Energy for a New Era

AMMONIA ENERGY
APAC 2025
Perth, Australia

JERA's Decarbonization Initiatives

~Exploring Results from the Ammonia Power Generation Demonstration at Hekinan~

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JERA Co., Inc.

June 16, 2025

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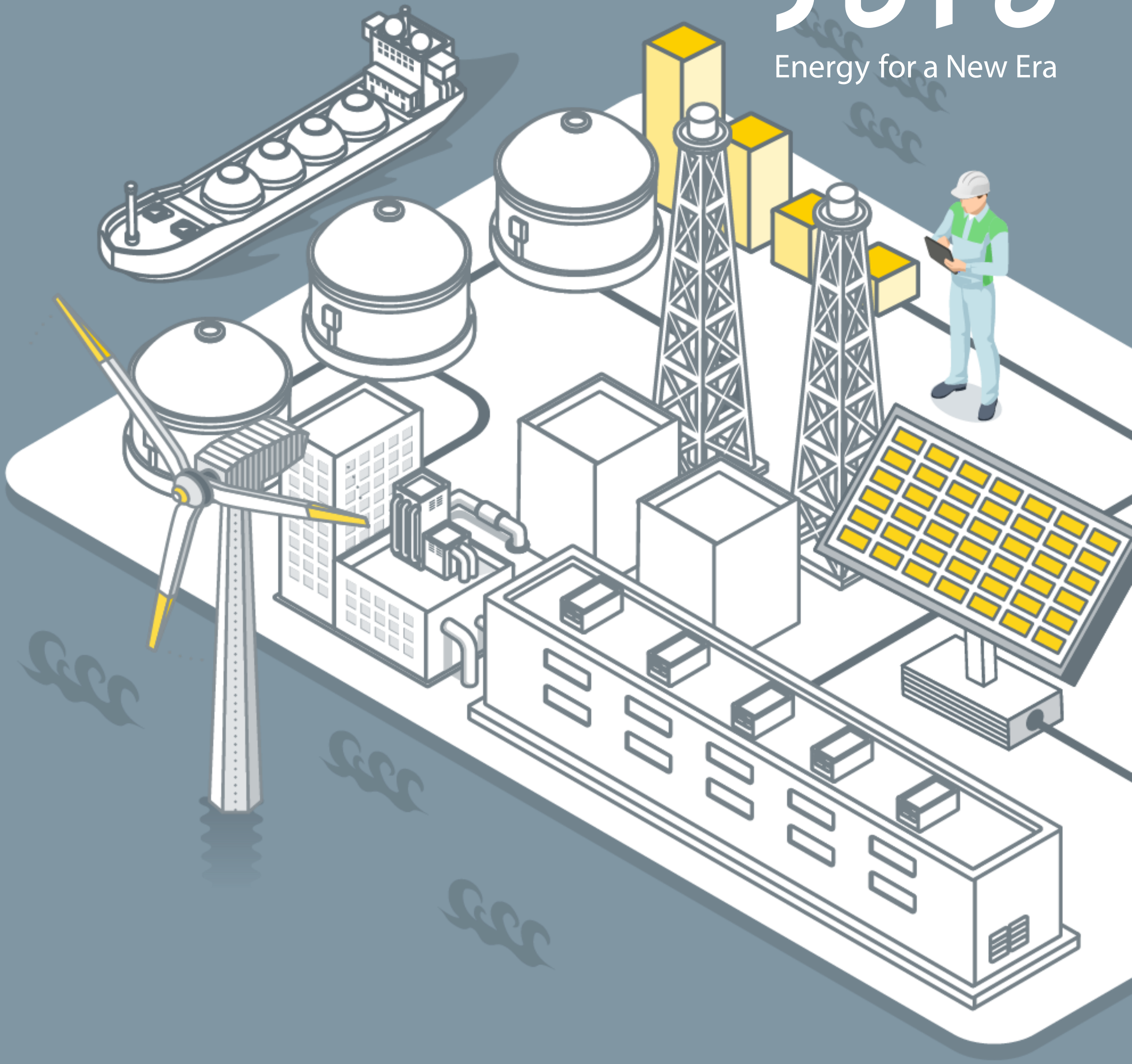
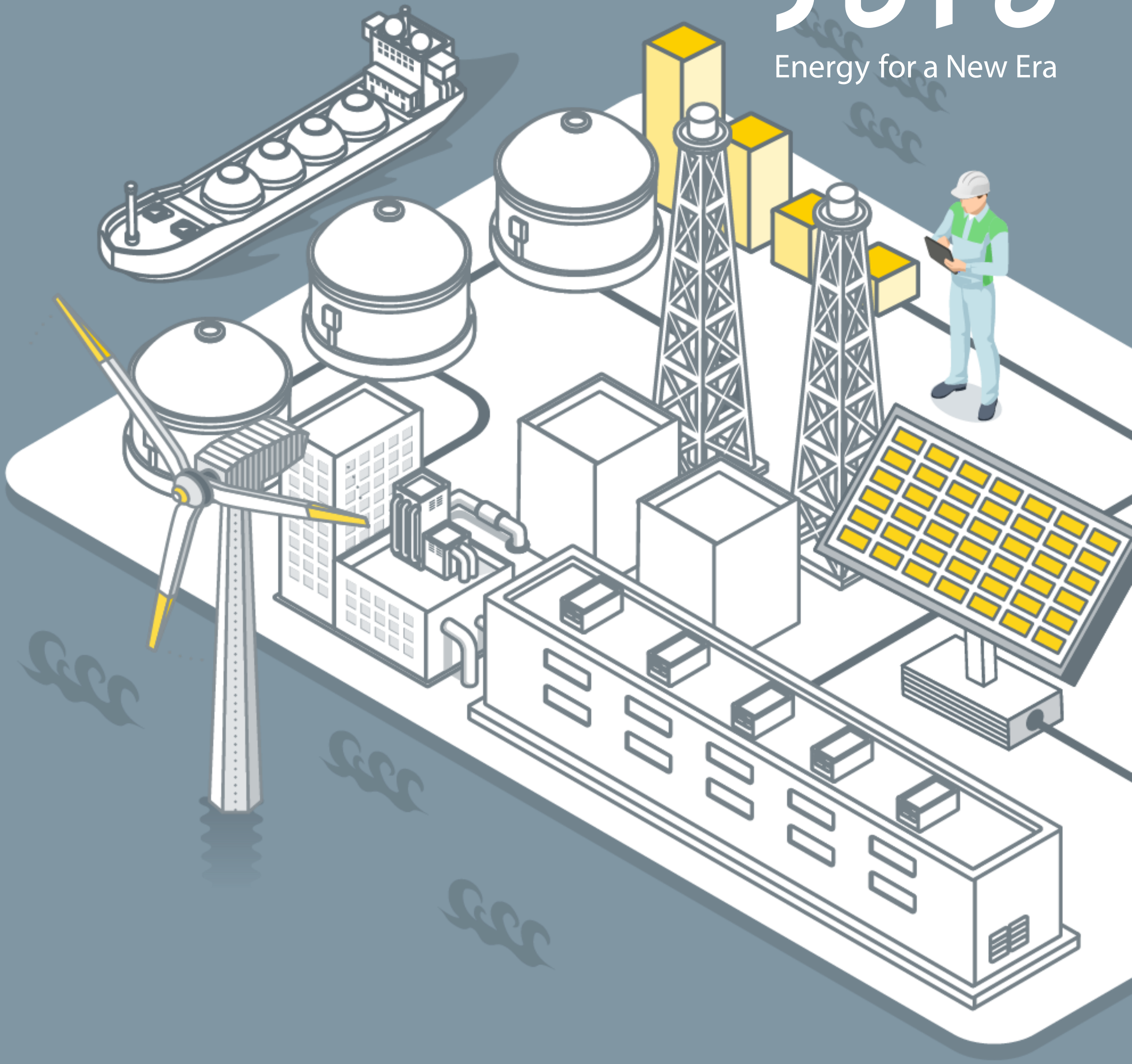


1. What's JERA ?



Corporate History

- Established in 2015 with the aim of creating a global energy company capable of competing in the international energy market, and simultaneously achieving a stable supply of internationally competitive energy and improving corporate value.
- The fuel and thermal power generation departments of Tokyo Electric Power Company and Chubu Electric Power Company were integrated in stages.

Founded in 2015 as a JV of TEPCO and Chubu

TEPCO

CHUBU Electric Power

jera

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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

JERA's Value Chain covers from upstream to downstream

LNG Transaction Volume[1]
Approx.36MTPA
Among the largest in the world

Total Assets
Approx. JPY 8.5trillion

Sales
Approx. JPY 3.7trillion[1]

As of March 31, 2024

Upstream Development Fuel Procurement

Photo: Chevron Australia

- Upstream Investment **6Projects**
- LNG Procurement from **14countries**

Fuel Transportation

- LNG Fleet Carriers **23 carriers**

Optimization and Trading

LNG Receiving and Storage Terminals

- LNG Tank Capacity in Japan **6.62million kL[3]**
- Equivalent to **Approx. 33%** of LNG tank capacity in Japan
- LNG Receiving Terminals in Japan **11 terminals[3]**

Domestic and Overseas Power Generation

Domestic Power Generation

- Thermal Power Station **26stations[4]**
- Power Generation Capacity **Approx.59GW** The Largest in Japan
- Power Generation Output **Approx.231TWh[1,4]** Equivalent to approx. 30% of power generation in Japan

Overseas Power Generation

- Number of projects **In more than 10Countries** **Approx.30Projects**
- Power Generation Capacity **Approx.13GW[4]** (Output Corresponding to Equity)
- Renewable Energy Capacity **Approx.3.4GW** (Included in the Power Generation Capacity)

