JMK Research & Analytics

OFFSHORE WIND ENERGY IN INDIA

A territory ready to be explored

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Introduction

Offshore wind turbines harness sea winds to generate power. They work in the same way as an onshore wind turbine, the only difference being that in offshore wind, turbines can be either installed on a permanent foundation attached to the seabed (a fixed installation) or on a floating base anchored to the seabed (a floating installation). Offshore wind has several benefits but not limited to the following:

- **High wind speeds:** Wind is much stronger, consistent and less turbulent over water bodies especially sea as compared to lands (due to the absence of any obstruction and less surface roughness) resulting in high wind speeds
- **No land utilization:** The scarcity of land owing to the overgrowing population has brought the focus to the construction of large offshore wind farms over the ocean. This shift would release the land for other useful purposes.
- **Higher energy production:** Offshore wind turbines can be much larger than their onshore equivalents resulting in more energy production.
- **Others:** The coastal areas benefit the most due to smaller amount of transmission costs and losses, smooth transportation of large-capacity turbines, and low sound pollution and visual intrusion.

The offshore wind energy offers vast potential, however harnessing it at scale has a lot of technical and operational challenges. Specifically, for countries like India, where offshore wind deployment has not yet taken off, understanding all the regulatory and technical challenges is critical.

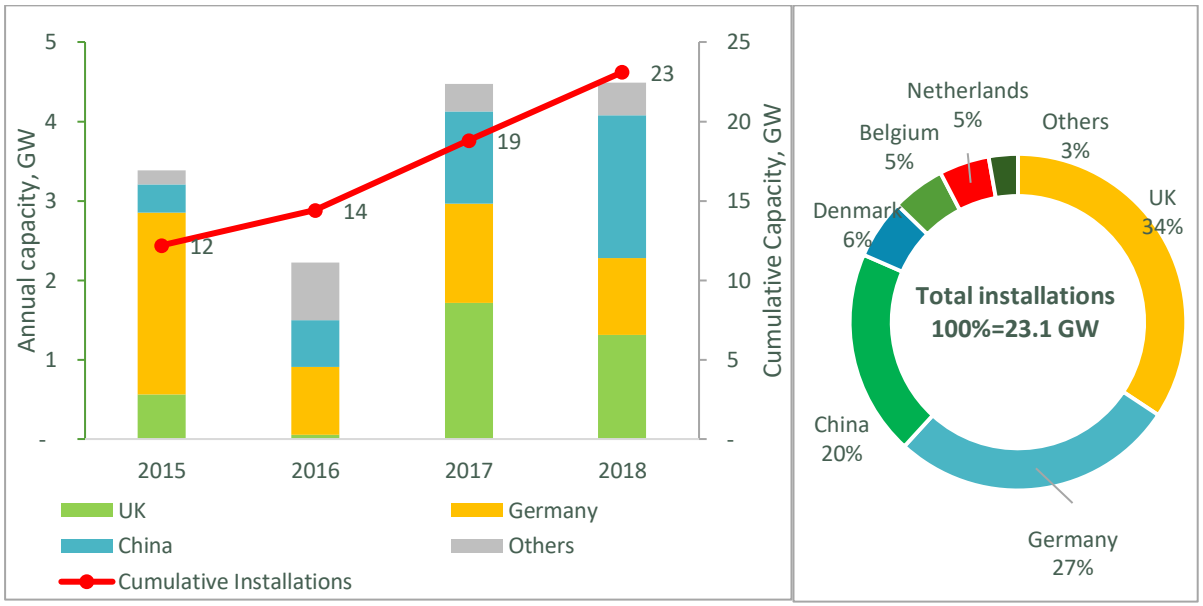
The objective of this report is to study in detail key trends around the global offshore wind market and understand how this market is going to evolve in India. The report examines recent initiatives, taken by the Indian Government, such as the announcement of offshore wind policy, the offshore wind targets for 2022, and the response to Expression Of Interest (EOI) for the first 1 GW of offshore wind project planned in Gujarat, among others. The report also details all the regulatory, operational, and execution challenges that would impact the growth of this market in India. Lastly, there is an outlook section which lists key factors that would drive the future growth of this market globally as well as in India.

