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Special report

Offshore renewable energy in the EU

Ambitious plans for growth but sustainability remains a challenge

EUROPEAN COURT OF AUDITORS

Contents

Executive summary

I The European Green Deal puts energy transition at the heart of the EU's efforts to reach climate neutrality by 2050 and fight biodiversity loss and pollution. The path towards these objectives requires an increase in the use of renewable energy in a sustainable manner. Offshore renewable energy is one of these renewable energy sources and is expected to contribute significantly to reaching the EU Green Deal objectives.

II In 2020, the Commission adopted its strategy to support sustainable development of offshore renewable energy. Its objectives cover the long-term challenges, such as a need for inclusive maritime spatial planning, improved regional cooperation and the need to protect the environment. The strategy contains specific targets concerning the future capacity of offshore renewable energy. Member states shape their 10-year climate and energy policies in the national energy and climate plans: they did so for the first time in 2020 and will have to submit updated plans in 2024.

III This report focuses on whether offshore renewable energy is being developed sustainably in the EU. We assessed the Commission's actions supporting the offshore sector, the contribution of national plans to reaching the EU-wide targets, and whether EU money has effectively financed offshore renewable energy development. We examined the role of maritime spatial planning, focusing on coexistence of different sea users and cooperation among member states. We also looked at how social and environmental consequences were assessed and addressed by member states and the Commission. The audit covers policy developments before and after the adoption of the EU Strategy on offshore renewable energy. For our analysis of the EU-funded projects, we selected projects financed between 2007 and 2022.

IV Our audit provides an insight into the Commission's and the four selected member states' actions undertaken to support the development of offshore renewable energy. Our audit findings are intended to be an input to the updates of the national energy and climate plans.

V Overall, we concluded that EU actions, including EU funding, have contributed to the development of offshore renewable energy, in particular offshore wind. However, the targets are ambitious and may be difficult to achieve, and ensuring the social and environmental sustainability of offshore renewable energy development remains a challenge.

VI The EU Strategy on offshore renewable energy set the offshore renewable targets at an ambitious level of 61 GW of installed capacity by 2030 and 340 GW by 2050. Three of the four member states we audited envisaged a large-scale rollout of offshore renewable energy and plan to contribute significantly to EU-wide targets, but annual deployment rates will have to increase significantly, and the recent surge in inflation may slow down the development of offshore wind. Widespread commercial deployment of ocean energy is not expected before 2030, and its contribution to reaching the 2030 renewable energy targets will most likely be marginal.

VII Maritime spatial planning is a necessary tool to allocate sea space for different uses, while minimising negative environmental impacts. The Commission actively supported national authorities with maritime spatial planning in the context of offshore renewable energy development. We found that while the concept of co-using sea space is encouraged, the coexistence of different sectors with offshore renewables is not yet common practice: in particular, the unresolved conflict with fisheries in some countries will have to be better addressed.

VIII Member states sharing the same waters consult each other when establishing their maritime spatial plans, but have rarely used this opportunity to plan common offshore renewable energy projects, thus missing opportunities to use scarce sea space more efficiently. Permitting procedures and their length vary significantly across the audited member states, and may slow down the rollout of offshore renewable energy. The pace of development may also be affected by the availability of raw materials necessary to deploy offshore technologies, for which the EU is heavily dependent on third countries, especially China.

IX The socioeconomic implications of offshore renewables development, for instance in terms of skill needs, have not been studied in sufficient depth. Similarly, numerous environmental aspects linked to planned offshore renewable energy deployment are still to be recognised and given the scale of the planned offshore renewable energy rollout in the coming years, the environmental footprint on marine life may be significant.

X Against this backdrop, we recommend actions aimed at boosting the development of offshore renewable energy while ensuring environmental and social sustainability.

Introduction

Climate neutrality and energy independence

01 The European Green Deal[1] puts energy transition at the heart of the EU's efforts to reach climate neutrality by 2050 and fight biodiversity loss and pollution. The path towards achieving its energy and climate objectives includes intermediate 2030 targets to increase the use of renewable energy[2].

02 In July 2021, the Commission presented its Fit for 55 package, which contained legislative proposals to revise the entire EU 2030 climate and energy framework. In its package, the Commission proposed to increase the target for the share of renewables in the EU's energy consumption by 2030[3], from 32 % to a minimum of 40 %.

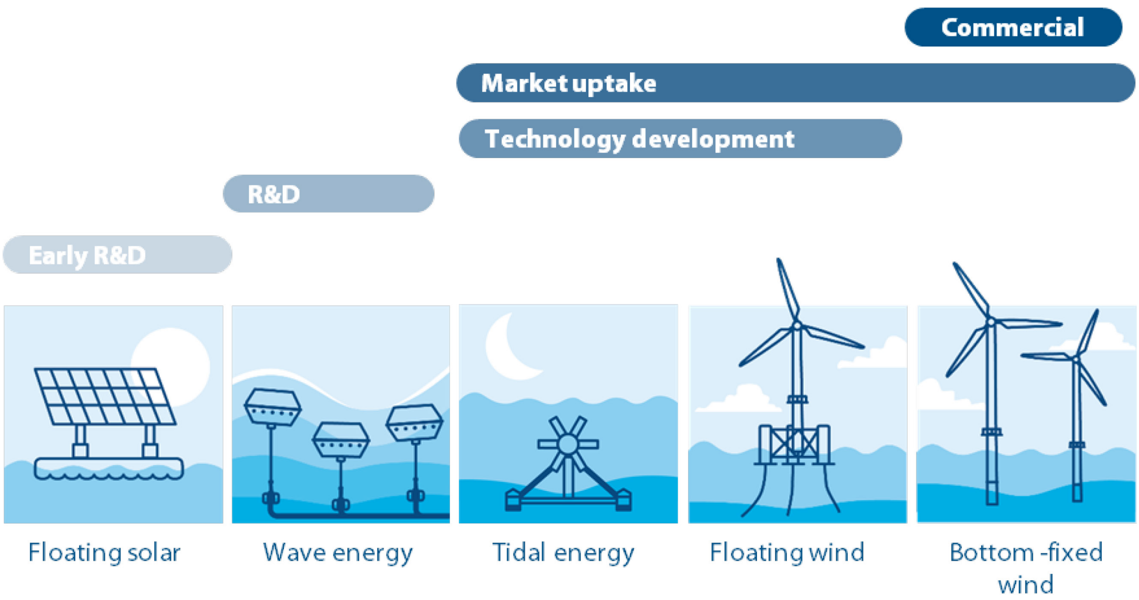
03 Offshore renewable energy (ORE) is one of these renewable energy sources. ORE can be generated by wind (bottom-fixed and floating), ocean (tidal and wave), and floating solar technologies. These are at different stages of development (see ***Figure 1***).

[1] COM(2019) 640.

[2] Special report 21/2023 on climate and energy targets.

[3] COM(2021) 557.

Figure 1 – Overview of ORE technologies



Source: ECA based on the EU ORE strategy.

04 The Russian invasion of Ukraine has highlighted the importance of the EU's energy independence. The Commission reacted by announcing its REPowerEU plan and proposed[4] a further increase, taking the 2030 target for the use of renewable energy to 45 %. On 29 March 2023, the Council and the Parliament negotiators reached a provisional political agreement to raise the share of renewable energy to 42.5 % by 2030 with an additional 2.5 % indicative top up that would allow to reach 45 %.

EU rules relevant for developing offshore renewable energy

Energy

05 The 2018 Regulation establishes the legal framework for the governance mechanism of the Energy Union and Climate Action to ensure the achievement of the 2030 and long-term energy and climate objectives and targets. Between 2019 and 2020, member states shaped their 10-year policies in the national energy and climate plans (NECPs). National plans should be updated once during the 10-year period covered to give member states the opportunity to adapt to significant changing circumstances.

06 In the 2024 update, the NECPs will have to reflect the higher EU energy and climate targets agreed under the FIT for 55 package as well as the increased security of supply

[4] COM(2022) 222.

concerns following the Russian invasion of Ukraine. The Commission will assess the drafts and issue recommendations, which national authorities must take into account when submitting their final plans by the end of June 2024.

Maritime spatial planning

07 The Integrated Maritime Policy is an approach to ocean management and maritime governance. It recognises maritime spatial planning (MSP) as a key tool for the sustainable development of marine areas and coastal regions. The aim of the EU MSP Directive is to manage human activities at sea in a coordinated manner, and increase cross-border cooperation between countries sharing the same marine waters.

Environmental protection

08 Numerous EU rules, such as the Marine Strategy Framework Directive (MSFD), the Birds and Habitats Directives, the Strategic Environmental Assessment and Environmental Impact Assessment Directives protect the marine environment and are focused on conservation and improving marine biodiversity. The EU Biodiversity Strategy to 2030 contains a package of commitments and actions to restore Europe's biodiversity.

EU financing to support offshore renewable energy

09 Industry and private investors make most of the investments in low carbon renewable technologies[5]. The EU budget has also supported ORE, mostly with grants, through a variety of funding programmes[6]. Data on EU-funded offshore renewable energy projects is not readily available, but rather spread across various databases. We identified ORE-related projects financed by the EU budget amounting to €2.3 billion between 2007-2022 (see paragraphs ***41***-***49***).

10 Member states can also use the Recovery and Resilience Facility (RRF) to finance ORE investments. This entered into force in February 2021, to mitigate the impact of the COVID-19 pandemic and support the green transition.

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[5] Telsnig et al., 2022, Wind Energy in the European Union – 2022 Status Report on Technology Development, Trends, Value Chains and Markets, JRC130582.

[6] E.g. EEPR, CEF, ESIF, FP7, Horizon 2020, Horizon Europe, LIFE, Innovation Fund.

11 Finally, the European Investment Bank (EIB) plays a leading role in raising and providing the finance needed to meet EU energy and climate targets. In support of ORE and using a combination of EU mandates and its own resources, it has provided loans and investments in equity, amounting to €14.4 billion since 2007.

Audit scope and approach

12 This audit covers EU offshore renewable energy. It provides an insight into the Commission's and selected member states' actions to support the sector's development. Our findings are intended to be an input to the revision of the national energy and climate plans.

13 We examined whether the EU had promoted sustainable development of ORE, taking into account its technological, social, and environmental dimensions. To answer the main audit question, we assessed whether:

- the Commission and member states promoted the development of ORE through an appropriate policy framework, implementation of national plans and targeting of funding;
- maritime spatial planning, permitting procedures, cooperation among member states and relevant studies facilitated the development of ORE and helped address social and environmental challenges.

14 The audit covers policy developments before and after the adoption of the 2020 EU ORE Strategy. For our analysis of the projects, we covered the 2007-2022 period. Our audit included four member states, namely Germany, Spain, France, and the Netherlands. This selection allowed us to analyse the development of ORE in two countries with an advanced offshore sector (Germany and the Netherlands), and in two (France and Spain) that face difficulties in accelerating the rollout of ORE.

15 We gathered evidence from:

- documentary reviews and interviews with representatives from the Commission;
- interviews with national representatives;
- a review of selected studies (see ***Annex II***);
- interviews with representatives from the EIB, the largest industry associations, and environmental non-governmental organisations (NGOs)[7] involved in the topic;
- an external expert.

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[7] Gardez Les Caps; Sea Shepherd; World Wildlife Fund (WWF): France, Spain, Germany; BirdLife; The North Sea Foundation; Vogelbescherming; Naturschutzbund Deutschland (NABU).

