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3-2. Policy Success Factors for Geothermal Electricity Development in the APEC Region

Chrisnawan ANDITYA
Senior Researcher, Asia Pacific Energy Research Centre (APERC)

Asia-Pacific
Economic Cooperation

Outline of Presentation

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- **APEC's Action**
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- **Uptake Challenges**
- **Geothermal Electricity in APEC Region**
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- **The Success Factor in Six APEC Economies** (the US, the Philippines, Indonesia, Mexico, New Zealand, and Japan)
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  - Environmental & Other Development Permitting
  - Government Support for Geothermal Industry
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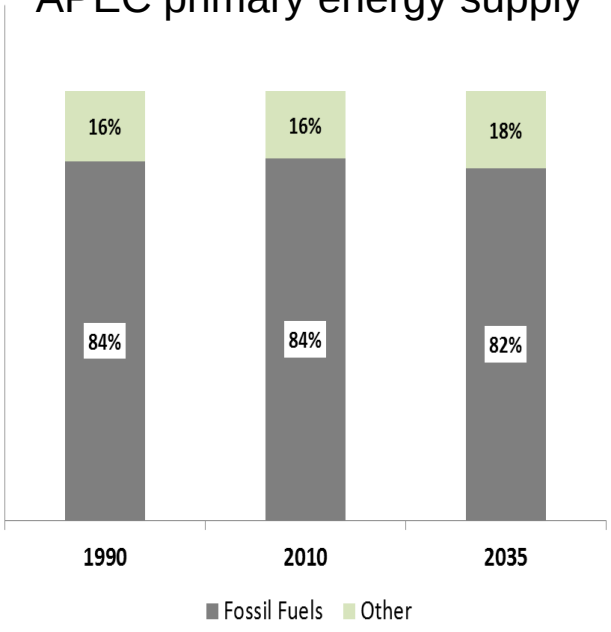
- **Conclusion**

APEC Energy Challenges

Dependence on fossil fuel

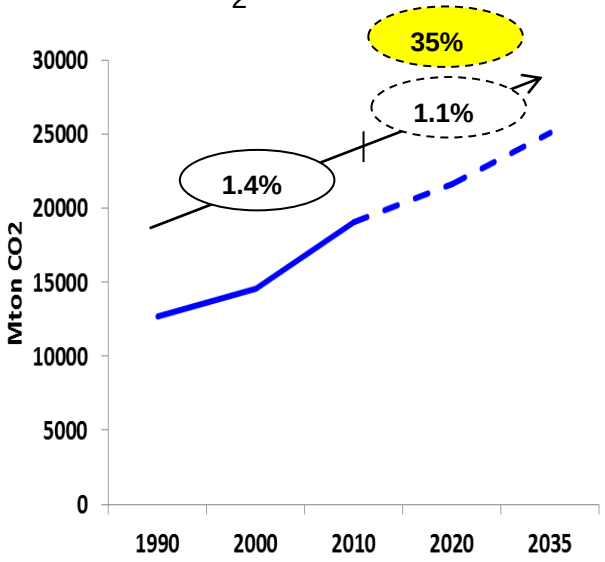
APEC primary energy supply



Around 80% of APEC's energy demand is supplied by fossil fuel.

Environmental deterioration

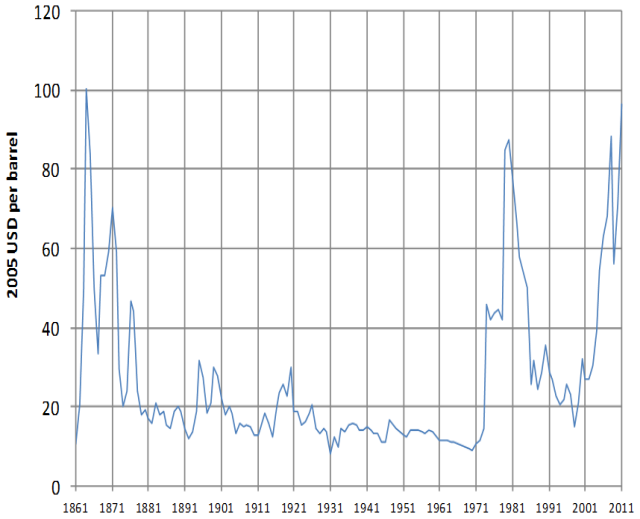
APEC CO_2 emissions



APEC's CO_2 emissions have been increasing since 1990 and are projected to rise by about 32% between 2010-2035.

Oil price increase and volatility

International crude oil prices



Oil price volatility has been high in recent years due to geopolitical events.

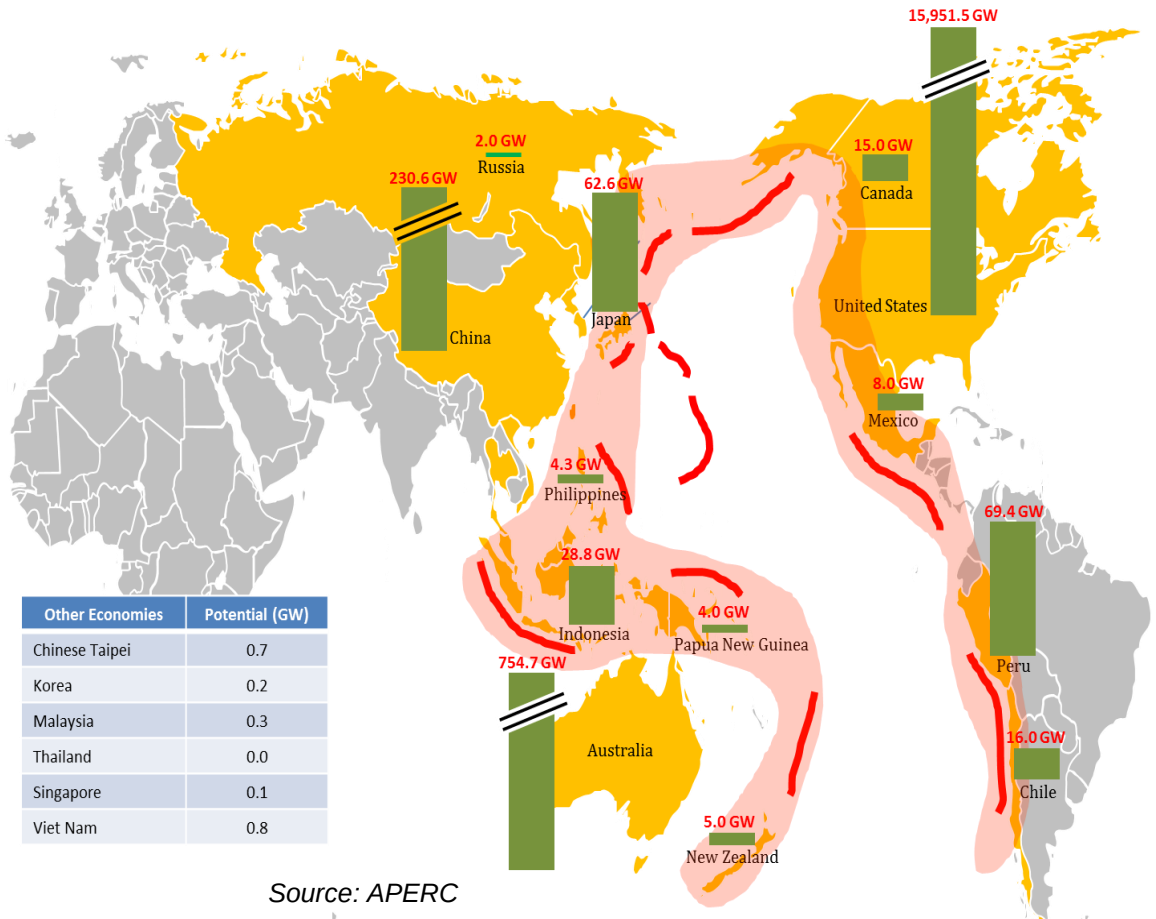
Source: APEC Energy Demand and Supply Outlook 5th Edition (2013) and BP (2012)