Offshore Wind – Global overview

As per Global Wind Energy Council (GWEC), at the end of 2018, the global offshore installed wind capacity was about 23.1 GW. In 2018, about 4.5 GW was added which is an increase of 57% from 2016 installations. Of all the offshore wind installations, the UK leads the world with the highest share of 34%, followed by Germany and China in second and third positions at 28% and 20%, respectively. Denmark (6%), Netherlands (5%), and Belgium (5%) comprise the remaining significant share. Other markets where offshore wind projects are deployed are Vietnam, Finland, Japan, South Korea, the US, Ireland, Taiwan, Spain, Norway, and France.

In 2018, China led the market with a 40% share of new offshore wind installations, followed by the UK with 29% and Germany with a 22% share. Compared to 2017, both the major European markets- the UK and Germany saw a decline of about 23% each in new offshore wind installations, whereas China saw a significant y-o-y growth of 55%.

Figure 1: Global cumulative capacity for offshore wind power



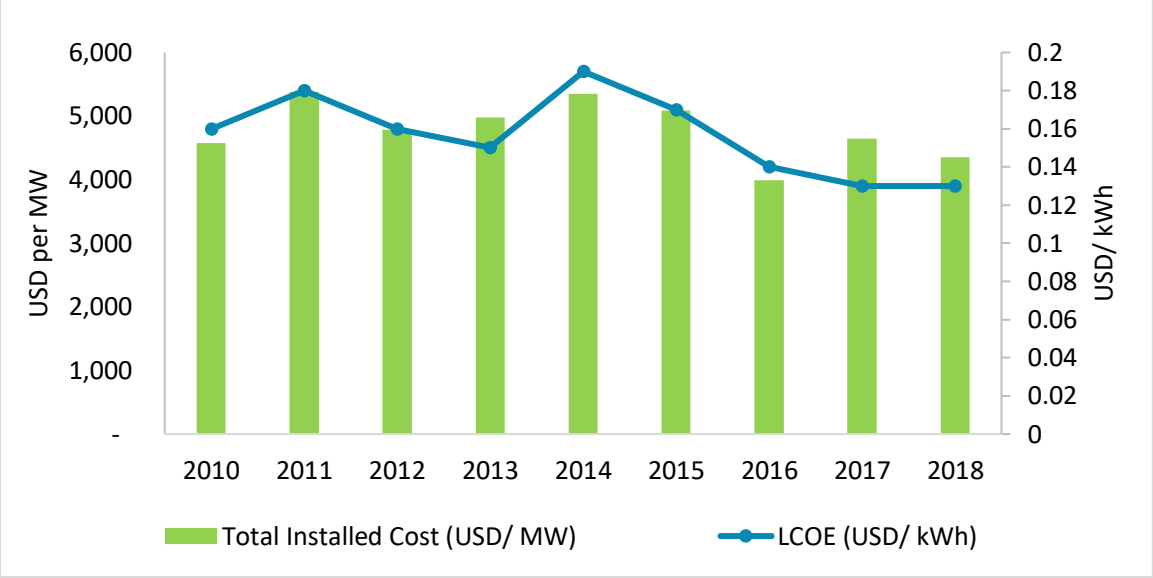
Source: Global Wind Energy Council (GWEC), JMK Research

With governments and industries around the world, committing to offshore wind, the associated technology is also advancing amidst an increase in plant efficiency. The average capacity of turbines has increased 16% annually since 2014, reaching 6.8 MW in 2018[1]. These factors have resulted in significant yields from offshore wind farms and have led the global weighted-average capacity factor for these farms to increase from 38% in 2010 to 43% in 2018[2]. The global weighted-average installation costs for offshore wind also declined by 5% between 2010 and 2018.

[1] https://www.windpoweroffshore.com/article/1525362/europes-offshore-wind-costs-falling-steeply
[2] Report on 'RENEWABLE POWER GENERATION COSTS IN 2018' by IRENA

As per IRENA, the global weighted-average Levelized Cost of Energy (LCOE) declined by 20% from USD 0.159/kWh in 2010 to USD 0.127/kWh in 2018. By 2022, the global weighted-average LCOE is expected to further decline by 15% to reach USD 0.108/ kWh (4% reduction every year).

