REQUIREMENT CATALOGUE

QUALIFICATION

DECOM TOOLS **2022**

Interreg
North Sea Region
Decom Tools
European Regional Development Fund

EUROPEAN UNION

Project Partners:

Hamburg Institute of International Economics

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Publication:	February 2022
Coordinator and Editor:	Hamburg Institute of International Economics (HWWI)
Layout:	Energy Cluster Denmark
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Project Title:	Eco-innovative concepts for the end of offshore wind energy farms lifecycle (DecomTools)
Reference Number:	Interreg North Sea Region – Project Number: 20180305091606

1. Introduction

Climate change and transition away from fossil fuels is one of the major challenges of our generation. There is even more demand for wind energy in the context of green hydrogen and the "Fit for 55" targets and the EU Green Deal (European Commission, 2021a). Accordingly, there will be an expansion of offshore wind energy in Europe, particularly in the North Sea due to its favourable conditions and no infringement in land usage. The number of turbines installed yearly needs to double by 2025 and with increasing size of turbines, also the complexity of projects is rising (Wind Europe, 2021a; 2021b). Not only the commissioning of new turbines needs to be looked at, also the question of decommissioning end-of-life offshore wind farms requires further research. The average running time of an offshore wind turbine amounts to 20-25 years, pioneer farms in the North Sea are increasingly reaching the critical stage and the first decommissioning projects have already been conducted. A market analysis shows that two cycles of decommissioning can be expected in the North Sea Region. The first cycle is already ongoing for the next years and is related to relatively low numbers of turbines to be decommissioned. The second cycle, however, which is expected to begin at the end of this decade, corresponds to large volumes in almost every region of the North Sea (see Figure 1). While the first cycle functions as a kind of test case for decommissioning strategies and methods, the high volumes in the second cycle require fully-developed solutions. Accordingly, questions of infrastructure or qualification, which have a long lead time, need to be addressed now to have sufficient preparation time (Kruse, 2019; Smartport, 2020; CRF Consultants, 2016).

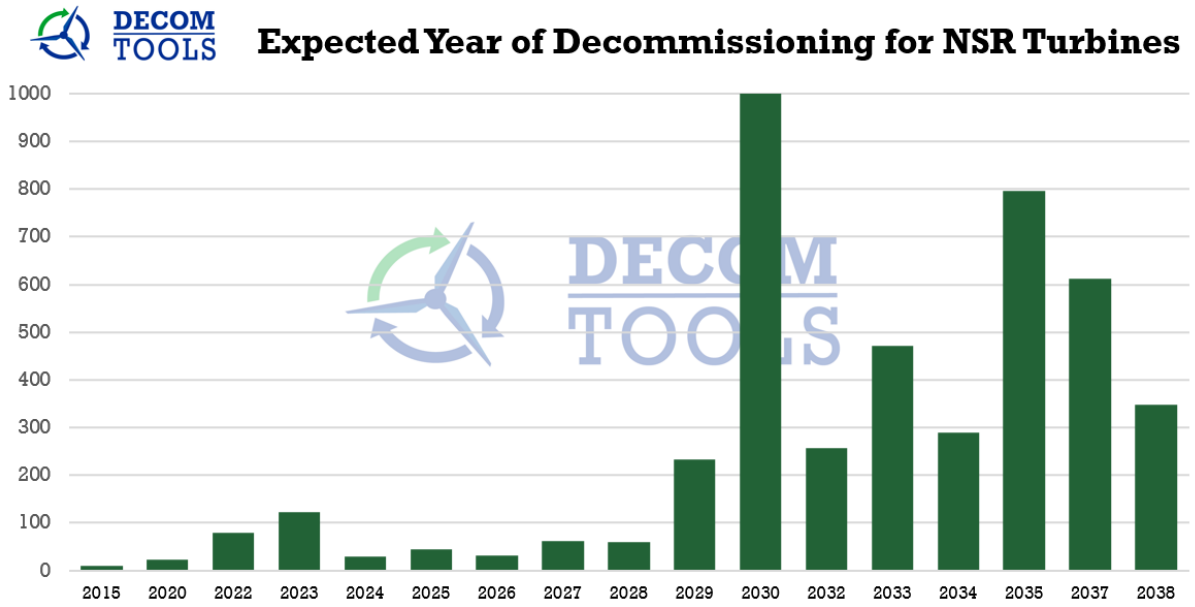

Figure 1: Expected Year of Decommissioning for Offshore Wind Turbines in the NSR

Source: Kruse (2019).

