation** : as an innitiative for investor to develop small/medium scale power generation from renewable energy to sell of electricity to PLN (state electricity company) with standardized price following government regulation.
3. ***Integrated Microhydro Development Program*** (IMIDAP) : a hibah from GEF through UNDP for 2007-2012 to acclerate microhydro implementation by removing existing barriers.
4. ***Micro Hydro Power Program (MHPP)*** : technical cooperation with Germany through GTZ to develop capacities on technology and sustainability of microhydro implementation.

Renewable Energy Program (2)

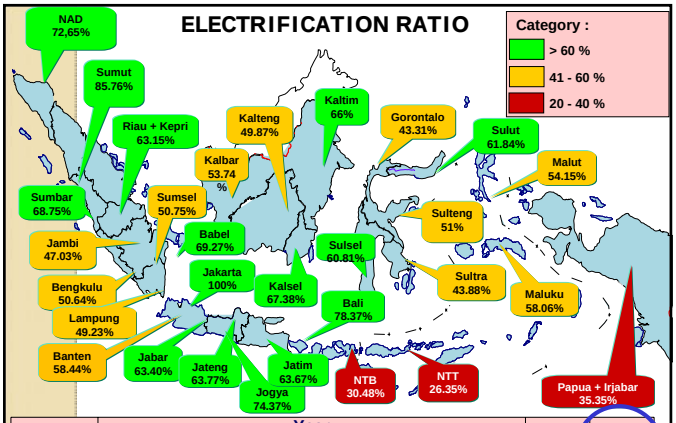
5. **Program on Urban Solar** : launched in 2003 to support solar photovoltaic implementation in urban society. The results are not significant yet
6. **Program on Biogas :** launched in January 2008 in cooperation with Dutch government; consists of technical assistance and financing mechanism development system.
7. **Program on Energy Self-Sufficient Village** : launched in 2007 to improve energy security on village level by diversifying rural energy mix; developing locally available renewable energy sources in the form of fuel (biofuel) and electricity for household and also productive end uses.
8. **Program on regulation preparation :** as mandated by Energy Law.

☼ *Self-sufficient Energy Village (SSEV) Program*

- ❖ **SSEV is a village having capability to produce a part/whole their energy demand for consumptive and productive use.**
- ❖ **CRITERIA**
  - Utilization of locally available energy (renewable energy)
  - Creation of productive activities
  - Job creation
- ❖ **PROGRAM:**
  - Utilization of locally available energy resources
  - Development of productive activities
  - Development of applicable technologies
  - Development of institution and people participatory

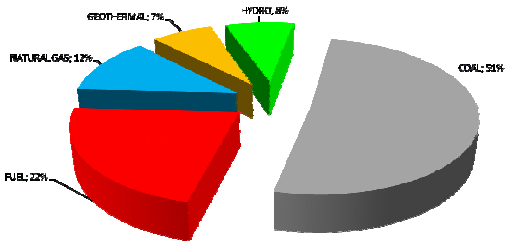
ELECTRICITY OBJECTIVES:

- INCREASE ELECTRIFICATION IN HOUSEHOLD SECTORS (RURAL - URBAN) AND INDUSTRY IN EFFICIENT AND ENVIRONMENTAL WAYS TO SUPPORT ECONOMIC GROWTH AND PEOPLES' WELFARE.

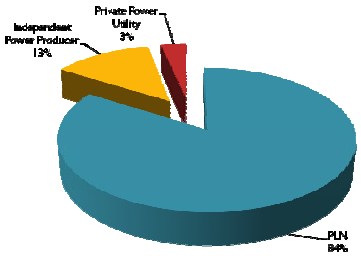


	Year								
	1980	1985	1990	1995	2000	2005	2006	2007	2008
Electrification Ratio	8%	16%	28%	43%	53%	62%	63%	64 %	64.5

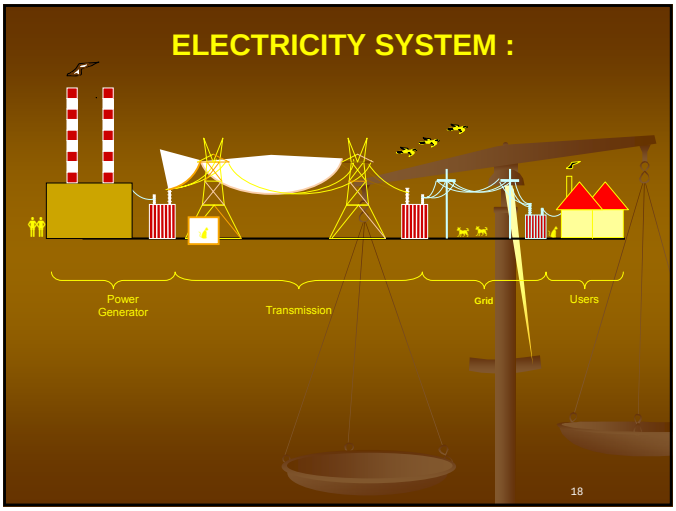
ELECTRICITY SOURCES:



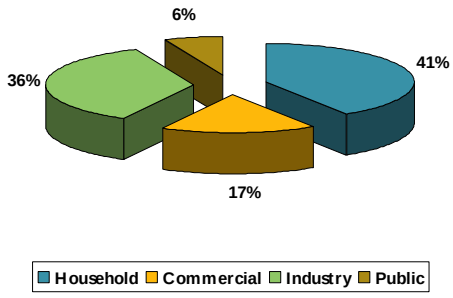
ELECTRICITY UTILIZATION SHARE:



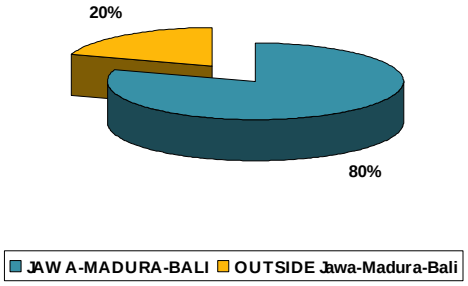
ELECTRICITY SYSTEM :



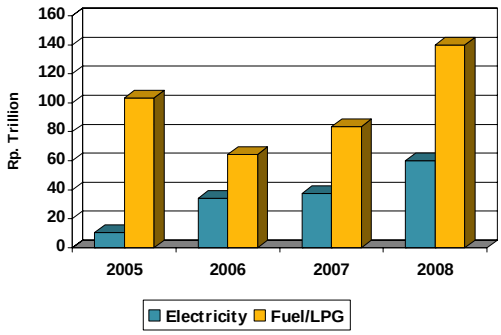
SALES TARGET BY PLN-2008 (TWh) :



ELECTRICITY BY REGION :



GOVERNMENT SUBSIDY :



SUPPORT POLICY TO RENEWABLE ENERGI:

- Non Fiscal Incentives through Regulation.
- Support Small-Medium Scale Power Connection Program at Medium and Low Grid.
- Non Uniform Tariff, based on Region, Peoples' Capability, and Sources.

APEC EGNRET-32 WORKSHOP

RECENT ADVANCES IN UTILITY BASED FINANCIAL MECHANISM THAT SUPPORT ON-GRID RENEWABLE ENERGY

Ario Senoaji

PT PLN (Persero)

March, 30 – April 3, 2009, Honolulu, Hawaii

PT PLN (PERSERO)
PUBLIC STATE ELECTRICITY CORPORATION

- Task:
  - Public service obligation on electricity service
  - As an electricity company
- System
  - Interconnection: Java-Bali and the majority of Sumatera
  - Others are still isolated
- Total installed capacity: 29,500 MW
  - PLN: 26,000 MW (88.6%)
  - IPP: 3,500 MW (11.4%)

PLN POWER PLANT DEVELOPMENT POLICY

- Non oil power plant development
- Non oil primary energy utilization (coal, natural gas etc) for PLN power plant
- Utilization of alternative-renewable energy sources (hydro power, geothermal, biomass, biofuel, solar, wind etc.) as long as in technically & financially feasible
- Reduce of oil consumption for power plant operation composition from 33 % (2007) to 2 % in 2018 (RUPTL-Electricity Supply General Plan 2009-2018)

OIL TO ALTERNATIVE ENERGY CONVERSION PROGRAM

Alternative Energy

- Renewable Energy utilities (geothermal, hydro, solar, wind)
- New Energy utilization (biomass, biogas etc)
- Coal gasification
- Biofuel/Biodiesel utilization

UTILIZATION OF RENEWABLE-ALTERNATIVE ENERGY FOR POWER PLANT

- Feasible in technical, economical and financial aspects
- As a substitution of diesel PP, to reduce oil consumption
- Majority from small scales in rural areas, especially for outside of Java island
- Developed by private participation and PLN as a partnership
- Availability of infrastructure support to reduce investment cost

Policies and Regulation on Renewable Energy for Electricity Generation

1. Regulation on Electricity Supply and Utilization (Government Regulation No. 26/2006)
   - As a revision of Government Regulation No. 10 Year 1989 in order to secure national electricity.
   - Relation with new renewable energy development:
     - Putting priority to utilize locally available renewable energy resources for electricity generation;
     - Process of procurement is implemented through direct selection (without tender)

Policies and Regulation on Renewable Energy for Electricity Generation

2. Small Distributed Power Generation Scheme for Renewable Energy (Ministerial Decree: No. 1122 K/30/MEM/2002)
   - **Developer : Small Enterprises**
   - **Capacity : ≤ 1 MW**
   - **Electricity Price by Utility :**
     - **60% x Utility's Production Cost, if connected to the low voltage grid**
     - **80% x Utility's Production Cost, if connected to the medium voltage grid**

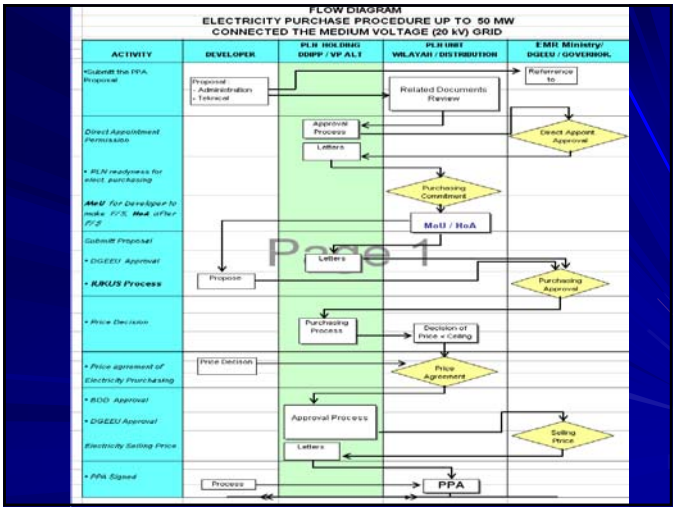
Policies and Regulation on Renewable Energy for Electricity Generation

3. Medium Scale Power Generation Scheme for Renewable Energy (Ministerial Regulation : No. 002/2006)
   - **Developer : Business Entity**
   - **Capacity : 1 < Cap ≤ 10 MW**
   - **Electricity Price by Utility :**
     - **60% x Utility's Production Cost, if connected to the low voltage grid**
     - **80% x Utility's Production Cost, if connected to the medium voltage grid**
   - **Purchase Contract : 10 years and could be extended**

Capacities, Contracts (PPA), Regional production cost and its declaration

Procedure

- Procedure of Renewable Energy Power Plant Development by Independent Power Producers (IPP) in PLN



Pricing Policy

- The price is Levelized Ceiling Price
- Capacity classification :
  - Up to 1 MW
  - 1 MW to 10 MW
  - > 10 MW
- Staging Price applied for :
  Up to 10 MW: 5 years first &10 yrs second
  > 10 MW : 10 years first & 20 yrs second

Financial Indicators

- For up to 10 MW :
  - IRR on equity : interest + margin (7%)
  - Interest : BI* rate + spread (5%)
- For > 10 MW :
  - IRR on equity : interest + margin (5%)
  - Interest : 6 month-LIBOR + spread (5%)

* : Indonesia Central Bank

THANK YOU

The Philippines' Current Financial Mechanisms that Support the Implementation of Utility Based Renewable Energy and Efficiency***

Dr. N. A. Orcullo, Jr.
Professor, De La Salle University-Dasmariñas,
Cavite, Philippines

*** Presented during the APEC workshop on " Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy " held at the Sheraton Waikiki Hotel, Hawaii, USA, March 30-April 1, 2009.

Presentation outline

1. Philippine renewable energy sources
2. Legal mandates
3. Overall policy for renewable energy development
4. Long-term objectives for RE of the policy framework
5. Renewable energy development status
6. Electricity grid system
7. Grid system and WESM
8. Power situationer at the regional grid system
9. Role of DOE, ERC and WESM
10. NRET projects connected to the grid
11. CEPALCO PV project
12. NorthWind Power Wind Farm
13. Montalban Methane Power
14. NRET Power sales
15. Financing/ Incentive schemes

Philippine renewable energy resources

A US-NREL study shows the following:

- **Wind resources – over 10,000 km^2 with 76,000 MW of potential installed capacity.**
- **Micro-hydro applications – potential capacity of at least 500 KW in Luzon and Mindanao islands**
- **Solar radiation nationwide – an annual potential average of 5.0 – 5.1 KWh/m^2/day**
- **Mini-hydro potential capacity of 1,784 MW capacity for 888 sites**
- **Ocean energy resources – potential CAPACITY OF ABOUT 170,000 MW**
- **Biomass (Bagasse) total potential of 235 MMBFOE**

Source: New and Renewable Energy Laboratory (USA) – E. Karunungan (Department of Energy, Philippines

Legal mandates, motivating laws and policies

1. Presidential Decree 910 (Energy Development Board) – 1976
2. Presidential Decree 1206 (DOE Charter) – 1976
3. Presidential Decree 1068 (NERDP Program) - 1977
4. Foreign Investment Act (RA 7042/RA 8719) - 1991
5. Executive Order 215 (BOT projects) – 1995
6. Executive Order 462/AEO 232 - 1997
7. DOE New Charter (RA 7638) – 1992
8. BOT Law (RA 6967/RA 7718) – 1994
9. Clean Air Act (RA 1234) – 1999
10. Ecological Solid Waste Management Act (RA 9003) - 2000
11. EPIRA Law (RA 9136) - 2001
12. Biofuels Law (RA 9367) - 2006
13. Renewable Energy Law (RA 9513) - 2008

EPIRA Law vis-à-vis NRET generation ventures

1. EPIRA LAW Categorized the major electric power sector into 4 sectors namely: generation, transmission, distribution and supply;
2. EPIRA Law demonopolized/privatized power generation secto;.
3. EPIRA Law established wholesale electricity spot market (WESM), Power Sector Assets and Liabilities Management I PSALM), and National Transmission Company (TRANSCO);
4. EPIRA Law made it a state policy to develop indigenous and renewable energy sources of energy;
5. Prices charged by power generation companies is not regulated and the law itself appeared investor-friendly;
6. EPIRA requires/encourages open access and market competition in power generation;
7. EPIRA allows distribution companies to have bilateral agreements as to sourcing of electricity allowing opportunities for NRET power generation projects.

Relevant provisions under the RE Law

1. Legal and policy commitment to develop and support NRET programs/projects;
2. Transformation of DOE Alternative Energy Division into fully-staffed bureau;
3. Establishment of a National Renewable Energy Board;
4. Encouragement of private sector investments/participation in NRET projects;
5. Variety of incentives to private investors in NRET projects;
6. Financial support from local, foreign and other sources
7. Mandatory and priority connection of RE to the electricity grid;
8. Having a Renewable Energy Portfolio Standards;
9. Putting in place the net metering mechanism;
10. Mandatory feed-in tariff scheme (Price premium for RE power)
11. Establishment of Renewable Energy Market (REM/WESM)
12. Entitlement to Renewable Energy Certificates
13. Concern for Kyoto Protocol and UN Clean Development Mechanism
14. Broad powers of DOE to allow more private investments in grid-connected NRETs (e. g., Wind power contracting, etc.)

Overall policy for RE development

1. Renewable energy policy framework launched in 2003.
2. Policy bias towards the development and utilization of renewable energy:
   a) Promote more private sector participation in RE development
   b) Encourage the use of renewable energy in rural and off-off grid electrification
   c) RE projects given " priority " for special incentives
3. A renewable energy law to promote development and utilization of clean energy. Renewable Energy Law already in place (RA 9513) and Implementing Rules and Regulation (IRR) now under national consultation process with final version due on or before mid 2009.

Long-term objectives of RE policy framework

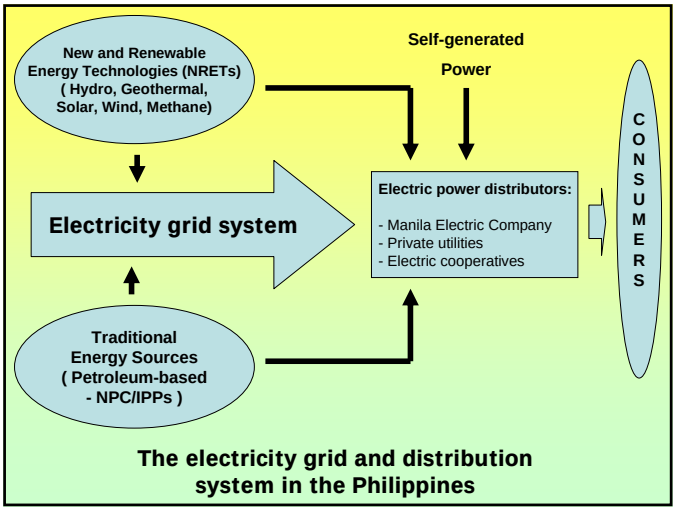
1. Increase RE-based capacity by 100 % - " 100 – 10 "
2. Be the number 1 geothermal energy producer in the world.
3. Be the number 1 wind energy producer in Southeast Asia
4. Double hydro electric capacity.
5. Be the solar cell manufacturing hub in ASEAN.
6. New contribution of biomass, solar and ocean energy by more than 100 MW
7. Increase non-power contribution of RE to energy mix by 10 MMBFOE with the next 10 years.

