Energized future:
New Energy, New Opportunities

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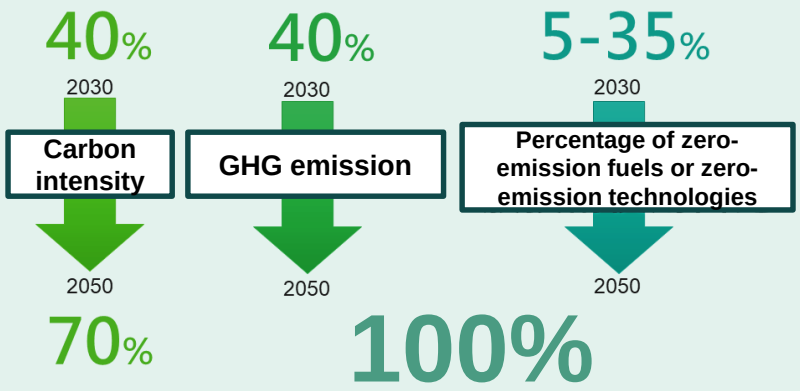
New Energy Trend for Vessel

New Energy Trend for Vessel (1/5)

IMO Regulations

90% of global trade is transported by ocean. The impact of pollutants produced by ship operations on the environment is highly valued. Maritime activities account for 3~4% of global man-made carbon dioxide emissions.

IMO Strategy on the reduction of GHG emissions from vessels



IMO emission standards for ships

2013	Improve energy efficiency on vessel design	EEDI
2019	Report actual fuel consumption and CO^2 emissions of vessel	DCS
2023	Improve energy efficiency on off-the-shelf vessel design	EEXI
2023	Improve the actual operational carbon intensity of vessel	CII
Undecided	Carbon pricing setting by market mechanism	CO_2 price
Undecided	GHG in Fuel Life Cycle (Well to wake)	GHG Fuel Standard

New Energy Trend for Vessel (2/5)

Alternative Vessel Fuels

Supply

- LNG: 36 bunkering stations worldwide (including those under construction), 24 in Europe, 6 in the Americas, and 6 in Asia.
- Methanol and ammonia: Liners work with port operators to develop bunkering services.
- Hydrogen: under R&D stage.

User

- Compared to methanol, ammonia, and hydrogen, LNG requires less ship storage space and less frequent re-fueling.

Fuel	Density(GJ/m³)
輕柴油 MGO	36.6
液化天然氣 LNG	23.4
甲醇 Mmethanol	15.8
氨 Ammonia	12.7
氫 Hydrogen	8.5

New ship costs and fuel costs

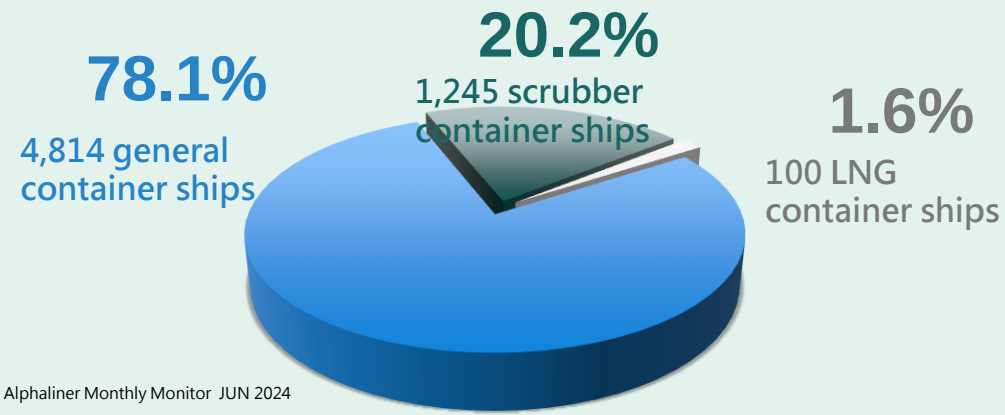
Item	Average ship cost (100 million U.S. dollars)	Fuel costs (traditional production)
Methanol	1.92	US$522/metric ton
LNG	1.67	US$766/metric ton
Ammonia	-	USD 407/metric ton
Install scrubber	1.38	HSFO US$442/metric ton
One ship	1.2	LSFO US$538/metric ton MGO $683/metric ton

New Energy Trend for Vessel (3/5)

The countermeasures of Liners - 1

- Liners mainly install scrubbers and use LSFO, followed by switching new ships to LNG and methanol fuel. Hydrogen is still under development.
- Among the 6,165 container ships under operation, there are 1,245 equipped with scrubbers (16.6%), 47 LNG container ships, 6 container ships with methanol, and no hydrogen, ammonia fuels is under operation yet.
- In the new container ship market, Alphaliner indicates there are 152 methanol container ship orders, accounting for 21.9% of total orders.

