Ammonia Energy Association, Australia 2022

Green Chemical/ Ammonia Demonstration Project

Enhancing **planetary health**

Aug 24, 2022

Mototaka KAI

Sustainability Co-Creation Department, JGC Holdings Corporation

Investment & Business Promotion Group, Low Carbon Energy & Chemical Division,

Sustainable Solutions, JGC Corporation

JGC Group Structure

JGC Holdings Corporation

JGC Corporation

Energy Solutions | **Sustainable Solutions** | Facility Infrastructure Solutions | Project Solutions Center

Total Engineering

- Oil and Gas Production, Separation, Integration
- LNG/ FLNG
- Petroleum Refining
- LNG/LPG Receiving Terminal
- Renewable Energy
- Healthcare/ Life Science
- Power Generation
- Water Treatment

- **Hydrogen/ Ammonia**
- **Chemical Recycling**
- **SAF**
- **Chemicals**
- **Non Ferrous Metal Refining**
- **Nuclear Energy**
- **CCS ***

* Together with ES & PSC

JGC Japan Corporation

Total Engineering

- Petroleum Refining
- Power Generation
- Manufacturing Facilities
- Healthcare/ Life Science
- Plant Maintenance
- Hydrogen/ Ammonia
- CCS
- SAF

JGC Catalysts and Chemicals

Japan Fine Ceramics

Manufacturing

- Catalyst
- Fine Chemicals
- Fine Ceramics

JAPAN NUS

Domestic and Overseas Affiliates

Consulting & Others

- Environment
- Energy and Resources
- Social Science

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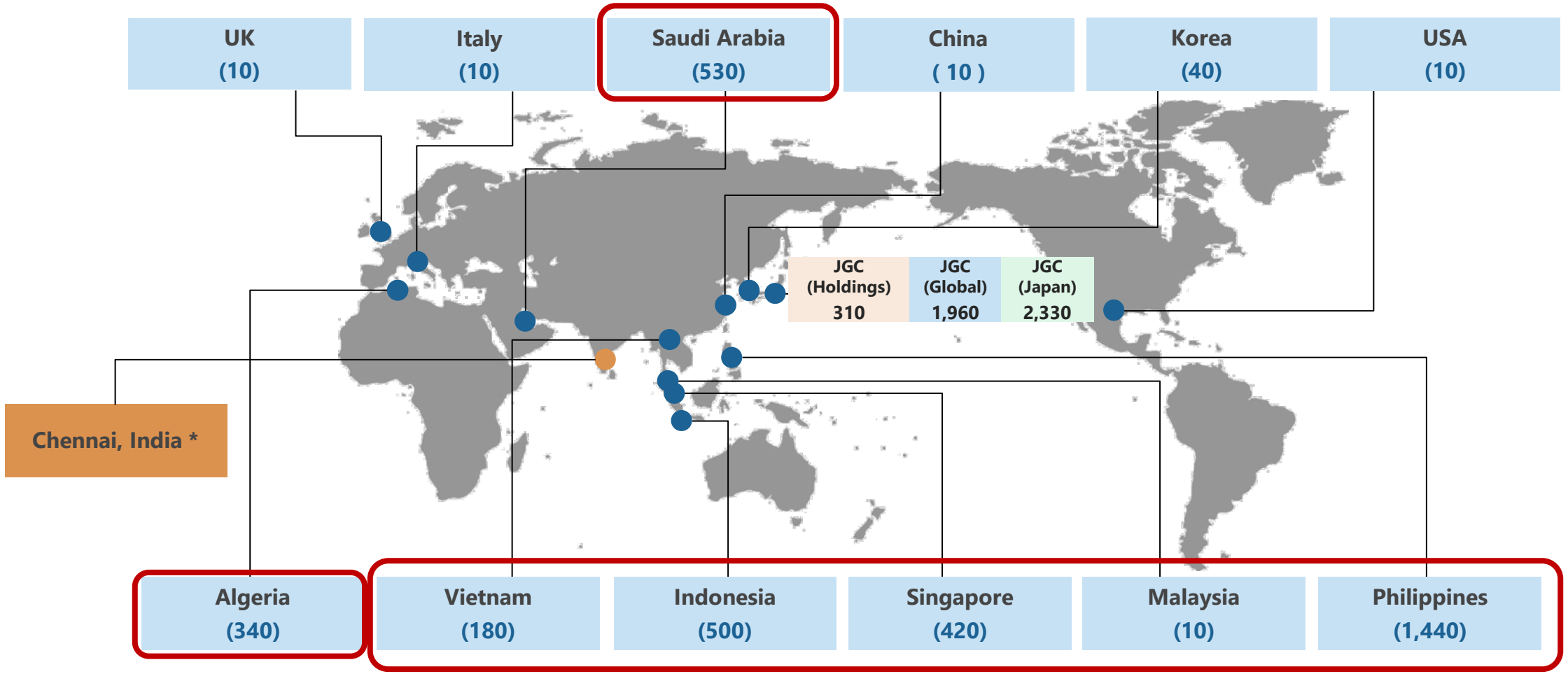
JGC Worldwide Resources

