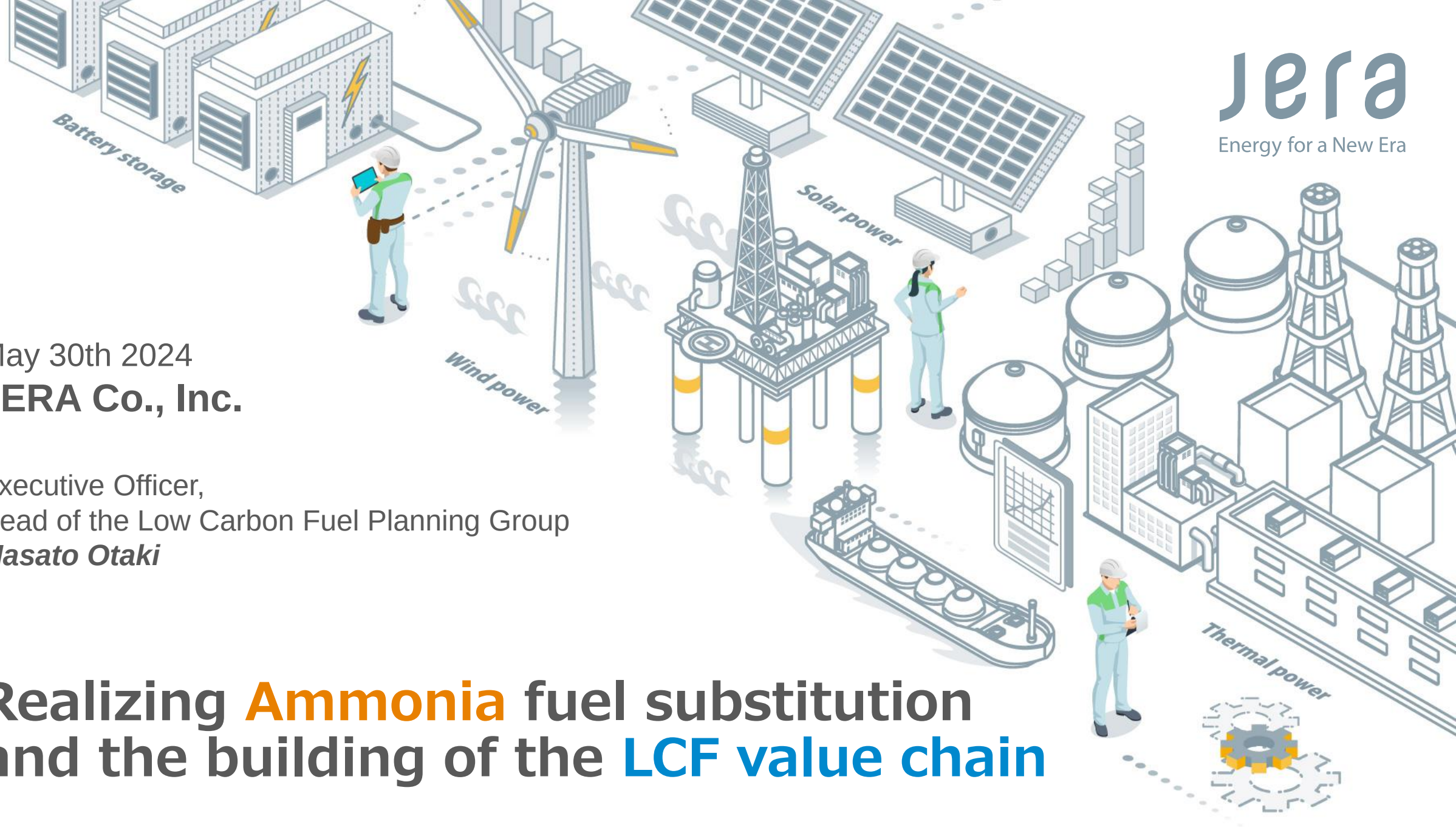


jera
Energy for a New Era

May 30th 2024

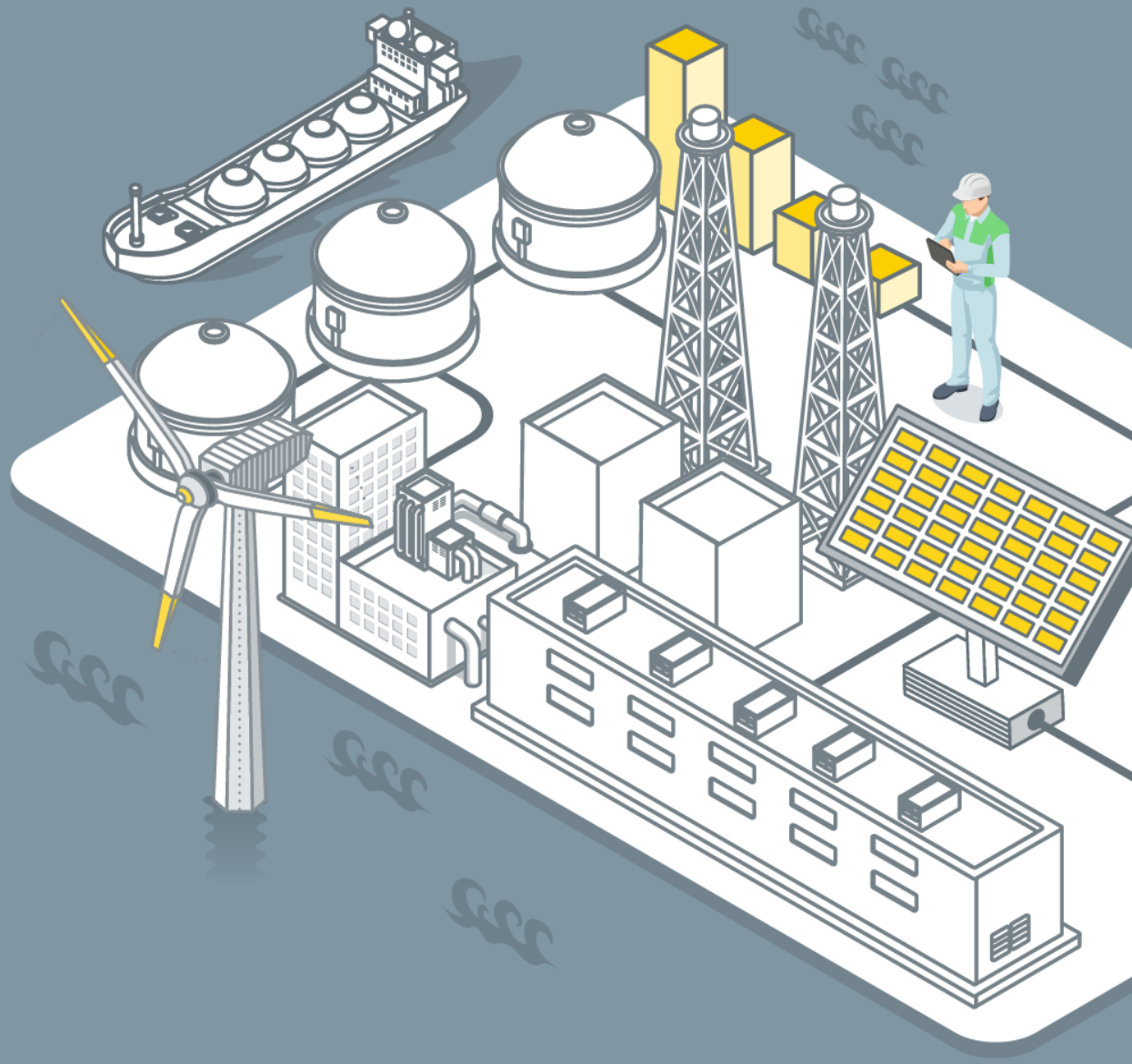
JERA Co., Inc.

Executive Officer,
Head of the Low Carbon Fuel Planning Group
Masato Otaki

Realizing Ammonia fuel substitution and the building of the LCF value chain

Our Company

Taking Energy into a New Era



JERA's Origins: The Path to Business Consolidation

TEPCO

CHUBU Electric Power

JERA
Energy for a New Era

April 2015
JERA established

October 2015
Consolidation of fuel transportation and trading businesses

July 2016
Consolidation of fuel sourcing and procurement, overseas power generation, and energy infrastructure businesses

June 2017
Joint-venture agreement concluded to consolidate existing thermal power generation businesses

May 2018
Absorption-type company split agreement concluded to consolidate existing thermal power generation businesses

April 2019
Existing thermal power generation businesses consolidated

JERA's Value Chain

Total Assets
Approx. JPY
9.1 trillion

LNG Transaction Volume (Annual)
Approx. **35** MTPA
Among the largest in the world

Revenue
Approx. JPY
4.7 trillion

Upstream Development Fuel Procurement

- Upstream Investment

6 Projects

- LNG Procurement from

15 countries [1]

Fuel Transportation

- LNG Fleet Carriers

