A CASE FOR A MALTESE OFFSHORE WIND FARM: CHALLENGES AND OPPORTUNITIES

Joe Meilak*

Abstract. This paper focuses on the economic aspects of building, operating and eventual de-commissioning of an offshore wind farm. It is based on the limited research currently available on this potentially lucrative economic resource and addresses the concept from a holistic independent point of view. It considers possible operational economic models for the funding, operation and continued operation of the project. It is proposed that by applying simple free market economics coupled with ‘green’ fiscal incentives, the net effect on the government’s pocket as the ultimate owner of Enemalta may be neutralised. Better still the green premium may be passed to polluters required to purchase green vouchers from the project owners. A phased increase in electricity prices is also necessary to ensure funding of alternative electricity generating power. If free market rules are applied properly, the case for wind energy by means of an offshore wind farm would be strengthened.

Introduction

The paper focuses on the Maltese economic aspects of building, operating and eventual commissioning of an offshore wind farm. It is based on the limited research currently available on this potentially lucrative economic resource and addresses the concept from a holistic independent point of view. It considers possible operational economic models for the funding, operation and continued operation of the project.

Malta’s signature of the Kyoto Protocol1 and its ratification by the EU, place obligations on the Maltese government to curtail greenhouse gases.

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1. See http://europa.eu.int/comm/environment/climat/kyoto.htm
Malta's main greenhouse gases emanate from the production of electricity from the two power plants. Further obligations arise out of EU directive 2003/87 whereby the mechanism for greenhouse gases trading quotas have been laid down by the EU for member states to comply with. Meanwhile demand for electricity in Malta has been on the increase mainly driven by the use of consumer electrical goods.

The obligations of the Kyoto Protocol may force Malta to buy excess emission quotas from countries that have surplus credit, given that our per capita emission of carbon dioxide is high at about 8,000 kg/capita/annum (Manduca, 2003). In this regard Malta, with another six EU states, is lagging behind in terms of a coherent national plan for limitation of emissions of greenhouse gases into the atmosphere.

Besides political obligations, a long term strategy of reliance on fossil fuels as a single source of power may be problematic in the future both from a sustainability as well as from a pricing point of view, thus exposing the Maltese economy to the perils of oil pricing. The input cost of electricity is a significant factor in the operation of the economy. It can be a single determining factor leading to inflationary pressures exerted on the economy, on which the government would have very little effective control, given that the price of oil may fluctuate on the international markets.

Various alternatives exist. Malta may tap into electricity supply from Sicily via a submarine cable. This solution would shift our dependency on the Italian, or rather Sicilian regional electricity generation situation which in turn is again exposed to international oil/gas prices.

A nuclear power plant, though possibly feasible, would still expose the Maltese economy to the price of uranium and imported technology and support, apart from the undesirable environmental impacts of such a

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4. In terms of per square kilometres Malta emissions are among the highest in Europe.
5. Environment Commissioner Margot Wallström announced on 7 July 2004 that Greece, Italy, the Czech Republic, Cyprus, Hungary, Malta and Poland have failed to send in their national plans against climate change (as quoted in the EU Observer of 8th July 2004 in the report by Mark Beunderman. http://www.euobserver.com/?sid=9&aid=16846).
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project. Furthermore, the upfront costs of a nuclear power plant are very high when compared to other sources of power.6

Harnessing wind power, which is the subject of this paper, is a potential solution. In a heavily built up area where the last expanses of agricultural land are at an environmental premium, building out to sea may be a reasonable alternative. A major source of such power may be offshore areas where Malta claims territorial jurisdiction for hydrocarbon exploitation. Although no legal acknowledgement has as yet defined these rights, it can be reasonably assumed that these territories can be exploited by the country claiming seabed jurisdiction. This is a significant area of about 30,000 square kilometres, however only about 20 per cent of such an area may be used for the purposes of a wind farm, due to either distance considerations, composition of the seabed and the water depth.7

Offshore Wind Farms

Offshore wind farms are in their infancy for a number of reasons, among which are technical and economic considerations. Such farms have been the pet projects of eco-conscious North Sea states, including Denmark which took the lead in this regard (EWEA, 2004) (see Table 1). From a technical point of view, the extreme weather and sea conditions drive up the cost of installation much higher than onshore installations (Finch, 2001). Currently, these installations are in shallow water, with depths of up to 15 metres.

