HOW BLACK SEA OFFSHORE WIND POWER CAN DELIVER A GREEN DEAL FOR THIS EU REGION

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Summary

An EU low-carbon economy, with a fully decarbonised power sector at its core, will require very large volumes of low-carbon electricity. To date, offshore wind holds the most promise for the necessary volumes to be realised. While the North Sea offers the best prospects by far, there is significant potential in other waters, including the Baltic Sea, the southern European waters and the Black Sea. Given past and expected cost reductions, Black Sea offshore wind is a major economic opportunity for EU and non-EU countries in the region under the European Green Deal.

From an energy perspective it offers a way to substitute increasingly uneconomic coal, without increasing dependence on imported Russian gas, including for landlocked countries. Offshore wind can rejuvenate harbour areas and attract new investment in future-proof technologies more generally, thereby creating jobs, many of them well paid. Low-carbon energy will become a precondition for attracting future investment, not just for low-carbon industries.

The Next Generation EU recovery fund is an opportunity for the region to take the next step; first plans are emerging. Given its historic size, good plans and projects will be supported. Member states and their regions must quickly develop comprehensive plans.

The experience shows that offshore wind requires a dedicated governance framework. With the Central and South Eastern Europe energy connectivity initiative (CESEC), the framework exists; it can be adapted to meet the needs of offshore wind. A successful EU Black Sea strategy may radiate beyond the EU and the Energy Community. There is interest in renewable energy and offshore wind, especially in Turkey, but also in Azerbaijan, Russia, and the Caspian region.

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1. Introduction

The European Green Deal to achieve climate neutrality by 2050 also aims for environmental sustainability and boosting the efficient use of resources. As such, decarbonisation of the economy is seen as an impetus to a growth strategy built upon "a modern, resource-efficient and competitive economy" in the EU. Four of the six principal actions relate strongly to offshore wind in the Black Sea: i) investing in environmentally friendly technologies; ii) supporting industry to innovate; iii) decarbonising the energy sector; and iv) working with international partners to improve global environmental standards.

In this context, the Blue Economy[1] – the economy of seas and oceans – offers opportunities for low carbon and sustainable growth. Among them are marine (or offshore) renewable energy,[2] in which offshore wind enjoys a leading role. The Blue Economy industrial sector is well established and growing, albeit still relatively small.[3] According to the European Commission, offshore wind is by far the most advanced technology among maritime energy sources and "the only commercial deployment of a marine renewable energy with wide-scale adoption".[4] The 2018 November European Commission's Long-Term Strategy ('A Clean Planet for All') has identified large-scale deployment of offshore wind as one of the decarbonisation opportunities.[5] It expects offshore wind to reach almost 14-16% of EU power generation capacity by 2050. In 2019, the 28 EU member states had 22 GW installed offshore wind capacity, accounting for about 10% of what the European Commission estimated as economical potential for 2050; IRENA and WindEurope arrive at similar results.[6]

As part of the European Green Deal, the European Commission is currently preparing an EU Strategy on Offshore Renewable Energy, to be launched towards the end of 2020; the public consultations were conducted between July and September 2020. The Offshore Renewable Energy Strategy aims to elaborate an approach that balances upscale offshore wind investment with other objectives, i.e. maritime environment protection, safeguarding EU global

[1] The European Commission understands the Blue Economy as all sectoral and cross-sectoral economic activities based on or related to the oceans, seas and coasts. The World Bank's definition of the blue economy refers to "the sustainable and integrated development of economic sectors in healthy oceans". (European Commission (2020), "The EU Blue Economy Report 2020", p. 2; World Bank (2019a), "Problue. Healthy oceans, healthy economies, healthy communities", 2019 Annual Report).

[2] In this study, the terms 'marine renewable energy' and 'offshore renewable energy' are used interchangeably. The terms include offshore wind and ocean energy (wave and tidal energy), as well as floating solar PV. Ocean energy technologies also include salinity gradient energy and ocean thermal energy conversion (OTEC).

[3] In 2019, reported turnover reached €4 billion, with Gross Added Value of almost €1.1 billion. (European Commission (2020), op. cit., p. 78.)

[4] European Commission (2020), op. cit., p. 77.

[5] For example, WindEurope (2017a) estimates that wind energy, offshore and onshore combined, will help saving from 279 to 485 $MtCO_2$ by 2030, or approximately 7-12% of total greenhouse gas (GHG) emissions in the EU-27 (3893.1 $MtCO_2$ in 2018). WindEurope (2017a), "Wind energy in Europe: Scenarios for 2030", September, p. 26.

[6] WindEurope (2017a), op.cit.; IRENA (2019), "Future of Wind. Deployment, investment, technology, grid integration and socio-economic aspects", International Renewable Energy Agency, Abu Dhabi, October.

competitiveness in wind technologies, and the post-crisis economic recovery.[7] As the most advanced offshore renewable energy source, offshore wind is steadily becoming more competitive and therefore a candidate for funding under the Blue Economy plans for economic recovery and technological innovation growth.[8]

While offshore wind is reported to have been one of the sectors that suffered severe initial impacts from the Covid-19 crisis, it is also expected to benefit from a relatively fast recovery.[9] This seems to be confirmed by the situation in the first half of 2020 – global offshore wind financing has reached €29.6 billion, up 319% year-on-year and well above the full-year results in 2019 including the largest ever, the 1.5 GW offshore wind farm in the Netherlands.[10]

Offshore wind is also a central ingredient for the actions specified in the strategies on Energy System Integration[11] and hydrogen,[12] published by the European Commission in July 2020, as well as for the strengthening of EU industrial leadership.[13] For all these strategies to be successful, offshore wind deployment will be required. In return, sub-sea land use and environmental issues will need addressing in close collaboration with Maritime Spatial Planning, also within national maritime spatial plans to be submitted by member states by 2021.

To date, the 22 GW offshore installed wind capacity is divided among ten member states, mostly in the North Sea region (almost half of it is owned by the UK, now no longer an EU member state).[14] Other maritime basins still lag behind and are mostly at the initial stages of offshore wind deployment. Reaching the 2050 EU 'offshore wind ambition', however, will require a focus beyond the North Sea, including for example the Baltic Sea, the southern European waters, and notably the Black Sea basin.

