Ines Heger

Wind Energy in Japan

Industrial Cooperation and Business Potential for European Companies

EU-Japan Centre for Industrial Cooperation
日欧産業協力センター

EU-Japan Centre
for Industrial Cooperation
日欧産業協力センター

The Author

Ines Heger worked several years for a WTG manufacturer with stays in Belgium, Germany and Chile, as a researcher for the Potsdam Institute for Climate Impact Research and on behalf of the European Commission's DG ENER, DG ENV and DG ENLAG. She stayed at the EU-Japan Centre for Industrial Cooperation in Tokyo, a venture between the European Commission and the Japanese Government (METI), doing policy and market analysis and monitoring the Japanese energy and wind market (MINERVA Fellow). Her focus lies on energy transition pathways, renewable energies, energy efficiency approaches in industrial manufacturing as well as climate change mitigation / adaptation strategies. She is trained in Management, European Law and Communication at Science Po IEP Aix-en-Provence, University of Miami, and University of Leipzig.

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Executive Summary

Japan has unfavorable conditions for wind energy as it regularly experiences typhoons, lightning strikes, and strong turbulent flows caused by the complex terrain. Also, Japan does not have a tradition of wind power installation and management like European countries. Thus, wind energy had long not been considered as an important pillar of Japan's electricity mix. Following the oil crisis in the 1970s, the sunshine project was created with the intent to substitute fossil fuels with renewable energy alternatives, but the main boost favored PV. Even after the introduction of a FIT system in 2012, wind turbine installations were way behind. PV has been easy to install since the strict EIA did not apply and grid connections were no longer cumbersome. However, a shift towards more wind is hoped as the FIT for PV has been cut back early this year and wind potential is bigger than the one for other renewable energy sources in Japan. The government started preparing the power grid in strong wind areas such as the island of Hokkaido and Tohoku region from 2013. But the utilities have been resisting efforts to integrate more wind into the grid especially in the north. Due to recent advancements in the unbundling of electricity segments, with full retail progression from April this year, 2016 is a time when decisive steps are taken, that will shape Japan's energy future and might solve current bottlenecks. The use of wind power is expected to increase in the coming years, opening doors for EU Companies to carry out business in a resource-rich environment.

All information and aspects discussed in this report were gathered through interviews with WTG manufacturers, developers, their associations, official sources and other WTG industry avenues.

5 Global Rank offshore installation

20 Global Rank cumulative installation

28 Global Rank new installation

70 % of WTG in Japan are delivered from abroad

50 % of the components for Japanese WTG manufacturer are supplied from abroad

+ 10 GW target by METI in 2030

+25 GW is predicted by JWPA in 2030

Japan and Europe compared:

1:11	Area
1:4	Population
1:46	Wind energy installed
1:3	Peak demand
1: 31	People employed by the wind industry
1:200	Offshore installed

80 % of Japanese WTG industry believes the wind market in Japan will grow in the future

5.000 are employeed by the wind sector, from them 3.500 work in the WTG related industry (WTG, component etc.)

0.5 % of Japan`s electricity supply accounts for wind energy

Introduction

Riding on the heels of Japan`s ongoing energy deregulation policies and reforms, wind power, an integral of the energy sector is poised to become a power to be reckoned with in the future. This is in consonance with the predictions of several industry players and pundits that wind power is likely to kick-off in the coming years. Although this is speculative, the predictions have some credence due to a moderate rise in wind energy installations all over the country and a high 6-7GW backlog, that is going through the EIA approval process. Power generation from wind rose to about 5,268MWh/year with 3,038MW at the close of 2015 due to an additional installed capacity of about 244MW the same year. This represented an improvement of 140MW over 2014's installation effort. As a result, the total installed capacity for 2015 generated 0.5% of Japan's power supply. It is worthy to note that Japan's installation capacity at the end of 2015 rose with 52.6MW coming from offshore wind power installations. In what represents a steady effort to increase wind power generation, about 2.3GW of wind power installations have scaled the extensive EIA processes and acquired FIT approval. As mentioned, an additional 6-7GW is in the pipeline.

But it is not all that long ago that in Japan a FIT-scheme similar to European systems has been introduced to encourage the use of renewable energies. The main motive of the 2012 FIT was to reduce carbon emissions, support green environment and to balance out power shortages left by the loss of nuclear power caused by the unavoidable shutdown of Japan's foremost nuclear power plants. The precursor to this was the Tohoku earthquake and tsunami disasters and the subsequent radioactive fallout and destruction of the Fukushima Daiichi Nuclear Plant in March 2011. The overwhelming effect of the nuclear disaster due to public outcry and political sentiments led to the stop of all existing 54 nuclear reactors in in May 2012. The massive closure of the nuclear plants was a turnaround for the Japanese energy industry, that had to face a wide disparity from the generation capacity before and after the Fukushima accident. To cushion the gap left by the loss and closure of the plants, oil and gas accounted for about 90% of power generation; hydropower provided 8% while other renewable sources of energy; for instance, solar, wind, biogas and geothermal, invariably filled up the gap. With the realization that hydroelectric capabilities of the country are unsatisfactory, the government initiated a drive to increase power generation with other renewables, chief among which was solar power. Although wind power was not much explored by FITs, the case was different for solar energy, which led the renewable energy revolution. The reason for this is not far-fetched: unlike other countries which are rapidly expanding their wind power capacity, the cost of wind power in Japan is expensive due to a pronounced absence of economies of scale. This was further compounded by the fact that OEMs are yet to provide solutions on how cost can be reduced in the future.

The massive introduction of solar PV increased awareness about limitations of the power system in Japan; such as difficulties of grid integration, missing transmission lines and oddities of the FIT-law. In particular, the limited and fragmented grid infrastructure are a major obstacle and remain a key challenge, especially for wind development due to the existence of favorable wind speed locations in the northern part of the country away from the industrial centers such as Tokyo region where demand for energy is high. Another barrier is the current electricity market structure and the management of grid operations by the existing Electricity Power Companies (EPCOs) that limit grid access for wind projects. This situation could be solved in the coming years with the full implementation of energy sector reforms that has just started with the liberalization of the retail market in April 2016. The full impact of the integrated energy system reforms with the lawful compartmentalization of power transmission, and distribution sector scheduled for April 2020 and the abolishment of the tariff regulation that follows. Further expansion of business opportunities is expected, with an increase in partnerships across regions and industries.

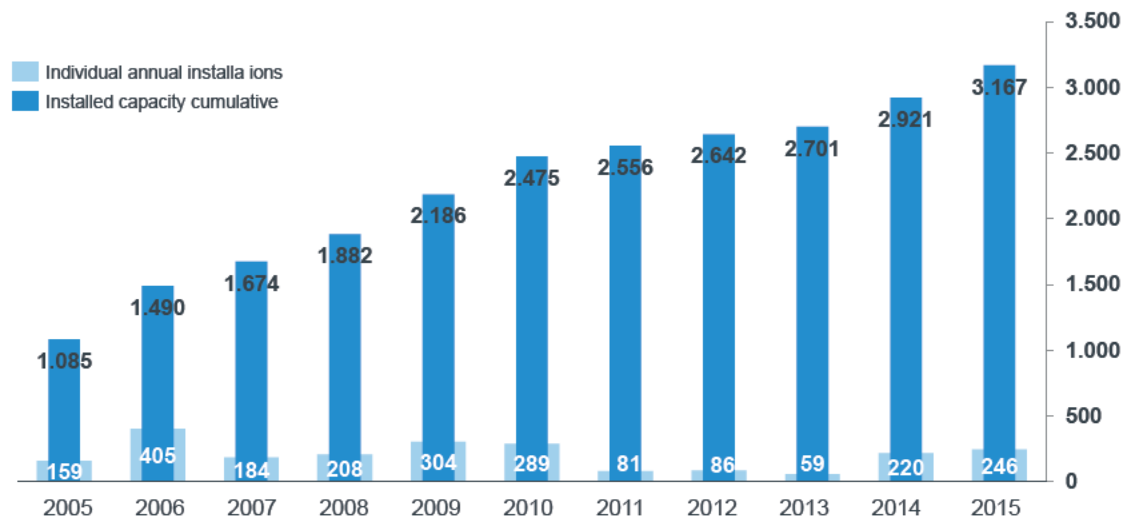
The government likewise tries to handle further obstructions, for example, a layer of controls identified with advancement grants, duration of the approval process, venture instability, and risk premiums. Social acknowledgment is also difficult due to the actions of past oversights which did not pay attention to neighborhood groups' concerns. The endeavors incorporate improvement of the EIA process to a shorter observation period and backing for business owners, as well as advancement of markets.

Consequently, there is a broad expectation that the use and promotion of wind power will be in leaps and bounds in the future. Wind power has bigger potential than several other renewables in Japan even though the FIT has not expanded wind establishment to date and the magnitude of bottlenecks has impeded extensive use and adoption of wind power. However, there exists an increase in wholesale and retail costs of power because of costly oil and LNG imports which drive up the viability of renewables as innovation costs fall. With respect to LNG, renwables could turn out to be cost competitive by 2025.

Since Japan is an island country, it is expected that offshore wind power will be introduced to exploit the expansive areas off the coast where issues, for example, visual effect, noise and the trouble of securing necessary sites are more flexible. The development of various offshore wind ranches has been arranged and is advancing. The Japanese government (METI, NEDO, MOE) is making massive investments in grooming offshore ventures; both mounted on the sea floor and those afloat. The substantial efforts to improve offshore technology give high chances to experienced European players for business opportunities and cooperation.

Wind market installations 2005-2015

Source: NEDO 2016



It should be noted, that long-term targets and clear commitments for wind energy are required to ensure a stable investment environment and secure growth. There are additional obligations for all stakeholders in the energy sector in Japan because reaching the global standard means accepting new duties, including a guarantee for the financial-savvy workings of the general energy framework and to secure the nation's energy sector. The government together with the WTG industry should keep having an impact by utilizing specific cost reduction initiatives, enhance venture certainty and consistency and to make it less demanding to integrate wind power into existing electricity frameworks.

Therefore, it is critical to get a good grasp of the workings of the energy market and the necessary input for penetration of the wind energy market in Japan. To attain that, this report aims to make a comprehensive analysis of the Japanese wind market to prospective and existing European companies interested in Japan's market. The report further depicts market opportunities, existing conditions of investments and availability of funding to simplify market accessibility for prospective investors and companies. Additionally, it also provides useful information on the necessary issues that every investor must pay attention to. The information presented by this study was garnered with the support of the EU-Delegation, METI, and the EU-Japan Centre for Industrial Cooperation. Several companies, experts and stakeholders from the wind energy industry were thoroughly interviewed to get further hindsight into the latest technical developments and economic machinations of wind power in Japan.

The following facets of the wind power sector among others will be considered in this report:

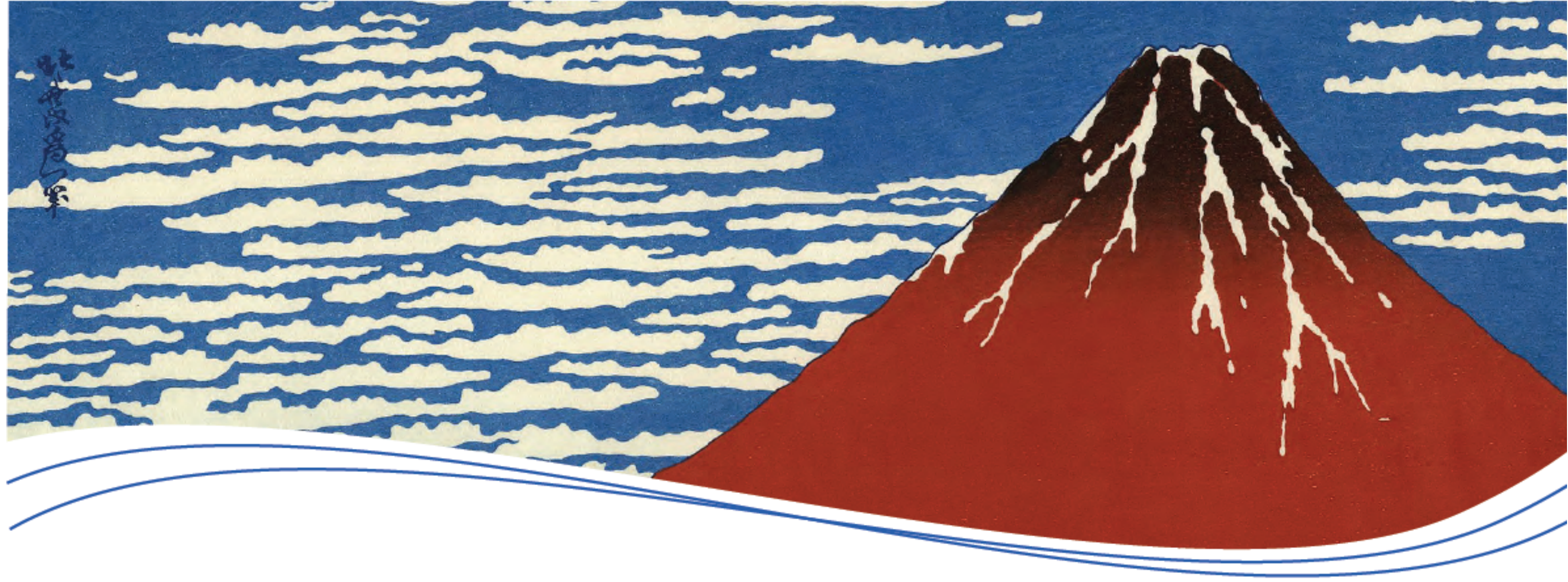
- Wind power market, policy and regulations in Japan
- Past and present experiences of Japanese companies in the Japanese energy market
- Market Entry & Procurement Processes
- Risk assessment, maintenance
- The nature of EU-Japan partnership and investment opportunities on Wind Energy

The report concludes by making recommendations on steps companies need to take to successfully enter the Japanese market by mapping out existing wind power projects, stakeholders as well as players in the sector.

The structure of the report is:

Section 1: Japanese Market and Business Practice
Section 2: Wind Market Japan
Section 3: Funding and Cooperation Opportunities
Section 4: Domestic Industry, Key Players
Section 5: Case Studies
Section 6: Challenges and Recommendations

The nature of Japan's business environment and trials for European companies



1. The nature of Japan's business environment and trials for European companies

Companies of European origins have regularly been afflicted with the perception that an entrant into the Japanese market will achieve little or no success. Japanese guidelines require high versatility, persistence and considerable adaptability. In any case, in spite of the lengthy procedure, the outcomes can be significantly more promising in Japan than other countries. Notwithstanding alluring rewards, there exists a wide cache of business partners and a business-oriented environment suitable for investment. Irrespective of the prospects of the business, the thorny question of concern as regards free market entry or local partnership will remain largely unanswered until diligent research and preparation has been done before market entry. Companies have a choice to either enter into joint venture agreements with local partners using intermediaries or organize and carry out demonstration ventures with Japanese companies or the academic community. Since its inception, the energy industry has been full of life and offers a lot of economic benefits for local companies who are becoming increasingly interested in collaborating with foreign and global energy companies.

Presently, in the face of current economic realities, cost-reduction is the primary concern in Japan's wind power industry. This concern places European companies in the best position to easily enter the market due to strong currency backing and lower cost of manufacturing for turbines and components, which are often cheaper than locally made parts.

The development of wind power in Japan cannot be done wholly by local firms; the input of European companies, therefore, remains indispensable to create a synergy to advance wind power installation and generation.

1.1 The political background of Japan

Japan runs a parliamentary system[1] of government, similar to the British model. Tennô, the Emperor of Japan, is addressed as the Monarch of the Japan both home and abroad, while absolute sovereignty resides in the Japanese people. The Acting Prime Minister is Shinzo Abe who is having his second spell in office. His Liberal Democratic Party (LDP) returned to power after a brief period of three years since 2012. Before this period, the arena of power and politics was largely controlled by the LDP which provided the Prime Minister for 50 years. The lawmaking body is a bicameral parliament with upper and lower houses. The strongest assembly is the lower house that picks the Cabinet and the Prime Minister, both emerging to make up the executive. The Supreme Court stands tall in the hierarchy of courts in the Japanese judicial system. The Japanese structure of governance has been bedeviled by bureaucratic bottlenecks in the decision-making process. Although various measures to control this have been implemented, the problem persists.

The strong interconnection between the administrative framework and political sphere perseveres through the political institution, which often limits successful implementation of reforms. Besides, implementation of such reforms is often more difficult due to the political instability created due to the short-term nature of the Prime Minister's tenure[2].

1 Since the adoption of the Constitution in May 3, 1947.

2 Before Shinzo Abe, there have been 90 prime ministers in place since 1885.

However, with the rise of Shinzo Abe to power, various political analysts are of the opinion that Japan is witnessing its first long-term era of political stability. Irrespective of serious concerns about Abe's economic policies, Japanese voters voted in mass for the LDP in the Upper House elections of July 2016 which signified the voters choice of political stability. Since then, Shinzo Abe has been at the helm of Japan's politics and executive administration which gave him the opportunity to propose constitutional changes in a nation-wide referendum. Before the elections, voters were less concerned about the energy objectives of his administration (renewables versus nuclear power); rather they were much more concerned about the nation's economic woes and instability. The voters have since moved on but Shinzo's convoluted energy policies coupled with the resuscitation of nuclear power and restructuring of Japanese core armed powers remain widely unacceptable. The displeasure of citizens as shown in recent opinion polls[3] suggest that a large number of citizens are not in support of the recent restart of several nuclear power plants as experience has shown the risks involved as well as the possible safety concerns of obsolete facilities[4].

As an index of long-term economic growth and development, various calls have been made to increase the labor market's flexibility and end the nation's protection for certain professions, businesses and occupations in a bid to deregulate more businesses. Although the government has declared its political will to combat the economic concerns raised by the public during its tenure, there exists severe opposition from several interest groups against such reforms. The question of when and how these reforms will be implemented during his tenure remained unanswered. This is also a question regarding energy liberalization reforms, the reality being that the big EPCOs in Japan will have to face the fact that when these reforms are implemented, their market penetration and share will continue to decline.

3 McCurry J. (2016): Japan split over restart of first nuclear reactor since Fukushima disaster. In: The Guardian. Available online: https://www.theguardian.com/world/2015/aug/09/japan-split-restart-first-nuclear-reactor-since-fukushima-disaster (accessed 11/08/2016).

4 Interviewees expect that a maximum of 20 nuclear plants will restart as half of the plants need massive reinvestments to ensure the stricter safety standards.

1.2 The economic background of Japan

In the two decades preceding 2016, Japans economy was characterized by low levels of inflation, deflation, economic growth and development. This economic meltdown discouraged local and household consumers as well as businesses from their regular spending patterns, with most preferring to wait till the economy improved. Nonetheless, the flow of Foreign Direct Investment (FDI) into Japan keeps decreasing, while in 2015 Japanese outward FDI soared to record heights. Likewise, Japan has a place among the world's most technologically-advanced nations with its interests and specialization in technological advancement, research, medicine, robotics, e-mobility platforms and the automotive industry.

Japan's economy was highly tipped to grow by 1.0% in 2016[5], based on the assumptions that government's loose fiscal policies turn out to be fruitful. However, Japan confronts real difficulties: apart from the high shortfall in revenues, the nation is faced with a genuine demographic issue: the populace is contracting and the working-age populace is additionally declining. Therefore, in the absence of counter-measures, Japan will unavoidably be confronted with less tax revenue and rising expenditure, especially on retirees. Numerous businesses presently experience a lot of challenges because of an absence of adequate work force, prompting higher work expenses and harming their status in the global market. As a result, Japanese companies' capital value remains low in contrast to other foreign competitors. The Return On Equity (ROE) of about 33% of registered companies is around 5% with half of them having not more than 8% ROE. This has changed drastically in the past few decades as a result of a shift in government's spending pattern from security and defense to economic growth. This move was popularly known as "the Japanese post-war economic miracle" of the 1960s.

Following the directives of METI (previously known as MITI), Japan witnessed a surge in its economic growth of 10% in the 1960s, 5% in the 1970s, and 4% in the 1980s. With this, Japan built the foundations of an economic empire to remain the world's second largest economy within 1978 to 2010 before it was overtaken by China. As of 1990, the per capita income in Japan was on par with or beyond that of most Western countries. Following years of tremendous financial support from the Japanese government in the economic miracle era to the 80s, the country's economy peaked in the 80s and 90s, but the growth rate plunged in 1991 following the Kobe earthquake. The decline became more significant with the securities market crash (the Tokyo Stock Exchange) of 1990-1992. To make matters worse, real estate assets became exorbitant with peak costs in 1991. From that point, Japan`s economy became debt-ridden which made it known as the country with the highest debt profile among developed nations. The overreaching impact of this development led to a slower economic growth rate for Japan in contrast to those of other developed nations. That era was defining in Japan's history and has been popularly referred to as the "Lost Decade".[6]

5 JETRO (2016): Global Trade and Investment Report. Available online: www.jetro.go.jp/ext_images/en/news/releases/2016/25775525206556e1/overview.pdf (accessed 11/08/2016).

Although the country's economy took a positive turn in the 2000s, the joy was short-lived; the global economic recession in the years that followed took its toll on the economy which subsequently set it on a decline. The Japanese economy has a fundamental framework designed to always rise against all odds as events in 2010 revealed. But the Fukushima nuclear disaster of 2011 upset the balance of things as Japan's economy was dealt a big blow the same year. With concerted efforts, the economy was reformed in 2012 which led to an increase in the growth index.[7] However, the growth in the opinion of economists[8] was insignificant to the nation's economic woes. Subsequently, the government created an economic policy called "Abenomics" which was largely beneficial to the nation's growth and big exporting businesses to the exclusion of SMEs.

This has to do with the fact that the Japanese economy operates on a dualist framework, between SMEs and big corporation bodies (Keiretsu). Similar to Europe, the former constitute 98% of Japan`s industry, thus, forming the backbone of the economy. Corporate bodies on the other hand mostly use SMEs as suppliers. Due to financial problems witnessed in previous years, the Keiretsu which have been frequently indisposed to foreign partnerships and are presently compelled to rebuild relations with other international companies. In any case, Japanese SMEs keep on suffering from the improvement of the yen, a development not directly related to increased rate of local consumption.

6 Gao B. (2001): Japan's economic dilemma. Cambridge University Press.
7 Schulz M. (2012): The World is turning Japanese: Opportunities for Japan in Asia and Europe. Available online: http://www.fcc.or.jp/pdf/Schulz2012-02-28.pdf (accessed 25/07/2016).
8 Ibid.

Most Japanese SMEs are customarily operated as scattered sub-divisions; they jettisoned global marketing strategies with a mindset that only big companies need it. A sizeable number of these SMEs need fundamental changes, for example, in the areas of support for pensions, insurance, gender support, etc. To make the reforms more meaningful, the government has stepped up its efforts with particular emphasis on the labor market. For instance, the "white-collar" exception changed salary structure to performance based rather than promotion level at work. Besides, the resource deficiency of Japan made it a highly import-dependent nation.

Japan's economic woes have been further aggravated with the rate at which government and private companies' financial prowess remain stunted. The effect of this made Japan a shadow among Asian nations when international companies seek to penetrate into markets in Asia. While other Asian countries are developing their economies at pace, Japan's resurgence remains on its level. Presently, Japan's economic focus is torn between letting the economy revive itself or to carry out comprehensive reforms in the coming years. Irrespective of which side the coin lands, this is a good time for European companies to get access to the market.

1.3 Nature of business activities in Japan

European companies are likely to face difficulties which may be encountered from efforts to create and foster business relations with Japanese partners. In any case, doing business in Japan and other neighborhood countries is very promising as soon as all fears and difficulties have been surmounted on hitting the ground.

JETRO reported that it is highly probable for companies whose products have the characteristics listed below to thrive in Japan[9]:

- ✓ Uniqueness
- ✓ Dependable
- ✓ Flexible
- ✓ Scalable
- ✓ Compatible
- ✓ Easy to Customize at low costs
- ✓ Adaptable
- ✓ Less costly
- ✓ Technologically Advanced
- ✓ Easy to Use
- ✓ With Japanese (language) adaptation

It should, however, be noted that Japan's economic climate is distinct from that of other nations. As identified by a Business-Index[10], the fundamental

9 JETRO (2015): ICT market opportunities in Japan. https://www.jetro.go.jp/ext_images/canada/pdf/japanictmarketpresentation.pdf (accessed 25/07/2016).

10 Dörrer K., P. Bessler (2016): Stabil und ertragreich. Geschäftsklimaumfrage AHK. Available online: www.japan.ahk.de/fileadmin/ahk_japan/JM_Artikel/JM_Artikel2016/JM_0506_2016_geschaeftsklima.pdf (accessed 25/07/2016).

hindrances that new businesses face in Japan are spelled out in the Table on the following page, referring mainly to Human Resource challenges. After all, entry into the market requires a lot of preparation. As a corollary, the cost of preparation is steep and all pre-market efforts won't be wasted if proper steps are followed with the right outlook. It is, therefore, imperative for European companies to pay attention to the key points briefly highlighted below:

Make products unique as much as possible: Japan's market is very competitive in nature, entering the market with a unique product gives a company an edge over other brands. The Japanese business sector is continually searching for new high caliber and (inventive) innovation goods which have their Unique Selling Points (USP). This likewise applies to the WTG industry with its high innovation drive. Correspondingly, the Japanese market has strong interest in technological products, both from home and abroad, that can be custom-made to their requirements. It is therefore imperative to enter the market with a good USP as its absence can be devastating for a new entrant. European companies without USPs imply that their presence is only to compete with existing business. European companies can offer advanced turbine technology, offshore technology, use of sensors and precision measurement instruments, as well as davanced manufacturing approaches. This will put a European company in a good market position due to its reputation, invention and experience and will ultimately make it a beneficiary of Japan's existing economies of scale in its industry.

Qualitative product investment: The Japanese understanding of quality is one of the major challenges in Japan business. Quality alludes for the most part not only concerning technical specification or parameters but to the client's expectation of pre-service and post-service experience which represents a comprehensive quality assurance. Every innovation or item needs to at first exhibit its quality. That implies frequent and extremely far-reaching clarification or specialized documentation that is normally expected in Japanese language. Japanese product description and invoice documents regularly contain substantially more definite specialized information and particulars, as it exists in Europe and other global markets. Interestingly, business deals are expected to be much less detailed in Japan. The same applies to customer service relations for a company which desires to get repeat buyers or customers. Usually, the normal quality of product and service may surpass what exists in other markets of the world. This makes Japanese companies spend much more money in a bid to increase the quality of their products. Along these lines, this produces higher profit margins, which may be used to complement or accommodate further development of products. European wind technology is associated with high quality standards and advanced technology. That is an advantage in the Japanese market. Japanese customers favor in particular market leaders, as a leading position is perceived as a proof for quality and long-term experience, which responds to the desire for knowledge transfer.

Knowledge about necessary product adjustments for the Japanese market: It is important that companies make their products suitable and befitting not only for Japanese technical standards but also concerning topographic conditions in Japan. For example, in the energy industry, attention must be paid to the workings of the grid framework as well as the manner in which the electricity supply is deployed to meet energy requirements of electrical components/appliances in both domestic and industrial areas (e.g. Japanese technical standards JIS). In any case, after a fruitful start or improvement of a venture, one can anticipate that Japanese companies will demonstrate a high level of eagerness to react to client demands in an appropriate manner and expect that vice versa. Subsequently, it is important to create individual structures within a company at the start to handle or monitor clients (B2B, B2C) requests and complaints. It is, therefore, unsurprising that Japanese businesses source and engage in multilevel relationships with foreign companies in a bid to determine or explore the possibility of a long-term partnership. The basis for the eventual business cooperation includes but is not limited to quality, delivery rates, dependability and possible prospects of improvements.

Get conversant with local laws and regulations[11]: European companies seeking to enter the Japanese market or collaborate with local partners must assemble a legal team to examine the details of Japanese local and national regulations, laws and processes to the letter as Japan's laws are in its local language with no exact translation available in the English language. Although this is unexpected of a country which is technologically industrialized, all laws are in Japanese and a correct understanding is certainly easier with the support of versed lawyers, language experts, or with the support of the country's Chamber of Commerce to avoid complexities which may further be caused by translation. To this end, the EU-Japan Center for Industrial Cooperation remains the first point of reference to get contacts and access support schemes.

Trust is essential in Japan's business cooperation and it may take a while to build: To Japanese companies, new partners, suppliers, etc. are areas of potential risk and uncertainty to their operating principles and business. As a result, business relationships are usually started on a small scale to test run an agreed model which will further determine the possibility of a bigger partnership. This is unfavorable to foreign companies as it negates their financial principles and poses a big risk.

11 Miller L. et al. (2013): Doing Business in Japan Guide. DLA Piper.

Doing business in Japan – main challenges and advantages

Source: AHK Geschäftsklimaindex 2016

Challenges	Advantages
78% - Attraction of qualified employees	85% - Stability and reliability of business relationships
56% - Exchange rate risk	76% - High qualified employees
34% - Cost of labor	75% - Economic stability
33% - Keeping employees	71% - High developed infrastructure
32% - Regulatory hurdles	67% - Security and social stability
30% - High corporate tax	64% - Stable political environment
29% - Layoff employees	59% - Openness towards hi-tech and innovation

However, the search by Japanese clients for products has assumed a new dimension with the desire for high-quality products over cheap alternatives. Thus, they crave for long-term partnerships which often start from a successful small-scale test model. To set this up, the client requests, even in the smallest parts, an abundance of data about the manufacturing procedures as well as product history and design ideology to comprehend the end product.

Regardless of the fact that a product has recorded high level of success in different markets, its manufacturers need to replicate same in the Japanese market as far as quality and desire for long-term partnership subsist. At the outset, the high cost of a small venture signifies further interest and commitment to the possibility of a long-term business relationship. At first, this may be a hindrance to European companies as regards opening an office and implementing total business structures until the shape of such partnership gains ground. Regular discourse with the client and the making of proper structures form a critical part of improving the business relationship and service. Service is not always the answer to this issue, but rather the nature of accessibility and guarantee. Japanese companies are usually disposed to and open to EU suppliers and their technology. In any case, it contrasts somewhat between the nations. But nations in Eastern Europe are not exceptionally understood and in this way no genuine picture exists. That said, this does not imply a business hindrance will ensue. Furthermore, larger business entities, irrespective of their origin or interconnectedness or interconnectedness with bigger companies are better understood in their particular buisness and, hence, likely to have a competetive edge since they are viewed as more dependable and experienced.

Service, Service, Service: By European standards, the Japanese business sector operates an incredible and unusual level of client service, which only a few Japanese customers take note of. From similar countries, the same or considerably high level of service is normal. This begins at an early phase of the task. It is, as of now, a recommendation amid counseling the client and giving practical solutions for a particular issue to meet the client's expectation. Should the potential supplier beat its rivals, projects and customer base must be monitored constantly over the lifecycle of the project. The importance of fast and efficient customer relations cannot be understated.

Unique distribution framework mostly through Sogo Shosha: Another trial for EU organizations entering the Japanese business sector is the puzzling distribution structure. It is usually the case that even big organizations and merchants work together through the use of intermediaries (Sogo Shosha in Japan's case)[12]. Notwithstanding the ordinary function of the intermediary, the service can also be handed over to the partner. Japanese distribution networks regularly work to facilitate sharing of information. In this way, products and technological innovations from foreign suppliers may be partially offered to the end users. Contingent upon the illustrative needs of a product or innovation, the marketing staff of the accomplices ought to be seriously prepared in the company's country of origin, to have experience in building the market with specialized aptitude. Particularly critical is the likelihood that an associate is required to independently carry out after-service functions.

This not just prompts higher retail costs by the extra margins inserted by middlemen, it also creates more complexities in distribution channels. It should be noted that although these trading firms act as importers in several cases, they are not structured to perform critical marketing functions. The Sogo Shosha have risen as an expansive body in both size and degree. They are, to a great degree, diversified in terms of products and services, as well as geological presence. Obviously, they are difficult to emulate. The nearest thing are the Korean chaebols Samsung and Hyundai. Be that as it may, they are much smaller and have less expertise and scope than the Japanese Sogo Shosha. Presently, there are seven major Sogo Shosha. The big 5, Marubeni, Mitsubishi, Mitsui, Itochu and Sumitomo, are trailed by Sojitz[13]. A recent merger between Nisho Iwai and Nichimen, and Toyoda Tsusho (which was the trading arm of Toyota Motor Corporation in charge of vehicle engines and vehicle spare parts), purchased the previous Sogo Shosha Tomen, which was in a bad position. In reality, Marubeni and Itochu were, for all practical reasons, the same organization before WWII, yet were isolated by the Allied occupation after the war. For the most part of the 1970s until the mid-2000s there were 9 Sogo Shosha.[14] Nisho Iwai and Nichimen, which were mentioned earlier, converged to create Sojitz.

The tendency of the Keiretsu is to limit access to the market and encourage partnerships[15]: Previously, the Keiretsu framework was a noteworthy obstacle to market entry of foreign firms in Japan. The Keiretsu is the ordinary Japanese firm network of Japanese OEMs, which are frequently shut systems and as a result restrict chances to collaborate outside their customary system structure. For instance, Toyota still holds to this and keeps a tight hold on its connected companies which make it hard for other firms to access this particular system. Because of the long-term business relations between two businesses, it must be expected that it will be difficult for foreign companies that collaborate with competitors. Therefore, attempts to sell a product with the same usage, ideology and characteristics in the same supply chain or distribution network won't amount to much. The determination of an effective long-standing and trustworthy relationship is frequently not acknowledged. A business opportunity is only seen when USPs force the change of a long-standing business relationship. Nonetheless, there is a continuous change happening and these rigid networks have been progressively opening up for a few organizations. Huge players, for example, Mitsubishi and Hitachi, are growing their foreign partnerships by trying to be an international player with global coverage. Furthermore, it has been discovered that Honda acknowledges suppliers from the Honda network, but also from pariah organizations, and even foreign suppliers. Also, the wind business is in its formative years, so Keiretsu involvement will assume a minor part (and if innovation drivers or market leaders from Europe are involved). But often there are an established partnerships between WTG manufacturers and Japanese developers or operators. Trying to sell products to a developer that is known to have strong ties with a specific turbine supplier is virtually impossible according to insiders. However, there are more and more open doors for organizations outside this conventional Keiretsu structure. Specifically, if generation chains are built up in third markets, specifically in assembling and innovation, the Japanese corporate systems are questionable from that point onward. For instance, how the independent systems avoid access to foreign organizations, principle esteem chains by outer suppliers or even anticipate. Be that as it may, European companies will be faced with companies from these networks, while attempting to access the Japanese business sector.

The Keiretsu are subdivided into horizontal and vertical networks, and can be further classified as Kigy sh dan ("horizontally diversified business groups"), Seisan keiretsu ("vertical manufacturing networks") and Ry ts keiretsu ("vertical distribution networks")[16].

Horizontal Keiretsu[17]: The Horizontal Keiretsu are groupings of financial (local) entities, intertwined through connections, such as minority interests. Their activities are not limited to a particular industry. Indeed, they regularly have an exceptionally diverse portfolio across a wide range of segments, e.g. in assembling, banking, and conveyance of B2B and consumer merchandise. The businesses are typically coordinated by a single establishment, such as a bank or general trading institution. In Europe, they are regularly known for a solitary purpose (e.g. Mitsubishi and Toyota for its automobiles). The main horizontal Japanese Keiretsu known as the "Big Six" are Fuyo, Sanwa, Sumitomo, Mitsubishi, Mitsui, and Dai-Ichi Kangyo bank groups.

Vertical Keiretsu[18]: In the center of a vertical keiretsu structure, stands an industry company, which is associated with members engaging in the same business in a vertical value chain. This makes them financially and unequivocally strong. Hitachi is an examples of manufacturers in the wind market that exist within such a structure. The companies are identified in a usual production-supplier relationship ("Production Keiretsu") or a manufacturer-distributors relationship ("Distribution Keiretsu"). The Production Keiretsu is structured like a pyramid with the manufacturer at the top and of a multi-level and colossal system of suppliers. The supply organizations are firmly reliant on the core industry company and the framework through human and monetary linkages. The goal of the "Distribution Keiretsu" is to give the center company more control over the distribution networks and manage deals in this way. Consequently, conviction-based trust is given to entities that are incorporated into a keiretsu, may be offered a share of the gains or benefits of the entire Keiretsu if it is fruitful.

It can be predicted that the procedure of globalization of the Japanese economy and associated pressure on Japanese companies will see efforts to make the Keiretsu structures flexible and allow entry of relevant foreign companies into such business structures.

These particular circumstances and business conditions in Japan ought to be remembered to achieve the goal of carrying out a fruitful business in Japan. With the support of various business incubators and funding options, there are different ways to meet the requirements described above.

12 Dicle A., U. Dicle (2015): The Role of the Japanese General Trading Companies (Sogo Shosha) in Globalization of Business. Springer International Publishing.
13 Ibid.
14 Idid.
15 Lincoln J., M. Gerlach (2004): Japan's network economy: Structure, persistence, and change. Cambridge University Press.
16 Ibid.
17 Ibid.
18 Ibid.

A synopsis of the wind energy market in Japan

2. A synopsis of the wind energy market in Japan

The chapters below provide a detailed synopsis of Japan's wind energy sector.

