經濟部能源署
Energy Administration,
Ministry of Economic Affairs






12 Key Strategies for Taiwan’s 2050 Net-Zero Transition (Draft)

Key Strategy 2 - Hydrogen

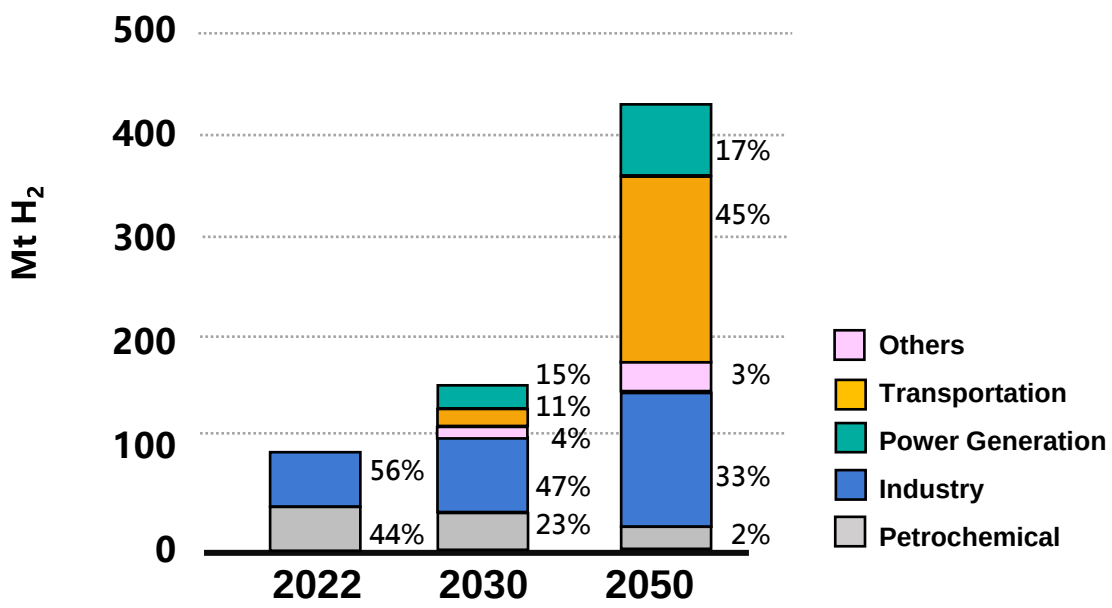
Energy Administration, MOEA

1. Analysis of Current Status
2. Project Goal and Pathway
3. Schedule
4. Unit Assignments
5. Strategies and Methods
6. Expected Benefits
7. Management and Examination Mechanism
8. Conclusion

1. Analysis of Current Status

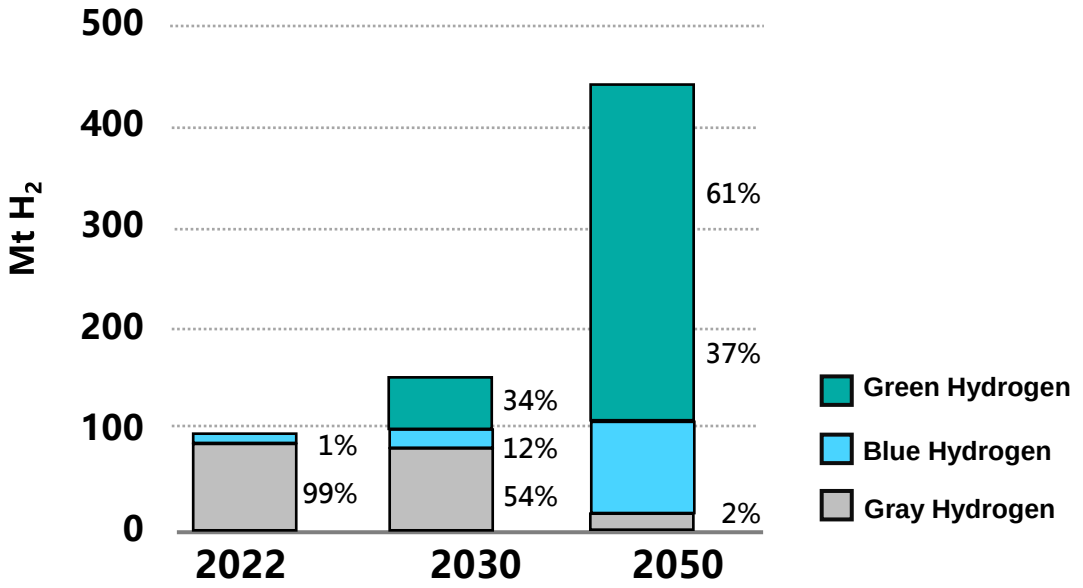
- As the ultimate clean energy source, hydrogen is an important option for countries to achieve a vision of net-zero emission or carbon neutrality.
- Hydrogen applications will centre at power generation, industry, and transportation.
- IEA indicates 2050 global H_2 demand is estimated over 430 million tons and global green H_2 supply will reach 34% in 2030. High-efficiency electrolytic system powered with renewable electricity will be developed in the near future.

