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Status and Challenges for the supply chain

for Offshore Wind in Greece

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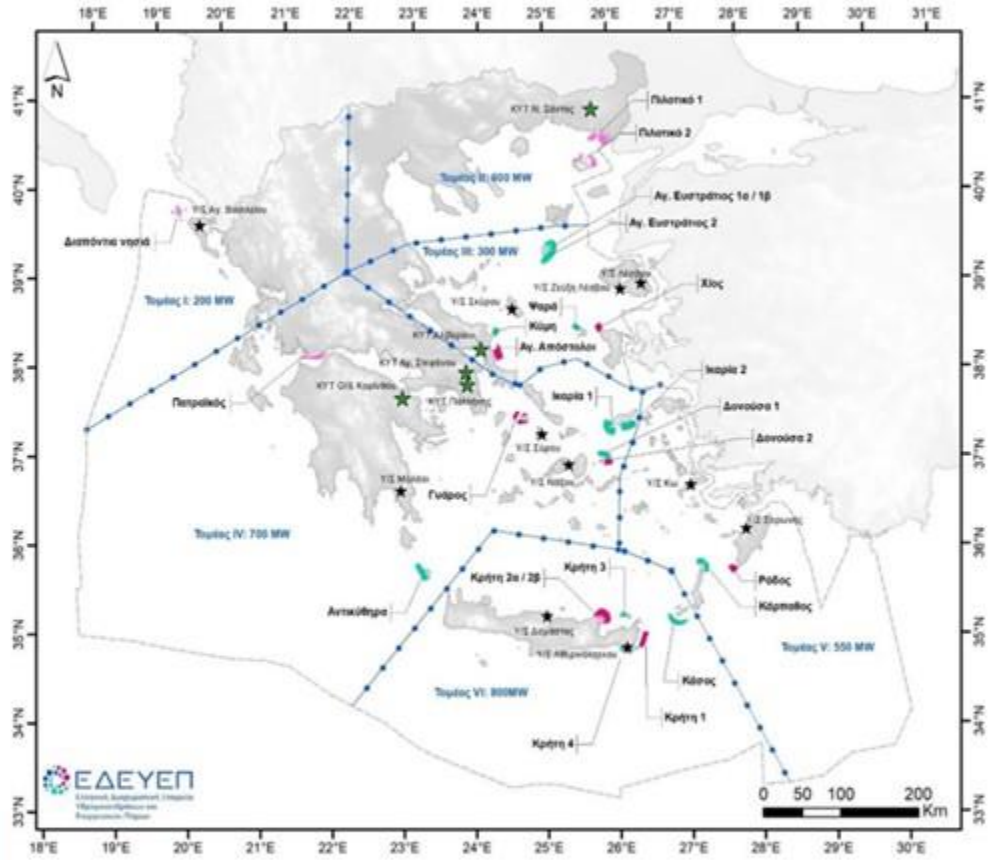
Background

According to the country's preliminary energy planning, the target for Offshore Wind Farms (OWF) is **1,900 MW for 2030** and **6,200 MW for 2035**. The **target for 2050 is 17,300 MW.**

The deployment of offshore wind can boost the gross domestic product by up to **€ 1.9 billion per year** on average over the period 2024-2050.
Over the same period, it can make a significant contribution to employment, supporting up to **44,400 jobs per year**.

Achieving these goals requires significant investments: over **€6 billion by 2030** and over **€ 28 billion by 2050**. These investments may have a **high local added value** (even up to 67%).

The effective implementation of the announced National Program for OWF **is an opportunity for the state and the society**.



The importance of developing a domestic supply chain

The emerging supply chain today is unable to cover even 10% of the wind farms that have been planned and announced internationally.

The development of the Greek offshore wind sector requires the development of a **domestic offshore wind energy supply chain**.

The latter requires significant development of manufacturing facilities, ports, vessels and a trained workforce to produce, transport install and maintain the major components required for an offshore wind energy project.

