Norsk Industri

LEVERANSEMODELLER FOR HAVVIND

Delrapport – Supply Chain

norskindustri.no

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Content

Summary – Conclusions and recommendations

MAPPING AND SURVEY RESULTS

Results from mapping of 521 supplier and service companies shows that Equipment suppliers are the biggest supplier group, and includes 219 suppliers in the Norwegian offshore wind supplier market. The second largest group is engineering and consulting companies with 146 companies, and marine operators with 79 entities. The O&M service providers and Ports&Yards include 52 and 25 companies, respectively.

The Tier 1 category is dominated by EPC contractors and major Marine operators. Equipment suppliers constitute more than 50% at the other two levels. The largest Tier group is Tier 3 with 246 suppliers, followed by 110 in the Tier 2 group and 19 in Tier 1.

The survey was carried out among the 521 suppliers with 313 responses, of which 185 states that are delivering to the industry today and qualified in customer qualification systems. EPC contractors, marine equipment suppliers, Marine operators and engineering and consulting companies are the major suppliers in this group. The number of companies delivering to the offshore wind industry is quite high, and the picture seems reasonable considering that the Norwegian EPC suppliers have a strong market position within Balance of Plant and Marine operator supply chains. Only 97 suppliers are saying that they have knowledge about rules, regulations, and standards in the industry.

There is no specific qualification system within the offshore wind industry except for the companies' own systems. This means that a supplier must be registered and qualified through a unique qualification system for each operator.

As part of this project, DNV GL has developed a guidance to relevant standards for both the bottom fixed and floating offshore wind power projects. A description of the certification regime and country specific requirements are included. The technical standards are acceptable worldwide, but different developers can include company specific requirements.

DISCUSSION

The Norwegian offshore wind industry is in the developing phase. The ongoing Hywind Tampen project is a good home market platform for the suppliers involved. Relevant offshore wind references are often requested to get further contracts, and help to develop a network and get access to important developers and procurement organization at the different Tier-levels.

The licenses to be given at the Norwegian Continental Shelf, in Sørlige Nordsjø II and Utsira will start to set orders for a major part of the supplies in best case from 2025. For the Norwegian suppliers to develop products and services fit for the market, prepare for being competitive and have continuity it is important that they are approaching the international market and not only waiting for the Norwegian projects to come.

It is estimated that 75–80% of the supply chain from bottom fixed can be used directly in the floating wind supply chain, and 30–40% of the supply chain from the oil and gas industry can be used directly in the floating wind supply chain.

About 160 of the Norwegian suppliers mapped has been reviewed to have an export potential today. Among these are about 15 EPC contractors, 85 equipment suppliers and 25 marine operators. Many of them have a strong position today within the substation supply chain, Marine operator installation, project logistics supply chain and Marine operator O&M supply chain, especially in the North Sea. Within these deliveries and services, experience from the oil and gas market can easily be transferred.

Until now, more or less all the offshore wind projects have been bottom fixed projects, and the supply chains are defined including already selected suppliers. It will be difficult for the Norwegian suppliers not already in this business to enter this market, but capacity constraints and harsher environment can open for opportunities if they are active in the international market.

All Tier 1 suppliers are doing business in the wind industry today, and the focus forward will be to develop the Tier 2 suppliers and Tier 3 suppliers. These are typically smaller companies with relevant products, but do struggle to come into the off-

Turbine installation – Anholt. Photo: Ørsted

shore wind market. The floating wind market where Norwegian suppliers have a lot of experience from the oil and gas industry, may give the Norwegian suppliers a great opportunity with their experience within this field given they manage to transfer from the oil and gas approach to the offshore wind approach.

The wind industry represents a different type of industry compared to the oil and gas industry with more focus on standardization, scalability, cost, environmental footprint, lean products and processes. It is also important that the suppliers entering from the oil and gas industry is open for changes and find their position in the Tier hierarchy and have defined products fit for the market. The described situation is supported by the interviews of 9 experienced Norwegian suppliers and newcomers with the focus on success factors and international trends in the wind industry.

RECOMMENDATIONS

For suppliers to take a position in the international market, they need to start to prepare now and increase knowledge level about the wind industry in the following areas:

- Rules and regulations, country specific requirements and technical standards.
- Supply chains and the suppliers' own position in it.
- Identification of the decision makers to get products and services "approved" for use in the projects as early as possible, and before design phases and development of supply chains by the developers are finally set.
- How their products can improve their customer's competitiveness.

It is very important that the Norwegian suppliers are preparing for the international market. Going into partnering agreements with local companies or companies already in the business to deliver a larger part of the project scope, get references and coming closer to the decision makers is a recommended strategy going forward.

In addition, it is important that the major Norwegian suppliers in the offshore wind industry today supports smaller suppliers to follow, through knowledge sharing about projects, opening for understanding of supply chain strategies and supporting in getting access to decision makers.

For the government and the organisations, it is important to facilitate within the following:

- Create a home market for the suppliers.
- Create predictability and continuity within the offshore wind industry in Norway.
- Create a framework based on international wind industry practise.
- Continue the work to support suppliers to enter the international offshore wind arena. especially within building network and get access to decision makers.
- Continue to support innovation of new products and services.

1 Introduction

Offshore wind is developing fast and Norwegian suppliers need to stay tuned with the development to succeed.

10 years ago, wind power was the 5th largest form of power generation in Europe. Today, onshore and offshore is the second largest. The production is expected to be 120 GW of offshore wind power[1]. Of this about 90 % will be bottom fixed and 10 % will be floating wind[6]. In 2050, it is predicted that between 500 and 1000 GW of offshore wind has been developed, with an expected split of 80–90 % on bottom fixed and 10–20 % on floating wind[6]. The bottom fixed market today is considered rather mature, in opposite to the floating offshore wind market which is in the developing phase.

Several Norwegian suppliers have been in the offshore wind business for more than 10 years, and they have managed to take an international position. Good examples are Baggerød within door supply, 3b Fibreglass within fibre material to blades, Fred. Olsen Windcarrier within installation and Dokka Fasteners within bolted connections. In total the Norwegian supply industry is today exporting up to 7 billion NOK per year[1], to the bottom fixed wind market. The offshore floating wind market up to now has been more or less non-existing. The exception has been smaller projects. But the ongoing Hywind Tampen project may be an incubator for many smaller Norwegian suppliers to build up their competence and obtain a reference project within offshore wind.

The market outlook for the coming years, points towards capacity challenges, more complex projects, harsh environment and need for new technology within the wind power industry. This is valid both for bottom fixed and floating wind power. Based on internal CAPEX assessments it is estimated that 75–80 % of the supply chain from bottom fixed can be transferred to the floating wind supply chain and 30–40 % of the supply chain from the oil and gas industry can be transferred to the floating wind supply chain. The windows the floating wind industry is opening up for Norwegian suppliers, may give opportunities if they want to go into the international market and manage to:

- react quick
- learn and adapt to the offshore wind business
- develop a unique value proposition based on offshore wind customer needs and experience achieved from the maritime and oil and gas industry

This report called “Supply chain to offshore” (No: Leverandørkjeder) includes the following:

- Categorization of Norwegian suppliers related to the contract hierarchy/supply chain, either Tier 1, Tier 2 or Tier 3, based on defined contract model and typical supply chains.
- Categorization of export potential for Norwegian suppliers based on their international footprint today and in the future.
- Overview of what type of barriers Norwegian suppliers are experiencing today when trying to enter the offshore wind market. This is based on a survey carried out by the project.
- Overview of success factors and trends in the wind industry based on interviews with both newcomers and suppliers which has been in the offshore wind industry for more than 10 years.
- Overview of authority requirements and regulations, technical requirements standards, and guidelines valid for the wind industry based on work carried out by DNV GL, see Appendix 1.
- Review of qualification systems and qualification requirements Norwegian suppliers will meet in the wind industry based on information from customers and available information on web pages.

The suppliers’ position in the contract hierarchy will have impact on how they should approach the market and their customers, and what kind of support they may need from government and organizations to succeed. It is also important to understand the magnitude of suppliers with an export potential, especially for organizations and government in their planning work.