APEC's Action

"to promote, develop, and deploy low-emission energy supply including clean and renewable energy"

- **2010 - Yokohama Declaration**: *"Growth Strategy includes promotion low-carbon policies as well as developing a low-carbon energy sector by introducing low-emission power sources and assesses the potential of renewable energy options"*.
- **2010 - Fukui Declaration**: *"the deployment of low-emission power sources should be promoted and the development of renewable energy technologies should be continued to further reduce their costs". The APEC Energy Ministers also instructed the EWG to continue its assessment of renewable energy options for reducing carbon emissions, spurring investment and creating new jobs*.
- **2011 - Honolulu Declaration**: *"called on economies to speed up the transition towards a global low-carbon economy in a way that enhances energy security and supports APEC's aspiration to reduce aggregate energy intensity by 45 percent by 2035"*.
- **2012 - Vladivostok Declaration**: *"to promote technology development and deployment of a low-emission energy supply including carbon capture, storage and use, and renewable energy sources"*.
- **2013 - Bali Declaration**: *"to invigorate work in developing clean and renewable energy"*.
- **2014 - Beijing Declaration**: *"to reinforce the trends toward low-carbon and clean energy production and consumption; develop renewable energy; doubling the share of renewables in the APEC energy mix, including in power generation from 2010 levels by 2030". The APEC Energy Ministers also instructed the EWG to develop the road map for the aspirational goal of doubling the share of renewables*.

Why Geothermal ?



Other Economies	Potential (GW)
Chinese Taipei	0.7
Korea	0.2
Malaysia	0.3
Thailand	0.0
Singapore	0.1
Viet Nam	0.8

Source: APERC

- Geothermal is a renewable energy source.
- The APEC region aligns almost perfectly with the ‘Pacific Ring of Fire’.
- The technologies are already proven and mature.
- Geothermal power generation has advantages.

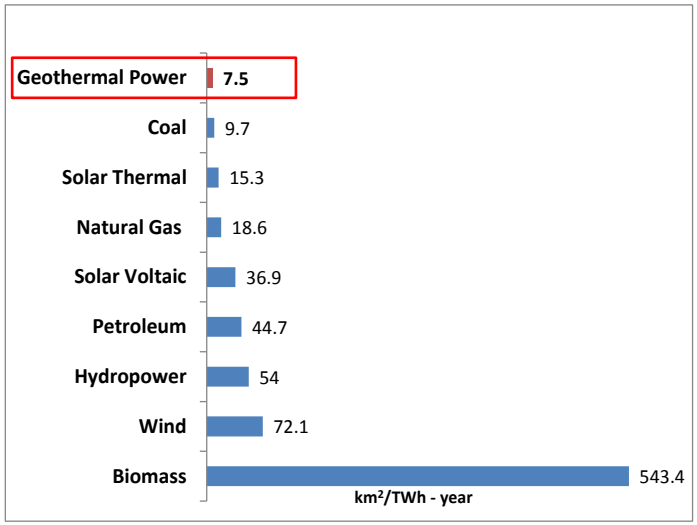
The estimation of APEC’s geothermal potential is more than **17,000 GW.**

(not included Brunei Darussalam and Hong Kong)

Benefits (1)

- **Energy Security.**
- **Small Land Footprint.**
- **Positive Impact on Economic Development.**
- **Near Zero Emission.**

Land Use based on the Anticipated State of Technology in 2030



Source: Matek et.al., 2013 p.14

Comparative Job Creation between Geothermal and Natural Gas in the US

Power Source	Construction Employment (Jobs/MW)	O&M Employment (Jobs/MW)	Total Employment for 500 MW Capacity (person-years)
Geothermal	4.0	1.7	27,050
Natural Gas	1.0	0.1	2,460

Source: Matek et.al., 2013 p.13

Estimated Emission Levels by Pollutant of Geothermal Power Plant based on Technologies

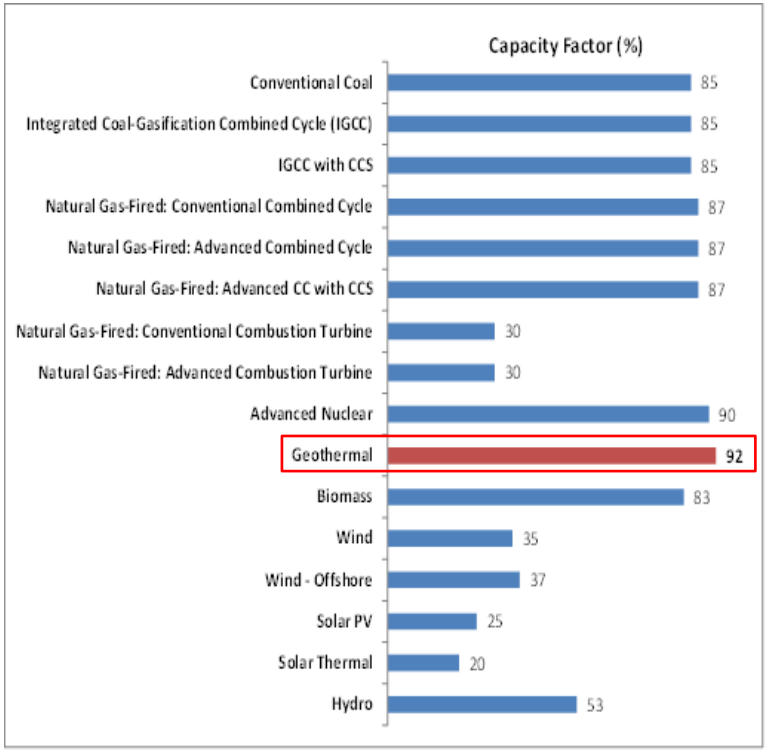
(lbs/MWh)	Flash	Dry Steam	Binary	Natural Gas	Coal
CO2	396.3	59.82	-	861.1	2,200
CH4	0.0000	0.0000	-	0.0168	0.2523
PM2.5	-	-	-	0.1100	0.5900
PM10	-	-	-	0.1200	0.7200
SO2	0.3500	0.0002	-	0.0043	18.75
N2O	0.0000	0.0000	-	0.0017	0.0367

Source: Matek et.al., 2013 p.15

Benefits (2)

- **Reliable and Flexible Power Sources.**
- **A Competitive among other power plants.**

Capacity Factors for Power Plants Entering Service in the US 2019



Source: EIA, 2014

The US Average Levelized Costs (2012 USD/MWh) for Plants Entering Service in 2019