Offshore waters in Malta are relatively deep plunging to 50~100 metres within a short distance from the shore, except for elevated submerged ridges. Although current offshore wind turbines are designed for operation depth in the region of 15 metres, it is technologically possible to have a platform operating in water depths of 50~150 metres. In fact a number of oil production and exploration systems operate in water depths of 150 metres, in the most difficult environmental scenarios throughout the world.8

6. The Economics of Nuclear Power Briefing Paper 8 March 2004, Uranium Information Centre Australia
7. This percentage is based on a review of the coastal seabed formation of Admiralty Charts information covering the Maltese islands.
The cost of producing such platforms is a determining factor in their economic deployment. For the purpose of this paper it is assumed that a platform housing three 2.3 MW wind turbines would be used, operating in water depth of 120 metres maximum, situated 5 kilometres offshore Malta to the south of the island.

### Technical Feasibility

The technical feasibility of such a wind farm in Malta depends on a number of factors. In this paper a number of assumptions have been made, as explained below.

#### Location

The location is a rocky seabed area, 5 kilometres offshore Benghajsa point. Given the water depth and lack of light penetration beyond 60
metres, the amount of living organisms affected is limited to the footprint of the jackup legs. Seven platforms are contemplated, housing three wind turbines each. The location is subject to mercantile shipping operations from Malta Freeport, hence it is important to redefine navigation of shipping lanes to either pass to the North or South of the location. The backhaul cable is expected to be either landed at Benghajsa point or else at the Delimara power station directly. The marginal cost of the extra 4 kilometres is only 20 per cent\(^9\) of the overall cost of shoring the cable and would save the operator of having a distribution centre specifically built at Benghajsa with the ancillary distribution costs on land. The site is situated circa 10 kilometres away from the approach line for the main runway 14/32 at Malta International Airport.

**Wind Resources**

Wind resources in the area look promising, and from initial indications by an academic paper\(^{10}\) one can obtain a working estimate based on the potential use of a 2.3 MW turbine which would be operational at 80 per cent capacity, during 40 per cent of the time.

This potential is further collaborated by Meteorological Office statistics for wind speeds and frequency registered at Luqa Airport taken on a number of sample days by the author and compared with those cited for the last 21 years (average) by International Station Meteorological Climate Summary on the Washington Post website\(^{11}\).

**Feasible Output**

Based on the above assumptions, the anticipated output from the farm using 21 turbines of 2.3 MW would be 135,000 MWh annually. For the 12 month period ending September 2003, Enemalta produced 2,208,015 MW/hrs, thus the proposed wind farm would have been able to substitute 6 per cent of the total demand for electricity of the island over a 12 month period.

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\(^9\) This calculation is based on the cost of a 7 kilometres cable laying project of laying a new cable between Malta and Gozo by Enemalta.

\(^{10}\) See Farrugia (1998). However, accurate on site data is not available so far.

This looks *prima facie* a small amount. However, the spin-off developments that will materialise from such a project may have many longer-term benefits. It may be argued that the investment can be more efficiently used to build additional generating capacity onshore using conventional oil/gas fired generators and investing in the latest clean energy systems for fossil fuel burning. This alternative will be further discussed below.

**Legalities**

It is assumed that the Malta Government or the Malta Resources Authority will allocate the site free of charge or at a nominal fee to cover administrative costs of notifying aero/naval navigational authorities. This will depend of course on whether or not hydro-carbon exploration is identified in the area referred to above. A ‘buy-all’ contract with Enemalta is assumed which would stipulate that Enemalta will unconditionally buy all the electricity produced by the operator at a price, which is dependent on certain criteria, as explained below.

