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Inspiring science, enhancing life

Cross-sector collaboration to realise new potential in ammonia to power

Priyan Mistry - Business Development Manager

AEA Annual Conference, New Orleans

JM and Doosan each bring our own expertise to help unlock the clean ammonia to power value chain

JM

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Platinum Group Metal Services

Catalyst Technologies

Hydrogen Technologies

Clean Air

Process engineering & licencing

High performance catalysts

HyCOgen™ FT CANS™ (SAF) | **Methanol** | **Ammonia cracking** | **LCH™ (Blue H_2)**

- 100+ years syngas experience
- 480+ licensed plants in over 60 countries

DOOSAN

Energy toward sustainability

Power Plant equipment, EPC and servicing

New Energy Solutions

Material Manufacturing

Materials & engineering → **Equipment manufacture** → **Construction** → **Service**

Wind power | **Gas turbine for power** | **Nuclear (SMRs)** | **Energy storage systems**

JM

DOOSAN

JM and **Doosan's** collaboration on the **integration of ammonia cracking with gas turbine power plants** to decarbonise commercial scale power generation.

JM Johnson Matthey Inspiring science, enhancing life | DOOSAN

EPC = Engineering, Procurement & Construction
SAF = Sustainable Aviation Fuel
SMR = Small Modular Reactor

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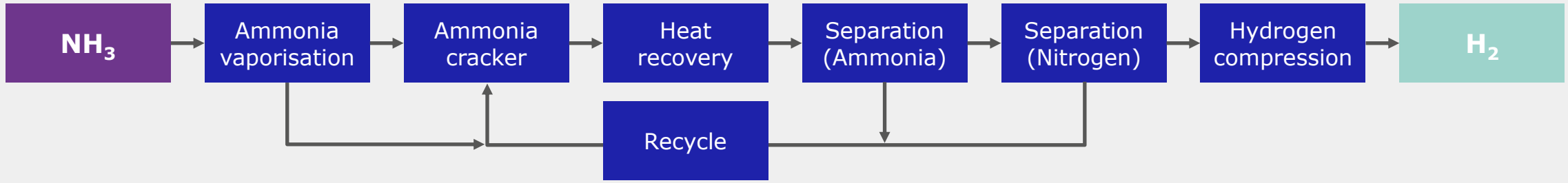
JM’s ammonia cracking flowsheet seeks to drive efficiency whilst achieving a low carbon intensity and footprint



Low Ammonia Consumption

Low Carbon Intensity

Small Footprint

JM’s ammonia cracking process is ready to licence backed up by process guarantees

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Decarbonising power generation is a key driver for hydrogen demand in South Korea

- The South Korean Government's plans to increase the share of clean hydrogen and ammonia-based power generation to **2.1% by 2030** and **7.1% by 2036**.
- This equates to:
  - 13 TWh by 2030 and 47.4 TWh by 2036,
  - 0.65 mtpa hydrogen by 2030 and 2.37 mtpa hydrogen by 2036*.
- Ammonia cracking is a promising solution to supply hydrogen for power generation in South Korea.

