



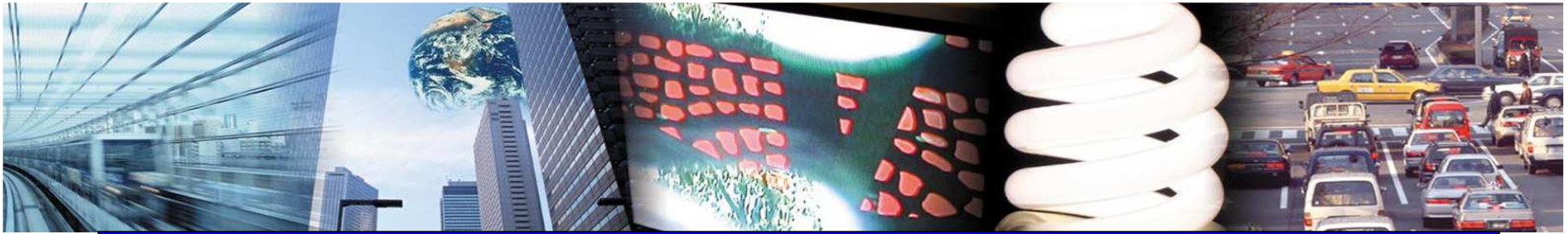
**The 44<sup>th</sup> Meeting of  
APEC Expert Group on New and Renewable Energy Technology  
Laoag, Philippines, 13 April, 2015**

**Attaining RE Doubling Goal by 2030  
(The Upcoming APEC Outlook 6<sup>th</sup> Edition)**

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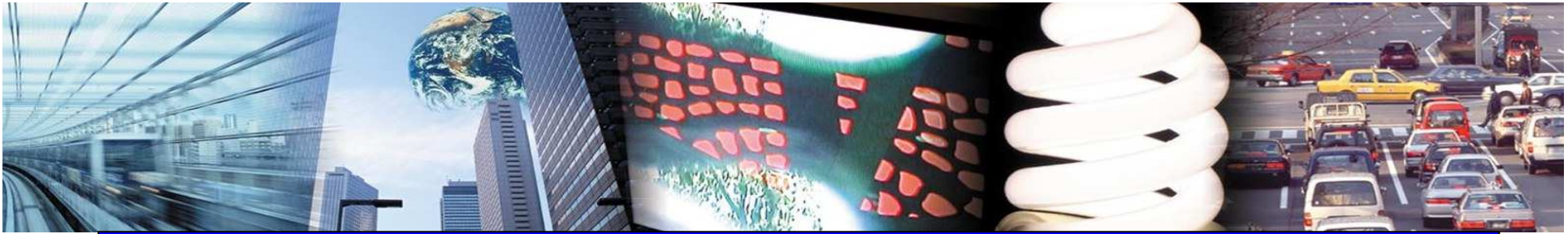


Asia-Pacific  
Economic Cooperation



# Outline of Presentation

- ❑ Rationale and Scope of the 6<sup>th</sup> APEC Outlook and Issues on RE Target
- ❑ RE Shares (Preliminary Results)
  - Final Energy Demand
  - Generating Capacity
  - Power Generation Mix
- ❑ RE Development per Technology (Preliminary Results)
- ❑ Approach to Alternative Scenario
- ❑ RE Share to Transport (Preliminary Results)
  - Approach to Supply Potential Projection



# Rationale for The 6<sup>th</sup> Edition



## APEC Energy Demand and Supply Outlook 5th Edition

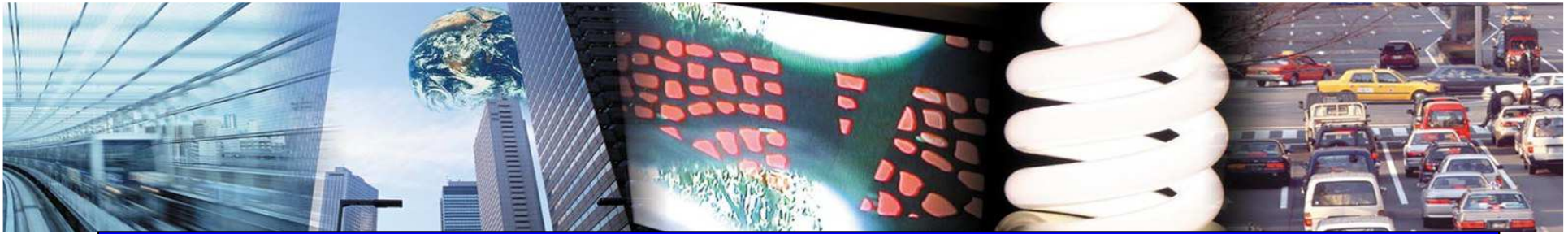
February 2013



APERC  
Asia Pacific Energy Research Centre

- Prolonged impact of 2011 Fukushima Nuclear Disaster.
- Shale gas revolution.
- Increased uptake and cost competitiveness of renewable energy.
- The unexpected fall in oil prices.
- Increased slowdown of the Chinese economy.
- Fast changing APEC economies' policies.





## Scope of The 6<sup>th</sup> Edition

- **Business-as-Usual (BAU) case**

Projection of the energy supply and demand is based on the current or existing policies of the respective economies, including policies in process of implementation.

- **Alternative case:**

- **Meeting APEC's Energy Intensity Target of 45% Reduction by 2035**

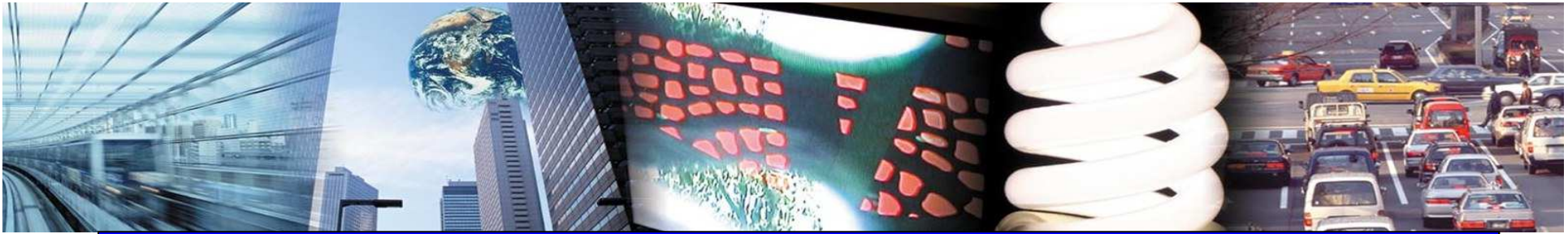
Focus on demand side policy options to meet APEC's Energy Intensity target of 45% reduction by 2035 taking into account improvement of economic structure, and reduction in energy consumption.

- **Attaining the APEC Renewable Energy Doubling Goal by 2030**

Focus on how the electricity sector and the transport sector could increase the development and deployment of renewable energy (RE) to achieve APEC doubling goal.

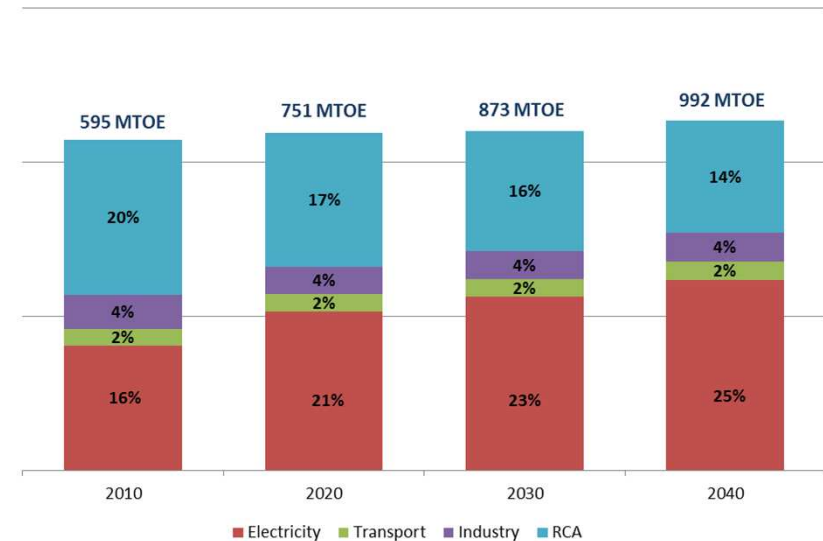
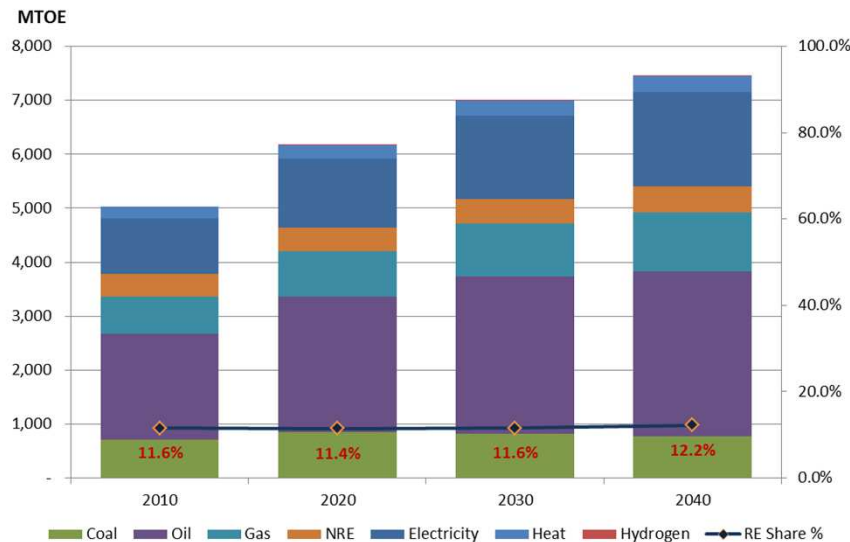
- **The Potential Power Mixes**