Only if local production is developed the country will be able to meet its needs for the first ten years or more, otherwise it will depend on the production capacity which may be created in other countries of the region.

Comparative advantages of Greece:

- ✓ Strategic location
- ✓ Optimal climatic characteristics
- ✓ Infrastructure with access to the sea
- ✓ Marine and shipyard industry with great experience
- ✓ Domestic industry of steel and cables
- ✓ Domestic cement industry

Scope of the Project

Current report aims to identify the possible parts of the OW supply chain and propose what is necessary to be done to establish this supply chain effectively, promoting the cooperation between Greek businesses and foreign ones

Analysis of the supply chain of offshore wind development in Greece:

01 Identify supply chain "links" -> Greek companies that could be part of the supply chain

02 Compose questionnaires to be filled by them

03 Execute surveys and interviews with the companies

04 Report the outcome of the interviews:

- Who are the companies?
- Are they willing to be part of the supply chain?
- Are they ready to be part of the supply chain?

For the first time, an attempt is made to record the entire potential offshore wind supply chain in Greece

Ports

- PIRAEUS
- THESSALONIKI
- VOLOS
- ALEXANDROUPOLIS
- ELEFSINA
- IRAKLEION
- KAVALA (FILIPPOS B')
- LAVRION
- EVIA (KYMI)

Shipyards

- ELEFSIS
- SYROS
- CHALKIS
- SALAMINA

Steel & Cables Industry

- CENERGY
- LYKOMITROS STEEL S.A.
- SIDMA STEEL S.A.
- ELASTRON S.A.
- EMEK- Group

Cement Industry

- HERACLES GENERAL CEMENT COMPANY S.A. (LAFARGE)
- TITAN CEMENT COMPANY S.A.

Key players (Survey participants)

Survey focus

Outlook on the Offshore Wind Farm Sector

- ✓ Awareness of the sector
- ✓ Opinion of the company's management on the offshore wind farm sector
- ✓ Views on public policies
- ✓ Willingness to involve
- ✓ Key factors for involvement
- ✓ Readiness of the company
- ✓ Strengths & Weaknesses