Number of ships in operation



Source: Alphaliner Monthly Monitor JUN 2024

New Energy Trend for Vessel (4/5)

The countermeasures of Liners - 2

- LNG has become one of the best choices for marine fuel due to the advantages of being low carbon, environmental-friendly, and economical. European liners are the pioneer to invest LNG. However, the rising LNG prices due to the Russia-Ukraine war has impacted shipping and its eagerness to embrace LNG as an alternative fuel.
- Maersk leads the world in building methanol-powered container ships and is committed to improving the methanol fuel supply chains. Liners such as COSCO, CMA CGM, and HMM are following the strategy of Maersk.

msc

819 ships under operation (19 LNG ships)

New Ships

2 General ships

1 Scrubber ships

65 LNG ships

5 LNG/Scrubber ships

5 Methanol ships

2 Methanol/Scrubber ships

19 LNG/Ammonia ships

Total 99 ships

MAERSK

709 ships under operation

New Ships

2 General ships

1 Scrubber ships

25 Methanol ships

3 Methanol/Scrubber ships

Total 31 ships

CMA CGM

639 ships under operation (46 LNG ships)

New Ships

7 General ships

2 Scrubber ship

42 LNG ships

32 Methanol ships

2 Ammonia ships

Total 85 ships

COSCO SHIPPING

501 ships under operation

New Ships

2 scrubber ships

13 Methanol ships

Total 15 ships

Hapag-Lloyd

282 ships under operation (7 LNG ships)

New Ships

2 Scrubber ships

6 LNG ships

4 Methanol/Scrubber ships

12 ships in total

New Energy Trend for Vessel (5/5)

The countermeasures of Liners - 3

- **Among national liners, Evergreen ordered methanol container ships; Yang Ming also ordered LNG dual-fuel container ships; Wan Hai is actively evaluating the demand for alternative energy.**
- **Currently there is no globally available new fuel that can be used on a large scale of ships. Therefore, the current situation is a transitional period for alternative fuels.**

ONE (OCEAN NETWORK EXPRESS)

236 ships under operation

New Ships
3 Scrubber ships 20 Ammonia/Scrubber ships
12 Methanol ships 2 Methanol/Scrubber ships

Japan is developing Ammonia policy to introduce Ammonia fueled ships

EVERGREEN

219 ships under operation

New Ships
34 Scrubber ships
30 Methanol ships

Ordered 30 methanol container ships with 16,000 TEU

HMM

79 ships under operation

New Ships
1 General ships 1 Scrubber ships
2 LNG ships 5 LNG/Scrubber ships
9 Methanol/Scrubber ships

Cooperation with the U.S. to develop green shipping corridors

YM

93 ships in operation

New Ships
5 LNG ships

Ordered 5 LNG Dual-fuel container ship with 15,000 TEU

ZIM

127 ships under operation

New Ships
4 General ships
8 LNG ships
1 Methanol ships

Energy transition policy, investing in various new ships with alternative fuels

WAN HAI

119 ships in operation

New Ships
10 General ships

Actively assessing future low- and zero-carbon alternative energy needs

2

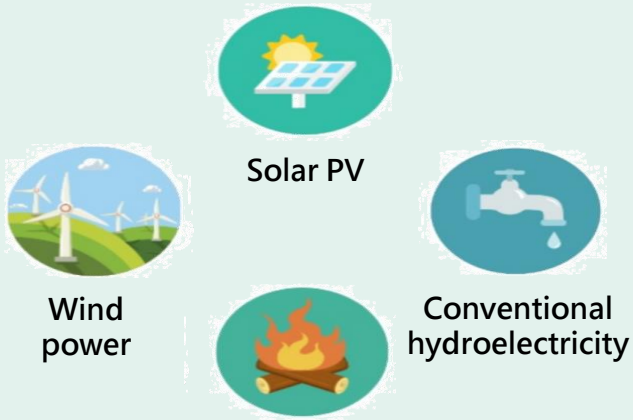
Overview of Taiwan New Energy Industry

2.1 Government policy and goal

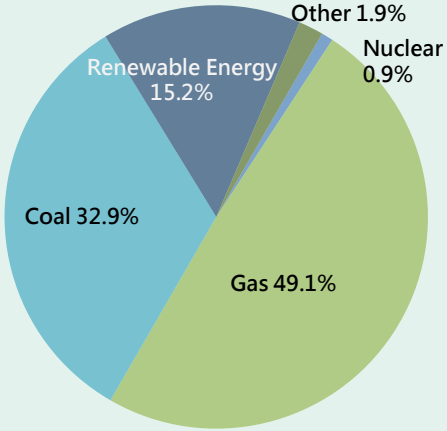
Government Energy Transition Policy(1/2)

Green Goals

- Energy transition in Taiwan is moving towards clean energy with the principles of "promoting green energy, in creasing natural gas, minimizing coal use, and achieving nuclear-free" to ensure stable power supply while red ucing air pollution and carbon emission.
- Promoting green energy is to expand the promotion of renewable energy, with the policy goal to reach 15.2% of renewable energy power generation in domestic energy ratio.
- It is expected that the accumulated solar PV installation capacity will reach 20 GW and the accumulated offsho re wind power installation capacity will reach 5.6 GW in 2025.