Observations

The EU is promoting substantial growth in offshore renewable energy, but its development varies significantly across the EU

The Commission set ambitious targets to develop offshore renewable energy

16 The Commission promotes the development of offshore renewable energy as part of its efforts to reach climate neutrality by 2050. We assessed whether it had set a policy framework consistent with the identified needs and that was also aligned with the European Green Deal.

17 In 2020, the Commission adopted its strategy to harness the potential of offshore renewable energy (the EU ORE Strategy). Prior to the adoption of this strategy, the Commission had concluded[8] that in general, the national energy and climate plans had not identified the potential of ORE. To address this and identify the different needs and challenges, the Commission carried out a citizen and stakeholder consultation process. The Commission also set up an inter-departmental group working on ORE to ensure coherence between various policy areas.

18 The issues raised during this consultation process were taken into account in the strategy to support the sustainable development of ORE in the EU. The strategy's objectives prioritise areas relevant for the sector's successful development. These include the factors of energy production, such as technology development and diversification, offshore infrastructure development, maritime spatial planning, research, development and innovation (RDI), and regional cooperation. The strategy acknowledges that ORE development should consider nature protection and the new Biodiversity Strategy (see paragraph ***08***). The investments required to reach the objectives were estimated to amount to €800 billion by 2050, most of which would come from private investments.

19 The Commission considered numerous decarbonisation scenarios[9] for ORE, including those that will achieve climate neutrality by 2050 in line with the European Green Deal ambitions. The estimates ranged from 230 GW to a maximum of 450 GW of predicted offshore wind capacity by 2050, the latter being strongly supported by industry. The scenario

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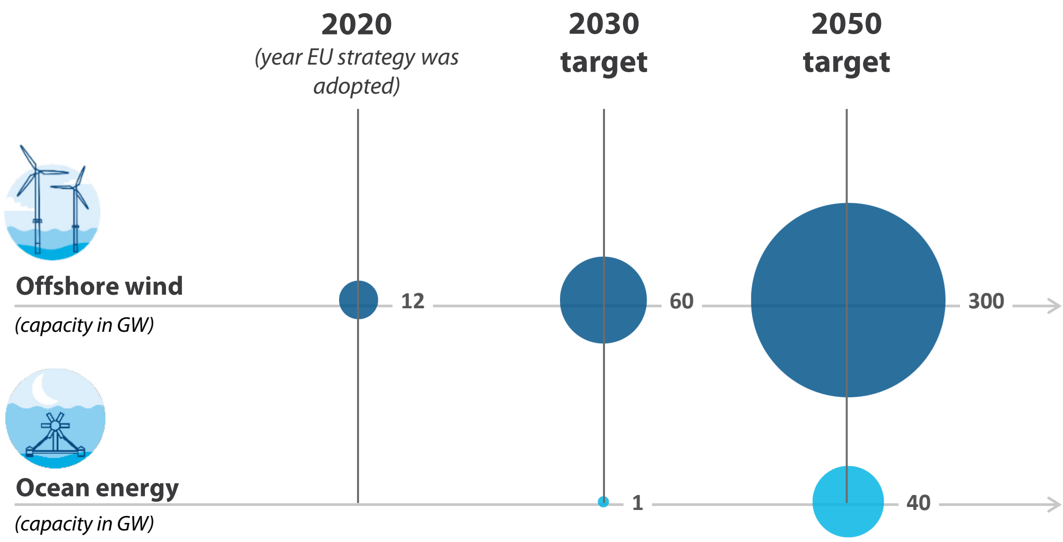
[8] COM(2020) 564, p.4.

[9] Facts and figures on Offshore Renewable Energy Sources in Europe, 2020, JRC 121366.

for ocean energy by 2050 estimated potential installed capacity to be 47 GW, comprising 31 GW of wave and 16 GW of tidal.

20 Based on these scenarios, the Commission set specific mid- and long-term targets concerning the future capacity of ORE, broken down by technology type (see ***Figure 2***). The 2030 objective of installed capacity for offshore wind was set at 60 GW and at least 1 GW for ocean energy. By 2050, capacity should reach 300 GW and 40 GW respectively. Given that when the EU ORE Strategy was adopted (2020) there was only 12 GW of installed offshore wind capacity and no commercial deployment of ocean energy, and in view of the challenges that we present later in the report, we consider that overall these targets, for both the mid- and long-term, are ambitious and may be difficult to achieve.

Figure 2 – The offshore renewable energy targets embedded in the EU ORE Strategy (in GW)



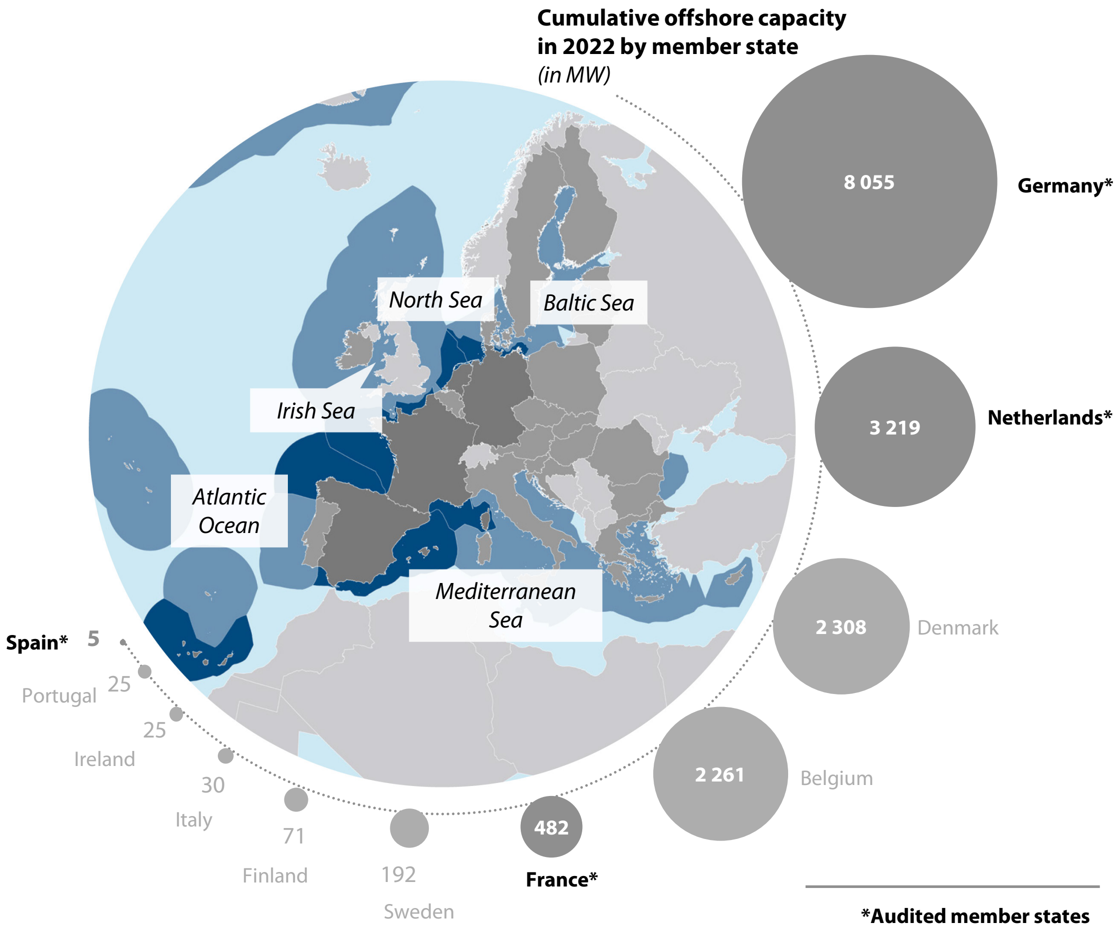
Source: ECA, based on the EU ORE Strategy.

21 The EU ORE Strategy does not provide for any specific governance arrangements to translate EU-wide targets into national objectives. The national energy and climate plans are the main tools for the Commission to assess national and subsequently EU energy and climate ambition. The Commission's monitoring of progress towards the targets is based in particular on the biennial integrated national energy and climate progress reports that member states submit. The Commission promotes the EU ORE Strategy at stakeholder and expert meetings, and makes EU funds available through dedicated RDI calls for proposals.

National plans in three audited member states envisage large-scale offshore renewable energy deployment contributing to meeting the EU-wide targets

22 Reaching the EU-wide ORE targets, which are not binding on member states, depends on deployment at national level. Each country decides on its own energy mix and the pace of ORE development (see ***Figure 3***). We analysed whether the EU policy framework had been used by national authorities and how national plans contribute to reaching the EU-wide targets.

Figure 3 – Overview of offshore renewable energy development in the EU



Note: The figure presents only those coastal member states which have installed offshore renewable energy capacity.

Source: WindEurope 2022 statistics.

23 Germany has the largest offshore capacity of all member states. By the end of 2022, it had installed offshore wind farms with a capacity of 8.1 GW, mostly in the North Sea. In July 2022, Germany significantly increased its ORE targets to 30 GW by 2030, 40 GW by 2035, and 70 GW by 2045. Reaching these targets will require substantial additional sea space.

24 The Netherlands has been rolling out offshore wind in the North Sea since 2007. Its 3.2 GW capacity is currently the second largest cumulative capacity of offshore wind in the EU. The national ORE targets were set before the EU ORE Strategy and were revised in 2022 to align the targets with the Fit for 55 package. The latest objective is to reach 21 GW of installed capacity around 2030, and as in Germany, it will require considerable sea space in the already crowded North Sea.

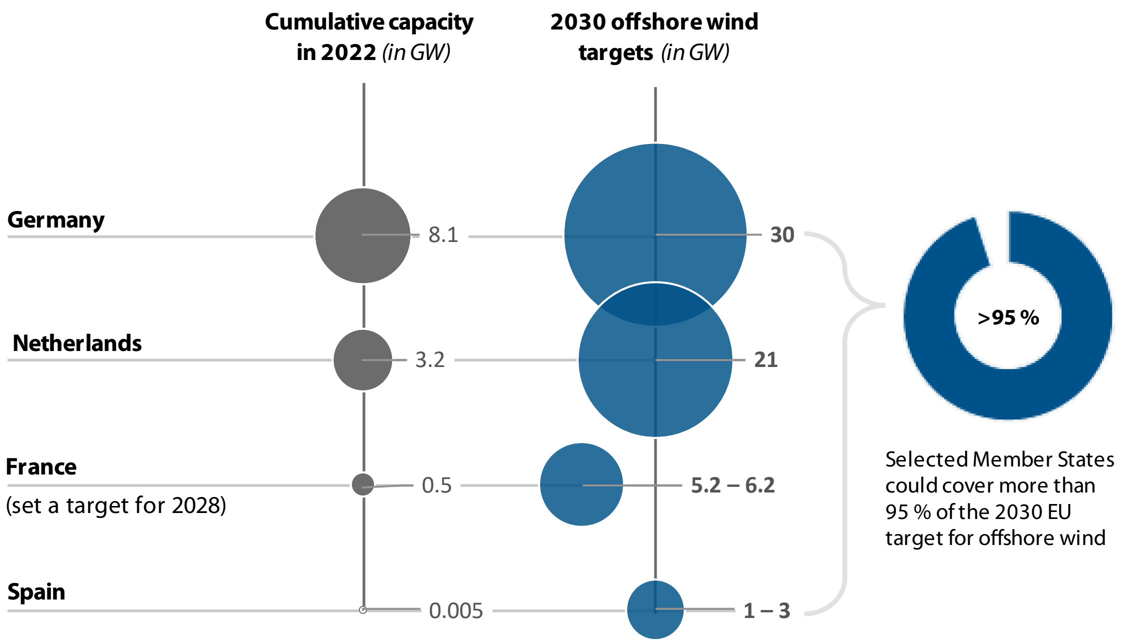
25 France defined its offshore strategy in 2009. However, the first commercial wind farm (Saint-Nazaire) has only been fully operational since November 2022. The current total cumulative capacity of ORE amounts to 482 MW. The national ORE target of up to 6.2 GW by 2028 was adopted in 2020, just before the EU ORE Strategy, and has not changed since. In February 2022, France committed to 40 GW offshore wind by 2050. The slow pace of ORE development indicates that in order to meet its target, a significantly more rapid rollout of ORE installations will be required.

