Draft Plan for
APEC Renewable Energy Roadmap

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1. Background of RE Doubling Goal

2014 Leaders' Declaration

We endorse the Energy Ministers' aspirational goal to double the share of renewables including in power generation by 2030 in APEC's energy mix.

2015 Leaders' Declaration

We therefore reaffirm our aspirational goals to reduce aggregate energy intensity by 45 percent by 2035 and double renewable energy in the regional energy mix by 2030 to achieve sustainable and resilient energy development within the Asia-Pacific.

2016 Leaders' Declaration

We reaffirm our aspirational goals to reduce aggregate energy intensity by 45 percent by 2035 and double renewable energy in the regional energy mix by 2030.

1. Background of RE Doubling Goal

EMM 11 2014

- Energy Ministers aspired to the goal of "doubling the share of renewables in the APEC energy mix, including in power generation, from 2010 levels by 2030."
- Energy Ministers instructed the EWG through the EGNRET to develop the road map .

- Role of EGNRET Toward the Doubling RE Goal
- Discussion on definition of RE
- Proposing project to develop a roadmap toward the Doubling RE Goal
- Roadmap development
- Report the draft report of RE Roadmap

2. RE roadmap Progress

Seminar on Conducting APEC RE Roadmap

- Two-phased approach: (1) Roadmap Baseline analysis (technology status & detailed potential assessment and (2) comprehensive Roadmap development (vision, incl. milestones and action items),
- Nominate 1 (one) expert to be contact point for the Roadmap,
- Analysis limited to electricity sector,
- APERC assists with quantitative analysis

APEC Workshop on Filling the Gap to Reach the Goal of Doubling RE

- Understanding the barrier and challenges when making strategies
- Taking APEC RE doubling goal into consideration when APEC economies make renewable energy targets and policies
- Try to maximize the potential in APEC region
- Strategies of government support could be divided into 6 approaches

2nd Seminar on Conducting APEC RE Roadmap

Key Conclusions of EWG54 related to RE Roadmap

- EGNRET is requested to improve the draft roadmap for renewable energy doubling goal and to report progress at EWG55, taking into account the gaps, contribution from thermal and fuels, and factors such as social impact, market reform and trade and investment issues.
- For renewable energy doubling goal, traditional biomass will not be counted; IRENA's definition of renewable energy is recommended; APEC data should be used for modeling and monitoring the progress.

Definition of RE and Biomass

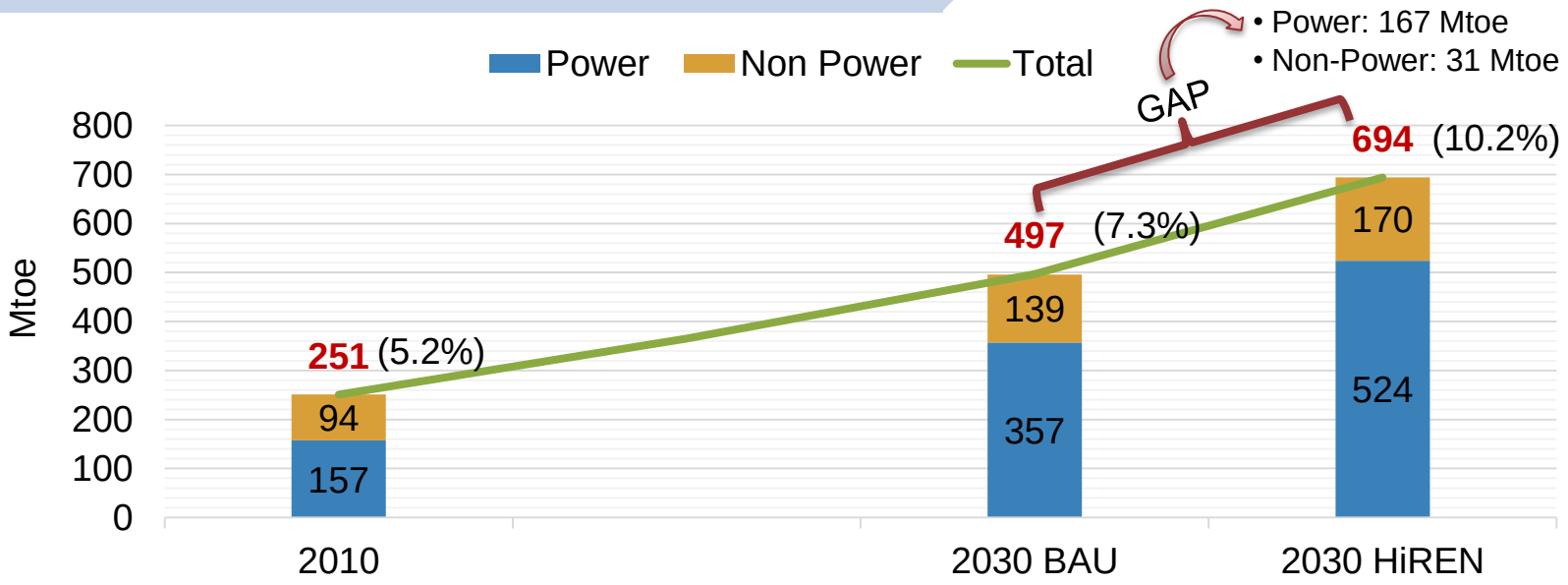
- IRENA definition for Renewable Energy

  Renewable energy includes all forms od energy produced from renewable sources in a sustainable manner, including bioenergy, geothermal energy, hydropower, ocean energy, solar energy and wind energy.

- IEA definition for modern biomass:

  includes all biomass (such as biodiesel), with the exception of traditional biomass which include wood, charcoal, agricultural resides and animal dung used for cooking and heating.

Target of RE Doubling Goal

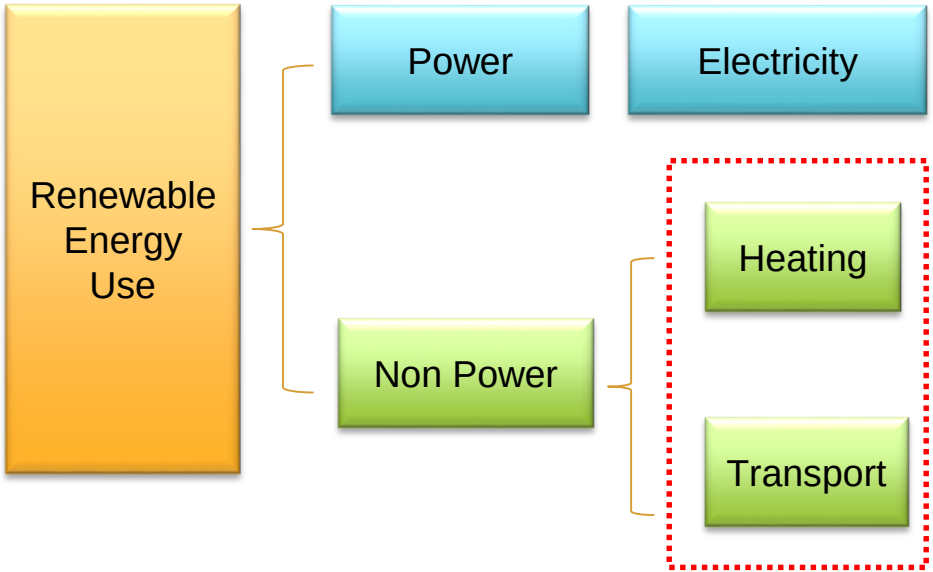


*BAU: Business-as-Usual Scenario, examining the potential to meet these challenge if current energy-related trend continue unchanged to the year 2040

