2-1. APEC Energy Demand and Supply Outlook: Introduction and Scenario Definition

APERC Workshop

The 70th Meeting of the APEC Energy Working Group (EWG70)

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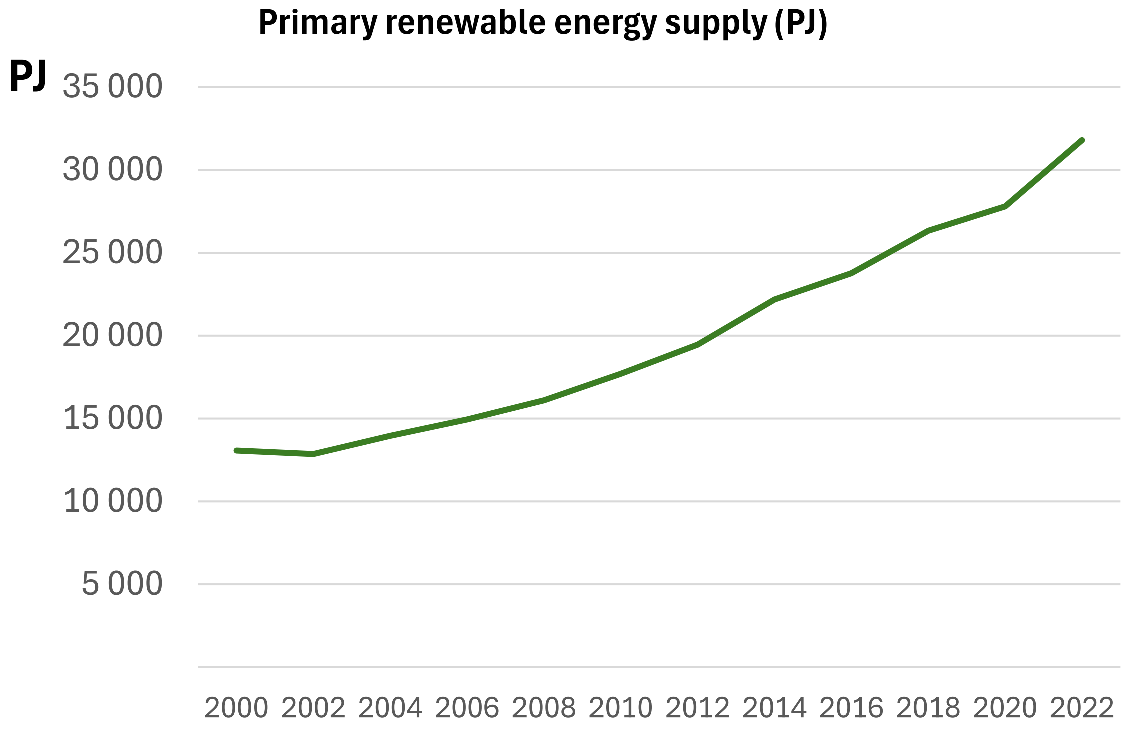
Outline

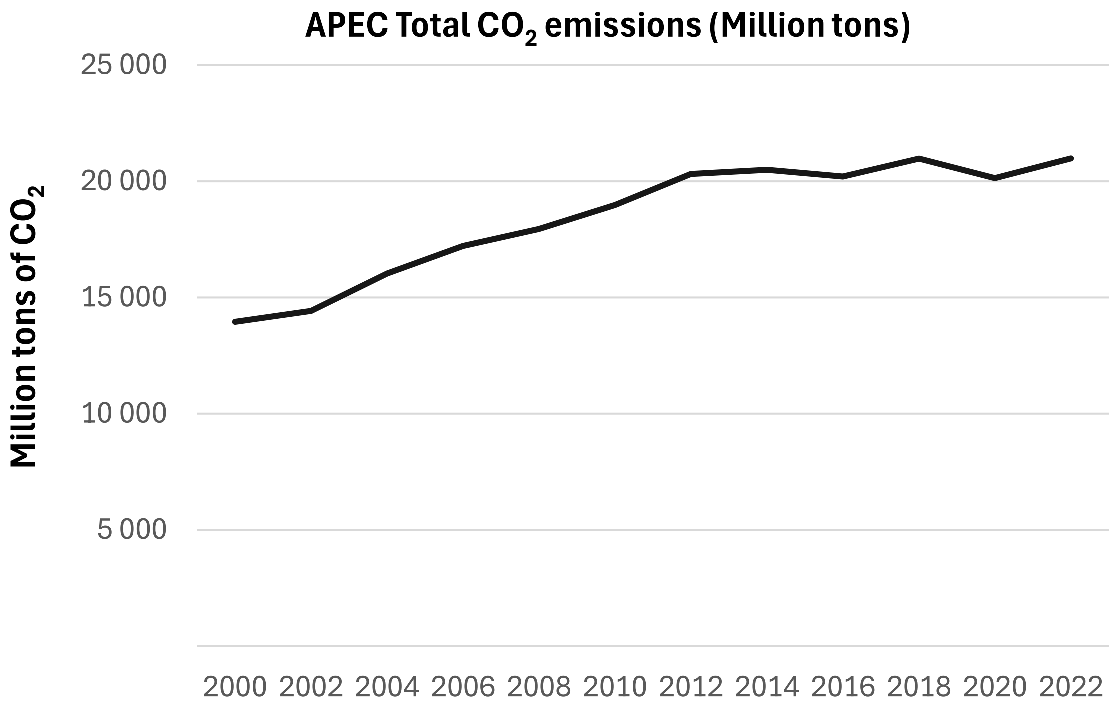
- **Energy Transition Challenges**
- Overview: APEC Energy Demand and Supply Outlook, 9th Edition
- Energy modeling improvements
- Summary

