



# Green Hydrogen Economy Roadmap: A Korean Perspective

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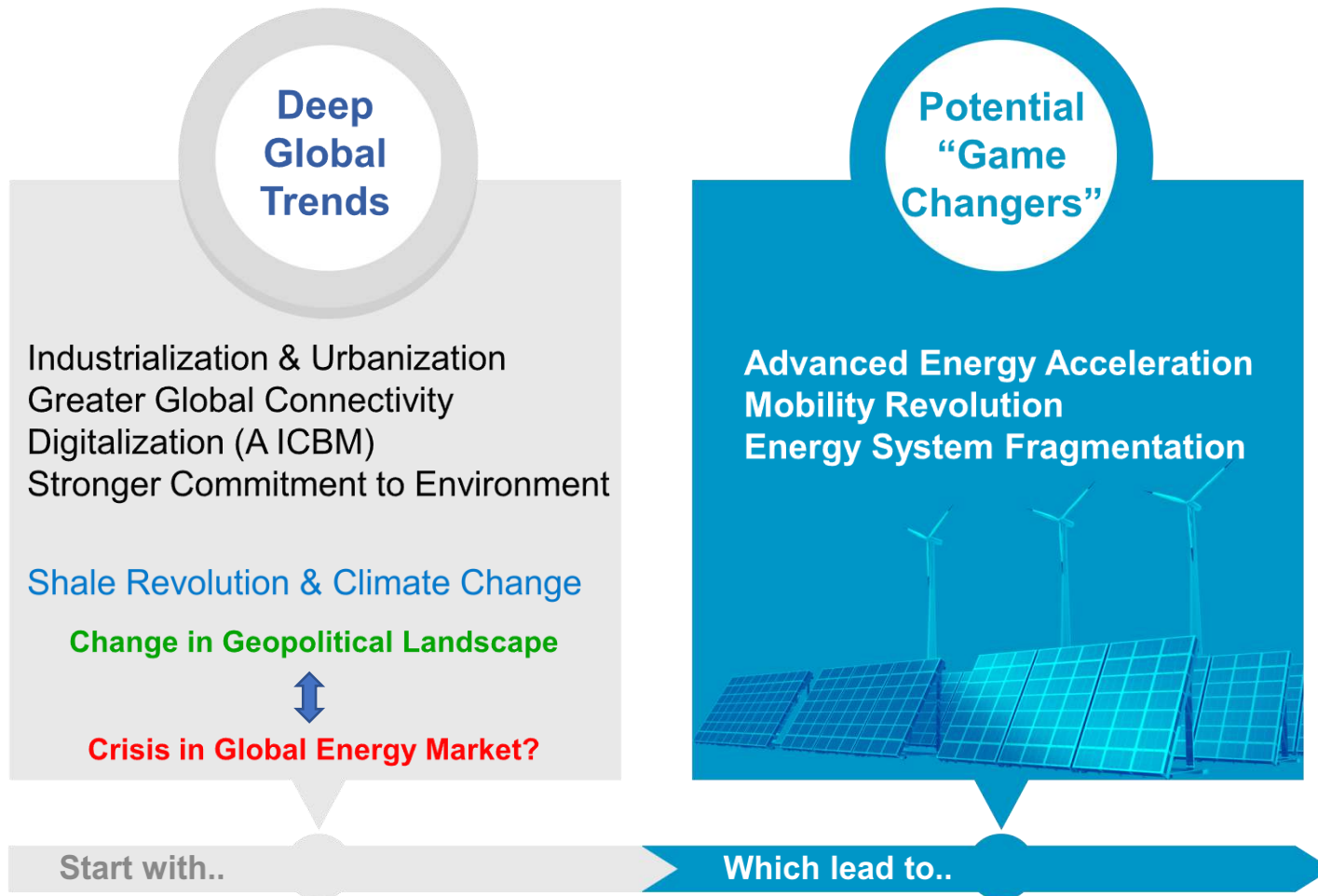
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- 1. Korea's Energy Transition & Innovation Strategy**
- 2. Korea's Green Hydrogen Economy Roadmap**



# **Part 1. Korea's Energy Transition and Innovation Strategy**

# Paradigm Shift in Global Energy Industry



\*Source: McKinsey & Company, World Economic Forum White Paper, 2017

## Opportunities Arising from a Revolution

**DECARBONIZATION**



**DECENTRALIZATION**



**DIGITALIZATION & DEMOCRATIZATION**



**Destruction?**

**Dr. John Murton (UK's COP26 Ambassador, Feb. 20, 2020)**

"Green growth and economic growth are mutually win-win. With increased investment in green growth, the transformation of the global industrial structure are taking place very rapidly. How well prepared and ready to change will determine the fate of enterprise and nation."