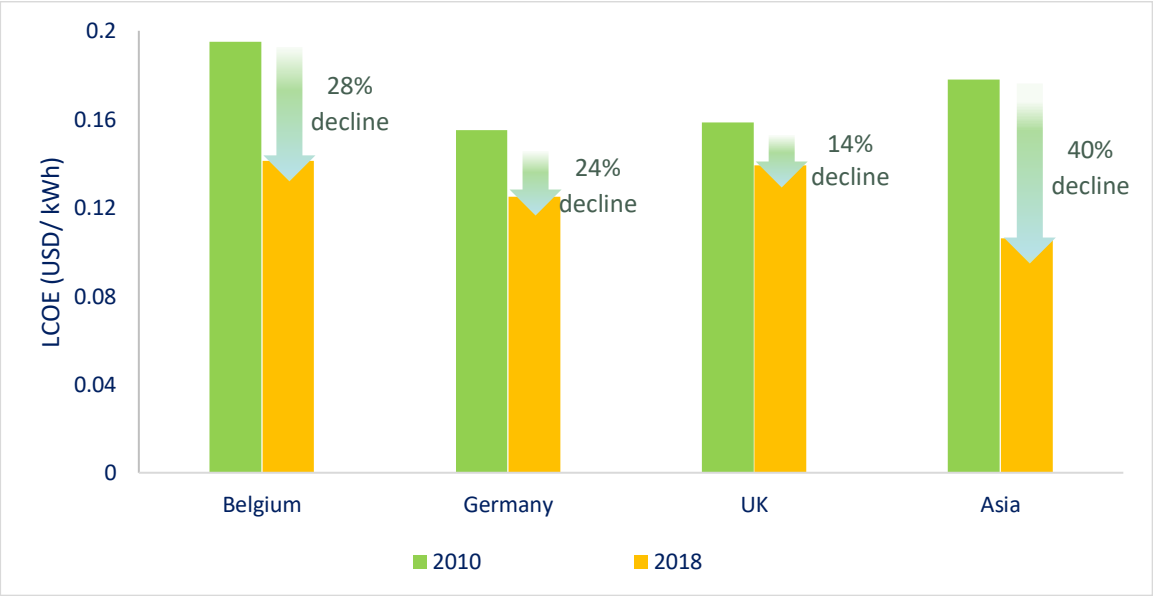
Figure 2: Global weighted average total installed costs and LCOE for offshore wind, 2010 –2018



Source: IRENA, JMK Research

The market for offshore wind is still relatively thin, and there is a wide variation in country-specific declines in LCOE since 2010. In Europe, there was an average 14% drop in LCOE for projects commissioned between 2010 and 2018, with the most significant decline of 28% in Belgium. In Asia, the LCOE reduction stood at 40%, which was driven primarily by China, comprising 95% of offshore wind installations in Asia.