Most APEC economies have adopted 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 CO_2 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 CO_2e 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 31.9% from BAU levels by 2030. With int’l support, increase reduction by 43.2% by 2030.	**Chinese Taipei**	Reduce GHG emissions by 50% relative to BAU levels by 2030.
Japan	Reduce GHG emissions by 46% by 2030 relative to 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.~~ Withdraw from Paris Agreement; phase out IRA subsidies for EVs, wind, and solar; open more acreage to oil and gas development.
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% and 35% relative to BAU levels by 2030 (unconditional and conditional, respectively).		

The energy transition quandary



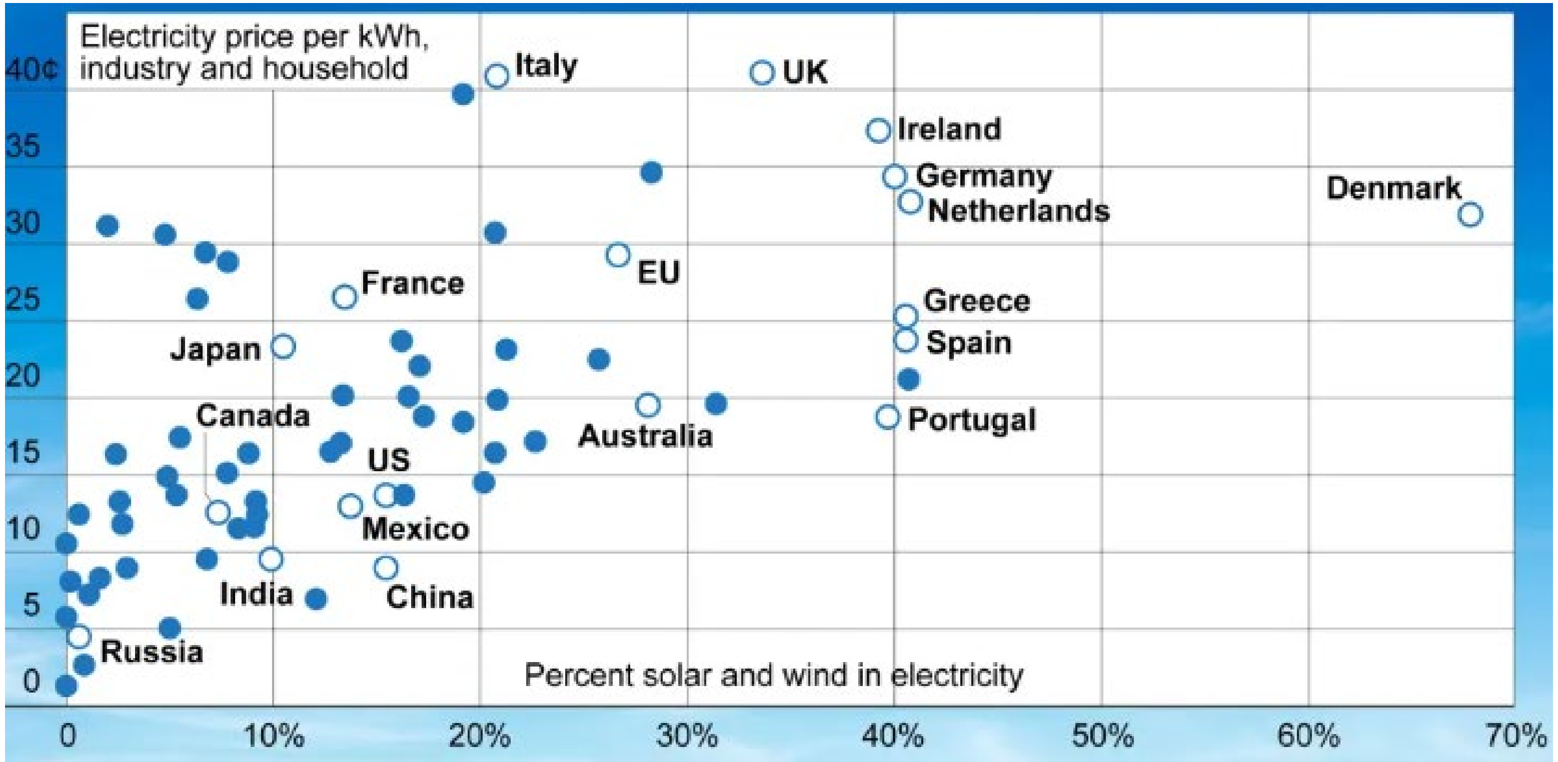


- *APEC energy intensity continues to decline and the growth in renewable energy supply is accelerating.*
- *Renewable energy increased 63% from 2012 to 2022, but CO_2 emissions have remained relatively constant over the same period.*

Renewable energy affecting grid reliability

Event	Variable Renewable Energy Complications
2016 South Australian Blackout	Effects of major storm were exacerbated by grid's reliance on wind farms which shut down during high winds. Lack of "inertia" in the system also led to cascading failures. Black start required.
2019 United Kingdom Blackout	Lightning strikes caused an offshore wind farm to trip. Low wind speeds prior to the event combined to create a blackout for 1 million customers.