18 carriers

Optimization and Trading

LNG Receiving and Storage Terminals

- LNG Tank Capacity in Japan

6.65 million kL [2]

- Equivalent to

Approx. 30% [2]

of LNG tank capacity in Japan
Source : The LNG industry, GIIGNL Annual Report 2022

- LNG Receiving Terminals in Japan

11 terminals [2]

Domestic and Overseas Power Generation

Domestic Power Generation

- Thermal Power plants

26 plants [3]

- Power Generation Capacity

Approx. 61 GW [3]
The Largest in Japan
Source : FY2022 Electricity Survey Statistics ("METI")

- Power Generation Output

Approx. 235 TWh [3]
Equivalent to approx. 30% of power generation in Japan
Source : FY2022 Electricity Survey Statistics ("METI")

Overseas Power Generation

- Number of projects

In more than 10 Countries
Approx. 30 Projects

- Power Generation Capacity

Approx. 12.4 GW [3]
(Output Corresponding to Equity)

- Renewables Development Capacity

Approx. 2.5 GW
(Included Power Generation Capacity)

Electricity and Gas Sales

*Upstream Development Photo: Chevron Australia

Current as of March 31, 2023 (FY2022)
[1] Represents the number of countries that imported LNG to LNG receiving terminals of JERA.
[2] Includes jointly operated terminals in Chita and Yokkaichi area.
[3] Includes capacity under construction. Excludes joint thermal power in Japan.