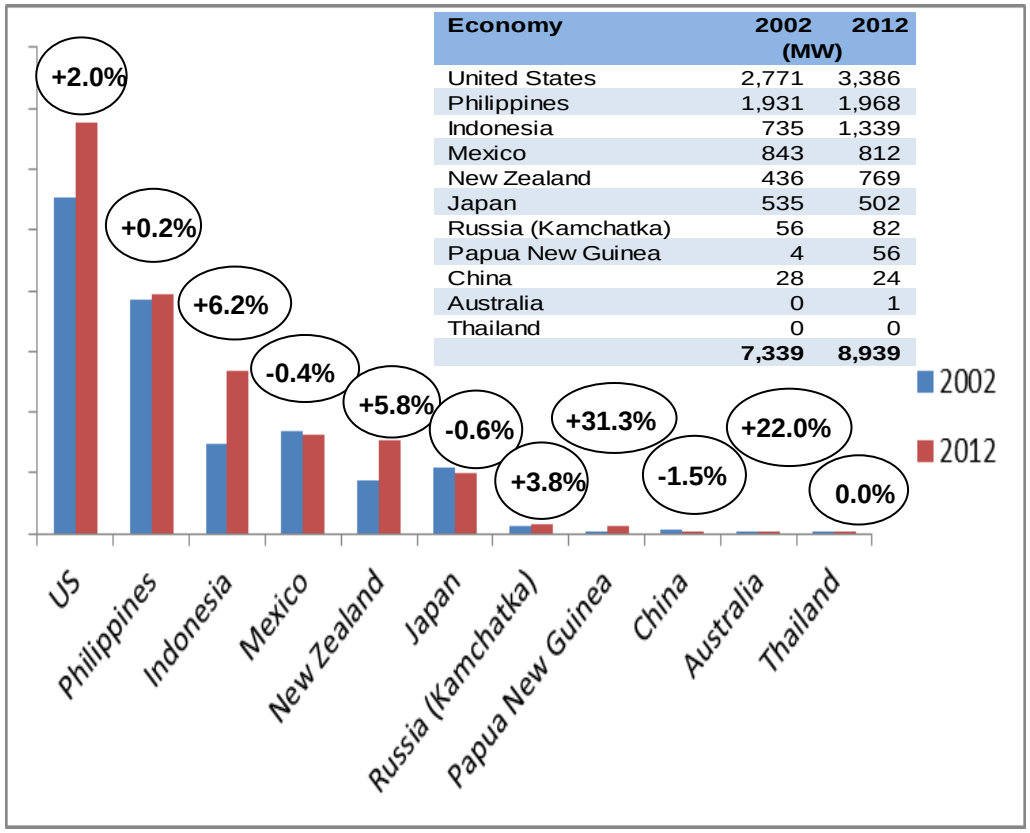
Plant Type	U.S Average Levelized Costs (2012 USD/MWh) for Plants Entering Service in 2019				
	Levelized Capital Cost	Fixed O&M	Variable O&M (Including Fuel)	Transmission Investment	Total System LCOE
Dispatchable Technologies					
Conventional Coal	60.0	4.2	30.2	1.2	95.6
Integrated Coal Gasification Cycle (IGCC)	76.1	6.9	31.7	1.2	115.9
IGCC with CCS	97.8	9.8	38.6	1.2	147.4
Natural Gas-fired					
- Conventional Combined Cycle	14.3	1.7	49.1	1.2	66.3
- Advanced Combine Cycle	15.7	2.0	45.5	1.2	64.4
- Advanced CC with CCS	30.3	4.2	55.6	1.2	91.3
- Conventional Combustion Turbine	40.2	2.8	82.0	3.4	128.4
- Advanced Combustion Turbine	27.3	2.7	70.3	3.4	103.8
Advanced Nuclear	71.4	11.8	11.8	1.1	96.1
Geothermal	**34.2**	**12.2**	**0.0**	**1.4**	**47.9**
Biomass	47.4	14.5	39.5	1.2	102.6
Non-Dispatchable Technologies					
Wind	64.1	13.0	0.0	3.2	80.3
Wind-Offshore	175.4	22.8	0.0	5.8	204.1
Solar PV	114.5	11.4	0.0	4.1	130.0
Solar Thermal	195.0	42.1	0.0	6.0	243.1
Hydroelectric	72.0	4.1	6.4	2.0	84.5

Source: EIA, 2014

Uptake Challenges

- **The resource is stored in the earth.**
  - Exploration and drilling needs to be undertaken (USD 1-7 million per well).
  - Definition of ‘geothermal resource’ can lead significantly different approaches in legal frameworks and resource management regulations.
  - The environment impact assessment needs to be mitigated where the procedures can be time consuming.
- **The resource is generally located in remote areas such as in the mountain.**
  - The necessary infrastructure needed to develop.
  - Connection to transmission network can be an issue, especially if those companies that develop geothermal power plant are different from the company that operates the transmission network.
- **The resources might be found in several types of areas.**
  - Development might be limited or prohibited in restricted areas.
  - It might be get resistance from existing or other possible land uses.
  - Development may require several regulatory requirements from various agencies with time consuming permitting process.

Geothermal Electricity in APEC Region



Economy	2002 (MW)	2012
United States	2,771	3,386
Philippines	1,931	1,968
Indonesia	735	1,339
Mexico	843	812
New Zealand	436	769
Japan	535	502
Russia (Kamchatka)	56	82
Papua New Guinea	4	56
China	28	24
Australia	0	1
Thailand	0	0
	7,339	**8,939**

Source: BP Statistical Review of World Energy (June 2013)

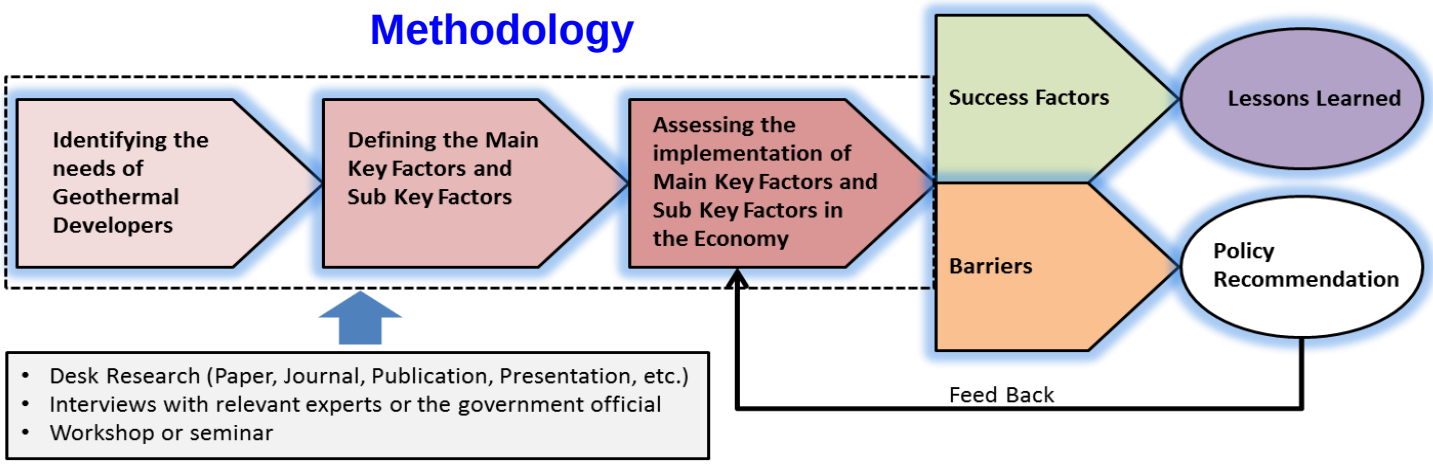
- Only 11 out of APEC's 21 economies have developed geothermal electricity. The total installed capacity was 8,939 MW in 2012.
- The APEC region contributed to 78% of the world's geothermal installed capacity which was about 11,446 MW in 2012.
- The US, Philippines and Indonesia are the world's leading economies in terms of installed capacity of geothermal.
- APEC's installed capacity is **still small** compared to its potential.

Policy Success Factors for Geothermal Electricity Development in the APEC Region

The Main Objectives:

- To assess current geothermal development process in the APEC region.
- To identify policy success in the geothermal electricity development process.
- To evaluate how each APEC economy rates against the success factors by providing an example matrix.
- To propose a set of recommendations for geothermal electricity in each APEC economy and in the APEC region as a whole.

