



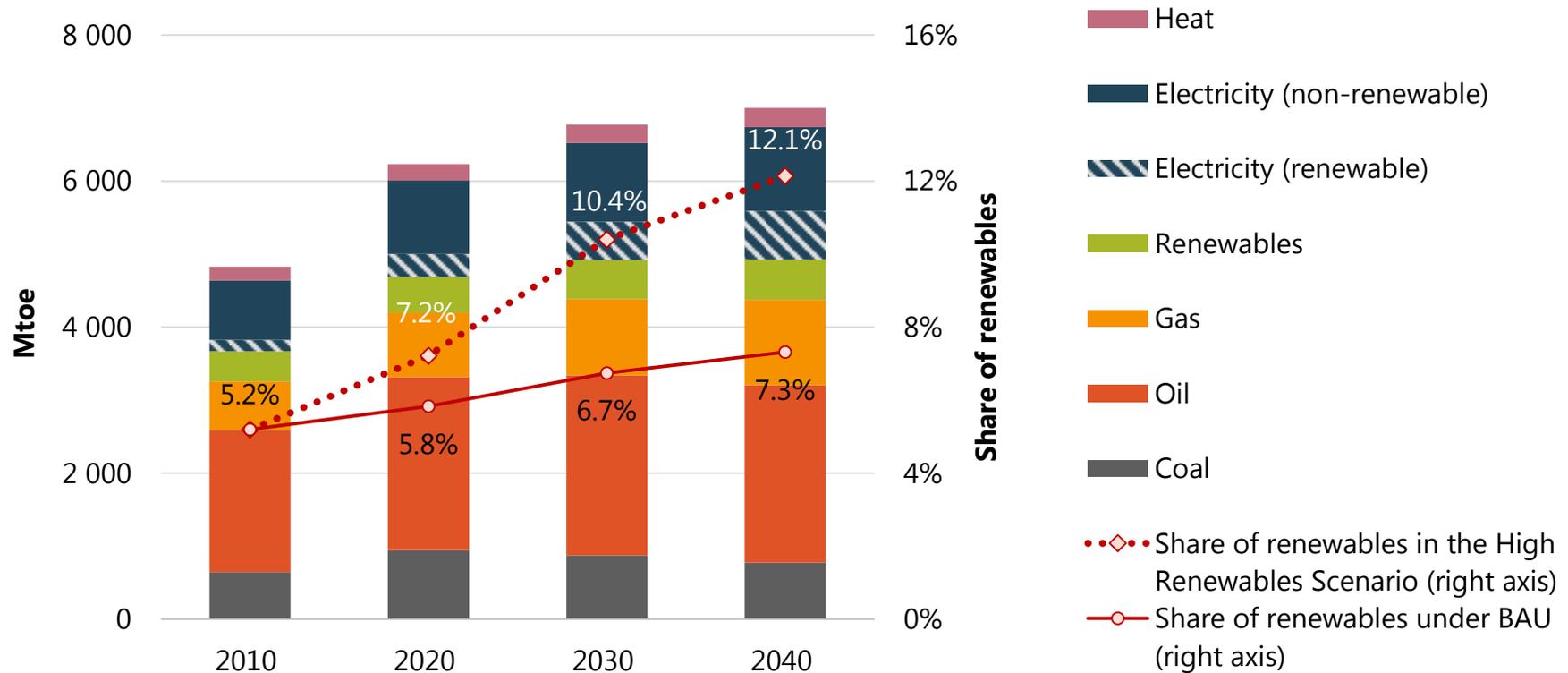
APEC Energy Demand and Supply Outlook 6th Edition High Renewables Scenario

Alexey Kabalinskiy
11 May, 2016, Canberra, Australia



Renewables drive growth

Total Final Energy Demand in APEC



***The Doubling goal is NOT achieved under BAU.
Accelerated development of renewables is necessary.***

Source: IEA statistics 2015 and APERC research.