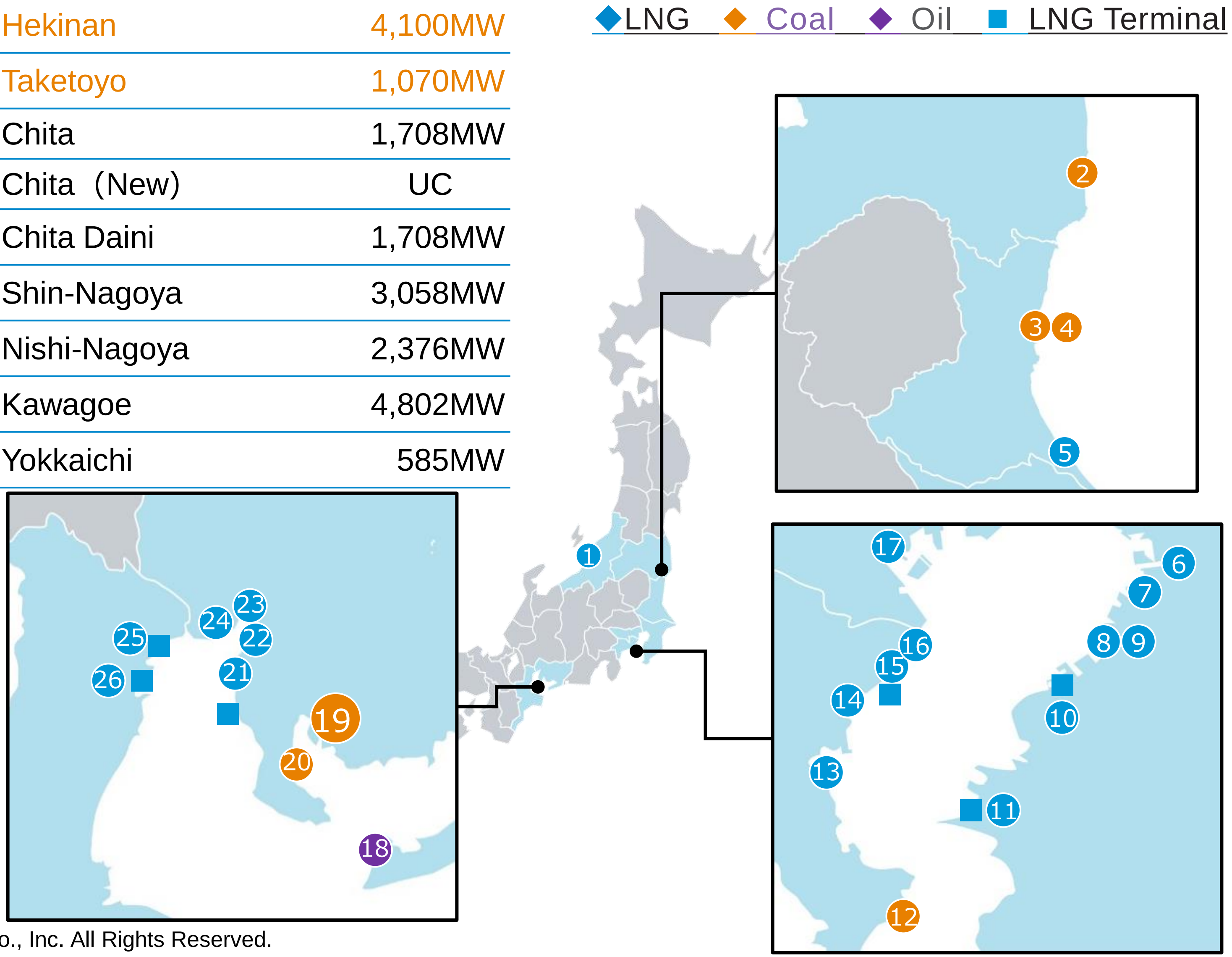
Electricity and Gas Sales

1:Fiscal 2023
2:Represents the number of countries that imported LNG to LNG receiving terminals of JERA.
3:Includes jointly operated terminals in Chita and Yokohama
4: Includes capacity under construction. Excludes joint thermal power in Japan.

JERA's power generation Asset

West

⑱	Atsumi	1,400MW
⑲	Hekinan	4,100MW
⑳	Taketoyo	1,070MW
㉑	Chita	1,708MW
	Chita (New)	UC
㉒	Chita Daini	1,708MW
㉓	Shin-Nagoya	3,058MW
㉔	Nishi-Nagoya	2,376MW
㉕	Kawagoe	4,802MW
㉖	Yokkaichi	585MW

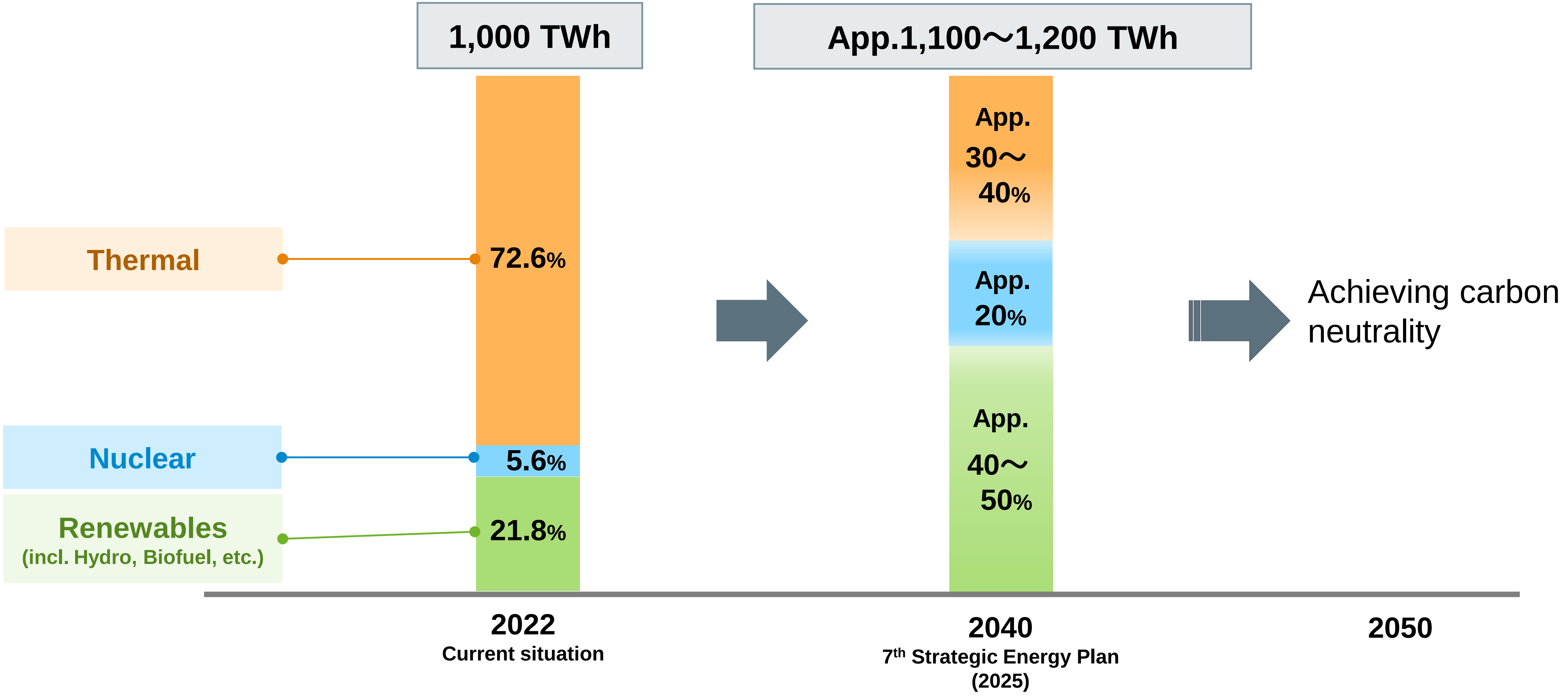


East

①	Joetsu	2,380MW
②	Hirono	1,800MW
③	Hitachinaka	2,000MW
④	Hitachinaka Generation	650MW
⑤	Kashima	1,260MW
⑥	Chiba	4,380MW
⑦	Goi (New)	2,340MW
⑧	Anegasaki	1,200MW
⑨	Anegasaki (New)	1,941MW
⑩	Sodegaura	3,600MW
⑪	Futtsu	5,160MW
⑫	Yokosuka	1,300MW
⑬	Minami Yokohama	1,150MW
⑭	Yokohama	3,016MW
⑮	Higashi Ohgishima	2,000MW
⑯	Kawasaki	3,420MW
⑰	Shinagawa	1,140MW

Japan’s Energy Mix Policy for electricity (image)

- Japan is aggressively pursuing renewables to decarbonize power – but renewable energy alone is not enough
- For grid stability and seasonality, hydrogen/ammonia and CCUS are needed



Addressing the trilemma – Zero-emission thermal power, via ammonia and hydrogen, will be key to achieving zero emissions in a responsible manner

Mission

To provide cutting edge solutions to the world's energy issues

Vision for 2035

Clean energy platform of renewables and low greenhouse gas thermal power

Goal 2050 zero-emission

Energy Trilemma → Solutions

- Cutting-edge solutions will be deployed from Japan to Asia and then to the world