2.1 The attractiveness of the Japanese wind energy market

The present capability of wind power in Japan is assessed to be 133GW, comprising of 65GW inland and 68GW offshore winds.[19] That introduces a high market potential because new installations added less then 3.2 GW (inland and offshore) in April 2016, much less than that of other EU nations.[20]

As such, wind power has developed at a moderate pace contributing just 0.5% to the power supply in Japan in 2015 (around 5.268TWh). 245MW has been introduced in 2015 (with 11.1MW in decommissions), multiplying the quantities of 2014 with 140MW.[21]

This put Japan in 20th place equivalent to 0.4% of world's cumulative wind installations[22]. This total amount is 10.1 times of the total 312.8MW output at the end of the FY2001. The average growth rate has been as high as 18%.[23]

In preparation for the transition to the new FIT, subsidies for wind power generation were aborted in 2011. Detailed information, including that on the purchase price of the FIT, was not announced until the Spring of 2012. Furthermore, in response to the impact of the application of the EIA, the amount of new introduced since FY2011 was sluggish with less than 100MW. However, it has returned to the level seen before the 2010 fiscal year in the past two years, and is expected to maintain or even exceed this level in the next years.[24]

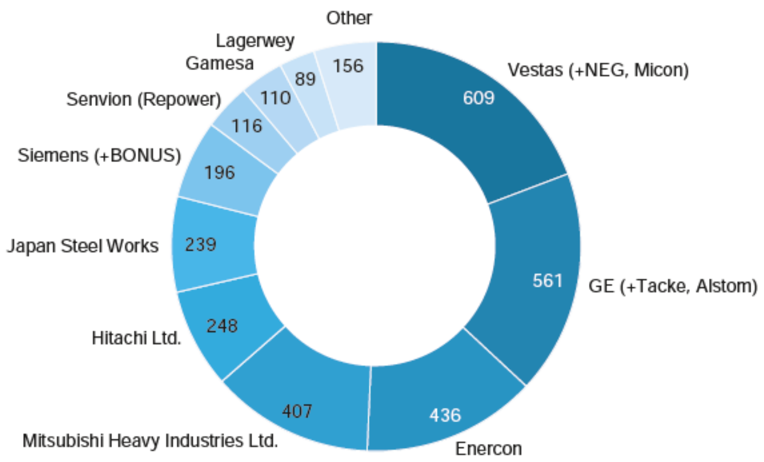
Further market development is predicted in Q3 and Q4 in 2016, driven by a overabundance of wind FIT-applications under the EIA approval process.[25] Because of the late cut in FIT for solar PVs this year, the energy market appears likely to move from a preference for PV in the earlier years, to more wind power (and biomass as well as thermal sources), which have lower but stable FIT-levels. The FIT-costs are particularly generous for offshore projects - with ¥36/kWh the highest price tag for offshore wind worldwide - while onshore FIT is steady at ¥22/kWh.[26] Setting the offshore FIT at that rate, gave investors the premium they had been searching for, particularly as the late moves to cut the solar based PV FIT gives offshore winds leverage among other sources of power that don`t fulfill government demands for baseload energy capable of supplying power 24 hours a day.

Nonetheless, from the present 3.2GW wind establishment, offshore wind produces just 52.6MW with a sum of 27 turbines in Japanese waters.[27] In 2015,

19 NEDO (2016): Graph of wind power generation amount Japan. (In Japanese). Available online: http://www.nedo.go.jp/library/fuuryoku/pdf/02_dounyuu_suii.pdf (accessed 25/08/2016)
20 NEDO (2016): Graph of wind turbine installed base per business. (In Japanese). Available online:http://www.nedo.go.jp/library/fuuryoku/pdf/08_jigyousha_setti_kisuu.pdf (accessed 25/08/2016)
21 NEDO (2016): Graph of wind power generation amount Japan. (In Japanese). Available online: http://www.nedo.go.jp/library/fuuryoku/pdf/02_dounyuu_suii.pdf (accessed 25/08/2016)
22 Ibid.
23 NEDO (2016): Situation of wind power generation in Japan end 2015. (In Japanese). Available online: http://www.nedo.go.jp/library/fuuryoku/state/1-01.html (accessed 25/07/2016)

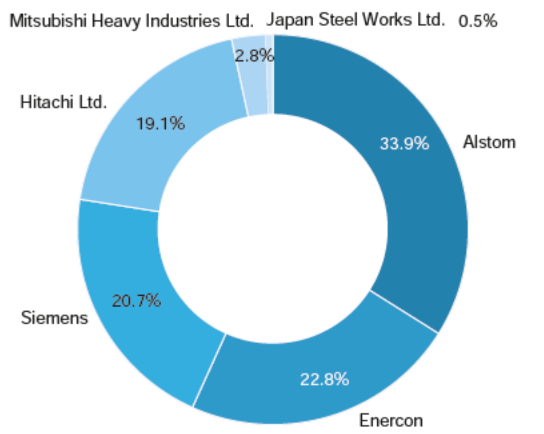
24 Ibid.
25 Uncommissioned EIA applications 3,604MW, February 2016
26 In April 2016, METI approved the FIT which remains the same for wind onshore and offshore.
27 MOE (2016): EIA Status (In Japanese). www.env.go.jp/policy/assess/3-1procedure/ (accessed 25/07/2016)

Total installed capacity 2015



Source: JWPA 2015, MAKE Global Wind Turbine OEM 2015

Market shares in 2015



Source: JWPA 2015, MAKE Global Wind Turbine OEM 2015

one Siemens 3MW turbine was introduced 100m from the Akita port. Regardless of the moderate advancement, some support ought to be given to developing enthusiasm for offshore wind. Japan has the world's 6th biggest Exclusive Economic Zone (EEZ), weighted heavily to its Pacific coastline, which reserves significant space for future improvement. Offshore wind advancement, specifically on floating structures, is a promising prospect with good backing from the Japanese government to become a potential exporter of technology. The FukushimaFORWARD demonstration project[28], formed from a consortium of OEMs, technology companies and academia, introduced a 14MW floating wind farm in 2016. It is collating a great deal of information on assets, port requirements, infrastructure and grid networks in order to establish new floating turbines in areas that were vigorously hit by the Fukushima mishap (see the case study in chapter 5 presented in this report). As of late, it has been decided that 4GW (2GW onshore, 2GW offshore) may be introduced in that area to supplant the Fukushima Daiichi Nuclear Power Plant[29].

Based on 2015 market share figures (cf. figure on the top right), 50.2% of the 235MW turbines commissioned by Japanese projetcs were supplied by Japanese WTG manufacturers (MHI, Hitachi, JSW). They have expanded their share from 19% to 72% of Japan`s market from 2009 to 2014, with a drop in 2015 after Siemens supplied the Yuri Kogan Wind Farm created by Eurus Energy Holdings. But concerning the cummulative share by the end of 2015 (cf. figure on the top left), foreign WTG players are way ahead, with Vestas (incl. NEG-Micon) and GE (incl. Tacke + Alstom) proceeding with their lead, although they did not supply tubines for 2015. Eco Power (a Japanese developer that ordered mainly Vestas turbines in the past) recently announced a high amount of new investments, thus it is expected that foreign WTG manufacturer will gain higher shares in 2016 and 2017. Hitachi has expanded its coverage by supplying 43MW of turbines in 2015. Other players with major aggregate market share are Enercon and Siemens (incl. Bonus + Gamesa)[30].

That implies that the OEM market development in 2015 was shared amongst Japanese and foreign companies (mainly European companies), while the development market remain controlled by local companies, often with individual preference to one WTG brand. Around the same time there have been increasing M&A activities globally in a very competitive WTG market.

Japanese manufacturers experience drawbacks in competing with the European firms in the wind business: for years, experienced European players have good economies of scale and a comparative advantage over imports due to a strong Yen. Furthermore, the local business sector has little prospects for Japanese organizations as numerous projects have not been commercially-realized amidst the promotion of other technologies (for example, nuclear and solar have been prioritized over other sources of power for many years).

In regard to developers and operators the picture is very different: Japanese independent power producers, Eurus Energy, J-Power, JWD and Marubeni are the main wind farm developers in Japan.[31] But these privately owned wind farms are financed through a set up with local companies and communities. That implies that wind farm developers act for foreign manufacturers and earn commissions for every turbine sold. As a result, wind farm developers could easily fund projects not just from subsidies but also from several other sources. Particularly at the outset (2010-2012), general contractors made much more profit by building wind parks with little to no regard to maintenance contracts. Maintenance regulations are however getting stricter with the need to send standard maintenance updates and progress to the administration from April 2017 (coupled with intermittent inspetions of all wind power plants with more than 500kW). These developments are being eyed by foreign companies showing presence at the Wind Expo 2016 in Tokyo[32]. Although WTG makers usually offer service contracts alongside local contracting, Japanese customers tended to waive service offers or reduce them to a minimum of 2 years in the past. As a consequence, older turbines in Japan are often lacking proper maintenance.

With particular regard to EU companies, new business opportunities in the wind energy sector may arise out of service and technology/R&D transfer as a result of pressure on the Japanese market to open up and to partner with foreign companies. EU companies with outstanding mastery in turbine manufacturing, venture development, service and maintenance of wind turbines and as a plus with technical knowhow of offshore installations, systems coordination and industry can be assured of new business opportunities in Japan. Taking advantage of its wind potential and available opportunities, depends on the government's endeavors and accomplishment in managing the present obstacles.

The SWOT analysis on the following page provides an outline of the primary difficulties and qualities of the Japanese business sector.

In any case, removing existing obstructions will require some serious efforts. The gradual rise of wind power won't be sustained without considered and stable policies. There is still a fundamental requirement for market and technology policies indicating government support for large-scale development of wind energy.

In the wake of Fukushima the status of renewables (specifically wind energy) in Japan has changed considerably, which is likewise noticeable in late strides towards a liberalization of the power market. Against this foundation, Japan remains at crossroads in the face of several business opportunities for the wind market. Since the Olympics are drawing nearer, Japan is enthusiastic to reshape itself as a technologically-advanced and superior nation and wind power fits well into that picture[33]. Enhancing wind energy improvement, relies on long-term government support. Its ability to handle the present issues is also dependent on the support from businesses to cut down expenses.

28 NEDO (2013): NEDO offshore wind energy progress Edition II. Available online: http://www.nedo.go.jp/content/100534312.pdf?from=b (accessed 24/07/2016), http://www.fukushima-forward.jp/projecto1/english/index.html

29 Information gained from interviews

30 NEDO (2016): Graph of wind power generation amount Japan. (In Japanese). Available online: http://www.nedo.go.jp/library/fuuryoku/pdf/02_dounyuu_suii.pdf (accessed 25/08/2016)

31 NEDO (2016): Graph of wind turbine installed base per business. (In Japanese). Available online:http://www.nedo.go.jp/library/fuuryoku/pdf/08_jigyousha_setti_kisuu.pdf (accessed 25/08/2016)

32 e.g. the Danish company blade partners (JV)

33 Movellan J. (2016): Tokyo's Renewable Energy Transformation To Be Showcased in the 2020 Olympics. Available online: http://www.renewableenergyworld.com/articles/2015/06/tokyo-s-renewable-energy-transformation-to-be-showcased-in-the-2020-olympics.html (accessed 18/06/2016)., Cruz M. (2016): Where Are The 2020 Olympics? The Host City Plans For Innovation In Sports And Technology. Available online: http://www.bustle.com/articles/172101-where-are-the-2020-olympics-the-host-city-plans-for-innovation-in-sports-and-technology (accessed 14/07/2016)

2.2 Japan's market size in comparison with other countries

As mentioned before, Japan dropped to 20th position in the 2015 worldwide wind power rankings[34]. Contrasted with other Asian markets Japan is in the third position. China had a gigantic development of wind power in the previous years. It is anticipated that India will have a massive development potential later on. Other than China and India, whatever is left of Asia did not gain much ground in 2015[35]. Japan is very far from the tremendous achievements of China and India, but with new efforts in 2015 and 2016, Japan can unlock its wind potential as well. Japan, Australia and South Korea will be the three key contributors to the 5GW new capacities added in the period.[36] With recent developments in Australia, the ASEAN biggest business partner, the volume of trade is anticipated to drop in 2016, which will pick up again when the Japanese business sector may takes off afresh in 2017. Both Japan and South Korea expected to introduce turbines offshore in the following years.[37]

The OECD-Pacific region has the third largest number of WTG manufacturers with nine suppliers from

34 FTI Financial (2015): Global Wind Market Update – Demand & Supply. FTI Consulting LLP., JWPA WindVison Report (2016): JWPA WindVision Report 29-02-2016. (In Japanese). Available online: http://jwpa.jp/pdf/20160229-JWPA-WindVisionReport-ALL.pdf (accessed 23/04/2016).

35 FTI Financial (2015): Global Wind Market Update – Demand & Supply. FTI Consulting LLP.

36 BNEF (2016c): Energy in Transition. BNEF Insights for executives.

37 IHS Energy (2015): Asia Pacific Renewable Power Country Profiles. Emerging Renewable Power Markets Advisory.

SWOT analysis of the Japanese wind market

Market strengths

- Commitment to climate targets. As the world's fifth largest emitter of CO_2, Japan plans to cut its greenhouse gas emissions by 3.8% by 2020 compared with 2005 levels.
- 70% of turbines and 50% of WTG components are imported from outside Japan.
- Moderate growth is expected near-term with development picking up after 2016 as projects get through the EIA process and government plans to reduce half of the EIA time.
- Good wind conditions (7-8m/s)
- Huge wind potential according to JWPA: 23GW in 2020, 28GW in 2030, and 50GW in 2050.
- Relatively stable market and governmental support for wind power development.
- Japan provides currently the highest FIT for offshore wind worldwide due to its high installation costs.
- Support scheme with Feed-in-tariff.
- Infrastructure provisions: government pays 50% of cost for grid construction in the northern rural area in Japan, such as Hokkaido and Tohoku.

Market weaknesses

- Onshore wind development faces significant barriers, including the remoteness of areas with good winds, poor infrastructure in rural areas, lack of social acceptance and high population density.
- The offshore wind market lacks skilled technicians and service vessels and suffers from the lack of a central government agency to manage maritime development and solve potential conflicts over fishing rights.
- High levels of curtailment in some regions.
- Japan has still not leveraged the full potential of wind power and effects of LCOE reduction (Levelized Cost of Electricity).
- Lack of grid integration and missing transmission infrastructure in favorable wind speed locations.
- Government announced its renewable target with only 20 percent RES share, and low 2 percent for wind in 2030.
- Still high environmental testing burdens, negative effects of the EIA law: hold back new wind projects until at least end 2016-2017. Some 98 projects with 6.5GW of potential remain stuck in the pipeline awaiting approval. It takes four years to pass Japan's strict environmental assessment procedures.
- After the government change in 2009 the government has supported PV to a large extent, which held to an explosive growth of the PV market - distributed PV makes up 40% of renewable installations.

Market opportunities

- Growing potential for EU Companies. Japan is Asia`s second largest energy market and offers various opportunities for foreign wind developers and WTG industry.
- Wind energy (onshore and bottom-mounted offshore) in Japan is around 15 years behind the development in Europe. This provides good opportunities for collaboration and knowledge transfer (e.g. repowering, maintenance etc.).
- Local supply chain (including BOP) is underdeveloped. Local turbine makers MHI, Hitachi and JSW Japan Steel Works offer offshore wind turbines in Japan but face challenge in sourcing balance of plant components locally.
- Committing to floating offshore with an ambitious target to become an export technology. Floating turbine technology is undergoing R&D testing, 12 fixed foundation/floating offshore wind projects with a combined capacity of 900MW are under development.
- The government shows efforts to ease complex permitting and approvals.
- Unbundling and market liberalisation has started with full effect in 2020.

Market threats

- Prime Minister Shinzo Abe has made restarting Japan's nuclear power plants a key priority, reversing the previous government's nuclear phase out policy.
- 10 powerful EPCOs control the electricity market and opposse the ongoing market liberalisation. They hinder grid integration of renwables as they still hold massive nuclear assets.
- Reducing wind generation costs due to technological difficulties, Japan`s geography is costing it.
- The deep waters around Japan require the adaptation of floating technology, making offshore wind an expensive solution to meet the country's energy needs.
- Record low fossil fuel prices.
- If the reforms of the complex testing, permitting and approval process are not sucessful, wind energy development will stay dauntingly expensive.

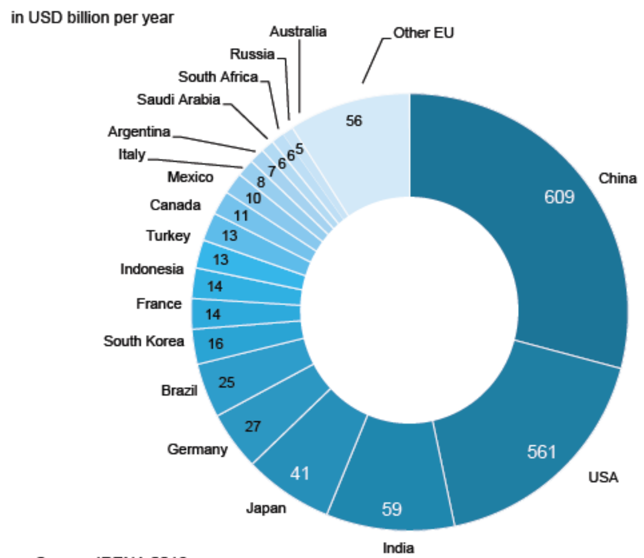
Japan and South Korea, of which most are industry corporations. Mitsubishi is by a wide margin the biggest in this district as far as aggregated installations are concerned but failed to make it into the worldwide top 15 in 2015.

The infiltration level of wind energy demonstrates an alternate picture, with high generation levels in Europe and North America, i.e. more than 10% is power ed by wind (which displaced the use of fossil fuel era). This feat is uncommon at the national and local levels in numerous parts of the world. Europe`s accomplishment is a far cry from that of the world`s two biggest economies, the US and China. To get more of wind energy, developing and developed nations of the world will require colossal investments in the energy industry and changes to market guidelines, as well as urge transmission framework operators to improve utilization of wind energy as a CO_2 substitute. The 2015 FTI Intelligence report outlined the most recent market penetration levels in 2015 in various parts of the world, with Japan at only 1.5%[38].

38 FTI Financial (2015): Global Wind Demand & Supply. FTI LLP.

Average annual investment needs for renewables until 2030 in G20 member countries

Source: IRENA 2016



Source: IRENA 2016

2.3 Future predictions

Japan's Wind Power Association (JWPA) trusts that wind power has a much higher potential in Japan. JWPA believes that wind power is the main innovation right now that can be massively installed at a larger scale sooner rather than later at the cost being advertised. However, regardless of Japan's steady market structure for wind improvement, speculation is repressed by the present hindrances. For instance, an extensive number of ventures are stuck in the EIA bottleneck, with the majority of them not likely to

JWPA strives to 20% of wind power in 2050

Source: JWPA 2016 WindVision

JWPA Target: 75GW by 2050	
Supply more than 20% of the domestic electric power demand from wind power generation by 2050	
Year	Forecast (including offshore)
Short-Term Installation Goal (2020)	About 11GW About 23,000GWh/year (ratio to total demands: about 2%), reduction of about 10M CO_2t/year
Mid-Term Installation Goal (2030)	About 28GW About 84,000GWh/year (ratio to total demands: about 9%), reduction of about 32M CO_2t/year
Long-Term Installation Goal (2050)	About 50GW About 188,000GWh/year (ratio to total demands: about 20%), reduction of about 99M CO_2t/year

Forecast Japan 2016-2019

Source: BNEF

Year	Forecast (including offshore)
2016	200
2017	300
2018	400
2019	500
Total by end 2019	5148

proceed until after 2016. JWPA has proposed a pathway to introduce 36.2GW of wind power limit out to 2030.[39] On the other hand, the Japanese Ministry of Economy, Trade and Industry (METI) declared most recent in its 2030 Energy Mix Plan on 16th July 2015, that only 1.7% electricity would be supplied by wind till 2030. However, it is expected that METI will increase the figures in the scope of its regular reviews over the course of time.

Short-term prediction 2019

Bloomberg`s Belt and Road report (B&R)[40] predicted that by 2020 and with 2.4GW of new installation plans and launches, there will be a total generation capacity of about 5.5GW in addition to the present 3GW of installed capacity in Japan. However, considering the possible outcomes of 133GW (comprising of 65GW onshore and 68GW offshore), these numbers are fairly direct representations of the present development underway. In comparison with other B&R nations, Japan is in the third position, but the development rate of China is eclipsing their endeavors as it is tripling the efforts of all B&R nations.

FTI[41] believes that the onshore wind business sector will endure the following years alongside the moderate development of offshore wind. It`s estimated for Japan to pass 5GW of introduced wind power limit by 2019.

Medium-term prediction 2020s-2030

The Japanese government is focusing in its "Energy Mix" of 10GW by 2030, while domestic associations (JWPA) and financial experts (BNEF) are predicting more offshore developments. The government projects that by 2030, installed capacity will be 9.18GW onshore in addition to 0.82GW offshore projects. That implies that wind will make up just 1.7% of Japan's energy blend by 2030, as noted in the 2015 government plan. This would mean 10GW of aggregate capacity including 0.82GW from offshore wind. This implies just 7GW of new projects will be realized in the next 15 years.

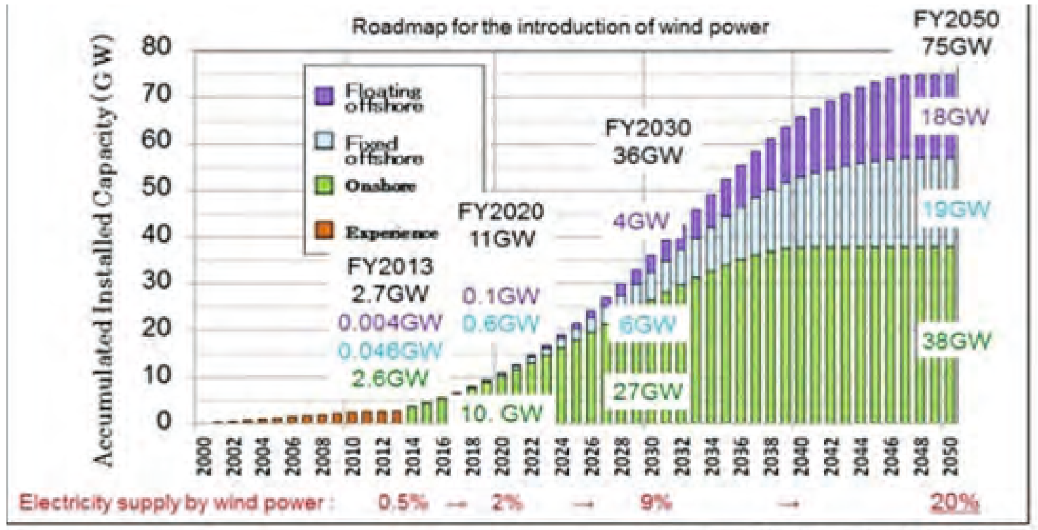
BNEF ventures with more offshore potential, calculating 8GW of onshore in addition to 3.1GW of offshore share of 2.4% in its energy blend, taking into account the EIA backlog. The government evaluates that onshore wind projects will cost ¥13.9 to ¥21.9 for each kilowatt hour while vast scale solar installations will cost in the region of ¥12.7 to ¥15.5.

JWPA's Prediction

JWPA issued its most recent "JWPA Wind Vision Report" in March 2016[42]. In the report, JWPA advances wind power improvement with an objective of 36.2GW by 2030. The prediction was based on new, unfinished and existing projects as there are 2.3GW of new wind power projects that are on the verge of completing the long EIA approval process and having procured FIT endorsement. Also, about 6-7GW of new projects has started the EIA procedure. Further presumptions are identified with the thought that resuscitation of onshore projects will begin very soon. They, however, pointed out that, the government`s nuclear target of 22 to 24% as sketched out in the energy mix 2030 is not realistic and that wind power may rise beyond 1.7% to fill the void.

The future of nuclear energy, its role and influence on renewables

After the March 2011 Fukushima calamity, large numbers of Japan's nuclear plants were closed down and a long process of security audits and overhauls was started. The two reactors of the Sendai Nuclear Power Plant have been back to the grid since August



Source: Japan Wind Power Association (JWPA)

2015 and further reactors are lined up to resume operations in 2016. Notwithstanding, the biggest plant, TEPCO's Kashiwazaki-Kariwa atomic plant in Niigata prefecture is not anticipated to restart soon. Complete overhauls and surveys will require additional time, so it will take until the end of 2016 for all nuclear power plants that are not being decommissioned to be totally restarted. With the initial two reactors been restored in 2015, clearly, nuclear energy is returning once more, through effective actions of the 10 EPCOs and the "nuclear village" in Japan, which have a high motivation to keep their assets which have been on-hold since the nuclear crackdown. It is probable that they will keep pushing despite the electricity deregulation to bring more nuclear power plants back into operation. Since the end of 2015, two nuclear reactors have been restarted and two other plants ought to have followed suit but were deferred for safety reasons. It is predicted that they will be restarted over the span of 2016. In line with plans to restart the nuclear stations once more, the nation set its 2030 energy mix to 20% nuclear, implying that around 20-22 nuclear reactors should be in operation once more. In spite of these figures from the METI, energy partners and expert foresee that only about ten nuclear stations will be restarted because of the strict security necessities and the existence of old nuclear plants which are likely to slow down a total restart in few years. There is, even more credence to this due to the surge of anti-nuclear groups in Japan.

In last July election in Kagoshima prefecture, the new representative, and an anti-nuclear supporter promised to stop the two functioning reactors that are in his Prefecture (Sendai)[43]. Likewise, the business group "Keizai Doyukai", an influencial lobbyist group[44] wrote an open letter to the government calling for more investment into renewable sources of energy rather than nuclear power. The group is known to be a more liberal body than other groups such as the influential Keidanren. The open letter resonated and found support from the public and other bodies.

Notwithstanding, Abe has turned into a dynamic leader who would not want a total abandonment of the Japanese nuclear technology as this may be devastating to Japanese business active in exporting nuclear plants which may turn away potential foreign customers. Abe's development methodology calls for tripling infrastructure and technological exports to ¥30,000 billion by 2020, with nuclear energy exports playing a big role in accomplishing this objective. At the start of the year, Japan (alongside French companies) secured a long-term ¥2,251 billion contract with Turkey (also a natural disaster-prone nation). It has likewise consented to an nuclear innovation arrangement with the United Arab Emirates and is looking towards sealing deals with Brazil and Saudi Arabia. Arrangements are additionally progressing with India to empower Japan to offer technological expertise there and Abe campaigned hard in the interest of Japan's nuclear exporters at a June 2013 Central European Summit of the Vise grad nations of Czech Republic, Hungary, Poland and Slovakia. He likewise consented to an arrangement with France in June 2013 to increase and develop participation in nuclear exports.[45]

The LDP Secretary-General, Ishiba Shigeru, contends that another motivation to restart nuclear reactors is to keep Japan's nuclear weapons capabilities open as an alternative. Disclosing to the media why he

39 JWPA WindVison Report (2016): JWPA WindVision Report 29-02-2016. (In Japanese). Available online: http://jwpa.jp/pdf/20160229-JWPA-WindVisionReport-ALL.pdf (accessed 23/04/2016).
40 Bloomberg B&B analysis, June 2015., BTM/Navigant Consulting (2015): World Market Update 2015.
41 FTI Financial (2015): Global Wind Market Update – Demand & Supply. FTI Consulting LLP.

42 JWPA WindVison Report (2016): JWPA WindVision Report 29-02-2016. (In Japanese). Available online: http://jwpa.jp/pdf/20160229-JWPA-WindVisionReport-ALL.pdf (accessed 23/04/2016)., BNEF (2015b): Japan's likely 2030 energy mix: more gas and solar. BNEF Energy - Japan - Whitepaper. 02/06/2015.

43 Kahaii M. (2016): New Kagoshima governor ready for Sendai plant shutdown fight. In: The Asahi Shimbun. Available online: http://www.asahi.com/ajw/articles/AJ201607290046.html (accessed 25/07/2016)

44 Lincoln J., M. Gerlach (2004): Japan's network economy: Structure, persistence, and change. Cambridge University Press.
45 Kingston J. (2015): Abe's Nuclear Energy Policy and Japan's Future. In: The Asia-Pacific Journal.

is against scrapping Japan's armada of 54 reactors, Ishiba says, "Having nuclear plants shows to other nations that Japan can make nuclear weapons."[46] He further remarked that Japan has no arrangements to make nuclear weapons, but that it is significant for Japan to keep the nuclear reactors running as an option. Due to its advanced level of innovation and development of a prototype intercontinental ballistic missile, Gavan McCormack remarked that "No country could match Japan as a potential member of the nuclear weapon club." He concluded that "Protected and privileged within the American embrace, it has evolved into a nuclear cycle country and plutonium upper-power."[47]

46 Ibid.

47 Ibid.

2.4 Key aspects of the sector

2.4.1 Historical evolution

In the wake of the oil crisis of the 1970s, Japan moved to cut its reliance on imports of gas, oil and coal through expanded utilization of nuclear energy, such that before the Fukushima nuclear energy represented 26% of the energy mix. This state of affairs has changed prominently. Nonetheless, before this period, the wind energy sector was supported by previous government but on a small-scale. This chapter of this report gives an outline on the advancement of wind energy in Japan and the nature of policy support from the government.

Growth of renewable energy after emergency oil crisis of 1970s

As in other countries, Japanese renewable energy sector gained support after the first ever oil crisis of 1973. Prior to that, Japan chiefly depended on coal for energy needs amid recuperation in post-World War II with oil as the fundamental energy source due to the resultant increase in economic growth and development at that time. Roughly 77.4% of the nation's essential energy supply was from oil in 1973. Specifically, the dependence on the Middle East was noteworthy, as 77.5% of oil imports[48] were from the region and other oil exporting nations. The oil emergency made the pressing requirement for the decrease of dependence on Middle East oil by securing oil supply from different locales of the world and propelling energy saving and also enhance and diversify energy needs from other energy sources. For the last reason, the Sunshine Program was started by the Ministry of International Trade and Industry (MITI, now METI) in 1974.[49] The Sunshine Program concentrated on four specific technologies: geothermal, solar, coal and hydrogen. In 1979, the MITI introduced the Moonlight Program which made headways with existing energy saving technologies and innovations.[50] The MITI further established the New Energy and Industrial Technology Development Organization (NEDO) in 1980 to oversee public efforts on R&D of new energy and energy-saving advancements and to facilitate their entry and reception into the market. In 1989, the MITI began another R&D program called the Earth Environmental Technology Development Program later fusing it with the Sunshine and Moonlight Programs to form the New Sunshine Program in 1993[51].

48 EDMC (2016): Energy & Economic Statistics Handbook. Available online: The Institute of Energy Economics Japan. http://edmc.ieej.or.jp/stat-j-toc.html (accessed 25/07/2016)
49 Mizuno E. (2014): Overview of wind energy policy and development in Japan. In: Renewable and Sustainable Energy Reviews 40 (2014), 999–1018.

Government support for the technology and its market in the 1990s

Decades after the oil emergency, Japan has bolstered wind energy with a two-fold approach:

- technological advancement policies and
- market policies

By and large, wind energy plans in Japan are mostly centered around making more strides to develop and come up with a wind energy components better than the existing ones rather than market policies to strengthen the market. The technological approach is led by NEDO, while market policies are managed by METI.

Technology policies on wind energy prior to 2011:

Meanwhile, the use of wind power generation has rapidly increased in Japan, primarily with onshore installation, from the first few years of the new millennium. But, wind energy was not picked as a main technology of the Sunshine Program, implying that R&D support for wind, which started in 1978, had the least share of the spending plan compared to solar or geothermal. Likewise, the wind R&D support was uneven throughout the years. The vast majority of the R&D support from the 1990s to the mid-2000s comprised of database creation for wind assets, development of technology for grid stability, for example, the Japan Wind Atlas Development, field testing and information collation projects, Local Area Wind Energy Prediction System (LAWEPS) improvement, wind database for LAWEPS, development of large-scale energy storage systems for harvested wind energy, and climate forecasting system improvement. The status quo was different for the years preceding 2010.[52]

50 Federation of electric power companies of Japan (2016): FEPC INFOBASE. (In Japanese). Available online: http://www.fepc.or.jp/environment/new_energy/renkei/ (accessed 25/08/2016)
51 Ibid.

Market policies: METI (formerly MITI) distributed three energy development roadmaps in 2007, 2008, and 2009. The roadmaps placed wind energy at its center of development. For coastal wind, they focused on turbine upgrades, composite materials advancement, power generation forecast, grid network operations and stabilization, cost reduction and the development of high-end turbines for low wind conditions. For offshore wind, the roadmaps enlisted the exploitation of seabed fixed installations and floating platforms, conversion and storage of energy, generation forecasting, grid regulation and stabilization. The restoration of concentration on wind energy by the METI was the consequence of expanded wind energy establishment everywhere throughout the world. The METI included wind energy R&D as a major aspect of its Energy Innovation Program in 2008[53]. This led to a major increase in spending from 2009 for the three multiyear programs. The Energy Innovation Program for Wind has three sections. The first was executed from FY2008 to FY2012, concentrating on creating innovative solutions to Japanese-particular climate and climatic conditions, for example, extreme lightening and storms. The second program altogether concentrates on offshore wind energy development (FY2008–FY2014) and it comprised of three projects: extensive scale of offshore wind system advancement, offshore wind experiments for both fixed and afloat installations and offshore wind resource estimation projects. The project is presently stretched out to FY2017[54]. The third program began in FY 2007, with emphasis on grid balancing technologies, e.g. storage and power control framework development, and improvement of data collection methods (FY2007–2011). The NEDO executed the majority of these tasks.[55]

52 EDMC (2016): Energy & Economic Statistics Handbook. Available online: The Institute of Energy Economics Japan. http://edmc.ieej.or.jp/stat-j-toc.html (accessed 25/07/2016)
53 METI (2007, 2008, 2009): Strategic technology roadmap 2007, 2008 and 2009. (In Japanese). Available online: www.meti.gpo.jp/policy.economy.gijutsdu_kakushin/str-top.html (accessed 25/07/2016)
54 NEDO programs P07015 and P13010 (all together: 9,080 billion yen budget), http://www.nedo.go.jp/activities/ZZJP_100074.html, http://www.nedo.go.jp/activities/FF_00383.html, http://www.nedo.go.jp/activities/ZZJP_100054.html

Growth policies for the market prior to 2011:

The two principal market strategies for wind were namely:

- capital subsidies
- and the Renewable Portfolio Standards (RPS), in view of "Special Measures Law Concerning the Use of New Energy by Electric Utilities".

Capital subsidies began in FY1998 and kept going until FY2010. One was meant for developing the private sector which gulped about 33% of the capital expenditure. The other was particularly focused on the non-profit sector while local wind ventures, taking up about half of capital expense. The last program was not authoritatively ended in FY2011, but rather there were no open applications for wind investments for the year.

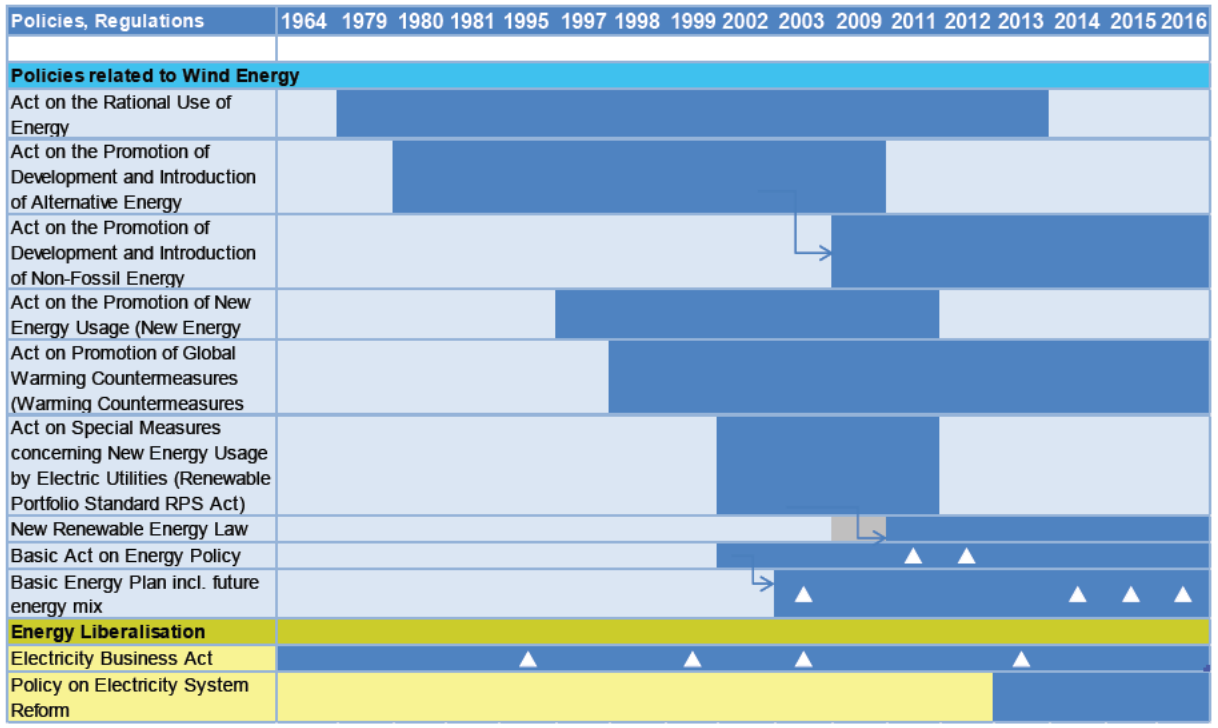
Renewable Portfolio Standards (RPS), in view of "Special Measures Law Concerning the Use of New Energy by Electric Utilities":

The major counterpart plan was RPS, which ran its course between April 1, 2003 to June 30, 2012. The RPS framework incorporated solar, wind, biomass, small-scale hydropower plants (up to 1MW limit), and twofold geothermal power era. A power retailer could itself generate power or buy energy through the "New Energy Certificate" from another company. The Usage Target Rates were constantly low, around 1% of the aggregate volume of power supply. According to the FEPC infobase, wind energy projects represent 28.4% (2,559.3MW) of the aggregate installed size under the RPS administration. It also created 38.2% (4630.58GWh) of power, which was 0.4% of the aggregate sum of power produced in Japan in 2011 (1,107,829 GWh). In FY2010, wind energy supplied just 0.01% of the aggregate power in Japan. Toward the end of 2011, the cumulative of wind energy projects worldwide was 238.35GW, implying that Japan had just 1% of the worldwide aggregate, a long way behind China, the United States, France, Spain, Germany, and numerous nations.

