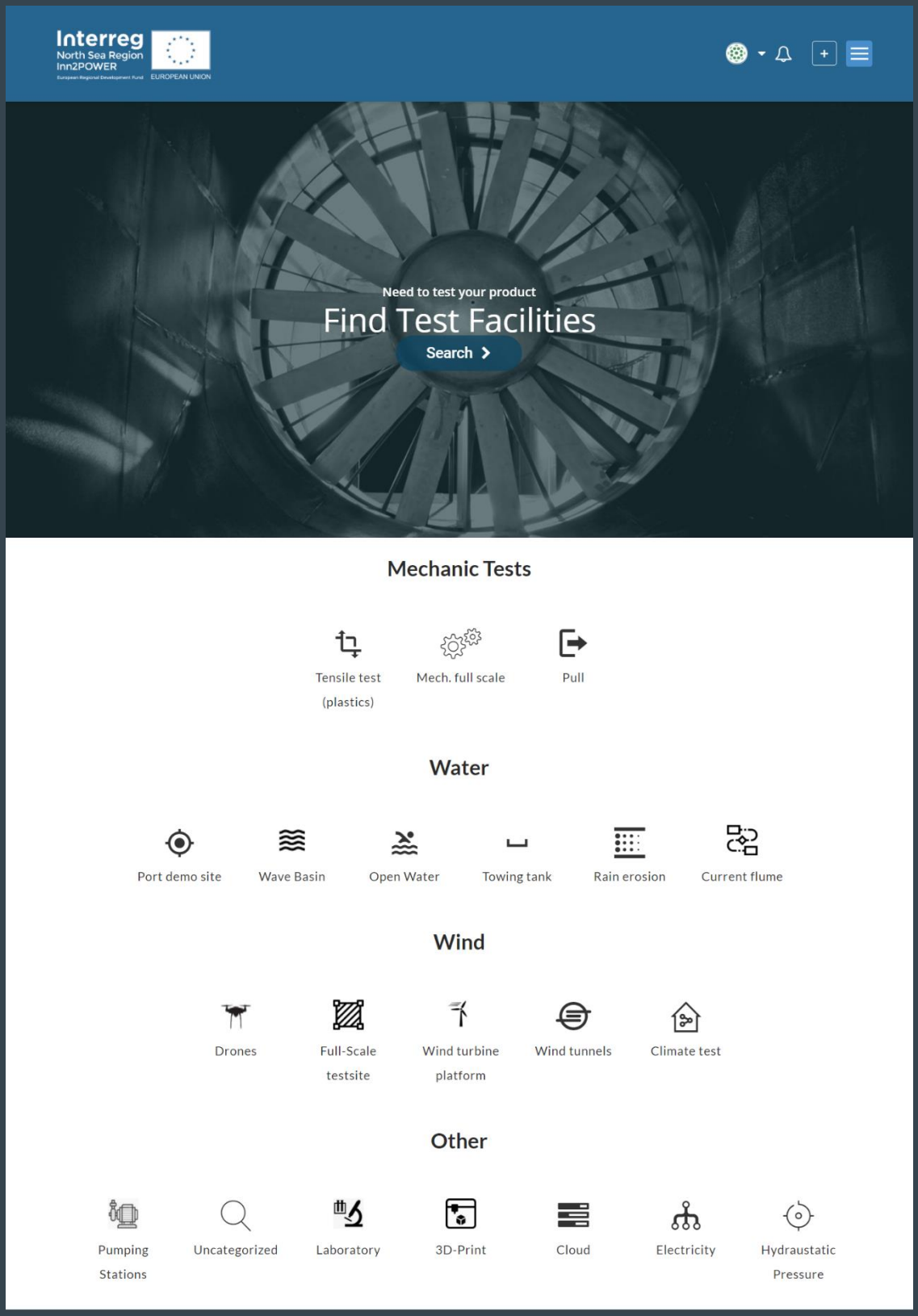
Improving Utilisation of Test Facilities



1 WP 4 Test Facilities

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2 Introduction

Prior research has shown that test facilities play important roles in technological developments (Frishammar et al., 2015; Hellsmark et al., 2016). For instance, test facilities have shown to promote commercialisation of new products (Cattani, 2006), verifying technologies (ref), elaborating products and process development (Lager et al., 2013) and reducing different types of risks (Hendry et al, 2010). Similar, research has found that different test facilities take different roles from conducting separate effects testing to reducing developmental technology risks during the different phase of technology development (Frishammar et al., 2015; Hellsmark et al., 2016). However, research has not studied the motives, challenges and benefits for the utilization of test facilities of SMEs.

We want to increase innovation through utilization of test facilities by helping companies find the test facilities they need. If you have a test facility upload yours to help other find you.

Testfacilities.eu is a user-friendly web-based marketplace allowing companies to browse a full directory of international test facilities for the offshore wind industry. In other words we want to make it as easy to find the test facility that you need to test your product, as it is to find an apartment with Airbnb. The key features are:

- Easy access to unique test facilities; e.g. a sound dead wind tunnel with wind speeds above 100 m/s or a climate chamber larger than 7*7*7 meters.
- Easy shortlisting of common test facilities, e.g. vertical pull tests in a given area that can handle objects of 1*2*5 meters, with pull load above 600 ton, who are third party certified.

The aim of the website is to help users shortlist the test facilities that are relevant for the testing you need. For this you can use the filters developed specifically for each category. On each listed test facility their contact details can be found. It will always be necessary to contact the test facility directly, Testfacilities.eu does not contain commercial information and is not involved in any commercial activities.

Research has shown that lack of knowledge and heavy costs are the two main barriers when companies seek to test innovation for offshore wind. Testfacilities.eu will solve two issues: Increase the knowledge of accessible test facilities by making it easily accessible on the website and lowering the costs for both the test owners and users by improving the fit between the users' needs and the given test facility capabilities.

2.1 Inn2POWER

Inn2POWER is a four-year Interreg project of eleven partners from the five leading offshore wind clusters in the North Sea Region – Denmark, United Kindom, Germany, Belgium and the Netherlands.

The aim is to expand the capacity for innovation and to improve access to the offshore wind industry for small and medium enterprises (SMEs) by connecting offshore wind businesses in the North Sea Region.

2.1.1 Objectives

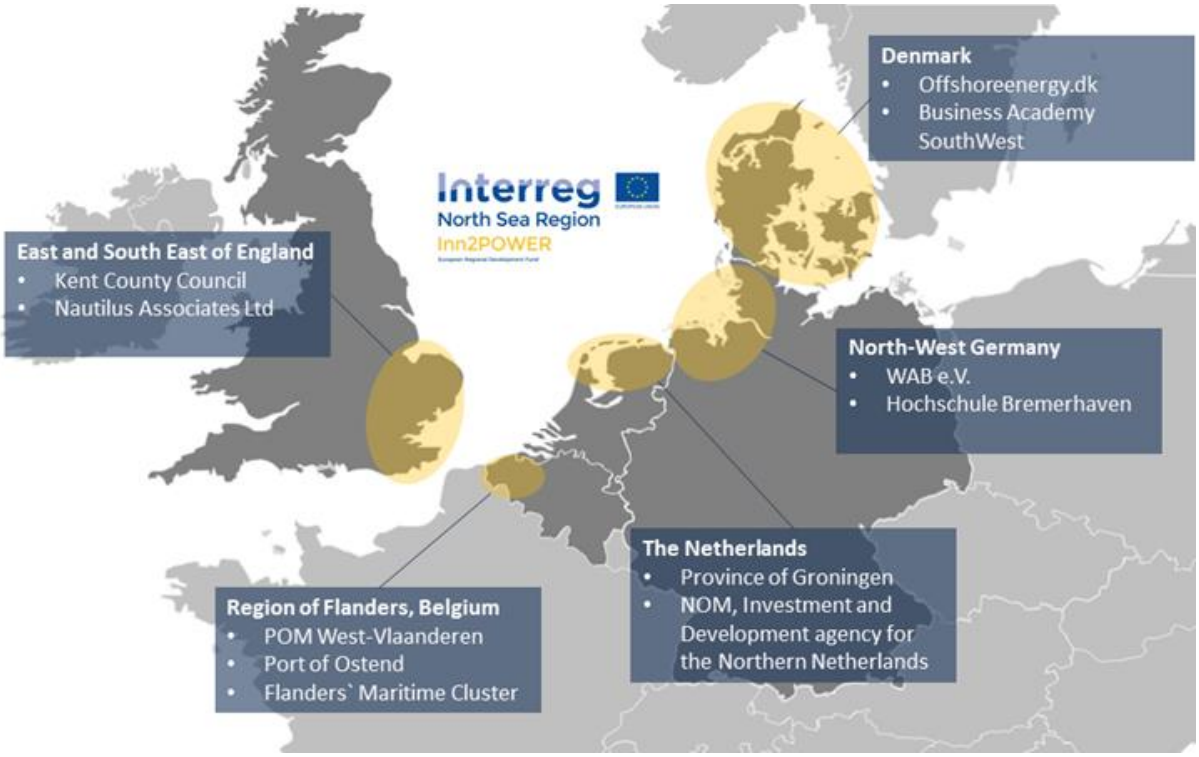
The project has the following objectives:

- Strengthening North Sea Region offshore wind clusters
- Supporting SMEs to collaborate and enter new markets
- Developing innovative concepts for port and harbour logistics
- Facilitating access to test and demonstration facilities
- Improving the skills and availability of personnel

2.1.2 Rationale for Inn2POWER

The offshore wind industry (OWI) is an important driver for economic development in the North Sea Region (NSR) but is challenged by the need for further cost reductions, continuous innovation and improved acceptance of the industry.

In order to secure growth in the OWI around the North Sea Region small and medium sized enterprises (SMEs) need to play a key role in tackling those challenges.



SMEs represent a high percentage of the industry and can be highly innovative, offering unique capabilities based on their specialized skills, drive and flexibility – especially if they work together.

Inn2POWER offers targeted support measures to SMEs and supports collaborations on a regional, sectoral and transnational level. Thus Inn2POWER helps SMEs to overcome possible structural disadvantages and to realize their full innovation potential.

3 The Challenge

The challenge was investigated by first carrying out a number of unstructured informal interviews in each country. The findings from these were then tested in a online questionnaire which was also distributed in each country. Below the findings will be presented with the more detailed examples from the interviews which were confirmed to represent a trend in the questionnaire.

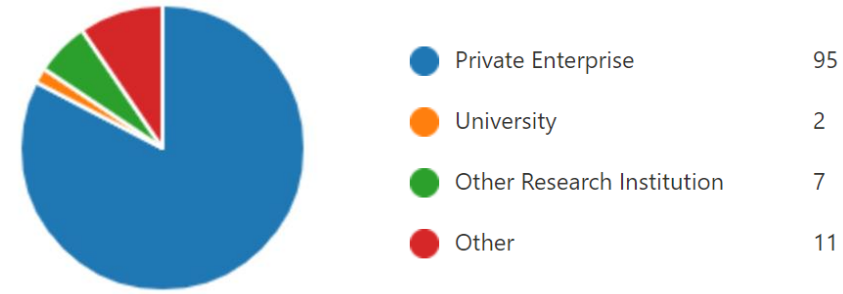
To have some similarity in the questions asked an interview guide was agreed upon, but not followed strictly. It can be seen in appendix 1 Interview Guide. In the design of the questionnaire special attention was on keeping the time to answer the closed questions to three minutes, this was verified through internal and external testing. This was done to increase the number of respondents.

From the interviews and the cluster participants accumulated knowledge it was clear that the two main barriers to increased use of test facilities were costs and knowledge of test facilities.

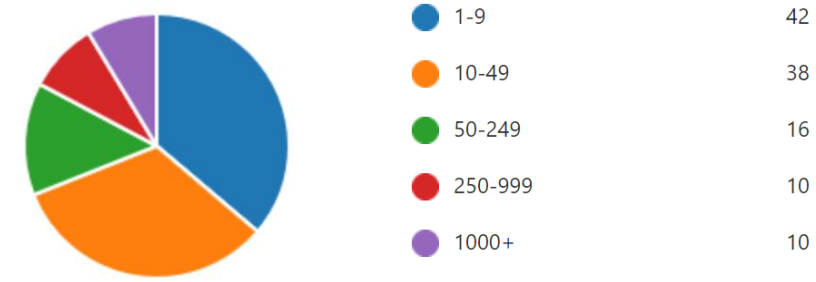
3.1.1 Respondents

The respondents of the questionnaire were primarily SMEs (83%) and primarily private enterprises (also 83%) and as such a good fit to the main targets of the Inn2POWER application. The needs of the large enterprises does not differ significantly from the SME's and a result their answers are included. The total number of respondents are 116.

What type of organisation are you?



Number of employees

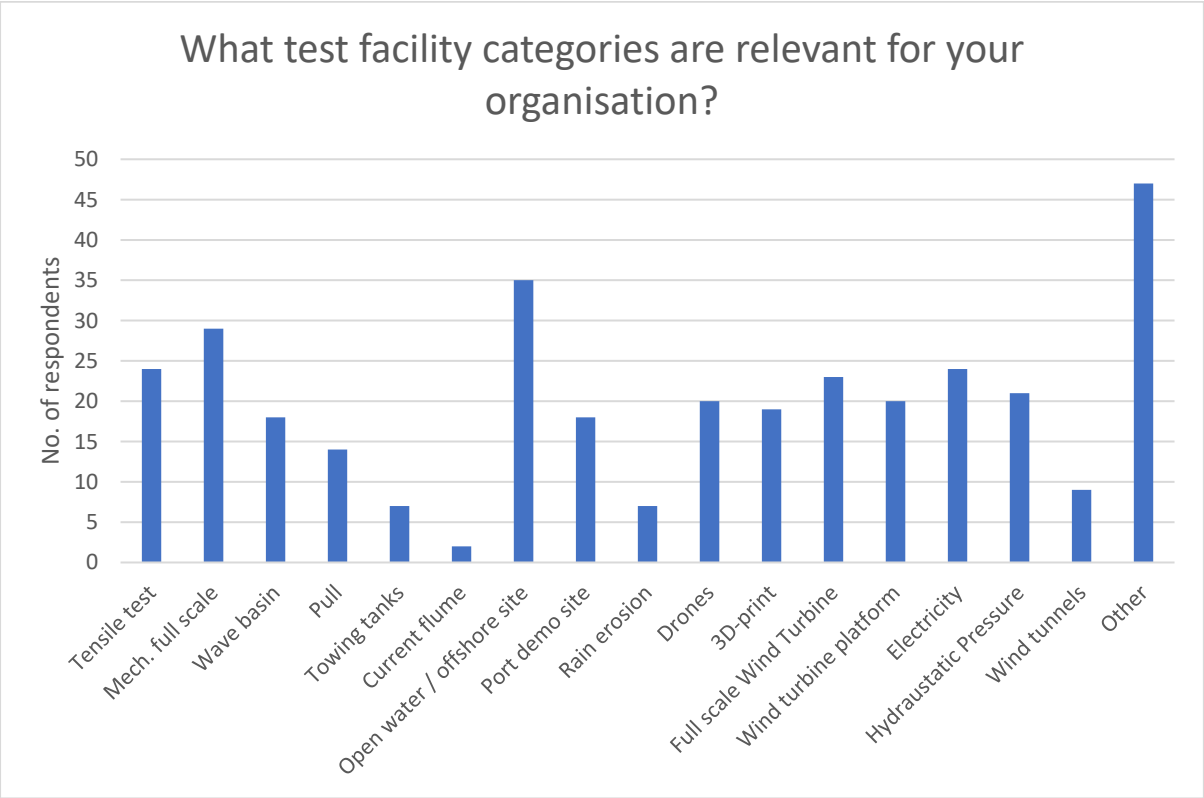


The respondents where from the following countries: Belgium (5), Denmark (95), Germany (1), Norway (1), UK (13). Similar methods were used in distributing the questionnaire in each country, it is unclear why the difference in the number of respondents is so significant, as a result a degree of Danish bias in the answers has to be considered.

3.1.2 Test facility needs

At the time when the test facility website was created no existing categorisations of test facilities had been identified as a result the basic list of test facilities was compiled by asking companies what

types of test facilities they had or needed. The table below shows how many need each type of test facility.