Of particular importance is the Black Sea offshore wind's potential to provide an alternative for baseload as coal, which will gradually need to be replaced and which is widely present in power

[7] European Commission. EU strategy on offshore renewable energy

[8] Up to the end of 2019, the European Fund for Strategic Investment (EFSI) contributed over €1.4 billion to offshore wind projects. The successor of the EFSI, InvestEU, will "switch from purely stimulating economic recovery towards being a primary instrument to accelerate measures under the Green Deal". European Commission (2020), op. cit., p. 11.

[9] European Commission (2020), op. cit., p. 23.

[10] REVE (2020), "Colossal six months for offshore wind energy investment in first half of 2020", 13 July. To some extent, this can be explained, as IRENA (2020) points out, by the fact that most offshore wind projects for 2020 and 2021 are already either partially commissioned or at the advanced stage, especially in Europe. IRENA (2020), "Post-COVID Recovery 2020. An agenda for resilience, development and equality", International Renewable Energy Agency, Abu Dhabi, p. 32.

[11] European Commission (2020), Powering a climate-neutral economy: An EU Strategy for Energy System Integration, COM (2020) 299 final, p. 10.

[12] European Commission (2020), EU Hydrogen Strategy, 8 July.

[13] European Commission (2020), A New Industrial Strategy for Europe, COM(2020) 102 final.

[14] In the EU, most offshore wind capacities are located in Germany (7.5 GW), Denmark (1.7 GW), Belgium (1.6 GW) and Netherlands (1.1 GW). Other member states' joint capacity reached 0.3 GW (Sweden, Finland, Ireland, Spain, Portugal and France). WindEurope (2020), "Offshore Wind in Europe in 2019. Trends and statistics", February, p. 11.

generation in the region. In addition to this energy policy benefit, offshore wind offers an opportunity to stimulate the region's economic development, possibly in the context of the EU's drive for developing a hydrogen economy.

2. Offshore wind prospects

The European maritime areas contain large technical potential for renewable energy.[15] While wave and tidal energy are primarily at the R&D stage and remain largely untapped sources,[16] their capacity is still projected to rise to 3 GW by 2030 and in the range of 6–16 GW by 2040.[17] However, it is fixed offshore wind, which is close to commercialisation, and therefore expected to play the crucial role in decarbonising Blue Economy energy. To date, offshore wind constitutes only 2.3%, but its growth is accelerating. In 2019, 3.6 GW net offshore capacity was added, most all in the North Sea.

The Long-Term Strategy ('A Clean Planet for All'), which has informed the European Green Deal, expects offshore wind power generation capacity to reach between 222 GW and 451 GW by 2050.[18] This would equate it to an annual installation rate of 30–50 GW between 2030 and 2050. For comparison, since 2009 the average annual offshore wind installation has been around 2 GW in the EU-28.[19] The National Energy and Climate Plans (NECPs) that provide the aggregated volumes are estimated to reach 100 GW of offshore wind by 2030.[20] This will also mean significant change to the onshore/offshore ratio, to the benefit of the latter.[21] Other projections confirm this. The IEA estimates some 77 GW of offshore wind for EU-28 and some 50 GW for EU-27 by 2030. IRENA (2019, p. 44) projects 78 GW for 2030 and 215 GW for 2050. WindEurope (2019) estimates are even higher, with 450 GW of offshore wind by 2050, of which about half would be installed in the North Sea alone.[22] The rest is allocated in roughly equal

[15] IEA estimates the total offshore wind technical potential in the EU as 36.728 TWh per year (excluding Greenland). IEA (2019), "Offshore Wind Outlook 2019", International Energy Agency, Paris, p. 70; this would be more than 60 times the German annual final electricity consumption (568 TWh in 2018, IEA (2020), "Germany", statistics).

[16] At the end of 2019, EU ocean energy accounted for 39.5 MW – among which 27.7 MW of tidal steam and 11.8 MW for wave energy – mostly spread along the Atlantic coast. Ocean Energy Europe (2020), "Ocean Energy. Key trends and statistics 2019", March.

[17] IEA World Energy Outlook 2019, quoted in Ocean Energy (2020) op. cit.

[18] In-depth analysis in support of the Commission Communication COM(2018) 773, p. 77; Supplementary Information. In-depth analysis in support of the Commission Communication COM(2018) 773, Figure 24, p. 22.

[19] However, around 4 GW was installed in the EU-28 in 2019. WindEurope (2020), op. cit., p. 14.

[20] An offshore renewable energy agenda for the European Union, Sustainable Energy Week 2020, video recording.

[21] WindEurope (2020), op. cit., p. 10.

[22] To meet this target, annual installation in the North Sea is expected to increase up to 2.8 GW pa until 2025, 4.5 GW pa during 2025–2035, and 9.8 GW pa during 2035–2045, with a slight decrease up to 7.6 GW pa from 2046. WindEurope (2019), 'Our energy, our future. How offshore wind will help Europe go carbon-neutral', November, pp. 8, 34, 72.

shares in the Atlantic Ocean (85 GW), the Baltic Sea (83 GW) and southern European waters (70 GW). Surprisingly, the Black Sea remains absent in this WindEurope projection.

Cost reductions

Installation costs for fixed offshore wind are steadily falling thanks to technological innovation, economies of scale, and maturing of supply chains. Offshore wind can operate without subsidies and achieving targets will become easier.[23] By 2017, IRENA had already reported a series of competitive tenders in the EU, which fell below 88 EUR/MWh,[24] and the 2019 BloombergNEF notes a strong annual decline in installation costs per MW with the benchmark price of 78 EUR/MWh.[25] Some projects in Germany and the Netherlands are already subsidy-free; the same is now expected in the UK.[26] This raises the prospect of offshore wind power becoming cheaper than conventional power generation.[27] Also, according to HSBC,[28] offshore wind is to be the most competitive source for carbon-neutral hydrogen production, largely because of the relatively stable load factor. Among other things, dropping costs has stimulated investment inflow into the sector; for example, BloombergNEF notes that global investments in offshore wind increased by 19% compared with 2018.