Methodology



List of APEC Economies Assessed

Indonesia
Japan
Mexico
New Zealand
Philippines
United States
Chinese Taipei (new comer)

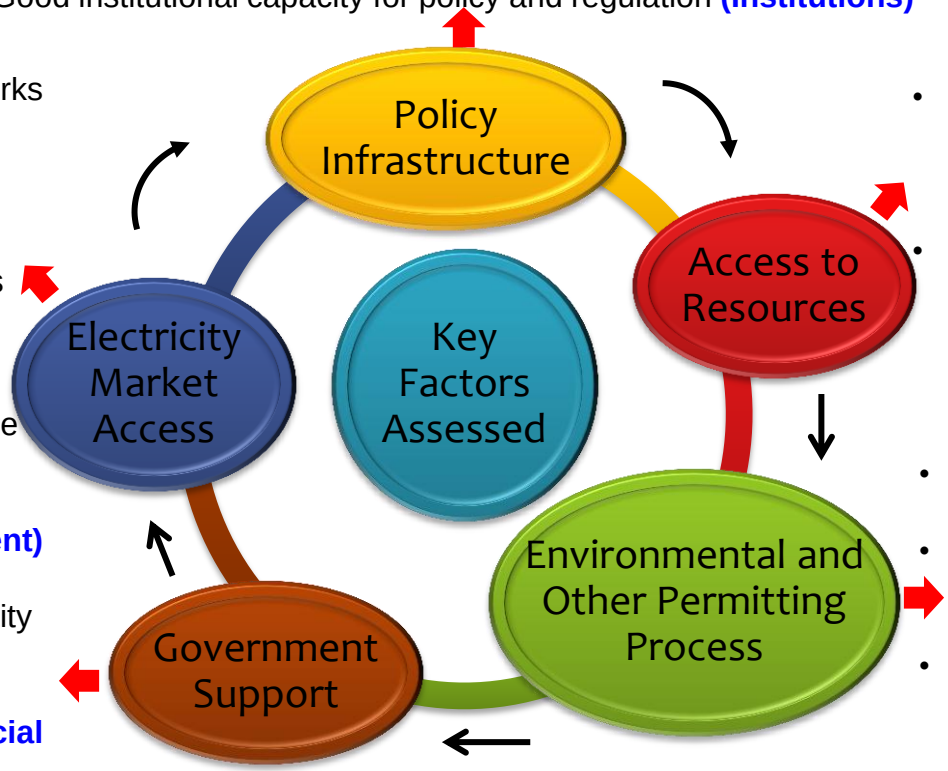
What a Geothermal Developer Needs?

(Policies for Successful Geothermal Electricity Development)

- Clear and certain legislation and/or regulation **(Legal basis)**
- Well-defined strategy for promoting geothermal **(The government strategy)**
- Keeping previous commitments to investors **(The government commitment to investor)**
- Good institutional capacity for policy and regulation **(Institutions)**

- Streamlined procedures to access transmission networks without discrimination **(Transmission network)**
- Long-term contract for electricity price with reasonable price structures **(Electricity sales contracting)**

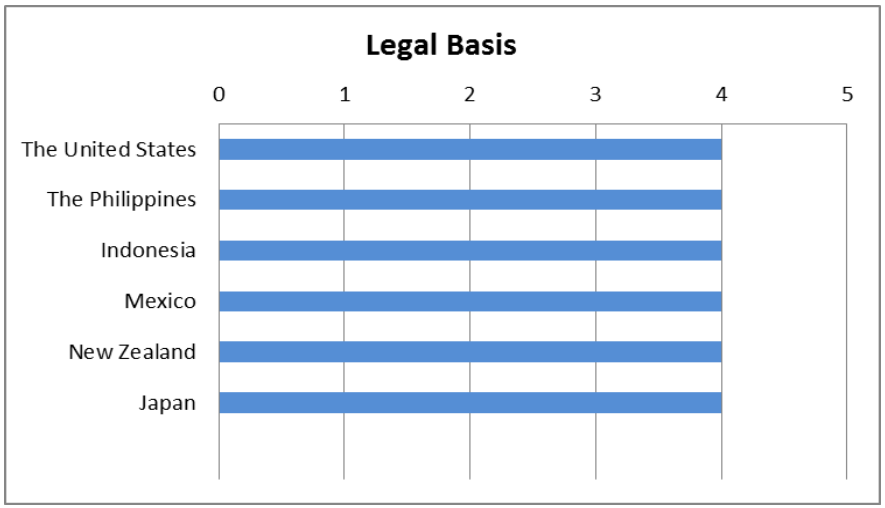
- Good quality public database **(Database)**
- Adequate funding for R&D **(Research and development)**
- Sufficient of professional personnel in quality & quantity **(Human resources and development)**
- Financial incentives **(Financial incentives)**



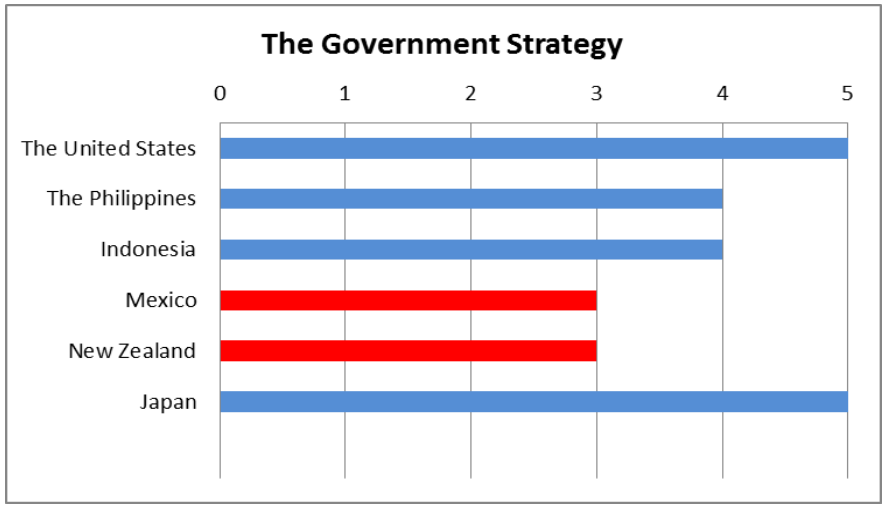
- Open and competitive basis for all players with reasonably simple procedure **(Access to geothermal resources)**
- Appropriately secure access to resources that developers have invested in **(Secure and exclusive rights to resources)**

- Reasonable time limits for permitting **(Permitting time limits)**
- Coordinate all aspects of permitting in one office **("One-stop shopping")**
- Good coordination among governmental agencies at all levels **(Inter-agency cooperation)**

Policy Infrastructure (1)