Identify the potential power mixes maximising the use of either Natural Gas, Cleaner use of Coal, or Nuclear.

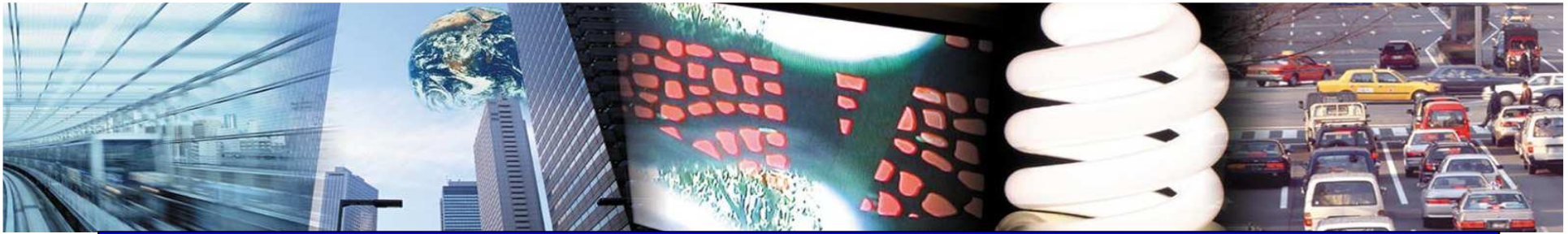


# The Share of RE in The APEC Region

## Total Final Energy Consumption (TFEC)



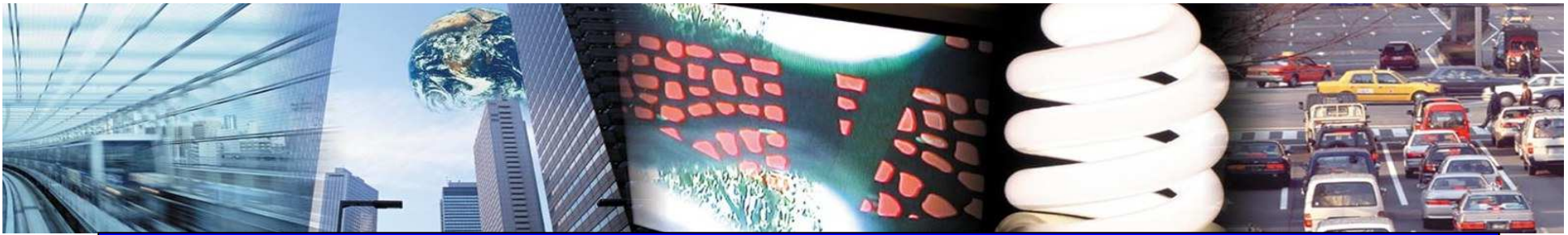
- RE share to total FED is expected to remain the same under the BAU.
- Electricity dominates the use of RE among other sectors.
- 1,621 MTOE of RE (or additional 1,040 MTOE) is required to realize doubling goal (23%) in 2030.



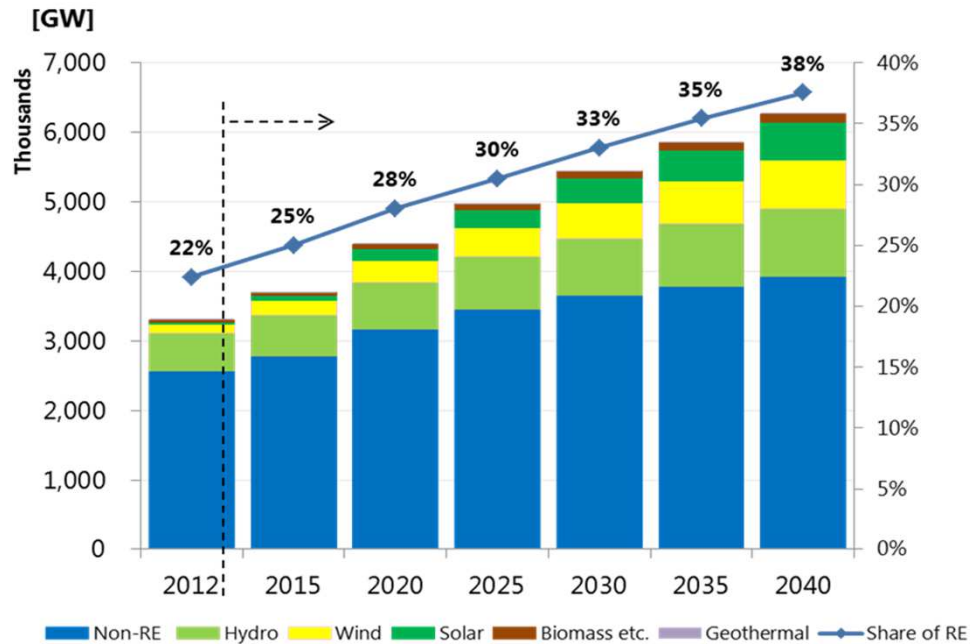
## Issue Needs to be Answered

- Can APEC achieve its doubling target for renewable energy (RE)?
- How to develop and deploy more RE?
- Will fossil fuel subsidy have an impact on RE development?
- Will fossil fuel (coal, natural gas, and oil) price reduction prevents substitution to RE?
- How much additional capacity is needed to meet the doubling target in terms of power generation?
- Is there a way to expand the biofuel (bio-ethanol & bio-diesel) production without competing with food security?
- How is the competitiveness of biofuel with other alternative fuels?