Taking Energy into a New Era

Mission

To provide

cutting-edge solutions

to the world's energy issues

Vision

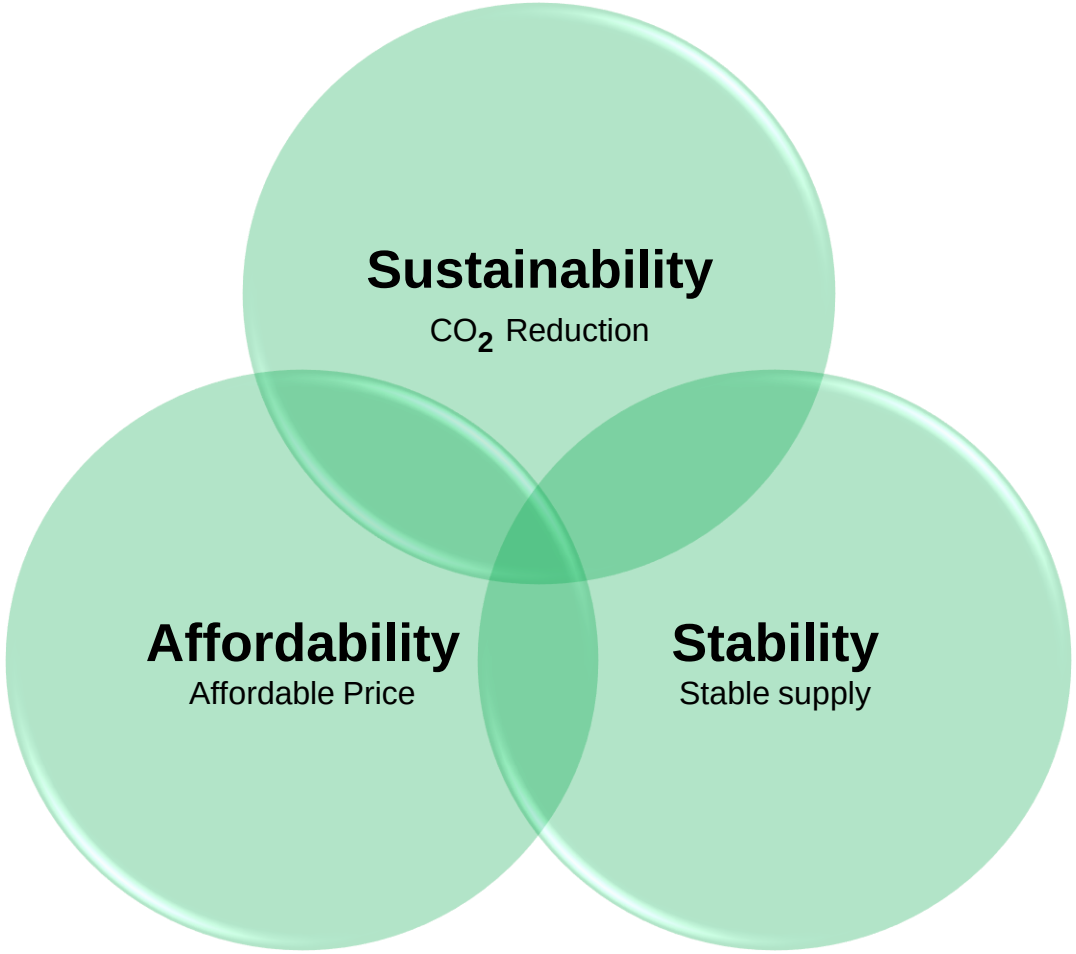
To scale up its clean energy platform of renewables and low greenhouse gas thermal power, **sparking sustainable development in Asia** and around the world

Energy for a New Era

Our Decarbonization Strategy

JERA Zero CO_2 Emissions 2050

What is the Global Energy ~~dilemma~~ Trilemma?



The challenge of achieving zero CO_2 emissions from domestic and overseas operations

The Three Approaches of JERA Zero CO_2 Emissions 2050

1

Complementarity between **Renewable Energy** and **Zero CO_2 Emission Thermal Power Generation**