Domestic energy distribution ratio in 2025



Source: Energy Administration, Ministry of Economic Affairs

Government Energy Transition Policy (2/2)

12 key strategies

Taiwan 2050
Net-zero
transition

12 key strategies

2.2 Overview of Taiwan's Offshore Wind Power Industry

Overview of Offshore Wind Power Industry (1/2)

Government 3-phase Policy

3-phase policy for promoting offshore wind power in Taiwan

2026~2035
Phase 3
Zonal development
Government-led
Establish industry

- Released capacity: 1 GW per year from 2026-2035.
- Installation site: Total installed capacity exceeding 10 GW.
- 2-stage investment strategy: pre-qualification review followed by price comparison.

2015~2025
Phase 2
Potential sites
Announce locations
Open for applications

- 2015: 36 potential sites announced
- 2017: 10.5 GW passed EIA
- 2020-2025: 5.5 GW commercialized
  - ✓ Selection of 3.8 GW
  - ✓ Bidding for 1.7 GW

2013~2020
Phase 1
Demonstration Incentives
Provide subsidies
Attract investment

- 2013: Completed selection of demonstration companies
- 2017: 2 demonstration units (8 MW) in Miaoli
- 2020: 2 demonstration wind farms (230 MW)
  - ✓ Miaoli Marine Demonstration Project (completed in 2019)
  - ✓ Changua Taipower Demonstration Project (completed in 2020)

Overview of Offshore Wind Power Industry (2/2)

Wind power industry chains

Types of offshore wind power industry chains

- Port infrastructure and berths (assembly, storage)
- Wind Farm Developers
- Wind turbine raw materials and components manufacturing
- Marine Engineering support
- Personnel transport (SOV)
- Heavy equipment logistics transportation
- Wind turbine inspection
- Wind turbine maintenance
- Training
- Financing and insurance

2.3 Overview of Taiwan's Hydrogen Industry

Overview of Hydrogen Industry (1/2)

Government strategic directions

- In 2021, the Ministry of Economic Affairs established a hydrogen promotion team.
- In 2022, the National Development Council announced "Taiwan's Pathway to Net-Zero Emissions in 2050," indicating that by 2050, Taiwan's electricity supply will be sourced 60-70% from renewable energy, 9-12% from hydrogen, 20-27% from coal-fired power, and 1% from pumped storage hydropower, achieving overall decarbonization of power supply.
- In January 2023, the Legislative Yuan passed the "Climate Change Response Act," setting the goal of net-zero emissions by 2050. The National Council for Sustainable Development of the Executive Yuan will impose carbon fees and establish dedicated funds for specific uses.
- The hydrogen power generation target: 91MW in 2025 → 891MW in 2030.
- The application of hydrogen will focus on carbon reduction in the energy sector and industrial sector in the short and medium term, and will be applied to the transportation vehicles in the medium and long term.

Overview of Hydrogen Industry (2/2)

Domestic applications

Hydrogen refueling station

- ✓ In 2024, Linde LienHwa will establish the first demo hydrogen refueling station in the Tree Valley Park area in Tainan.
- ✓ In 2024, CPC Corporation, Taiwan will build mobile and modular hydrogen refueling stations.
- ✓ In 2024, CHEM and CPC Corporation, Taiwan will set up a demo hydrogen refueling station at Port of Taipei.



Taipower Company

- ✓ Signed an MOU on hydrogen mixing technology cooperation with Westinghouse Electric Company in April 2022. A 5% hydrogen mixing demo at the Xingda power plant for gas turbine generator will be completed by 2025.
- ✓ Signed an MOU on ammonia mixing technology cooperation with Mitsubishi Heavy Industries and Mitsubishi Corporation in November 2022. A 5% ammonia mixing demo at the Linkou power plant for coal-fired boiler will be completed by 2030.
- ✓ Signed an MOU on ammonia mixing technology cooperation for Dalin coal-fired power plant with IHI Corporation and Sumitomo Corporation in February 2024. A 5% ammonia mixing demo at the Dalin power plant will be completed by 2030.

Vehicles

- ✓ CHEM invested in Stellar Power System in developing and applying fuel cell systems, including light electric vehicles, 2-wheel, 3-wheel, and 4-wheel vehicles, and generators, extending into hydrogen storage and refueling equipment.
- ✓ Hotai Motor will introduce the H2 City Gold hydrogen low-chassis bus in 2024.


Gas suppliers

- ✓ Air Liquide Far Eastern is a joint venture set up in 1987 by Air Liquide and Far Eastern New Century Corporation.
- ✓ Air Products San Fu is the Taiwan partner of Air Products.
- ✓ Linde LienHwa is a joint venture of the Linde Group, the largest industrial gas manufacturer in Taiwan.