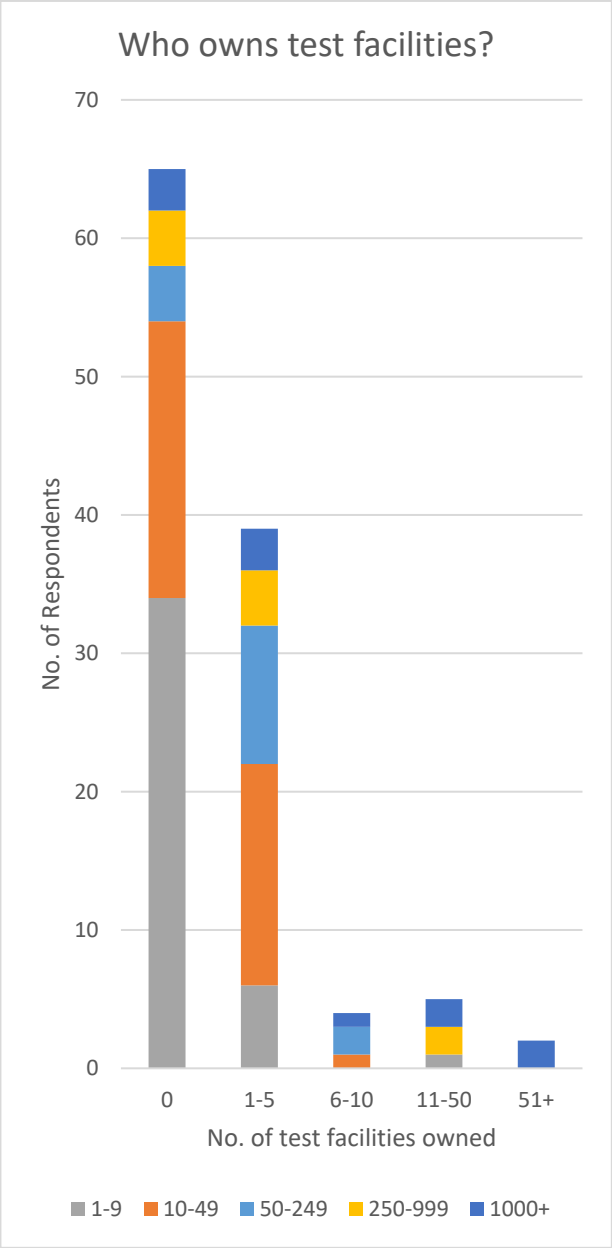


It should be noted that although 47 respondents selected “other”, very few mentioned what other test facilities they needed in the open-ended question for that.

3.1.3 Who owns test facilities?

In general, three types of test facilities exist, these are listed below:

A. **Public test facilities**, typically publicly funded research institutions e.g. universities
B. **Private test facilities**, private company that have providing test facilities as one of their core activities, e.g. not for profit consultant organisations such as FORCE Technology or Fraunhofer or companies with a specialised commercial testing unit such as PolyTech or East Metal.
C. **Private companies owning test facilities** A private company who has test facilities, but letting other use them is not a part of their core activities. E.g. Dynamica Ropes or ???.

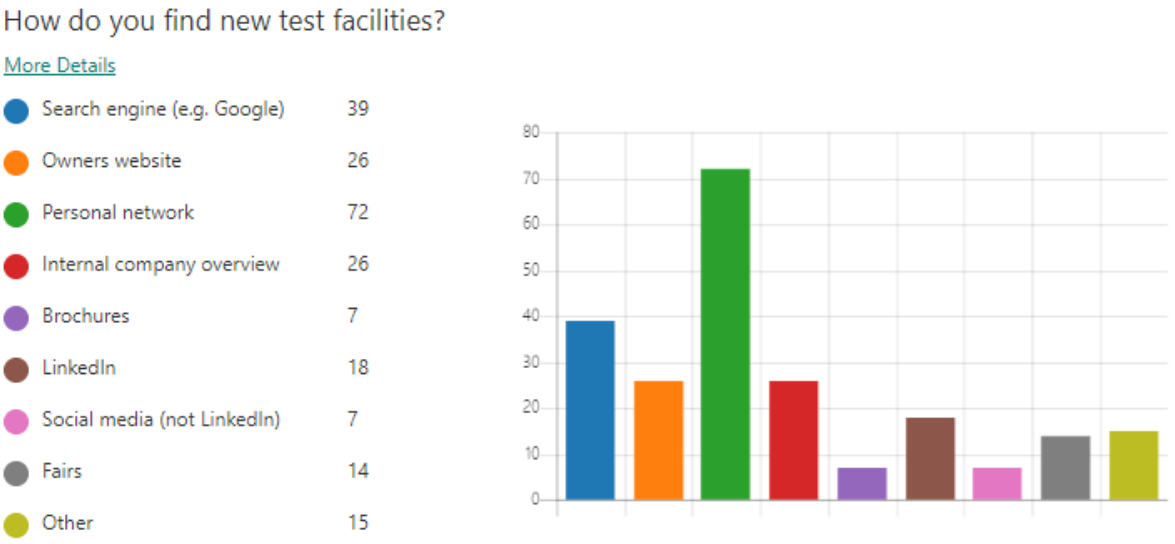


From the interviews it was clear that many private companies that had their own product development activities and/or production also had one or more test facilities. This was verified in the questionnaire where 43% of the respondents had their own test facilities. The table to the right shows the number of test facilities owned on the horizontal axis and the number of respondents on the vertical axis. Then each column has been divided in colours to show how many organisations of each size there is in each category. E.g. the second bar from the left shows how many respondents owns between one and five test facilities. In this bar the grey part indicates how many of those that own 1-5 test facilities are companies with 1-9 employees.

It is clear that the majority of organisations that own test facilities own few (1-5). At the same time they are the hardest to find using the existing mappings in 4 Previous Test Facility Mappings.

3.1.4 How are test-facilities found?

In the interviews it was found that it was hard to get a good overview of test facilities and that users primarily used the ones they knew in beforehand. This is to some degree confirmed in the responses below showing that the most used way to find new test facilities is personal network followed by google searches. The group least likely to use an internal company overview is, not surprisingly the micro companies (1-9 employees) where only 5% uses one.



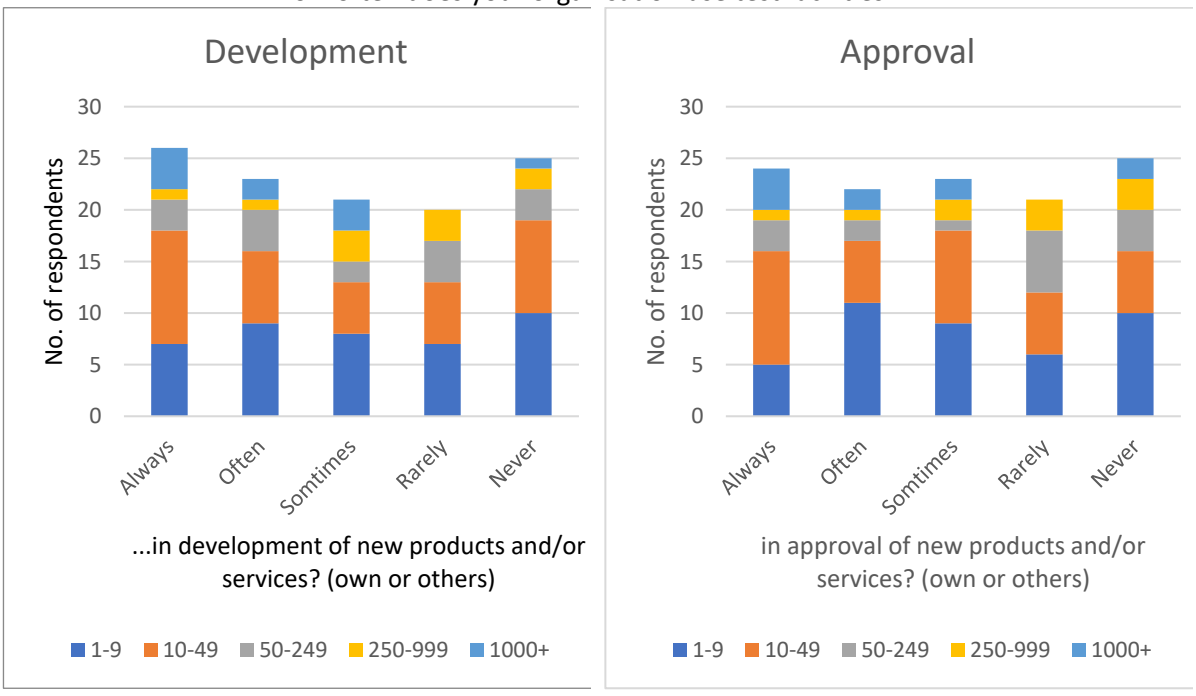
3.1.5 Frequency of use

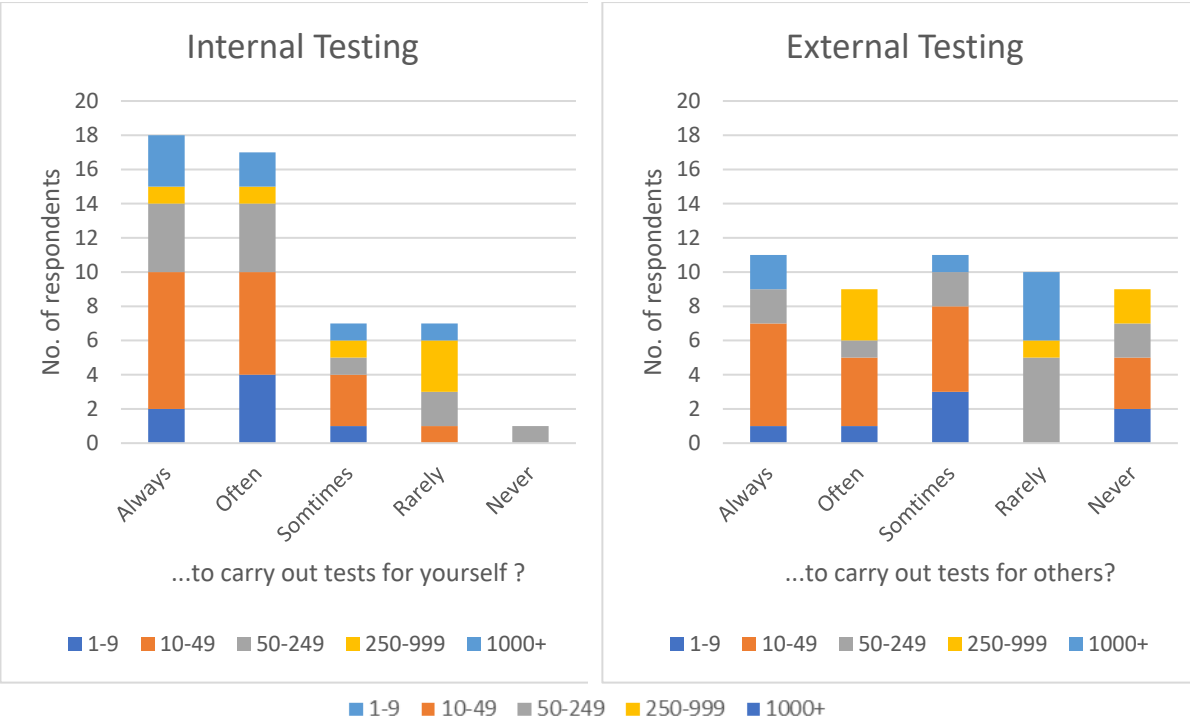
The graphs below summarise the frequency of using test facilities. In the two lower graphs (internal and external testing) the respondents who answered they did not have their own test facilities were filtered out as, if they do not own a test facility, they cannot use it for internal or external testing.

Some respondents only use test facilities for development and some only for approval. Some do not use test facilities currently but indicate by other answers that they would like to.

There is no significant difference in the frequency the various sizes of companies use test facilities in development and approval. Not surprisingly companies that do have test facilities tends to use them for internal testing.

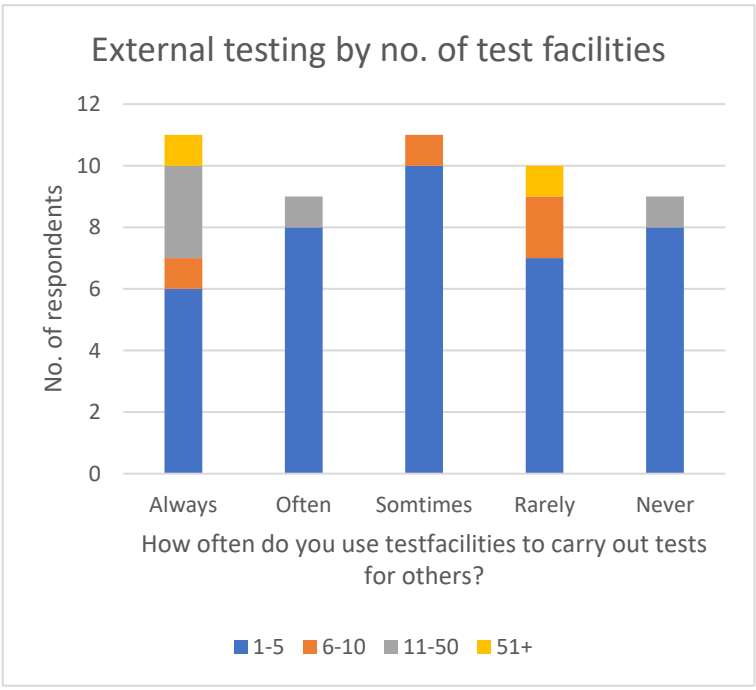
How often does your organisation use test facilities...





Most importantly the finding from the interviews confirmed that while test facility owners frequently use their test facilities to carry out tests for themselves, they far less often use their test facilities to carry out tests for others (seen in the two lower graphs).

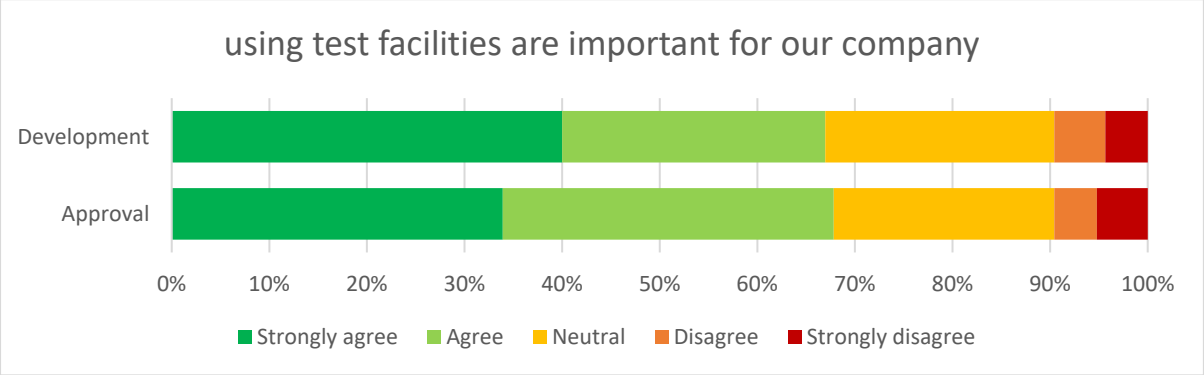
The interviews indicated that the more test facilities and the larger the company, the more frequently they use their test facilities to carry out tests for others. The questionnaire results indicates this is correct, as shown in the two external testing graphs (by company size above and by no. of test facilities to the right). But the number of respondents is to small to be conclusive.



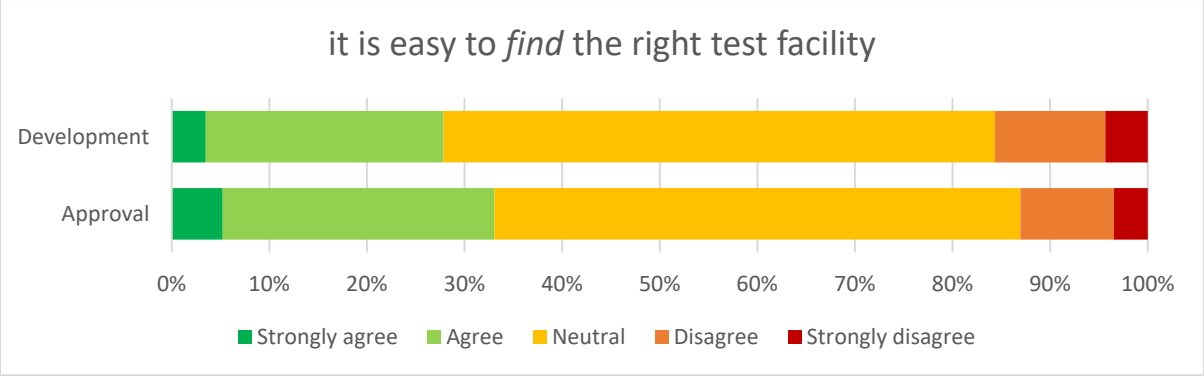
One interview case was a medium sized shipyard who had at one point built a test setup for boat landings because they needed it in a specific project. They then stored the test setup for several years and occasionally others were allowed to use it for various boat landing related testing purposes. But their main business is being a shipyard and eventually the test setup was scrapped. But what possibilities would potential users have had to find the test setup? They had to know someone who knew it was there or do a lucky google search.