55 Federation of electric power companies of Japan (2016): FEPC INFOBASE. (In Japanese). Available online: http://www.fepc.or.jp/library/data/infobase/index.html (accessed 25/08/2016)

Policies related to wind energy in Japan

Source: overview based on policies and regulations in Japan



Energy policy regulation after 2011

Regulatory bodies and their responsibilities

The decision-making body on energy matters is METI. Under METI, the Agency for Natural Resources and Energy (ANRE)[56] is in charge of the issue of energy directives, policies and reforms. The ANRE comprises of three areas:

- Energy Conservation and Renewable Energy Department
- Electricity and Gas Industry Department
- Natural Resources and Fuel Department

The ANRE is supported in its responsibilities by an assortment of advisory groups, which are made up of agents from research bodies, industries and different fields. After a bill or a proposal has been put together (taking into account existing laws), it will be unveiled within a few weeks so that changes, assessments and feedback can be presented to the public.

This framework is designed to increase accountability in the creation and amendment of laws. Usually, all legal matters are sorted out before the release of the bill to the public for feedback.

Post-2011 Energy Policy

Japan experienced the Great East Japan Earthquake and Tsunami on March 11, 2011. The Tsunami caused the Fukushima Nuclear Plant Accident. This changed the energy scenario drastically in Japan as many problems were uncovered after the nuclear plant accident. Prior to the event in 2011, nuclear power accounted for about 20% of the power needs of the country. After the disaster, a total of 54 nuclear plants had to be shut down for safety reasons. With the triple-fold catastrophe, Japan was compelled to reexamine its energy policies. The first issue was the absence of an adaptable framework to transmit power past districts. The Great East Japan Earthquake, Tsunami, and the Fukushima Nuclear Plant Accident led to a huge deficiency of power during the ensuing days and months after March 2011 in the densely populated eastern parts of Japan. The inadequate transmission system prevented the Tokyo and Tohoku districts, which were encountering huge deficiency of power, from accepting power from the western part Japan with its copious power supply. Furthermore, the rigid market set-up made it difficult for consumers to get access to low-cost power replacements. Numerous clients were enraged by the rigid price control mechanism, arranged power outages, and their helplessness to select the electricity supplier of their choice. The mid-2011 experiences laid the foundation for the Electricity Sector Reform (see Chapter on Transmission and Integration) that set the structure for a full deregulation of the electricity industry till 2020.

56 METI and ANRE: http://www.enecho.meti.go.jp/en/

Brief Look at The Electricity Business Act and its revisions since inception

The legitimate premise for the energy market in Japan is the "Power Business Act"[57], which was enacted on July 11, 1964. The law, among other objectives, seeks to protect consumers, guarantee a sound improvement of utilities and safety, as well as protect the environment and its resources. Thus far, the Act has gone through five revisions[58]:

The Revision of 1995 paved the way for IPPs to enter the electricity market as it allows companies to run plants for their usage.

The Revision of 1999 led to a partial deregulation of the energy sector with the offer of power by PPS to Extra High-Voltage (EHV) users (with a prerequisite of not less than 2,000kW), utilization of the transmission systems of the power generating firms by PPS to guarantee net fairness, coupled with the use of accountability mechanisms and regulations for the utilization of transmission systems by PPS ("Retail Wheeling Service"). With this, stipulations for levy plans were facilitated

The Revision of 2003 led to increased deregulation of the energy market with the sale of power by PPS at high-voltage (HV) buyers (with a prerequisite of no less than 500 kW). This applies to all consumers (from 2005) of 50kW or more, which led to the set up of impartial bodies to screen transmissions (ESCJ) and the Japan Electric Power Exchange (JEPX) to advance the nation's electricity trade and broaden power generation

The Revision of 2008 witnessed the gradual amendment and usage of provisions contained in the "Retail Wheeling Service" regulations

The Revision of 2013: Resolution of the "Policy on Electricity System Reform" introduced an update to the Chapter on Transmission and Integration which was completed with the use of three bills, the 1st in 2013, 2nd in 2014 and 3rd in 2015 respectively New Basic Energy Plan 2014. Other than the most recent modification of the Electricity Business Act in 2013, including its sister bills which reformed the energy sector, the future energy mix initiated by the government was likewise set for review.

In April 2014, the Legislature received another Basic Energy Plan, which declared among other things that:

- Nuclear power is an indispensable part of the nation's electricity generation "which will be reduced as much as possible", while a "certain amount will be preserved with regards to security of supply and costs".
- No particular limit was set for individual sources of power; rather the aim is for renewables "to go beyond previous targets set in the past plan".
- The policy on closed-fuel cycle was set to continue.

In July 2015 METI affirmed another energy mix for 2030, meeting objectives such as safety, energy security, financial productivity and environmental protection. The objective comprises of 20-22% nuclear, 27% LNG, 26% coal, 8.8-9.2% hydro and 13.4-14.4% of other renewables. In July 2012, another FIT plan for renewables became effective. Duties been reduced on a step-by-step basis, yet grid networks are overburdened and the future improvement of renewables is hard to evaluate.

57 The Electricity Business Act. Legal text. Available online: http://www.japaneselawtranslation.go.jp/law/detail_main?re=&vm=02&id=51 (accessed 25/07/2016)
58 TEPCO (2016): Liberalization of the Electric Power Market. Available online: http://www.tepco.co.jp/en/corpinfo/ir/kojin/jiyuka-e.html (accessed 25/07/2016)

2.5 Feed-in-Tariff (FIT) and Revision 2016

Taking off after the passage of The Renewable Energy Bill in 2011, Japan announced fixed charges for wind energy in June 2012 in order to assume control over the old EEG regulations which were adopted from Germany.[59]

During the announcement of FIT in Japan, offshore wind was valued with little or no difference to onshore wind power charges. This changed in March 2014, following METI's release of new wind duties for FY2014/15. Onshore get ¥22/kWh while the tariff for offshore wind is ¥36/kWh. Both tariffs are set for 20 years. However, the FIT rate is revised every year. The last revision in 2016 saw no change to the FIT rates for the present year, though the PV FIT was cut significantly. To be eligible for the FIT, an applicant must satisfy the following conditions:

- The power plant development plan must be have governmental approval.
- The plan must specify in detail how transmission from the power plant to the grid network is to be carried out.
- The applicant must be ready to submit copies of facility land documents and equipment purchase orders to METI within 180 days from the scheduled date of the next approval.

59 BNEF (2016d): Impact of changes to Japan's feed-in tariff law. BNEF Renewable energy - APAC - Analyst reaction. 02/05/2016.

- METI can revoke the approval if necessary documents are not submitted at due date or if the submitted reports are not adequate.

Problems after solar PV introduction:

When FIT was originally introduced and a boom of solar PV projects begun, there were no links between getting endorsement and a venture's credibility. This opened the floodgates for several applications as there was no direction about when the facility was expected to start electricity generation. Subsequently, developers of solar PV leveraged this which led to inconsistencies about the status of approved and ongoing projects. This need has been addressed following investigations by the government.

Nonetheless, wind developers, who need to utilize the recent FITs, require the endorsement of METI. With a specific goal to acquire its assent, they must incorporate an affirmation of their capacity to deliver a steady measure of quantifiable current. After affirmation, a long-term power purchase agreement with one of the EPCOs has to be negotiated. To get a grid connection permit, operators of the wind park have to check with their respective EPCO to know how much of the power plant's installed capacity the grid network can accept. The power purchase agreement is usually done before the development of the power plant.

Under the arrangements of the new FIT, EPCOS are essentially obliged to buy the power generated by renewable energy. Be that as it may, METI has given a few special cases, under which the power supply or power deals can be denied. EPCOs can deny association with the mains under the accompanying conditions:

- In the event that substantial variation in power generation exists.
- In the event that the wind farm operator declines to repay costs for non-conveyed energy.
- In the event that the operator declines to pay the total connection costs, the expenses on setting up new power systems for newly-assembled wind turbines will be taken care of by wind farm operators. Expenses on any inverter and so on must be guaranteed by wind farm operators.

In addition, the acquisition may be rejected if:

- The aggregate power supply surpasses demand in the catchment region. For this situation, the system administrator may decline to purchase up to 92% of power.
- In the event that the amount of power from a particular plant(s) surpasses the limit of the power network.

EPCOs have various concrete and legitimate reasons to decline grid connection requests. It cannot be guaranteed that technical or legal issue or risks will arise during the course of developing a project. Therefore, the possibility of such occurrences and steps to resolve them must be discussed or addressed when drawing up or entering into a power purchase agreement.

FIT for wind energy 2012 -2016

Source: METI, BNEF 2016

Year	Onshore 20 kW or more	Onshore Less than 20 kW	Offshore 20 kW or more	Duration
Price (2012)	¥22 (0,17 Euro) + tax	¥55 (0,41 Euro) + tax	-	20 years
Price (2013)	¥22 (0,17 Euro) + tax	¥55 (0,41 Euro) + tax	-	20 years
Price (2014)	¥22 (0,17 Euro) + tax	¥55 (0,41 Euro) + tax	¥36 (0,27 Euro) + tax	20 years
Price (2015)	¥22 (0,17 Euro) + tax	¥55 (0,41 Euro) + tax	¥36 (0,27 Euro) + tax	20 years
Price (2015)	¥22 (0,17 Euro) + tax	¥55 (0,41 Euro) + tax	¥36 (0,27 Euro) + tax	20 years
Price (2016)	**¥22 (0,17 Euro) + tax**	**¥55 (0,41 Euro) + tax**	**¥36 (0,27 Euro) + tax**	**20 years**

The 10 EPCOs have similar objectives and policies but sometimes they may differ. It, therefore, becomes imperative to check each EPCO's policies on renewable energy with particular regard to existing and future energy sources. As a result, the right region must always be chosen with regard to prospective EPCO's policies on renewables and available resources.

Feed-in-Tariff Revision in 2016[60]

A reform proposal of the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities was submitted toward the start of 2016 to Japanese legislative body (Diet), and declared as law on June 3, 2016. After an audit of Japan's FIT plan on renewable energies, another accreditation framework and tender process for PV schemes is proposed for sometime after April 2017.

The modification depends on a proposition of the RENA approved reform panel of inquiry, which proposed new guidelines for the FIT law. Boston Consulting was contracted by METI for inputs on the new reform, which may be to redesign the reform in a bid to evade criticism from international quarters.

The new accreditation framework was designed not only to certify facilities; it was meant to certify projects as well. The benefit of this is that once a certification has been given, the project operators can go on to negotiate and reach an agreement with a potential buyer of the facility before its completion. Interestingly, the new framework will apply to every new venture, as well as existing holders of a similar certificate obtained under the present FIT framework.

The essence of the revisions was primarily aimed at addressing oddities created by the influx of solar PV (as mentioned before) in previous years so as to:

- surmount the present scenario where photovoltaic energy generation (more than 10kW) represents around 90% of the aggregate sum of electricity approved under the FIT plan and advance a more balanced equalization of all renewables
- reduce the general population load, with the consumption cost amounting to ¥1.8 trillion;
- create an effective exchange and distribution of electricity for businesses to leverage on Electricity System Reform, following the withdrawal of applications by Kyushu Electric Power Co., Inc. and others for entry into the renewable energy market in 2014.

In effect, the reform sought to put an end to the usual practice of solar developers seeking to get FIT approval for their projects and enjoy a high FIT without ultimately building them as stated in their plans but instead trying to cut costs by building smaller projects. This saturated the PV industry and turned out to be a great burden for public costs. The new guidelines addressed this by making provisions only for approval of finished projects rather than planned or unfinished ones. This was a radical change which eliminated money grabbers, middlemen and briefcase developers. The overall goal was to give approval to worthy projects to allow astute developers to benefit from the scheme.

Presently, a solar PV conduit project of nearly 80GW has been initiated, of which 27GW has been constructed with 53GW to go. METI anticipated that around 20 to 30GW of that might be dropped by April 2017. The estimated installed capacity for PV is 7 to 8GW in 2016 with a drop of 6 to 7GW in 2017. From 2017, a tender process will be for large-scale PV projects.

With regard to wind power, the timing of the FIT certification – which, as of now, is geared towards grid connection and the conclusion of the EIA process – might be faster in the future. The period of grid negotiations for wind power connection may then be in the middle of EIA process (2-3 years from start EIA) rather than to almost finishing EIA process (4 years from start EIA). A faster FIT certification and EIA approval process will encourage further investments into the wind energy sector. METI plans to speed up and reduce CAPEX with an announcement of future lower FIT rates to spur further development. The uncertain nature of the approval process for grid connections remains unsolved as it further complicates grid operations. As a result, the reform is yet to be revised for wind energy sector even though it may hold sway in other sectors.

Here is a brief outline of changes that will be effective from April 2017:

The Inception of a new authorization method: As regards the business plan that a renewable energy generation utility ought to submit before entering the energy business, the Revised Act stipulates arrangements to make another approval framework

60 BNEF (2016d): Impact of changes to Japan's feed-in tariff law. BNEF Renewable energy - APAC - Analyst reaction. 02/05/2016.

under which the practicality, e.g., certification of connection to grid networks, and points of interest of the business arrangement are affirmed, as well as when the utility is projected to have the capacity to operate the business before the METI Minister approves the utility.

A Revised Method for Price-fixing regime: With particular attention to procurement costs, the Revised Act stipulates arrangements to introduce another framework under which charges are set with the use of public tenders to reduce or cut the costs which consumers are likely to face. It, therefore, aims to permit utilities to receive a price-setting framework as dictated by the attributes and different workings of energy sources.

Also, the Revised Act stipulates arrangements to permit utilities to set costs to cover future power arrangements concerning power sources that require long-term development.

Revision of regulations on firms obliged to buy power from renewable sources: The Revised Act stipulates arrangements to pinpoint the definition of firms obliged to buy renewable energy from power retail companies to power transmission and distribution businesses in order to facilitate or extend the introduction of renewable energy through the operation of wide-range grid networks amidst several measures.

Also, the Revised Act provides measures to compel utilities to offer bought power for sale to the wholesale power market as well as oblige them to send a notification to METI on arrangements that stipulate and state the status of such power supply.

Revision of plans on the reduction of extra charges on electricity tariffs: A business that devours a huge amount of electricity is qualified to benefit under the plan from reduced extra charges on power rates. Based on this, the Revised Act made arrangements to introduce a framework under which a business that has submitted an application to benefit under this plan is endorsed in consideration of its energy saving activities and its status amidst competition from foreign peers.

2.5.1 Siting and development

Topography

As a small island, Japan is made up of a landmass scattered with mountains. It is prone to earthquakes and typhoons, and it is also exposed to substantial snowfall in most parts of the nation. The mountainous nature of the Japanese landscape poses several difficulties (for example, erosion, landslides) which have caused the building of uneven road networks and grid networks. These have divided the power frameworks in urban regions coupled with high costs of development, which results into a higher LCOE for wind power.

Aside other natural resources, Japan's solar resources is average (less than 13% capacity factor), while it has robust winds especially in Hokkaido and Tohoku (cf. table on the following page). Land limitations and siting restriction have limited the usage of onshore wind. The offshore wind speed is very high (> 7-8m, cf. wind map on the following spread), but remains largely unexplored. Extreme water depths along the nation's shores (more than 50m) has greatly limited offshore development projects. But, new experiments with the usage of floating and fixed platforms may be the solution to boost offshore wind power in the years to come.[61]

Wind project in Japan: steps and duration

Source: BNEF 2016, status Q1 2016

High backlog of wind projects due to EIA

Source: Statistics from 2016

Development: Application and Approval procedure

Similar to European nations, a formal approval process to build a wind farm must be initiated by any interested party in Japan. This may take about four to five years, but sometimes even longer to accommodate input from the public. The development stage entails consultations with various bodies, groups and local communities. The local community near a proposed site must be informed of the whole scope of the project. This is normally done through interactive sessions and gatherings with the interested parties. Once there is an understanding between the developer and the host community, approvals from the authorities can be duly obtained. Then, as outlined in the previous chapter, a power-purchase contract has to be arranged with one of the EPCOs. The siting choice and arrangement with the regional authorities regularly takes around one to two years, while further bureaucratic processes with the EPCOs may add one or two years. The possible duration of development i.e. from construction to operation may take another year or two.

Theoretical introduction wind energy potential in Japanese region

Source: JWPA 2016

Location	In ten MW		
Theoretical potential	140,000	770,000	
Target in total	Onshore (7,000-30,000)	Offshore fixed (510-31,000)	Offshore floating (5,600-130,000)
Hokkaido	3.000 – 5.000	470 - 12.000	3.800 - 28.000
Tohoku	2.100 – 7.400	7 - 4.400	1 - 18.000
Tokio	100 - 450	32 - 2.800	640 - 5.200
Hokuriku	**44 - 520**	**0 - 420**	**0 - 5.900**
Chubu	**250 - 870**	**0 - 1.900**	**110 - 1.900**
Kansai	**330 - 1.300**	**0 - 160**	**0 - 2.400**

Insufficient legislation is also responsible for the lengthy planning and development stages which have restricted extensive development of both offshore and onshore wind power. The JWPA has reviewed six areas of legislation such as the EIA and its sister laws, which have been responsible hindering wind energy development:

Environmental Impact Assessment (EIA) Law:[62] This law was ascertained to be of equal application to wind power in 2012. EIAs are costly to carry out and take about 3-4 years to complete through to getting approval. A streamlining of the EIA administrative process to halve the processing time is underway (currently about 570 days). It is expected to become effective in 2017. A lack of basic nationwide environmental data requires developers to gather a large amount of data over a long period of time. Simplifying Environmental surveys required by developers while guaranteeing EIA quality is an issue.

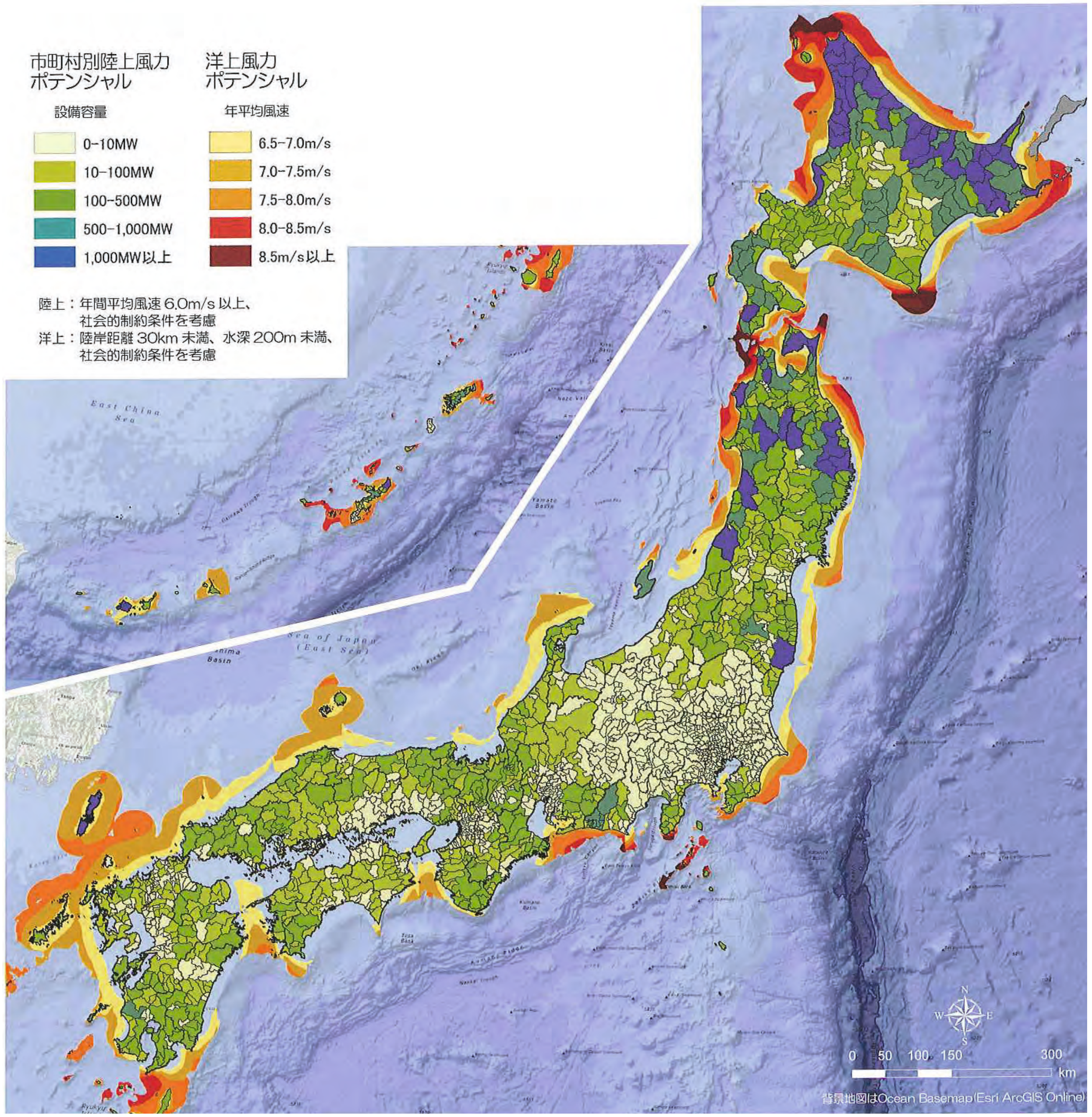
Building Codes: Previously wind turbines were regulated by the Building Standard Act (considered as a building), but this has now been integrated into the Electricity Business Act with a unified process for examination of power system/nacelle and tower. Previously, construction laws and guidelines which apply to tall buildings (e.g. skyscrapers) were also applicable to wind turbine installations. This is not the case anymore as the building code has been incorporated into the Electricity Business Law. Now, turbines have to comply with these regulations.

Agricultural Land Act: Dispossessing rightful occupants of land is easy when a compromise is reached, but land meant for agricultural purposes can be very hard to process; it typically takes at least one year to get approval. As wind development can coexist on agricultural land (there were some good examples of this in Japan before 2010), wind turbine siting on first class agricultural land should be permitted again.

Forest Act (Regulations on National Forest): This is even more difficult to develop on than agricultural land: an application to secure land protected by legislations may amount to a utopian task. It makes release from forest conservation difficult and siting permits in protected forest areas included various conditions so were extremely difficult to obtain. Also, the decision-making rules that were applied at prefectural level were very unclear. Wind projects in national forest land by non-EPCO developers were not permitted.

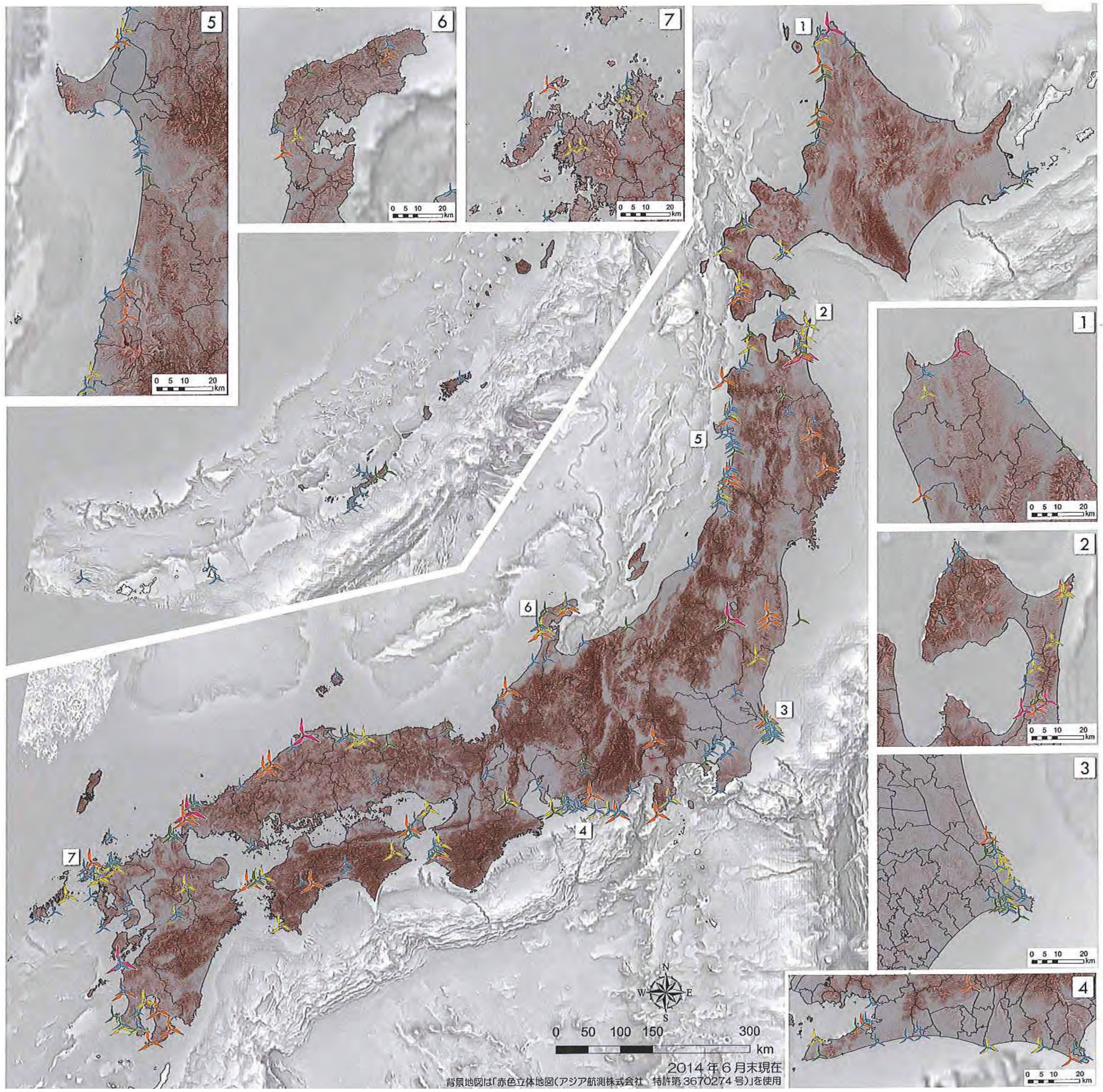
61 JWPA (2016): Japan Chapter for GWEC annual report. Internal JWPA paper.
62 EIA Div. Environmental / Policy Bureau MOE (2012): EIA. Available online: https://www.env.go.jp/en/focus/docs/files/20120501-04.pdf (accessed 25/07/2016)

Wind Map of Japan



Source: Ocean Basemap, JWPA, 03/2012

WTG installed



Source: Ocean Basemap, JWPA, 06/2014

1MW=1000KW

Natural Parks Act: Getting land located on natural parks for wind power installation is nearly impossible with ambiguous legislations which make little or no provision for such usage.

Specific Safety Standards: related to extreme weather conditions and the potential for turbine accidents.

Coast Act, Ports and Harbors Act: Due to the nature of operations at ports and harbors, it has become very difficult to site wind power installations near these two places. However, by April 2016 the Act was been changed to clear the authorization body for offshore wind projects arranged under the General Common sea range. The change settles the offshore tender framework and grants usage for 20 years. Furthermore, it directs that the General Common sea zone (GC) is controlled by the separate port power that is in control to issue permits for private purposes. Before then, there was no law or control that provided authorization for undesignated sea locations, making it a business hazard for projects under the GC. The classification of marine territory in Japan has been either as a port related sea zone or a general common sea zone. The marine territory is under the authority of the port and this settled the question of who is the proper authority to issue permits for offshore projects. For its counterpart, the GC, no law or direction had been set except that its permit remains tied to tourism in Public Private Partnership (PPP) schemes with the port authority.

Kitakyushu City administration will be the first body to follow its bidding processes of offshore wind power projects after August as indicated by this new law (e.g. Hibikinada offshore facility[63]). It is anticipated that this will facilitate the development the 300MW project. Altogether, around 600MW of similar projects in Japan are influenced by the new control, found for the most part in the GC in Fukuoka, Niigata and Yamaguchi districts.

The EIA has been tagged as a controversial barrier to wind energy projects in Japan. In the paragraphs that follow, the EIA law and its impacts will be discussed in more detail.

The Environmental Impact Assessment process (EIA)

All construction or installation projects involving wind power are expected to pass through the EIA approval process. The legal regimes for the approval process are contained in two separate legislations namely: The Basic Environment Law 1993 (BEL) and the Environmental Impact Assessment Law 1997 (EIAL).[64]

The BEL controls all values of nature and the environment, for example, wildlife conservation, protection of biodiversity, nuisance, safety, air and sources of pollution. Information on the values stated in the BEL are then compared with the legislation of each policy. The EIAL, on the other hand, proceeds to draw out an authorization process for projects that are likely to affect the environment negatively and to put in place measures to adjust them to the standards which will sustain the environment during and after use of such land. The EIA process[65] is initiated by dispatching an application with the Ministry of Environment (MOE) and will incorporate the participation of the public, local government (who will be represented by MOE and METI for power plant projects). It is a prerequisite for MOE to give its consultative and final opinion before METI endorses the development license.

Other than these two primary forms of environmental laws, there exist different laws which have links to the subject matters of environmental protection and conservation, for example, the “Hot Spring Law 1949” and “Regular Parks Law”, the “Transitory Bird Law”, the “Clamor Regulation Law” or the “Horticultural Land Law”. The approval process for these laws go hand-in-hand with the EIA process, but they may be approved separately by different agencies.

Moreover, local governments (prefectures and municipalities) adapt and modify the EIA Act as per the applicable EIA Law in their localities. The scope of the modified legislation may have been expanded beyond that covered by the original EIA.

It is unsurprising that solar PV, irrespective of size and generation capacity, has gained so much prominence as a result of its exclusion from projects requiring EIA approval process. Wind power was initially excluded from the EIA process but was later included for health and safety reasons (such as noise pollution, bird accidents), and because strong opponent groups campaigned against it.

EIAs are regularly required for wind power and geothermal power plants that surpass the electricity generation capacity of 10MW. Power plants operating with the capacity range of 7.5-10MW only need to be screened to determine whether they have to pass through the usual EIA approval process or not. The EIAL was revised in 2011, with additional frameworks added at the start and end of the EIA process. The major goal was to link “Primary Environmental Impact Consideration” (PEIC) and “Impact Mitigation Reporting” (IMR) with Strategic Environmental Assessment (SEA) standards without enacting a possible SEA law.

Since their introduction, these extra procedural frameworks in the EIA approval process have had the tendency to elongate the process, which will no doubt spell doom for, or limit the success of, such projects. Various stakeholders in the wind energy sector have referred to the long, lumbering and exorbitant EIA process as one of the fundamental purposes behind the stoppage of a large number of projects that were waiting to get the final approval. The EIA approval process is being fast-tracked and presently takes about three years. However, experience has shown that large-scale wind farms projects may spend five years in the process.

The main imperfection of the EIAL, as noted by industry players and developers, is the baffling number of steps which contain meetings and discussions with government agencies, stakeholders, the public, etc. These are then followed by the PEIC, screening, draft preparation and final of the Environmental Impact Statement (EIS) and the IMR stage. With the rigorous requirements of participation and input from all stakeholders, the public and interested parties, several divergent opinions are bound to arise which will ultimately drag the process and increase its duration.[66]

Also, onshore developers of large-scale projects have to pass through the approval process for the mentioned sister EIA laws (Hot Spring Law, the Migratory Bird Law, the Natural Park Law or the Agricultural Land Law). This is another form of bureaucracy which will significantly increase the approval process.

Hot spring proprietors, for instance, can inconclusively object to geothermal installations on the premise of worries that the project would exhaust hot water reserves in the long-run. Also, environmental non-profit organizations (NPOs) can slow down wind power projects because of the stringent bird law. The administration constrained and intensely-controlled geothermal and wind power development in national parks with two protection zones. The first protection zone forbids all types of energy projects while the second permits them only under specific cases. The use of farmlands is managed by the government and its usage for non-agricultural purposes is restricted.

The lack of a coordinated permit issuance process encourages operators to look for independent approvals from various government bodies. This is due to the stringent requirements laid out by the EIA which leads to circumstances either excessively grave or unreliable for most designers to proceed. The resultant effect is that most developers abandon their projects or commit resources to small-scale projects - or solar PV not regulated by the EIAL process.

The Reform Process

By monitoring the bureaucratic limitations in the environmental approval and licensing phases, the Japanese government has been striving to deregulate and streamline the stringent environmental laws with the EIA law as a priority. This is to be done by modifying the restrictive arrangements inside the different laws which serve no practical purpose in the face of dwindling investment in wind power. From 2017 and onwards, improvements are expected.

The Japanese government and ministries have been making gradual changes to ease large-scale investments in onshore wind and geothermal projects to ideally balance, diversify and increase power generation capacity from renewable energy resources. A portion of the measures were incorporated into an EIAL reform draft that proposes the reduction of the EIA approval procedure to be half the current period it takes. That is, from three years to eighteen months, such that all EIAL and minor laws (e.g. Hot Spring Law, Migratory Bird Law, and so on.) are dispatched and performed concurrently, coupled with the usage of data from past surveys. Another proposal to save time, cut bureaucracy and cost is to carry out a national EIA survey alongside local authorities' surveys.

The government is also taking steps to reform the minor laws as well, principally by increasing the scope of land usage for each law. Although the government has extended the land usage of the National Park Law, such usage comes with strict restrictions.

Wind projects are forbidden to be built on farmlands due to the topography of the country. But, wind farm and renewable energy projects with considerable potential are now approved under certain conditions.

Having addressed the legal regimes of environmental laws in Japan, its importance and destructive tendencies of frustrating investments on renewable energy, the following section will examine differences with the EU equivalent.

Japan's EIA and EU's EIA

A comparison of Japanese and EU EIA legal system and the latest reforms shows that despite the fact that EIA is just one of numerous barriers stifling massive investment in renewable energy, it also increases the cost and length of the approval process which

63 more details about the offshore call: www.city.kitakyushu.lg.jp/kou-ku/30300004.html

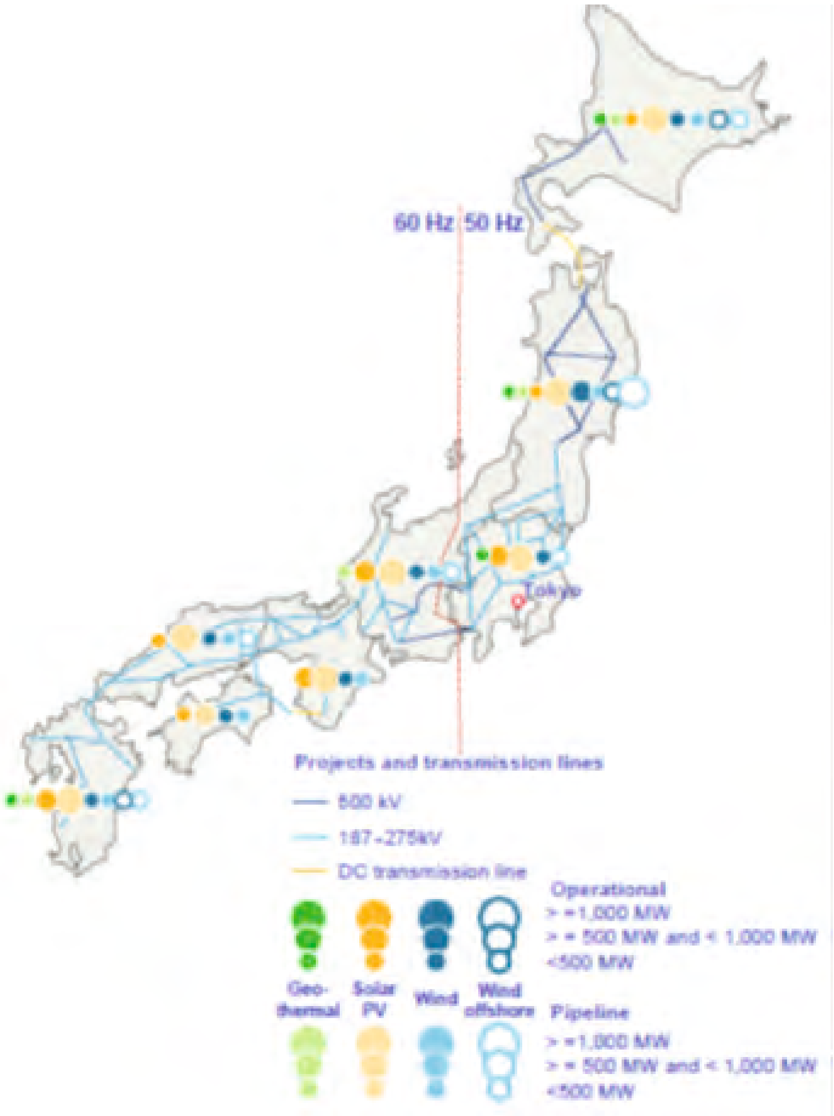
64 EIA Div. Environmental / Policy Bureau MOE (2012): EIA. Available online: https://www.env.go.jp/en/focus/docs/files/20120501-04.pdf (accessed 25/07/2016)

65 Ibid.

66 Ibid.

Japan`s grid system with renewable operational capacity

Source: IHS Energy 2015



developers cannot bypass.