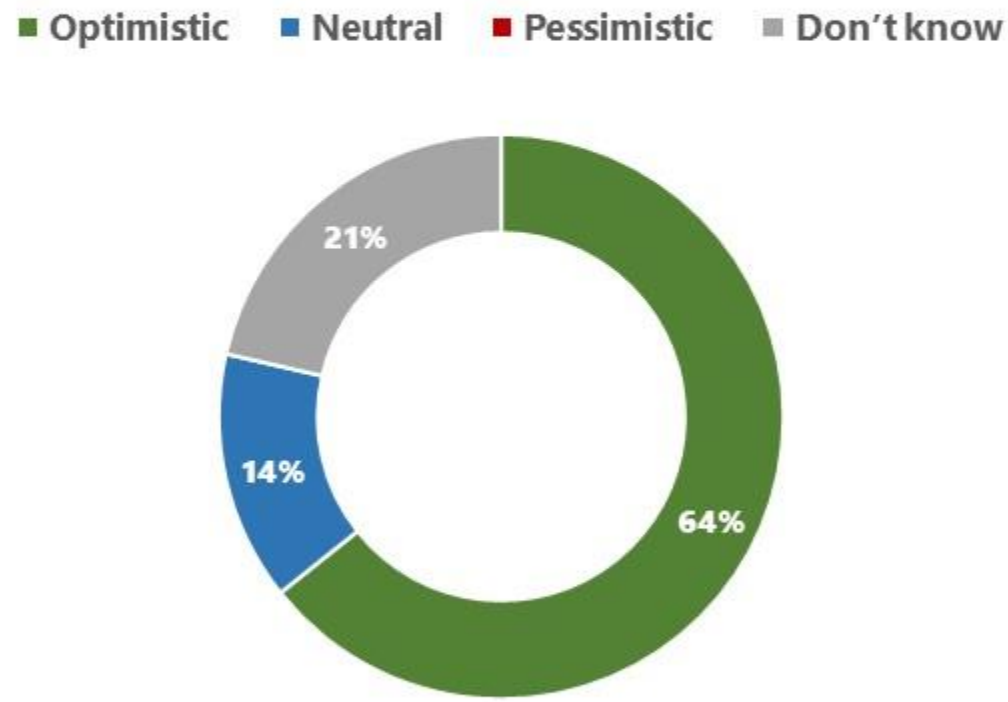
Technical information

- ✓ Identify current situation
- ✓ Report existing infrastructure
- ✓ Examine compliance with "Typical Greek Offshore Wind Farm" and "Reference Turbine"
- ✓ Report any relative experience in similar projects
- ✓ Point out possible obstacles

Positive attitude but also low knowledge on the prospects of the offshore wind farm sector.

6 out of 10
are positive about the industry's prospects

Outlook of the offshore wind farm sector



Positive opinion

about government policy regarding the development of the offshore wind farm sector

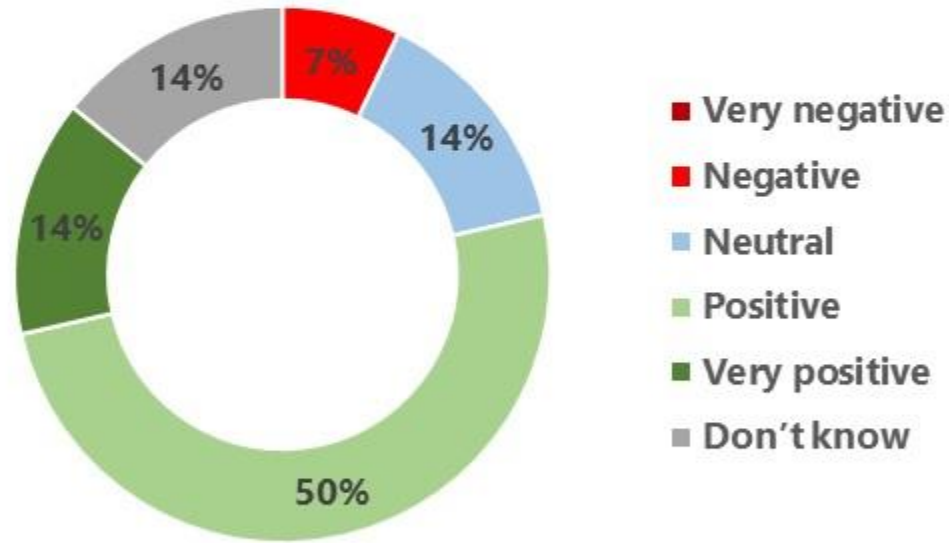
Main positive points:

- Strong commitment to carbon neutrality/ transition toward renewable energy
- Orientation for investments in energy projects
- National Program for OWF announcement

Main points of concern:

- Risk of delays: OFW Roadmap must stay on schedule otherwise the opportunity may be lost
- Licensing process: Ensuring that projects will not face bureaucracy obstacles and delays
- Uncertainty about state consistency until legislation is issued

*Views on current **public policies** for the development of the offshore wind farm sector*

