Project Overview

Developing energy carrier technologies to contribute to the creation of a hydrogen-based society

Social Landscape / Social Agenda

Japan's energy self-sufficiency rate is very low. The country needs to create and implement an energy infrastructure that uses hydrogen energy, cuts down on CO_2 emissions, and reduces dependence on imported fossil fuels.

Long-term Vision

(1)Establishing a CO_2-free hydrogen value chain
(2)Improving energy security and contributing to the creation of a resilient, low-carbon society

During the Tokyo Games

Promoting Japan's potential to create a hydrogen-based, environmentally friendly society

Three Priorities

1 Social Impact

Promoting the promise of a hydrogen-based society by proposing concrete measures for the production, transportation, storage, and utilization of hydrogen

2 Hospitality during the Games

Providing opportunities for both the Japanese people and foreign visitors to learn about the potential of hydrogen-related technologies through events and demonstrations

3 Shared Value

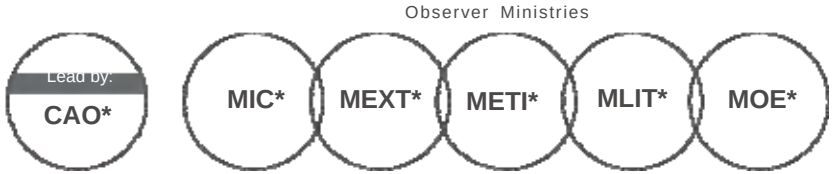
Improving Japan's competitiveness in the global hydrogen industry

Concept for 2020

Energy Innovation 2020

Hydrogen Energy System

Moving toward the next stage of clean transportation and living with the latest low-carbon energy system



* CAO : Cabinet Office
* MIC : Ministry of Internal Affairs and Communications
* MEXT : Ministry of Education, Culture, Sports, Science and Technology
* METI : Ministry of Economy, Trade and Industry
* MLIT : Ministry of Land, Infrastructure, Transport and Tourism
* MOE : Ministry of the Environment

Course of Action Toward 2020

Verification tests in the following fields are being proposed around the Olympic and Paralympic venues to create a low-carbon, hydrogen-based society.