With maturing commercial scale by 2030, costs of floating wind farms' installation could also decrease to €40–60/MWh[29] for the first commercial-scale projects with final investment decision between 2023 and 2025, according to WindEurope's (2018) estimations. In addition, some studies already expect green hydrogen production from offshore wind to become profitable by 2030.[30]

3. Potential in the Black Sea region

The Black Sea region has barely featured in EU discussions about offshore wind.[31] This can be partly explained by the fact that, to date, there have been no plans for offshore wind in the Black Sea waters. The region's focus was on onshore wind, with Romania hoisting the biggest onshore wind park in Europe. In 2018, however, Eurelectric and WindEurope presented a joint

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[23] M. Jansen et al. (2020), "Offshore wind competitiveness in mature markets without subsidy", *Nature energy,* Vol. 5, pp. 614-622.

[24] IRENA (2018a), "Renewable power generation costs", International Renewable Energy Agency, Abu Dhabi, May, p. 25.

[25] BloombergNEF(2020), "Clean energy investment trends", July.

[26] Jansen et al., op. cit.

[27] I.e. according to the recent publication by the UK Government, renewables are cheaper than nuclear and gas power plants.

[28] HSBC (2020), "Global Hydrogen. Approaching sector tipping point – hydrogen FAQs", 10 July.

[29] Wind Europe (2018), "Position Paper, Floating offshore wind energy: a policy blueprint for Europe", p. 5.

[30] V. N. Dinh et al (2020), "Development of a viability assessment model for hydrogen production from dedicated offshore wind farms", *International Journal of Hydrogen Energy*, in press, corrected proof.

[31] WindEurope (2019), "Our energy, our future. How offshore wind will help Europe go carbon-neutral", November, p. 72.

statement to the CESEC high-level meeting with a call to "map the potential for offshore wind deployment in the Black Sea alongside an action plan for developing large interconnectivity projects."[32]

The relative lack of interest from the EU side strongly contrasts with a recent World Bank map, which estimates the Black Sea region's technical potential at 435 GW, of which 269 GW is fixed and 166 GW floating (Table 1), although not all of this potential is located in the EU or Energy Community member states. This is significant, even if it is only a fraction of the North Sea region.[33]

Table 1. Technical potential of offshore in the Black Sea region, GW

Country	Fixed	Floating	Total
Bulgaria	2	24	26
Romania	22	54	76
Ukraine	183	68	251
Turkey	12	63	75
Black Sea region – Total	*269*	*166*	*435*

Source: World Bank.

3.1 EU and Energy Community member states

While there are no current projects under development, the region is showing an incipient appetite for offshore wind. One of the first projects, Hidroelectrica in *Romania*, aims to invest 600 MW of wind power by 2026, of which 300 MW is designated for offshore wind.

Romania's total fixed offshore wind technical potential equals the country's installed generation capacity (22 GW). Theoretically, therefore, offshore renewable energy could be a substitute for the country's currently stalled offshore gas projects.

In *Bulgaria*, fixed offshore wind potential is more modest (2 GW), yet is still reaching a sixth of the country's installed generation capacity. Floating offshore wind remains an option for the country in the future, along with commercialisation of the technology.

[32] Eurelectric and WindEurope (2018), "Priority actions for wind energy deployment in South East Europe", June, p. 2.

[33] For example, WindEurope (2017b) calculated technical potential of offshore wind by 2030 in the maritime territories including exclusive economic zones for Baltics, North Seas, as well as the coastal territories of Ireland and France, Belgium and the Netherlands as 2695 GW and 2919 GW in the baseline and upside scenarios respectively. WindEurope (2017b), 'Unleashing Europe's offshore wind potential. A new resource assessment,' June, p. 30.

As shown by the World Bank, the wind potential of the Black Sea region goes beyond just EU member states; it offers opportunities for renewable energy development in the entire region. Among the contracting parties of the Energy Community, it is *Ukraine* that has by far the highest potential, with more than 250 GW. If realised, offshore wind would easily outstrip the value of its reserves in coal, a commodity that rapidly loses market share.

Although there are no offshore installations in the country currently, the fast-growing onshore wind sector, which reached 620 MW in 2019 – a more than sixfold increase since 2010[34] – could give the impetus to developing offshore wind as a complement and as a step to beginning the transition to a low-carbon economy. However, most suitable territories are located in the Sea of Azov and around the Crimea, which could make the situation sensitive to the region's geopolitical tensions.

Georgia commissioned the onshore wind park of 20 MW in Kartli in 2017 and is considering other onshore wind projects. Exploring the regional renewable and especially the offshore potential could offer an opportunity to revitalise ongoing discussions about the construction of the Georgian-Romanian Black Sea Submarine Transmission Line that would connect Georgia to the European power grid. Electricity generated from offshore wind in, for example Romania, could become an alternative to imports of electricity from Russia and Azerbaijan.

3.2 Non-EU/Energy Community Black Sea countries

Options to develop offshore wind have received close attention in *Turkey* in recent years.[35] Another World Bank study exploring offshore wind potential in a set of developing countries highlights the opportunities for Turkey.[36] The best potential is located in the Mediterranean Sea,[37] while the areas with the best offshore wind potential in the Black Sea are situated close to or in the disputed areas of the western parts of the country. Turkey's first offshore wind tender had been announced in 2018, but this received no bids, reportedly because of high – possibly too high – local content requirements.[38] Cooperation between Turkey on the one hand and Denmark, Germany and the World Bank on the other hand to unlock the Turkish offshore potential also attests to the country's interest in offshore wind opportunities.[39]

[34] From 90 to 620 MW since 2010. Ukrainian Wind Association (2019), "'Wind Energy Sector in Ukraine 2018", in Ukrainian, p. 7.

[35] For example, M. Argin et al. (2019), "Exploring the offshore wind energy potential of Turkey based on multi-criteria site selection", *Energy Strategy Reviews,* Vol. 23, pp. 33-46.

[36] World Bank (2019b), "Going Global: Expanding Offshore Wind to Emerging Markets", Report, October.

[37] The first offshore auction was announced for the territories in Çanakkale and Kıyıköy in the northwestern Marmara province of Tekirdağ.

[38] Not less than 60% local content and 80% of project employees are required to be Turkish nationals. SHURA, "On the way to efficiently supplying more than half of Turkey's electricity from renewables", SHURA Energy Transition Center, p. 18 .

[39] The joint Danish Turkish studies about the regulatory framework started in 2018; the joint Turkey Germany study is part of the Turkish German Energy Forum and started in 2018 as part of a wider cooperation on renewable energy, energy efficiency, energy infrastructures and electricity and natural gas regulation.