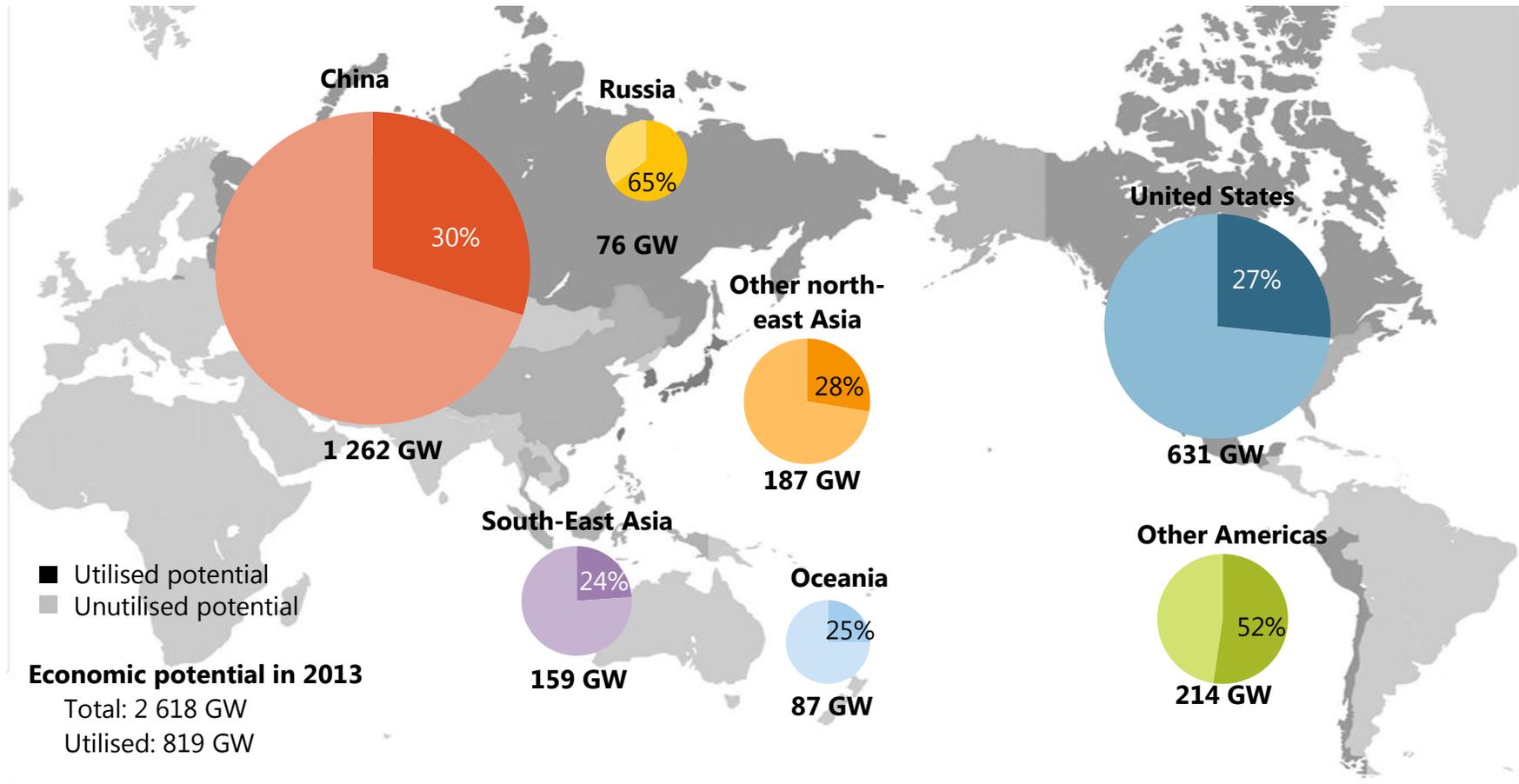


Renewables in power

Renewable policies in APEC

Economy	RE-specific legislation	RE-related policy /plan	Development strategy	Target RE generation share	Feed-in Tariff (FiT)	Renewable portfolio standard (RPS)	Tax incentive
Australia	√	√	√	23.5% in 2020	-	-	√
Brunei Darussalam	-	√	√	10% by 2035	-	-	-
Canada	-	√	√	√*	√*	√*	√
Chile	√	√	√	20% in 2025, 70% in 2050	-	-	-
China	√	√	√	20% primary in 2030	√	√	-
Hong Kong	-	√	√	√	-	-	√
Indonesia	-	√	√	232 Mtoe (247.4 GW) in 2050	√	-	√
Japan	√	√	√	22-24% in 2030	√	-	√
Korea	√	√	√	(13.4%) in 2035	-	√	√
Malaysia	√	√	√	3% in 2020	-	√	√
Mexico	√	√	√	(29.1%) in 2028	-	-	√
New Zealand	-	√	√	90% in 2025	-	-	-
Papua New Guinea	-	-	-	100% in 2050	-	-	-
Peru	√	√	√	60% (5%^) in 2020	-	-	-
The Philippines	√	√	√	(+9.9 GW, +200%) in 2030	√	√	√
Russia	-	√	√	4.5%^ (25 GW^) in 2030	√	-	-
Singapore	-	√	√	-	-	-	-
Chinese Taipei	√	√	√	12.6% (27.1%) in 2030	√	-	√
Thailand	-	√	√	20% in 2036	√	-	√
United States	-	√	√	√*	√*	√*	√
Viet Nam	-	√	√	6% in 2030	√	-	-

