2-4. Decarbonizing Coal-fired Power Generation

APERC Workshop

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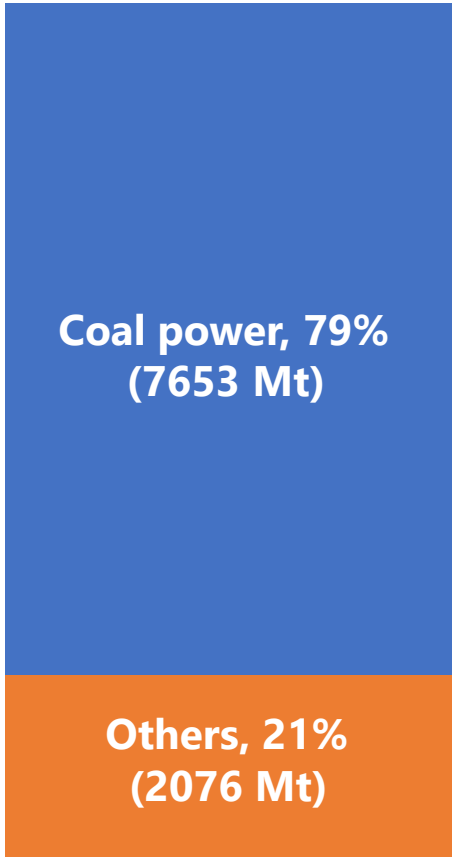
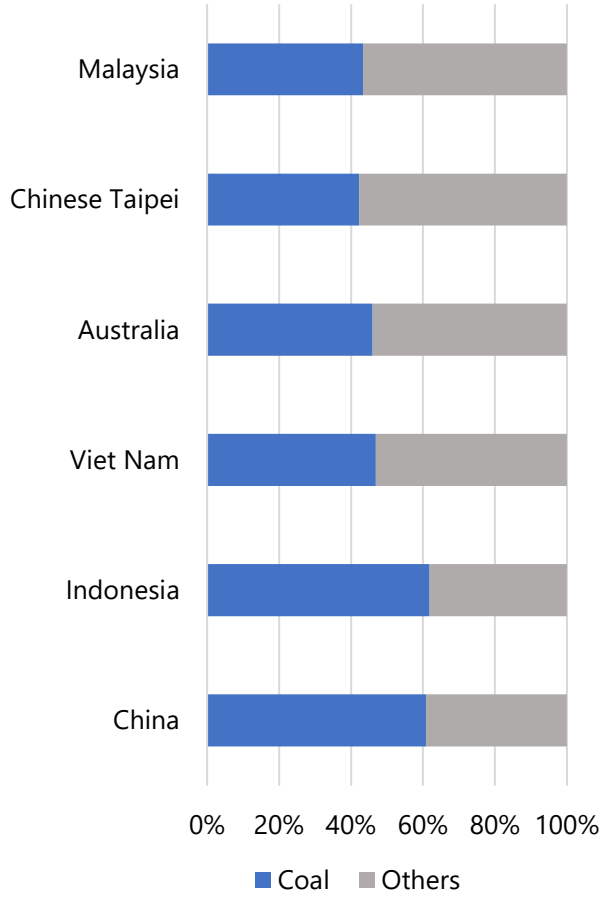
Why is decarbonizing coal-fired power generation an urgent issue in APEC?

