The Economics of Ammonia Co-Firing in Japan

Understanding the Costs, Subsidies, and Policy Trade-Offs

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Ammonia co-firing in Japan

The importance of discussing the technology as a decarbonisation solution

Japan promotes ammonia co-firing at coal plants by:

- Awarding capacity payments via long-term decarbonisation power auctions
- Planning major Contract for Difference (CfD) fuel subsidies within a year

Power utilities view ammonia co-firing as a **core Net-Zero strategy** for young coal fleets:

But:

- No accessible cost analysis vs other decarbonisation options
- No financial transparency on co-firing projects
- No contingency plan if high co-firing ratios (>50%) remain unachievable

Reassessing the ammonia strategy

Our research challenges the economic case for ammonia co-firing at coal plants

Co-firing will result in excessive costs:

- Power generation costs will become 1.5x to 2x higher than revenues.
- Estimated ¥15-30 trillion of fuel subsidies are required for Japan's coal fleet.
- Japan's current low-carbon fuel subsidy budget is only ¥3 trillion.

→ Key findings indicate a limited role for ammonia in power sector decarbonisation.

Modelling the impact of ammonia co-firing

Developed simplified income statement models for a 1GW ultra-supercritical (USC) coal plant under three scenarios:

- **Baseline** model simulating current operations under 2025 conditions
- **20% co-firing** model under 2030 conditions
- **50% co-firing** model, also under 2030 conditions

Key input assumptions by scenario:

Assumption	**Baseline**	**20% Co-firing**	**50% Co-firing**
Electricity price	12,878/ MWh	10% below baseline	10% below baseline
Capacity utilization	65%	50%	50%
Blue ammonia price	N/A	¥75,750/tonne	¥75,750/tonne
Operating costs (excl. fuel)	¥12.6 billion	+13% vs baseline (at 50% capacity factor)	+28% vs baseline (at 50% capacity factor)
Co-firing capex depreciation	N/A	+8% vs baseline	+16% vs baseline

Source: ARE

Ammonia co-firing is not economically viable

Plants face heavy financial losses without subsidies.

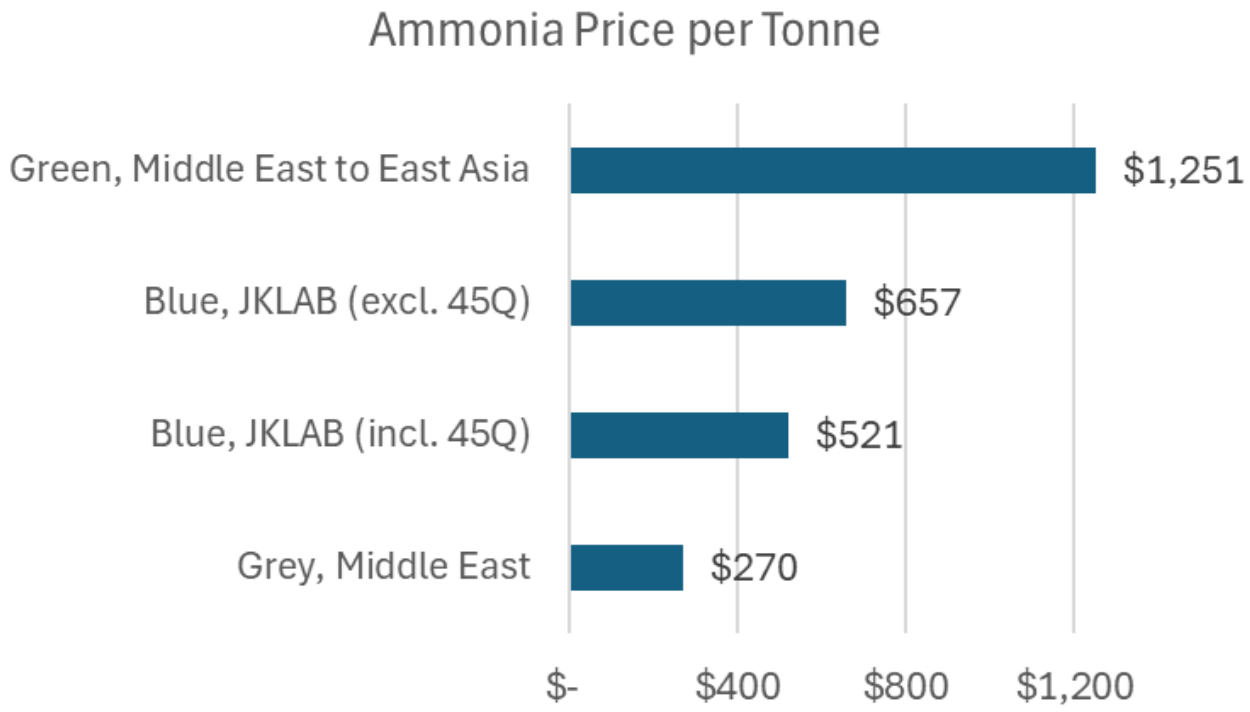
JPY million	Baseline (2025)	20% Co-firing (2030)	50% Co-firing (2030)
Revenue	71,811	52,268	52,268
Fuel Cost	49,692	59,237	90,597
Operating Cost	12,575	12,272	13,938
EBITDA	9,545	-19,241	-52,268
Depreciation	5,303	5,606	6,060
EBIT	4,242	-24,846	-58,328
EBITDA Margin	13%	-37%	-100%
EBIT Margin	6%	-48%	-112%