In respect of renewable energy goals set by Japan (22-24% of TEPS until 2030) and the EU (27% of RE usage until 2030), alongside the reduction of greenhouse gases (26% in Japan by 2030, benchmark 2013; and 40% in the EU by 2030, pattern 1990), large-scale renewable energy research and advancement needs to be scaled up if these objectives are to be achieved.

Japan's present moves to reform the industry largely apply to a few areas of the legal system by targeting single issues without a blanket application to resolve a huge number of the bureaucratic hindrances contained in the different ecological laws in the approval procedure. However, the recently altered EU EIA Directive offers few enhancements over the old forms, but does exclude obligatory one-time actions when giving approvals. The most extensive motivation for Japan is not the Directive but rather the "TEN-E" Regulation of 2013; this includes managerial components into the EIA procedure and makes them a necessity for energy projects designated as "Project of Common Interest". An examination/adoption of the TEN-E would reform the Japanese EIA process by tagging projects as "urgent" or by order of importance coupled with harmonization of the approval process at local and national government levels. When combined with time-management practices, the entire procedure may become faster, cost-effective and offer predictable legal outcomes for developers, the public and the government without any lapses.

European wind power companies wanting to do business in Japan are advised to monitor all policy updates of the EIA, paying particular attention to the approval process and framework.

2.5.2 Transmission and Integration

As shown in the figure on the next page, power is supplied by 10 vertically-unified Electricity Power Companies (EPCOs) while the market for the four primary islands is separated into nine districts who have poor transmission capacities across district boundaries.

The hurdle for the combined usage of renewables lies within the convoluted frameworks, with different transmission lines between energy-endowed zones (e.g. 500kV/50Hz in Hokkaido, and Tohoku) and energy-ravaged zones (i.e. 187-275kV/60Hz in Hokuriku, Chubu).[67] Provincial utilities control transmission and distribution and operate grids using annual RES generated capacity. However, efforts to unbundle the transmission arm are in progress. With recent electricity market reforms[68], Japan's energy retail market was completely deregulated in April 2016 and other reforms are upcoming.[69]

Japan has two electricity frequency networks: Eastern Japan (Hokkaido, Tohoku, and Tokyo EPCOs) utilizes the 50HZ frequency. However, Western Japan (the remaining six EPCOs) utilizes the 60Hz frequency. During and after the Great East Japan Earthquake, the conversion rate of both frequencies was 1.035GW, which was expanded to 1.2GW in February 2013. There is fundamentally just a single connection linking nearby EPCOs to each other. The setup is longitudinal and provides angle stability, load consistency, with an optimal thermal limit of n_1 possibility to decide the transfer limit of interconnection. Because of the constrained transfer limit between territories, there is a need to match demand with supply and vice versa in such areas.[70]

Grid capacity problem

The surge of solar-oriented projects has evolved beyond grid interconnectivity in many districts in Japan. Hokkaido and Tohoku Electric Power Companies have requested that wind power engineers accept to be paid for power consumption alone (rather than full payment for power used and extra capacity) if they desire to get reconnected to their grids in December 2015.[71] TTherefore, wind developers are left with huge financing difficulties, especially in securing bank loans. JWPA is in talks with Electric Companies to take care of this issue. As outlined in the FIT chapter, it was resolved in the recent FIT reform that all FIT approvals for solar plants with no grid connection should be canceled. With this, it is expected that this will boost wind power generation sent to the grid network.

It is against this background that the JWPA made the following recommendations[72] on how the present grid capacity can be enhanced, if not upgraded:

The proposed reduction shall be based on an "hour unit" rather than by "day unit."

As far as possible, the capacity limit should not be assessed solely on the summation of solar-oriented and wind power projects. Also, a balanced effect may arise so that wind power can get extra spending to fill the gap left by cuts in solar projects. Also, METI is building an expanded capacity for R&D while keeping in mind energy targets and adapting the capacity limit of the grid framework accordingly.

As regards the grid framework expansion, METI has offered subsidized costs on four domestic grid augmentation projects in Hokkaido and Tohoku wind power of 50%. One of the projects by SB Bank (Softbank) at Hokkaido was slowed down while the other three are active as shown below:

- **Tohoku (Akita & Aomori Pref.),** Akita Souden Company (Marubeni, local banks): On-going
- Northern Hokkaido Souden Company (Eurus Energy, Eco Power, etc.): On-going
- Kamikita Souden Company (JWD, etc.): On-going
- Nippon Souden Company (Softbank/SB Energy, Mitsui Trading Co., Marubeni, etc.): Suspended

67 Fasol, G. (2014): Japan energy market research report. http://www.eurotechnology.com/store/j_energy/ (accessed 25/07/2016)
68 IEEFA (2016): Japan Briefing. Japan`s Energy Transformation. Available online: http://ieefa.org/wp-content/uploads/2016/03/Japan-Energy-Brief.pdf (accessed 23/04/2016)
69 Stapczynski, S. (2016): Japan's Power Market Opening Challenges Entrenched Players: Q&A. Bloomberg Technology. Available online: www.bloomberg.com/news/articles/2016-03-28/japan-s-power-market-opening-challenges-entrenched-players-q-a (accessed 20/04/2016)
70 Ibid.

71 Federation of electric power companies of Japan (2016): FEPC INFOBASE. (In Japanese). Available online: http://www.fepc.or.jp/environment/new_energy/renkei/ (accessed 25/08/2016)
Federation of electric power companies of Japan (2016): FEPC INFOBASE. (In Japanese). Available online: http://www.fepc.or.jp/library/data/infobase/index.html (accessed 25/08/2016)
72 JWPA WindVison Report (2016): JWPA WindVision Report 29-02-2016. (In Japanese). Available online: http://jwpa.jp/pdf/20160229-JWPA-WindVisionReport-ALL.pdf (accessed 23/04/2016)

Other than METI, Fukushima local government plans to bolster neighborhood grid line augmentation in the Fukushima Prefecture. Also, Prime Minister Abe has declared plans to construct a hydrogen test field at Fukushima using renewable energy assets. Recently, a capacity of 8GW, resulting from the decommisioning of the nuclear plant, has been released for wind onshore and offshore (2GW each).

The ongoing inter-regional grid augmentation relies upon the advancement of the Electric Power Reform in Japan. The unbundling of power generation, transmission and distribution has started at TEPCO since April 2016 and is to apply across the nation from 2020. There are many nodes in Japanese grid framework. The most acclaimed are the inter-Hokkaido and Honshu connecting line ("Kita Hon line"). Regrettably, there is no agreed payment structure for the grid upgrade costs in Japan now. JWPA suggests that the expense might be paid by power charge. However, other individuals who detest the increase of power expense have another thought - that grid line users, i.e. the developers ought to pay.

Reforms in the Electricity Sector

After March 2011, Japan's utility model was set for assessment. A METI advisory group on industry reform recommended unbundling power generation from transmission operations and the establishment of a nationwide company to operate major transmission networks. Right now, Japan's transmission system is focused on the power generation areas, the major one being the transmissions at 500kV. Three converter stations link the 50Hz and 60Hz systems.

Differentiation between European and US grids depend on the "mesh concept" for utilization of High Voltage Direct Current (HVDC), which offers more adaptability in energy streams between adjacent locations and with a simpler integration of unconventional energy sources into the network.

As outlined before, Japanese utility industry is controlled by ten privately owned EPCOs that have a domineering business model on power generation, transmission and distribution in every zone. By March 2000, deregulation of retail power supply for additional high voltage clients had been initiated on a small-scale. The Electricity Industry Committee (ANRE), a consultative body of METI, settled on a closed model of deregulation, where the vertical integration of generation, transmission and distribution was maintained so as to secure a steady supply of power.

Policy on Electricity System Reform (from 2013)[73]

Following the Tohoku disasters of Fukushima, the Japanese government ratified the "Approach on Electricity System Reform" in April 2013. Objectives include a steady power supply, moderate energy costs, increased decision-making options for customers and the growth of businesses. To accomplish these goals, the reform will be gradually executed in three stages.[74] The three support stages are in focus:

1. **Trans-regional management of the power grid**

Phase 1 was completed in 2013 while objectives below were executed in 2015:

- Establishment of the "Organization for cross-regional Coordination of Transmission Operators" (OCCTO)
- Establishment of other independent regulatory organizations

2. **Full deregulation of the electricity market**

Phase 2 was completed in 2014 while its objectives (listed below) are planned to be implemented by 2016:

- Establishment of a licensing scheme for power generation, trading, transmission and distribution networks
- Electricity market deregulation (trade and production)

3. **Legal separation of transmission and distribution sector**

Phase 3 was completed in 2015 while the following objectives are planned to be implemented by 2020:

- Legal separation of transmission and distribution network of power companies
- Eradication of the tariff guidelines

Japan's reliance on imports is mostly determined by international financial and political variables. Although uranium has been largely available through the years (though opinions about actual years differ), this has not been the same for coal, gas and oil, a break in the importation of these fossil fuels will create a major problem for the energy industry.

To guarantee satisfactory supply, Japanese companies have been effectively taking part in "upstream" exploration of oil and gas. "Upstream" in this setting, means the industry level at which mineral deposits are discovered and explored. Moreover, a significant part of the oil reserves is managed directly by the government to avoid dangers which bureaucratic structures might cause.

73 METI (2014): Electricity system reform presentation. Available online: www.meti.go.jp/english/policy/energy_environment/electricity_system_reform/pdf/201410EMR_in_Japan.pdf (accessed 20/04/2016), METI (2016): Full liberalization of the electricity market begins. (In Japanese). Available online: http://www.enecho.meti.go.jp/en/ (accessed 25/07/2016

74 Ibid.

The electricity deregulation opens doors for new players which further pressurizes EPCOs to find ways to easily integrate wind energy into the grid network.

The total deregulation and separation of generation and transmission of electricity are set to be completed in 2020.

2.5.3 Maintenance, Safety and Certification

Technical Standards

The technical guidelines for wind turbines set by the Japanese Industrial Standards Committee (JIS)[75] are somewhat unique in relation to international standards. On account of climatic and topographic conditions, for example, e.g. lightning, Japan has evolved its own homegrown standards. The standards are partially similar to those of the International Electrotechnical Commission (IEC). However, they have been modified and adapted to fit the Japanese outlook. The Annex of this report has an outline of the Japanese standards.

Wind parks generating more than 20kW must conform with the modalities of the FITs. Wind turbines generating than 20kW must also meet the JISC14200-2 standard as well as the benchmark set by the Japan Small Wind Turbine Association (JSWTA) or other related international standards.

High Cost of Maintenance

In correlation to its normal wind power conditions, maintenance and safety issues are a different ballgame in Japan's energy sector compared with other countries. Japan has a mind-bogglingly windy atmosphere with regular turbulence, hurricanes, and serious lightning strikes, which increases components' failure rates e.g. mechanical failure or accidents which significantly increase maintenance and insurance costs compared to those of European countries.

While there are particular companies which carry out O&M services for a multitude of wind farms for lesser costs with higher operational effectiveness in Europe, the limited wind energy market in Japan does not offer such a business-friendly atmosphere. Besides, wind project developers or producers are increasingly carrying out O&M on their own with lower operational proficiency. The European experience in wind energy development is unrivaled and Japanese companies willing to learn can be assured of a fruitful outcome.

There is no prerequisite that turbines should be outfitted with a CMS framework to exploit "Big Data" for execution and maintenance operations. The majority of the turbines in Japan are not configured with sensors or CMS frameworks (or have lost the access to CMS interfaces as service contracts were discontinued), making it hard to upgrade, maintain and service the turbines. A possibility being discussed currently is that FIT could be restructured in 2017 with a prerequisite for turbines to have CMS/monitoring frameworks in place and providing incentives for that (for example, expanding the FIT if a turbine is furnished with such components).

As Japan is inclined to ICT, the fusion of turbine maintenance, digitalization and troubleshooting could be of great benefit to Japanese companies and would provide various business opportunities.

The Proposed Periodic Inspection System of April 2017

The government concluded in 2015 that a Periodic Inspection System should be introduced. The action was propelled by three wind turbine accidents. The blades of wind turbines fell off in 2013 in Japan due to inadequate maintenance and repair work as investigations showed. At that point, METI's Power Safety Division created and began implementing the periodic inspection system for all wind power plants with more than 500kW capacity. This framework is mostly applicable to fossil-powered power plants in Japan. The Electrical Business Law was adjusted on June 17, 2015 and should be in operation after April 2017. JWPA set up an internal study task force for a periodic inspection framework and passed a resolution on the "Wind Turbine Inspection Scheme" in 2015. JWPA has been carrying out pre-training activities at 14 of its wind ranches in preparation for future periodic inspections.

Early on, Japanese turbine operators (often individuals) often rejected maintenance contracts or only contracted service for a few years hoping for knowledge transfer to maintain the turbines themselves. This has led to a high amount of turbines in the field in poor condition. Maintenance operation remains a field of expertise of European companies with longer experience and stricter standards. Thus, this situation provides market potential as maintenance regulations are getting stricter in Japan as well.

Transport, and construction

Modern large wind turbines are large and heavy,

75 JISC http://www.jisc.go.jp/

therefore they need specialized transportation and construction machinery. First of all, the access road has to be raised so that blades (40 to 50m) and nacelle (100t) could be transported. Secondly, land is raised around where the turbine is installed to the diameter of rotor, so that rotor can be assembled there. If it is impossible to secure the land for assembling the rotor, blades are installed one by one. When a steep landform prevents using the large crane wind lift method, a tower is sometimes used to install the top part of the tower, nacelle, and rotor. When it is difficult to transport blades on the road because of steep land, large-size helicopters have been used (e.g. Hayama wind power plant in Kochi prefecture). There is an example where a concrete tower was used (600kW turbine in Niigata). This overcomes the constraint of height (4.2m, pass under the overhead walkway and under viaduct). It is said that a high concrete tower over 90m is more economical than a steel one (such as are popular in Germany).

For offshore, methods of construction vary depending on the form of foundation, offshore distance, and depth. Particularly in the full-scale construction of offshore wind turbine off the coast, it is common to use SEP (Self Elevation Platform, or Jack-up-ship), which operates while fixing itself by stretching its legs from its four corners to the bottom of the sea.

O&M, operation & maintenance

The cases of O&M of wind power generation in Japan are categorized into three groups as follows:

- Wind energy firms independently carry out O&M, such as: Eurus Energy Holdings (Eurus Energy Japan), Electric Power Development Co. (J wind service).
- Engineering & Service is consigned to a maintenance firm, such as Hokutaku or Hokkaido Power Engineering.
- O&M is carried out by WTG manufaturers (through a service contract), such as MHI, Hitachi, Nihon Seiko (for JSW), Vestas Wind Technology Japan (for Vestas), Hitachi Power Solutions (for Enercon), General Electric International Inc. (for GE Wind), Meidensha (for Repower), ALSTOM (for Ecotecnia), etc.

Training of O&M technician

Shortage of O&M technicians are predicted because the operator's periodic inspection of turbine becomes mandatory in accordance with the amendment of the Electricity Business Act (as outlined before) and because the number of installations of wind turbine is increasing. Following world-wide trends, it is predicted that cumulative installations of turbines being operated will increase to a little

Decommissioning Units

Source: FTI Intelligence 2015

Country	2015
Japan	11
Denmark	29
Germany	386
Italy	3
Taiwan	2
Finland	6

under 600GW; and, of that old turbines, whose warranty period provided by the original turbine makers has expired, will account for 371GW. This means, that there will be a great demand of O&M. In Europe, a training course has been opened in order to help reduce the shortage of O&M technicians in the future, with governments providing support for universities and colleges. Japan is lacking the same kind of action in order to respond to that need.

Protection against Lightening

It is hard to make an estimate the scale of O&M in Japan due to the small size of growth and scattered infrastructure projects. Similarly, it is hard to demonstrate the extent of the rate of wind turbine damages caused by natural phenomenon, such as lightning, is certainly much higher in contrast to European nations. NEDO reports stated that the mishaps and failures due to lightning strikes significantly affect project feasibility more than other causes. The high capital expense is viewed as one of the main bottlenecks of wind energy use in Japan. It is essential to investigate the issues behind the high cost and determine possible policy solutions to it, as well as business endeavors to diminish it.

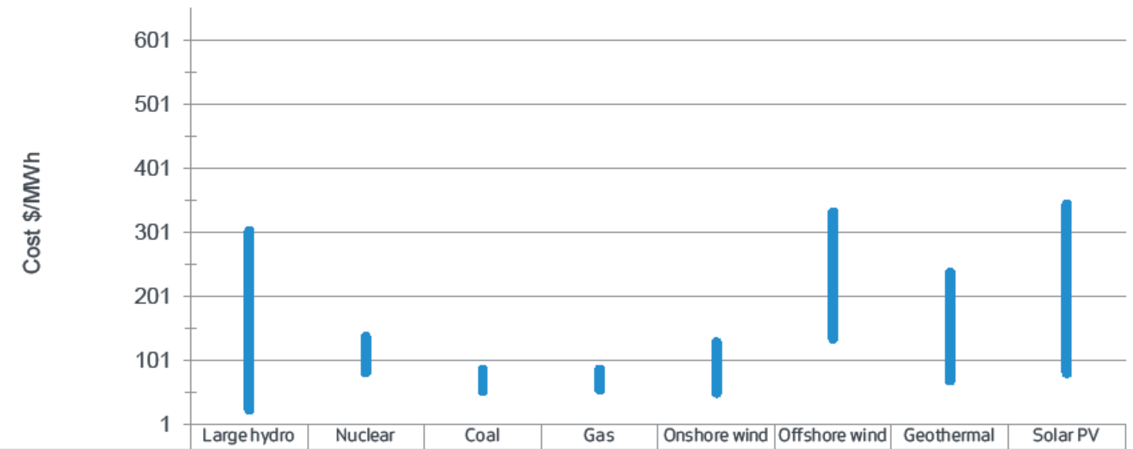
In scenarios like this, European experience, support and service with use of lightning protection technology will be of immense benefit to developers of wind installations in Japan.

Offshore Maintenance

It is very difficult to carry out maintenance operations offshore as offshore wind farms have higher operating costs, which leads to increased development expenses of wind energy. In this regard, offshore wind turbines require unwavering quality, yield and high output per unit. To make this a reality, information on

Cost ranges for selected energy technologies

Source: Bloomberg New Energy Finance 2014



	Large hydro	Nuclear	Coal	Gas	Onshore wind	Offshore wind	Geothermal	Solar PV
Lowest cost ($/MWh)	24	82	53	55	50	135	69	81
Highest cost ($/MWh)	302	137	86	86	128	332	237	344

offshore conditions is essential for maintenance systems. This information is presently being amassed in Japan. The FukushimaFORWARD project is relied upon to gain more information on resources, maintenance needs, port facilities and infrastructural requirements, with grid integration considered a major aspect of the installation of the new floating turbines. After this assignment, the commercialization of this technology is expected to lower energy costs with experience gleaned from the learning curve.

Repowering

A lot of wind turbines are nearing their estimated life span. Replacing old turbines with new ones, normally referred to as "repowering" is a new and fast-growing line of business in Japan. European countries are experienced in repowering, especially nations like Germany with a moderately long history of wind improvement and a stable business sector structure. Reports of the decommissioning of more established turbines are growing in European nations and similar trends will likely materialize in Japan in a few years. This is very likely as a lot of turbines will reach the end of their 20-year lifespan by 2020 even though they enjoy good winds and can perform beyond their due date. According to JWPA, it is critical to advance the removal of old turbines in favor of repowering old installations with new high-tech turbines.

Technology transfer and service by EU companies is likely to increase the advancement of wind power technology in Japan.

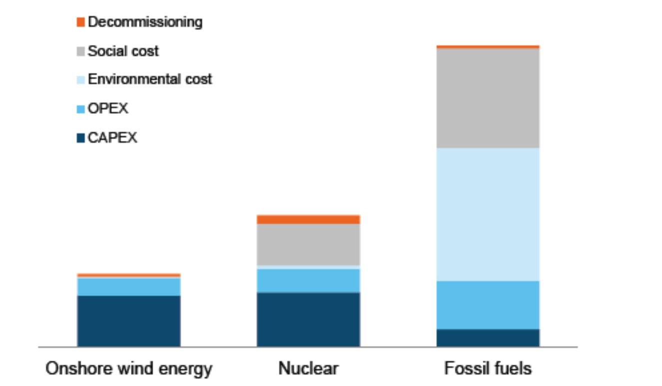
2.5.4 LCOE-Economies and Costs

Most interviewees agreed that reducing the cost of energy is certainly the major issue in Japan. If the wind sector is not able to embrace a learning curve in the future, wind development will be hindered and government's support will remain low.

The principal components of the cost of wind energy include capital investment, operation and maintenance, and finance. Wind projects require a significant capital investment, comprised of a number of other costs beyond the turbines alone. However, approximately 75% of the total investment cost is asso-

Cost of Energy (averages) compared to nuclear and fossil

Wind (onshore) has the lowest external costs of all energy technologies



Source Direct costs compiled from EER 2009 and 2010 and IEA 2010. Indirect costs compiled and/or calculated based on data from EPA 2011, World Bank 2011, and Stern Review 2006. Fossil fuel data based on supercritical coal and CCGT gas technologies. Wind energy data based on onshore wind plants. Nuclear data is pre-Fukushima, based on new-build using generation III technology.

ciated with the cost of the wind turbine. Other costs include grid connection, foundations, installation, and construction-related expenses. Decommissioning costs are set aside at the initiation of a project and these are included in the initial capital investment because they are required by some countries.

Outlook for LCOE reduction in Japan:

LCOE range and wind tariffs: Japan's LCOE range and wind tariff are relatively higher than those of the top-ranked wind power nations. Japan retained its wind FIT of $192/MWh from a year ago. India and China have a comparable wind power tariffs at $82/MWh, which are just a bit over the project`s costs. Vietnam has stopped its intended public wind usage FIT policy of $78/MWh since 2013. There are reports that the construction of a wind project with a FIT of $98/MWh is underway and is scheduled to be implemented in 2017. This is 25% higher than the original FIT; it is still much lower than the country`s average wind LCOE.

LCOE reduction

A Cost Examination Committee was set up by the National Policy Unit in December 2011. The Cabinet Office subsequently distributed a report regarding Levelized Cost of Energy (LCOE) from different energy sources in Japan. The motive behind the report was to determine the actual LCOE of nuclear and other sources of power in the country. The examination was finished by assuming a run of the mill model plant in 2010 and 2030 and utilizing data acquired from financial insurances. The report says that wind LCOE is anticipated to be competitive in 2030 and to go below the threshold of coal, LNG and nuclear energy if large production occurs in the local market courtesy of impetus from government policies, deregulation and grid connection.

Accordingly, capital expense of inland wind farms in Japan is around ¥300,000/kW. This figure was passed on to the Procurement Price Calculation Committee of FIT in 2012 and 2013 and was instrumental in the FIT framework of the following year. From this information, an average 58% of the aggregate capital expense is spent on wind turbine, yet the report expresses that capital cost diminished with the installation of turbines. Japan's capital expense (¥300,000/kW) in in contrast with the figures of different nations released by the IEA Wind and the IRENA which showed that the cost of wind projects in Japan has doubled from what it was in 2010.

The JWPA expects that the expense can diminish after 2020 to ¥8-9/kWh by large-scale manufacturing and the use of new technology. Until 2020 JWPA expects that the expense will decrease slightly but that construction costs may not in the mid-term due to the development fervor of the Tokyo 2020 Olympics.

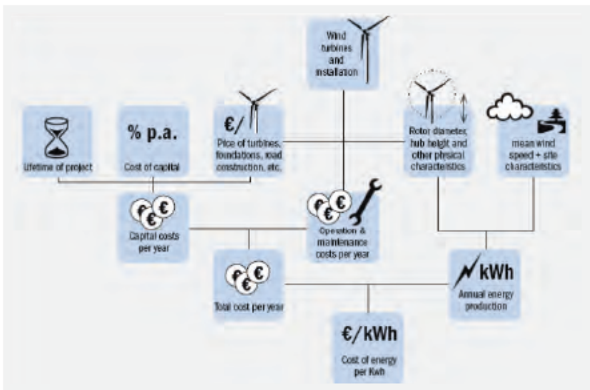
- Low volumes of purchase orders because of the scattered and minute nature of domestic markets in Japan which decreases scaling value of extensive volume orders found in Europe and other continents;
- Small individual project sizes and scattered siting of those installations across mountainous terrain increases installation and transportation costs and, in addition, makes it hard to create and enjoy economies of scale;
- A vast majority of wind turbines are foreign-made, which adds transportation charges to wind turbine costs;
- Japanese infrastructure development cost, in general, is more than that of other developed nations; and
- The past utilization of the strict Building Codes (due to uniform application of seismic measures to high rise buildings higher than 60m) and Technical Codes on wind turbines adds expenses to engineering, turbines, and installation, notwithstanding IEC 61400-1, which is in operation in Europe and other continents.

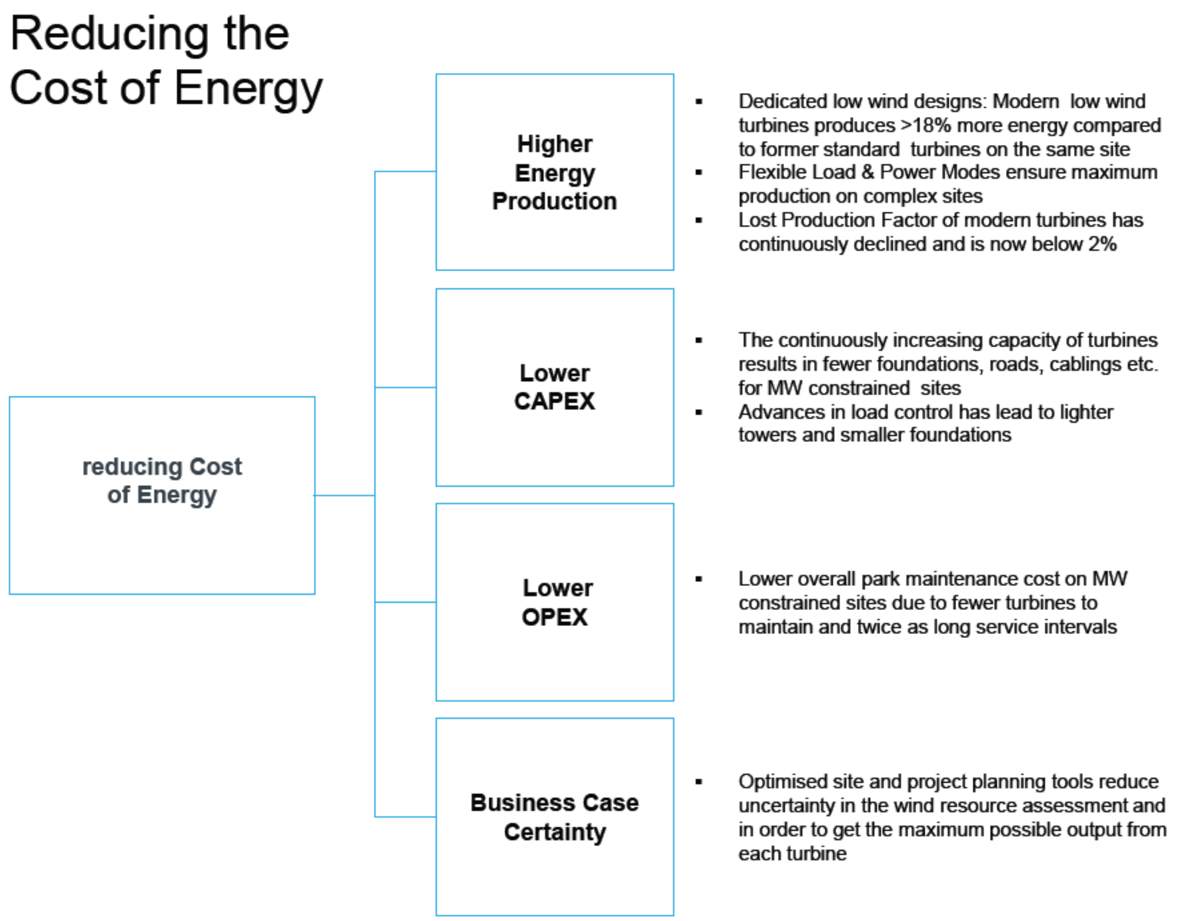
Analysts have critizised that it is hard to demonstrate the points raised by the JWPA, due to a lack of data for cost analysis. This has been compounded by the increased rate of private small-scale projects in Japan (in contrast to other countries) that will likely make the realization of economies of scale very difficult in Japan. There is no genuine information to carry out an O&M cost comparison with that of other nations. As a result, the JWPA assumed that the Japanese O&M costs surpass that of other nations in light of the fact that:

- Private equity and multilateral loan investments in Japan are usually not adequate
- Although, multilateral loans and private equity investments have been increasing, less-developed project loans (e.g. offshore wind) still need government support. During the post-Fukushima era, the shock caused by the loss of the base load from nuclear energy generation which led to power cost inflation emphasized the significance of LNG generation.
- The supply network bureaucracies and expensive permit issuance process have increased the CAPEX for onshore wind and also for PV. Liberal FITs, which partially reflect high CAPEX, needs to descend as costs fall. Gigantic utilities permitted waiving 80% of FIT additional charge; while an admonition may temper FIT benefit.

Cost of Energy components

Source: EWEA report 2009





Cost structure of wind turbines in Japan

The current large-scale wind turbine is based on the mass production processes of products like automobiles. Wind turbine manufacturers buy components from part manufacturers, assemble and adjust the product before shipping it. Among the components, the tower, the rotor blades and the gearbox account for the largest proportion of the cost at 60% of the total cost. An increase in installation area is due to the size of recent wind turbines because there is a tendency that as the size of the entire wind turbine increase in proportion to one half square of the wind receiving area, the volume related to the amount of steel usage for a wind turbine increases in proportion to the 3/2 power of the wind receiving capacity of the area.

Despite innovation the amount of material per rated output (t / MW) and kW unit price (\ / kW) also tends to increase. In regard to offshore wind turbines, the ratio of the basic structure which corresponds to the tower of the anchor increases. In foreign countries, there is a trend to produce the tower and the rotor blade in their own country, along with national and local government-arrange support systems ("local content"). Some industry associations in Japan promote that idea as an important step to developing the wind power industry domestically.

Different to onshore wind projects, offshore projects vary in cost because foundation structure, transportation distance and installation method differ depending on the installed sea area. Onshore projects also vary in cost depending on the installation site and scale. For onshore, the turbine accounts for 70% of the cost, but for offshore WP farms, the ratio of Balance of System such as fundamental and processing, electric facility is high, and it is the feature that it has a large economic ripple effect through related industries such as ocean engineering construction. In addition, offshore WP farms have to include the cost of a surety bond and insurance.

Economic ripple effect by the improvement of WPG related equipment industry

Ripple effects are not only expected in regard to the component industry but also material processing industry and TIER3 industry. JWPA estimates that if the industry achieves the wind target as defined in its JWPA Vision (cf. chapter forecast), the employment creation effect would be 74,000 in 2020, 197,000 in 2030, and 290,000 in 2050 based on an Input-Output calculation. Furthermore, some researchers recognize these economic ripple effects as the creation of a new industry in Japan or countermeasure to a hollowing-out of the domestic industry.

In order to realize this economic ripple effect, creation of new industry and suppression of the hollowing-out of the domestic industry, stable development of this industry and the setting of more ambitious goals are important. The installation amount of domestic WP facilities in Japan by year has increased (MW base) in recent years. After 2011, the domestic product ratio has been over 50%, (91% in 2013, 69% in 2014). This increase of installation of domestic WP facilities in Japan is expected to contribute to development of domestic WPG related equipment industry.

Improvement of trade balance

Power supply configuration in Japan has been changing drastically due to the East Japan Great Earthquake and accident at Fukushima Daiichi Nuclear Power Plant. Comparing power supply configuration in 2010 and 2014, thermal power increased from 61.8% to 87.8% (increase by 26.0%). The export cost of oil product, LNG and coal has increased by ¥2.4 trillion in 5 years.

Since 2011, trade balance in Japan has been in the red. 2014 saw a deficit of ¥12.8 trillion, which was the largest in the history. It is said that one of the main reasons for the rapid deterioration of the trade balance in 2011 to 2014 was an increase in fuel imports and fuel prices. It is expected that the trade balance of 2015 would be still in the red, but will have decreased to ¥2.8 trillion. This is believed to be due to the decrease in thermal power generation because of the increase of renewable energy and reoperation of nuclear power plants, as well as the weak yen and drop of resource prices.

Unlike fossil fuel, almost all of which Japan depends on import for, renewable energy including wind power is "pure domestic" energy. Japan's WTG industry promotes the idea, that the procurement from domestic WPG related industry will not deteriorate the trade balance. European companies should be aware of that potential preference.

The WP generation related equipment industry varies according to the competitiveness of each system or component and in the relationship of the upstream and downstream supply chain. In Japan, Japanese WP generator makers (MHI, Hitachi, Nihon Seiko, and etc.) are increasing their share in Japan. On the other hand, Japanese makers of bearings for WP generators and yaw/pitch driving systems ship most of their product to overseas.

In the field of WPG related equipment industry, market size and competitiveness are different among categories. They reflect the market trends in Japan and the world, so the content and the extent of support need to be considered by each category. The following is a look at the industrial cross-cutting challenge and a proposal in expansion of WP generation related equipment industry.

The most important challenge of expansion of the WPG industry in Japan is improving competitiveness. Previously, wind turbine body or component makers in Germany, US, Denmark, Spain, China, India, and so on, have been growing to be global companies by expanding abroad, after suceeding in a domestic market created by clear installation goals and political incentives, accumulating experience and achievement, and achieving cost reduction and quality. In addition, European companies, particularly, intend to enforce further international competitiveness through rationalization of product development and industrial agglomerations by utilizing public facilities (research institute and test site) with the support of governments and through reorganization and M&A activities of the manufacturers. It is important to refer to this as common successful cases or strategies for growing to global companies. In Japan, actors believe in the need for a strategy to compete with such markets. It is believed to be important to promote action as an all-Japan system, where government and private sectors cooperate to enable domestic companies to develop by making use of superior manufacturing technologies and industry improvement support from the government.

The industrial cross-cutting goal in Japan is to expand and develop the domestic wind sector continuously to achieve relevant world market share by expanding abroad. In order to achieve that goal, the industry is pushing for mid-term and long-term installation goals as a priority, and then for developing a market environment (infrastructure, optimizing regulation) to operate FIT properly. The cases in Germany and Spain, where FIT promotes installation of renewable energy and reduces generation costs, are seen as suitable references. According to this approach, the industry expects an increase of domestic employment, and effects from economies of scale, so that wind energy costs can be reduced and trade profit can be increased. It is desired to evaluate these comprehensively and achieve them systematically.

LCOE related to live-time extension

In European countries the concept of live-time extension of wind turbines is not only a theoretical concept but already part of certification bodies (such as the Deutsche WindGuard and others), but manufacturers in Japan have not embraced it yet.

What does the concept of live time extension of wind turbines mean? Usually, regulations and certification requirements state, that the design life of the wind turbine is accepted with at least 20 years. And as a rule, onshore wind turbines have been sized for an operating time of exactly 20 years because every design life greater than 20 years would theoretically lead to increased manufacturing costs and thus higher prices. However, the design lifetime is a theoretical assumption and is also referred to as the "scheduled service life". For this period, performance and serviceability evidence are used. After that time, there is an economic and ecological interest to continue turbine operation instead of discontinuing (e.g. scrapping) it after reaching the planned life time. With improvements in efficiency, process control and continuous optimization strategies in manufacturing, the quality of turbines had increased considerably in recent years. As a result, aspects of certification and support schemes regarding turbine live-time extension are being discussed, especially in Europe where new regulations have been released. These regulations vary depending on the country and its indicative trajectory of wind energy.

2.5.5 Offshore wind

While onshore wind projects have attempted to extend the energy market, Japan has set its sights on offshore advancement so as to use the asset potential, which represents more than 80% of the nation's wind assets. For over five years, Japan remained the pioneer of utility-scale floating offshore wind platforms. As one of the world's biggest economy, it has the industrial and innovative muscle to drive fast improvement and development. The experience of the 2011 Fukushima debacle has reiterated the nation's yearning for safe energy which appears to be significantly self-evident.