*HiREN: High Renewables Scenario, outline a pathway to double the share of renewables in APEC between 2010 and 2030

Source: APEC Energy Demand and Supply Outlook 6th Edition

Framework of APEC RE roadmap



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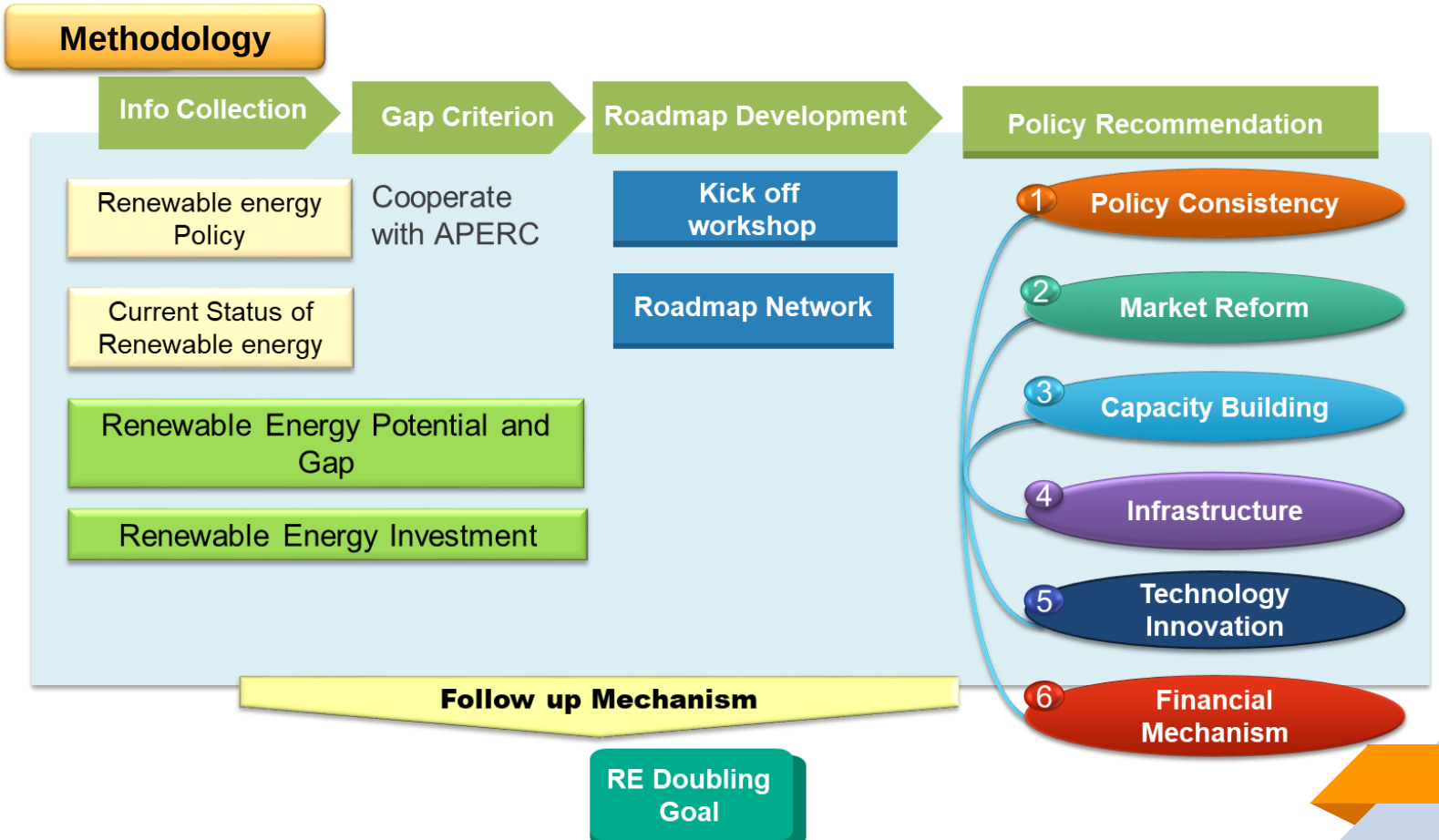
RE Roadmap for Electricity

Roadmap for Electricity



Roadmap for Electricity

Economy	RE law	RE R&D			Renewable electricity transmission/distribution
		Development of RE technology	RE storage	RE hybrid system	
Australia	Y	Y			
Brunei	Y				
Canada	Y	Y			
Chile	Y	Y	Y		Y
China	Y	Y	Y	Y	Y
Hong Kong, China					
Indonesia	Y	Y		Y	
Japan	Y	Y	Y		
Republic of Korea	Y	Y	Y		Y
Malaysia	Y	Y			
Mexico	Y	Y			Y
New Zealand	Y				
Papua New Guinea	Y	Y			
Peru	Y				
The Philippines	Y				
Russia		Y			Y
Singapore	Y	Y			
Chinese Taipei	Y	Y	Y	Y	Y
Thailand	Y	Y			Y
United States		Y	Y		
Viet Nam	Y				Y

