2-1. Outlook 9th Edition – Overview

APERC Workshop

The 68th Meeting of APEC Energy Working Group (EWG68)
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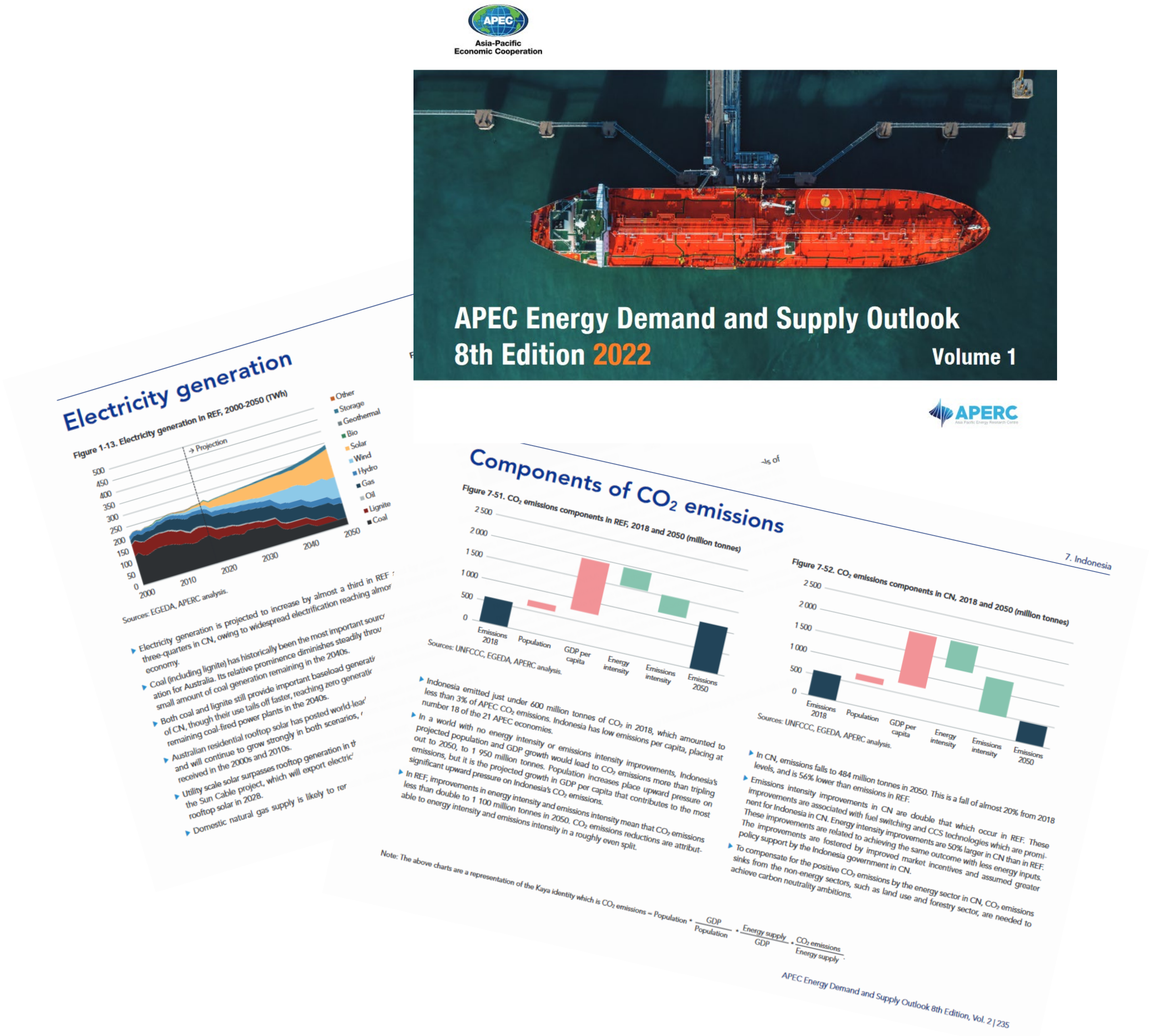
Glen Sweetnam, Senior Vice President, APERC

Outline

- Update on APEC Energy Demand and Supply Outlook 9th edition
- APEC economy NDC commitments require a more complex computer model
- Model improvements implemented to handle new technologies and decarbonisation efforts
  - Increased electrification
  - Variable renewable energy sources
  - Storage
  - Hydrogen/Ammonia
  - Carbon Capture and Storage (CCS)
- Projecting implications and estimating incremental system costs
- Summary

APEC Energy Demand and Supply Outlook

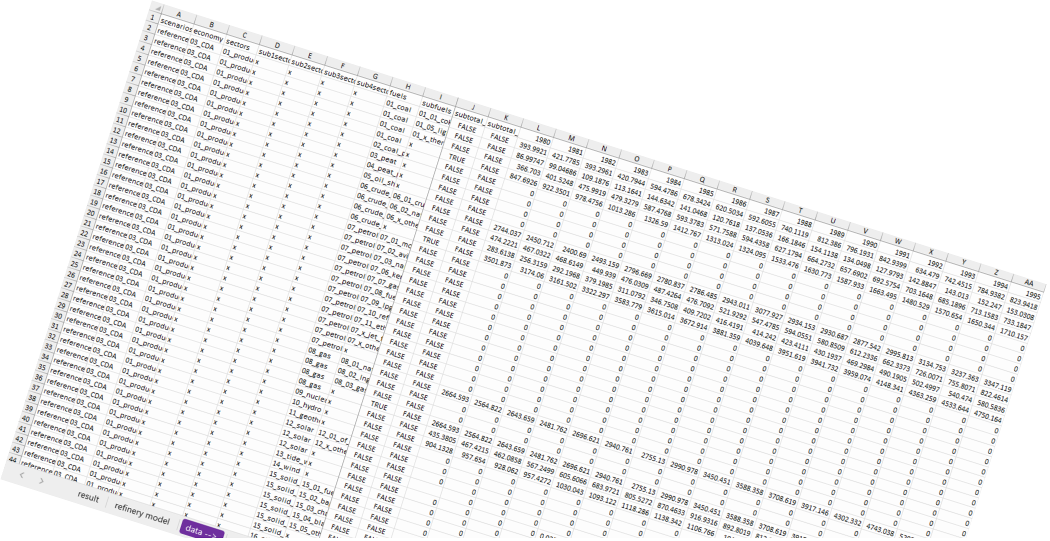
- Priority task for APERC under the APEC Energy Action Programme adopted by leaders in 1995
- Provide analyses and policy insights about future energy demand and supply in APEC economies
- APERC researchers are now generating the model results for the 9th Edition Outlook to be published in September 2025, with a forecast horizon to 2060
- Separate energy and emissions projections for each APEC member economy



EGEDA data is the basis for the 9th Outlook modelling

Additional data and assumptions are needed to incorporate new fuels and technologies:

- Hydrogen (and ammonia and e-fuels)
- Carbon capture technologies
- Storage technologies, etc.



