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# EUROPEAN COMMISSION

The European Union will have at least 32% of its energy demand (heat and power) from renewable sources by 2030, meeting an estimated 50% of the power demand. Notably, in 2020, renewable energy production surpassed for the first time that of fossil fuel sources [1].

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In November, the European Commission published the Offshore Renewable Energy Strategy [2], which highlights the role that every offshore technology will have in supporting the key ambition of the European Green Deal—carbon neutrality by 2050. Thus, considering the European Green Deal long-term vision of climate neutrality through a new growth strategy [3], the EU is currently in the process of reviewing these targets, aiming at a 55% GHG reduction target by 2030. Together, these goals, new and ongoing alike, represent a powerful driving force for renewables, particularly wind energy.

TABLE 1. KEY NATIONAL STATISTICS 2020: EU

| | |
|---|---|
| Total (net) installed wind power capacity* | 179 GW |
| Total offshore capacity | 15 GW |
| | |
| New wind power capacity installed | 10.8 GW |
| Decommissioned capacity (in 2020) | 0.4 GW |
| Total electrical energy output from wind | 382 TWh |
| Wind-generated electricity as percent of electricity demand | 15.2% |
| Average national capacity factor** | 25% |
| Target | 32% RES by 2030 |
| Wind energy R&D budget | 57.0 million EUR (69.7 million USD) |

In 2020, the European Union installed 10.8 GW of wind capacity, a 1% decline from 2019 due to the COVID-19 pandemic. However, number of new installations was higher than in 2018 when only 8.5 GW were installed due to the shift from feed-in tariffs to auctions and delays in permitting. Permitting remains the main bottleneck for the industry across the EU, which results in undersubscribed auctions for onshore wind energy and consequently with low installations.

Even though 2020 brought a lot of uncertainty to fossil fuel prices, wind power proved to be resilient and provided reliable power throughout the pandemic. By the end of 2020, 179 GW of wind power was connected to the grid, which represented 15% of the EU's electricity demand.

In 2020, EU research funding on wind energy through H2020 experienced another strong year supporting new concepts and innovations with about 57.0 million EUR (69.7 million USD). Notably these funds were granted to fewer large-scale projects with nine out of thirteen projects receiving support of more than EUR 2 million. With about 64% of EC funding (36.2 million EUR (44.3 million USD)) the focus is clearly set on wind energy projects focused on offshore wind or floating offshore technology research, followed by new materials & components (24%).

## Market development

### Targets and policy

The current 2030 targets for the EU to generate 32% of its energy from renewable sources is likely to be increased. The new target comes because of the new EU Climate Law where the greenhouse gas reduction target for 2030 was increased from 40% to 55%, to reach carbon neutrality by 2050. Further, in November 2019, the EC presented the Offshore Renewable Energy Strategy [2], which foresees 300 GW of offshore wind in the EU by 2050.

### Progress and operational details

In 2020, 10.8 GW of wind power capacity was installed across the European Union (8.3 GW from onshore), a 1% decrease on 2019, due to COVID-19-related supply chain disruptions and restrictions to the movement of people and goods (Figure 1). Most of the disruptions were observed in onshore wind, while offshore installations were in line with the projections before the pandemic. Although the number of installations was higher than the 8.5 GW installations in 2018, installations did not increase significantly in the past decade—in 2012, the EU installed 10 GW.

Despite the challenging circumstances brought about by the COVID-19 pandemic, the EU invested 26 billion EUR (31.8 billion USD) in new wind farms in 2020, the second-highest annual amount on record. Investments in new onshore wind farms were 12.9 billion EUR (15.8 billion USD), which financed 9.6 GW of new onshore capacity. Investments in offshore wind farms in three EU countries were higher than investments in all onshore wind farms in the EU as 13.1 billion EUR (16 billion USD) financed 3.6 GW new offshore capacity [5].