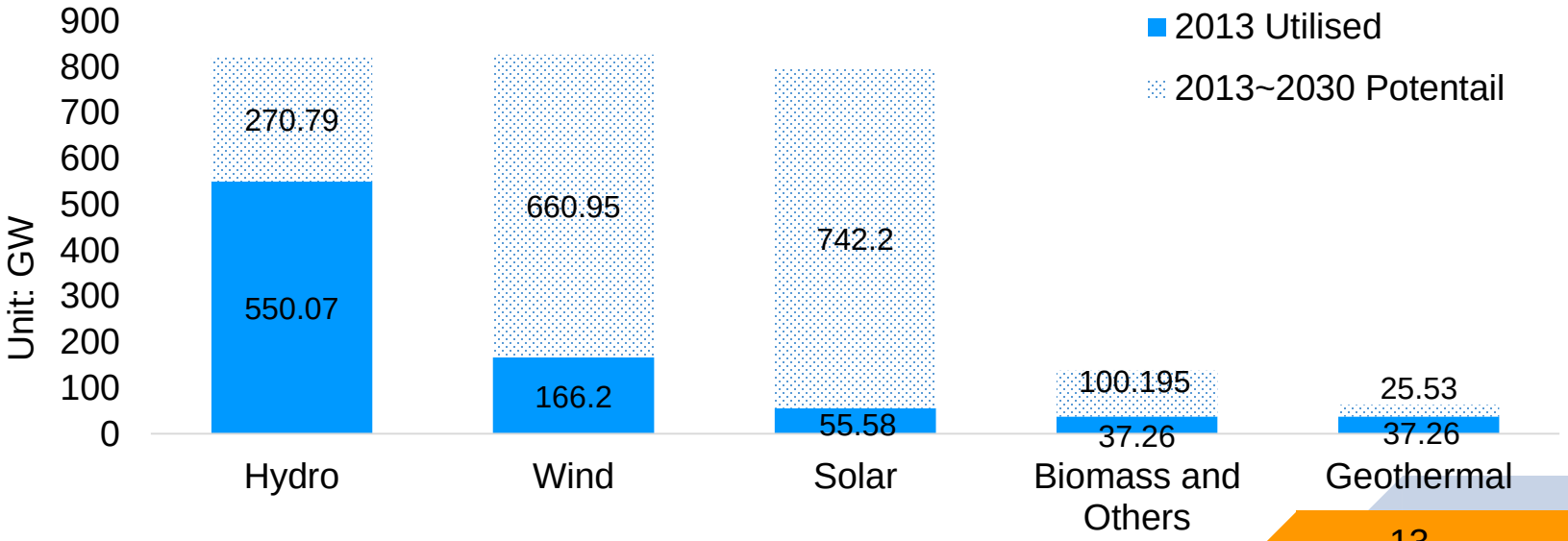
Roadmap for Electricity

Economy	Renewable energy incentive							Renewable energy fund	Carbon reduction tax	Fossil fuel subsidy reform
	Feed in Tariffs (FiT)	Feed in Premium (FiP)	Renewable portfolio standard (RPS)	Auction (bidding)	Net metering	Renewable energy certificates (RECs)	Others financial incentives			
Australia	Y		Y			Y	Y	Y	Y	
Brunei										
Canada	Y				Y	Y	Y	Y	Y	
Chile					Y		Y		Y	
China	Y		Y			Y	Y	Y	Y	
Hong Kong, China										
Indonesia	Y						Y		Y	Y
Japan	Y				Y	Y	Y	Y	Y	
Korea			Y	Y	Y	Y		Y	Y	
Malaysia	Y							Y		
Mexico	Y		Y	Y	Y	Y	Y	Y		
New Zealand							Y		Y	
Papua New Guinea										
Peru				Y			Y			Y
The Philippines	Y	Y	Y		Y	Y	Y		Y	
Russia		Y		Y			Y			
Singapore							Y		Y	
Chinese Taipei	Y					Y		Y	Y	
Thailand	Y						Y			Y
United States	Y		Y	Y	Y	Y	Y		Y	
Viet Nam	Y				Y		Y		Y	Y

Source: Official data from each economy, IEA

Renewable Energy Potential

- In the APEC region, until 2013, **the total utilized renewable energy potential was 846.37 GW, and the renewable energy potential from 2013 to 2030 is estimated as 1,799.6 GW.**

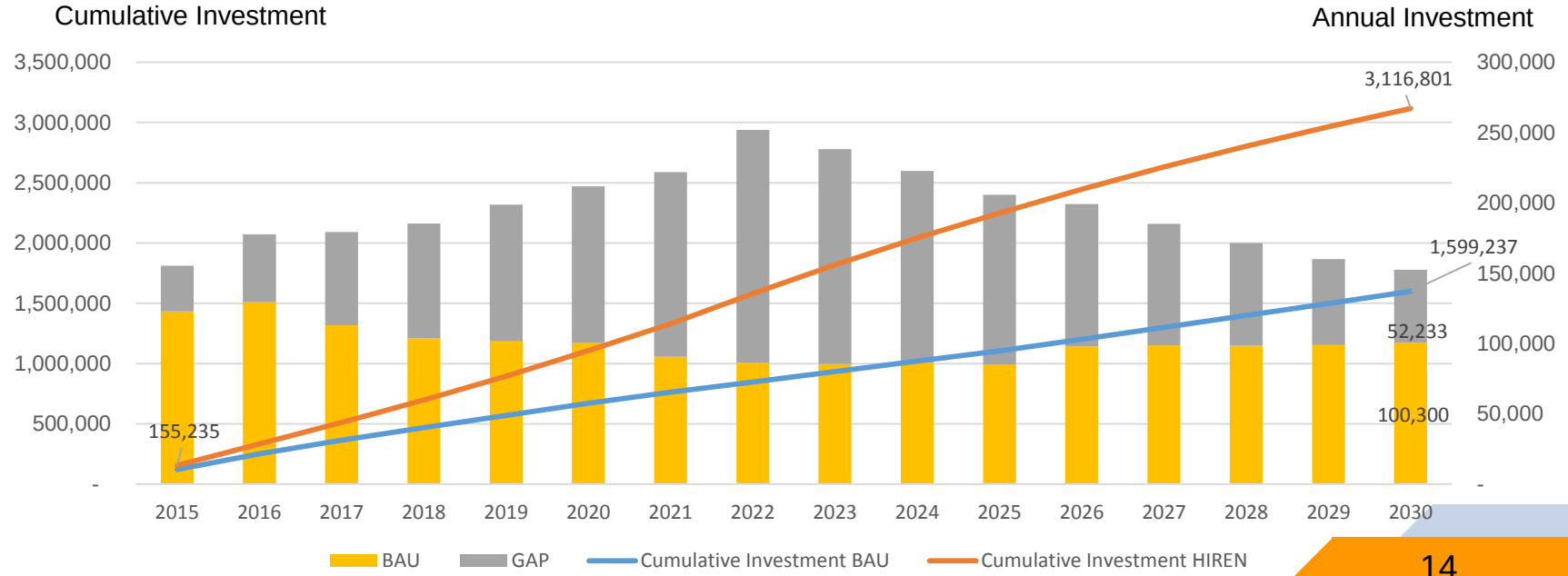


Source: APERC, 2016

Renewable Energy Investment

- APEC renewables investment was USD 236,477 million in 2015.
- APEC region still needs to increase around 92,679 million per year to reach the doubling renewable energy goal.

Unit: USD Million (Additional Transmission and Distribution)



Source: APERC, 2016

Recommendations

Approach	Recommendation
Policy Consistency	➢ Make a Strategy for Long-term Renewable Energy Development ➢ Strengthen Renewable Energy Policy Commitment ➢ Reduce Fossil Fuel Subsidy Gradually ➢ Enhance the Subsidy for Renewable Energy ➢ Impose the External Cost on Fossil Fuel
Market Reform	➢ Renewable Energy Certificates Market Building ➢ Electricity Market Design
Capacity Building	➢ Professional Skill ➢ Public Awareness ➢ Gender Equality
Infrastructure	➢ Introducing Micro-grid ➢ Introducing Smart Grid ➢ Formulating Legislations for Related Techniques
Technology Innovation	➢ Combination of RE development and efficiency improvement of RE technology ➢ Providing R&D funding for the innovation of RE technology ➢ Electricity transition and distribution ➢ Electric vehicle ➢ Energy storage
Financial Mechanism	➢ Grants ➢ Venture Capital Equity ➢ Bond ➢ Resource /Political Insurance ➢ Tax Credit

Conclusions

1 Recommendation

Target

Policy

Taking APEC RE doubling goal into consideration when APEC economies are making their renewable energy targets and policies