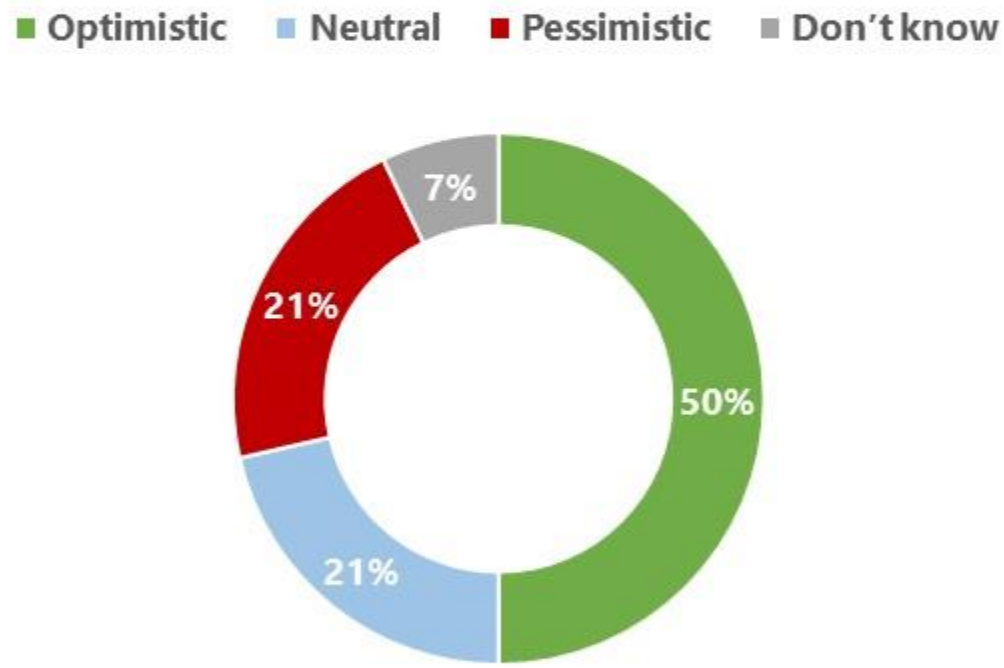


Balanced expectations on state incentives

Main points:

- State funding is a prerequisite for investments in ports.
- EU funding needs to be exploited.
- High locally added value should be assured.
- Compensation to local communities must be examined to reduce reactions (NIMBY effect).

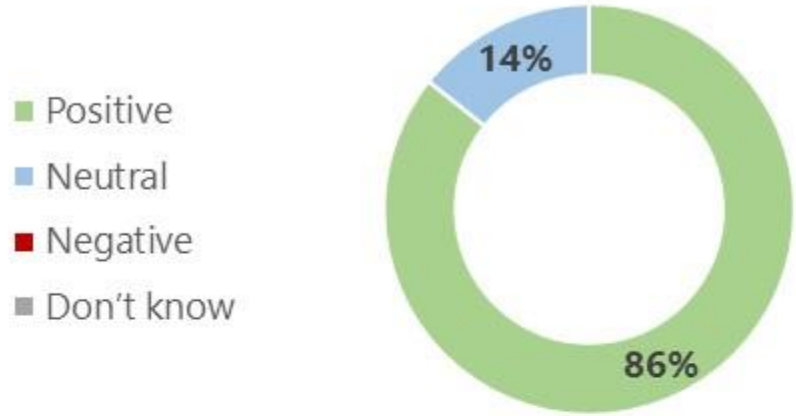
Expectations on state incentives by the Government for the development of the offshore wind farm sector