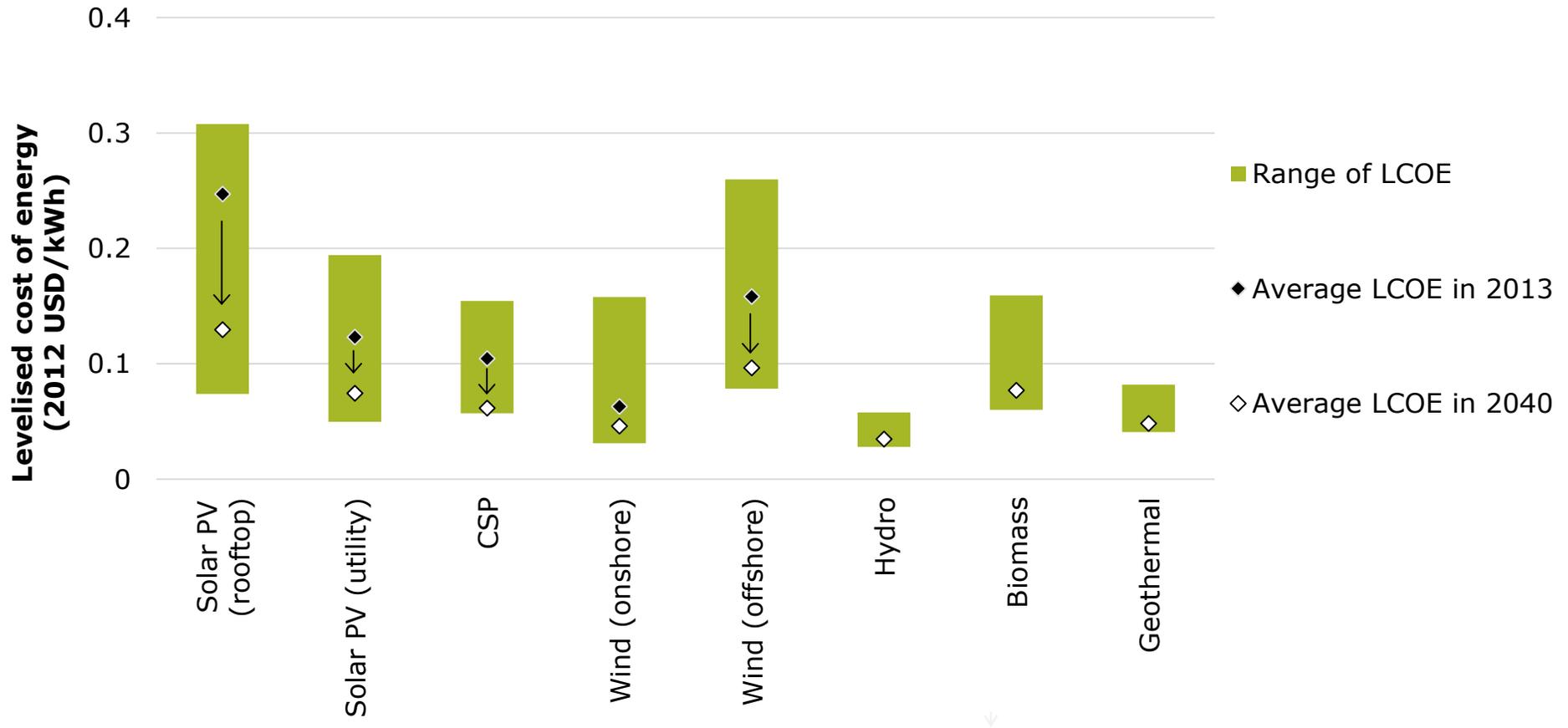
APEC Renewable capacity potential in 2013



***Only 31% of renewable economic potential is utilised in APEC.
 Solar and biomass potential to be developed in South-East Asia.***

Note: this map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory, **Oceania** (Australia, New Zealand and PNG), **Other Americas** (Canada, Chile, Mexico and Peru), **Other north-east Asia** (Hong Kong, Japan, Korea and Chinese Taipei), **South-East Asia** (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam).