2020 California Blackouts	Operators struggled to manage the "duck curve" in the evenings after 9 gas-fired plants and one nuclear power plant were closed due to environmental considerations and increased confidence in wind and solar capacity.
2021 Texas Winter Storm Blackout	Icing and low wind speeds froze wind turbines which combined with reduced gas fired generation and peak load to create blackout.
2022 California Heatwave Outages	California's push for 60% renewables by 2030 amplified challenges, as insufficient storage and dispatchable power couldn't compensate for VRES variability.
2024 Victorian Blackout	Wind farms temporarily offline due to high wind speeds. 40% renewable share complicated grid stabilization, as variable output required careful load shedding to prevent a system-wide failure.
2024 UK Low Wind Events	Low wind speeds. UK's 30% wind power share exposed reliability risks caused by insufficient storage and interconnection capacity.
2025 Heathrow Airport Substation Fire	Still under investigation, extreme day-night thermal cycling associated with solar can degrade transformers not designed for these conditions.
2025 Spain and Portugal Blackout	Report by the Transmission System Operator indicates that an inverter associated with a photovoltaic solar plant induced voltage oscillations that triggered a cascade of protective equipment disconnections.

Increasing wind and solar share raises total system costs



Source: IEA Data, Bjorn Lomborg

- Bjorn Lomborg estimates that every 10 percentage point increase in solar and wind share raises systems costs by 4 cents per kWh
- Richard Schmalensee states that relying heavily on wind and solar complicates grid management requiring electricity storage and backup generation that increase total system costs.