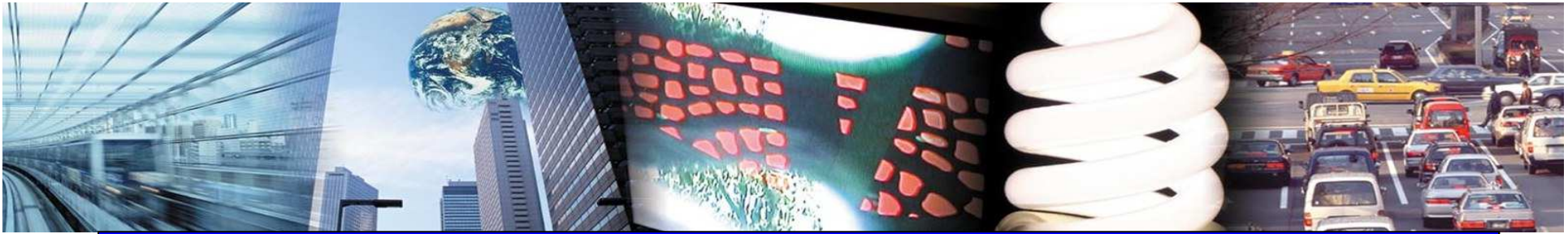


# RE Capacity and Share

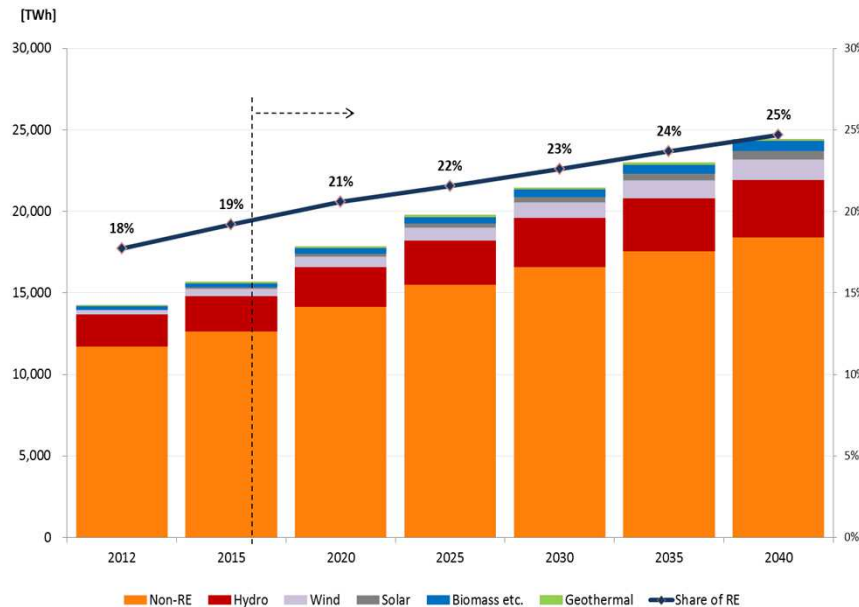


Share to Total RE (%)	2012	2030	2040
Solar	5%	20%	23%
Wind	18%	29%	32%
Hydro	72%	46%	41%
Biomass etc.	5%	5%	5%
Geothermal	1%	1%	1%

- RE share to total installed capacity will increase from 22.0% in 2012 to 33.0% in 2030 and 38.0% in 2040.
- RE capacity is growing at 4.2% AAGR with solar and wind growing at the fastest rates of 11.1% and 6.2% average annual, respectively.
- China will provide the largest share with 45.0% in 2012, 63.0 % in 2030 and 68.0% in 2040 to total APEC RE capacity. RE capacity addition in China will be growing at 5.8% AAGR.



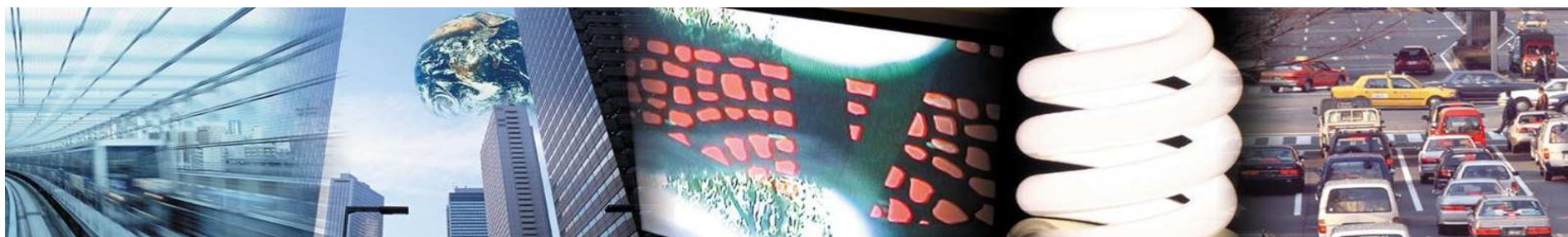
# RE Share to Generation Mix



Share to RE Generation (%)	2012	2030	2040
Solar	1%	8%	9%
Wind	11%	19%	20%
Hydro	78%	62%	59%
Biomass	8%	10%	10%
Geothermal	2%	2%	2%

- RE share to total generation mix will increase from 18.0% in 2012 to 23.0% in 2030, and 25.0% in 2040.
- RE generation will grow at an AAGR of 3.2% with solar exhibiting the fastest growth rate of 11.4%, followed by wind with 5.6%.
- China will contribute more to RE generation in the APEC region – 40% in 2012, 54% in 2030, and 58% in 2040.

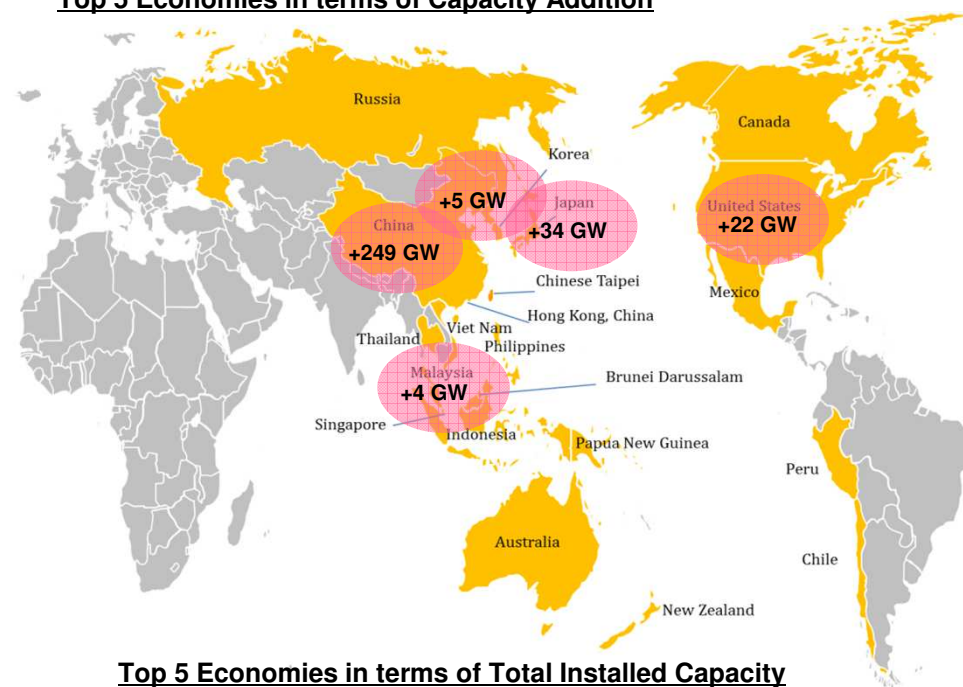




# Solar Development (2012-2030)

- All APEC economies show their interest to develop more solar power up to 2030 (except Viet Nam & Papua New Guinea).
- Capacity addition in China will reach 249 GW until 2030 (20.6% AAGR), followed by Japan (8.1%), United States (16.0%), Korea (13.1%) and Malaysia (22.5%).
- China, Japan, United States, Australia, and Korea are still top 5 economies in terms of total installed capacity of solar power in 2030.

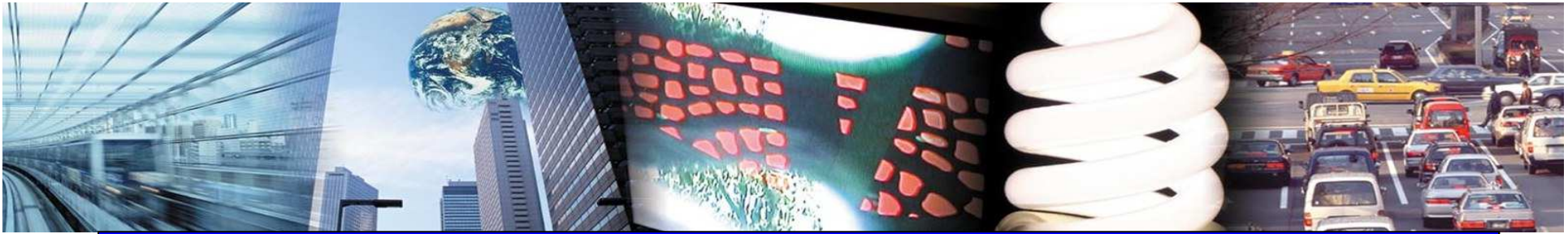
**Top 5 Economies in terms of Capacity Addition**



**Top 5 Economies in terms of Total Installed Capacity**

No	2012	2030
1.	Japan (11.1 GW)	China (258.0 GW)
2.	China (8.9 GW)	Japan (44.9 GW)
3.	Australia (4.0 GW)	United States (23.3 GW)
4.	United States (1.6 GW)	Australia (7.4 GW)
5.	Korea (0.7 GW)	Korea (6.0 GW)