2 APEC Project

Encouraging a variety of development plans to support the doubling goal

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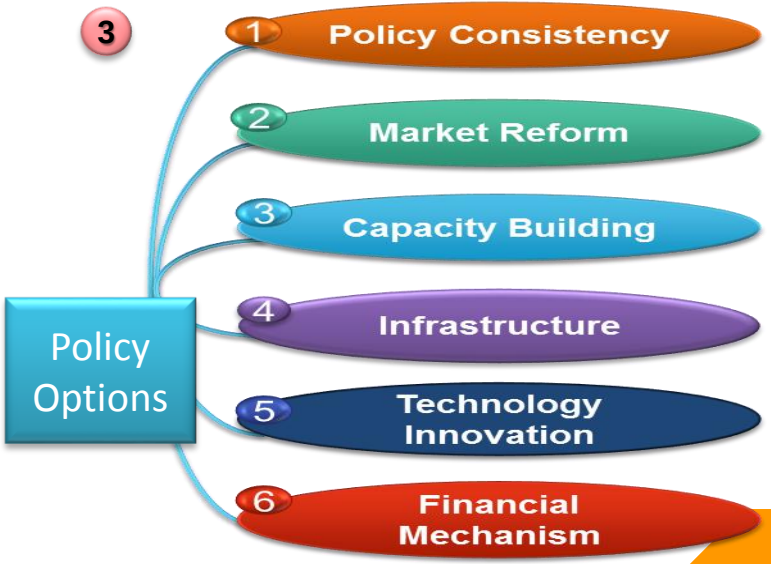

Discussion

Any suggestions for improving this RE roadmap?

e.g. Methodology, data/ Information harmonization, or any factors should be also taken into consideration…etc.

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RE Roadmap for Transport

RE Transport Roadmap

Outline - the Biofuel Roadmap

Vehicles in APEC region

Potential and Gap Identification

- Potential
- Gap

Biofuel

- Conventional and advanced biofuel technology
- Feedstock
- Biofuel Price and cost
- Policies and Target

Policy Recommendation

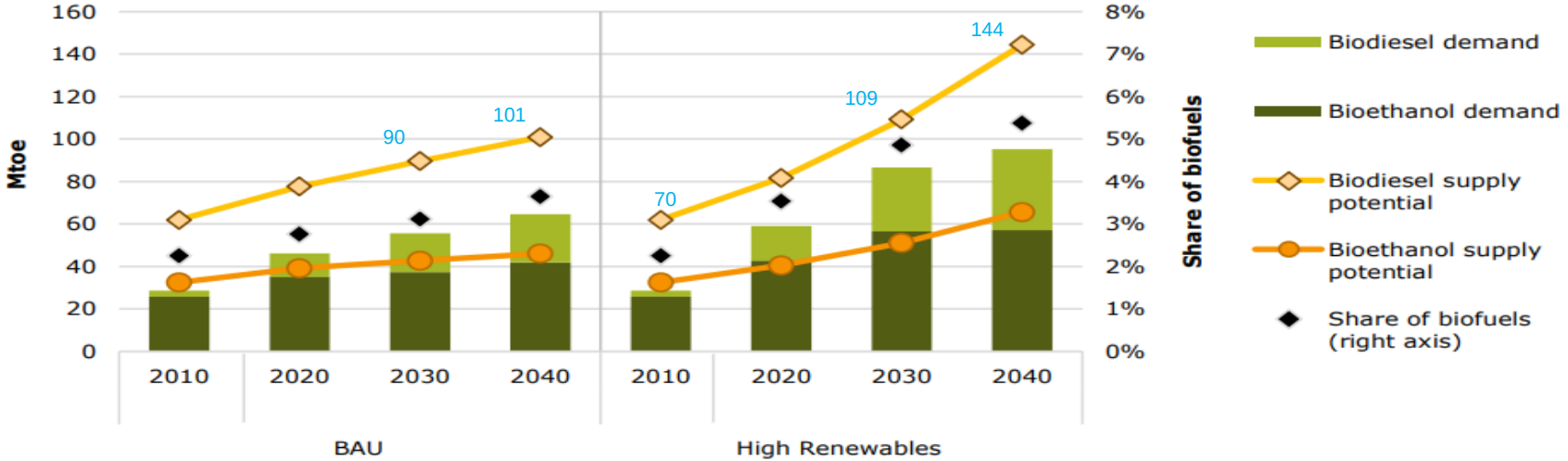
- Policies and Regulations
- Financing
- Capacity Building
- Market Building
- . . . . . .

(6 Approaches)

RE Transport Roadmap

Biofuel Potential

- Biodiesel : 75% biodiesel supply potential in APEC comes from South-East Asia.
- Bioethanol: 63% bioethanol supply potential is in U.S.

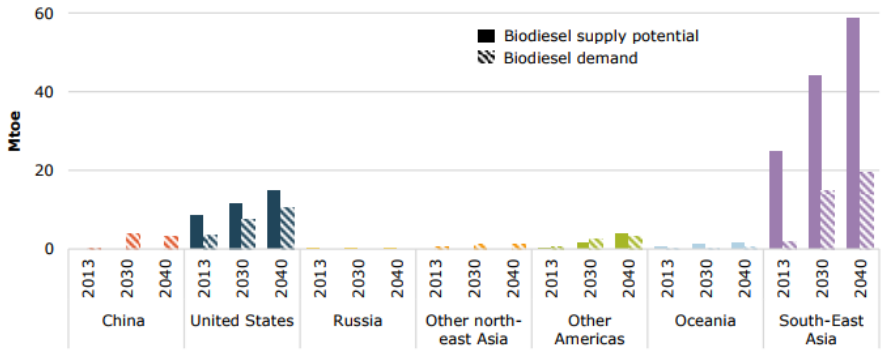


Source: APERC analysis and IEA (2015a).