The predictability of the timing of offshore wind turbine decommissioning is comfortable in the sense that aspects such as the quantity, age, and technical details of operational turbines are well known. On the other hand, decommissioning and recycling of offshore structures such as oil and gas platforms or onshore wind turbines are well established for small volumes but decommissioning larger volumes of offshore wind turbines is still a case (Ramsay, 2021; ARUP, 2014). The uncertainty thereby not only involves questions of adequate decommissioning vessels, capacity, and availability of employees, but also recycling of materials such as steel, concrete, or composite materials (Ramsay, 2021).

Against this background, the report at hand is prepared as part of the project "Eco-innovative concepts for the end of offshore wind energy farms lifecycle (DecomTools)" which funded by the European Regional Development Fund (ERDF) Interreg North Sea Region (NSR) programme 2014-2020. The project recognises that an overall sustainable approach to the offshore wind farms' end of lifecycle is still missing, and the project shall assist in closing this gap. This is achieved by devising and developing eco-innovative concepts that:

- Reduce decommissioning costs by 20 per cent and environmental footprint by 25 per cent (measured in CO2 equivalents),
- Increase the know-how and expertise of North Sea Region (NSR) involved stakeholders.

The project consortium consists of thirteen partners from six NSR countries, namely Belgium, Denmark, Germany, the Netherlands, Norway, and the United Kingdom. The four-year project will carry out research, demonstrate pilots, and develop working tools in different areas such as logistics, infrastructure, ship design, safety, or up-/re-cycling. Already available technologies will be combined to tackle some of the major aspects of the decommissioning challenges, including optimisation of existing (port) infrastructure. Transnational cooperation and multidisciplinary cross-sector competences will improve framework conditions for innovation and technology transfer in this specific niche area and help the sector to become more sustainable.[1]

The report at hand will deal with the topic of qualification. A complementing report on infrastructure is published in parallel (link). The underlying research consists of published evidence, a local quantitative assessment in the partner regions of DecomTools in Belgium, Denmark, Germany, Netherlands, Norway, and the United Kingdom, as well as several in-depth interviews with stakeholders around the North Sea Region. The interviews were carried out between 2019 and 2021 and amount to a total of 16 interviews with infrastructure providers, knowledge institutions, service providers, training facilities and other experts. The findings are complemented with findings from a previous interview round conducted for a stakeholder report, also in the scope of the DecomTools project (Kruse, 2020).

[1] For more information about the project, see https://northsearegion.eu/decomtools/about/

2. Qualification Requirements – General

The age of offshore wind farms particularly in the North Sea as a frontrunner region makes it clear that the market for wind turbine decommissioning and recycling is going to increase in the next years, particularly in countries such as Germany, the Netherlands and Denmark. Accordingly, the supply chain for decommissioning activities is still nascent when it comes to recycling and disposal of decommissioned components (Ramsay, 2021). Looking at oil and gas as an established industry dealing with decommissioning for decades, it can give indications what to expect by decommissioning offshore wind turbines (ARUP, 2014). Among the required activities are project management, planning and engineering, offshore preparation, lifting and cutting, transport of heavy large-scale structures, subsea decommissioning, site remediation, licensing and regulation, onshore processing, digital skills, remanufacturing and reuse, recycling, waste management, or disposal. Thereby, the variety of activities related to a decommissioning project make it a serious business case for training providers, knowledge institutions, and employers offering skills such as engineering, planning, trade-specific skills, or semi-skilled manual tasks. As technology is expected to play an increasing role in the future of decommissioning, additional training will be required to apply new technologies in areas such as cutting. Even the development of new and unique sets of skills might be needed (Skills Development Scotland, 2019).

The oil and gas sector in the UK has already developed a skill action plan, including an identification of relevant employers and knowledge providers to define concrete skill requirements. Further steps such as an engagement with other industries that are related to decommissioning challenges to identify potential of mutual learning are outlined. One potential sector of cooperation could be offshore wind which could benefit from skills developed for oil and gas decommissioning and are transferable. However, the oil and gas industry cannot be seen as a provider of all relevant skills for offshore wind decommissioning. This is because the specific sets of skills differ in certain details and, moreover, the oil and gas industry has to cope with challenges particularly when it comes to attracting qualified personnel. Current shortages of qualified employees in oil and gas decommissioning include qualified and experienced managers, scaffolders, cutting and demolition staff, rope access team leaders, engineers with digital skills, or quality management (Skills Development Scotland, 2019).