When looking into country installations, the Netherlands installed the most wind capacity in 2020, mainly offshore wind. Spain followed with 1.7 GW of onshore installations, while Germany was the

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FIGURE1. NEW WIND INSTALLATIONS IN THE EU

third-largest market, but its new installations were at its lowest since 2010. Finland installed the most powerful onshore wind turbines with an average rating of 4.5 MW. The Netherlands and Belgium had the most powerful new offshore turbines with an average rating of 8.7 MW. There was also 388 MW of decommissioning, coming from projects in Austria, Belgium, Denmark, France, Germany, and Luxembourg.

Last year, wind energy secured volumes of 8 GW through renewable energy auctions across seven countries. Onshore wind secured 7.4 GW, while offshore got only 759 MW. All the planned auctions were carried out aside from Lithuania and Slovakia. The Spanish auction, postponed from December 2020 to January 2021, saw wind farms secure 1 GW with bids below €30/MWh ($36.7/MWh).

The corporate sourcing of renewable electricity via Power Purchase Agreements (PPAs) has been growing steadily since 2015. 2020 was a record year for corporate renewable PPAs as 3.7 GW were contracted in the EU. There were 22 new PPAs signed in 9 countries with wind farms for a total of 1.9 GW.

Corporates have a variety of different motives to source power from renewables, but the possibility to lower and fix electricity costs is a major part of the rationale for these deals. Until 2018, wind accounted for 90% of the contracted capacity in Europe but the last couple

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FIGURE 2. NEW ASSET FINANCE IN WIND ENERGY PER COUNTRY IN 2020 (€BN)

TABLE 2: WIND ENERGY SPECIFIC FUNDING UNDER H2020 GRANTED TO PROJECTS STARTING IN 2020.

| H2020-funded projects | Total project cost Million EUR (Million USD) | EU contribution Million EUR (Million USD) | Number of projects |
|---|---|---|---|
| Wind-specific projects | 68.4 (83.6) | 54.3 (66.4) | 10 |
| Non-wind-specific projects* | 3.4 (4.2) | 2.7 (3.3) | 3 |
| Total funding for wind energy† | 71.8 (87.8) | 57.0 (69.7) | 13 |

* In 2020, non-wind-specific projects include the following projects with limited wind energy share: FuturePowerFlow, Powerbox and ROBINSON.

† Funding does not include the latest European Green Deal Call as projects will start in 2021

of years has seen a rapid expansion in solar PPAs, which helped drive the market growth. However, wind energy is still very well placed to accommodate corporates' needs for renewable electricity due to its modular scale, cost-competitiveness, and low risk-profile. Corporate renewable PPAs also come with certain benefits for generators. Price visibility over a long period of time and a guaranteed offtaker are important to lower the cost of debt financing.

Finally, wind energy generated enough electricity to meet 15% of the EU's electricity demand in 2020. This is one percentage point higher than in 2019 and results from the new installations as well as windy conditions around Europe throughout 2020. Denmark had the highest share of wind in its electricity mix (48%), followed by Ireland (38%), Germany (27%), and Portugal (25%). 14 Member States had a wind share above 10% [4].

## Matters affecting growth and work to remove barriers

The next few years of implementation of the Offshore Strategy will determine whether the EU sets the right framework to meet the 25-fold increase of capacity expected by 2050. The governments will have to improve permitting, including the coordination of their maritime spatial plans, and the grid build-out, both onshore and offshore. Delivering these big offshore wind volumes by 2050 will require development such as offshore hybrids, energy islands, offshore renewable hydrogen production, and multi-terminal