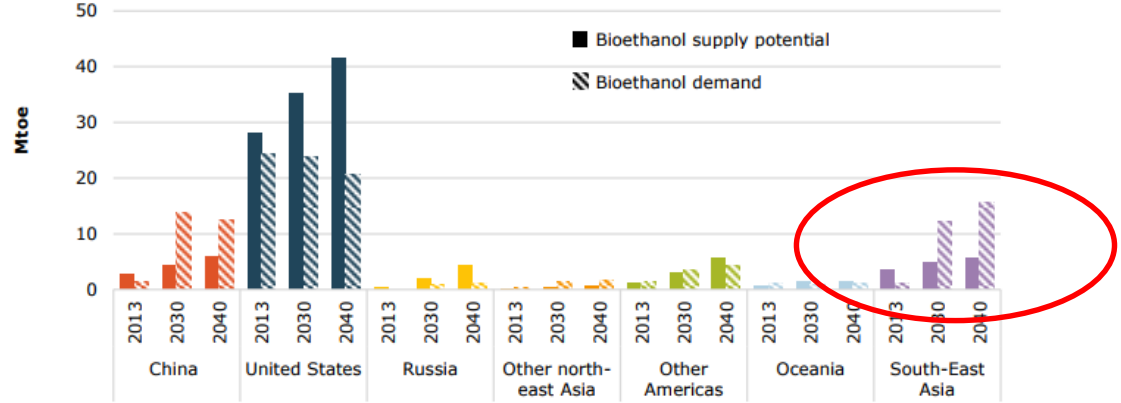
Source: APERC, 2017; APERC, 2016

Biofuel potential in APEC economy

Biodiesel Supply potential and demand



Bioethanol Supply Potential and Demand



South-East Asia accounts for 22% of APEC bioethanol consumption in 2030

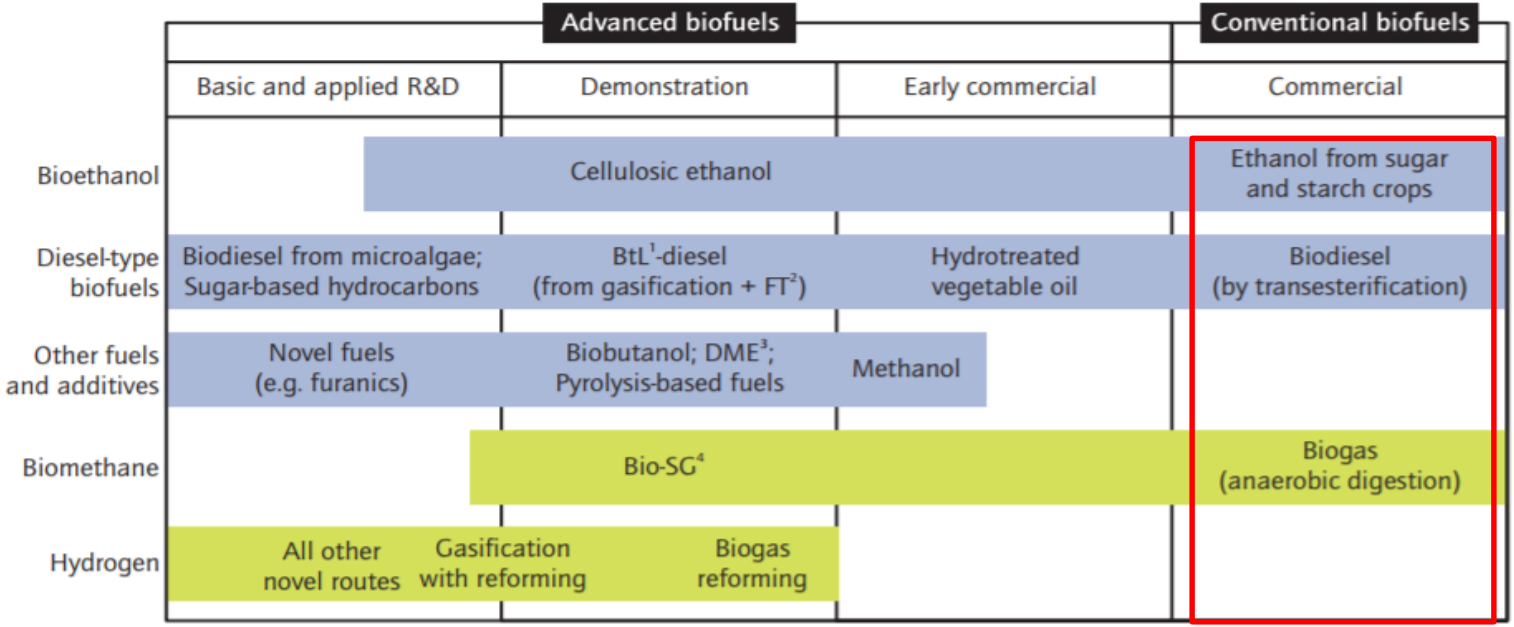
Bioethanol production doesn't meet the bioethanol demand during 2019-34. It needs to secure additional supplies from overseas or deploy advanced or alternative sources of feed stock.(APERC, 2016)

Biofuel Status in APEC Region

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

Source: APERC, 2016

Commercialization Status of Main Biofuel Technologies



1. Biomass-to-liquids; 2. Fischer-Tropsch; 3. Dimethylether; 4. Bio-synthetic gas.

Source: Modified from Bauen *et al.*, 2009.

Source: IEA, 2011

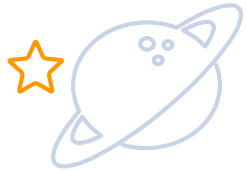
Challenges and Recommendations

	Challenges	Suggestions
Policies and Regulations	◆ Lack of clear land ownership ◆ Fossil fuel subsidies	◆ Remove fossil fuel subsidies ◆ Blending mandates ◆ Monitoring mandate ◆ Providing a long term policy framework ◆ Creating domestic land-use database
Financing	◆ Limited financial resources to new technology development	◆ Grants and loan guarantees ◆ Tax incentive
Capacity Building	◆ Lack of skilled labor (feedstock, refinery, blending, etc.) ◆ Public awareness	◆ Cross APEC economy - collaboration on capacity building ◆ Training Programs ◆ Public discussion
Market Building	◆ Commercial scale ◆ Feedstock cost fluctuation ◆ Relative low oil price	◆ Certification ◆ Remove trade barriers
Infrastructure	◆ Poor rural areas are lack of infrastructure ◆ Poor accessibility to rural areas	◆ Infrastructure policies on a domestic level
Technology Innovation	◆ 10%-15% ethanol in gasoline vehicle compatibility constraints ◆ Advanced biofuel technologies are not yet commercialized	◆ International collaboration ◆ Technology transfer ◆ Ensuring sustained funding and support mechanism to innovate advanced biofuel technologies