Alternatively, the offshore wind development of the Black Sea could revive the old discussion for a high-voltage direct current (HVDC) link between Romania and Turkey (as well as the Georgian–Romanian interconnector) as well as a Black Sea HVDC infrastructure primarily serving the expanding renewable energy sector.

Although offshore wind has not been present in the market in *Russia* so far, opportunities for its development are being discussed. Wind power currently constitutes less than 1% of total installed capacity.[40] However, there is particular interest in the development of renewable technologies, partly driven by local content requirements with an eye on nearby export markets.[41] At the same time, onshore wind capacity grew at relatively high rates, reaching 190 MW in 2019. Offshore wind development is rather active in the south-western regions close to the Black Sea. According to the Russian Wind Association ranking (2020), the Rostov and Krasnodar regions are top-ranked among the regions, with high development potential in the wind energy market. With an additional 300 MW of onshore wind installed in the first half of 2020, the Rostov region expects to reach 20% of renewables by 2022 and by then be a powerful 'wind champion area' in Russia. The Azov has economic offshore wind potential; its shallowness significantly reduces investment costs.

3.3 Azerbaijan and the Caspian region

While not located on the shores of the Black Sea, *Azerbaijan* is usually considered as part of the Black Sea region and included in regional cooperation frameworks.[42] With an estimated 157 GW of technical potential, the country has expressed increasing interest in developing offshore wind parks in the Caspian Sea. Currently, the country is preparing the Roadmap for Offshore Wind, jointly with the International Finance Corporation of the World Bank Group, to identify the relevant territories.

With a technical potential of 845 GW, the Caspian Region's potential is nearly double that of the Black Sea. Almost half of that potential (418 GW) belongs to *Kazakhstan*, with its northern maritime territories entirely suitable for fixed wind (Table 2). *Turkmenista*n has an offshore wind potential (73 GW) with some floating options located in its northern maritime zone (27 GW). With this potential for offshore wind in the Caspian Sea, the best sites for offshore wind are considered to be in its northern parts.[43]

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[40] RAWI (2020), "Review of Russian Wind Energy Market and Russian regions ranking 2019", Russian Association of Wind Power Industry.

[41] Among others, the first export of blades manufactured in south-west Russia to Denmark took place in April 2020.

[42] For example, Azerbaijan is included in the EU Black Sea Synergy and is a member of the Black Sea Economic Organisation.

[43] F. Onea and E. Rusu (2019), "An Assessment of Wind Energy Potential in the Caspian Sea", *Energies,* Vol. 12, 2525.

Table 2. Offshore wind technical potential in the Caspian Sea, GW

Country	Fixed	Floating	Total
Azerbaijan	35	122	157
Kazakhstan	265	153	418
Turkmenistan	46	27	73
Caspian Sea – Total	*509*	*336*	*845*

Source: World Bank.

4. Offshore wind as a unique economic opportunity

A consensus has emerged that the post-pandemic recovery should be based on carbon-neutral energy options, particularly on renewable energy technologies that proved resilient during the crisis.[44] Front loading investment in offshore renewable energy where possible is likely to provide enduring jobs and economic activity – thereby contributing to the green recovery.[45] Given the scale of investment required in the development of offshore wind, significant investment in projects will have a meaningful impact on the economy. For example, calculations made before the pandemic estimated a positive macroeconomic effect for the UK from investing in offshore wind – gross value added per GW installed was calculated at £1.8 billion (€2 billion) in 2017 with a potential to increase to £2.9 billion (€3.2 billion) by 2030, in the case that 65% UK content can be achieved.[46]

Offshore wind also creates highly skilled labour, jobs and income along the segments of the value chain, covering for example installation, maintenance and operation employment. In 2016, wind energy was responsible for about 150 000 direct jobs generated by companies in the wind industry and about 260 000 including indirect jobs.[47] According to WindEurope (2017), the EU wind sector could account for more than half a million (560 000) direct jobs by 2030.[48] In 2018, by comparison, the oil and gas sector (extraction and support activities) provided

[44] For example, IEA (2020), "Sustainable recovery", World Energy Outlook Special report; GWEC (2020), "Global Offshore Wind Report 2020", Global Wind Energy Council; IRENA (2020), "Post-COVID Recovery 2020. An agenda for resilience, development and equality", International Renewable Energy Agency, Abu Dhabi.

[45] IRENA (2020), op.cit.

[46] M. Noonan and G. Smart (2017), "The Economic Value of Offshore Wind. Benefits to the UK of Supporting the Industry", ORE Catapult, March.

[47] Onshore and offshore combined. WindEurope (2017c), "Local impact, global leadership. The impact of wind energy on jobs and the EU economy", November, p. 44.

[48] WindEurope (2017a), op.cit, p. 26.

around 100 000 jobs, and the coal- and lignite-mining sector was responsible for about 250 000 jobs, though this number is decreasing.[49]

Offshore wind requires different skills than the coal industry, for example,[50] creating incentives for the development of engineering schools and training, including for those who are directly employed by the industry. It will almost inevitably trigger the development of suitable offshore education facilities and training programmes alongside reskilling as far as necessary, perhaps with opportunities to become 'expertise exporters' to the rest of the Black Sea basin or even the Caspian Sea.

In the case of the Black Sea region, offshore wind, with its high load factor combined with decreasing costs, could become a long-term solution for replacing carbon-intensive coal and lignite power plants. To this day, however, the Black Sea region depends greatly on lignite and coal-fired generation, which is not only incompatible with EU decarbonisation goals, but is also becoming increasingly uncompetitive, particularly with renewables.[51] Offshore wind provides stable power generation, which can serve as a baseload power generation. In 2019, an average offshore wind capacity factor reached 38%, with a potential to perform at almost 50%, compared with 24% for onshore wind and around 20–25% for solar.[52] The UK provides a recent example of coal being replaced by offshore wind; the deployment of offshore wind along with other renewable sources allowed the share of coal in electricity generation to be decreased, from 28% in 2010 to 5% in 2018.[53]

Black Sea offshore wind potential could catalyse not only the development of large-scale renewable energy generation but also investment in the complex supply chain that such development will require. Among other benefits, installation and commissioning of offshore wind farms could revive the shipping industry and the harbour activities required for the installation and functioning of offshore wind farms.[54] In addition to direct job creation, there are opportunities to attract investment from turbine manufactures locating their manufacturing plants within the region, particularly in rural parts and coal regions.[55] A plan for significant development of offshore wind could lead to a new components industry.