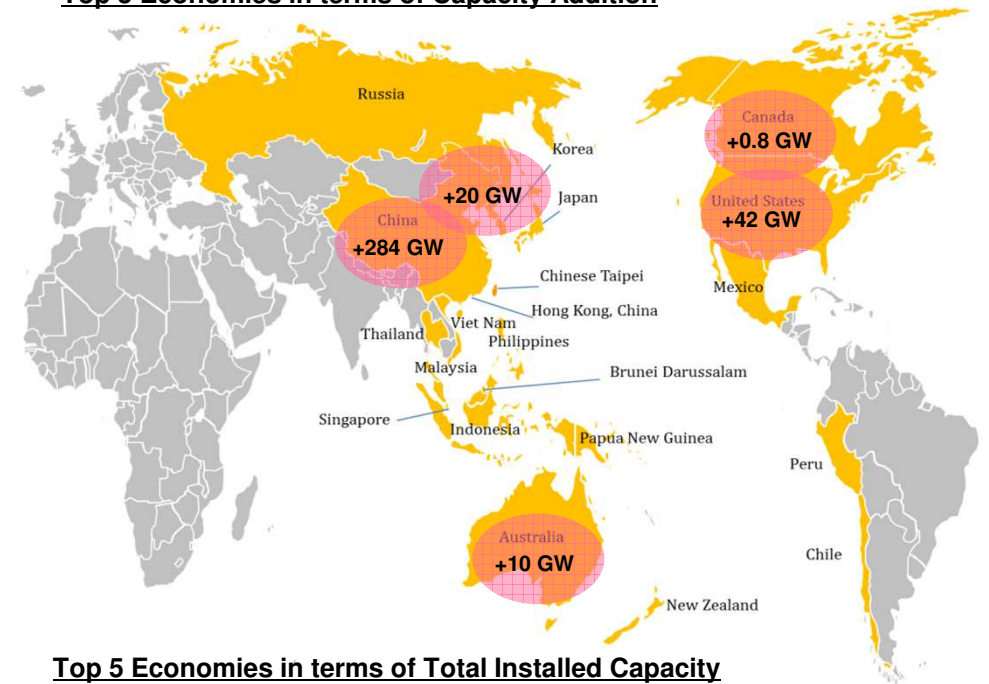
Source: APERC Analysis



# Wind Development (2012-2030)

- All APEC economies show their interest to develop more wind power up to 2030 (except Brunei, Malaysia, Papua New Guinea, and Singapore).
- Capacity addition in China will reach 284 GW in 2030 (9.3% AAGR), followed by United States (3.6%), Korea (25.3%), Australia (9.7%), and Canada (5.2%).
- China, United States, Korea, Canada, and Australia are top 5 economies in terms of total installed capacity of wind power in 2030.

**Top 5 Economies in terms of Capacity Addition**

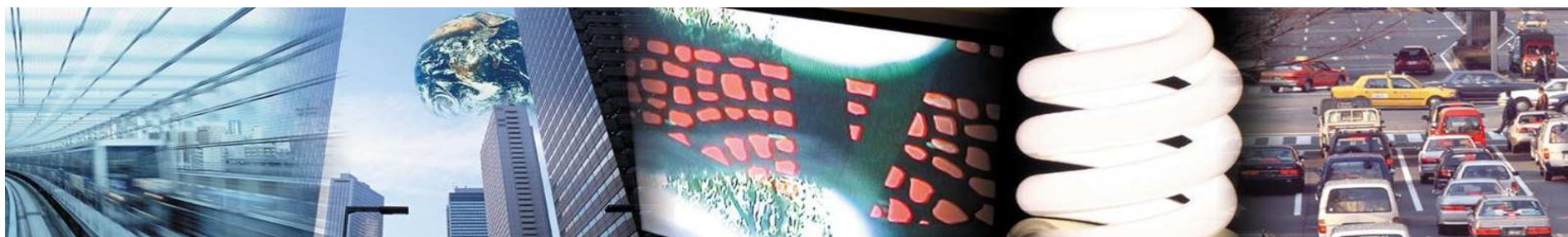


**Top 5 Economies in terms of Total Installed Capacity**

No	2012	2030
1.	China (71.3 GW)	China (355.1 GW)
2.	United States (46.7 GW)	United States (88.5 GW)
3.	Canada (5.1 GW)	Korea (20.6 GW)
4.	Japan (2.6 GW)	Canada (12.8 GW)
5.	Australia (2.4 GW)	Australia (12.8 GW)

Source: APERC Analysis

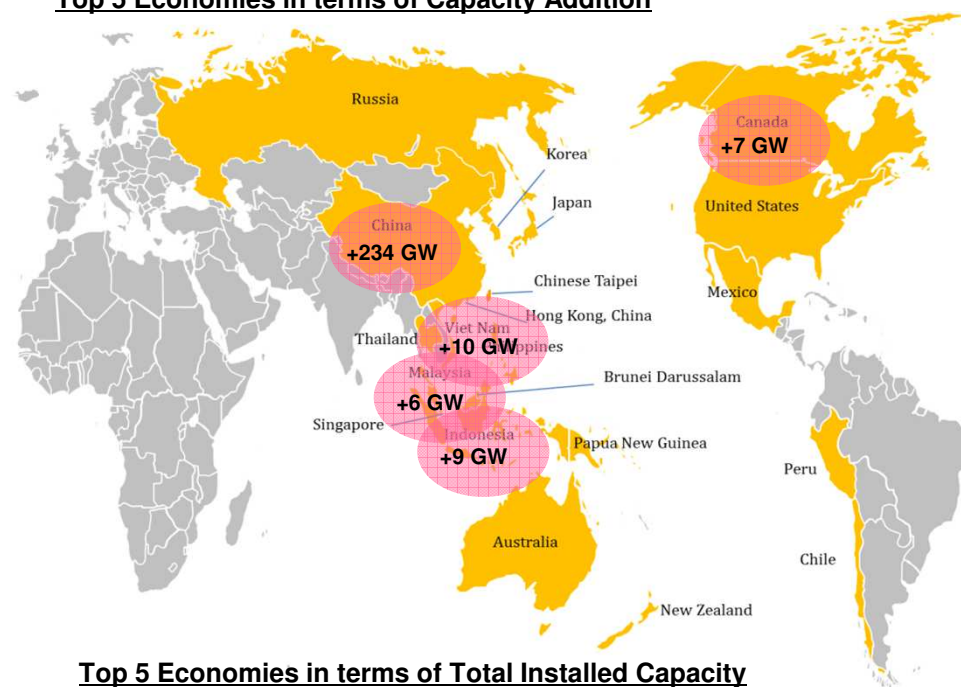




# Hydro Development (2012-2030)

- All APEC economies show their interest to develop more hydro power up to 2030 (except Brunei, Hong Kong, Papua New Guinea, and Singapore).
- Capacity addition in China will reach 234 GW in 2030 (3.8% AAGR), followed by Viet Nam (3.7%), Indonesia (6.8%), Canada (0.5%), and Malaysia (4.3%).
- China, Canada, United States, Russia, and Viet Nam are top 5 economies in terms of total installed capacity of hydro power in 2030.

Top 5 Economies in terms of Capacity Addition

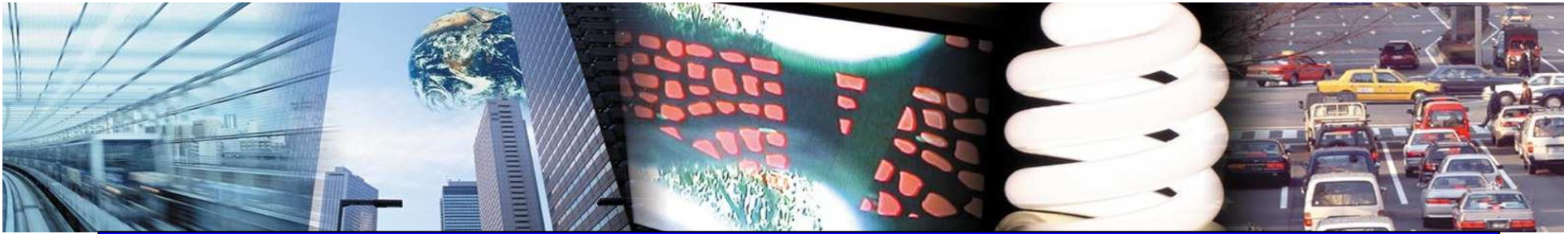


Top 5 Economies in terms of Total Installed Capacity

No	2012	2030
1.	China (246.0 GW)	China (480.0 GW)
2.	United States (77.9 GW)	Canada (83.8 GW)
3.	Canada (76.6 GW)	United States (80.4 GW)
4.	Russia (48.5 GW)	Russia (50.0 GW)
5.	Japan (20.8 GW)	Viet Nam (21.5 GW)