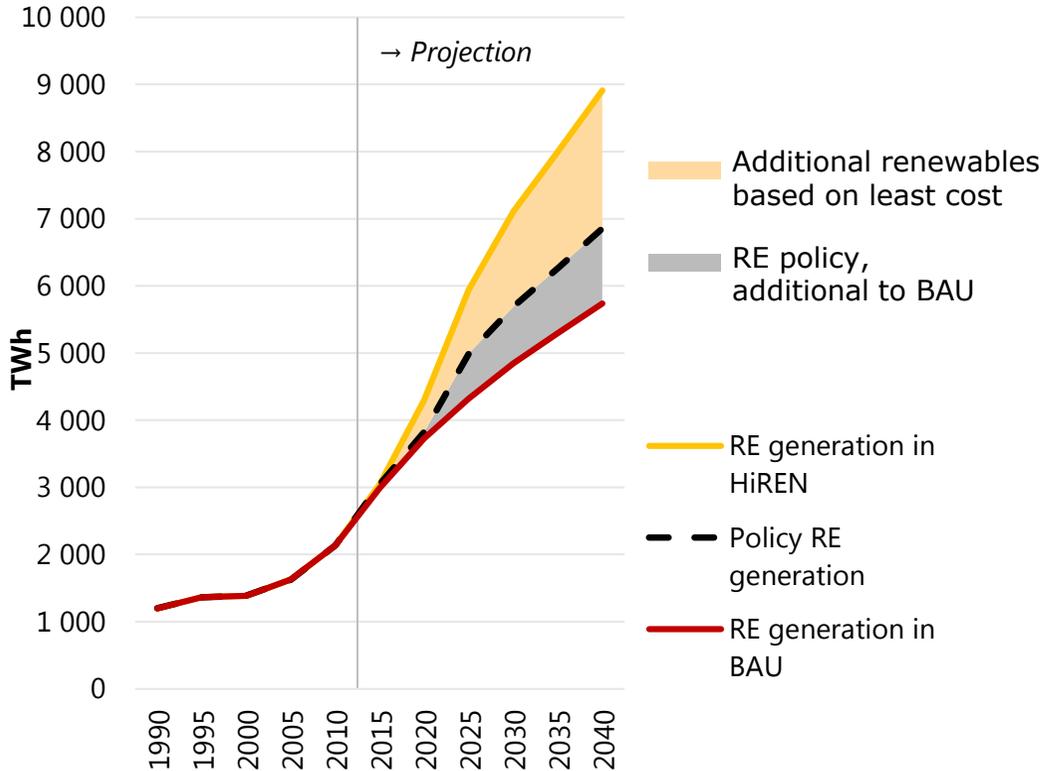
APEC renewables supply cost curve



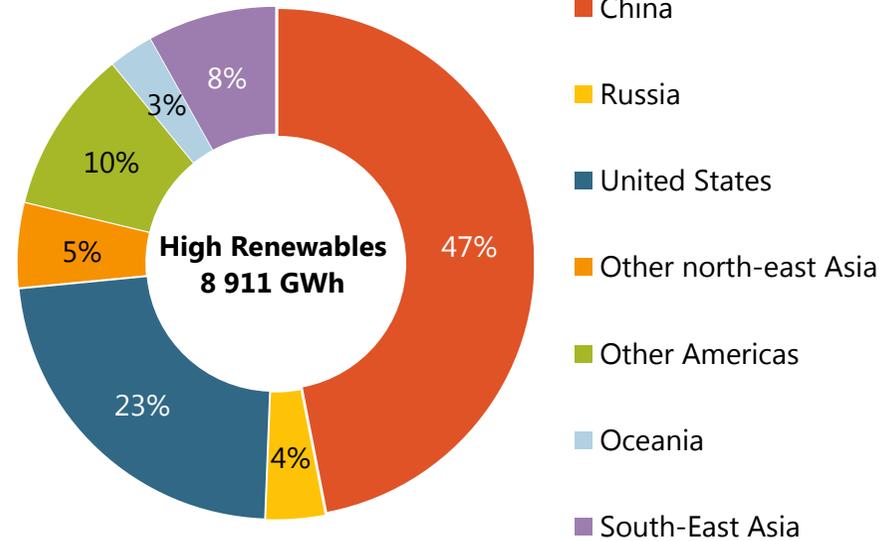
***Continued reduction of LCOE for solar and wind technologies.
Large range of LCOE is due to resource availability and cost of financing.***