Wind power development offers new prospects for decreasing carbon footprint for the entire energy supply sector, notably those operating in regions with offshore wind potential such as

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[49] EU Energy in Figures. Statistical Pocketbook 2019, Luxembourg: Publication Office of the European Union, p. 156.

[50] EWETP (2013), "Workers wanted: The EU wind energy sector skills gap", European Wind Energy Technology Platform, August.

[51] See, for example, C. Egenhofer, J. Nunez Ferrer, I. Kustova and J. Popov (2020), "The time for rapid redevelopment of coal regions is now", Centre for European Policy Studies, Brussels, May.

[52] IEA (2019), "Offshore Wind Energy Outlook 2019", International Energy Agency, Paris, November.

[53] National Statistics (2019), "UK Energy in Brief 2019", p. 27.

[54] IRENA (2018b), "Renewable energy benefits. Leveraging local capacity for offshore wind", International renewable energy Agency, Abu Dhabi, May.

[55] European Commission (2020), op.cit., p. 81.

the Black Sea. Following the successful examples of Ørsted and Equinor, upstream operators can use their technical skills and expertise in the construction of sea platforms for floating offshore.[56] In the short run, the development of offshore wind would also decrease hydrocarbon companies' carbon footprints, for example by utilising offshore wind for oil platforms.

The EU industry today is a global leader in the offshore wind industry, with European companies occupying 90% of the global market. While the market is still small,[57] preserving competitiveness in the global market is essential given the rapid increase in the global offshore wind market, of nearly 30% between 2010 and 2018.[58]

Offshore wind is a suitable energy source to produce green hydrogen, which is crucial for decarbonisation of the 'hard-to-abate' sectors, such as energy-intensive industry, heavy-duty transport or buildings. This will also allow electricity generators to store energy by using power-to-gas technologies (for example water electrolysis). The fact that wind-to-hydrogen (W2H2) turbines could be completely independent of the power grid offers further cost reduction opportunities.[59] W2H2 can shift industry's reliance on fossil fuels towards green hydrogen produced, among other things, with offshore wind power.[60]

Following the adoption of the EU hydrogen strategy in July 2020, each member state will have to introduce power capacities to produce carbon-free hydrogen. Pioneering projects are already being launched in the Netherlands and Germany.[61] The Black Sea, as a region with relatively well-developed electricity grids, will have particular opportunities for this. Hydrogen can also be used in decarbonising district heating, which prospectively plays an important role in the regional energy demand; the share of central district heating in residential energy consumption constitutes 23% in Romania and 16% in Bulgaria. Arguably, only large-scale hydrogen production optimised with offshore wind electricity generation is able to satisfy those needs.

The development of offshore wind in southern regions may add flexibility to the entire power generation system. A joint study by ETH Zurich and Imperial College London found that continent-scale weather patterns across Europe create complementary conditions to wind

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[56] A. Klein (2020), "Winds of change: can big oil make the transition to offshore wind?", World Bank blogs, 4 February.

[57] In 2016, the EU *net* exports of wind technologies accounted for €2.4 billion (€7.8 billion and €5.4 billion of export and import respectively, real prices, constant 2010).

[58] IEA (2019), op. cit.

[59] IRENA (2018c), "Hydrogen from Renewable Power. Technology outlook for the energy transition", September.

[60] C. Philibert (2018), "Offshore wind and hydrogen for industry in Europe", Commentary, International Energy Agency, 25 May.

[61] Europe's largest renewable hydrogen project starts in Groningen, 28 February 2020.

power generation.[62] This way, the southern offshore wind grid may contribute to better use of energy resources by complementing northern offshore wind power. Also, seasonality of offshore wind can complement that of solar PV. In Europe, offshore wind tends to produce more electricity during the winter; and the seasonal profile of offshore wind complements solar PV, which tends to produce more electricity in summer.[63]

Apart from decarbonisation benefits from substituting coal and gas in power generation, offshore wind could notably increase security of supply in the Black Sea region. It can address the frequent electricity shortages that have become exemplary over the past years, including the infamous cold spell in late December 2016 and early 2017.[64] Among others, Romania has faced serious problems with power generation. As recently as 2019, the country was twice close to blackout due to technical problems largely invoked by under-investment in nuclear and coal power generation.[65] In light of the political motivation for offshore wind seen in the region, an offshore wind strategy for the Black Sea could also counter both gas import dependence and increasing inward investment in 'grey' energy in the region, as well as create an upturn for the cross-border electricity trade in the wider region – with a high potential for green electricity export.

5. Black Sea offshore wind – the governance challenge

Large-scale deployment of offshore wind will require regional cooperation; grid planning and investment is but one example, traditionally a challenge in the region.[66] It will also require co-ordination and cooperation in marine resource management, i.e. the allocation of seabed tenure and the granting of development rights.[67]

Use of maritime territories

Scaling up of offshore wind requires the use of large maritime territories and, by extension coordinated access to the seas with other users. Coordinated spatial planning within the entire

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[62] C. Grams, Beerli, R., Pfenninger, S. et al. (2017), "Balancing Europe's wind-power output through spatial deployment informed by weather regimes", *Nature Climate Change,* Vol. 7, pp. 557–562; H. Dunning (2017), "European cooperation could provide more stable wind power", Imperial College London, 17 July.

[63] IEA (2019), op. cit., pp. 21-22.

[64] C. Egenhofer and C. Stroia (2017a), "In security of energy supply possible without deeper cross-border market integration? Lessons from the cold spell in South-Eastern Europe", Policy Insights No. 2017/45, CEPS.

[65] Despite the fact that the total installed capacity in the country accounts for 24 GW, the net available power was only 10.8 GW – the difference derived largely from power plants temporarily shut down for repairs and reserve capacities for system services.

[66] In particular, the recent study on Baltic offshore wind energy cooperation under BEMIP indicates a number of benefits from regional cooperation. European Commission (2019a), "Study on Baltic offshore wind energy cooperation under BEMIP", Final report, August. See also North Seas Energy Cooperation (2020), "Joint Statement of North Seas countries and the European Commission", 6 July, p. 3.