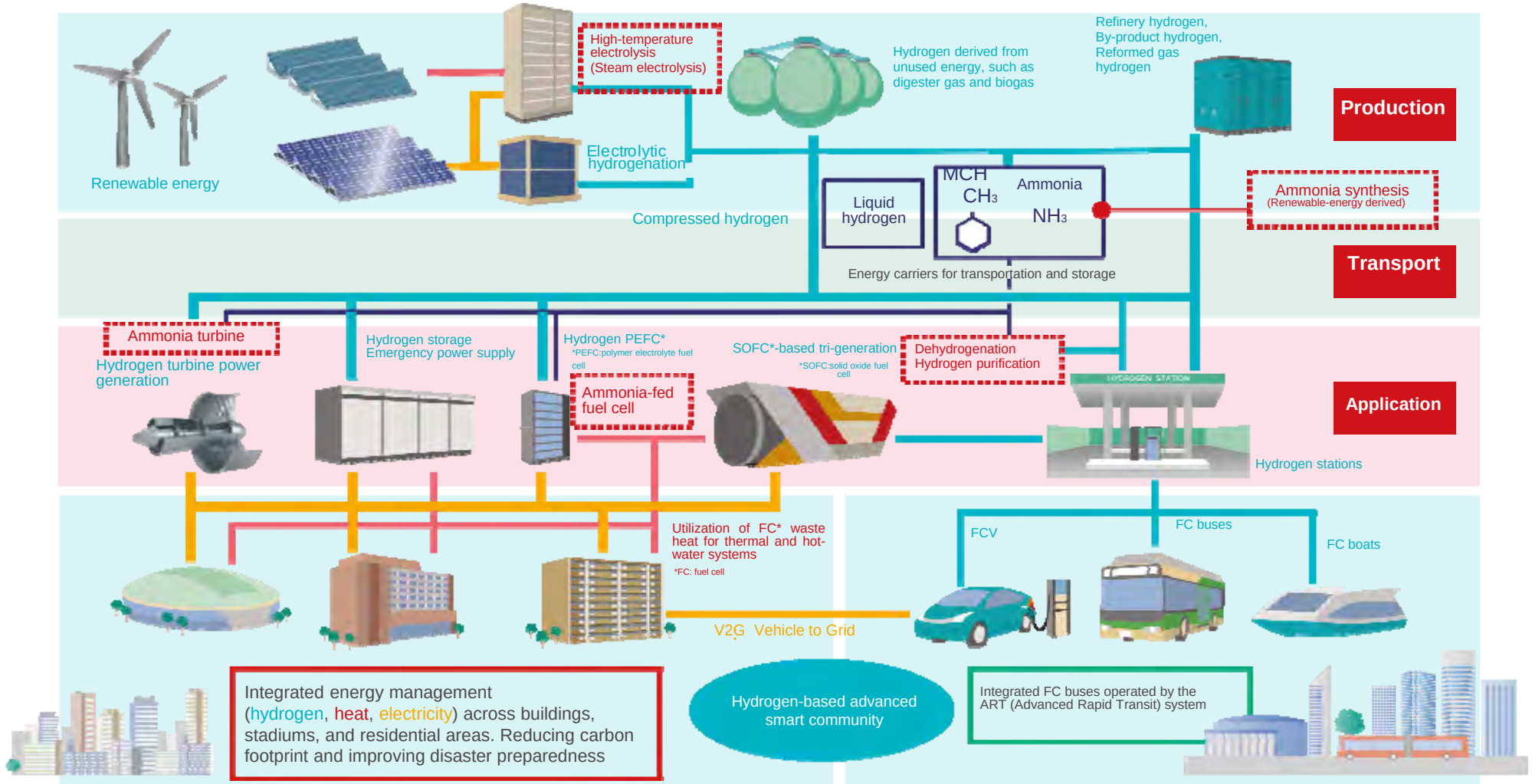
Fields		Measures
Promoting the latest developments	Conducting demonstrations and exhibits on technologies that may have not reached commercial rollout by 2020	▪ Verifying technologies on high-temperature electrolysis (steam electrolysis), ammonia and organic chemical hydride carriers, and dehydrogenation ▪ Verifying technologies on ammonia synthesis, ammonia-fed fuel cells, and turbine generators ▪ Launching a hydrogen energy demonstration site to showcase the latest developments and raise awareness
Application in transportation	● Using FC* buses, FC vehicles, and FC boats for the transportation of athletes, organizers, and visitors ● Installing hydrogen stations *FC: Fuel cell	▪ Deploying FC buses during the Games especially on bus routes around the venues ▪ Building hydrogen stations around the Olympic venues ▪ Introducing hydrogen derived from renewable energy
Application during the Games	● Providing hydrogen energy to supplement some of the power supply needed at the Games venues ● Using hydrogen derived from unused and renewable energy as much as possible	▪ Providing part of the power supply for the Olympic venues and dining facilities with hydrogen PEFC* and SOFC* *PEFC : polymer electrolyte fuel cell *SOFC: solid oxide fuel cell ▪ Sharing a hydrogen-based distributed energy generation mechanism between venues and residential areas. Optimizing power supply through integrated management of hydrogen, heat, and electrical energies ▪ Reducing dependence on general electric grids for power to better prepare for disasters ▪ Introducing hydrogen derived from renewable energy

: To be overseen by the Cabinet Office

Conceptualization

Creating a low-carbon, clean-energy society by utilizing technologies in hydrogen production and hydrogen energy

※ The diagram below is a conceptual drawing of a future hydrogen-based society.