EGEDA participating in pilot **hydrogen** and **carbon capture technology** data collection in consultation with IEA and Eurostat

→ This new data will be valuable for data users, such as the Outlook modeling team

APEC format for annual Hydrogen data

Table 2. Consumption in the transformation and energy sectors

Unit: Terajoules

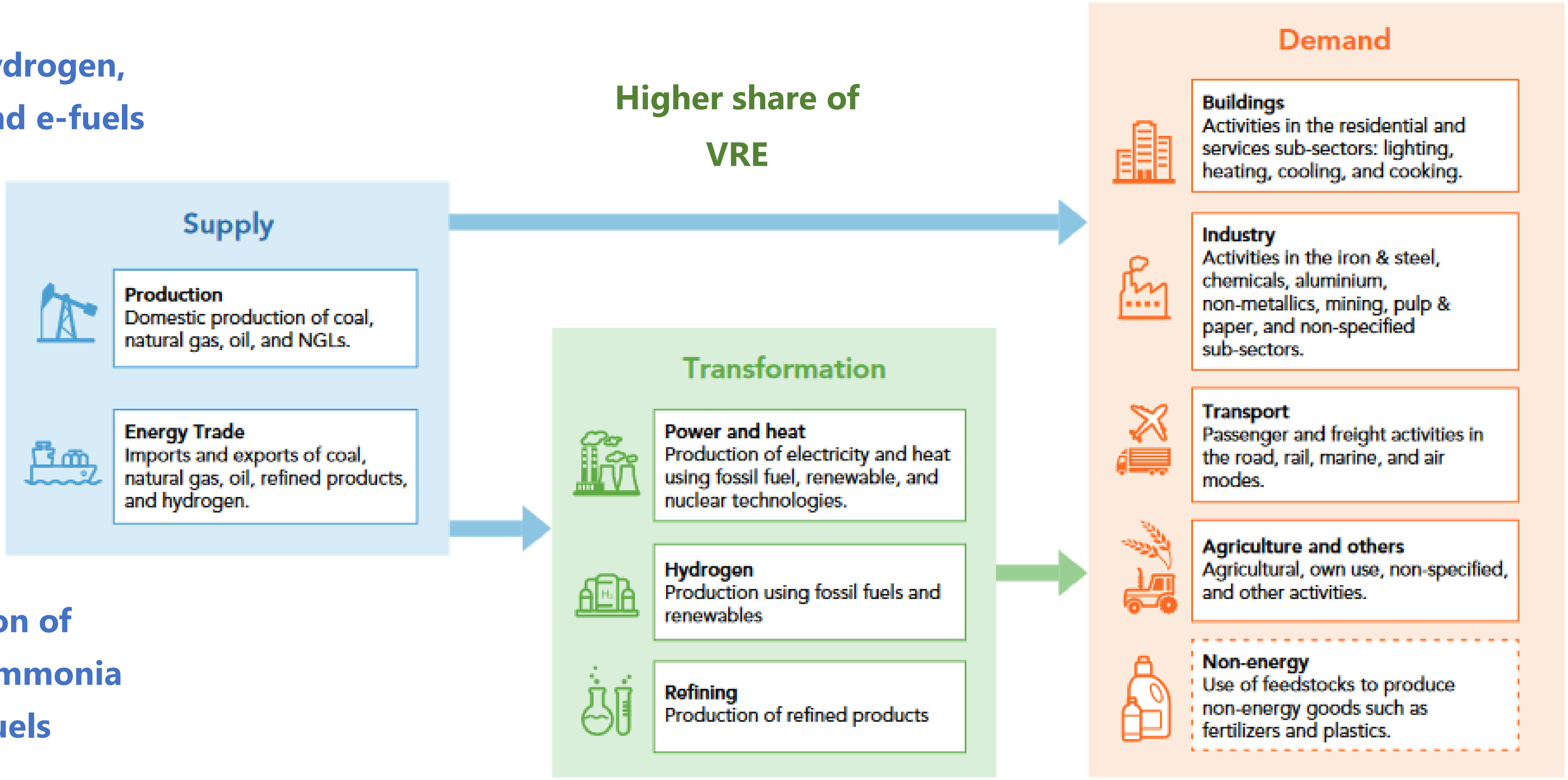
		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
TOTAL TRANSFORMATION SECTOR	1	0	0	0	0
Main activity producer	2	0	0	0	0
Electricity plants	3				
CHP	4				
Heat plants	5				
District cooling plants	6				
Autoproducer	7	0	0	0	0
Electricity plants	8				
CHP	9				
Heat plants	10				
District cooling plants	11				
Natural gas blending plants	12				
Gas works plants	13				
Coke ovens	14				
Blast furnaces	15				
Natural gas liquefaction	16				
LNG regasification	17				
Gas-to-liquid plants	18				
Oil refineries	19				
Petrochemical industry	20				
Hydrogen compound production (hydrogen to ammonia)	21				
Hydrogen reconversion (ammonia to hydrogen)	22				
e-fuels production (hydrogen to e-fuels)	23				
Other transformation	24				

		Hydrogen	Ammonia	e-fuels	Total
		A	B	D	E
TOTAL ENERGY SECTOR	25	0	0	0	0
Coal mines	26				
Oil and gas extraction	27				
Oil refineries	28				
Coke ovens	29				
Gas works	30				
Electricity, CHP and heat plants	31				
Natural gas liquefaction plants	32				
LNG regasification	33				
Natural gas blending plants	34				
Gas-to-liquid plants	35				
Oil refineries	36				
Hydrogen production	37				
Hydrogen compound production (hydrogen to ammonia)	38				
Hydrogen reconversion (ammonia to hydrogen)	39				
Hydrogen liquefaction	40				
Liquefied hydrogen regasification	41				
e-fuels production (hydrogen to e-fuels)	42				
Other energy sector	43				
Losses	44	0	0	0	0
Distribution	45				
Transmission	46				