[67] O. Fitch-Roy (2016), "An offshore wind union? Diversity and convergence in European offshore wind governance", *Climate Policy,* Vol. 16(5), pp. 586-605.

sea basin – not within the national borders – is crucial for offshore grid development. It ensures efficient use of the limited maritime space and the protection of the environment and biodiversity.[68] The new Commission's Biodiversity Strategy for 2030 adopted in May 2020 establishes that at least 30% of sea areas should be protected.

Detailed national and regional assessments of the offshore wind potential are likely to be needed, including public consultations. It may also require the development of a common Maritime Spatial Planning strategy for cross-border areas including a mechanism for the Black Sea basin cross-border cooperation.[69] Currently, Bulgaria and Romania are elaborating national maritime spatial plans under the framework of the Maritime Spatial Planning Directive, scheduled for 2021. Aligning national maritime spatial plans with NECPs could help reduce potential spatial tensions between neighbouring countries.

Regulatory framework

Significant investments in network capacity are required up to 2050 to accommodate both the shift to low-carbon sources of generation and increases in demand, driven by electrification, for example of heating and transport. While there is a significant variation in the market, regulatory, planning and licencing regimes applicable to offshore wind across the EU, joint (hybrid) projects may benefit from a dedicated regulatory framework. Such a framework would allow divergences in national regulatory approaches to be overcome and transaction costs to be reduced. Recently, the North Seas Energy Cooperation countries have pushed for a better long-term regulatory framework and streamlining of administrative requirements to give certainty to the market and enable stable deployment of offshore wind projects.[70]

Grid planning

Offshore wind power affects internal grid costs by affecting internal power flows and congestion patterns – offshore wind power is likely to increase congestion close to the connection points. This highlights the importance of considering offshore wind power and network investment planning together. For example, the Study on Baltic Energy Market Interconnection Plan (BEMIP) offshore wind estimates that regional cooperation can increase internal grid cost savings for Baltic offshore wind by from €50-75 million up to €125-150 million in 2030, depending on the scenario, and by €160-€400 million by 2050.[71] The study on costs of offshore wind development found that combining offshore wind power generation with interconnectors

[68] Such as underwater noise and displacement of seabirds, maritime mammals and fish.

[69] The activity is supported by the EU-co-funded project Cross-border Maritime Spatial Planning for Black Sea, Bulgaria and Romania (MARSPLAN-BS II) for 2019–2021.

[70] North Seas Energy Cooperation (2020), op. cit.

[71] European Commission (2019a), op. cit., p. 15.

among several neighbouring countries in 'hybrid' projects has proved to be a cost-efficient deployment of offshore wind.[72]

Next opportunity: the revision of the Trans-European Networks – Energy (TEN-E) Regulation

The importance of offshore wind can also be grasped in the context of the ongoing revision of the TEN-E Regulation. The EU's greater ambitions under the European Green Deal will require more ambitious grid solutions. This could include solutions to hybrid offshore projects but also complementary hydrogen networks. There may also be synergies with trans-European transport networks by, among other things, multiplying and reviving harbour and port activities.

Overall, grids related to offshore wind would offer significant opportunities both for onshore locations and landlocked countries of the south eastern region such as Hungary, North Macedonia, Moldova or Serbia.

5.1 Offshore wind governance

The North Seas Energy Cooperation hints at a gradual bottom-up regional offshore wind cooperation framework. Its flexible format of a high-level group, ministerial meetings and the coordinators committee brings together eight member states, Norway and the European Commission.[73]

BEMIP, an initiative led by the European Commission and eight countries of the Baltic Sea, also suggests governance structures for offshore wind are emerging in the Baltic region.[74] Estonia and Latvia, for example, have recently agreed to develop a 1 GW offshore wind farm by 2030, and Lithuania and Poland have also committed to 700 MW and 3.8 GW by 2030 respectively.

5.2 Options for the Black Sea

Considering the experience of the North Seas Energy Cooperation and the Baltic Sea, a bottom-up initiative in the Black Sea region, aligned if not built on existing governance structures, could be envisaged. The framework would need to be adjustable in light of technological progress and possibly not exclusively EU-based, considering other interested actors, especially from the

[72] Among other things, by reducing significantly the need for physical infrastructure and by this reducing CAPEX and OPEX of offshore power generation. Offshore wind hybrid projects are also more efficient in terms of maritime space use. European Commission (2019b), "How to reduce costs and space of offshore development: North Seas offshore energy clusters study", Roland Berger GmBH, May, pp. 11–19.

[73] Also included the UK before the UK departure from the EU on 31 January 2020.

[74] European Commission (2019a), op. cit., p. 15.

Energy Community, as is the case with CESEC, for example.[75] This helps to avoid the 'ins' and 'outs' of the EU regulatory space, at least between EU and Energy Community countries.

CESEC, therefore, is an obvious docking station. Initially intended to accelerate the integration of gas and electricity markets, CESEC proved its steering capacities, having successfully brought together ministers and the European Commission and gradually expanding into the areas of renewables and energy efficiency.[76]

One of the advantages of CESEC is that it already encompasses EU member states and contracting parties of the Energy Community,[77] while offering a ready-to-go working platform for issue-specific engagement. This platform could be expanded to offshore wind, maritime renewable energy in general and other relevant maritime issues. The current CESEC framework, however, does not foresee a significant role for non-EU/Energy Community parties.

A starting point could be the creation of a dedicated *Offshore Wind Group* as a sub-group under CESEC. This group would not need to assemble all CESEC countries; to create 'pull', a 'coalition of the willing' might suffice to start with. The relevance of offshore wind might impinge on the immediate interests of coastal member states to include landlocked countries of the region.[78] On the 'push' side, the EU might want to consider establishing concrete benchmarks over time, for example through links to the NECPs, especially in light of the soon-to-be-revised targets for greenhouse gas and renewable energy in 2021, which will mean the updated NECPs in 2023/24 will have to be more ambitious.

Taking into consideration the experience of North Seas Energy Cooperation, as well as CESEC itself, a regional dialogue could begin with informal consultations among governments and stakeholders such as civil society and investors, regarding opportunities for offshore wind and its benefits for the region. CESEC has also proved that the involvement of investors facilitates projects.[79]

It is feasible that such a group might be led by the Bulgarian and Romanian governments, possibly in cooperation with the European Commission. Potentially, given the importance of offshore renewable energy, and depending on the stakeholders' appetite for tidal and wave energy and floating solar PV, the group could be enlarged to include other maritime energy sources, if appropriate, for example in a 'maritime renewable energy group'.