Figure 3: Region-wise weighted average LCOE for offshore wind, 2010 –2018



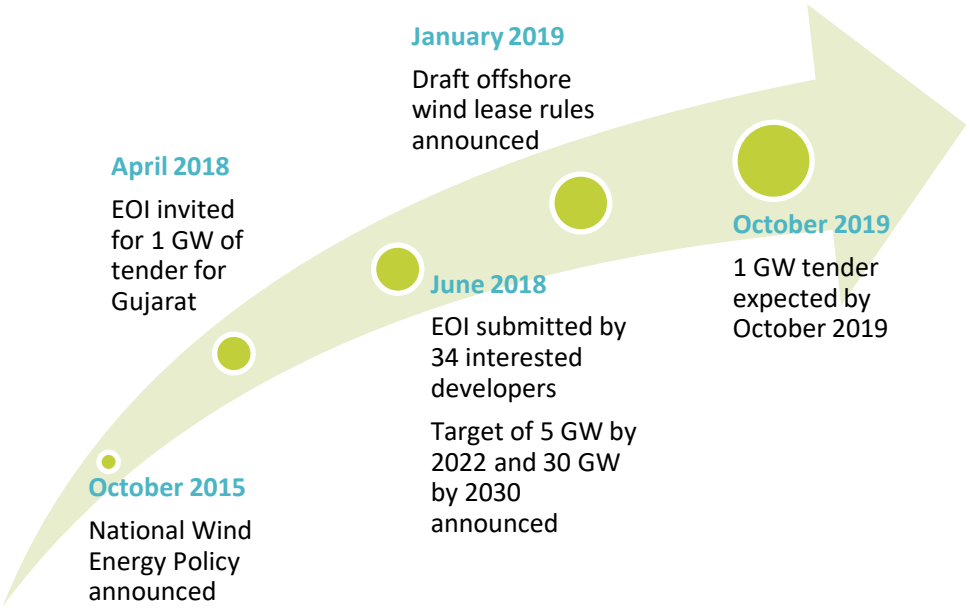
Source: IRENA, JMK Research

The falling tariffs have made the power from offshore wind plants competitive compared to that generated from other sources like gas, nuclear, solar, and wind onshore. Recent auctions in Germany and the Netherlands have also seen zero-subsidy bids. As the market is becoming competitive it is expected that new regions such as India which has huge offshore wind potential would also start exploring this market.

Offshore Wind - India status

In India, offshore wind is still at its infancy, both from a technological point of view and in terms of capacities of relevant stakeholders. However, given India's coastline of 7,600 km, the country has a massive potential of about 127 GW of offshore wind power. The Government has already identified coasts of Tamil Nadu, Gujarat, and Maharashtra as potential destinations for offshore wind projects in the country. The key initiatives undertaken, by the Government of India, in the last year to promote offshore wind energy deployment are summarised below in Figure 4.

Figure 4: Key initiatives taken by the Indian Government for offshore wind deployment



Source: JMK research

Offshore Wind Policy of India

In October 2015, the Government released its first National offshore wind energy policy. Some of the key objectives of the policy are:

a) To explore and promote the deployment of offshore wind farms in the Exclusive Economic Zone (EEZ) of the country, including those under the Public-Private Partnership in ideal coastal regions.
b) To reduce carbon emissions by switching to offshore wind energy farms for harnessing the wind to generate electricity on a large scale.
c) To promote investment in energy infrastructure and achieve energy security.
d) To promote spatial planning and management of the offshore renewable energy resources in the exclusive economic zone of the country through suitable incentives.
e) To encourage indigenization of the offshore wind energy technology.
f) To promote research and development in the offshore wind energy sector.
g) To create a skilled workforce and employment in the offshore wind energy sector.

h) To facilitate the development of Project EPC (Engineering, Procurement, and Construction) and Operation & Maintenance concerning the offshore wind industry.

i) To develop as well as maintain the coastal infrastructure and supply chain to support heavy construction & fabrication work and the Operation & Maintenance (O&M) activities in the offshore wind energy sector.

As per the offshore wind policy, offshore wind farms would be developed in Exclusive Economic Zone (EEZ) along the Indian coastline (farms up to the seaward distance of 200 Nautical Miles from the baseline).

The designated agencies under offshore wind policy are:

- Ministry of New and Renewable Energy (MNRE) is the Nodal Ministry for the use of offshore areas.
- National Institute of Wind Energy (NIWE) is the Nodal Agency for the development of offshore wind projects.

Expression of Interest (EOI) for First Offshore Wind Project in India

In April 2018, the Union Ministry of New and Renewable Energy (MNRE) released an expression of interest (EOI) to set up a 1 GW offshore wind farm within the Gulf of Khambhat, off the coast of Gujarat. The EOI received an overwhelming response from 34 Indian and International players.

Table 1: Details of players submitting EOI response to 1 GW offshore wind farm in India

Country	Name of the Firm or Collaborator
India	• Renew Power • Greenko • Engie • Sterlite • CLP • SembCorp • Rattan India • Inox • Mytrah • Leap Green • Terra Form Global • Suzlon Energy • I Squared Advisors • Shell India Markets • Van Oord India Pvt. Ltd. • Offshore Wind Energy for India (Consortium) • Torrent and Vaayu Power Corporation (Consortium)

Germany	• PNE Wind AG • WPD Offshore Solutions • EON Climate and Renewable • Senvion
Denmark	• Orstead • Copenhagen Infrastructure Partners
UK	• Macquarie Group • Innogy Renewable
Belgium	Park Wind
Canada	Northland Power
Ireland	Mainstream Renewable Power
Italy	Saipem
Norway	Equinor ASA
Saudi Arabia	Alfanar
Singapore	Heerema Marine Contractor
USA	Deep water Structures Inc.

Source: MNRE, JMK Research

Target for Offshore Wind

In June 2018, the Ministry of New and Renewable Energy (MNRE) announced medium and long-term offshore wind energy targets of 5 GW by 2022 and 30 GW by 2030, respectively. These announcements indicate a political direction towards the future of the offshore wind energy in India and a significant role it would play in the medium and long term energy security of India.