Current renewable policy falls short of the doubling

Renewable generation by scenario



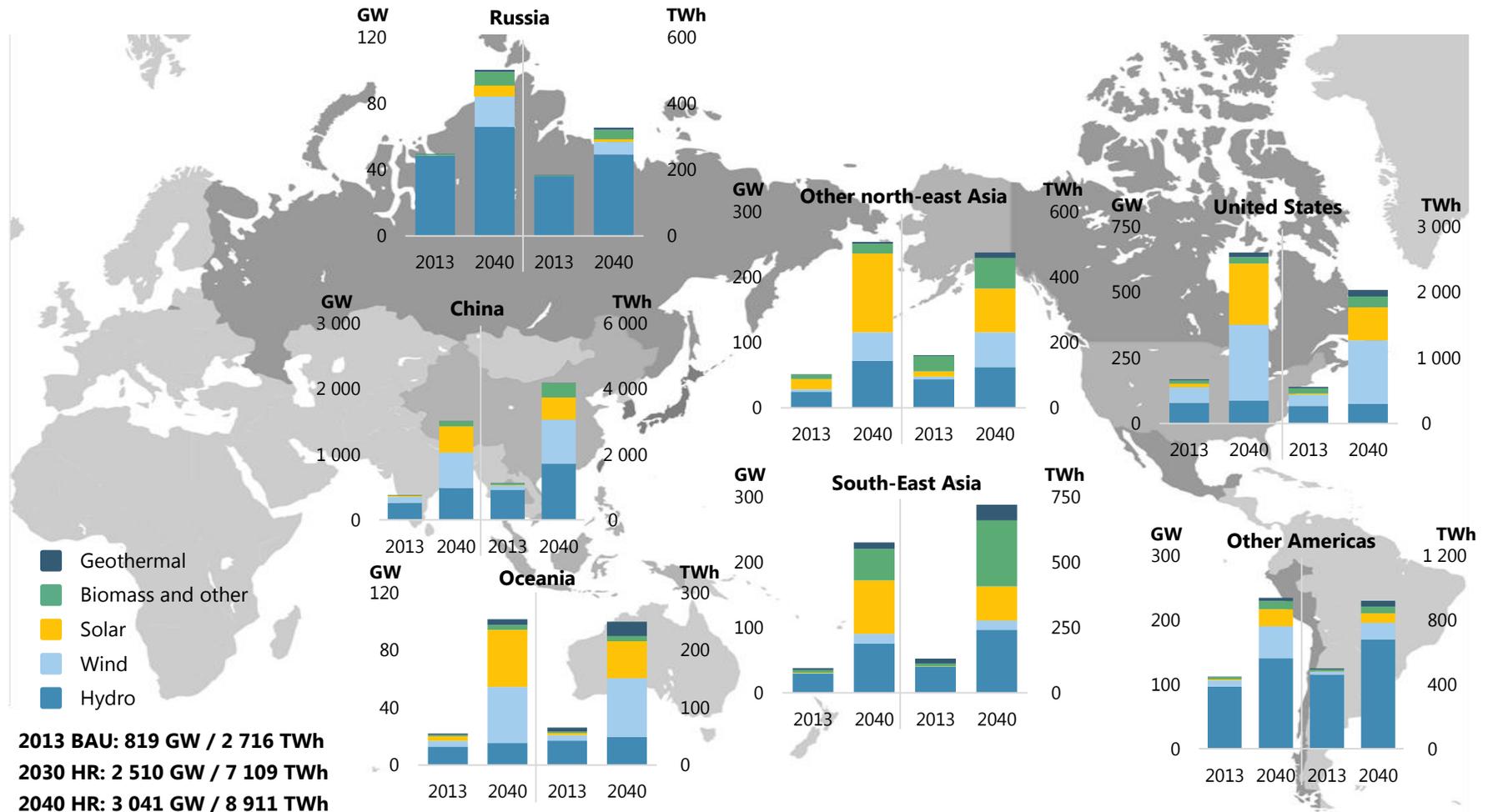
Renewable generation in 2040



Renewables expand greatly in China, the United States and South-East Asia. China is leading in both installed capacity and generation.

Note: this map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory, for **sub-regions** see slide 5.

Renewable power in the High Renewables Scenario



Major growth of solar in Asia, the United States and Oceania

Note: this map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory, for **sub-regions** see slide 5, **BAU** = Business-as-usual, **HR** = High Renewables