Source: APERC Analysis

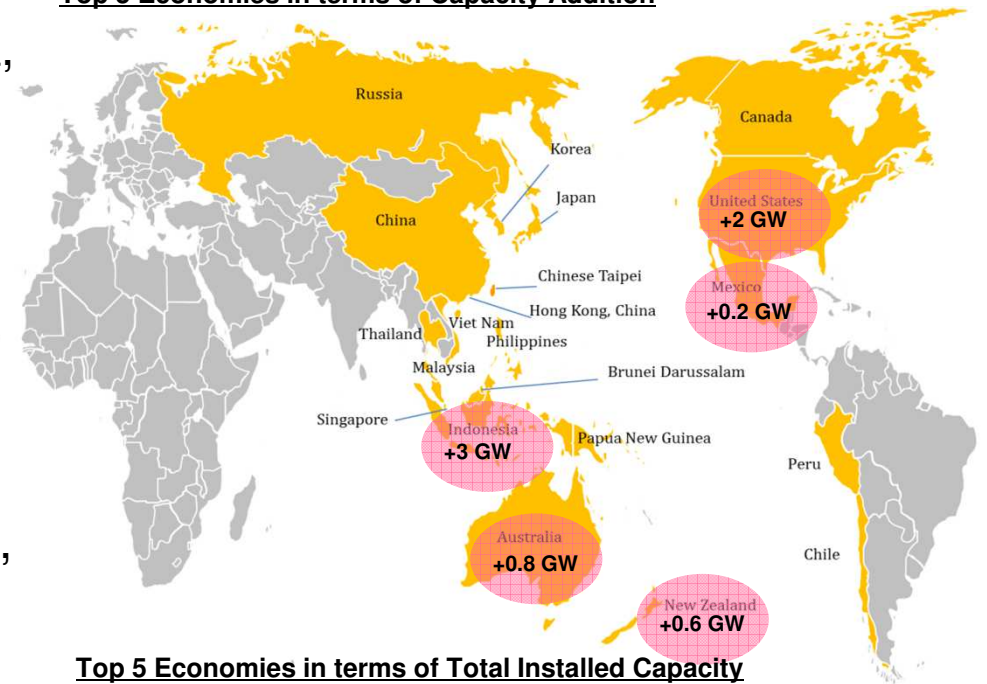




# Geothermal Development (2012-2030)

## Top 5 Economies in terms of Capacity Addition

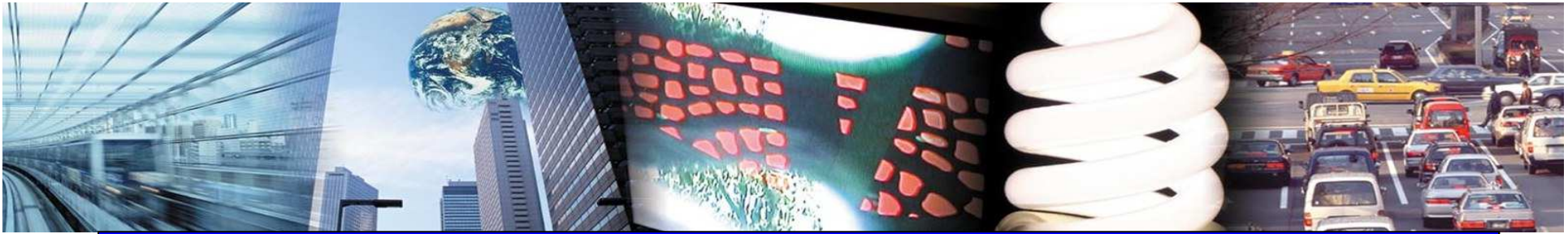
- Only 7 economies (Australia, Indonesia, Malaysia, Mexico, New Zealand, Philippines, Russia, and United States) show their interest to develop more geothermal power up to 2030.
- Capacity addition in Indonesia will reach 3 GW in 2030 (6.3% AAGR), followed by United States (2.3%), Australia (64.6%), New Zealand (3.4%), and Mexico (1.0%).
- United States, Indonesia, Philippines, New Zealand, and Mexico are top 5 economies in terms of total installed capacity of geothermal power in 2030.



## Top 5 Economies in terms of Total Installed Capacity

No	2012	2030
1.	United States (3.5 GW)	United States (5.3 GW)
2.	Philippines (1.8 GW)	Indonesia (4.1 GW)
3.	Indonesia (1.3 GW)	Philippines (1.9 GW)
4.	Mexico (0.8 GW)	New Zealand (1.3 GW)
5.	New Zealand (0.7 GW)	Mexico (1.1 GW)

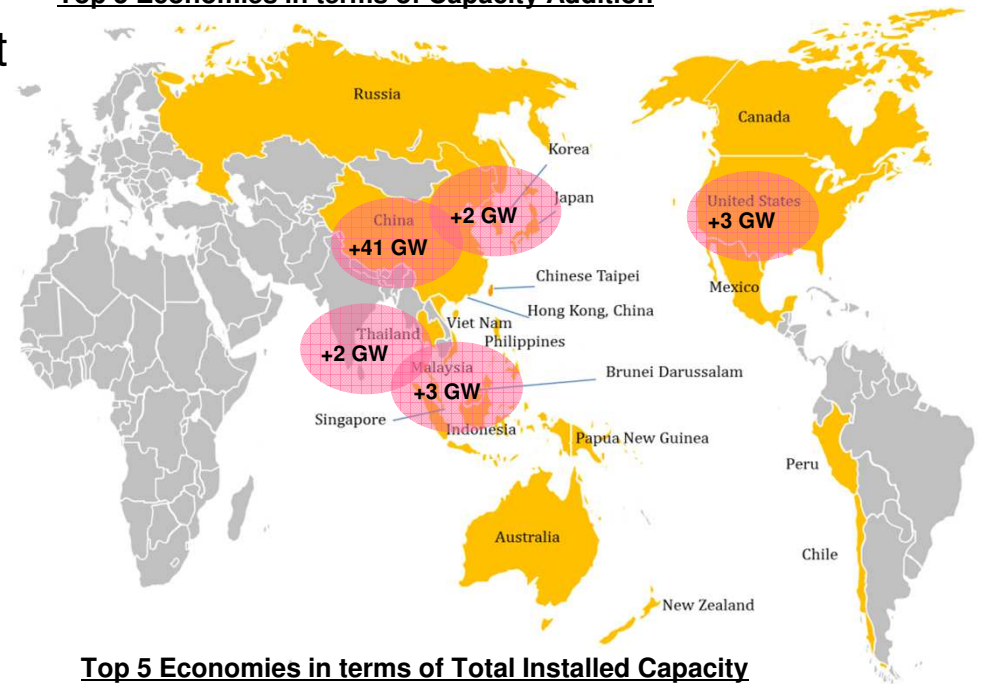
Source: APERC Analysis



# Biomass etc. Development (2012-2030)

Top 5 Economies in terms of Capacity Addition

- All APEC economies show their interest to develop more biomass etc. up to 2030 (except Hong Kong, Papua New Guinea, and Singapore).
- Capacity addition in China will reach 41 GW until 2030 (10.2% AAGR), followed by United States (1.1%), Malaysia (7.3%), Thailand (4.7%), and Korea (5.5%).
- China, United States, Japan, Thailand, and Malaysia are top 5 economies in terms of total installed capacity of biomass etc. in 2030.



Top 5 Economies in terms of Total Installed Capacity

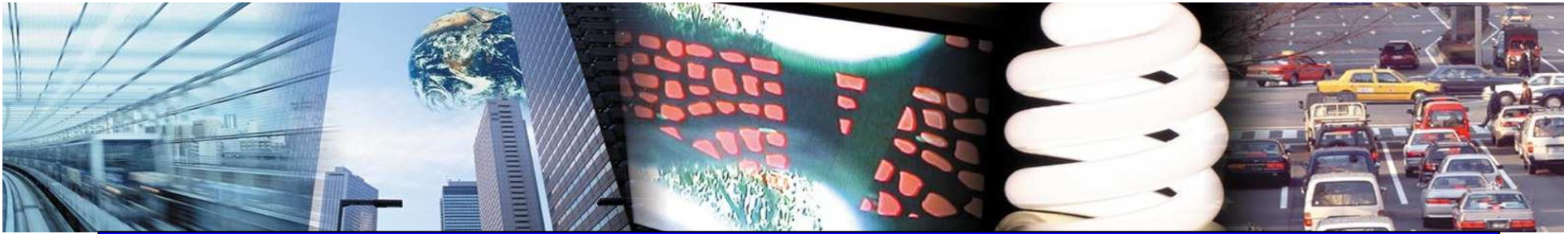
No	2012	2030
1.	United States (13.7 GW)	China (49 GW)
2.	China (8.5 GW)	United States (16.6 GW)
3.	Japan (4.5 GW)	Japan (5.6 GW)
4.	Thailand (1.9 GW)	Thailand (4.3 GW)
5.	Canada (1.7 GW)	Malaysia (3.8 GW)

Note:

Etc. means other renewables such as ocean power.