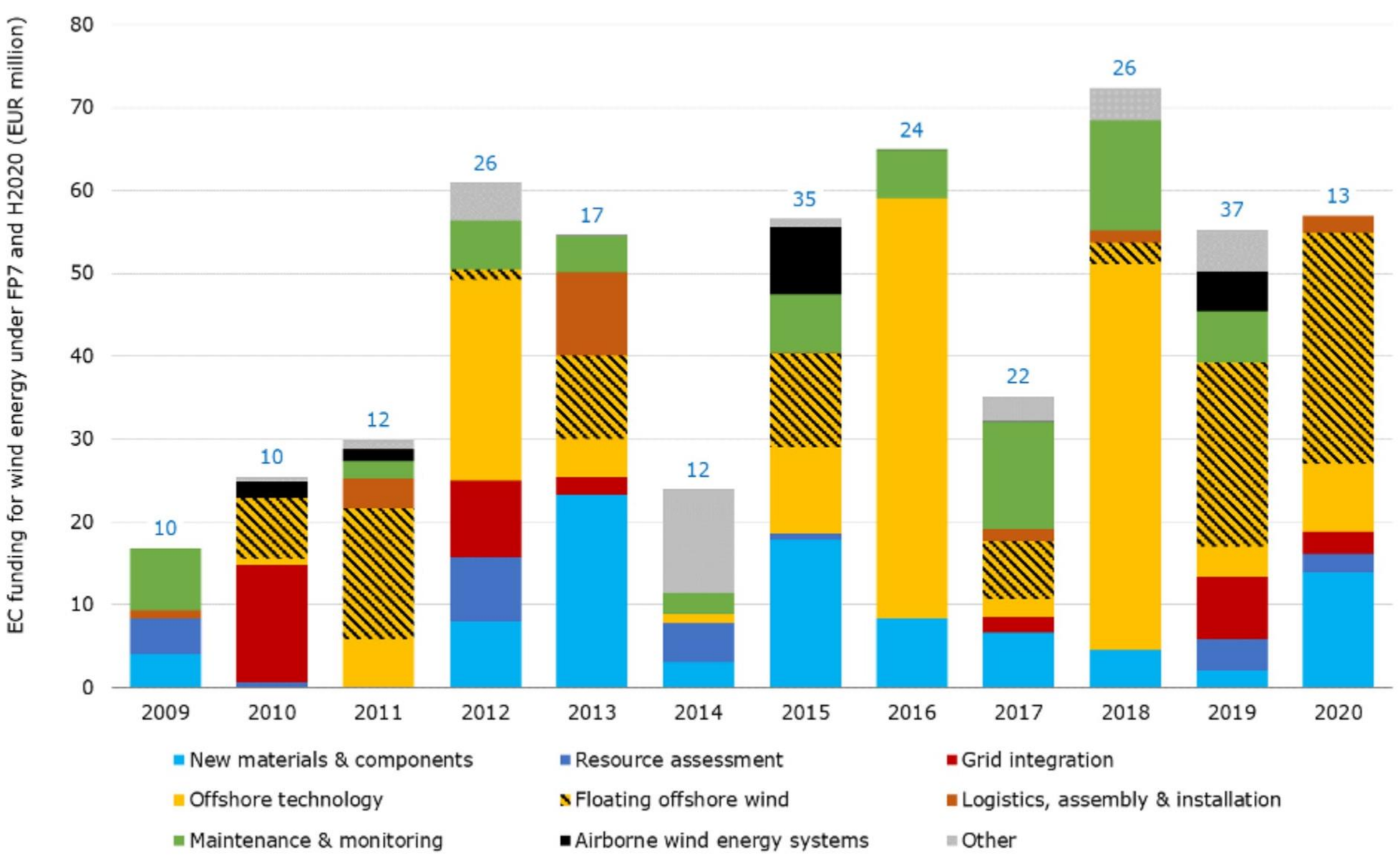


FIGURE 3: EVOLUTION OF EU R&I FUNDING CATEGORIZED BY R&I PRIORITIES FOR WIND ENERGY UNDER FP7 (2009-2013) AND H2020 (2014-2020) PROGRAMMES AND THE NUMBER OF PROJECTS FUNDED IN THE PERIOD 2009-2020. PROJECT SPECIFICALLY ON WIND ENERGY AND THOSE WITH A SIGNIFICANT WIND ENERGY COMPONENT ARE ACCOUNTED FOR (TABLE 2). NOTE THAT THE ITEM OTHER INCLUDES SOME PROJECTS EXPLORING EMERGING TECHNOLOGIES SUCH AS SOCIAL ACCEPTANCE AND CRITICAL RARE EARTH ELEMENTS, AMONG OTHERS. FUNDS GRANTED REFER TO THE START YEAR OF THE PROJECT [6].