Source: IEA statistics 2015 and APERC analysis



Renewables in transport

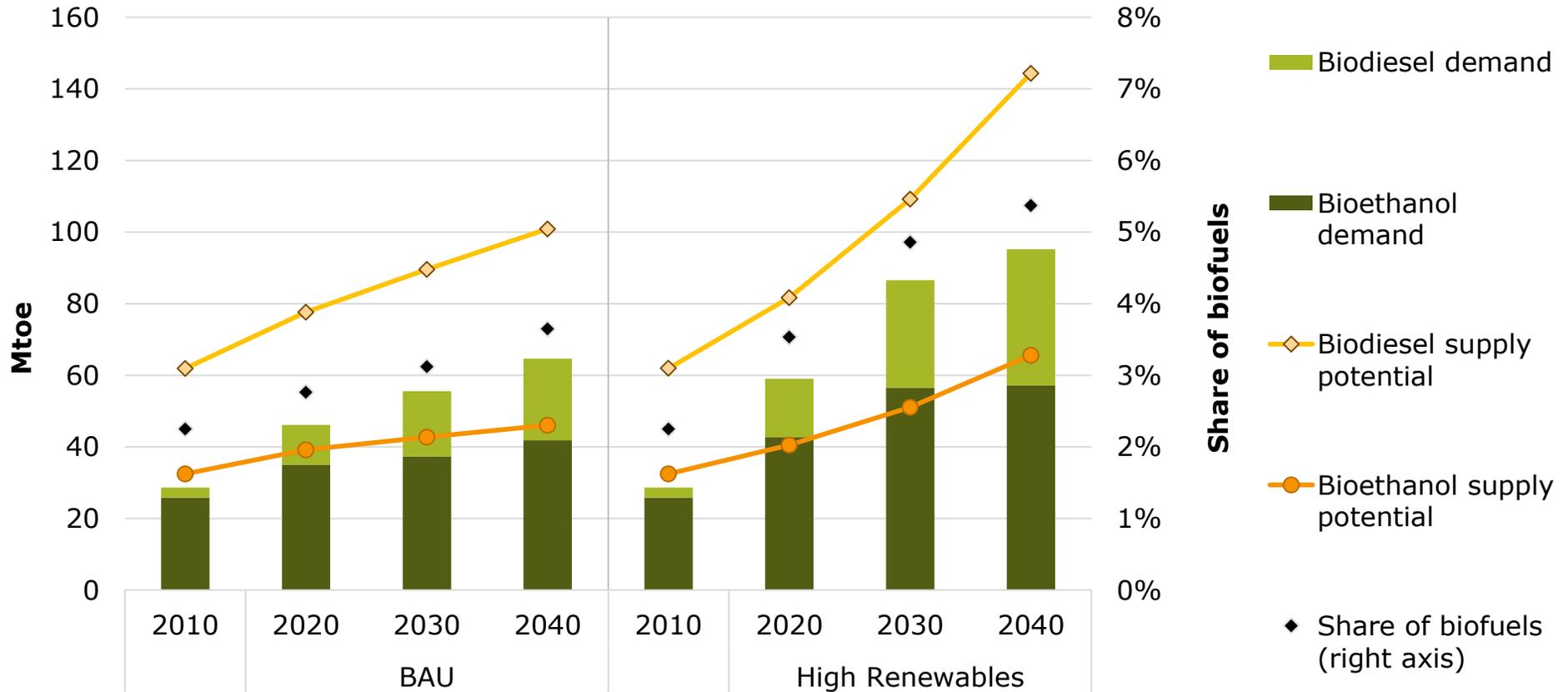
Biofuel policies in APEC

Economy	Regulation	Blend rate mandate		Blend rate target		Incentives, subsidies and taxation
		Bioethanol	Biodiesel	Bioethanol	Biodiesel	
Australia	√	√*	√*	E4/E5*	B2*	√
Brunei Darussalam	-	-	-	-	-	-
Canada	√	up to E8.5 [^]	up to B4 [^]	E5	B2	√
Chile	-	-	-	-	-	-
China	-	E10 [^]	-	10 Mt (2020)	2 Mt (2020)	√
Hong Kong	√	-	-	-	-	√
Indonesia	√	E3	B10	E20 (2025)	B30 (2025)	√
Japan	√	√	-	0.5 million Loe (2017)		√
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)	-	√

Note: √ = existing; - = not existing currently; * = applied in New South Wales and Queensland for bioethanol and in New South Wales for biodiesel; ^ = applied at federal level and in some local territories or states; # = biofuels traded with no mandated blend rate; Mt = million metric tonnes; Loe = litres of oil equivalent; L/yr = litres per year.

Sources: APERC analysis and IEA statistics 2015.

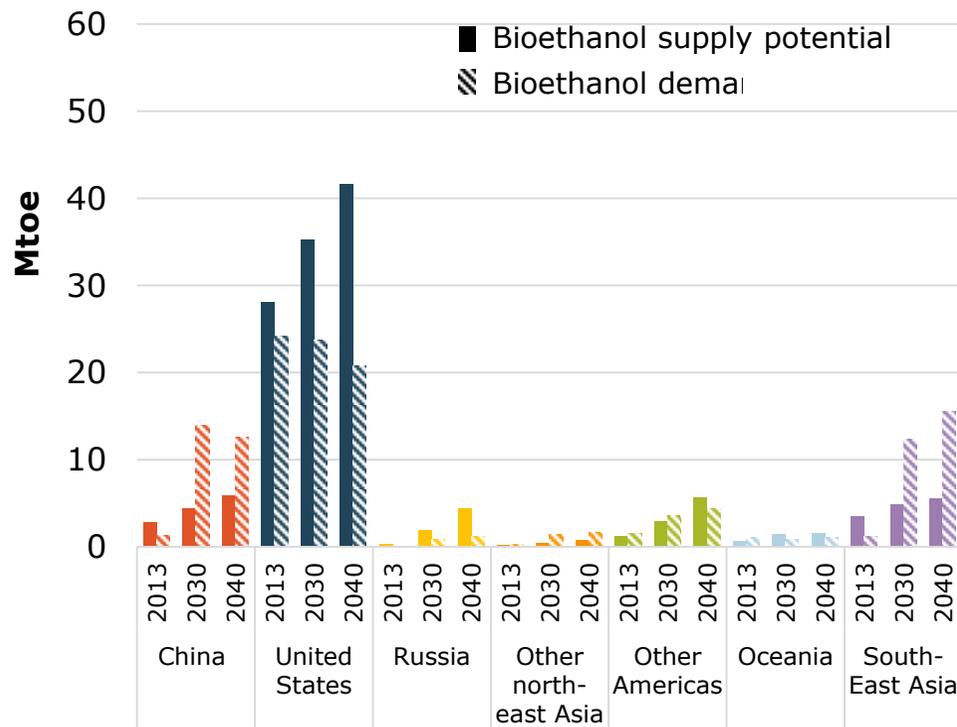
APEC biofuels in BAU and the High Renewables scenario