26 Spain's first attempt at deploying ORE was in 2007. The bottom-fixed wind technology available at that time was not compatible with the Spanish continental shelf, which is narrow and deep. No major commercialised ORE installation existed in Spain in early 2023. The current 2030 ORE target of up to 3 GW was approved in 2021 and was triggered by the EU ORE Strategy. Spain considers that its contribution to the EU renewable energy target will be mostly based on onshore technologies with its potential for onshore wind and photovoltaics.

27 In Germany and the Netherlands, the impact of EU policies on national ORE strategies and targets was limited, as these countries had launched their own policies long before the EU ORE Strategy. In Spain and France, the EU climate and energy policies were more useful in providing an input into national ORE strategies.

28 All four national plans targeting offshore renewables that we have assessed should contribute to the EU climate objectives. In ***Figure 4***, we present the overview of national ORE capacity and 2030 targets in these member states. If implemented successfully, they would cover more than 95 % of the 2030 EU target for offshore wind, mostly thanks to those member states that had already been developing the sector prior to the EU ORE Strategy. At the time of the audit, out of the four member states we reviewed, only Spain set a target for ocean energy representing 6 % of the EU-wide target for that technology.

Figure 4 – Overview of national offshore renewable energy in 2022 and targets for 2030 (in GW)



Source: ECA based on national ORE strategies.

Offshore bottom-fixed wind technology is well-established, but ocean energy is lagging behind

29 Offshore renewable energy can be generated using different technologies. The EU ORE Strategy breaks down the targets between offshore wind and ocean energy (tidal and wave).

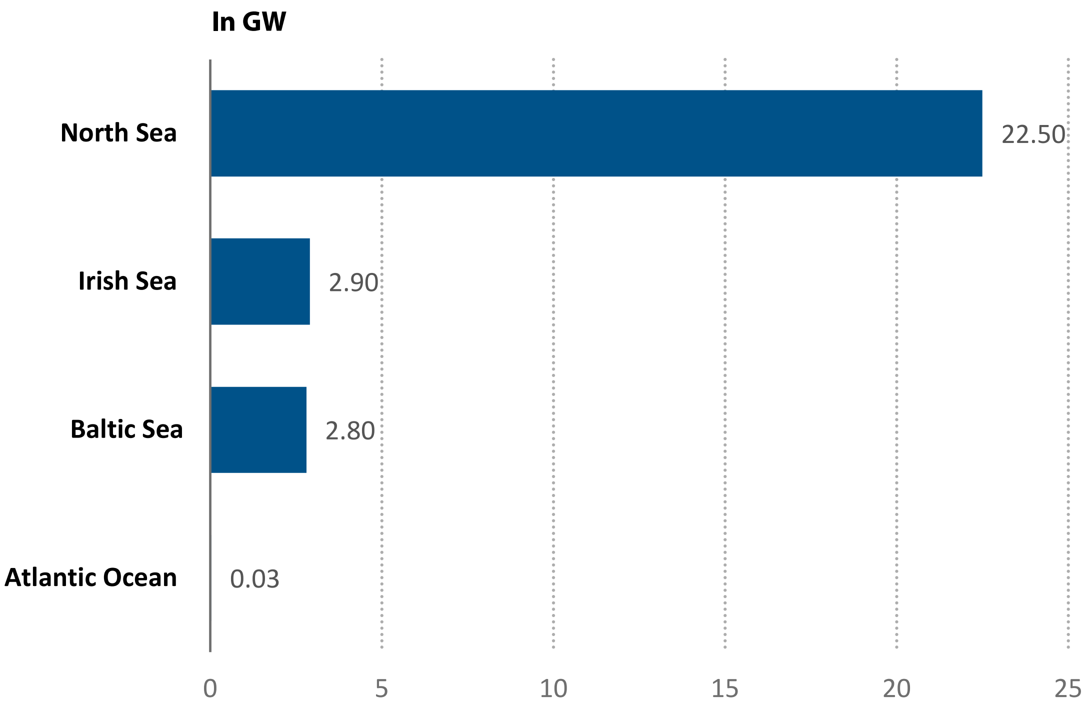
30 At present, each offshore energy technology is at a different stage of development. **Bottom-fixed wind** (see *Picture 1*) is a technology which is at the commercialisation stage, and it is currently the most advanced. In 2022, its total cumulative capacity reached 16 GW

Picture 1 – Offshore wind farm

© stock.adobe.com/halberg

in the EU[10]. At the level of the European continent, over the last decade, bottom-fixed wind has been mostly developed in the North Sea (see ***Figure 5***). The technology costs have decreased[11] significantly over time, to a level where it represents a cost-competitive source of energy. Of the four audited member states, Germany, France and the Netherlands have based their national offshore targets on bottom-fixed offshore wind technology.

Figure 5 – Offshore wind by sea basin in Europe (EU and non-EU countries) at the end of 2021



Source: ECA based on WindEurope.

31 Most of the existing offshore wind farms were deployed as national projects that are directly connected to the shore. According to the EU ORE Strategy, the future development of offshore wind farms may take form of so-called hybrid projects, which connect offshore wind farm to a cross-border interconnector. The first “hybrid project farms” have recently been authorised (see ***Box 1***).

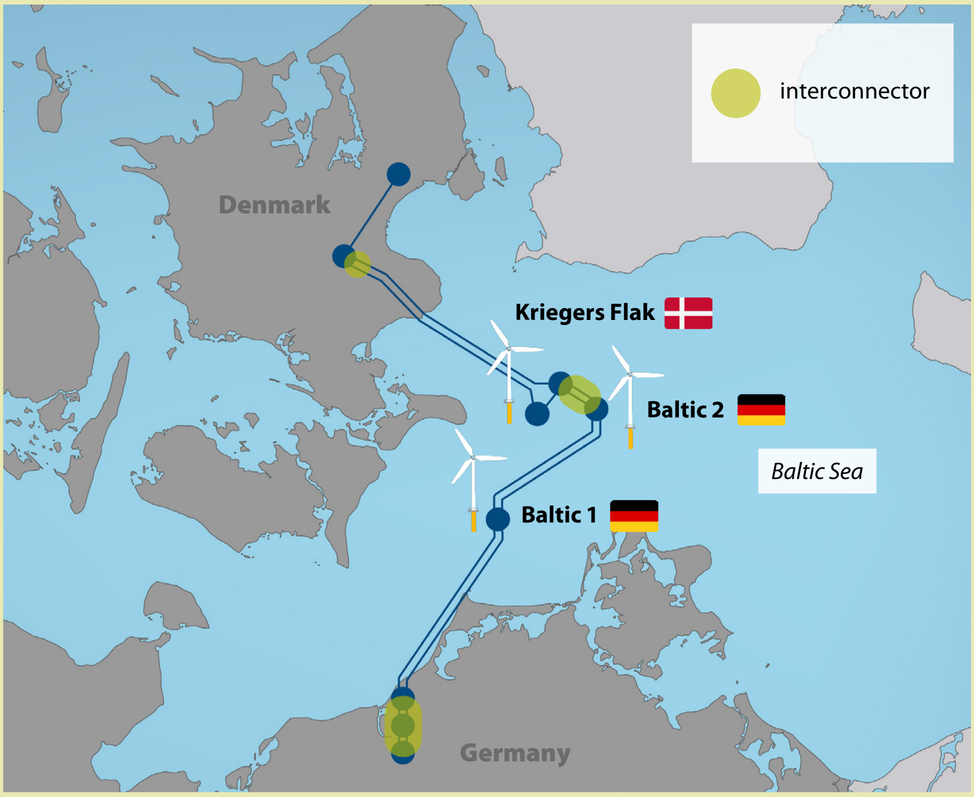
[10] WindEurope: 2022 statistics and the outlook for 2023-2027.

[11] Unleashing Europe’s offshore wind potential, WindEurope, 2017.

Box 1

Hybrid offshore energy farms - Kriegers Flak combined grid solution

In 2020, Denmark and Germany put an interconnector project into operation in the Baltic Sea, with the objective of connecting the Danish region of Zealand with the German state of Mecklenburg-Western Pomerania via two offshore wind farms, German Baltic 2 and Danish Kriegers Flak. It is the world's first project to combine grid connections to offshore wind farms with an interconnector between two countries. The European Energy Programme for Recovery financed the project.



Source: ECA based on Energinet.

32 Taking into account plans to develop bottom-fixed wind energy at national level, combined with technology maturity, the 2030 EU-wide targets for offshore wind could be achieved, on the condition that annual deployment rates increase significantly[12]. On the other hand, the recent surge in inflation may slow down the development of offshore wind.

33 **Floating wind** is an attractive offshore technology for sea basins with deep waters, as it allows floating installations to be deployed in waters at depths greater than 50 metres. This technology is compatible with the conditions in the member states bordering the Atlantic Ocean, the Mediterranean Sea and potentially, the Black Sea.

34 By the end of 2021, the EU had deployed 27 MW of floating offshore wind capacity. According to a 2022 Joint Research Centre study[13], a pipeline of projects will lead to the installation of 247 MW of floating capacity in EU member states by 2025. Moreover, according to this study, the costs of floating wind are expected to decrease significantly by the end of this decade and become comparable with those of bottom-fixed installations.

35 Of the four member states covered by this audit, France and Spain are developing this technology, and Spain's 2030 offshore target is mainly based on floating wind technology. This technology is still at the pre-commercialisation stage, but thanks to the knowledge transfer from established offshore industries, and the increasing number of floating wind projects being deployed, it is developing rapidly and may become an important source of offshore renewable energy[14].

36 Generated by tide (see ***Picture 2***) and waves, **ocean energy** can play an important role in the European energy mix. The ocean is a stable and predictable source of energy, which can produce energy at different times to offshore wind and solar, helping to balance electricity supply and demand.

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[12] GWEC, Global Offshore Wind Report, 2022; Telsnig et al., 2022, Wind Energy in the European Union – 2022 Status Report on Technology Development, Trends, Value Chains and Markets, JRC130582.

[13] Telsnig et al., 2022, Wind Energy in the European Union – 2022 Status Report on Technology Development, Trends, Value Chains and Markets, JRC130582.

[14] WindEurope, Position paper on Scaling up Floating Offshore Wind towards competitiveness, 2021; GWEC, Floating Offshore Wind – a global opportunity, 2022.

Picture 2 – Tidal turbine

Source: Balao for Sabella.

37 However, ocean energy technologies have not yet reached the commercialisation stage, nor have they been consistently tested over the long term. According to the industry, this is due to the lack of effective policy support, including funding[15]. At the beginning of 2023, in Europe, there was 13 MW of operational ocean energy capacity, out of a total of 43 MW of cumulative demonstrators capacity that has been installed since 2010. The remaining installations were decommissioned once the demonstration projects or associated research projects were completed.