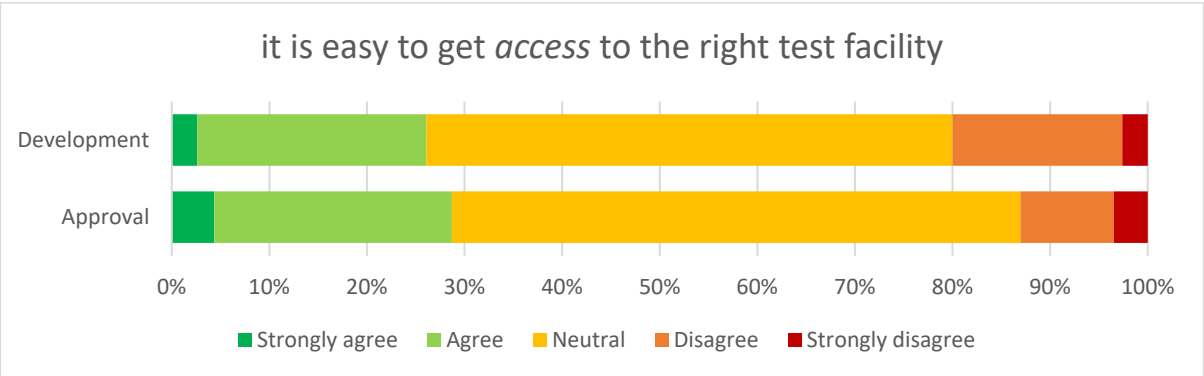
3.1.6 Development and Approval

The interviewees all stated that test facilities are important to them in both development of new products and services and in approval of new products and services. This is confirmed in the questionnaire where more than two thirds strongly agree or agree that using tests facilities are important for their company, this is true for both development and approval.



As respondents can be more likely to agree than disagree the next question was framed so agreeing would refute the hypothesis that companies need help finding test facilities. However more than two thirds of the respondents did not find it easy to find and get access to test facilities. This indicates that there could be a need for making it easier to find and get access to the right test facilities.





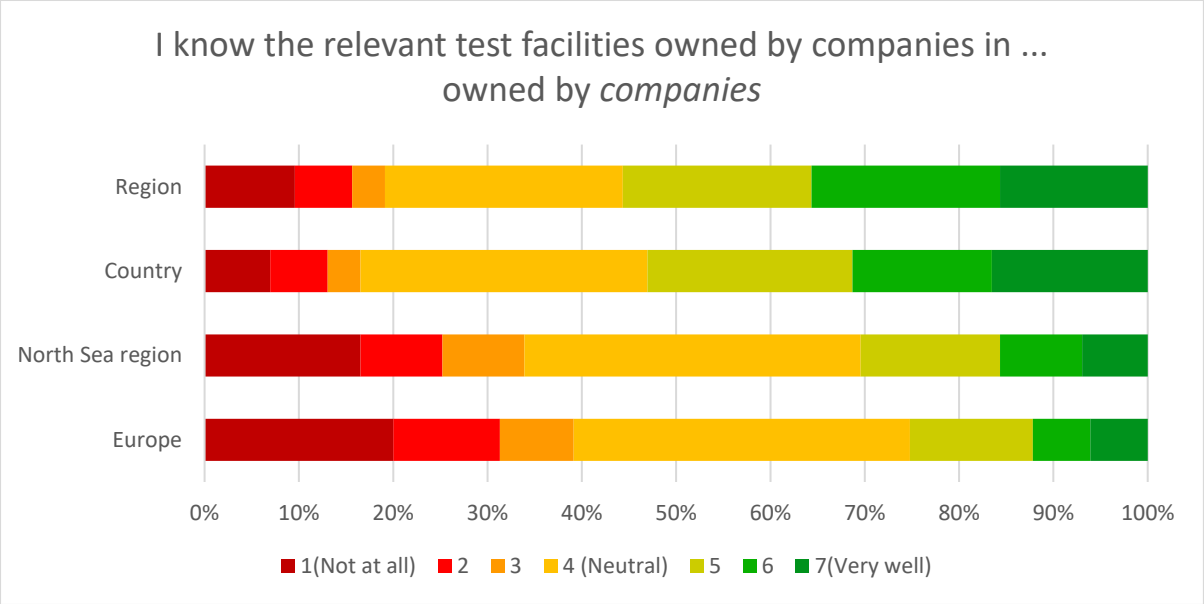
3.1.7 Overview of test facilities

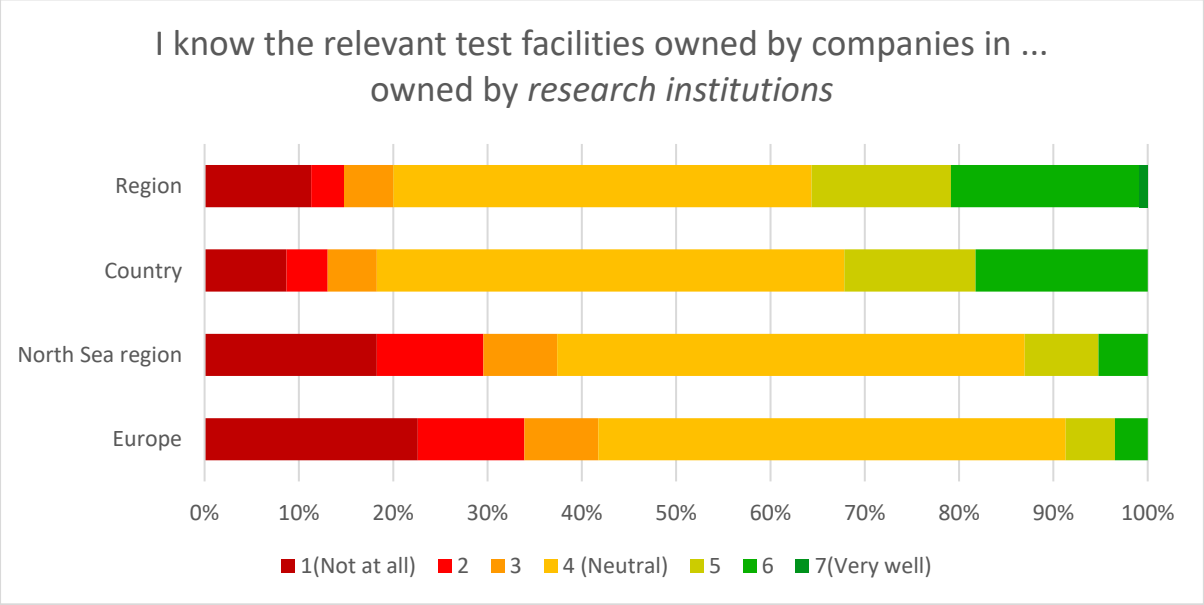
In the interviews the industry knowledge of test facilities was found to be limited. This was especially true when the interviewees where asked if they knew about a large (but not iconic or world class) testing facility relevant to them located in their own country, e.g. East Metals pull test bench in

Denmark which can create a pull of 2250 tons and handle test objects of 30*5,3*13 meters weighting up to 50 tons. World class or iconic test facilities such as the Poul la Cour wind tunnel at DTU in Denmark were usually known to the interviewees if they were relevant.

The respondents were asked to grade their knowledge of test facilities owned by first companies and then research institutions in their region, their country, the North Sea region and finally Europe on a scale of one to seven where 1 was not at all and seven was very well.

One third of the respondents believe they have a good overview of test facilities owned by companies in their own region. For research institutions this is only one fifth and notably almost no respondents asses that they know relevant test facilities owned by research institutions very well.





The respondents in the questionnaire seems to have a significantly better knowledge of test facilities than those in the interviews, although the short questionnaire did not allow for testing the participants knowledge of test facilities. As a result, there could be some bias in the answers where the respondents overestimate their own knowledge.

3.1.8 Conclusion

The six bullets below summarize the challenges identified:

- Almost 80% of test facility owners has only 1-5 test facilities and often promotion is limited.
- Users lacking knowledge of test facilities can lead to scrapping valuable test facilities, i.e., if no-one knows it exists no one will use it.
- Personal network being selected almost twice as many times as the second option for finding test facilities, google searches.
- A significant number of companies use their test facilities for internal testing much more frequently than external testing
- Less than one third of respondents finds it easy to find and access the right test facilities
- Only one third believe they know relevant test facilities in their own country well or very well – and know less of test facilities abroad.
- Almost no respondents know relevant test facilities at research institutions very well.

4 Previous Test Facility Mappings

Before the creation of testfacilities.eu other attempts at creating an overview of test facilities had been done with varying scope and level of detail. These mainly fall in three categories:

A. On the knowledge institution or company's own website e.g. DTU Wind Energy and Dynamica Ropes
B. National collections of test facilities e.g. teknologiskinfrastruktur.dk and renewableenergyfacilities.co.uk
C. Databases specific for a field of research, e.g. Eurocean Infrastructure

In category A a potential user must know a test facility exists or be able to find it through generic search engines (e.g. google). In category B the limit is typically that only one type of owners are involved, usually either research institutions or national technological consulting companies. In category C the limit is that they are targeting research activities.

In the identified mappings the focus has in general been high level, i.e. listing that the university has a number of wind tunnels, but not the specific wind tunnels. This is a challenge I a larger geographical scope as the north sea because the number of test facilities that can be listed in most categories are so high a filtering method is necessary for the user to find the relevant ones.

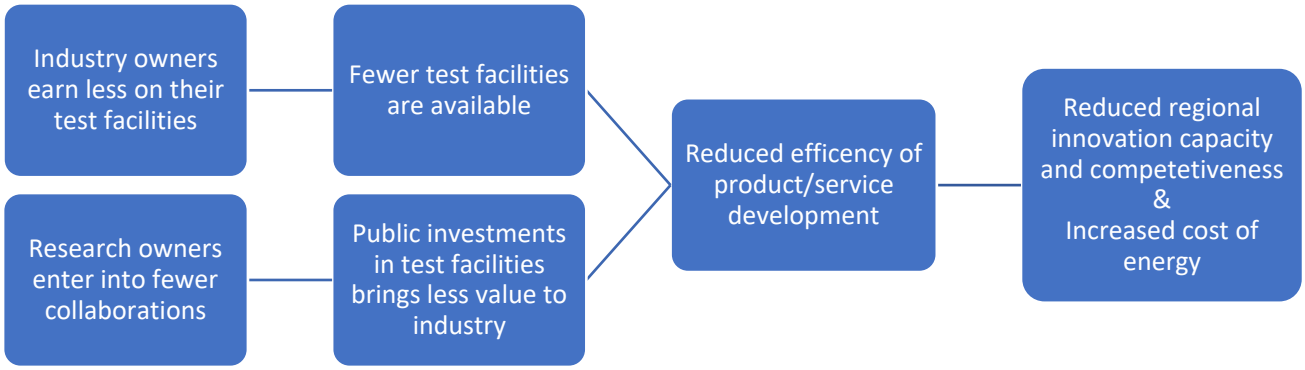
5 Strategy: Inventory development and learnings

This section will describe how to solve the challenge though a co-developed strategy and solution i.e. how testfacilities.eu was developed.

To reiterate, two main challenges are identified above:

- A large number of test facilities has been built, but utilisation is low because owners do not focus on promoting them and potential users cannot find them.
- Even when test facility owners focus on promotion of test facilities, many potential users do not know them.

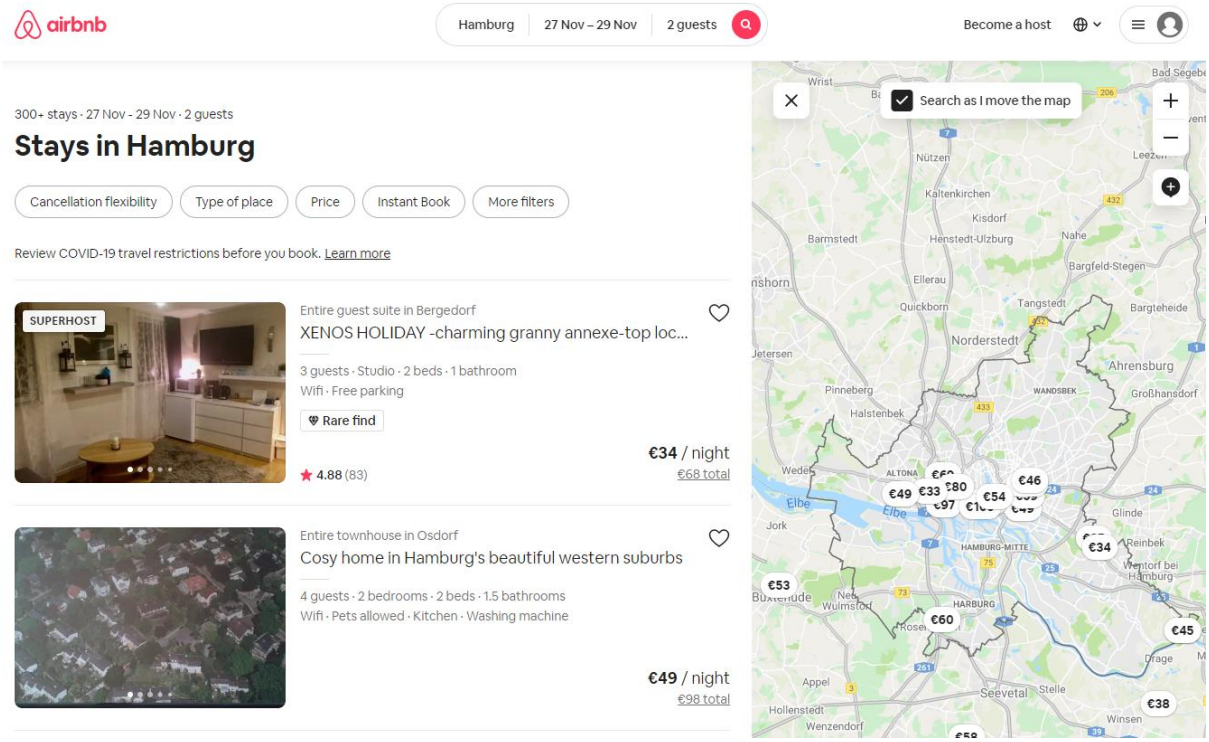
These have the following consequences:



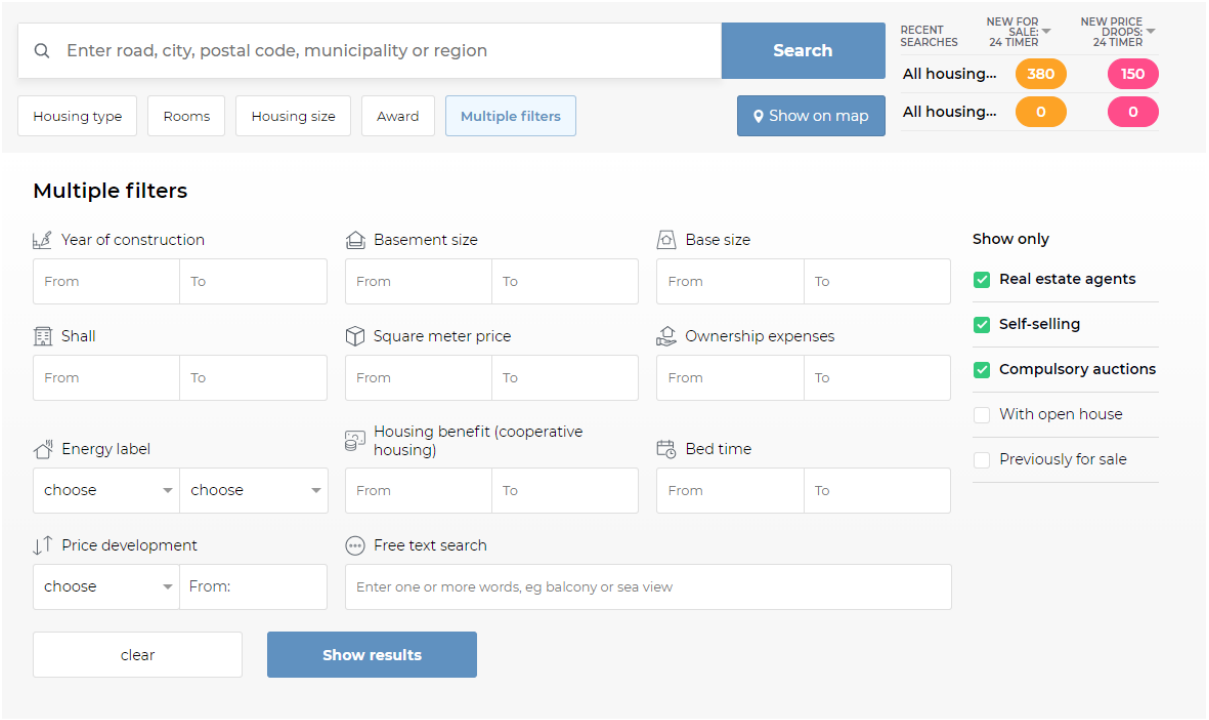
Testfacilities.eu was developed to address these two main challenges.