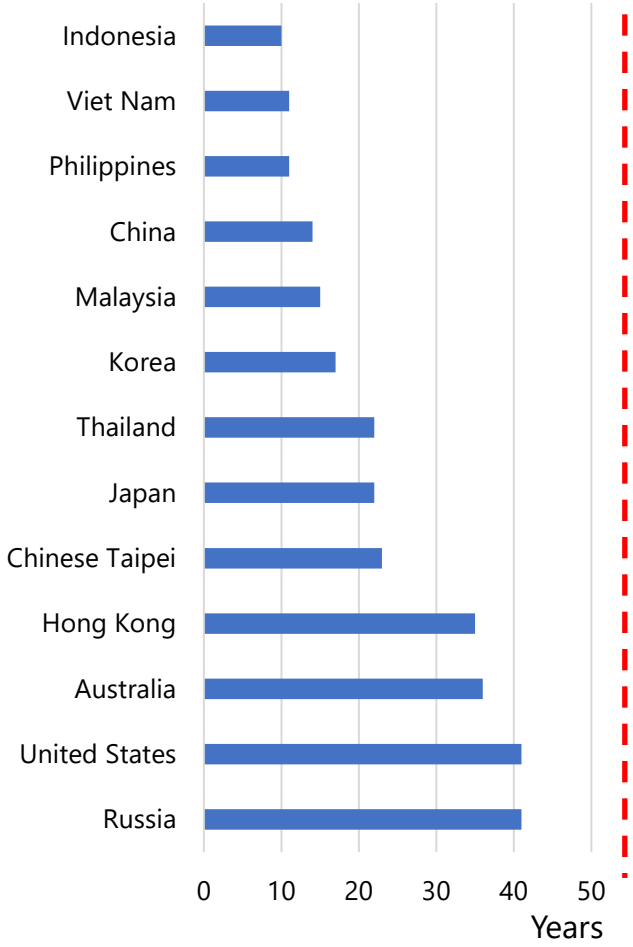
The most carbon-intensive power generation



High share of coal power in generation mix



Young age of existing coal-fired power fleet



Meeting Net-zero target of economy

Note: All the charts above use data from the year 2023.

Source: IE (2024), IEA (2021), MSCI Sustainability Institute (2023), Ember, Global Energy Monitor

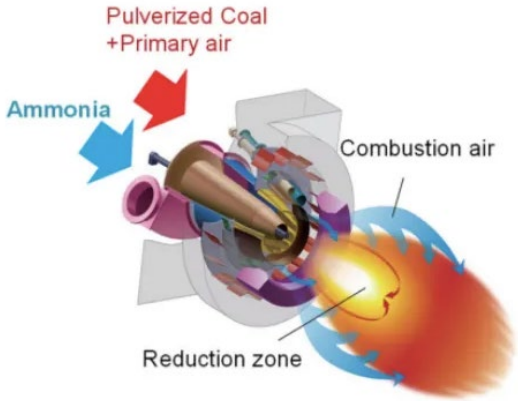
What are the potential solutions?