**Technical Design**

The design of the platform is crucial to the project. A number of options are available depending on the philosophy adopted by the operator and the designer. On the one hand, designing a dedicated platform may be too expensive for a production run of 7 units, however lessons could be learnt from the operation of offshore wind farms in other countries, such as Sicily, Crete, Sardinia, and the Balearic Islands, having similar wind characteristics. Malta can be a centre of excellence in this genre of engineering, given its central location in the Mediterranean, and its experiences in offshore structure construction, steel fabrication and an offshore support industry.

**Ownership, Operation and Funding**

The ownership, operation and funding should be in private hands, such as a public limited liability company. The economic strength of the company will be derived from a ‘buy-all’ contract with Enemalta whereby all the electricity produced is sold to Enemalta at a price under a long term contract spanning at least 20 years.
Various formulas can be used to arrive at an equitable price for all parties. A formula that could be used for this purpose is the following:

\[ P = \frac{\sum_{t=1}^{N} MW_t (C_t + E_t)}{N} \]

- **P** = average price Enemalta will guarantee to pay the operator for electricity generated from the wind farm per annum, over a period of **N** years.
- **MW_t** = expected amount of MWh delivered per annum. It can be assumed that the project will work at 80 per cent capacity, 40 per cent of the time.
- **C_t** = expected cost of each MWh of electricity generated by Enemalta.
- **E_t** = amount of eco-tax per MWh imposed on Enemalta.
- **N** = project lifetime in years, which can be assumed to be 20 years.

Based on this formula the calculations shown in Table 3 have been made to determine the financial feasibility of the project. It is assumed that an annual minimal payment will be guaranteed which is equivalent to 90 per cent of the projected electricity supplied.

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### Table 2
**EU Member States’ Offshore Wind Energy Plans and Targets**

<table>
<thead>
<tr>
<th>Country</th>
<th>Plan/Target (GW)</th>
<th>Year</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>8.7 (Capacity expected from exploration: Licence granted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>0.5</td>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>4.5</td>
<td>2030</td>
<td>(1997 target)</td>
</tr>
<tr>
<td>Germany</td>
<td>25.0</td>
<td>2030</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>2.0 (Capacity expected from exploration: Licence granted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>6.0</td>
<td>2020</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>2.3</td>
<td>2014-2019</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>2.0</td>
<td>2012</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Up to 52.0</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Background paper, Offshore Policy Workshop*
## Table 3
### Calculations of Financial Feasibility

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Years</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Cost of Production Index (Average)</td>
<td>1.14</td>
</tr>
<tr>
<td>3</td>
<td>Eco-tax (Average)</td>
<td>19%</td>
</tr>
<tr>
<td>4</td>
<td>Electricity Production efficiency index (Average)</td>
<td>1.12</td>
</tr>
<tr>
<td>5</td>
<td>Electricity produced by Farm</td>
<td>3,031,137 MWh</td>
</tr>
<tr>
<td>6</td>
<td>Price per MWh by Enemalta</td>
<td>Lm 29</td>
</tr>
<tr>
<td>7</td>
<td>Project revenues</td>
<td>Lm 103,542,212</td>
</tr>
<tr>
<td>8</td>
<td>Discounted Project Revenues at risk fee rate @8%</td>
<td>Lm 47,437,652</td>
</tr>
<tr>
<td>9</td>
<td>Platforms including siting costs</td>
<td>Lm 17,500,000</td>
</tr>
<tr>
<td>10</td>
<td>21x2.3 MW turbines</td>
<td>Lm 18,260,870</td>
</tr>
<tr>
<td>11</td>
<td>15 km cabling and ancillary transmission equipment</td>
<td>Lm 600,000</td>
</tr>
<tr>
<td>12</td>
<td>Administration, maintenance and insurance</td>
<td>Lm 10,000,000</td>
</tr>
<tr>
<td>13</td>
<td>Initial setup expenses</td>
<td>Lm 1,000,000</td>
</tr>
<tr>
<td>14</td>
<td>Total</td>
<td>Lm 47,360,870</td>
</tr>
</tbody>
</table>