New and renewable energy technologies have implications throughout the energy system

Trade in hydrogen, ammonia and e-fuels

Higher share of VRE



Hydrogen based steel production

EVs, hydrogen powered trucks

Production of hydrogen, ammonia and e-fuels

Grid storage technologies

Blending hydrogen with gas; ammonia with coal

APEC economies adopt ambitious decarbonization targets

Economy	2030 Reduction target	Economy	2030 Reduction target
Australia	Reduce GHG emissions by 43% below 2005 levels by 2030	**New Zealand**	Reduce GHG emissions by 50% by 2030 from 2005 levels.
Brunei Darussalam	Reduce GHG emissions by 20% relative to BAU levels by 2030	**Papua New Guinea**	Carbon neutrality within its energy industries sub-sector by 2030
Canada	Reduce GHG emissions by 40 – 45% below 2005 levels by 2030	**Peru**	• Reduce GHG emissions by 30% relative to BAU levels by 2030 • Further reduce up to 40%, subject to international support
China	• Peak CO_2 emissions before 2030 • Reduce CO2 emissions per unit of GDP by over 65% from 2005 level by 2030	**The Philippines**	Reduce GHG emissions by 75% relative to BAU levels by 2030 (2.71% unconditional, and 72.29% conditional)
Chile	• Peak GHG emissions by 2025 • GHG emissions level of 95 million tonnes CO_2e by 2030	**Singapore**	Reduce GHG emissions to around 60 million tonnes CO2e in 2030
Hong Kong, China	Reduce emissions by 26 – 36% by 2030 below its 2005 levels	**Russia**	Reduce GHG emissions by 70% relative to 1990 levels by 2030
Indonesia	• Reduce GHG emissions by 31.89% relative to BAU levels by 2030 • Increase reduction to 43.20% by 2030, subject to international support	**Chinese Taipei**	Reduce GHG emissions by 50% relative to BAU levels by 2030
Japan	• Reduce GHG emissions by 46% by 2030 from its fiscal year 2013 levels • Increase efforts to further reduce by 50%	**Thailand**	• Reduce GHG emissions by 30% relative to BAU levels by 2030 • Further reduce up to 40%, subject to enhanced support.
Korea	Reduce GHG emissions by 40% by 2030 from its 2018 levels.	**United States**	Reduce its GHG emissions by 50 – 52% below 2005 levels by 2030
Malaysia	Reduce GHG emissions intensity (against GDP) by 45% in 2030 from 2005 levels	**Viet Nam**	• Reduce GHG emissions by 15.8% relative to BAU levels by 2030 • Further reduce up to 43.5%, subject to international support
Mexico	• Reduce GHG emissions by 30% relative to BAU levels by 2030 (Unconditional) • Reduce GHG emissions by 35% relative to BAU levels by 2030 (Conditional)		

Scenarios for the 9th edition of the Outlook

The Reference scenario (REF)

- A set of economy-specific pathways where existing policies are retained, and new policy measures are included if and only if they are supported by implementation detail.

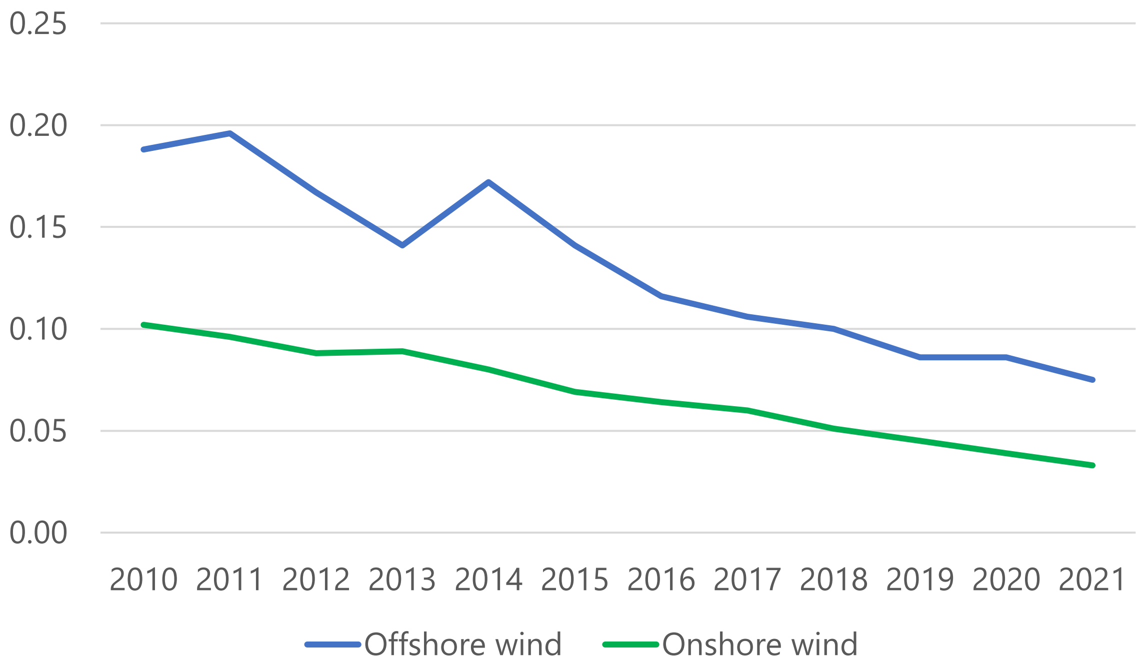
The Target scenario (TGT)

- Illustrates a hypothetical pathway for each economy towards realising energy-related policy targets, even if implementation details are not available.