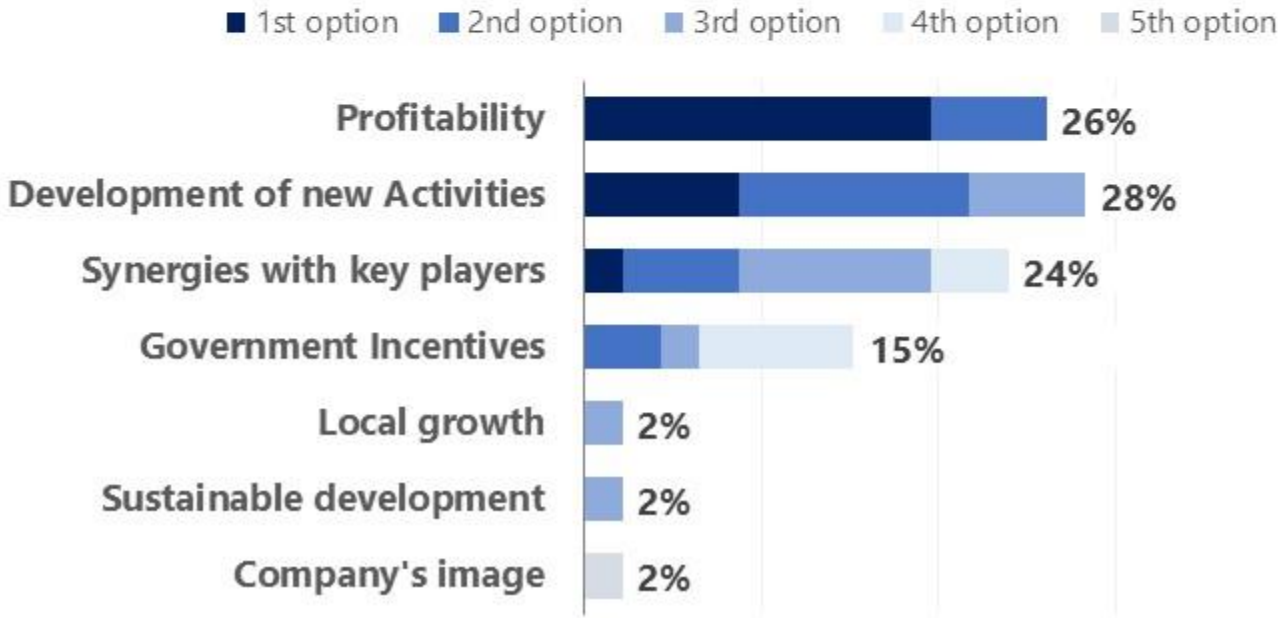
Absolutely positive attitude about involvement with the offshore wind farm sector

Development of new and innovative activities and profitability are the most important factors for involvement with the offshore wind farm sector

Willingness of the management to involve with the offshore wind farm sector



Key factors for involvement with the offshore wind farm sector (rank by importance)



Harbour needs for the reference wind turbine and wind farm

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Basic Assumption: a typical Greek offshore wind farm and a reference turbine

300MW
installed capacity

20x15MW
turbines of the reference type. (IEA offshore wind turbine).
A typical three-bladed upwind design, with variable speed and pitch control, having:

- **240m** rotor diameter
- **150m** hub-height
- **8,700t** total system mass (fixed ballast 2,540 t, hull steel mass 3,140 t, tower mass 1,263 t and RNA 991t)

STAGING NEEDS

3,570 m2
net staging space per 15MW turbine

Net staging space depends on the number of WTGs being installed at the same time which impacts timing, scheduling and collaboration with suppliers

SOIL BEARING CAPACITY

3.35t/m2
the highest value of surface pressure for the dry components of the reference wind turbine.

13.5 t/m2
the soil bearing capacity (assuming that weight load will be undertaken by the ¼ of the projected area, leading to a soil bearing capacity of 4*3.35).

DRAFT

20m
The draft of the fully assembled and moored turbine (assuming that the floater with will be transferred with tag boats having the turbine assembled on top and its fixed ballast in place)

12m
The minimum harbour draft (assuming that the transfer of the less than half-weighted system will have a draft around 10m, adding a 2m margin)