5.1 Overall design

The first step to identifying a solution was to consider others who had solved a similar challenge in another industry. Two examples were identified one regarding renting rooms/apartments/houses and one in buying the same. In any given area, even if there are no free rooms to be rented in the businesses that focus on short term renting of rooms, a large number of unused rooms exist. Without a common service it would be very hard for users to identify owners with rooms/apartments/houses that lives up to their requirements. With Airbnb users can easily identify those that are available for rent. A search in a large city results in hundreds of potential places, many more than a potential user would invest the time in considering. The solution is relevant filters such as price, pet allowed, wifi, no. of bathrooms, etc. Airbnb earns money by charging a percentage of the rent cost. This works well because users will usually travel to a different destination each time. While the overall setup seems fitting it is unlikely that the commercial model would work with test facilities as the users will often be repeat customers once the test facility is identified and the selection of a test facility is a much more significant and expensive decision.



A second example is websites that gives an overview of houses available for sale. Here the number of listings at a given time is usually less, but since the choice is more important and users can wait for the right listing to appear, more filters are included. An example of such a site and the available filters is shown below. These types of websites are usually either financed by commercials or by being a jointly financed by several real estate agents. Both of these options seems more likely for a test facility website.



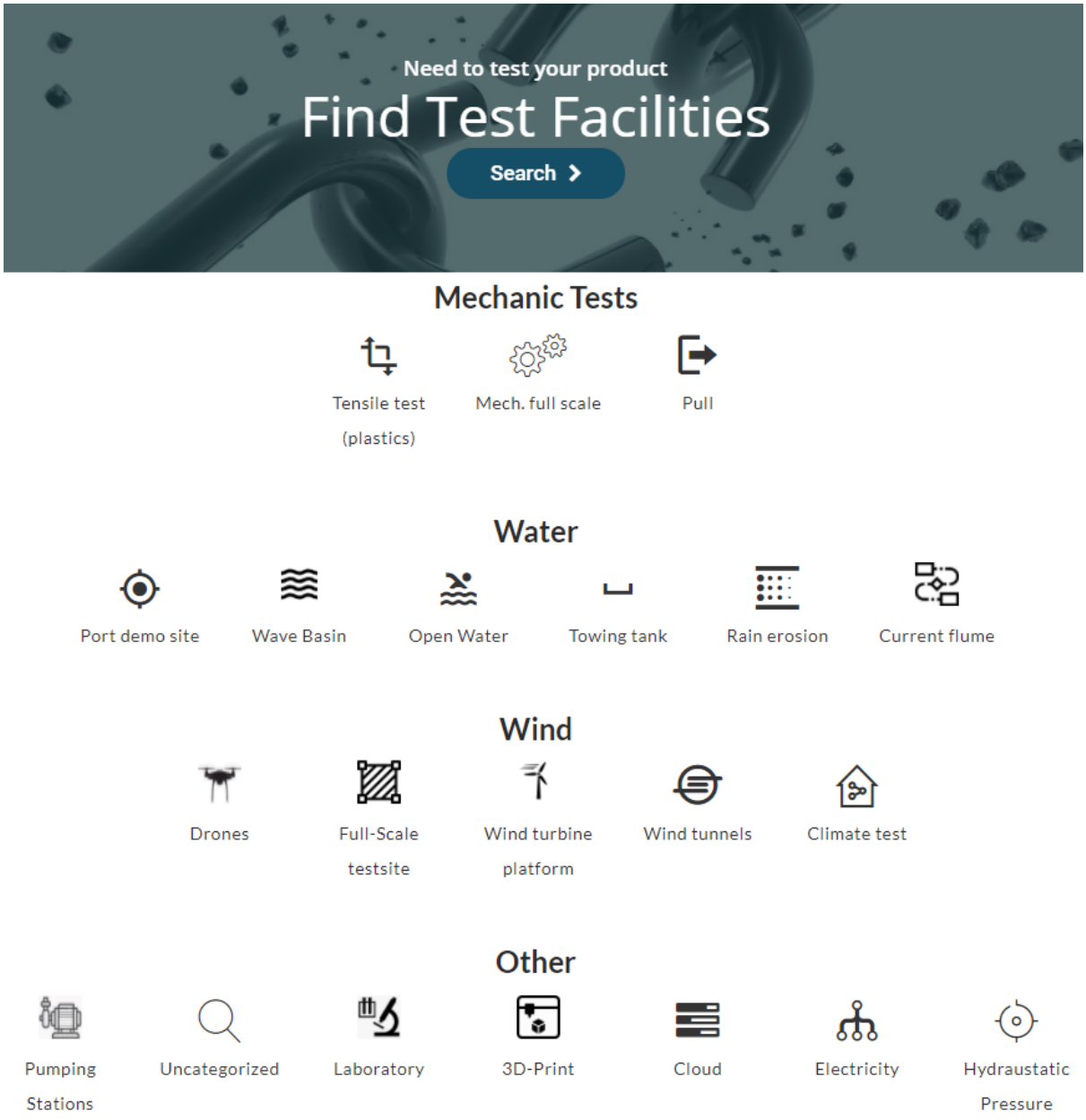
In both cases above the listings on the websites are relatively homogeneous and the filters are sensible for all listings on the website. If this approach was applied to test facilities very few or no

meaningful filters could be implemented, e.g. if it should cover a pull test- and current flume facilities, see example pictures below.

Pull test at Dynamica Ropes

Multifunctional Modular Large Flow Flume at Flanders Hydraulics Research

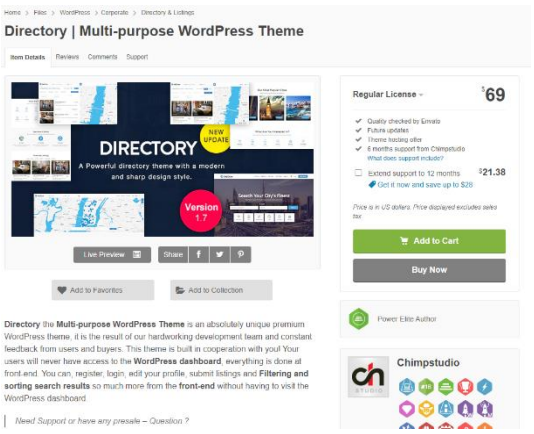
The result was that each time a test facility type was identified where the filters of an existing category did not work, a new category had to be made. An attempt was made at identifying suitable frameworks to build upon. But as a new category could only be made in collaboration with an owner or user of that type of test facility an organic approach was chosen, i.e. when an owner wanted to add a test facility to the website for which there was no category one was made. At the end of the project the result was as shown below:



5.2 Choice of platform

Four main factors influenced the choice of platform

1) It should be able to implement filters similar to the ones described above
2) It was key that the test facility owners could log in and edit their test facilities themselves for the overview to stay updated.
3) It should be very cheap as there was no budget for creating a website (it was the initial aim to only present the test facilities in a report format)



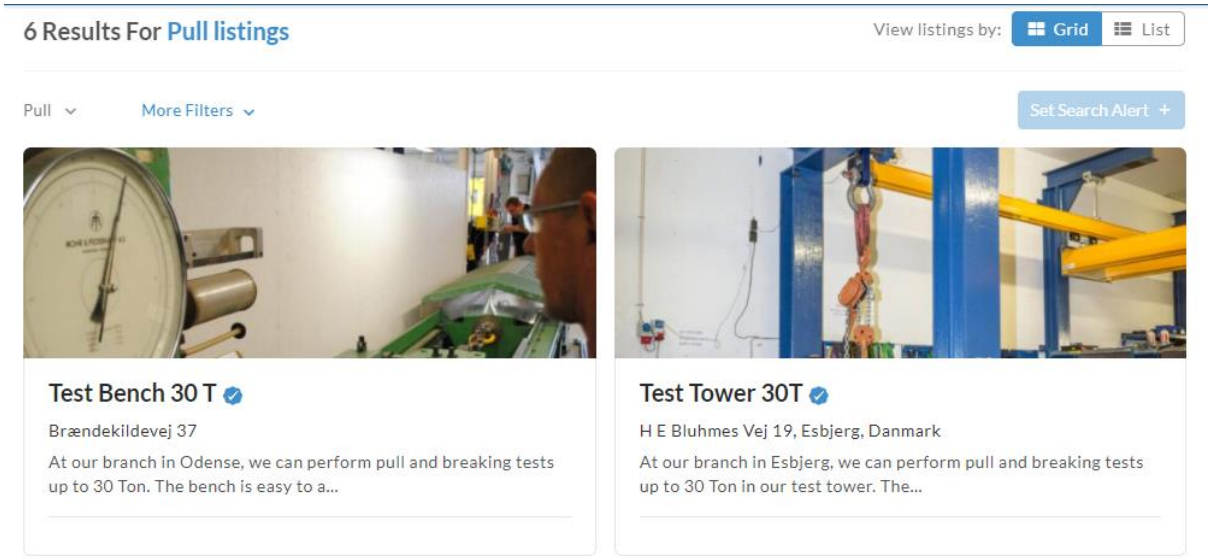
This led to the purchase of a WordPress theme named directory box which could be adapted to show test

facilities. This is a working solution. It does have several limitations and instabilities. When the value hypothesis of an online supermarket for test facilities is proved it should be considered to program a website specifically for the purpose as it would enable several valuable features.

5.3 How to make categories

It was clear from the outset that to make the appropriate filters for a category it was necessary to involve at least one experienced owner or user. Below reasoning behind the filters in the pull test category will be explained.

The overall purpose of all filters is for the user to easily reduce the list of potential test facilities to a number that the user is willing to invest the time in considering. The list and map view of available test facilities is adjusted every time the user adds a filter, this ensures 1) that the user is aware of when filters are applied that removes many test facilities and 2) the user knows when enough filters has been applied that the list of potential test facilities is short enough to go through one by one.



5.3.1 Status

There were two reasons for the status part: 1) Owners of test facilities expressed interest in adding test facilities to the website that where only planned or under construction as lead times can be long. 2) The earlier owners add their test facilities the easier it will be for others to adjust their plans so two test facilities with the same capabilities does not go into operation unintentionally.

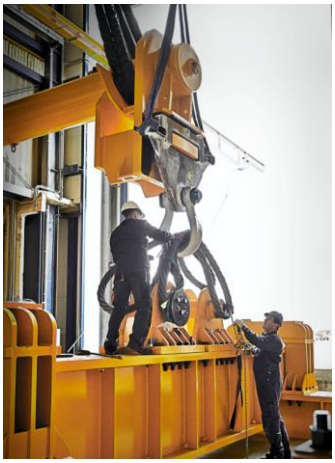
5.3.2 Availability

Industry owned test facilities are always available on commercial terms. But test facilities owned by research institutions may be available only on commercial terms, but some are only available for joint research projects, i.e. the potential user has to enter into a joint research project with the research institution to access it. Finally some test facilities may be available through student projects, which could be especially relevant for early stage development.

5.3.3 Test types

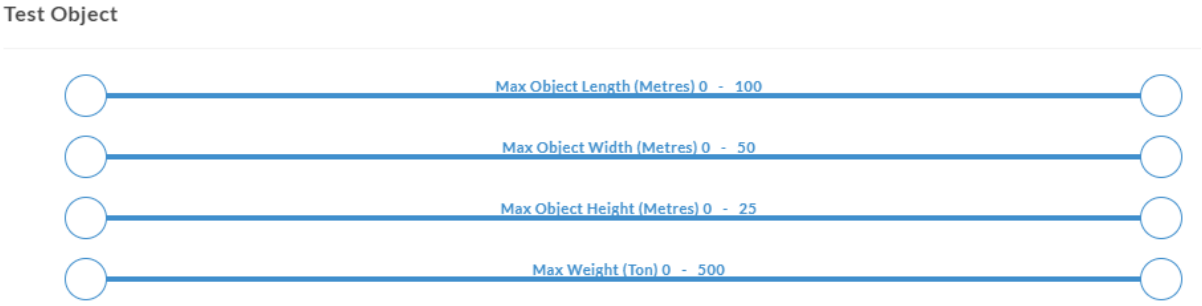
Sometimes a category has a number of subcategories where the same filters are relevant, but a user that needs one type clearly does not need another. E.g. if a horizontal pull test is needed then the vertical ones are irrelevant and should be filtered out.

Horizontal Pull test at Dynamica Ropes



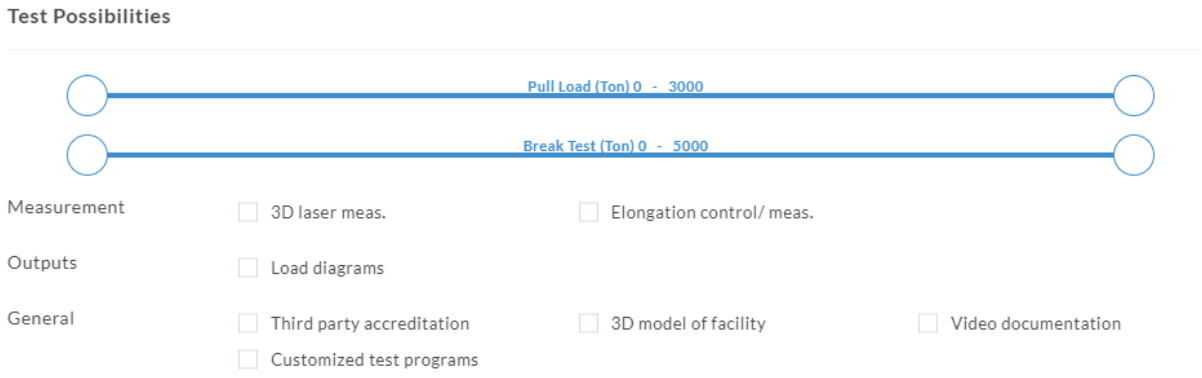
Vertical Pull test at East Metal

5.3.4 Test object size and weight



With the exception of standardised test the size of test object that the test facility can handle will often be important as larger scale demonstrations often requires large test facilities. It is an easy way for a user to know if a test facility is relevant, if the test object is too large or too heavy then other parameters are irrelevant. The sliders can be used to set both an upper and lower limit, the reasoning will be presented in the next section.

5.3.5 Test possibilities



This section, together with test type, is the one which will vary the most between categories. For pull tests it is relevant for the user to know how many ton the test facility can pull and how many ton it can do break tests at. Again it is possible to set both an upper and a lower limit. If a user only

requires a pull of 25 ton, then it is unlikely that the very large pull tests will be relevant due to the higher costs and the user can remove test facilities which can pull more than e.g. 500 ton.

This concludes the overview of how to set up categories.

After creating 20 categories the general learning is that:

- A more detailed filtering makes it easier for the user to reduce the number of potential test facilities and get a quick overview of each test facility.
- A simpler filtering makes reduces the perceived difficulty for test facility owners in adding test facilities to the website.

As a result the detail in filtering will always be a trade-off between the two. The most important factor is how many test facilities there is expected to be in the category, e.g. there is a large number of pull test facilities in each country, but the number of full scale test sites is small.

5.3.6 Addition of New Categories

Throughout the process incremental steps were taken to streamline the development of new categories. Below is the text guidance used at the end of the project on the website for creating a new category:

Website New category text

We are very open to adding new categories if you have a test facility that does not fit within the existing ones. Based on how we have made the existing categories we can only make them in close collaboration with a specialist in that category, this will usually be the owner of a test facility in the category.