Total JGC Group Manpower: Approx. 8,100



* To start operation from Nov 2022, and plan to be 250 by Mar 2023, and 1,000 by 2040

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JGC&TOYO; Ammonia Alliance Japan

JGC and TOYO entered Business Alliance for Fuel Ammonia Project

Strengths	Strengths
• Extensive experience in **large scale projects** and **modular construction** • More than **20,000 projects** in over 80 countries	• Extensive experience with **KBR licensed ammonia** plant • More than **80 Ammonia projects**

JGC&TOYO Ammonia Alliance Japan can

- **provide one stop high value solution from planning phase to EPC in a timely manner with KBR licensed ammonia process**
- **offer the competitive proposal based on the extensive experience of both parties**

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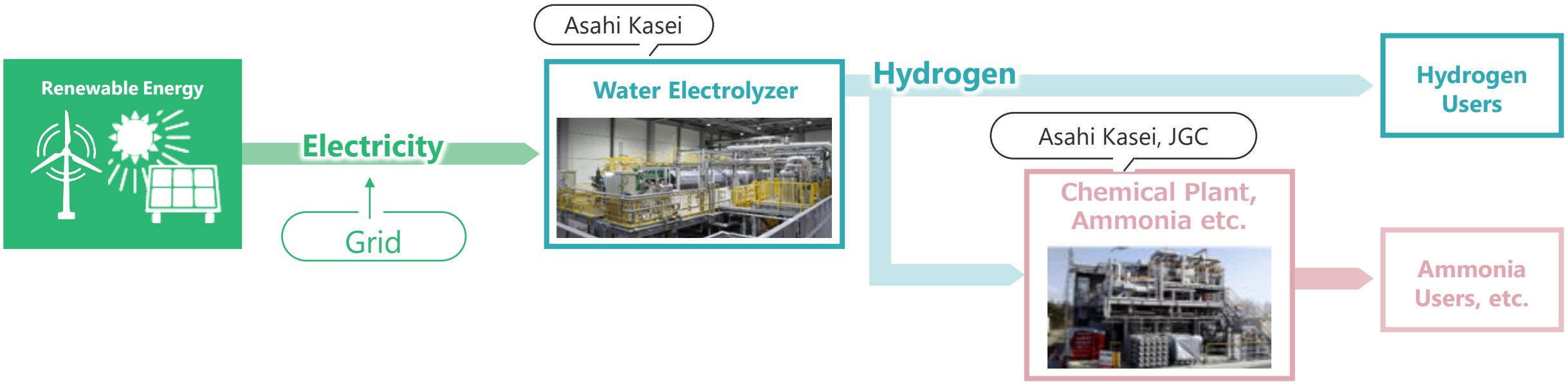
JGC's Activities for Green Ammonia <Power to Chemical Demonstration>

Outline

- JGC and Asahi Kasei have been selected and started "**Large-scale Alkaline Water Electrolysis System Development and Green Chemical Plant Demonstration**" under "Green Innovation Fund" by NEDO＊
- Semi-commercial scale (Phase 1) and Commercial scale (Phase 2) for 10 years till FY 2030



＊NEDO（New Energy and Industrial Technology Development Organization）, https://www.jgc.com/jp/news/assets/pdf/20210826j.pdf