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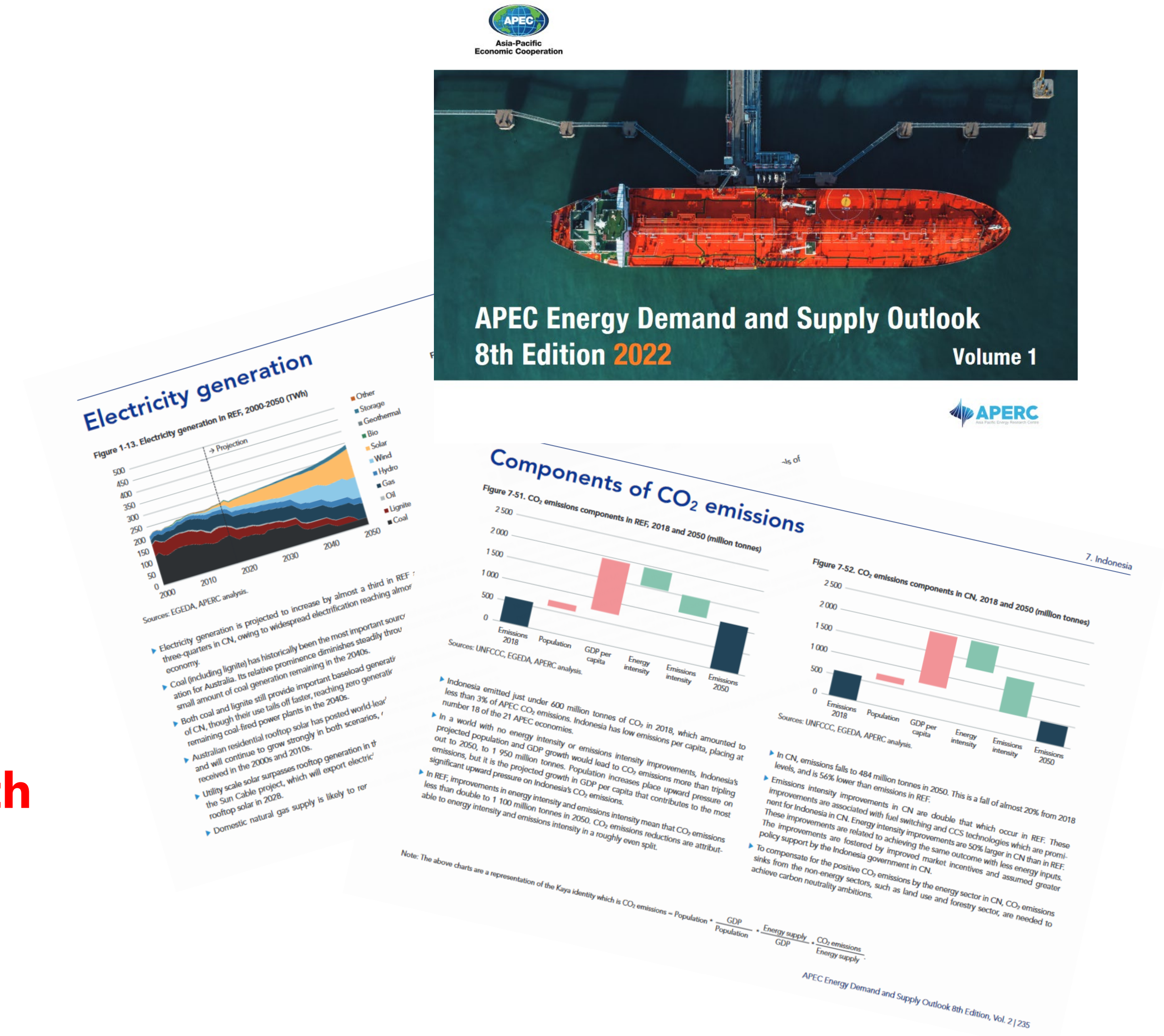
APEC Energy Demand and Supply Outlook

- 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
- Separate energy and emissions projections for each APEC member economy
- 2022 EGEDA data are used as the base year for modeling.
- APERC researchers have developed and are now sharing with economies the projections for the **9th edition of the Outlook** to be published in October 2025, with a forecast horizon to 2060



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Scenarios for the 9th edition of the Outlook

The Reference scenario (REF)

- Economy-specific pathways based on historical trends, recent developments, and APERC's assumptions about the evolution of the energy system within each APEC economy, while acknowledging technical restraints. REF offers a baseline to compare with TGT projections.

The Target scenario (TGT)

- A hypothetical pathway where each economy achieves its energy-related policy targets regardless of cost-effectiveness. When implementation details are lacking, assumptions are inferred from the targets themselves or emissions-related goals..

Goal: Provide key insights for policy-makers

The 9th edition of the *Outlook* provides projections for two scenarios in four key areas:

1. CO2 emissions
   - Both REF and TGT scenarios

2. Dependence on energy imports
   - Share of total primary energy supply

3. Electric grid reliability
   - Dispatchable versus non-dispatchable power sources

4. Cost associated with the energy transition
   - Focus on the power and hydrogen sectors

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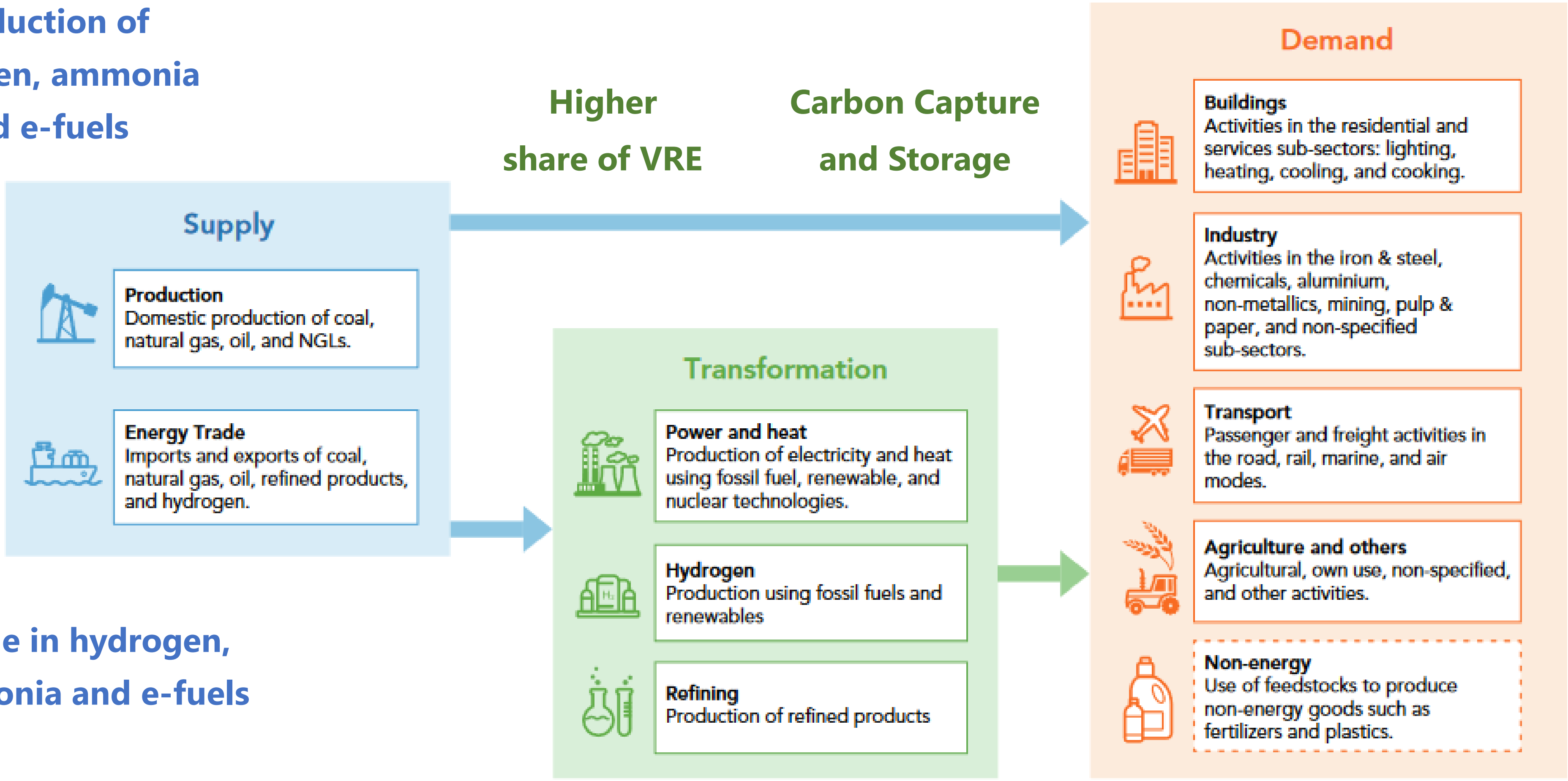
New and renewable energy technologies have implications throughout the energy system

Production of hydrogen, ammonia and e-fuels

Higher share of VRE

Carbon Capture and Storage

Separate electricity projections for data centres



Hydrogen based steel production

EVs, hydrogen powered trucks

Synthetic fuels

Trade in hydrogen, ammonia and e-fuels

Grid storage technologies

Blending hydrogen with gas; ammonia with coal

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Summary

- The energy transition is more difficult than many had assumed.
- Balancing energy sustainability, security, and affordability is key.
- APERC made improvements to our model to address energy transition issues.
- We have projected four key parameters for two scenarios:
  - CO_2 emissions
  - Energy import dependence
  - Dispatchable power generation needs
  - Required capital, fixed, and operating costs in the power and hydrogen sectors
- We hope these projections will be helpful for policymakers

Thank you.

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