## Basic Principles

Enhance Citizens' Wellbeing as well as Maintain Sustainable Growth through Energy Transition

Revamp Energy Consumption Pattern



Transform Towards Cleaner & Safer Energy



Expand Distributed & P2P Energy Systems



2040 Renewable Electricity Target: 30~35%

Strengthen Global Competitiveness of Energy Industry

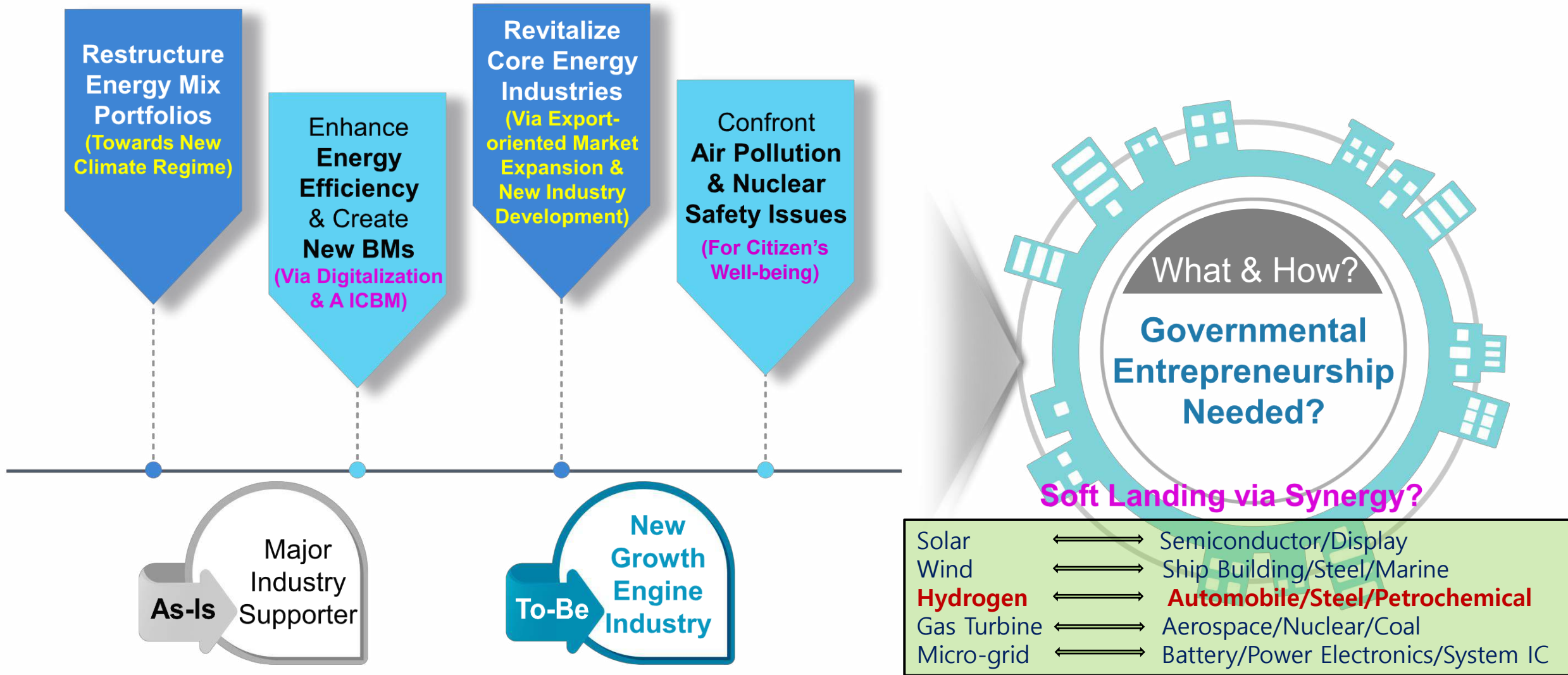


Build New Infrastructure for Energy Transition





# Innovative Growth Strategies in Energy Industry





## **Part 2. Korea's Green Hydrogen Economy Roadmap**

# I. Current Status of Hydrogen Economy in Korea

## Production

### ■ Production (2017) : 2.2 Mton

- Oil refining process : 75%
- Naphtha cracking : 13%
- LNG reforming (SMR) : 7%, and others