Source: Taiwan Institute of Economic Research

3

Opportunities and Applications for Green Energy Industry Development at Ports

3.1 Offshore Wind Power

Offshore Wind Power at Ports (1/7)

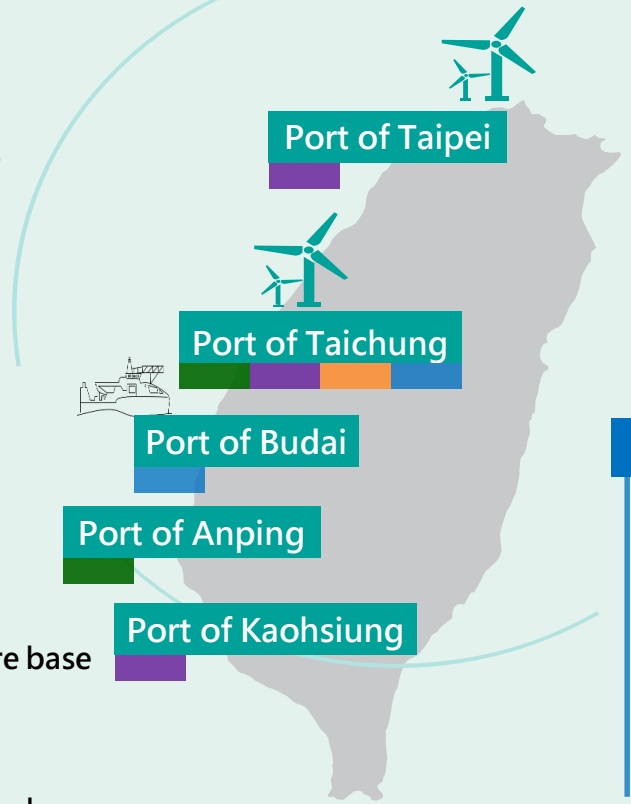
4 Aspects

Turbine pre-assembly Area

- Port of Taichung
  - Turbine pre-assembly area
  - Home port for working vessels
- Port of Anping
  - Warehousing and storage for import turbines

Manufacturing Area

- Port of Taichung
  - Turbine manufacturing area for local turbine components
- Port of Taipei
  - Underwater foundation manufacture base
- Port of Kaohsiung
  - Maritime engineering support
  - Underwater foundation manufacture base



Training Center

- Port of Taichung

Set up an OWP training center to provide GWO and customized courses

TIWTC

O&M Services

- Port of Taichung and Budai
  - Land-based & water-based O&M base
  - Ship repair services
  - Maritime transport services
  - Stevedoring, warehousing & logistic services

TIPH

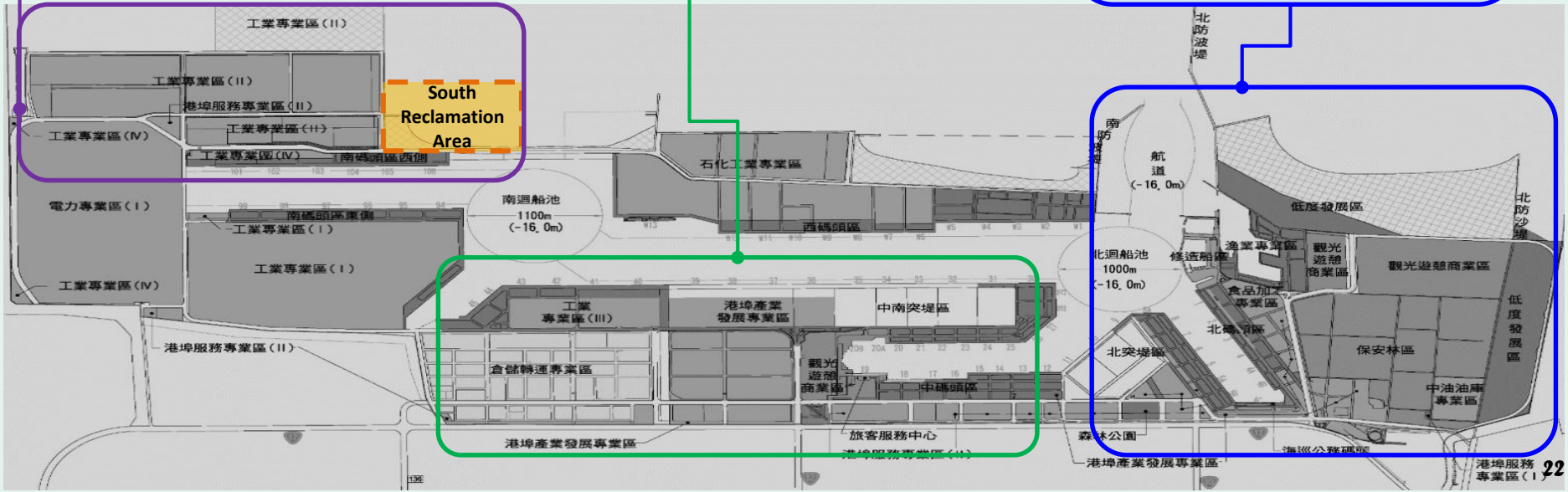
Offshore Wind Power at Ports (2/7)