Energy Trilemma

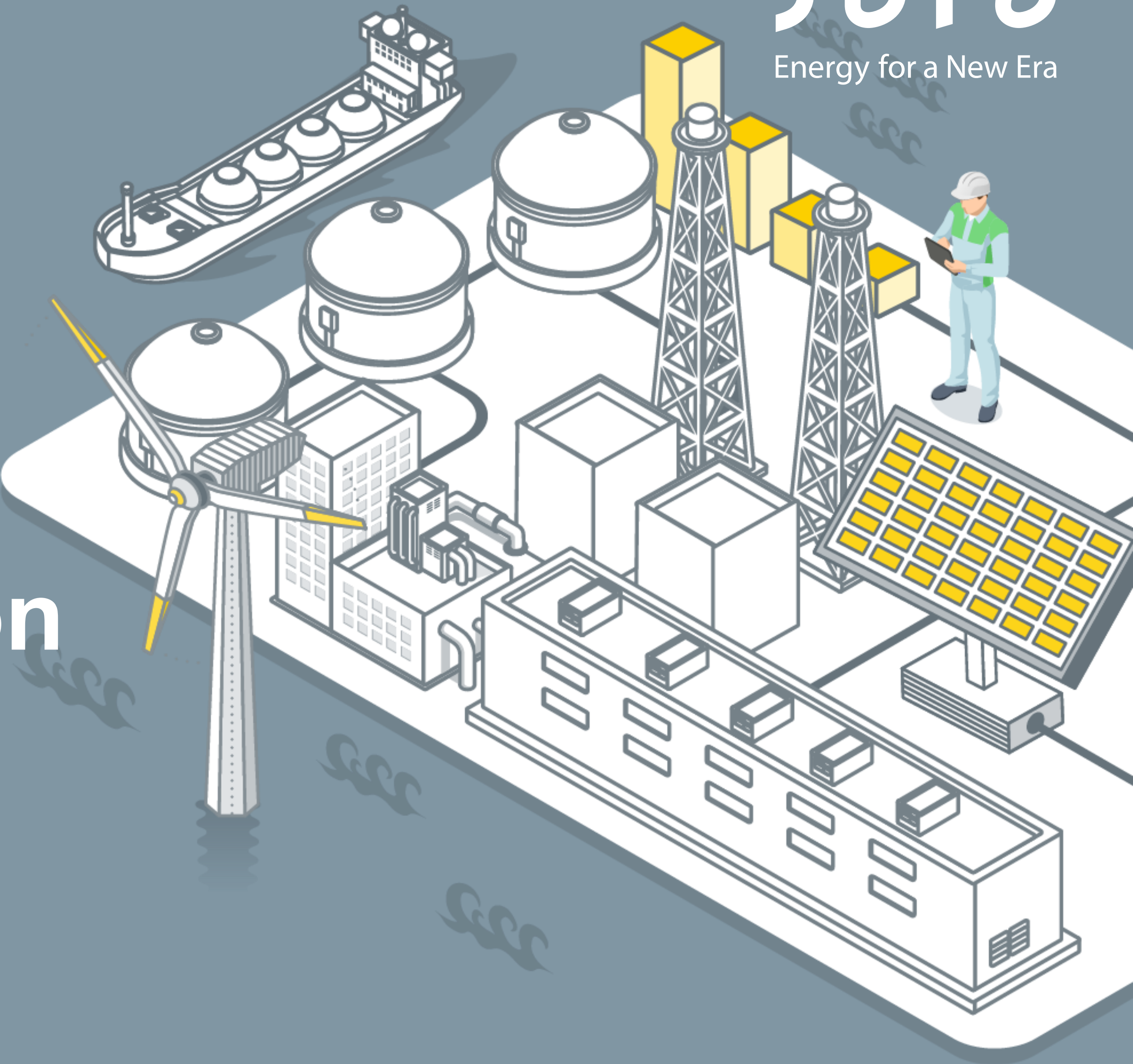
- **Sustainability**: CO_2 reduction
- **Affordability**: Affordable Price
- **Stability**: Stable Supply

Solutions

2024	2035	
LNG-fired thermal power →	Conversion to hydrogen →	Zero-emission thermal power
Coal-fired thermal power →	Conversion to ammonia →	Zero-emission thermal power
Renewable energy →	Expansion →	Renewable energy

1 | 2. JERA's ZERO Emission | 3 | 4 | 5 | 6

2. JERA's ZERO Emission



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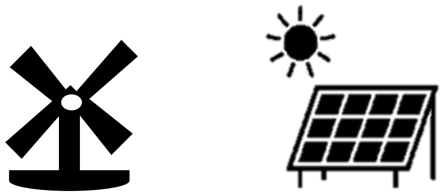
Zero CO_2 Emission thermal power generation

- Renewable power alone is not enough to cover the entire electricity demand of Japan, due to limited potential, power grid unconnected to other regions, etc.
- By introducing "clean fuel (Hydrogen/Ammonia)" into thermal power generation, we can realize CO_2 reduction while securing stable electricity supply.

Renewable Power



Advantage

- No CO_2 emissions during power generation

Disadvantage

- Unstable output due to weather conditions

Thermal Power Generation

Advantage

- Sufficient and Stable supply
- Flexibility and adaptability on demand

Disadvantage

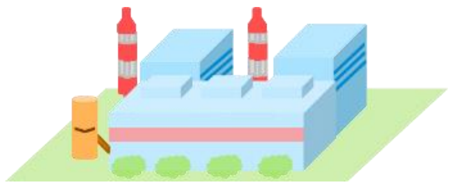
- CO_2 emissions from fossil fuels combustion

Complement

Maintain

Improve

Zero-Emissions Thermal Power Generation

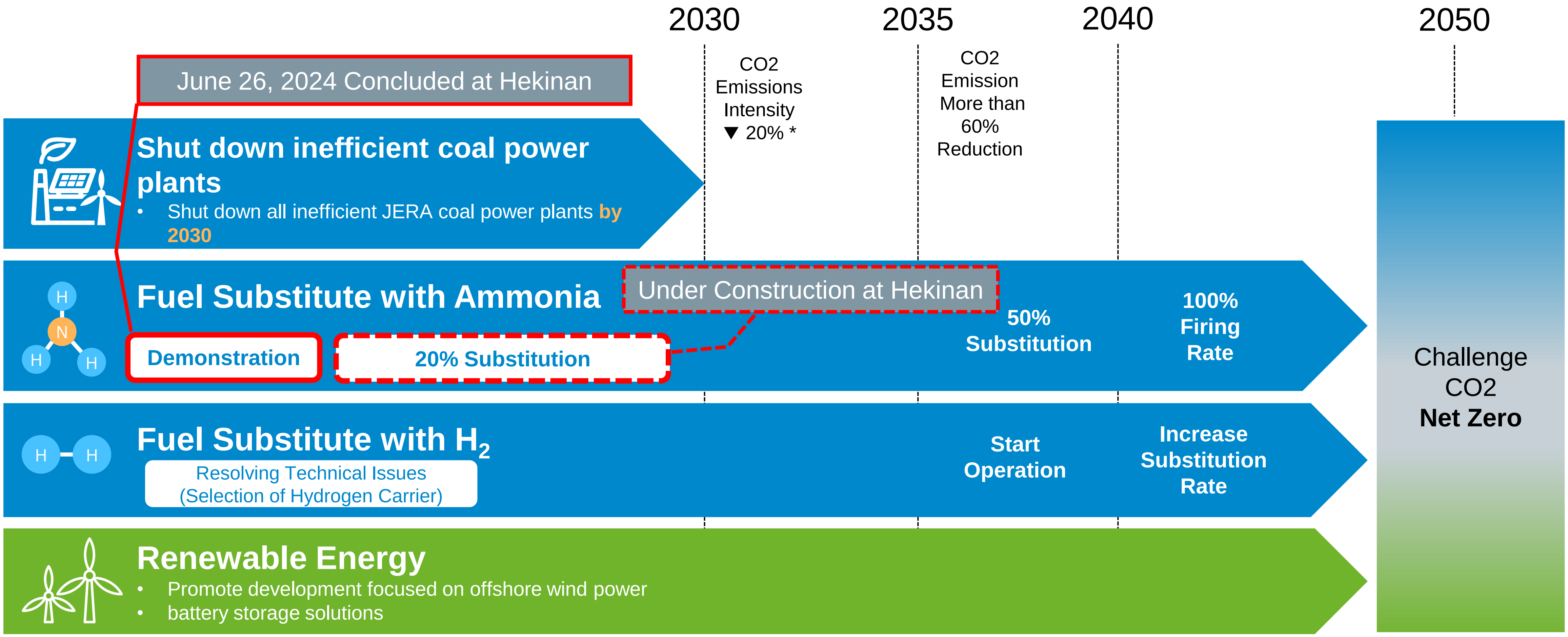


Advantage

- Low CO_2 emissions while keeping the benefits of thermal power generation

JERA Zero CO2 Emissions 2050 Roadmap for its business in Japan

- JERA is taking on the **challenge of achieving, by 2050, Zero CO2 emissions** in Japan and overseas.
- The path to zero emissions varies depending on the situation of the economy or region. Develop optimal roadmap overseas sequentially



*Compared with the emissions intensity of thermal power generation for the whole economy based on the long-term energy supply and demand forecast for FY 2030 presented by the government.