### ■ External circulation (2017) : 0.25 Mton

- Pipeline : 88% (200 km\*)
- Tube trailer : 12% (500 T/T)

## Utilization

### ■ FCEV Domestic Dissemination (2019F)

- Passenger cars : 5,058 units; Buses : 15 units; Taxis : 10 units

### ■ Hydrogen Refueling Station (2019F) : 54 Stations

### ■ FCEV<sub>(passenger car)</sub> Export (May 2019) : 1,288 units

### ■ Fuel Cell for Power Generation (2019F)

- Power Plants : 397 MW
- Fuel Cell for Domestic Buildings : 7.1 MW

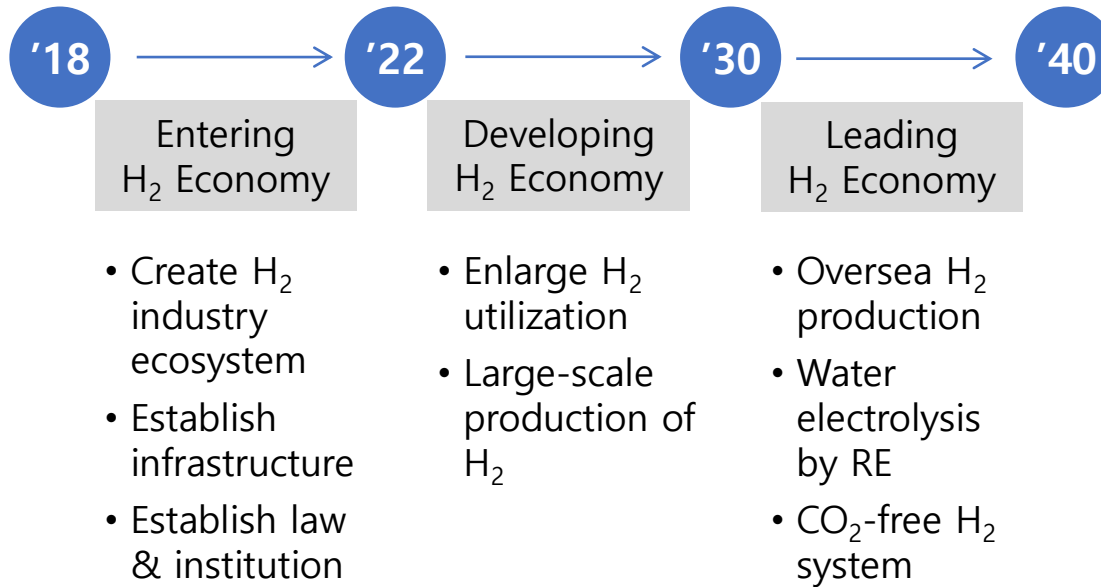
\*LNG pipeline : 4,857 km



## II. Hydrogen Economy Roadmap of Korea

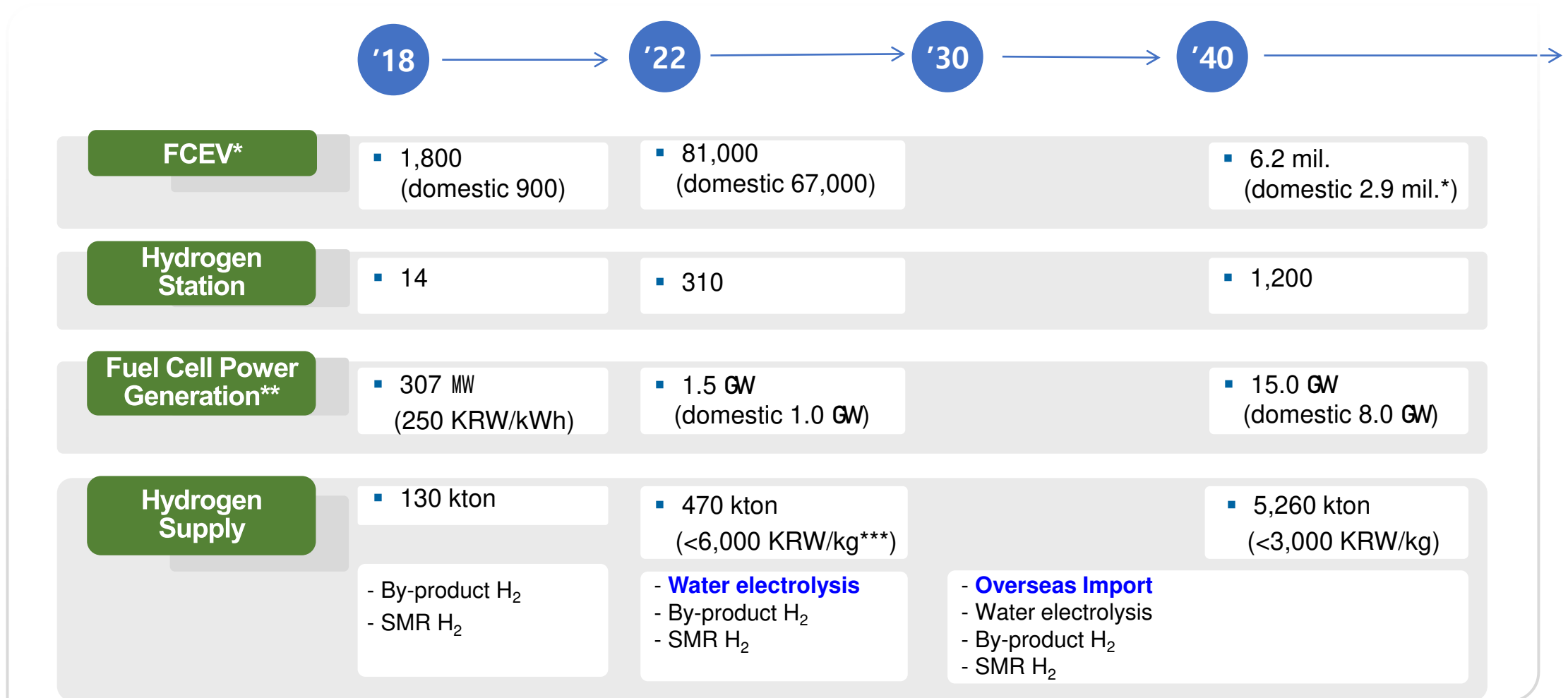