38 In Spain, due to the favourable natural conditions, numerous ocean energy prototypes are being tested, and of the audited countries, the Spanish authorities are the only ones to have set a specific target for ocean energy.

39 Widespread commercial deployment of ocean energy is not expected before 2030 and its contribution to reaching the 2030 renewable energy targets will most likely be marginal. None of the four member states has excluded using ocean energy technologies for future capacity installations, but their support is currently limited to providing test sites.

[15] Ocean Energy: Key trends and statistics 2022, Ocean Energy Europe, 2023.

EU financing targets the need for technological progress in offshore renewable energy

40 The EU has financed ORE development for almost four decades, through a variety of funding programmes. To use EU money in the most effective way, we expected the Commission to identify the needs and allocate EU funds to projects that addressed the challenges identified. We analysed various EU funds allocated under shared and direct management[16], then focused on the Recovery and Resilience Facility and the EIB.

41 There is no single repository of EU-funded projects that support ORE. Such information is available and spread over various databases relating to individual EU funding programmes. We therefore accessed the available databases[17], and analysed all identifiable ORE projects funded by the EU budget since 2007.

42 In total, we identified 496[18] EU-funded projects that supported ORE. EU support amounted to €2.3 billion. They concerned wind, wave and tidal, and other offshore technologies, such as floating solar.

43 The Commission identified the main issues to address as the need for increased performance and reliability of offshore wind technology, and to reduce the cost of energy production. Technological advances were to be achieved through producing more powerful turbines (see ***Figure 6***), for example. Developing floating wind technology was also listed as a priority. Non-technological aspects included the acquisition of deeper knowledge about the potential effects of wind energy on the environment, and greater social acceptance of offshore wind technology.

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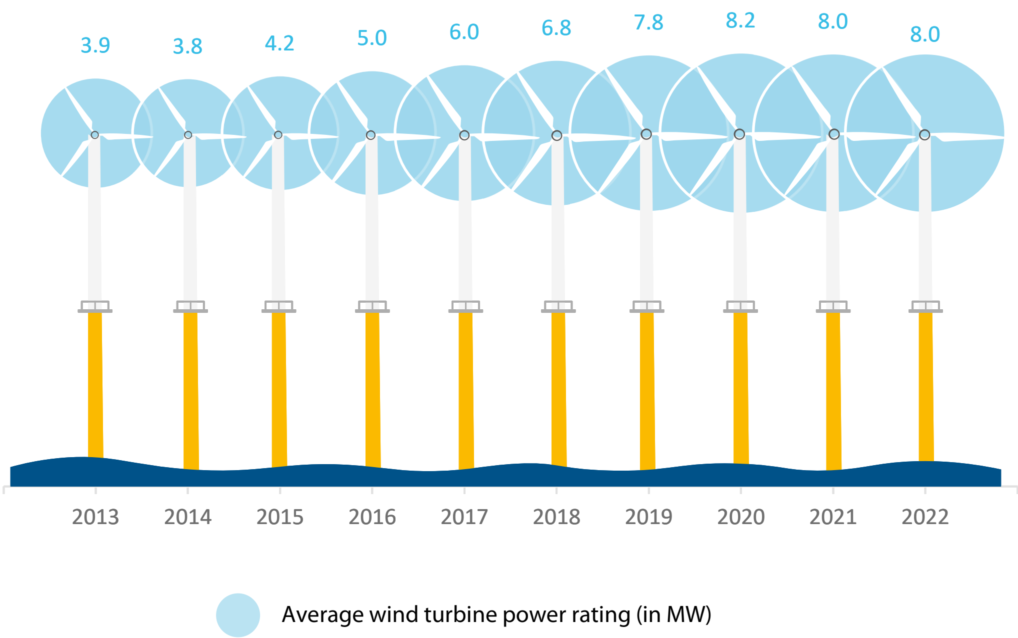
[16] NER 300, CEF, ESIFs, FP7, Horizon 2020, Horizon Europe, Innovation Fund, LIFE and EEPR.

[17] CEF, LIFE, Kohesio.eu, Cordis, Interreg, Overview of EU funding for ORE.

[18] The projects may overlap, meaning that in terms of money and number they are not cumulative.

Figure 6 – Evolution of turbine power rating



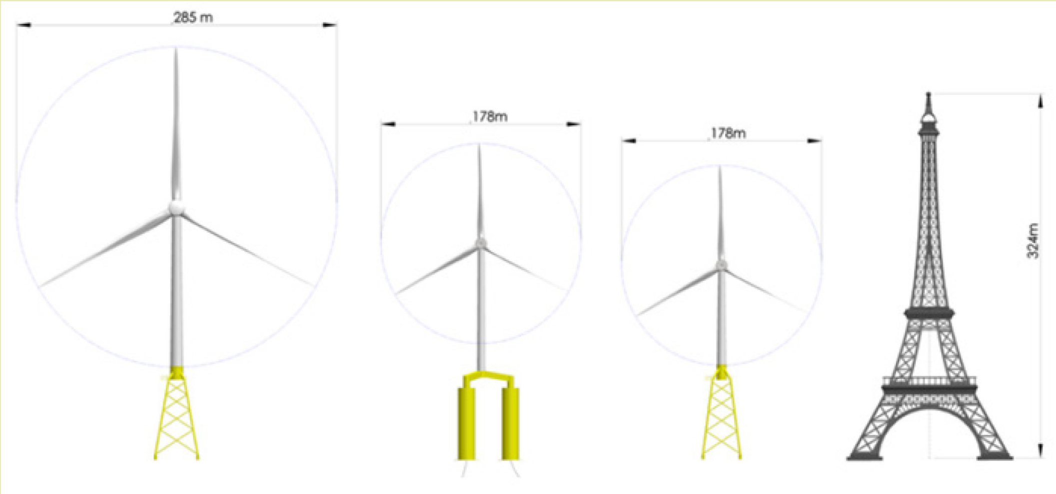
Source: WindEurope 2022 statistics.

44 Of the 496 EU-funded projects we identified, 281 supported offshore wind (including floating) with a total budget of €1.7 billion. The aim of the projects was to advance wind turbine technology (see ***Box 2***), support testing and demonstrations, or optimise the manufacturing process, with the ultimate goal of providing solutions that could be cost-effectively deployed on an industrial scale. We consider that these projects addressed the identified needs. Other aspects, such as the environmental and social implications caused by ORE development, were addressed to a lesser extent.

Box 2

Larger offshore wind turbines developed through an EU-funded project

INNWIND is an EU-funded project with a budget of €20 million financed under the seventh framework programme for research, and carried out between 2012 and 2017. Its objectives were to create the conceptual design of 10-20 MW offshore wind turbines. As demonstrated by the project, moving from the conventional offshore turbine of a 5 MW to a 10-20 MW model would mean a cost reduction of 30 %, getting the offshore wind technology closer to the market. The project also produced and tested novel floating wind turbines.



Source: Innwind.eu.

45 The objectives to support developing ocean energy were agreed in 2016, and focused on making it commercially viable. We identified 176 EU-funded projects supporting ocean energy, with a total budget of €502 million. Most of the projects were intended to advance the technology with a strong emphasis on bringing it to market (see ***Box 3***). The majority of the projects resulted in creating prototypes and demonstrators.

Box 3

An EU-funded project supporting the development of ocean energy

PLOCAN in the Canary Islands, was funded through the ERDF in 2007 with a budget of €7.1 million. It is an offshore multi-purpose technical-scientific platform supporting experimentation and the testing of new technologies (including ORE). PLOCAN hosts several other EU-financed demonstration projects, such as PLOTEC (ocean thermal energy), RedSub Electrical (connecting marine energy), X1 WIND, FLOTANT and PivotBuoy (floating wind).

Source: Oceanic Platform of the Canary Islands.

46 We also analysed EU support from the perspective of the technology readiness level (TRL) based on Horizon 2020 projects in the four member states audited. The TRL is a scale from 1 to 9 to estimate technology maturity, where TRL 1 is basic research and TRL 9 means that actual system has proven in operational environment and is ready for scale up.

47 We found that most of the Horizon 2020 projects (77 % in terms of number of projects and 68 % in financial terms) focused on passing the TRL 6 barrier between the testing and operational phases. Therefore, EU money mostly targeted projects with the objective of pushing the technology through the demonstration to the (pre)commercialisation stage.

48 The EU established the European Energy Programme for Recovery in 2009 to fund projects in key energy transition areas, including offshore wind energy. The programme supported nine offshore wind projects with a total budget of €565 million. Six of those projects involved large-scale testing, manufacturing, and deployment of innovative turbines and offshore foundation structures. The remaining three projects supported integrating large amounts of wind-generated electricity into the grid.

49 With regard to projects integrating wind energy into the grid, two out of the three projects were completed (see ***Box 1***). Of the six projects devoted to offshore turbines and structures, five were completed[19]. They delivered innovative solutions, for example in terms of wind farm turbines and foundations. The remaining two projects were terminated without having delivered any results.

50 We analysed whether coastal member states have planned to use the Recovery and Resilience Facility to finance investments in ORE. Of the 22 coastal member states, 11[20] have planned to use their national recovery and resilience plans as an opportunity to boost ORE. The national plans focus on offshore wind. Italy and Poland have set targets for installed capacity, while the nine other countries pledged reforms, such as amendments to their current legislation, to facilitate the deployment of ORE installations.

51 We identified 48 ORE projects[21] which the EIB supported over the 2007-2022 period for a total signed financing amount of €14.4 billion. It did so using its own resources as well as, in 23 cases, financing under the portfolio guarantee or the risk-sharing mechanism of different EU financial instruments, such as EFSI, InnovFin - EDP (Energy Demo Projects) and Risk Sharing Finance Facility. These 48 projects aimed to increase the EU's ORE capacity by 10.4 GW[22]. Whilst the majority of the 48 projects related to bottom-fixed wind energy, four recent projects related to floating wind farms, two projects supported corporate RDI programmes, and one project related to wave energy converters.

[19] COM(2022) 385.

[20] Belgium, Bulgaria, Estonia, Greece, Spain, Italy, Lithuania, Netherlands, Poland, Romania and Finland.

[21] Based on the data available on the EIB/EIF website as of November 2022.

[22] Belgium, Denmark, Germany, Spain, France, Netherlands, Portugal, and the United Kingdom.

Deploying offshore renewable energy faces practical, social, and environmental challenges that have not yet been sufficiently addressed

52 European seas are used extensively for shipping, fishing, energy production, recreation, and tourism. The national maritime spatial planning process should help national authorities to allocate sea space for different uses, while avoiding conflicts and protecting the environment.

53 The MSP Directive requires member states to establish national maritime spatial plans to identify existing and future uses of their marine waters, including renewable energy installations. The deadline for drawing up national maritime spatial plans was 31 March 2021.

54 The Commission recognises the important role of maritime spatial planning for developing ORE. In the EU ORE Strategy[23], the Commission encourages member states to use MSPs to plan ORE development, assessing environmental, social, and economic sustainability, guaranteeing coexistence with other activities, and ensuring that the public accepts the planned deployments. We checked whether the Commission supported member states in implementing the MSP Directive. We also analysed whether and how national authorities identified and addressed the challenges involved in sustainably deploying ORE.

The Commission supports national authorities in implementing the Maritime Spatial Planning Directive by providing guidance and sharing knowledge

55 Recognising the importance of MSPs in the development of ORE, we expected the Commission to facilitate the implementation of the MSP Directive through various measures and EU-funded projects.