2

Establishment of Roadmaps Suitable for Each Country and Region

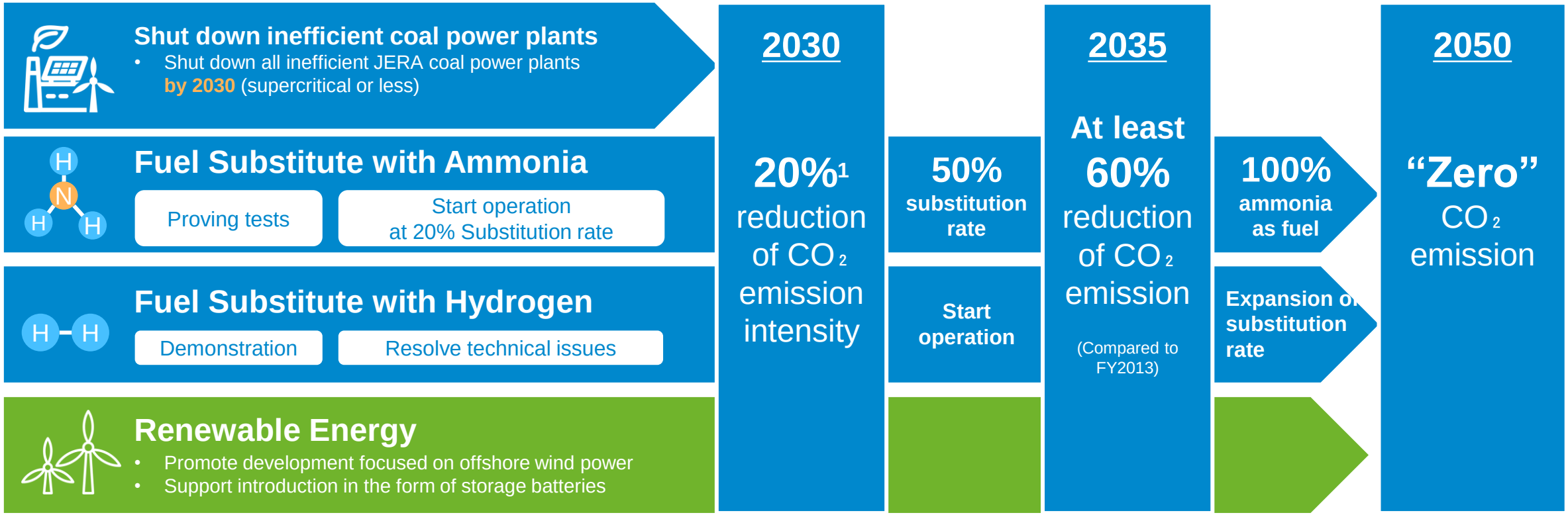
3

Adoption of “Smart Transition”

JERA Zero CO_2 Emissions 2050 is premised on the continual development of decarbonization technology, economic rationality, and consistency with government policy. JERA is continuing to develop original decarbonization technologies and is taking the initiative to ensure economic rationality.

JERA Zero CO_2 Emissions 2050 Roadmap for its Business in Japan

- We have established the “JERA Zero CO_2 Emissions 2050 Roadmap for its Business in Japan,” which comprises four initiatives.
- Energy situations vary by country and region and include issues like the presence of regional transmission lines or pipelines. JERA works with stakeholders on a country and regional basis to establish viable roadmaps.



[1] Reduce carbon emission intensity of thermal power plants by 20% based on the long-term energy supply-demand outlook for FY 2030 as set by the government

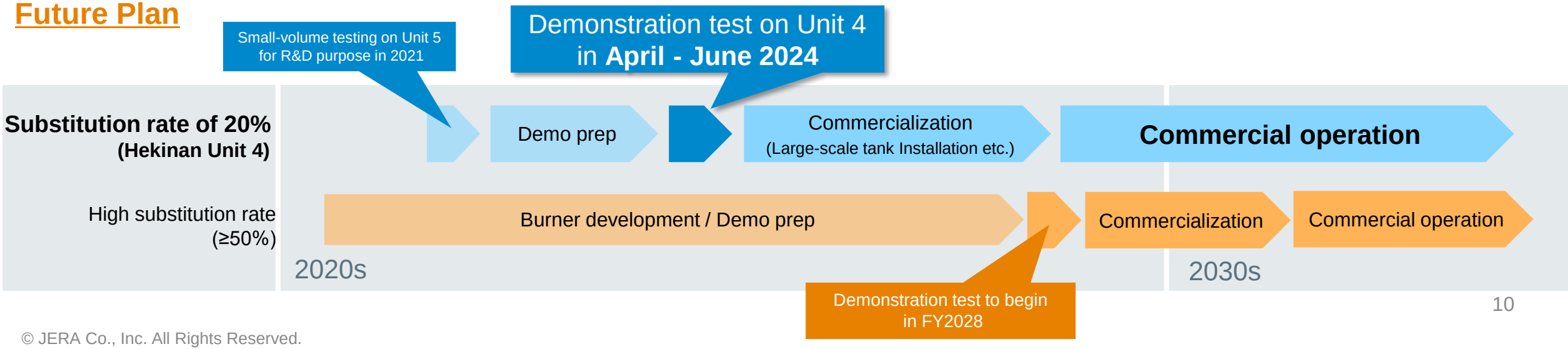
Demonstration Test of Fuel Ammonia Substitution at Hekinan Thermal Power Station

Overview of Our Ammonia Fuel Substitution Demonstration Test and the Steps for Commercial Operation and High-ratio Combustion

World's first demonstration test of large-volume fuel ammonia substitution (20% of heating value) at a large-scale commercial coal-fired thermal power plant **funded by NEDO.**