### Vision

- To Become the World's Top-Class Country in Hydrogen Economy



# II. Hydrogen Economy Roadmap of Korea

## Goal



\*Includes FCEVs for 80,000 taxis, 40,000 buses and 30,000 trucks

\*\*Includes additional 2.1 GW for residential/commercial use by 2040

\*\*\*~50% of the current gasoline price in Korea

# II. Hydrogen Economy Roadmap of Korea

## Strategies for Value Chains

### Production

#### Green Hydrogen

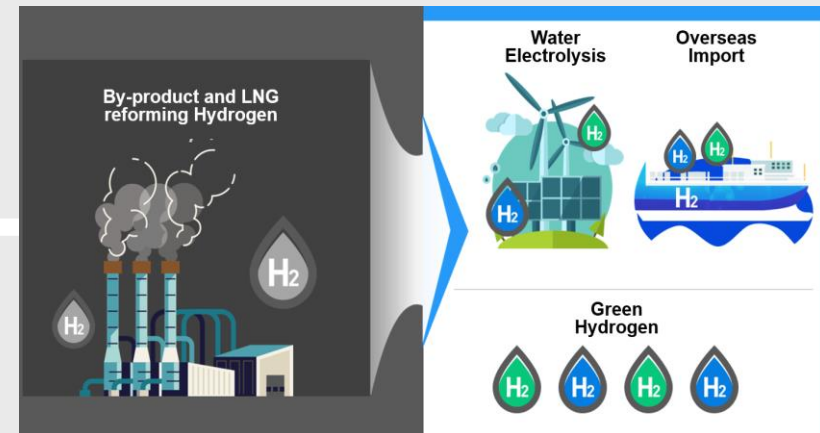
- Development of efficiency improvement technology for water electrolysis
- Development of long-term storage technology for high capacity hydrogen

