Opinion of the European Economic and Social Committee on 'Marine energy: renewable energy sources to be developed'

(own-initiative opinion)

(2017/C 034/08)

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	Own-initiative opinion
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1. Conclusions

1.1. Scientists and engineers have been working for many years to harness the energy of the oceans. Currents, tides and the force exerted by swells contain indefinitely renewable reserves of energy. In France, EDF's Rance tidal power station, inaugurated in 1966 by General de Gaulle, generates a capacity of 240 MW, its 24 turbines each generating 10 MW. The latest wind turbines generate at most 8 MW. Thus this technology is effective, even if the Rance barrage was for a long time the only such facility in the entire world. There is now another example of a similar installation in Lake Sihwa, South Korea, with a capacity of up to 254 MW. There were projects in the UK, but they have been blocked or suspended due to objections on ecological grounds.

1.2. The fact remains that such investments are worthwhile when installed in favourable geographical locations with strong tidal coefficients, and should be given more consideration in the national energy mix.

1.3. The first industrial applications have been implemented, showing that these techniques should not be seen as risky experiments but as clean energy sources to be developed.

1.4. The EESC is therefore of the view that this type of renewable energy production should be developed and that there should not be an exclusive focus on wind turbine and solar technologies. Of course, marine energy cannot be harnessed everywhere, but it would be detrimental to disregard a predictable source of renewable energy with a minor — or manageable — impact on the environment. It is universally acknowledged that the future of energy will be based on a variety of sources of supply.

1.5. On 6 June 2016, Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden decided to strengthen their cooperation on offshore wind energy. Along with the European commissioners for Energy Union and the climate, they signed an action plan tailored to Europe's northern waters. Specifically, this cooperation will involve harmonising regulations and the subsidy system for offshore wind energy, as well as interlinking electricity networks.

1.5.1. The EESC strongly recommends adopting a similar approach regarding marine energy — whether water turbines or tidal barrages — that promotes cooperation between Member States or neighbouring countries of the European Union that have suitable sites for this type of facility (mainly those with Atlantic or North Sea coastlines).

1.6. It is also of the view that techniques that have yet to be fully developed — such as wave power and ocean thermal energy — should not be neglected; however, at a time when public funds are scarce, funding should be allocated according to efficiency criteria. Therefore, priority should be given to the technologies that offer the fastest progress.

1.7. It emphasises that investing in this field would enable the European Union to eventually take its place at the forefront of new renewable energy sources. European companies already hold 40 % of renewable energy patents. The EESC recommends keeping up research and development efforts in the area of marine energy, but also with regard to storing energy produced from intermittent sources, so the production of renewable energy can be smoothed out.

1.8. It warns against the temptation to restrict subsidies to the classic forms of renewable energy, an approach that would reduce the number of options and distort the renewable energy economy in favour of technologies promoted by an effective lobby.

2. **General comments**

2.1. Most of our planet is covered by oceans, and it would be more accurate to call it 'planet sea' rather than 'planet earth'. Humans have always fished for food. Recently, we have managed to exploit the resources that lie in or under the sea floor (polymetallic nodules, oil, etc.). Meanwhile, the energy generated by the oceans has been used for centuries, but on a small scale, by means of tide mills on some coastlines.

2.2. The current need to combat all kinds of pollution and to reduce greenhouse gas emissions should encourage us to look into the energy potential of the sea. Indeed, how could the European Union and Member States with access to the sea not take an interest in the energy opportunities that the oceans could offer?

2.3. While Europe has an extensive maritime domain, making use of the renewable energy resources of these vast expanses is still in its infancy. However, the European Union and Member States could help innovative companies and industrial groups within the energy sector to promote the implementation of new techniques to harness sea energy. This is what the marine energy forum hopes to do.

2.4. The sea offers various renewable energy sources: swells, waves, currents, tides, temperature differences between surface waters, wind. Each technique and method has its own geographical and ecological requirements, meaning that these innovative techniques are only feasible if the constraints and the consequences involved are taken into account.

3. **Harnessing the energy of currents, tides, swells and waves: water turbines**

3.1. Anyone who has ever contemplated a calm or raging sea knows that there are forces at work in the vastness of the oceans, and that they are constantly moving. It is therefore natural to wonder whether it would be possible to harness or harvest the energy produced by the sea.

3.2. In practice, what techniques have been studied and put in place?

— estuary barrages with tidal turbines. The Rance barrage in France has been operating well for decades. There are two projects in the UK, but they have been blocked by environmentalist pressure groups;

— offshore turbines mounted on columns or buoys;

— turbines attached to the sea floor ('water turbines'). There are projects in Brittany which will soon be implemented.