You are welcome to use the guide and excelsheet to suggest the category by yourself. You can also email testfacilities@energycluster.dk,then we will contact you and fill out the excel sheet together.

It is helpful to keep in mind that the purpose of having the categories and the filters in them is to make it easy for potential users to filter out test facilities that are not relevant for them. If you know there are hundreds of test facilities in northern Europe in the category you suggest, more filters are needed. If you know there is only three only a few filters are needed.

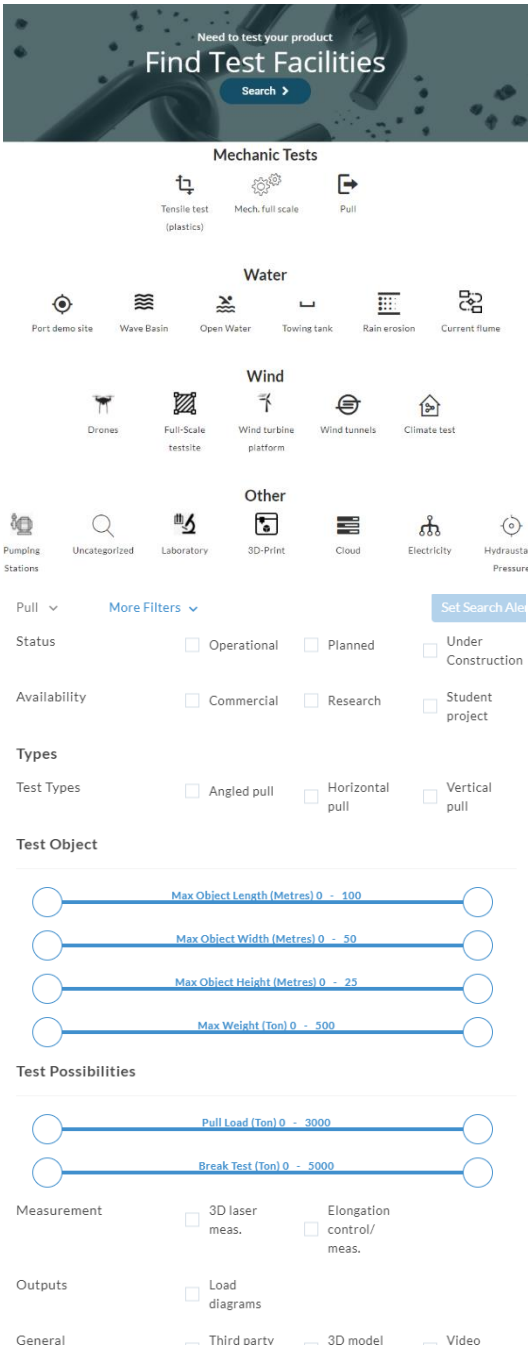
When suggesting a new category, remember that the test possibilities you suggest and the minimum and maximum numbers for them should work for all test facilities in your category. E.g. if you have a climate chamber and the climate test category does not yet exist. Your climate chamber might be able to go to -20 degrees, but if you know some climate chambers can go to -40, then suggest -50 for the category. Or your climate chamber only measures temperature, but you know some others can also measure humidity, then add both to the category.

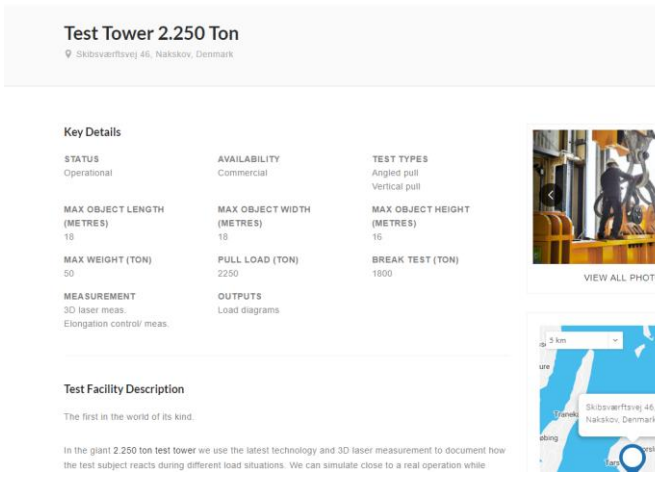
When the excel sheet has been filled out we will add the category to the website and send it to you for verification.

This proved a good starting point for creating new categories.

6 Test facility market place (testfacilities.eu)

The test facility supermarket is online at www.testfacilities.eu. Currently there is 20+ categories and 100+ test facilities. Each category has efficient filters like the pull test example above. In addition to showing the test facilities on a list, they are also shown on a map as some types of test objects may be problematic to move long distances.





Test facility owners can easily add their test facilities to the website and edit them using the same interface. Besides the pre-defined filters owners can add their own free form text and upload pictures, pdf documents etc.

Add New Listing

About Your Listing

Prior to listing your test facility, it is recommended that you spend a few minutes looking at the website to see how the filtering works and how your test facility will appear. You can edit your test facility at any time while you are logged in. For further help please download the user guide at the bottom of the page. If you cannot find your category, you can suggest a new one by following the links at the bottom of the page.

Listing Title *

Listing Title *

Description

Normal -

Listing Description

Category

Pull

Keywords/Tags(maximum)

Enter tags or keywords

Status

- select -

Availability

- select -

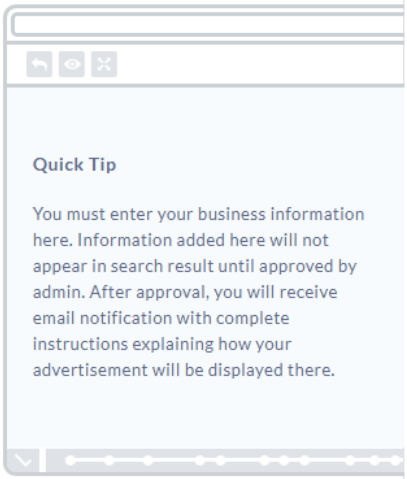
Test Types

- select -

Max Object Length (Metres)

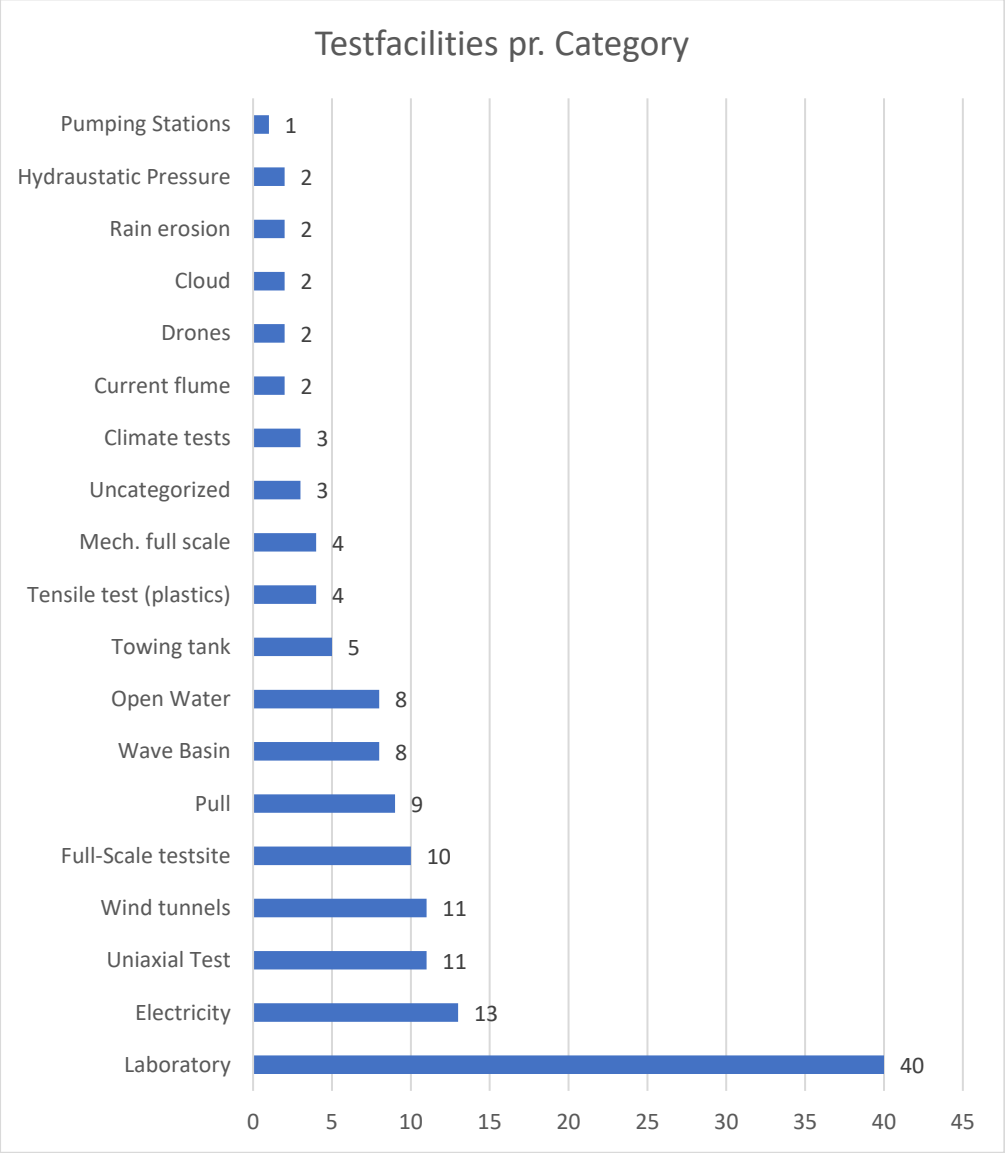
Max Object Width (Metres)

Max Object Height (Metres)

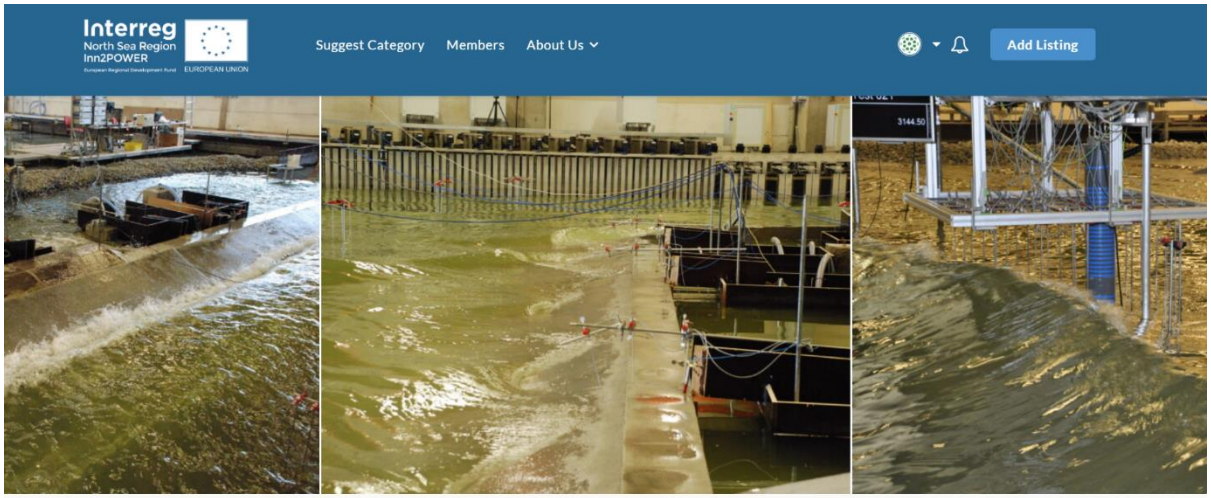


6.1 Statistics with examples

The graph below shows the number of test facilities pr. Category. It should be noted that the total number of test facilities that exist in the north sea region varies significantly between categories. As an example the 8 listed wave basins is expected to represent a fair amount of the total wave basins, where as the pull test facilities represent only a small fraction of the total number of pull test facilities.



Below are three concrete examples of test facilities on the website. Each listing first shows a number of pictures to give an overall impression of the test facility. Then the key details are listed which are the ones used when sorting test facilities. To the right of key details are more pictures and a map showing the location of the test facility. At the bottom is a free text field and an option to contact the owner. Here the test facility owner can also attach files with more detailed information if they so wish.



DHI Shallow Water Basin 1

Agern Alle 5, 2970 Hørsholm, Denmark

Key Details

STATUS
Operational

AVAILABILITY
Commercial
Research
Student project

FACILITY LAYOUT
Rectangular

FACILITY WIDTH (METERS)
35

FACILITY LENGTH (METERS)
25

FACILITY HEIGHT (METERS)
1

MAXIMUM WATER DEPTH (METERS)
0.7

MAXIMUM CURRENT VELOCITY (METERS PER SECOND)
0.5

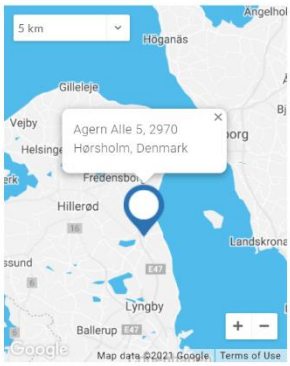
MAXIMUM WAVE HEIGHT (METERS)
0.3

WAVE MAKER
Active Wave absorption
Directional Waves
Short Crested Waves

TYPES
Piston

MEASUREMENTS
Water Surface Elevation Measurement
Current Velocity Measurement
Wind Velocity Measurement
Pressure Measurement
Force Measurement
Overtopping Measurement
Optical Tracking Measurement
Bathymetry Profile Measurement

VIEW ALL PHOTOS (7)



Listing Description

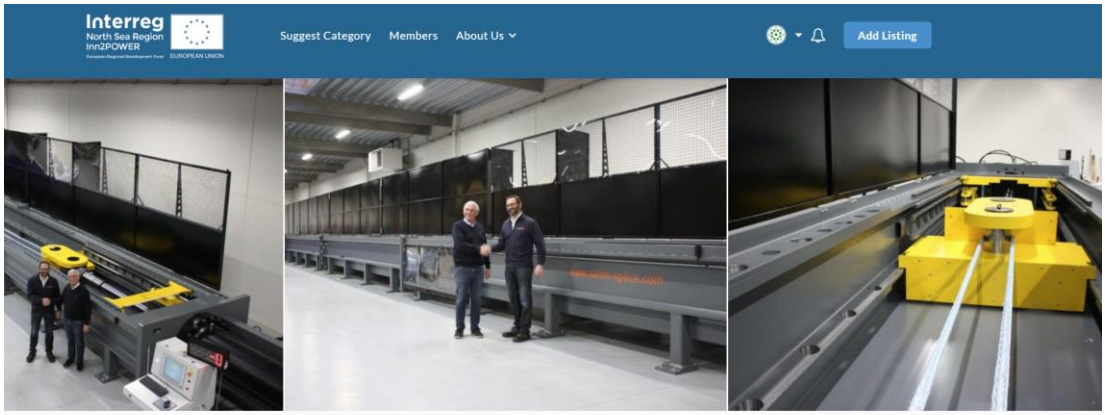
The DHI Hall 1 shallow water basin is capable of producing regular and irregular waves as both long and short crested (3D directional spreading) waves. Focused wave groups can be generated for breaking wave impact testing. The basin is equipped with a current generation system with a maximum flow rate of about 1 m3/s for combined wave-current testing. Wind generators can be mounted in the basin for generating wind forcing on floating bodies.

The facility is used for consultancy and research activities for e.g. offshore wind, load and scour tests, floating wind, ports and harbour tests for breakwater stability, overtopping, wave agitation, ship motions and mooring studies, oil and gas such as FSRU and platform installation tests, and wave energy converters.

DHI A/S

CONTACT AGENT

Below are two screenshots of two additional test facilities, more can be found a www.testfacilities.eu.