Source: ARE

Low-carbon ammonia costs drive losses

Our ammonia assumptions

- Blue ammonia which is ~50% cheaper than green (but over 3x more expensive than coal).
- Argus' price modelling for delivery of blue ammonia to Japan and South Korea from the US (JKLAB).
- Only marginal cost declines due to mature gas-to-ammonia technology (ATR).



Source: Argus

Notes: prices are for various dates between Nov '24 and Feb '25, based on publicly available information.

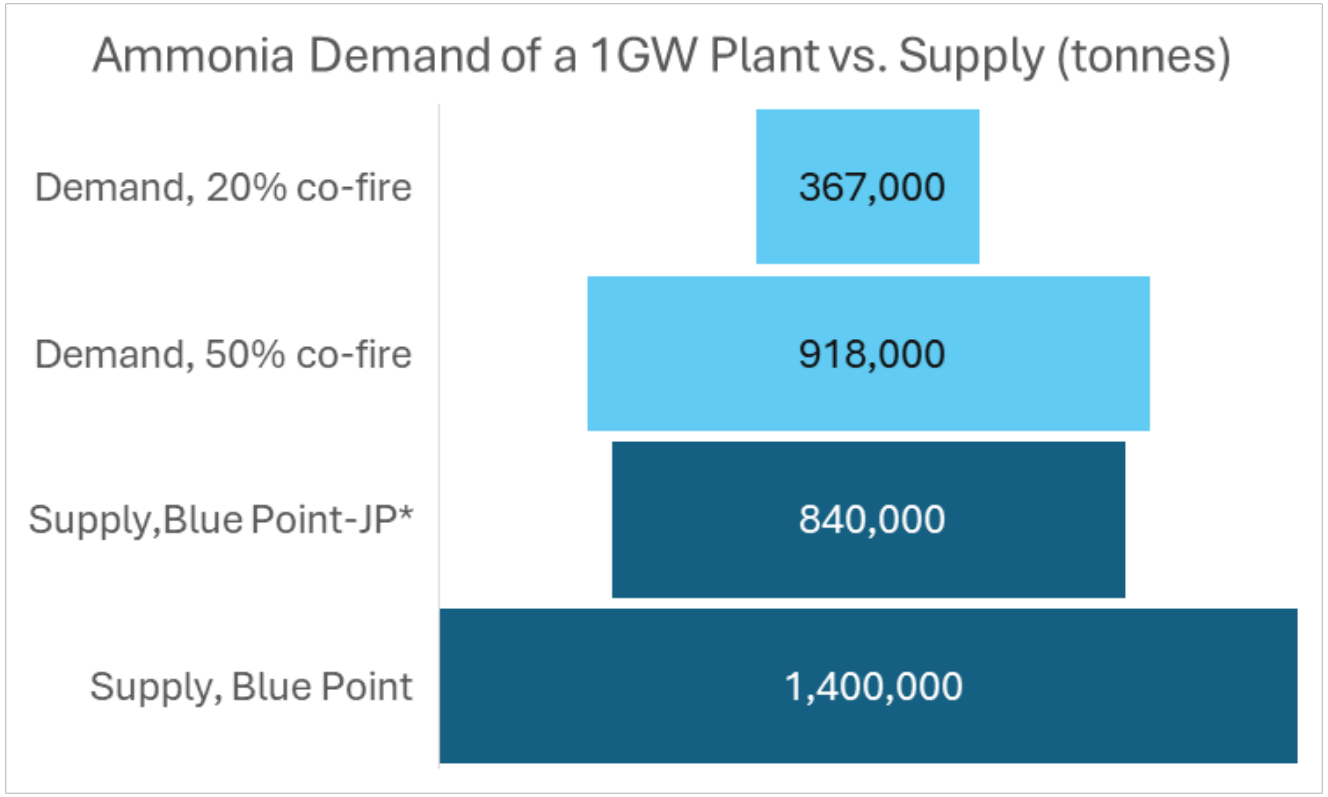
45Q are US tax credits that provide financial incentives for capturing and storing CO_2 for a period of 12 years.

Power generation requires high ammonia volumes

- Ammonia's energy content is ~29% lower than coal

→ Higher volumes required to produce the same electricity.

- A 1GW plant at 50% co-firing and 50% capacity, would consume more ammonia than Blue Point's entire Japan-linked output.