Source: APERC Analysis

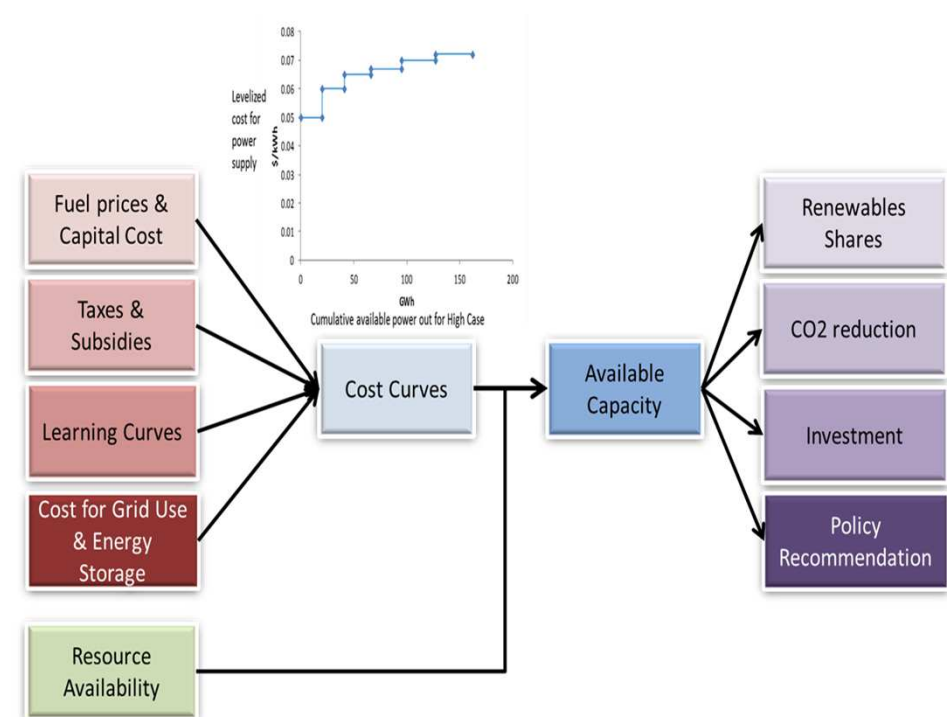




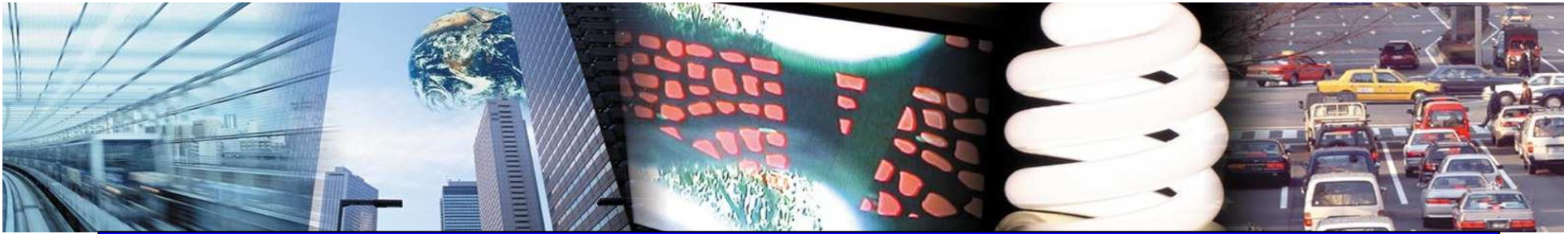
# Approach to Alternative Case

- Review and assess the APEC's energy resources potential and capacity.
- Identify the possible type of RE to be developed by share and capacity, and also looking at some factors (e.g. technology, economics, etc.).
- Assess the capacity of each APEC economy to develop those possible types of RE.
- Find the implications and challenges for
  - APEC as whole
  - each APEC economy
- Provide policy recommendation for
  - APEC as whole
  - each APEC economy