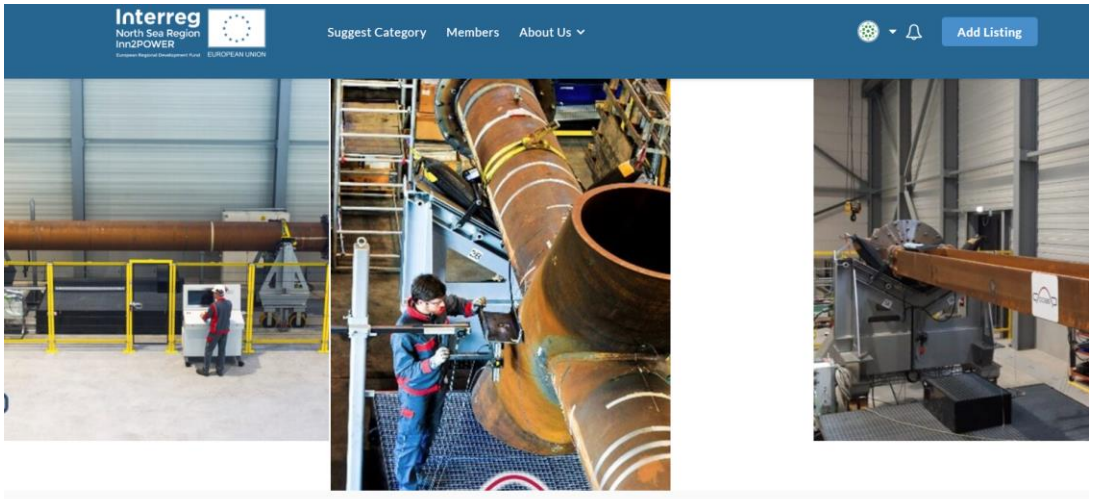
35 M Pull Test

Børupvej 80, 7000 Fredericia, Denmark

Key Details

STATUS	AVAILABILITY	TEST TYPES
Operational	Commercial	Angled pull Horizontal pull Vertical pull
MAX OBJECT LENGTH (METRES)	**MAX OBJECT WIDTH (METRES)**	**MAX OBJECT HEIGHT (METRES)**
35	1	0.5
MAX WEIGHT (TON)	**PULL LOAD (TON)**	**BREAK TEST (TON)**
2.5	500	500

VIEW ALL PHOTOS (4)



Accelerated Large Scale Fatigue Testing (CRONOS)

Technologiepark-Zwijnaarde 48, Gent, België

Key Details

STATUS	AVAILABILITY	MAX OBJECT LENGTH (METRES)
Operational	Commercial	12
MAX OBJECT WIDTH (METRES)	**MAX OBJECT HEIGHT (METRES)**	**MAX WEIGHT (TON)**
4	4	25
TEST POSSIBILITIES CONT.	**MEASUREMENTS**	**GENERAL**
Dynamic test	Displacement meas.	Third party accreditation

VIEW ALL PHOTOS (3)

6.2 Government Support, Legislation & Recommended Test Facilities

In the project it was considered if testfacilities.eu could provide more value to users if additional information related to test facilities were presented on the website.

As one of the barriers mentioned to using test facilities was the cost a brief overview of the public support options for both users and owners of test facilities were made for each country.

An overview of relevant legislation was also initially considered to be of value, but neither interviews nor questionnaire placed any emphasis on this. As a result, some information was gathered on this, but the effort was limited.

Finally, the many dialogues over the projects lifetime included a number of suggestions for new test facilities. As market research on the specific needs for new test facilities would go beyond the scope of this project information gathering on…

This information is presented in the following structure and can be found on a pr. Country basis in appendix three.

a. How does the country support test facilities through legislation?
    i. Government support schemes.
    ii. How was the last 3-5 major test facilities funded in each country? (One thing is what the government support options are, but how is the test facilities funded in practice?)
    iii. Test facility specific legislation if relevant.
b. Suggestions for new test facilities, if any.

7 Promotion

During Inn2POWER project a number of study tours were held in connection to the B2B event with the aim of promoting test facilities and cooperation. Generally, they were well attended and the participants were impressed with the test facilities shown and the trips represented a good opportunity to network.

Despite this the study trips had two main challenges,

a. the participants in the B2B events were rarely the development engineers who were would be relevant for selection of test facilities.
b. Test facilities that are relevant to the same target group are usually located far away from each other, making it hard or impossible to visit two in a day.

As a result it was hard to make an attractive program focusing on study tours of test facilities for the target group of development engineers.

Besides the study tours the website (testfacilities.eu) was promoted through direct contact to test facility owners, presentations at the Inn2POWER B2B events and external events, videos on LinkedIn etc. Regardless it was a challenge for the website to achieve input of new test facility owners and users.

To address these challenges a webinar series was developed.

7.1 Webinars

Within the project, access for SME's to test facilities had to be facilitated by presenting a clear overview of test facilities to potential users. A NSR network had to be created focussing on the delivering of information tailored to SME's and promoting the test facilities.

A dedicated budget - within the budget line 'external expertise' - was foreseen for the organisation of study visits for SME's to visit test facilities. Due to the Covid-19 pandemic, it was not possible any more for SME's to visit test facilities abroad.

Notwithstanding the pandemic, the innovation process within companies goes on and the need to continue testing remains. To reduce costs and stimulate innovation, test infrastructure available for SME's is essential. Also, information on test facilities needed to be spread to the relevant target group.

The purpose of the webinars was threefold: giving a platform to test facilities within the NSR to introduce themselves to a specific audience, giving information to SME's regarding a test facility that suit their needs best and networking among test facilities during the preparations of the webinars and the presentations.

7.1.1 Setting of the webinars

During the WP4 call, several options on categories of test facilities were discussed, also considering the results of the survey on test facilities.

In total, 4 webinars were organised on 4 categories of test facilities:

1. Open water test facilities
2. Wave basins & wave flumes
3. Cabling test facilities
4. Test facilities related to drones in offshore wind

During each webinar, 3 test facilities within the chosen category of test facilities were presented.

In that way, the participants had the opportunity to receive information on several test facilities with specific USP's and by this way, be able to choose the test facility that suit their needs best.

The aim was to reach between 30 and 50 participants per webinar.

7.1.2 Results

7.1.2.1 Webinar on open water test facilities

Participating test facilities and participants in the webinar

1. Blue Accelerator (BE)
2. Fabtest (UK)
3. DanWec (DK)

The first webinar on open water test facilities had the highest participation rate. The target of participants was exceeded by far: 84 participants took part at the first webinar and there were 109 unique viewers. The replay was viewed by 12 registered persons but also 57 times the replay was viewed via LinkedIn. The participants were from 14 countries all over the world (cfr. scheme below).

Outcome

- Future cooperation between DMEC and Blue accelerator
- Interconnection between the three participating test facilities

7.1.2.2 Webinar on wave basins/wave flumes

Participating test facilities and participants in the webinar

1. Coastal & Ocean Wave Basin & multi directional wave basin (Flanders Hydraulic Research, University of Ghent & University of Leuven - BE)
2. Large wave flume (Forschungszentrum Küste - DE)
3. Wave flume (Ocean Grazer & Rijksuniversiteit Groningen- NL)

For the second webinar on wave basins & wave flumes, there were 55 persons registered from 7 countries, especially the Inn2POWER partner countries (cfr. scheme below). There were 46 unique viewers and 11 registered persons viewed the replay (no information available on viewers via social media). We noticed that during this webinar, the participants were mostly related to the participating test facilities.

Outcome

Seen most of the participants were already related to the test facilities, and seen two of three test facilities were already connected, no concrete leads came out of this webinar.

7.1.2.3 Webinar on cabling test facilities

Participating test facilities and participants in the webinar

1. E-lab (Nexans - BE)
2. High Voltage and Materials Laboratories (ORE Catapult - UK)

37 participants registered for the third webinar on cabling test facilities. This webinar had a very specific topic and really attracted a niche audience. The participants came from 8 different

countries, again mostly from the Inn2POWER partner countries (cfr. scheme below). There were 28 unique viewers and 4 registered person watched the replay (no information available on viewers via social media).

Outcome

- Most specific and direct questions during webinar
- Some first connections between several participants and E-lab

7.1.2.4 Webinar on test facilities regarding drones in offshore wind

Participating test facilities and participants in the webinar

1. Climate Chamber (OWI – lab - BE)
2. DroneHub GAE (NL)
3. UAS Denmark Airspace (DK)

The last webinar on test facilities regarding drones in offshore wind attracted also a lot of participants: 76 persons from 8 countries registered for this webinar. There were 28 unique viewers and 4 registered persons viewed the replay (no information available on viewers via social media).

Outcome

- Connections between several participants and OWI-lab via mailing

7.1.2.5 General overview of participating countries during the 4 webinars

During the 4 webinar, 252 participants from 24 different countries were reached.

Country	Webinar 1	Webinar 2	Webinar 3	Webinar 4	TOTAL
Belgium	25	37	18	60	**140**
The Netherlands	5	1 2	3	6	**26**
The United Kingdom	10	2	5	3	**20**
Denmark	7	0	0	1	**8**
Germany	0	1	1	2	**4**
Other	37	3	10	4	**54**
TOTAL	**84**	**55**	**37**	**76**	**252**

7.1.3 Learnings

Notwithstanding the Covid19 pandemic and the specific target group of the webinars, we succeeded in reaching a lot of participants – 252 - for this four-part webinar series. We managed to integrate each time three test facilities from several North Sea Region countries, in total 11 test facilities promoted themselves to a broad audience. We offered them the possibility to network with other test facilities.

Regarding the SME's, they had the opportunity to listen to several experts from the participating test facilities and were able to have more information on the test facility that suit their needs best. During the webinars, the web platform testfacilities.eu was promoted as well.

So, the several targets and indicators related to WP4 – creating a network between test facilities, informing SME's on test facilities, development and promotion of testfacilities.eu, were certainly reached.

8 Future steps

Two clear possibilities for improving access to test facilities were identified, but not achieved in the project; full buy-in from large research institutions to develop the marketplace further and a closer collaboration between industry owned test facilities and research owned test facilities. These will be described below.

8.1 Market place

One of the limiting factors for testfacilities.eu was that developing new categories requires an expert in that category to participate in the process, preferably two. When a category has been developed leading test facilities within the category has to be present for other test facilities within the category to perceive the website as a place they need to be present. This is again required for the website to achieve the required volume, which is required for the website to give users the overview they need for the website to be fully valuable.

If more funding is allocated to development of an online marketplace for test facilities in the future it is the suggestion that it should only happen if a number of large research institutions are a part of the application to ensure buy-in. Similarly it is the recommendation that the initial geographical area should be limited to reduce the buy-in required to achieve a large percentage of the relevant test facilities being present on the platform. I.e. it is easier to convince 80% of the test facilities in one country to join the online marketplace than 80% of the test facilities in the NSR. Similarly the categories should be chosen that have approximately 8-20 test facilities in the country, this is enough that it is likely that one potential user does not know them all, but few enough that one person taking charge on all of them being entered into the system is reasonable. As a result e.g. wave basins would be a good candidate for the early test facility categories to focus on whereas pull test facilities would not.

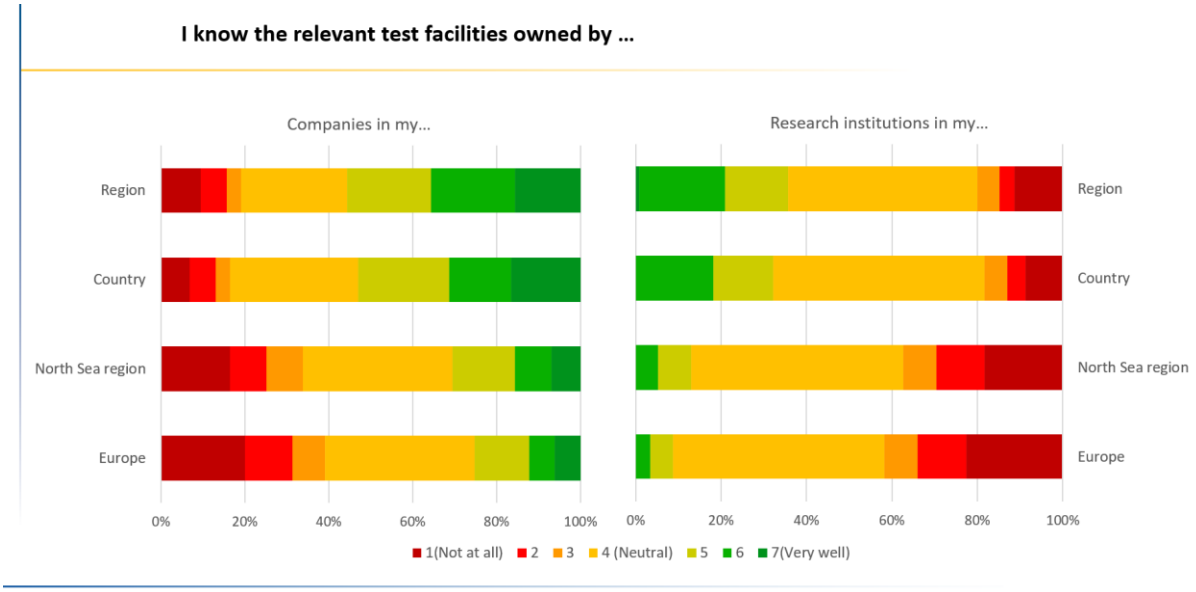
8.2 Collaboration possibilities

As part of the many interviews and dialogues with test facility owners and users from both research institutions and industry a promising possibility was identified. Test facilities owned by industry often has less sophisticated additional capabilities (sensors etc.) than research institutions. But while the test facility itself is often stationary, sensors (e.g. strain gauges) are easy to move to another test setup. As a result the investments in test infrastructure done by industry could be leveraged if test services could be carried out in collaboration with a research institution. A hypothetical example is that a company needs a large component tested in a pull test facility, but the research institution they ask to carry out the testing either does not own a pull test facility of the required size or it is already booked. In such a case the research institution could carry out the test at an industry owned test facility, but using their own measurement setup.

This closer collaboration between a research institution and an industry partner was investigated in the project but was ultimately not successful. The concept seems to have potential and it would be worthwhile to investigate it further.

9 Conclusion

In the Inn2POWER project the barriers to use of test facilities and in extension thereof innovative capacity in the north sea region were investigated through interviews and a questionnaire. The key findings were that test facilities are important for more than two thirds of the respondents, but as the graph below shows knowledge of relevant test facilities is limited, especially for test facilities owned by research institutions.



To address this an online marketplace for test facilities were developed: testfacilities.eu. The website is available online any owner of test facilities can add their test facility to the marketplace to increase its visibility.

At the end of the project the website had 22 categories with detailed search parameters. This enables the user to filter the test facilities in a category so the website only shows the ones that are relevant, e.g., only wind tunnels which do boundary layer simulation and can produce wind speeds above a given meter pr. Second. In total 142 test facilities were available on the website at the end of the project. The total number of test facilities in the north sea region is unknown, but it is the assessment that the websites coverage differs widely between categories. I.e. a similar number of wave tanks and pull test facilities has been added to the website, but for the wave tanks the majority of the important test facilities has been added, this is not the case for pull test facilities.

To promote testfacilities.eu various initiatives were taken, the most successful of these were a webinar series which had 252 participants in total and drove an increase in both the number of test facilities and visitors on testfacilities.eu.

As it is the website is a good option for increasing the visibility of a test facility and, at least for some categories, give an overview of the relevant test facilities in the North Sea Region. The website can be used as-is and there is potential to develop it further if there is interest.

Appendix

1 Interview Guide

Headline	Questions	Why this questions?
Classifications	What is the firm's name?	So we can link them to the company search engine
	What is the respondent's name?	
	What is the person's position and experience?	Get to know the person a bit and build rapport
Current use (5 years)	What test facility have you used in the last five years?	Mapping, then we know the background they have for answering the other questions. Based on one test facility or many?
	Why did you choose to use that/those test facilities? How did you chose?	THen we know how thoroughly they consider the choice. Personal relations? Reputation? Previous experience? Only one I knew? Technical capabilities? etc. etc.
	How many times has your company used a test facility in the last five years?	It matters a lot what their experience is, to know what their assessment of the barriers and needs are based on.
	What have your company used the test facilities for?	We need to know this to understand the context they are using the test facility in (type of innovation etc.)
Barriers	Have there been any complications, limitations or barriers when you used the test facilities? • If yes which? • If no - did everything just go smooth?	This one of the key questions in the project.
	How many times in the last 5 years could your company have like to use a test facility but didn't? If yes: Why didn't you use a test facility? (barriers for not) Possible follow up: what could be done to remove those barriers?	Again, this is also to identify the barriers. These are exactly the ones we hope to identify and remove.
Needs	What does your company need from test facilities? (now and in the future)	Specific technical needs, process needs, support capabilities etc.
	What benefits does your company get from using test facilities?	Technical? Marketing? Development? Approval? (especially whether they use the test facility for development, or approval is important because of the large difference in between the two)
	How was the testing financed?	

2 Questionnaire form

Test facility Questionnaire (3 minutes)

In the Inn2POWER project we are trying to make it easier for organisations in the north sea region to develop and get approval for new products and services by using test facilities.