[75] The CESEC high-level working group, set up in February 2015, comprises Austria, Bulgaria, Croatia, Greece, Hungary, Italy, Romania, Slovakia and Slovenia and the EU and eight Energy Community contracting parties: Ukraine, the Republic of Moldova, Serbia, the Republic of North Macedonia, Albania, Bosnia and Herzegovina, Kosovo and Montenegro.

[76] See, for example, C. Egenhofer, and Stroia, C. (2017b), "CESEC 2.0: Opening the door to a new level of regional cooperation", Centre for European Policy Studies, Brussels, September.

[77] Except Georgia.

[78] For example, landlocked Luxembourg is part of the North Sea Energy Cooperation Platform.

[79] M. Catuti, I. Kustova, C. Egenhofer (2020), "Delivering the European Green Deal for southeast Europe. Do we need a regional approach?" Research paper, Centre for European Policy Studies, Brussels, June.

If it stays within the existing CESEC framework, focus could be on identifying key issues and strategies for offshore wind and could be broken down to the following levels (Table 3):[80]

(i) High-level group to focus on steering of priorities and strategies

(ii) Technical support groups with workstreams to discuss more specific issues:

a) *Technical workstream* could address regional peculiarities of offshore wind development, such as maritime spatial planning, accessibility and quality of geospatial data, and regional grid planning in cooperation with transmission system operators (TSOs) and European network of transmission system operators (ENTSO-E). The tasks can also exceed the EU regulatory space attracting non-EU countries of the region interested in offshore wind technologies.
b) *Projects & investments workstream* could engage in spotting regional business opportunities and stakeholders' interests in offshore wind projects. Considering the importance of various EU funding (for example, the Modernisation Fund, the Just Transition Fund, the Connecting Europe Facility (CEF) and the draft the Union renewable energy financing mechanism), private investment would remain the key for driving offshore wind deployment in the region.
c) The *Regulatory workstream* could focus on identifying administrative and regulatory barriers to offshore wind projects at EU and regional levels.

Table 3. CESEC Offshore Wind Group: an organisational structure

CESEC Offshore Wind Group EU member states and Energy Community contracting parties, potentially to be expanded to informal cooperation with non-EU countries		
High-level group Steering of priorities and strategies		
Technical groups:		
Technical	*Projects & Investments*	*Regulatory*
For example: hybrid offshore projects, cross-border spatial planning, and available wind power technologies	For example: stakeholders' interest, opportunities to attract private investment and funding of renewable cross-border projects	For example: barriers to investments in offshore wind; alignment of regulatory frameworks
Potential collaboration:		
ENTSO-E and TSOs; North Seas Energy Cooperation; BEMIP; Energy Community; North Sea Wind Power Hub; Black Sea Synergy; Black Sea Economic Cooperation, etc.		

Source: authors' compilation.

[80] In the design of the organisational framework of the Offshore Wind Group, the experience of the North Seas Energy Cooperation can be used (Work programme).

Such a group could have an impact beyond the Black Sea countries, facilitating a dialogue on offshore wind and best practice within the EU, e.g. North Seas Energy Cooperation, BEMIP and the Black Sea, as well as with non-EU countries of the Baltic Sea region. A dialogue with stakeholders' initiatives in the northern region, such as North Sea Wind Power Hub and the Baltic Sea Offshore Wind Forum, could provide important input from non-governmental stakeholders such as transmission system operators, industry, investors and civil society. Finally, the Energy Community could also assume a greater role in further identifying barriers to investment in wind power, especially those related to lack of experience and grid integration, in relevant contracting parties.[81]

6. Offshore wind cooperation as part of the external dimension of the Green Deal

The initial objectives of any governance framework will be mainly to enable the development and scaling up of offshore wind in the EU and, if applicable, Energy Community member states. However, engaging with other non-EU countries of the region, i.e. Azerbaijan, Russia and Turkey, may be crucial for achieving 'the climate-neutral' continent envisaged by the European Green Deal. As the European Green Deal document indicates, without at least a gradual raising of climate ambition of non-EU states, EU efforts alone will be unable to decrease greenhouse gas (GHG) emissions in the Wider Europe.[82] Emerging risks of regional carbon leakages will also need to be dealt with.[83]

A 'geopolitical' Commission will certainly not underestimate the importance of the region for delivering 'responsible global leadership', among others things, in 'clean energy'. If successful as a global leader, the EU will need to offer more attractive and sustainable technological and financial solutions than those offered by competing interests in the region.[84]

While comprehensive partnerships with many non-EU countries seem impossible in the current political context, informal engagement through, for example, the proposed CESEC Offshore Wind Group or other vehicles, might help to unlock a dialogue on regional offshore wind. This would not only increase the EU visibility but also help to affect and possibly 'organise' the

[81] See Energy community's Renewable Energy Coordination Group Work Program 2019 – 2020.

[82] Considering that the GHG emissions' reduction potential outside the EU outstrips the European levels, the Green Deal explicitly stipulates that the 'climate-neutral' continent cannot be delivered without cooperation with EU neighbours. Only Russia and Turkey combined are already projected to bypass the EU emission level by 2030, while the economies of Eastern Europe and South Caucasus significantly depend on coal and hydrocarbons. See: C. Egenhofer and M. Elkerbout (2019), "Can Europe offer a Green Deal to the world?", Centre for European Policy Studies, Brussels, 16 December.

[83] For example, the discussion by A. Mezősi, Z. Pató, and L. Szabó (2020), "Why Not ETS? Comparative assessment of border carbon adjustment and the extension of ETS in the power sector in Europe", the Regulatory Assistance Project (RAP), May.

[84] For example, within the 16+1 format led by Beijing in Eastern Europe and the Balkans. G. Grieger (2018), "China, the 16+1 format and the EU", Briefing, European Parliamentary Research Service, September.

influence of non-EU countries in the region. Informal engagement on wind technologies, joint studies or assistance in drafting offshore wind programmes and strategies could be further enhanced, for example with Turkey, also in the light of the country's interest in offshore wind development. Azerbaijan, which has already taken the first steps towards developing offshore wind, might express interest in expertise and best-practice exchange, arguably with the potential to become a leader in offshore wind technologies in the Caspian region. Taking into account the ample offshore wind potential of the Caspian Sea, regional stakeholders' appetite for offshore wind projects should be expected to increase in the coming years.