Source: E. Karunungan (Department of Energy), Philippines

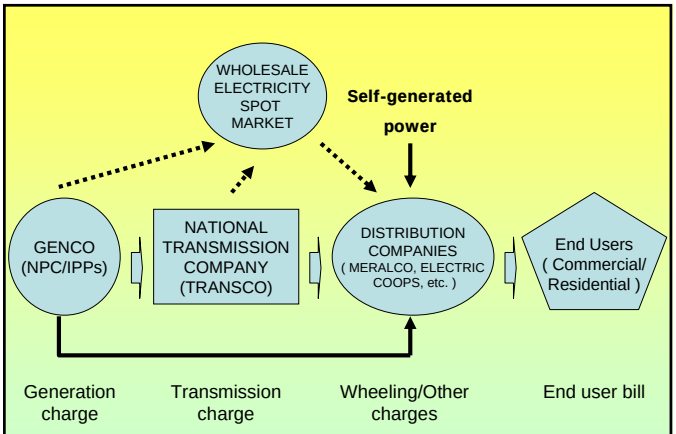
Renewable energy development projects status

Resource	Existing capacity (MW)	Number of plants in operation	On-going projects
Geothermal	2,027.07	14 geothermal plants	10 projects offered to private investor (300 – 500 MW)thru Contracting Round
Hydro	3,367.07	21 large hydro, 52 mini-hydro, 61 micro hydro	4 mini-hydros, 14 large hydro under evaluation
Wind	33.2	33 MW In Ilocos Norte, 5 KW Camarines in 180 KW in Batanes, 6 KW in Boracay	NPDC wind farm, 7 sites on resource assessment
Solar	5.161	960 KW – CEPALCO, Cagayan e Oro 729 KW Camarines Sur	Sunpower Phil Solar Plant/rural electrification projects
Biomass	20.93		1 MW Isabela
Ocean			R & D activities – Demo projects in Leyte/Mindanao

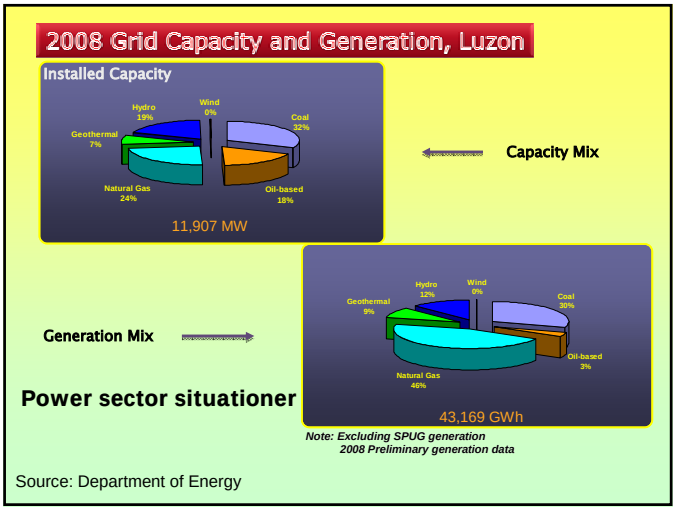
Source: E. Karunungan (Department of Energy)/Philippine Daily Inquirer



The electricity grid and distribution system in the Philippines

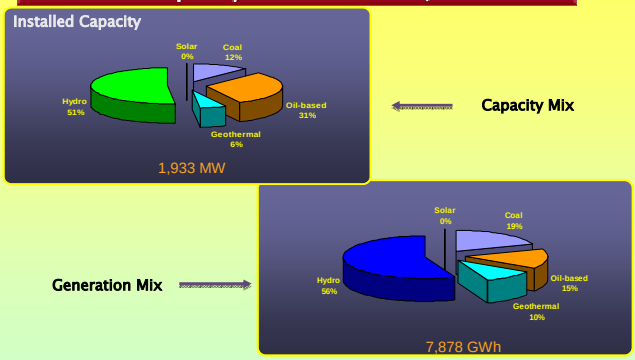


The power distribution system and WESM



Source: Department of Energy

2008 Grid Capacity and Generation, MINDANAO

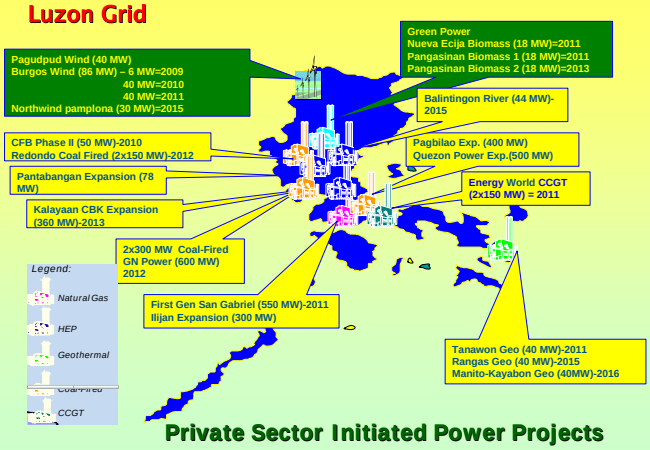


Power sector situationer

Note: Excluding SPUG generation
2008 Preliminary generation data

Source: Department of Energy

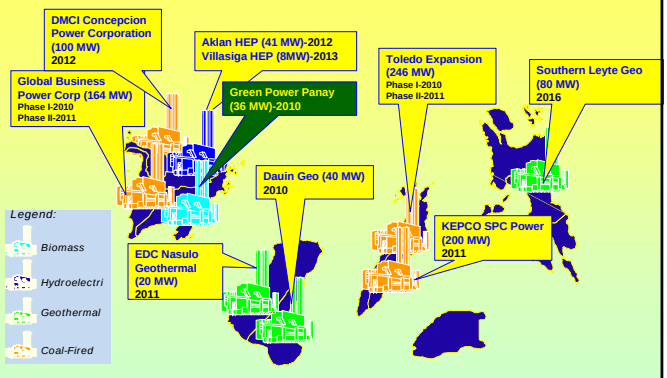
Luzon Grid



Private Sector Initiated Power Projects

Source: Department of Energy

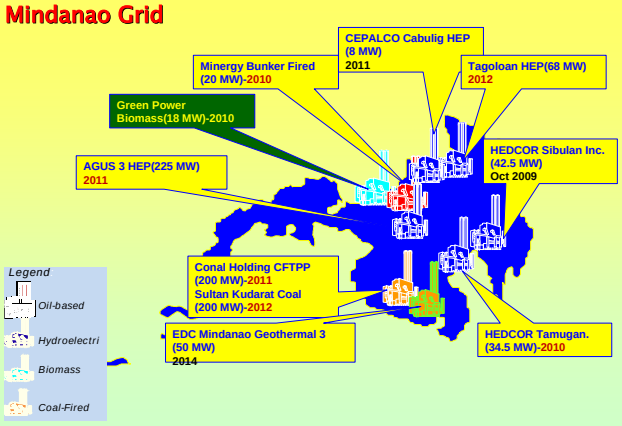
Visayas Grid



Private Sector Initiated Power Projects

Source: Department of Energy

Mindanao Grid



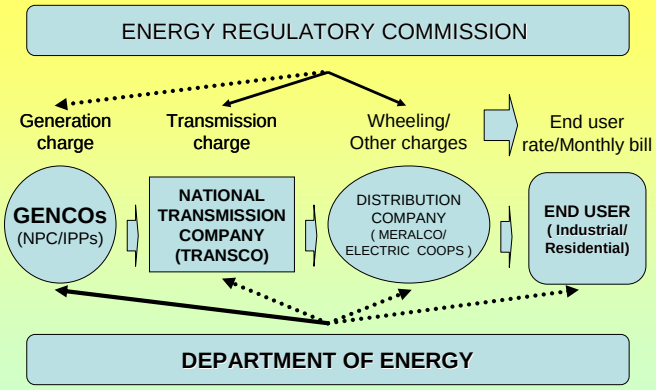
Private sector initiated power projects

Source: Department of Energy

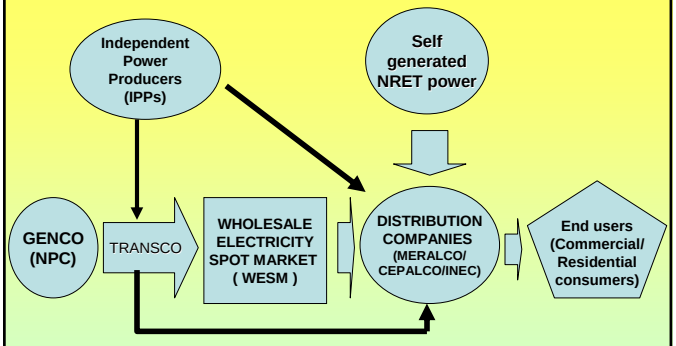
Energy supply mix of the Philippines, MTOE

	1993	% Share	1995	% Share	2000	% Share	2005	% Share	2007	% Share
INDIGENOUS ENERGY	**15.49**	**53.07**	**15.43**	**46.51**	**19.48**	**49.07**	**21.20**	**54.57**	**21.97**	**55.69**
OIL	0.45	1.53	0.13	0.39	0.06	0.14	0.61	1.57	0.63	1.59
NATURAL GAS	-	0.00	0.00	0.01	0.01	0.02	2.70	6.95	3.03	7.69
COAL	0.80	2.73	0.68	2.05	0.71	1.80	1.52	3.91	1.80	4.55
Subtotal	**16.73**	**57.33**	**16.24**	**48.96**	**20.26**	**51.03**	**26.03**	**67.01**	**27.42**	**69.52**
HYDRO	1.25	4.29	1.55	4.68	1.94	4.89	2.09	5.37	2.13	5.41
GEOTHERMAL	4.87	16.70	5.28	15.90	10.00	25.19	8.52	21.92	8.78	22.27
BIOMASS (Bagasse and Other RE)	8.12	27.82	7.79	23.48	6.76	17.02	5.77	14.84	5.56	14.10
SOLAR AND WIND				0.00			0.00	0.00	0.01	0.01
CME				0.00			0.00	0.00	0.03	0.08
Subtotal	14.25	48.81	14.62	44.06	18.70	47.10	16.37	42.14	16.51	41.87
NET IMPORTED ENERGY	**13.70**	**46.93**	**17.75**	**53.49**	**20.22**	**50.93**	**17.65**	**45.43**	**17.48**	**44.31**
OIL	13.02	44.62	16.84	50.77	16.39	41.30	13.94	35.87	13.40	33.96
COAL	0.67	2.30	0.90	2.72	3.82	9.63	3.71	9.55	4.08	10.34
ETHANOL				0.00	-	-	0.00	0.00	0.00	0.01
				0.00						
TOTAL ENERGY	**29.19**	**100.00**	**33.18**	**100.00**	**39.69**	**100.00**	**38.85**	**100.00**	**39.44**	**100.00**
GROWTH RATE (Total Energy), %			**5.49**		**2.93**		**0.10**		**1.81**	
Self Sufficiency %	**53.07**		**46.51**		**49.07**		**54.57**		**55.69**	

Source: Department of Energy



The electric power industry of the Philippines



Power sourcing options for electric power distributors

Existing grid-connected NRET projects

1. **NorthWind Power Development Corporation (NPDC) / Ilocos Norte Electric Cooperative (INEC) – A 33 MW facility from 20 wind turbine unit and soon another 40 MW wind farm in another area**
2. **Cagayan Electric Power and Light Company (CEPALCO – A 1MWp Photovoltaic power plant**
3. **Montalban Methane Power Corporation (MMPC) – A 15 MW Biogas / Methane Power Plant over 10 years period**

Plus – Expansion projects underway in wind, solar, hydro, and biomass-based power generation projects

From unproductive agricultural farm to a wind farm

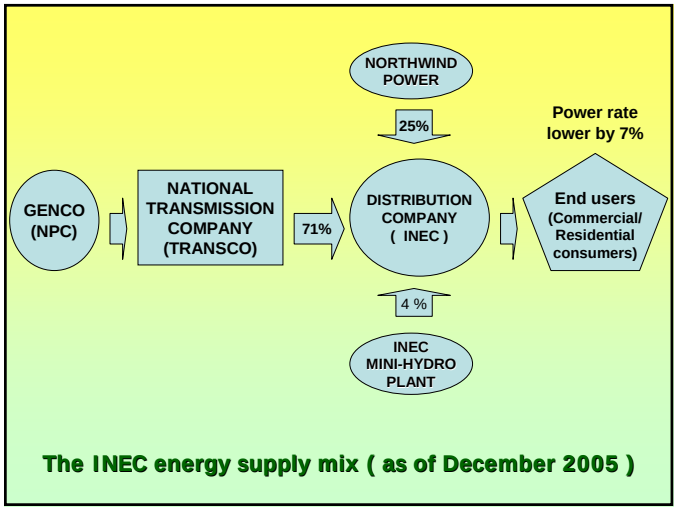
Specifications of NorthWind Power System

Turbine's hub height	- 70 meters
Blade length	- 41 meters
Rotor diameter	- 82 meters
Windswept area	- 5,281 sq. m.

*** Ground level to center of nacelle

The turbine are oriented facing the sea, effectively eliminating windbreaks and achieving terrain roughness of class 0.

Annual generation capacity	- 74,482 MWh
Wind turbine arrangement	- Single row
Spacing	- 326 meters
Orientation	- North
Prevailing wind direction	- Northeast



The INEC energy supply mix (as of December 2005)

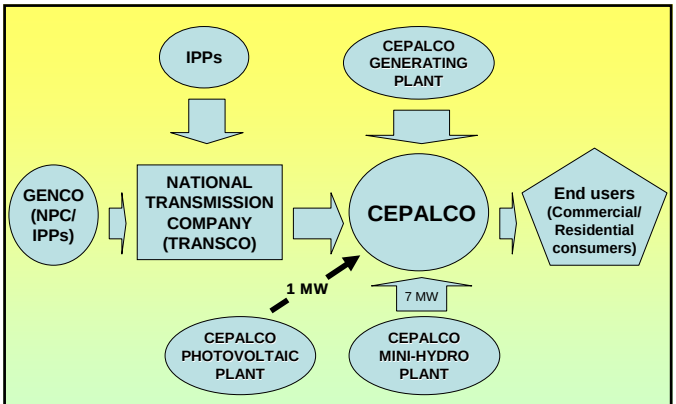
Energy supply mix of INEC (2005)

Months	Mini Hydro	% share	NPC	% share	NorthWind	% share	Total	DEMAND
	(KWh)		(KWh)		(KWh)		(KWh)	(KWh)
January	906,220	7%	11,961,974	93%	0	0.00%	12,868,194	33,465
February	587,200	4%	12,743,614	96%	0	0.00%	13,330,814	33,608
March	657,670	5%	11,943,508	95%	0	0.00%	12,601,178	33,544
April	450,060	3%	15,762,013	97%	20,789	0.13%	16,232,862	34,306
May	249,180	1%	15,660,217	93%	849,165	5.07%	16,758,562	35,486
June	201,600	1%	14,500,913	91%	1,268,114	7.94%	15,970,627	34,958
July	138,600	1%	13,738,983	87%	1,850,940	11.77%	15,728,562	33,182
August	195,300	1%	13,487,345	87%	1,769,442	11.45%	15,452,087	28,689
September	174,300	1%	12,795,817	86%	1,826,552	12.34%	14,796,669	33,542
October	137,600	1%	11,176,063	78%	3,037,368	21.16%	14,351,031	32,319
November	319,200	2%	11,497,740	76%	3,404,884	22.37%	15,221,824	32,862
December	621,600	4%	9,930,433	71%	3,442,196	24.60%	13,994,229	32,374
Total	4,638,530		155,198,620		17,469,450		177,306,600	
Average		2.75%		87.51%		9.74%		

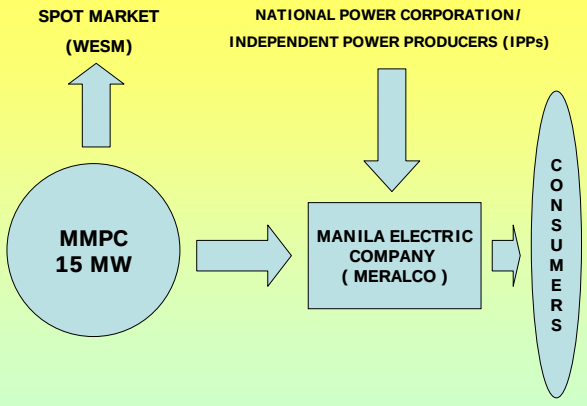
Source: www.erc.gov.ph

CEPALCO renewable energy initiatives

1. Cabulig river hydro project
2. Culaman River Hydro Project
3. Lower Bubunawan Hydro Project
4. Biomass-fired energy facilities
5. Cagayan de Oro Landfill Gas-to-Energy (LFGE) Conversion Project
6. Cogeneration (Combined Heat and Power) projects
7. The solar photovoltaic (PV) plant - Operational
8. The planned 10MWp Solar Park



The CEPALCO energy supply sources



Montalban Methane Power Corporation (MMPC)

Installed cost comparison

1.	NPDC's wind power	- US$50 M / 33 MW	- (US$ 1.5 / MW)
2.	CEPALCO PV power	- US$ 7 M / 1MW	- (US$ 1 / MW)
3.	MMPC Methane power	- US$ 30 M / 15 MW	- (US$ 2 / MW)

Sale of NRET power system outputs

1. Renewable Energy Sales Agreement (RESA) between NorthWind Power Development Corporation (NPDC) and Ilocos Norte Electric Cooperative (INEC) and hopefully via the spot market/WESM.
2. Electricity output of Cagayan Electric Power and Light Company (CEPALCO) is fully consumed internally hence no external sales.
3. Electricity output of Montalban Methane Power Corporation (MMPC) is sold to major utility (Manila Electric Company - a sister company of MMPC) and hopefully via spot market/WESM.

Price of NRET-based electricity

1. NPDC energy sales/cost to INEC is benchmarked against NPC rate (i. e., 7 per cent discount) – and the 7 percent discount is directly passed on to end users bill
2. CEPALCO PV power is used internally and cost is tied in to company's internal power generation costs related to hydro project
3. MMPC electricity output is sold to MERALCO (a sister company) and hopefully to thru the spot market (WESM).

Some concerns and NRET power sales

1. Some conflict and concerns between GENCO-Distributor's sales contract (RESA, Off-take, power purchase agreement, etc.). Legal case now exists between NPDC and INEC and ERC adjudication underway.
2. Income from carbon sales undiscussed in generation cost determination

Carbon Sales Credit

1. NPDC carbon generation of 65 tonnes equivalent per year (Estimated value: US$ 65,000 per year)
2. CEPALCO carbon generation of 10,000 throughout its project life (Estimated value: US$ 10,000)
3. MMPC carbon generation of 500,000 tonnes equivalent (Estimated value: US$ 5 million)

Financial support schemes

1. Available financial support and assistance from Government Financial Institutions (GFIs)
2. Availability of support funds from foreign multilateral sources (e. g., GEF, IFC, DANIDA, etc.)
3. Availability of loan portfolio from commercial banking sources
4. Available funding sources from internal (corporate) sources
5. Existence of investment bankers who arrange/package new and innovative commercial ventures

Success factors for NRETs in the Philippines

1. Available natural resources (e. g., solar/wind/biomass)
2. Government policy pronouncements and incentive support schemes (e. g., privatization of the power sector)
3. Existence of laws that ,motivates and induce investments in NRET-based power generation system
4. Availability of foreign/local financing schemes (e. g., DBP, LBP, WB/IFC, DANIDA, etc.)
5. Existence of guaranteed or captive markets
6. Support of local government units.
7. Advocacy support from private sector groups and NGOs (WWF, Church, etc.)
8. External inducements/incentives to venture into NRETs (e. g., Kyoto Protocol and carbon market)
9. Existence of mature and commercially available NRETs
10. Willing local/foreign investors and concerned entrepreneurs

Thank you very much
and
Good Afternoon!

Full/MS Word version of the presentation is available on request at email address:

my_eclass_professor@yahoo.com.ph

The Philippines' Current Financial Mechanisms that Support the Implementation of Utility Based Renewable Energy and Efficiency[**]

Dr. N. A. Orcullo, Jr.[***]
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Cavite, Philippines

1. Background

The energy crisis of the early 1970s made the world realize that development of nations and volatile market prices of petroleum-based products are intertwined. Leaders of both developed and developing countries realized that something has to be done to address this concern and reality. The volatility of market prices of petroleum-based fuels in the global markets and its used as a political as well as economic tool among the major oil producers made it clear to world leaders that strategic decisions have to be made to cushion the implications of erratic prices of crude products and its derivatives.

The Philippine government accepted the reality and in mid-1970s, then President Marcos reacted by putting in place a government corporation (Philippine National Oil Company) and established Petrophil Corporation (the successor of Esso Philippines). Realizing the importance of energy as a dominant commodity with a pivotal role in Philippine economy, Presidential Decree was issued creating the Energy Development Board (EDB) and PD 1206 creating the Department of Energy (DOE) thus having a cabinet-level post for energy matters. During the administration of the President Marcos, an ambitious energy plan and policy was put in place and this includes developing alternate sources of energy such as solar power, wind power, hydro, and geothermal power if only to cushion impact of high cost of imported oil particularly on the country's foreign exchange reserve. Eventually, the National Energy Plan was crafted under the auspices of the DOE and its attached agencies. The development of the Philippine Energy Plan was institutionalized and it requires a series and parallel programs/projects to address energy supply amidst threats of global energy crisis. Non-petroleum energy sources like geothermal and hydro power were developed to the fullest extent and petroleum exploration in the domestic scene became a vibrant industry.[1]

2. Legal mandates established

Over the last three decades commencing in early 1970s when the Philippine government reacted to the global energy crisis brought by the unilateral moves of oil exporting countries and the OPEC oil embargo, a number of decrees and laws were put in place. An enumeration of the relevant decrees and laws that resulted to a number of power

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[**] **Presented during the APEC workshop on " Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy " held at the Sheraton Waikiki Hotel, Hawaii, USA, March 30 - April 1, 2009.**

[***] **Professor, De La Salle University-Dasmariñas, Dasmariñas, Cavite, Philippines**

[1] A personal account of the author being one of the pioneering technical staff of the Non-conventional Energy Resources Division of DOE and having been a part of DOE circa 1979 – 1990.

Table 1. Legal mandates and motivating laws and policies

1. Presidential Decree 910 (Energy Development Board) – 1976
2. Presidential Decree 1206 (DOE Charter) – 1976
3. Presidential Decree 1068 (NERDP Program) - 1977
4. Foreign Investment Act (RA 7042/RA 8719) - 1991
5. Executive Order 215 (BOT projects) – 1995
6. Executive Order 462/AEO 232 - 1997
7. DOE New Charter (RA 7638) – 1992
8. BOT Law (RA 6967/RA 7718) – 1994
9. Clean Air Act (RA 1234) – 1999
10. Ecological Solid Waste Management Act (RA 9003) - 2000
11. EPIRA Law (RA 9136) - 2001
12. Biofuels Law (RA 9367) - 2006
13. Renewable Energy Law (RA 9513) - 2008

development projects including efforts related to renewable energy development is shown in Table 1.

In the renewable energy sector, Presidential Decree 1068 was issued in 1977 mandating the wider and organized efforts in the development, promotion and commercial utilization of non-conventional energy sources. The Non-conventional Energy Resources Development Program (NERDP) of the DOE was in the forefront of the efforts to develop the potentials of renewable energy technologies triggering research and development projects dealing with solar, wind energy and biomass energy sources. A number of academic institutions as well as research organizations were involved in various R & D efforts funded under the NERDP. A variety of undertakings were pursued from research to technology promotions all aimed at developing the potentials of biomass-based resources and technologies eventually popularizing the use of biogas, gasifiers, solar water heaters, wind-powered pumps, wind power conversion systems, bioethanol, coco-diesel, and most recently biodiesel in the form of crude methyl ester (CME).