Port of Taichung – 3 Major Areas

1st Region #105、#106、#107
L=780m、Water depth-13m~-16m
Backyard area (South Reclamation Area)：65ha
Loading：3、10、40 t/M²
Function：Manufacturing area、Turbine pre-assembly area
South Reclamation Area will provide by the end of 2026

2nd Region #36、#37、#38
L=990m、Water depth-12m~-16m
Backyard area (manufacturing area)：Total 69ha
Loading：20、40 t/M²
Function：Turbine pre-assembly area

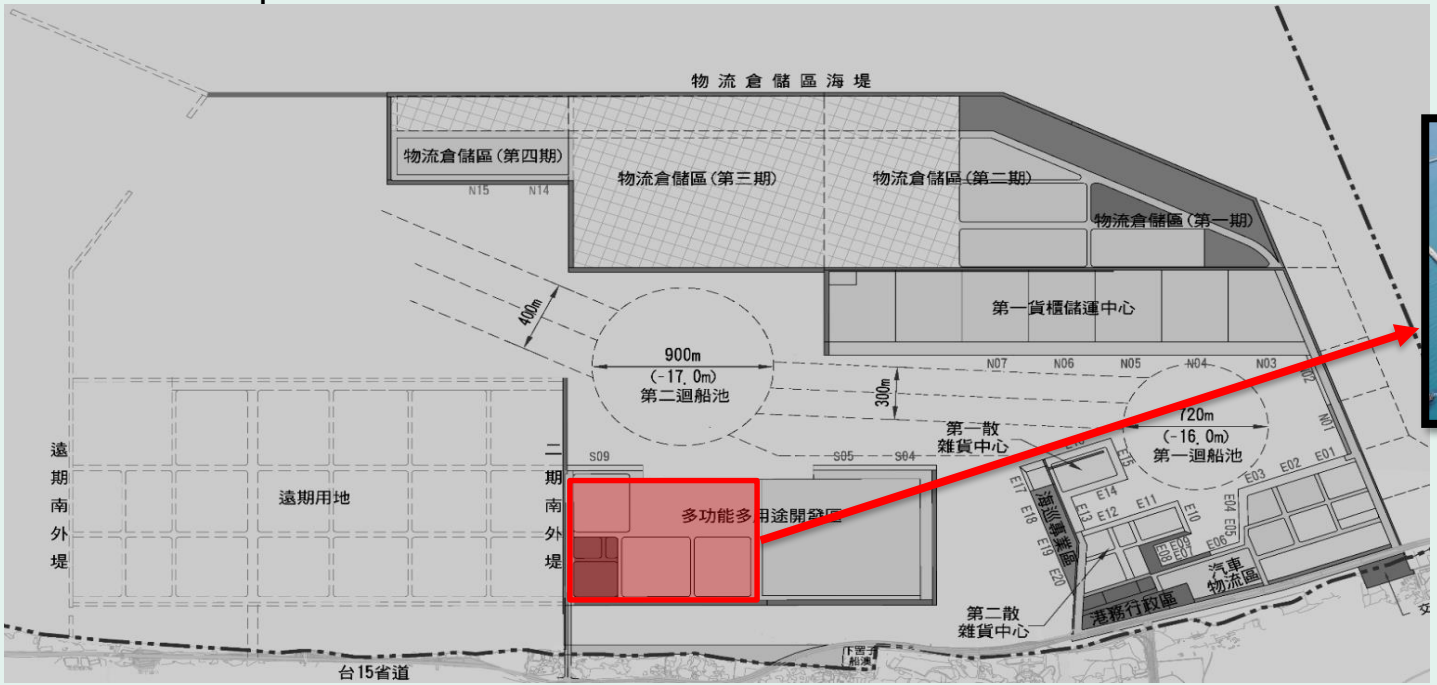
3rd Region #5A、#5B
L=400m、Water depth-11m
Backyard area(incl. release from protection forest 47ha)：Total 61.5ha
Loading：50 t/M²
Function：Turbine pre-assembly area、O&M Service、Training Center



Offshore Wind Power at Ports (3/7)

