Press release

# Japan's move to co-fire ammonia in coal power plants to have adverse impacts on air quality

***The risks of toxic air pollution outweigh the gains from lowered carbon emissions***

**TOKYO, TUESDAY 16 May 2023 -** The Japanese government's efforts to prolong the life of coal-fired power plants by adding ammonia ($NH_3$) to the fuel mix, which also reduces carbon emissions, will have deadly consequences on the country's air quality, finds latest research from the independent Helsinki-based research organisation, Centre for Research on Energy and Clean Air (CREA). While burning ammonia does not generate greenhouse gases, its production is carbon-intensive. The transport and burning of ammonia also lead to a substantial increase in emissions of ammonia, which is a key precursor to particulate matter, resulting in a profound impact on public health – both regionally and across national borders. Moving to large-scale co-firing of ammonia in coal power plants could undo Japan's impressive efforts in improving its ambient air quality in the past decade.

Unit 4 of Hekinan Thermal Power Station was the first in the country to undergo technical changes to allow for co-firing of ammonia in coal-fired power plants, and was used as a pilot project by the government to understand the benefits of co-firing ammonia. CREA's latest research studied the increase in pollutant emissions with varying levels of ammonia. The results were clear: displacing coal with ammonia leads to a substantial increase in total pollutant emissions and subsequent public health impacts. With ammonia at 20%, total emissions increased by 67% - from 1,348 tonnes to 2,249 tonnes. In a 50:50 scenario, emissions were up by a whopping 167%. "In contrast, emissions reduce only marginally for $PM_{2.5}$ (4-9 tons) and $SO_2$ (106-265 tons), and emissions do not change at all for $NO_2$", read the report. Plans are underway to increase the ratio to 50% at this plant.

Riding high on the apparent success of Unit 4 of the Hekinan Thermal Power Station, the Japanese government plans to scale-up these technical upgrades to allow for burning ammonia across all supercritical power plants in the country. As a result, the government estimates the demand to increase to three million tonnes per year in 2023, and 30 million

tonnes  by 2050.  To meet this rising demand – for both ammonia and the technology to retrofit old coal-fired power plants, the national government has already begun international competitive bidding and signing memorandums of understanding with industries.

Investing in ammonia is likely to be fraught with unexpected climate and pollution risks, if the production of ammonia is not taken into account. Nearly 2% of the world's carbon emissions comes from producing ammonia.

"*While the Japanese government and power industry have an ambitious roadmap for how ammonia will be used as an energy carrier in the coming decades, they have not committed to how the ammonia will be produced. I am pessimistic that this projected rise in Japanese demand for ammonia will be met by clean methods, especially considering that current ammonia is predominantly produced from fossil fuel, and the technical and political challenges in cleaning up the global chemical and shipping industry.* ," said Jamie Kelly, air quality analyst at CREA and the co-author of the report.

Ammonia is also a precursor to the formation of particulate matter. While the secondary formation of PM, NOx and SOx is well understood in the production, transport and combustion of coal, it is yet to be quantified for ammonia. The Japanese government reports that co-firing coal and ammonia had no impact on NOx, when compared to firing only coal.

"*The air pollution consequences of using ammonia to supply such a high energy demand are largely untested, and highly uncertain. For instance, estimates of the amount of ammonia left unreacted and emitted into the atmosphere range anywhere between 0.1% and 25%. In contrast, it's well established that transitioning to renewable energy sources, like wind and solar, will almost completely eliminate pollution from the power sector*," said Kelly.

This move could reverse significant gains Japan has made towards clean air. Between 2010 and 2018, the $PM_{2.5}$ concentrations have reduced by 30%, though it still remains higher than guideline values suggested by the World Health Organisation.

"*Our research shows that displacing coal with ammonia will undermine, or even offset, Japan's recent gains in clean air*," emphasised Kelly.

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The full report, and all other CREA publications, can be found here: energyandcleanair.org/publications.

# About CREA

The Centre for Research on Energy and Clean Air (CREA) is an independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution. CREA was founded in December 2019 in Helsinki and has staff in several Asian and European countries. The organisation's work is funded through philanthropic grants and revenue from commissioned research.

www.energyandcleanair.org

# About the methodology

For this study, we explored the air quality implications of coal and ammonia co-firing at Unit 4 of Hekinan Thermal Power Station by quantifying emissions of $PM_{2.5}$ and the precursor species under multiple coal:$NH_3$ fuel mix scenarios of (100:0, 80:20, and 50:50), whilst keeping the total energy demand constant. We accounted for emissions from each aspect of the fuel lifecycles (mining, industrial production, transport, and combustion).

We used a variety of different methods to calculate emissions, depending on the activity, fuel mix scenario, and species. As JERA currently operates under the 100:0 fuel scenario, and they already report emissions of $PM_{2.5}$, nitrogen oxides, and sulphur oxides from combustion; we directly use these values. For the remaining scenarios for these activities, we assume emissions of $PM_{2.5}$ and sulphur dioxide decrease proportionally to the reduction in coal, and no change in emissions of nitrogen oxides. For the remaining activities, species, and scenarios, we combine underlying activity data (coal production, ammonia production, ammonia transport, ammonia combustion) with measured

emission factors from the scientific literature. Note, for ammonia combustion, we assume an emission factor of 0.1 %, which is at the lower end of the range of estimates (0.1 - 30 %), and therefore provides a conservative estimate.