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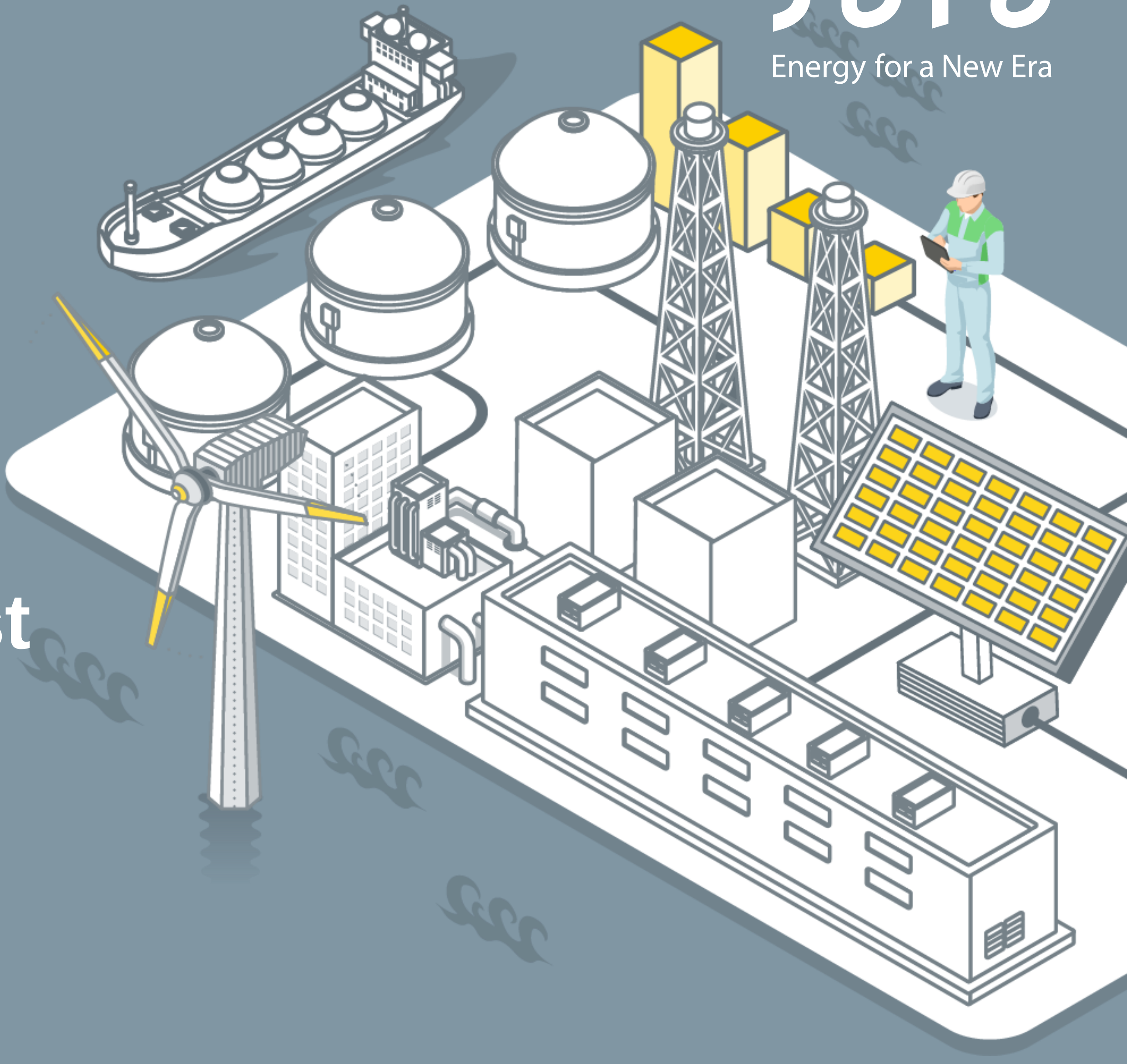
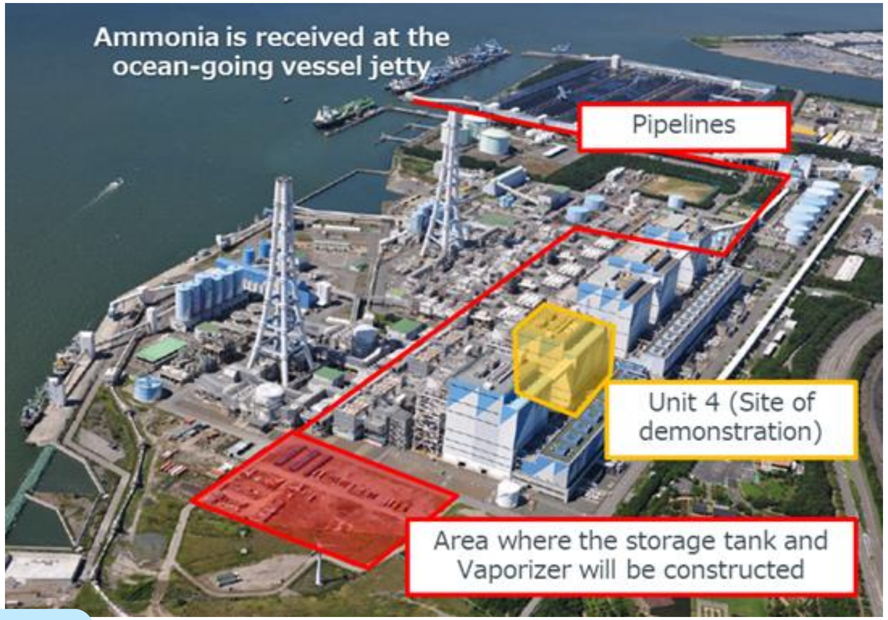
3. Result of Demonstration Test



Demonstration Project for Ammonia Generation at Hekinan Thermal Power Station (2024)

Overview	
Companies	**JERA and IHI (subsidized by NEDO※)**
Place	**Hekinan Thermal Power Plant Unit 4** (1,000MW) in Aichi prefecture, Japan
Test Period	April - June 2024
Activities	- Installation of ammonia bunner & ammonia supply facility - **20 cal% of coal were replaced by ammonia.**
Ammonia Consumption	**30,000 tons** during the test

※NEDO:New Energy and Industrial Technology Development Organization



What we're checking through the test

Safety
(Ensure work safety and equipment security)

Environmental Characteristics
(Impact on NOx, exhaust gas, coal ash, etc.)

Operational Characteristics
(Verify load changes, controllability, thermal efficiency, etc.)

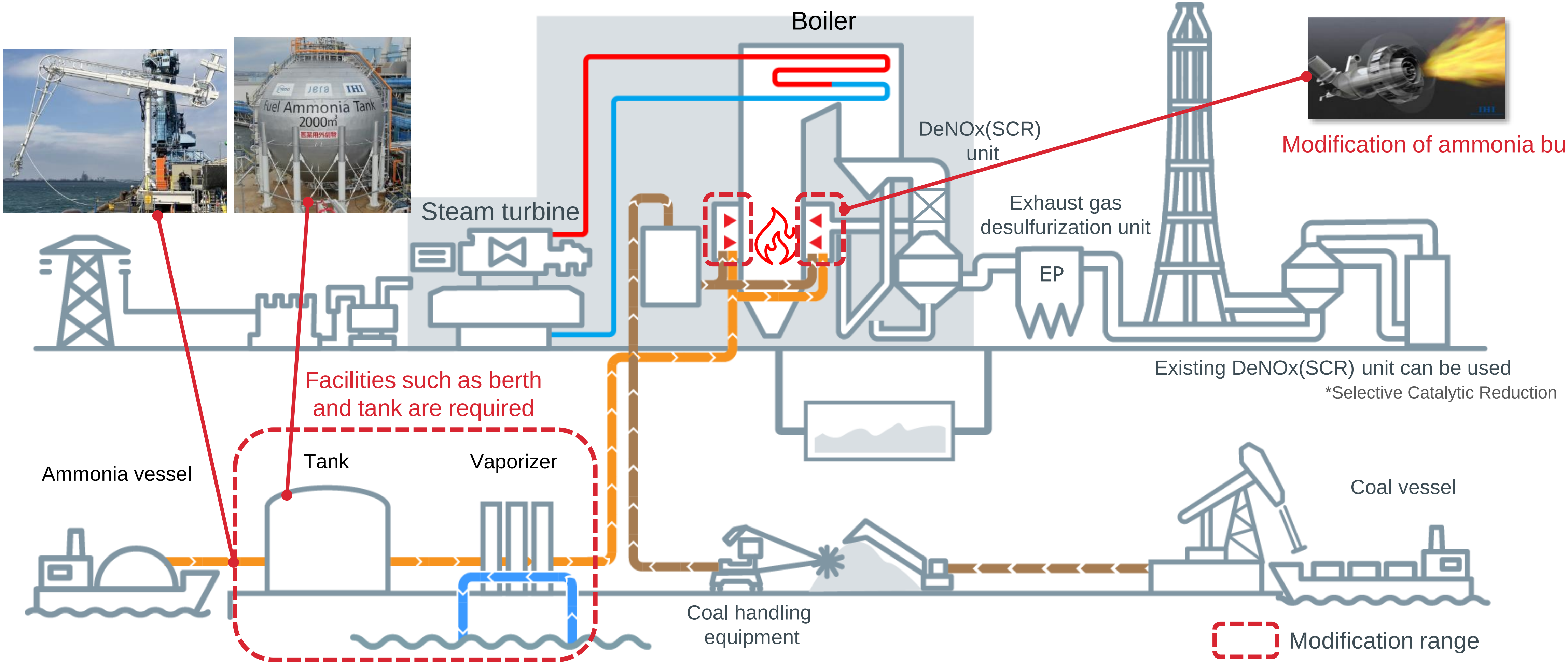
Cost
(Cost containment)

What our expectations are

- **To establish fuel ammonia handling and operating technology**
- **To establish 20% substitution technology for commercial operation**

Outline of required modification for Ammonia Substitution

- Jera made modification works for Ammonia in Hekinan Unit 4.
- Small modification was required, but the most of existing facility and DeNOx (SCR*) unit for treatment of exhaust gas could be used.