#### Overseas Import

- Construction of H<sub>2</sub> receiving terminal for imported hydrogen
- Development, demonstration and commercialization of liquified H<sub>2</sub> Carrier

### Storage and Transportation

- Development of hydrogen liquefaction technology
- Development of technology for liquefied plant, tank and related parts
- Transition from high-pressure gas transport to liquid and/or liquefied carrier transport



## II. Hydrogen Economy Roadmap of Korea

### Strategies for Value Chains

#### Utilization

##### FCEV

- Expansion of production capacity of hydrogen car (\* 2025 : 100 thou. units/year)
- Development of technology for reducing price and improving durability of core components
- Increase of the supply of hydrogen taxis, buses, trucks and special vehicles

##### Ship

- Development and demonstration of fuel cell systems for ships
- Full-scale dissemination : (coastal ships) from 2027, (ocean liners) from 2030

##### Train

- Gradual replacement of diesel trains by hydrogen trains
- Demonstration after technology development until 2022

##### Power Generation

- Development of core technology and expansion of fuel cell power supply
- Development and commercialization of hydrogen gas turbine power generation technology in the medium to long term

##### Hydrogen City

- Construction of hydrogen city by applying technology, products and systems using hydrogen

# III. Promotion Plan

## Enacting Hydrogen Law (passed on January 9<sup>th</sup>, 2020)

- Preparing Promotion System and Comprehensive Planning System
- Establishing Hydrogen Safety Management System

## Preparing Roadmap for Technology Development

- Green Hydrogen Production, Liquification, Carbon Dioxide Capture and Use
- Fuel Cell, Hydrogen Utilization

## Infrastructure Building

- Building Hydrogen Filling Station and Hydrogen Production Base
- Building Hydrogen Acquisition Base
- Constructing Hydrogen Industry Clusters and Hydrogen Cities



## IV. Representative Applications in Korea



**National Assembly  
Hydrogen Station**



**Hyundai Hydrogen-Powered Car  
Nexo**



## IV. Representative Applications in Korea



Seoul Noel Park (near World Cup Park)  
LNG Fuel Cell PJT (POSCO Energy)



Daesan Hanwha Total Petrochemical  
Hydrogen Fuel Cell PJT (Doosan)

# 2020 Plan of Ministry of Trade, Industry & Energy on Hydrogen

- **(Commercial Vehicle) Small-size Electric Truck, Mid to Large-size Hydrogen Truck**
  - **10 ton Hydrogen Truck Manufacturing & Export** (2020~2025, 1,600 Trucks for Switzerland),  
**Cargo Truck for Postal Service** (2020, 1,000 Trucks)
  - Initiate Tech Development for Manufacturing Sweeping Vehicles, Special Vehicles, etc.
- **(Win-Win Cooperation) Mobility Alliance → Vitalization of Future Mobility Service Industry**
  - \* Participants : Automaker, Parts Supplier, IT Company, Insurance Company, Telecom Company, Game Company
  - **Cooperative Manufacturing of Hydrogen Buses by Large Companies and SMEs** → Market Penetration
- **(Infrastructure Building) Mobility Alliance → Hydrogen Industry Clusters, Hydrogen Cities**
  - **Hydrogen Industry Clusters** : Regions to foster R&D cooperation between knowledge institutes, companies and organizations. These regions will be testbeds for demonstrating newest technologies.  
(Planned by Ministry of Trade, Industry and Energy, and selected 5 candidate regions on Dec. 15, 2019)
  - **Hydrogen Cities** : Cities using hydrogen as the fuel for cooling, heating, electricity and transportation  
(Planned by Ministry of Land, Infrastructure and Transport, and selected 4 cities on Dec. 29, 2019)



First Mass-production

Exported to Switzerland

34 ton; 7 H<sub>2</sub> tanks (32 kg H<sub>2</sub>);  
190 kW fuel cell; 476 hp;  
8 min charging time for 400 km

