Implementation of Clean Fuel Ammonia Value Chain

AEA Australia Conference
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Key Events for the last one year in Japan

October, 2020

Declaration of "Carbon Neutrality by 2050“

December, 2020

Announcement of “Green Growth Strategy”
Fuel Ammonia is ranked as one of 14 Growth Sectors

October, 2020

"Public-Private Council on Fuel Ammonia Introduction" was launched
Announcement of Interim Report in February, 2021

April, 2021

"Demonstration Project on Ammonia Mix Combustion in 1GW Coal Power Plant" has started
（20% mixture in Hekinan Power Station of JERA）

Update of Key Technologies

Mix combustion in coal fired boilers

- 20%-60%NH_3 in Coal
- Large scale demonstration from 2021-24
- Development of NH_3 combustion up to 100%

SOFC

- Development of 10kW-200kW systems

Industrial Furnaces

- Development of mix combustion with natural gas in glass melting furnace

Marine Diesel Engine

- Implementation of NH_3 driven vessels by mid 2020s

Gas turbines

【50kW】

- Demonstration of heat and power supply in greenhouse agriculture from 2021-2022

【2MW】

- 20%-70%NH_3 in natural gas
- Development of NH_3 single fuel system by 2023

【40MW】

- Development of NH_3 single fuel system by 2025

【ACCGT】

- Development of H_2 GT with NH_3 cracking system by 2025

Public-Private Council on Fuel Ammonia Introduction

Established : October 2020 under Natural Resources and Fuel Department of METI
Interim Report : February 2021

1. Objectives

Identifying issues for expanding the use of fuel ammonia, and sharing the roles and timelines of the public and private sectors in solving these issues, with the aim of promoting a unified approach.

2. Members

Public sector	Private sector
Natural Resources and Fuel Department, Agency for Natural Resources and Energy, METI	IHI Corporation
Japan Oil, Gas and Metals National Corporation (JOGMEC)	JERA Co., Inc.
Japan Bank for International Cooperation (JBIC)	Electric Power Development Co., Ltd. (J-POWER)
Nippon Export and Investment Insurance (NEXI)	JGC HOLDINGS CORPORATION
	Nippon Yusen Kabushiki Kaisha (NYK Line)
（Observers）	Marubeni Corporation
Material Industries Division, Manufacturing Industries Bureau, METI	MITSUBISHI HEAVY INDUSTRIES, LTD.
Ports and Harbours Bureau, Ministry of Land, Infrastructure, Transport and Tourism	Mitsubishi Corporation
Maritime Bureau, Ministry of Land, Infrastructure, Transport and Tourism	The Institute of Energy Economics, Japan (IEEJ)
	Clean Fuel Ammonia Association (CFAA)

Public-Private Council on Fuel Ammonia Introduction

Outline of Interim Report

- Promotion of involvements by Japanese companies in Clean Fuel Ammonia Value Chain from production, transportation, storage, utilization to finance for cost reductions and mid to long term supply security

- Contribution to the decarbonization of the world and Asia where thermal power generation will continue to be significant portion of power supply.

- Expected demand in Japan is 3MMtons in 2030, 30MMtons in 2050 and 100MMtons for global supply chain by Japanese companies in 2050.

- Targeted price by 2030 is upper 10yen range per Nm3 hydrogen equivalent (upper $1 range per kg).

- Development of technologies for ammonia GTs, CHPs, industrial furnaces, marine diesel engines, low cost and high efficiency production and CCS.

- Establishment of international standards and criteria.

Roadmap of Fuel Ammonia Value Chain

Supply

Green (Renewables)
Blue (Natural Gas+CCS)
Gray

Utilization

Coal Power Plants (~1,000MW)