Before the end of 2015, Japan had 52.6MW of offshore wind installed, including two 2MW floating turbines. One Siemens semi-offshore 3MW wind turbine at Eurus Akita port has been included while 915MW is in Japan's offshore project plans until 2019. Japanese government set the FIT at ¥36 per kWh for offshore wind in March 2016. This is 1.6 times higher than the onshore tariff of ¥22kWh and contrasts with world market that grows at an average annual rate of 8.7% from 2015-2019.

27 offshore wind turbines with 52.6MW are in operation (including five semi-offshore sites 44.2MW, 23 units and two floating type sites with 4MW, 2 units) now in Japan. A lot of offshore wind power development plans have been drafted mainly around Japan`s harbor areas: 800MV is planned in harbor areas and 592MW in general sea areas. In the demonstration test of floating offshore wind power generation in Fukushima, a 7MV wind turbine started operation in 2015 and a 5MV turbine started in 2016. In terms of private projects, a plan of Kashima harbor by Komatsuzaki urban development group and SB energy the 1st period construction (20 5MV turbines, 100MW) started in 2016 (ground construction) and will begin operation in the second half of 2017. Among the items under plan, only 4 (Fukushima, Yasuoka in Yamaguchi prefecture, Murakami in Niigata prefecture, and Oki in Kitakyushu city) are located in general common sea areas and the rest are all planned in port areas. This is because the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) specifies the areas as "areas for utilizing renewable energy resource" in its port plan and because Fishery Rights have often expired. The draft amendment of the Port and Harbor Law, which the Cabinet determined in 2016, describes procedures for the installation of facilities like offshore wind power generation which occupy water area within a Port Area for a long period of time. Because of this, offshore wind power generation facilities are expected to be installed without issue in Port Areas from now on.

Mitsubishi Heavy Industries developed the 7MV wind turbine for Fukushima, Hitachi 5MV turbine for several plans, and Toshiba/UNISON 2.5MV offshore wind turbines.

However, advancement for offshore has been moderate, with Japan's administration seeming to be more interested in getting its nuclear energy back on its feet to supplant its reliance on fossil fuels importation, instead of turning to wind for solutions.

At inception, the idea of developing offshore wind projects in Japan was strongly rebuked for the following reasons:

- Initially, 80% of Japan's offshore assets are in water deeper than 100 meters, much more than the seafloor baseline that holds in place the offshore projects on northern Europe's continental.

- Secondly, the atmosphere and its antecedent conditions - tropical storms and tidal waves - present considerable difficulties to the installation and maintenance of wind turbines.
- Thirdly, Japan's powerful sea logistics and fishing industries have unequivocally stood against sharing open water space with wind power engineers.

Nevertheless, the Fukushima disaster gave impetus to reforms in Japan's outlook to wind power. By November 2011 METI confirmed that a financial plan of ¥40.5 billion was available, and that a consortium of some of the nation's greatest industrial and financial firms - as well as scholars - had been tasked with the development of the floating wind farm in the Fukushima prefecture. The main task was to resuscitate the intensely hit Fukushima district and transform it into an exploratory field for green innovation. FukushimaFORWARD installed the last floating turbine in August 2016 with operation expected to begin in Q3 of 2016 (as noted in the case study in chapter 5). But, the floating wind projects are excessively costly for business application, although this is expected to change with the experience gained from the Fukushima project.

Other three shoreline projects listed below are presently commercialized:

- Sakata Offshore project in Yamagata Prefecture (launched in January 2004, 10MW),
- Setana Offshore Project in Hokkaido (launched in April 2004, 1.2MW);
- and Kashima Offshore project in Ibaragi prefecture (launched in June 2010, 30MW).

Also, the four offshore observatory installations listed below being are constructed with support from MEITI, NEDO, and MOE:

- The duo of Choshi Seabed Foundation Offshore Demonstration installations in Chiba Prefecture and Kitakyushu Seabed Foundation Demonstration in Fukuoka Prefecture by the NEDO began their studies in 2012 with one 2MW turbine and an observation tower for every project. The METI and NEDO spent about ¥5.2 billion in FY2012 and another ¥3 billion in FY2013 on both projects.
- A similar project off the shoreline of Goshima Island in Nagasaki Prefecture is being supported by MOE. The reason for this project is to test the country's first offshore grid network: the initial 100kW turbine was set up in June 2012 and another 2MW turbine began operation in 2013. The MOE spending plans for this project stood at ¥3 billion in FY2012 and ¥1.6 billion for FY2013.
- Additionally, there are plans to build 1,407MW of offshore wind projects while 12MW of floating offshore turbines are scheduled to begin operation in 2016. Other similar projects are expected to kick-off in a few years with Kashima port project 1 stage 1 likely to start first.

NEDO has distributed a mock document or demo for mapping offshore areas. Opinions and solicitations collected in May 2016 identified that a demo rendition had been enlisted which should see the final form of the offshore wind guide being released at the end of 2016. According to NEDO, the guide will give information on water profundities, wind and seabed conditions, nearness to ports and also on social and ecological effects of the proposed projects.

Production and manufacturing aspects of offshore wind

Type and structure of offshore wind turbine: Offshore wind turbines are roughly categorized into "bottom-mounted type", installing foundation directly to seabed, or "floating type", fixing a floating structure using a mooring. The depth of both types varies according to the type of floating structure. It is generally said that the floating type is appropriate for depths of 50~60m. One of the reasons is that in depths over 50m the cost of constructing the bottom-mounted type becomes high so the floating type is advantageous. Potential calculation of offshore wind power generation by METI draws a line at 50m between bottom-mounted type and floating type. While in Europe, where the bottom-mounted type has prevailed, the floating type is under consideration for the future. In Japan and the US, where the depth increases as it goes further from the coast, development of the floating type is expected as well as bottom-mounted type. The structure of an offshore wind power turbine requires support structures that enable a stable power generation even in adverse weather conditions such as strong waves, wind/typhoons, rain and lightning strikes. In addition, it is necessary to consider additional conditions particular to offshore wind power generation, such as environmental control and salt tolerance so that the turbine functions even under the environmental conditions particular to offshore where humidity and salinity are high. Additionally, greater reliability is required because it is difficult to access to the installed site and structure.

In the following, the features of the structure of the bottom-mounted type and the floating type are described respectively:

Bottom-mounted type offshore wind turbine

The three basic forms are mono pile, gravity type and jacket. Other structure types are hybrid combinations of these three types. The application depth of the basic mono-pile and gravity type is less than 30m, while the basic jacket type and developed tri-pile tri-pod type will be installed in less than 60m. The mono-pile type has a simple structure and is straight-forward in design and construction, but cannot be used for large-scale wind turbines or deep depths. While it doesn't need submarine construction and its cost is cheap, it requires a large-scale hydraulic hammer to place piles with large diameters and requires large working ships/vessels. In Japan, Kamisu's offshore wind turbine in Ibaraki adopted a mono-pile support structure, but was constructed with an onshore crane. As for the gravity type, the structure is suitable for places where submarine ground is relatively good (i.e. it's not suitable for soft grounds) and requires detailed seabed investigation and the manufacturing of a mound in order to confirm the flatness of the seabed. Besides, it requires an onshore yard manufacturing and a large transport ship for installation. Jacket type is more rigid than a mono-pile. Its structure is supported by a steel tube pipe so it can be sited in lower depths (away from impact from waves' outer power) and soft ground. It is adopted in oil and gas platforms, but the structure is complex and requires specific techniques.

The bottom-mounted type began in Europe, mainly in Northern Europe after 2000. The first generation (2000~2003) is what converted 1MW class onshore wind turbine into offshore ones. The inside nacelle is reinforced as a salt damage countermeasure. The second generation (2005~) is 2.5~3.5MW. It was intended to improve reliability of components and devices so the encapsulation of the nacelle was promoted as a way of managing the environment inside the nacelle. The third generation (2008~) is 4.5~5.0MW. The wind turbine is exclusively processed for offshore and sees the entire encapsulation of the whole nacelle as well as a reduction in the number of components.

Floating type offshore wind

This type of supporting floating structure is designed for floating type offshore wind farms and is categorized by way of generating restoring force. It is

Offshore-wind demand forecast Japan compared with world markets, 2016-2020 (in MW)

Source: FIT Intelligence, BNEF 2016

Country	2016	2017	2018	2019	2020	2021	CAGR
Japan	12	20	16	100	196	352	
EMEA	1,133	3,649	3,652	3,444	4,363	27,063	23%
APAC (incl. JP)	634	915	1,964	3,032	5,724	13,641	72%
AMER	30	0	12	24	100	166	53%
Global	1,797	5,464	5,628	6,500	10,187	40,369	32%

Offshore wind's share of the annual market for global wind power is expected to rise from 6.9% in 2015 to 10.7% in 2019:

- Europe, led by the UK and Germany, will continue to install most offshore wind capacity in the five years to the end of 2019, representing 49.94 % of global offshore wind installations. The five top European markets for offshore wind in the 2015-2019 period will be the UK, Germany, the Netherlands, Denmark and Belgium.
- Asia Pacific, under the dominant leadership of China, is expected to close the gap on Europe. The region will account for 43.85 % of the world's total new offshore wind installations during the forecast period. Chinese offshore wind is expected to take off from 2015 and both Japan and South Korea are forecast to install offshore wind plant during 2015-2019.
- In North America, both Canada and the US are exploring offshore wind opportunities with the US closest to the first installation of a full scale wind turbine, which may occur with the Block Island project during 2015-2019.

roughly categorized into three types: the type which secures stability by putting meta centre at high position, the type which secures stability by descending a centre of gravity and the tension mooring type which connects foundation and floating body with a tendon in the seabed and restricts floating body motion (TLP type). The typical example of the type which secures restorability by descending a centre of gravity is a spur floating body that is long in vertical direction. On the other hand, the typical example of the type which secures restorability by raising meta centre is a semisubmersible floating body.

Floating type offshore projects have the floating structure relatively higher compared to that of the floating body type used for oil/natural gas development, so it receives a huge falling moment from the wind turbine mounted at the top. Therefore, the compound response of the wind turbine and floating body is essentially significant when the turbine is operating. On the other hand, the load that the wind turbine generates is highly dependent on the pitch control of the wing, but it is challenge to analyze the compound behaviour, because the control method is related to the power generation performance of wind turbine and its detail is not released. Under these circumstances, the design of the floating type offshore wind power farm nowadays adopts the design policy of installing a floating body to a wind turbine developed for onshore use. Therefore, the maximum steep is required to be less than 10 degrees so that it doesn't affect the power generation function of the wind turbine and accelerator in nacelle below 2.0MW. As mentioned above, for the design of the floating type, a dynamic motion analysis method of the wind turbine and floating body is of importance. Besides, a design is needed that takes into consideration phenomena such as negative damping (or Jairo effect by wind turbines) and VIM (vortex induced motion effect). After all, optimizing design is necessary in trade-off between the challenge of how to suppress the motion of floating body but still allow some motion.

The year 2013 was an epoch year for offshore wind in Japan, as empirical experiment began of both of bottom-mounted and floating types:

Bottom-mounted type offshore wind: Offshore projects using the bottom-mounted type have begun commercial operation in three locations in Japan. All of them are the bottom-mounted type installed in shallow areas close to the land. Empirical experiments were launched in 2013 at locations off Choshi in Chiba and off Kitakyusyu in Fukuoka. These experiments are aimed at establishing the technology that is important in introducing offshore wind power generation to Japan, such as operation and maintenance technology indispensable for reliability of wind turbines and continuous generation. In addition, quantitative evaluation of the characteristics of offshore becomes possible by establishing an offshore wind state observing tower (first in Japan) nearby and by installing them in both the Pacific and Japanese oceans. It also enables us to evaluate the wind load that affects the wind turbine or to inspect the wind state prospect methods. These results are expected to be utilized for power generation amount prospect of offshore wind turbine.

Floating type offshore wind: There are four empirical experiments of the floating type offshore wind farm and three of these have begun. MOE selected off Kabashima in Goto city, Nagasaki, where they were able to acquire agreement of local fisheries cooperative association and residents. MOE collects data on environmental affects and safety, evaluates business potential while operating and plans to commercialize in around 2016. METI launched "Fukushima restoration floating type offshore wind farm empirical experiment project" because they wanted to accelerate restoration of Fukushima after the East Japan Great Earthquake and because the topology of the seabed and wind conditions in Fukushima are suitable for an offshore wind farm. Its main purpose is to investigate the business potential of floating type offshore wind farms. In addition, the project establishes the world's first floating type offshore observation system and thus establishes observation methods of weather and sea conditions (key for monitoring the motion of the floating body type) and, at the same time, make it possible to evaluate performance of floating type offshore wind farms. Furthermore, it reveals the characteristics and effects of each kind of floating type by using several types of wind turbines and floating bodies. And, they are developing high performance steel materials and construction technologies. However, what is more important is whether it can achieve social agreement and whether it can coexist with fisheries, particularly in terms of noise, landscape, radio wave interference etc. At this moment, fisheries have agreed to testing operation and make use of the monitoring equipment installed at the offshore premises for fishing purposes.

Challenges

The challenges involved in offshore wind power development may be divided into three key categories. The first is that of cost. Because offshore wind turbines are installed within ocean environments, the cost is said to run roughly twice that of onshore facilities. This includes the wind turbines themselves, the foundations (bases submerged in the water), submarine cable installation work and other project aspects. In addition, the operation and maintenance (O&M; referring to parts replacement and other upkeep) work also differs from onshore wind turbines

Overview on Offshore projects in Japan

Source: JWPA 2016, NEDO 2016

Type	Location		Distance (km)	Depth (m)	Rated (MW)	No. WTG	Total (MW)	Start operation
Fixed	Hokkaido	Setana Port	0.7	13	0.6	2	1.2	12/2003
	Akida	Akita Port	0.1	-	3.0	1	3.0	2/2015
	Yamagata	Sakata Port	0.05	4	2.0	5	10.0	1/2004
	Ibaragi	Kamisu Kamisu	0.04 ~0.05	4 4	2.0 2.0	7 8	14.0 16.0	2/2010 2/2013
	Chiba	**Choshi**	3.1	12	2.4	1	2.4	3/2013
	Fukuoka	**KitaKyusyu**	1.4	14	2.0	1	2.0	6/2013
Floating	**Nagasaki**	**Kabashima**	1.0	100	2.0	1	2.0	10/2013
	Fukushima	**Iwaki city**	20	120	2.0	1	2.0	12/2013 12/2013
		Naraha			7.0 5.0	1 1	12.0	2016 2016
					Total	27	52.6	

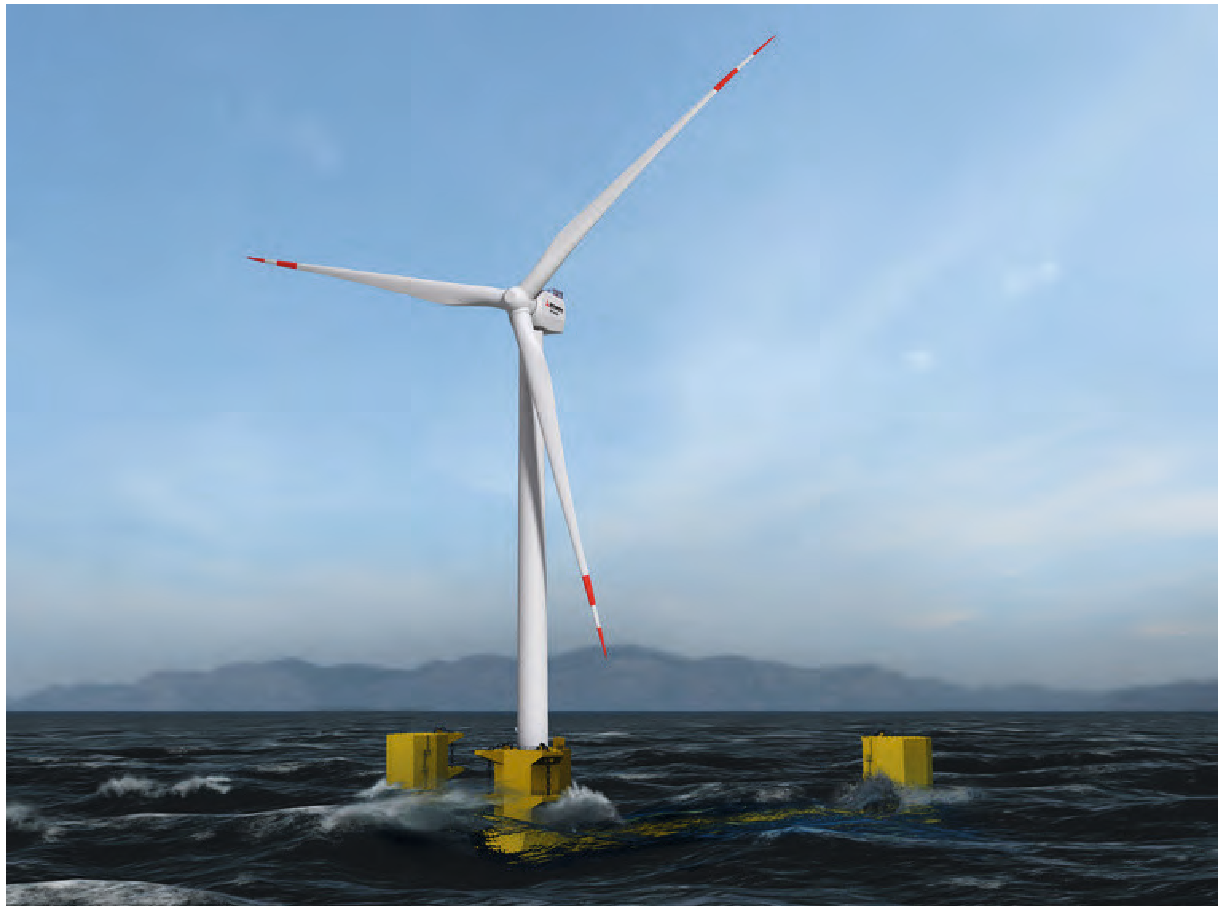
insofar as the demand for heavy expenditures. Costs, likewise, vary by distances from the shore, water depth and other elements. Because offshore wind farms in Europe are steadily moving further away from continental areas and into deeper waters, installation costs are also on the rise. The second challenge category is technology. With early offshore wind turbines suffering frequent breakdowns in their step-up gears and generators, development of technology was required in order to improve reliability involving salt damage and improve monitoring of wind turbine conditions. In addition, when moving installation locations from shallow to deeper waters, there is a need to increase the per-turbine power generation in order to lower cost. This makes increased size and improved reliability a major theme in developing the technology for offshore wind turbines. The third challenge concerns social acceptance. Clearly, offshore wind power generation will never be realized without the understanding of fisheries operators and other marine users. Several projects in Japan have been pushed back due to delays completing and verifying environmental impact assessment (EIA). Maeda Corp. suffered a further delay to their EIA for the 60MW Shimonoseki project due to public opposition to the project – the opposition group apparently stole EIA equipment and are being sued by Maeda Corp.

To earn the support of fisheries and citizens, environmental assessments are a must. In Japan, there are aspects of the natural and social environments (and other conditions surrounding offshore wind power development) that differ widely from those in Europe. Consequently, it will be essential to utilize the proving research currently being advanced to establish low cost offshore wind power generation technologies compatible with the conditions in Japan.

Local turbine makers such as MHI, Hitachi and JSW offer offshore wind turbines in Japan, but face challenges in sourcing plant components locally. This provides good opportunities for European suppliers to access their supply chain with competitive prices.

A lack of "jack-up" ships for turbine installation work is a big problem for Japan currently. And, a lack of consistent policy and regulations for offshore wind development have been also big hurdles. But, recently, a new regulation was approved: On May 13th, the 190th Diet session approved the modified port and harbor law , which is relevant for offshore wind applications in Japan. Following the Cabinet`s approval on February 5th this year, the modification settles the offshore bidding system and sets the permission duration for sea area use to 20 years.

Further, regulations now state that the General Common sea area (GC) is controlled by the respective port authority that is in charge to issue the private use permit. Prior to this, there was no law or regulation that cleared permission authorities for undesignated areas, creating a business risk for projects planned under the GC. The categorization of marine areas in Japan has been either a port associated sea area or a general common sea area. The former was controlled by port authorities, therefore the entity from which official permissions for offshore had to be requested was clear. For the latter area, no law or regulation had been in place until now. The modified regulation is bundled with another issue that promotes cruise passenger facilities (tourism) in public-private partnerships with the port administration.



Kitakyusyu City authorities will be the first that intends to carry out the bidding of offshore wind power development after August following this new law. It is expected that this will ease the development of a wind offshore project near Kitakyusyu to generate approximately 300MW. In total, around 600MW of projects located mainly in the GC in Fukuoka, Niigata and Yamaguchi prefecture are affected by the new regulation.

As for national projects, MOE is conducting a Floating Offshore Wind Turbine Demonstration Project (GOTO FOWT) at Kabashima in the Goto-islands in Nagasaki prefecture. A Hitachi 2MW downwind rotor wind turbine on the spar type floater has operated since October 2013. The electricity produced by this wind turbine was used for producing hydrogen in 2015. This hydrogen was used for fuel for the maintenance boat. The turbine is to move from Kabashima to Fukue Island because there is a greater population and greater demand for electricity.

As for METI`s Fukushima Forward project a more in-depth analysis will be given to the respective case study in chapter 5.

NEDO started a feasibility study for new advanced floating offshore wind power demonstration project in 2015. Two groups are nominated as candidates. Each group will try to develop two floating offshore turbines creating 7.5MW in total and intends to achieve a cost reduction compared with former projects.

In another NEDO R&D project for offshore wind, an offshore wind turbine and an offshore measurement platform were planned to be installed at two offshore sites, Choshi in Chiba Prefecture and Kitakyusyu in Fukuoka Prefecture. The main purpose of this offshore R&D project is to demonstrate the reliability against Japan's severe external offshore conditions such typhoons. In the Choshi offshore site, the installation of a MHI 2.4-MW wind turbine with gravity foundation and offshore platform were completed in the Pacific Ocean 3 km offshore of Choshi in October 2012. In the Kitakyusyu site, an offshore measurement platform was installed 1.4 km offshore in June 2012. A JSW 2-MW gearless offshore wind turbine was installed in 2013 in the Kitakyusyu offshore site. A distinctive feature of the Kitakyushu offshore project was the adoption of the "hybrid gravity type" as a substructure for both the offshore platform and the offshore wind turbine. R&D of very large offshore wind turbine generation system technology has also been supported in this NEDO offshore project. An innovative hydro-drive train and 80m class long rotor blade for very large offshore wind turbines was developed in this project.

Offshore Outlook

Looking to the future, estimates are that there will be a decrease in inappropriate onshore areas for wind power generation because of wind conditions, land usage limitations and other unforeseen circumstances. Keeping in mind the goal to grow the execution of wind power projects regardless of these conditions, the need exists to progressively increase offshore wind power advancement. In this manner, offshore locations are accepted to offer enormous potential for the wind power industry.

2.5.6 Social acceptance

Social acknowledgment of wind projects is a genuine bottleneck in Japan. Specifically, elimination of issues such as noise pollution, undesirable installations within national parks, reserves and conservation zones as well as scenery obstructions are viewed as most imperative to creating and improving relationships between host communities and stakeholders. During the late 1990s, these issues were uncommon because the population regarded wind power as naturally inviting. The situation become complicated because some private wind engineers and districts constructed wind projects without appropriate consideration of the issues above and this increased resistance towards such projects at the start of the millennium.

Links between anti-nuclear agitations and wind power reception

A former TV-writer, Satoshi Mitazono, an antinuclear campaigner, was chosen by the electorates as the new Governor of the Kagoshima prefecture (Kyushu) in July 2011. He guaranteed to suspend operations at the two reactor sites of the Sendai atomic plant, situated in the southern prefecture – the area which experienced more than 1000 seismic earthquakes in April, including the dangerous Kumamoto 7.0 magnitude. The two reactors in Sendai, operated by Kyushu Electric Power Co., are presently the only plants that have been reactivated in Japan after the Fukushima disaster. If the operation of the plants are halted as the Governor planned this year, Kyushu Electric will lose JPY 18bn in revenues (ca. EUR 152m, around 33% of their profit) according to a Mizuho Securities Co.`s report.

The nuclear plant that is planned to be restarted in the Q3 2016 is the Shikoku Electric Power Co's plant in Ikata, in the southern Ehime prefecture. The government`s plan is to resuscitate no less than 32 of Japan's 54 reactors in order to achieve the 20% target it set for nuclear power generation by 2030. 16 reactors, including the six faulty reactors of the Fukushima Daiichi, may be written off completely. In any case, industry insiders expect that only 20 of the 32 plants which are in good condition will go online for safety reasons, and reviving them will lead to resistance at a community level.

Satoshi Mitazono's triumph has been seen as a proof for the eminence of the antinuclear sentiment of the nation. After the 2011 triple emergencies at the Fukushima Daiichi atomic plant, Japanese citizens remain distrustful of safety reports of atomic power plants and its environment as they started screening food and water for radioactive contamination. Local communities who are hosts to the plants are resisting arrangements to restart reactors. In March 2016, a magistrate court in Fukui prefecture issued an injunction halting the operations of two reactors at Kansai Electric Power Co's. Takahama atomic plant (near Tokyo) a few months after their relaunch. The court said Kansai Electric had failed to prove to the public that the reactors were safe, regardless of having passed rigorous safety regulations in place after the Fukushima misfortune. Additionally, the natives in Kagoshima attempted to utilize the judicial framework to halt relaunch plans of the Sendai plant. However, the appeal to stop the restart of the two plants was dismissed by the court on April 6.

Nonetheless, plans to replace nuclear power with renewable forms of energy have become a challenge for Japan on account of severe opposition by the EPCOs and lack of political will. To balance the deficiency after Fukushima, oil and gas generated almost 90 percent of the country's power (Japan is one of the major buyers of LNG gas in the world), with hydropower accounting for around 8 percent and other renewable sources (for example, solar, wind, geothermal and biogas), making up the rest of the equation. An open survey in 2011 asked the question "Can wind and solar replace nuclear power plants in the future?". The answer was a positive response of YES from 64% of respondents. This was followed by another inquiry assessing interest "even if electricity prices go up?", 65% reacted in the affirmative. Since then, the imperviousness to atomic power and backing for renewable sources has increased in Japan.

Wind power can benefit from the current sentiment about nuclear energy. However, political will is still required to ease the execution of wind energy projects. According to the Environmental Impact Assessment (EIA), a project requires the assent of residents before making an application for approval, yet apprehensions on "noise pollution" and "low-frequency vibrations" remain obstacles to a smooth approval process. As there is no proven approach to reaching an understanding with residents, project developers will have to rely on experience.

Apart from ISHO hostilities to wind development, there exist other anti-wind social groups in Japan which can be isolated into five classes namely bird enthusiasts, landscape darlings, noise and infra-sound concerns and economist/grid operators/nuclear energy advocates.

Landscape protection

The Shin Izumo wind farm program was compelled to restructure WTGs in 2006 because of agitations from activists that were worried about the scenery appeal of the area. Before that, 58 individuals tendered their signatures on a petition to review and restructure the program to stop further destruction of the landscape.

Noise and Infra-sound concerns

Mr. Shiomi, a neighborhood doctor living in Wakayama prefecture, has asserted from the 1970s, that "infra-sound is harmful to human health". Before then, he had been promoting EcoCute - an energy efficient electric heat pump, water heating and supply framework which produces and saves high temp water using inexpensive evening time power for homes. He has however shifted his focus to wind turbines with appeals to the media about his theory

Economist, Grid operators, nuclear advocates

Some Japanese economists are against the increased cost of energy. They contend that it is more favorable to use nuclear energy and natural gas over solar or wind as it is much less expensive.

Electricity grid operators, on the other hand, condemn wind power as a result of its unstable power generation capabilities. Meanwhile, others are of the opinion that renewable forms of energy are obstructions to nuclear energy resuscitation and promotion.

The last group is the most radical, while ISHO remains the most dynamic.

Key Points:

Local perceptions to the substitution of nuclear power with renewable sources of power, with particular reference to wind power.

Interestingly, social recognition on wind power is considerable in Japan. Notwithstanding this, the attitude of inhabitants near wind turbines differs. As such, Japan is not that different from other nations. Truth be told, in some areas, social reception of wind projects can cause bureaucratic delays. Specifically, attention to issues identified with noise, faint vibration, installations within national parks and other conservation territories, and scenery inclinations are viewed as very essential for building partnerships and understanding with local groups.

During the formative years of wind programs, the late 1990s, there were little or no concerns because the populace's perception that wind is naturally benevolent. This changed when some private wind designers and districts initiated wind projects without legitimate recourse made to these issues. The resistance gained momentum for a few years after this. The resistance finally took shape with agitations made by second house owners in the Izu area (ISHO development, see Fig. 1) who were politically exposed persons. The ISHO group remain much

Background of anti-wind movement in Japan: Opposition group of second house owners in Izu region

Category	Details
Name	The ISHO group consists of mainly second-house owners spending their week-ends in Izu or moved over after retirement. Originally, they came from major cities, such as Tokyo. They are considerably rich, retired and have enough time, money and skills. As they haven't been part of the Izu local resident committee, they were not aware of the information given in advance by the wind developer.
Arguments	Their arguments referred to noise, infra-sound and missing information ("Wind turbine is noisy. We didn't hear about it!"). They insisted that the turbine sound leads to illness, so called "Wind turbine syndrome". At that time, a severe economic recession started in Japan with real estate prices decreasing. ISHO blamed the devaluation of their assets to the wind turbines and not to the recession. In alliance with Mr Shiomi, a doctor in Wakayama prefecture, ISHO distributed information that state that "Infra-sound" is a health risk for pregnant women.
History	The ISHO movement started when a Japanese wind power developer, the Clean Energy Factory (CEF) built the Izu-Aragawa wind farm with ten 1.5MW-GE-turbines at the Izu peninsula in Shizuoka prefecture in December 2007. Before starting construction, CEF explained their project including a simplified environmental impact assessment to the local government and the local resident committee. But after the wind farm started operation, Izu second house owners (ISHO) began to aggressively protest against the wind farm. ISHO started a quarrel with CEF, covered by local press.

more active than other anti-wind power movements in Japan and they possess the capacity to influence political decision-making process, as shown by the rigorous application of the Environmental Impact Assessment Law (EIAL) for wind farm projects.

ISHO: From a regional to nationwide anti-wind power movement

The ISHO movement grew stronger as a result of the association with the doctor in Wakayama Prefecture (Mr. Shiomi) who later went on to circulate information declaring that "Infra-sound" was dangerous to the health of pregnant ladies. There have been numerous reports in the media, which has fortified the group's ideology, although, only a few have questioned the scientific basis for the group's position. Lack of community consultation and input has aggravated social attitudes to wind power projects. The dominant attitude in the past was that wind power projects serve no beneficial usage to host communities; rather they serve as unusual harbingers of all forms of nuisance, e.g. noise pollution and landscape disruption. In the past few months, local and host communities are getting increasingly involved in wind power projects - and others are planning to start their renewable energy projects with support from MOE subsidies and the FITs.

Resistance to offshore wind parks

A different challenge is faced is the social reception of offshore/offshore wind parks by fisheries operators and several marine users. It is undisputable that fisheries operators, communities and users are all marine stakeholders. Hence, offshore wind power generation will never be accepted without their understanding. There have been individual cases where fisheries have vehemently opposed offshore wind power installations. In the case of Kitakyushu, fisheries and neighboring occupants on the coastline are against the proposed 60MW wind park which is to cover an area about 1.5 to 2km from the shoreline of Kitakyushu with 15 4MW turbines located in water depths of 10-20 meter. The supposed Shimonoseki Yasuoka project has been in planning since 2009. The project designer Maeda Kensetsu needed to pass several years of EIA before being able to submit the details of the application in May 2016 while it is being examined. Not about to give up, on July 19, a local initiative by a citizen from Yasuoka delegates of the city of Shimonoseki gathered 6,234 signatures from the residents who oppose the wind park. They asserted that the fisheries would be endangered due to the proximity of the turbines to the coastline. The same day, a hearing of the case initiated by four fishermen from the neighborhood against the project was held before the district court in Yamaguchi.

But, EPCOs have lost the trust of the public and are out-of-favor

The electric power industry has experienced harsh criticism for covering up numerous misfortunes and falsifying information and this has damaged the trust between them and the general public. As a result, there have been several petitions from all corners of the country that the industry should abandon its conservative stand on safety and use of information following radioactive fallouts from the tsunami-hit Fukushima Nuclear Power Plant under the management of Tokyo Electric Power Co. (TEPCO). Irrespective of this, Kyushu Electric, refused to learn from experience with its attempt to hoodwink the public into reactivating two reactors at the Genkai Nuclear Power Plant. The company got reprimanded severely in the court of public opinion for its clandestine move.

Questions on the safety and resistance of nuclear plants to natural disasters still remain unanswered

The regulatory framework for atomic power generation has been changed since the 2011 crisis. The defunct Nuclear and Industrial Safety Agency, which experienced harsh criticism for the Fukushima catastrophe, has been supplanted by the NRA, and new policy guidelines were introduced in 2013 to require operators of nuclear power plants to enhance safety against natural disasters, e.g. major earthquakes or tsunamis, which can put such facilities and the environment in great danger. In any case, the NRA itself expresses concerns that a full implementation of NRA standards is not a fail-safe strategy for the plants. The government has, however, declared that plants that have met the NRA standard are ready and fit for operations. The globally acceptable term of a plant is 40 years, which may be extended for 20 years if the international nuclear agency approves same.

Radioactive effects after Fukushima fallout still remain unclear

A study on the radioactive fallout pattern which got deposited on Tokyo's city center a couple of days after Fukushima observed that the aftermath "was concentrated and deposited in non-soluble glass microparticles, as a type of 'glassy soot'." The study by Kyushu University finally assumed that "This meant that most of the radioactive material was not dissolved in rain and running water, and probably stayed in the environment until removed by direct washing or physical removal. The particles also concentrated the radioactive Caesium (Cs), meaning that in some cases dose effects of the fallout are still unclear."

Restarting Japan's nuclear power plants a key priority for Shinzo Abe's government

In the July parliamentary election race, Shinzo Abe and his LDP, Japan's ruling group, recorded a landslide victory as voters favored political stability regardless of anxieties over Abe's fiscal policies. That leaves Shinzo Abe in undisputed control of the Japanese governance structure and the chance to call for constitutional reform through a nationwide referendum. Prior to the elections, a mock election revealed that voters were much more concerned about the uncertain economic future of the country rather than issues surrounding nuclear energy. Nuclear energy and Japanese Self-Defense Powers and military restructuring remain contentious policies of Abe's administration. These issues are connected with each other: a potential military utilization of nuclear plants has been identified as the reason behind government`s plan to restore 32 reactors. This is in sharp contrast with past opinion polls which reiterated Japanese citizens discontent with the government's plans to restart atomic power plants for any reason whatsoever. Also, a 2012 survey targeting media houses revealed that 47 of the 50 mainstream media outlets in Japan declared that they are against all efforts to resuscitate nuclear facilities.

Business potential for European players in ongoing decommissioning market

Whereas Japanese firms, such as Toshiba Corp. and Hitachi Ltd. have won bids to construct plants abroad, European bigwigs, on the other hand, for example, AREVA and British Cavendish Nuclear Ltd. are taking part in the Japanese decommissioning process. Last year, they signed an agreement with GE-Hitachi Nuclear Energy for the decommissioning of boiling water reactors. The increasing public desire for a speedy closure of nuclear facilities to guarantee safety from radioactive facilities will likely result in more business opportunities in the decommissioning market and increase European involvement in projects of a similar nature. Credence to this was given by Germany's Minister of Environment, Barbara Hendricks when she announced in May that Germany may turn into an exporter of technology to decommission reactors abroad in a few years due to the experience gained from its phasing out of nuclear energy.

European experience on public engagement processes

These impediments demonstrate a growing need in Japan for key ways to secure social understanding using the passion of designers and investors to tap European expertise on massive wind projects and public engagement processes.

2.5.7 Innovation and Concepts

Innovative projects in the field of wind energy are frequently identified in relation to landmark offshore pilot projects in Japan. In addition to those, there are other new ideas in the field of wind energy technology, usually operating on a small-scale basis. ICT trends, for example, M2M (Machine-to-Machine), IoT (Internet of Things) and enormous information offer bigger benefits for the wind industry to end up more astute to intelligently managing installed capacity and to enhance manufacturing procedures. Moreover, brilliant grid ideas include a connection between power generation and distribution to smart homes, autos and IoT in general. Joint efforts between local companies (Mitsubishi Heavy Industry and Hitachi, and so on.) and international companies (Toshiba and Landis+Gyr, Osaki and SMB United, Toko and WGN, Fuji Electric and GE, Panasonic and Itron, Mitsubishi Electric and Echelon, and so forth) have also increased. For the FY 2016, METI "facilitates innovation by utilizing the IoT, Big Data, robots and artificial intelligence and promotes investment for the future with the aim of achieving a productivity revolution". For example, JPY0.39 billion was budgeted to support "projects to enhance safety regulations for new energy".