The series of efforts led to putting in place administrative and legal frameworks. Major policy decisions were made by the government leadership and landmark laws were put in place via a decree during Martial Law period as well as Executive Orders and by acts of Congress. The Foreign Investment Act (RA 7042 as amended by RA 8719) served as a come on for many local and foreign investors for the incentives it promises and the investors in the power generation sectors took advantage of it. The issuance of the Executive Order 215 that eventually resulted to the enactment of the Build-Operate-Transfer Law (RA 6957 as amended by RA 7718) resulted to a large number of private sector-financed power generation plants once a major responsibility and monopoly which later became the budgetary burden of the government. Moreover, the enactment of the Clean Air Act (RA 8749) and Ecological Solid Waste Management Act (RA 9003) also gave a push and served as the motivator for investors to consider green, renewable and clean energy technologies. Furthermore, the enactment of Electric Power Industry Reform Act (RA 9136), Biofuesl Law of 2006 (RA 9367), and most recently the Renewable Energy Act of 2008 (RA 9513) are developments

that further triggered private sector investments in power generation as well as transmission and many looked at this particular law as a great booster for inviting more local and foreign investments in renewable energy projects.

Prior to the enactment of the abovementioned laws, investments in energy projects/ventures were included in the investment priorities program of the Board of Investments thus entitling investors a number of incentives such as tariff/duty privileges as well tax holidays. Along with the political will of the government leadership as well as management initiatives of concerned government agencies, the renewable energy sector is now a vibrant sector of the economy. Several renewable energy companies are now serving the market and more conspicuously are the megawatt level business project in wind and solar photovoltaics that is now part of the electrical grid system.

3. Renewable energy resources and policies [2]

The country is endowed with natural resources which allowed it to develop its potentials and in many ways contributed a lot to the power supply of the country. In a study released by the New and Renewable Energy Laboratory (NREL) of USA, the following potentials of renewable energy was identified.[2]

a) Wind resources – over 10,000 km^2 with 76,000 MW of potential installed capacity.
b) Micro-hydro applications – potential capacity of at least 500 KW in Luzon and Mindanao islands
c) Solar radiation nationwide – an annual potential average of 5.0 – 5.1 $KWh/m^2/day$
d) Mini-hydro potential capacity of 1,784 MW capacity for 888 sites
e) Ocean energy resources – potential capacity of about 170,000 MW
f) Biomass (Bagasse) total potential of 235 MMBFOE

To enable the development of the potentials of its renewable energy resources, the Philippine Energy Plan enshrined a commitment to a renewable energy policy development as follows:

a) Renewable energy policy framework launched in 2003.
b) Policy bias towards the development and utilization of renewable energy:

i) Promote more private sector participation in RE development
ii) Encourage the use of renewable energy in rural and off- grid electrification
iii) Renewable energy projects given " priority " for special incentives

c) Having a renewable energy law to promote development and utilization of clean energy (enacted in 2008 as Republic Act 9513)

Giving substance and concrete meaning, the renewable energy development policy framework was translated into long-term objectives as follows:

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[2] Karunungan, E., Renewable Energy Fuels: Key to Energy Independence and Security, Department of Energy, Makati City, Philippines, 2008

a) Increase renewable energy-based capacity by 100 % - " 100 – 10 "
b) Be the number 1 geothermal energy producer in the world.
c) Be the number 1 wind energy producer in Southeast Asia
d) Double hydro electric capacity.
e) Be the solar cell manufacturing hub in ASEAN.
f) New contribution of biomass, solar and ocean energy by more than 100 MW
g) Increase non-power contribution of RE to energy mix by 10 MMBFOE with the next 10 years.

Giving concrete results to the long-term objectives set forth are the various completed and on-going undertakings as summarized in Table 2.

4. Market system for electric power

The monopoly of power generation by National Power Corporation under Presidential Decree was dismantled through a privatization policy. This policy statement tempered with the enactment of the Electric Power Industry Reform Act or EPIRA Law (RA 9136) resulted to a new market system for the electric energy sector. The electric power sector in particular was transformed from a monopolistic market to that of a free market system open to any interested parties limited only to ownership structure as mandated by the Philippine constitution.

The developments in the power generation sector resulted to a new market system as shown in Figure 1. As shown in Figure 1, the National Power Corporation (NPC) is still presented as a power generator or generating company (GENCO) pending its full privatization. However, private sector investments in power generation are now in place as evidenced by a growing number of independent power producers (IPPs). Also a significant

Table 2. Renewable energy development status

Resource	Existing capacity (MW)	Number of plants in operation	On-going projects
Geothermal	2,027.07	14 geothermal plants	10 projects offered to private investor (300 – 500 MW)thru Contracting Round
Hydro	3,367.07	21 large hydro, 52 mini-hydro, 61 micro hydro	4 mini-hydros, 14 large hydro under evaluation
Wind	25.2	33 KW In Ilocos Norte, 5 KW Camarines in 180 KW in Batanes, 6 KW in Boracay	NPDC wind farm, 7 sites on resource assessment
Solar	5.161	960 KW – CEPALCO, Cagayan e Oro 729 KW Camarines Sur	Sunpower Phil Solar Plant/rural electrification projects
Biomass	20.93		1 MW Isabela
Ocean			R & D activities – Demo projects in Leyte/Mindanao

Source: E. Karunungan (Department of Energy), Philippines

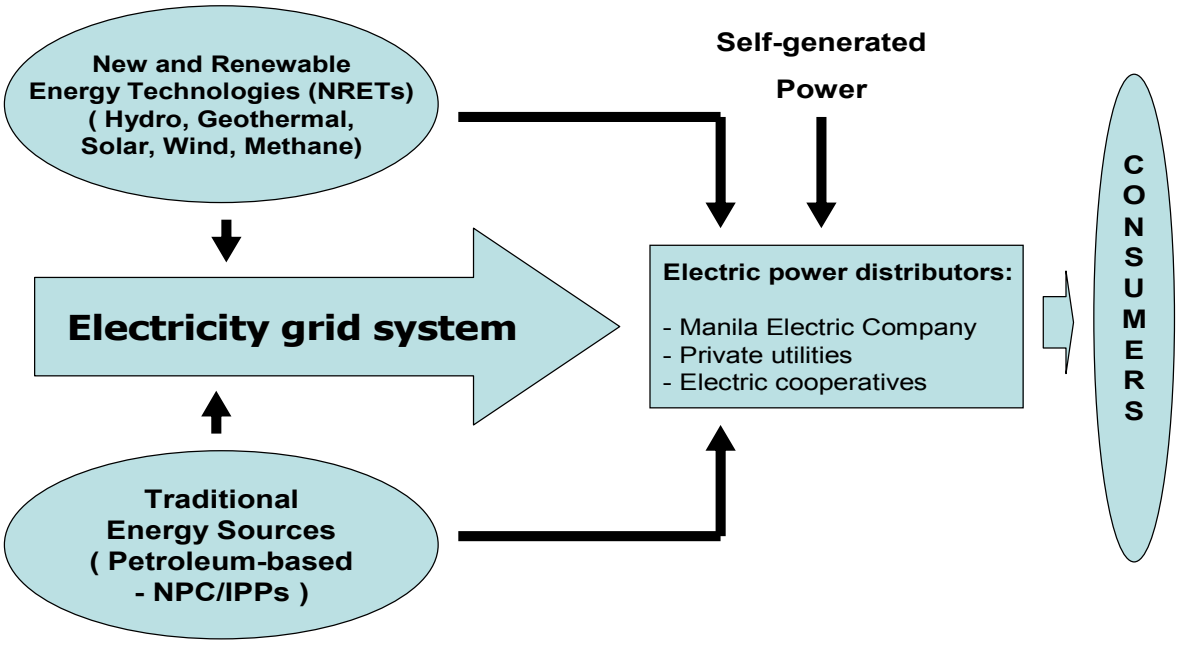


Figure 1. The electricity grid and distribution system in the Philippines

development in the new market system is that electricity distribution companies (i. e., privately-owned utilities and electric cooperatives) are now authorized to develop and produce their electric power thus allowing backward integration opportunities not only for economic but also for technical reasons as well.

Adding more incentives to both the generators and buyers of electric power is the provision in the EPIRA Law which mandates the establishment of the Wholesale Electricity Spot Market (WESM). The spot market is a platform that simulates a free market system that can work to the advantage of both the GENCOs and the distribution companies or in certain cases, to the contrary. Hopefully, the new market framework illustrated by the diagram shown in Figure 2 will result to benefits to end users in the form of affordable or cheaper tariffs for electric power.

The variety of laws and policies set forth by the government ensure and allow the free market system to work giving market competition to play well. With new and renewable energy technologies (NRET) fitted against petroleum-based power plants with more incentives favoring the former, it is hoped that new and renewable energy businesses and industry would emerge and flourish.

5. The electrical grid system

To ensure connectivity and markets for the output of commercial power generation projects large or small, the country operates an electricity grid system. This grid scheme was in place even at the time when power generation and region-wide distribution was a

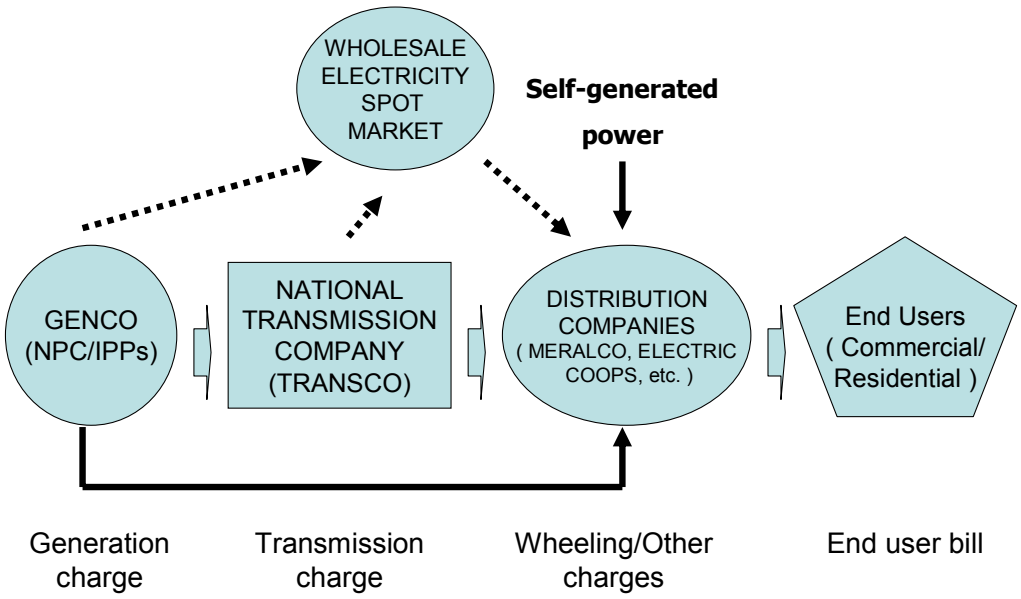


Figure 2. The power distribution system and WESM

responsibility monopoly of NPC. There is grid for the major islands of Luzon, Visayas and Mindanao where provincial level power distributors (e. g., electric cooperatives) can source their power for retail to institutional and residential consumers.

As mandated by the EPIRA Law, the idea of the grid and Grid Code was put in place. As defined in the EPIRA Law, grid refers to the high voltage backbone system of interconnected transmission lines, substations and related facilities. The EPIRA Law espouses a Grid Code referring to the set of rules and regulations governing the safe and reliable operation, maintenance, and development of the high voltage backbone transmission system and its related facilities.[3]

Also forming part of the provisions of the EPIRA Law, a National Transmission Corporation (TRANSCO) is organized to acquire all the transmission assets of the NPC. TRANSCO was specifically organized to assume the electrical transmission function of NPC, and have all the powers and functions granted unto it. TRANSCO assumes the authority and responsibility of NPC for the planning, construction and centralized operation and maintenance of high voltage transmission facilities, including grid interconnections and ancillary services.

With regional grid system now in place, sufficient infrastructural provision are also in place for any generation company (GENCO) using renewable energy sources to interconnect with the electricity grid thus assuring a ready market of its output. It is just a matter for the

[3] Electric Power Industry Reform Act of 2001 (RA 9513)

renewable energy power generator to deliver an electrical energy output consistent with the voltage levels of the power grid nearest to it or to the specific demand of its buyer/user should it opt to directly embed its output to the distribution system of the utility company.

The grid system at the regional level allows the transport of indigenous and renewable energy-based system to other parts of island in the country thus enhancing efficiency and maximizing the use of the energy output at the same time providing the electricity supply in areas with insufficient generation capacity. This is the particular case in Negros island where excess capacity from geothermal plants was transmitted to Cebu island (both in the Visayas region) using the submarine cable that connects these two islands.

Following the mandate under the EPIRA Law, there is now a Philippine Grid Code promulgated by the Energy Regulatory Commission (ERC) which it approved per Resolution No. 115.

6. Power sector situationer

The development of various energy sources to produce electricity is one of the lessons learned by developing countries in reacting to the negative impacts of the unilateral actions of the major oil producers particularly the Organization of Petroleum Exporting Countries (OPEC). The developments in the supply side of the energy sector consistent with the government policy of diversifying energy sources resulted to an energy supply mix across various parts of the country. In particular, shown on Figure 3 is the power situationer in the electric power grid of Luzon showing the capacity and generation mix.

As shown in Figure 3, the combined share of indigenous and renewable energy (geothermal, hydro) is already at 26 percent (in installed capacity) with a small percentage from wind energy which is totally zero years ago. The grid capacity and generation mix for Mindanao region is shown in Figure 4. As shown in Figure 4, the Mindanao grid is largely hydro-based power sources and it accounts for 51 percent in terms of installed capacity. Also in Mindanao, solar energy is making a dent both in capacity and generation mix where in fact years back, it is zero just like wind energy sources. In the coming years, it is hoped that both wind and solar energy will have substantial number or quantities in the country's installed capacity and generation mix.

Indicative of the increasing concerns of the private sector in directly participating in the supply side of the energy business by way of direct investments is the diagram shown in Figure 5. As shown in Figure 5, renewable energy-based power sources are expanding in capacity in the Luzon grid. Wind power project in Burgos (NorthWind Power Development Corporation) is expected to increase to 86 MW by 2011, Pagudpud wind power project is projected to be generate 20 MW and Pamplona wind power project is expected to install 40 MW.

Projected to be major renewable energy projects also to contribute to the Luzon grid are the green energy projects expected to be established. The Nueva Ecija biomass project of 20 MW in capacity is projected to be on stream by the year 2011,

In the Visayas grid, the projected contribution of biomass energy is shown in Figure 6. As shown in Figure 6, private sector initiative is active with a projected energy supply of 36