The information from this report is meant to be a basis for Norwegian suppliers to take the necessary actions to obtain a good position for getting contracts within offshore wind. The report and recommendations are also meant for authorities and organizations to give the necessary support to enable Norway to take a strong position within the offshore wind business in the coming years.

1. Multiconsult, Kartlegging av den norskbaserte fornybarnæringen i 2019, oktober 2020/01
2. Norsk Industri, Leveransekjeder - Teknologi og Produkter, mars 2021
3. CenSES, Conditions for growth in the Norwegian offshore wind industry, april 2019
4. Norsk Industri, Leveransekjeder – Marine operations in Offshore Wind, March 2021
5. Norsk Industri, Leveransekjeder – Havner, mars 2021
6. Menon Economic, Verdiskapingspotensialet knyttet til utviklingen av en

2 Study Framework

Offshore wind is a global market with opportunities through the whole value chain and supply chains. It is essential that the supplier define their targets and value addition, and find their position in this market.

2.1 OVERALL FRAMEWORK

The framework for the work is presented in Table 2.1.

Table 2.1: Project framework

FRAMEWORK ELEMENT	FURTHER EXPLANATION
Market	• Offshore wind: Bottom fixed and floating • Norway, Europe, USA and Asia
Value chain	From wind farm development to lifetime extension/decommissioning
Contract model	• Multi-contracting model See section 2.2 for further description
Supply chain examples	• Turbine supply chain • Substation supply chain • Cable supply chain • Marine operation supply chain • O&M supply chain See section 2.3 for further description
Tier 1,2 and 3	Definitions: Tier 1: Contract with developer Tier 2: Contract with Tier 1 Tier 3: Contract with Tier 2 See section 2.3 for further description

Supplier groups	The Norwegian supplier industry is represented by the following defined groups in this project: • Engineering, Procurement, Construction (EPC) and equipment suppliers. Typical companies in this group are Aibel (EPC), Baggerød (Fire doors) and MacGregor (Mechanical equipment) • Marine operators including installation, logistics, ROV and diving operators (named Marine operators). Typical companies in this group are Fred.Olsen Windcarrier and Østensjø Rederi. • Ports, assembly yards and shipyards (named Ports&Yards) Luteland offshore AS and Ulstein group ASA are representative companies for this group. • O&M service providers including also training and survey companies (named further as O&M). Representative companies in this group are IKM Group, Rely on Nutec and Isurvey • Engineering, consulting, class and test facility companies (named Support services). Typical companies in this group are Dr. Tech. Olav Olsen, DNV, Cognite and MetCenter Some companies have many activities and products and can hence be placed in several of the groups. A company is defined to belong to the group where it is most likely to get an offshore wind project today. Some of the Norwegian EPC contractors delivering e.g., substations, are also offering O&M Services, but have for this purpose been categorized as EPC supplier.
Export potential for suppliers	Whether the suppliers have an export potential is based on assessment of the following parameters • Are they already selling their products and services in the international market (not necessarily in the wind market)? • Have offices outside Norway? • Have products and services, financial strength, and sufficient number of people in the organization to operate in the international market.
Data basis – Developed supplier register	Categorization of Norwegian suppliers into supplier groups and Tier 1, 2 and 3 groups are based on defined supply chains, contract model, information on the companies web pages and general assessment carried out by the project team. The following has been used as basis for identifying companies: • Screening of 615 Norwegian companies registered in Brønnøysund register and taken from Norwegian Wind Cluster and GCE Node member lists down to 521 companies relevant for this analysis work. • Law companies, banks, investors, agents, brokers, developers/operators and onshore service providers as e.g., hotels and taxi companies are not included. The 521 companies identified are not necessarily delivering to the offshore wind industry today. A survey has been carried out among the 521 companies and 313 companies have responded. Among these, 59 % are saying that they are delivering to the wind industry today and the remaining 41 % are saying that they have ambitions to deliver. It has been observed that many of the large companies known to deliver to the wind industry have not responded to the survey. Therefore, it is reasonable to believe that all companies on the list are either delivering to the wind industry or have ambitions to deliver. This has formed the basis for the further work.

Cable installation. Photo: Nexans

Data basis – Survey	• A survey has been carried out among the identified suppliers in cooperation with the group "Teknologi og produkter"[2] • 313 of 521 companies asked responded to the survey • See appendix 2 for companies used as basis for the work
Data basis – Interviews	• Interview with Tier 1,2 and 3 suppliers in addition to owners/developers in the industry – 9 interviews • See appendix 3 for list of companies interviewed
Data basis – other sources	The work is also based on other sources as: • Available offshore wind reports in the market • Companies' websites • Marketing portals • Media

2. Norsk Industri, Leveransekjeder - Teknologi og Produkter, mars 2021

2.2 MULTI-CONTRACTING MODEL

There are many contract models used in the offshore wind industry, depending on factors as project complexity, experience, developers' risk profile, project location and number of resources to follow up in the developer's organization. The contract model used as basis for this study is a so-called Multi-contracting model and the set-up shown in Figure 2.1. This model is often used in the industry.

2.3 SUPPLY CHAINS LINKED TO TIER 1,2 AND 3 LEVELS.

It is important to work actively towards the decision makers to get your product "approved". The developers are often defining and standardizing their supply chain early to have more control in the risks and develop profitable projects.

In the following some of the supply chains in the value chain to wind power projects are presented, including the Tier levels linked to it, see Figure 2.2, 2.3 and 2.4. The supply chains presented are not exhaustive, but meant as examples to explain the approach used when categorizing suppliers into Tier 1, 2 or 3.