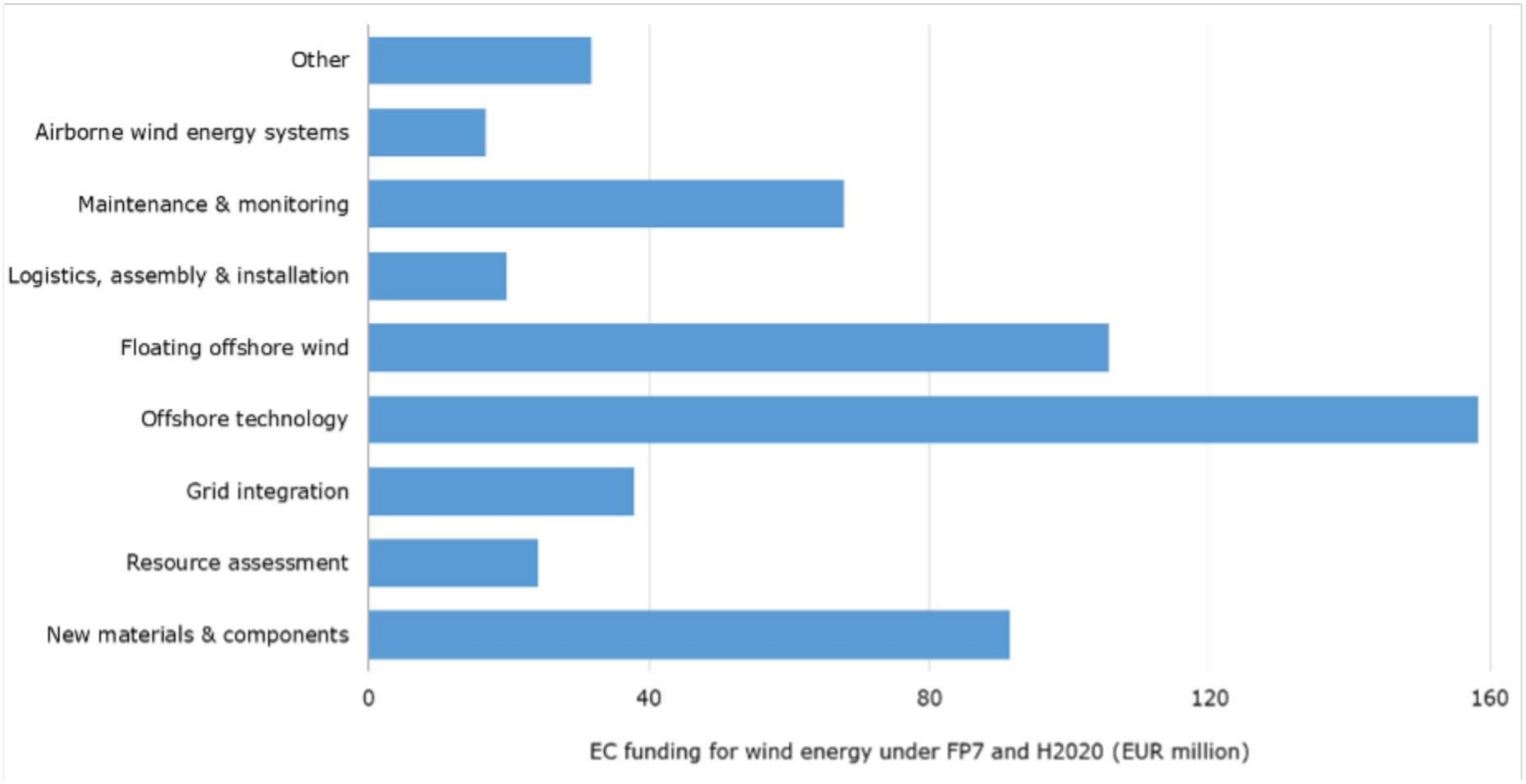


FIGURE 4: EC FUNDING ON WIND ENERGY R&I PRIORITIES IN THE PERIOD 2009 - 2020 UNDER FP7 AND H2020 [6].