The diversity of APEC economy energy and emissions planning requires models flexible enough to deploy new technologies and new energy types that are not necessarily captured in historical data

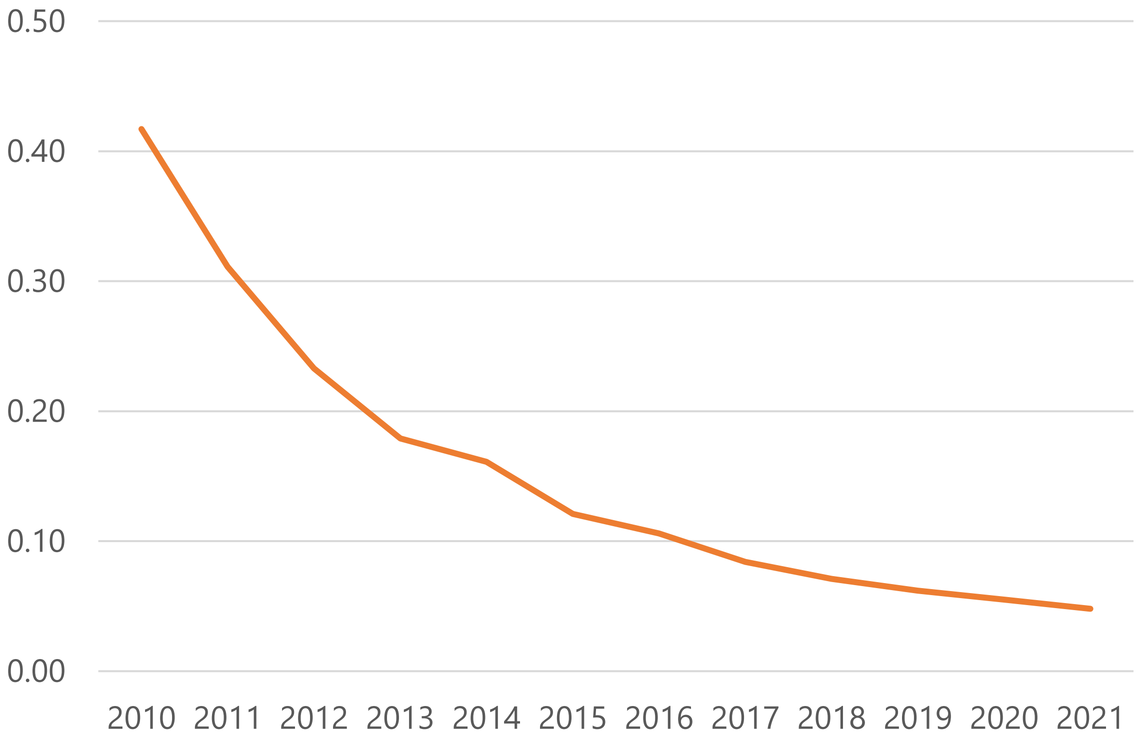
Cost of wind and solar energy have dropped dramatically

Weighted average LCOE for wind energy (2021 USD/kWh)



Source: IRENA (2022)

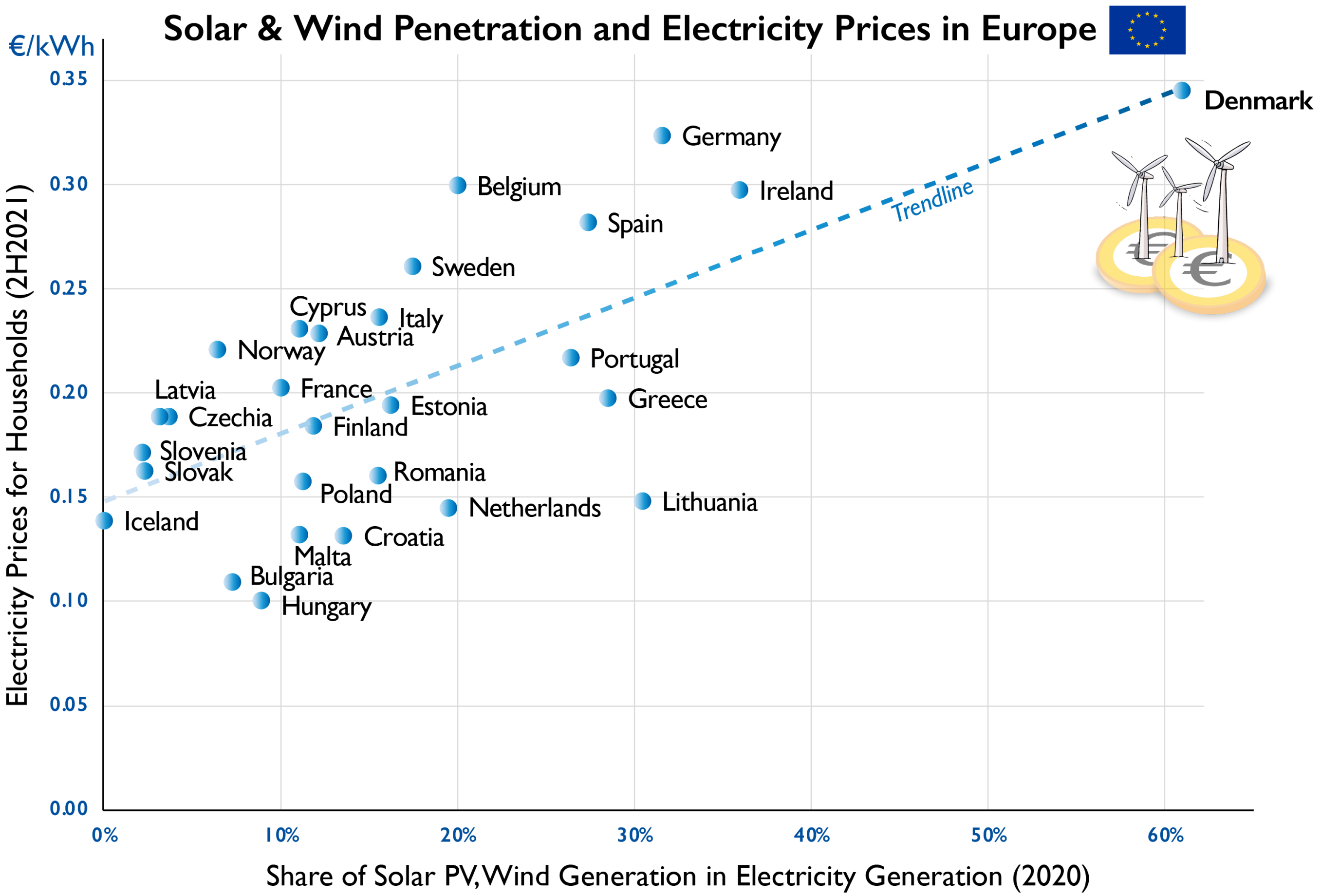
Weighted average LCOE for solar PV energy (2021 USD/kWh)



Source: IRENA (2022)

- The levelized cost of energy (LCOE) for offshore and onshore wind decreased by 8% and 10% per year (2010-2021).
- Solar LCOE dropped 88% from 0.417 USD/kWh in 2010 to 0.048 USD/kWh in 2021.