Trend of Hydrogen Application by IEA



Reference： Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach-2023 Update. P.101

Sources of Hydrogen



- Grey hydrogen is created from natural gas, or methane, using steam methane reformation.
- Blue hydrogen： Grey hydrogen +CCS (Carbon capture and storage) .
- Green hydrogen is hydrogen produced by splitting water by electrolysis.

2. Project Goal and Pathway - Short to Medium Term Goal

Policy-led Market Demand

0.571 MW

2022

Phase1

- Environment/Safety Examination
- H_2 Blending Demonstration

91 MW

2025

Phase2

Gradually Complete by 2025

- H_2 Co-Combustion>91 MW
- 5% H_2 Blending

900 MW

2030

Phase3

2026-2030

- H_2 Co-Combustion Demonstration
- 5% H_2 Blending

91 MW in 2025

891 MW in 2030

Existing Units

Infrastructure & Safety Monitoring

Unit Retrofit

Power Plant Transformation

2. Project Goal and Pathway - Short-to-Medium Term Method

Hydrogen is one of the 12 key strategies to reach net-zero transition.

- "Hydrogen Energy Promotion Taskforce"
  - Strategies for hydrogen applications, hydrogen supply, and infrastructures
  - 8 promotional methods

Hydrogen Application	1-1 H_2 blending/pure H_2 combustion technology introduction 1-2 Domestic technologies development and maintenance 1-3 Hydrogen-based steelmaking technology 1-4 Demonstration and verification of hydrogen vehicles
Hydrogen Supply	2-1 Stable Hydrogen Supply
Infrastructure	3-1 Hydrogen transportation and storage infrastructures 3-2 High-pressure transportation and storage technology and infrastructures 3-3 Domestic liquified hydrogen-related infrastructures

3. Schedule - Short-term (2023~2030)

Hydrogen Application

- Power Generation: Co-combustion technology, operation, and maintenance
- Steelmaking: H_2-based steelmaking technology development
- Industry: Low-carbonization in manufacturing processes first
- Vehicle: Demonstration of hydrogen energy vehicle

Hydrogen Supply

- Technology development and evaluation of H_2 production
- Cooperation of international hydrogen supply chain
- Early demonstration and evaluation of hydrogen import
- Safety evaluation of liquified H_2 infrastructures, tank, and pipelines
- Research of H_2 metering and calibration. Capability of detection and verification

Infrastructure

- Hydrogen transportation and distribution infrastructures
- High-pressure transportation and storage infrastructures
- Liquified hydrogen-related infrastructures

3. Schedule - Medium to Long-term (2031~2050)

Hydrogen Application

- Power Generation: Hydrogen for power generation reaches 9%-12% in energy mix in 2050
- Industry: H_2-based technology development for carbon reduction
- Steelmaking: Application of H_2-based steelmaking technology
- Vehicle: Complete the safety-related regulations and detection capability