A starting point of such informal cooperation could be discussions on offshore technologies and grid development with regional business communities, as well as knowledge sharing in regulatory issues and best-practice exchange. The experience of INOGATE, an EU-funded energy technical assistance programme that ran for 20 years (1996–2016), can be used to design technical support projects in the region. Also, ENTSO-E has rich expertise in renewables-based grid development and will be instrumental for the development of hybrid projects. It can also consider expanding its current activities of designated training on regulatory issues and expert exchange for the countries of the Energy Community to other non-EU countries of the region.

The Black Sea Synergy, a bottom-up and project-oriented initiative launched in 2007 within the European Neighbourhood Policy (ENP), covers various issues including energy, and can further engage with the non-EU countries more specifically. In a similar way to the 2007 Black Sea Synergy, Bulgaria and Romania could assume a greater role – if not leadership – in delivering this dialogue on offshore wind opportunities. Further actions can also rely on the Common Maritime Agenda for the Black Sea, the first of its kind in the region and the result of a process initiated in Bucharest in 2019, backed by the European Commission and endorsed by Bulgaria, Georgia, the Republic of Moldova, Romania, Russia, Turkey, and Ukraine.[85] In addition, knowledge sharing about opportunities for offshore wind in the region can be further channelled through the existing avenues of the Organisation of the Black Sea Economic Cooperation (BSEC),[86] a regional international organisation aimed at wider economic cooperation in various areas, including energy.

Any Black Sea governance will need to work first and foremost towards achieving internal EU and Energy Community objectives. At the same time, however, in light of the offshore potential both in the Black Sea and the Caspian region, it would be beneficial to add tools to facilitate engagement with non-EU countries. As EU member states, both Romania and Bulgaria, supported by the EU, are well placed for a leadership role.

[85] Ministerial Declaration on A Common Maritime Agenda for the Black Sea, Bucharest 21 May 2019.

[86] See, for example, Plan of Action of the BSEC Working Group on energy for the period 2018–2019.

7. Conclusions and next steps

Growth in low-carbon electricity is the precondition for achieving climate neutrality by 2050. Offshore wind is the area with the highest medium- to long-term growth potential, and its principal focus in the EU has been the North Sea. Increasingly, there is evidence of offshore wind potential beyond the North Sea, for example the Baltic Sea, southern European waters and notably the Black Sea basin.

Recent analysis shows that Bulgaria and Romania alone have a technical potential for more than 100 GW capacity, or the projected total EU capacity by 2030; Ukraine's potential is two and a half times that. More potential exists in all other Black Sea basin countries. Thanks to technological innovation, economies of scale, and maturing of supply chains, costs – notably for fixed offshore wind – are steadily falling.

Offshore wind with load factors of up to 50% or more offers stable power generation. It can also play a major role in substituting increasingly uneconomic coal. This allows the weaknesses of power systems to be addressed, which is a recurrent theme in the Black Sea region, both for EU and non-EU countries alike. With adequate development of the transmission grid, landlocked countries such as Hungary, Serbia, Moldova and Northern Macedonia could equally benefit. The forthcoming review of the TEN-E Regulation will be a crucial moment for offshore wind in the region.

In addition to providing low-carbon electricity to feed growing electrification, the high load factor also makes offshore wind a suitable energy source to produce green hydrogen. Low carbon electricity and hydrogen will increasingly become a precondition for attracting investment for manufacturing and services, especially but not only for the low-carbon value chain. Over time this will offer opportunities for jobs and growth, including in South East Europe. The development of low-carbon technologies will be able to create jobs along a wide segment of the value chains, covering for example R&D and manufacturing but also installation, maintenance and operation. Once the industry settles in the region, it will require IT and other services as well as training and skilling. Many jobs will require highly skilled labour. Beyond that, a flourishing offshore wind industry could revive the harbour regions, possibly in the same way that international oil and gas industry investments has done.

There is evidence that offshore wind in southern regions will make a significant contribution to the stability and the flexibility of the EU grid as a whole, as a result of the continent-scale weather regimes. The southern offshore wind grid is most likely to contribute to a better use of energy resources by complementing the northern offshore wind power.

Offshore wind has been identified as a promising opportunity to accelerate the low-carbon transition under the historic Next Generation EU recovery fund. In all likelihood, there is less risk of a lack of money than of good plans and projects at local, member state and regional level. The precondition is that member states and their regions must quickly develop comprehensive plans.

The North Sea experience has brought to the fore the need for a governance framework to build the necessary grid extensions, but also for the management of the marine space or the coordination of sea uses. While in the North Sea, a framework is being built from scratch, in the Black Sea, with CESEC, a governance framework for EU and Energy Community member states already exists. The most promising seem to incorporate a special 'offshore wind' framework into the CESEC process. The EU might want to consider establishing concrete benchmarks, for example through links to the NECPs, especially in light of the soon-to-be-revised targets for GHG and renewable energy in 2021.

Because of the potential of and the interest in some of the EU neighbour countries, offshore wind could be an area where EU leadership could fall on fertile ground. Several institutional frameworks are already in place to intensify EU/third-country discussions.

7.1 Recommendations and next steps

Against this background, a number of steps should be taken.

EU level

- The forthcoming offshore wind communication should fully acknowledge the opportunity that offshore wind offers for the region.
- The review of the TEN-E Regulation should lay the groundwork for grid extensions, for electricity, for hydrogen and also transport for harbour regions.
- To accelerate developments on the ground, the European Commission might consider establishing concrete benchmarks for offshore wind – possibly in conjunction with other renewable energy – in the NECPs that are up for review in light of the soon-to-be-revised targets for GHG and renewable energy in 2021.
- The EU and CESEC should consider how integration of offshore wind can be incorporated into CESEC governance, to make full use of the already existing governance framework.

Member state action

- Coordination in Maritime Spatial Planning could be intensified, for example between Bulgaria and Romania, to develop the Maritime Spatial Planning common strategy, with a focus on identifying the territories available for offshore wind deployment.
- National offshore strategies should be urgently developed, with a view to identifying plans and projects to be submitted under the Next Generation EU recovery plan.
- Existing and potential opportunities for hybrid projects in the border maritime zones of Bulgaria and Romania should be explored.

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