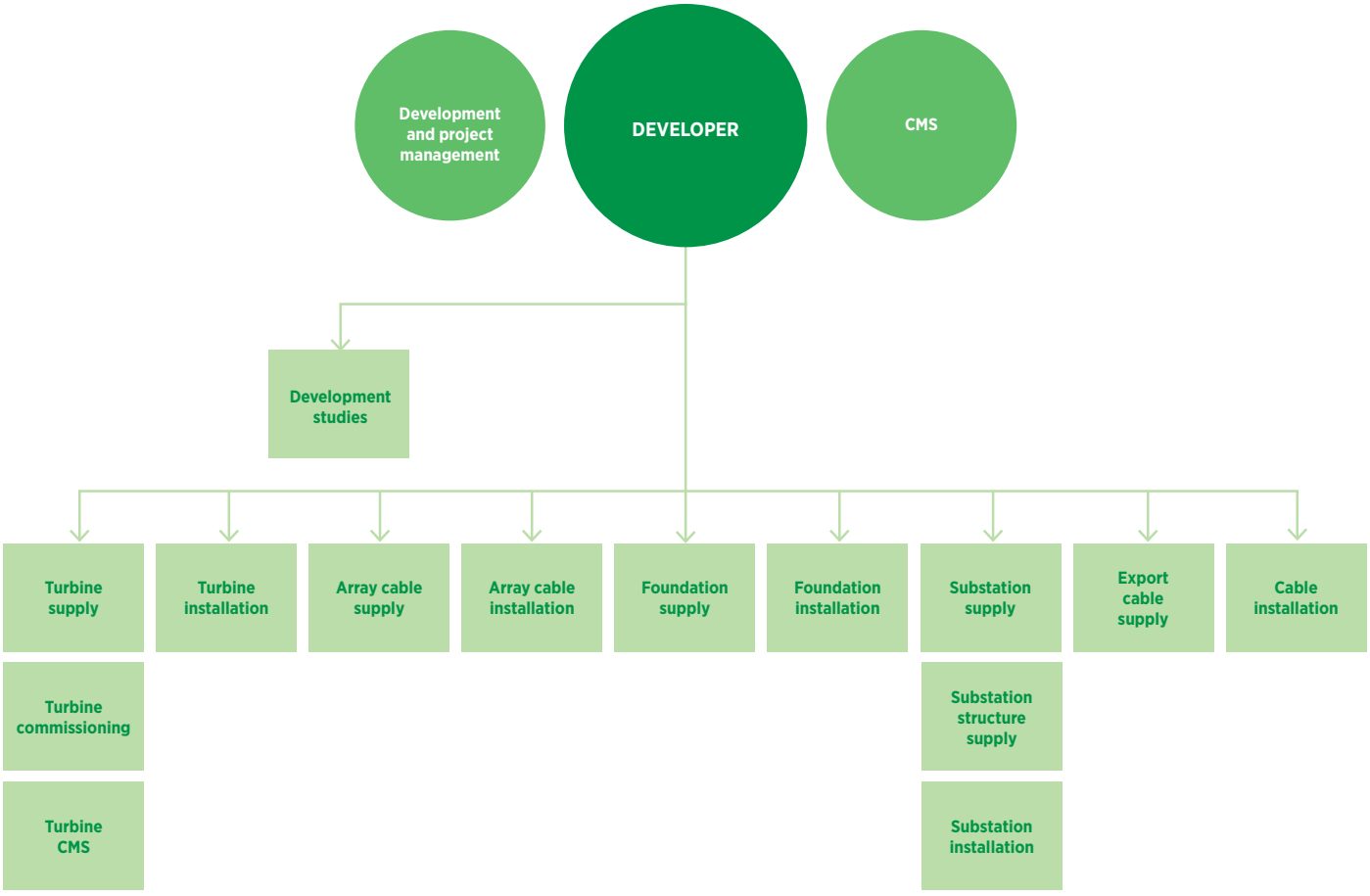


Figure 2.1: Multi-contracting model

FIGURE 2.2 – SUPPLY CHAIN – EPC/EQUIPMENT SUPPLIERS

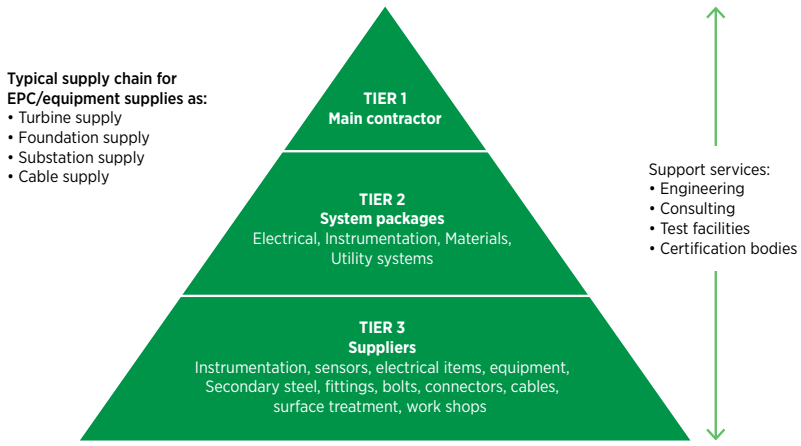


FIGURE 2.3 – SUPPLY CHAIN – MARINE OPERATORS

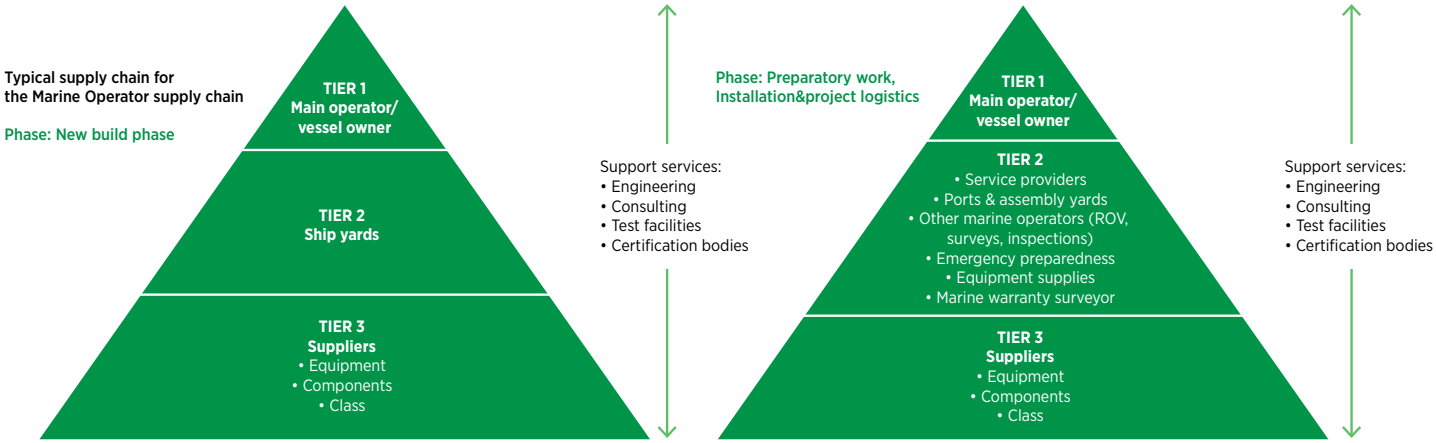
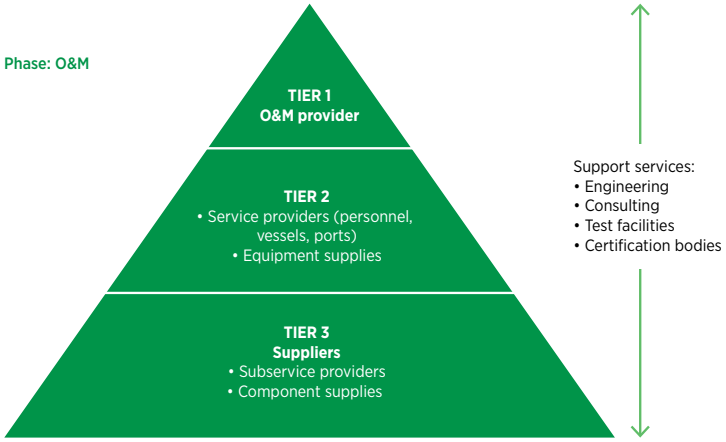


FIGURE 2.4 – SUPPLY CHAIN – O&M SERVICE PROVIDERS



3 Mapping of Norwegian suppliers

Many Norwegian suppliers want to enter the offshore wind industry. Knowledge about their position in the contract hierarchy and their export potential increases their possibilities to succeed.

A total of 521 Norwegian suppliers have been mapped based on assessment carried out by the project team within the following areas based on principles described in Section 2 Study Framework:

- Identification of number of suppliers in 5 different supplier groups
- Identification of number of suppliers at the different levels in the contract hierarchy (Tier 1, Tier 2 and Tier 3)
- Identification of numbers of suppliers having an export potential.

3.1 SPLIT OF COMPANIES INTO DEFINED SUPPLIER CATEGORIES

Table 3.1 shows the number of companies categorised into the different defined supplier groups defined in Section 2.

Table 3.1: Number of companies in defined supplier groups

Supplier group	No. of suppliers	Supplier distribution (%)
EPC and equipment suppliers	219	42
Marine operators	79	15
Ports&Yards	25	5
O&M service providers	52	10
Support Service providers	146	28
Total	**521**	**100**

The EPC and equipment supplier group constitute the largest group followed by the Support Service group. The groups presented above include the companies with only 1- 2 employees up to companies with several thousands employees. Based on the work carried out by[3], we found the following characteristics:

- 35 % of the companies have 10-50 employees
- 30 % have 50 – 500 employees
- The remaining 35 % is equally spread between below 10 and more than 500 employees.

In reference 2 (footer), more information can be found about the suppliers' location in Norway, what value chain group they are delivering to and the products' TRL-level.

The above categorization of supplier groups and number of companies in each group has been used as basis for the Tier categorization and number of companies with export potential assessment.