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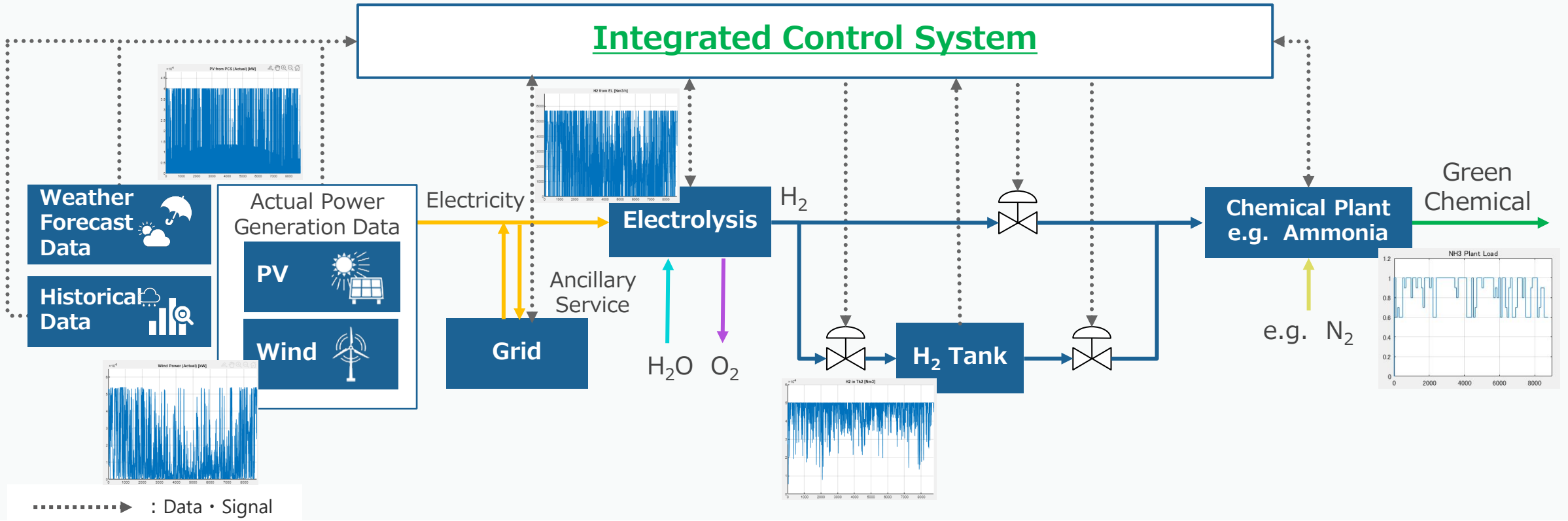
JGC's Activities for Green Ammonia <Integrated Control System>

Outline

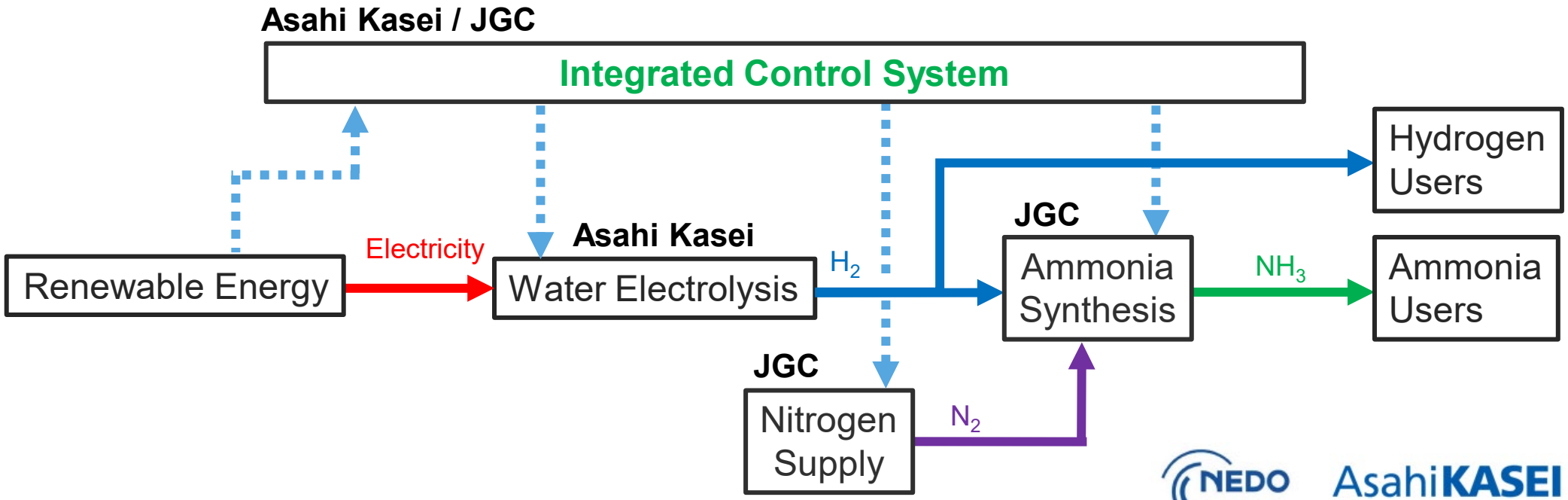
In Green Chemical Process, such as Ammonia, fed with Hydrogen derived from Fluctuating Renewable Energy, "**Integrated Control System**" which manages hydrogen supply and realize chemical plant's optimum operation with minimum downtime will be developed and demonstrated.