Moreover, the demand for environmental scientists, drilling supervisors, subsea engineers, professionals in geology and geophysics, riggers, experts in quality, health, safety, and environment, skills in robotics and mechanisation, and digital skills is likely to increase which threatens to further tighten the shortage, not only in decommissioning but in offshore operations generally. The qualifications required therefore include a variety from apprenticeships and short courses to post-graduate level with a strong emphasis on “on-the-job” experience (Skills Development Scotland, 2019). Coping with the challenges of decommissioning offshore wind farms in terms of qualification will therefore require a collective effort of schools, universities, operators, government, and supply chains (ARUP, 2014). Among the skill and learning providers necessary in this context are universities, colleges, as well as a range of private providers of short courses as for example safety

training. Although the shortage of skills does not apply to each qualification described, the situation is likely to change due to increasing decommissioning requirements as well as an overall changing sector environment (Skills Development Scotland, 2019).

2.1 Practical Training

The more practical aspects of decommissioning are taught in training courses by different knowledge providers, ranging from colleges to private training providers. Thereby, short courses focus primarily on practical training of scaffolding, rope access, different cutting techniques, and environmental surveying, as well as more theoretical aspects such as project management, finite element analysis, planning for decommissioning, or safety case regulations (Skills Development Scotland, 2019). Such courses are, among others, provided by the Society of Petroleum Engineers offering a global training series on offshore decommissioning. By mixing presentations, discussions, and workshop exercises, the course strives to introduce the cross-discipline nature of offshore decommissioning, addressing engineers, managers, regulators, accountants, insurance brokers, lawyers, and other professionals (SPE, 2021). Another five-day training course is offered by Kensington Training addressing those involved in decommissioning interested in obligations and liabilities and the management aspect of decommissioning. The course covers the value chain of end-of-life operation, including planning, estimating, preparation, execution, and close-out by offering real-life examples. The course is taught in English and Arabic (Kensington Training, 2021). While these courses address professionals looking for additional qualification for decommissioning or a refresher course, apprenticeships take a broader and more basic approach. Apprenticeships related to decommissioning include, for instance, engineering, fabrication, and welding (Skills Development Scotland, 2019).

Generally, the skills required for decommissioning are considered to be very similar to those needed for the oil and gas industry which makes available skills transferable and allows oil and gas professionals to also work in decommissioning. Nevertheless, differences have been highlighted, such as decommissioning requiring skills such as milling, pulling, and handling. Differences will also play a role when it comes to transfer decommissioning skills from oil and gas to offshore wind farms. Nevertheless, the need for new, stand-alone decommissioning courses on operator or technician level is considered to be limited. Instead, it is argued to further develop already existing courses to better recognise the decommissioning characteristics (Skills Development Scotland, 2019).

2.2 University Training

The knowledge providers required to train the skills for decommissioning also include the university level. Decommissioning is a highly multidisciplinary topic which not only involves practical tasks but also aspects of law, economics, geology, biological sciences, and engineering, offshore decommissioning, in terms of oil and gas and, presumably, offshore wind, is increasingly recognised as a topic for universities. This trend is not to be understood as a substitute for training at other levels but more as a complementing training as biological

questions of the marine habitat, or regulatory considerations could overload other training courses (University of Aberdeen, 2021a). In this context, the University of Aberdeen offers both an introductory course on offshore decommissioning, and a Master of Science (MSc) programme on decommissioning. The introduction course covers 3 weeks (7-9h per week), is held online and offers to provide a deeper understanding of environmental, legal, economic, and health and safety aspects of decommissioning to teach the principles of managing an offshore decommissioning project. The course addresses oil and gas professionals, engineers, managers, finance and procurement personnel, as well as people working in related industries (University of Aberdeen, 2021b). Here, the physical process of decommissioning offshore platforms is taught covering engineering, project management, aspects of business, law, health and safety, and environmental studies. The course has been designed in collaboration with major industry and regulatory stakeholders and practical relevance is ensured by guest lectures and industry-based projects. The target group here are graduated or experiences professionals, also as a complementing course for full-time employees (University of Aberdeen, 2021c).