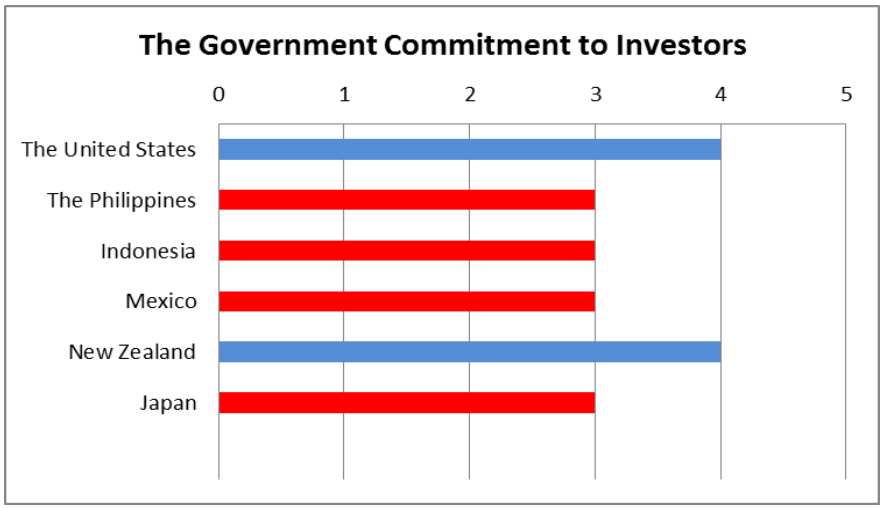


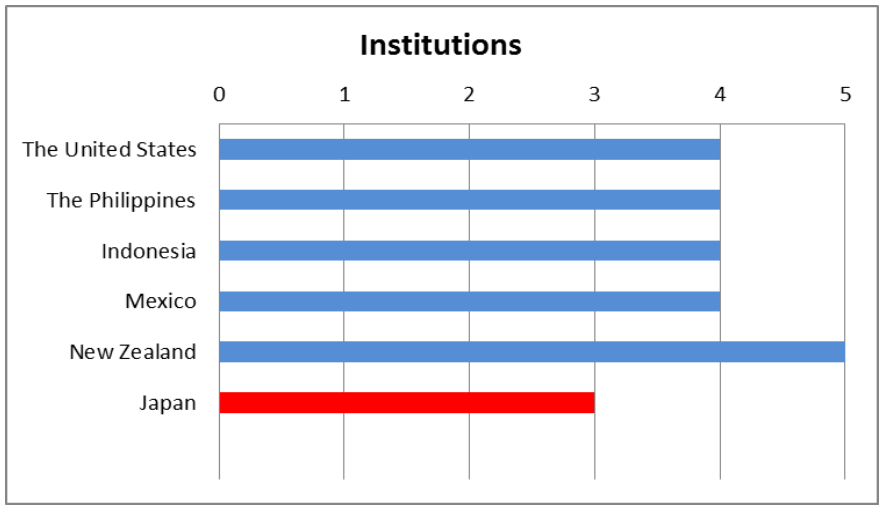
- The assessed economies have implemented geothermal electricity development regulation. The regulation provide clarity and certainty for resource ownership, legal definitions, permitting processes or other resource access methods.
- However, under these regulations, the owner of surface land is different from the owner of the underground resource, except in New Zealand. The developer also needs to comply with several other regulations such as forestry, natural park, and indigenous land rights laws.



- The assessed economies, except for Mexico and New Zealand, have mechanisms to help developers reduce the risk of early stage development through database, cost sharing, and fiscal incentives; and to help developers raise capital through loans, RPS/FIT, and financial assistance.
- In Mexico private sector participation is limited.
- In New Zealand there are no financial incentives, only a relatively low price on carbon.

Policy Infrastructure (2)

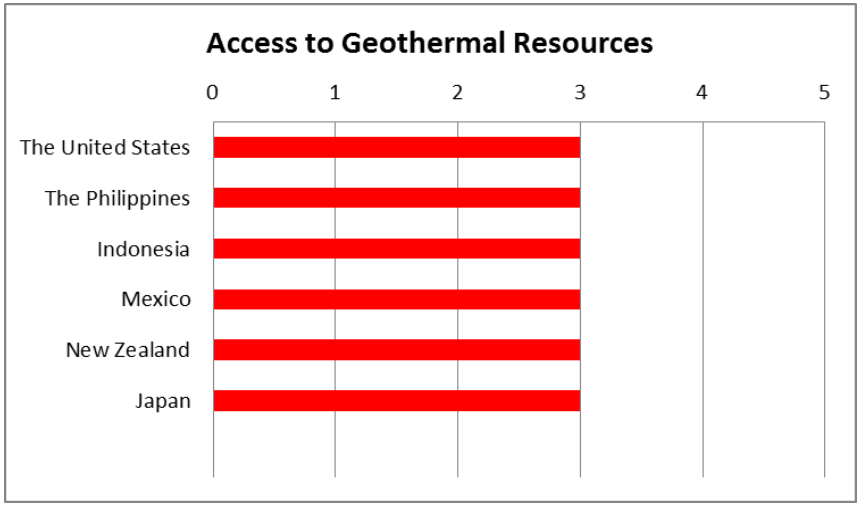




- All assessed economies' governments except for the United States and New Zealand have historically provided inconsistent commitments to investors.
- The Philippines: changed the risk sharing mechanism to fiscal incentives; RPS/FIT issue
- Indonesia: see the Karaha Bodas Company, and Himpurna California Energy cases; and the annulment of the new Electricity Law of 2002.
- Mexico: limited participation from the private sector as the Federal Electricity Commission (CFE) has preferential rights.
- Japan: stopped geothermal R&D in 2002; and RPS issue.

- All assessed economies, except for Japan, have established a specific agency, which is responsible for geothermal policy and regulation
- Japan: the Ministry of Economic, Trade and Industry (METI) and the Ministry of Environment (MOE) have joint responsibility for geothermal policy and regulation.
- Local government and/or indigenous people are also key players in geothermal development.

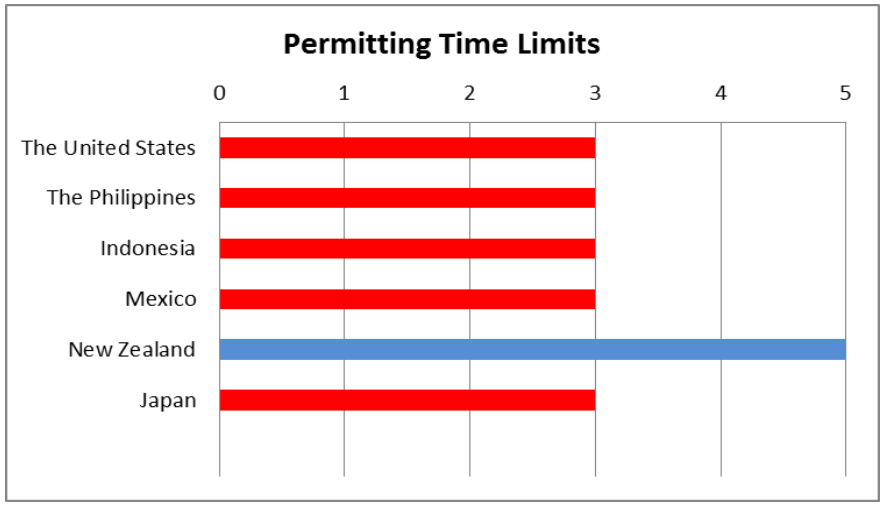
Resources Access



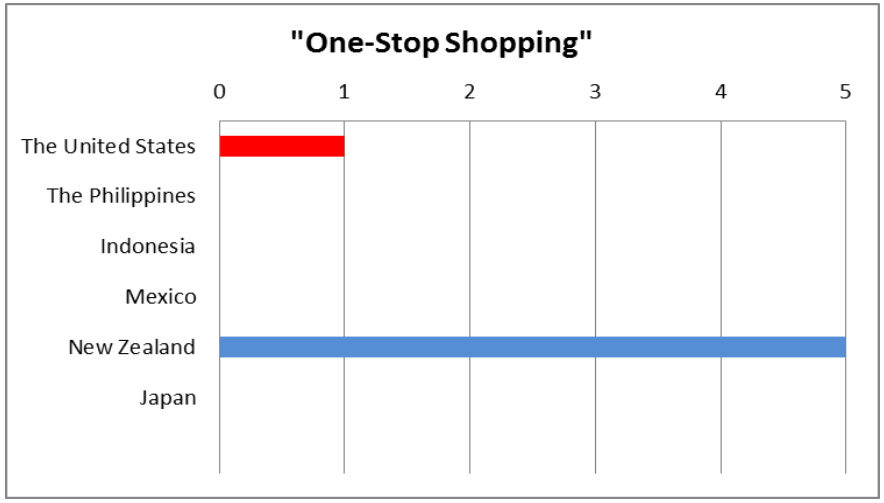
- In the United States, the Philippines and Indonesia, geothermal resource development is available to all developers on an open and competitive basis.
- In New Zealand and Japan, geothermal development is open to all developers on a ‘first come, first served’ basis.
- In Mexico geothermal development is not open to the private sector.
- Developers must go through cumbersome procedures to obtain permits and licenses from various agencies as well as land owners (either public, private or indigenous owners)