HVDC systems, which will require adjustments to EU legislation, notably on market design.

The current low installation figures are a result of the slow and complex permitting procedures across different European countries, which can be seen in undersubscribed auctions across different markets. In Germany, for example, six out of the seven onshore wind auctions held in 2020 were undersubscribed. Thus, only 2.7 GW out of the 3.9 GW on offer were awarded for there were not enough projects permitted. In Italy, all three auctions for wind and solar PV were undersubscribed due to the slow permitting process. This inefficiency meant that project developers had to wait many years to receive responses from planning authorities. This will undoubtedly lead to undersubscribed auctions in 2021 as well.

Although, wind energy remains an attractive investment, and there is plenty of capital available to finance it, it is critical that both EU and national economic recovery plans are aligned with the European Green Deal and help accelerate the transition to a low-carbon energy system, particularly when it comes to issues related to permits. Accordingly, the new Renewable Energy Directive mandates the Member States to identify and remove administrative barriers to corporate PPAs and facilitate their uptake in their National Energy and Climate Plans, which set out their Climate & Energy policies from 2021 to 2030.

## R,D&D activities

### R,D&D priorities and budget

Research funding in Europe's biggest Research and Innovation programme, Horizon 2020 (H2020), showed continued support to wind energy in its last year. Although the number of wind energy projects decreased from 36 to 13 in 2020, cumulated investment granted to European wind energy projects grew at about 3% (57.0 million EUR (69.7 million USD)) as compared to 2019 (Table 2).

Figure 3 shows the development of R&I funding in the period 2009 - 2020 under H2020 funding programme (2014-2020) and its predecessor FP7 (2007-2013). It shows that in 2020, 49% of EC funding (27.9 million EUR (34.1 million USD)) granted to wind energy projects focused on floating offshore technology wind research, followed by new materials & components (24%) and offshore wind technology (14%) [6].

Since 2009, FP7 and H2020 have allocated substantial funding across all wind research R&I priorities with projects on offshore wind technology (158 million EUR (193.2 million USD)), floating offshore wind (106 million EUR (129.5 million USD)), and research on new materials & components (91 million EUR (111.2 million USD)) accumulating most of the funds (Figure 4).

### Research initiatives and results

In 2020, 14 projects reached their conclusion (with a cumulated EC investment of 32 million EUR (39.1 million USD)), with the following selected research results:

- The DEMOWIND programme (DemoWind and Demowind 2) was funded via two H2020 calls and brought together offshore wind innovators from six EU countries (BE, DK, NL, PT, ES, NO, and UK) to support the development and demonstration of innovative technologies capable to reduce offshore wind costs. Facilitating transnational calls for proposals led to 12 transnational projects covering a wide range offshore wind innovation.

Among others this led to the installation of the first multirotor floating platform worldwide and the first floating wind platform in Spanish waters (WIP10+ project). Other examples include aerodynamic and structural enhancements, blade monitoring systems, and blade erosion protection solutions to decrease O&M costs (Offshore Demonstration Blade project) or improving the safety and productivity of offshore wind technician transit (SPOWTT project) [7].

- The NEOHIRE project aims to reduce the use of rare earth elements, and Co and Ga, in the permanent magnets used in wind turbine generators through a new concept of bonded NdFeB magnets and the usage of new recycling techniques from future and current permanent magnets (PM) wastes. Results show that the neodymium demand can be reduced by about 30wt% and novel design improvements allowing to increase the deliverable electric power at the same time [8].