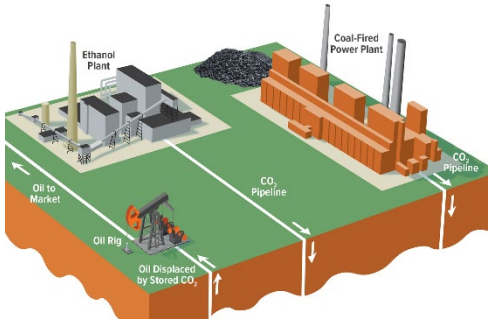
01 Improving thermal efficiency

02 Cofiring with biomass

03 Cofiring with ammonia

04 Retrofitting CCUS



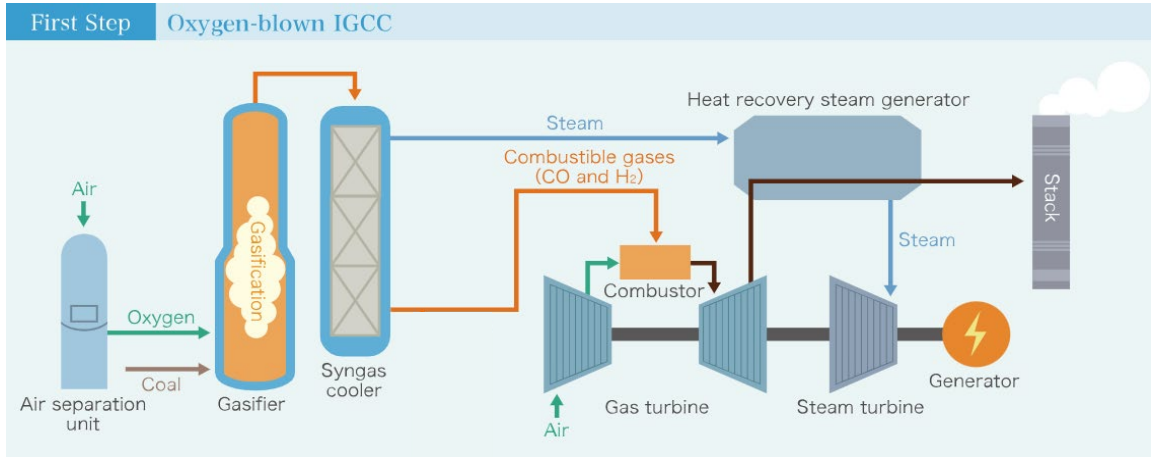


Improving thermal efficiency

Thermal efficiency in different coal power technologies

Technology	Efficiency (%)	Coal consumption (g/kWh)	Steam temperature (°C)	CO_2 intensity (gCO_2/kWh)
Integrated Coal Gasification Combined Cycle (IGCC)	46 to 50%	256-272	1300	629-680
Advanced Ultra-supercritical	45 to 50%	230-320	≥700	670-740
Ultra-supercritical (USC)	Up to 45%	320-340	≥600	740-800
Supercritical	Up to 42%	340-380	550-600	800-880
Subcritical	Up to 38%	≥380	≤550	≥880

Osaki CoolGen demonstration project, Japan



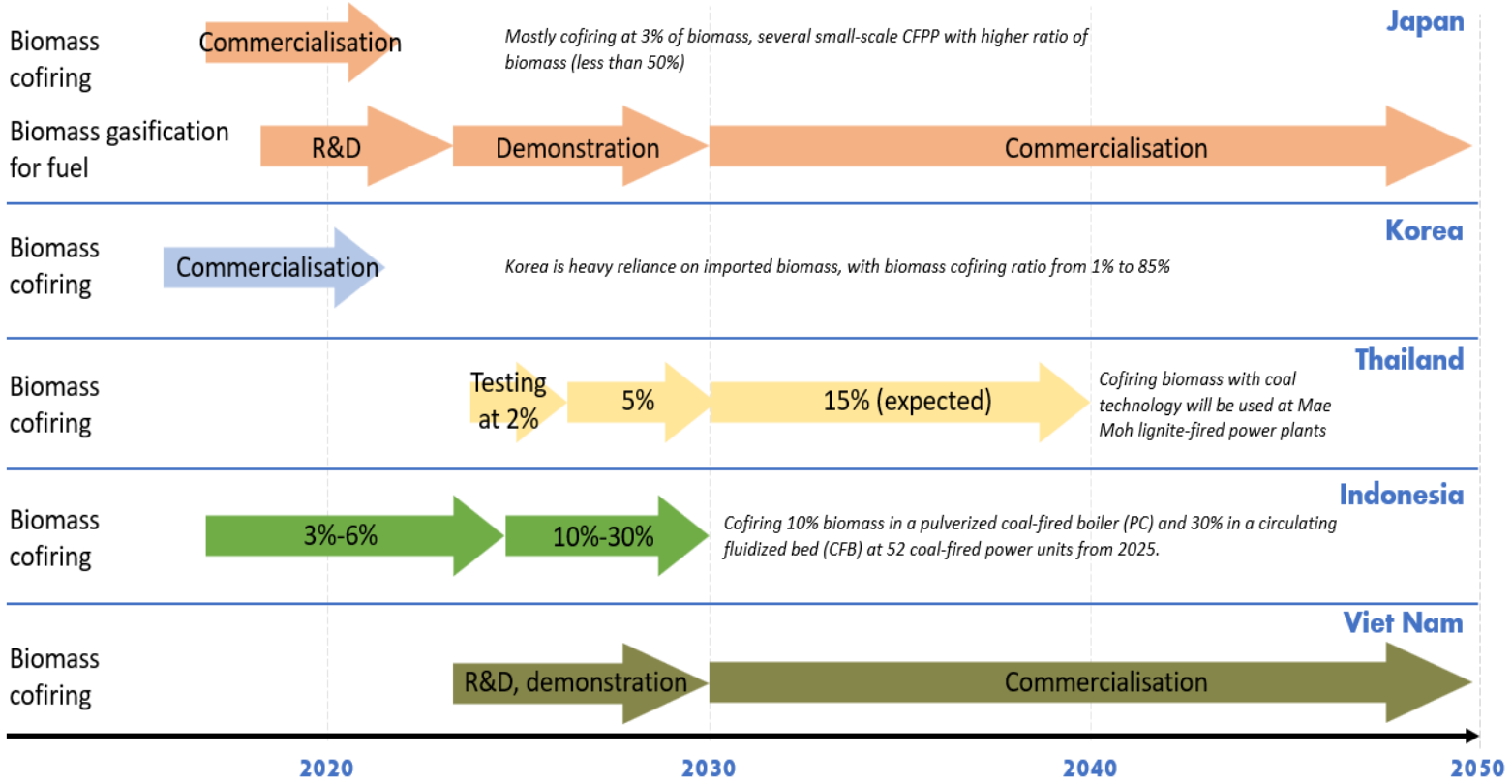
- 2013-2017: Construction of 166-MW oxygen-blown IGCC demonstration plant.
- Thermal efficiency: around 46% on commercial units.
- CO_2 emission: **reduced by 15% compared to USC**.