Please fill out this questionnaire to help us help you, it should take less than three minutes to fill out the required part.

The Partners are: Business Academy Southwest (DK), Blue Cluster (BE), Hochschule Bremerhaven (DE),
Kent County Council (UK), Opergy Ltd., (UK), NOM (NL), Energy Cluster Denmark (DK), POM – West-Vlaanderen (BE), Port of Oostende (BE), Provincie Groningen (NL) and WAB (DE). The project is funded by: Interreg North Sea Region and co-funded by: West-Vlaanderen, Region of Southern Denmark and NNOW.

* Required

1. Name *

2. Email address

3. Organisation name *

4. What type of organisation are you? *

- ◯ Private Enterprise
- ◯ University
- ◯ Other Research Institution
- ◯ Other

5. What country are you from? *

- ◯ Belgium
- ◯ Denmark
- ◯ Germany
- ◯ Netherlands
- ◯ UK
- ◯ [ ] Other

6. Number of employees *

- ◯ 1-9
- ◯ 10-49
- ◯ 50-249
- ◯ 250-999
- ◯ 1000+

7. What test facility categories are relevant for your organisation?

- [ ] Tensile test
- [ ] Mech. full scale
- [ ] Wave basin
- [ ] Pull
- [ ] Towing tanks
- [ ] Current flume
- [ ] Open water / offshore site
- [ ] Port demo site
- [ ] Rain erosion
- [ ] Drones
- [ ] 3D-print
- [ ] Full scale Wind Turbine
- [ ] Wind turbine platform
- [ ] Electricity
- [ ] Hydraustatic Pressure
- [ ] Wind tunnels
- [ ]

Other

8. How many test facilities (pull test bench, wave tank, climate chamber, etc.) does your organisation have? *

- ○ 0
- ○ 1-5
- ○ 6-10
- ○ 11-50
- ○ 51+

9. How do you find new test facilities? *

- ☐ Search engine (e.g. Google)
- ☐ Owners website
- ☐ Internal company overview
- ☐ Brochures
- ☐ Fairs
- ☐ Personal network
- ☐ Social media (not LinkedIn)
- ☐ LinkedIn
- ☐ Other

10. How often does your organisation use test facilities... *

	Never	Rarely	Somtimes	Often	Always
in development of new products and/or services? (own or others)	◯	◯	◯	◯	◯
in approval of new products and/or services? (own or others)	◯	◯	◯	◯	◯
to carry out tests for yourself ?	◯	◯	◯	◯	◯
to carry out tests for others?	◯	◯	◯	◯	◯

11. New product/service development *

Please select the option that best describes how you feel about each statement:

In new product/service development...

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
using test facilities are important for our company.	◯	◯	◯	◯	◯
it is easy to find the right test facility	◯	◯	◯	◯	◯
it is easy to get access to the right test facility	◯	◯	◯	◯	◯

12. New product/service approval *

Please select the option that best describes how you feel about each statement:

In new product/service approval...

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
using test facilities are important for our company	○	○	○	○	○
it is easy to find the right test facility	○	○	○	○	○
it is easy to get access to the right test facility	○	○	○	○	○

13. Owned by companies *

I know the relevant test facilities owned by companies in...

	1(Not at all)	2	3	4 (Neutral)	5	6	7(Very well)
my region	○	○	○	○	○	○	○
my country	○	○	○	○	○	○	○
the North Sea Region	○	○	○	○	○	○	○
Europe	○	○	○	○	○	○	○

3 Government Support and Legislation

3.1 Belgium

3.1.1 Government support schemes

3.1.1.1 Aimed at test facility owners

In Belgium, at federal level, there is no specific government structural support foreseen for the test facility owners given our state structure and competence division.

At the regional level, VLAIO (Flanders innovation & entrepeneurship) does foresee the distribution of European budget via several projects (EFRO, Horizon2020, Horizon Europe, Interreg…) and (partial) co-funding. For example: via the EFRO project "Blue accelerator", the test facility Blue accelerator receives budget via VLAIO.

3.1.1.2 Aimed at test facility users

At federal level, there is no specific government support for SME's to test their product in test facilities. given our state structure and competence division. Within Belgium, like in other EU countries, in general the percentage of support regarding SME's is higher than regarding non SME's.

At the regional level, VLAIO foresees financial support for SME's to be able to grow via the "SME e-wallet". But this support does not include budget for testing. Besides this SME e-wallet type of subsidy, the Flemish regional government also foresees project subsidies for research- and development projects of enterprises. Via calls managed by the cluster organization Blue Cluster, test facility users might receive budget related to blue economy as part of an innovation project.

At local level, there are some initiatives taken, such as the Quick-wins blue energy by which a company can receive budget for testing a prototype (POM West-Flanders).

At European level, among others MARINET2 provides access for companies to shared relevant Research Infrastructures related to ORE (offshore renewable energy). This project has received funding from the Horizon 2020 research and innovation programme. MARINET2 foresees several calls for companies to test their product in test facilities that are part within the MARINET2 network/programme.

3.1.2 Funding 3-5 major test facilities in BE

All test facilities related to blue economy in Belgium are funded by **public funding**. There are no commercial laboratories related to that topic in Belgium.

Regarding the 3-5 major test facilities:

- **Blue Accelerator**
  Blue accelerator is funded by public funds, there is no private financing.
  Blue accelerator has co financing of the ERDF project 'Blue Accelerator' (European Regional Development Fund - 3.7 Mio €)

- 40% financing via EFRO
- 20% financing via Hermes Fund (VLAIO)
- 21% financing via Province of West-Flanders
- 19% financing via POM West-Flanders

- **Coastal & Ocean Basin (COB)**
  The coastal & ocean basin is funded by the Flemish government and academic institutions (University of Ghent and KULeuven). The COB is part of the Gen4WAVE project (total budget of the project: 5 Mio €) and also received budget from the Hercules programme (2.3 Mio €).

- **Climate chamber**
  SIRRIS, the test facility owner, is a non-profit organization. Sirris was founded by Agoria, the Federation of the technological industry. Also for the climate chamber, there is public funding. Private funding takes place via consortia or cluster organizations.

- **Port of Ostend as test location/demo site**
  The Port of Ostend is a limited company under public law.
  The port doesn't receive public finances for their operations, but the port participates in EU projects. The port facilitates testing in the port (wave energy,..) but there is for example no laboratory in the port.

3.1.3 Legislation

See table below

	Construction platform	Coating, corrosion	Wave energy	Aquaculture	Coastal defence	Cabling	Boatlanding	drones	ROV	
Port of Ostend		**R**:- Decree concerning budget - DFG[1] on granting authorisation, retributions for private use of public domain of a.o. waterways,.. - Flemish code spatial planning - Decree on environmental permit and regulation on substantial environmental provisions - RD[2] police- and shipping regulation for BE territorial sea, ports and beaches of BE coast **L:** police regulation Port of Ostend	**R**:- Decree concerning budget - DFG on granting authorisation, retributions for private use of public domain of a.o. waterways,.. - Flemish code spatial planning - Decree on environmental license and regulation on substantial environmental provisions - RD police- and shipping regulation for BE territorial sea, ports and beaches of BE coast **L:** police regulation Port of Ostend	**R**: - Flemish code spatial planning - Decree on environmental license and regulation on substantial environmental provisions - RD police- and shipping regulation for BE territorial sea, ports and beaches of BE coast **L:** police regulation Port of Ostend			**N:** General regulation of shipping lanes of the Kingdom (probably not relevant in practice)	**E: -**implementing regulation of EC on establishment of common aviation regulation and operational provisions on aviation navigation services and -procedures **R**: - RD concerning regulation of aviation – RD concerning aviation regulation and operational provisions on aviation nagivation services and-procedures - draft RD on the use of remotely operated aircrafts in the BE airspace	**Operational use of a ROV: has to respect a.o.:** **N:** -law on the prevention of pollution by vessels - Law on the safety of vessels - General regulation on shipping lanes of the Kingdom **R**: RD on nautical inspection regulation	
1km outside Port of Ostend	**N**: - Law on protection marine environment **R**: - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE	**N:** Law concerning protection of marine environment **R**: - RD on the establishment of Marine spatial plan - RD on procedure for	**<u>Installation for the production of electricity from water, current or wind</u>** **N:** - law on the organization of the electriticy market - law concerning the protection of marine environment			**<u>Trenching</u>** **N**: law on the protection of marine environment **R**: - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE		**E: -**implementing regulation of EC on establishment of common aviation regulation and operational provisions on aviation navigation services and -procedures	**N**: - law concerning the protection of marine environment **Operational use of a ROV: has to respect a.o.:**	

[1] DFG = Decision Flemish Government

[2] RD = Royal Decree

	- RD on establishment of the Marine spatial plan - RD on creation of special protected zones and special zones for the conservation of nature in sea area under jurisdiction of BE - RD on environmental impact assessment - RD police- and shipping regulation for BE territorial sea, ports and shore of BE coast	licenses and authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment	**R**: RD on the conditions and procedure for the awarding of domain concessions for the construction and exploitation of installations for the production of electricity of water, current and wind, in sea aereas where BE has legal power - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment - RD on establishment of a marine spatial plan - RD police- and shipping regulation for BE territorial sea, ports and shore of BE coast			- RD on creation of special protected zones and special zones for the conservation of nature in sea area under jurisdiction of BE - RD on environmental impact assessment **<u>Installation of power lines and datatransmission cable</u>** **N**: - law concerning the exploration and exploitation of non-living resources of the territorial sea and the continental shelf - law concerning specific rules on cabling (law 12.03.2002)		**R**: - RD concerning regulation of aviation – RD concerning aviation regulation and operational provisions on aviation nagivation services and-procedures - draft RD on the use of remotely operated aircrafts in the BE airspace	**N:** -law on the prevention of pollution by vessels - Law on the safety of vessels - General regulation on shipping lanes of the Kingdom **R**: RD on nautical inspection regulation	
Harbor Jetty Zeebrugge		**R**:- Decree concerning budget - DFG on granting authorisation, retributions for private use of public domain of a.o. waterways,.. - Flemish code spatial planning - Decree on environmental license and regulation on substantial								

		environmental provisions								
On shore and foreshore				**N:** Law concerning protection of marine environment **R**: - RD on the establishment of Marine spatial plan - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment	**<u>On shore</u>** **R**: :- Decree concerning budget - DFG on granting authorisation, retributions for private use of public domain of a.o. waterways,.. - Flemish code spatial planning - Decree on environmental license and regulation on substantial environmental provisions - RD police- and shipping regulation for BE territorial sea, ports and shore of BE coast **<u>In territorial sea</u>** **N**: - Law concerning protection of marine environment **R**: - RD police- and shipping regulation for BE territorial sea, ports and shore of BE coast - RD on procedure for licenses and authorization of certain activities			**E: -**implementing regulation of EC on establishment of common aviation regulation and operational provisions on aviation navigation services and -procedures **R**: - RD concerning regulation of aviation – RD concerning aviation regulation and operational provisions on aviation nagivation services and-procedures - draft RD on the use of remotely operated aircrafts in the BE airspace	**N**: - law concerning the protection of marine environment **Operational use of a ROV: has to respect a.o.:** **N:** -law on the prevention of pollution by vessels - Law on the safety of vessels - General regulation on shipping lanes of the Kingdom **R**: RD on nautical inspection regulation	

					in sea areas under jurisdisction of BE - RD on establishment of a marine spatial plan - RD on creation of special protected zones and special zones for the conservation of nature in sea area under jurisdiction of BE - RD on environmental impact assessment					
windfarms		**N:** Law concerning protection of marine environment **R**: - RD on the establishment of Marine spatial plan - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment	**<u>Installation for the production of electricity from water, current or wind</u>** **N:** - law on the organization of the electriticy market - law concerning the protection of marine environment **R**: RD on the conditions and procedure for the awarding of domain concessions for the construction and exploitation of installations for the production of electricity of water, current and wind, in sea aereas where BE has legal power - RD on procedure for licenses and	**N:** Law concerning protection of marine environment **R**: - RD on the establishment of Marine spatial plan - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment				**I**: - UN treaty on the law of the sea - treaty of Chicago on international civil aviation - ICAO regional aviation navigation agreements	**I**: UN treaty on the law of the sea **N:** -law on the prevention of pollution by vessels - Law on the safety of vessels - General regulation on shipping lanes of the Kingdom **R**: RD on nautical inspection regulation	

			authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment - RD on establishment of a marine spatial plan **<u>No production of electricity from water, current or wind</u>** **N**: - law concerning the protection of marine environment **R**: - RD on procedure for licenses and authorization of certain activities in sea areas under jurisdisction of BE - RD on environmental impact assessment							

3.2 Denmark

3.2.1 Government support schemes

3.2.1.1 Aimed at test facility owners

For a number of years there has not been general public funding available for establishing new test facilities in Denmark. This was changed in June 2020 when the Green Labs DK funding program was reopened which aims at establishing facilities where companies can demonstrate and test new energy technologies under realistic conditions. The public funding available is shared with Denmarks general energy technology development and demonstration program (EUDP) i.e. the test facilies are competing for public funding with applications for development of new energy technology, e.g. a new energy storage technology. The total funding available was not increased as part of reopening the Green Labs DK funding program. The full rules can be found on EUDP's website energiteknologi.dk, but a summary is presented in the table below:

Who can apply?	'innovation clusters' as defined in EU's General Block Exemption Regulation. Structures or organised groups of independent parties (such as innovative start-ups, small, medium and large enterprises, as well as research and knowledge dissemination organisations, non-for-profit organisations and other related economic actors) designed to stimulate innovative activity through promotion, sharing of facilities and exchange of knowledge and expertise and by contributing effectively to knowledge transfer, networking, information dissemination and collaboration among the undertakings and other organisations in the cluster.
Percentages	Max 50% funding rate.
Budget	Max 7,5 mEUR pr. Test facility.
Funded expenses	The fund is primarily aimed at the materials for creating the test facility. Internal hourly costs for personnel at the cluster partners are explicitly not funded.
Other requirements	The terms for accessing the facilities and the associated services as well as price lists must be published on the website of the individual test facility It must be possible for multiple users to access the test facility, and access must be granted on transparent and non-discriminatory terms. The payment charged for the use of the facilities belonging to the cluster and for participation in the activities of the cluster must correspond to the market price or reflect the costs.

Because of the limited public funding for test facilities an important possibility to access capital through loans is the Danish Green Investment Fund, Vækstfonden and EKF-Denmark's Export Credit Agency. These public organizations provide capital that is less risk averse than private investments, but the conditions for the loan (interest rates etc.) are otherwise comparable to market conditions.

3.2.1.2 *Aimed at test facility users*

The primary funding source for development and demonstration of energy technologies in Denmark is EUDP. The table below summarizes the funding option, full rules can be found on energiteknologi.dk.

Subject	Development and Demonstration of All Energy Technologies
TRL stage	2-8 (primarily 3-6)
Budget	Usually 0,7-4 mEUR, 1 mEUR average
Support	LE ✓ SME ✓ Research Institutions ✓
Consortium	Usually 3+ partners
Covered	Hourly cost ✓ Externals ✓ Equipment ✓
Percentages	LE: 40%, SME: 60%, Knowledge inst.: 90%, Overhead: Actual
Calls	Primo March and September
Processing time	3-4 months
Budget pr. year	67 MEUR (approximate)
Applications pr. year	260 MEUR (approximate)

3.2.2 Funding 3-5 major test facilities in DK

Most test facilities related to offshore wind in Denmark are primarily privately funded either directly or indirectly.

In 2020 one project with a total budget of 11,6 mEUR was awarded 5,8 mEUR in public funding as part of the Green Labs DK funding scheme. In the period 2011-2018 where the Green Labs DK funding was also available a total of 11 projects were funded. Only two projects are aimed directly at offshore wind (one in 2020 and one in 2011), but due to the limited number and because of the increased integration of the energy system they are all listed in the table below. The total grants given in 2011-2020 is 32,2 mEUR for projects with a total budget of 69,6 mEUR, i.e. an average funding rate of 46%.