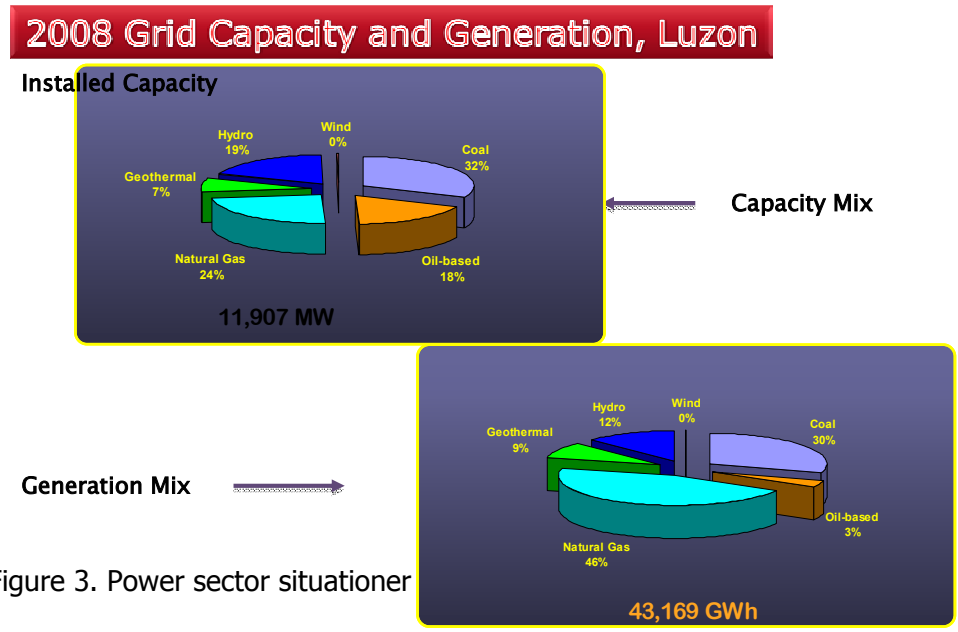


Figure 3. Power sector situationer

Source: Department of Energy

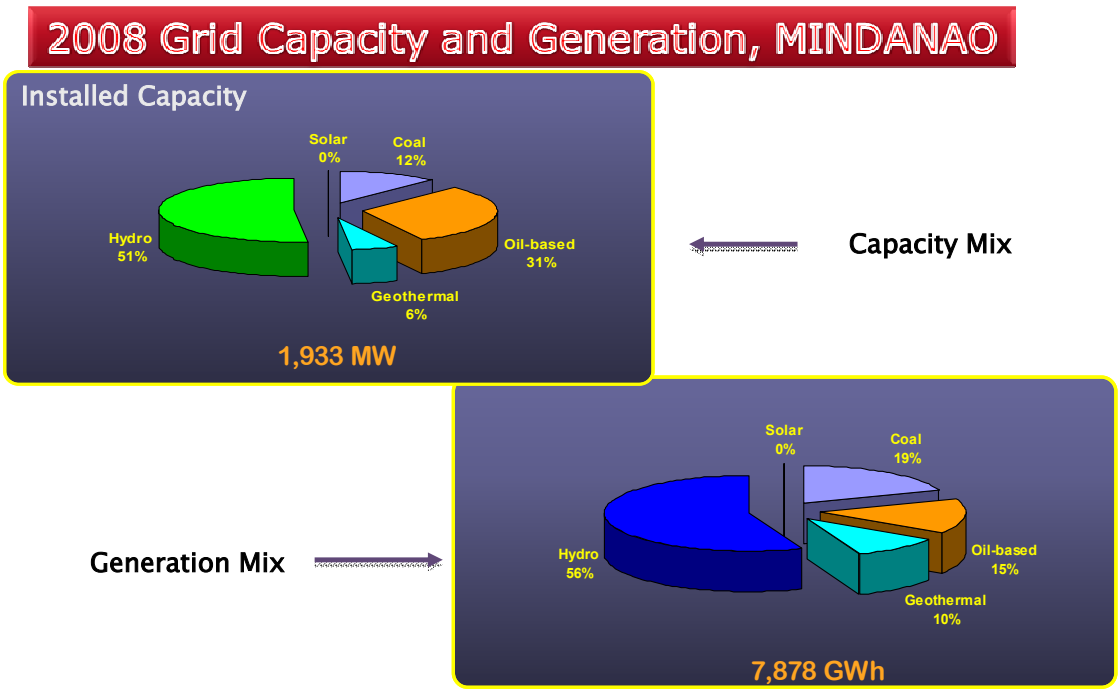


Figure 4. Power sector situationer

Source: Department of Energy

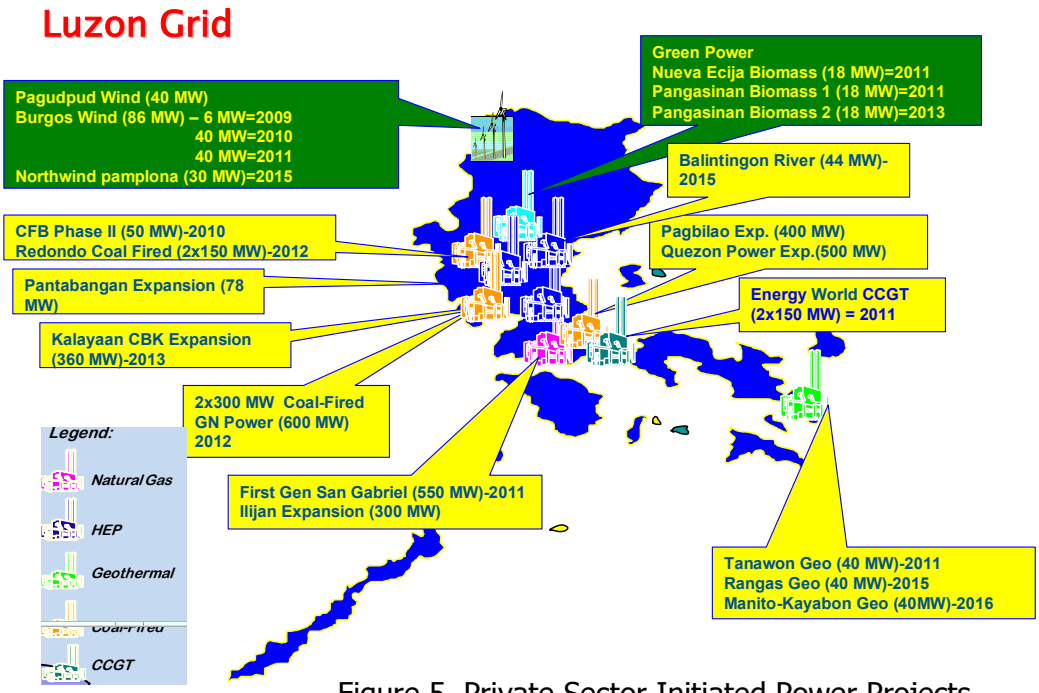


Figure 5. Private Sector Initiated Power Projects

Source: Department of Energy

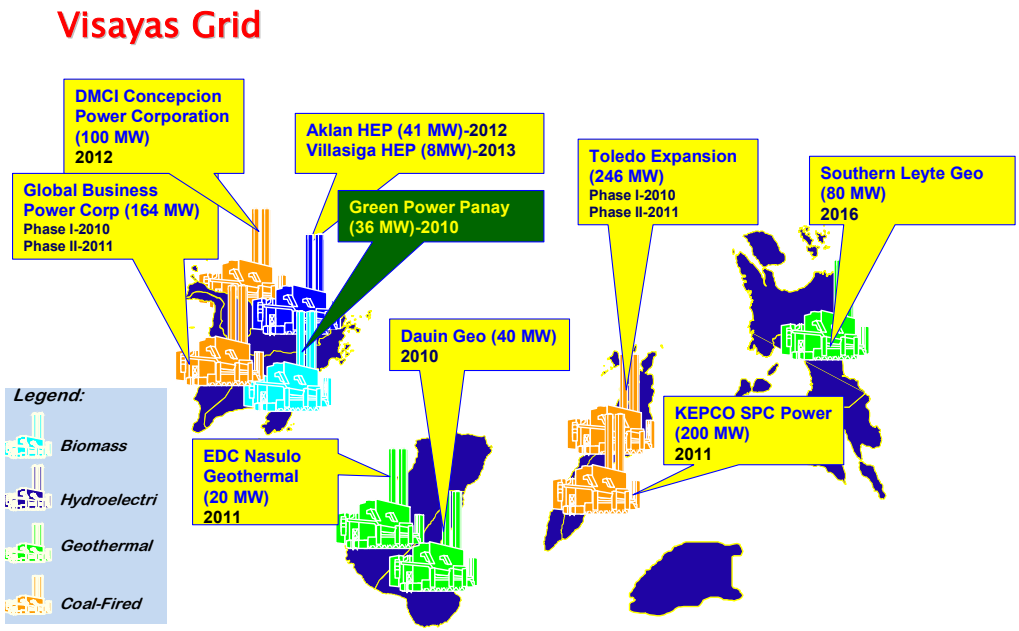


Figure 6. Private Sector Initiated Power Projects

Source: Department of Energy

For the Mindanao grid, the upcoming contribution of biomass-based energy is shown in Figure 7. A 10 MW power plant of Green Power Biomass is projected to be on stream by the year 2010.

The historical energy supply mix in the country as facilitated by the grid system is shown in Table 3. As shown in Table 3, indigenous energy production increased from a share of 15.49 percent in 1993 to 49.07 percent in 2000 and 55.8 percent by the end of year 2007. Much of the increase in contribution of indigenous energy supply is accounted for by hydro, geothermal, solar, wind, and to a certain extent, biodiesel in the form of crude methyl ester (CME).

7. The Renewable Energy Act of 2008

Giving inspiration and impetus to the development of the renewable energy sector of the Philippines are the administrative policies/directors set forth and various laws enacted as earlier mentioned as well as the political will to undertake the specific programs and projects.

After a series of programs, projects, and a variety of initiatives to develop, promote, and commercialize the use of renewable energy in the country, a landmark legislation for the renewable energy sector was put in place by Congress. This is the enactment of the Republic Act No. 9513 otherwise known as the Renewable Energy Law (REL) of 2008.

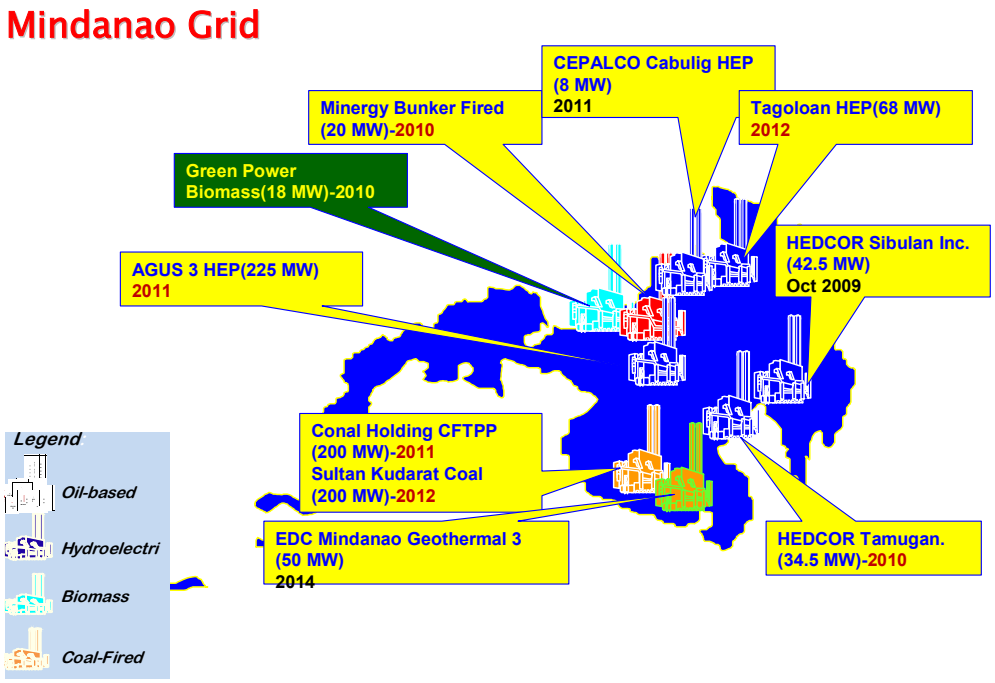


Figure 7. Private sector initiated power projects

Source: Department of Energy

Table 3. Energy supply mix of the Philippines, MTOE

	1993	% Share	1995	% Share	2000	% Share	2005	% Share	2007	% Share
INDIGENOUS ENERGY	**15.49**	**53.07**	**15.43**	**46.51**	**19.48**	**49.07**	**21.20**	**54.57**	**21.97**	**55.69**
OIL	0.45	1.53	0.13	0.39	0.06	0.14	0.61	1.57	0.63	1.59
NATURAL GAS	-	0.00	0.00	0.01	0.01	0.02	2.70	6.95	3.03	7.69
COAL	0.80	2.73	0.68	2.05	0.71	1.80	1.52	3.91	1.80	4.55
Subtotal	**16.73**	**57.33**	**16.24**	**48.96**	**20.26**	**51.03**	**26.03**	**67.01**	**27.42**	**69.52**
HYDRO	1.25	4.29	1.55	4.68	1.94	4.89	2.09	5.37	2.13	5.41
GEOTHERMAL	4.87	16.70	5.28	15.90	10.00	25.19	8.52	21.92	8.78	22.27
BIOMASS (Bagasse and Other RE)	8.12	27.82	7.79	23.48	6.76	17.02	5.77	14.84	5.56	14.10
SOLAR AND WIND				0.00			0.00	0.00	0.01	0.01
CME				0.00			0.00	0.00	0.03	0.08
Subtotal	**14.25**	**48.81**	**14.62**	**44.06**	**18.70**	**47.10**	**16.37**	**42.14**	**16.51**	**41.87**
NET IMPORTED ENERGY	**13.70**	**46.93**	**17.75**	**53.49**	**20.22**	**50.93**	**17.65**	**45.43**	**17.48**	**44.31**
OIL	13.02	44.62	16.84	50.77	16.39	41.30	13.94	35.87	13.40	33.96
COAL	0.67	2.30	0.90	2.72	3.82	9.63	3.71	9.55	4.08	10.34
ETHANOL				0.00	-	-	0.00	0.00	0.00	0.01
				0.00						
TOTAL ENERGY	**29.19**	**100.00**	**33.18**	**100.00**	**39.69**	**100.00**	**38.85**	**100.00**	**39.44**	**100.00**
GROWTH RATE (Total Energy), %			**5.49**		**2.93**		**0.10**		**1.81**	
Self Sufficiency %	**53.07**		**46.51**		**49.07**		**54.57**		**55.69**	

Source: Department of Energy

The Renewable Energy Law (REL) made a number of significant provisions to address the development, financing, and marketing electricity as well as incentives for renewable energy-based power generation systems. Under the provisions of the Renewable Energy Law, general incentives have been accorded to investors in renewable energy projects as stipulated under Chapter III of the said act. In particular, the said law provided as follows:

> **SEC.15.** ***Incentives for Renewable Energy Projects and Activities.*** **– RE developers of renewable energy facilities, including hybrid systems, in proportion to and to the extent of the RE component, for both power and non-power applications, as duly certified by the DOE, in consultation with the BOI, shall be entitled to the following incentives:**
>
> **(a) Income Tax Holiday (ITH) – For the first seven (7) years of its commercial operations, the duly registered RE developer shall be exempt from income taxes levied by the national government.**
>
> **Additional investments in the project shall be entitled to additional income tax exemption on the income attributable to the investment:** ***Provided, That*** **the discovery and development of new RE resource shall be treated as a new investment and shall therefore be entitled to a fresh package of incentives:** ***Provided, further,*** **That the entitlement period for additional investments shall not be more than three (3) times the period of the initial availment of the ITH.**
>
> **(b) Duty-free Importation of RE Machinery, Equipment and Materials – Within the first ten (10) years upon the issuance of a certification of an RE developer, the importation of machinery and equipment, and materials and parts thereof, including control and communication equipment, shall not be subject to tariff duties:** ***Provided, however,*** **That the said machinery, equipment, materials and parts are directly and actually needed and used exclusively in the RE facilities for transformation into energy and delivery of energy to the point of use and covered by shipping documents in the name of the duly registered operator to whom the shipment will be directly delivered by customs authorities:** ***Provided, further,***

That endorsement of the DOE is obtained before the importation of such machinery, equipment, materials and parts is made.

Endorsement of the DOE must be secured before any sale, transfer or disposition of the imported capital equipment, machinery or spare parts is made: *Provided,* That if such sale, transfer or disposition is made within the ten (10) -year period from the date of importation, any of the following conditions must be present:

> **(i) If made to another RE developer enjoying tax and duty exemption on imported capital equipment;**
>
> **(ii) If made to a non-RE developer, upon payment of any taxes and duties due on the net book value of the capital equipment to be sold;**
>
> **(iii) Exportation of the used capital equipment, machinery, spare parts or source documents or those required for RE development; and**
>
> **(iv) For reasons of proven technical obsolescence.**

When the aforementioned sale, transfer or disposition is made under any of the conditions provided for in the foregoing paragraphs after ten (10) years from the date of importation, the sale, transfer or disposition shall no longer be subject to the payment of taxes and duties;

(c) *Special Realty Tax Rates on Equipment and Machinery.* – Any law to the contrary notwithstanding, realty and other taxes on civil works, equipment, machinery, and other improvements of a Registered RE Developer actually and exclusively used for RE facilities shall not exceed one and a half percent (1.5%) of their original cost less accumulated normal depreciation or net book value: *Provided*, That in case of an integrated resource development and generation facility as provided under Republic Act No. 9136, the real property tax shall only be imposed on the power plant;

(d) *Net Operating Loss Carry-Over (NOLCO).* – The NOLCO of the RE Developer during the first three (3) years from the start of commercial operation which had not been previously offset as deduction from gross income shall be carried over as a deduction from gross income for the next seven (7) consecutive taxable years immediately following the year of such loss: *Provided, however,* That operating loss resulting from the availment of incentives provided for in this Act shall not be entitled to NOLCO;

(e) *Corporate Tax Rate* – After seven (7) years of income tax holiday, all RE Developers shall pay a corporate tax of ten percent (10%) on its net taxable income as defined in the National Internal Revenue Act of 1997, as amended by Republic Act No. 9337. *Provided,* That the RE Developer shall pass on the savings to the end-users in the form of lower power rates.

(f) *Accelerated Depreciation.* - If, and only if, an RE project fails to receive an ITH before full operation, it may apply for Accelerated Depreciation in its tax books and be taxed based on such: *Provided*, That if it applies for Accelerated Depreciation, the project or its expansions shall no longer be eligible for an ITH. Accelerated depreciation of plant, machinery, and equipment that are reasonably needed and actually used for the exploration, development and utilization of RE resources may be depreciated using a rate not exceeding twice the rate which would have been used had the annual allowance been computed in accordance with the rules and regulations prescribed by the Secretary of the Department of Finance and the provisions of the National Internal Revenue Code (NIRC) of 1997, as amended. Any of the following methods of accelerated depreciation may be adopted:

i) **Declining balance method; and**
ii) **Sum-of-the years digit method**

(g) *Zero Percent Value-Added Tax Rate* – The sale of fuel or power generated from renewable sources of energy such as, but not limited to, biomass, solar, wind, hydropower, geothermal, ocean energy and other emerging energy sources using technologies such as fuel cells and hydrogen fuels, shall be subject to zero percent (0%) value-added tax (VAT), pursuant to the National Internal Revenue Code (NIRC) of 1997, as amended by Republic Act No. 9337.

All RE Developers shall be entitled to zero-rated value added tax on its purchases of local supply of goods, properties and services needed for the development, construction and installation of its plant facilities.
This provision shall also apply to the whole process of exploring and developing renewable energy sources up to its conversion into power, including but not limited to the services performed by subcontractors and/or contractors.

(h) ***Cash Incentive of Renewable Energy Developers for Missionary Electrification*** **-- A renewable energy developer, established after the effectivity of this Act, shall be entitled to a cash generation-based incentive per kilowatt hour rate generated, equivalent to fifty percent (50%) of the universal charge for power needed to service missionary areas where it operates the same, to be chargeable against the universal charge for missionary electrification;**

(i) ***Tax Exemption of Carbon Credits*****—All proceeds from the sale of carbon emission credits shall be exempt from any and all taxes;**

(j) ***Tax Credit on Domestic Capital Equipment and Services.*** **– A tax credit equivalent to one hundred percent (100%) of the value of the value-added tax and custom duties that would have been paid on the RE machinery, equipment, materials and parts had these items been imported shall be given to an RE operating contract holder who purchases machinery, equipment, materials, and parts from a domestic manufacturer for purposes set forth in this Act:** ***Provided,*** **That prior approval by the DOE was obtained by the local manufacturer:** ***Provided, further,*** **That the acquisition of such machinery, equipment, materials, and parts shall be made within the validity of the RE operating contract.**

In addition to the aforementioned incentives under Section 15 of the law, Section 21 provided incentives for commercialization of renewable energy technologies to cover all manufacturers, fabricators and suppliers of locally-produced RE equipment and components duly recognized and accredited by the DOE (in consultation with DOST, DOF and DTI), shall, upon registration with the BOI. This particular provision identified the Renewable Energy Sector as a priority investment sector that will regularly form part of the country's Investment Priority Plan. As such, all entities duly accredited by the DOE under the REL are entitled to all the incentives such as the following:

(a) Tax and Duty-free Importation of Components, Parts and Materials. **– All shipments necessary for the manufacture and/or fabrication of RE equipment and components shall be exempted from importation tariff and duties and value added tax:** ***Provided, however,*** **That the said components, parts and materials are: (i) not manufactured domestically in reasonable quantity and quality at competitive prices; (ii) directly and actually needed and shall be used exclusively in the manufacture/fabrication of RE equipment; and (iii) covered by shipping documents in the name of the duly registered manufacturer/fabricator to whom the shipment will be directly delivered by customs authorities:** ***Provided, further,*** **That prior approval of the DOE was obtained before the importation of such components, parts and materials;**

(b) Tax Credit on Domestic Capital Components, Parts and Materials. **– A tax credit equivalent to one hundred percent (100%) of the amount of the value-added tax and custom duties that would have been paid on the components, parts and materials had these items been imported shall be given to an RE equipment manufacturer, fabricator, and supplier duly recognized and accredited by the DOE who purchases RE components, parts and materials from a domestic manufacturer:** ***Provided,*** **That such components, and parts are directly needed and shall be used exclusively by the RE manufacturer, fabricator and supplier for the manufacture, fabrication and sale of the RE equipment:** ***Provided, further,*** **That prior approval by the DOE was obtained by the local manufacturer;**

***(c) Income Tax Holiday and Exemption.* – For seven (7) years starting from the date of recognition/accreditation, an RE manufacturer, fabricator and supplier of RE equipment shall be fully exempt from income taxes levied by the National Government on net income derived only from the sale of RE equipment, machinery, parts and services; and**

***(d) Zero-rated value added tax transactions* – All manufacturers, fabricators and suppliers of locally produced renewable energy equipment shall be subject to zero-rated value added tax on its transactions with local suppliers of goods, properties and services.**

8. Feed-in tariff system for renewable energy sources

Assurance of market outlet for renewable power generation project is vital to the development of renewable energy sector. To have this scenario and to encourage proliferation of energy from renewable energy sources particularly those intended for connection with the regional electricity or utility grid, Section 7 of the REL made specific provisions and quoted herein as follows:

SEC. 7. *Feed-In Tariff System*. -- To accelerate the development of emerging renewable energy resources , a feed-in tariff system for electricity produced from wind, solar, ocean, run-of-river hydropower and biomass is hereby mandated. Towards this end, the ERC in consultation with the National Renewable Energy Board (NREB) created under Section 27 of this Act shall formulate and promulgate feed-in tariff system rules within one year upon the effectivity of this Act which shall include, but not limited to the following:

(a) Priority connections to the grid for electricity generated from emerging renewable energy resources such as wind, solar, ocean, run-of-river hydropower and biomass power plants within the territory of the Philippines;

(b) The priority purchase and transmission of, and payment for, such electricity by the grid system operators;

(c) Determine the fixed tariff to be paid to electricity produced from each type of emerging renewable energy and the mandated number of years for the application of these rates, which shall not be less than 12 years;

(d) The feed-in tariff to be set shall be applied to the emerging renewable energy to be used in compliance with the renewable portfolio standard as provided for in this Act and in accordance with the RPS rules that will be established by the DOE.

The Renewable Energy Market (REM) is likewise established to facilitate compliance with the provisions of the law. The Department of Energy is tasked to establish the REM and shall direct Philippine Electric Market Corporation (PEMC) to implement changes to the WESM Rules in order to incorporate the rules specific to the operation of the REM under the WESM.

9. Net-metering mechanism

To have a sure or captive market for electrical energy output of renewable energy project particularly in situations where there is an excess power at the level of institutional consumers who ventured into self-generation, there has to be a mechanism to address the possibility of selling out extra output to the electrical grid system. This predicament has been addressed by the provisions of the REL on net metering and this in fact is one of the unique provisions of the law.

The net-metering scheme provided for under Section 10 reads as follows:

> **SEC. 10.** ***Net-metering for Renewable Energy.*** **– Subject to technical considerations and without discrimination and upon request by distribution end-users, the distribution utilities shall enter into net-metering agreements with qualified end-users who will be installing RE system.**
>
> **The ERC, in consultation with the NREB and the electric power industry participants, shall establish net metering interconnection standards and pricing methodology and other commercial arrangements necessary to ensure success of the net-metering for renewable energy program within one (1) year upon the effectivity of this Act.**
>
> **The distribution utility shall be entitled to any Renewable Energy Certificate resulting from net-metering arrangement with the qualified end-user who is using an RE resource to provide energy and the distribution utility shall be able to use this RE certificate in compliance with its obligations under RPS.**
>
> **The DOE, ERC, TRANSCO or its successors-in-interest, DUs, PEMC and all relevant parties are hereby mandated to provide the mechanisms for the physical connection and commercial arrangements necessary to ensure the success of the Net-metering for Renewable Energy program, consistent with the Grid and Distribution Codes.**

The net metering mechanism stands to benefit electricity distributors and institutional consumers with potentials for generating their own electricity whose excess power capacity can be sold back to the gird system. The importance of the net metering scheme lies in the fact that renewable energy plant capacity can be maximized when done by users and distributors so that there is a sure market for surplus energy production.

10. Role of government agencies

Under the stated deregulation policy in the energy sector, private investors are given much leeway and privilege in doing their business particularly with prices of petroleum-based products which is left to market conditions. Such is not the case however, with the electric power sector where certain controls and regulations are put in place but giving the investors in the power generation and distribution business the opportunity to recoup their investments plus reasonable returns at the same time addressing the concerns of end users of electric power. This concern is done by way of a series of public or consultative hearings whenever there are tariff rate changes.