56 We found numerous activities carried out by the Commission, the aim of which were to support national authorities with the implementation of the MSP Directive in general, and ORE development in particular. For example, it established the MSP platform for sharing knowledge and experiences, prepared guidance on managing conflict with sectors in competition with ORE, and issued best practice for multi-uses of space and cross-border cooperation.

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[23] COM(2020) 741, section 4.

57 We also identified 59 EU-funded projects related to the planning of maritime space, which address the link between MSP and ORE deployment. The funding for these 59 projects amounted to €156 million.

58 Most projects relate to offshore wind farms; only six explicitly refer to other technologies. The majority of the projects address nature protection and seek to gather data and share knowledge to better understand the marine ecosystem.

Maritime spatial planning facilitates the development of offshore renewable energy, but has not resolved conflicts of use

59 We assessed whether the EU MSP Directive had been useful to the audited member states and whether their national plans served as a tool to designate areas for planning ORE. We also checked whether the co-use of sea space was reflected in the national MSPs and whether national MSPs identified and addressed existing and potential conflicts between ORE and fisheries.

60 Germany and the Netherlands were using MSPs well before the adoption of the MSP Directive and the latter had little impact on national processes. In France, the nationwide strategy to manage maritime spatial planning entered into force in 2017, transposing the EU MSP and MSFD Directives. The MSP Directive also prompted the Spanish authorities to integrate all relevant human activities into one strategic document. At the time of our audit, Spain had not yet adopted its national maritime spatial plan. The plan was adopted in February 2023, almost two years after the deadline.

61 All four national maritime spatial plans that we reviewed zoned potential areas for ORE (see ***Annex I***). When designating potential areas for ORE, authorities first define the areas for offshore wind energy in spatial and temporal terms. These areas are identified, taking into account technical criteria such as wind speed and other sea uses. The areas then undergo a preliminary assessment to designate the optimal location for an offshore farm.

62 The EU ORE Strategy indicates that ORE can and should coexist with many other activities, including fishing, aquaculture, and nature preservation and restoration. We found that the principle of coexistence is integrated into all four national MSPs that we looked at, but there are few projects of commercially viable co-use within wind parks. For example, the Dutch authorities have granted a permit to a company to test new offshore mussel cultivation methods within the Borssele 3 wind park.

63 Fisheries are an important sector for coastal regions and EU waters are densely covered by fishing lanes and areas. The EU common fisheries policy sets the rules for managing European fishing fleets and conserving fish stocks. It does not specifically address fishing and aquaculture in and around ORE installations. The Commission has conducted studies and issued guidance on how to address potential conflicts of demands for sea space, including those with the fisheries sector. These are helpful tools to guide national authorities when allocating sea space to different users.

64 According to the available studies[24], conflicts concern spatial exclusion of fisheries from the area used for offshore wind farms. For safety reasons (e.g. the risk of accidental collision), fishing vessels are only allowed to enter ORE areas under certain conditions (e.g. 500 metre buffer zone around ORE installations), but in theory are not excluded.

65 Increased EU ORE targets will lead to the development of installations at sea. This may result in a progressive reduction of access to fishing areas, which could lower revenue from fishing and increase competition between fishermen[25]. On the other hand, while an improved fish population on a larger scale is uncertain, some fish density increases in the ORE area have been observed[26], indicating potential benefits for fisheries.

66 We found that conflict between the two sectors is still unresolved and is managed in different ways in the audited member states. For example, in Spain and the Netherlands, ORE zones have been redesigned to minimise any interaction with bottom-gear fishing. In France, the offshore wind installation developer is required to compensate fishermen for financial losses. In Spain and France, two countries with strong fisheries sectors, consultation on future ORE zones has not yet dispelled fishermen’s concerns, and opposition to ORE may re-emerge as individual projects are assessed.

Coastal member states consult each other, but rarely cooperate on common offshore renewable energy projects

67 As part of the planning process, the MSP Directive requires[27] those member states with bordering marine waters to cooperate. We checked whether the audited member states had

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[24] Gee et al., 2019, Addressing conflicting spatial demands in MSP; Van Hoey et al., 2018, Overview of the effects of offshore wind farms on fisheries and aquaculture; Dupont et al., 2020, Recommendations for positive interactions between offshore wind farms and fisheries.

[25] Ibid.

[26] Galparsoro et al., 2022, Reviewing the ecological impacts of offshore wind farms.

[27] Article 11 of Directive 2014/89/EU.

consulted each other during the MSP preparatory process, whether member states cooperate at sea basin level, and whether such cooperation had led to common ORE projects.

68 All four member states that we audited had consulted other national authorities within the same sea basin when drawing up their plans. This helped resolve most of the potentially conflicting issues with regards to demarcation and informed neighbouring authorities about the planned offshore renewable energy installations. Additionally, most EU coastal countries cooperate within different regional organisations, bringing together representatives from the national authorities.

69 The North Seas Energy Cooperation (NSEC), a voluntary organisation made up of North Sea countries[28] and the Commission, was created with the aim of facilitating the deployment of offshore renewable energy. In April 2023, seven North Sea member states[29], Norway and the UK signed the Ostend Declaration, setting offshore wind energy target at 120 GW by 2030 and 300 GW by 2050.

70 The aim of the EU Strategy for the Baltic Sea Region is to increase the region's share of renewables. In August 2022, the governments of eight Baltic States[30] agreed to increase offshore installed capacity to 19.6 GW by 2030.

71 The Atlantic Action Plan addresses the importance of marine renewables in the region. It included a specific goal on promoting offshore renewable energy and created a dedicated ORE working group.

72 The development of ORE in the Mediterranean Sea has been slow. Offshore wind is more complex to deploy in this sea basin due to deep waters. The current sea basin potential consists of pilot projects for floating offshore wind, wave, and tidal energy. Cooperation at regional level takes place through various organisations, such as the Association of Mediterranean Energy Regulators.

73 Two EU member states, Bulgaria and Romania, border the Black Sea, which they share with Georgia, Moldova, Russia, Türkiye, and Ukraine. In 2019, all Black Sea countries

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[28] Belgium, Denmark, Germany, Ireland, France, Luxembourg, Netherlands, Sweden and Norway.

[29] Belgium, Denmark, Germany, Ireland, France, Luxembourg and Netherlands.

[30] Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Finland and Sweden.

endorsed the Bucharest ministerial declaration on the common maritime agenda for the Black Sea.

74 The Trans-European Networks for Energy Regulation includes a specific chapter on developing offshore grids. In this context, in January 2023, 23 EU countries[31] agreed non-binding goals for ORE generation by 2050, with intermediate goals for 2030 and 2040, in each of the EU's five sea basins. Overall, they aim to reach a capacity of around 111 GW in 2030 and 281 – 354 GW in 2050. We noticed that in many countries the exact ORE targets are yet to be determined, especially looking beyond 2030 (nine countries). In some cases (e.g. the Netherlands or France), the agreed targets are below the level enshrined in the national strategies.

75 Despite numerous cooperation forums, cross-border ORE projects are not yet common practice, although recently some member states have taken action to translate political commitments into reality. For example, Denmark and the Netherlands have agreed to undertake joint research activities to develop a North Sea Wind Power Hub.

Unsuitable permitting procedures slow down offshore renewable energy rollout in some member states

76 Lengthy national permitting procedures are one of the main non-technical barriers that hinder the rollout of renewable energy in Europe[32]. We analysed different national procedures to see how the member states' authorities address this problem.

77 Permitting procedures vary across the four audited member states. In Germany and the Netherlands, the procedure is streamlined, in accordance with the EU rules[33] requiring a "one-stop shop" approach for authorising renewable energy projects. For example in Germany, one body is responsible for developing and carrying out the preliminary assessment of areas for constructing and operating offshore wind energy, and it also authorises project applications (including all related decisions). In the Netherlands, the permitting procedure is one of the shortest in the EU and the time between offshore wind site tender and commissioning takes up to four and a half years.

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[31] All EU member states except Czechia, Hungary, Austria and Slovakia.

[32] See for example special report 8/2019, Wind and solar power for electricity generation: significant action needed if EU targets to be met, paragraphs 60-61.

[33] Article 16 of Directive (EU) 2018/2001.

78 France has one of the longest lead-times in Europe for approving offshore wind installations, which can extend up to 11 years, and it has not yet established a "one-stop shop" approach. In Spain, the rules for permits date back to 2007 and are currently under review. As there is no commercial ORE installation in Spanish waters to date, there is no experience of a permitting procedure for such projects.

79 According to industry[34], lengthy permitting practices constitute a high level of risk. Long and multifaceted consent procedures lead to higher costs, thereby delaying the creation of a successful offshore wind market.

80 The Commission has actively supported national authorities in accelerating the permitting procedures for renewable energy. As set out in the REPowerEU plan, the Commission has proposed changes to the Renewable Energy Directive[35]. According to the proposal, member states will have to designate "renewables go-to areas", on land or at sea. The proposed revision also operationalises the presumption of renewable energy as being in the overriding public interest. This would allow new projects to benefit from a simplified environmental assessment with immediate effect. The proposed changes were under discussion at the time of our audit. In December 2022, the Council adopted a regulation[36] establishing temporary rules of an emergency nature to accelerate the deployment of renewable energy, including provisions on the permit-granting process, which are also applicable to ORE.

The social implications of offshore renewable energy development have not yet been comprehensively taken into account

81 The MSP Directive requires member states to consider social aspects when establishing and implementing their MSPs[37]. According to the EU ORE Strategy, offshore renewable energy will only be sustainable if it does not have an adverse impact on social cohesion[38]. We checked whether the MSP process identified and addressed the social dimension of ORE development.

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[34] See for example: WindEurope or GWEC.

[35] COM(2022) 222.

[36] Council Regulation (EU) 2022/2577.

[37] Article 5.1 of Directive 2014/89/EU.

[38] COM(2020) 741, section 4.

82 ORE development will have major social implications in terms of employment, infrastructure, and services. The sector is growing significantly: in 2020, 77 000 people were directly and indirectly employed by the offshore wind sector[39], compared to fewer than 400 in 2009. Germany is the biggest employer, followed by Denmark, the Netherlands, and Belgium.

83 The availability of a skilled workforce along the entire supply chain will be crucial for further sector rollout. In 2021, 30 % of companies in the ORE sector faced shortages of skilled staff[40]. Exploring the potential of reskilling and upskilling existing employees who previously worked in the oil and gas sector is one way of attracting people to work in the ORE sector, as well as a way to mitigate the negative impacts of the declining oil and gas sectors. In 2020, the Commission launched the Pact for Skills initiative to promote skills development, including in the ORE sector.

84 However, there is a risk that jobs may be lost in the fisheries sector due to growth in the ORE sector. Fishermen raise concerns about the lack of alternative employment opportunities and the limited reskilling possibilities. We could not find any quantification of the key economic effects on fisheries resulting from ORE development that had been prepared by the Commission.

85 There are few studies of the socioeconomic implications of ORE development, although recently the Commission has started researching this topic. In most cases, national authorities recognise the job creation potential stemming from ORE development. The Spanish national authorities planned measures to obtain better knowledge about the impact of offshore installations on fisheries. France and the Netherlands had carried out analysis on the socio-economic effects of ORE development, but the results were not available at the time of our audit.

86 Social acceptance of ORE is an important factor that may have an impact on the length of time it takes for the process of establishing an ORE installation. For example, in France, offshore wind farm development has been delayed by protests, mainly from local residents, fishermen, and environmental NGOs. For the first six ORE projects awarded, French courts dealt with 50 litigation cases. Recently, the French authorities have intensified their efforts to deepen the dialogue with different stakeholders, including fishermen, and have also simplified legal proceedings to speed up the procedure.