3.3. In practice, harnessing tidal currents seems to be the most promising technique. However, location has a large impact on the potential of these techniques. The most promising areas of the Atlantic and the North Sea are those with the biggest tidal coefficients, for the most effective areas are those with a large tidal range. The great advantage of this type of power generation is that it is predictable and regular, as tides are constant and their range is well known in advance.

According to EDF, the European Union could generate around 5 GW of power (2,5 GW of which would come from the French coastline) — the equivalent of twelve 10 800 MW nuclear reactors. Nevertheless, aside from the Rance barrage, harnessing tidal currents is in the technological research phase and is not yet operational.

3.4. What water turbine technologies are being tested?

— The Arcouest (1,5 MW), a prototype water turbine, was submerged off the coast of Paimpol in Brittany in 2014. This water turbine was developed by OpenHydro (DCNS shipbuilding group) for Paimpol/Bréhat, the first EDF tidal power plant. It consists of four turbines, with a capacity, once they are installed, of 2-3 MW. The machinery is simple and robust, consisting of an open centre with a low-speed rotor that operates without lubricant, which minimises its impact on marine life. This water turbine was tested for four months. The turbine rotated continuously for 1 500 hours and numerous mechanical and electrical readings were taken. The tests were successful and confirmed the viability of this type of water turbine. The decision was therefore made to start a demonstration site in the summer of 2015. The turbines have been constructed and are ready to be installed, but weather and sea conditions have delayed their installation. It is worth noting that these two turbines were built in Cherbourg and Brest, which shows that these new technologies can stimulate industrial activity in coastal regions.

— Semi-submerged water turbine able to be raised for maintenance. This is a British technology, developed by the Tidalstream company. A prototype has been developed for a ship to turbine (STT) installation operating in the Pentland Firth. This consists of four turbines of 20 m in diameter, with maximum total capacity of 4 MW. By way of comparison, a wind turbine would require a diameter of 100 m and a wind speed of 10 m/s to generate an equivalent amount of power. Moreover, the wind turbine's foundation, 25 metres below sea level, would be 25 % larger than the STT's foundation. Tidalstream therefore believes that its system would be competitive in comparison to offshore and onshore wind turbines. The cost of electricity produced by the STT system could reach GBP 0,03 per kWh (approximately EUR 0,044 per kWh). This system has been tested in trials on the Thames and has been shown to be viable.

— Water turbines mounted on columns, developed by Marine Current Turbines. This technology requires anchoring a column to the sea floor, which therefore means that the depth to which they can be submerged is limited. The water turbines can move up and down the column, enabling them to be raised above the surface for servicing and maintenance.

— Water turbines mounted on an anchored buoy were installed in the Hammerfest Strait in Norway in 2003.

— Finally, tidal turbines mounted underneath an estuary barrage, such as the Rance barrage, which is the oldest example of this type and has been operational since the 1960s. Two projects are being studied in the UK, but they have been blocked for environmental reasons.

4. **Harnessing the energy of swells and waves: wave power**

4.1. There is a vast array of wave power solutions: submerged, surface, onshore and offshore prototypes. Energy is captured differently from one prototype to another: mechanical energy is captured at the surface (undulations) or under water (translational or orbital motion), pressure variations between waves are captured (variations in water level) or an amount of water is physically captured by means of a reservoir.

4.2. The main drawback is that wave power is not easy to predict, unlike tidal currents. Harnessing the energy of swells and waves is currently at the technological research stage and is not yet operational. However, six different techniques are being tested:

— a floating, articulated chain, known as a 'sea snake'. This consists of a series of long floats — the head of which is anchored to the sea floor via a cable — oriented in the same direction as the wind, perpendicular to the waves. The waves make the chain oscillate, and these oscillations compress a hydraulic fluid at the joints, driving a turbine. This system has been tested with varying degrees of success;

— oscillating wave surge converter;

— point absorber;

— submerged pressure differential device;

— oscillating water column;

— overtopping device.

5. **Harnessing ocean thermal energy**

5.1. This involves making use of the temperature difference between surface water and deep water in the oceans. A frequently used acronym is OTEC, which stands for ocean thermal energy conversion. European Union texts use the term ‘hydrothermal energy’ to mean ‘energy stored in the form of heat in surface water’.

5.2. Solar energy raises the water temperature at the surface — it may exceed 25 °C between the tropics — while deeper down, starved of solar radiation, the water is cold, at around 2 °C to 4 °C, except in enclosed seas such as the Mediterranean. Moreover, the cold layers do not mix with the warm layers. This temperature difference can be harnessed by means of a heat engine. To produce power, a heat engine needs a cold and a warm source, and uses deep water and surface water as these cold and warm sources.