The Electric Power Industry Reform Act of 2001 (RA 9136) has given government agencies like the Department of Energy (DOE) and Energy Regulatory Commission (ERC) certain specific mandate. These agencies have substantial authority to protect the various stakeholders like the investors in the electric power sector including the interests and concerns of the public at large. Generators of power from whatever sources including renewable energy resources and systems/technologies has to apply for and be cleared and/or endorsed by the Department of Energy. Final authority (i. e., Certificate of Compliance) to market the output of generation companies (GENCOs) as well as distribute the same at certain prices or tariff is left to the judgment of the ERC guided by the provisions of the EPIRA Law and its implementing rules and regulations. Deregulated as it is, the electric power industry is fully monitored by DOE and ERC as diagrammatically shown in Figure 8.

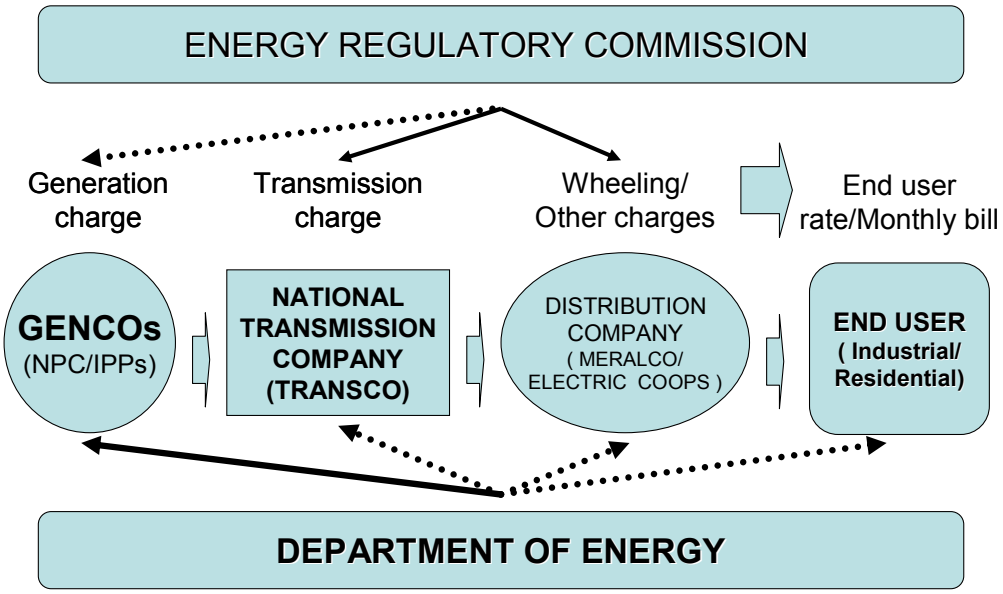


Figure 8. The electric power industry of the Philippines

10.1 The role of ERC in the EPIRA regime

Among others, the privatization policy of the government gave the private sector privilege and rights to invest in the power generation sector under the Build-Operate-Transfer (BOT) Law particularly in the early 1990s when the country experienced an acute power outages. This scenario gives the distributors and users of electric power an option from whom to buy or source their electricity which they will eventually distribute in their respective franchise or service areas. This scenario has also given some power distributors to go into horizontal and backward integration options thus making the price of electric power and object of competition hopefully to the benefit of the end users.

Added to this scenario is the creation of Wholesale Electricity Spot Market (WESM) which further give the institutional buyers (i. e., utility companies/electric cooperatives) the option where the buy or source their power at any given time of day which they believed is advantageous. This scenario is diagrammatically explained by Figure 9.

Given the liberalized scenario in power generation and the options available to distributors of electricity at end user level, ERC plays a critical role given its mandate to address the interest of the consumer - the pubic at large – without jeopardizing the return on investment and profit motives of the generation companies and the investors in general.

Under the EPIRA Law, prices charged by a generation companies is not categorically stated as subject to regulation by ERC, however, generation companies are required to submit their financial statements (to ERC) to address market power abuse or anti-competitive behavior. Unlike generation companies, transmission of electric power is a regulated common

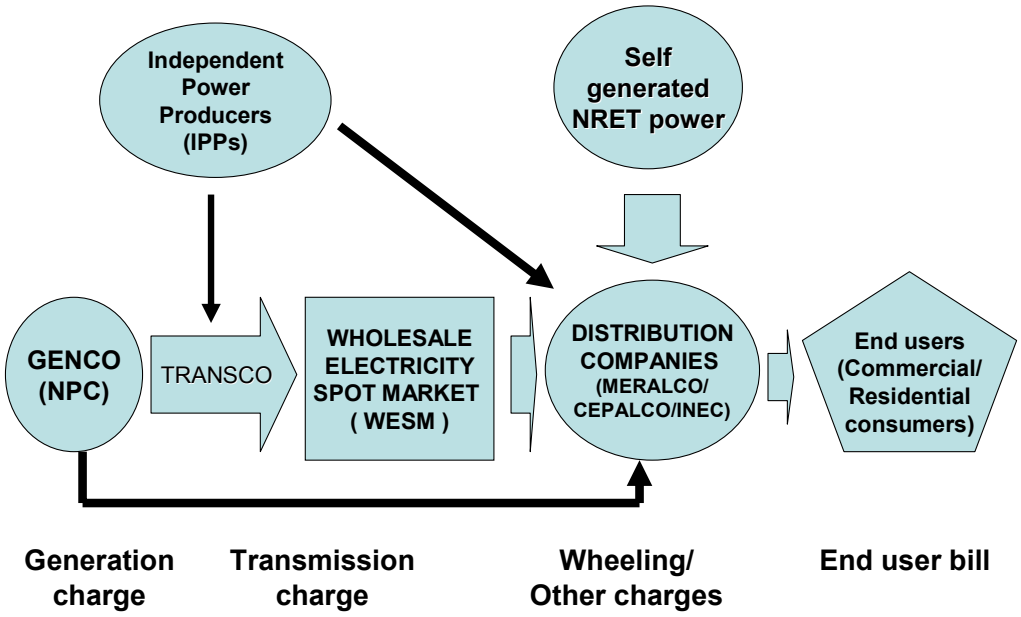


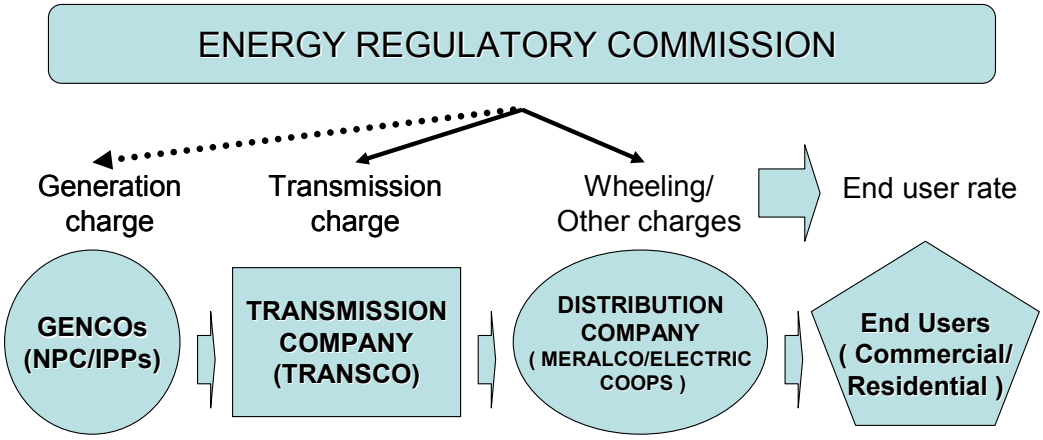
Figure 9. Power sourcing options for electric power distributors

electricity carriers and subject to ratemaking powers of the ERC. The distribution of electricity (by private utilities and electric cooperatives) to end users/consumers is subject to regulation by ERC hence tariff rates and other charges has to be approved by ERC. Diagrammatically, the role critical role played by ERC and the electricity rate or tariff making process is shown in Figure 10.

10.2 Role of WESM in electricity trade

The EPIRA Law established the Wholesale Electricity Spot Market (WESM) giving further options to concerned parties get the most out of the benefits of a free market enterprise. As referred to under the EPIRA Law, DOE is mandated to established a wholesale electricity spot market composed of the wholesale electricity spot market participants.

As provided for under the EPIRA Law, the DOE facilitated the creation of the Philippine Electricity Market Corporation (PEMC). The PEMC undertook the preparatory work and initial operation of the WESM. PEMC was established to maintain, operate and govern an efficient, competitive, transparent and reliable market for the wholesale and purchase of electricity and ancillary services in the Philippines in accordance with applicable laws, rules and regulations. The Articles of Incorporation and By-laws of the PEMC were finalized in collaboration with the WESM Technical Working Group. PEMC is a duly incorporated non-stock non-profit corporation registered with the Securities and Exchange Commission (SEC) on 18 November 2003.



Scenario 1: GENCOs submits generation rates charges to ERC
Scenario 2: TRANSCO petitions ERC for transmission charges to distributors/utilities.
Scenario 3: Distributors/Utilities petitions ERC for tariff rates to consumers/end users.
Scenario 4: Other stakeholders petitions ERC regarding tariff matters.
Note: In all scenarios, ERC involves all stakeholders in tariff setting process.

Figure 10. Electricity tariff setting process in the Philippines

Simply put, the WESM mechanism runs similar to a stock market wherein instead of trading shares of stocks, electric commodity is placed on the trading floor for any interested parties to grab. WESM shall provide the mechanism for identifying and setting the price of actual variations from the quantities transacted under contracts between sellers and purchasers of electricity.

10.2.1 Membership in WESM

To be a player in the wholesale spot market, both generation companies (GENCOs) and distributors (private utilities and electric cooperatives) have to be accredited with PEMC who runs/manages the wholesale electricity spot market.

To date, the parties directly and indirectly involved in WESM operations is shown in Table 4. As shown in Table 4, 30 generators have been accredited with WESM to sell their electricity. Seven (7) electric power distributors/retailers comprising of Manila Electric and Light Company (MERALCO) have been accredited to source their power using the WESM market system. Four (4) generators and 1 supplier have expressed their intension to be accredited with WESM. Nine (9) organizations have filed their applications with WESM.[4]

[4] www.wesm.ph

Table 4. List of accredited WESM participants

1. Generators	30
2. Distribution utilities	1
3. Electric cooperatives	6
4. Suppliers	5
5. Indirect participants	16
6. Intending WESM participants	5
7. Applicants	9

Source: www.wesm.ph (13 March 2009)

10.2.2 How does WESM work?

WESM is a system of electronically connected market players who sell and buy their need for electricity at any time of day. WESM does this by scheduling electricity generation and dispatch while balancing with demand at all times. A typical trade is as follows:

> ***Step One:*** **Trading participants submit hourly bids stating their price of, and demand for, electricity. Bids are submitted to the Market Operator (MO). Price bids reflect only the energy costs.**
>
> ***Step Two:*** **The MO matches bids using the Market Dispatch Optimization Model (MDOM), which takes into account market requirements and physical system constraints. As such, the MO first dispatches generators with the lowest offers until demand is fully met at the market clearing price.**
>
> ***Step Three:*** **The MO submits the dispatch schedule to the System Operator (SO) for implementation.**
>
> ***Step Four:*** **Suppliers and buyers settle respective payments through the WESM. Under its price determination methodology, the total cost of electricity is computed using the market clearing price (spot price), market fees, and charges for ancillary services. In the case of bilateral power supply contracts however, the involved trading participants have the option of settling directly with their contracting parties.**

This system allows for transparency wherein electricity is provided at its true cost, based on the economic principles of supply and demand.

11. Cagayan Electric Power and Light Company, Inc.

Cagayan Electric Power and Light Company (CEPALCO) is based in Cagayan de Oro City in Northeastern Mindanao. The company is one of those enterprising and socially conscious organizations who took advantage of the benefits of a deregulated electric power sector and by generating electricity using renewable energy technologies like hydro as well as solar energy sources.

The company began its operations in 1952 with a modest power later generating capacity of 5000 KW and a customer base of only 750. The company was granted congressional franchise back in June 17, 1961. Today, CEPALCO has over a hundred thousand residential, commercial and industrial customers within its franchise area that covers the City of Cagayan de Oro and the Municipalities of Tagoloan, Villanueva and Jasaan, all in the Province of Misamis Oriental, including the 3,000-hectare PHIVIDEC Industrial Estate.[5]

CEPALCO is now the 3rd largest electric distribution company in the Philippines outside of Manila Electric and Light Company (MERALCO), the biggest distributor. The company's growth in energy consumption has consistently been among the highest in the country. Modern facilities and equipment as well as efficient service network have made CEPALCO one of the most reliable electric service companies in the country. The company's distribution network includes 138KV, 69KV, 34.5KV and 13.8KV systems.

The company is a closely held company, where the Abaya family is the founding and the major shareholder. The combined four top shareholders (Fullmax Philippine Development, LLC, Abaya Investments Corporation, Breavel, Inc., and the Abaya family) together own 63.1% of the company.

11.1 CEPALCO's renewable energy development initiatives

CEPALCO has been very active in developing alternative and indigenous resources for power generation to meet its increasing demand requirements and to augment the increasingly non-dependable central generation facilities of its major power supplier. Among these indigenous resources are renewable resources, which include hydro resources, solar photovoltaic and biomass-fired generation facilities. The 7MW Bubunawan River hydro plant in the municipalities of Libona and Baungon, Bukidnon is the first hydro commissioned by CEPALCO in 2001 through its subsidiary company, the Bubunawan Power Co., Inc. (BPC) while the 1MWp solar photovoltaic plant located in Indahag, Cagayan de Oro City is the developing world's largest when it was commissioned by CEPALCO in 2004.

In the area of hydropower development as well as biomass-based technologies, following are projects and initiatives undertaken by CEPALCO:

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[5] www.cepalco.com.ph

11.1.1 Cabulig river hydro project

The Cabulig River is located in Claveria, Misamis Oriental, around 45 minutes east of Cagayan de Oro City. The feasibility study was completed in October 2006 with financial assistance from the EC – ASEAN Energy Facility. The plant technical design was completed by IT Power of UK while the environmental studies and evaluation were performed by Centric International of Austria; the financial analysis was performed by EEEC of Thailand. The Cabulig River hydro project is expected to supply CEPALCO with not less than 40 million kWh annually starting 2011. The proposed 8MW plant features 2 x 4MW Francis turbines, an open canal water conveyance system of around 3 km and a head of around 55 meters.

11.1.2 Culaman River Hydro Project

The proposed Culaman River Hydroelectric power project is located in the municipalities of Sumilao and Manolo Fortich in Bukidnon, approximately 50 km southeast of Cagayan de Oro. CEPALCO's reconnaissance activities in the Culaman River during the early part of 1990s resulted to a feasibility study indicating a hydroelectric power potential of up to 10 MW at full supply water level of 425 meter ASL and tailwater level of 200 meter ASL and discharge of 5.6 cms. Other estimates indicate that mean annual flow can go as high as 10.8 cms. The proposed hydro plant features two horizontal Francis type turbine and two synchronous generators to maximize electricity production even during low flow.

The feasibility study of the plant which was conducted in 1998 is currently being updated. The Culaman River hydroelectric power plant is expected to help satisfy the growing electricity requirements of CEPALCO beyond 2010.

11.1.3 Lower Bubunawan Hydro Project

The proposed Lower Bubunawan hydroelectric power project is located in the municipality of Baungon, Bukidnon and around 1.5 km downstream of the existing 7MW Bubunawan Power Plant. The proposed hydroelectric power project still needs a full blown feasibility study (including geotechnical and environmental studies) but pre-investment investigations indicate a potential of up to 20MW

11.1.4 Biomass-fired energy facilities

The area around the service territory of CEPALCO is pre-dominantly agricultural and a number of agro-industrial facilities exist within the 100 km radius from Cagayan de Oro. Further, Cagayan de Oro is a fast growing, highly urbanized area where the volume of the municipal solid waste is growing tremendously each year. Recognizing that these agricultural as well as municipal solid wastes are potential sources of energy, CEPALCO embarked into waste-to-energy studies, some of which are discussed below.

11.1.5 Cagayan de Oro Landfill Gas-to-Energy (LFGE) Conversion Project

Together with its foreign partners (based in Czech Republic and in Thailand), a reconnaissance study was conducted by CEPALCO in late 2005 at Cagayan de Oro's landfill site at Calaanan, which has been the dump site of Cagayan de Oro's garbage for more than 25 years. A pre-feasibility study, made part of the EAEF-funded "Increasing Access to Local Sources of Financing for Renewable Energy Investment and Design of Innovative Financing Instruments", was completed in early 2007.

On a base case scenario, the proposed LFGE project is estimated to produce around 89,000 kWH of electricity per day during its 15-year lifetime at a power plant capacity of around 4.1 MW. This volume of electricity will replace fossil fuels and reduce carbon emissions while at the same time capture the environmentally hazardous methane that naturally comes out of the landfill.

11.1.6 Cogeneration (Combined Heat and Power) projects

Combined Heat and Power requirements of some agro-industrial plants increase the value of the energy generated by a waste-to-energy cogeneration facility (a cogeneration facility produces heat as well as electrical energy). In 2006 CEPALCO conducted studies for a cogeneration facility that will satisfy the heat or steam requirements of a local manufacturing facility for its food processing while at the same time provide the electricity requirements of its equipment. The cogeneration facility shall use a mixture of biomass feedstock, which includes the manufacturing facility's own waste products, wood wastes and rice hulls.

The proposed 4.2 MW cogeneration plant is estimated to produce not less than 24 million kWh of electricity per year and a steam generation of around 260,000 tons per year. The proposed plant will also displace the bunker diesel used by the food processing plant for its conventional boilers.

CEPALCO also considered a biomass-fired facility running on full-condensing mode (electricity generation only) and using feedstock available within Misamis Oriental and from the nearby provinces (e. g., bagasse, wood waste and rice hull). Estimated volume of these agricultural wastes can supply the fuel requirement of plant with a capacity of not less than 10MW and an annual electricity generation of not less than 68 million kWh.

A bagasse-fired cogeneration facility of Crystal Sugar in Maramag, Bukidnon is presently generating an excess power of not less than 5MW, especially during off-milling season. In line with CEPALCO's renewable energy initiatives and its thrust of utilizing indigenous resources to supply its growing electricity requirements, CEPALCO is considering the addition of the 5 MW bagasse-fired power capacity into its power supply portfolio.

11.1.7 The solar photovoltaic (PV) plant

CEPALCO made a major and innovative decision by venturing into investments in renewable energy technology particularly on the photovoltaic (PV) facility. The site of the PV plant is a 2-hectare property and construction of the photovoltaic power plant was handled

by Sumitomo Corporation and it started in August 2003. The PV plant was finished in April of the succeeding year. It is this particular project of CEPALCO that shoots up the publicity of company not only in the Philippines but globally as it puts the country among the major generator of solar power from among developing countries.

The plant's 1 MW capacity consists of 6,480 Sharp ND-Q7E6Z photovoltaic modules/panels and was designed to provide up to 1,500 MWh of electricity annually. The solar PV modules are manufactured by Sharp Japan with inverters manufactured by Sansha with all the other components locally made.

The PV plant of CEPALCO started its commercial operations in September 26, 2004. After a period of 3 years of commercial operations, International Finance Corporation (IFC) of the World Bank reported that the PV plant has operated with greater expected annual energy production. Since its commercial operations, the plant has exported to CEPALCO a total of 4,169,100 KWh. At its current generating capacity, the PV plant supplies the equivalent requirement of not less than 900 CEPALCO residential customers.

The CEPALCO photovoltaic power plant generates 1.1 MW of power and is currently the 133rd largest solar power plant in the world. The PV plant puts the Philippines at number 9 among the countries in the world having the largest solar power plants! The Philippines is behind solar powerhouse Germany (who has 64 out of the top 100 largest solar power plants), Portugal, Spain, Japan, USA, Italy, the Netherlands, and South Korea.

11.1.7.1 Project cost of the photovoltaic plant

The total project cost of the photovoltaic plant of CEPALCO is about US$ 7-8 million in funding from Global Environment Facility (GEF) through the International Finance Corporation of the World Bank in the about of US $ 4 million (inclusive of grant component). The GEF support is a loan that turns into a grant after five years of successful operations of the plant by CEPALCO. Co-financing component of the project from CEPALCO is about US $ 3 – 4 million.