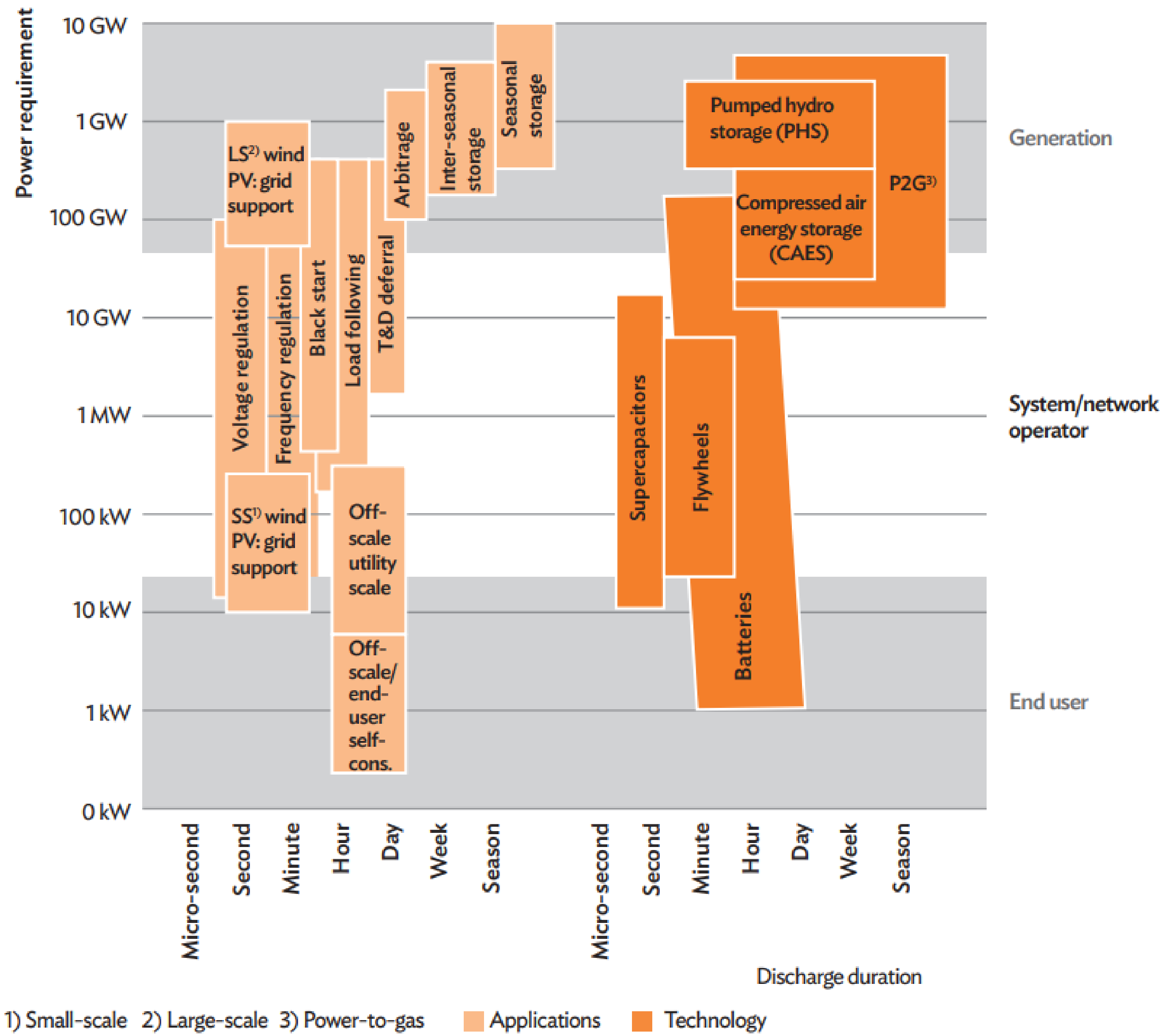
Integration costs more than offset declining wind and solar prices

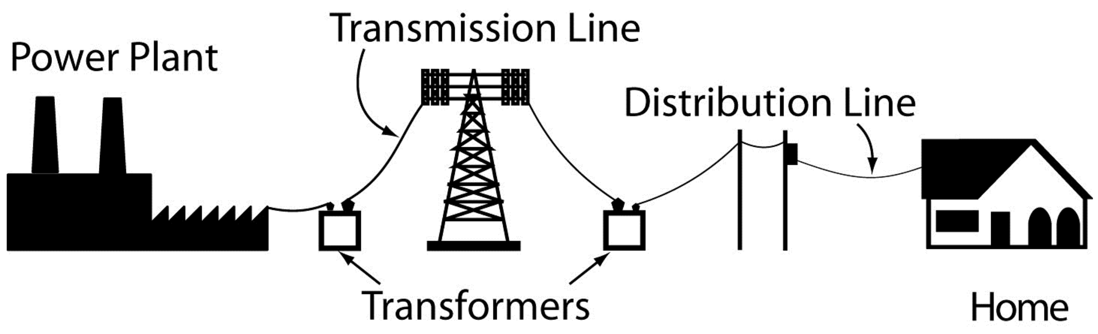


Data sources: Eurostat, IEA World Energy Statistics

- Although the cost of wind and solar has declined, the costs of creating grid reliability while using variable renewable sources appear to raise total system costs
- High integration costs explain the paradox that increasing the share of low-cost wind and solar generation actually raises electricity tariffs