Item	Content
Project location	**HEKINAN** Thermal Power Station - Unit 4 (Output: 1GW) / **JERA, IHI**
Objectives	✓ Establish ammonia substitution technology at a large-scale commercial coal-fired power plant ✓ Evaluate boiler heat absorption characteristics, environmental impact and operation ability
Project Concept	✓ Modify and replace all 48 existing burners for ammonia firing ✓ Construct the facilities for ammonia fuel supply and sufficient equipment for safety operation
Ammonia Usage	approx. 40,000 tons
Ammonia Receiving	Unloading arm for fuel ammonia at coal jetty for demonstration test purpose

Future Plan



Overall Layout of Hekinan Thermal Power Station (Demonstration test purpose)

Ammonia is received at the unloading berths for coal ships

Coal storage yard

Unit 1

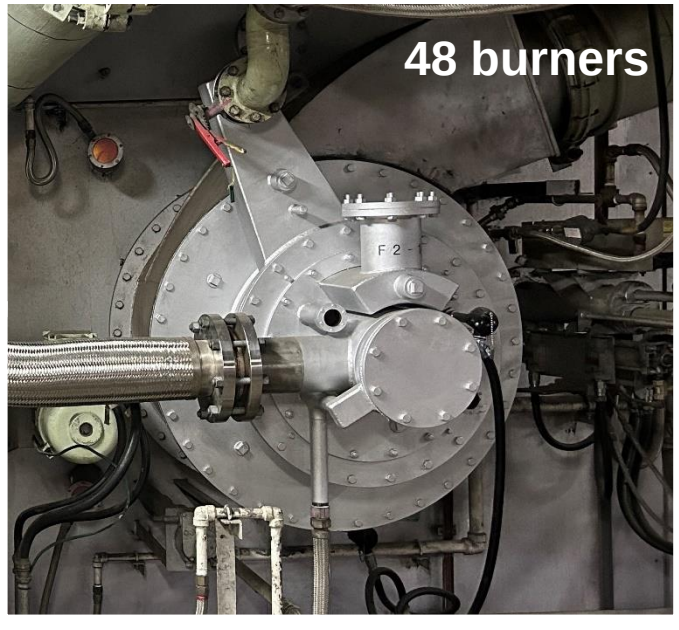
Unit 2

Unit 3

Unit 4