Semi-commercial scale（2024～ Demonstration operation ; Phase1）

- To establish system connecting Asahi Kasei's Water electrolysis(**10MW**) with JGC's Ammonia synthesis facilities (**4 ton/day**)
- Planning to utilize Asahi Kasei's Water electrolysis system in FH2R *
- Joint development of "**Integrated Control System**"
- Produced ammonia will be utilized as De-NOx agent in thermal power plant, or material for chemical or fertilizer production plant, and local supply chain will be studied.

* Fukushima Hydrogen Energy Research Field



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Semi-commercial scale（2024～ Demonstration operation ; Phase1）

Current Status and Milestone

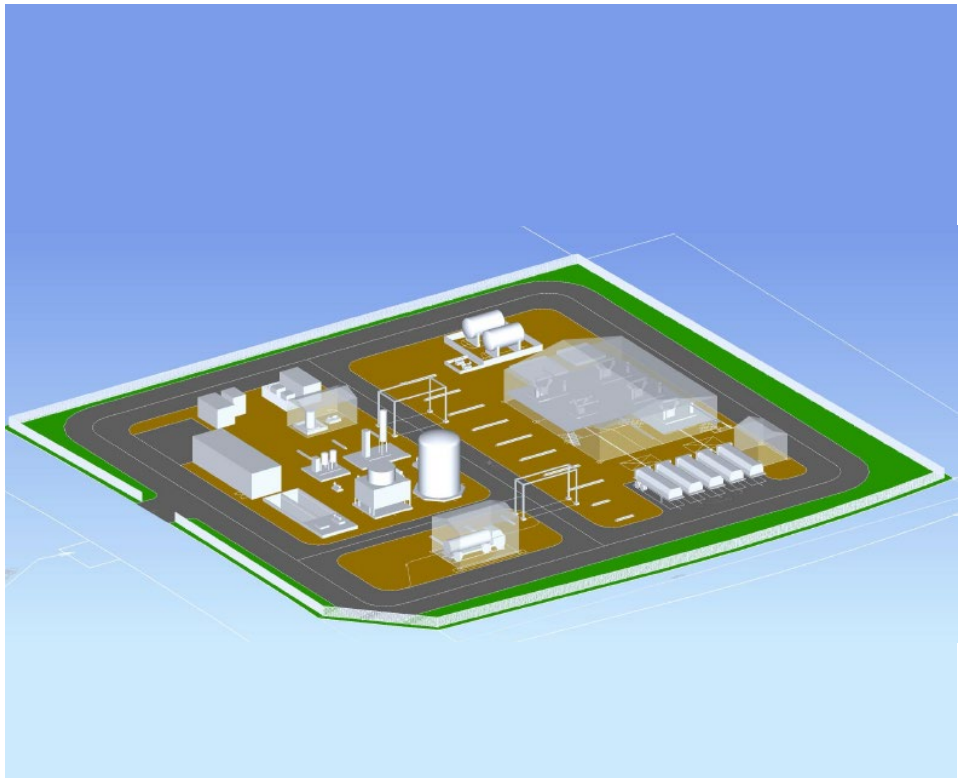
FEED* for Green Ammonia Plant has been completed By JGC & JGC Japan, with KBR Ammonia Synthesis Process

▼

Within Fiscal Y.2022 : Start of EPC**

▼

Within Fiscal Y. 2024 : Start of Demonstration Operation, Operation until Fiscal Y. 2026



Sample of 3D Image of Ammonia Plant

＊ FEED = Front End Engineering Design
＊＊ EPC = Engineering Procurement Construction