A range of electricity technologies will be required for reliability



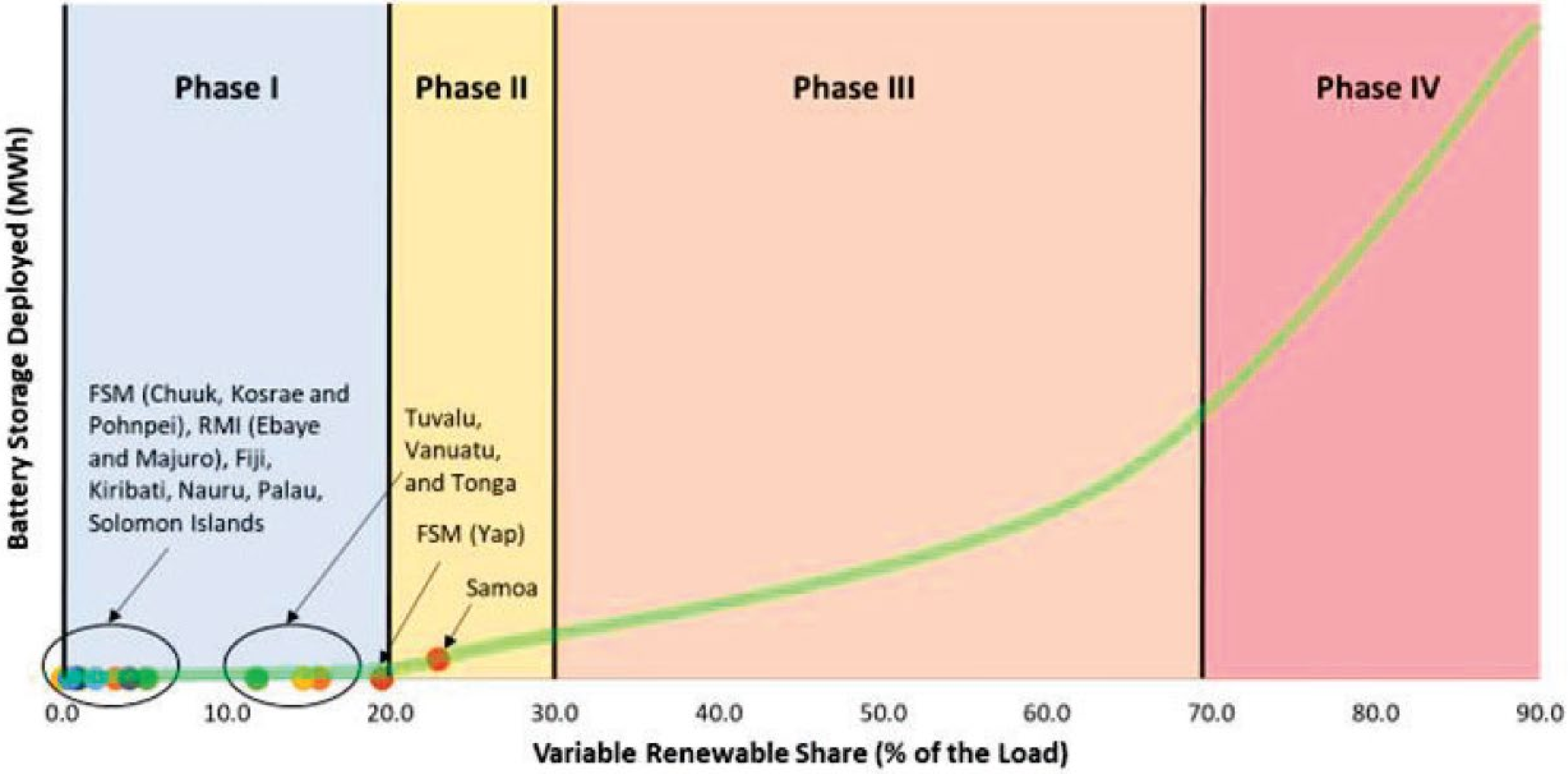


- No silver bullets
- Each technologies can serve a specific application

HANDBOOK ON BATTERY ENERGY STORAGE SYSTEM, 2018

Estimating future costs requires Outlook model improvements

Battery Storage Needs Increase with Variable Renewable Energy Share



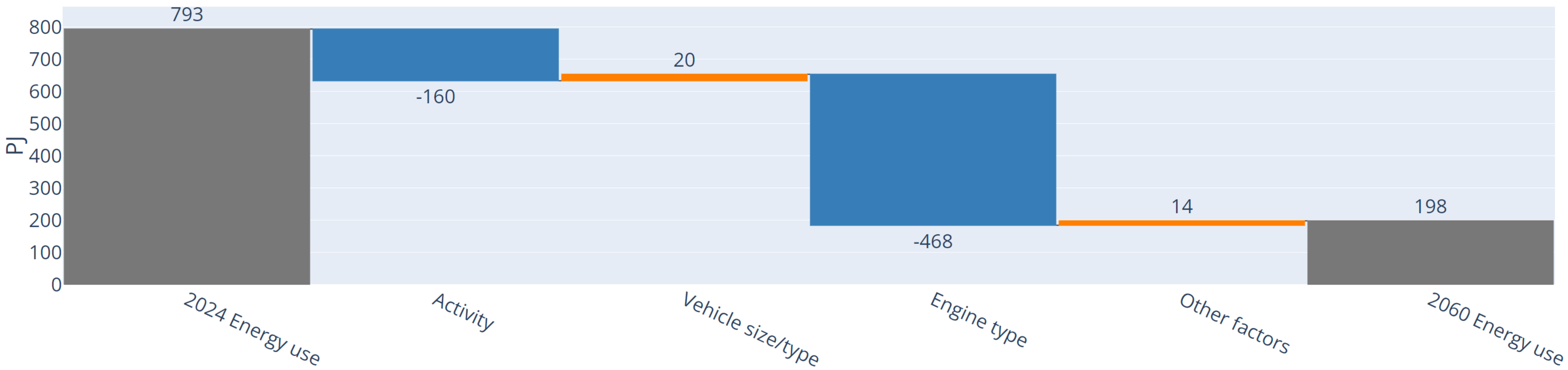
Source: Delphos & Hawaiian Natural Energy Institute. *Developing Renewable Energy Storage Systems for the Pacific Island Countries* (2022)

Required model improvements

- APERC has improved its 8th edition Outlook model to handle:
  - Increased electrification
    - Transport
    - Industry
    - Buildings
  - Variable renewable generation sources, including wind and solar
  - Short-term and seasonal electricity storage
  - New decarbonisation technologies
    - Hydrogen
    - Carbon capture and sequestration

Improved transport model enables decomposition analysis

Components of energy use by passenger vehicles in Japan (TGT scenario)