Draft offshore wind energy lease rules

In January 2019, MNRE came up with draft offshore wind energy lease rules. Main highlights of these rules are as follows:

a) Players awarded lease in identified areas would have exclusive rights to carry out geological and other geotechnical studies & surveys.
b) Allocated lease areas would be 100-500 square km.
c) Lease periods would include five years to carry out surveys, and 30 years for construction and operation. Lease renewals beyond this would be awarded at five-year increments.

These rules, once finalized, would lead to faster development of the offshore wind sector as provisions have been provided for the state and central governments to work in tandem.

Challenges of Offshore Wind

The potential of offshore wind energy is enormous, but not without the technical and execution level challenges that make harnessing offshore wind energy difficult and expensive. Following are some of the challenges associated with these projects:

High capital cost

The foundation and installation cost of the offshore wind projects is much higher compared to onshore wind projects. Also, in India, the cost is likely to be on the higher side because of lack of installation and support vessels, local sub-structure manufactures, and scarcity of trained workforce.

High tariff

High capital cost leads to higher tariffs as compared to present onshore wind rates. For the offshore wind in India, tariffs are expected to be in the range of INR 7-9 per unit as compared to the prevailing rate of INR 2.8 -2.9 per unit for the onshore wind.

Lack of availability of historical technical data

The historical data, including resource map and bathymetric data (information about the sea depth at various positions), is essential for the identification of suitable wind turbine locations, designing wind turbine foundations, and estimation of energy production. However, this data is not available which could lead to ambiguity and delay in project design. Inaccessibility of a lot of relevant information about shipping lanes, military area, dredging region, oil exploration and fishing zones, submarine communication cables, among others, is also a hindrance.

Cumbersome clearance process

The list of Central Government Ministries/ Departments which are likely to be involved in the process of granting clearances for offshore wind power projects in India is quite exhaustive. This might hold up the approvals and, eventually lead to overall project delays and cost overruns. Listed below are some key agencies and the clearances that are likely to be needed for offshore wind projects:

S. No.	Ministry	Clearances required
1	Ministry of Environment and Forest	Environmental Impact Assessment (EIA) and Coastal Regulations Zone (CRZ) clearance
2	Ministry of Defence (MoD)	Clearance related to defense & security aspects, related to Army, Navy, Air force, DRDO, and other such institutions under MoD.

3	Ministry of External Affairs	Clearance for the development of offshore wind energy projects within the maritime zones of India.
4	Ministry of Home Affairs	Clearance deployment of foreign nationals in offshore wind energy blocks.
5	Ministry of Civil Aviation	Clearance for construction near aviation Radars/ aerodromes. No clearance required for all other locations.
6	Ministry of Petroleum & Natural Gas	Clearance for installations proposed in Oil & Gas Blocks and No Objection Certificate for construction outside the offshore Oil & Gas Blocks.
7	Ministry of Shipping	Clearance for projects near Major Ports. No Objection Certificate to operate away from shipping lanes.
8	Department of Space	Clearance from security angle with regard to Dept. of Space installations and for minimum safety distance to be maintained from the Department of Space installations.
9	Department of Telecommunication	No Objection Certificate to operate outside subsea communication cable zones.
10	Ministry of Mines	No Objection Certificate to operate outside mining zones.

Source: MNRE, JMK Research

Other major technical challenges

The other significant challenges that exist in offshore wind power deployment relates to:

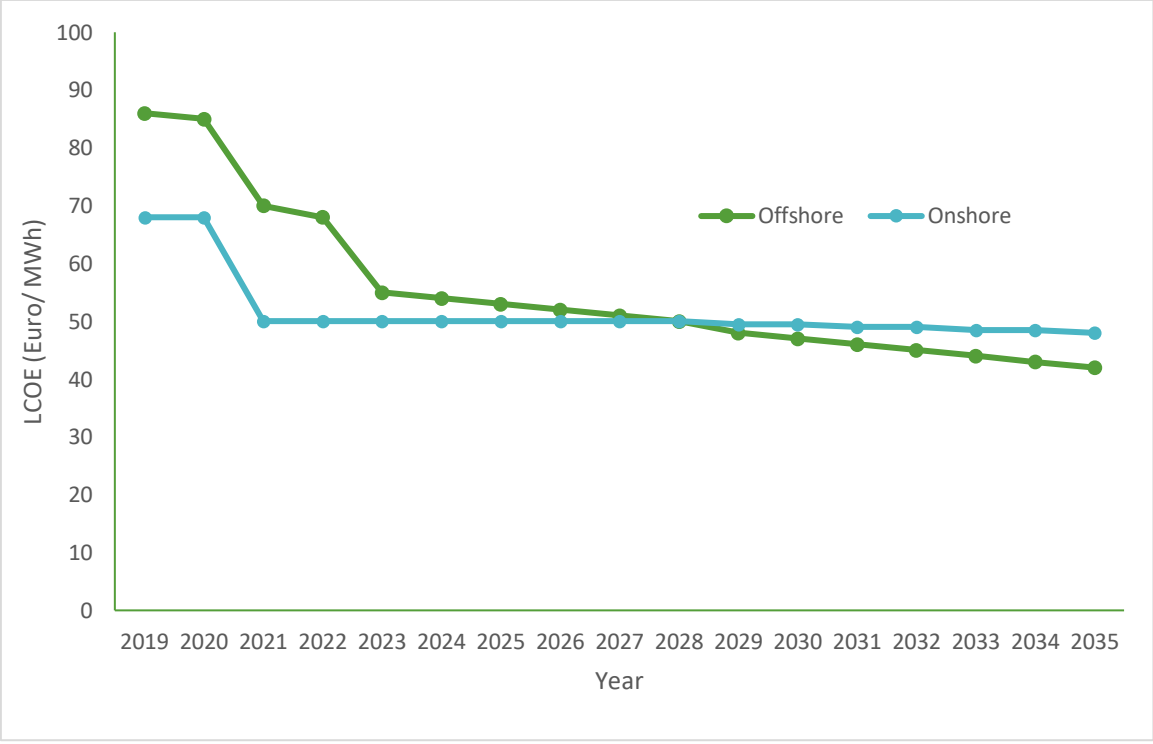
- Resource characterization
- Subsea cabling
- Construction of foundation of the turbine
- Installation of turbines (logistics, grid interconnection, and operation)
- Development of transmission infrastructure
- Coastal security for the wind farms during construction as well as operation period

Way Forward

Offshore wind power can play a significant role in generating clean and sustainable energy on the world map of renewable energy. As per IEA[3], the global installations of offshore wind would be tripled by 2025 and is expected to reach close to 200 GW by 2040. Key drivers for the growth of the offshore wind industry are many including, the improvement in technology leading to reduction of prices, the introduction of a new generation of turbines, maturity of the offshore wind industry, and the increase in investor confidence.

As per various industry estimates, the cost of offshore wind technology is expected to fall below the onshore wind by the year 2028[4]. The fall in costs is due to improvements in technology and an increase in the size of offshore wind turbines. Although at present, mostly 8 MW turbine models are deployed across the globe, the future turbines would be of 10-12 MW in size. Players like VESTAS and GE have already developed 10 MW and 12 MW turbines, respectively. With bigger wind turbines and larger wind farms, the economies of scale would come into play leading to a fall in overall costs.

Figure 5: LCOE comparison of wind technologies



Source: Cornwell Insights, JMK Research

[3] http://ieefa.org/iea-offshore-wind-capacity-could-top-200gw-by-2040/
[4] https://www.businessgreen.com/bg/news-analysis/3070028/could-offshore-wind-soon-prove-cheaper-than-its-onshore-cousin

With falling costs this market is expected to grow multi-fold across the globe. India is also expected to make progress and take crucial steps in the right direction for the deployment of offshore wind energy. Facilitating Offshore Wind in India (FOWIND) classifies five "action items" that are critical to implementation of offshore wind in India [5] :

- Development of a long-term offshore roadmap
- Clear consenting and permitting procedures
- Regional and national grid development
- Financial support mechanisms
- Development of skills and competences

Along with these crucial action items, India's political will of self-reliance towards energy security backed with relevant policy, regulatory, financial, and technological support would provide a unique opportunity to tap this unexplored market.

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[5] https://gwec.net/wp-content/uploads/2017/12/FOWIND_2017_Final_Outlook_2032.pdf