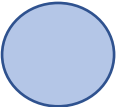

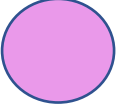
First 10 Hyundai XCIENT Hydrogen Trucks

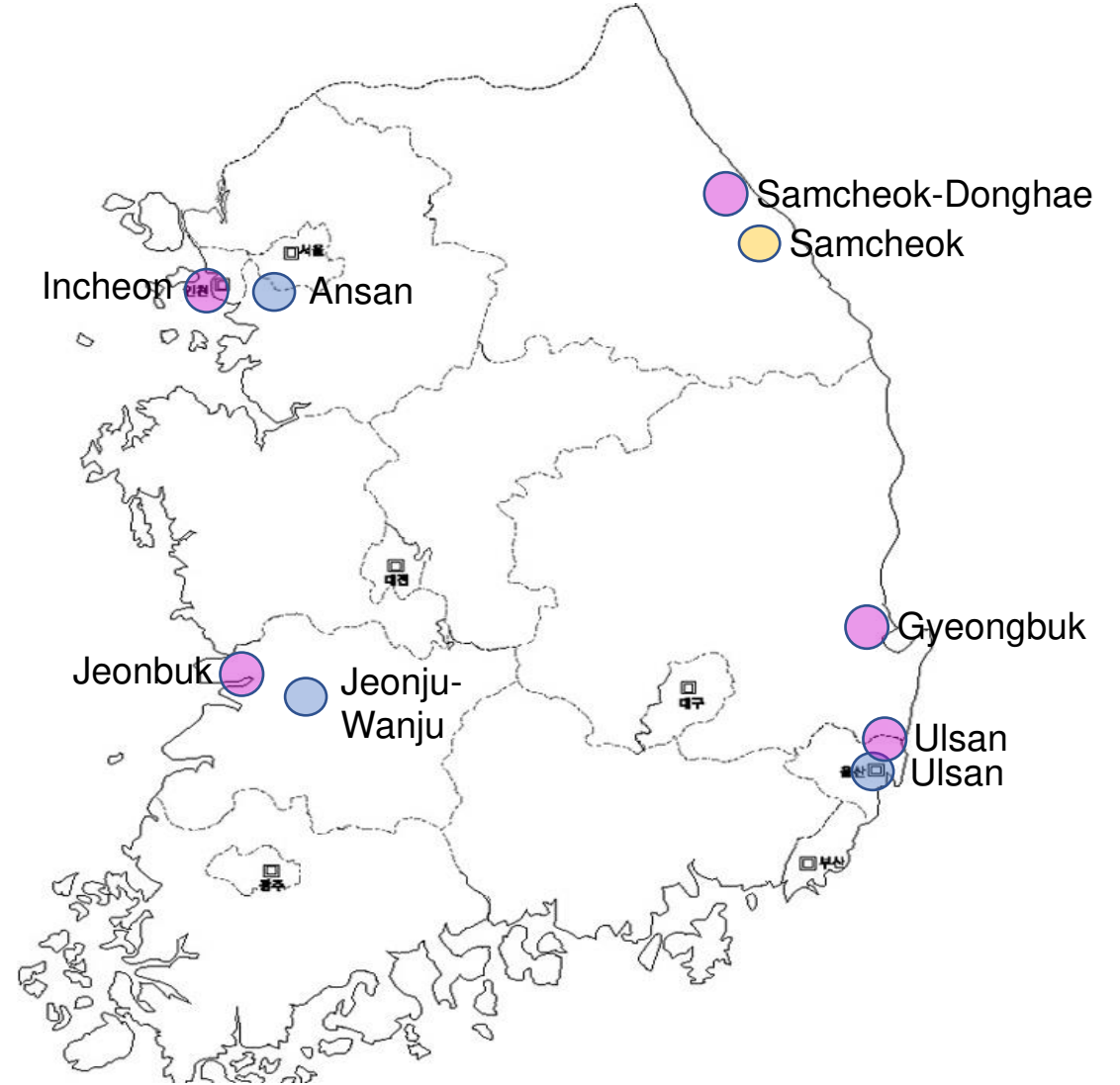
# New Concept Hydrogen Truck - Neptune





# VI. Hydrogen Cities and Hydrogen Industry Clusters in Korea

-  Hydrogen Pilot City by 2022
-  Hydrogen R&D Specialty City by 2022
-  Hydrogen Industry Clusters from 2021
  - Incheon : Hydrogen Production
  - Jeonbuk : Hydrogen Production
  - Samcheok : Hydrogen Storage/Transport
  - Ulsan : Hydrogen Mobility
  - Gyeongbuk : FC Power Generation/H<sub>2</sub> Terminal