Hydrogen Supply

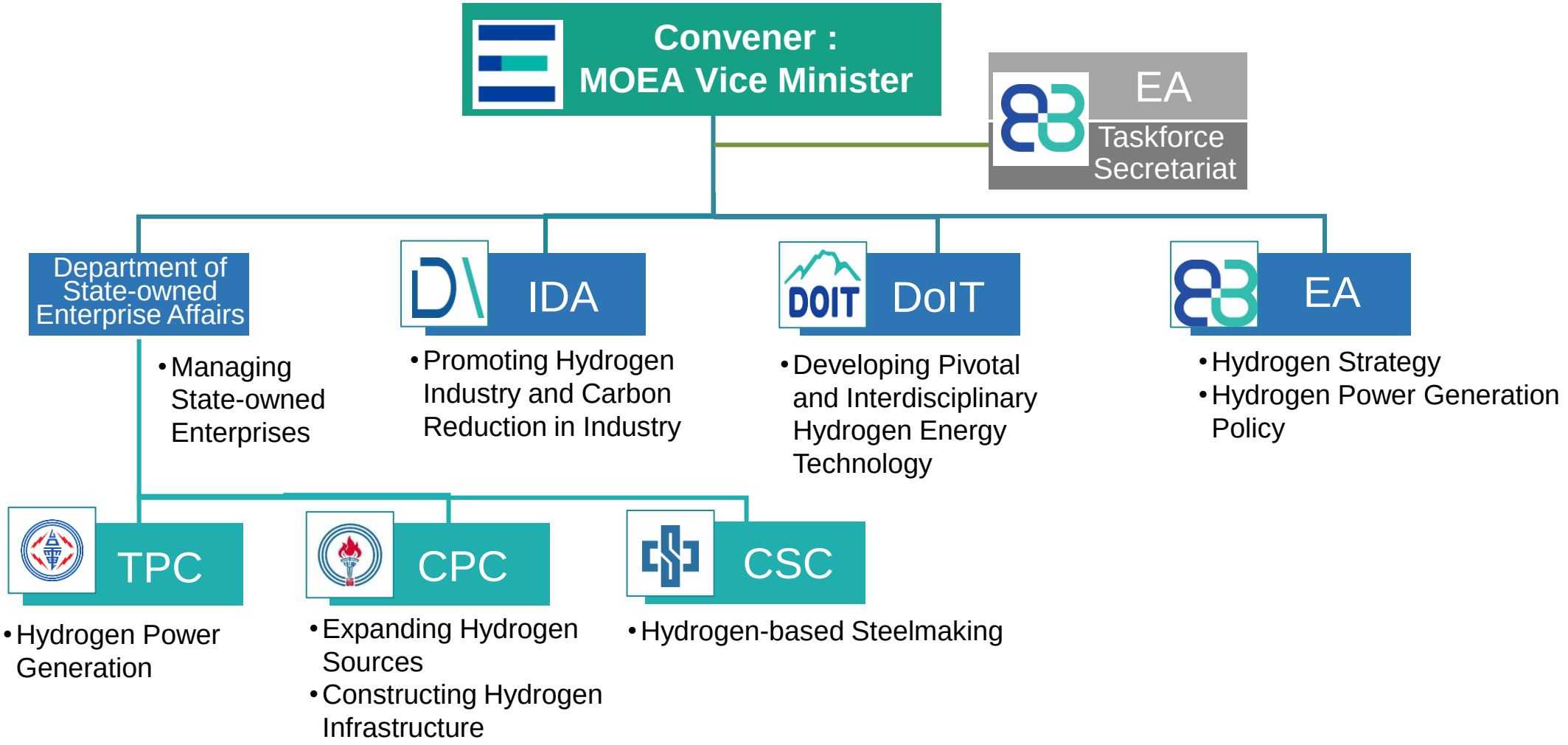
- International cooperation for hydrogen supply chain
- Key domestic technology of hydrogen production for long-term hydrogen supply

Infrastructure

- Large-scale H_2 transportation and storage infrastructures
- Commercial mode for the operation of hydrogen refueling station
- Expansion of hydrogen supply network

4. Unit Assignments - Hydrogen Energy Promotion Taskforce

- MOEA has organized the "Hydrogen Energy Promotion Taskforce" for the promotion of hydrogen development.



4. Unit Assignments - Work Assignments

- Application: Hydrogen vehicle application, energy and industrial sectors.
- State-owned enterprises as leading role.
- Technical and resource integration to promote H_2 application in energy and industry sectors.

Hydrogen Application	1-1 H_2 blending/pure H_2 combustion technology introduction 1-2 Domestic technologies development and maintenance 1-3 Hydrogen-based steelmaking technology 1-4 Demonstration and verification of hydrogen vehicles	NSTC, MOEA (EA, DoIT, IDA, TPC, CSC), MOTC
Hydrogen Supply	2-1 Stable Hydrogen Supply	NSTC, MOEA (EA, DoIT, IDA, BSMI, CPC, TPC)
Infrastructure	3-1 Hydrogen transportation and storage infrastructures 3-2 High-pressure transportation and storage technology and infrastructures 3-3 Domestic liquified hydrogen-related infrastructures	NSTC, MOEA (EA, DoIT, IDA, CPC, TPC)

5. Strategies and Methods - Power Generation

Issues

- Foreign countries possess more mature technology of large-scale centralized hydrogen co-combustion unit.
- Taiwan should invest in the research for basic capability and establish operation and maintenance technologies.