Challenges: high investment cost, constraints in retrofitting existing plants

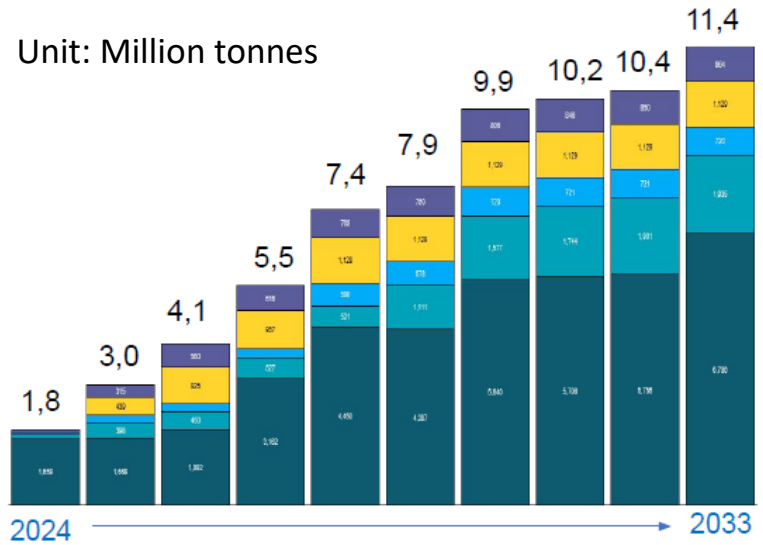
Source: Osaki CoolGen Corporation, APERC Coal Report 2023.