3.2 TIER DISTRIBUTION INCLUDING ALL SUPPLIERS AND SPLIT INTO SUPPLIER GROUPS

Based on the framework described in Section 2, the 521 suppliers have been categorised either to be a Tier 1, Tier 2 or a Tier 3 supplier. The Service Support supplier group is categorised into a Tier group called Tier123, since these companies are providing services to all levels in the contract hierarchy. Percentage

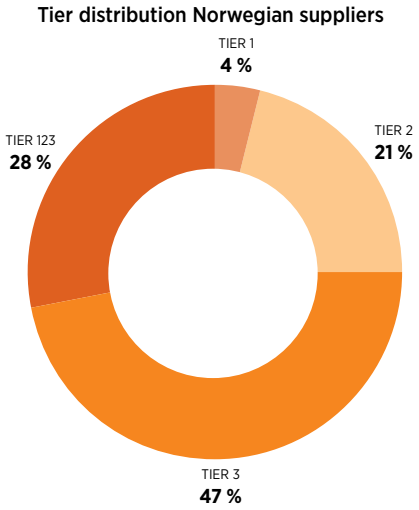


Figure 3.1: Norwegian suppliers – Tier distribution 1–3 (% distribution based on total 521 companies)

2. Norsk Industri, Leveransekjeder - Teknologi og Produkter, mars 2021
3. CenSES, Conditions for growth in the Norwegian offshore wind industry, april 2019

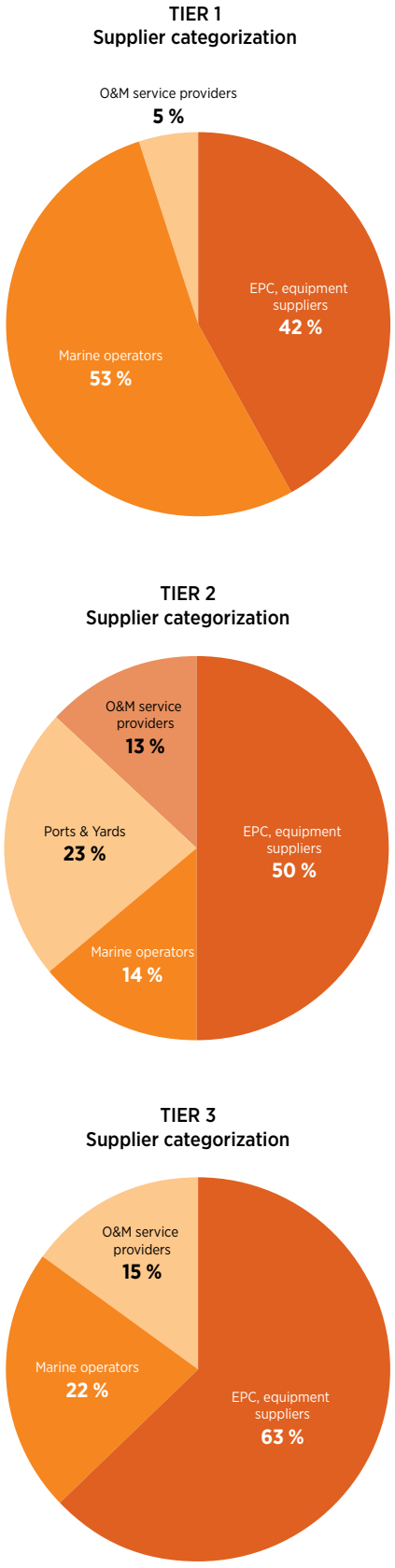


Figure 3.2 Supplier group distribution in Tier 1 (total 19 companies), Tier 2 (total 110 companies) and Tier 3 (total 246 companies)

distribution of companies (based on total 521) in the different Tier-categories are shown in Figure 3.1.

Figure 3.1 shows that 21 % (110) and 47 % (246) of the Norwegian suppliers are defined to be in the Tier 2 and Tier 3 category respectively, and only 4 % (19) are Tier 1 suppliers. The Tier 123 group represents 28 % (146) of the total supplier base, and this shows that the "Service Support" companies represent a major part of the Norwegian companies who wants to invest in wind.

Figures 3.2 presents the supplier group distribution in the various Tier categories.

According to Figure 3.2 most of the Tier 1 suppliers are EPC companies and marine operators. The Tier 1 suppliers are mainly delivering into the substation, installation, project logistic and O&M service supply chains. They have managed to take a position within offshore wind, especially in UK.

Figure 3.2 also shows that equipment suppliers constitute more than 50 % of both the Tier 2 and Tier 3 group, and a major part of them are delivering equipment to the EPC contractors' substation deliveries and to shipyards/vessel operators. In addition, there are Tier 2 and Tier 3 equipment suppliers who are capable to deliver to floating wind foundations and associated equipment, some of them with experience already from the Hywind projects in the North Sea.

Photo: MacGregor

3.3 SUPPLIER GROUPS SPLIT INTO TIER 1,2 AND 3

Based on the same principles as in Section 3.2, the Tier distribution within each supplier group is categorised and presented in the following.

EPC/Equipment suppliers

In Figure 3.3, the Tier distribution is presented for the EPC/Equipment supplier group, constituting in total of 219 companies.

The Tier 1 group includes all the EPC contractors, in total 8. All of them are already well positioned in the wind industry. All the equipment suppliers are either Tier 2 (in total 55) or Tier 3 (in total 156) suppliers. Most of the Tier 2 equipment supplier companies are well known companies with a defined product, and many of them are already well positioned in the wind industry. It is important to note that there are very few equipment suppliers delivering to the Turbine supply chain, most of them as earlier mentioned are delivering to the substation supply chain, the marine operator supply chains, or the O&M supply chain.

Photo: Baggerød

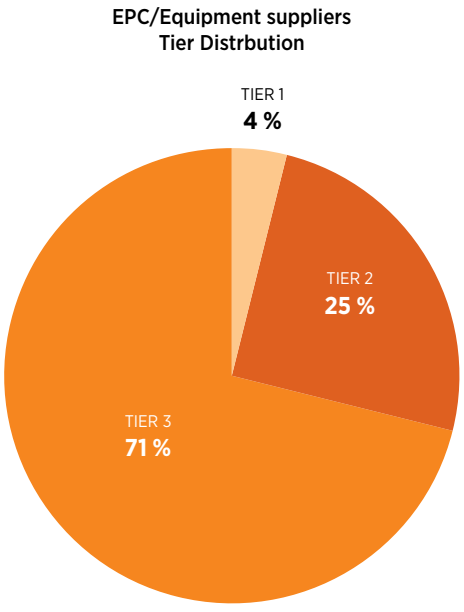


Figure 3.3: Tier distribution – EPC/Equipment suppliers (Total companies 219)

Products and services offered by Tier 1 and many of the Tier 2 EPC and equipment suppliers, can directly be transferred from the oil and gas industry to the offshore wind industry. These companies have managed to take a market share in the offshore wind industry, examples here are delivery of EPC substations offshore and subsea cables.

The Tier 3 group includes many smaller machinery workshops delivering their services today to the oil and gas industry and equipment suppliers delivering to the maritime industry (shipyards and ship owners). 46 of the equipment suppliers in the Tier 3 group are marine equipment suppliers delivering to shipyards which are building vessels for vessels owners which again is providing their vessels/services to installation and O&M phases. About 30% of the suppliers in Tier 3 will not have a market if the Marine operators do not have success in the offshore wind market, as it is assumed that they depend on the “home market”.

Marine Operators

Figure 3.4 presents the Tier distribution for Marine operators, in total 79 companies.

This group has a rather high portion of Tier 1 operators compared to the other groups, three and six times higher in % compared to EPC/Equipment supplier and O&M service providers. In total 10 Marine operators are in the Tier 1 group, 16 in Tier 2 group and 53 in Tier 3 group. Overall, within the Marine operator group there are many reputable companies on all Tier levels. Among acknowledged Marine operators are Østensjø Rederi, Solstad Rederi, DOF, Havila, REM Offshore, Eidesvik and Fred.Olsen Windcarrier operating in the North Sea. In total there are about 60 vessel operators/owners in the group with capacity to deliver their services during the installation, logistics and O&M phase. The rest of the companies, 19 in total, in this group are ROV and survey operators, of rather local character. Many of the vessel operators/owners independent of Tier level, have managed to position themselves within the offshore wind industry. Their equipment and services developed either in the maritime industry or in the oil and gas industry can easily be transferred to offshore wind. For more in-depth analysis of Marine Operators[4].