Foundation to be Established

Strategy: technology introduction and establishment of domestic operation and maintenance technologies

- To complete 5% H_2 blending in 2025
- Introduction of international technologies
- Existing units retrofits
- Establishment of domestic operation and maintenance technologies
- Talent training and cultivation


Hsinta Power Plant


Linkou Power Plant


Hydrogen Supply for Power Generation Test


Infrastructures & Safety Monitoring

5. Strategies and Methods - Steelmaking, Industry

Issues

- Hydrogen-based technologies in industrial and steelmaking sectors are still under development and need to be evaluated.

Technology & Application Improve-ment

Strategy: International Alliance and Cooperation. Low carbonization in manufacturing processes first.

- Steelmaking:
  - ✓ Evaluation of HBI (Hot Briquetted Iron) import. Organization of "low-carbon ironmaking technology development" research team
  - ✓ H_2 as reducing agent in the ironmaking process
- Industry:
  - ✓ Low carbonization in manufacturing processes first
  - ✓ Evaluation of process reaction and heating


H2-based Steelmaking abroad

H2-based Steelmaking (Hyundai & Pohang Iron and Steel)


By-product Hydrogen Recovery (Hanwha Petrochemical Plant)


Japan COURES50 Blast Furnace

5. Strategies and Methods- Transportation

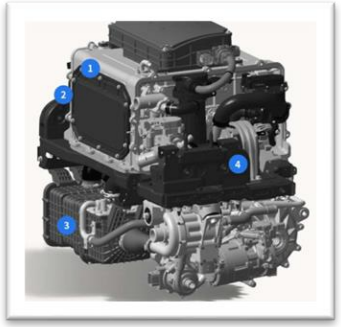
Issues

- Lithium battery EV: Long charging time and insufficient battery life.
- Long-distance commercial vehicle (bus, etc.): over-loaded batteries and the long charging time would influence the efficiency.

Hydrogen Vehicle Development & Applica-tion

Strategy: Organization of alliance for hydrogen power module and key technologies.

- Development of hundreds of kW-class, high-power and high-voltage hydrogen power module. (FC and stack design included)
- Integration technology of motor/electric control/battery in H_2 vehicles.
- Verification platform of components and subsystem.
- Demonstration and verification for hydrogen FC buses into actual driving routes.



Hundreds of kW-class FC System

Intelligent Composite Energy Management System

Test Platform of high-power FC stacks

5. Strategies and Methods- Hydrogen Supply

Issues

- International hydrogen supply chain is still under development. large-scale overseas transportation technology needs to be verified. Commercialization will be reached until 2030.
- Domestically-produced hydrogen capability should be developed for long-term and stable hydrogen supply.

Stable H_2 Supply

Strategy: Import and domestic production

- Import: Cooperation with major hydrogen production countries (such as Australia) for hydrogen import and the import evaluation will be completed by 2030. With preconditions of sufficient international supply and cost competitive hydrogen production, hydrogen import will be developed progressively.
- Domestic Production: Develop domestically-produced blue hydrogen with CCSU pilot project. To build the domestic key hydrogen production technology at demonstration site and further evaluate future capacity of domestic production.

Ultra-pure Green H_2 Production (Air Liquide Far Eastern)


Green H_2 Production


(Fukushima Hydrogen Energy ReSearch Field, FH2R)


Blue H_2 Production from abroad

5. Strategies and Methods- Infrastructures

Issues

- Development of related infrastructures, such as LH_2 receiving terminal, pipelines, and storage tank, is still at the initial stage. Large-scale hydrogen import technology will reach commercialization after 2030.
- Further evaluation and plan for related construction depend on the expansion of domestic hydrogen demand.

Transportation & Storage Infrastructure

Strategy: International Cooperation and Demonstration

- **International Cooperation**: Exchange information with leading countries to build common specification and further evaluate the demand and feasibility of the construction of related infrastructures.
- **Demonstration**: First domestic mobile hydrogen refueling station in 2024.
- **R&D**: Develop anti-hydrogen embrittlement welding materials and apply hydrogen permeation-resistant surface treatment technology to high-pressure transportation and storage systems to solve the problem of leakage caused by hydrogen embrittlement.