According to International Finance Corporation (IFC), the purpose of the project was to demonstrate solar PV's effectiveness (through a conjunctive-use application) in addressing distribution capacity issues. The IFC funds were used to build 1 MW distributed generation solar PV plant, which is integrated into the 80 MW distribution network of CEPALCO, and operated in conjunction with an existing 7 MW mini-hydro electric plant. The plant was operated without incident since its inauguration in 2004. It appears to have been successful in proving solar PV to be an effective and technically reliable technology to address peak-load energy supply issues. IFC reported that the CEPALCO solar PV plant has made a strong technical case for reliability or a utility scale solar PV power plants and the project has resulted in a significant reduction in greenhouse gas emissions.[6]

The PV project is categorized by World Bank's International Financing Corporation (WB/IFC) as a Category B project according to the Procedure for Environmental and Social

[6] World Bank/International Finance Corporation (IFC) – Project No. 502486

Review of Projects because a limited number of specific environmental and social impacts may result which can be avoided or mitigated by adhering to generally recognized performance standards, guidelines or design criteria. The project was funded in the context of technical, environmental and social information submitted by the company.

11.1.7.2 Generation cost of the PV plant

The photovoltaic power plant is a project of CEPALCO as part of its investment. As such, and having no separate organization as well as personnel for the PV plant itself, the generation cost of PV facility on a per watt or kilowatt basis is somehow unique to compute or estimate and matters deemed to be private at this time. Given the fact that as a private business organization, financial data are deemed confidential. As commercial organization, however, it is presumed that the operation of the PV facility is deemed to be a profitable business proposition given the fact that similar project is to be replicated on a larger scale.

11.1.7.3 Non-energy benefits from the PV plant

The electrical energy output of CEPALCO's PV plant may be considered small compared with other sources like large-scale hydropower plant and petroleum-based power plants. However, the contribution of the PV plant to the climate change initiatives is somehow substantial. The solar PV plant of CEPALCO is expected to displace 24,000 tonnes of CO_2 over its lifetime.

Being one of a kind, CEPALCO's PV Plant has already been visited by over 13,000 students and visitors both local as well as foreign renewable energy enthusiasts since it started operations.

The facility was even visited by the judges of the Court of Appeals in the hope that the agency can consider the project one of it models or inputs in the construction of its upcoming building.

11.1.8 Energy supply mix of CEPALCO

CEPALCO is doing every possible effort to improve the company's independence from its major electricity supplier (NPC) and this is explained by the fact that the company has now four sources of power (refer to Figure 11), three of which are from their own power plants. The entrepreneurial decision of the management of CEPALCO management to venture into PV project resulted to a variety of energy sources and flexibility. The energy supply mix of CEPALCO is diagrammatically shown on Figure 11. As shown in Figure 11, CEPALCO sources its power externally (from NPC/TRANSCO Mindanao Grid) and also internally, from its own electric generating facility, mini-hydro plant and the 1 MW photovoltaic facility.

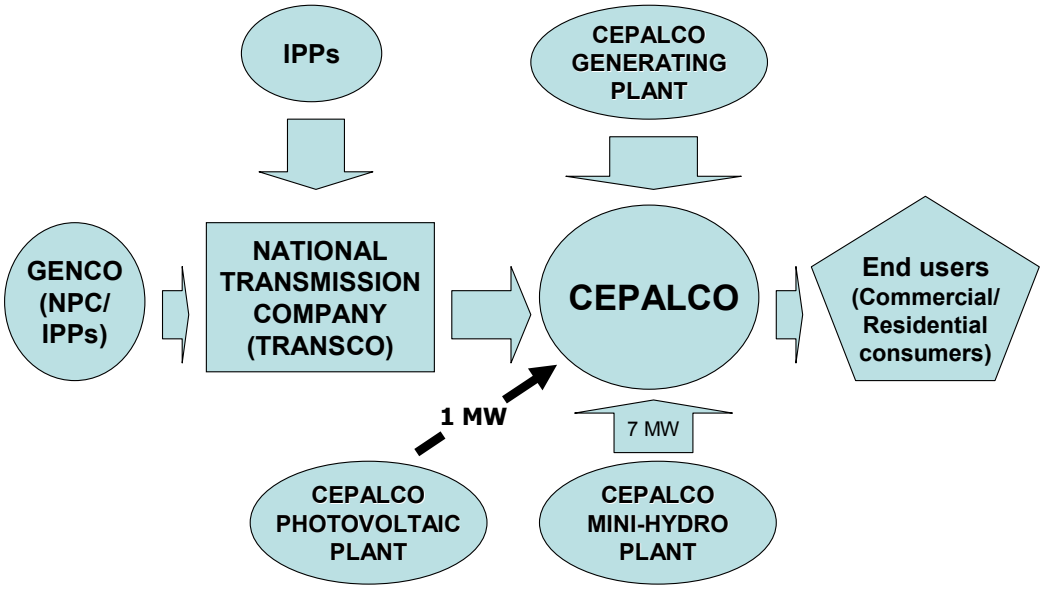

Figure 11. The CEPALCO energy supply sources

11.1.9 Expansion of the PV plant

Given the positive and encouraging experience from the existing PV facility, CEPALCO now plans to embark unto an even larger solar park within its service territory. The envisioned solar park shall make use of a 30-hectare lot within the First Cagayan de Oro Business Park in Villanueva Oriental, some 30 minutes east of Cagayan de Oro City, its base of operation.

Pre-feasibility study of the proposed PV plant expansion indicates that it will be able to supply the CEPALCO distribution network with no less than 14,000,000 KWH of electricity annually, which is equivalent to not less than 30,000 barrels of fuel oil per year. The proposed PV plant, with a total installed capacity of at least 10MWp, shall be constructed over a period of at least five years and shall use the best available solar technology in the market. The phased-in construction strategy will enable CEPALCO to capitalize on the increasing efficiency but decreasing costs of solar cells which currently command not less than 60 percent of the PV plant's installed costs. It will also cushion the impact of generation costs on CEPALCO's customers.

If implemented according to plans, the first phase of the proposed 30-hectare solar park shall be commissioned by 2012 to augment the expected shortfall of firm capacity in Mindanao Grid.

12. NorthWind Power Development Corporation (NPDC)

The Philippines has been found to have potential wind power of 76,600 MW, leading other wind power-producing countries like Germany (14,000 MW potential wind power),

Spain and the US (6,000 MW each), Denmark (3,000 MW) and India (2,100 MW). A wind mapping study conducted by the United States National Renewable Energy Laboratory has found Bangui Bay in Ilocos Norte to be one of the areas across the country where 10,000 sq. km. of windy land exists with good to excellent wind resource potential.

NorthWind Power Development Corporation (NPDC) is a relatively new business organization involved in power generation but capitalizing on wind potentials in the Bangui Bay off Ilocos Norte in Northern Luzon. The wind farm project in Ilocos Norte was drawn in 1996 though a wind resource analysis and mapping study conducted for the Philippines by the National Renewable Energy Laboratory (NREL). The study showed that various areas spread in the Philippines are receptive to wind power installations. These areas include Bangui and Burgos towns in Ilocos Norte, Batanes and Babuyan islands also north of Luzon and the higher interior terrain of Mindoro, Samar, Leyte, Panay, Negros, Cebu, Palawan and eastern Mindanao.

NorthWind Power Development Corporation (NPDC) took advantage of the wind power potentials of the country particularly the Ilocos region by investing into the first wind farm in the country and in Southeast Asia. The wind farm established by NDPC in Bangui, Ilocos Norte uses wind turbines arranged on a single row stretching on a three-kilometer shoreline off Bangui Bay facing the South China Sea. The wind farm uses a 1.65 MW Vestas V82 wind turbines supplied by **Vestas Asia Pacific A/S**, the leading supplier of wind turbines in the world. The turbines are on-shore and arranged in an arc spaced about 326 meters apart. Other technical details of the wind turbines are shown in Table 5.

Table 5. Specifications of wind power system of NPDC

Turbine's hub height***	- 70 meters
Blade length	- 41 meters
Rotor diameter	- 82 meters
Windswept area	- 5,281 square meters

*** Ground level to center of nacelle

The turbine are oriented facing the sea, effectively eliminating windbreaks and achieving terrain roughness of class 0.

Annual generation capacity	- 74,482 MWh
Wind turbine arrangement	- Single row
Spacing	- 326 meters
Orientation	- North
Prevailing wind direction	- Northeast

Harnessing the strong winds coming from the north-northeast of the country, the wind farm is the largest wind power project in Southeast Asia. A first in Southeast Asia, the wind power plant is now composed of 20 turbines, each standing 70 meters or equal to the height of a 23-story building. The wind farm can generate a maximum capacity of 33 MW. The company is considering another 40-megawatt wind-power project in Cagayan province also in Northern Luzon in the next two years.

The first phase of the project started with 15 wind turbines in 2000 with an aggregate capacity of 25 Megawatt and a 69-kilometer transmission line to the Ilocos Norte Electric Cooperative in Laoag City. In June 2008, NPDC added five more turbines, raising the wind farm's capacity to 33 MW.

12.1 Funding the NPDC project

Initially, the funding that was provided by NPDC for 5 turbines, which is equivalent to 8 megawatts. Eventually, the Danish International Development Agency (DANIDA) partially funded the first phase of the Bangui Bay project. All 15 wind turbines under Phase 1 project are connected to the Luzon grid, and have been delivering power to the Ilocos Norte Electric Cooperative. The second phase comprising of additional five turbines is an additional investment of NPDC amounting to US$13 million and total project cost now amounted to US$ 50 million.[7]

In all, DANIDA shelled out $29.35 million of the $50-million project cost through a zero-interest mixed-credit facility, which was complemented by a guarantee from the Philippine Export-Import Credit Agency. About $10.5 million came from grants, while the balance was put in by NPDC shareholders. NorthWind's major shareholders include Moorland Phils., Phildane Resources Corp. and Fabmik Construction and Equipment Corporation.

12.2 NPDC expansion and creation of a new subsidiary

To handle its expansion project, NPDC has created a new subsidiary to take charge of its expansion program in the Cagayan area worth $95 million. NPDC will put up a 40-megawatt (MW) wind farm project in Aparri, Cagayan this year (2009). The company is bullish in expanding their capacity with the passage of the Renewable Energy Law. For its expansion project, NPDC may tap the Danish government and other investors and creditors for the Cagayan wind project. The company also expects to tap Japanese and Spanish investors and creditors. Former Energy Secretary Vincent Perez now of Alternergy said with the growing interest in renewable power sources, an increase in foreign investment is projected for renewable projects in emerging countries. Perez, who is also chairman of energy advisory firm Merritt Partners and managing director of renewable power developer Alternergy, said that investments in renewable energy sources such as wind, hydro and solar power is expected to pick up. After an extensive road show in the US, Middle East and Europe, Perez group were able to identify $150 million in equity commitment into Alternergy from foreign investors primarily for wind power development.

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[7] www.northwindpower.com

12.3 Sale price of NPDC power output

The only market for now of the electricity output of NPDC is the Ilocos Norte Electric Cooperative (INEC) with which is has existing **Renewable Energy Sales Agreement** (RESA). The distribution system of NPDC's wind farm is embedded in the INEC grid and thus negated the power-delivery charges of the National Transmission Corporation (TRANSCO) and it is considered a savings for INEC. NPDC has a pending accreditation with WESM where other than INEC as a market, excess power output of NPDC can be sold in the spot market being administered by WESM.

As stated in the RESA, NPDC will extend a 7-percent discount to INEC benchmarked against rate of the National Power Corporation (NPC). This pricing scheme will reduce the power charges being paid by Ilocos residents. The wind energy produced by the Bangui wind farm of NPDC translates to a 7 percent reduction in power costs from prevailing rates or a 5 percent discount of the weighted average price in the wholesale electricity spot market (WESM).

On top of reduced power rates, the wind farm will pave the way for the entry of additional investment opportunities whose operations depend on good power quality. The province's unstable power would force the Coca-Cola Bottlers' Company to avoid switching to INEC's power line due to low voltage between 5 to 10 p.m. The bottling company is one of the few huge power-dependent companies in the province.

The Bangui Bay wind farm project sells electricity to the Ilocos Norte Electric Cooperative and it now provides 40 percent of the power requirements of the province of Ilocos Norte and gradually increasing by 70 percent once Phase II is completed.

12.4 Carbon credit for NPDC

The electricity that NPDC generates will displace green house gas emissions such as carbon dioxide by approximately 65,000 tons per year. It is the first to be registered with the executive board of the United Nations Framework Convention on Climate Change- Kyoto Protocol. When carbon credits are duly accredited and issued the appropriate Certificate of Emissions Reduction (CER), the same can be traded in the carbon market. CERs are the carbon offset credits generated under the **UN Clean Development Mechanism** (CDM) for emissions reduction investment in developing countries. CERs are bought by developed countries and their firms to count towards their own domestic emissions targets.

The prices of Certified Emissions Reductions (CERs) in the global carbon markets ranges from US$ 10 – US$ 30 per tonne. In the Europe carbon, price was around €9.60 as of December 2008.[8]

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[8] http://www.carbonpositive.net/viewarticle.aspx?articleID=137

If the CER of NPDC is sold at low market price of US$ 10 per tonne, the annual carbon equivalent production of NPDC translates around US$ 650,000 per year or estimated to be about US$ 6.5 million over a 10 years period.

The ERC lauded NPDC for investing in eco-friendly renewable energy projects for cheaper electricity service as well as clean and green environment. With its compliance to the technical, financial and environmental standards set by law, electricity consumers in the area are assured that the ERC has carefully reviewed the safety and reliability of the NPDC's wind farm facilities.

12.5 LGU efforts paid off

The electricity supply from NPDC was a welcomed development by the local government unit (LGU) and the provincial officials. Already, business developers have started discussing potential industries with the provincial government ranging from glass to cement plant in eastern Ilocos Norte towns. It was Ilocos Norte Gov. Ferdinand Marcos, Jr., who, as a congressman back in the 1990s, pursued aggressively the development of a power plant in the province. The governor had previously disclosed that Ilocos Norte had let loose potential investors in the past due to poor power quality in the province. Governor Marcos had always complained then from NPC to do something about its power service, but to no avail. At present, Ilocos Norte is most affected during power outages because it is found at the end of the power grid coming all the way from Bauang, La Union.

12.6 Contribution of NPDC to the grid

NPDC's aggregate installed capacity of 33 MW is only 0.33 percent and 0.25 percent of the Luzon grid and the national grid, respectively. This share provided by wind energy in terms of generation capacity is way below the current limit set by the ERC. These figures may be considered miniscule but when one looks at the fact that the electricity production of NPDC supplies 40 percent of the power needs of INEC with potentials to supply up to 70 percent of the province's need, the contribution of NPDC is substantial.

The ERC must ensure that a generating company does not exceed the market-share limitations in the grid set at 30 percent where it operates and in the national grid set at 25 percent. The ERC determines the compliance of a generating company to the market-share limitations by determining the maximum load-carrying capability of the facility operated by the generation companies on a yearly basis. To prevent anti-competitive behavior, the ERC ensures that an electricity generation company does not exceed the market share limitations in the grid (set at 30 percent) where it operates and in the national grid, which is set at 25 percent.

12.7 NPDC awards

For its pioneering efforts in the area of wind power development, NPDC has been accorded a number of recognition and awards both by local and international bodies. Among these awards and recognition are the following:

a) Green Energy Award. For Renewable Energy On-Grid Electrictricity Generation. Awarded by the Department of Energy and the Center of Excellence for sustainable energy in Southeast Asia. Mandarin Oriental Manila, 2006.

b) Green Energy Award. Special citation: For exemplary achievement as a pioneer commercial wind farm in the Philippines, the largest in Southeast Asia, and for being the first Philippine Renewable Energy Project to be covered with an Emission Reduction Purchase Agreement (ERPA). Mandarin Oriental Manila, 2006.

c) 2005 ADFIAP Development Award for Local Economic Development. Given to Philippine Export-Import Credit Agency (Phil-Exim) recognizing their support for the realization of the 25MW Northwind Bangui Bay Project.

d) Model Corporate Citizen Award. Given by the Governor of the Province of Ilocos Norte. Laoag City Provincial Capitol, 2006.

e) **Renewable Energy Project Competition.** 1st Runner Up: On-grid Category. Awarded by the ASEAN Center for Energy. Vientiane, Lao PDR, 2006.

Other than the abovementioned citations, the World Bank (WB) has cited the success of NorthWind Power Development Corporation in generating electricity through the wind power technology in Bangui Bay, Ilocos Norte.

13. Ilocos Norte Electric Cooperative

Ilocos Norte Electric Cooperative (INEC) is consumer-level electric power provider in the northern-most province of Luzon province once sourcing its electricity from the National Power Corporation (NPC). INEC has a power demand of 32,425 KW (substation capacity) with a load factor or 58.76 percent. As of February 29, 2008, INEC has energized all the 21 municipalities of Ilocos Norte including Laoag City and City of Batac posting a record of 100 percent energization of the province and 100 percent of the province's 557 villages (barangays).

The electric cooperative used to source its power from the Luzon grid of the National Power Corporation (NPC) who provide electric power to all over the Philippines. In 2001, INEC linked up with the **NorthWind Power Development Corporation** (NPDC) – the first wind-power producer in the Philippines. At the time of initial link up in 2001, NPDC had a rated capacity of 24.75 MW from its 15 wind turbines. This capacity increased to 33 MW with the addition of 5 turbines more. The Bangui bay wind farm of NPDC generates power at wind speeds averaging 7 meters per second. NPDC's wind farm can help reduce INEC's system loss by improving its stability, electric quality and reinforce its transmission system through a 50-kilometer, 69,000-volt line constructed by NPDC.

13.1 Energy supply mix of INEC

The availability of wind power-based electricity provided by NPDC made it possible for INEC to diversify its power sources aside from NPC and its own mini-hydro power plant. As of the year end 2005, the energy supply mix of INEC is shown in Figure 12. As shown in Figure 12, from zero contribution in the early part of 2005, the contribution of wind power rose to 25 percent by year end 2005. As power from INEC sourced from wind resources increased to 25 percent, electric power sourced from NPC reduced to only 71 percent from 93 percent in early 2005 (refer to Table 5).[9]

The details of the energy supply mix of INEC is shown on Table 5. As Shown in Table 5, the energy sourced from its own mini-hydro plant appeared to be fluctuating, and in fact, reducing in term of share. Clearly increasing in terms of magnitude and per cent share is the energy supplied by wind power thru NPDC indicating the critical role played by wind energy technology.

13.2 INEC benefits from wind power

It is indeed a blessing for INEC to be the beneficiary of the electricity from wind sources owing to the following benefits:

a) An electricity source cheaper in acquisition cost about 7 percent lower than its usual energy source (i. e., National Power Corporation). This lower rate is passed on to the consumers of INEC's electric power;
b) Savings on the part of INEC on account of transmission cost usually budgeted or paid to TRANSCO. NPDC's power output in embedded into the INEC transmission system thus negating TRANSCO fees. The connection and power sourcing from the wind-farm project generated a savings of approximately $2.54 million for the consumers of the INEC in 2006 and 2007. The savings happened since NPDC was embedded in the INEC grid and thus negated the power-delivery charges of the National Transmission Corporation (TRANSCO).
c) An assurance of localized energy source with potentials to displace up to 70 percent of INEC's power demand and hopefully means more long-term monetary benefits to INEC and its customers;
d) The energy from the wind farm of NPDC supplies the energy needed by INEC thus addressing the voltage fluctuation problem in the INEC service area which in the past they complain about.