Bird view of the Ammonia generation demonstration test facilities

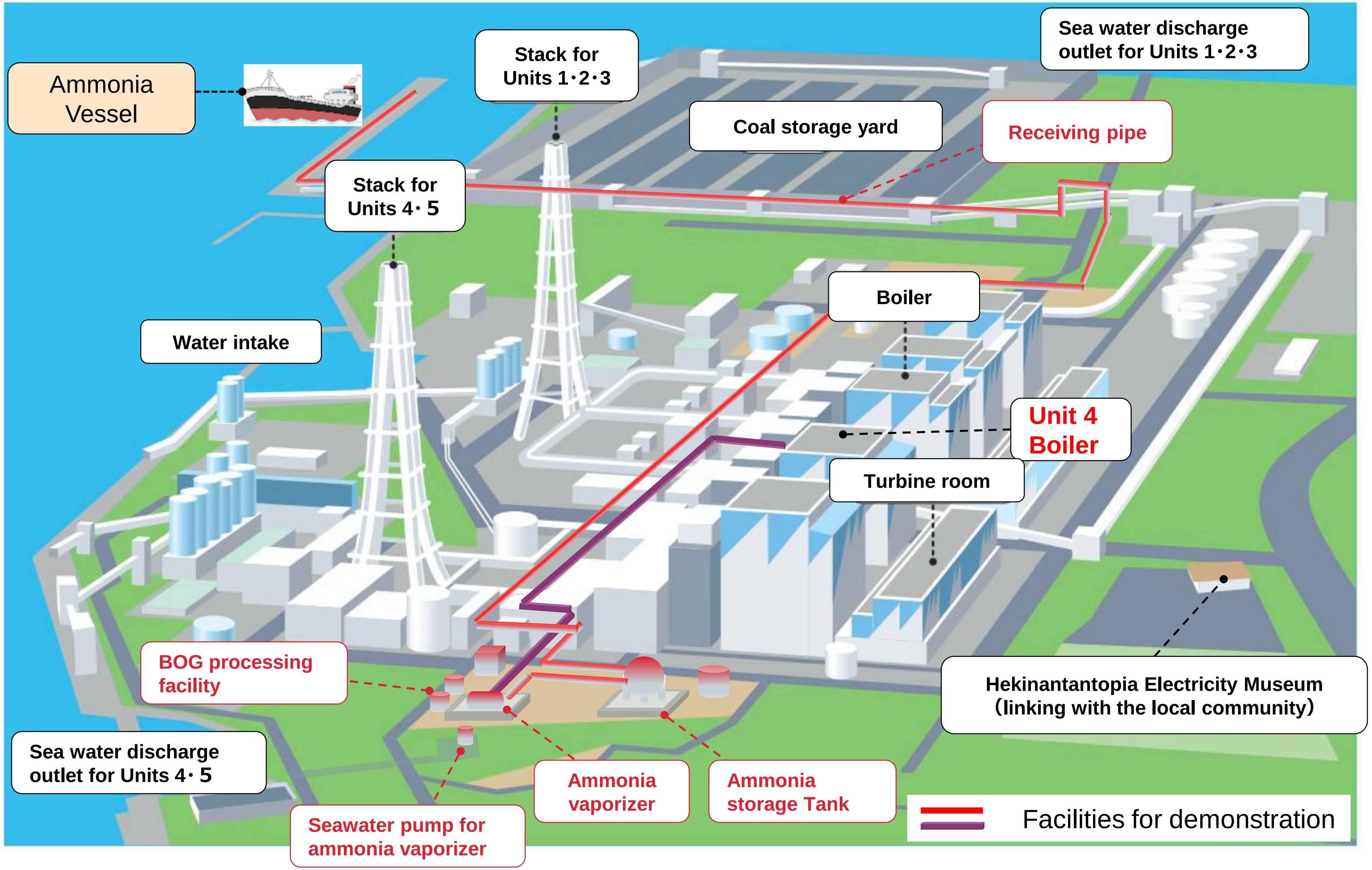
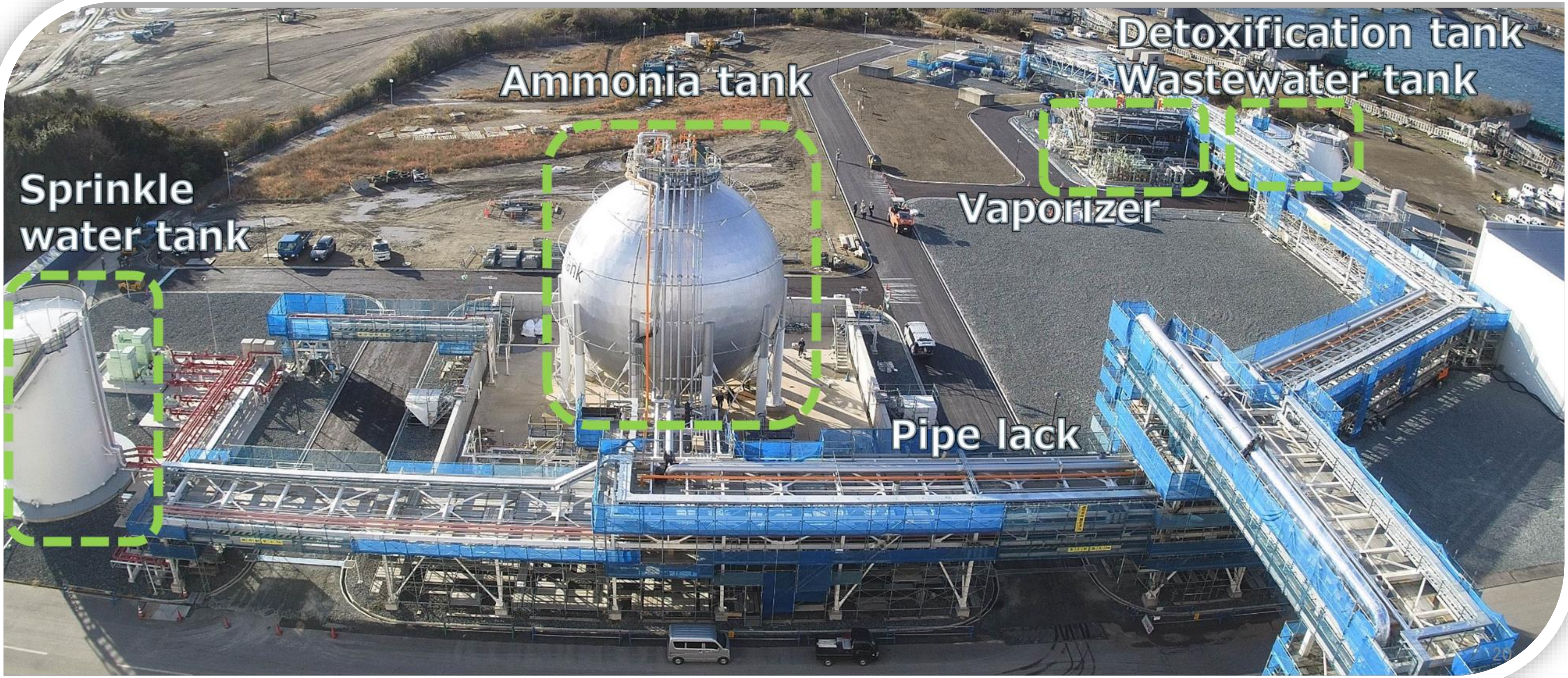


Photo focusing on ammonia facilities



Results of ammonia 20% substitution demonstration test

- 20% substitution at 1,000 MW was achieved on April 10th and the test was completed on June 26th
- NOx was confirmed to be equal or lower than that before 100% coal fired
- No emission of N_2O (Nitrous oxide), which has a strong greenhouse effect, was confirmed

[Actual schedule]

2024

February | March | April | May | June

- ▼2/23 First receipt of fuel ammonia
- Cooldown
- Fuel facility commissioning
- ▼4/1 First ignition
- ▼4/10 Achieved 20% substitution@1,000MW
- Point fire extinguishment test
- Collection of combustion data
- Various tests (load change, combustion characteristics,coal type change)
- 6/26 Concluded demonstration test ▼

[Test results]

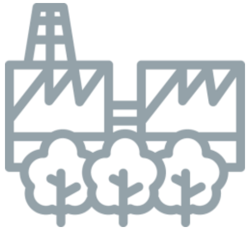
○: Coal equivalent ◎: Decrease (improvement) compared to coal

Item	Plant operational performance	Exhaust gas characteristics			
		NOx	N_2O	SOx	Soot and dust
Results (coal comparison)	Coal equivalent	Coal equivalent	Not detected	Approximately 20% reduction	Approximately 20% reduction
	○	○	○	◎	◎

Summary of demonstration test results

- Test results confirmed operational and environmental performance equivalent to 100% coal fired
- Ammonia substitution was evaluated as a viable technology for social implementation

Plant operational performance



- Confirmation that ammonia combustion has the same operability as coal-fired operation, such as minimum load, load change rate.（400MW～1,000MW、10MW／min、Max 28%ammonia with 600MW）
- Confirmation that there is no change in the properties of reused materials such as coal ash.

Exhaust gas characteristics

- NOx emissions were equivalent to those of coal, while SOx and soot were reduced by approximately 20%.
- N_2O(Nitrous oxide), which has a high greenhouse effect, was found to be below the limit of quantification.

multi-types of coal

- It is evaluated that changes in combustion and exhaust gas behavior at the time of ammonia fuel conversion due to differences in coal properties (sources) can be handled by adjusting properties through mixed coal operation.