## Methodology

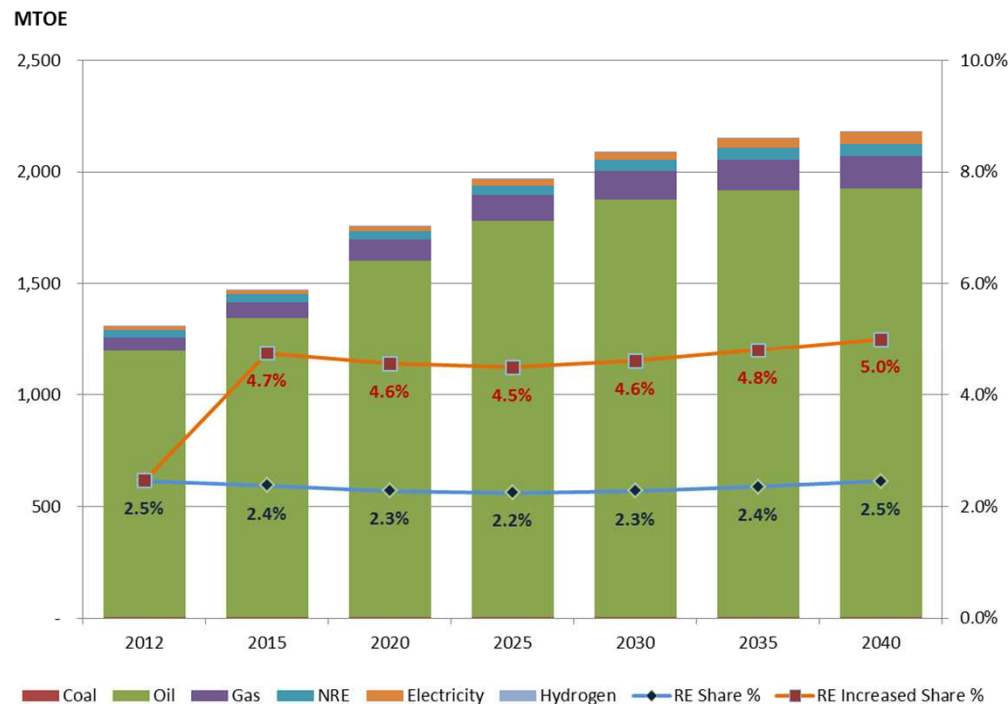






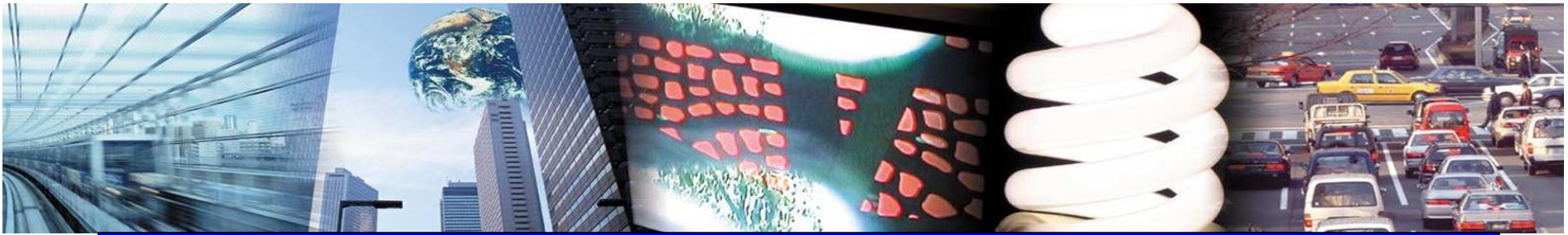
# The Share of RE in Transport Sector

## Total Final Energy Consumption (TFEC)



Source: APERC Analysis

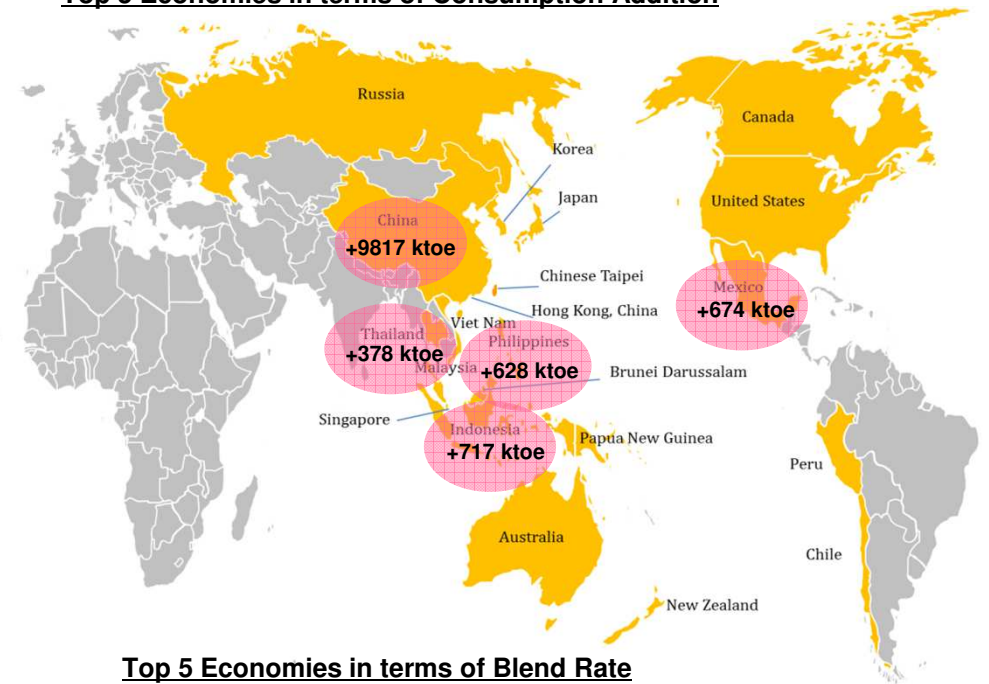
- With no changes in the blend rates of biofuels in APEC economies, the share of biofuels to total transport energy demand will remain the same.
- To increase the share of biofuels (double the share) to total transport demand, biofuels consumption should increase from 32 MTOE in 2012 to 95 MTOE in 2030, and 107 MTOE in 2040.
- To increase share of biofuels, blend levels for biodiesel and bioethanol must be higher, such as from 5% blend rate to 10% blend rate.



# Bioethanol Utilization in 2012-2030

- Bioethanol will be utilized more in 10 APEC economies up to 2030 (Australia; Canada; China; Indonesia; Mexico; New Zealand; Peru; Philippines; Thailand; and Viet Nam).
- Additional consumption of bioethanol will be rapidly increased in China, reaching 9,817 ktoe in 2030 (13.8% AAGR), followed by Indonesia Mexico, Philippines, and Thailand.
- United States, Philippines, Peru, Thailand, and Canada are top 5 economies in terms of blend rate of bioethanol in 2030.

**Top 5 Economies in terms of Consumption Addition**

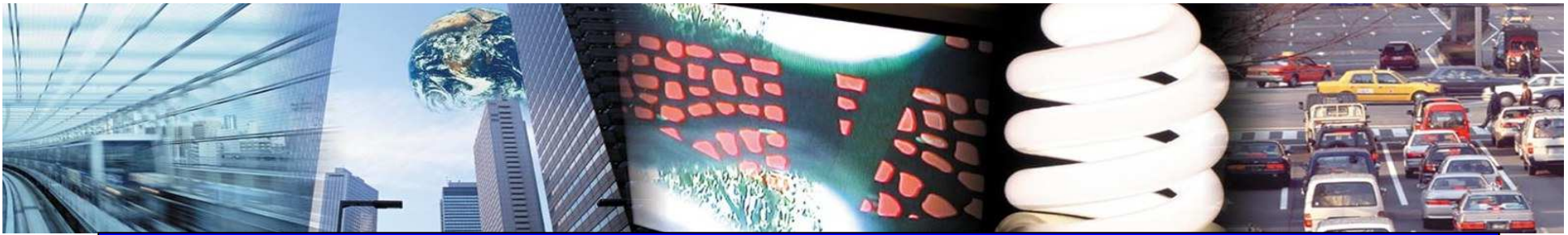


**Top 5 Economies in terms of Blend Rate**

No	2012	2030
1.	United States (6.23%)	United States (7.06%)
2.	Philippines (5.55%)	Philippines (6.21%)
3.	Peru (4.65%)	Peru (5.73%)
4.	Canada (3.92%)	Thailand (4.61%)
5.	Thailand (1.90%)	Canada (4.60%)

Source: APERC Analysis

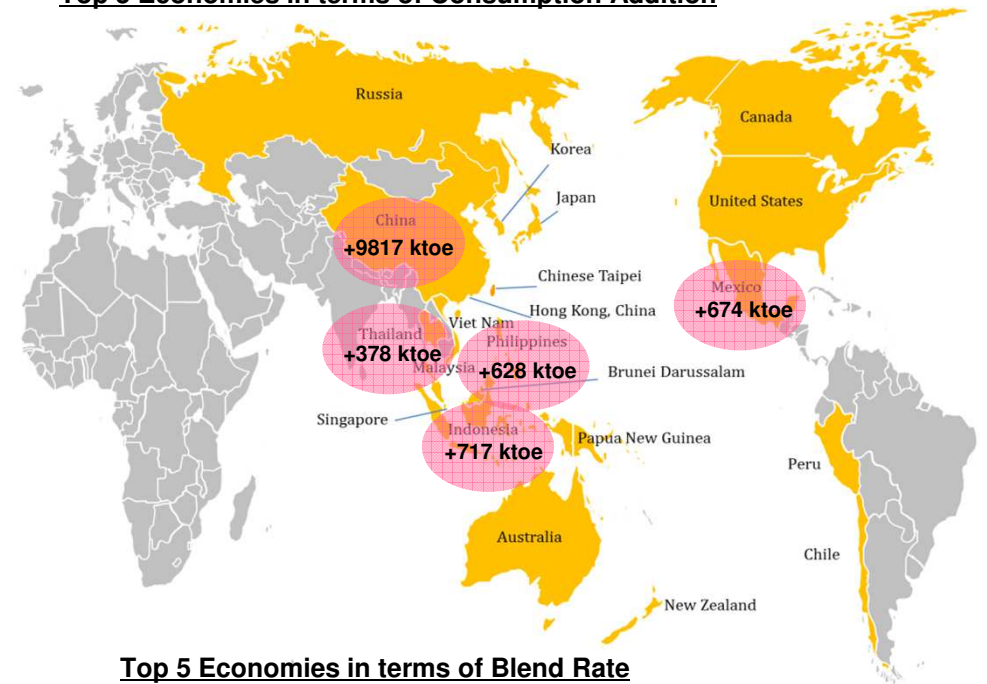




# Biodiesel Utilization in 2012-2030

## Top 5 Economies in terms of Consumption Addition

- Biodiesel will be utilized more in 11 APEC economies up to 2030 (Australia; Canada; China; Hong Kong; Indonesia; Korea; Malaysia; New Zealand; Peru; Philippines; and United States).
- Additional consumption of biodiesel will be rapidly increased in United States, reaching 1,983 ktoe until 2030 (3.9% AAGR), and followed by Indonesia Peru, China, and Philippines.
- Thailand, Peru, Indonesia, Korea, and Canada are top 5 economies in terms of blend rate of biodiesel in 2030.