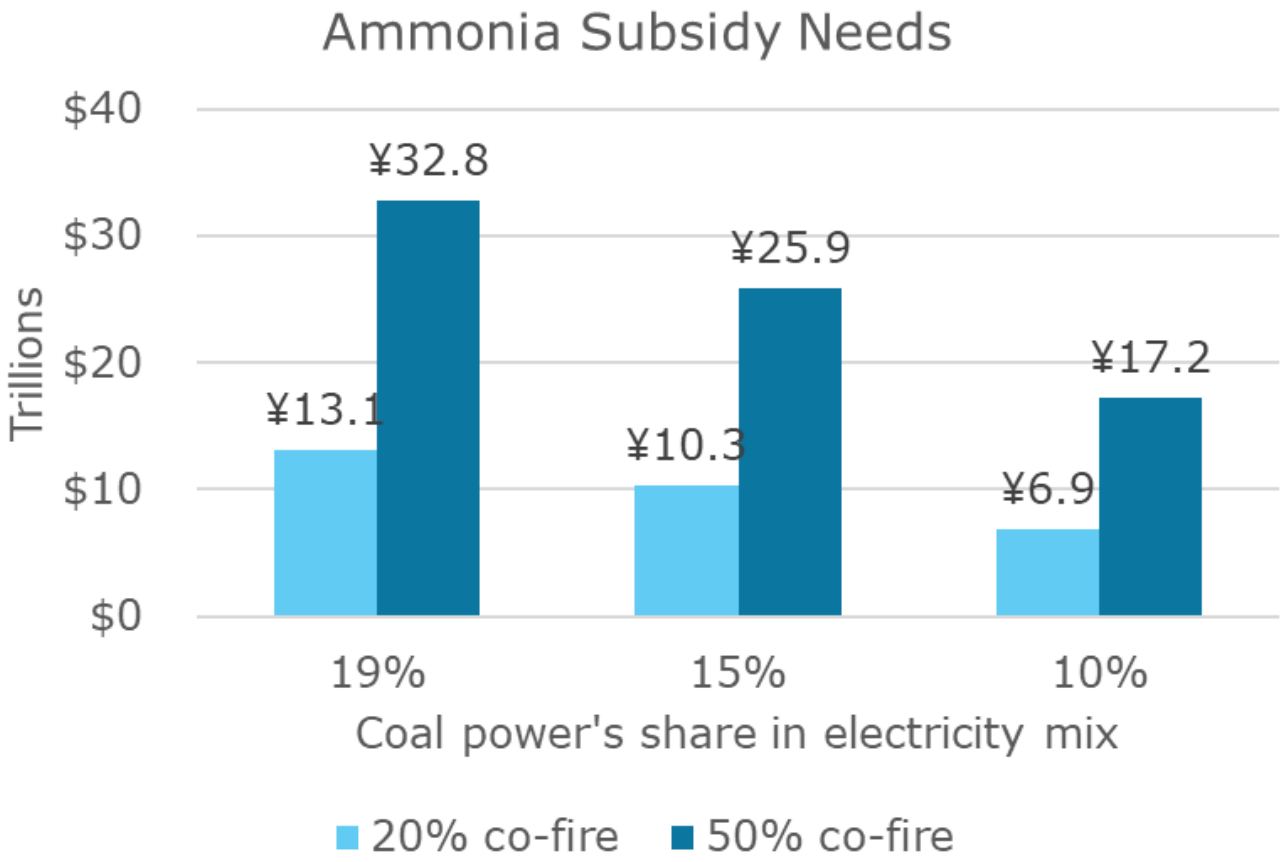
Source: Jera, ARE

**Jera and Mitsui hold a 60% share in the Blue Point project.*

Subsidy Needs Far Exceed Budget

- Japan targets 19% coal in its 2030 power mix (further cuts likely).
- Roughly ¥15-30 trillion fuel subsidies needed to bridge the ammonia–coal cost gap.
- Only ¥3 trillion allocated for low-carbon fuels across *all* hard-to-abate sectors.

→ Ammonia subsidies may crowd out other transition pathways



Source: ARE

Conclusion: Policy Re-assessment Needed

- Japan has long demonstrated remarkable ingenuity in developing innovative technological solutions, and the government's widely commitment to decarbonising the economy – including the power sector – is widely recognized.
- At the same time, Japan's support for ammonia co-firing is currently built on an economically challenging foundation.
- High ammonia costs and significant fuel volume requirements would likely result in negative financial outcomes for power generation.
- The level of fuel subsidies required (¥15–30 trillion) far exceeds Japan's budget for low-carbon fuels and may take away subsidies from other important decarbonisation technologies.
- In addition, without proven scalability to 50% co-firing or higher, the emissions reduction potential remains modest.
- A thoughtful review of current policy priorities could help focus on lower-cost, higher-impact solutions that reduce emissions more effectively and ensure responsible use of public funds.
- Japan's energy transition will benefit from a transparent and cost-conscious approach to decarbonisation.

Collaborating for credible progress in Japan's decarbonisation.

Thank you!

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