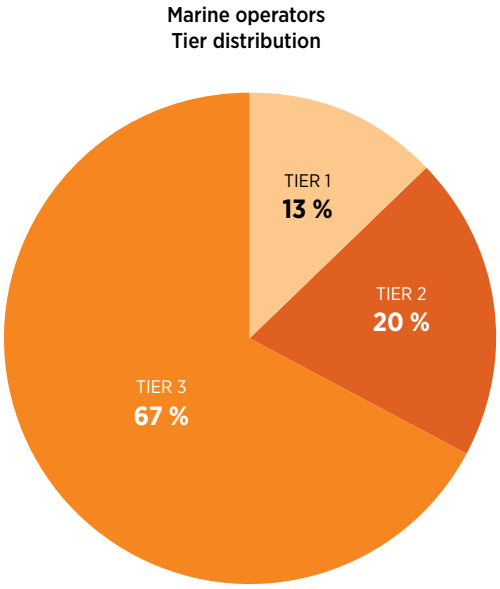


Figure 3.4: Tier distribution – Marine operators (Total companies 79)

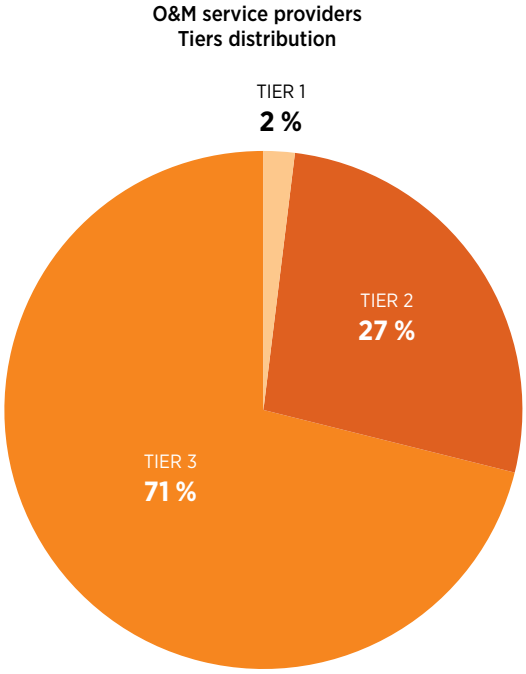


Figure 3.5 – Tier distribution – O&M service providers (Total companies 52)

O&M service providers

Figure 3.5 presents the Tier distribution for the O&M service providers, consisting of 52 companies.

The reason for the small portion of Tier 1 suppliers in the O&M group could be that a large portion of the operating and maintenance work in the offshore wind industry is carried out by the operators and equipment suppliers themselves. In Tier categories 2 and 3 there are many local companies, including many small companies. Based on this, there is a very limited number of companies in Norway in a position to take larger O&M contracts in the wind industry, except for the EPC contractors. However, the huge experience from maintaining structures and equipment below sea level from the oil and gas industry could open for also Norwegian O&M providers to take a larger market share the coming years. However, this requires that O&M providers enters the international arena. O&M will be more analysed in a separate work stream as part of the project "Leveransemodeller for havvind" for Norsk Industri during spring 2021.

Ports & yards

In total 25 ports&yards are registered in the available data base and according to defined supply chains, ref. Section 2.3, they are all defined to be in the Tier 2 group. Reference is made to reference 5 for further descriptions and assessment of ports and assembly yards.

4. Norsk Industri, Leveransekjeder – Marine operations in Offshore Wind, March 2021
5. Norsk Industri, Leveransekjeder – Havner, mars 2021

Turn to the industry – you are selling to experienced players in the wind industry, identify the pain points in the industry, do not come with the oil and gas language

Dogger Bank. Photo: Equinor/Jan Arne Wold

3.4 EXPORT POTENTIAL

Table 3.2 presents a number of suppliers that have an export potential within the different Tier groups based on assessment carried out by the project team according to principles described in Section 2.1. The assessment is carried out based on a total of 521 companies.

Table 3.2 – No. of suppliers having an export potential within each Tier group.

Supplier group	No. of suppliers having an export potential vs total companies	(%)
Tier 1	19/19	100
Tier 2	61/110	66
Tier 3	63/246	26
Tier 123	20/146	14
Total	**163/521**	**31**

All the Tier 1 companies are delivering to the international market today. This is a good starting point for companies on lower Tier-levels to be selected in the international market. In the interviews carried out with Tier 1 suppliers, it is stated that they want to use Norwegian suppliers that they also have used in especially oil and gas projects. But the Norwegian suppliers need to understand that there are other margins and less tailor-made solutions in the offshore wind industry compared to the oil and gas industry. The suppliers need to develop their products and cost structure thereafter. With a rather small portion of Tier 1 suppliers in Norway, it is believed that companies on lower Tier-levels are depending on their own abilities to sell their products and services in the international market.

Further, evaluation of companies in the Tier 2 and 3 group shows that 124 of in total 356 companies in these two groups have products, services, and necessary financial strengths to work in the international market to some extent on their "own".

The Tier 123 group including "Support Service" providers, includes many small companies and only 20 of the total 146 companies in this group are evaluated to have a potential to work in the international market. It is believed that many of these are depending on following a Norwegian company with a strong international footprint outside Norway to get a business out of it.

Table 3.3 present the number of suppliers with an export potential within each supplier group.

Table 3.3: Number of suppliers having an export potential within each supplier group.

Supplier group	No. of suppliers having an export potential	% within supplier group
EPC and equipment suppliers	100/219	46
Marine operators	25/79	32
Ports& yards	13/25	52
O&M service providers	5/52	10
Support Service providers	20/146	14
Total	**163/521**	**31**

Of 219 companies in the EPC/Equipment supplier group, about 100 of them is assessed to have an international footprint. That includes 100 % of the EPC companies, about 65 % of the Tier 2 equipment suppliers and about 35 % of Tier 3 equipment suppliers.

With 71 % of the equipment suppliers in Tier 3 and rather few of them with an international footprint, many of these companies will struggle to come into the offshore wind industry. They will need specific help through the marine operators or are working to be unique in their product portfolio and manage to have competitive prices.

Both Tier 1 (the EPC suppliers) and many of the Tier 2 equipment suppliers should be well positioned to take higher market share in the offshore wind industry than today together and by their "own" with their broad experience from the oil and gas industry. This is especially true within floating wind, where Norwegian equipment suppliers are strong within floating foundation experience in general and associated equipment as e.g., mooring systems.

In total 25 marine operators have been assessed to have an export potential within offshore wind, followed by Ports&Yards with 13 and O&M with 5 suppliers.

All the remaining 350 companies are assessed to have a small international potential and is believed to depend on a home market to come in a position to deliver to the offshore wind industry. In the survey carried out, ref. Section 4.2, 12,5 % of the companies responded saying that a lack of a home market is a barrier for them to enter into the wind industry.

However, it is important to mention that many of the 350 companies are delivering products and services to Norwegian companies that already are operating in the international market, and therefore some of them will not see a need to have an international footprint on their own.

4 Survey and interview results

The offshore wind industry' characteristics are product standardization, scalability, unique value proposition and as low Levelized Cost of Energy as possible.

4.1 SURVEY RESULTS – KNOWLEDGE ABOUT STANDARDS AND QUALIFICATION SYSTEMS

In the survey carried out some questions asked were:

- Is your company delivering to the offshore wind industry today?
- If not, does your company have ambitions to deliver?
- Is your company registered in any customer qualification system?
- Has your company a clear picture of standards within offshore wind?

In the following the feedback is summarized and discussed.

Is your company delivering to the offshore wind industry today? And if not, does your company have ambitions to deliver?

59 % of the responders reply positive to that they are delivering to the wind industry today. This is a rather high figure taking into account that there are no offshore wind projects at the moment at the Norwegian Continental Shelf (NCS) except for Hywind Tampen. However, there are a lot of activities ongoing among suppliers to develop and make their products fit for the wind industry. Many companies are involved especially in ongoing UK projects that can support this high figure. The results can be split into the following Supplier groups and Tier groups, see Table 4.1 and Table 4.2 respectively.

Table 4.1: Overview of Supplier groups delivering to offshore wind today

Supplier group	No. of suppliers delivering to the offshore wind industry vs. responders in each supplier group (total supplier group)	% within supplier group responded positively
EPC and equipment suppliers	83/139 (219)	59%
Marine operators	33/41 (79)	80%
Ports & yards	9/14 (25)	64%
O&M service providers	14/36 (52)	39%
Support Service providers	46/83 (146)	55%
Total	**185/313 (521)**	**59%**

The Marine operators is the group having the highest percentage of suppliers delivering to the offshore industry today, followed by Port&Yards that are linked to the Marine Operator's success in this market. O&M service providers have the lowest percentage, but it is considered that many of these companies are local having a set up for delivering services to the Norwe-

gian market only. The NCS market is currently more or less non-existing, so this picture seems reasonable. That said many of them are supporting the Marine operators operating in the O&M market.