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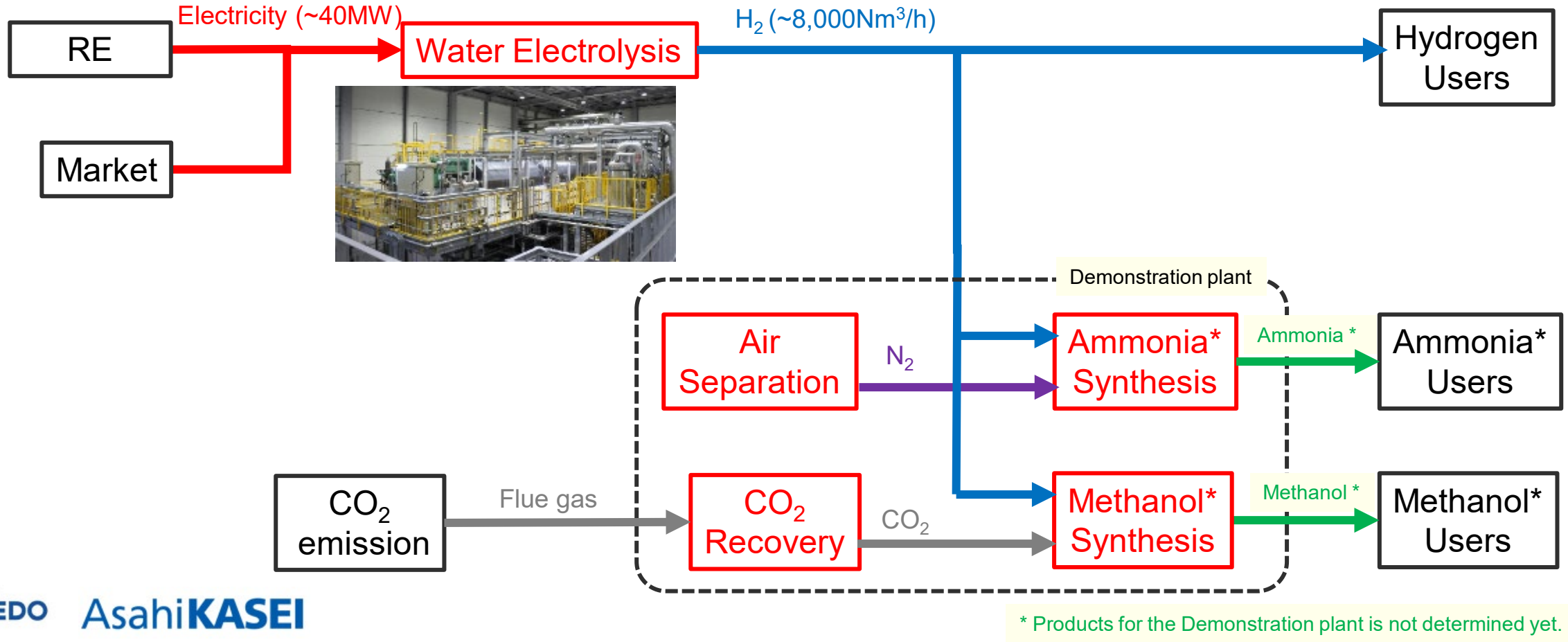
Commercial Scale（2027～Demonstration operation；Phase 2）

- Installation of **Large-scale Alkaline Water Electrolysis System (40MW)** with Basic Chemical Synthesis Facility
- Hydrogen production by renewable energy and electric power market、Basic Chemical Synthesis, such as **Ammonia and/or Methanol**, Demonstration operation as Decarbonized plant



* Products for the Demonstration plant is not determined yet.

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THANK YOU VERY MUCH

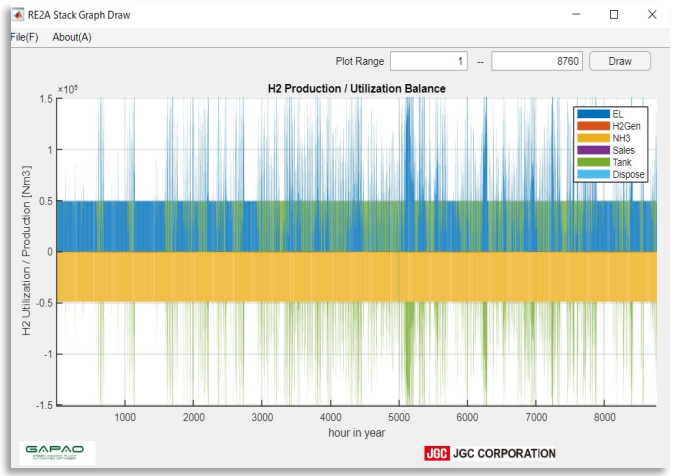
WE LOOK FORWARD TO BEING INVOLVED IN YOUR CLEAN H_2 & AMMONIA/CHEMICAL PROJECTS, AS ENGINEERING AND/OR INVESTMENT PARTNER