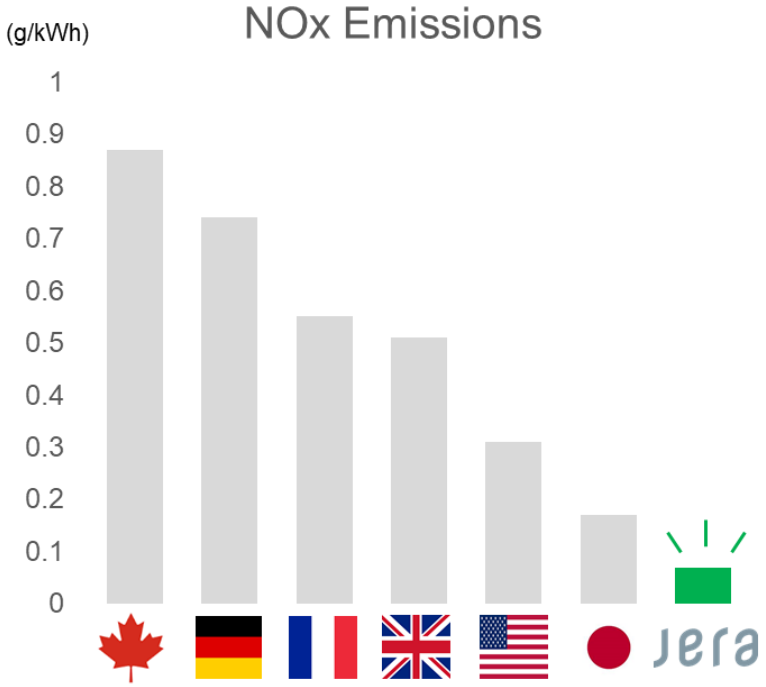
Unit 5

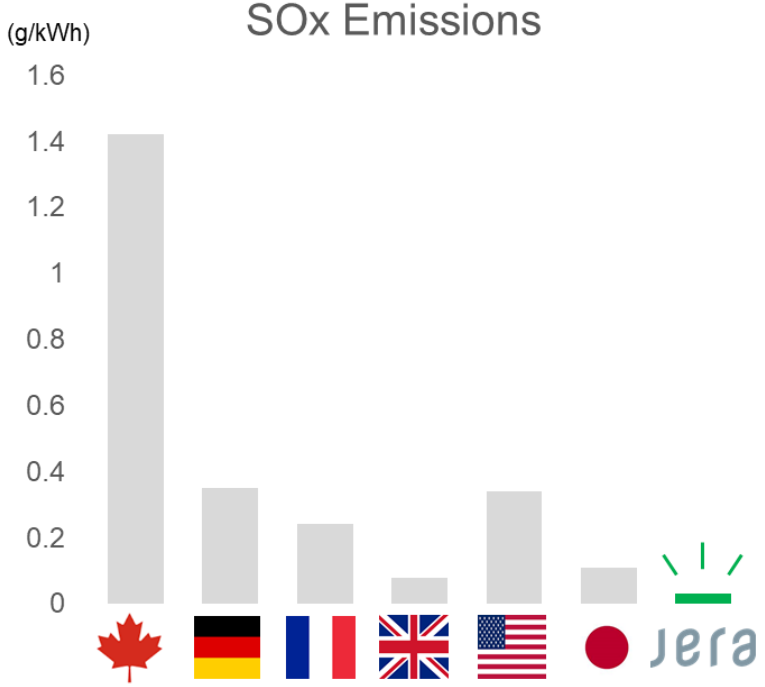
Boiler



Ecosystem Conservation - JERA's Efforts to Reduce NOx/SOx

- JERA committed to sustainable energy supply from a broad perspective, addressing not only CO2 emissions but also aiming to protect the global environment and ecosystems."
- JERA has succeeded in **reducing NOx/SOx emissions to the world's lowest level** by utilizing high-performance denitrification and desulfurization technology. JERA will continue to introduce the latest technologies to further reduce emissions.





Ammonia Fuel Substitution Demonstration Test

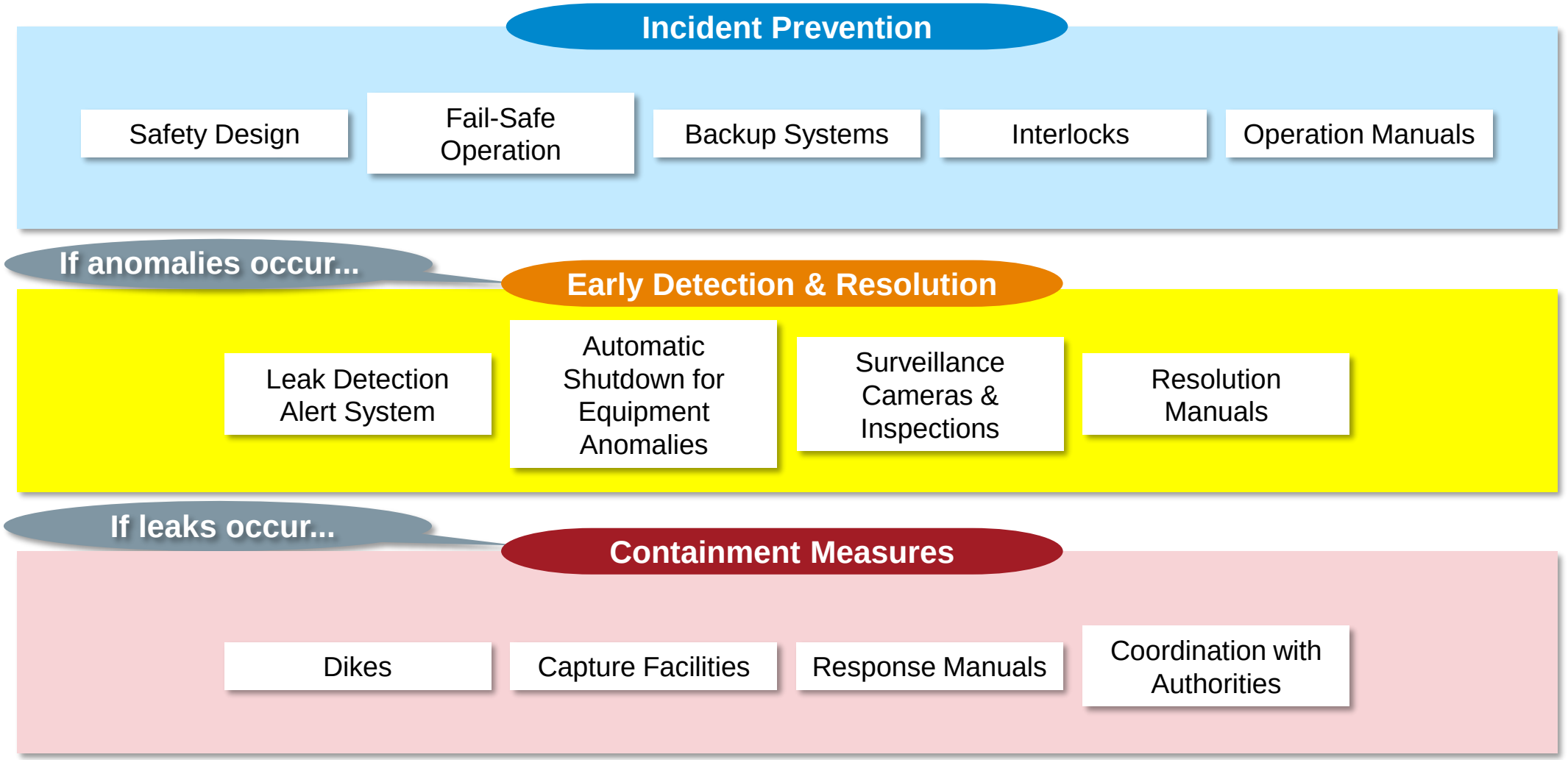
Results of the evaluation are good so far,
NOx and SOx are equal or less than before*
the fuel substitution.

Sources: OECD Stat (NOx emissions), IEA "WORLD ENERGY BALANCES" (Electricity generated).