13.3 INEC's concerns on the spot market

The EPIRA Law calls for the establishment of the Wholesale Electricity Spot Market (WESM) wherein electric requirements of electric cooperatives has to purchase from the spot

[9] www.erc.gov.ph – ERC Case No. 2005 019 RC, p. 9

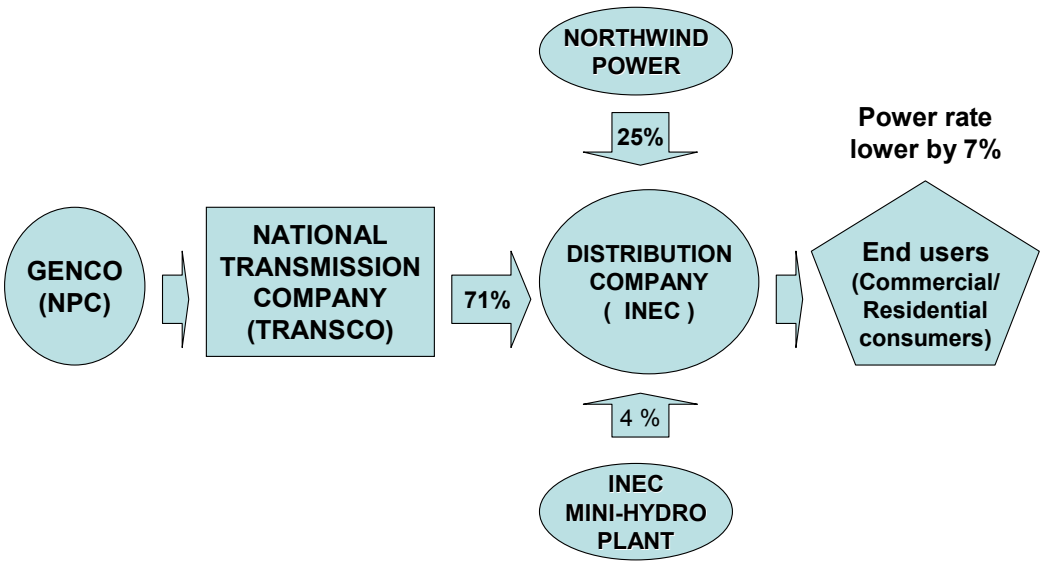

Figure 12. The INEC energy supply mix (as of December 2005)

Table 5. Energy supply mix of INEC (2005)

Months	Mini Hydro (kWh)	% share	NPC (kWh)	% share	NorthWind (kWh)	% share	Total (kWh)
January	906,220	7%	11,961,974	93%	0	0.00%	12,868,194
February	587,200	4%	12,743,614	96%	0	0.00%	13,330,814
March	657,670	5%	11,943,508	95%	0	0.00%	12,601,178
April	450,060	3%	15,762,013	97%	20,789	0.13%	16,232,862
May	249,180	1%	15,660,217	93%	849,165	5.07%	16,758,562
June	201,600	1%	14,500,913	91%	1,268,114	7.94%	15,970,627
July	138,600	1%	13,738,983	87%	1,850,940	11.77%	15,728,562
August	195,300	1%	13,487,345	87%	1,769,442	11.45%	15,452,087
September	174,300	1%	12,795,817	86%	1,826,552	12.34%	14,796,669
October	137,600	1%	11,176,063	78%	3,037,368	21.16%	14,351,031
November	319,200	2%	11,497,740	76%	3,404,884	22.37%	15,221,824
December	621,600	4%	9,930,433	71%	3,442,196	24.60%	13,994,229
Total	4,638,530		155,198,620		17,469,450		177,306,600
Average		2.75%		87.51%		9.74%	

Source: Energy Regulatory Commission./ www.erc.gov.ph

market through electronic bidding. In its initial implementation, INEC has applied as one of the pilot electric distribution utilities and the first electric cooperative to participate in the WESM. However, INEC appears to be not so excited about this possibility.

As per the WESM rules, electric cooperatives are required to purchase at least 10% of their energy requirements from the spot market. At present, INEC's energy requirements are purchased from the National Power Corporation (NPC) and NPDC as well as INEC's own Mini-hydro Power Plant. During the trial operation by INEC personnel with the WESM system, it was observed that there are times that the price of electricity in the spot market is higher than the NPC price but there are also times that the price of electricity is lower. In the WESM operation, distribution utilities are required to submit their bids for their energy requirements one hour ahead, thus, the price of electricity that INEC will purchase from the spot market will change every hour. To closely monitor the prices of electricity in the spot market, there is a need to man the INEC Energy Trading Office for 24 hours. This project is a new concept in the Philippine electricity industry but it aims to reduce the rate of electricity because of the competitive bidding. To date, several assets of NPC have already been privatized, the most recent of which is Magat Hydroelectric in the province of Isabela acquired by the Aboitiz Group of Companies. Given this scenario, it is possible that the 7 percent discount rate from NPDC and the spot market prices WESM as well as renewable energy sales agreements with NPDC may have complications that can potentially jeopardize the concern of INEC to serve its customers through affordable prices.[10]

According to the ERC legal office, there is now a legal case filed by NPDC and this concerns the refusal of INEC to settle the entire bill submitted by NPDC to INEC.[11]

14. Montalban Methane Power Project

Other than the solar photovoltaic plant of CEPALCO and wind-powered generation system of NPDC, the Philippines takes pride in the methane-powered facility that is connected to the distribution utility (MERALCO). In previous years, the country had a number of biogas/methane project considered commercial in scale but now of these projects was ever connected to the electricity grid. The Montalban Methane Power Corporation (MMPC) is a project of First Balfour, Inc., one of the power/energy companies belonging to the Lopez Group. The project makes use of the garbage from Metro Manila that is dumped at the landfill facility located in Montalban, Rizal. MMPC has secured an agreement with the local government of Rizal Province to put up the country's first waste-to-energy power plant in Rodriguez (formerly Montalban) landfill site. MMPC will capture the landfill gas or methane from the 14-hectare landfill to produce electricity enough to provide 15,000 households with power. The methane-powered facility operationalized in July 2008 and no less that President Gloria Macapagal Arroyo launched the project.

The project is a build-own-and operate (BOO) project and Monark Equipment Corporation (MEC) was commissioned to put up the power plant for the project. First Balfour

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[10] www.inec.gov.ph

[11] Per phone conversation with Atty. Adriano of ERC Legal Office (23 March 2009)

will be responsible for the installation of nine (9) units of generator set with 2MW capacity each but derated at 850 KW using methane as fuel. The project scope included construction of the powerhouse building, equipment foundations, piping works for fuel/gas header, condensate and cooling water, cabling works, small power and lighting, plumbing, ventilation system and monitoring system.[12]

Methane-based project in the Philippines is not really new in the country but this particular scale and kind of project is the first of its kind in the Philippines and one of the largest in Asia. With an estimated construction cost of $30 million, it is expected to generate 15 megawatts of power over 10 year. MMPC officials said that at least 1,500 metric tons of garbage would be needed to sustain the plant's operations. Increasing the volume of trash to 2,500 metric tons can extend production to 10 years instead of just five years.

The company plans to sell its power to Manila Electric Co. and the Wholesale Electricity Spot Market. The project expects to generate an income of US$ 50 Million. In addition, it can earn some more once it qualifies as a Clean Development Mechanism project under the United Nations Kyoto Protocol, and will generate at least 500,000 Certified Emission Reductions.

The methane gas facility of MMPC follows the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) initiative and provides carbon credits for developed countries under category of projects that reduce emissions in developing economies under the Clean Development Mechanism. Furthermore, the power plant project is a candidate for a Gold Standard (GS) Clean Development Mechanism status.

15. More wind power projects

San Carlos Wind Power Corporation, a Filipino-Danish joint venture, is investing P2.987 billion for the construction of a 30-megawatt wind power project. This is the third new and renewable energy project approved by the Board of Investments. The project would be located around Mount Malindog in Barangays Linubagan and Prosperidad, San Carlos City, Negros Occidental, which is 700-800 meters above sea level. BOI approved the project on a pioneer status having met the minimum investment requirement for wind technologies at $1.25 million.

For the development of the project, the partnership between Smith Bell Wind Technologies, Inc. and Global Renewable Energy Partners was put together to establish and organize the San Carlos Wind Power Corporation. San Carlos wind farm will comprise of 16 to 20 wind turbine generators each with a capacity of 1.5 to 2 MW with a total rated capacity of 30 MW. When operational, San Carlos intends to sell the generated power to the electric distribution facilities in the Negros and Panay sub-grids. Of the total cost, the firm intends to spend P1.7 billion for the acquisition of turbine, while the rest will be used for the construction and development of the facilities. Bulk of the cost at P2.2 billion is expected to come from loans, while the rest from equity. The project is also seeking Danish foreign aid in the form of grant on interest payments, and from European banks.

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[12] www.firstbalfour.com

San Carlos is the third wind power project to be registered with the BOI. The other two projects, also approved on pioneer status, are the 40-MW Northern Luzon Wind Project of PNOC-Energy Development Corp. and the of North Wind Power Development Corporation.

16. Wind Power Contracting Round

To further entice investors in renewable energy technologies, the Department of Energy has employed creative means fashioned after the oil concessionaire system. DOE has launched the **Wind Power Contracting Round** that offered 16 wind sites. Three companies earlier awarded pre-commercial contract (PCC) to harness the country's wind energy are now conducting actual wind assessment under their respective work programs. Philippine Hybrid Energy Systems, Inc. was awarded three PCCs for wind projects in Marinduque; Baleno, Masbate; and Tablas, Romblon with a combined 30MW of capacity. Trans-Asia Renewable Energy Corporation was also awarded a contract for a potential 30-MW wind project in Sual, Pangasinan and San Carlos Wind Power Corp. in San Carlos City, Negros Occidental for a 25MW wind farm. Companies that bid for the 11 other sites are now in the process of securing PCC at the Department of Energy.[13]

17. Financial support mechanism for NRETs

With many renewable energy technologies now in mature and commercial stage particularly solar and wind technologies, the next constraints and obstacle to its widespread use is more of financial and economic considerations.

It is, therefore, important to provide a financial support scheme and incentive to address investors concerns. It is along this premise that renewable energy development programs in the Philippines has given substantial emphasis on the financial support scheme particularly on credit availability as well as incentives in the form of duty-free importations and tax holidays. Aside from the pre-operating incentives, renewable energy projects in commercial operations are given additional incentives when the project is covered by the Incentives Act or the Investment Priorities Plan (IPP) being administered by the Board of Investments.

The above concerns are even more emphasized and concretized in the form of financial support schemes as well as incentive measures are enshrined under the Renewable Energy Law of 2008. Following are some of the elaborations in this regard.

17.1 Financial support under the RE Law

To encourage investors to venture into renewable energy projects, the Renewable Energy Las made specific provisions on financing commercial projects as provided for under Section 29 which reads as follows:

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[13] Department of Energy, 2008

SEC. 29. ***Financial Assistance Program.*** **– Government financial institutions such as the Development Bank of the Philippines (DBP), Land Bank of the Philippines (LBP), Phil-Exim Bank and other government financial institutions shall, in accordance with and to the extent allowed by the enabling provisions of their respective charters or applicable laws, provide preferential financial packages for the development, utilization and commercialization of RE projects as duly recommended and endorsed by the DOE.**

The Development Bank of the Philippines has financing packages under its **Wind Energy Financing Program**, **RE Project Preparation Revolving Fund**, **Rural Power Project for Type A Beneficiaries**, **Rural Power Project for Type B Beneficiaries** and **CDM Initiatives**.

Philippine Export-Import Credit Agency (PhilExim), for its part, provides loan guarantees to selected wind power projects such as the Bangui Bay wind farm.

17.2 Available financing from private sector

Even prior to the enactment of the Renewable Energy Law, the commercial banking system in the Philippines has available commercial loans and financing schemes given the fact that products of energy-based project are always in demand.

It is a matter of practice among private commercial banks to support and finance renewable energy projects that are bankable or who cash flow and income stream cash support the business venture and it appears some these technologies are already in the stage.

17.3 Financial support from external parties

Large-scale or commercial renewable energy-based power generation technologies are somehow expensive and come with techno-economic apprehensions. Hence, support of external parties, both from bilateral and multi-lateral sources are considered of great help.

Other than the availability of domestic funds from the banking and financial system, international or foreign-based sources also offer financial assistance such as the Global Environment Facility (GEF) and International Finance Corporation of the World Bank (WB/IFC) who provided the funds for the photovoltaic power plant of Cagayan Electric Power and Light Company (CEPALCO) in Cagayan de Oro City.

The **United Nations Development Programme-Global Environment Facility (UNDP-GEF)** also offers assistance in project preparation and in securing loan guarantee for the project.

Developed countries and donor organizations noticed the growing energy demand hence the Asian Development Bank and its development partners are setting up a facility that would provide seed capital for renewable energy and energy efficiency projects in the Asia-Pacific region.

Asian Development Bank said it would develop the **Seed Capital Assistance Facility** that would be initially funded by a $4.2-million grant from the Global Environment Facility, a

global partnership established in 1991 to help developing countries fund projects that protect the global environment. The seed capital assistance facility would be jointly managed by ADB and United Nations Environment Programme. The ADB said the facility would "provide technical assistance to private equity fund managers and entrepreneurs to develop sustainable clean energy funds and financing for the early stages of such projects, share in the costs of development and transactions, and encourage taking riskier portfolios through a seed capital return enhancement offered on a per-project basis. It further noted that the facility would increase access to financing at the early stages of sustainable energy enterprises and projects around the Asia-Pacific region. With increased experience among financiers in investing in small-scale renewable energy and energy efficiency projects, mainstream energy investors would be encouraged to invest more in clean energy enterprises and projects.[14]

18. Technical and economic efficiency

Renewable energy technologies in general suffer the perception of relatively low technical efficiency and hence the economic/financial efficiency as well. Technical efficiency for solar photovoltaic system stands at just a little above 10 percent with wind energy conversion systems limited by Betz coefficient that leads to a maximum theoretical efficiency below 60 percent. Adding demerit to this low technical efficiency is the fact that these systems produce direct current (DC) type of electricity as against the alternating current (AC) type of current demanded by the grid and system loads. Output of solar photovoltaic and wind power system have to be converted to AC electricity thus increasing initial system costs and thus affecting financial/economic efficiency computations even as the inputs (sun and wind) is available for free courtesy of Mother Earth.

The policy of the Philippine government, as enshrined it the Renewable Energy Law and other laws earlier enacted makes it attractive to renewable energy power system generators. Outputs of renewable energy systems can be connected to the regional electricity grids hence allowing the supply of NRET-generated power to be distributed or sold elsewhere too far away from the point of power production – realities which could have been too costly for alternative/renewable power generation system due to technical losses. This interconnection scenario, therefore, takes care of the limitations and low competitiveness of the NRETs vis-à-vis the traditional petroleum-based power generation system. It is in this light that renewable energy-based power generation system becomes somehow competitive as it can even serve a balancer to voltage instability in some areas served by the grid as in the case of the situation of Ilocos Norte province.

With the output of the photovoltaic plant of CEPALCO forming part of the power supply and distribution lines of the company as well as the electric power output of NPDC embedded in the distribution grid of INEC, the question of low technical efficiency is now a foregone issue as in fact, the output of these facilities serves as voltage stabilizers aside from the financial/economic benefits it provides on top saving some operating expenses on account of savings from wheeling charges from TRANSCO.

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[14] www.adb.org

18.1 Margin advantage for NRET electricity

Unlike tariff rates charge by distribution utilities and electric cooperatives which are explicitly regulated under the provisions of the EPIRA Law and other ERC regulations, electricity outputs or rates of power generators from renewable energy sources is some treated differently though implied to be considered regulated under the rate setting mandate of ERC. As such, the profitability of operations of renewable energy-based companies is not controlled or curtailed hence very much attractive and motivating for investors. It can be said then that potentially or in reality, financial/economic attractiveness or efficiency is expected to be relatively high on account of the expected higher return on investment levels that it can set as compared to electricity distribution business – and this scenario favors the investors in NRET-based projects.

The above notion is explained by the current situation of both CEPALCO and INEC. The photovoltaic system of CEPALCO is part of its power plant as distribution utility at the same time as generating company. The company owns and operates hydro and photovoltaic plant whose output is part of the electricity it supplies to its institutional/residential consumers. This being the case, CEPALCO is not necessarily required to divulge the costs and returns of the PV generation facility hence there is really no way of knowing whether the priced charge by the PV facility is sky high or not. The same is true with the electric power out of NPDC which is sold to INEC by way of an Energy Sales Agreement (ESA). The ESA assures NPDC a market outlet and guaranteed price benchmarked against the NPC rate at a discount rate of 7 percent. It was INEC who petition and clear up with ERC the ESA who eventually approved the 20-year ESA between INEC and NPDC. When NPC is fully privatized, the same discount rate will apply but benchmarked against the going electricity rate in the province as the buyer of NPC interest inherits the provisions in the ESA. What is not factored in the determination of cost of electricity sold by NPDC to INEC is money equivalent of the CERs which NPDC can sell to the carbon market. This is somehow a gray area which in the view of the author is favorable to the renewable energy generators like CEPALCO and NPDC.

A very important aspect and motivating factor in constructing and operating a renewable energy-based company is that aside from sales from electricity, the generator can earn substantial income from the sale of carbon credits if the firm is duly certified by appropriate bodies to be qualified for **Certificate of Emissions Reductions** (CER). These reality is substantial if not more than enough to offset whatever inefficiencies NRET technologies may have. This appears to be an advantage that redounds to economic or financial efficiency and advantage as it steps up early recovery of investment apart from helping the host country improve its contribution to the **Kyoto Protocol**.

20. More investments renewable energy needed and expected

Envisioning a goal of having 4,500 megawatts of new renewable energy capacity in the next 10 years, the renewable energy sector will need some $8.5 billion in fresh investments. This investment required is even an estimate on the conservative side. Director Mario Marasigan of the Department of Energy's energy utilization and management bureau, expressed confidence saying that that investors would find the renewable energy sector quite lucrative, particularly when the implementing rules and regulations for RA 9513, or the Renewable Energy Act of 2008, is finalized by June.

Right now, DOE may not have an exact handle on the number of investors that were seriously interested in investing in renewable energy projects. What the department knows at this point are the renewable energy projects that are most attractive to potential investors, he said. Most of these investors are looking at wind, hydro, geothermal and biomass, including solid waste-to-energy concepts, and biofuels. At least one company is interested in ocean energy thermal conversion.[15]

The finalization of the Implementing Rules and Regulations (IRR) for the Renewable Energy Law should prompt potential investors to finalize their investment plans in the sector. The IRR is expected to be completed by June 2009,ahead of the July deadline set by the law. The law is widely expected to spur investments in the renewable energy sector, due mainly to incentives that are offered to potential investors. Some of these incentives are exemptions from tariff duties and zero-rated value-added tax for the importation of machinery and equipment for the first 10 years of an operating contract, as well as tax credit on domestic capital equipment and services. Special realty tax rates will also be imposed on equipment and machinery to be used for renewable energy development. An income tax holiday will also be granted to potential investors for the first seven years of operations.[15]

21. Success factors in the Philippines NRET programs/projects

Whatever experiences and successes as well as failures the Philippines may have on NRET matters is a combined products and results of political will in developing the National Energy Plan that it keeps to continually update. This would have been impossible where it not for a variety of legislatives and administrative provisions to support the attainment of the vision set forth in the energy plan.

The global developments and the volatility of the global markets for petroleum products was a dilemma but in some ways served as untiring reminder on the need to continually pursue efforts on developing the potentials of renewable energy sources as a potent component of the projected generation capacity and eventually the energy supply mix. The efforts made in the area of commercializing the gasification technology, commercial experiences in biogas technology, the progress made in developing coconut-based fuel from a pure CNO-diesel fuel mix to coconut methyl esters (biodiesel), the initial failures in small-scale wind power projects as well as the pilot projects in the area of photovoltaics all contributed to the initiation and commercial-scale ventures in solar and wind power projects that is now generating megawatt-level capacities already connected to the grid system.

To name a few then, the following factors may have greatly contributed to the commercial use and megawatt level power generation projects using renewable energy sources:

a) Availability and abundance of natural resources (e. g., solar, wind, biomass);
b) Political will and government policy pronouncements on private sector participation in the area of power generation resulting to privatized power generation system.

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[15] Ho, A., $8.5B in renewable energy investments needed, Philippine Daily Inquirer, March 23, 2009

c) Commitment to pursue research and development as well promotional development efforts to popularize and commercialize the use of renewable energy sources;
d) Existence of a number of laws and administrative interventions principally incentive schemes thus favoring investments and private business ventures in the power sector;
e) Availability of foreign/local financing support schemes (e. g., loans and grants from DBP, LBP, WB/IFC, DANIDA, etc.) to augment local financial limitations;
f) Existence of guaranteed or captive markets as well as government assurance to ensure reasonable returns to private investors;
g) Support of local government units in concretizing the intents and purposes built into the national energy plan;
h) External pressures in terms of volatile global markets and environmental concerns (e. g., Kyoto Protocol, etc.) that favorably offsets the economic disadvantage of some renewable energy technologies;
i) Existence of mature and commercial technologies using renewable energy sources;
j) Willingness of local and foreign investors as well as concerned entrepreneurs who cares for clean energy and environment-friendly power generation technologies.

22. Summary

If there is any success in the development of renewable energy technologies in the Philippines resulting to establishment of megawatt-level capacity power plants, this can be traced to a number of incentives and mandatory provisions of laws as well as series of efforts done by the government commencing back in the late 1970s all the way to present time. The variety of laws like the Investment Act, BOT Law, Biofuels Law, EPIRA Law, Clean Air Act, Ecological Solid Waste Management Act, and most recently, the Renewable Energy Law, are indications of the commitment of the Philippine government to make renewable energy take a role in the country's energy generation capacity down to the energy supply mix. These efforts appear to have been well received by the private sectors such that ownership and management of power generation is now largely in the hands of the private sector. A number of investments has been made by foreign or international organizations including the World Bank's International Finance Corporation who supported the CEPALCO photovoltaic project and DANIDA who partly financed NPDC's wind power project.

The 33-MW production of NPDC using wind energy potentials of Bangui in Ilocos Norte is the biggest in Southeast Asia and the first venture accredited with a Certificate of Emissions Reduction (CER). Its connection to the electricity grid with potentials to supply up to 70 percent of the electricity demand of the province of Ilocos Norte is worth noting and encouraging for other prospective investors. The company's plan to put up more wind generators of 40 MW in Cagayan province also in Luzon is a living proof that the wind energy conversions system is indeed a mature technology and one that is now tested successfully in the Philippines.