Japan LH_2 Carrier


Japan LH_2 Storage Tank


LH_2 Tank Trailer


Pipelines and Metering Equipment

5. Strategies and Methods - Budgets

■ Total budget over NT$4.615 billion for 2023-2024.

Units	Budget for 2023~2024 (Unit: NT$100 M)
EA	2.82
DoIT	15.48
CPC	1.61
CSC	24.0
NSTC	1.4
MOTC	0.84*
Total	46.15

*TPC budgeted NT$530 million for 2025.
*MOTC budgeted NT$86 million for 2025-2026.

5. Strategies and Methods - Just Transition and Public Communication

- Communication with related units and industries about hydrogen supply, applications, and infrastructures. Topics about administrative procedures and regulations will be conducted.
- To promote the benefits of hydrogen energy through propaganda or technical achievement exhibition.

Hydrogen Application	Hydrogen Supply	Infrastructure
Effected Objects		
■ Electricity costs may be increased due to hydrogen power generation. ■ Related employment opportunities will be created.	■ The cost and the way to secure hydrogen energy will influence the power generation industry, renewable energy industry, and gas industry, etc..	■ Effected stakeholders would include landlords, original land users, and neighboring residents.
Countermeasure and Strategy		
■ Combination of public sectors and state-owned enterprises to encourage industry participation. ■ Job Training for new hydrogen applications.	■ Domestic hydrogen production site concerns the aspects of environment, society, and administration. ■ Sufficient information should be provided to deepen the public understanding of hydrogen energy technology and safety issue.	■ Fire control and safety issue should be taken into consideration. ■ Regulations related to land use and environment protection should comply with domestic fire safety regulations.

6. Expected Benefits

Hydrogen Energy

	2025	2030	2050
Cumulative Capacity	91 MW	91~891 MW	7.3~9.5 GW*
Annual Carbon Reduction*	N/A (Co-combustion under test)	427~6,877 tons	17.5 M tons*

Expected Benefits

- International Cooperation for H_2 import. Construction of production, transportation, and storage infrastructures, including international supply chain and LH_2 receiving terminal to secure the long-term and stable H_2 supply.
- Pilot demonstration from state-owned enterprises to promote the industrial participation: Encourage the business investment from H_2 demand side and build the Industry chain from the cooperation of public and private sectors.
- Develop the H_2 co-combustion and pure H_2 combustion technology. To study and further establish the regulations of hydrogen energy technology demonstration & verification site for reaching the goal of 9-12% hydrogen power generation in 2050.

*Carbon reduction calculation would be adjusted depending on the actual operation test results (such as actual unit output, co-combustion time, supply volume of feedstock, etc.)
*Taiwan has announced the “Taiwan’s Pathway to Net-Zero Emissions in 2050” , and hydrogen energy for power generation accounts for 9%~12% in domestic energy mix.

7. Management and Examination Mechanism

- The goal of this action plan is to promote the development of hydrogen energy with the coordination of other key strategic action plans and will be supervised by “Hydrogen Energy Promotion Taskforce.”

- The review meeting will be held every six months to control the project progress.

- The group meeting will be held irregularly for reviewing the action content and achievement to adjust execution methods.

8. Conclusion- Future Expectation & Subsequent Plan

To promote domestic hydrogen energy development, this action plan will integrate and improve R&D capacity, establish basic environmental construction and regulations, and cooperate with foreign countries for stable hydrogen supply, and eventually strengthen domestic technical advantages.

- Application: Focus on hydrogen vehicle application, low-carbonization in industrial manufacturing process and hydrogen-fired gas turbine for power generation.
- Hydrogen Supply:
  - Short Term: Domestic-produced grey hydrogen, verification of environmental construction, and other applications.
  - Medium Term:
    - ✓ Overseas hydrogen import.
    - ✓ Evaluation of long-term cooperation with hydrogen exporting countries to secure stable hydrogen supply.
  - Long Term: Gradually developing domestically-produced hydrogen under the premise of the sufficient renewable energy supply.
- Infrastructure: Evaluation of infrastructure construction in accordance with the hydrogen supply and application field.

Thank you

經濟部能源署
Energy Administration,
Ministry of Economic Affairs