* Official announcement of the results of the demonstration test shall be made after further evaluation with IHI/NEDO

Our Safety Initiatives

- Based on the safety design of **cryogenic LNG facilities** and **ammonia facilities for de-nitration**, which have been handled in thermal power stations for many years, **safety design and measures** are taken to take into account the characteristics of fuel ammonia.

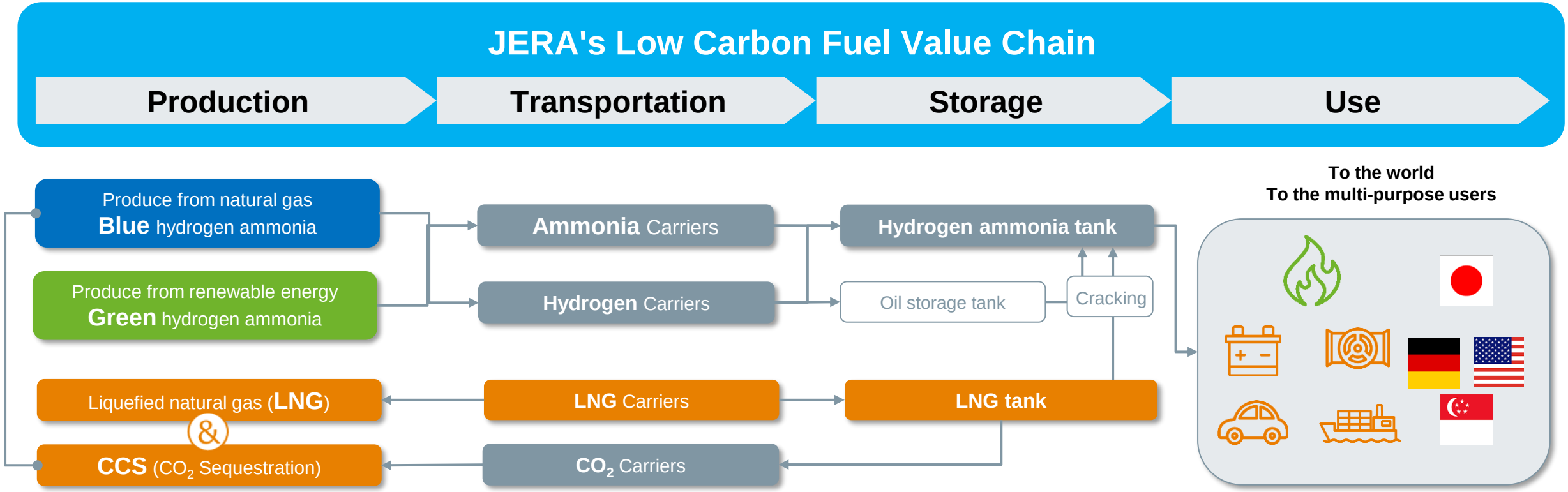


The Pathway forward

How to establish LCF value chain

JERA's initiatives for establishing Low Carbon Fuel Value Chain

- Challenge to establish LCF solutions including hydrogen and ammonia to decarbonize existing thermal power plants
- FY2023: Completed the turbine modification for the combustion of a **40% hydrogen mixture** at gas-fired power plants in U.S.
- FY2027: **World first commercialized ammonia power** generation in Japan.
- In the future, JERA will work on CCS and other projects in parallel, aiming **to provide low-carbon fuel solutions** across countries.



JERA’s initiatives for establishing Low Carbon Fuel Value Chain

JERA's Low Carbon Fuel Value Chain

Production → **Transportation** → **Storage** → **Use**

United States
CF Project

JERA and **CF Industries** have executed a **Joint Development Agreement** for low carbon ammonia project in Louisiana, the United States for annual capacity is approximately 1.4 million tons of low-carbon ammonia.

United States
ExxonMobil Project

JERA has reached a **Project Framework agreement** with **ExxonMobil** to jointly explore the development of a low carbon hydrogen and ammonia production project in the United States.

Middle East
ADNOC Project

JERA has concluded a **Strategic Collaboration Agreement** with **ADNOC**, related to cooperation in the clean hydrogen and ammonia fields.

Asia
Renew Project

JERA has concluded an agreement with **ReNew** to **Jointly Develop** a **Green Ammonia Production Project.** Target capacity is approximately 100,000 tons of green ammonia annually

JERA's initiatives for establishing Low Carbon Fuel Value Chain

JERA's Low Carbon Fuel Value Chain

Production → **Transportation** → **Storage** → Use

Transportation (Ammonia)

- JERA has signed MOU with "NYK" and "MOL" respectively to cooperate in transporting fuel ammonia

Main cooperation area :
- ✓ Building a fuel ammonia transportation and receiving system
- ✓ Working with related parties to foster the formation of rules related to the reception of fuel ammonia

Transportation (LOHC)

- JERA Invests in Hydrogenious LOHC Technologies GmbH
  - ✓ Joint investment with Temasek, Chevron Technology Ventures and Pavilion Capital, and JERA Americas

Storage (Hekinan)

- **Several large-scale ammonia tanks** will be constructed as part of the modification works for commercialization of our ammonia fuel substitution project at Hekinan
- These tanks will be used for power generation and other industrial applications ("multi-purpose users").