Ports & Shipyards Technical Characteristics

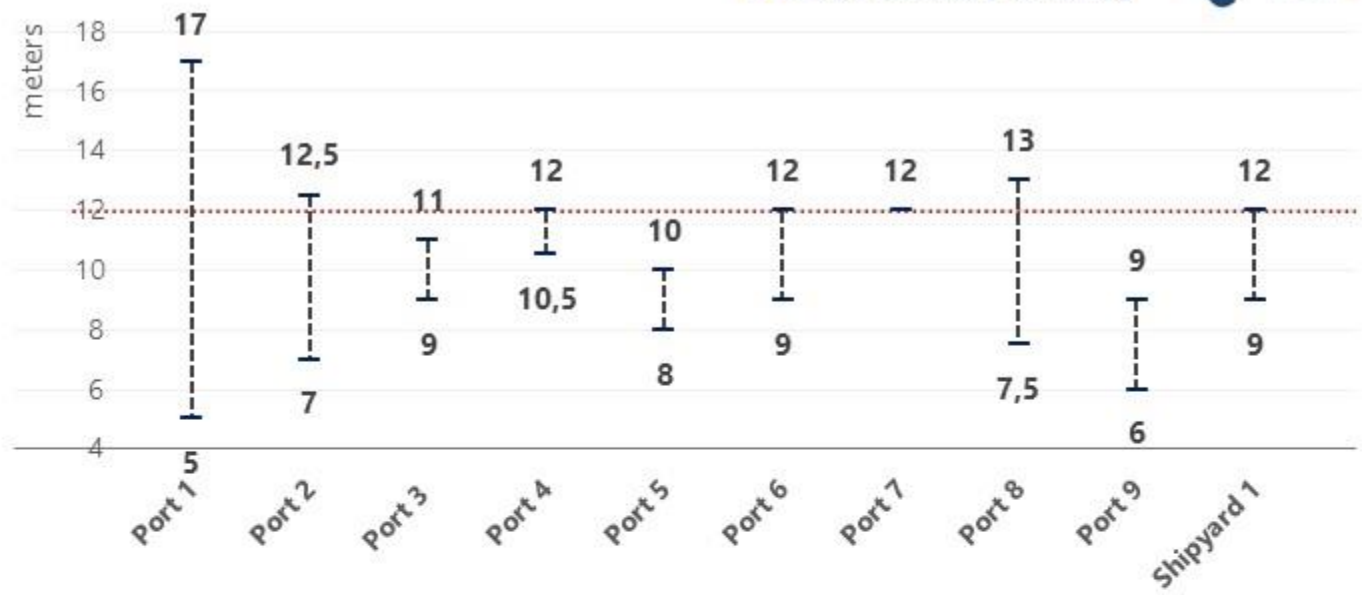
General Info			Technical characteristics								
Port/Shipyard	**Main activity**	**Employees**	**Surface available** sq.m.	**Soil bearing capacity** tn/sq.m.	**Water depths** meters	**Piers**	**Wharves**	**Available equipment and machinery**	**Plans for possible expansions**	**Direct National Road Network Access**	**Rail Network Access**
Port 1	Container Terminal / Cruise / Coastal	962	Project specific	n/a	5-17	5	24	✓	✓	✓	✓
Port 2	Commercial	486	n/a	2-10	7-12,5	6	21	✓	✓	✓	✓
Port 3	Commercial	42	~ 60.000	25	9-11	4	11	✓	✓	✓	×
Port 4	Commercial	12	~ 400.000	n/a	10,5-12	4	8	By lease	✓	*under construction	✓
Port 5	Commercial	36	~ 50.000	n/a	8-10	1	4	By lease	✓	✓	✓
Port 6	Coastal Shipping	34	~ 95.000	n/a	9-12	6	17	✓	✓	×	×
Port 7	Commercial	*	*	*	*	*	*	*	*	*	*
Port 8	Commercial / Cruise	16	~ 40.000	n/a	7,5-13	0	2	By lease	✓	✓	×
Port 9	Coastal Shipping	3	~ 14.000	n/a	6-9	2	3	By lease	×	×	×
Shipyard 1	Ship Repairs	~1.000	~ 64.000	10	9-12	1	3	✓	✓	✓	✓

Inadequate port infrastructure
is the most significant challenge to support the projected growth in offshore wind