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[39] Blue economy report, 2022.

[40] Ibid.

The supply risk for raw materials may slow down the rollout of offshore renewable energy

87 Developing ORE technologies requires critical raw materials, in particular rare earth elements. These are currently necessary for the manufacture of permanent magnets for wind turbine generators[41] and demand for these scarce resources is constantly increasing[42].

88 Currently, critical raw materials are almost entirely supplied by China[43], which also has a crucial role in manufacturing permanent magnets for wind turbine generators, covering almost 90 % of global needs. The Commission has recently proposed the Critical Raw Materials Act[44] to support the development of domestic capacities and strengthen sustainability and circularity of the critical raw material supply chains in the EU. It also launched a call for projects to finance research for developing innovative solutions that would help reduce the use of raw materials in clean technologies.

89 The EU's dependence on raw materials may create potential bottlenecks, and raises concerns about the security of supply amid current geopolitical tensions. The issue of increased circularity, including recyclability, is essential in the long term.

The impact of offshore installations on the marine environment has not been adequately identified, analysed or addressed

90 The EU ORE Strategy promotes the coexistence of offshore renewable energy and biodiversity. It also underlines that the deployment of offshore installations must comply with EU environmental legislation[45]. According to the strategy, the necessary scaling-up of offshore wind will require less than 3 % of the European maritime area and is therefore compatible with the EU's Biodiversity Strategy.

91 One of the biggest challenges is the assessment of the cumulative effects on the marine environment, stemming from both ORE development and its interaction with other human

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[41] Alves Dias et al., 2020, The role of rare earth elements in wind energy and electric mobility, JRC122671.

[42] Carrara et al., 2020, Raw materials demand for wind and solar PV technologies in the transition towards a decarbonised energy system, JRC119941.

[43] Telsnig et al., 2022, Wind Energy in the European Union – 2022 Status Report on Technology Development, Trends, Value Chains and Markets, JRC130582.

[44] COM(2023) 160.

[45] COM(2020) 741, section 1.

activities at sea. Cumulative effects are those caused by combined past, current, and future activities[46], which are not exclusively related to one sector, and which cover all types of human activity in a given zone. Assessing the cumulative effects from all human activities at sea is an MSFD[47] requirement.

92 Based on a literature review (see ***Annex II***), we identified environmental impacts of offshore installations. We also checked whether national authorities and the Commission had analysed and addressed the potential cumulative consequences resulting from the planned ORE deployment.

93 According to the available studies, ORE development may entail both negative and positive environmental impacts (see ***Figure 7***). These impacts depend on the type of technology used and the life-cycle phase of the installation. The site location, which in the case of wind may be granted for up to 40 years, is crucial for the potential effects it may have on both the marine environment and life above the sea.

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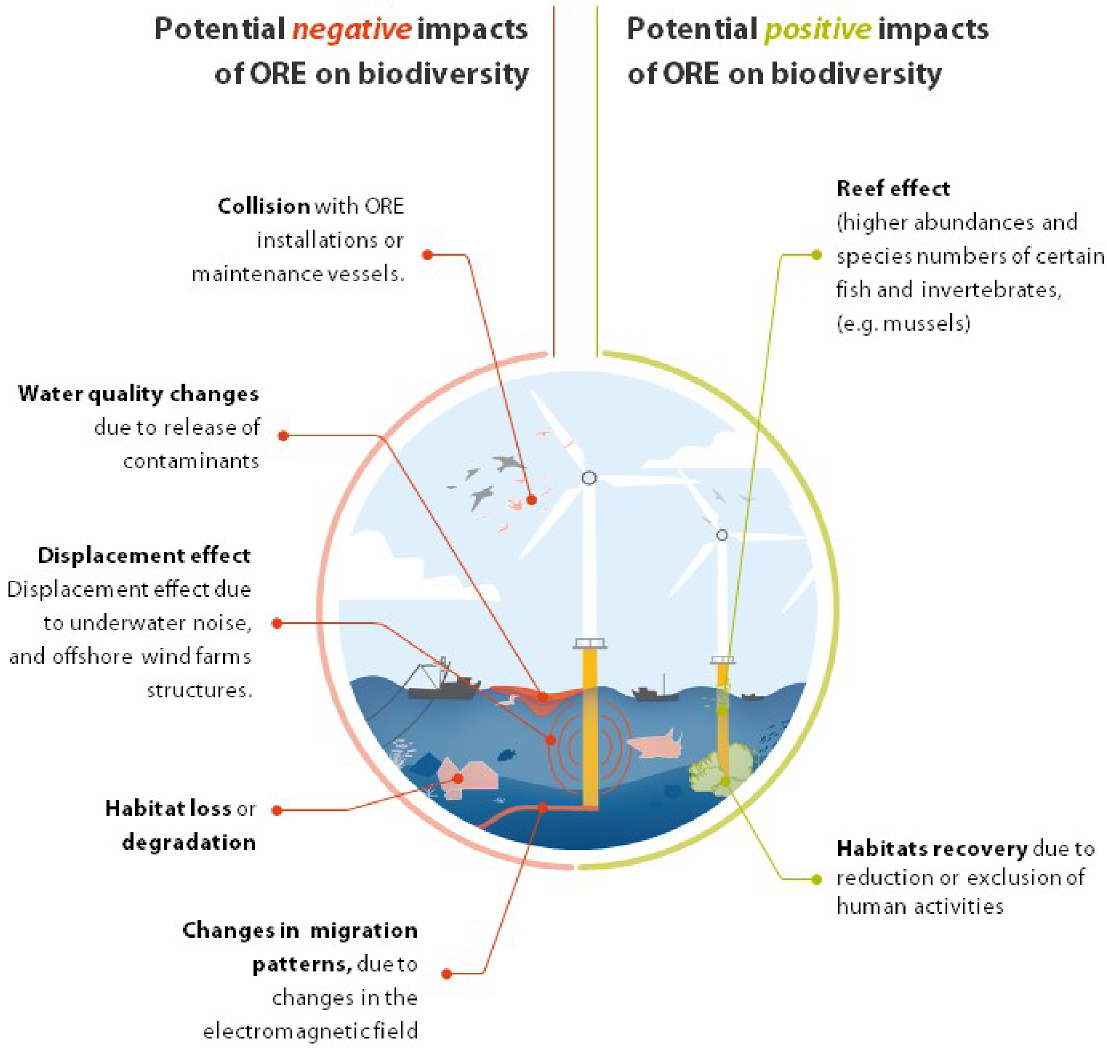
[46] Commission Notice C(2020) 7730, Guidance document on wind energy developments and EU nature legislation.

[47] Article 8 (1) (b)(ii) of Directive 2008/56/EC.

Figure 7 – Overview of the environmental impacts of ORE



Source: ECA based on literature review.

94 Potential cumulative effects may result in species displacement, changes in populations' structure, changes in food availability or changes in migratory patterns (see ***Box 4***). Environmental impact also needs to be considered, bearing in mind a degree of uncertainty due to the as yet unknown effects of climate change and resulting changes in the environment that will have an effect on marine biodiversity and ecosystems.

Box 4

Marine biodiversity at stake

The harbour porpoise, a species present in parts of the Atlantic Ocean and the Baltic Sea, is protected under the Habitats Directive. There is evidence that offshore wind farms have negative effects on the animal, at both individual and population level, such as displacement, especially during construction phases, which results in serious health effects. There are indications of positive effects as well, e.g. increased presence of porpoises inside the wind farm due to food availability or the absence of fishing vessels[48].

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95 A 2022 study[49] attempted to map and analyse the potential environmental impact of ORE. The analysis shows that some stressors caused by offshore energy production can have

[48] Tethys, Harbor Porpoises and Offshore Wind Energy, Science summary, 2017.

[49] Galparsoro et al., 2022, Mapping potential environmental impacts of offshore renewable energy.

a large impact radius, although the greatest cumulative effects occur in the immediate vicinity of the offshore installations.

96 The study also highlights that while the EU ORE Strategy claims that reaching 2030 climate targets would require less than 3 % of the European sea space, it does not consider the fact that deploying ORE might influence a much larger proportion of certain habitat types and their biodiversity.

97 In our interviews with NGOs one of the concerns expressed was the uncertainty surrounding the cumulative environmental effects. Another issue discussed was the knowledge gaps that make it difficult to predict the environmental impact of future offshore installations (see *Box 5*).

Box 5

Saint-Brieuc, an example of an offshore wind farm raising environmental concerns

The Bay of Saint-Brieuc, located on the Atlantic Channel migration corridor, is a particularly biodiversity-sensitive area. It is home to many bird species, including those that are protected or in serious danger of extinction.

The wind farm is located in close vicinity to seven Natura 2000 zones. The French authorities considered that overall environmental studies demonstrated a lack of significant negative impact on the local marine ecosystem. They designated the area for the prospective wind farm in 2011, construction is under way and it should become operational in 2023.

In total, 59 derogations for harming protected species (5 marine mammals and 54 birds species) have been issued to allow the construction of this wind farm. In 2021, the French national council for the protection of nature (CNPN) expressed an opinion stating that protecting biodiversity had not been sufficiently taken into account when the French authorities decided on the location of the wind farm.

Source: ECA based on exchanges with the national authorities and stakeholders.

98 We found that the Commission had not estimated the environmental impact that may have resulted from the ORE expansion proposed in its Strategy. This would have helped the Commission to evaluate the environmental effects stemming from the implementation of its Strategy objectives, and to better balance and alleviate potentially negative impacts.

99 All four audited member states apply environmental criteria when designating areas suitable for ORE installations. Moreover, national MSPs are subject to a strategic environmental assessment, and an environmental impact assessment is required for individual planned installations. These assessments are limited to the area under the jurisdiction of the individual member state, and do not take into account the cumulative environmental effects triggered at sea basin level.

100 At national level, different solutions have been used to identify and minimise the potential adverse environmental impact (see *Box 6*). Mitigation measures at project level also help to reduce the environmental damage caused by an ORE installation. These may include stopping wind turbines during the bird breeding or migration season, ensuring safe bird corridors between farms, or providing sound insulation for wind turbines.

Box 6

Examples of good practice in identifying environmental effects

The Dutch authorities included environment protection as an additional, non-price criterion in the assessment of applications for the Hollandse Kust (west) Kavel VI offshore wind farm. The aim was to build an offshore wind farm that would have as little impact as possible on nature and marine biodiversity. The design of the winning wind farm is "nature-inclusive" and includes, for example, the construction of reef structures on the sea bed, or allocating a section where the wind turbines are widely spaced so that birds can safely fly between them.

Source: Netherlands Enterprise Agency.

101 However, based on the literature reviewed, we found that numerous environmental aspects linked to planned ORE deployment are still to be recognised. There is insufficient empirical data, as well as limited knowledge about non-northern species and marine environments since most of the existing studies are based on the North Sea offshore installations. We consider that given the existing human activities at sea and the scale of the planned ORE rollout, from the current 16 GW of installed ORE capacity to the planned 61 GW in 2030 and beyond, the environmental footprint on marine life may be significant and has not been taken sufficiently into account by the Commission and member states.

Conclusions and recommendations

102 Overall, we concluded that EU actions, including EU funding, have contributed to the development of offshore renewable energy, in particular offshore wind. However, growth objectives are ambitious and may be difficult to achieve, and ensuring the social and environmental sustainability of offshore renewable energy development remains a challenge.