- In the United States, the Philippines and Indonesia, developers are given concession based on field or area for some of period years. This provides developers with more security for their investments as they are given an exclusive right to the resources, even where there is a sanction (suspended or termination).
- In Mexico, and Japan, concession for geothermal resources are granted by well and in New Zealand, it depends on permission from the landowners; not by field or area. This means that investments are not protected during exploration and exploitation phases.

Environmental & Other Development Permitting (1)

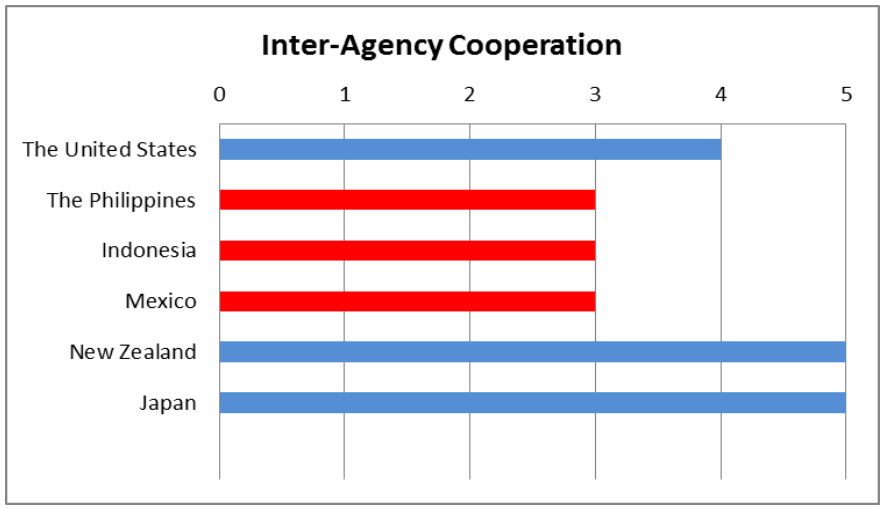


- It is hard to predict the completion time for permits in all assessed economies, except for New Zealand, as the developers must obtain permits from various government agencies, both central and local.
- In New Zealand the permitting process to obtain 'Resource Consent' is closed with 'One-Stop shopping' which provides reasonable time limits within which a permitting decision must be made.



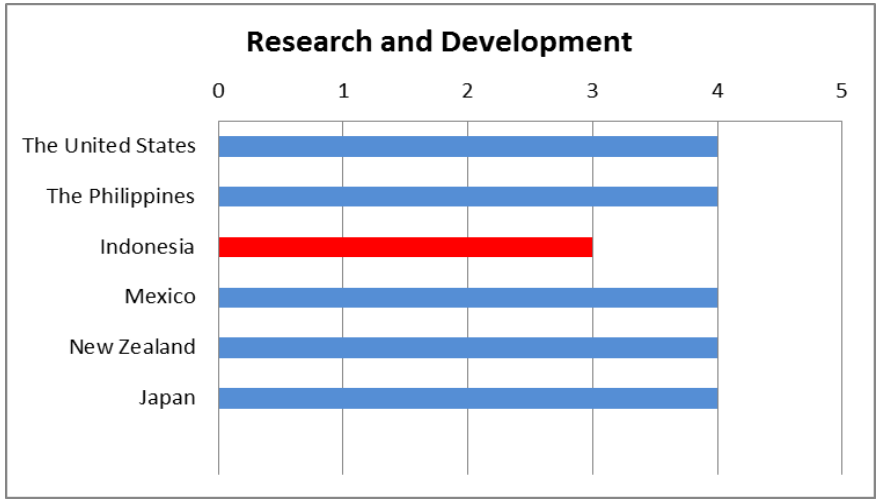
- Only New Zealand has 'One-Stop shopping', for permits out of the assessed economies. However, the United States is currently determining whether to establish a 'Geothermal Coordinating Permit Office'.

Environmental & Other Development Permitting (2)



- Inter-agency cooperation has been good established in the United States through 'the Renewable Energy Coordinating Offices' .
- in New Zealand and Japan, inter-agency cooperation between the central and the local government have been good to reach decisions on resources consents and environmental protection.
- Other economies, there are still duplication of responsibilities and policy conflicts.
    - The Philippines: conflicting between environmental and socio-cultural
    - Indonesia: overlapping duties and responsibilities between central and local governments.
    - Mexico: duplication of the permitting procedures among agencies.

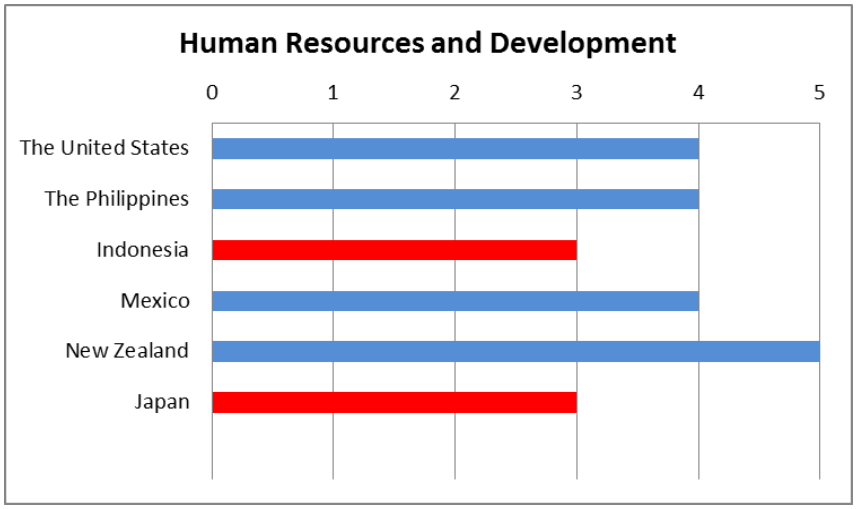
Government Support for Geothermal Industry (1)



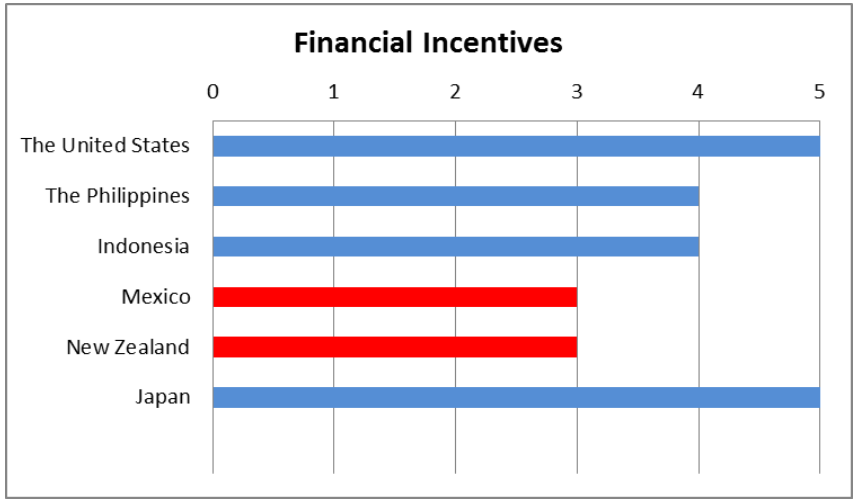
- The majority of the assessed economies provide developer with access to good quality public data on the potential of geothermal resources.
  - By a national database: the United States and the Philippines; or
  - through others government agencies: New Zealand and Japan.
- Indonesia: the government's data is not bankable and developer needs to conduct re-survey.
- Mexico: CFE holds all data, and it cannot be easily accessed by the public.