JGC

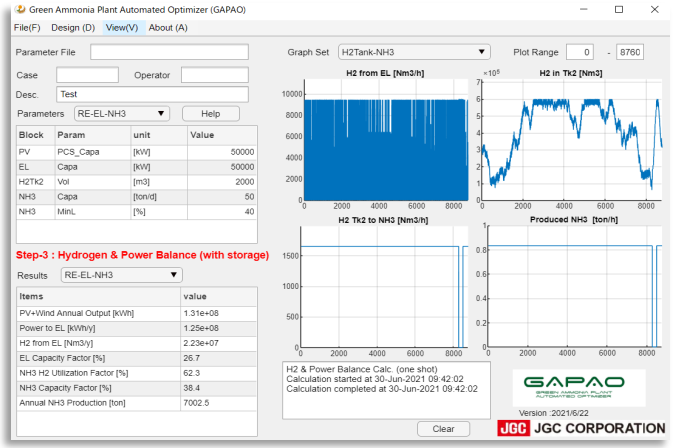
Enhancing planetary health

Green Ammonia Plant Automated Optimizer (for Design)

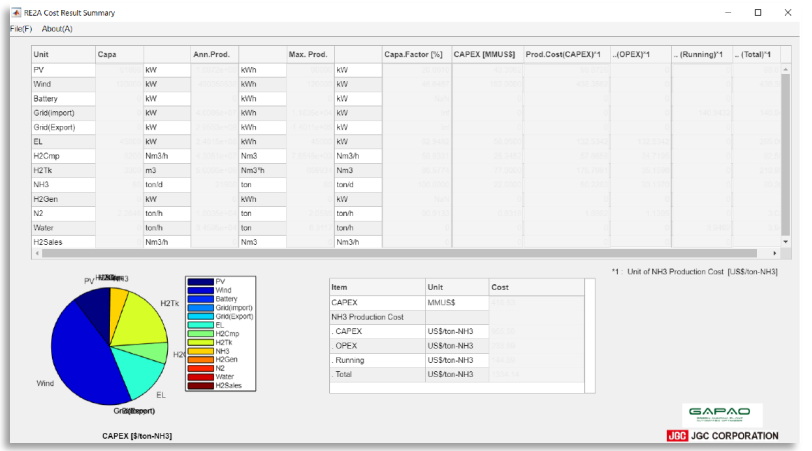
◆ Output Image



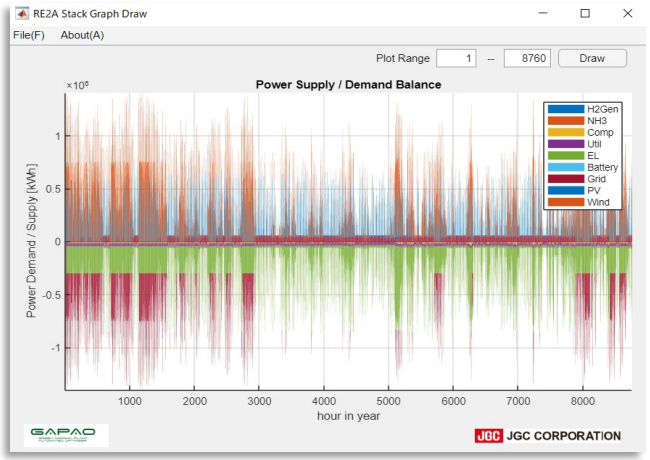
Hydrogen balance



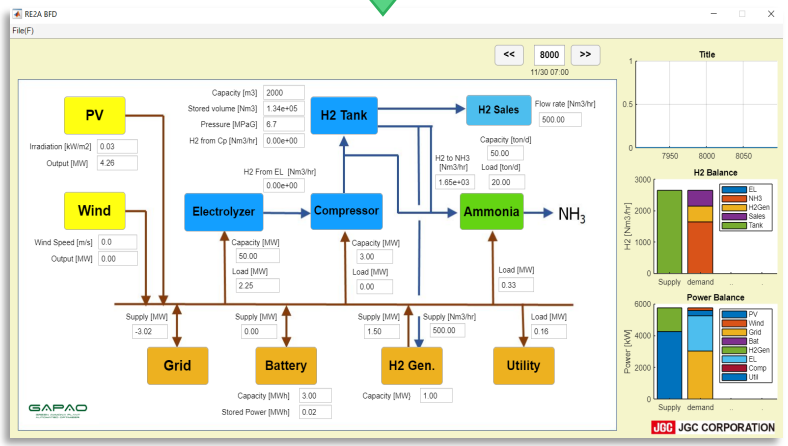
Main GUI