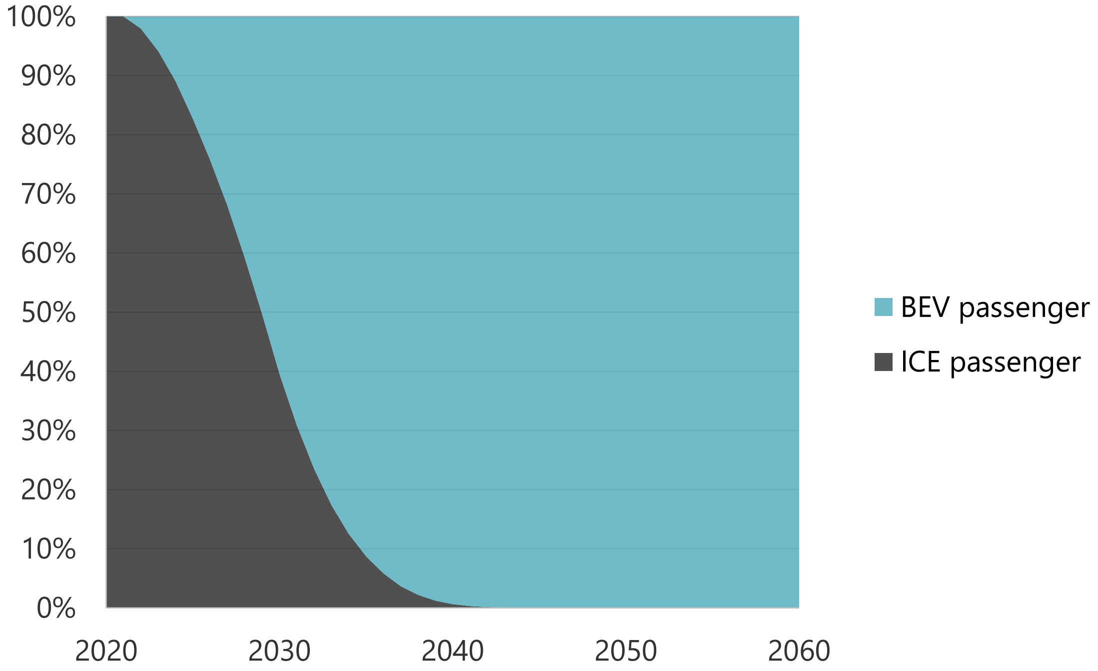


- A high amount of public transport and smaller cars which means there is not much room to improve in the **Vehicle size/type** driver
- An already declining population means **Activity** and energy use is already decreasing
- The effect of changing **Engine type** is lower than other economy's because of a more technology neutral approach

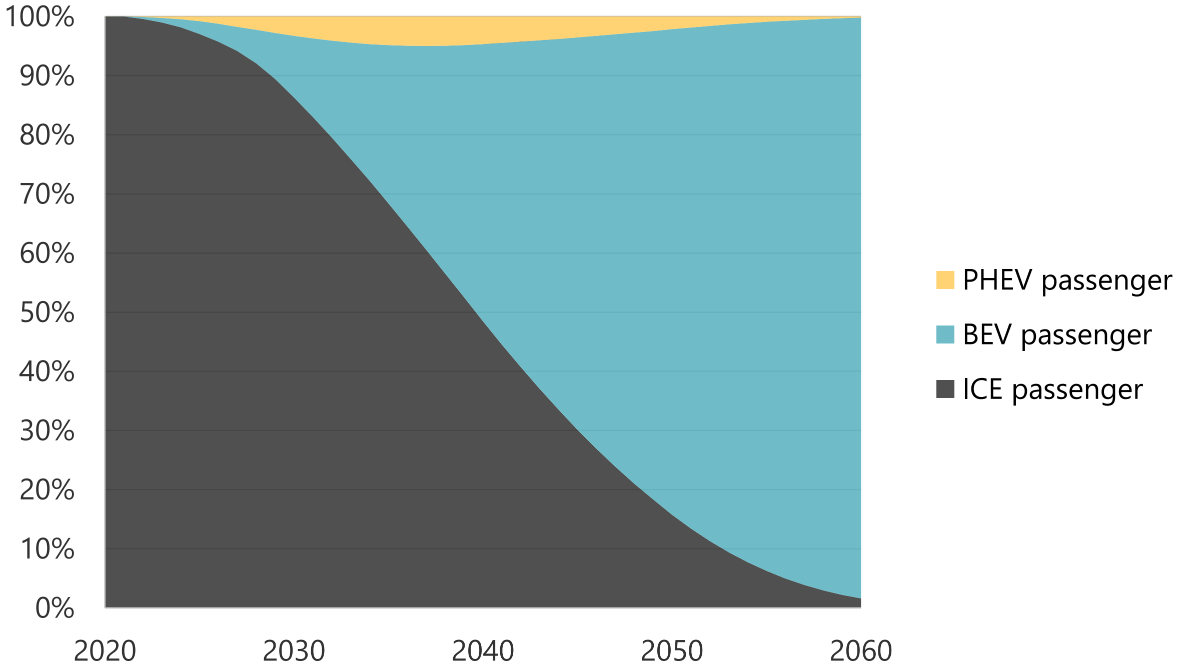
Transport electrification – population density and weather matters

- Singapore; Hong Kong, China; and Brunei – BEVs well-suited, less used car imports, higher turnover means a more rapid transition
- Low density OECD – longer ranges, colder weather, higher income means low-cost smaller BEV's aren't favored so transition will take longer.