Name	Grant year	Grant	Total Budget	Funding Rate
Modern 66kV grid emulator for the renewable energy sector	2020	5,8	11,6	50%
iGLEEB - Intelligent building installations and decentralised integrated energy systems	2018	0,6	1,6	40%
Digital Energy Lab	2018	1,9	3,8	50%
SUS - Smart Urban Service Green Lab Platform	2014	0,8	1,6	48%
Danish Outdoor Lighting LAB - DOLL	2012	2,0	2,4	82%
DEIL - District Energy Innovation Lab	2012	2,0	-	-
Green Power Electronics Test Lab	2012	2,4	2,4	49%
Danish Wave Energy Center	2012	0,9	1,7	50%
Lindoe Nacelle Testing (LNT)	2011	10,2	23,1	44%
PowerLabDK	2011	2,0	14,1	14%
Green Lab for Energyefficient Buildings - GLEEB	2011	3,4	6,7	50%
Green Gas Test Center	2011	0,2	0,4	44%
Total		32,2	69,6	46%

Two other recent major test facilities in Denmark aimed at offshore wind are the 25 MW nacelle test stand at LORC and the expansions of the full-scale wind turbine test centre in Østerild, these are described below.

The 25 MW nacelle test stand at LORC was financed with approximately 15% public funding and 85% private funding. A part of the private funding was secured as a loan from the public organizations: the Danish Green Investment Fund, Vækstfonden and EKF-Denmark's Export Credit Agency and a part of it from a private bank. The public organizations provide capital that is less risk averse than private investments, but the conditions for the loan (interest rates etc.) are comparable to market conditions.

The full scale test centre for wind turbines in Østerild has been expanded a number of times. Some of the test stands are used by Danish Technical University (5) and some by Siemens Gamesa (2) and Vestas (2). All costs related to operation and expasion of the test centre has to be covered proprotionally by the users of the test stands i.e. the Danish Technical University (DTU) covers 5/9 and Vestas 2/9. But DTU are required to cover all of their costs by charging the users of their five test stands.

3.2.3 Legislation

As an example of the legislation for test facilities in Denmark there is Law regarding test centre for large wind turbines at Høvsøre and Østerild[3]. This governs the purpose of the test centre, the

[3] LBK nr 1069 af 21/08/2018 https://www.retsinformation.dk/eli/lta/2018/1069

operation responsible, that the users must cover the cost of all related expenses, nature protection, allowed turbine heights, etc.

3.3 UK

Offshore Wind Testing Facilities in the UK

i. Government Support Schemes

The UK's Industrial Strategy sets out four Grand Challenge areas, one of which is Clean Growth. Investment in offshore wind testing facilities will help to achieve this by driving innovation and allowing the expansion of this sector to provide a greater proportion of renewable energy for the UK.

Testing Facility Users (SMEs & Academics):

UK Research and Innovation

UKRI is an independent organisation that brings together the seven research councils, Innovate UK and Research England. It is funded primarily through the Science Budget from the Department for Business, Energy and Industrial Strategy (BEIS). Their Energy Programme aims to meet the UK's energy demands and environmental obligations through high quality research and post graduate training. They are also the largest public funder of the Energy Technologies Institute, which seeks to accelerate the deployment of new energy technology and the UK Energy Research Centre (UKERC), an independent facility that carries out interdisciplinary research into sustainable energy systems and acts as a gateway between UK research and international scientific communities. UKERC has entered phase four of its funding from UKRI and the research councils, running from 2019-2024, and is focussing on the UK's transition to net zero emissions.

The Industrial Strategy Challenge Fund is delivered by UKRI and seeks to drive forward the UK's leading research and support businesses to innovate towards a more sustainable future. It has £4.7 billion to invest over four years to support the Industrial Strategy. In line with the Clean Growth grand challenge, the Prospering from the Energy Revolution Challenge had £102.5 million to invest in developing smart, clean energy systems. The funding was separated into three focussed areas: smart local energy systems, the Innovation Accelerator Fund and research & integration services. This competition ended in July 2018 and new funding opportunities are announced intermittently.

The Research Councils

The individual research councils are grant giving bodies, the most relevant of which are the Engineering and Physical Sciences Research Council (EPSRC), the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC). They will make calls for certain research topics that require further study and then grant funding to proposed projects that address these issues. There are 12 active grants from EPSRC related to wind power, including the Industrial Doctoral Centre for Offshore Renewable Energy, the Holistic Operation and Maintenance for Energy from Offshore Wind Farms, the Supergen ORE Hub and Extreme Loading on Floating Offshore Wind Turbine in Complex Environmental Conditions, worth total of over £21 million.

Innovate UK

Innovate UK is a government funded organisation that provides support to UK businesses to drive productivity and commercialise technologies. Some of their funded projects include a feasibility

study for a multi-MW ferrite based permanent magnet generator for wind turbines, the Fugro Marine Remote Operations Centre and a demonstrator for robotic inspection and maintenance of offshore wind turbine blades. They are also a key funder for the ORE Catapult (mentioned below). Some of the current funding opportunities that are open for applications are the following:

- Innovate UK's Smart Grants offer small medium enterprises (SMEs) the opportunity to access a share of £25 million to deliver research and development innovations that significantly impact the UK economy. Proposals must be business focussed and the best game-changing and commercially viable projects will be awarded. The competition closes on the 25th November 2020.
- Knowledge Transfer Partnerships (KTPs) are opportunities for SMEs to collaborate with a higher education institution or Catapult and apply for a share of £10 million to work on a project that innovates. Round 4 of the KTPs closes on the 28th October.
- Innovation Continuity Loans, totalling £210 million, are being offered to SMEs who are at risk of halting innovation projects due to the interruptions from Covid-19. Projects must have a focus on growth and commercialisation; this is available until 4th November 2020.

Other sources of funding include Innovate UK's Open R&D Funding programme, the Small Business Research Initiative, Innovation Loans, the Investment Accelerator programme and Innovation to Commercialisation of University Research (ICURe).

Offshore Renewable Energy Catapult

The ORE Catapult allows academics and developers/SMEs to work cohesively in research and development of offshore wind technologies, using world class facilities. Their aim is to be the internationally recognised go-to for testing and validation for original equipment manufacturers (OEMs). ORE Catapult ensures learning is shared and that innovation challenges are identified clearly for the government and developers. As of 2018, they supported 121 companies in their development and through ORE Catapult and funding from the Scottish Government, the Platform for Operational Data has been created to provide open access data to benefit research and testing.

The Catapult's core funders are Innovate UK and the UK government, as well as the devolved administrations in Wales and Scotland. Some of this money goes towards funding research projects that use their facilities and they also identify and aid SME applications for publicly available funding.

The Department for Business, Energy and Industrial Strategy

BEIS is a grant giving body that recently promised £160 million to upgrade ports and infrastructure for offshore wind, increasing capacity to 40GW by 2030. The focus of investment is in Northern England, but Scotland and Wales will also see huge increases in offshore wind capacity. The government also wants floating offshore wind to deliver 1GW by the same deadline. The initial focus of support is developing sites with multiple large manufacturing facilities or clusters where smaller producers can work side-by-side, by 2023. BEIS have submitted a recent request for information from coastal landowners/developers of potential sites that have an interest in supporting the UK's offshore wind sector to be considered for funding. The initial focus is more on manufacturing infrastructure, but further phases of funding may invest in infrastructure for testing, especially for the offshore floating wind target.

The UK government, through BEIS, has also established a Sector Deal with offshore wind, which was published in March 2019. This sets out a commitment from the sector to increase UK content in the supply chain up to 60% by 2030. £250 million is being invested in building up the UK supply chain and

the newly established Offshore Wind Growth Partnership will receive £100 million of this, via the Offshore Wind Industry Council. This partnership is a long-term business transformation programme and will be delivered by ORE Catapult. Eight wind 'clusters' have been formed which are a collaboration between developers, regional supply chain, public sector and educational bodies. These are: Deep Wind (North Scotland), Forth & Tay Offshore, North East England, Humber, East Anglia, Solent, Celtic Sea Cluster and North West & North Wales.

BEIS is also funding £1.3 million in the Offshore Wind Innovation Hub (OWIH), which is jointly delivered by ORE Catapult and the Knowledge Transfer Network (KTN). The Hub is the primary coordinator of innovation, focussing on cost reductions and maximising economic impact. The first programme will be the Offshore Wind Innovation Exchange.

European Funding

The UK government has invested up to £8 million in the DemoWind programme, which has also received funding from Horizon 2020. This European programme aims to reduce costs of offshore wind and funded seven projects in its first phase and five in its second.

Horizon 2020 is the largest European research and development funding programme, investing €79 billion until 2021, which is extended from the original deadline of 2020 due to interruptions from Covid-19. The funding calls are based around three areas: excellent science, industrial leadership and societal challenges. Businesses can access this funding for the lifetime of individual projects, including those finishing after the 1st January 2021 despite Britain exiting the European Union. The successor to this is Horizon Europe, which would be a €100 billion programme that is stated to be "open to the world" but membership details are still uncertain at this time.

Testing facility owners:

UK Government

According to ORE Catapult's annual report, they are the owner and operator of £250 million worth of testing facilities. They directly invest money into developing new facilities and their latest innovation update from 2018/19 states that they will be updating their testing and validation facilities to accommodate the new 10MW+ turbines of the near future.

Funding to develop or update new test facilities can also be accessed through programmes such as the Regional Growth Fund (RGF) which supports projects which create economic growth and provide lasting jobs in certain areas across the UK. The RGF is run by national or local organisations. It is stated that no future rounds are proposed but money is still available through a small number of programmes which are mostly focussed on SME energy efficiency.

Other funding competitions include the Women in Innovation Awards 2020/21 where 10 female business owners will be awarded £50,000 and bespoke mentoring to support their company. There is a Coastal Communities Fund that has provided £182 million since 2012 in various projects around the UK, but the last round of funding closed in 2018 and there are not currently any open competitions for funding. The Coastal Revival Fund also provided £3.8 million in 2018-19 but no new funding has been announced.

The European Regional Development Fund (ERDF) is one of three European Structural Investment Funds (ESIF), that provide investment for EU nations to achieve a sustainable future while supporting

local economies from 2014-2020. Projects funded by this must fit with the Smart Specialisation Strategy in England, which helps to identify priority areas for investment as identified by LEPs. The ERDF will continue to invest after 31st December 2020 despite the UK leaving the EU but will finish by the end of 2023. There are not currently any open funds listed on the government website concerning renewable energy.

Scottish Government

Scotland's Energy Strategy was published in 2017 and outlines their goals for their already well-established offshore wind industry. Scotland is home to the world's first floating offshore wind array, which was made possible by their high level of support through the renewables obligation legislation (ROS). The established supply chain for offshore wind here was also aided by the existing expertise in the offshore oil and gas industry and a strong innovation hub, with the ORE Catapult headquarters based in Glasgow.

The ERDF has given the Scottish government €476 million to correct imbalances between regions and build towards a smart, sustainable and inclusive future. One of the identified themes to achieve this is working to achieve a sustainable, low-carbon Scotland through the Low Carbon Infrastructure Transition Programme (LCITP), which was launched in 2015. £50 million is currently available through the LCITP to large scale projects based in Scotland that reduce emissions, demonstrate economic and social benefits and are replicable. This closes on the 13th November 2020.

The Coastal Communities Fund has also funded local authorities in Scotland since 2012. No open funding opportunities are advertised at the moment.

Welsh Government

The Welsh European Funding Office (WEFO) manages grants from the EU that are accessible in Wales. WEFO administers the ESIF such as the ERDF, which is of interest to offshore wind test facility owners. Examples of the use of this fund for test facilities are listed below.

The Welsh Coastal Communities Fund focusses on creating and safeguarding sustainable jobs. This is supported by the National Lottery Community Fund. The CCF has run since 2012 and provided £16.1 million worth of funding to projects. Round 6 of funding had £3.7 million available and closed on 2nd October 2020. This is subject to the UK government providing a proportion of the revenue raised by the Welsh government.

The Targeted Regeneration Investment Fund (TRIF) has £100 million available until 2021 for local authorities to work with partner organisations. Meanwhile, the Building for the Future programme has £38 million from the ERDF, making up a total of £54 million in funding to allow certain local authorities to partner with organisations for projects.

More European Funding Opportunities

- **MariNET2** is a €10.5 million project funded by Horizon 2020. Its 5th call for access to free testing facilities closes on 16th October 2020.

- The **Ireland Wales programme** is worth €100 million and aims to bring together the adjacent coastlines of Ireland and Wales.
- The **Atlantic Area programme** has €140 million to support regional development and sustainable growth in Ireland, Northern Ireland and the west coast of England, Wales and Scotland.
- The **North West Europe** programme has €396 million to encourage collaboration in regional development.
- Interreg?

How were the last 3-5 major test facilities funded in each country?

England:

1. The **South West Marine Energy Park** includes the FaB test facility and the Wave Hub:

- **Falmouth Bay (FaB) Test Site** – At Sea Marine Technology Demonstration Site, Falmouth, Cornwall. Established in 2011. Research is conducted here by the Renewable Energy Group, University of Exeter, who also share management with Falmouth Harbour Commissioners. This was partly funded with £549,000 from the Regional Growth Fund, from the Cornwall and Isles of Scilly LEP.
- **Wave Hub**, Cornwall, fully commissioned in 2012. Wave hub's test facilities were used for a range of offshore technologies, including wave, tidal, floating wind and hybrid wind/wave devices. However, it is now in a transitional stage to become a focal point for the Celtic Sea floating offshore wind (FLOW) cluster, through selling the assets to private sector developers in 2020. They will acquire a consented site with existing offshore and onshore infrastructure that will enable a research focus on tech development, commercialisation, fostering a supply chain and the transfer of knowledge.

2. **ORE Catapult** has a variety of testing facilities that are open access for research and development.

- The **National Renewable Energy Centre** (Narec) is based in Blyth, Northumberland and merged with ORE Catapult in 2014. The facilities located here include the High Voltage and Materials Laboratories, the National Offshore Anemometry Hub (NOAH), a 27m turbine training tower, blade test facilities and three subsea docks.
- The **Power Train Research Hub** (PTRH) is a £2.4 million project between ORE Catapult and the University of Sheffield, spread over 5 years. The hub was announced in April 2019. The university is contributing a minimum of £1.7 million, the Catapult is contributing £700k and GE Energy is providing £500k in funding.
- The **Energy Central Offshore Wind Demonstrator** project is being proposed by ORE Catapult and Advance Northumberland. The application is being prepared for Oct/Nov 2020 and depending on planning permission, the first turbine will be installed in 2022. The design work is supported by Energy for Growth funding from the Local Growth Fund, North East Local Enterprise Partnership (LEP).

3. **Universities:**

- **Coastal Ocean and Sediment Transport (COAST) Laboratory, University of Plymouth**. Opened in 2012. Includes an ocean basin, coastal basin and sediment wave flume. Future developments will include a wind generation facility. Funded by University of Plymouth (?).
- **University of Surrey Wind tunne**l?

Scotland:

- **Levenmouth Wind Turbine,** Fife, Scotland. Acquired by **ORE Catapult** in 2015 from Samsung Heavy Industries. A 7MW open access offshore turbine that is dedicated to research and development. It removes the restrictions of developers having to gain access to working wind farms to test their technology.
- **FloWave Ocean Basin, University of Edinburgh**. Highly complex sea states are replicable with video motion capture system. Built in 2014, costing £9.5 million and funded by the EPSRC and University of Edinburgh.
- **Kelvin Hydrodynamics Lab, University of Strathclyde**. The tank is used for measuring the performance of floating and underwater structures in different wave conditions.
- **European Offshore Wind Deployment Centre (EOWDC), Aberdeen.** This site is Scotland's largest offshore wind testing facility and has deployed 11 8.8MW turbines with the first suction bucket jacket foundations. It was awarded 40 million from the European Commission and completed in 2018. The ORE Catapult and Vattenfall, who manage the centre, have agreed that developers can use this as a test site for new technology in real-world conditions.

Wales:

- **Marine Energy Test Area** (META), Pembroke, Wales. A new development, providing early stage testing for a variety of marine energy equipment. It aims to bridge the gap between tank testing and Welsh open water demonstration zones. Phase 1 provides five low-risk sites and opened for business in September 2019 and phase 2 is expected to be available sometime in 2020. META is part of the Swansea Bay City Deal and is funded by the UK government, the Welsh government and the Coastal Communities Fund, costing £1.9 million.
- **The Marine Energy Engineering Centre of Excellence (MEECE)** is a £5 million project that began in 2019 and is set to be complete in 2022. It is funded by the West Wales and the Valleys ERDF and will focus on innovation towards a low carbon economy. The lead organisation for MEECE is the ORE Catapult.
- **The Pembrokeshire Demonstration Zone** is also funded by almost £3 million from the West Wales and the Valleys ERDF. It began in January 2020 and is scheduled to finish in mid-2023. This will provide a licensed and grid connected area for developers to test and deploy offshore wind technology.