- The LEADFLOAT project aims to develop IDEOLs floating offshore concept (floating barge) for new offshore wind markets allowing developing projects farther away from shore and with no restriction on the water depth or on the seabed soil conditions. Since 2018, two demonstrators are operating in France (2 MW Floatgen demonstrator) and Japan (3 MW Hibiki project). Further, a pre-commercial plant is expected to be operational by 2023, following the French government selection of the Eolmed consortium for the development of a 30 MW Mediterranean offshore wind farm (3 wind turbines) 15 km off the coastal town of Gruissan [9][10][11].

Other projects ending in 2020 focus on new turbine materials and components such as the TRIBLADE project introducing a modular blade concept, the Njord project introducing a durable VAWT intended for extreme wind conditions or the LEP4BLADES project developing an innovative leading-edge protection (LEP) polymeric coating to prevent blade erosion. Moreover, the AIRCRANE project addresses the 'Logistics, assembly & installation' R&I category, with its new concrete-towers assembly system for taller wind turbines.

Simultaneously to the closing of these activities, in September 2020, the EC launched the H2020-funded European Green Deal Call (1 billion EUR (1.2 billion USD)) for R&I projects that respond to the climate crisis and help protect Europe's unique ecosystems and biodiversity. Among its several thematic areas, there was a dedicated section addressing the wind R&I sector, particularly offshore renewable energy technologies (EUR 86 million (105 million USD)) and their integration into the energy system and industrial applications (EUR 60 million (73 million USD)) [12].

Finally, October 2020 saw the first call for proposals of the Innovation Fund (successor of the EC NER300 programme), one of the world's largest funding programmes for the demonstration of innovative low-carbon technologies. In this first large-scale project call, over 300 applications were received, around 70 of them in renewable energy generation). This programme will provide around 10 billion EUR (12 billion USD) of support over the next 10 years for the commercial demonstration of innovative low-carbon technologies, aiming to bring to the market industrial solutions to decarbonise Europe and support its transition to climate neutrality [13].

### Selected examples of new R&I projects

With about 25 million EUR (30.6 million USD), the Iberdrola-led FLAGSHIP floating offshore wind project received the highest EU funding to demonstrate the viability and profitability of installing >10 MW wind turbines on floating platforms. The semi-submersible concrete concept will be demonstrated in the Norwegian North Sea and includes innovations in the design and installation of anchors, moorings, and cables. The demonstration project in the harsh conditions of the North Sea will suit as a starting point for large-scale projects ensuring the deployment in other sea basins such as the Atlantic Ocean, Mediterranean or Baltic seas.

MAREWIND addresses the main aspects related with materials durability and maintenance in offshore structures by enhancing corrosion protection systems and durability, effective and durable antifouling solutions without using biocides, erosion protection and mechanical reinforcement in wind blades, predictive modelling and monitoring, and increasing recyclability. EU support: 6.7 million EUR (8.2 million USD).

The MODVION project develops the next generation of cost-efficient tall wooden towers for wind turbines. The Modvion technology builds on modular wind turbine tower made from laminated wood (LVL) and claims to reach tower heights beyond 150 metres at costs reductions up to 40% resulting in a 6% lower cost of energy. A 30-metre prototype near Gothenburg (SE) is currently under development and the projects aims for TRL 9 and full commercial projects under this research funding scheme. EU support: 2.4 million EUR (2.9 million USD).