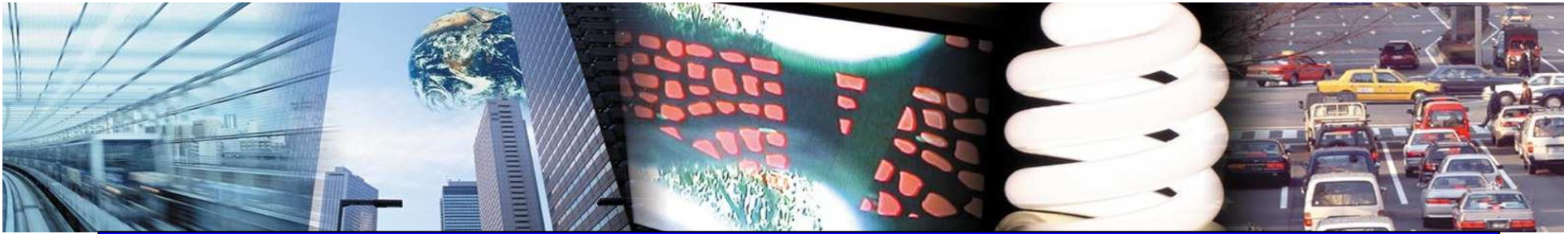


## Top 5 Economies in terms of Blend Rate

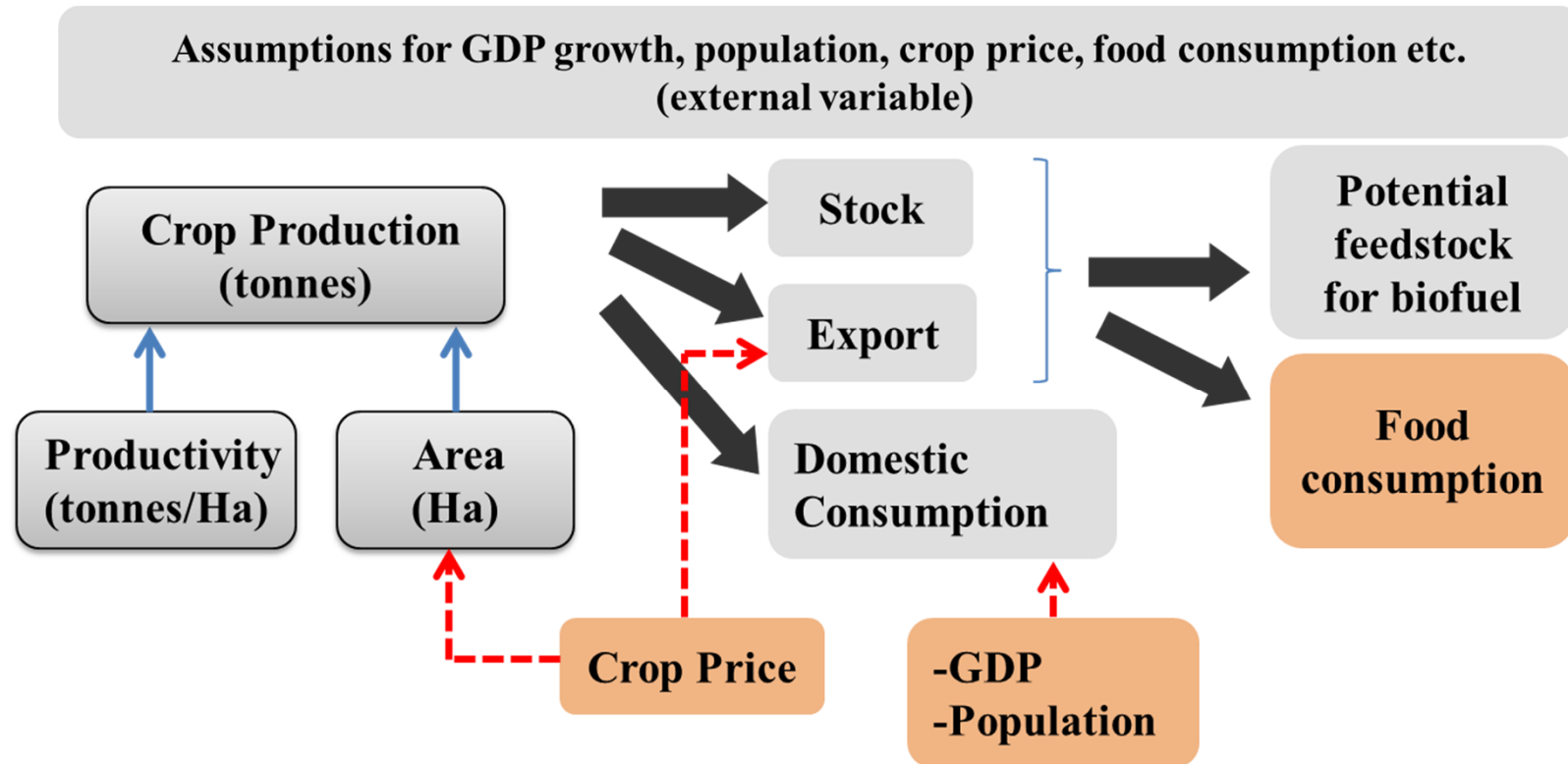
No	2012	2030
1.	Thailand (5.64%)	Thailand (6.51%)
2.	Peru (6.07%)	Peru (6.46%)
3.	Indonesia (3.65%)	Indonesia (3.79%)
4.	Canada (2.53%)	Korea (2.69%)
5.	Korea (2.08%)	Canada (2.60%)

Source: APERC Analysis





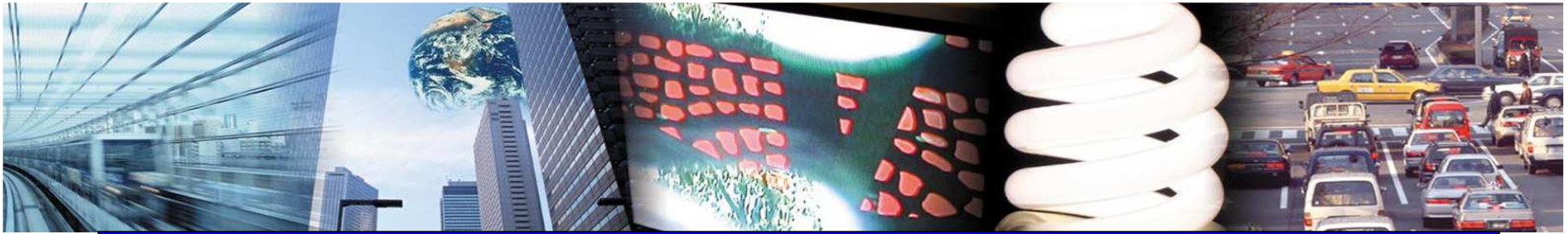
# Approach to Supply Potential Projection



Area (Ha): Regression by crop price

Productivity (Unit/Ha): Technology parameter

Domestic Consumption: Regression by using GDP and/or Population as drivers



# Approach to Supply Potential Projection

## BAU Case

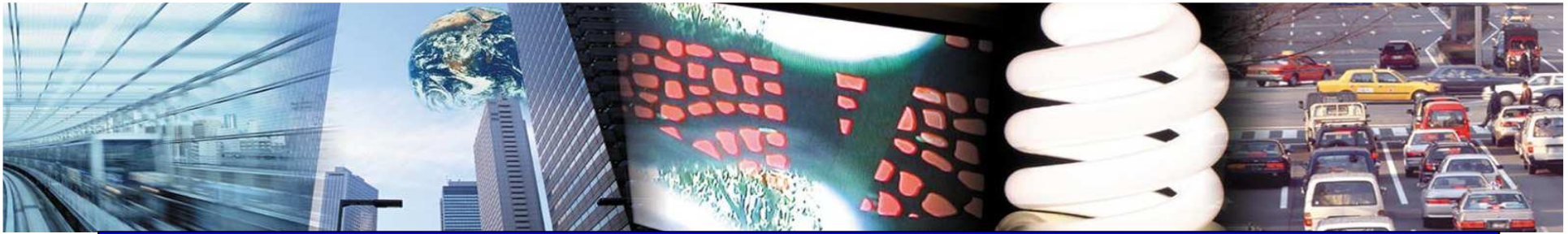
The projection is based on existing cultivation condition and structure. Only the crop with surplus production after the domestic consumption and food export for international demand as defined by FAO will be considered as potential feedstock.

## High Case

Maximize the unutilized agricultural area and productivity per cultivated area.

**Arable land** as defined by FAO is the full expansion of agricultural area. The model considers as an external variable the increase in cultivated area through maximization of arable land.

**Higher productivity level** on each type of crop in the region is set as the baseline value. The sources of high productivity level such as technology are said to be available and could be shared and transferred in the region.



# Approach to Supply Potential Projection

## Arable Land for Expansion

<Assumption>

- ❑ Maximize the unutilized agricultural land\* in member economies.
- ❑ The expansion of agricultural land will be based on improving the cultivation structure by crops.

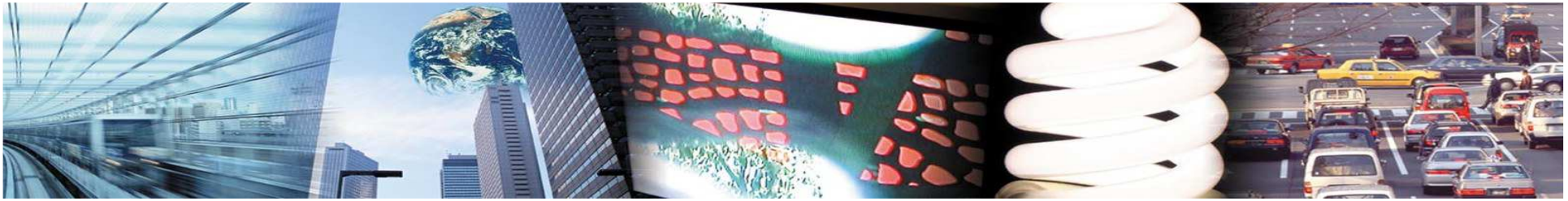
## Potential to increase productivity

<Assumption>

- ❑ Maximize the productivity per cultivated land in member economies.
- ❑ Some economies with higher productivity levels for crops will be chosen as benchmarks for other economies for possible improvement or increase in crop production productivity.
- ❑ The cultivation technology could be transferred to all member economies.

*(Note) \* FAO Statistics define as arable land + permanent crop.*





**Thank you for your kind attention**

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