Cofiring with biomass

Development status in cofiring with biomass at selected APEC economies



Cofiring with biomass in Indonesia



The Target of Biomass Utilization in 2031

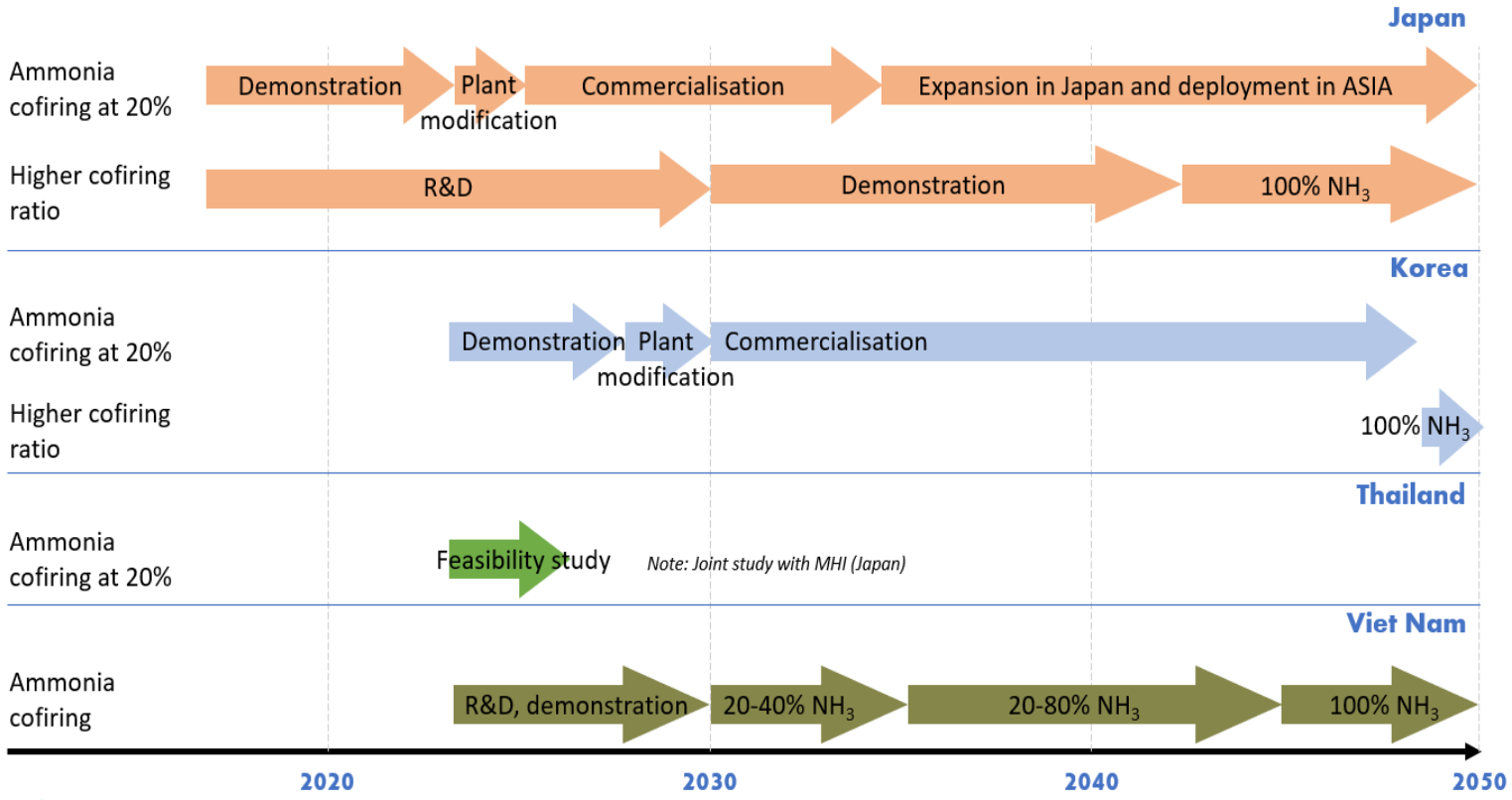
Number of CFPP	:	52 Power Plant
Total Capacity of CFPP	:	18.895 MW
Biomass Needed	:	10,2 Mn Ton/yr
Ration Biomass *Co-firing*	:	12 %

Challenges: shortage of biomass, deforestation issue

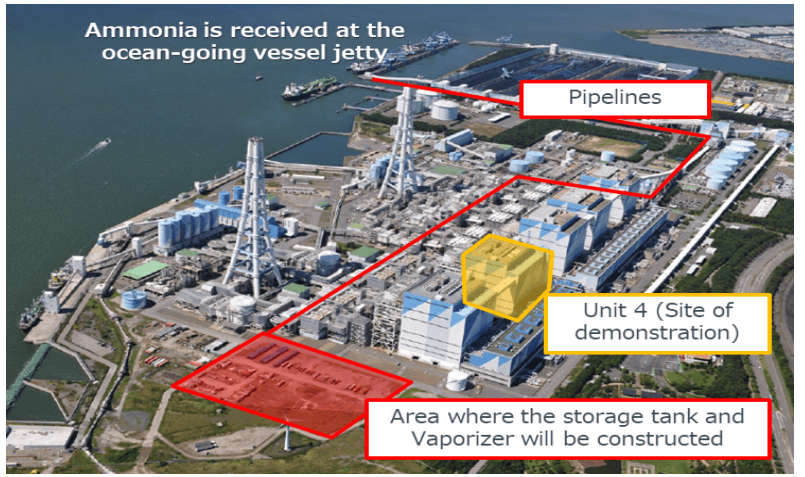
Source: APERC Coal Report 2023, PLN (2024)