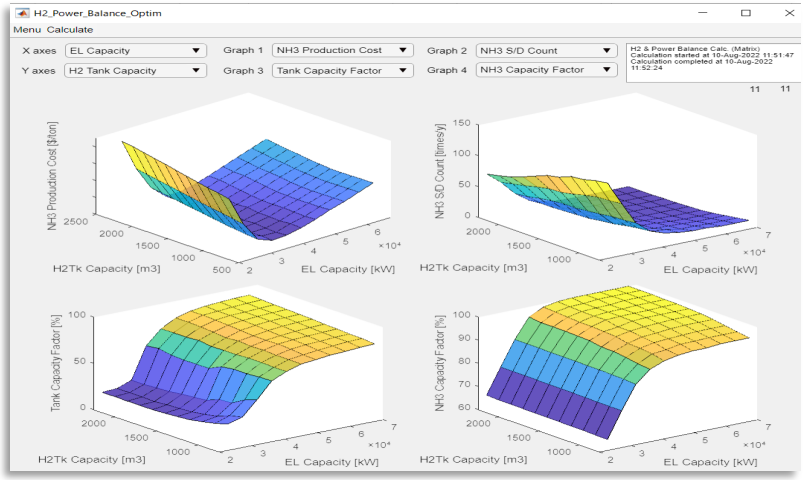
Levelized cost and breakdown



Power balance



Block flow diagram and material balance



3D graphs visualizing optimum design point

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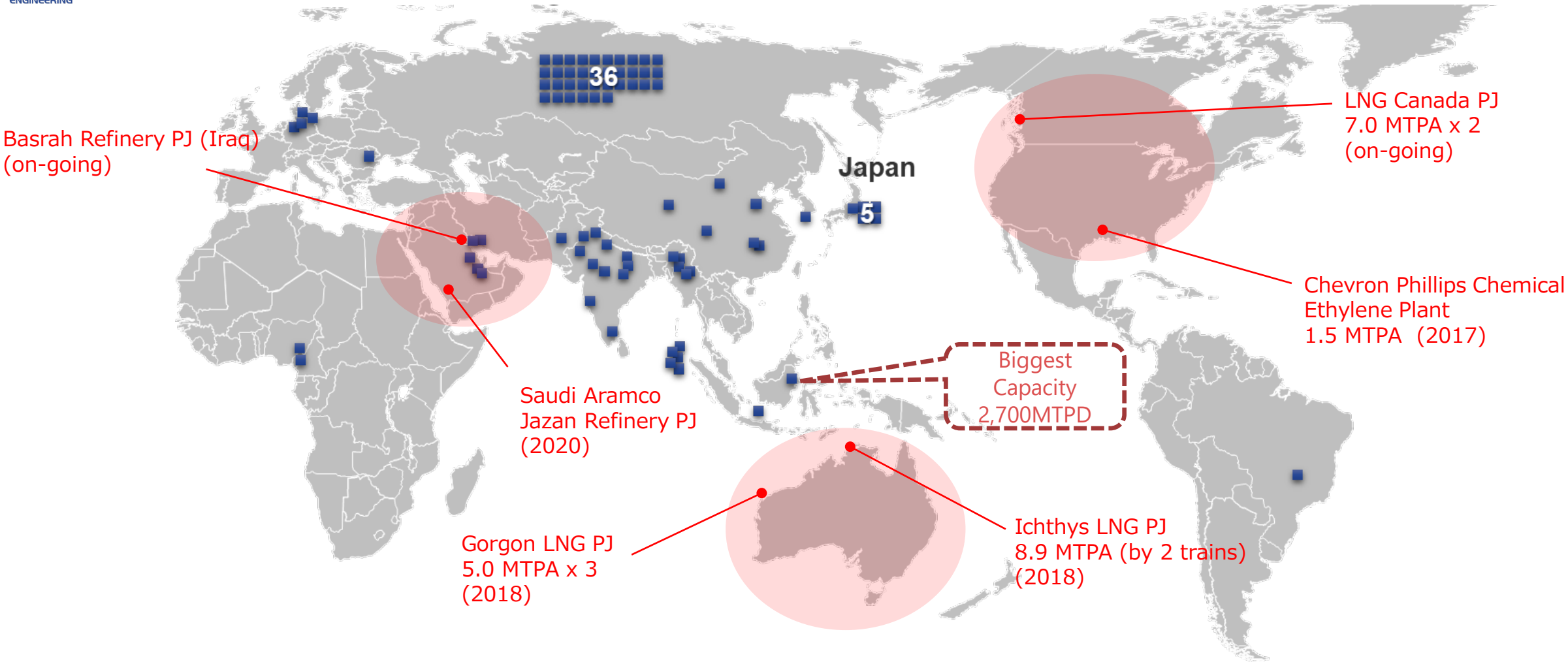
TOYO's Ammonia Experience × JGC's Large EPC Experience