3

RE Roadmap for Heating

Research Process for Heating Roadmap



RE Sources for Heating

- Input
- Process
- Output

Heating Status

- Technology and Application
- Market Development
- Demand
- Cost
- Policy

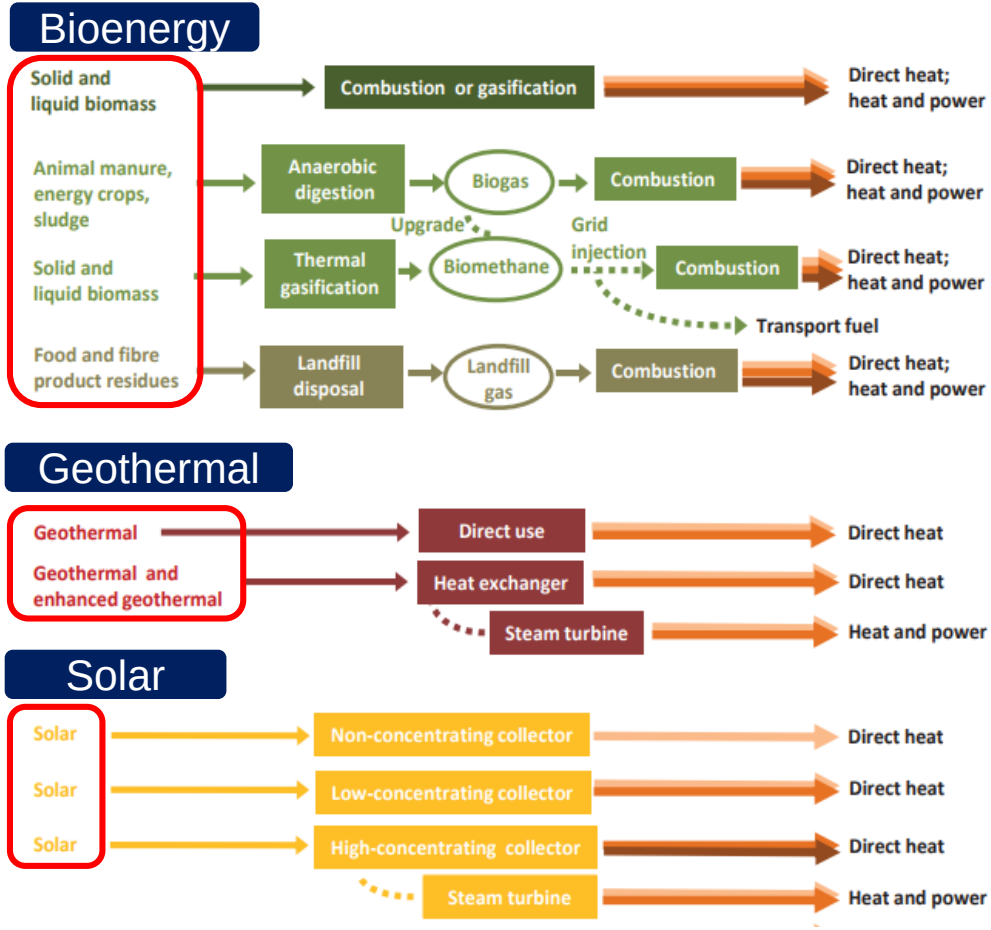
Potential

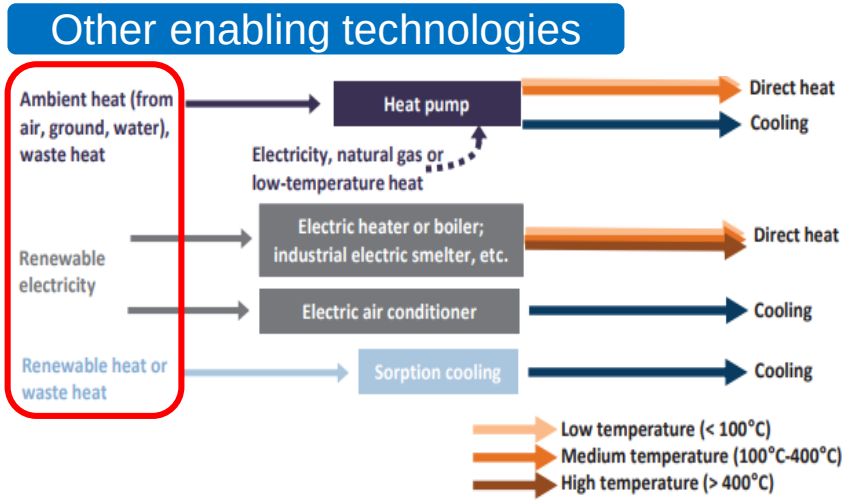
- Heating Applicability Assessment for Each Economic