Port of Taipei – Manufacturing Area

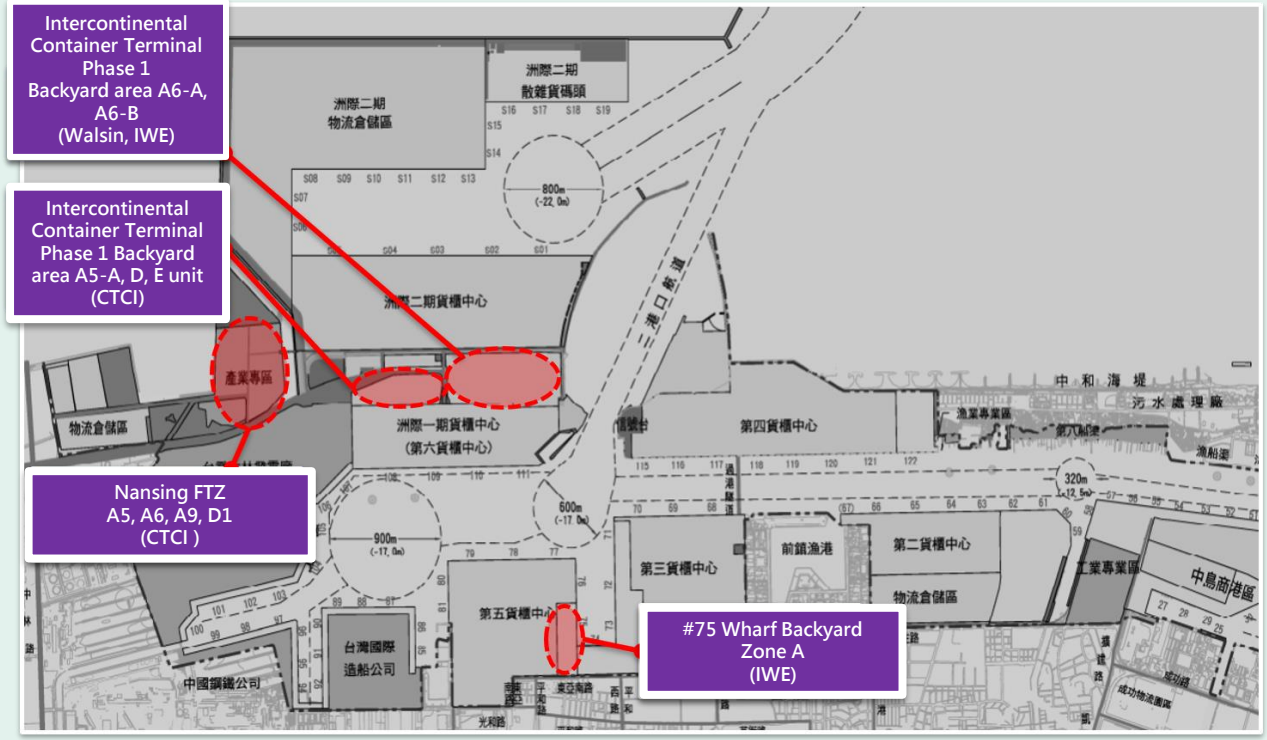
- Underwater foundation manufacturing base
- Century Wind Power Co., Ltd. invests and operates underwater foundation manufacture factory.
- Started production in October 2020.



Offshore Wind Power at Ports (4/7)

Port of Kaohsiung – Manufacturing Area

- Underwater foundation manufacturing base, submarine cables, and storage



PP (Pin Piles): Stored in A5-D

TP (Transition Pieces): Stored in A5-E

Offshore Wind Power at Ports (5/7)

TIPC Marine Corporation, Ltd.

Set up	October 6, 2014
Capital	NT$ 4 billion (Wholly-owned subsidiary of TIPC)
Main Business	Port tugboats, ship repair, marine rescue, ship rental, offshore wind power operations and maintenance base services (storage, warehousing, anchoring, parking lots), loading and unloading services (offshore wind turbine components)

TIPC Marine boat services

CREW OPERATION AND MAINTENANCE BOAT SERVICES

Various stages of the wind farm: crew / supply transport services.

TUGBOAT SERVICE

Port area: ship docking operations.

Wind farm exploration period: used for underwater exploration surveys and the deployment and retrieval buoys.

Wind farm construction period: used for whales and dolphins observation monitoring, buoy deployment and retrieval, and towing platform operations.

MARINE ENGINEERING SERVICES

Wind farm construction period: Barge used to transport turbine underwater foundations, nacelle, and other heavy equipment.

Offshore Wind Power at Ports (6/7)

TIPH – Heavy equipment transportation

Taiwan International Ports Heavy-Machinery Corporation, Ltd.

Set up	December 16, 2020
Captial	NT$ 100 million (49% owned by TIPC)
Business	- Integrated heavy equipment transportation one-stop service, and engineering project management. - Provide technical reviews of surveys, planning, detailed design, feasibility of transportation routes, terminal load capacity, bridge load capacity and transportation stability, and prepare Chinese and English version of professional construction plans. - Executive of lifting and transportation operations.

Heavy equipment transportation projects

Special heavy equipment transportation vehicles

Offshore Wind Power at Ports (7/7)

TIWTC – Training Center

Taiwan International Windpower Training Corporation Ltd.

Set up	May 17, 2018
Capital	NT$ 100 million (28% owned by TIPC)
Share holders	Taiwan International Ports Corporation, CWIND Taiwan, Taipower Company, China Steel Corporation, CSBC, Synera Renewable Energy

- Year 2020 and 2021 : Ranked No. 1 in the issuance of GWO certificates in the Asia region.
- Year 2022 : Entered the Japanese market, completed its first transnational service and obtained wind power training contracts.
- Year 2023 : Began planning to establish a subsidiary in Japan and on Feb. 5th 2024 completed the registration of the Japanese subsidiary "TIWTC Training Corporation Ltd."