To be overseen by the Cabinet Office's SIP* Energy Carrier group

*SIP: Strategic Innovation Promotion Program

It is crucial to develop technologies to utilize energy carriers (liquid hydrogen, organic chemical hydride, ammonia) as well as establish ways to use hydrogen as an energy source to enable a hydrogen-based society in the future

Core Technologies To Be Overseen by The Cabinet Office's SIP* Energy Carrier Group

Technological development in the production of hydrogen energy carriers

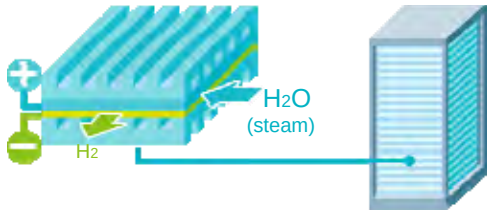
*SIP : Strategic Innovation Promotion Program

※ The diagram below is a conceptual drawing of a future hydrogen-based society. The Energy Carrier group of the Cabinet Office's SIP Program is involved in the technologies illustrated in the large boxes.

Part 1 Producing Hydrogen Energy Carriers

High-temperature Electrolysis (steam electrolysis) Technology
(Producing hydrogen from renewable energy)

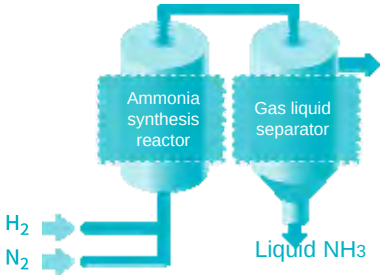
High-temperature electrolysis cell Stack



Core Technologies

Proton conductive electrolytes
Enlarging the electrolysis cells

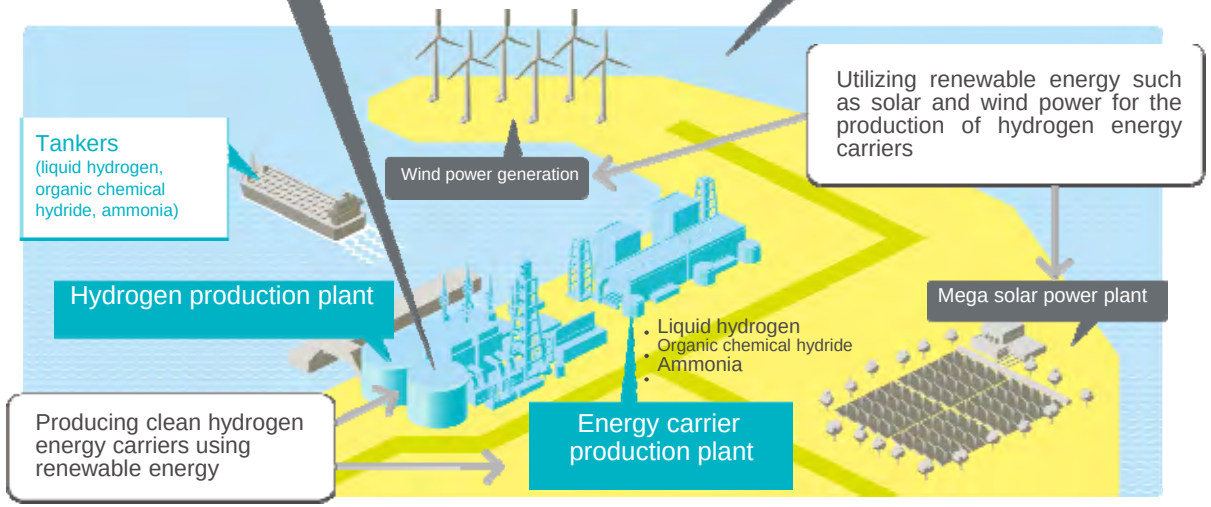
Ammonia Synthesis Technology
(Producing energy carriers from renewable energy)



Core Technologies

Ammonia synthesis catalysts
Heat balance

Producing clean hydrogen energy carriers



Core Technologies To Be Overseen by The Cabinet Office's SIP* Energy Carrier Group