# The 4<sup>th</sup> Energy Technology Development Plan\_(December, 2019)

New Industry  
in Energy

Renewable Energy (PV & Wind) and Hydrogen Economy Development

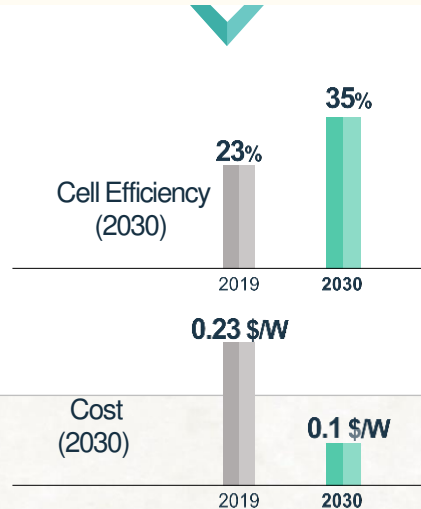
Materials & Parts Development for Global Value Chain Risk Management

## < R&D Strategies >

### PV



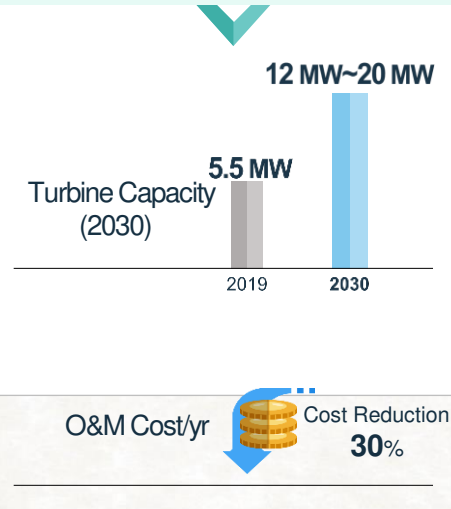
Cost Reduction & High Efficiency  
(Crystalline Si);  
Ultra-high Efficiency (Next Gen PV)



### Wind



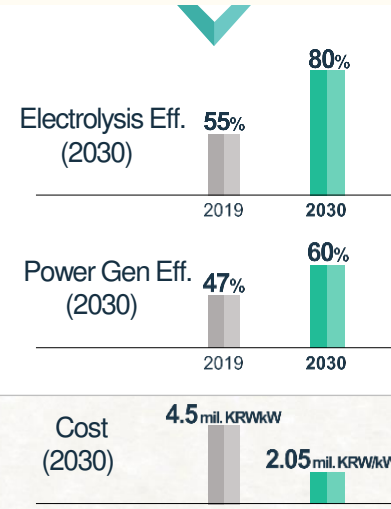
Core Parts Localization; Ultra-high Cap.  
Off-shore Wind Development;  
Turbine & Floating Wind Development



### Hydrogen



Green H<sub>2</sub> Production; Large Cap. Storage  
& Transport; Efficiency & Durability  
Improvement



### New Materials



Localization of Core Materials;  
Enlargement of Industry  
Applications

- \*(Localization Items)
- Fuel Cell MEA, Separator
- Catalyst & Electrode Materials
- Metals for Gas Turbine
- Nuclear Shielding Materials
- \*(Next Generation Items)
- Post-Li Materials
- Materials for Secondary Battery
- Materials for Electrolysis
- Light-weight Materials for PV

## **Korean New Deal Plan was announced on July 14<sup>th</sup> 2020, and included,**

Total 160 Bill. USD will be invested till 2025, and 1.9 million jobs will be created in three major areas: Digital New Deal; Digital-Green Convergence; Green New Deal.

**Green New Deal** projects include **1) Green Remodeling, 2) Green Energy, and 3) Eco-friendly Future Mobility – 73 Bill. USD, 650,000 jobs**

**Digital-Green Convergence** projects include **1) Green & Smart School, 2) Digital Twin, 3) Digitalized SOC for Safety, and 4) Smart & Green Industrial Complex.**

## **International Energy Agency's General Secretary, Dr. Faith Birol, stated,**

"Hydrogen is today enjoying unprecedented momentum, driven by governments that both import and export energy, as well as the renewables industry, electricity and gas utilities, automakers, oil and gas companies, major technology firms and big cities."

"The world should not miss this unique chance to make hydrogen an important part of our clean and secure energy future."