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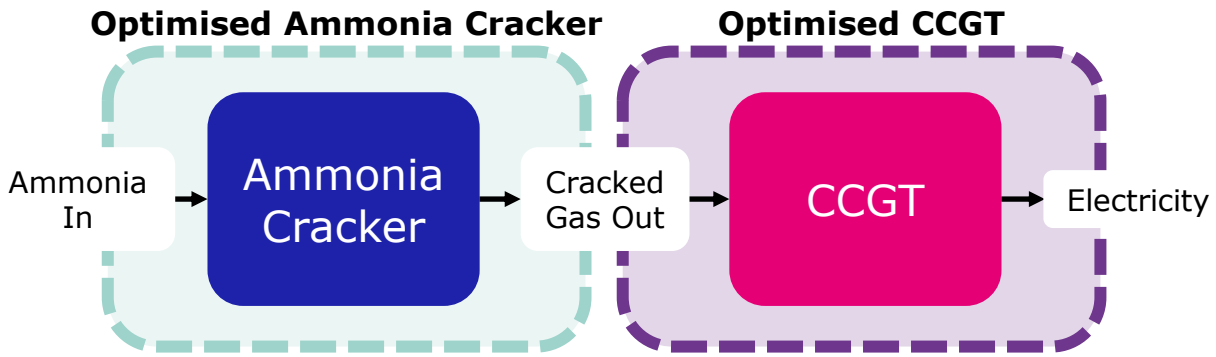
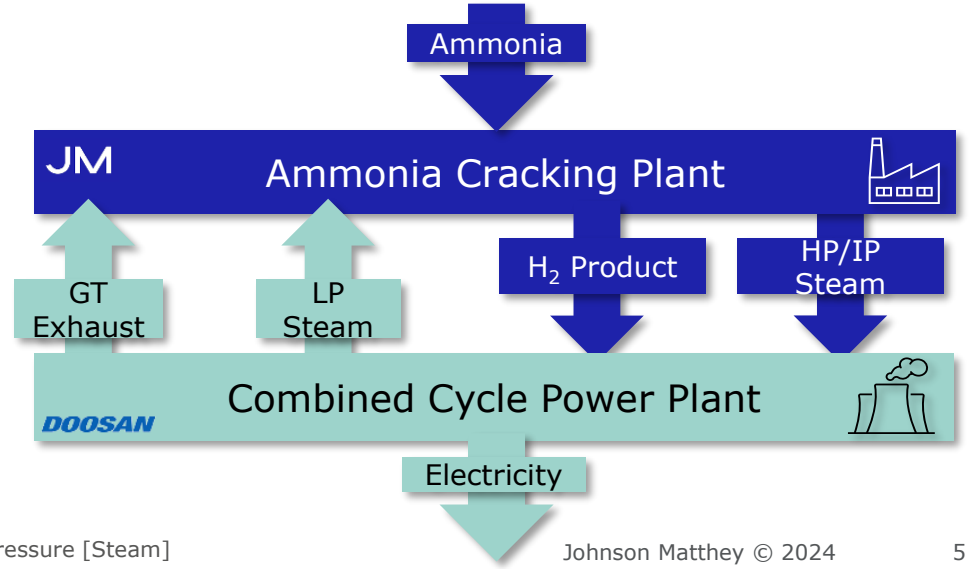
International Trade Administration, "Energy - Carbon Neutrality Initiatives", 2023
* LHV basis assuming 60% CCGT efficiency

A holistic flowsheet optimisation approach was used to drive improvements

- JM and Doosan have designed an ammonia cracking flowsheet utilising **hot turbine exhaust gases** that is **integrated with the CCGT's steam system**.
- Enables **flexibility**, capable of operating at **low turndowns**, operating on **hot standby**, and **ramping** back up **quickly** to meet CCGT demands.

Optimised Seperately **<** **Optimised Together**





CCGT = Combined Cycle Gas Turbine
GT = Gas Turbine
HP/IP/LP = High/Intermediate/Low Pressure [Steam]

The integrated flowsheet offers superior performance and daily start-up and shut down

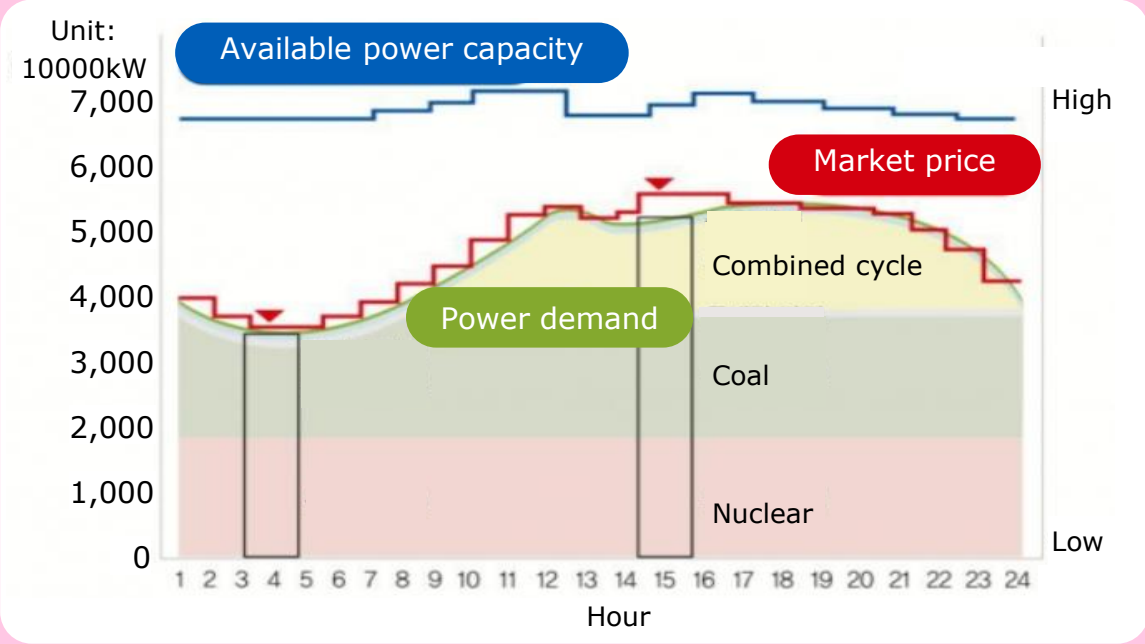
Superior Hydrogen Combined Cycle Performance