Table 4.2: Overview of Tier groups delivering to offshore wind today

Supplier group	No. of suppliers delivering to the offshore wind industry vs. responders in each Tier group (total in Tier group)	% within Tier group responded positively
Tier 1	10/11 (19)	91%
Tier 2	44/61 (98)	72%
Tier 3	85/158 (261)	54%
Tier 123 Support Service providers	46/83 (146)	55%
Total	185/313	59%
Total	**185/313 (521)**	**59%**

The above is showing that the Tier 1 group has the highest percentage within its group that delivers to the offshore wind market followed by Tier 2 and Tier 3 groups. The reason for this order could be that EPC contractor and Marine operators which are the main supplier groups in the Tier 1 group have managed to penetrate the offshore wind market early (some of them have been in the business for more than 10 years) with their products and services that could easily be transferred from their involvement in the oil and gas industry.

Companies that are responding negatively to their participation in the wind industry today, are all saying that they have ambitions to deliver equipment and services in the future.

Is your company registered in a customer qualification system?

58 % of the responders have qualified in customer qualification systems. The distribution of positive responses within Supplier groups and Tier groups are the same as described above.

Does your company have a clear picture of the standards within offshore wind?

Of 521 suppliers and 313 relevant responders, 31 % of the suppliers had a clear picture of standards within the offshore wind industry. The Tier 1 group has the highest knowledge within offshore wind standard, 50 % responded positively, followed by Tier 2 (45 %) and the Service Support group (35 %). Tier 3 had 23 % positive responses. It is not surprising that Tier 3 scored lowest considered that this supplier group are typically delivering equipment and services often "independent" of market type and that Tier 1 scored highest being the most experienced of the Tier groups.

31 % positive responses over all is rather low and is showing that there is a need to improve the knowledge about standards within offshore wind industry. This is important to knowledge to develop products according to industry requirements. Reference is made to Section 5 describing relevant standards within both the fixed and floating offshore wind industry.

4.2 REPORTED BARRIERS FROM NORWEGIAN SUPPLIERS FOR NOT ENTERING THE OFFSHORE WIND MARKET

As part of the survey carried out, Norwegian suppliers were asked which barriers they met and needed to overcome to enter the offshore wind market and have success. 253 of 521 companies have responded on this question. The feedback is summarized in Table 4.3.

Need to be involved early in the design phase with your product in order to be part of the early standardization process to the developer/customer

Table 4.3 Identified barriers among Norwegian suppliers

Barrier	No. of suppliers (#)	%
Knowledge and competence - Lack of knowledge and competence about the offshore wind industry in general (needs to the customers, understand the supply chain, rules, regulations, and standards)	36	14
Home market - Lack of home market to get the necessary experience, references, contact with procurement organizations and continuity in projects	32	12,5
Network - Missing a network needed to come in a market position	35	14
Customer visibility - Difficult to understand who the customer is and get the opportunity to discuss solutions	29	11,0
Price level - Difficult to develop products that are competitive, being scalable and having the right quality with the right price level	39	15,5
Financial strength - Lack of financial strength to develop products and take the necessary risk	17	7
Experience – Lack of wind references and experience from oil and gas is not worth anything – competing with suppliers having wind references	25	10
Timing – Have the necessary time, resources, and competence in the establishment phase	10	4
Standards – Lack of standards within utilities and grid connections	8	3
Procurement access – Difficult to get access to the procurement organization, not a transparent organization and little willingness to open for new suppliers	10	4
Sustainability – Difficult to meet sustainability requirements in the wind industry, to represent a sustainable industry with products and services	5	2
Others: • Missing information about projects • No sharing of operational data • Complex contracts/risk sharing • Lack of continuity of projects at the NCS • Need for local presence in areas where the projects are	7	3
Total	**253**	**100**

Some statements from the survey linked to identified barriers:

- "In the oil and gas business it is more focus on the project itself and tailor-made solutions, whereas in the offshore wind industry it is a focus on standardized solutions to be used in all projects"
- "Norway is far behind in the wind industry and it is very difficult to get a foot inside this industry as a supplier"
- "Need to customize the company in order to meet larger and repetitive assignment volumes at lower margins than in the oil and gas industry"
- "Need to be involved early in the design phase with your product in order to be part of the early standardization process to the developer/customer"

4.3 INTERVIEW RESULTS

9 interviews have been carried out among the companies listed in Appendix 3. 8 of them have more than 10 years' experience from the offshore wind industry and one newcomer. This should be a representative sample of companies including developers, EPC contractors and equipment suppliers in Tier categories from 1 to 3.

4.3.1 Success factors within offshore wind

Statements from the interviews about what is needed to have success within the offshore wind industry are presented below:

- Ability to predict and solve market challenges
- Ability to contribute to the green energy market developments
- Be curious and open to change
- Be collaborative and proactive
- Offshore wind has similarities with O&G and experience with offshore environment and co-existence with fishery industry maybe an advantage. However, technical complexity and cost must be kept low
- Relatively new industry with room for improvements through innovation and smart thinking:
  - Improve safety
  - Reduce costs
  - Increase reliability(uptime)
  - Increase effectivity (e.g., less power loss for cables) of the total system
  - Monitoring systems / Remote inspection/ digitalisation
- Reference and competence within the offshore wind market
- Be present, find your position in the supply chain with a clearly defined product
- Think lean processes and solutions
- Forget what you have learned within oil&gas – in the offshore wind industry you need to be prepared for repetitive processes, standardized products, and scalability – more focus on the process than the products
- Be prepared for HSE and then cost, cost, cost
- Adjust to deliver products to another type of customer / industry. You cannot bring the oil and gas history with you
- Norwegian customers helped us to be competitive abroad.
- Join NORWEP and participate actively
- Sell a product that is helpful for the customer, with a good product difficult to change supplier
- Be prepared for more bargaining the further you come from Norway,
- Do not win on price – quality, service and critical delivery is the most important parameters.
- Price situation same in offshore wind as in O&G (a system segment independent of delivery either to wind or O&G)
- Important to deliver products that need little maintenance – biggest difference from the oil and gas industry
- Turn to the industry – you are selling to experienced players in the wind industry, identify the pain points in the industry, do not come with the oil&gas language
- When selling your product connect it to a need in the industry and how to reduce the cost picture to the customer
- Learn the language in the industry
- Coming with "Petter Smart" solutions" and lack of industry experience in a competitive market will not work – be a bit humble
- Digitalization, automation, and vessel control integration

The development goes very fast and companies not started need to take action now if they want to take a position in the offshore wind industry

4.3.2 Trends within offshore wind

Summary from the interviews related to what they look upon as international trends in the offshore wind industry and characteristics to the industry is presented below:

Trends:

- Turbine size growth
- Purpose built vessels
- Multi-contracting vs. integrated contracts
- Stricter requirement showing that the company have

offshore wind references, not enough to have oil and gas references
- Local content
- Show improvement within HSE
- Cost reduction
- Larger projects, more projects further from shore, new countries and more demanding projects are opening for new suppliers due to competence and capacity constraints
- High competition, land crabbing - owner / developers, high willingness to take risks (developers, investors), developers also want suppliers to take a greater risk
- Expectations to small environmental footprint and being a sustainable supplier are greater compared to the oil and gas industry
- The development goes very fast and companies not started need to take action now if they want to take a position in the offshore wind industry
- Specific geographical requirements (Jones Act challenges)

Characteristics:
- International context/bankability requires comprehensive and detailed contract formats
- Lower prices/margins compared to the oil and gas industry
- Global supply chain
- Global rules and regulations

Photo: MacGregor

5 Rules, Regulations and Standards within Offshore Wind

Technical standards largely used in the offshore wind industry are primarily global standards. This supports the need for standardization of products in the industry to make projects profitable and the products relevant. Developing separate Norwegian requirements may put Norwegian suppliers behind in their development of standardized products to be valid worldwide.

DNV has on behalf of the project developed a report including an overview of offshore wind standard and certification requirements. The report is enclosed in Appendix 1. In this section a short summary is presented including the following:

- Applicable standards for offshore wind
- Certification schemes for offshore wind
- Regulation on product, certification, accreditation, and recognition
- Country specific certification requirements

The details are left for the DNV report in Appendix 1.