## Impact of wind energy

### Environmental impact

In the EU Offshore Renewable Energy Strategy, the EC aims for an installed capacity of at least 60 GW of offshore wind by 2030, with a view to reach by 2050 at

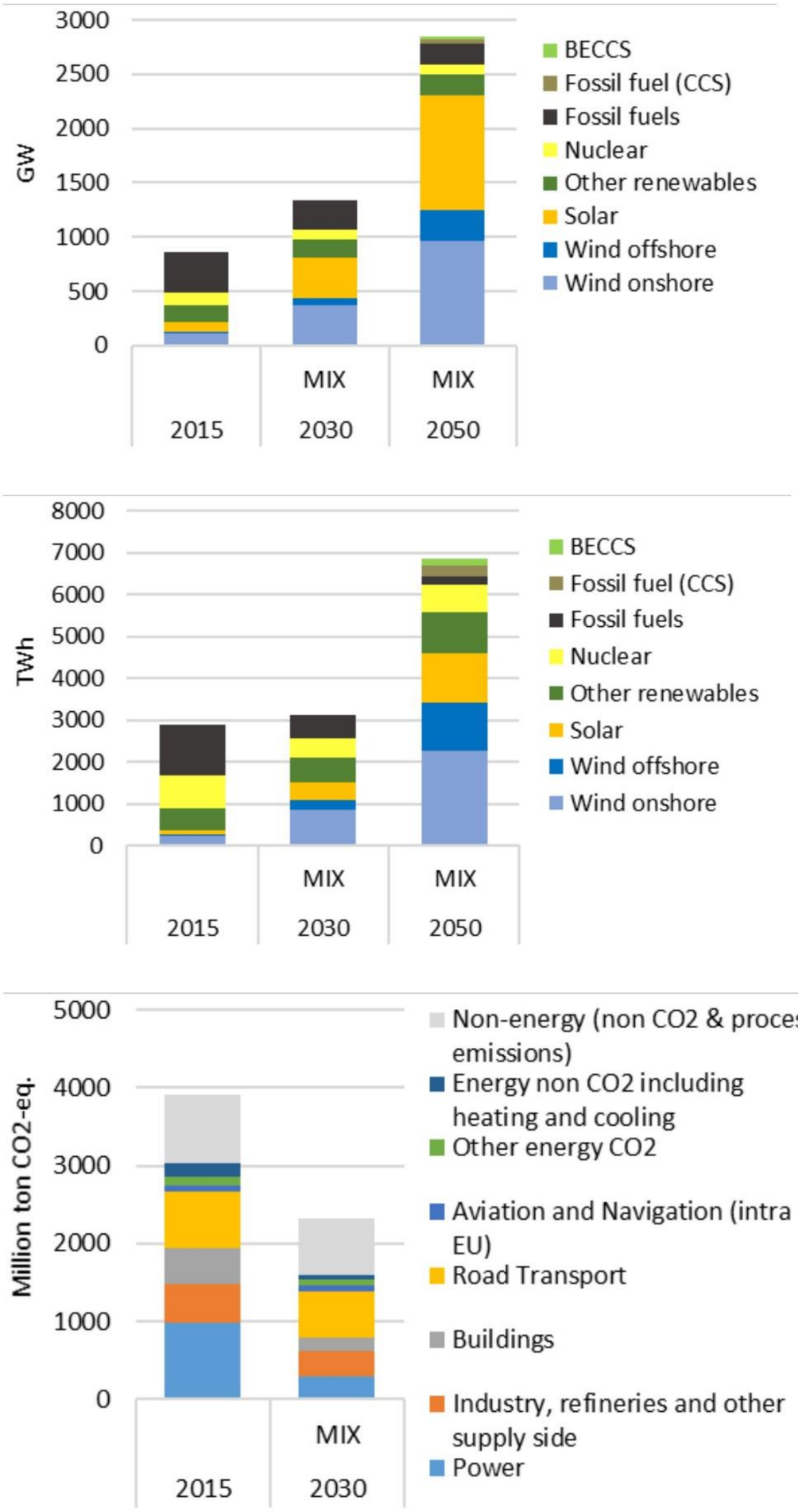


FIGURE 5: INSTALLED POWER CAPACITIES (TOP), ELECTRICITY GENERATION (MIDDLE), AND SECTORAL GHG REDUCTIONS (BOTTOM) WITHIN THE EU ENERGY SYSTEMS IN THE CTP-MIX SCENARIO OF THE EC 2030 CLIMATE TARGET PLAN STRIVING FOR CLIMATE NEUTRALITY BY 2050 [15].