Storage (Hub)

- Idemitsu and JERA agreed to jointly consider establishing a hydrogen supply chain based in the Ise Bay area, Japan

Main cooperation area:
- ✓ Establishment of hydrogen receiving, storage, processing, and supply bases
- ✓ Technological and economic analysis of transportation methods for hydrogen in the Ise Bay area
- ✓ Development of a hydrogen supply network

JERA’s initiatives for establishing Low Carbon Fuel Value Chain

JERA's Low Carbon Fuel Value Chain

Production → Transportation → Storage → **Use**

the United States
Expanding overseas distribution for low carbon hydrogen/ammonia

Heads of agreement for the sale of low carbon hydrogen/ammonia produced in US with German company Uniper

uniper

ConocoPhillips

Japan
JERA with 7 Japanese utility companies to consider collaboration aimed at the adoption of hydrogen and ammonia as fuel for power generation

KYUSHU ELECTRIC POWER CO.,INC. / Energia

Tohoku Electric Power

YONDEN / 北陸電力

沖縄電力 / ほくでん

Europe
Pioneering hydrogen societies through investment and alliance building in ammonia cracking

EnBW, VNG and JERA plan a feasibility study for an ammonia cracker demonstration plant in Rostock

EnBW

VNG

Japan
Empowering tugboat operations

Announcing the launch of a joint study with NYK Line and Resonac aimed at achieving the supply of fuel ammonia to ships

NYK LINE NIPPON YUSEN KAISHA

RESONAC Chemistry for Change

Singapore
Explore establishing an ammonia direct combustion power plant with Jurong Port, Mitsubishi Heavy Industries Asia Pacific

XYZ

XYZ

XYZ

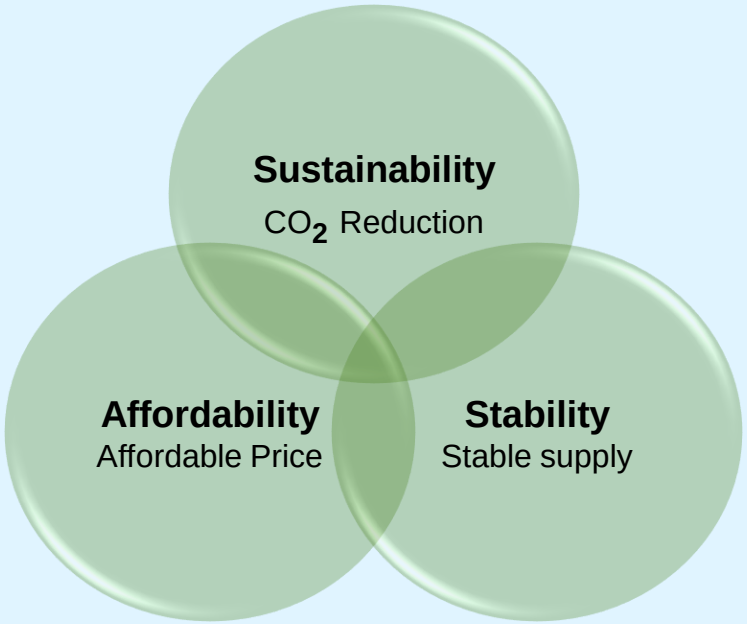
Confidential

Key message from JERA

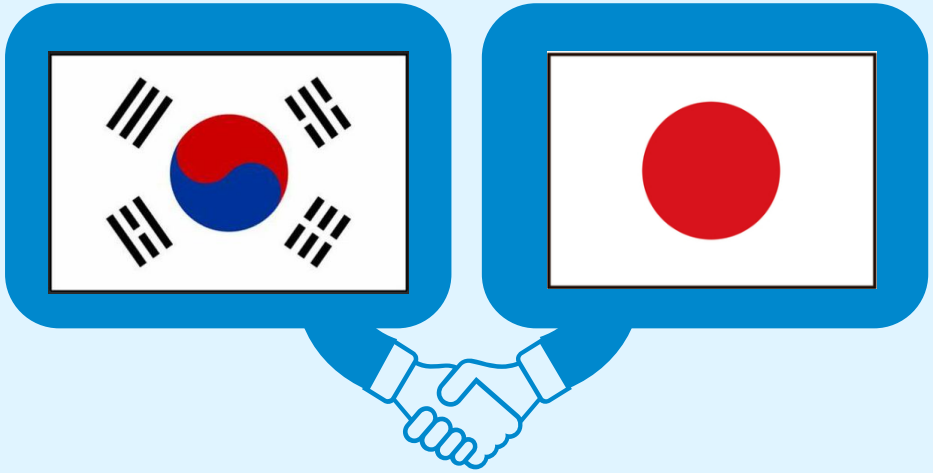
One of the largest LNG Players

To Be

One of the largest LNG & LCF Players



JERA to explore the possibility of collaboration with South Korean companies



- Joint purchasing
- Logistics
- Safety management
- ...

Energy for a New Era

JERA would like to work together with you towards a decarbonized society, while promoting various initiatives.