**Source:** Calculation by the author

**Notes:**

1. The projections are over a period of 20 years
2. The cost of production index is the assumed increase due to production costs that Enemalta will incur for higher fuel prices over 20 years based on historical information for Brent Crude Oil.
3. Eco-tax is assumed to be a production burden imposed on heavy oil burning entities in Malta imposed by the Malta Resource Authority or another competent authority.
4. Assumed to be the marginal efficiency achieved by the operator from experience in the operation of the project and profiling over time of predictable wind efficiency of the turbines.
5. This is the total MWh produced by the farm after twenty years continuous production net of any maintenance and other stoppages.
6. This is the average cost by Enemalta to produce one MWh of electricity using the figure quoted in its financial report dated for the period ending September 2003.
7. These are the total undiscounted revenues generated over the lifetime of the project.
8. This is the discounted revenues at a risk free rate of interest over the 20 year lifetime of the project.
9. This is the cost of construction of the platforms and their towing and *in situ* commissioning.
10. Average price of 21 turbines quoted by two EU manufacturers.
11. 15 kilometres of underwater cabling from the shore-most platform, equipment for transmission and shoring of the cable at an agreed point within Enemalta’s Delimara power plant.
12. This is the total costs of 20 year operation of a small team of operators, insurance and ancillary operational services.
13. Initial setup expenses payable to site surveyors, permits, EIA and other pre-project expenses.
14. This is the total cost of operation net of any profits.
Environmental Impact

The impact of the offshore wind farm on the environment may be classified into acoustic, aesthetic, electromagnetic, mechanical and biological.

Sound emanating from the turbines would be significant within a 500 metre radius area (Moriarty and Migliore, 2003). Given that the site is 5 kilometres offshore, the impact on humans would be negligible. The impact on fish, mammals, fauna and birds frequenting the area has not been adequately studied scientifically and it is difficult to ascertain such impact. It is pertinent to note that the area is already frequented by major container ships that already produce a significant amount of acoustic pollution in the area both above and under the water surface.

The aesthetic effect will be the most impacting. The area lies circa 10 kilometres away from Fifla. The farm will be mostly visible from Benghajsa Point and Ghar Hasan area. This area presently (July 2004) has been de facto earmarked by Malta Maritime Authority as a rig berthing area (see http://www.mma.gov.mt/uploads/22of2004.pdf). These are non-permanent berths, given the proximity to Fifla. The area is also currently used by container ships on their approach to Malta Freeport Terminal. No tourist areas are affected by the farm and no such complexes are planned for the future.

Electromagnetic disturbance from the concentration of 21 high powered generators 10~15 kilometres, set at about 20~30 per cent to the port side to the approach to runway 14/23 is not considered to be of any significant threat to aviation services be they ILS, DME, VOR, NDB or PAPI systems. Maltacom’s Benghajsa coastal transmission station should also not be effected by the farm.

Mechanical vibrations transmitted into the seafloor are expected to be minimal in most conditions. Effects of mechanical vibrations on fauna, marine life and other organisms are very scarcely available since long term studies on this effect has not yet been documented.

Biological disturbance from the platforms are likely to be minimal although no scientific evidence has yet been researched so far. Shade
from the sun would be reduced to between 20~100 per cent of the platforms surface area depending on the type of platforms used. The effect of shade may actually attract lampuki when in season. Other fish may also be attracted by the jackup legs organic growth between each cleanup. What is certain is that no foreign chemicals will be released into the sea as the platform will not use any hydrocarbon fuels except as lubrication agents in enclosed gear boxes.

**Economic Feasibility**

The feasibility of the project is totally dependent on the price that Enemalta will be prepared to pay for this green-electricity generation. This is a critical factor that can make or break the project.