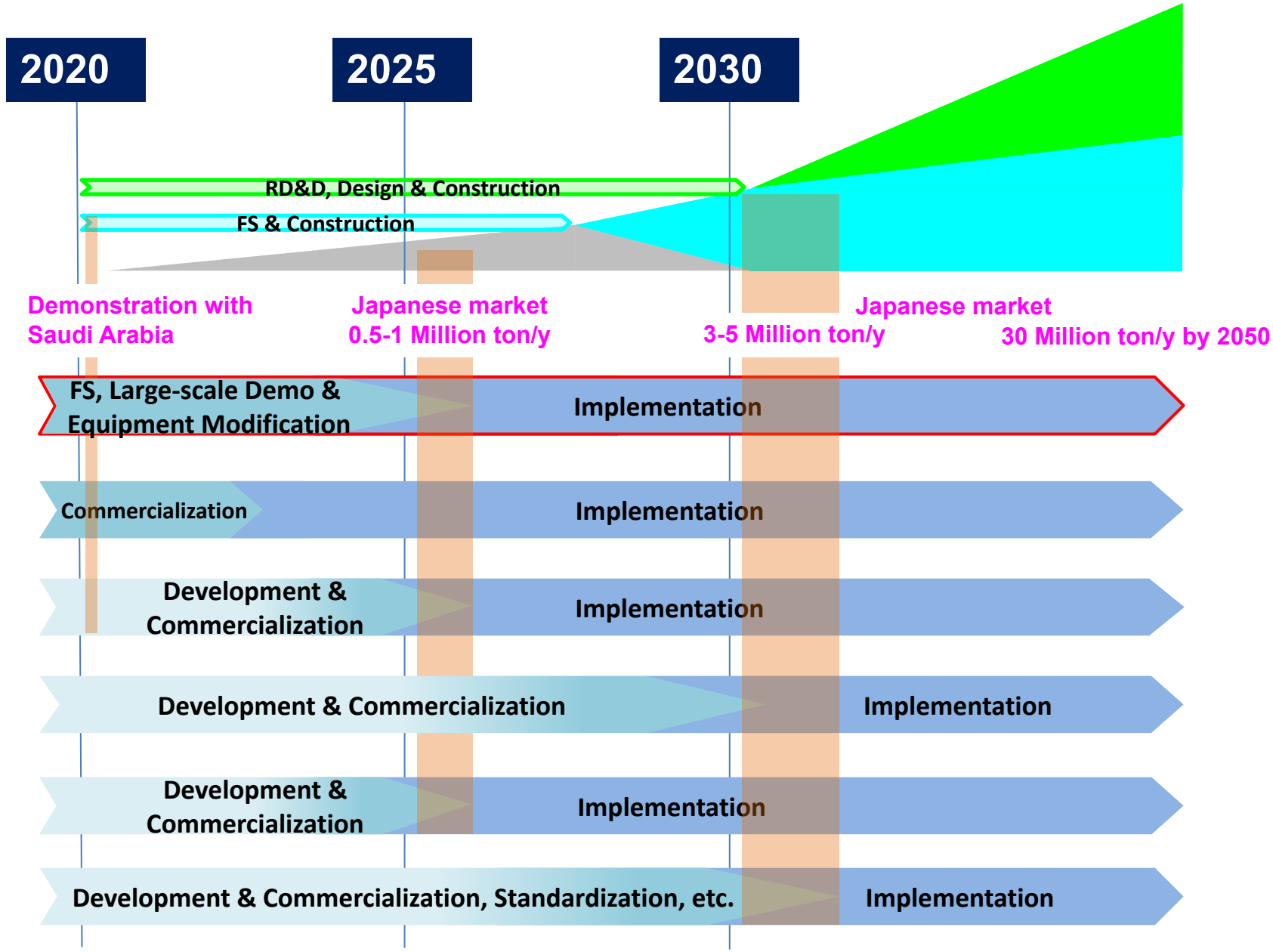
GTs (~0.3MW)

GTs (2MW～), **SOFC**

ACCGT (100MW～)

Industrial Furnaces

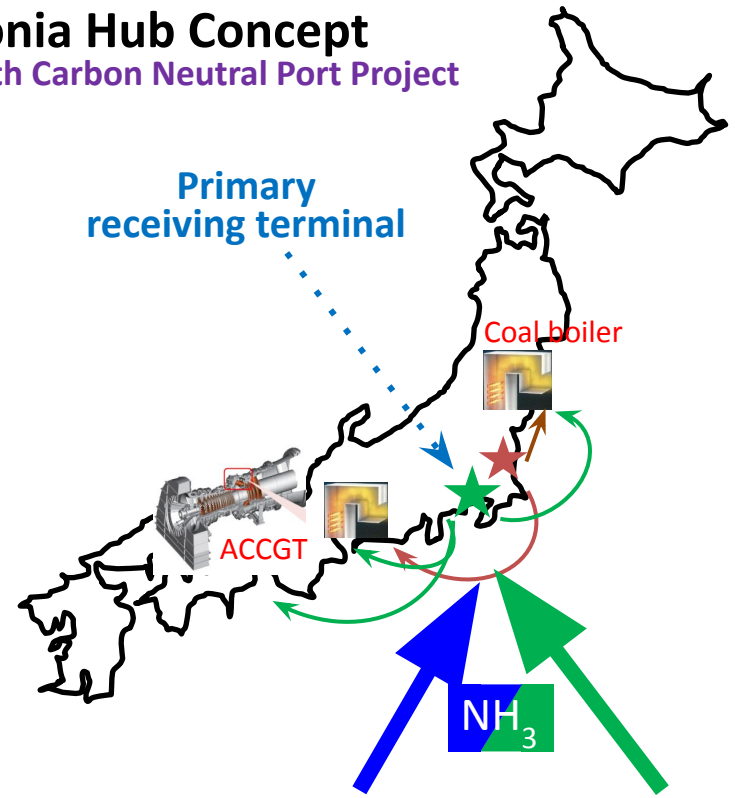
Marine Engines



Implementation Plan of Clean Fuel Ammonia Value Chain

Ammonia Hub Concept

Collaborate with Carbon Neutral Port Project



Australia, USA, Middle East

Phase Ⅰ

- Mixed combustion in coal power generation
- Development of ammonia supply infrastructure
  （Primary receiving terminal + domestic delivery system）
- Establishment of supply chain（mainly from Australia and USA）