Technological development on the utilization of hydrogen energy carriers

*SIP：Strategic Innovation Promotion Program

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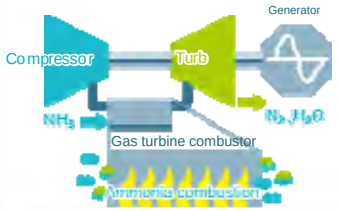
Part 2 Utilization of Hydrogen Energy Carriers

Ammonia-fueled Combustion Turbine Power Generation



Core Technologies

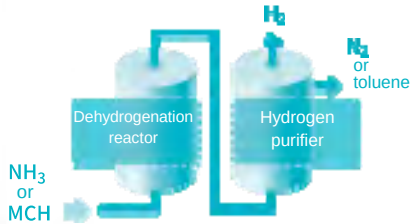
Combustion technology
Reducing nitrogen oxides

Ammonia-fed Fuel Cells

Core Technologies

Heat balance
Enlarging fuel cells

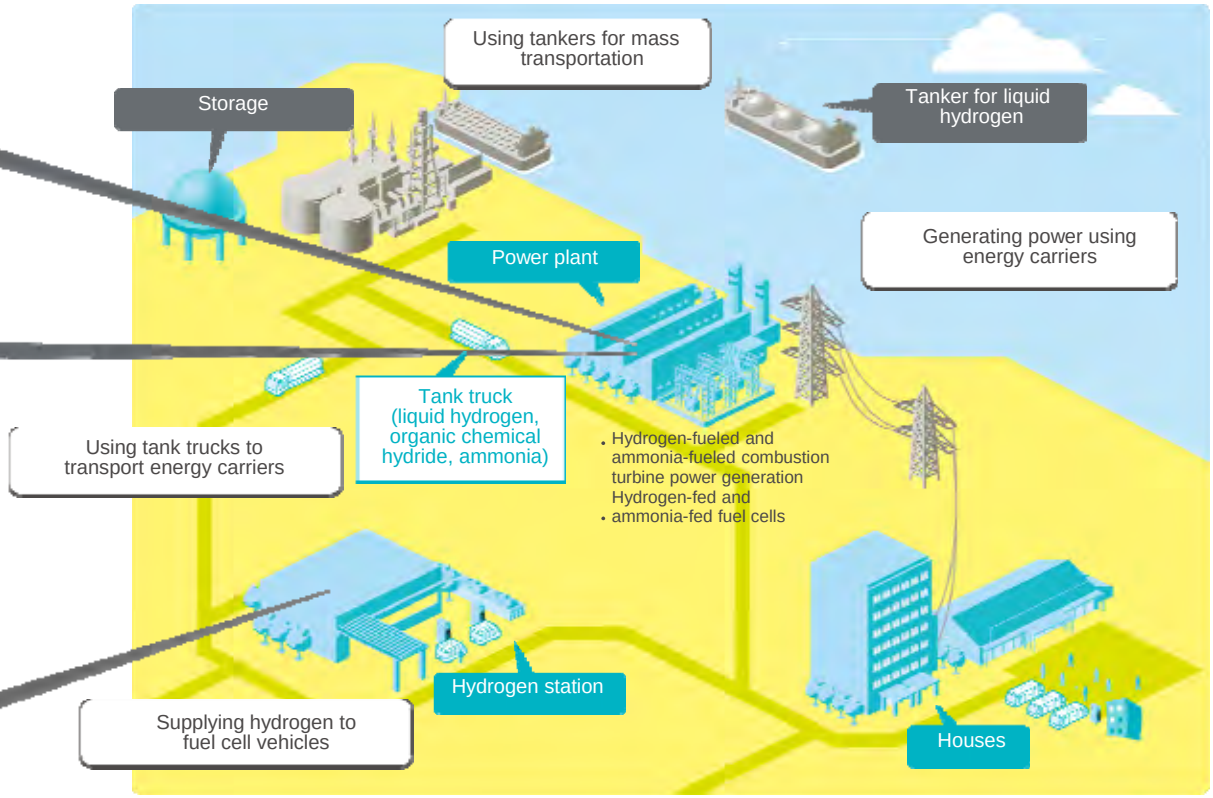
Energy Carriers (ammonia, organic chemical hydride) Hydrogen Stations