At this stage Enemalta separated administratively the production and distribution costs of its operation in view of the potential unbundling of the two independent units. In the latest available accounts (September 2002) reference to costs is made, as shown in Table 4.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Enemalta Electricity Production Costs as at Year Ending September 2002 (Lm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages and salaries</td>
<td>6,508,000</td>
</tr>
<tr>
<td>Fuels</td>
<td>34,942,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>2,412,000</td>
</tr>
<tr>
<td>Staff welfare and training</td>
<td>4,000</td>
</tr>
<tr>
<td>Insurance</td>
<td>185,000</td>
</tr>
<tr>
<td>Depreciation</td>
<td>5,831,000</td>
</tr>
</tbody>
</table>


The gross profit on generation made by Enemalta was about 5.72 per cent. This would not be very attractive for private investors. This gross profit would turn into a loss of Lm9 million if transmission, administrative and financing expenses are taken into account. This commodity is therefore being produced at an non-economical price. In an open market the price of producing electricity would have to reflect a commercially
acceptable rate of return which would attract investors to the project. With every government hand-out, the tax-payer is indirectly subsidising energy users.

This situation is not unique to Malta. According to EWEA (November 2001)\textsuperscript{12} the price of electricity in the EU-25 is not economical in the long term, if one is to discount the price of capital sunk into power generation by governments.

In addition, decommissioning costs have not been factored. The eventual dismantling of the farm to be replaced by another more modern farm in 20 years time is estimated to be Lm7,000,000 at current market prices.\textsuperscript{13} The argument that these costs may be absorbed by the investment at that point in time was considered and upheld, assuming that the technology by that time would be more advanced and either the platforms will be reused or refurbished or dismantled at the expense of the new investment. It should be noticed that no provisions are made in Enemalta’s accounts for future power station decommissionings.

Assuming that an attractive rate of return for a private investor is 30 per cent it follows that, if the project is to be privately funded, Enemalta would need to consciously decide to acquire green-energy at a premium. If the amount of energy bought is small (6 per cent in this case), then the price effect on clients would be minimal. If a higher percentage of production is bought at a ‘commercial’ price on the ‘free market’ then at a point the price difference will need to be passed on the consumer.

It must be pointed out that fossil fuel powered energy generation will still be required to meet peak demand when wind energy is not available mostly in hot windless summer days. Wind energy is of major importance in the EU’s target that by 2010, 22.1 per cent of electricity will be generated from renewable energy. Two alternative systems are being promoted as legitimate incentives, namely:

a) a fixed price system, and
b) requesting distribution entities to purchase a percentage of the green energy generated.

\textsuperscript{12}http://www.ewea.org/documents/14_EWEA_position_security_of_supply.pdf
\textsuperscript{13} Discounted at 8 per cent per annum.
Fixed Price Systems will enable the government or the National Energy Regulator (NER) to establish a fixed price at which electricity distribution companies shall buy wind powered electricity. This is the EU’s preferred method. Private investment will then dictate how much capacity it will install. The NER will then regulate the market by changing the set price up down depending on whether it wants to attract more or less investment in the industry.

In the US the preferred method is for the NER to set the percentage of green energy that the electricity distribution entities must buy, leaving the market to determine the price at which this quantity is bought. Additionally in the US, tax credits to the tune of Lm6.43 per MWh (based on a Lm/US$ exchange rate of 2.8) are paid as a tradeable tax credit. The current cost per MWh for Enemalta is Lm25.83

The assumption that an ecological tax would be levied is fair and justified given the fact that the polluter-pays principle is being recognised as a more effective and efficient way for shifting economic costs from ecological inefficient systems to more efficient ones. The actual percentage is debatable. It would be ideal to have this specific tax invested again in green projects. This is of long term strategic importance for the national economy and the promotion of sustainable sources of energy such as solar energy system.

It is also assumed that the project will have no direct fiscal or financial incentives from the government per se. This may sound paradoxical against the argument of imposing eco-tax and fiscal incentives.

An eco-tax may be self-funding and the net effect on government coffers may be neutral in the long term. An eco-tax would be payable by Enemalta as a polluter, when producing energy from fossil fuel. On the other hand, Enemalta would not pay the tax on any renewable energy it produces or buys for distribution.