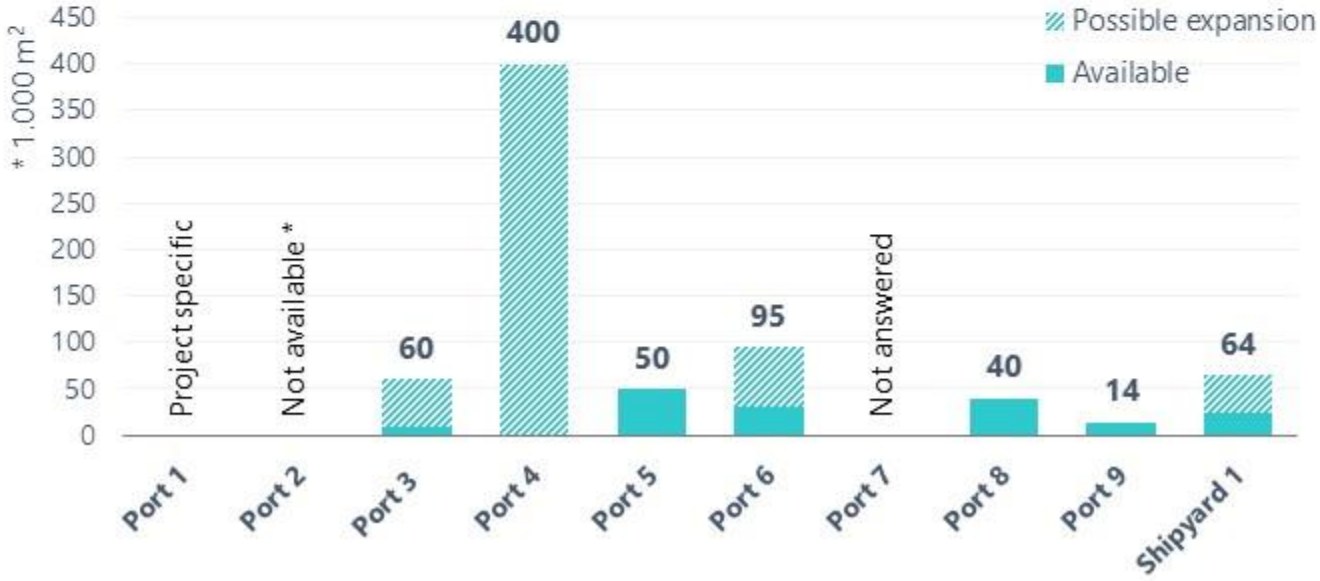
Main challenges:

- Limited space.
- Low water depths.
- Weight restrictions (soil geotechnical evaluation need to be done).
- Insufficient equipment.

Water depths



Surface available for staging needs



** Available surfaces may vary depending on other existing port activities*

Readiness of the company, in view of its commercial strategy, to involve with the offshore wind farm sector (score 1-10)

Low level of readiness and several challenges for ports

Higher level of readiness and waiting attitude for shipyards & industry

Main challenges

- Orientation of management to other activities – competition to existing activities, mainly due to limited space
- Management uncertainty due to port privatization plans
- Lack of funds for infrastructure investments
- Master plans define Land use – Will need to be updated
- Licensing issues

- Constant upscaling of design restricts production planning
- Industrialization is a key factor to cost reduction
- Limited available space in ports
- Uncertainty due to lack of confidence that the state tenders will take place on schedule
- Capital expenditures required
- Uncertainty due to unknown tariffs

Summary

STRENGTHS

- Significant wind potential.
- Strategic location.
- Maritime heritage.
- Industry and shipyards know-how.
- Skilled workforce.
- Experience by the management of onshore wind farms.
- Political will.

WEAKNESSES

- Insufficient infrastructure in port space and equipment.
- Lack of assembly know-how in ports.
- Regulatory constraints.
- Uncertainty due to port privatization plans.

OPPORTUNITIES

- A new innovative technology that may be developed in Greece.
- Novel industrial sector with prospects of at least 30 years of activity.
- Potential high local added value for Greece.
- Side – activities development: a new industry in offshore wind maintenance.

THREATS

- Risk of delays.
- Lack of a clear legal framework.
- Bureaucracy.
- Limited or lack of social acceptance.
- Increasing costs.
- Investments required in infrastructure
- Constant design upscaling.
- Limited capacity Europewide.

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