Apart from Aberdeen, also other universities around the world have included decommissioning in existing courses or created new courses with a specific focus. For instance, Curtin University offers a four-week masterclass to improve knowledge about offshore decommissioning in Australia. The focus here is on legal requirements and processes (particularly planning and restoration) and addresses industry professionals in the oil and gas sector while also encouraging students or recent graduates to attend (Curtin University, 2021). Moreover, the Centre for Advanced and Professional Education of the Petronas University Malaysia has included an intermediate skill level course on decommissioning in its curriculum (CAPE, 2021). Additionally, an online training course is offered by GLOMACS Training and Consultancy located in Dubai. The course lasts 5 days, focuses on project management and addressed individuals and organisations involved in decommissioning with a focus on “real life” exercises during the course. Regulators, industry bodies, operators, and other stakeholders are invited as well as oil and gas professionals (GLOMACS, 2021). It becomes clear from the overview that the oil and gas industry has an increasing demand for qualified personnel with an academic background to cope with current and upcoming decommissioning projects or increasing complexity. However, in the North Sea Region the University of Aberdeen is the first to take this new focus specifically into account in its course design.

2.3 Skill Profiles to come

Again, the oil and gas industry can be used as an example of what to expect when it comes to decommissioning qualifications in offshore wind. This reference reveals an upcoming skill shortage not only when it comes to decommissioning but engineering-based industries in general which is likely to also affect offshore wind decommissioning in the future (Royal Academy of Engineering, 2013). Particularly three aspects are noticeable when it comes to offshore operations and decommissioning: 1) The mindset required for offshore

decommissioning, 2) the relevance of experience rather than pure training, and 3) a lack of attractiveness of decommissioning in general.

Regarding the first point, it is regularly emphasised that decommissioning requires skills to be applied differently compared to exploration or development which adds up to a certain mindset which differs from other fields of work (Skills Development Scotland, 2019; Sharp, 2020). Moreover, not only is decommissioning a special sector but also offshore operations differ significantly from onshore activities. Offshore decommissioning therefore needs a very specific set of skills that not everyone is provided with. Regarding the second point, it is not so much the academic or practical qualification which is valued but on-site experience (Royal Academy of Engineering, 2013). Since the equipment currently used is ageing while, at the same time, new technologies are introduced, a mixture of skills is required to adapt to different assets and systems (Sharp, 2020). Regarding the third point, a study highlighted a preference of employees working on development and production rather than decommissioning projects. This observation is explained with decommissioning being regarded as less attractive because of uncertain timing of upcoming projects (Skills Development Scotland, 2019).

As decommissioning remains to be a niche operation, the focus of qualification activities appears to be a focus on transferable skills that can also be applied in other offshore activities. This is also the approach followed by the oil and gas industry which has already been dealing with decommissioning for a considerable amount of time. Thereby, the three core aspects described above need to be addressed. In order to position offshore decommissioning as a promising and long-term career option, the negative connotation needs to be overcome. As the environmental and ecological relevance of clean decommissioning is significant, such projects play a major role in the current green transition. This positioning is even more important as the market for qualified employees is becoming increasingly competitive so that the challenge to attract and retain good personnel is likely to intensify (Skills Development Scotland, 2019). The skills required are diverse and require a combination of theoretical / academic and practical / hands-on training (Royal Academy of Engineering, 2013). However, it is not so much new skills but the related mindset that matters calling for a change of attitude when it comes to decommissioning (Skills Development Scotland, 2019).

3. Qualification Requirements – Expert Interviews

The more theoretical analysis based on literature research above has been complemented by an own qualitative study. Here, several interviews with regional experts were conducted between 2019 and 2021. In general, 4 interviews in Norway (with 4 decommissioning companies specialised either in recycling, or, additionally, maintenance and service expertise), 3 interviews in the Netherlands (with a port, a transport and service provider, and a training provider), 4 interviews in Denmark (with a port, a knowledge institution, and two training providers), 2 in Belgium (with a technology centre, and a knowledge provider), 5 in Germany (with a knowledge institution, and four service providers), 2 in the UK (with a

research institution and a technology centre) were analysed for this report and will be summarised below. Also, previous interviews from an earlier report on stakeholder demands were considered for the identification of infrastructure recommendations (Kruse, 2020).

3.1 General

Many stakeholders around the North Sea Region see the labour market and access to qualified employees in terms of offshore decommissioning as an increasing problem. On the other hand, companies, knowledge institutions, and training providers, which have not been involved in decommissioning before, see it as a potential business case and attentively follow the current developments. Here, the knowledge about offshore decommissioning is still limited so that it still needs to be figures out which new requirements and competences are needed to develop suitable education or training. Some companies recognise a shortage of certain skills but, however, trust their employees to still be able to cope with the new challenges, assuming the right training is provided (Kruse, 2020). This point of view is particularly common in Norway where companies already possess long decommissioning experience in terms of oil and gas. Here, it is expected to simply transfer oil and gas experience to offshore wind decommissioning projects thus benefiting from already existing infrastructure and trained professionals.