In the broad scheme of things, Japan has a high invention rate as evident with the record number of registered patents in the world. But, conversely, the majority of these patents are yet to be commercialized. An examination of the ratio of patent/execution reveals that Japan is far behind in the implementation of registered patents. The aim of this chapter is to present notable projects and areas of new research to showcase the potentials of new and trending wind technology in Japan.

The following sources can help European companies to check and keep up with these trends:

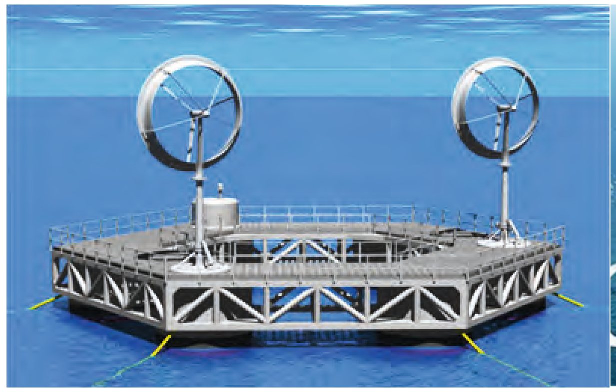
The Technology Transfer Helpdesk (http://www.eu-jp-tthelpdesk.eu/) provided by the EU-Japan Centre for Industrial Cooperation offers support with IP search and rights which serve as a useful tool to screen Japanese patents.

- Several institutional websites (e.g. J-Store, JETRO) provide facilities to check patents in Japan.
- Technology Licensing Organizations of the major universities and research institutions are disposed to provide feedback and additional information on request.
- Examples of innovation & concepts in the wind sector
- The examples given in the following demonstrate only some examples of many innovations, concepts and applications that have been trending in the wind power sector. Therefore, the list is not exhaustive.

1. Turbine design

Practical use of typhoon power generation system

- This project uses strong wind power to generate electricity using the "Magnus Effect" created by vertical-axis wind turbines. This framework was produced by Challenergy Inc. as an endowment project of Sumida Ward (Tokyo) and is fit for generating power even in the presence of full-blown winds during hurricanes. The Magnus Effect is a mono-directional turbine which operates uses a lifting force to rotate a cylinder in an airstream (wind) towards a direction. Since Challenergy's turbine has an unusual vertical axis plan, the installation space won't need to be as large as that of regular designs and engineers foresee extra benefits to this including enhanced safety and noise-reduction mechanism. Besides, the amount of power generated can be controlled by limiting the rate of cylinder pivot (which acts as a gear system). Challenergy is making arrangements to manufacture a test turbine in the late spring of 2016, in Nanjo City, Okinawa Prefecture, to showcase the world's first tropical storm powered wind turbine. It has been raising funds for this through crowd-funding.



Downwind turbine

- Hitachi adjusted the downwind plan to target markets vulnerable to standard hurricanes and electrical storms to apply it to its 5MW offshore turbine for the Fukushima Forward project. A downwind model implies incoming wind be made to bypass the nacelle of the tower edges before reaching the blades. The Hitachi outline uses more adaptable blade edges, to give blades more flexibility under strong winds without any collision risk to the tower. This allows excess wind around the blades to easily disintegrate rather than stressing the core of the blades. To further protect the tower from blade mishaps, the tip of the rotor blades are aligned towards the skyline rather than horizontally. A disadvantage of the downwind plan is the shadowing impact of the tower due to the turning of the blades behind it. To fix this, the tower can be streamlined with the blades by using robust design which will invariably increase manufacturing costs.
- nosystems has arranged to use hydrogen for producing electricity and carrying out maintenance services. On the other hand, Toyota Tsusho will coordinate and supervise the projects.
- The MOE has likewise carried out tests to showcase the development of a fuel cell ship running on hydrogen which was manufactured using electricity from offshore wind power installation. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) intends to create safety guidelines for fuel cell ships by fiscal 2017 to safeguard installations from salt damage and collisions.
- European nations are endowed with broad experience on hydrogen-related projects, for instance in a few urban communities in Germany, public transport vehicles that are outfitted with fuel cell devices which are fed by hydrogen. Therefore, possibility of future relationship, technology transfer and cooperation between the EU and Japan remain boundless.

Wind lenses

A wind lens is an alteration made to a wind turbine to make it a more effective trap of wind energy. The modification is in the form of a ring structure called a "brim" or "wind lens" which encompasses sharp ends to divert air far from the exhaust compartment behind the blades. The turbulence made as an after-effect of the new arrangement results into a low tension sector behind the turbine, causing more prominent winds to go through the turbine. These will, in turn, increase blade revolutions and energy yield. In Japan, wind lens is being studied into by the Wind Engineering Section of Kyushu University. (See additional details beneath under Hybrid Systems).

Plasma aerodynamic control on blade surface

Toshiba showcased its special innovation "plasma aerodynamic control on blade surface" at the Nagashima site in 2015. Plasma's electromagnetic power empower the blade surface stream and enhance wind turbine performance by preventing stalls. The Japanese Wind Energy Association (JWEA) awarded the innovation with a "2015 Technical Paper Award" in November 2015.

2. Measurements & Sensors

GPS-equipped seabirds being used to gauge wind speeds

An international group including specialists from Japanese colleges has succeeded in measuring precise wind speeds adrift and in seaside locations by using seabirds outfitted with Global Positioning System gadgets. The group measured the way that the flight velocity of seabirds alters according to the course of ocean winds. In their exploration - on the Sanriku coast in the Tohoku area. Hawaiian Islands and the southern Indian Ocean - the group analyzed information collected by small GPS gadgets installed on three seabird species (namely streaked shearwater, wandering gooney and Laysian albatross birds). Thus, the group could precisely quantify the heading and speed of winds not obtained by satellites. Another strategy to record precise wind information on water and in seaside regions is being looked into to refine climate assessment and resolve conflicting figures.

As of now, satellites and floats are mainly used to gauge course speed, which additionally serves as essential inputs for an elementary science database. Unfortunately, satellites and floats have limits; they must be everywhere but can't collect data on all covered areas on a 24/7 basis. For instance, a satellite is fit for collecting information in the same area just twice every day. Furthermore, radio wave reflections from coastal environments can disrupt data collection by satellites. Observation using birds, therefore, remains a viable option as they can cover long distances and seabirds exist all over the world. Bio-logging can, likewise, be an effective approach to develop exact information for refining conjectures in the field of wind energy.

3. Offshore (floating) concepts

Japan is a maritime nation which has the sixth biggest EEZ and shoreline. While demonstration projects on floating wind power generation is going full swing in Europe, there is a momentum where more and more floating wind power generation is going to be installed in Japan. Floating systems have huge potential in offshore Japanese sea areas because they have relatively steep submarine topologies. One characteristic of floating systems is that they do not allow similar profit to onshore wind power generation. The cost of the construction, the installation work, the floating foundations (floating structures and moorings) and the system interconnection is higher than that of an onshore "implementation". This is why the power generation unit price is more expensive compared to onshore wind. There are following approaches in Japan:

Wind turbine floating concept A wind turbine system which allows swinging and steep and a floating wind turbine system which is capable of keeping the posture despite excitation of blade rotation, wave and wind is being developed. Study of the various floating structures and mooring systems have been advanced as one of the cost reduction measures of the floating generation, whose generating cost (\/kWh) is said to be higher than the implantation generation. In addition, several kinds of wind power generators are under consideration; they are aimed at selecting the optimum range of single unit capacity of turbine and drainage of floating body and the floating system. Besides common problems with implantation and floating body, the following issues are also under consideration: expansion of the blade diameter, development of a reliable generator drive system which is capable of handling large torque due to the large size, integration, rationalization, and maintenance-free of the components, ault Tolerant Design, and Multi-path design. In addition, the annual average wind velocity of Japan is lower than that of Europe. In addition, the wind power generation system is also under consideration; this is applicable to the floating offshore body which adapts to ocean environment in Japan where it is necessary to adapt to strong winds such as typhoons.

Hitachi (5MV), Senvion (6.2MV), BARD (6.5MV), Sinovel (6.0MV), MHI (7MV), MVOW (8MV), Northern Power Systems (8MV) are examples of Multi-Megawatt-offshore wind power generators in the range of 5 to 8 MV. Some of these wind turbines are installed on floating bodies for demonstration tests. Besides there are development plans for supersize wind power generation over 10MW, such as the 10MW (American Superconductor, Sway Turbine, Goldwind, Sinovel, etc.), and 10~12MW (United Power), 15MW (GE Wind, Gamesa).

Transport, installation, port

In floating offshore wind turbine, it is common to load the floating body in a shipyard or a port and tow to a predetermined sea area.

In order to reduce the cost of the floating foundation structure

- installation work,
- system interconnection,

- operation and maintenance of offshore wind power generation
- reduction of power generation unit costs,
- development and introduction of dock, ship,
- dedicated wharf etc.

have been investigated. Through the new packaging of industry, combining Japan's ship-building industry, offshore engineering industry and the wind power industry, Japan hopes to create a future export industry.

Development and maintenance of the system interconnection facilities

The power transmission system is comprised of an offshore collector system (offshore substation equipment), which connects each wind turbine of a wind park and aggregates the electric power generated from the floating wind turbine facility, and a power transmission system which transmits collected power to land. Offshore collector system accounts for around 33 ~ 36kV (cumulative) in Europe and is designed to adapt to an environment in the ocean or on the seabed.

High-voltage alternating current (HVAC) system is adapted for a short transmission distance. In the long-distance submarine cable transmission, there are cases where a high-voltage direct current (HVDC) system is adopted, because the charging current by AC transmission becomes excessive.

Floating wind turbine

In Europe, a bottom-mounted offshore wind turbine is the mainstream method for installing offshore wind power. However, in the countries with small shallow sea areas (such as Norway, Portugal, France, etc.), demonstration projects of floating offshore have been carried out or are being planned and have received subsidy funding of the respective country for the purpose of technology development, cost reduction and development of material. In Japan, there are offshore demonstration projects of floating wind by MOE and an offshore wind farm demonstration research project by METI as listed in the table. The former is a project that was started in the fiscal year 2010 and an empirical study of the floating wind turbine with a 2MV turbine demonstration unit off Kabashima, Goto city in Nagasaki Prefecture. A small-scale testing turbine (100kW) was set up in 2012 and a demonstration unit (2000kW) in 2013 in order to consider the installation and operation of a full-scale demonstration unit. METI`s FukushimaForward project is explained in more detail as a case study in chapter 5. The goal of these empirical studies is to establish a floating wind turbine technology compatible with the natural environment conditions of Japan, yet offer high reliability and economic efficiency and safety, and make Fukushima Prefecture a major cluster of wind power related industries.

Future prospect & challenge: Japan is far behind other countries in bottom-mounted offshore wind turbine.

However, as far as the current floating offshore wind power situation goes, Japan is catching up and overtaking research abroad. Thus it is desirable that Technology research and development of "upset mitigation" and "cost reduction" are carried out, both of which are key challenges of floating wind turbine.

Advancing the technology research and development of floating wind power is seeking to establish elemental technologies to implement cost reduction to improve the international competitiveness of Japan`s floating wind technology and is leading to the strengthening and development of the domestic industry.

Bottom-mounted offshore wind turbines and floating wind turbines create more industries than land-based wind turbines, aside from the point of windmill production. There is development of infrastructure such as port facilities where assembling the floating wind turbine system is possible, involvement of the shipbuilding industry (involved in manufacturing of the floating body) and the offshore engineering industry creating the mooring equipment and laying submarine cable. Future progress is expected.

Several offshore demonstration projects in Japan are underway or in the process of being finalized in the last couple of years, as outlined below:

Floating Offshore Wind Turbine Demonstration Project (by MOE): FHI Subaru (Hitachi) 100kW on the spar floater in Aug. 2012. Near Kabashima Island at Goto Islands in Nagasaki Prefecture, 1.6 billion JPY budget for FY2013. Hitachi 2MW on the spar floater in 2013.

Demonstration of Offshore Wind Power Generation (by NEDO), At Choshi in Chiba Pref. and at Hibikinada in Fukuoka Pref., 4 billion JPY budget for FY2013, MHI 2.4MW on the gravity foundation at Choshi in Jan 2013. JSW 2MW on the hybrid jacket foundation at Hibikinada in 2013.

Floating Offshore Wind Farm Demonstration Project (by METI), Hitachi 2MW on the 4 column semi-sub. floater in 2013. MHI 7MW (SeaAngel) on the 3 column semi-sub. floater in 2015. At Fukushima. 40.5 billion JPY budget for FY2013-FY2016, Hitachi 5MW on the advanced spar floater in around 2016.

Advanced Wind Turbine Technology Development (by NEDO), Aims to develop 7MW offshore turbine using advanced technologies, 2 billion JPY budget for FY2013.

4. Hybrid-Systems

Some other floating trials with hybrid characteristics need to be are due a mention even though they are highly theoretical in nature:

Hybrid Wind-Solar Systems

In the first place is the Wind Lens floater created by Kyushu University. A scale model with two 3kW covered turbines (wind lenses) was produced in December 2011. It is a semi-submersible stage with its 18m wide which incorporates two turbines (2 x 3kW) and solar panels with 2kW. The Ministry of the Environment (MOE) is the financial backbone of this project. Presently, only the scale model (18m) in existence.

Hybrid Wind-Tidal Systems

The Modec Skwid, a current and flow hybrid design using a vertical-axis turbine, was expected to begin testing last October, however, a key module sank to the bottom of the sea during installation. Towards the end of December 2014, the Modec's 500kW Skwid hybrid wind/tidal offshore turbine also sank off the coast of the Japanese island of Kyushu, marking the most recent difficulty in the Japanese marine contractor's attempts to test the lofty prototype.

5. Wind energy and hydro fuel: Wind Energy in the Scope of Smart Energy and Mobility

Demonstration of Japan's Hydrogen Energy Project at 2020 Olympics in Tokyo to Show Future of Low-Carbon Communities

Japan intends to illustrate, at the 2020 Tokyo Olympic and Paralympic Games, how low-carbon societies can be made through the combination of these advances to deliver and utilize CO2-free hydrogen at cheaper costs. METI has been promoting the utilization of fuel cells and vehicles to families and businesses in schemes in places such as in Yokohama City; Toyota Motor Corp. has set a significant pace by producing hydrogen using electricity generated from wind power plants. The hydrogen manufactured will then be conveyed by truck to coastline distribution centers and factories to be used as fuel for adapted forklifts. Confirmation tests will be carried out within FY 2016 to 2019.

Wind electricity to produce hydrogen, which can be used by fuel-cell forklifts or ships

The MOE has been preoccupied with several projects to show that forklifts and waste vehicles fitted with fuel cell energy units can be powered with energy from the wind and the sun. It has carried out tests on forklifts trucks powered by fuel cells. It has also scheduled a series of tests for Q3 2016 on waste dump trucks. Apart from Toyota Motor Kyushu Inc, Kyuden Technosystems Corp (Fukuoka Perfecture) are also involved in projects investigating the production of hydrogen using electricity generated by solar and wind power to electrolyze water and harvest hydrogen as a byproduct which will be used to fuel forklifts at their respective manufacturing plants. The projects bring hopes of an effective reduction (especially by heating and cooling mechanisms) of CO2 through the production methods. Hydrogen power offers a much greener source of energy. The project inception dates back to June 28, 2016, while an inert fuel cell system is expected to be installed in 2017. While Toyota Motor Kyushu will utilize hydrogen, Kyuden Technosystems has arranged to use hydrogen for producing electricity and carrying out maintenance services. Toyota Tsusho will coordinate and supervise the projects.

The MOE has likewise carried out tests to showcase the development of a fuel cell ship running on hydrogen generated by electricity from an offshore wind power installation. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) intends to create safety guidelines for fuel cell ships by fiscal 2017 in order to safeguard installations from salt damage and collisions.

European nations have broad experience of hydrogen-related projects, for instance in a few urban communities in Germany, public transport vehicles that are outfitted with fuel cell devices which are fed by hydrogen. Therefore, possibilities of future relationships, technology transfers and cooperation between the EU and Japan exist.

Funding and cooperation opportunities from Japan and Europe

3. Funding and cooperation opportunities from Japan and Europe

Cumulatively, investments on renewable energy in Japan in 2015 added up to around ¥4.2 trillion. As will be discovered in the next few paragraphs, Japan usually provides assistance to renewable and wind energy projects at a level comparable to that of similar countries. Government R&D programs concentrate mainly on landmark offshore projects while manufacturing companies in Japan invest on a somewhat medium scale. However, the frequent shocks of the Japanese market have pressurized them into not only making more investments but also exporting their products. This has led to the creation of trade relations and partnerships with foreign businesses which, in turn, have driven up the rate of M&A economic activities. The result of this is that Japanese manufacturers and distributors control a bigger portion of the global market as regards the supply of vehicle and engine spare parts, as well as power-generating sets. This is largely due to the popularity gained from the usage of precision tools and cutting-edge technology.

3.1 System support

Funding was redefined under the New Energy Law

Wind projects can get support under the structure set up by the "New Energy Law" (NEL). With the New Energy Law, about one third of expenses over a project can be financed. Likewise, costs of planning, siting, materials, research, development and different utilities can be sponsored.

Also, if the investor is a provincial government or NGO, about half of the expenses on materials and parts of the planning and positioning may be subsidized by the government. Additionally, the expenses of about one-third of batteries and different types of energy storage systems can be covered under the NEL, as discussed in the links shared in the next paragraph.

- Act for Promotion of Japan as an Asian Business Centre, http://www.meti.go.jp/english/policy/external_economy/investment/act_information.html
- Subsidy Program to Promote Investments in the Cutting-Edge Sectors of the 21st Centuryhttp://www.pref.aichi.jp/youchi/e/index.html
- Subsidy Program for Projects Promoting Foreign Direct Investment, Site Location and Regional Development in Japan http://www.jetro.go.jp/en/invest/incentive_programs/

The above is not a full list of regional support programs available; several others can be checked on The New Energy Promotion Council's (NPC) website (www.nepc.or.jp).

A conducive environment is not enough for SMEs to delve into building and operation of renewable energy structures. The government, therefore, created a credit scheme to give out loans to the tune of €2.77million with low-interest rates which can be accessed by SMEs interested in development of renewable energy sources.

Green Investment Tax Break

The Green investment tax rebate framework is a Tax incentive for the industry which was established af-

Trends in funding of Renewable Energy in Japan

Source: UNEP 2015

Category	Growth trend 2014-2015
General RES investment growth	around 34 billion US $
New investment in Wind compared to other RES	small
Technology development	
Venture capital	medium
Government R&D	small
Corporate RD&D	small
Equipment Manufacturing	
Private equity expansion capital	medium
Public markets	medium
Projects	
Asset finance	small
Of which reinvested equity	high
Small distributed capacity	medium
M&A transactions	
Private equity buy-outs	very high
Public markets investor exits	small negative
Corporate M&A	
Project acquisition & refinancing	small

ter the abolition of the energy proficiency framework associated with the preferential tax system in use until 2012. Business operators who buy qualifying equipment within the period April 1, 2013 to March 31, 2016 will qualify for an extraordinary discount of 30% against standard market costs or a 7% tax obligation (for SMEs alone). Business operators who buy any of the equipment which is secured by both the green investment tax rebate and the energy reform tax framework, can choose which tax regime they desire to be applied to such purchase, but are not entitled to enjoy the benefits of both systems concurrently.

The tax holiday/rebate applies to common renewable facilities, such as:

- wind power facilities
- facilities using new energy (such as small and medium sized hydroelectric facilities)
- PV facilities
- carbon dioxide emission limiting equipment (including electric vehicles)
- energy usage control facilities (energy control systems)

The Green Investment Tax incentive is accessible for any taxpayer who has been authorized for the feed-in-tariff and had procured solar or wind power generation components and integrated it into their business within one year of the acquisition. Such a person can choose one of the following incentives if the equipment/component is already being used by the business by 31 March 2016:

- 30% special depreciation plus ordinary depreciation value
- 100% depreciation for wind power generation equipment, i.e. a complete refund of the project costs in the form of a tax credit (7% of acquisition costs, only applicable to SMEs with mandatory paid-up share capital of JPY100 million or with 50% paid-up share capital and not under the control of foreign entities or companies).

Japan ended tax incentives for solar power installations on March 31st, 2011 due to increasing use of solar power across the country and the attendant fiscal costs of continuous subsidies. This move, according to analysts, was to break corporate tax returns to less than 30%. The tax rebate is still available for wind and hydro power projects.

Funds

From the early 2000s, communal private placement securities have emerged and been developed as an investment into a few wind power projects alongside investments by citizen funds (however, note that they didn't materialize as ordinary investment assets). After increasing accessibility with the FIT introduction in 2012, the business market for private placement capital for institutional and corporate investors has been continuously expanding, especially for solar PV projects. The major funds in Japan for renewable energy are from private capital funds and, by 2016, the first wind power financed by the fund had been established.

2016 First solely wind power fund in Japan (JDB & JWD)

By January 13, 2016, the Development Bank of Japan and the designer Japan Wind Development (JWD) declared that they would jointly work on a JPY 50bn capital wind power project. This was Japan`s first wind farm fund and it began operations in April 2016. The fund intends to obtain wind energy installations with a total capacity of 200MW under the management of JWD and its sister companies. This also includes plans to raise capital from institutional investors to bankroll new wind projects. JWD has made arrangements to manufacture 11 new inland wind projects (454MW in total, 394MW of which is planned to be sited in Hokkaido and Aomori Prefectures).

MOE investment in wind power with its renewable fund (Green Finance Organization)

Japan's Ministry of Environment created a fund in 2013 to invest in renewable energy projects to bolster local companies and diminish carbon dioxide emissions. The project is financed by the Japanese Carbon tax regime that had been in place since October 2012. The MOE announced, in March 2016, its plan to invest ¥590 million ($5.2 million) in a 14-megawatt wind power project under an arrangement with Japan Wind Development Co. The urban-center plant in Kakegawa City, Shizuoka Prefecture, will be finished by mid-2018, as revealed by Green Finance Organization which has been in charge of the project. Japan Wind Development is to invest ¥610 million and the project will secure loans from top financial groups. Electricity generated from the station will be sold to Chubu Electric Power Co., as further revealed by the MOE.

The Tokyo Stock Exchange created a listed infrastructure fund market geared towards giving impetus to corporate and private investors. A good example of this is the Hula Assets funds renewable energy power equipment and facilities management for air terminals, seaports, rails, etc. Concession rights, however, are required under this program. The only firms that can access the fund are those that have procured and are managing installations (especially solar and wind power plants). Only solar PV and other associated assets have been listed since inception.

3.2 Government support

The Abe led administration has earmarked the renewable energy industry as a "strategic growth area" of its government. Every year the Japanese government defines a financial plan on a nationwide level to bolster renewable energy (wind energy inclusive). In a bid to boost and get the best energy blend, JPY 59.65 billion was budgeted for renewable energy in the 2016 fiscal year. A breakdown of the budget shows that:

- Subsidies for the implementation of the Feed-in Tariff Scheme for Renewable Energy: ¥48.3 billion (¥45.6 billion)
- Subsidies for the utilization of renewable energy facilities for self-consumption: ¥4.85 billion (New)
- R&D project as regards energy generation expectations and mitigating variations in renewable energy: ¥6.5 billion (¥6 billion)

The effective use of public funds enhances the development of the wind energy sector in Japan as it regularly targets bureaucratic barriers such as grid power advancement. The financial plans that are listed above are mostly directed to aid the efforts of the private sector. For instance, the floating offshore wind power project off the coast of Fukushima is financed by METI and was awarded to the over ten industry players who make up the Fukushima consortium. In contrast to the pattern of funding abroad, the Japanese government has increasingly taken measures as of late to increase remote direct investment in the nation. These include initiatives, for example, the "Act for Promotion of Japan as an Asian Business Cen-TRE1" of METI that was passed in November 2012. The "System to Promote Investments in the Cutting-Edge Sectors of the 21st Century" of Aichi Prefecture was also passed the same year.

As a thorough initiative, METI aids projects carried out by approved companies with various incentives such as waivers, tax holidays, etc. There are other incentives for foreign companies willing to transfer their research center or continental headquarters to Japan. METI's framework with the "Subsidy Program for Projects Promoting Foreign Direct Investment, Site Location and Regional Development in Japan" is structured to attract start-ups and stimulate formation and operation of companies in regional groups.

Japanese STI programs that match making to European Horizon 2020[76]

The landscape of public STI programs in Japan is very fragmented with several ad hoc programs in each ministry that have a different scope and focus. A list was drafted by the EU-Japan Centre for Industrial Cooperation based on open calls/programs of 63 organisations as part of the JEUPISTE deliverable on main domestic Japanese Science, Technology and Innovation (STI) programs.[77]
It was found that the Japanese STI programs' landscapes are rather fragmented as 319 programs (302 public, 17 private) have been identified in February 2016. This list includes open calls during February 2016 and call that were recently closed. Of them, the following have been identified as related to wind energy. The list is not a complete overview of all existing programs as calls tend to be open only for a limited period and the overview only takes into account programs on a national level.

76 see next chapter

Programme Name	In Japanese	Field	Sponsor	Budget
Environmental assessment study early implementation demonstration project	環境アセスメント調査早期実施実証事業	Energy	NEDO (METI)	FY2016 ¥0.8 billion (€6.50 million)
The next generation off-shore DC transmission system development project	次世代洋上直流送電システム開発事業	Energy	NEDO (METI)	FY2015 ¥0.18 billion (€1.46 million)
Advanced Low Carbon Technology Research and Development Program	戦略的創造研究推進事業／先端的低炭素化技術開発	Green innovation	JST (MEXT)	FY2016 ¥5.2 billion (€42.2 million)
Environment Research and Technology Development Fund	環境研究総合推進費	Environment	ENV	FY2015 ¥5.1 billion (€41.6 million)
Collaborative Research Based on Industrial Demand	研究成果展開事業／産学共創基礎基盤研究プログラム	Science	JST (MEXT)	FY2015 ¥0.7 billion (€5.69 million)
Power system output variation corresponding technology R&D project/Renewable energy interconnection expansion measures sophistication	電力系統出力変動対応技術研究開発事業／再生可能エネルギー連系拡大対策高度化	Energy	NEDO (METI)	FY2016 ¥6.5 billion (€52.8 million)
Adaptable and seamless technology transfer program through target driven R&D/stage 1,2	研究成果最適支援プログラム／ステージⅠ、Ⅱ	Wide range field expected	JST (MEXT)	FY2015 ¥10.2 billion (€82.9 million)
Research Program on Climate Change Adaptation”	気候変動適応技術社会実装プログラム	Climate	MEXT	FY2015 ¥5.8 billion (€47.1 million)
Project for International Energy consumption efficiency technology and system demonstration	国際エネルギー消費効率化等技術・システム実証事業	Energy	NEDO (METI)	FY2015 ¥13.5 billion (€109 million)
Leading R&D Project of Hydrogen use	水素利用等先導研究開発事業	Energy	NEDO (METI)	FY2015 ¥1.5 billion (€12.1 million)
Innovative hydrogen energy storage and transportation technology development	革新的水素エネルギー貯蔵・輸送等技術開発	Energy	NEDO (METI)	FY2016 ¥1.55 billion (€12.6 million)
Research Institute of Science and Technology for Society	戦略的創造研究推進事業／社会技術研究開発	Human studies, social science	JST (MEXT)	FY2016 ¥0.03 billion (€0.24 million)

E-Rad announcements: As Japanese calls are often very short-time announcements, it is advised to monitor regularly E-Rad, which lists main calls: http://www.e-rad.go.jp/jigyolist/present/index.html

Programme Name	In Japanese	Field	Sponsor	Budget
Wind power generation advanced practical research and development (lightning strike)				
Research grants joint research commissioned research demonstration projects (field test) equipment introduced auxiliary spread enlightenment business	風力発電高度実用化研究開発（落雷）	Research	NEDO	limit 999,999,999

There are also Japanese research facilities open for European participation:

Name	Field	Facility	Contact/ Information
FEEMA (Facility for Energy and Environmental Material Assessment)	material	OASIS	Information: http://oasis.muroran-it.ac.jp/FEEMA/english/index.html
Low-turbulence wind tunnel facility	wind tunnel	Tohoku Univ	Information (Japanese): http://www.fri.niche.tohoku.ac.jp/innovation/flow.html Mail:innovation@fri.niche.tohoku.ac.jp EU user: Available. Including technical advice.
Institute of Carbon Science and Technology	nano-tech	Shinshu Univ	Information (Japanese): http://www.shinshu-u.ac.jp/institution/icst/kyoyo/ EU user: Available for free.
New Industry Creation Hatchery Center	material	Tohoku Univ	Information (Japanese): http://www.fri.niche.tohoku.ac.jp/innovation/flow.html Mail: innovation@fri.niche.tohoku.ac.jp EU user: Available. Including technical advice.

3.3 Support by the European Commission

EU-Japan Centre for Industrial Cooperation, www.eu-japan.eu

The objective of the EU-Japan Center for Industrial Cooperation is to advance all types of industrial, trade and investment engagements between Japan and the EU and to fortify the technological capacities and attractiveness of the European and Japanese industrial frameworks. It is partly funded by the European Commission (DG Grow) and the Japanese Ministry of Economy, Trade and Industry (METI). It oversees policy matters and business aid operations, including, but not limited to, administrative training programs, research, group missions, seminars, student internship programs, business conferences and help desk services to create synergy between European and Japanese businesses with the following actions:

Step in Japan

The EU-Japan Center for Industrial Cooperation will also give support through free transitory office space (Step in Japan), trade matching (using the European Enterprise Network), group support, and their website which contains information for EU businesses. The EU is additionally running two projects to support firms in the energy market. The programs are the Executive Training Program (ETP) and the EU Gateway Program. The main focus of the EU Gateway Program is green energy. This policy provides background knowledge of the Japanese business environment to European firms, primarily SMEs, on several important topics, particularly "Environmental and Energy related Technologies". The EU-Japan Center for Industrial Cooperation also offer helpdesk services on tax inquiries, technology transfer protocols, patent search and public acquisitions in Japan.

EU Gateway to Japan http://www.euinjapan.jp/en/tag/eu-gateway-to-japan/

The "EU Gateway to Japan" program supports SMEs intending to penetrate the Japanese market. The promotion program is an initiative financed by the EU with the sole aim of coordinating intercession of potential business contacts with potential associates/partners with regards to topical business visits to Japan.

Enterprise Europe Network (EEN), http://www.eu-japan.eu/business-technological-partnership-support-een

As a result of the peculiar characteristics of the Japanese market, a large portion of companies from abroad have been able to surmount hindrances through partnerships with local firms. To give assistance, the EU-Japan Center for Industrial Cooperation provides a matchmaking service using the Enterprise Europe Network (EEN). The Enterprise Europe Network (EEN) is funded by the COSME program under the management of DG Grow, which helps businesses reach markets in and beyond the EU. The EEN for Japan is part of the EU-Japan Center for Industrial Cooperation. The project aims to help SMEs to locate business and technical partners. It also funds various IPR (Intellectual Property Rights) SME Helpdesks.

Japan Tax and Public Procurement Helpdesk: http://www.eu-japan.eu/japan-tax-public-procurement-helpdesk:

To conquer these obstructions, the Japan Tax and Public Procurement Helpdesk, is offering tender interpretations and backings with tenders and offers.

Procurement and challenges

In spite of the fact that Japan is a subscriber to the World Trade Organization's Government Procurement Agreement, EU businesses still face administrative hurdles such as a lack of access to information (especially the transparency and verifiability of such information where it is available) and administrative high-handedness during the procurement process. The EU evaluates that, despite the GPA, EU businesses should be able to get contracts worth 0.7% of Japan's GDP (about 22 billion EUR), while Japanese firms in sharp contrast can secure contracts worth 2.1% of EU GDP (exactly 312 billion EUR). This development has been attributed to deliberate confinements, low consideration of bids and requirements set for securing contracts by railroad and urban transport operators.

No access to contract information / Lack of transparency: The Japanese legal system for public acquisitions is an intricate arrangement of statutes and guidelines available in various legal writings. In usual practice, the central government's procurements are guided by the Accounting Law while regional government's acquisitions are regulated by the Local Autonomy Law. There is no abridged English version of these legislations.

Lack of an exclusive point of access to tender declarations/announcements. A similar counterpart of the EU's central electronic Tender Database (TED) is absent from Japan's public procurement framework. Though the central government's tender announcements are all accessible in the National Gazette, local tender announcements are scattered across different sources and on several undetermined websites. Additionally, only the declarations published by central government are available on the JETRO site (https://www.jetro.go.jp/en/database/obtainment/) are accessible in English

Tendering process: Administrative obstructions: the procedure of business assessment (keishin) is too long to permit organizations to partake sufficiently in a specific tender after the publication of a tender notification. One specific range of concern is the absence of a minimum level required for every particular ability. The registration is necessary before joining each procurement agency and is renewable every two years without the option of automatic renewal.

Redresses available: it is exceptionally hard to dispute awards of contracts done by a contracting authority. The body responsible for investigating award disputes (CHANS) is constituted by the Cabinet Office, its decisions are merely unenforceable recommendations. Besides, it doesn't address award disputes involving local authorities which don't have such a setup. The Acquisition is mostly on a cost-basis rather than on a value-for-cash basis.

EU Framework: Horizon 2020, ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

Horizon 2020 is the greatest EU Research and Innovation program in existence with almost €80 billion of funding accessible over a 7-year period (2014 to 2020). It targets not just European players with projects in the EU; it can also be used to foster EU-Japan cooperation and projects in Japan. The EU-Japan Center has been appointed as the approved National Contact Point (NCP).

In respect of wind energy development, the four programs listed below are well-founded to meet their goals:

- LCE-06-2017
- LCE-13-2016
- LCE-14-2017
- LCE-21-2017

(Additional details about these programs is provided in the Annex to this work)

European firms can easily accept invitations to collaborate with European partners in Japan or with Japanese associates in Japan or Europe because European companies have ready-made financial backing, while their Japanese counterparts habitually need to apply for funding from the Japanese government.

EU Framework: Small Business Act for SMEs

Furthermore, the European Union provides business support under the Small Business Act for European SMEs. The SBA is an extensive system for the EU approach on Small and Medium Enterprises (SMEs). It plans to enhance the ways of dealing with enterprises in Europe to streamline the regulatory and administrative framework for SMEs and remove remaining obstructions to their advancement. It should be noted that the SBA is a support scheme and not an actual target for entry into the Japanese market.

Available funding opportunities for SMEs can be researched on the SME Internationalization Portal (https://ec.europa.eu/development/tools-databases/smeip/). The majority of them provide services such as seminars, export credit schemes, forum discussions, matchmaking opportunities, support for new businesses etc. It is an exceptionally significant tool that is indispensable for any European exporter as it could help facilitate businesses in several ways.

The Market Access Database (MADB)

The Market Access Database (MADB) is managed by the European Commission. It provides information about import requirements in third country markets to firms exporting from the EU.
http://madb.europa.eu/madb/

EU Member States` embassies, EU Delegation http://www.euinjapan.jp/en/

The Delegation of the European Union to Japan can likewise be an essential contact point. It is the EU's representative in Japan and is entitled to the full status and privileges of a diplomatic mission. Its mission is to speak for, advance and propel the interests and principles of the European Union in Japan. It also has the responsibility to create and reinforce bilateral political, cultural, social, economic, scientific research interests and other sectorial partnerships between the European Union and Japan. This delegation is expected to use its mandate to advance and propel EU interests and principles at international and local levels.

Moreover, most EU member states have government offices in Japan by employing policy staff to research, compile and supply information on a particular segment of the industry. Additionally, individual business promotion firms, for example, the DIHK/AHK for Germany enhances entry for new and existing businesses. Similar to the EU-Japan Center for Industrial Cooperation, they also offer an extensive variety of training and business discussions from a bilateral point of view. These bodies provide firms with consultancy services, workshops and seminar events, appointments and group missions, and also supply relevant industry contacts.

3.4 Business support

Other bodies such as Jetro also serve as contact points for new entrants into the market.

JETRO

JETRO is Japan's main entity promoting Foreign Direct Investment (FDI) inflows into Japan. It recognizes organizations interested in investing in Japan and backs them from the phase of business development to the point of corporate establishment. They provide several services to encourage establishing a commercial presence in Japan. JETRO does not charge its registered client for services rendered. JETRO`s offices have a JETRO's business library with a database corner containing the Japanese organization database (TSR Company info Index, KOMPASS Online, and so forth) https://www.jetro.go.jp/en/jetro/lib.htmlAHK

JETRO also has a database to search for public tenders of the central government: https://www.jetro.go.jp/en/database/procurement/

Local support

Regional governments also provide assist in the setting up of offices to facilitate entry into the market. Cases include the Osaka Business and Investment Center and the Tokyo Business Entry Point. Some private initiatives are attempting to draw in foreign companies to specific areas of the market and also aid their entry into the market. For instance, EGG JAPAN Business Development is an initiative for creating new businesses situated in the Marunouchi municipality in Tokyo which is primarily targeting IT and environmental technology firms to open a branch office in the areas. The Business Development Center BDC Tokyo is an example of a Tokyo-level initiative. It uses a local methodology to create access to the market, provide support through free business consultations and connection to Tokyo's professional networks. It also offers suitable office space in Tokyo through the Special Economic Zones of Tokyo program.