5.1 APPLICABLE STANDARDS FOR OFFSHORE WIND

Bottom fixed standards

Complete sets of offshore wind specific standards are available. The most extensive sets are provided by IEC and DNV GL. Common practice in the wind industry is to apply these standards. But in special cases are standards developed for other industries like the petroleum or maritime industries applied. It should be noted that recently there are also standards developed that are intended for offshore structures in general (wind turbines, petroleum platforms, fish farms etc.) e.g., DNVGL-ST-N001

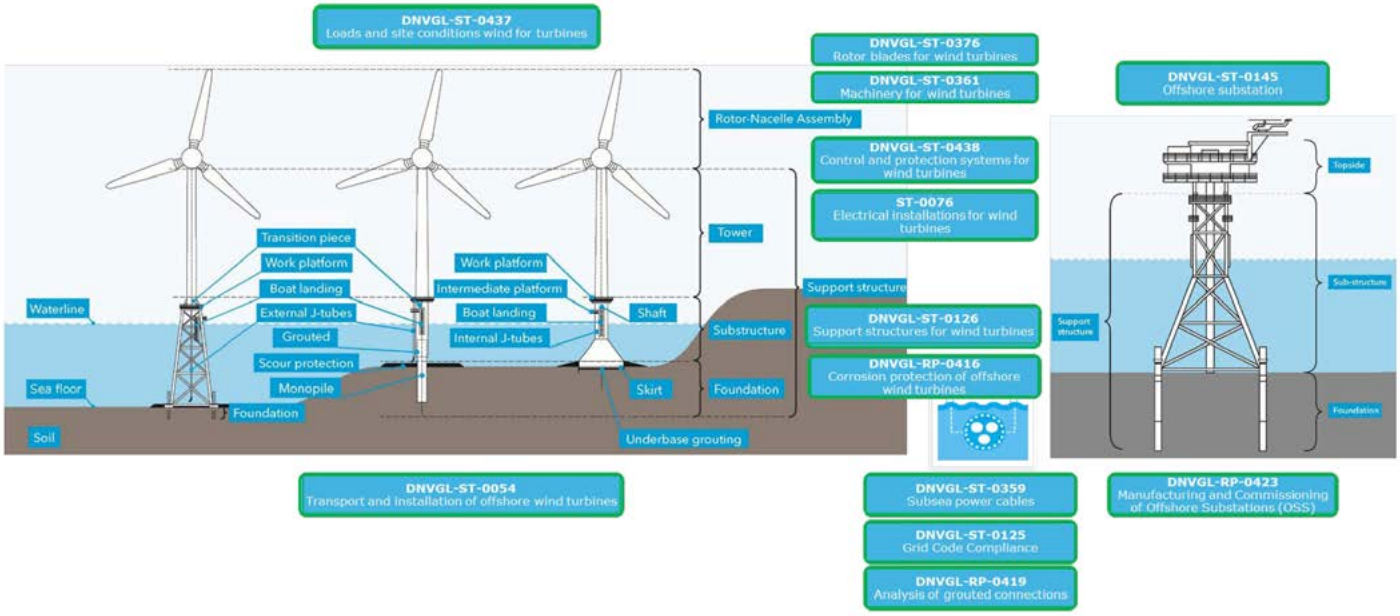


Figure 5.1 DNV GL standards for fixed bottom wind farms

Marine operations and marine warranty.

The main IEC relevant standards which cover wind energy generation systems are the IEC 61400-series. The IEC 61400-1 Design requirements is the main standard used for wind turbine design (Rotor Nacelle Assembly) by turbine manufacturers. The standards in the 61400-series are maintained by IEC Technical Committee (TC) 88. Other IEC standards are also applied in the wind energy sector. The standards are focusing on the electrical components but are also including requirements for the support structure.

The relevant standards and other guidance documents provided by ISO, IEC, DNV GL and other standardization organizations, clustered per asset of a wind power plant, are listed in Appendix A.

Figure 5.1 gives an overview of DNV GL standards for fixed bottom wind farms which represent the most used standards within this area together with IEC standards for turbine design.

Floating wind standards

Figure 5.2 shows an overview of the standards that has been developed specifically for floating wind turbines and associated asset in a farm. It should be noted that these standards do not apply for the turbine, but for the support structure and the station keeping system. The standard (DNVGL-ST-0119) also covers the dynamic power cable (the mechanical part). The common practice for the turbine, is to use a type certified turbine. However, at the current stage the turbines are only type certified for bottom-fixed foundations. Therefore, in a floating wind project, a site and floater specific assessment of the turbine (including control system) is performed to ensure that the turbine is suitable for operation on the floating foundation. In many cases, modification to the turbine control system is needed to keep the loads imposed on the turbine from the floater within the limitations given in the type certificate. In addition, the tower will often need to be used on floating foundation.

Figure 5.2: Overview of applicable standards for floating wind

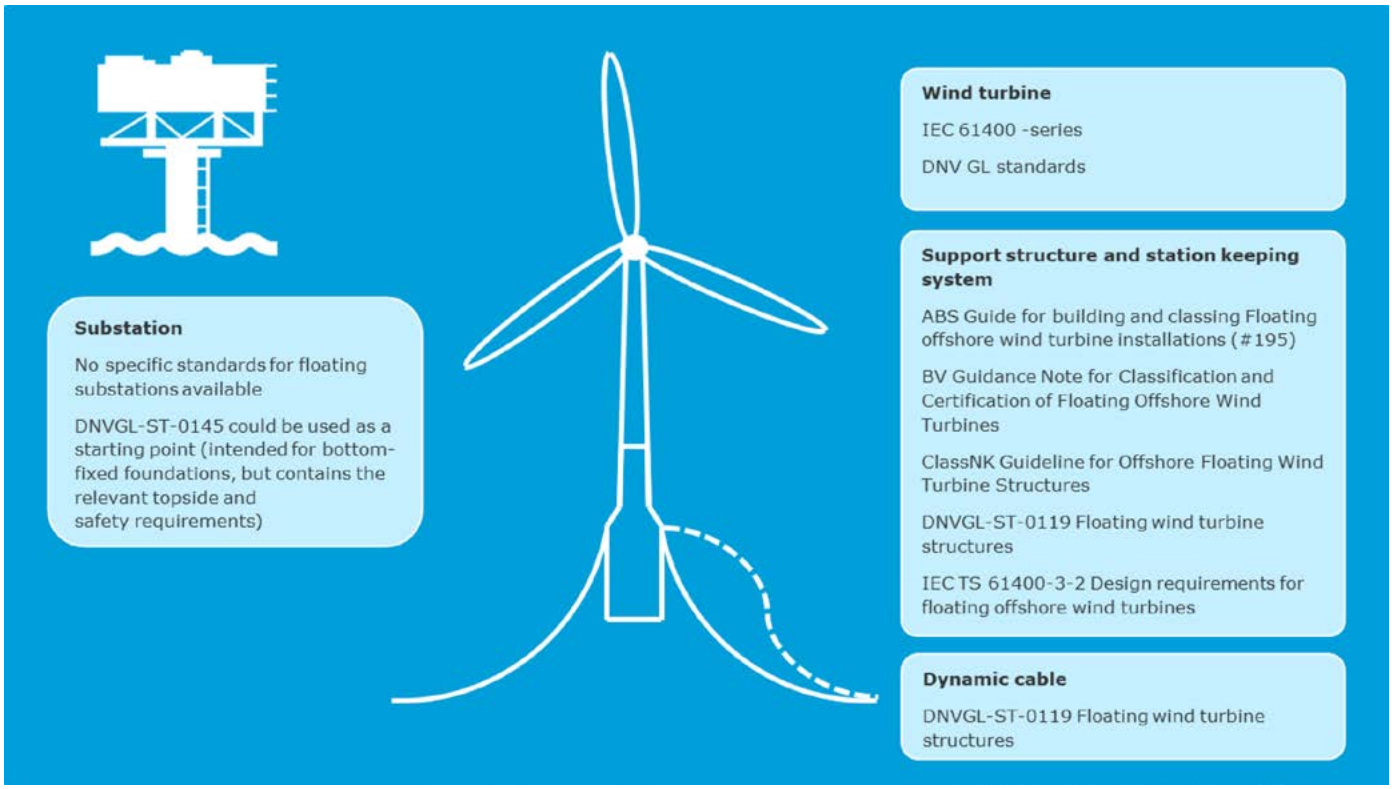


Figure 5.2: Overview of applicable standards for floating wind

5.2 CERTIFICATION SCHEMES FOR OFFSHORE WIND

Certification is to attest that a wind power plant is fulfilling the defined requirements (applicable standards and state of the art knowledge) for the defined phases. Typically, the phases from development to construction, operations and de-commissioning, are included. A successful certification shall document compliance with the defined requirements. A typical reason for asking for certification is to assure by an independent and qualified third-party, that the wind power plant including its assets (e.g., wind turbines incl. support structure, substation and power cables) is safe and reliable. There are three types of certification schemes in the offshore wind industry (the process is the same for other industries):