103 More specifically, we found that the EU Strategy on offshore renewable energy identified the needs well, and set the offshore renewable targets at an ambitious level of 61 GW of installed capacity by 2030 and 340 GW by 2050 (paragraphs ***17***-***20***). Three of our four audited member states envisaged a large-scale rollout of offshore renewable energy and plan to contribute significantly to EU-wide targets (paragraphs ***23***-***26*** and ***28***).

104 According to the Commission, the national energy and climate plans have failed to identify the potential of offshore renewable energy. The EU Strategy on offshore renewable energy was set to address this. We found that the EU strategy on offshore renewable energy was particularly useful to member states such as France and Spain, which are only now starting to roll out offshore renewables, by triggering more ambitious national actions aimed at offshore development. Others, such as the Netherlands and Germany, had already established their policies long before the advent of EU targets and therefore the impact of the latter was limited (paragraph ***27***).

105 In its strategy, the Commission proposed offshore renewable energy targets, broken down by technology. The 2030 EU targets for offshore wind fit into the national offshore renewables plans well, envisaging its deployment on a large scale. Considering national plans and technology maturity, these targets could be achieved, on the condition that annual deployment rates increase significantly, and the identified challenges are addressed. On the contrary, targets for ocean energy are rarely reflected at member state level and the contribution of ocean energy to the 2030 EU-wide targets will most likely be marginal (paragraphs ***30***-***39***). The Commission and national efforts at sea basin level concentrate on rolling out offshore wind, with far fewer actions dedicated to ocean energy (paragraphs ***69***-***70*** and ***74***).

106 Over the years, the EU budget has provided €2.3 billion to support offshore renewable technologies. EU funding supports this sector by providing funds for projects mostly targeted at technological advancement and which aim to commercialise offshore technologies, both for wind and ocean energy (paragraphs ***42***, ***44***-***51*** and ***57***-***58***).

Recommendation 1 – Boost the development of offshore renewable energy

To scale up the development of offshore renewable energy, the Commission should:

(a) in its assessment of the draft national energy and climate plans, invite member states to include their national offshore renewable energy targets, broken down by technology type;

(b) trigger and support initiatives to promote offshore wind and particularly ocean energy technologies at sea basin level.

Target implementation date: end of 2024 for (a), and end of 2025 for (b)

107 Maritime spatial planning is a necessary tool to allocate sea space for different uses. We found that the Commission had facilitated national maritime spatial planning by identifying potential conflicts, providing guidance, and targeting EU money at issues essential for offshore renewable energy development (paragraph *56*). Countries that are less advanced in terms of deploying offshore renewable energy have just started using maritime spatial planning as a tool for offshore renewable energy development (paragraphs *60*-*61*).

108 We also found that while the concept of co-using sea space is encouraged, the coexistence of different sectors with offshore renewables is not yet common practice (paragraph *62*). In particular, the unresolved conflict with fisheries in some countries will have to be better addressed to ensure the coexistence of both sectors (paragraphs *64*-*66*).

109 Member states sharing the same waters consult each other when establishing their maritime spatial plans, but have rarely planned common offshore renewable energy projects. This results in lost opportunities to use scarce sea space more efficiently and to minimise the adverse environmental effects caused by the offshore installations (paragraphs *67*-*75*).

110 Unsuitable permitting procedures may slow down the rollout of offshore renewable energy. We found that these procedures and their length vary significantly across the audited member states. Recent legislative changes proposed by the Commission and the Council aim to address these bottlenecks and accelerate the necessary administrative processes (paragraphs *76*-*80*).

111 Thus far, the socioeconomic implications of offshore renewables development have not been studied in sufficient depth. Job creation will be one of the benefits, and most member states have estimated this potential. However, more nuanced analysis is required in terms of skills needs, including re- and upskilling of existing staff employed in the offshore energy sector. The potential negative consequences of offshore renewable energy development on the fisheries sector need to be better identified and addressed (paragraphs ***82***-***86***).

112 The EU is heavily dependent on third countries, especially China, for the raw materials necessary to deploy clean offshore technologies. The high level of dependence on imported raw materials may affect the pace of offshore renewable energy development and have an impact on achieving the EU offshore renewable energy targets. The Commission has recently proposed a Regulation on critical raw materials and is launching research on circularity of offshore wind technology, an area not well developed for the moment (paragraphs ***87***-***89***).

113 The planned growth of offshore renewable energy poses challenges to environmental sustainability. When proposing the EU Strategy on offshore renewable energy, the Commission did not estimate the potential environmental effects. We found that numerous environmental aspects linked to planned offshore renewable energy deployment are still to be recognised. We consider that given the existing human activities at sea and the scale of the planned offshore renewable energy rollout in the coming years, from the current 16 GW of installed capacity to 61 GW in 2030 and beyond, the environmental footprint on marine life may be significant and has not been sufficiently taken into account (paragraphs ***91***-***101***).

Recommendation 2 – Better address the challenges raised by offshore renewable energy development

The Commission should assist member states in addressing challenges that may have an adverse effect on the development of EU offshore renewable energy. In particular, the Commission should:

(a) assess the potential employment, skills and social implications of ORE development in the offshore energy sector and for other users of the sea, notably fisheries;

(b) building on the proposed Regulation on critical raw materials, promote the results of the ongoing research on circularity and monitor their uptake by the industry;

(c) complement its support to member states in terms of identifying, estimating and addressing the effects that offshore renewable energy installations have on ecosystems and biodiversity, by including the cumulative effects at sea basin level.

Target implementation date: end of 2025 for (a), and end of 2027 for (b) and (c)

This report was adopted by Chamber I, headed by Ms Joëlle Elvinger, Member of the Court of Auditors, in Luxembourg at its meeting of 5 July 2023.

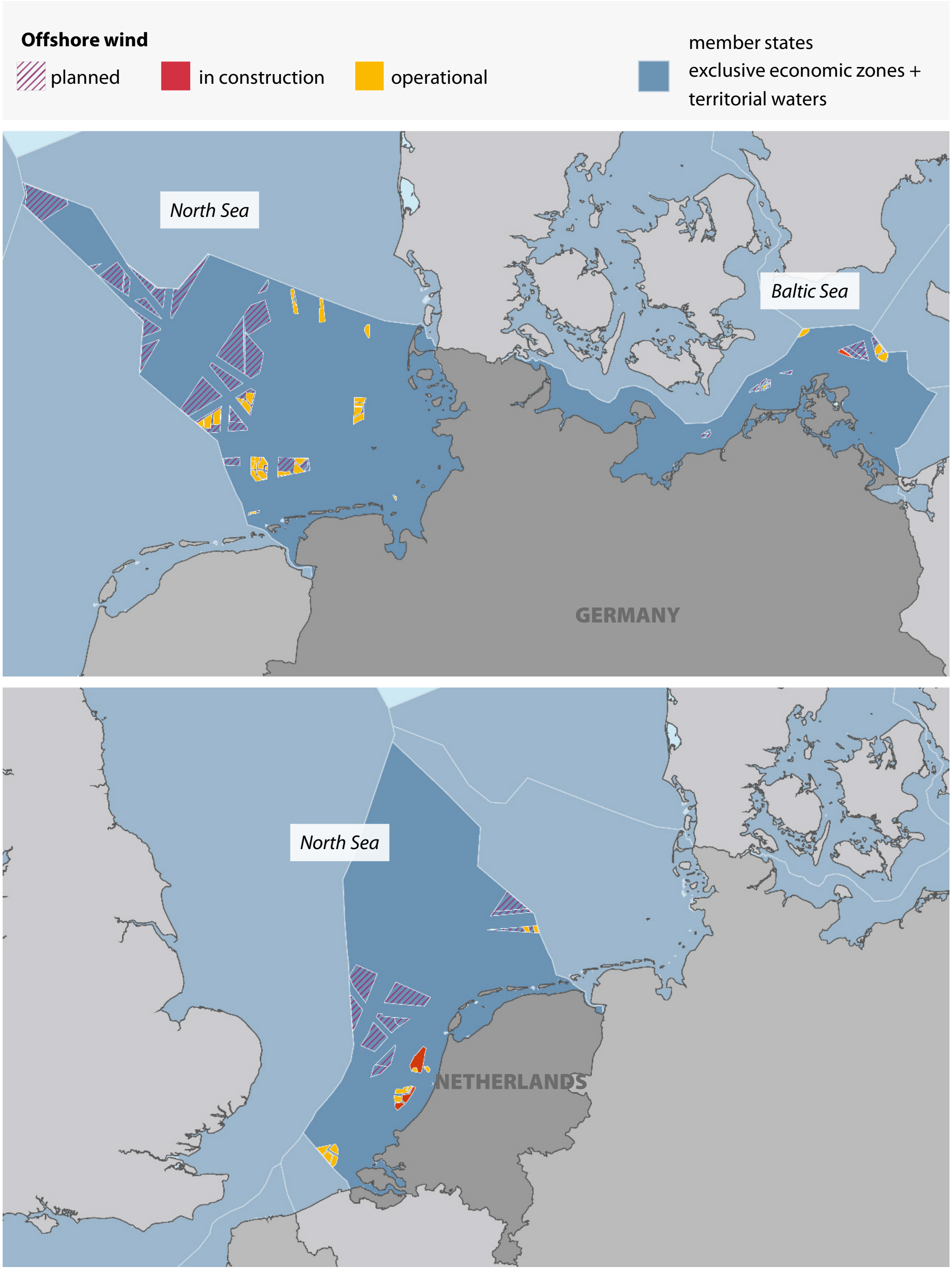
For the Court of Auditors

Tony Murphy
President

Annexes

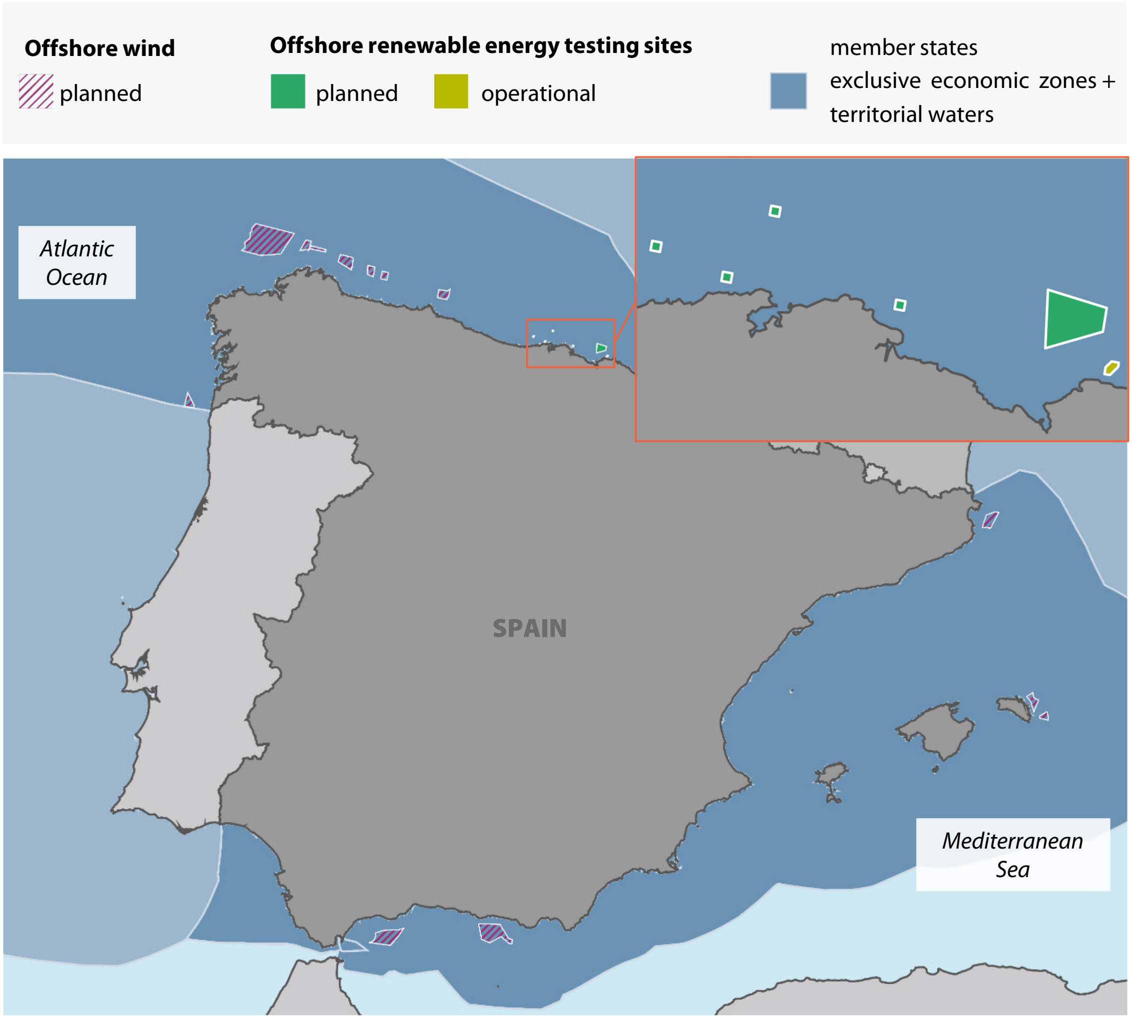
Annex I – Offshore renewable energy installations in audited member states