least 300 GW. This is in line with the CTP-MIX scenario from the Impact Assessment accompanying the 2030 climate target plan, which reduces greenhouse gas emissions by 55% in 2030 compared to 1990, thus providing a more accelerated pathway climate neutrality by 2050 [14]. Following this scenario foresees 35% of the electricity generation in 2030 stemming from wind energy with onshore and offshore wind generating about 850TWh and 230TWh, respectively. This will significantly contribute to GHG emission reduction already in 2030 as sectoral GHG emissions of the power sector will decline by 71% as compared to 2015 levels (total emission reduction of the energy sector in 2030 in the CTP-MIX scenario will decline by about 40%). Looking further ahead towards a zero-carbon economy in 2050, this share will further increase to about 50%, making wind energy together with solar PV the main pillar of EU electricity generation.

## Economic benefits and industry development [16]

Wind energy is an important asset for the European economy. The sector contributes 37 billion EUR (45.2 billion USD) to the EU's GDP and employs 300,000 people (75% of these are in onshore wind and 25% in offshore wind.). Wind energy also directly benefits communities living near wind farms, and it pays 5 billion EUR (6.1 billion USD) in taxes across Europe every year. In addition to this, wind farms often make direct payments to communities, offer benefits-in-kind, and in many cases, communities participate partially in the ownership of the local wind farm.

The wind industry today generates 2.5 billion EUR (3.1 billion USD) of value-added to the EU economy for each new GW of onshore wind installed and 2.1 billion EUR (2.6 billion USD) for each new GW of offshore wind. These amounts per GW will continue to 2030 even with expected cost reductions.

European wind turbine manufacturers have a 42% share of the global market for wind turbines. This is up from 33% ten years ago. Of the ten biggest wind turbine manufacturers in the world, five are EU-based.

European manufacturers' competitive edge depends in large part on their home market. Europe hosts 31% of all the wind components production facilities, with 30% of the global wind capacity.

## Next term

In 2020, the EC has published the Offshore Renewable Energy Strategy [2], which highlights the role that every offshore technology will have in supporting the key ambition of the European Green Deal [3]—carbon neutrality by 2050. The offshore strategy sets clear targets and mechanisms to support the large-scale deployment of offshore wind energy, as well as ocean energy, thus proposing to increase Europe's offshore wind capacity, including floating wind, from its current level of 12 GW to at least 60 GW by 2030 and to 300 GW by 2050 [2]. In short, there are dedicated actions to encourage the necessary investment needed to reach these targets (estimated at almost 800 billion EUR (978 billion USD), to promote regional cooperation and enhance maritime spatial planning, to develop a predictable legal framework for cost-effective deployment, and to strengthen supply chains and continuous innovation. Altogether, these set of actions will have far-reaching consequences for the economy through investments and growth for the European industry and the creation of green jobs, for the environment through increased production of

renewable energy and further biodiversity protection measures, and for the society through more affordable energy and improved health and well-being.

2020 also marked the closing of H2020 and the beginning of Horizon Europe, which will be the main European financial instrument for research and innovation (95.5 billion EUR (116.7 billion USD)), and thus it will play a key role on supporting the European Green Deal. Further, it will contain several different types of activities, such as partnerships and missions, to improve European and national synergies and to adapt to different kinds of technological challenges.

The near future for wind energy in the EU is bright and yet challenging. On one hand, it is expected to see a huge growth both in deployment rate and in technological advances; and on the other hand, this growth must be done in a sustainable way, with circularity and societal support at its heart. Thus, more effort and support will be seen to strengthen these policies, focusing on composite recycling technologies, strategic critical raw material substitution, societal engagement, systems efficiency, as well as upskilling, reskilling, and training.

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