FUTURE ENERGY – BLUE AND GREEN AMMONIA END MARKETS

CO-FIRING DECARBONISED AMMONIA IN COAL FIRED POWER PLANTS

OVERVIEW

Globally, coal is the largest source of energy for electricity generation (43% in 2021, IEA). Coal-fired power plants are highly cost competitive in electricity generation. They account for about 30% of global CO2 emissions (2021, IEA). Co-firing Coal-fired power plants with decarbonised (Blue and/or Green) Ammonia or **DCAmmonia** has the potential to significantly cut their carbon emissions. Ammonia does not emit Carbon Dioxide (CO_2) when burned.

THE CHEMICAL REACTION

Coal combustion reaction:

$$CH_4 + 2\,O_2 \rightarrow 2H_20 + CO_2$$

Methane + Oxygen → Water + Carbon Dioxide

Ammonia combustion reaction:

$$2NH_3 + \frac{3}{2}\,O_2 \rightarrow 3H_20 + N_2$$

Ammonia + Oxygen → Water + Nitrogen

Ammonia does not emit CO_2 when burned

DIRECT & BLENDED COMBUSTION OF AMMONIA IN PULVERISED COAL FIRED POWER PLANT

To accommodate the combustion of decarbonised Ammonia in existing Coal-fired power plants, relatively minor modifications are required to existing plants. **DCAmmonia** is fed into the modified burners where the ratio and flow rate of **DCAmmonia**, pulverised coal and air mixture is controlled to achieve an efficient and effective combustion process.

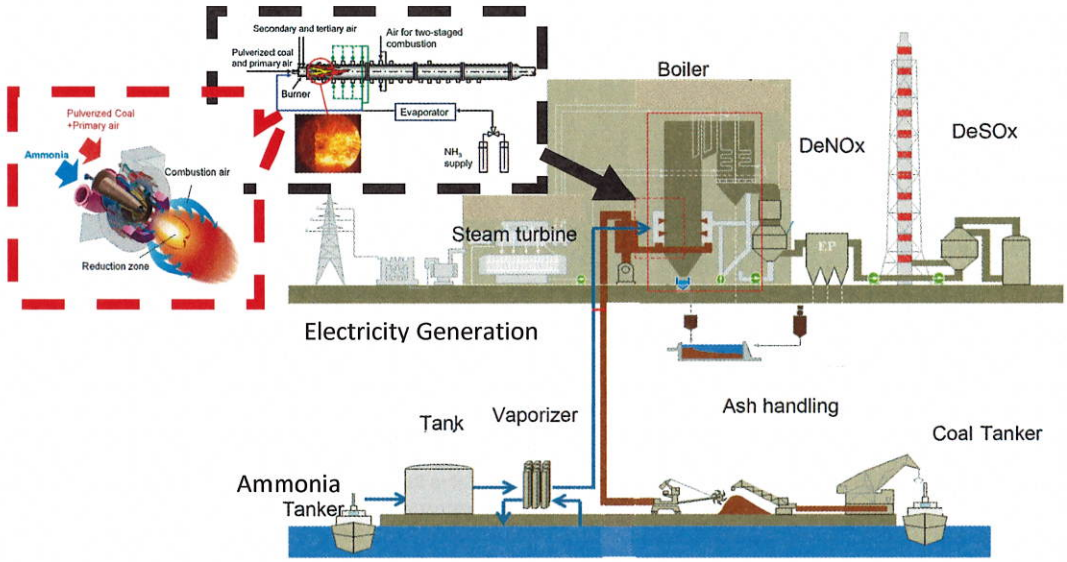

Figure 1 DCAmmonia and Coal cofired power plant schematic (IHI Corporation, 2019) (IHI Corporation, 2021) (Kobayashi et al., 2021)

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INCREASING PERCENTAGE OF DCAMMONIA CO-FIRE TO REDUCE CO_2 EMISSIONS

By using **DCAmmonia** and technologies that increase the percentage of **DCAmmonia** that can be co-fired, CO_2 emissions from coal fired power plants globally could be significantly reduced. If 50% **DCAmmonia** is used (around 20 B tonnes) as shown in the Figure 2 below, CO2 emissions from coal fired power plants globally could be halved.

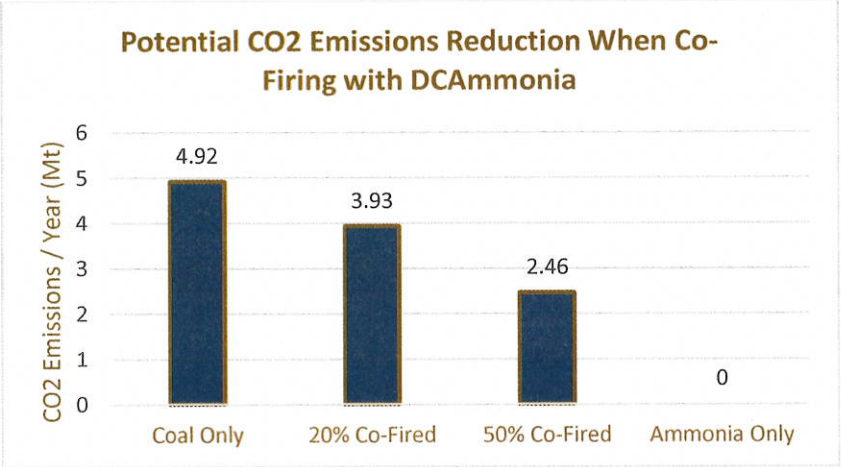

Figure 2 Potential CO_2 emissions reduction when co-firing with DCAmmonia for 1 GW Coal Fired Power Plant (Hirata & Ito, 2021)

DCAMMONIA ADVANTAGES FOR COAL FIRED POWER PLANTS

- No **DCAmmonia** related CO_2 emissions
- Storage of **DCAmmonia** using existing technologies
- Minor modification to existing infrastructure for **DCAmmonia** co-fire
- Ammonia already in use at thermal power plants as part of de-nitration equipment
- Increasing availability of **DCAmmonia** worldwide
- Established international trade (supply chains) for Ammonia can be used for **DCAmmonia**
- Well established **DCAmmonia** transportation processes by vessel versus Hydrogen (H_2)
- Workforce already highly skilled in handling Ammonia

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