Key Issues and Policy Recommendation

- Financing
- Policies and Regulations
- Capacity Building
- Market Building

RE Sources for Heating

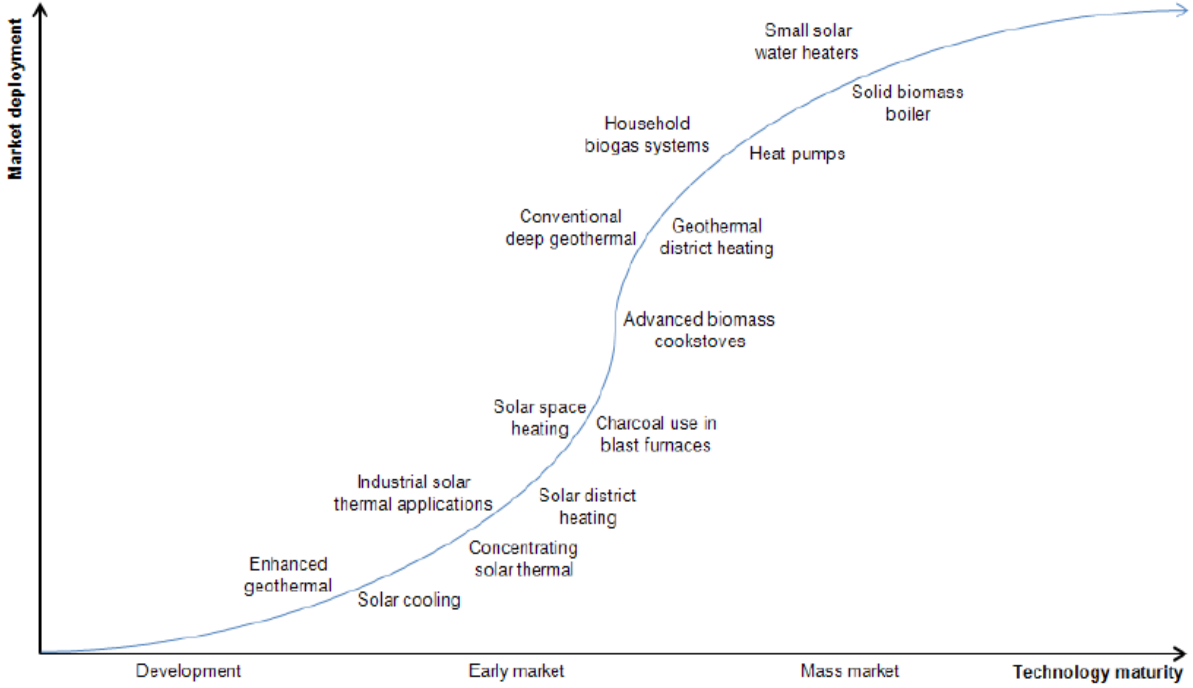




Source: IEA, 2014

RE Heating Market Development

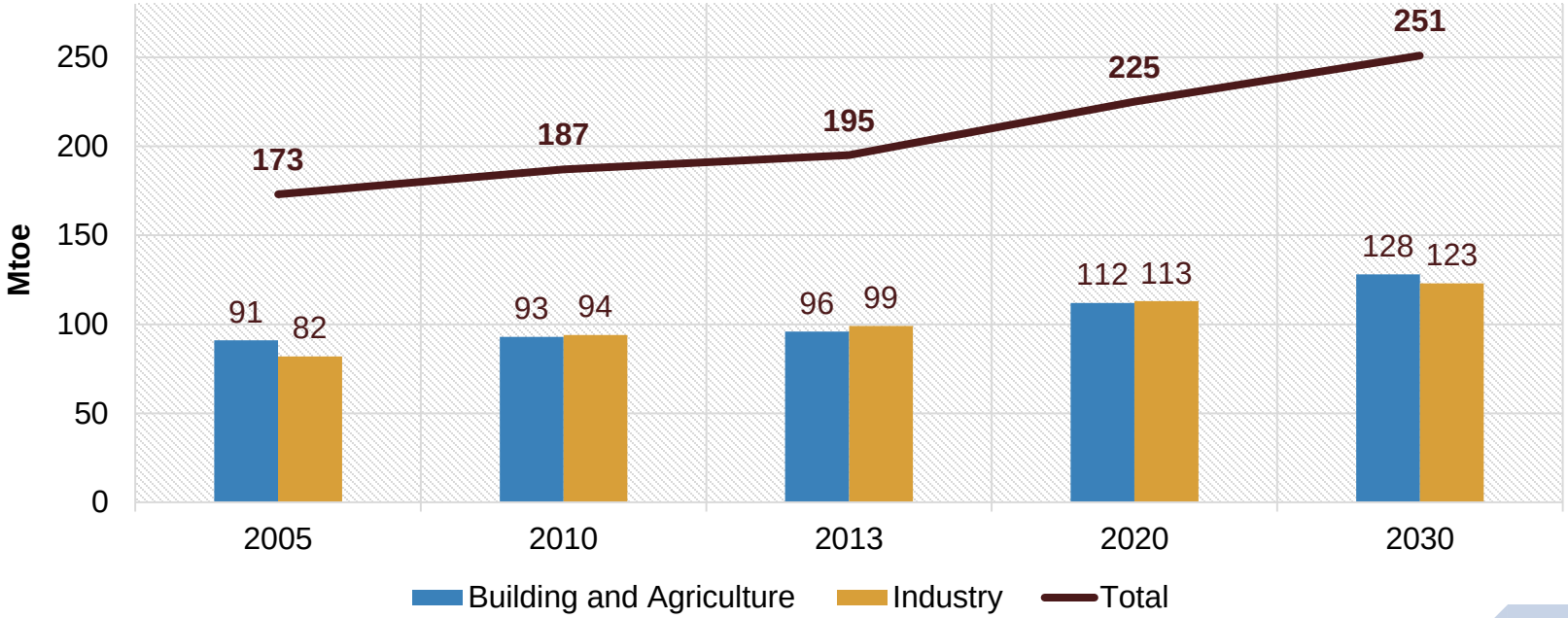
- **Current state of market development of RE heating and cooling technologies**



Source: IEA, 2014

Final Demand in APEC Region

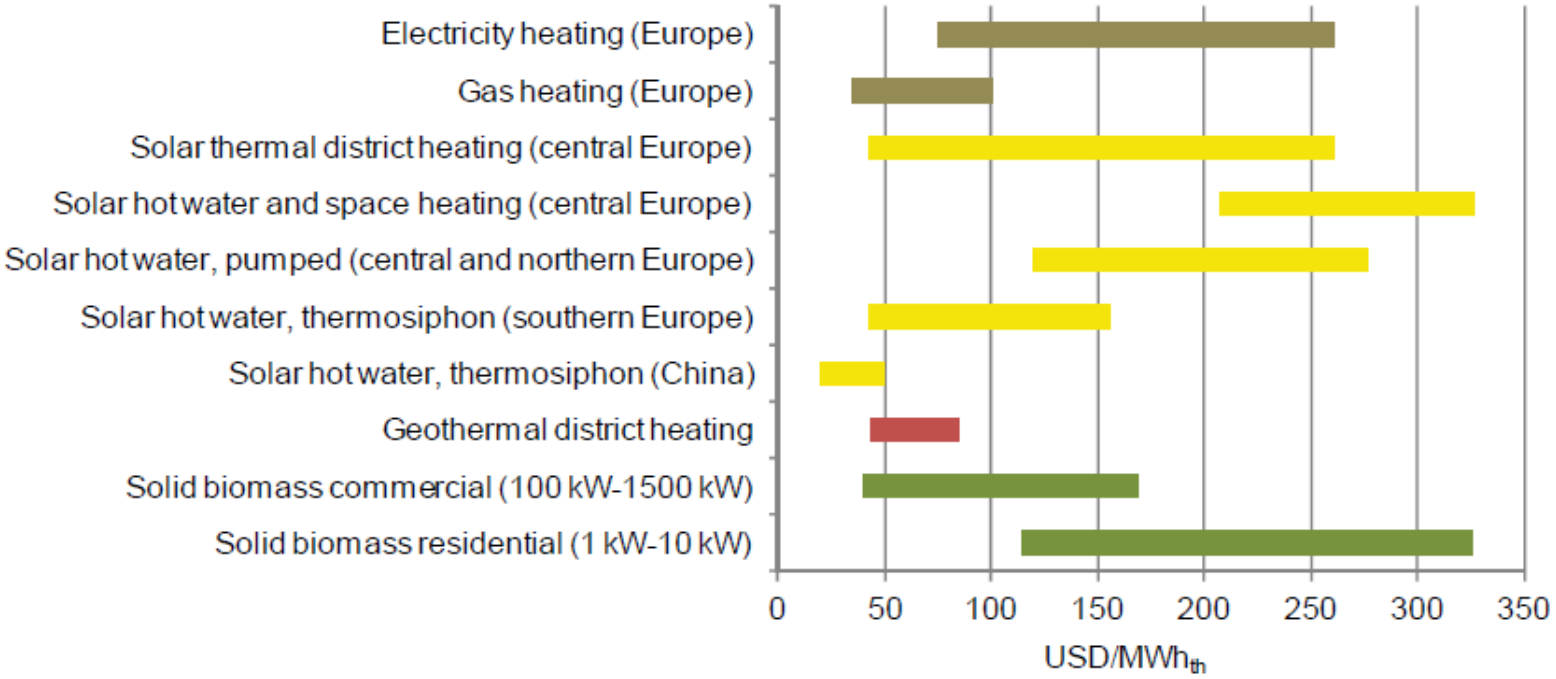
Heat demand (BAU) in APEC region by sectors



Source: APERC, 2016

Heating Cost Comparison

- **Comparison of Renewable Heat Cost in the Building Sector Compared with NG and Electricity-Based Heating**