Cofiring with ammonia

Development status in cofiring with ammonia at selected APEC economies



Cofiring with ammonia in Japan



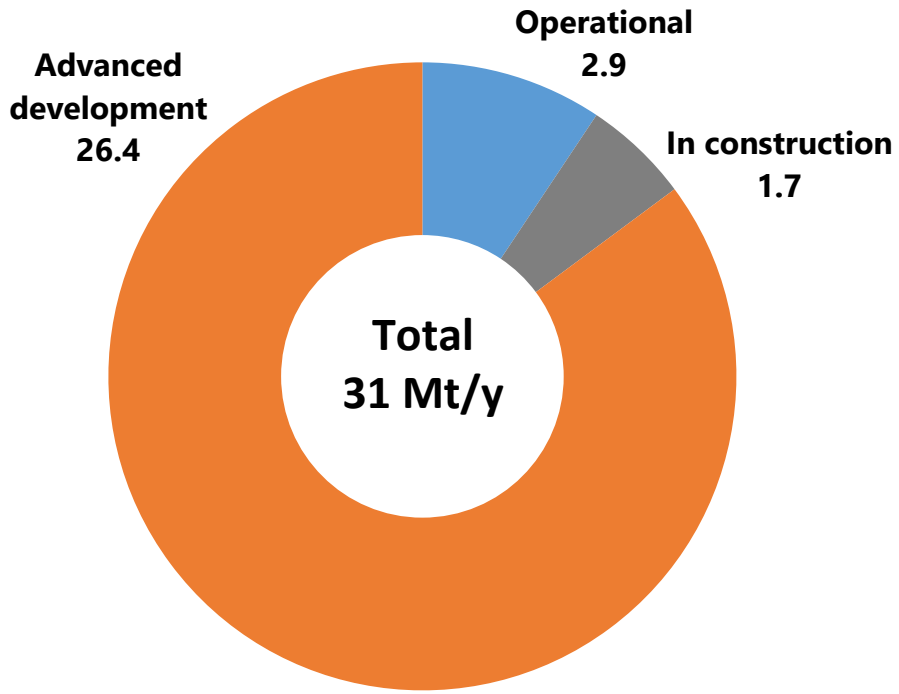
- Name: Hekinan CFPP, Unit 4
- Location: Aichi Prefecture, Japan
- Installed capacity: 1000 MW
- Co-firing rate: **20% ammonia**
- Testing duration: Jan-Jun 2024
- CO_2 emissions: **reduced by 20%**
- NO_x emissions: ≤ mono-firing coal

Challenges: has not been commercialized yet, ammonia supply chain

Source: JERA (2022), APERC Coal Report 2023.

Retrofitting CCUS

CCUS capacities at APEC coal-fired power plants



Challenges: need substantial capital investment, storage sites, public acceptance

The largest coal-fired power plant equipped with CCUS in Asia

- Capacity: 500 000 tonnes/year
- Location: Jiangsu province, China
- Capture type: Post-combustion
- CO_2 Utilization: Enhanced Oil Recovery

Source: IEA (2023), Power, Zhejiang University.

Decarbonizing solutions in selected APEC economies

Economies	Thermal efficiency improvement	Cofiring with biomass	Cofiring with ammonia	Retrofitting CCUS
Australia	●			
Canada	●			●
China	●	●	●	●
Indonesia	●	●	●	●
Japan	●	●	●	●
Korea	●	●	●	
Malaysia	●			
Mexico	●			
Philippines	●			
Russia	●			
Chinese Taipei	●			●
Thailand	●	●	●	●
USA	●			●
Viet Nam	●	●	●	●

Key takeaways

- **Urgency of decarbonizing coal-fired power generation**
  - High carbon intensity
  - High dependence on coal
  - Young coal-power fleet
  - Net-zero target
- **Potential solutions**
  - Improving thermal efficiency
  - Cofiring with biomass
  - Cofiring with ammonia
  - Retrofitting CCUS
- **Challenges**
  - Significant investments are required for all solutions
  - Technical and logistical barriers, including infrastructure limitations and resource constraints
  - Balancing economic and environmental considerations

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Thank you.

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