5.3. But to be able to function optimally and profitably, this type of OTEC must operate in specific areas with surface water at a certain temperature and with water of a certain depth. The necessary pipes can be sunk to a depth of around one thousand metres at reasonable cost and using current technology. It would be senseless, therefore, to install OTEC facilities kilometres offshore, as this would require longer pipes, incurring additional costs. In practice, the optimal area is between the Tropic of Cancer and the Tropic of Capricorn, i.e. between a latitude of 30 °N and 30 °S — in the European Union’s ‘outermost regions’.

6. **Harnessing wind energy at sea: offshore wind turbines**

6.1. Although they do not, strictly speaking, fall under the category of marine energy, wind turbines that are attached to the sea floor or floating (while anchored, of course) should also be mentioned. They are by far the most developed offshore technique and seem almost conventional compared to those explored above. However, they have an undeniable visual and environmental impact. The question of conflicting use with fishermen has often been raised. In practice, wind farms that are attached to the sea floor act as marine reserves in which fish proliferate. As a result, they indirectly benefit fishermen by rebuilding stocks in areas closed to fishing, where mast foundations perform the function of artificial reefs.

6.2. This is the most frequently used method in Europe, and it is booming. To date, almost one hundred wind farms have been installed, mainly in the North Sea, the Atlantic Ocean (United Kingdom) and the Baltic Sea. There are few installations or plans in the Mediterranean, which is a deep sea with little or no continental shelf.

6.3. The major milestones in implementing these techniques can be summarised as follows:

— the first offshore installation dates from 1991 in Denmark (Vindeby), and generates 450 kW;

— the deepest foundation goes down to 45 m, installed in 2007 in the United Kingdom (Beatrice Wind Farm, which generates 2 × 5 MW);

— the first large floating wind turbine in deep water (220 m) dates from 2009; installed in Norway (Hywind), it generates 2,3 MW;

— the most powerful offshore wind turbine is in Belgium (Bligh Bank) and generates 6 MW;

— the largest offshore wind farm is under construction, on Dogger Bank in the United Kingdom. It has a planned a capacity of 12 000 MW with 166 turbines. It should be noted that the United Kingdom, mindful of its energy independence, already has 1 452 turbines in 27 wind farms.

6.4. There are also two significant projects off the French coast, one in Brittany, and the other between the islands of Noirmoutier and Yeu. The calls for tender have been issued and the operating consortia have been chosen.

6.5. The economic return of offshore wind farms is affected by their location, in particular by the strength and regularity of the wind. It can thus vary by a factor of two. During periods of slack demand, surplus power supplied by wind has occasionally been sold on spot markets at negative prices. Thus the considerable boom of this type of electricity production can lead to surpluses that are very difficult to make use of, because they are linked to one-off, random weather events (see Professor Wolf's opinion on intermittent energy sources).

6.6. The development of this method and technological advances linked to the use of wind turbines over the last 20 years are making them cheaper to invest in and to operate. In the early 2000s, the cost per megawatt hour was EUR 190; now it is between EUR 140 and EUR 160. In comparison, a modern EPR nuclear reactor generates one megawatt hour at a cost of EUR 130, although it does so stably and predictably.

6.7. Clearly, the other techniques for generating offshore power will have to confront competition from offshore wind turbines if they are to be able to expand to an industrial scale, and will have to prove that they have a competitive edge over offshore wind turbines, which incur not insignificant monitoring and maintenance costs. Water turbines and estuary barrages currently seem to be the most effective and most profitable systems. One of their advantages is that they provide predictable and regular power.

7. **What is the future of offshore renewable energy?**

7.1. As it is a type of green energy, offshore renewable energy is eligible for various European or national support schemes, including preferential purchase terms. However, apart from offshore wind turbines, these technologies — particularly water turbines — still need to be tested 'in real life'. Hopefully, a certain strain of ecological conservatism will not impede the new techniques being tested. It is well known that fierce opposition from environmentalists and fishermen, in particular, has prevented estuary barrages from being developed. Any installation has environmental impacts. We therefore need to be able to measure these impacts as accurately as possible so as to assess the real balance between costs and benefits.

7.2. The first water turbine array was recently submerged between Paimpol and the island of Bréhat. The currents created by the rising and falling tides drive the turbines' rotors; each device can generate 1 MW and these water turbines will be able to meet the energy needs of 3 000 homes.

7.3. Finally, these techniques for generating marine power all depend on their location to be effective. Therefore, they are not a universally effective source of power. We will therefore need to be more sensible in this area than in the case of some other subsidised renewable energies, such as solar panels, which are sometimes installed more due to tax advantages than because they are effective. It should also be noted that taxing CO_2 will help to make renewable energy production techniques, currently at an embryonic stage, economically worthwhile.

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The President
of the European Economic and Social Committee
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