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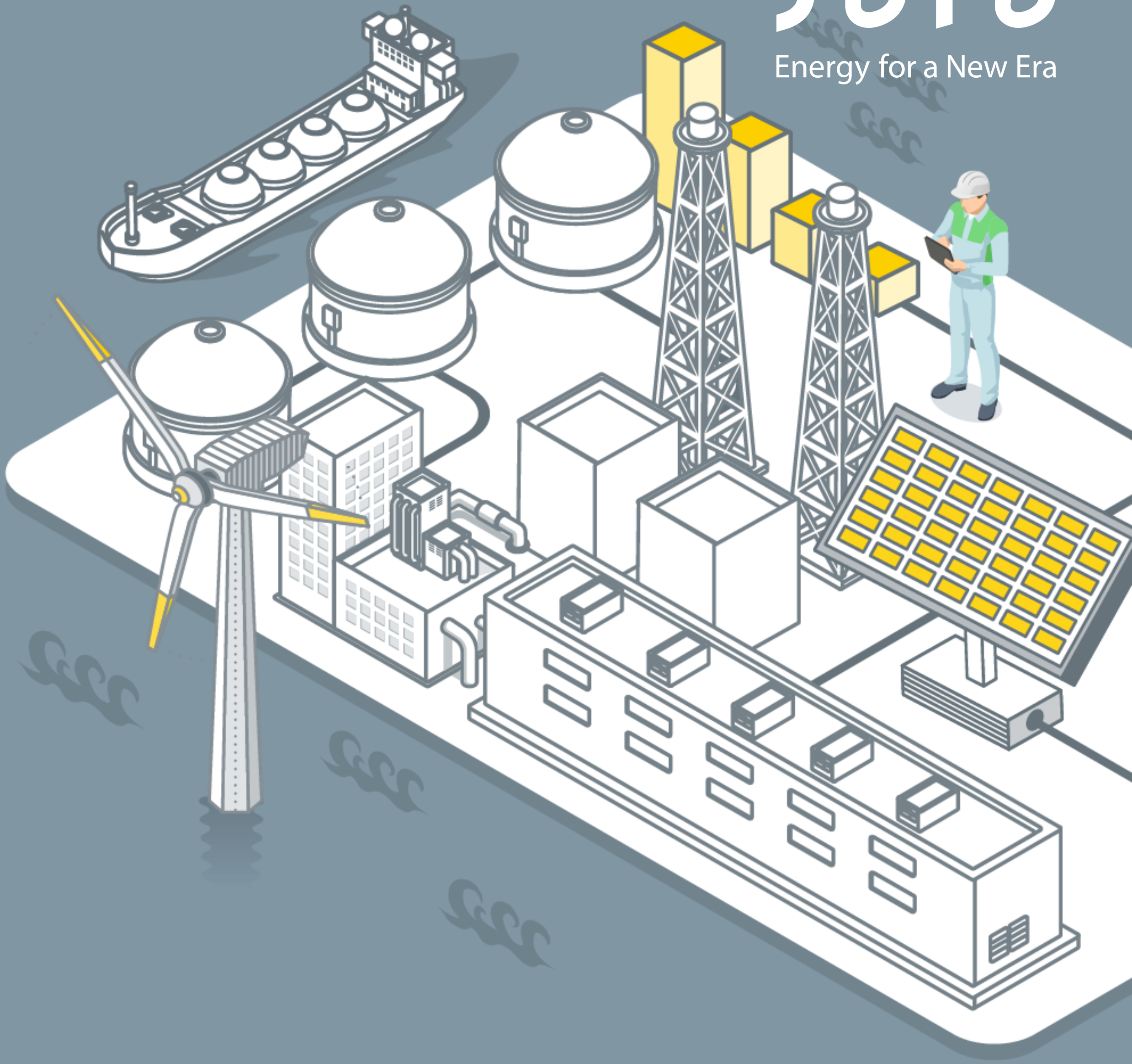
4. Safety Measures



Safety measures

➢ Measures to prevent ammonia leakage

❶ Prevention

- **Safety design** (design with allowance for one of the largest natural disasters expected)
- **Safe side operation** (Mechanism to operate on the safe side even if equipment fails)
- **Backup** (Do not create a situation where safety equipment does not function due to a single facility failure)
- **Interlock** (wrong operation is not accepted by the machine)
- **Operation Manual** (Thorough prevention of operation errors)

❷ Early detection and treatment

- **Device for reporting by leak detection**
- **Device for automatic stop due to equipment abnormality**
- **Monitoring camera and patrol** (Detection of abnormal signs)
- **Procedure Manual** (Thorough Expedited Procedures)

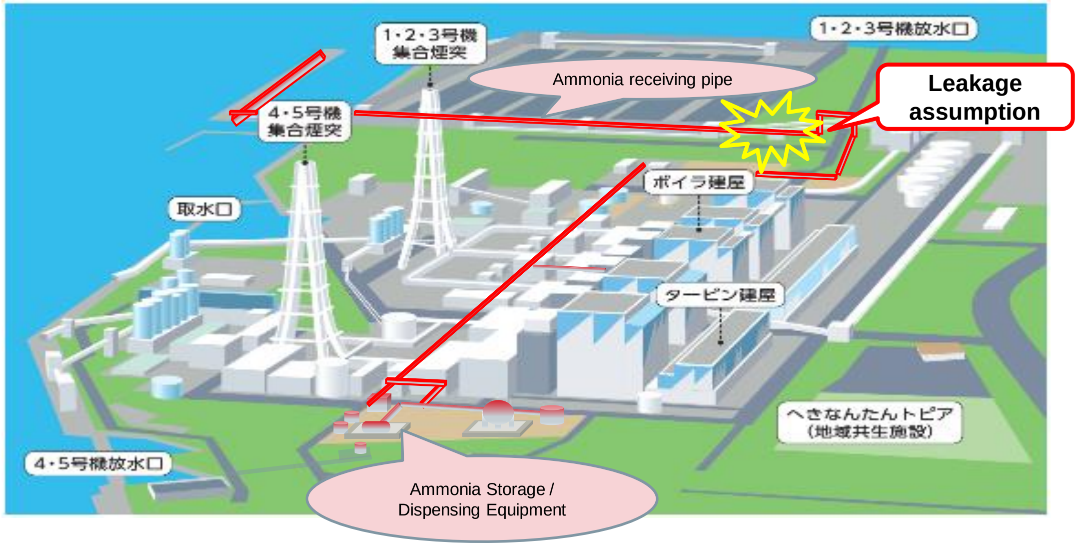
❸ Prevention of spread

- **Liquid barrier wall** (Prevention of outflow from facilities)
- **Recovery Facilities** (containment)
- **Response manual** (Thorough emergency response)
- **Cooperation with community** (Fire departments and local governments)

Disaster response training at Hekinan thermal power plant (1)

Summary

- Study of Low-temperature liquid ammonia characteristic
- Confirmation of route to on-site
- Wearing protective clothing and rescuing disaster victims
- Emergency repair methods and decontamination measure for leaked areas(Assumed)



Disaster assumption

Training for Wearing Protective Clothing

Rescue training for disaster victims

Disaster response training at Hekinan thermal power plant (2)

Evaporation and diffusion suppression of low temperature liquid in a dike by tarp and cover

Tape repair of small diameter piping

Shower Tent (Decontamination Products)

Materials and equipment carrier

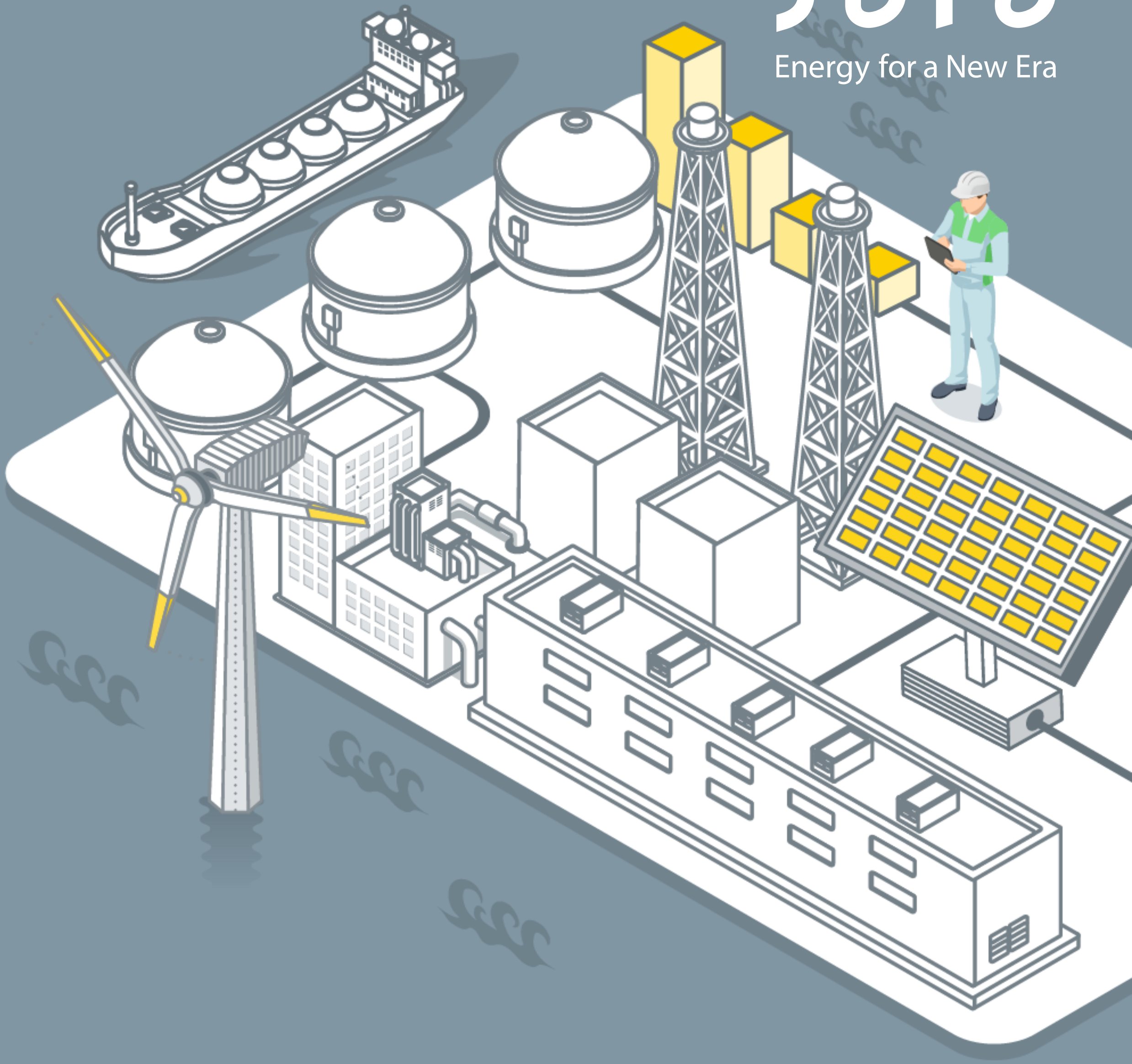
Disaster response training at Hekinan thermal power plant (3)

- Developing an application that can display disaster location, evacuation routes, evacuation status, etc. in the event of a disaster.