Research support and collaboration

There are especially great prospects for cooperation between European and Japanese associations in the scholastic energy and environment field, which works in synergy with industry in Japan. Japan is making incredible efforts to lessen CO_2 emissions and improve the climate. It is focused on renewable energies, as well as energy-effective manufacturing techniques, power devices, fuel cells and e-mobility. Research and development, as well as university projects, are firmly involved in its unique innovation efforts.

With regard to renewable energy, solar power technology and research has progressed very well in Japan. Interestingly, wind energy remains largely undeveloped, while research on further advancement is frequently centered around landmark offshore projects. In any case, wind energy specifically is thought to have considerable potential. Although Japan has made huge advances in the improvement of small-but-exceptionally-resourceful wind turbines, mid-sized wind turbines are usually manufactured and imported from Europe. The growing market has a lot of opportunities for European companies through partnerships with Japanese companies in business and research areas.

The three main funding groups in Japan are the Japan Society for the Promotion of Science (JSPS), the Japan Science and Technology Agency (JST), and the New Energy and Industrial Technology Development Organization (NEDO). The JSPS and JST principally finance scholastic research, with the JSPS primarily in a "bottom-up" design, while the JST chooses topics and calls for academic papers or contributions that might be of benefit to the advancement of technology. NEDO, which funds industrial R&D through partnerships and connections, largely operates along similar lines to the JST due to the manner in which it issues calls and evaluates research projects.

The JSPS operates the Grant-in-Aid program: a major funding instrument meant to competitively assign research grants. This is done with an annual application in autumn from all disciplines such as the natural, social sciences and humanities with room for special applications in distinctive areas for small groups interested in such research. A larger part of the funding program is mostly granted to competitive applications in response to selected topics and issues. For instance, the JST issues such calls under its ERATO plan or for international partnership effort on predetermined issues through its SICP plan.

Often beneficiary of the funds are national colleges, independent administrative institutions, private colleges and private industry. Examples of previous beneficiaries are:

- Japan Science and Technology Agency - JST http://www.jst.go.jp/EN/
- New Energy Development Corporation - NEDO www.nedo.go.jp/english/
- Japan Society for the Promotion of Science - JSPS www.jsps.go.jp/english/

Also, there are several bilateral research and partnerships on research in Japan. The German Research and Innovation Forum Tokyo is an example of such research collaborations.

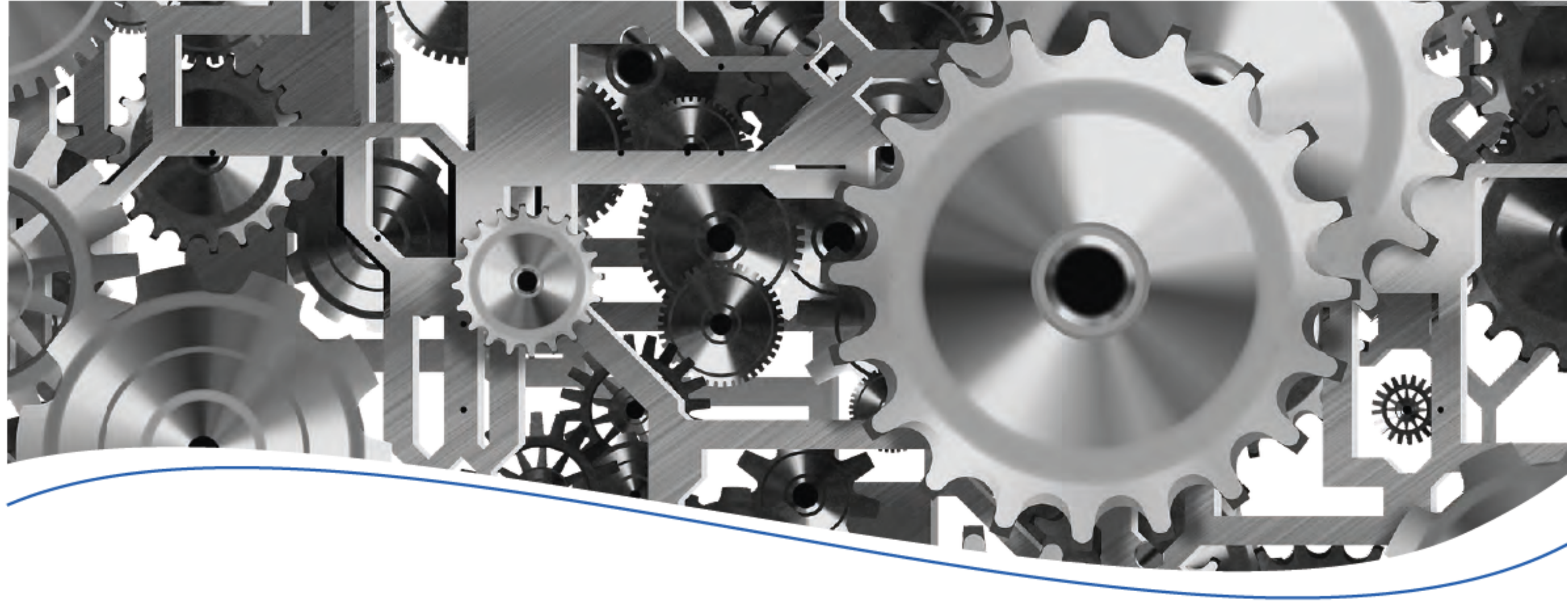
The German Research and Innovation Forum Tokyo

The German Research and Innovation Forum Tokyo (DWIH Tokyo) stands as an umbrella body for all German scientific and research matters in Japan. Its objective is to coordinate the activities of German research bodies and innovative firms in a purposeful fashion to reinforce economic and scientific ties with Japanese associates.

The DWIH Tokyo forms an essential point of contact for Japanese and German research bodies, colleges, the general public and businesses.

The DWIH Tokyo was jointly established in 2010 by the German Rectors' Conference (HRK) and the German Chamber of Commerce and Industry in Japan (GCCIJ) as the initiative of the Federal Foreign Office of Germany and the German Federal Ministry of Education and Research.

Wind energy industry in Japan: stakeholders and domestic industry trends



4. WTG related industry in Japan: stakeholders and domestic industry trends

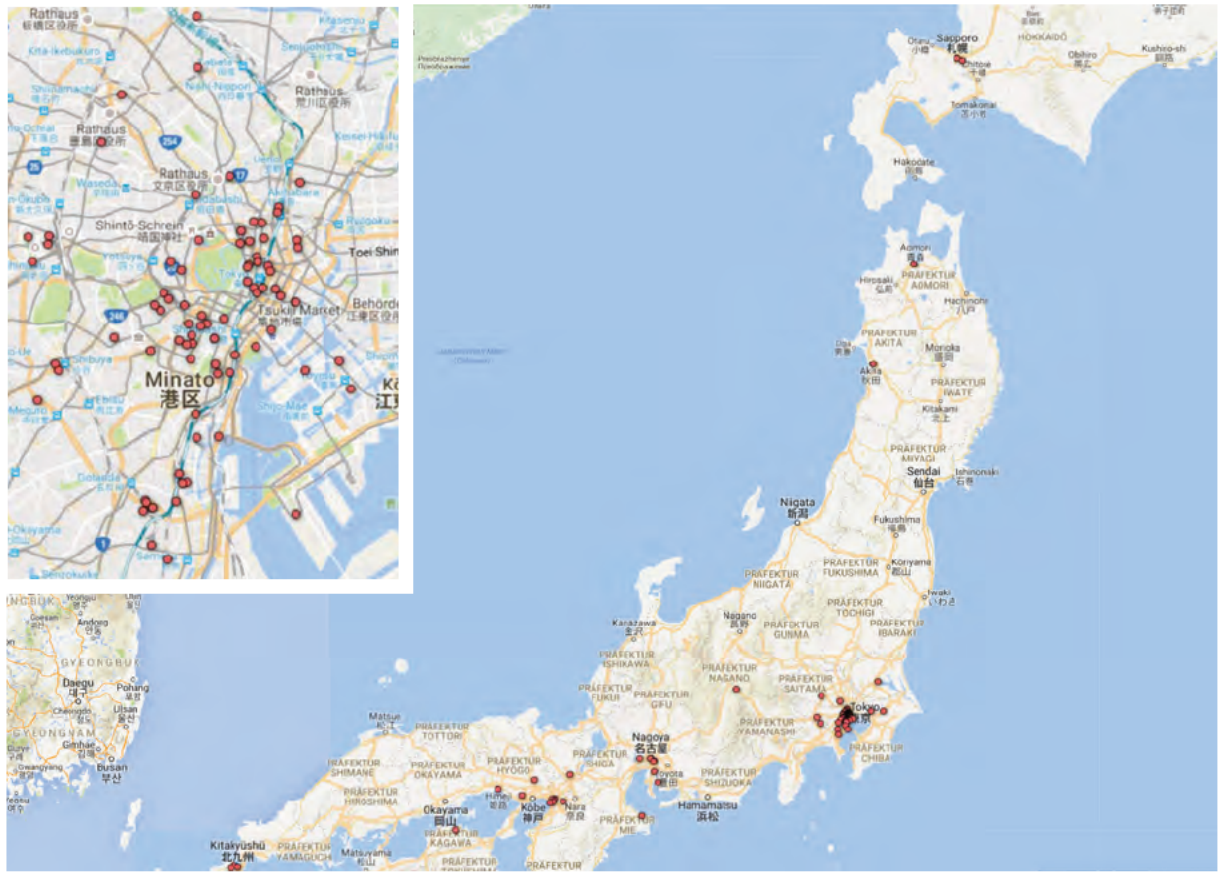
The following chapter provides an overview on main stakeholders in Japan, ranging from project development to turbine manufacturing, equipment and component suppliers, as well as political bodies and sector groups and associations. The overview of the industrial sector in Japan is based on interviews with key players and experts from the field as well as the latest reports by JEMA, the Japan Electrical Manufacturers' Association.[78]

78 JEMA (2016): The Japan Electrical Manufacturers' Association 2016 WTG Industry Survey (In Japanese). Publication by JEMA.

4.1 Virtual map of industry players and stakeholders in Japan

As part of the research, a list of all relevant industry players has been conducted for this report, that is attached in the Annex. Based on that list, a virtual map was created to visualize ca. 280 relevant companies, linking their GPS data with website, address, details on business, telephone and email-contact. Screenshots below and on the follwing page provide examples. This map can be accessed through the follwing URL:

http://www.eu-japan.eu/publications/wtg-industry-related-players-japan



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4.2 Size of the WTG industry in Japan

A survey was recently carried out by the Japan Electrical Manufacturers Association (JEMA) and the Japan Society of Industrial Machinery Manufacturers (JSIMM) on the domestic WTG industry in Japan. This report discovered that due to, the modern size of the wind power sector (the equipment aspect especially), the industry experienced further developments and advancements in 2015. The report ended by pointing out that there is substantial potential for Japanese WTG organizations in the global market ("Future is bright").

The number of domestic companies and employees in wind-related industry has been increasing while the amount of domestic factories has remained stagnant over the previous year:

- 64 companies with 72 sites in Japan now exist in the WPG equipment industry (previous year 59 companies)

According to the 2015 JWMA report, around 58 million people (previous year 54 million people) are employed at these companies, of which about 3.500 are directly or indirectly engaged with the wind sector (previous year 3.000 people).

Production base sales revenues have increased with significantly higher sales than last year:

- Production base sales revenues of domestic production volume account for 103,6 billion Yen (¥54 billion previous year)
- Overseas production with an amount of ¥6.8 billion (¥13 billion previous year)
- Overseas shipments of domestic production is ¥50.6 billion (¥36.8 billion previous year)
- Expansion potential for domestic companies has enlarged: For 2020, the domestic industry projects an increase of 28% (previous year 24%).

As revealed by these figures, there seems to be a market demand for Japanese technology as shown below:

- 24% increase in "the development of new technologies" (17% previous year)
- 23% reduction of withdrawal from the industry (24% previous year)
- 19% reduction in cost of product (30% previous year)

High oversea shipping/ export ratio

The figures show that numerous assembling firms, both turbine and segment suppliers, earned more in markets abroad than in Japan. The assembling representation of Japanese firms are, in this manner, solid in contrast with the size of the local market. Around 80% of those involved believe that the local business sector will develop in the future whilst also expanding their market share in Japan.

Miniaturized scale/little turbine manufacturers primarily produce for local markets and don't dispatch much of their products abroad. Medium size turbine manufacturers sold the majority of their items to local markets in 2015, but intend on focusing on outside markets with current and future output. Recently, there has been an increase in the quantity of extensive scale turbine production. Last year the majority of producers sent their products to local business sectors, but this year, most manufacturers are primarily focusing on international markets. Bearing producers regularly ship abroad, and shipments of yaw/ pitch driving frameworks/ braking mechanisms/ pressure driven components are sold. As indicated by 2015 JEMA overview figures however, the greater part of component producers still sold to the local market.

In the field of miniaturized scale/little WP generators for wind turbine design, abroad acquisitions of components were unstable due to the manufacturers direction of business. The abroad acquisition proportion of moderate size WP generator producers is low, with that of huge scale WP generator creators being about half. Component producers have high local acquirement proportions, however in the area of blades body/ nacelle cover and rotor hub/ main shaft/ speed increaser/ gear, abroad acquisitions are varied for different makers.

One of the JWMA report 2016 findings revealed a high amount of oversea shipping, meaning that:

- 49 % of wind WP generators and 68% of parts were produced for overseas
- The sales of large-scale WPG production volume of control panel/ converter system/ transformers, generators, ancillary facilities have increased significantly
- Bearing, yaw, pitch drive systems/ hydraulic equipment has seen stable sales in the last year.

Overseas shipment ratio/ Import

With regard to the importation of equipment, the survey says:

- Micro/small wind generator manufacturers had few shipments, mainly to Japan
- Medium-sized wind power generator manufacturers overseas shipments remain low
- Large wind power generator manufacturers overseas shipment is about half of their stock
- Spare parts makers mainly sell their products to the domestic market

WTG/ OEMS buy a lot of parts

A relatively large number of manufacturers have purchased parts from other companies in the industries of Yopitchi drive systems/ brake systems/ hydraulic equipment, blade, etc. But there is a difference between the purchase ratio of parts by manufacturers for body/ nacelle covers and control panel/ converter systems/ transformer.

Overseas procurement rate

There is a difference in the in the domestic production content of products as certain parts are being procured from overseas by manufacturers in the micro/ small wind power generator industry.

- Overseas procurement rate of medium-sized wind power generator manufacturer is small, while
- large wind power generator makers have acquired about half of the parts from abroad.

Manufacturer of parts have generally a high parts procurement rate in the country. In the industry, the procurement ratio of the blade body/ nacelle covers and rotor hub/ main shaft, gearbox/ gear is dependent on the manufacturer.

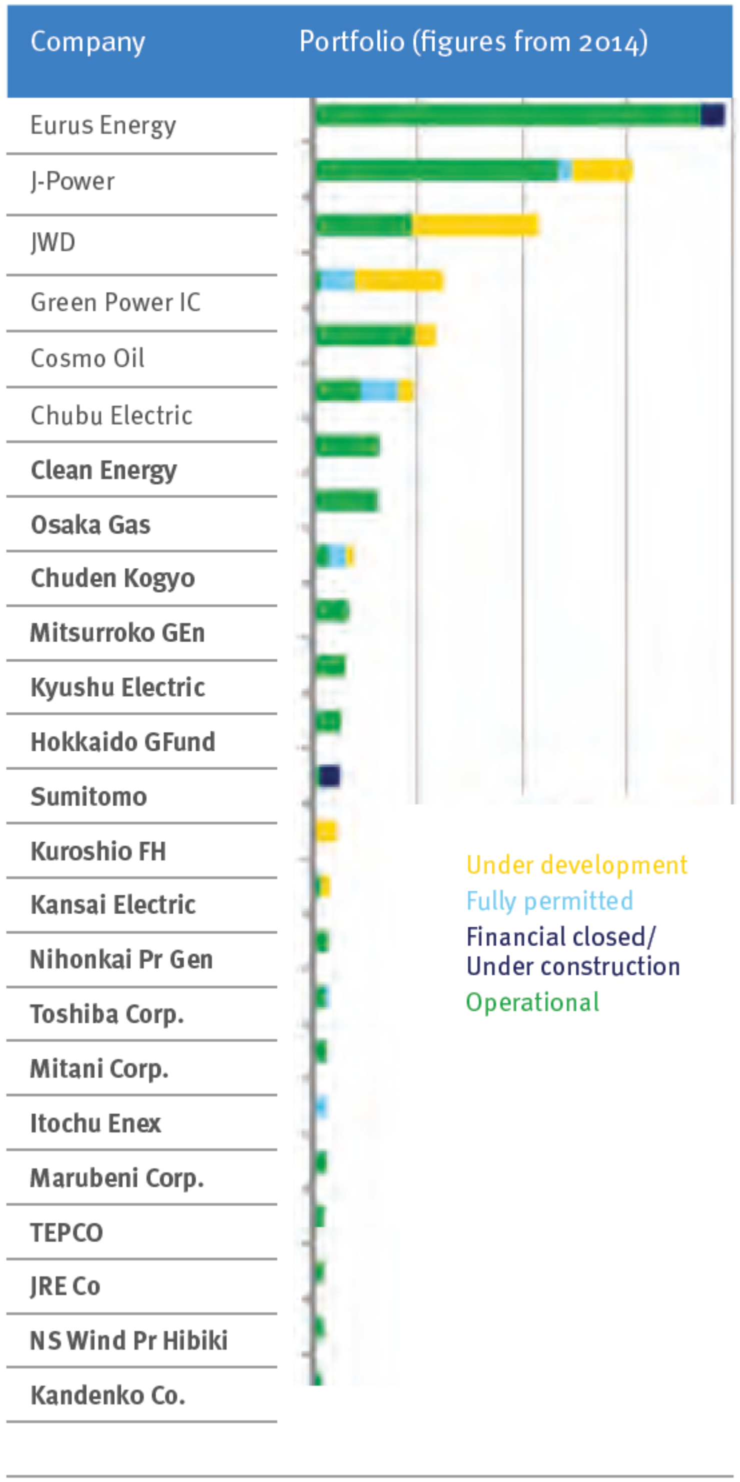
Industrial cross-cutting request

The Industrial cross-cutting proposal of the WPG industry in Japan is that the industry of wind turbine body and related components should expand and develop continuously. The goal after that is naturally to achieve a dominant world market share by expanding abroad.

In regards to turbine bodies, in 2014, overseas procurement was high in every scale with large scale seeing a 55.2% rate in procurements from overseas, alongside half of purchased components also coming from overseas procurement. Due to high proportions of large scale WPG, the average of WPG bodies is 55.2% of imports. As for components, auxiliary facility, and others, the categories with high overseas procurement ratio as seen were "yaw/pitch driving system/brake system/hydraulic equipment"(62.8%), "rotor hub/main shaft/speed increaser/gear" (58.5%), and "onshore transformer equipment system stabilizer device/offshore WPG related" (52.2%). The overseas procurement ratios of "generators" (15.0%), "control plates/ converter systems/ electrical transformers" (0%), "bearings" (0%), "tower and other accessories" (0%), are low, and almost all of them are procured in Japan. The overall average of components is 26.9%. The overseas procurement ratio of "yaw/pitch driving systems/ brake systems/ hydraulic equipment" increased rapidly in 2013, but this is because for the previous four years up until 2012, shipment to abroad had not been calculated due to the circum-

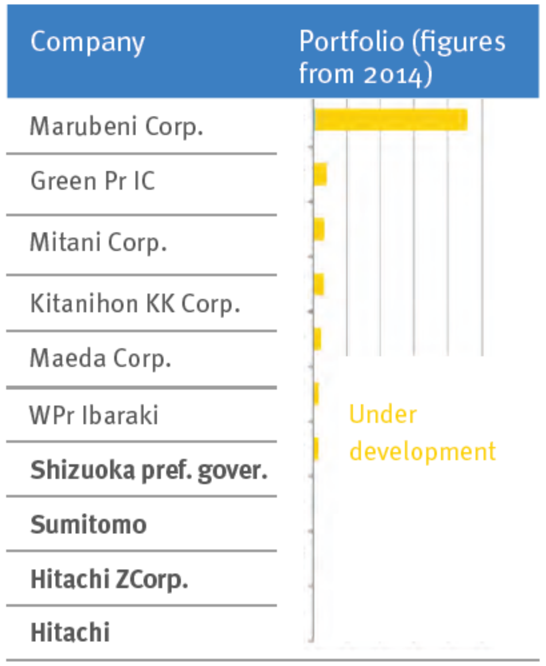
Onshore wind energy developers

Source: IHS 2014



Offshore wind energy developers

Source: IHS 2014



stances of response. As for the total average of 2014, the overseas procurement ratio of purchased components was 52.0%. As for the total average, "large scale WPG" accounts for a high proportion of total expense. This is heavily influential and accounts for around 50% of the total. The overseas procurement ratio is still high and Japan seeks for the possibility of expanding domestic procurement.

Market forecast of domestic market scale

Micro/small WPG manufacturers: Until last year, there was an extreme difference in the predicted values from manufacturers, but this is no longer the case. Large-scale manufacturers produced two times the outcome that was initially predicted last year.

For component makers: By the most recent JEMA forecast from 2015, the market is expected to expand by an average increase of 1.6 times by 2020 and 2.6 times by 2030. The prediction scale of 2020 has increased by about 30% compared with last year's survey. Calculations are as followed; 2020: ¥3,162-4,079billion, 2030: ¥5.346-6,648billion for domestic markets.

Domestic market prospect

As for the market prospect of micro/ small WP generators, there was a huge gap in predicted value among makers until last year, but this year the gap has disappeared. This seems to be because the micro/small WP generator business is making efforts to dominate the domestic roadmap and because the market of certain scale is being formed due to an increase of certified small WPG. The predicted values of large scale WP generators possessed a possible range of two times, which is the same result as that of last year. Additionally, for components manufacturers, predicted values of yaw/ pitch driving systems/ brake systems/ hydraulic mechanisms see no gap among manufacturers but bearings have a range of three times the usual range. The predicted value of control plates, converter systems/ transformers has a range of 8 times among manufacturers. As for generators, the predicted values range more than 60 times by manufacturers. It is predicted that supposing that the prediction of the last year is the standard, the domestic market will expand on average by1.6 times in 2020, and 2.6 times by 2030. This predicted scale for 2020 has increased more than three times over the expected estimate in the last year. The predicted market scale of the domestic market is ¥316.2-407.9 billion in 2020 and ¥534.6-664.8 billion in 2030.

World market size prediction:

As for small WPG from Japan, the predicted world market size differs by Japanese manufacturers. This is because in Japan both, the kW-and the relatively middle in size MW-class, are categorized into a group called "small size generators", and each of them has different markets. As for large scale WPG, the predicted value ranges in as small as 1.3 times. The components manufacturers' market scale is also different from the trends in the domestic market. The predicted values of control plates/ converter systems or transformers have a wide range. But for other components the gap is smaller. The world market shrank a little in 2013 but is expected to expand again in the future. It is predicted to expand on average 1.5 times by 2020 and 1.8 times by 2030. The current world market size is 40 times the size of the domestic market, with the domestic market being sluggish during recovery. However, Japanese WPG manufacturers and components manufacturers predict that the domestic market will expand rapidly from now on; estimating the total value of 1/50 of the world market by 2020 and 1/30 by 2030. In the long run, its share in the world market will increase. The predicted world market size is ¥12-16 trillion for 2020 and ¥15-22 trillion for 2030, which is almost the same as that of last year.

Domestic industry trends

The domestic sales prospects until 2020 of WPG related industry were measured by each company; 28% expect to expand (24% last year), 27% expect to expand a little (35%) while 55% (59%) of manufacturers predicted that sales will increase. The reason for expansion are: private sector demand (26%), induced policy" (25%), better technology compared to other companies, and better cost compared to other companies. Last year the policy option accounted for the largest proportion, i.e. the expectation towards influences of private sector demand and cost compared to other companies increased.

The world's industry trends

The world's sales prospect until 2020 of WPG related industry by each company was 39% to expand (40% last year) and 18% to expand a little (13%). 57% in total (53%) of manufacturers predict that sales will increase while 28% (30%) of the manufacturers responded with the sentiment unchanged. Justification or explanation of growth perceptions within the industry are as follows; 24% of the makers think the expansion occurs by technical superiority compared to other companies, and 22% refer to induced policy, which is a little different from domestic trends.

Strategy of domestic players

The strategies which manufacturers think as necessary were technology development (24%), differentiation of product (23%), shrink of or withdrawal from wind turbine product" (19%). The result of last year's survey was as follows; price/ cost reduction (30%), differentiation of product (24%) and technology development (17%). Price/cost reduction has decreased to 15% and shrink of or withdrawal from wind turbine products has increased sharply from the last year. As for strategies in the world market, technology development and price/cost reduction were 23%, differentiation of product and shrink of or withdrawal from wind turbine product were 14%. According to last year's survey, technology development (34%), differentiation of product (25%), and price/cost reduction (17%) placed top, in similar fashion with this year's trend, while shrink of or withdrawal from wind turbine product has seen an increase in popularity.

4.3 Project developers onshore

As visible in the table on the previous page, the leading wind farm developer with the largest wind portfolio in Japan is Eurus Energy (Japanese) followed by J-Power (Japanese) and JWD (Japan Wind Development, Japanese). Eurus Energy is jointly owned by Toyota Tsusho (60%) and Tokyo Electric Power Company (TEPCO, 40%). Eurus additionally runs ventures in Europe. As wind power still accounts for just less than 1% of Japan's electricity supply, the business sector remains small.

The biggest wind designer, Eurus Energy, built the Yuri Kogen Wind Farm (51 MW Siemens) in the Akita Prefecture on December 18, 2015. This was the largest wind farm commissioned in 2015. . Eurus keeps on being dynamic in Japan`s wind market; it has 526

MW of inland ventures in progress, including those under the EIA procedure. Eight of this, totaling 406 MW are in Hokkaido and Northern Tohoku districts. These locales are trying to access the grid vehemently but further works have been ceased as projects regularly need to scale back.

An Akita-based wind designer, Wind Energy, established by Akita Bank and different firms, has finalised arrangements to assemble a 44.7 MW wind farm on the Katagami Coast of Akita Prefecture.[79] On January 26, 2016, the MOE unveiled their conclusions about the preparatory EIA report, a report on measures for ecological conservation in the undertaking site in view of the EIA examination. MOE requested A-Wind to do a subsequent examination to reevaluate the area and types of WTG because of worries about clamor, shadow glimmer, and bird accidents. The may not be completed before 2020.[80]

79 BNEF 2016, renewable market snapshot
80 https://www.env.go.jp/policy/assess/3-1procedure/

4.4 Project developers offshore

The situation for offshore wind power developers varies broadly from that of coastal developers. As shown by the present condition of things, this division needs enormous investment from bigger partnerships and technology companies as it has greater prospects which are yet to be explored. Marubeni contributions have been very influential and important; however, this is basically due to the Fukushima Forward project, which was recently completed with the 14 MW drifting offshore farm (see case study). Additionally, Japanese speculators and trading partners, for example, Marubeni, Mitsubishi, and so on need to invest more into wind power development in Europe.

4.5 The manufacturing sector

As market growth in the wind sector is expected, other international manufacturers are entering the market. For instance, Senvion recently opened an office and Siemens officially announced in 2016 its commitment and belief in the takeoff of the Japanese market.[81]

However, in 2015, three local turbine suppliers (above 1MW) still dominate the Japanese market: Mitsubishi Heavy Industries (MHI), Hitachi-Fuji and Japan Steel Works (JSW). They accounted for more than 70% of new wind installations in 2014. This has been very different to last 10 years when foreign manufacturers had been very present with high market shares in Japan, causing additional transporting fees and exchange rate risks and variations (e.g. in 2011, Japanese manufacturers were involved in only 23% of the cumulative installed capacity of Japan). These three manufacturers' cumulative domestic market share between 1995 and 2011 was about 23%, and all other wind turbines were imported, mostly from Europe. However, the market shares vary a lot every year. The market share of the three Japanese firms was 18.8% in 2006, 9.5% in 2007, 24.5% in 2008, 19.4% in 2009, and 33.3% in 2010, but increased to 61.9% in 2012. In terms of their presence in the world market, it is miniscule (2013-2015).

Domestically manufactured wind turbines account for about 28% cumulative introduction and 23% newly installed. The share of WTG manufacturers varies year by year. Reforms of Construction Standard Act could have caused the difference, and there is no trend where a certain manufacturer keeps a large or dominant share. In the market of hundred MWs per year, the WTG manufacturer who supplied large or several wind firms gain a large share of the year, and the market share of domestic turbines depends on whether that manufacturer is located in Japan or abroad.

Accordingly, there has been a strong shift towards domestic manufacturing since 2013. However, because of the existence of a small-scale domestic market, the Japanese wind energy industry is also small.

MHI is the largest among the three but has shifted its wind turbine business to the joint venture company Mitsubishi Vestas Offshore Wind (Vestas MHI, MVOW). Hitachi acquired the wind turbine manufacturing division of Fuji Heavy Industries in July 2012. Hitachi made an agreement with MHI to acquire a license to manufacture and sell MHI`s MWT100A-2.5 wind turbines in Japan`s wind market on December 14th, 2015. Hitachi will also be able to provide O&M services for turbines. This will diversify Hitachi`s wind turbine capacities and strengthen its position in the domestic market. Previously, Hitachi only offered a 2MW downwind onshore turbine and a 5MW downwind offshore turbine. Hitachi has been increasingly growing its share of the wind turbine market, supplying 93MW between 2012 and 2014.

81 "Japan's energy market is experiencing a liberalisation of electricity retailing and the outlook for future wind power business is very promising," said Siemens Onshore Wind CEO Thomas Richterich. http://www.windpowermonthly.com/article/1391490/eurus-awards-siemens-416mw-japan-order

In addition, some of the bigger (international) Japanese companies began strengthening their offshore-related technologies and functions, in particular, those engaged in the Fukushima Offshore Demonstration Project.

A majority of foreign manufacturers, including Siemens (Germany), GE (U.S.), Vestas (Denmark) and Enercon (Germany) are also active in the Japanese market. The global wind market is currently very competitive with a high M&A activity (e.g. Gamesa-Siemens and Nordex-Acciona) amidst pressure through country auctions that increase renewables' competitiveness and drop in prices of wind energy components (Mexican auction 2016, Morocco tender 2016). Against that background, the Japanese market is attractive as it promotes offshore wind farms, which are seen as having more room to grow with reasonable onshore prospects.

4.6 Japanese New Turbine Models and Designs

Hitachi's HTW 5.0-126 5MW model has begun operation in Kamisu city (close Tokyo) since September 2015. The second 5MW turbine for FukushimaFORWARD was fabricated at Hitachi's processing plant; it has now been introduced on the JMU's spar floater and it began operation in August 2016. Hitachi intends to get approval from Kashima port offshore wind project for its 5MW turbines.

Details on key WTG manufacturers from Japan:

Hitachi Ldt. (Japan), www.hitachi.com/products/power/wind-turbine

Hitachi (a Japanese multinational engineering and electronics conglomerate corporation) and Fuji Heavy Industries (FHI) have reached a basic agreement on the assignment of FHI's wind turbine business to Hitachi. The assignment of wind business from FHI to Hitachi was completed in July 2012. Hitachi produces 2-MW downwind type wind turbines and announced a plan to develop a 5-MW downwind type offshore wind turbine. The prototype testing of 5-MW offshore wind turbines commenced at the start of the 2014 fiscal year and Hitachi has started selling the 5-MW offshore wind turbine from FY2015. Hitachi's HTW5.0-126 5MW prototype started operations in Kamisu City in September and has been installed in the Fukushima Forward project. Hitachi is presently seeking orders from the Kashima Port Offshore Wind Project for its 5MW turbines.

Hitachi began the development of a WP generation system of 2000kW in partnership with Fuji Heavy Industries Limited (FHI) in 2003. Mass production began in 2008 with the transfer of the wind turbines department from FHI in 2012. As of 2016, it owns the 2,000kW wind turbine HTW2.1-80A, HTW2.0-86, 2500kW wind turbine, HTW2.5-100, and the 5,000kW wind turbine HTW5.0-126.

A brief history of Hitachi and its involvement in the wind turbine industry:

Hitachi entered into wind turbine industry:

- 1998-1999 entrusted with improvement of research of WINDMEL-2 (16.5kW)(FHI)
- 1999-2003 entrusted with development of NEDO WP generation system for isolated islands (FHI)
- 2000 developed SUBARU15/40 40kW wind turbine (FHI, electric system by Hitachi)
- 2002 developed SUBARU22/100 100 kW wind turbine (FHI, electric system by Hitachi)
- 2005 co-developed HTW2.1-80 (former model SUBARU80/2.0) with FHI
- 2008 began shipment of mass production turbine of HTW2.1-80 (former model SUBARU80/2.0)
- 2012 business transfer of wind turbines department form FHI and integrated into Hitachi
- 2012 began development of 5,000kW WP generation system (HTW5.0 series)
- 2014 the first farm of wind turbine HTW2.0-86 began operation
- 2015 obtained license of 2.5MW WP generation system from MHI

Downwind turbine type adopted in 2MW and 5MW wind turbine has following advantage

- efficiently catch the blow-up wind at mountain site
- able to maintain wind direction and control (yaw control) at the time of blackout, have specific stability
- blade and tower don't get damaged, even when the length of the blade is increase.

The factories for nacelle, generator, and PCS are located in Hitachi city, Ibaraki prefecture.

Details on key WTG manufacturers from Japan:

Mitsubishi Heavy Industries (Japan), www.mhi.co.jp

Mitsubishi Heavy Industries (MHI) installed its first turbine in 1980 and is Asia's oldest wind turbine manufacturer. Its manufacturing footprint remains solely in Japan, having been unsuccessful in the US in 2013 in an attempt to locate production outside its home country. MHI turbines are installed in more than 10 countries with a combined cumulative capacity of more than 4.5 GW. Its core products include the MWT 62-1 MW and MWT 92/95/100/102 2.4 MW turbines. The most recent addition to its product range is the MWT 167H/7 offshore turbine, known as SeaAngel. The prototype was installed at Hunterston, in Scotland, at the end of 2014. The formation of MHI's offshore joint venture with Denmark's Vestas in September 2013 has overshadowed the SeaAngel's development, with the MHI-Vestas Offshore JV's 8 MW turbine taking centre stage. MHI produces 1-MW, 2.4-MW, 2.5-MW wind turbines and are developing 7-MW offshore wind turbine with hydro-drive train. Mitsubishi Heavy Industries, Ltd. (MHI) built the second 7MW turbine for the Fukushima floating offshore wind power project (FukushimaFORWARD). It finished installation of the semi-sub type offshore floater and was commissioned in September.

However, in order to make the business domestically stable, each supplier and manufacturer requires a larger domestic market. As this hasn`t been the case in past years, MHI switched to the joint venture with Vestas in 2013. As a relatively large player, MHI had large domestic wind manufacturing expenses due to its two-digit wind turbine capacity in Japan unlike large global players such as Vestas and Siemens, which have four-digit annual production. As a result, MHI has a very weak business basis with large expenses, making it disadvantageous for its manufacturing arm to be a strong force in a small domestic market.

Toshiba (Japan), www.toshiba.co.jp

Toshiba, also a Japanese multinational engineering and electronics conglomerate corporation, has historically been one of the big players in Japan's nuclear industry: the reactors at the Fukushima nuclear power plant which faced the partial meltdown were Toshiba technology. Toshiba has decided to join the wind power generation business by partnering up in 2011 with Unison, a South Korean wind turbine manufacturer (with an investment around EUR32 million). Toshiba has started selling its 2MW wind turbine. In 2013, Toshiba moved into wind development with the acquisition of Japanese developer Sigma Power Janex, a subsidiary of Kyushu-based Janex. Sigma has two wind farms in operation (16MW Shin-Kamigoto Whales wind farm in Nagasaki prefecture and 2MW Nagashima-Kuronose wind farm in Kagoshima prefecture). The company is also set to build a new farm in Shin-Nagashima in Kagoshima, which is scheduled to start operation in 2014. There are also plans at various stages of development for four more wind farms in Tohoku, Chugoku and Shikoku regions of Japan

JSW, Japan Steel Works (Japan), www.jsw.co.jp/en/products/wind_turbine/

JSW produces 2-MW gearless permanent magnet synchronous generator (PMSG) wind turbines. Another 2.7-MW wind turbine has also been launched. Japan Steel Works (JSW) has also started producing 3MW class gearless PMSG type wind turbines.

Hitachi has implemented a downwind plan to target markets vulnerable to standard tropical storms and electrical tempests. A downwind design implies that the wind disregards the nacelle and pass around the tower before making contact with the blades. The Hitachi plan empowers blades to be flexible and adaptable to strong winds so that the edges can flex outwards without the risk of hitting the tower. Permitting the blades to flex implies the energy from the compelling winds can be dispersed, as opposed to driving unbending blades to snap. To encourage a decrease in the possibility of a blade-tower collision, the Hitachi rotor is adversely disposed to the center so that it focuses skywards as opposed to being on a level plane. The downside of the downwind plan is the shadowing impact of the tower as the blades go behind it. To reduce these effects, the tower can be streamlined, but this must be remunerated by sturdier configuration – unavoidably prompting an increase in manufacturing costs.