3.2 Solar PV

Solar PV at Ports (1/2)

Already Built

Third Container Terminal, Port of Kaohsiung

Warehouse No. 6, Port of Hualien

- In 2019, TIPC completed the "one-bid turnkey" of solar energy investment project for 7 international commercial ports with operators to install solar PV generation equipments on the rooftops of existing building in each port area.
- According to TIPC 2022 ESG report, the total solar power generation in Taiwan's port areas is approx. 24.24 GWh.

Solar PV at Ports (2/2)

Under Construction

- Kaohsiung Container Terminal 7 is installing solar power generation equipment, aiming to: (1) be eligible for early installation incentive for renewable energy as energy-heavy industry; (2) comply with the regulation of Kaohsiung City Green Building Self-Government Ordinances.
- With a capacity of 7,000 kWp and expected to generate 8.75 GWh annually, the project began on July 1, 2023 and is expected to be completed by 2025.
- "Intelligent Energy Management System" introduced at Kaohsiung Container Terminal 7 as a demonstration zone, before expanding to other areas.

3.3 Hydrogen

Hydrogen Development at Ports (1/4)

Development Concept

Development Direction

With 2050 Net Zero Carbon Emission as goal, ports play a crucial role in the energy supply chain, leveraging key advantages. Riding the trend of new energy transition, TIPC aims to move beyond traditional models of land lease but participate in feasible business models.

Current Actions

Signed MOU with potential developers for joint researching on the concept and feasibility of establishing Power-to-X (PtX) plants.

Commission the Taiwan Institute of Economic Research to conduct the "Feasibility Study of Hydrogen Development and Collaboration at Taiwan ports."

Communicate with various organizations and operators on international hydrogen policies, current industry developments, future market trends, and port advantages to explore the feasibility of hydrogen development at ports.

Hydrogen Development at Ports (2/4)

PtX Collaboration Project

Background

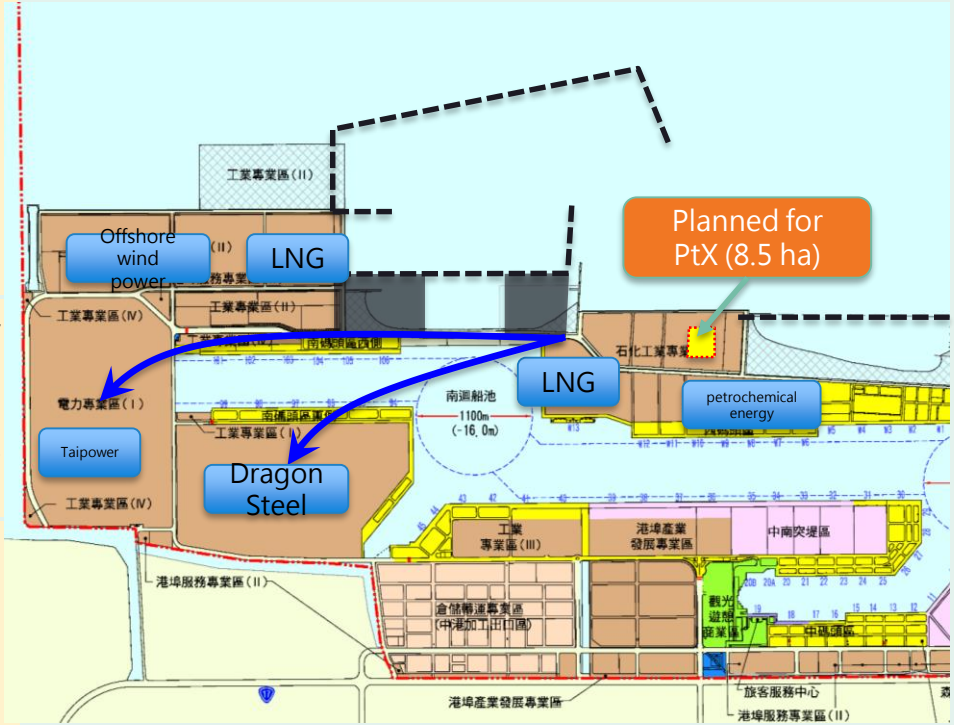
The Port of Taichung is close to offshore wind farms with petrochemical, steel, and power plants in the area, an advantage for developing PtX with wind power. Therefore wind power companies and state-owned business proposed in the first half of 2022 to collaborate with TIPC on joint development of PtX, the three parties signed an MOU in mid-September.

Content

Divided into phases of demo and validation, capacity upgrade, and scale expansion, each phase requires a preparation period of 4-6 years prior to operation with 2-3 years for planning and design phase and 2-3 years for construction.

Current Status

Considering the lack of mature policy, legal, and incentives, the OWF developer is unable to provide specific plans, and the state-owned enterprise has not made the decision yet, thus the project is still available for further discussion.



Hydrogen Development at Ports (3/4)

Hydrogen Study at Ports

Background

Considering the importance of ports in the hydrogen supply chain and to grasp the future development of hydrogen, TIPC commissioned TIER to conduct a study in July 2023.

Content

The study collects and discusses information on the current status and future trends of international hydrogen development, related construction and safety management aspects of hydrogen at ports in Taiwan, and conducts a preliminary assessment of future hydrogen development models at ports.