Image of Web screen

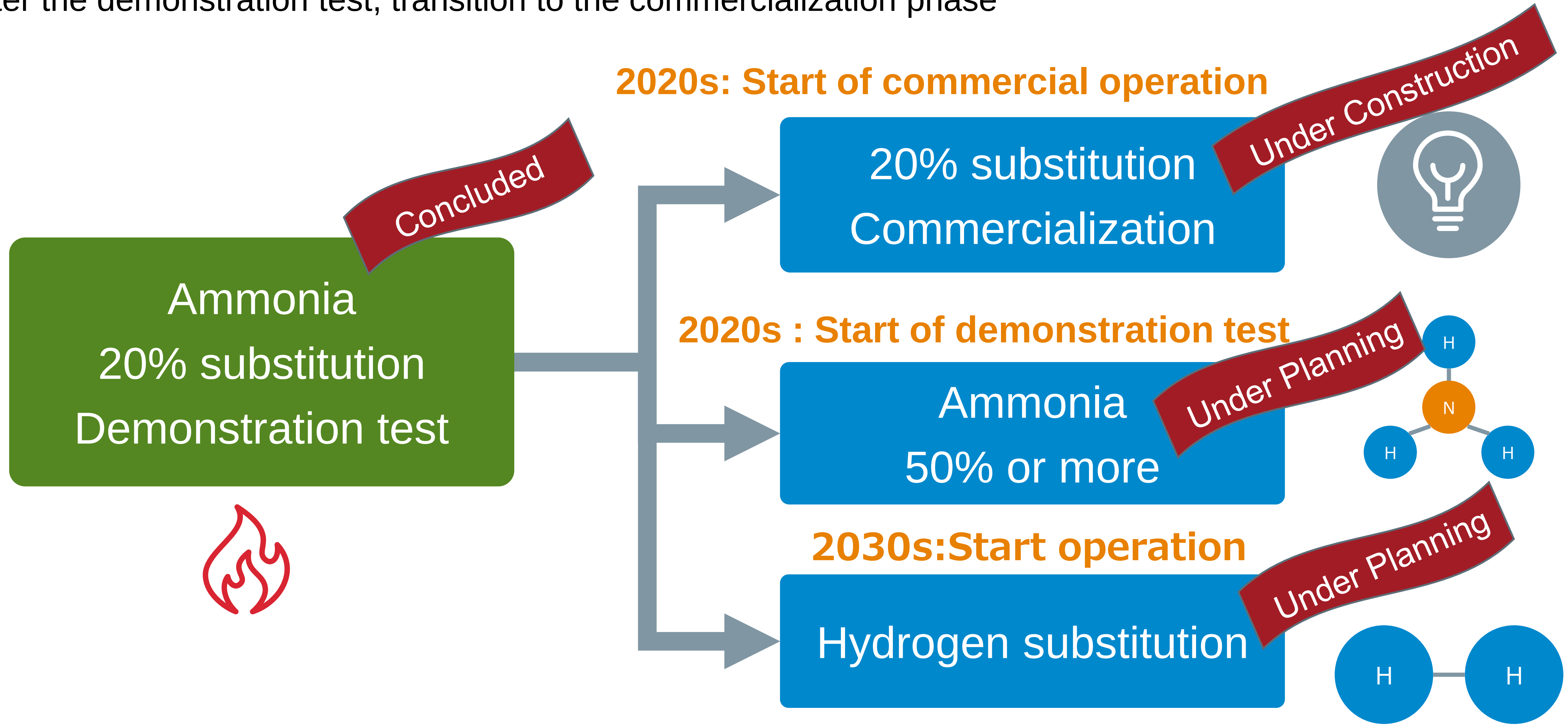
Image of Mobile phone

5. For the Future

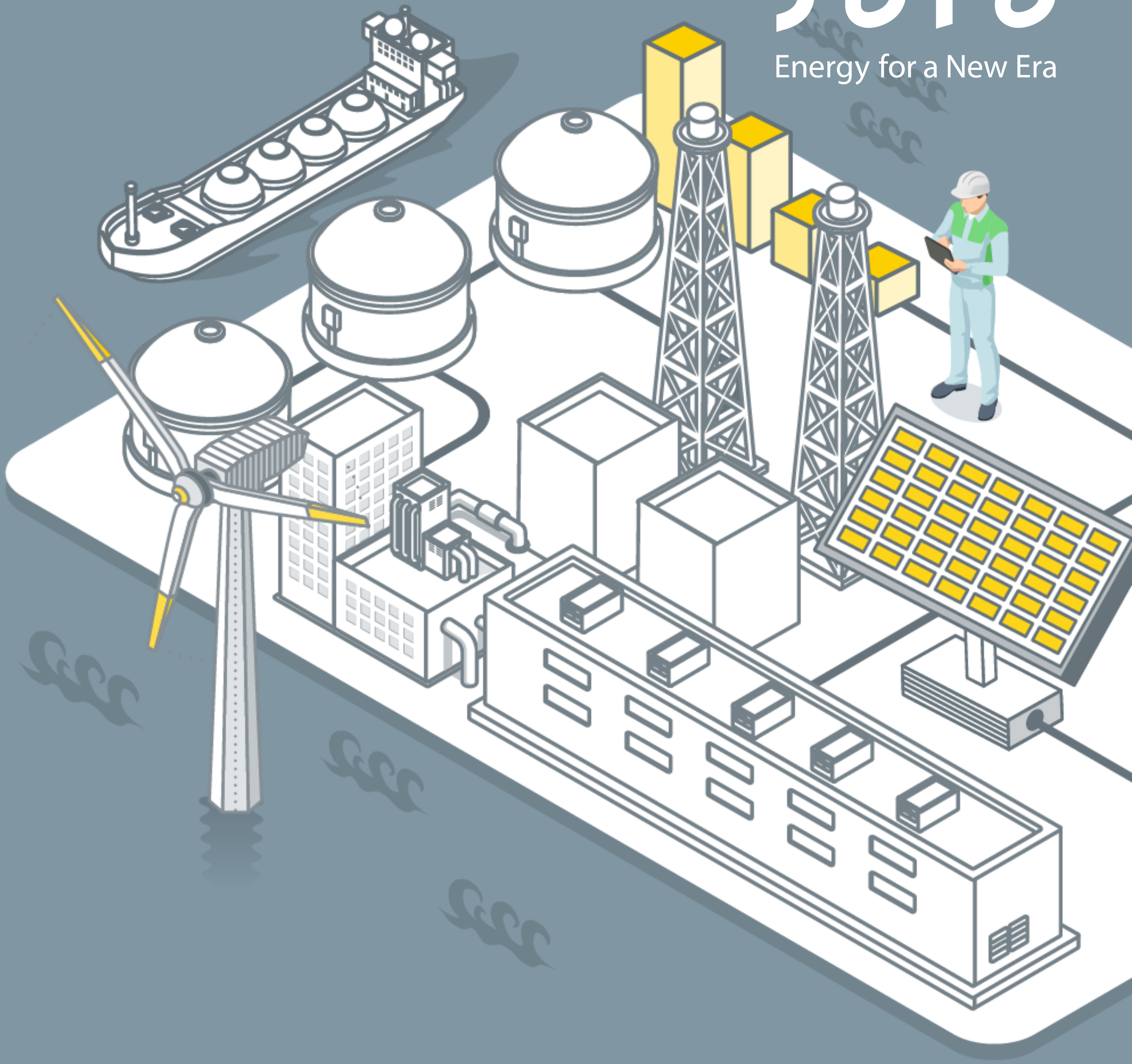


Outlook after the 20% ammonia substitution demonstration test

- After the demonstration test, transition to the commercialization phase

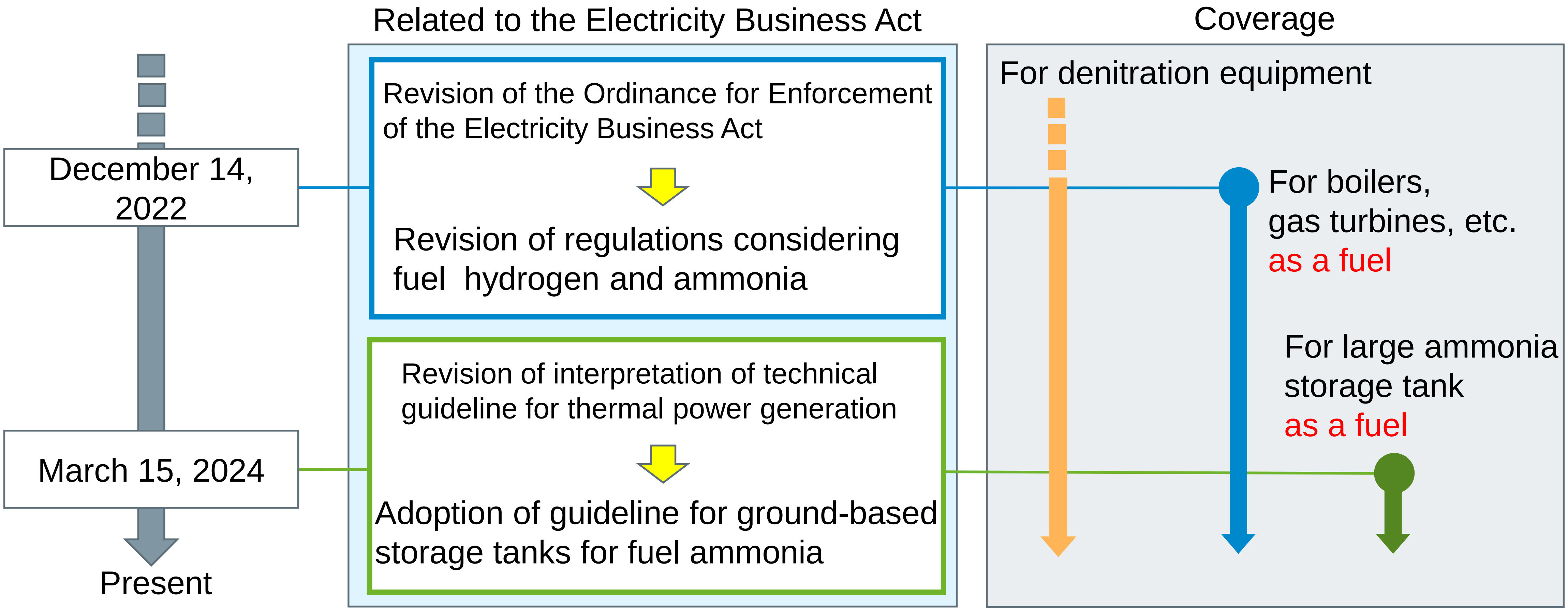


6. Others



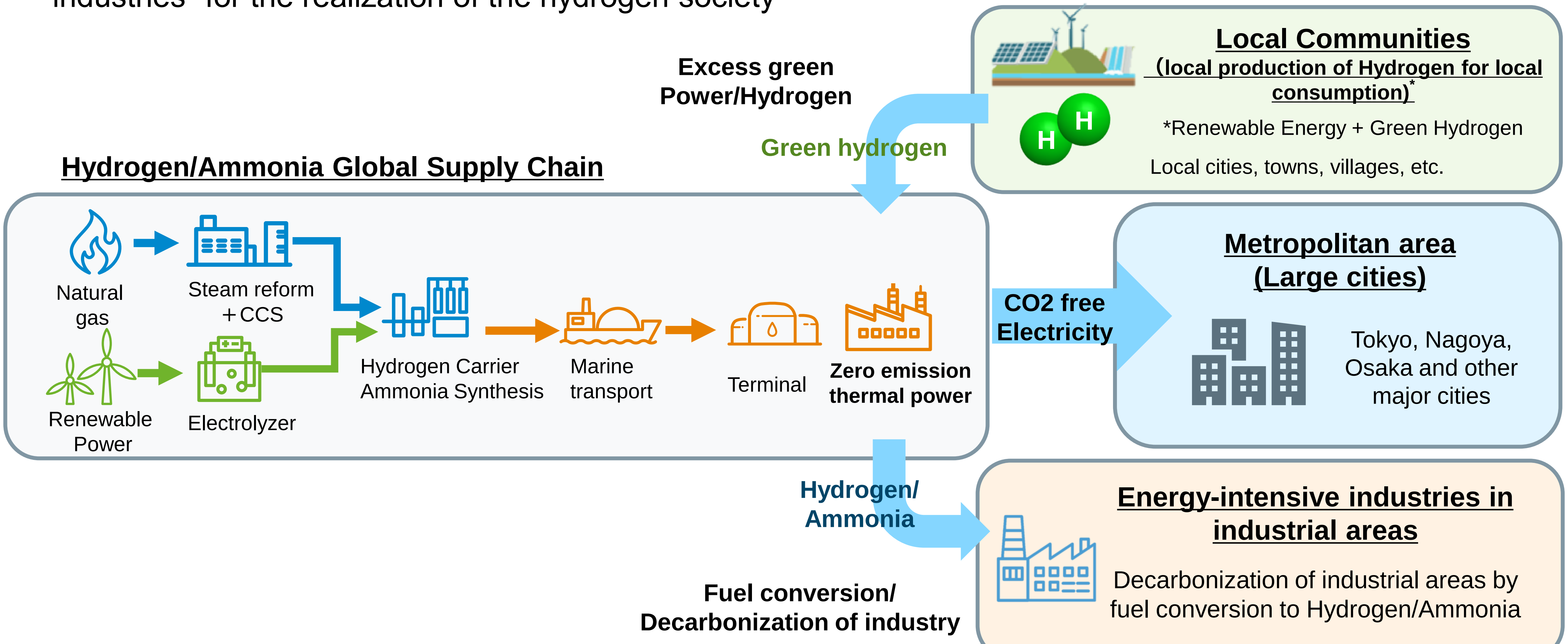
Status of legislation to use ammonia as a fuel for power generation in Japan

- Ammonia was not defined as a fuel for power generation until now
- However, the revision of the Electricity Business Act allowed it to be used as a fuel for power generation



Building a Hydrogen-based Fuel Supply Chain to Realize a Hydrogen Society

- Ammonia is the most promising hydrogen energy carrier