Core Technologies

Dehydrogenation catalysts
Membrane modules for hydrogen purification
Adsorption-separation technology

Creating an Environmentally Friendly Hydrogen Society



H_2 hydrogen
NH_3 ammonia
MCH methylcyclohexane
N_2 nitrogen

Initiatives and Partners

iatives	Cooperating Organizations	Details
Research and Development		
High-temperature electrolysis (steam electrolysis) (Producing hydrogen from renewable energy)	SIP* Energy Carrier group (Cabinet Office and other relevant organizations)	Developing technology for hydrogen production by using heat and electricity from renewable energy to efficiently separate hydrogen from steam
Energy carrier (ammonia) hydrogen stations	SIP Energy Carrier group (Cabinet Office and other relevant organizations) Industrial gas companies SIP	Developing dehydrogenation catalysts, reactors, and hydrogen purification systems to separate hydrogen from ammonia and supply it to fuel cell vehicles at hydrogen stations. Ammonia is seen as a promising candidate as an energy carrier.
Energy carrier (organic chemical hydride) hydrogen stations	SIP Energy Carrier group (Cabinet Office and other relevant organizations) Oil companies	Developing dehydrogenation catalysts, reactors, and hydrogen purification systems to supply organic chemical hydride (methylcyclohexane) to fuel cell vehicles at hydrogen stations. Organic chemical hydride is seen as a promising candidate as an energy carrier.
Ammonia-fed fuel cells	SIP Energy Carrier group (Cabinet Office and other relevant organizations)	Developing a power generating system using ammonia-fueled SOFC (solid oxide fuel cell)
Ammonia-fueled combustion turbine power generation	SIP Energy Carrier group (Cabinet Office and other relevant organizations)	Researching power generation systems using ammonia-fueled combustion
Ammonia synthesis	SIP Energy Carrier group (Cabinet Office and other relevant organizations)	Researching highly efficient ammonia production processes using hydrogen derived from renewable energy
Course of Action for Smooth Rollout		
Inquiry into cost-cutting measures in the field of development	SIP Energy Carrier group (Cabinet Office and other relevant organizations)	Launching initiatives for cost-cutting measures
Research on risk assessment and safety evaluation ahead of social implementation		Launching initiatives on safety evaluation, risk mitigation, and public reception
System Design		
Evaluating the practicability and economic efficiency of each technology Outlining the demonstrations and verification tests	Cabinet Office, relevant companies and organizations	Examining the details of demonstration methods, designing/constructing/testing prototypes, designing demonstration devices

*SIP: Strategic Innovation Promotion Program

Timeline

Agenda	2015 (FY)	2016	2017	2018	2019	2020	Legacy of Tokyo 2020
Research and Development	**※Timeline for SIP* Energy Carrier group** (Cabinet Office and other relevant organizations) Developing elemental technology		Prototyping	Testing under real-life conditions			
Course of Action for Smooth Rollout	**※Timeline for SIP Energy Carrier group (Cabinet Office and other relevant organizations)** Safety evaluation			Risk mitigation		Tokyo 2020 Olympic And Paralympic Games	
	Cost-cutting measures and initiatives to improve public reception						
System Design	Reviewing each R&D initiative to assess the possibility of moving to the verification phase. Outlining verification and demonstration of applicable R&D initiatives	Examining the details of demonstration methods	Designing prototypes	Constructing and testing prototypes, designing demonstration devices			○ Promoting commercialization of relevant technologies ahead of public implementation ○ Promoting Japanese technology to the world

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