Singapore's passenger stock shares



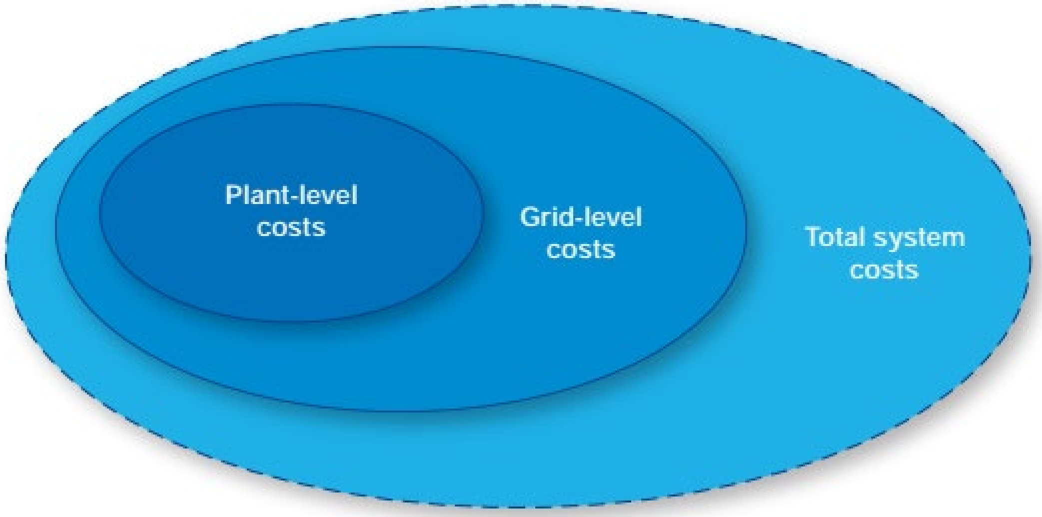
Australia's passenger stock shares

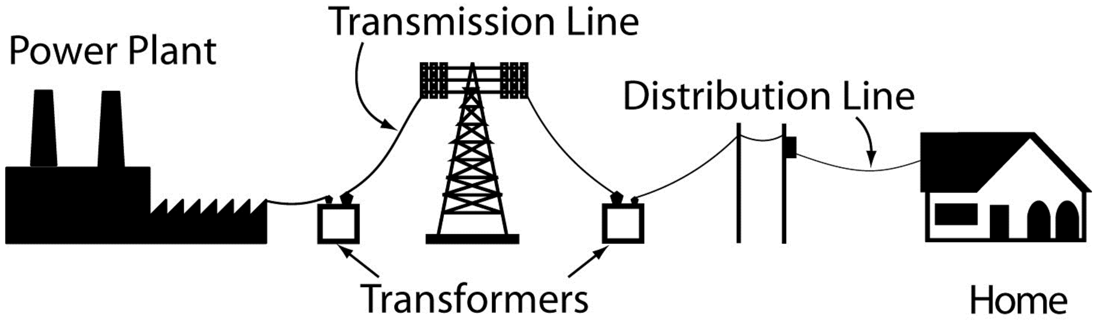


Both charts are from the Target scenario

APERC will also be estimating costs outside the model

Cost Components

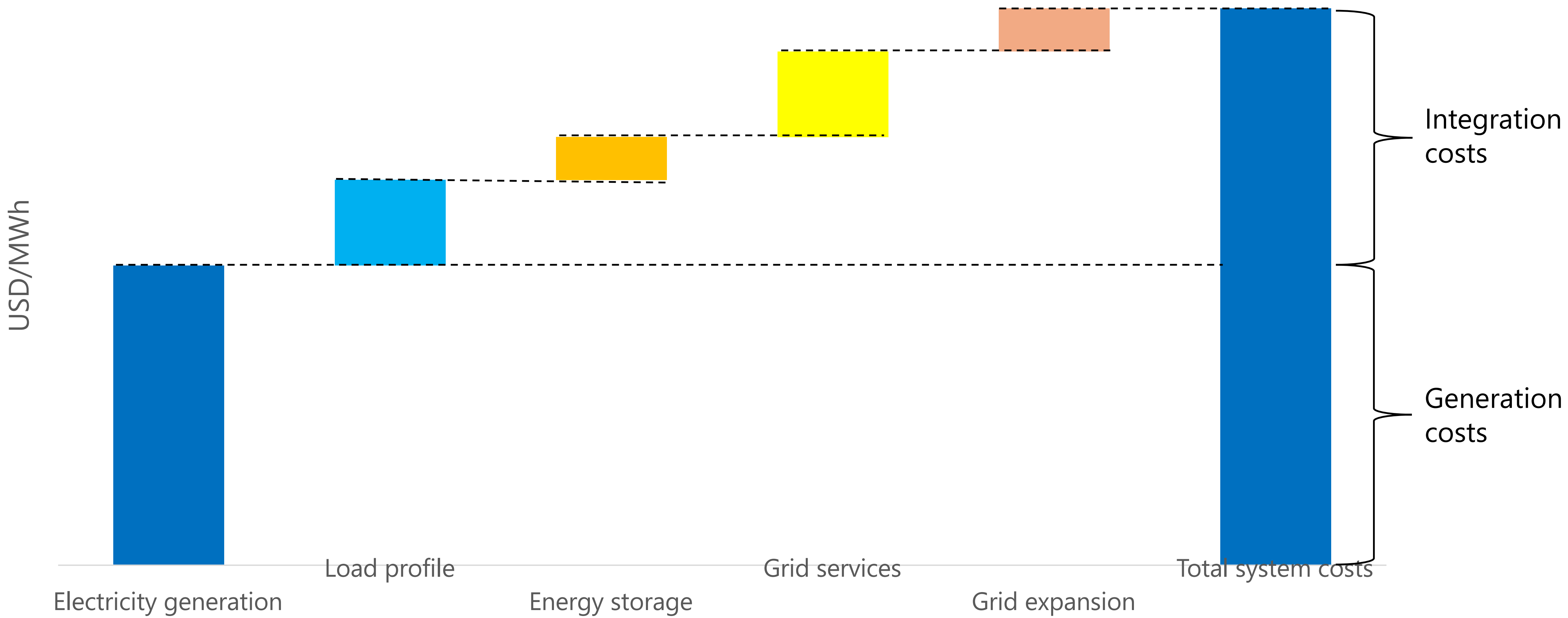




Source: Nuclear Energy and Renewables: System Effects in Low-Carbon Electricity Systems

- Focusing only on the plant-level costs of reducing carbon emissions underestimates the total system costs required to implement the energy transition.
- The 9th edition of the Outlook will include results from our efforts to estimate total system costs.

Estimating total system costs (Illustrative)



Summary

- APEC economies are raising their decarbonisation goals.
- Estimating the implications and costs of these transition efforts requires a more complex model.
- APERC has improved its 8th edition Outlook model to handle:
  - Increased electrification
    - Transport
    - Industry
    - Buildings
  - Variable renewable generation sources, including wind and solar
  - Short-term and seasonal electricity storage
  - New decarbonisation technologies
    - Hydrogen
    - Carbon capture and sequestration
- We are now sharing preliminary results with APEC economies

Thank you.

https://aperc.or.jp