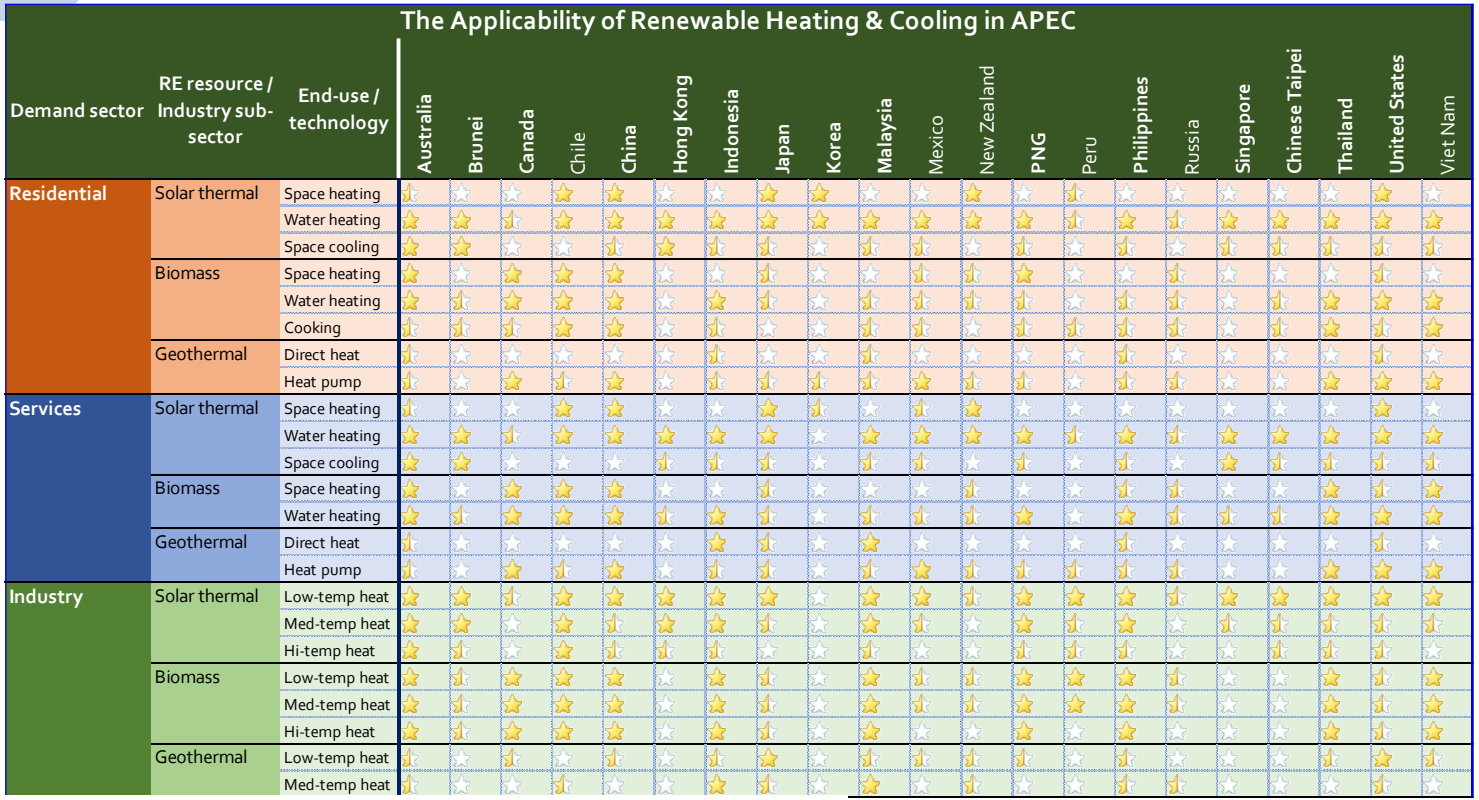
Source: IEA, 2014

Heating Policies in APEC Region

Economy	Title	Year
Australia	Solar Communities Program	2016
Canada	Manitoba Geothermal Program	2016
	ecoENERGY for Renewable Heat Program	2007
	Manitoba Hydro Power Smart Bioenergy Optimization Program	
Chile	Regulatory Framework for Solar Water Thermal (Law 20,365)	2009
People's Republic of China	Notice on straw briquette fuel boilers as demonstration projects	
	Notice on strengthening the construction of straw briquette fuel boiler as demonstration projects	2014
	Notice on planning the exploitation and utilization of geothermal energy for power and heating	
Republic of Korea	Home Subsidy Program	2004
	New and Renewable Energy Equipment Certification	2003
Mexico	Solar Water Heating Mandate of Mexico City	2006
New Zealand	Carbon Reduction Programmes	2014
	Energywise Solar Water Heating Grants	2007
Peru	Implementation and application of the alternative heating technology "passive solar energy collection system" (Implementación y aplicación de la tecnología alternativa de calefacción “sistema pasivo de recolección de energía solar de forma indirecta”) Decree 019 - 2008	2008
Chinese Taipei	Regulations for Subsidizing the Utilization of Renewable Heat	2015
Thailand	Solar hot water hybrid system promotion project	2008 to 2011

Source: IEA/IRENA Joint Policies and Measures Database

RE Heating Applicability Assessment



0 there is no technical potential

1 there is technical potential, but demand and policy support is weak

2 there is technical potential, and demand or policy support is strong

Source: APERC

Key Issues and Policy Recommendation

Key Issue	Challenge	Suggestion
Financing	■ High up-front investment costs ■ High investment risk	☐Capital grants and operating grands ☐ Low interest or no interest loan/ long term loans/ loan guarantees ☐ Tax incentives (tax credits, reduction, accelerated depreciation)
Policies and Regulations	■ Lack of policies for specific renewable heating on specified sectors ■ Lack of standards for heating equipment	☐ Building regulation for specific renewable heating technologies (ex. Solar thermal system for hot water) ☐ Standard for heating equipment (prevent less efficient technology design, create greater confidence in the reliability of the technology, reduce investment risk)
Capacity Building	■ Lack of public awareness ■ Lack of skilled labors for installing	☐ Information campaigns (technical assistance, finance advice, labeling of appliances, information distribution) ☐Provide training to increase installer knowledge
Market Building	■ Fossil fuel subsidies ■ Enhance the Economic competitiveness of RE technologies	☐ Balance the subsidies for fossil fuel and RE technologies ☐ Co2 taxes and carbon trading system

Future work

Project list

- Workshop on Low Emission Development Strategies (LEDS) for APEC Economies with a Focus on Energy and Transport
- Transport, Energy and Environmental Benefits of Intermodal Freight Strategies
- APEC Workshop on Energy and Green Transport Benefits of Electric Vehicles
- Transport, Energy and Environmental Benefits of Transit-Oriented Development
- Survey of Transport Efficiency Policies in APEC Economies
- APEC 21st Century Renewable Energy Development Initiative (Collaborative IX): Alternative Transport Fuels - Implementation Guidelines
- Workshop on Policies to Promote Energy Efficiency in Transport in APEC Economies
- Biofuel Transport and Distribution Options for APEC Economies
- Seminar on Best Practices in Regulation and Promotion of Efficiency in Transport Infrastructure Facilities
- Recent Trends on Investment Liberalization and Facilitation in Transport and Telecommunication Infrastructure
- Workshop - Enhancing Transport Supply Chain Connectivity: Reducing Post-Harvest Lossess Measures in Selected Economies
- Promoting Regional Economic Integration by Deriving Supply Chain Connectivity Benefits over Cross-Cutting Issues in Transport, Energy, Environment and Human Health
- Workshop - Enhancing Transport Supply Chain Connectivity in Developing Economies through Public-Private Partnerships in Transport Infrastructure
- Supporting the Development and Implementation of Low-Emission Development Strategies (LEDS) in Transport Sector
- Cooperation in the Field of Transport Education for the benefit of Transport Connectivity in APEC
- Combined Heat and Power (CHP) Technologies for Distributed Energy Systems
- Evaluation and Initial Draft of Harmonized Test Methods and Level Definitions for Heat Pump Water Heaters

Any suggestions for improving this RE roadmap?
e.g. Methodology, data/ Information harmonization, or any factors should be also taken into consideration…etc.

THANKS!

Reference

- **The Renewable Route to Sustainable Transport: A working paper based on Remap, 2016, IRENA**
- **Heating without global warming, 2014, IEA**
- **Renewable energy in district heating and cooling, 2017, IRENA**
- **Renewables for heating and cooling, 2007, IEA**
- APEC Energy Demand and Supply Outlook 6th Edition