- All assessed economies, except for Indonesia have provided adequate funding for geothermal research and development. Enhanced Geothermal System (EGS) is one of the activities under R&D for some economies (the United States, the Philippines, and Japan).
- Even though the Indonesian Government has allocated modest funding for R&D, for developers, however, the lack of technology, research and development support is still one of the major challenges for renewable energy development in Indonesia.

Government Support for Geothermal Industry (2)

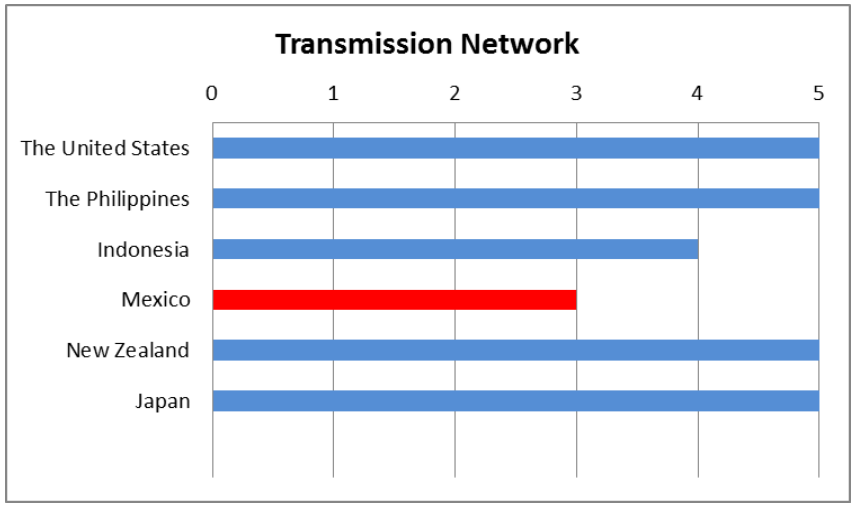


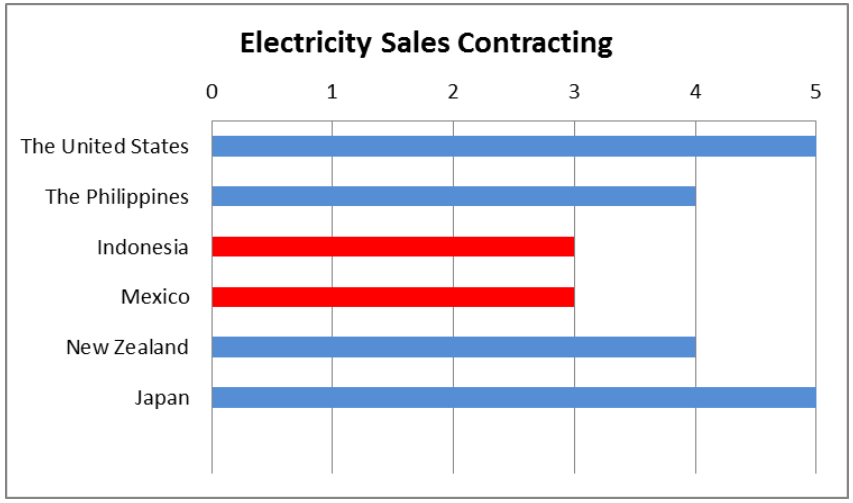
- All assessed economies have at least some level of trained personnel from tertiary training programs.
- In Indonesia the numbers of professional personnel is not enough to meet near future demand
- In Japan the numbers of professional personnel has declined as no new geothermal plants have been constructed since 1999.



- All assessed economies, except Mexico and New Zealand provide developers with financial support to reduce the risk of early stages development (e.g. data, cost sharing, fiscal incentives) and to help developers raise capital for projects (e.g. loan guarantees, RPS/FIT, financial assistance).
- In Mexico there are no financial incentives for geothermal development. It competes on the same basis as fossil-fuel, conventional hydro and nuclear energy.
- In New Zealand there are no financial incentives, only a relatively low price on carbon.

Electricity Market Access



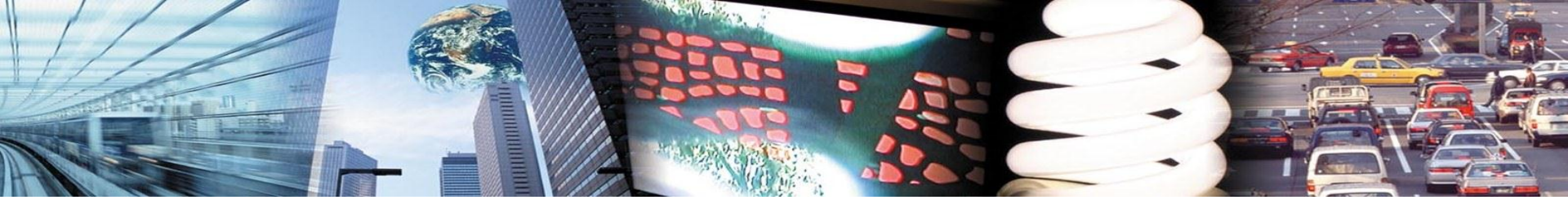


- All assessed economies (except Mexico) have regulations to ensure that transmission services are open and on a non-discriminatory basis and procedures for transmission connection (e.g. grid code).
- Mexico has no private geothermal developers, hence there is no need for regulation for access to transmission network.

- Some of the assessed economies have good regulatory mechanism for electricity sales, that enable producers/developers to sell geothermal power to utilities and/or retail consumers/end users through long-term contracts at reasonable prices:
  - RPS in the same states in the United States.
  - FIT in Japan.
- In Indonesia, selling price needs to be negotiated between producers/developers with the State Owned Electricity Enterprise-PLN, which is time consuming without clearly standard of contract.
- In Mexico there is no electricity sales contracts between private developer and CFE, except EPC contact or well drilling contract.

Conclusion

- As part of APEC's action, each APEC economy should consider promoting, developing and deploying geothermal electricity.
- In order to reduce the risks of early stages development and to increase the ability of developers to raise capital for projects, intervention from the government through its public policy development is much needed. In particular:
  - Policy infrastructure;
  - Resources access;
  - Environmental and other development permitting;
  - Government support for geothermal industry; and
  - Electricity market access.
- The policy success factors in the 5 APEC economies can be a benchmark for developing geothermal electricity in each APEC economy.
- Cooperation on geothermal electricity among APEC economies as well as regional and international organization in the fields of information exchange, technology transfer, human resources/capacity building, and financing needs to be strengthened.