Either way, significant effort of education and training of staff to cope with new challenges arising from offshore decommissioning is expected. While additional training of employees can be organised on relatively short notice, education generally is a late adopter. Although basic courses in universities or other knowledge institutions are considered helpful, it might take more time to establish them compared to training courses. Moreover, attracting qualified and motivated employees in an increasingly competitive market is expected to become challenging. Since it is claimed that offshore decommissioning jobs require a particular mindset, the number of suitable candidates is limited, and these will be increasingly courted. It is expected that the high share of workers being hired overseas is likely to increase further. While companies in larger cities have an advantage when it comes to attracting new, young employees, companies in more peripheral locations possibly need to increase their efforts.

3.2 Practical Training

Practical training as an additional course for employees is already provided, for instance in terms of offshore safety training, or courses on decommissioning with a focus on oil and gas platforms. Generally, training is provided in onshore training centres with a basic course at technical institutes and a practical part of on-site learning. There appears to be a tendency in companies to organise training in-house to keep knowledge on technologies and procedures confidential. Particularly Norwegian companies have adapted to the need for particular trainings and developed their own courses, focusing on machine operation for cutting, lifting and other activities. As for existing training providers, it is expected that certain aspects of offshore or decommissioning training will be transferable to train professionals for offshore wind decommissioning. However, the specific characteristics and differentiations

still need to be figured out and included in existing courses or be used as the basis for new courses. An example is the specifics of offshore operation which even qualified engineers often lack an understanding of, while offshore specialists often require further engineering skills (Kruse, 2020).

3.3 University Training

At university level, decommissioning is particularly regarded from a research rather than a teaching point of view, as becoming apparent from the conducted interviews. Moreover, wind energy in general is much more common in teaching than the decommissioning aspect to it. Although certain courses (particularly in Aberdeen) exist that cover decommissioning or focus exclusively on it, there appears to be no broad tendency in other countries in the North Sea Region to follow. However, existing courses are adapted to fit changing requirements, although not exclusively for decommissioning now. On the other hand, the research aspect of decommissioning offshore wind farms is increasingly recognised. Different research projects have already been established or planned to analyse decommissioning as a challenge and be in time for planning. Here, particularly the cooperation of different stakeholders with different perspectives on decommissioning is considered an important aspect to close knowledge gaps and develop sustainable solutions for the future.

4. Qualification Requirements – Summary

General

- Offshore decommissioning is a highly diversified field of activity, requiring skills such as project management, planning and engineering, offshore preparation, lifting and cutting, transport of heavy large-scale structures, subsea decommissioning, site remediation, licensing and regulation, onshore processing, digital skills, remanufacturing and reuse, recycling, waste management, or disposal.
- Further define which new requirements and competences are needed in terms of training for offshore wind decommissioning. Decide whether existing training facilities are sufficient or whether new capacities need to be established.
- Offshore decommissioning requires a specific mindset compared to onshore operations or exploration and development.
- Experience rather than pure training matters due to the high diversity of skills required.
- Decommissioning tends to be regarded as less attractive, for instance because of uncertain timing of upcoming projects. This image needs to be improved.
- Learn from related industries (oil and gas decommissioning) and countries which are already experienced in offshore decommissioning (such as Norway or the UK).
- More competitive labour market situation is to be expected and more effort is needed to attract a sufficient number of qualified and motivated employees for upcoming decommissioning projects.

Practical Training

- Some experience from oil and gas decommissioning can be transferable but the specifics of offshore wind decommissioning need to be identified in order to either adapt existing training courses or establish new ones focusing on offshore wind.
- A streamlined provision of courses at different levels (additional or refresher courses, apprenticeships) needs to be developed, preferable on an interregional level.

University Training

- Increasing demand for professionals with academic qualification in decommissioning.
- Decommissioning courses in universities are no substitute for training at other levels but more as a complementing training as biological questions of the marine habitat, or regulatory considerations could overload other training courses.
- Monitor the experience gathered in universities such as Aberdeen and conceptualise new courses or include decommissioning as content of existing courses also in other regions.
- Establishing new courses needs a high amount of time so that plans should start as early as possible.
- Use the opportunities of research projects on offshore wind decommissioning.

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