14. The EU lists a number of targeted polluters such as iron, glass, cement and paper manufacturers of which in Malta we do not have major operators as described in terms of Directive 2003/87/EC of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC. See http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_275/l_27520031025en00320046.pdf
In the formula suggested above, the amount of eco-tax will be factored in the price offered to the wind farm operator. According to this proposal, Enemalta will have to decide whether it is to its advantage to continue producing fossil fuel energy on which an eco-tax is charged or buy alternative renewable energy, transferring the amount of the eco-tax to the wind farm operator. These alternatives will have to be considered within the targets set by the EU and Malta’s international obligations.

An alternative arrangement could be based on green fiscal certificates. Under this arrangement, Malta Resources Authority would issue green certificates to recognised renewable energy operators. These certificates will be tradable on the market and can be purchased by polluting entities (such as Enemalta). Again, this arrangement will have to be considered within the targets set by the EU and Malta’s international obligations.

It should be noted here that the cost of producing energy from fossil fuel is still generally economically attractive, given the current stage of technology, and the attraction of using alternative energy sources is mostly environmental. Hence there is still the need for imposing targets for renewable energy use, rather than relying on market forces. However, the gap between the cost of fossil fuel use and wind energy is closing. Thus eventually there will also be long term economic advantages.

In order to attract private capital the right incentives for an adequate return on capital, given that the project is run efficiently, is the most important policy the government should consider. The appropriate policies in this regard can be summarised as follows:

- Instigate the Malta Resources Authority to enforce a minimum price per MWh on Enemalta for distribution, which is based on the true cost of electricity production, factoring in medium and long term capacity financing and a commercial return on funding. The effect of this measure would be to create a level playing field for all prospective wind farm operators and incentivising the most efficient farm.
- Legislate transferable tax credits for the operator to trade with polluting companies in a wider polluter pays regime. This can be regarded as a second-currency paid to the wind farm operator who can in return exchange it with companies who are heavy polluters e.g. importers of disposal equipment/goods/containers. The benefits for Enemalta of having a private wind farm feeding into its distribution...
system would be a lower fuel bill, less depreciation on installed electricity generation equipment, a secondary dependable resource and less pollution generated. Stockpile space and their financing costs will be lower as well.

The economy in general, will shift its energy bill from a recurrent cost to an upfront investment. Additionally an ecologically less impacting site would be used on a currently disused offshore space.

In the interest of long term benefits for the economy, the price for consuming electric energy would however need to increase. If this economic measure is not implemented in time, the Government would have to finance additional production capacity, irrespective of whether or not a wind farm is operational.

If the platforms are built locally, a contract worth about Lm17 million for local shipyards would assist this business diversify the production and would foster a cottage industry in marine surveying and other support industries, including specialised engineering. The multiplier effect of this contract and perhaps others that would follow may revive the current ailing ship building/repair establishment and generate a new industry capitalizing on human resources already available in the economy and give a boost to exports of high value services.

Skill development will also be encouraged in meteorological financial, legal and technical aspects of wind farming, possibly leading to making Malta a centre of excellence in a huge market which is just rearing its head.

**Conclusions**

This paper provides an initial assessment of an offshore wind farm project. By applying simple free market economics coupled with ‘green’ fiscal incentives, the net effect on the government’s pocket as the ultimate owner of Enemalta may be neutralised. Better still the green premium may be passed to polluters required to purchase green vouchers from the project owners. A phased increase in electricity prices is also necessary to ensure future funds for the funding of electricity generating power. If free market rules are applied properly, the case for wind energy by means of an offshore wind farm would materialise.
Obviously more detailed studies into the project in terms of exact meteorological statistics and on a potential site should be carried out. Detailed designs and costs quotations from operators, builders and operational engineers would fine tune the investigation.

Offshore wind power is a growing industry set to evolve from a marginal operation pioneered in eco-conscious countries to a multi-million dollar industry. Along with hydrogen, solar power and geo-thermal sources, wind will be a driving power in the coming decades.

References