Thank you for your kind attention

http://aperc.ieej.or.jp

New Regulation on Geothermal in Indonesia

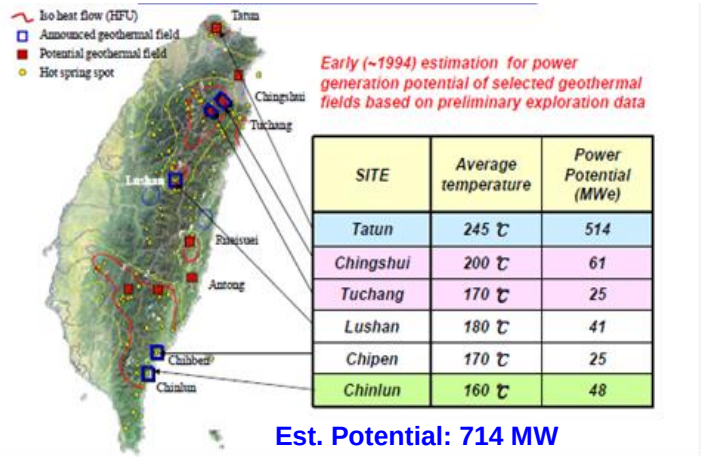
Issues	Old Geothermal Law of 2003	New Geothermal Law of 2014
Are geothermal activities defined as mining?	Yes. “Geothermal Mining Permit”.	No. Changed from “Geothermal Mining Permit” to “Geothermal Permit”.
Are activities in forest areas limited/prohibited under the Forestry Law?	Yes. Limited and/or forbidden in protected and conservation forest areas under the Forestry Law.	No. Geothermal development are allowed as long as they adhere with forestry regulations. Developer should have ”Permit of Environmental Service Use” from the Ministry of Forestry.
Which government authority issues the Geothermal Working Area (GWA)?	The Minister of Energy and Mineral Resources (MoEMR) or Governors or the Regents/Mayors in accordance with their respective jurisdiction.	The MoEMR.
Which government authority issues geothermal permit/license	The Minister of Energy and Mineral Resources (MoEMR) or Governors or the Regents/Mayors in accordance with their respective jurisdiction.	The MoEMR.
How wide is the concession?	Maximum 200,00 hectares with a maximum area of 10,000 hectares for exploitation. A Larger area is subject to approval from MoEMR or Governors or the Regents/Mayors in accordance with their respective jurisdiction.	GWAs will be determined based on assessing the capacity of individual geothermal system.
What is the period of concession	Maximum period of 35 years (3 years for exploration with two extensions of up to 1 year per extension and 30 years for exploitation). Possible to obtain further extensions.	Maximum period of 37 years (5 years for exploration with two extensions for up to 1 year per extension and 30 years for exploitation). Possible to obtain another 20 years each time an extension is approved.

New Reform on Geothermal in Mexico

Issues	Before Energy Reform	After Energy Reform
Is private sector participation encouraged?	No. It is very limited and only for drilling contractors or a EPC contractor (under the Public Electricity Service Law).	Yes. Any interested party may participate either in exploration and/or exploitation (Under the Geothermal Energy Act).
Which authority offer concessions.	The National Water Commission (Comision Nacional del Agua - CNA).	The Ministry of Energy (the Secretaria de Energia – SENER) through tender, except for hydrothermal reservoir, which needs to have water concession from CAN.
What are the types of concessions	Water concession by well (under the National Water Act). *)	Geothermal concession by area (under the Geothermal Energy Act).
How wide is the concession?	Per m3 of water *)	≤150 km2
What is the period of concession	5-30 years *)	Maximum period of 36 years (3 years for exploration with one extension for 3 years and 30 years for exploitation). This can be extended.

Sources: SENER, 2013 (indicated by *))

Geothermal Development in Chinese Taipei (1)



Early (~1994) estimation for power generation potential of selected geothermal fields based on preliminary exploration data

SITE	Average temperature	Power Potential (MWe)
Tatun	245 ℃	514
Chingshui	200 ℃	61
Tuchang	170 ℃	25
Lushan	180 ℃	41
Chipen	170 ℃	25
Chinlun	160 ℃	48

Est. Potential: 714 MW

Geographical Distribution and Exploitation Potential of Geothermal Resources in Chines Taipei (ITRI, 2013a)

Current Status and Future Plan

- The estimated Potential is about 714 MW.
- As of December 2013, there was a 50 kW demonstration plant in operation with another 1 MW under construction.
- Target for geothermal installed capacity:

Year	2015	2020	2025	2030
Installed Capacity	4 MW	66 MW	150 MW	200 MW

Sources: ITRI, 2013

Resources Access

The system:

- The Hot Spring Act is the legal instrument for geothermal development. ‘Geothermal heat (steam)’ is defined as one hot spring by-products. It is owned by the state.
- The Water Act or the Mining Act is also the legal instrument since a developer who wants to develop ‘hot spring’ must obtain the ‘water right’ pursuant to the Water Act or the ‘mining right’ pursuant to the Mining Act.

Evaluation of the system:

- The government needs to draft regulations that guide geothermal development, as neither the Water Act nor the Mining Act clearly refer to ‘geothermal’ as a products to be regulated.

Geothermal Development in Chinese Taipei (2)

Environmental Permitting

The system:

- 'The hot spring development permit' will be given by the local government after the developer secures the right to use land from the landowner (public, private or indigenous people), provides plan of development and use of resources (not conflict with the local government's hot spring administration), and the resource is not located at area of the hot spring outcrop*).
- Obtaining the 'water right' pursuant to the Water Act or the 'mining right' pursuant to the Mining Act.
- The basis for accessing geothermal resources is 'first come first serve'

Evaluation of the system:

- Unclear which agency decided whether a developer should get a water right or mining right.
- The permitting process from various agencies usually takes times.
- No 'One-Stop Shopping'.

*) *Hot spring outcrop means a site where hot spring is gushed out naturally.*

Government Support for Geothermal

The system:

- Database for geothermal potential, FIT scheme; subsidy up to 50% of exploration cost or not exceed NT$ 50 million; fiscal incentives, and R&D have been provided.

Evaluation of the system:

- Capability and capacity of geothermal industry still need to be created.
- Capability and capacity of professional personnel in geothermal need to be established by providing enough public training.

Electricity Market Access

The system:

- The transmission operator company must provide grid integration; the power lines connecting the geothermal power plant equipment and the grid must be constructed, installed and maintained by geothermal producer or developer. A fixed long-term price guaranteed up to 20 years.

Evaluation of the system:

- Securing the right to use land for transmission line can be time consuming for the developer.
- The developer still needs to negotiate with Taiwan Power Company for cost of transmission.

Policy Success Factors for Geothermal Electricity Development

Policy Infrastructure

- Clear and certain legislation and/or regulation.
- Well-defined strategy for promoting geothermal electricity including mitigation of high risk of the developer.
- Keeping previous commitments to investors.
- Good institutional capacity for policy and regulation.

Resources Access

- Open and competitive basis for all players with reasonable and simple procedure.
- Provide developers with appropriately secure access to resources that they have invested in.

Environmental and Other Development Permitting

- Establish reasonable time limits within which permitting decision are reached.
- Establish 'One-Stop Shopping' to coordinate all aspects of permitting and to monitor the licenses.
- Good coordination among governmental agencies at all levels to avoid duplication of responsibilities and policy conflicts.

Government Support for Geothermal Industry

- Establish a good quality public database.
- Provide adequate funding for R&D on a continuing basis.
- Provide sufficient of professional personnel in quality and quantity by establishing enough public training.
- Provide financial incentives to reduce the risk of geothermal developer in the early stages and to increase the ability of the developer to raise capital for geothermal project.

Electricity Market Access

- Provide standard and streamlined procedures for developers to access transmission networks without discrimination and within reasonable time frames.
- Establish long-term contracts for electricity price with reasonable price structures.