- **Type certification:** Type certification means certification of the wind turbine rotor-nacelle assembly (RNA) and its components. The type certificate can also cover the RNA and tower. Especially for offshore wind the tower is always site-specific designed, thus typically not part of the type certificate. Also, other site-specific components such as foundations and assets such as offshore substation and power cables are not type certified. The type certification is in general a certification of a type of turbine considering generic wind conditions (wind turbine class). The type certification scheme according to IEC 61400-22, DNVGL-SE-0073 or IECRE OD-501 consists of five mandatory modules and three optional modules. The five mandatory modules refer to five major tasks during the design, manufacturing and testing of the wind turbine. The three optional modules refer to design and manufacturing of the foundation for the wind turbine and to type characteristics measurements

- **Component certification:** Component certificates may be issued for specific components, such as rotor blades, generators, gearboxes, electrical components, brakes, couplings, nacelle frames, towers, main bearings, or systems such as pitch systems, yaw systems, fire protection systems, condition monitoring systems or parts such as bolts and tower internals. The component certification scheme is like the type certification scheme and following IEC 61400-22, DNVGL-SE-0073 or IECRE OD-501, see 5.6.2. Component certification covers relevant modules of type certification with the extent depending on the component in question,

- **Project certification:** Project certification has been developed and is applicable for all phases in the life cycle of onshore and offshore wind power plants. It constitutes a robust means to provide, through independent certification, evidence to stakeholders that a set of requirements laid down in standards are met during the development and construction and is maintained during operation of the wind power plant. The five certification phases within the project certification extend from design basis to commissioning, operation and maintenance.

5.3 REGULATION ON PRODUCT, CERTIFICATION, ACCREDITATION, AND RECOGNITION

To support international trading, it is important that certificates are accepted by their stakeholders. To support the acceptance recognition, arrangements are defined by the IAF and EA related to the Accreditation Bodies. The arrangements enable the recognition of conformity assessment results and thus acceptance of Accredited Certification Bodies' work in countries those being members. In Figure 5.3 an example/overview on product, certification, accreditation and recognition.

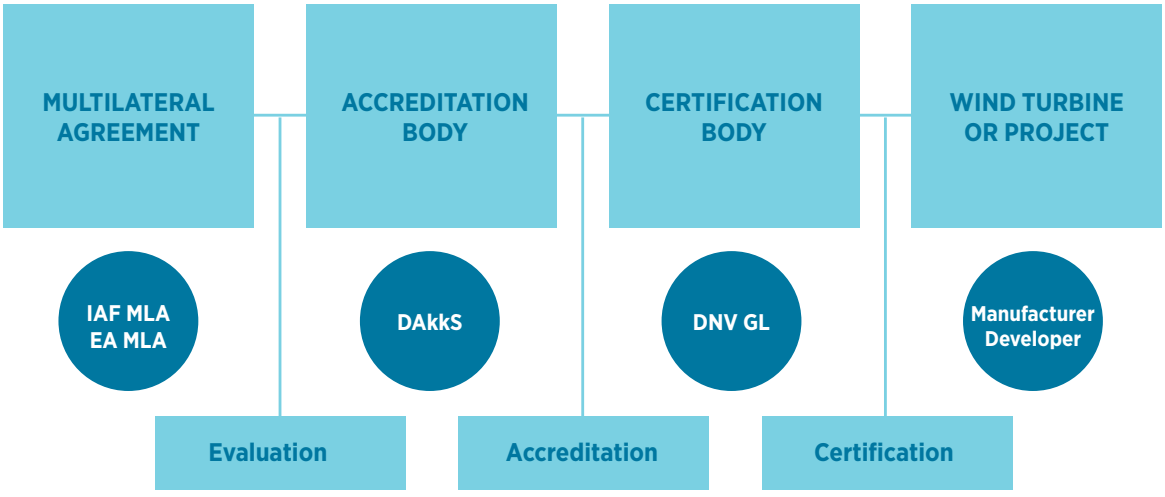


Figure 5.3 Example/Overview on product, certification, accreditation and recognition

5.4 COUNTRY SPECIFIC CERTIFICATION REQUIREMENTS

The table below provides an overview of the country specific requirements for offshore wind power plant certification.

Table 5.4 – Overview of country specific requirements for offshore wind power plant certification.

COUNTRY	PROJECT CERTIFICATION	MAIN STAKEHOLDER AND EXTENT
 France	✓	Not required by authorities, but by investors Requirement: full project certification of the wind turbines
 Germany	✓	Responsible authority: BSH Requirement: full project certification of the wind turbines and offshore substation, plus in-service certification of operating wind power plants
 Norway	–	Responsible authority: PSA Requirement: not yet in place (for petroleum installations the operator are responsible for sufficient third party involvement)
 South Korea	–	Responsible authority: KFA Requirement: not yet in place
 Taiwan	✓	Responsible authority: BSMI Requirement: full project certification of the wind turbines, offshore substation and power cables
 United Kingdom	✓	Not directly required by authorities, but common practice for design basis and design phase Requirement: Health and Safety Legislation requires a company to prove that reasonable measures to ensure safety of the structures are taken, in practice, certification of design basis and design phase are applied
 United States of America	✓	Responsible authority: BOEM Requirement: full project certification of the wind turbines, offshore substation and power cables

✓ requirement by laws/acts/orders

✓ indirect requirement e.g. by investors, insurance

– no requirement yet

The Alfa lift vessel – An Ulstein design including many Norwegian suppliers onboard.

6 Qualification Systems within Offshore Wind

There is no specific qualification system within the offshore wind industry except for the customer's own qualification system. It is important to be registered in these systems to be considered as supplier.

Today there are no specific qualification systems within the Offshore wind industry except for the qualification systems of the customer/developer itself. Qualification systems available today for use in the North Sea and used by some offshore wind developers/customers are:

- EPIM JQS (For use at the NCS and replacing Achilles and based on IOGP 423 and IOGP 510/511)
- Achilles (For use at the NCS based on Norsok S-006)
- FPAL (used by some in the UK)

The above systems are mainly developed for the oil&gas industry, but not limited to this. It is very important to note that there are no requirements in the offshore wind industry in general to be qualified according to these systems or any other developed systems worldwide. Based on this the most important qualification system will be the customers' own systems.

Be present, find your position in the supply chain with a clearly defined product

The customer will normally have an assessment of the different suppliers within the typical topics listed below and rate the suppliers accordingly. The principle is the same as in the oil&gas industry that the Norwegian suppliers are used to:

- Management Responsibility
- Quality Management
- Environmental
- Risk Management
- Project Management
- Production
- Training
- Product Development
- Purchasing
- Cost Control
- Warranty
- Product Liabilities
- Logistic
- Spare Parts
- Facilities

As identified as barrier in the survey, Norwegian suppliers look upon the procurement organization to developers as very little transparent and difficult to reach also due to limited network within the wind industry. A home market could be a help here in order to come closer to the big player's procurement organizations because they may have interest in using local companies. The majority of the customers and Tier 1 suppliers have also supplier days' which is an important arena to get a foot inside the industry.

7 References

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Appendix 1 – Report DNV GL

Can be received upon request to Norsk Industri.

Appendix 2 – List of companies assessed

Can be received upon request to Norsk Industri.

Norsk Industri

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