Up to **2.3% increase in steam turbine output** through ammonia cracking and CCGT integration

		Standalone type	Integrated type	
			Base case	Optimised
Interface between cracker & CCGT	HP Steam Flow to HRSG	N/A	100	223
	IP Steam Flow to HRSG	N/A	100	68
	LP Steam Flow from HRSG	N/A	100	138
ST Power Output		100.0	101.4	102.3

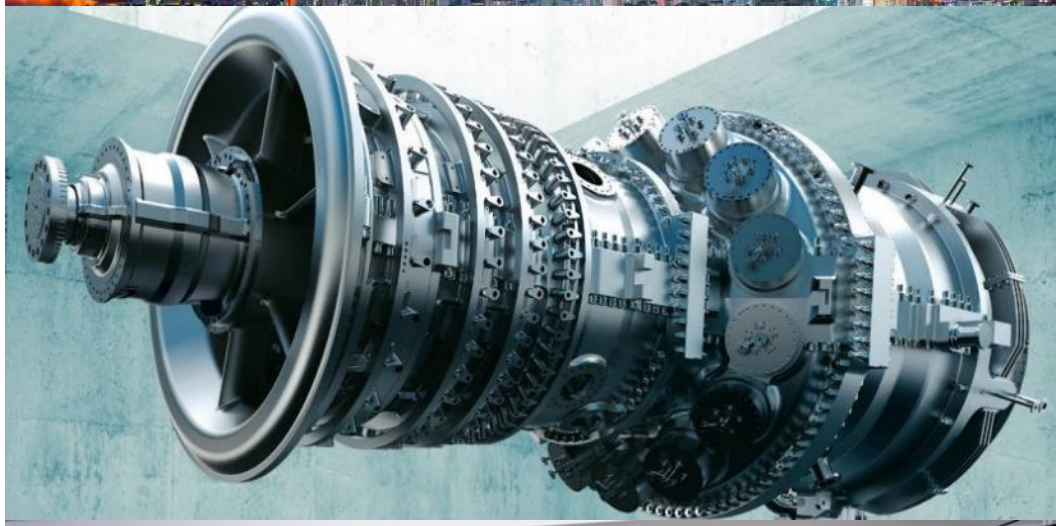
Effective "Daily Start-up and Shut-down" (DSS)

Solutions developed to address the allow the ammonia cracker to operate in a DSS environment



Driving hydrogen power in South Korea: efficient integration of ammonia cracking and CCGT for a flexible, reliable energy future

- South Korean Hydrogen Power Policy is driving the demand for the use of hydrogen in the power sector.
- Gas turbines that utilise a natural gas and hydrogen mix are expected to contribute to achieving targets.
- Ammonia cracking provides a **flexible and reliable source of hydrogen**.
- Integration of ammonia cracking with CCGT provides **process and energy efficiencies**.
- **JM & Doosan's collaboration** has created a solution **optimised** around the **fluctuating demand** required of a Combined Cycle Power Plant, enabling a **reliable hydrogen supply** and **improving efficiency**.



Graphic Courtesy of Doosan Enerbility

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