Phase Ⅱ

- Increase of fuel ammonia co-firing ratio in coal power generation
- Mixed combustion in natural gas ACCGT

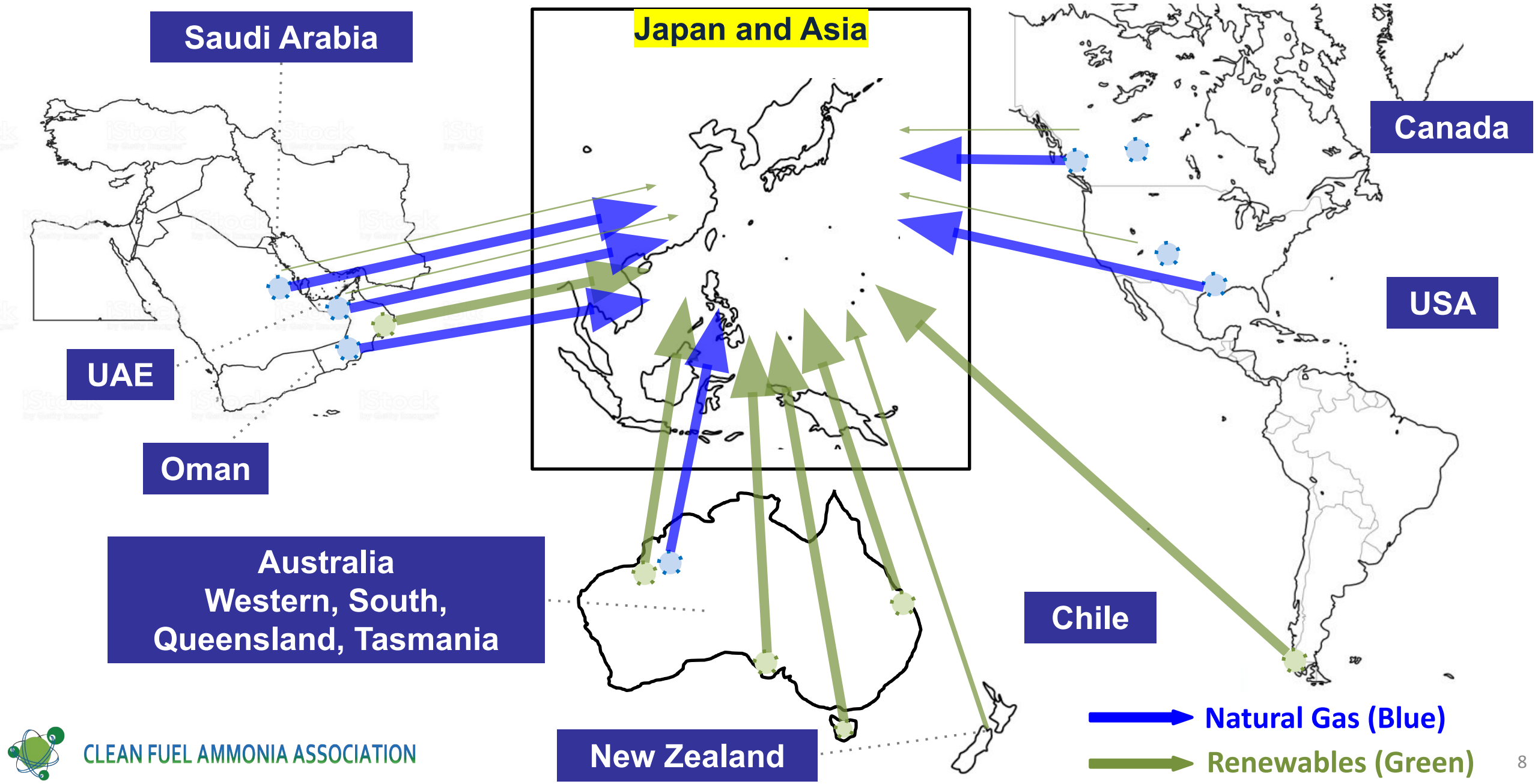
Distributed power （small & medium GTs, SOFC）
Industrial Furnaces
Marine Engine
＜C-free Power Generation＞

- Ammonia single fuel combustion in coal power plants
- Ammonia ACCGT
- Expansion of mix combustion in coal power generation in Asia

（ACCGT：Advanced Combined Cycle Gas Turbine）

2050 Demand in Japan, more than 30M Tons
CO_2 reduction more than 60M Tons

Potential Supplies of Blue and Green Ammonia



CLEAN FUEL AMMONIA ASSOCIATION