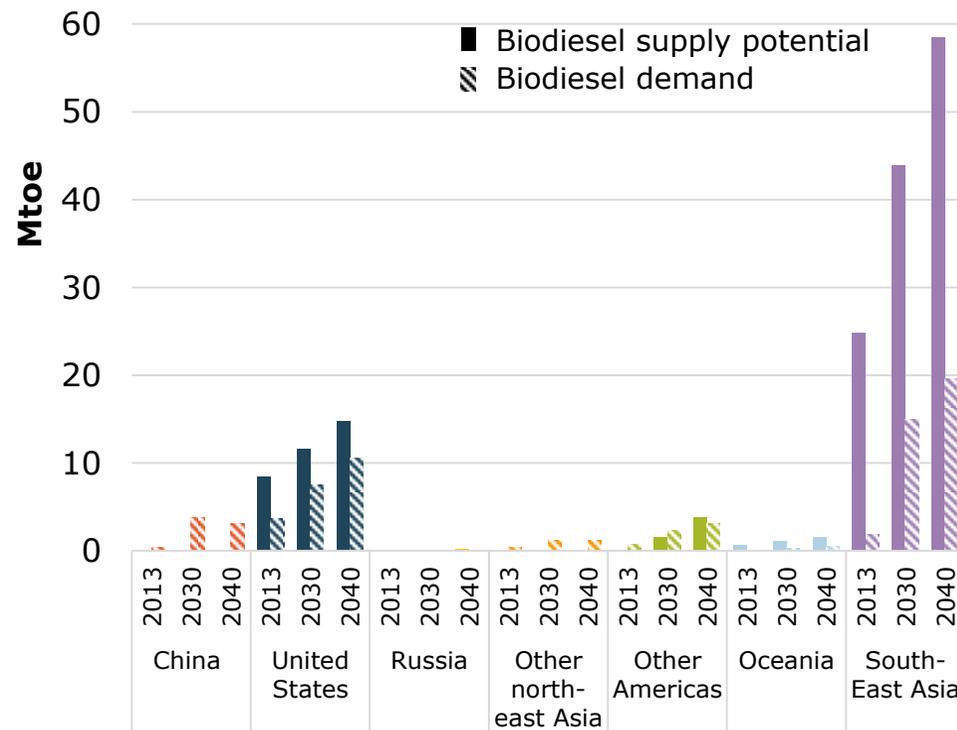
Biofuel supply growing 2.7%/yr could meet over 5% of transport demand. Enough bioethanol to meet the growing demand, and surplus of biodiesel.

Sources: APERC analysis and IEA statistics 2015.

Bioethanol supply potential and demand



Biodiesel supply potential and demand



Bioethanol surplus in the US could offset shortfalls in South-East Asia and China. Excessive biodiesel supply, especially in South-East Asia, export opportunity.

Sources: APERC analysis and IEA statistics 2015.

APEC biofuels trading opportunities, ktoe

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

Sources: APERC analysis.



Summary



Challenges

- Uncertainty or insufficiency of renewable policy,
- Costs of renewable technologies for consumers, developers and investors,
- Fossil fuel subsidies,
- Lack of policy and taxation support for biofuels,
- Vehicle engine technology, and
- R&D for cost-effective 2nd and 3rd generation biofuels

Opportunities

- Set strong and clear renewable energy targets with supporting policy framework, see examples of China, Korea, Japan and the Philippines,
- Active research, development, demonstration and deployment (RDD&D),
- Removal of fossil fuel subsidies,
- Educational programs and training,
- Enhance international and inter-area collaboration.

Recommendations for policy action

- Formulate a comprehensive, APEC-wide renewable energy plan,
- Renewables policy should cover power, transport, buildings and industry,
- Provide R&D support for current and next generation technologies,
- Provide fiscal and non-fiscal incentives, e.g. FiT, RPS, market access,
- Accelerate standardisation, development and deployment of biofuels, including advanced biofuels.