Current Status

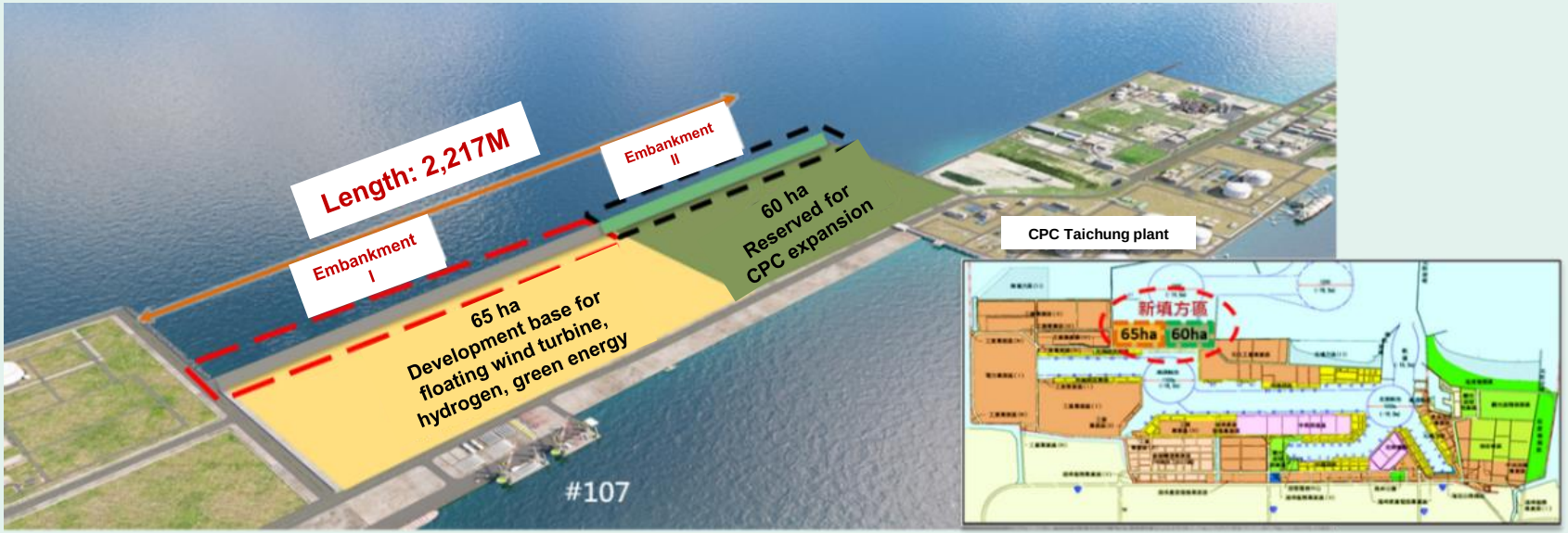
Mid-term report completed. Initial suggestion for Ports of Keelung and Taichung is to be designated for "Hydrogen Production", with short-term plan for technology research and medium to long-term plan for blue and green hydrogen production; Port of Kaohsiung is designated for "Hydrogen Import" with short-term plan for technology research and medium to long-term plan to build receiving facilities. The final report is expected to be completed by the end of September 2024.

Hydrogen Development at Ports (4/4)

Land planning at Port of Taichung

South Reclamation Area for Green Energy at Port of Taichung

Due to land demand for national energy policies and wind power industry development, the south Reclamation Area (III) and part of the South Reclamation area (IV), 65 hectares in total, are planned as development base for floating wind turbines, hydrogen, and green energy.



3.4 Forward-looking Energy

Forward-looking Energy at Ports

Marine energy

- Types of marine energy include tidal power, ocean current power, wave power, temperature difference power, and salinity gradient power, etc.
- There is 1 company executing a pilot plan according to TIPC "Smart Port Innovation Technology Industry Pilot Test Promotion Regulations," using a tidal current meter installed at Port of Taichung for wave observation, data collection, and power generation efficiency evaluation.
- TIPC always Port of Suao as a Pilot Test evaluation port, providing companies to install offshore wave Power generation equipment.

Biomass

- Foreign biomass gasification technology and biomass gasification generators are imported by operators. Green power will be produced by burning woody waste.
- Commercial models include selling equipment only, or looking for partners to lease lands in the port areas, invest in the construction and operate biomass power plant.

4

Conclusion

Optimize Port Infrastructure

Proactively review, adjust, and upgrade port service capabilities to provide quality infrastructure and facilities for green energy industry in Taiwan.

Strengthen Collaborations

Keep attracting partners, and drive deeply the operation of emerging green energy businesses in Taiwan from the perspective of TIPC Group.

Promote

sustainable port

and operation development

Provide Diverse Services

Utilize affiliates to offer services related to port operation and maintenance, personnel training, transportation and logistics, and promote the development of green energy industry.

Compile Wind Power and Green Energy Trends

Continue to communicate with operators, extensively collect and compile information on future trends and technologies related to floating wind turbines and green energy.

Thank You