- The fuel ammonia for thermal power generation will be multi sourced to the “local communities” and “industries” for the realization of the hydrogen society



Closing remarks

- To solve the energy trilemma, a combination of zero-emission thermal power and renewable energy sources is needed according to the characteristics of the region.
- The 20% ammonia conversion demonstration test, a precursor to zero-emission thermal power, was a success, and plans are underway to further lower the carbon footprint of thermal power generation.
- Safety is the top priority in achieving zero-emission thermal power.
- Zero-emission thermal power will play an important role in achieving a hydrogen-ammonia society. Cooperation with local communities and industries is also important.

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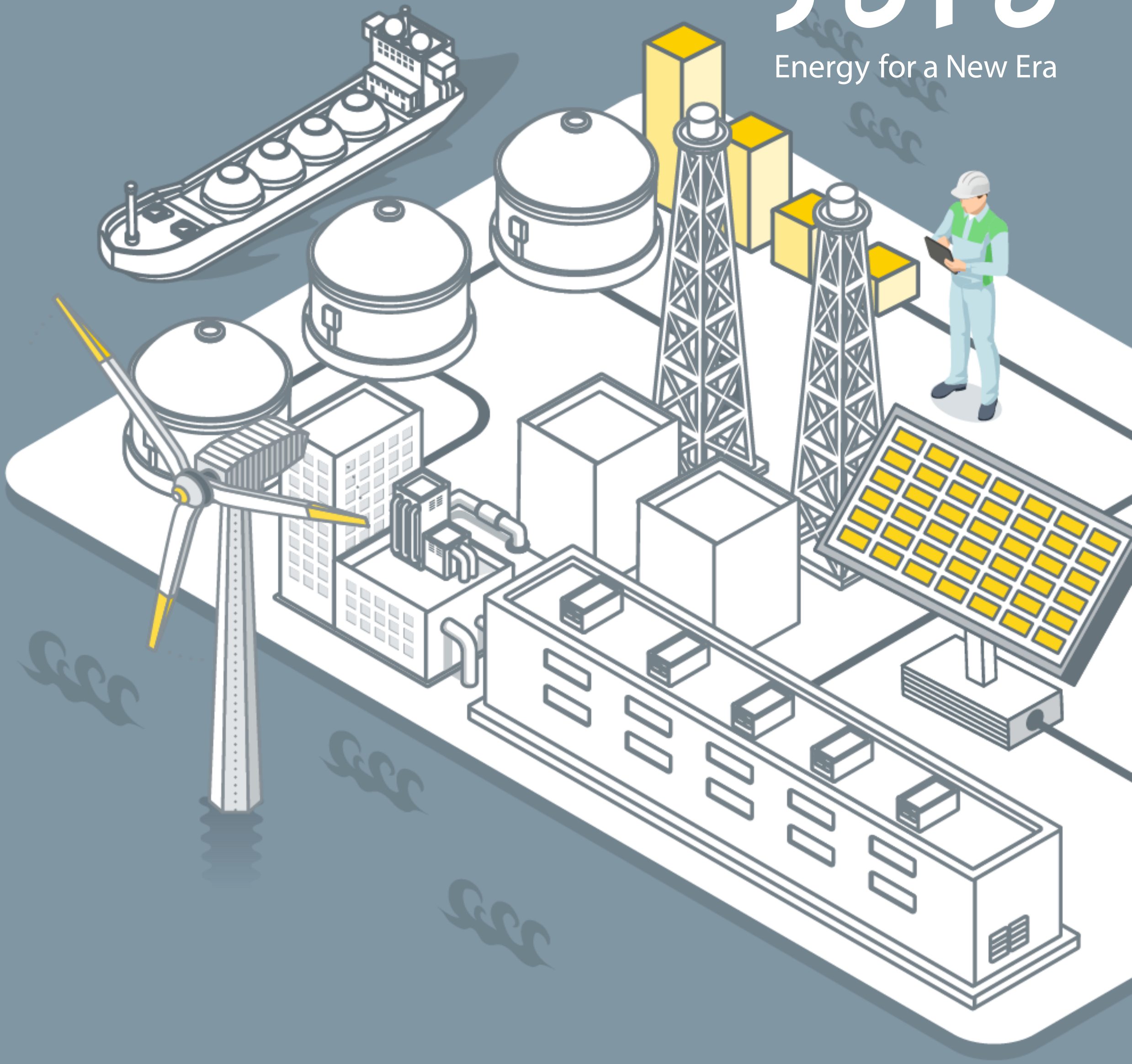

Thank you for your attention