86 Ammonia Experience



JGC Experience with more than 20,000 projects in over 80 countries

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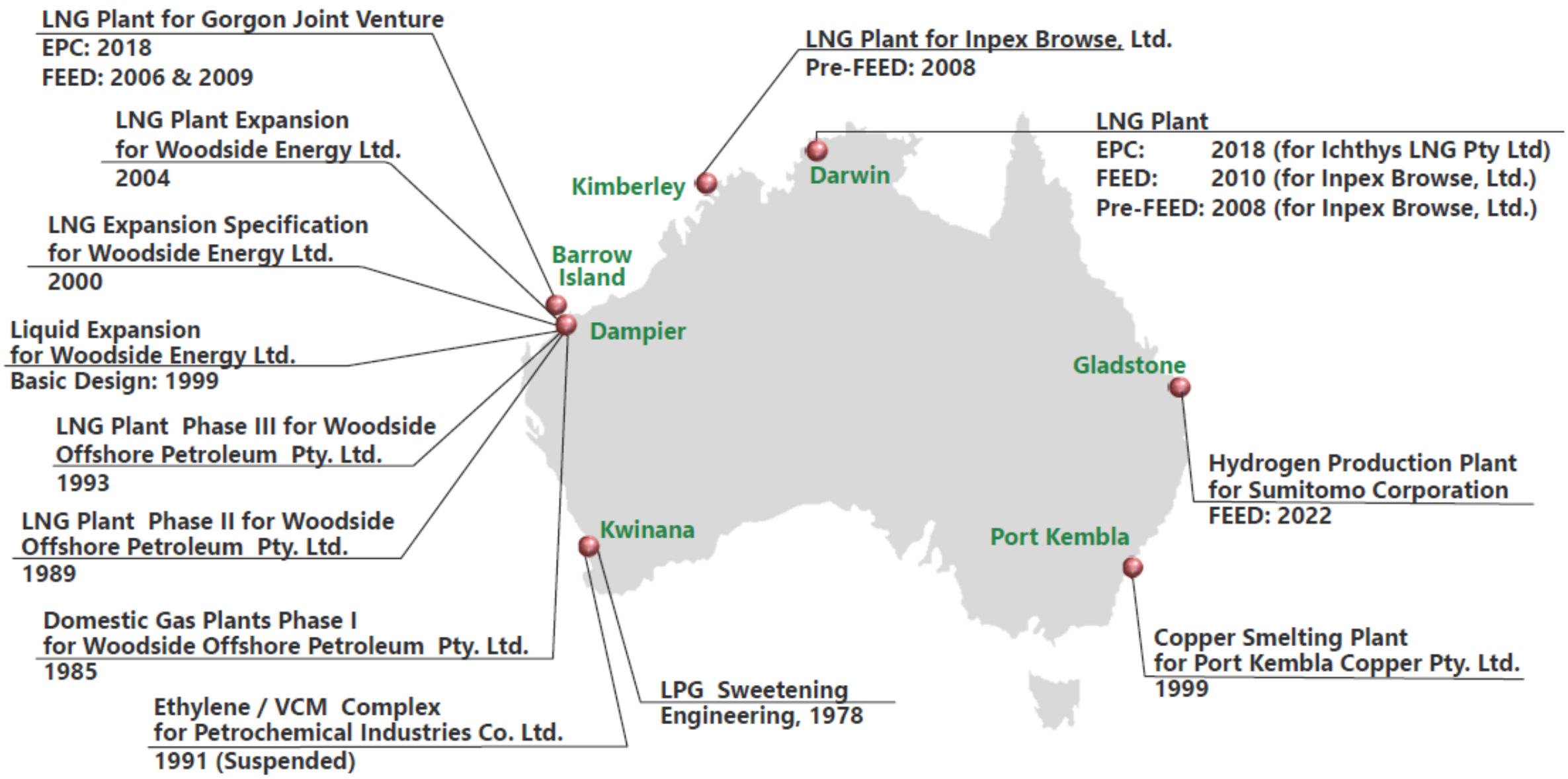
JGC's Experience in Australia



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JGC's Modular Construction Experience

Onshore Module

- Gorgon LNG (Australia, 2009-2017)
- Ichthys LNG (Australia, 2012-2018)
- Yamal LNG (Russia, 2014-2018)
- LNG Canada (Canada, 2018-)

Offshore Module

- PFLNG2 (Malaysia, 2014-)
- Prelude FLNG (Australia, 2016-2017)
- Coral FLNG (Mozambique, 2017-)

Engaged in modularized plant for more than 30 years in each project phase; Pre-FEED, FEED and EPFLC/EPCIC

JI Module

- **Innovative Module Concept to minimize on-site work**
- **Relieve impact of various project risk**