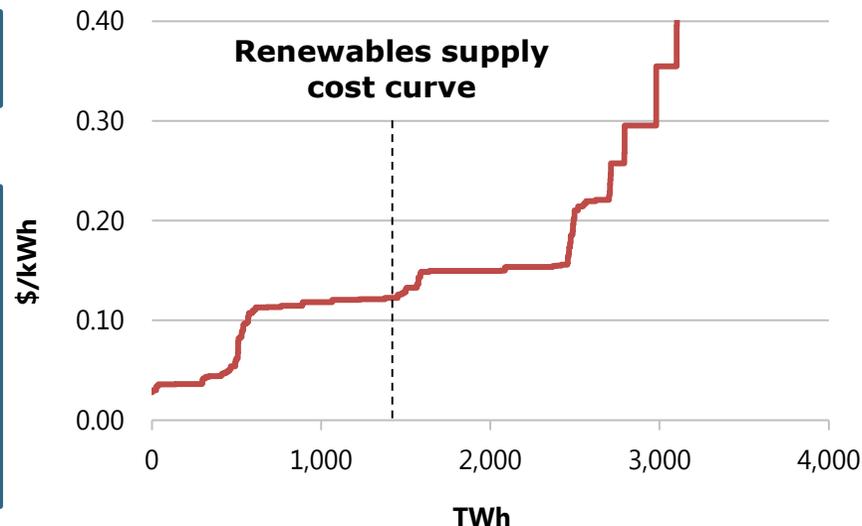
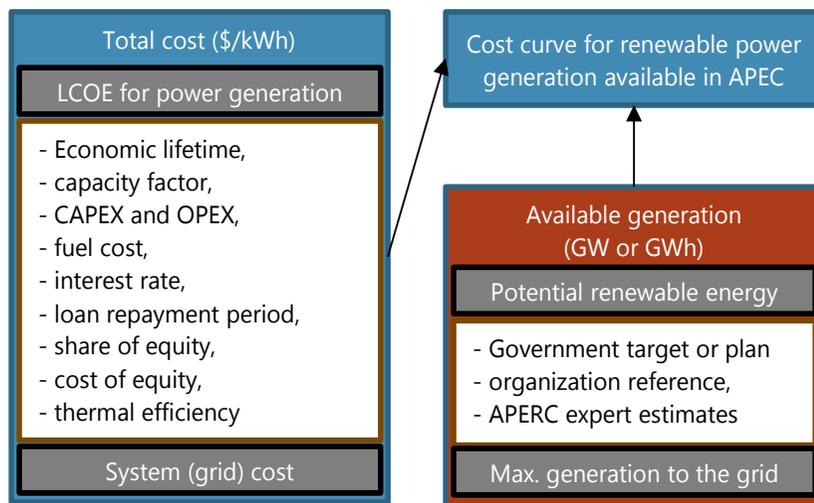
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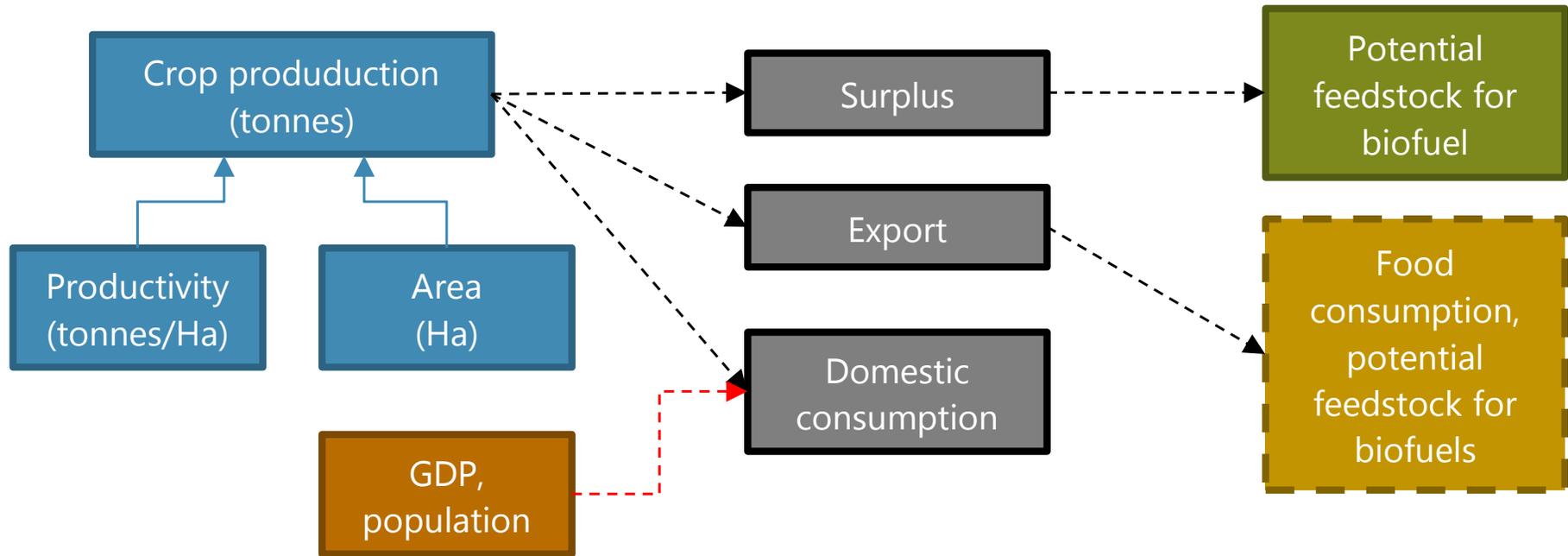
Appendix

APEC supply cost curve for renewables in power



- Total cost of RE electricity = LCOE of RE generation + system (grid) costs
- A mix of additional RE generation is defined by using the supply curve, while knowing the required RE generation for a certain year;
- LCOE varies from \$0.03/kWh (hydro) to \$0.31/kWh solar PV rooftop.

APEC biofuels supply potential estimation



- 1st generation biofuels from 12 energy crops,
- maximising the arable land and enhancing productivity,
- surplus energy crops could be used as potential feedstock for biofuel supply,
- Biofuels demand is estimated through the current gov't biofuels policy and plan, in the absence of which, the supply potential is considered to introduce biofuels minimum blend rates.