For solar energy technology by photovoltaics, the 1 MW solar photovoltaic plant is another first of a kind in Southeast Asia that is also connected to the grid and now playing a key role in supplying the electricity needs of the service area of CEPALCO. No less than World Bank's IFC has given positive endorsement of the project for its success. The plan of CEPALCO to put up a much bigger solar park capable of generating 10 MW is an indication of an encouraging financial returns to the company.

Being a new project and unique in the sense that power generation is part of CEPALCO business activity and with RESA scheme to guarantee a market for the electricity output of NPDC, true costs and returns figures of the two NRET power plants (by CEPALCO and NPDC) remain confidential given the fact that these organizations are private commercial ventures. Nonetheless, the expansionary attitude these companies are doing is indicative of a bright future for these ventures giving the fact that outputs of their plants can be easily sold or disposed through the electricity grid system.

The climate change mitigation contribution of the 3 major projects mentioned is an annual carbon generation of 65,000 tonnes equivalent for NPDC. Throughout the projects life, MMPC projects to produce an equivalent of 500,000 tonnes with CEPALCO which stand to produce 10,000 tonnes equivalent. When traded in the carbon exchange market, it means additional income for the 3 companies which also mean compliance to the Kyoto Protocol on the part of the Philippines. Investment wise, it meant an investment of about US$ 88 million for the 3 NRET-based power project alone.

All the 3 renewable energy projects (CEPALCO, NPDC, MMPC) connected to the electricity grid are all supported by private investors with funding support from international financing institutions (e. g., WB/IFC and DANIDA) and local investors as well. This is an indication that even without financial support from Government Financial Institutions (GFIs) as mandated by the Renewable Energy Law, renewable energy projects connected to the electricity grid can take off, and in fact, the existing projects are into expansionary ventures.

In the meantime, the full implementation of the Renewable Energy Law with its Implementing Rules and Regulations (IRR) now being discussed and given the fact that the law mandates government financial institutions to make available its financial resources along with a variety of incentives to private investors, there is a reason to be optimistic both at the end of the local and foreign investors and the government as well.

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FINANCIAL ASPECTS AND POTENTIAL OF SMALL GRID CONNECTED HYDROPOWER IN VIETNAM

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Outline of Presentations

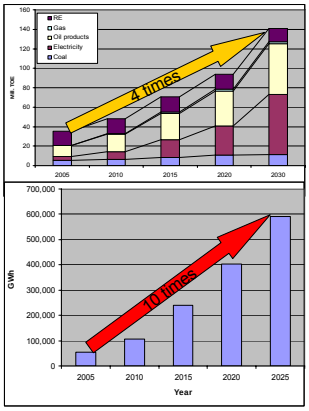
1. OVERVIEW ON ENERGY/ELECTRICITY/RENEWABLE ENERGY IN VIETNAM

2. FINANCIAL ASPECTS AND POTETIAL OF SMALL GRID CONNECTED HYDROPOWER IN VIETNAM

1. OVERVIEW ON ENERGY/ELECTRICITY/RE IN VN

1.1. Demand on Energy & Electricity in VN Increasing Rapidly

- On the year 2030, energy demand of VN will increase about 4 times comparing with 2005.
  Attending on after 2012, VN will have to import coal for electricity generation.
- The electricity demand in VN is forecasted growing up more than 10% per year until 2025. Currently, Vietnam purchases power from other countries to prevent shortages.
- The Government of VN has recognized the importance of RE and considered master plan for RE development for long term.



1.2. An Overview: Renewable Energy Development

- Despite the high potential, electricity production from RE is still negligible, only about 1% of total power generation (2007).
- The Government of VN has recognized the importance of RE for electricity generation.
- The Electricity Law requires support for RE
  - *Decision No.110/2007/QD-TTg: targeting RE of 4,051 MW by 2025*
  - *Decision No.1855/2008/QD-TTg: sets up the target with share of RE (3% in 2010; 5% in 2020)*
- August 2007, the Government has issued the decision 130/2007/QD-TTg on mechanisms and financial policies for projects invested in accordance with Clean Development Mechanism (CDM) that supports RE development.
- July 2008, jointly, the Ministry of Finance and the Ministry of Nature and Environment have issued the Joint Circular 58/2008/TTLT-BTC-BTN&MT to guide implementation of provisions of the decision 130/2007/QD-TTg.
- Clearly, this Joint Circular has also prescribed the object of subsidy, condition of subsidy, the calculation method of subsidy rate for one unit of electricity produced, annual subsidy amount, term of subsidy for CDM Projects in VN

2. FINANCIAL ASPECTS AND POTETIAL OF SMALL GRID CONNECTED HYDROPOWER IN VN

2.1. Grid Connection RE Projects in VN

- In 2001 the Government of Vietnam launched the RE Action Plan which set the general directions of Government intervention to encourage renewable energy. Most of the effort (and the success) has been in the development of an institutional framework to facilitate grid-connected RE projects. Before 2004, only 67 MW of small hydro projects have already connected to the grid, and, up to 2008 more than 700 MW of small hydro power in 78 projects are under construction or at final stages of financing and licensing.
- A comprehensive package of reforms that will be in place by the end of 2008 has been a key enabling factor (including a new avoided cost tariff, a standardized power purchase agreement (SPPA), new regulations for licensing, a grid/distribution code) for grid-connected RE projects.
- The actual contribution of small hydro power generation (plants with capacity ≤30 MW) was 575 GWh, and is expected to reach 2,000 GWh in the next few years. Moreover, according to the new survey, there will be about 3,443 MW of SHP capacity in 319 identified projects – corresponding to some 16,600 GWh.

2.2. Financial aspects and potential of grid connected of SHP

- Hydro in Vietnam falls into four main classifications:
  i). Pico-hydro systems, owned by individual households in rural areas, between 200 W and less than 1,000 W in size.
  ii). Off-grid hydro systems that serve isolated mini-grids, typically from 1 kW to less than 1 MW in size.
  iii). Grid-connected small hydro systems in the 1-30 MW size range.
  iv). Large hydro, greater than 30 MW.
- Size of small hydro power not exceeding 30 MW (defined by 2006).
- Small hydropower potential: more than 4,000 MW breaks down by size category as below:

Capacity range (MW)	Total capacity (MW)
0.1 - <1	126.8
1 - <5	1,030.2
5 - <10	1,048.3
10 - <15	648.0
15 - <20	562.8
20 - <25	309.0
25 - <30	290.0
Total (<=30 MW)	4,015.1

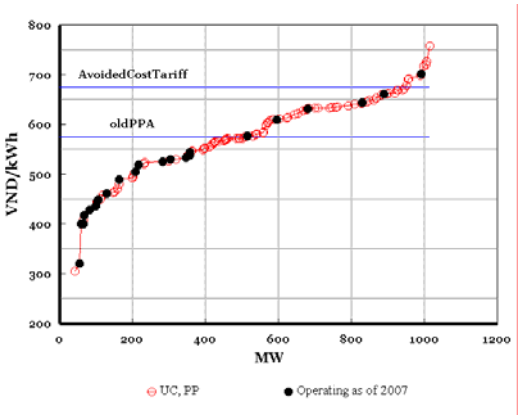
Existing utilization

Capacity range (N)	Total	
	No. of Stations	Capacity (kW)
5 kW ≤ N < 50 kW	362	4,709
50 kW ≤ N < 100 kW	28	1,681
100 kW ≤ N ≤ 10 MW	117	90,883
Total:	*507*	*97.273*

Project Pipeline

	Number of projects	Total installed capacity	Average project size
		MW	MW
MoU	178	2,175	12.2
Under construction, no tariff information	21	260	12.4
Under construction, tariff known	67	630	9.4
Under construction, signed PPA	11	101	9.2
In operation	42	278	6.6
Total	319	3,443	10.8

Supply Curve of SHP Project Pipeline



This supply curve intersects with the new avoided cost tariff at around 950 MW.

Several existing projects lie above the average level of tariff of past PPAs – a reflection of the fact that in the past, capital costs for some projects were understated (in order to meet the acceptable range of FIRR required under the MoIT regulations.

There is limited information about the daily peaking capacity of many of the projects in the MoIT survey: daily peaking capacity would result in a higher remuneration under the new ACT because peak hour generation in the dry season attracts a capacity payment.

When LRMC is used as the proxy for economic costs, a capacity penalty must be added to the cost of non-dispatchable renewable energy. The magnitude of this penalty will depend upon the load factor (and the extent of daily peaking storage).

Master Plan for RE and SHP Development in VN

Strategy, Master plan for RE Development in VN in the period to 2015, with outlook to 2025 was prepared and submitted Gov (at 12/12/2008) for approval.

Set up the target of RE for grid connection

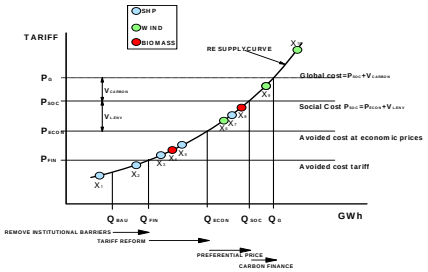
Set up the target of RE for off-grid

Set up the target of RE for heat utilization

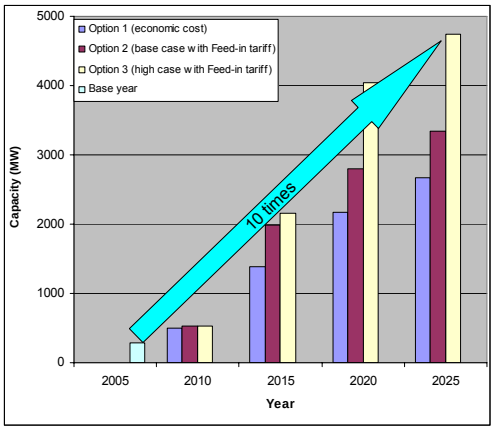
Establish framework for supporting RE

Establishing measures to implement (management, support mechanisms, procedures. etc.)

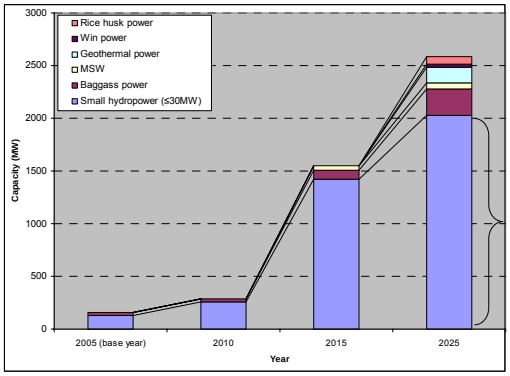
Supply curve of RE project based on existing tariff and reform tariff (Avoided cost in term of Financial & Economic)



Renewable Electricity Target



Grid Connected SHP Target by Type (Option 1)



Principal SHP 78.5%

VIETNAM ELECTRICIY

32nd Meeting of the APEC Expert Group on New and Renewable Energy Technologies
and
Associated Workshop on Recent Advances in Utility Based Financial Mechanisms

Development of Small Grid-connected Hydropower at EVN's Power Distribution Companies

Presented by Ms. Phan Thi Thuy Tien
Director
Science Technology and Environment Department (EVN)

30 Mar - 30 Apr, 2009 - Honolulu, Hawaii, USA

Contents

- EVN's Overview in 2008
- EVN's Small Grid-Connected Hydropower Development

Contry and Sector issues

- **Rapid Economic Growth and GoV:**

  Strategy Socio-Economic Development Plan 2006-2010: transition Viet Nam for reaching middle-income country status and continuing transition to a market economy by 2010;

  Role of GoV: transformed from a major producer of goods and services to regulator and provider of foundations for a well-functioning, equitable, and modern market economy.

Contry and Sector issues

- **Power Sector Dynamics:**

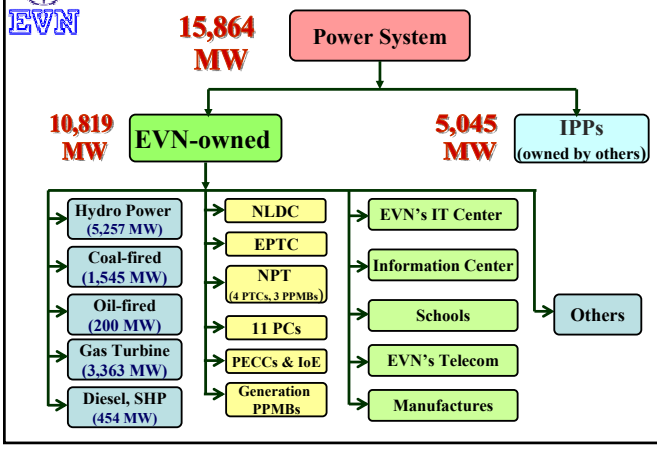
  Recently, economic growth of over 7%/year => many issues in energy sector.

  Electricity: met challenge well in 1995-2008, household access 50% to ~94%; annual per capita consumption 156 kWh to ~800 kWh. However, supply shortage has become more visible.

  EVN: main electricity provider, owns 2/3 of all generation; owns and operates transmission and MV distribution systems, LV distribution to urban areas and LV distribution in some rural areas.

  Non-EVN: BOTs/IPPs own 1/3 of generation; 2/3 of LV distribution owned and operated by local distribution utilities (LDUs) received electricity from EVN.

EVN's role in Vietnam power system



Electricity Generation in 2008

	Installed Capacity		Energy Output	
	(MW)	%	(GWh)	%
TOTAL	**15,864**		**75,955**	
EVN-owned	**10,819**	*68.20*	**52,875**	*69.61*
* HYDRO POWER	5,257	*33.14*	23,627	*31.11*
* COAL-FIRED	1,545	*9.74*	8,921	*11.75*
* GAS&OIL-FIRED	3,563	*22.46*	20,311	*26.74*
* SMALL HYDRO, DIESEL	454	*2.86*	(D) 16	*0.02*
IPPs (owned by others)	**5,045**	*31.80*	**23,080**	*30.39*
* HYDRO POWER	241	*1.52*		
* COAL-FIRED	225	*1.42*		
* GAS&OIL-FIRED	4,005	*25.24*		
* OTHERS *(biogas cogeneration, SHP, imported)*	574	*3.62*	1,370 (SHP)	*1.80*

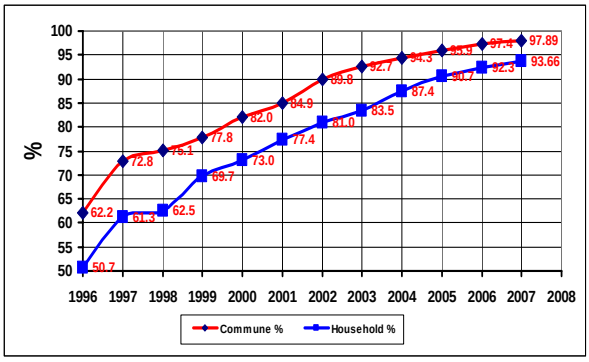
Transmission & Distribution Network in 2008

kV	km	MVA
500	3,286	7,050
220	7,101	18,639
110	11,751	23,834

Average buying tariff from non-EVN's IPPs in 2008:
903 VND/kWh ~ *5.16 US cents/kWh*

EVN's average selling tariff to customers:
870.81 VND/kWh
~ 4.98 US cents/kWh

Rural Electrification Rate



Contry and Sector issues

- **Rapid Economic Growth and GoV:**

  A market-oriented Electricity Law passed in November 2004.

  Electricity Regulatory Authority of Vietnam (ERAV) established in 2005.

  Roadmap for reform is being implemented: Generation Competitive Market established & unbundle the sector (*separation of generation, transmission and distribution*) scheduled to be completed in 2009.

Contry and Sector issues

- **Major Power Sector Issues:**

  Central task: is to meet demands for electricity in sufficient quantity and of an acceptable quality, in commercially and financially efficient way.

  - Optimizing power investments (particularly for generation);

  - Financing investments;

  - Implementing the reforms;

  - Improving access and service quality;

  - Addressing shortcomings in pricing and tariffs.

Contry and Sector issues

- **Major Power Sector Issues (continued):**

  - *Optimizing power investments*: Generating capacity increased 15,864 MW (2008) to 25,000 MW (2010), 41,000 MW (2015) and 60,000 MW (2020); Transmission and distribution system investments must accompany the increase in generation capacity.

  - *Financing investments*: ~$20 billion (2006-2010), or $4 billion/year. About $2.3 billion on expanding generation capacity, the balance on transmission and distribution.

  - *Implementing the reforms*: EVN has separate generation, transmission and distribution operations in a group structure under a holding company.

Contry and Sector issues

- **Major Power Sector Issues *(continued):***

  - *Improving access and service quality*: better electricity supply to all consumers (to improve living standards and support development of local for economic growth and employment);

  - *Addressing shortcomings in pricing and tariffs*: tariff is a key part of the power sector reform; increases in tariffs needed for EVN and its successor companies to retain earnings for investment and to attract outside investors (matching tariffs more closely to cost of supply; and setting tariffs in a way that is compatible with the reformed power sector).

Role of Renewable Energy

Challenges:

- **Vietnam is well endowed with renewable energy resources.**
- **Small grid-connected hydropower potential: located mainly in north and central regions => supplement generation from large projects, reduce losses and improve grid stability by providing generation at the far reaches of the grid.**
- **Recently, developers (mostly private companies) interested in exploiting renewable energy resources to sell electricity to national grid.**

Role of Renewable Energy

Barriers to large-scale development of grid-connected renewable energy:

- **High transaction cost of negotiating a PPA with main player (EVN)**
- **Inhospitable and non-transparent regulatory framework with a lengthy approvals process;**
- **Absence of a procedure for allocating or re-allocating project sites to those most able to develop them;**

Role of Renewable Energy

Barriers to large-scale development of grid-connected renewable energy *(continued):*

- **Weakness of private sponsors to develop a site in a technically, socially and environmentally sustainable manner and take it to financial closure;**
- **Licensing burden as for large projects;**
- **Absence of suitably long financing tenors;**
- **Lack of skills among sponsors and bankers in assessing risk in such projects.**

Small Grid-Connected Hydropower at EVN's Power Companies

- **EVN's Rural Regional Power Companies (*North, Central*):**

  Renewable energy projects less than 30 MW: standardized "no negotiations" PPA is now mandatory – applied avoided cost tariff (based on costs EVN avoids by purchasing electricity from small generators).

  To setting ACT, regulation permits developers to hedge against fuel price volatility by putting a cap and a floor of 10% of the ACT.

Small Grid-Connected Hydropower at EVN's Power Companies

Approved Master Plans of small hydropower development:

- **Power Company 1 (*in the North*):**

  Potential of 344 subprojects with 3,978 MW located in 15 provinces => heavy burden for grid connection.

  In 2009-2010: 97 subprojects with 1,232 MW put into operation (?).

- **Power Company 3 *(in the Central)*:**

  Potential of 337 subprojects with 3,044 MW located in 13 provinces.

  Currently: 40 hydropower plants with ~187 MW put into operation.

Small Grid-Connected Hydropower at EVN's Power Companies

Lesson learn from PC3 (in the Central):

- **In dry season 2008: Pmax ~890 MW; 700 MW from national grid, remains from local small hydropower generation about 247 million kWh at peak hours, 101 million kWh at normal hours, totally ~ 348 million kWh (*even with higher tariff than buying from EVN's network*). Some small grid-connected hydropower plants generated at higher energy output (~20% in comparison with average amount).**
- **Due to mostly as run-off-rivers => limitation of generating in dry season (while power demand is increased) that causes heavy power shortage.**

Small Grid-Connected Hydropower at EVN's Power Companies

Lesson learn from PC3 (in the Central):

- **Otherwise, many power plants located in remote areas that require capital investment for connection to national grid (with high cost) as well as causing high losses, poor electricity quality in operation.**
- **Lacking of forecasted information of water flows that is causing inefficient operation.**
- **Weakness of private sponsors to develop a site in a technically, socially and environmentally sustainable manner and take it to financial closure;**

Small Grid-Connected Hydropower at EVN's Power Companies

Lesson learn from PC3 (in the Central): propose measures

- **Environmental and using land issues: Planning for small grid-connected hydropower development mainly based on water resources not really considered about density of sites that cause wasting natural resources (such as land, forest).**
- **Unsuitable connection to national grid causes high technical loss (*for example: local power demand is about 25 MW but planned small grid-connection hydropower is developed about 492 MW in Kontum province*).**

Small Grid-Connected Hydropower at EVN's Power Companies

Lesson learn from PC3 (in the Central): propose measures

- **Lacking of standardization of technical design that need to be issued soon.**
- **Added subprojects into approved Master Plan resulting inefficiently development and operation.**
- **Lacking of incentive financing mechanism issued by related Ministry for renewable energy development.**

THANK YOU