Offshore Wind installations in Germany and the Netherlands; end of 2022



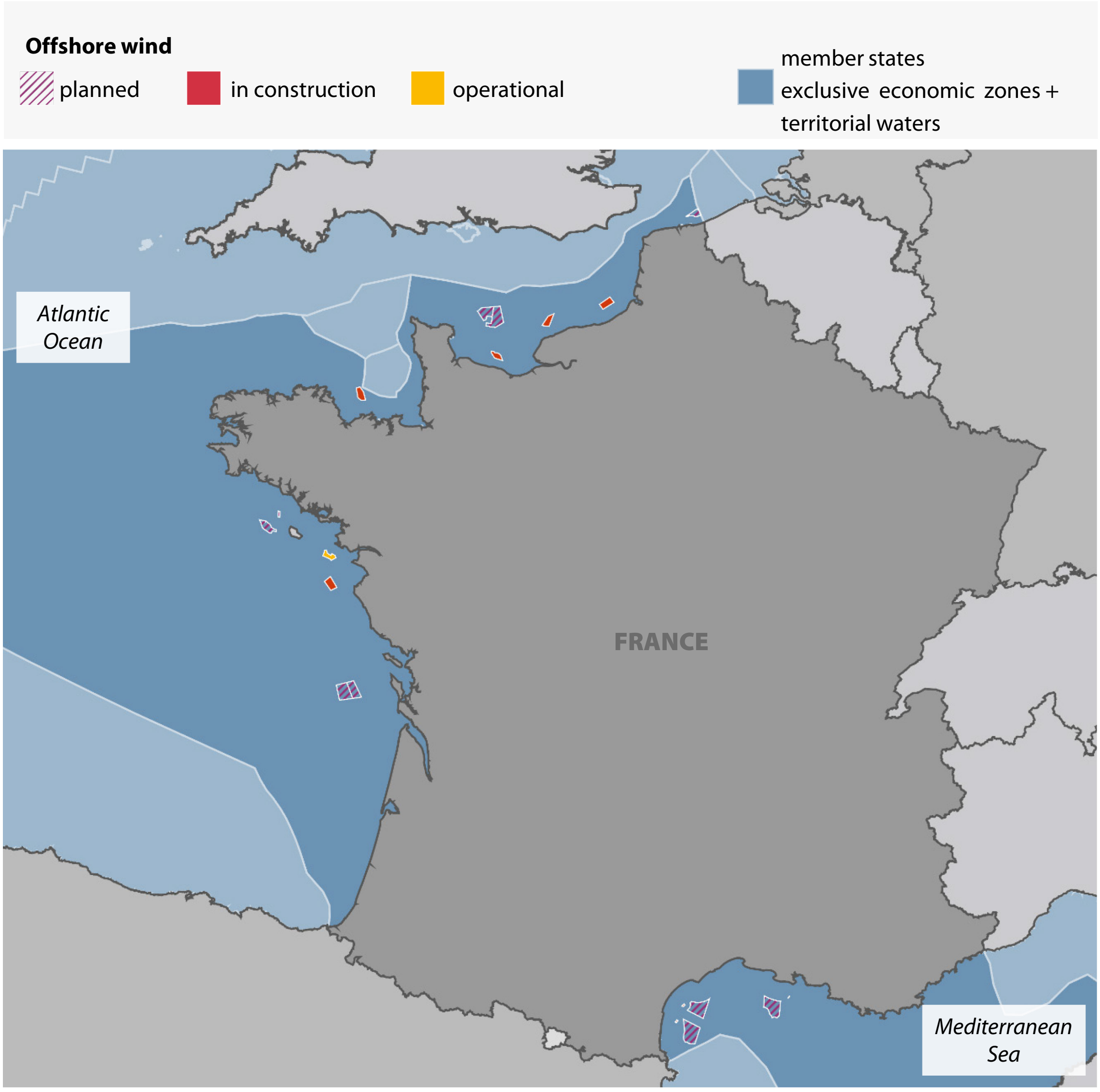
Source: ECA based on data provided by the national authorities and EMODNET.

Offshore Wind and Ocean Renewable Energy RDI installations in Spain; end of 2022



Source: ECA based on data provided by the national authorities and EMODNET.

Offshore Wind installations in France; end of 2022



Source: ECA based on data provided by the national authorities and EMODNET.

Annex II – List of selected studies on environmental impacts of offshore renewable energy

- Garthe et al., 2023, Large-scale effects of offshore wind farms on seabirds of high conservation concern.
- Galparsoro et al., 2022, Mapping potential environmental impacts of offshore renewable energy.
- Galparsoro et al.,2022, Reviewing the ecological impacts of offshore wind farms.
- Willsteed et al., 2018, Obligations and aspirations: A critical evaluation of offshore wind farm cumulative impact assessments.
- Gasparatos et al., 2017, Renewable energy and biodiversity: Implications for transitioning to a Green Economy.
- Dannheim et al., 2019, Benthic effects of offshore renewables: identification of knowledge gaps and urgently needed research.
- Kastelein et al., 2013, Behavioural responses of a harbour porpoise to playbacks of broadband pile driving sounds, Marine Environmental Research.
- Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES).
- WindEUrope: Wind energy and environment.
- Tethys; 2022, Marine Renewable Energy: An introduction to Environmental Effects.

Abbreviations

CEF: Connecting Europe Facility

ESIFs: European Structural and Investment Funds

FP7: Seventh framework programme for research

MSP: Maritime spatial planning

NECP: National energy and climate plan

ORE: Offshore renewable energy

Glossary

Bottom-fixed wind: Method of power generation that uses offshore wind turbines on fixed foundations in shallow water.

Circularity: System based on reusing, sharing, repairing, refurbishing, remanufacturing, and recycling materials in order to minimise resource use, waste and emissions, notably through the circular design of products and of production processes.

Connecting Europe Facility: EU instrument providing financial support for the creation of sustainable interconnected infrastructure in the energy, transport, and information and communication technology sectors.

Demonstration project: Project designed to prove the technical viability of a new technology or approach.

Direct management: Management of an EU fund or programme by the Commission alone, as opposed to shared management or indirect management.

European Fund for Strategic Investments: Support mechanism launched by the EIB and the Commission, as part of the Investment Plan for Europe, to mobilise private investment in projects of strategic importance for the EU.

European Green Deal: EU growth strategy adopted in 2019, aiming to make the EU climate-neutral by 2050 and fight biodiversity loss and pollution in a fair and inclusive way.

European Structural and Investment Funds: The five main EU funds which together support economic development across the EU in the 2014-2020 period: the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development, and the European Maritime and Fisheries Fund.

Floating solar: Method of power generation that uses solar panels mounted on a floating structure.

Floating wind: Method of power generation that uses wind turbines on floating structures in water deeper than 50 metres.

Gigawatt: Unit of electrical power equal to one billion Watts or 1 000 Megawatts.

Horizon 2020: The EU's research and innovation funding programme for the 2014-2020 period.

Horizon Europe: The EU's research and innovation funding programme for the 2021-2027 period.

InnovFin- Energy Demo Projects: Joint scheme between the Commission and the European Investment Bank that provides loans and guarantees for innovative demonstration projects relating to the transformation of the EU's energy system.

InnovFin: Joint Initiative by the European Investment Bank Group and the Commission to help businesses and other organisations access finance for research and innovation.

LIFE: Financing instrument supporting implementation of the EU's environmental and climate policy through co-financing of projects in member states.

Maritime spatial planning: Analysis, organisation and designation of sea and ocean areas to ensure that competing human activities are efficient, safe and sustainable.

National energy and climate plan: Ten-year document outlining a member state's policies and measures to meet the EU's climate objectives.

NER 300: EU funding programme for innovative low-carbon technology.

Risk Sharing Finance Facility: Joint scheme between the Commission and the European Investment Bank to improve businesses' access to loan finance for higher-risk research and innovation.

Seventh framework programme for research: The EU's research and innovation funding programme for the 2007-2013 period.

Shared management: Method of spending the EU budget in which, in contrast to direct management, the Commission delegates to the member state while retaining ultimate responsibility.

Tidal energy: Energy from the natural rise and fall of tides.

Wave energy: Energy from the movement of ocean and sea waves.

Replies of the Commission

https://www.eca.europa.eu/en/publications/sr-2023-22

Timeline

https://www.eca.europa.eu/en/publications/sr-2023-22

Audit team

The ECA's special reports set out the results of its audits of EU policies and programmes, or of management-related topics from specific budgetary areas. The ECA selects and designs these audit tasks to be of maximum impact by considering the risks to performance or compliance, the level of income or spending involved, forthcoming developments and political and public interest.

This performance audit was carried out by Audit Chamber I Sustainable use of natural resources, headed by ECA Member Joëlle Elvinger. The task was led by ECA Member Nikolaos Milionis, supported by Kristian Sniter, Head of Private Office and Matteo Tartaggia, Private Office Attaché; Paul Stafford, Principal Manager; Katarzyna Radecka-Moroz, Head of Task; Milan Šmíd, Servane De Becdelievre, Laura Fitera Murta, Pekka Ulander, Auditors. Marika Meisenzahl provided graphical support. Laura McMillan and Michael Pyper provided linguistic support. Cécile Fantasia and Judita Frangež provided secretarial support.

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The EU strategy for offshore renewable energy sets ambitious deployment targets for 2030 and 2050. We examined whether the Commission and the member states had promoted the sustainable development of offshore renewable energy. We found that while their actions have supported this type of energy, ensuring its social and environmental sustainability remains a challenge. Maritime spatial planning facilitated the allocation of sea space, but has not resolved conflicts relating to its use. Thus far, the socioeconomic implications of developing offshore renewables have not been studied in sufficient depth, and numerous environmental aspects have yet to be recognised. Against this backdrop, we recommend putting in place actions to boost the development of offshore renewable energy, while ensuring environmental and social sustainability.

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