Mitsubishi Heavy Industries Ltd. (MHI) created one 7MW wind turbine for the Fukushima gliding offshore wind power venture-FukushimaFORWARD (see case study). It has also installed it on the semi-sub spar floater at the quay of Onahama port (20km seaward) in July 2015 and was subsequently commissioned in September. However, MHI has moved its wind turbine business to a JV with Vestas, named Mitsubishi Vestas Offshore Wind (MHIVestas) after it decided to stop producing wind turbines.

For the Fukushima project, Hitachi (with its downwind design) and Mitsubishi has implemented extra measures to protect their turbines from electrical tempests. The higher frequency and dexterity of the lightning security is to rapidly move incoming electric currents into the ground to keep key parts in the nacelle away from danger. Hitachi`s blades incorporate conductors that keep running from the blade tip to the tower base where the current is released into the ground. Mitsubishi`s SeaAngel utilizes a copper network beneath the surface to permit the current to easily get away. Similarly, Vestas employs a copper blade tip system to protect installation from lightening impacts.

Japan Steel Works (JWD) has also begun producing 3 MW class gearless PMSG type wind turbines.

Toshiba has begun offering its 2 MW wind turbine. Three wind turbines have been installed at Nagashima in Kagoshima prefecture and Tomamae in Hokkaido in 2015. Toshiba showed its one of a kind innovation with its "plasma aerodynamic control on blade surface" at Nagashima site. Plasma's electro-magnetic power empower the sharp edge surface stream and enhances wind turbine operation by averting stalls. The Japanese Wind Energy Association (JWEA) awarded the innovation with a "2015 Technical Paper Award" in November 2015.

Foreign WTG manufacturers in Japan:

A majority of foreign manufacturers, including Siemens (Germany), GE (U.S.), Vestas (Denmark) and Enercon (Germany) are also active in the Japanese market. The global wind market is currently very competitive with a high M&A activity (e.g. Gamesa-Siemens and Nordex-Acciona) amidst pressure through country auctions that increase renewables' competitiveness and drop in prices of wind energy components (Mexican auction 2016, Morocco tender 2016). Against that background the Japanese market is attractive as it promotes offshore wind farms, which are seen as having more room to grow with reasonable onshore prospects.

Foreign WTG Manufacturer and Joint Ventures

Manufacturer	Country	Represented by
Vestas MHI (JV)	Denmark + Japan	in the past: Vestech / since 2011 Vestas (with MHI for offshore since 2012)
GE Wind Energy (+Tacke)	US	GE Japan
Enercon	Germany	Hitachi Engineering & Service (Due to Japanese regulations, Enercon's concrete tower can not be installed in Japan.)
Siemens (+Bonus)	Germany	Siemens
Senvion (formerly Repower)	Germany	Meidensha
Gamesa	Spain	Toshiba Plant System
Lagerwey	Netherlands	JFE Engineering (License)
IHI-Nordex	Germany + Japan	Ishikawajima-Harima Heavy Industries (IHI)
Hitachi-Fuji	Japan	License for MHI MWT100A-2.5
Ebara-Pfleiderer Wind Power	US, Italy	Ebara Corporation
DeWind	Germany	Fuji Electric
Ecotecnica	Spain	
Fuhrlander	Germany	Ebara

Vestas Wind Systems (Denmark), www.vestas.com
Vestas is one of the leading turbine manufacturers in terms of annual capacity installed, the lead has been briefly lost to GE in 2012, but regained in 2013 and maintained in 2014. In 2015, Goldwind took the pole position in a very competitive market due to China`s extreme growth (with only small share for non-chi nese manufacturers). In Japan, Vestas successfully gained market share when the company entered the market as Japanese are very prone to cooperate with market leaders. However, the company were not able to maintain good reputation and relationships with Japanese customers, which complained about a lack

of market adaptation and business understanding. After a seven-year absence, Vestas re-entered the Japanese market with the launch of a 2.85 MW turbine specifically developed for local conditions in Japan. Furthermore, Vestas strengthened its standing by entering a 50/50 joint venture with Japan's Mitsubishi Heavy Industries in September 2013 to form MHI-Vestas Offshore Wind to develop and sell its 8MW-offshore turbine. Behind Siemens, it has held the world's number two position in the offshore sector for the past decade. Vestas has turbine assembly and component manufacturing facilities in China, Denmark, Germany, Spain, India, Italy, the UK and the US.

Suzlon (India), www.suzlon.com
Suzlon denied any negotiations with Japanese companies, after reports in 2014 suggested it was seeking to establish a joint venture to develop offshore turbines in Japan. to establish a joint venture to develop offshore turbines in Japan.

Enercon (German), www.enercon.de
Enercon has been active in Japan since 1998. It has installed more than 250 turbines with 396.65MW capacity. The company concentrates on Onshore wind turbines. Enercon recently supplied Eurus Energy`s 18.37-MW Otoyo Wind Farmwill with 8 wind turbines. The wind farm will be sold to the Shikoku Electric Power Co Ltd.

Siemens (German), http://www.energy.siemens.com/hq/en/renewable-energy/wind-power/
Siemens is a German multinational engineering and electronics conglomerate corporation which has secured several orders in Japan in 2016, such as 13 3.2MW turbines to the Eurus Higashi Yurihara project near Yurihonjo City in Akita prefecture. Siemens Onshore Wind CEO Thomas Richterich has been cited in 2016 with optimistic statements about the Japanese wind market and called the market "very promising". Siemens is currently ranked number one in the offshore market worldwide. Siemens also won an order from local developer J-Wind Setana to supply 16 turbines for the 50MW Setana Osato wind farm in northern Japan. The company announced it would install 3.2MW D3 direct drive turbines at the site near Setana town in the east of Hokkaido Island with commercial operation scheduled for 2018. In 2016 Siemens and Gamesa (Spain, www.gamesa.com) have signed binding agreements to merge Siemens' wind business with Gamesa. The tie-up would create the world's largest producers of wind turbines. Gamesa's strong onshore business and Siemens' leading position in offshore are perceived as highly complementary.

GE (American), www.ge.com, represented by GE Japan
The American multinational company re-entered the Japanese market in 2014. GE purchased the wind power business of bankrupt U.S. energy company Enron in 2002. GE has profited in recent years from a very strong US wind uptake. In Japan, GE is also active in the PV market e.g. the delivery of 1.5kV solar inverters for Japanese projects.

Senvion (German), www.senvion.de
Senvion SE (formerly REpower Systems SE) is a German wind turbine company founded in 2001, now owned by the private equity firm, Centerbridge Partners. In April 2016, Senvion announced the opening of its office in Tokyo to service the local market. BPrior to this, Senvion had already secured some orders for its MM92 turbines.

Goldwind (Chinese), www.goldwindglobal.com
Goldwind surpassed Vestas in 2015 and is now the leading wind turbine manufacturer, due to the very strong Chinese wind market, with 98% of its installations located in China. Traditionally, there are strong business ties between China and Japan.

4.7 EU-Japan industrial partnerships

In most cases, Japanese firms carry out specialized partnerships with foreign companies or out right acquire them. Specifically, there is a great deal of cases of coordinated efforts identified within the offshore wind power industry, for example, the IDEOL organization. Wind turbine industry in Japan is becoming more global on a step by step basis.

Examples of past/ current Japanese activities in this area:

- 12/2010: In December 2010, MHI acquired Artemis Intelligent Power, Ltd. of Scotland to
- provide important hydraulic technology capacity to build 7MW offshore wind turbines for the Fukushima Demonstration Project as well as for other offshore markets around the world.
- 05/2011: Alliance between Toshiba and UNISON, acquired in 2012 (Unison are a Korean wind turbine manufacturer) [82]
- 03/2011: IIn March 2012, Marubeni Corporation, in partnered with the Innovation Network
- Corporation of Japan to acquire Sea Jacks International Ltd, UK, which specializes in offshore wind project installation.[83]

82 www.toshiba.co.jp/about/press/2011_05/pr_j2302.html
83 www.marubeni.co.jp/dbps_data/news/2012/120319.html

New Turbines by Japanese Manufactures

Manufacturer	WTG	MW	Status	Type
MHI	**MWT167/7.0**	7.0MW	**Under commissioning**	**Hydraulic drive**
Hitachi	**HTW5.0-126** **HTW2.0-86**	5.0MW 2.0MW	**September 2015** **March 2014**	**Downwind** **Downwind**
JSW	**J100-3.0**	3.0MW	**September 2013 (2.7MW)**	**Gearless PMSG**
Toshiba	**U88**	2.0MW	**March 2015**	**Plasma control**

- 11/2012: A technical cooperation in floating offshore wind turbines between Hitachi Zosen and Statoil ASA, Norway[84] was recorded in November 2012.
- 03/2014: Toray Industries, Inc. acquired the entire stake in Zoltek Companies, Inc. (headquarters: St. Louis, Missouri, U.S.) making the manufacturer of large-tow carbon fibers a wholly owned subsidiary. [85]
- 04/2014: Mitsubishi Heavy Industries and Danish company Vestas, Inc. (Vestas Wind Systems A/S) formed the JV "MHI Vestas Offshore Wind A/S", specialized in offshore wind.[86]
- 07/2014: Yaskawa Electric Corporation acquired The Switch, a Finnish supplier of megawatt-class permanent magnet generator and full-power converter packages for wind power and other renewable energy applications. Yaskawa is a world leader in motion control and robotics.[87]
- 03/2015: Mitsui & Co., Ltd. entered into an agreement to invest in Gonvarri Eólica, S.L. ("Gonvarri Eolica"). Gonvarri Eolica controls the GRI Renewable Industries Group ("GRI") of Spain, which is the world's leading manufacturer of wind turbine towers and flanges for wind power generation. An Agreement was signed on March 5, 2015. Subject to regulatory approvals by the relevant authorities, Mitsui acquired a 25% shareholding in Gonvarri Eolica by accepting a third-party new share allotment by Gonvarri Eolica and buying shares from existing shareholders.[88]
- 03/2015: Hitz Hitachi Zosen Corporation formed a JV with IDEOL SA Ideol, a French company, which has a floating base structure technology in offshore wind power generation equipment. They recently signed a technical cooperation agreement for floating wind turbine. Less than a month after the official launch of Ideol's first demonstrator (Floatgen), Hitachi Zosen and Ideol have signed a contract launching the construction phase of their 2 floating offshore wind turbines. This second contract follows the design & engineering phase which started a year before. These 2 floaters will be separately manufactured with different materials (concrete and steel) and will be equipped with different wind turbines planned to be anchored using different mooring line materials.
- 04/2016: Japan Steel Works Co., Ltd. and Sumitomo Corporation formed JV Gel Dow Summit with Gerdau SA, Brazil`s largest iron and steel company (headquarters: Brazil Rio Grande sul in Porto Alegre City).[89]

Also, Japanese companies have acquired significant holdings in Belgian offshore wind farms with the formation of a Japanese-Bulgarian JV to supply electricity in Bulgaria using power generated by Japanese owned wind turbines. A German-Japanese consulting work partnership is also in place.

84 www.hitachizosen.co.jp/news/2012/11/000638.html
85 www.toray.com/news/manage/nr140303.html
86 www.mhi.co.jp/news/story/140401212.html
87 www.theswitch.com/2014/07/02/the-switch-to-be-acquired-by-yaskawa-electric-corporation/
88 www.mitsui.com/jp/en/release/2015/1204975_6474.html
89 www.jsw.co.jp./news/20160128_000544.html

4.8 WTG related industry (components, equipment)

Strategic market suppliers
It is believed that the number of components of a wind turbine is around 10,000 to 20,000 in a 2MV turbine, and it is an accumulation of a wide assortment of parts, for example, electrical and control items, iron and steel items, apparatus parts, water powered gear, and gum moldings. These parts, which must be customized to wind turbines-particular loads and ecological conditions, are frequently wind turbine exclusive parts as opposed to broadly useful items. Pivotal course (thrust) load and the heading opposite to the hub (radial) load which the

blade is subjected to is bolstered with the main shaft (rotor shaft) bearing, gearbox, and so forth.

There are powerful Japanese suppliers who enjoy a big share of the global market in the field of bearings, carbon fiber for blades, generators, and inverters. For bearings of a wind turbine, there are primary rotor bearings, gearbox, and headings for the generator. Likewise, there is pitch control hardware at the base of the blades and slewing bearing for working yaw. Japanese makers are aggressive active in large bearings and electric gadgets in the global market. Altogether, roughly 30 bearings are utilized as a part of one unit. Among these, big bearings with 1 to 3 meters OD (outside diameter) require secure innovation and stable quality. Along these lines Japanese bearing producers that were developed alongside the automotive business have solid standing as suppliers. Later on, as wind turbines increase in size and are introduced to offshore locations, there will be an expanding interest for bearings with bigger measurements and high caliber. The position of highly innovative Japanese bearing producers will no doubt increase in the global market. In any case, production facilities abroad could be one choice for remaining competitive as transport expenses will be an issue because of the size of parts.
These days, a blade is fundamentally produced using GFRP; glass fiber fortified plastic. However, as wind turbines get bigger (5MV, 7MV), carbon fiber will attract more consideration because of its high inflexibility and quality. Carbon fiber innovation is from Japan, and products from Japanese firms, for example, Toray, Toho Tenax, and Mitsubishi Rayon represent a vast noteworthy share of the global market. Be that as it may, carbon fiber is costlier than glass fiber and it is normal that the carbon fiber industry will develop further in the field of wind power industry by downsizing (contrasted with carbon fiber for planes) wind turbine blades. In March 2014, Toray acquired Zoltek, a carbon fiber producer in the US.

NSK, JTEKT and NTN are producing big main bearings for wind turbine makers around the world. They are celebrated for high dependability as they were prepared by the Japanese auto companies. Hitachi, TMEIC, Meidensha and Yasukawa Electric are creating generators for wind turbines.

Likewise, wind sector developers additionally support their generation keeping in mind the end goal to take care of the expanding demand for wind turbines, which increases demand for wind machine components around the globe and creates more advantages for machine instrument producers in Japan. In addition, the use of offshore WTGs includes fusing offshore designing and shipbuilding into the wind power industry.

The Japanese yen was reinforced against the Euro in the autumn of 2008. The rate balanced out with 1 euro = 120-140yen and 1 euro = 100 yen before the winter of 2012. Before, wind turbines from Europe and overseas acquisition of components were less expensive. In December 2012, the second Abe cabinet made a startling move, with the Abenomics and fiscal relaxation policies by Japan Central Bank which brought about a weaker yen and exchange rate. Since 2013, the Exchange rate has stayed at 120 to 140 yen per euro. The low yen rate provided domestic wind turbine manufacturers with comparative superiority over price competitiveness. However, it also leads to the higher cost of equipment supplied from abroad.

Electric generators

In Japan, there is a tendency for large domestic corporations to engage in the production of generators. Hitachi, Fuji Electric, Meidensha, TMEIC, and Yasukawa Electric have already begun production. As for transformers, the ratio of overseas procurement is high because of overseas production by European manufacturers. It is believed that it is possible to achieve a reduce in the weight of the nacelle as the installation site of generator and transformer moves inside of the nacelle to the interior of the tower to enlarge generator capacity. In the future, there is a need for converter and transformer durability improvement since maintenance costs in particular regard to offshore wind are high.

It is estimated that the wind market size for generators will reach up to 600 billion Yen and for control equipment, converter systems, and transformers up to 500 billion yen in 2020.

With the enlargement of wind turbines, and as offshore wind power generation increases, the introduction of a direct-drive system where wind turbines are directly connected to the generator without a gearbox is advancing. The method of gear drive system using a gearbox is also being introduced, where the structure of the gearbox is simplified by lowering the speed increase ratio with the use of a mechanism and medium speed generator drives.

Both types are intended to minimize the maintenance and trouble of gear and generators whose maintenance is not easy for offshore installations. Therefore, a permanent magnet type synchronous generator tends to be used for drive systems above.

Permanent magnet synchronous generator is superior in maintenance to the wound-rotor induction generator and normal type synchronous generator because it has no winding on the rotor or slip rings and brushes for power supply. The magnet used in the synchronous generator is made of rare earth magnet which runs on strong magnetic fields. Rare earth magnet price soared astronomically in 2011. Because of this, the introduction of a permanent magnet-type synchronous generator has been stagnant for a certain period. An abnormal rise in price occurred because rare earth producing manufacturers has been limited to China, and moreover, because the Chinese government treated the rare earth metal as a strategic material (neodymium Nd, disk dysprosium Dy). Now however, more countries produce this rare earth magnet thus price has stabilized back to normality. Price has drastically reduced such that neodymium costs are now less than $60/kg, which is a good situation for permanent magnet-type synchronous generators.

The wind turbine generator system requires a power conditioning circuit called a power converter that is capable of adjusting the generator frequency and voltage to the grid. Research and development is proceeding in this field to reduce the size, weight, and cost of advanced power converters.

Machinery gearing

Machinery gearing device consists of the rotor hub, main shaft, speed increaser, and gear wheel. The number of companies that have entered the wind industry in Japan has been increasing year by year while sales (about ¥1.5 billion in 2013) per company keeps decreasing. This is partly because the domestic market has not increased to the present day as the launch of large-scale projects has been delayed due to environmental impact assessments. It Is also likely to be due to Japanese component manufacturers not being sufficiently competitive enough yet to produce large gear such as speed increasers in Japan and successfully exporting it abroad. On the

WTG industry players from Japan

Source: overview based on market research, complete list can be found in the annex of the report

Large wind turbines manufacturer	Small wind turbines manufacturer	Blade	Blade materials	Gear	Converter	Bearing	Electric Equipment	Generator	Hydraulic	Machine Equipment	Steel Casting
MHVestas Hitachi (incl. Fuji Heavy Industries) Japan Steel Works JSW Komaihaltec	Komaihaltec Symphonia Technology ZEPHYR Daiwa Energy Kikukawa F-Tec Nikko NKC Nasudenki MECARGO GH Craft Loopwing	Japan Steel Works (JSW) GH Craft	Carbon Fiber Toray Mitsubishi Rayon Teijin FRP Japan U-Pica SHOWA HIGHPOLYMER Co. Ltd. DIC Nippon Reinetsu Ashai Glass Company (AGC) Nippon Electric Glass	Ishibashi Manufacturing Sesa Komatsu Onex K-netsuren	Fuji Electric Risho	Jtekt NTN NSK All 3 bearing manufacturer have their factories in Europe and in the US.	HitachiMitsubishi Electric Toshiba TMEC Fuji Electric Yaskawa Electric Meidensha Fujikura	Hitachi Meidensha Yaskawa Electric TMEIC	Kawasaki Heavy Industries Moog Japan	Nabtesco Sumitomo Heavy Industries Komatsu Akebono Brake Nippon Roballo Toyooki	JSW Nippon Chuzo

other hand, the export numbers of reduction gear used for yaw/pitch control device is increasing. This is because Japanese manufacturers have been developing products superior to foreign manufacturers due to the severe climate conditions, and because domestic products are recognized and adopted by foreign customers in a growing number of cases- in foreign countries, an increasing amount of wind turbines are planned to be installed in locations where wind condition is severe.

There is no heat treatment facility for large-scale gear in Japan and there is a need to develop facilities to reduce cost and endurance in order to compete with foreign gear manufacturers. At the same time, testing apparatus of large gear devices such as speed increasers requires large-scale test equipment, which in some cases has become a barrier to entry.

As for the test equipment and testing laboratories which examine large gear apparatus alone or the entire drive train including gear apparatus, an inspection agency is desired to be developed for the use of various companies. On the other hand, in Europe and elsewhere, including the UK and the US, a public inspection agency of wind power industrial equipment has been established and measures to reduce burden related to testing facilities are being carried out, including a large investment in the product development stage of the private sector. These play the role to remove large barriers when new entrants or even existing entrants deal with the development of larger products.

The current tough market environment is an adverse condition for investment into research and development. But if the domestic market expands, there will be more opportunities for domestic as well as foreign gear machinery and equipment with high durability and efficiency.

Bearing

Bearings used for wind turbines vary depending on the place where they are used. They are categorized into parts directly involved in (a) power generation and (b) parts related to control and assists in driving devices.

(a) The Power generation system is the part directly related to the power generation mechanism, that is, what is used for the main shaft support part, gearbox, and generator. Bearings with 200mm-2500mm of outer diameter are used. Bearings vary depending on the part. In the case of the gearbox mounted type, 200-30 bearings are used, and in the case of the direct drive type, which doesn't mount a gearbox and in which the main shaft directly drives the generator, only one or two bearings are used as the main bearing supports both of the main shaft and generator rotors. In both cases, bearings tend to become larger and have higher load capacity in accordance with enlargement of the wind power generator body.

(b) Related to drive accessory: Although they aren't directly related to power generation mechanisms, yaw drive systems of the nacelle, pitch angle control of blades, swivel seats used in driving part, and bearings used for driving speed reducers are interpreted as part of the demand in a broad sense. Among these, slewing bearing used for yaw/pitch control parts are included in the category of gear in this report, because bearing rings also serves as the gear function as it doesn't rotate at all times like other parts' bearings.

As for bearings for the main shaft, by its enlargement, double row integrated conical roller bearing with steep ascent is more frequently used instead of the conventional spherical roller bearing. The combination of conical roller bearings with cylindrical roller bearings and the rear face duplex of single row conical roller bearings are also expanding so as a result the bearing type of the main shaft is being diversified. The mechanism for increasing the speed of wind power generators is also being diversified due to enlargement. As for the class over 5MW, more and more wind power generators are adopting ways that combine the middle speed generator which has more poles than usual and the one which has middle-speed increasing ratio. This is because that class has a small rotation and requires more than 100 times of speed increasing ratio if it is to use the usual way of increasing speed. The gear type used for this is torque split type of two or three planet type. It tends to need bearings larger than the conventional ones used for the speed increaser. In addition to that, there is a tendency to shorten bearing clearance so that the bearing can endure high torque. More and more bearings are adopted in which the gear and outer ring of the bearing are integrated in order to increase the load capacity of the bearing. Besides, there is a demand for downsizing bearings and increasing its load capacity. Load capacity has become the significant factor to differentiate the performance of bearings. Bearing manufacturers have produced new models aiming at speed increasers for wind power generators.

Considering the involvement of the bearing industry and its demand structure from the viewpoint of the supply chain of wind power related equipment, with wind power generator manufacturers at the top, the bearing industry have a side of the primary supplier (TIER 1) which deals directly with the wind turbine manufacturer and a side of secondary supplier (TIER 2) which go through the major components manufacturer. As for main bearing and slewing bearing of yaw and pitch part related to control, wind power generator manufacturers are the direct customers. As for gearbox, generators, and other accessories, which are main components, the bearing industry is a secondary supplier, because there is a demand from each component supplier. In addition to that, there is a case in which the bearing industry supply various repair works through wind turbine maintenance companies. Other than that, lubricating and lifting devices includes indirect demand for bearings.

In Japan most of the demand comes from bearings for large wind power generators over 1MW, so there is a need for the enlargement of bearings as wind power generators become larger. It is also believed that new participation requires adequate financial and technological resources, considering the necessity for more sophisticated technology from wind power generator manufacturers and the trend for higher quality and reliability. There are four large companies in Japan (NTN, Nihon Seiko, Jtekt) that are related to the bearing industry associated with wind power generation facilities. According to JEMA, these four companies employ around 100,360 employees in total. Among them, only 810 employees engage in projects for the wind industry, which accounts for only 1% of total employees above. This is because customers of bearings vary widely among a range of industries such as the automobile industry, electronics industry, etc. In the future, the ratio is expected to increase as the market of the wind power generation facility industry expands, even though, as of the previous three years, little in the way of market share distribution has changed.. The sales of domestic products was approximately 17 billion yen in 2014 and accounted for approximately 24% of the total sales of 70.8 billion yen. In 2014, the sales of products shipped abroad was around 16.1 billion yen, 95% of 17 billion yen. High export dependence is characteristic for that business. This reflects the reality that large wind turbine manufacturers and related components manufacturers put production bases around demand areas, mainly from abroad such as The US, Europe, and China. There is an expectation by the Japanese suppliers that demand from abroad will increase in the medium to long-term. The overseas procurement ratio of components and materials is marginal, just as it was the previous year. It is believed that this is because manufacturers use domestic high-quality parts and materials to respond to customer's high-quality demand level of bearings for wind turbines, and because it is difficult to obtain the customers' approval on the specification changes such as level of parts and materials from the viewpoint of reliability. However, in addition to the overseas procurement of parts and materials, Japanese suppliers are considering the possibility of relocating production activity itself to foreign countries, from the viewpoint of cost reduction and foreign exchange risk aversion. Overseas production is gradually expanding, from 10 million yen per year in fiscal 2011 to 120 million yen per year in 2012. Accordingly, future strategies of Japanese suppliers in that sector ranges between high-value creation, such as technology development, product differentiation, relocating production abroad and expanding to volume zones by reducing costs.

Japanese bearing manufacturers are reputed to have designed high quality (internal design, FEM analysis, test evaluation of bearings) and good manufacturing quality. However, due to the expansion of offshore installation in which access to the generator is more difficult, higher reliability is required in bearings for offshore and there is a demand for quality guarantee based on nondestructive inspection of bearings especially from European wind turbine manufacturers. Furthermore, monitoring the condition of the whole system including bearings has come to be of more importance, so offshore turbine developers tend to be obliged to install CMS (condition monitoring system). NEDO has been doing related R&D for two years ago within its own projects.

As European countries are advanced in wind energy and by having this competitive advantage they can promote related equipment industries in Europe. Thus they can maintain related equipment industries including bearing makers as well as wind turbine manufacturers. China accounts for nearly half of the market of new installation as a result of the policy supporting domestic production of wind energy. But it is also expected that Japan's wind industry drives and bearing market for wind energy will expand, because of the implementation of FIT in July 2012 and the plan for wind energy in the energy mix announced by the government. Since 2014s, NEDO has promoted R&D projects to develop wind energy which matches the situation in Japan in which several Japanese bearing manufacturers participate. These policies are expected to continue and contribute to the employment and promotion of the bearing industry in Japan.

Speed increaser

TThe current mainstream theme of the MW class speed increaser is the mechanism in which high-speed stage and middle-speed stage reduction gear is combined into one stage planet. Failure is often derived from damage on the intermediate shaft bearing, but it varies from solar gear, middle-speed stage gear, intermediate shaft pinion, torque arm, etc. The main reason of failure is said to be the problem of system interconnection. Due to down of a transmission line side, torque related to the power generator rapidly changes; it may cause inversion of gear torque, resonance, or omission of meshing. There were failure cases which threatened management of manufacturers in Europe. In Japan, the environment is tough on wind power generation because wind state changes drastically in speed and direction and because typhoons frequently occur, even though wind speed may not be so high. If wind turbines from oversea are installed in Japan, its speed increaser tends to experience failure more frequently than in western countries because it doesn't necessarily correspond to the environment in Japan. In addition, there are many cases where it has to cease operation for a long time, due to the service system, which is a big risk for power generation operators. The enlargement of speed increasers has progressed rapidly recently, as it becomes necessary to invest in large-scale processing devices. In addition, in the process of development, manufacturers are required to have large scale facilities and investigations by test operating actual machines with a designed total load of (or more than that); not only investigating in noise and vibration, but if it has planet mechanism, investigation of "equidistance arrangement ratio", cleanness of lubricating oil, and efficiency is required. If it is for the cold district, a freezer test is required. This is an entry barrier for manufacturers that want to enter that field.

In order to contribute to minimizing lifecycle costs, the following challenges for speed increasers can be summed up:

- have to be light, compact, with a simple structure and suppressing the initial cost
- possess enough endurance to handle fluctuating loads
- the structure which is easy to repair in the nacelle and capable of division repair/replacement
- capable of reducing maintenance cost by detecting damages at an early stage or predicting failure by condition monitoring
- aim at optimizing the drivetrain including generator as well as the speed increaser

Pitch /yaw control

Large-scale wind turbines in recent years implement three operation controls: yaw control (wind direction control), pitch control (output control), and variable speed control (excessive output prevention). Pitch control (output control) and yaw control (wind direction following) are used as the standard. With the gradual increase of wind turbines after the 2000s, manufacturers shifted to pitch control. Others shifted to active stall control (to twist the blades in the direction reverse from that of normal pitch control and drop the output forcibly, same as combi stall) instead of passive stall control, but this didn't prevail. Generally, simple epicycle reduction gear or inscribed engagement-type epicycle reduction gear is used. The former is relatively cheap and used in areas where wind direction doesn't change frequently like large-scale wind power plants in western countries. But in Japan, wind speed changes drastically, therefore driving/control devices which control pitch for stable power generation which receives loads repeatedly is predominant. Besides, because changes in wind direction occur more frequently in Japan than in Europe, the speed reducer of driving/control device of yaw control also receives loads repeatedly. In addition to that, the risk of small damages due to typhoons or other natural forces lead to early damage because of high load pressure. The challenge is how to receive biased loads and ensure a robust driving device. Japanese component manufacturers focus on this severe condition by doing analysis and investigations in accordance with the characteristics of wind state, and are known to provide high-quality products and have the potential to compete in foreign markets. However, they are in a high competitive market without large mass production scale compared to European manufacturers. It is expected that with the growth of the wind market in Japan the gear machinery equipment sector will evolve as well.

Blades

Blade production requires a large exclusive factory with comprehensive manufacturing know-how, but that kind of factory doesn't exist in Japan. Besides, the knowledge to secure quality is derived from past long-term experience which advanced manufacturers have, and there is a high barrier for new market entrants. Therefore, domestic players wish to develop standards and guidelines, etc. must rise up with necessary investments. According to the JEMA, it is necessary to produce around 1,200 blades (400 units) per year in order to ensure a stable business case, and maintain a large-scale wind turbine factory. Total domestic demand is now as little as 10%. Therefore it is perceived that it is difficult for companies to decide to establish a new factory in Japan. In addition, the transportation costs of large-scale blades are high because of its size and weight; therefore, it seems difficult for foreign companies to site a domestic factory in Japan. As for domestic market size related to blades, seven companies of blade body/nacelle covers, four blade material companies (fiber, resin), 11 in total responded to the recent JEMA survey. Seven companies of blade body/ nacelle covers responded to the survey, and as early as 2013, there were 152 employees engaged in wind power generation, and 4 factories in Japan with no sales in Japan last year.

As for blade material companies, there were four respondents, one more than 2013, there were 8 employees engaged in wind power generation, 5 factories in Japan, sales of 1 million yen in Japan. There are no large manufacturing companies, and market size is decreasing like last year.

The countries promoting installation of wind power generation as national policy such as European countries, US, and China have been successful in commercialization and accompanying investment in the long-term as well as working on forming an alliance with companies in the long-run. On the other hand, Japan's energy policy doesn't put any priority on wind power generation as all investments are based on short-term budget, therefore it is difficult for entities to develop. JEMA highlights the strength of wind power to develop social infrastructure entailing long-term investment to improve business opportunities. As a result, JEMA considers it indispensable to position wind energy in a long term energy policy which is not subject to fluctuation of crude oil price.

Tower

- Currently, the average Japanese turbine tower (2 MW class) has a height of 65-80m, with a weight of 135 to 200t, and 3 to 4 parts (depending on height and transporting condition. The diameter of the top is around 3m, and 4.5m at the bottom.. One of the challenges in constructing wind power is the transportation of the aforementioned tower. Tower transportation is categorized into marine transport and ground transport. In ground transport, the tower is divided into 3-4 pieces and unloaded onto a particular low-floor trailer or etc. before being transported from the coast to the construction site. Permission is also needed from road administrators and police based on form, size, and weight. An accompanying escort car is also required for safety reasons during transport. In addition, the length of tower in transport is 20-30m though it is separated, therefore widening approaching roads, cutting off trees, or transferring poles is needed when transporting to mountain areas.
- Main maintenance items are retightening bolts just after construction, bolt checks at periodic inspection, and inspections of mounted internal facilities.

The suppliers of main components of tower are as follows:

- steel material makers (Japan, Korea, China, others)
- tower manufacturing makers (Korea, China, others)
- flange makers (Korea, others)
- bolt makers (Japan, Europe, others)

Generally, tower manufacturing manufacturers procure the steel material, flange, ladders, etc. designated by wind power generators makers, and make products through welding. A Winch is often supplied by wind turbine manufacturers, installed and shipped from manufacturing factories. Bolts are procured by wind turbine manufacturers, supplied to construction companies at the place and used for assembling the tower. Nowadays, the domestic main wind turbine manufacturers procure towers as mentioned, and there is no consistent manufacturing of wind turbines including towers. Korea and China have already experienced contracted manufacturing of foreign wind power generation towers. There is no big challenge in manufacturing ability or technology. In addition, tower manufacturing factories in both countries are generally located close to port areas, to improve convenience in manufacturing and shipment. While manufacturing cost is relatively stable,

Examples of suppliers/producers from Japan and EU:

Nihon Seiko Ltd. (Japan), www.nsk.com

NSK is a top-tier supplier of generators and gearbox bearings for wind turbines of up to 8 MW rated capacity. It has more than 60 factories globally. It is also a major supplier of main shaft bearings, producing bearings of up to 2,400mm. Customers include leading wind turbine manufacturers and companies making gearboxes and generators.

In the second half of the 1990s, NSK began making bearings, for wind power generation facilities, which requires high reliability and economic potential, for the European wind turbine industry, who happened to dominate the market at that time, to be interested in. Nowadays it has begun suppling bearings to Japan, US, China, and India. Among the top ten wind power generation facility manufacturers, as many as 9 companies adopt the bearings of NSK, and have contributed to global environment conservation efforts. The bearings used for wind power generation facilities have been increasing in size. Some bearings are required to have an internal diameter of 100-1000mm, or over 2m for some models. Different types of bearings are adopted for main shaft bearings, bearings for speed increasers and generators. NSK can supply these different large bearings to the market. In addition, the WP generation facilities industry is now globally developed. NSK can engage in sales activity and technology services at its main bases around the world. Since bearings for wind power generation facilities required high reliability, sophisticated analyzing techniques, materials and know-how on heat treatment are necessary.

steel material price tends to be subject to market trends, and it is unstable.

Before April 2014, legal regulations towards the turbine itself had been split into Building Standards Law, which covered the supporting item (tower) and the Electricity Business Act, which covered the other parts.

That meant, for the tower an acquisition of qualification by the MLIT and a building certification application to the construction director were required in accordance with the provisions of the Building Standards Law. For other parts of wind turbines, based on the Electricity Business Act, it was necessary to submit the construction plan report, which must be accepted before construction could start. It was also necessary to carry out pre-use self-inspection after construction. Since April 2014, every activity on wind turbines including the foundation and the tower

Examples of suppliers/producers from Japan and EU:

NTN Co. Ltd. (Japan), www.ntn.co.jp

NTN began producing bearings for wind turbine in the second half of the 1990s. It manufactures and sells main bearings such as bearings for speed increaser, generator, yaw/pitch driving reduction gear and mass production of main bearing with diameter 2.5. They also produce test products and supply bearings with further large diameter. It independently developed the world's largest test facility "WIND LAB" where it is possible to evaluate main bearings and their actual size, improve its reliability by actual product evaluation in order to intend to diffuse condition monitoring system (CMS) for wind power generators. It is a participant in NEDO's smart maintenance technology, R&D project with the promotion of 40 units of empirical research.

Main bearings: Main bearings supports the rotor. NTN is mass-producing bearings with low-temperature rise by a adopting design in which roller motion is stable and slip is not likely to occur.

Bearings for speed increaser: speed increaser accelerates to the rotation necessary for generating electricity. Bearings with high reliability are necessary. NTN is mass-producing the bearings with high load capacity and surface damage isn't likely to occur.

Bearings for generator: There is the possibility that the passage of current in bearing can cause spark phenomenon (electrolytic corrosion) for the bearings supporting the rotor of the generator. NTN is mass-producing insulation bearings with ceramic sprayed on their surface.

CMS: The system can monitor the condition of bearings and gears used for the main shaft, speed increaser and generator from distant locations.

NTN's CMS "Wind Doctor" is the minimum size class data collecting device. NTN's "Wind Doctor" is the only holder of the GL certification, a worldwide certification body for wind turbines.

NTN entered into wind turbine industry:
1998: began mass production of bearings for wind turbine
2003: began mass production of ceramic-sprayed insulation bearings for generator
2006: began mass production of bearings for offshore wind turbine
2007-2009: enforce producing ability of ultra-large-scale bearings for wind turbine
2012: developed CMS "Wind Doctor" and also begin selling it the same year.

The Switch (Finland), www.theswitch.com

The Switch, acquired by Japan's Yaskawa in 2014, is headquartered in Finland and has manufacturing facilities in Finland as well as China and the US. The Switch manufactures permanent magnet generators (PMG) for turbines of up to 6.4 MW. In the offshore market, its reference list includes ScanWind 3.5 MW and GE 4 MW turbines. The Switch also manufactures power converters for turbines in the 2-5 MW size range.

Examples of suppliers/producers from Japan and EU:

Jtekt Corporation (Japan), www.jtekt.co.jp

Jtekt is "the young company with history" established in 2006 following the integration of "KOYO", which had contributed to society and had gained recognition as an international bearings brand by producing and manufacturing different bearings. . It began supplying bearings for the main shaft of wind power generation facilities to European markets in 1997. In the wind turbine market, bearings of Jtekt are widely adopted by the world's major supplier for main spindle, speed increaser, reduction gear and wind power generators.

Bearings for main spindle processes complexly change rotation speed and the load of rotor appropriately. Bearings for power generation facilities in which a ceramic ball is used lead to a high insulation performance of the rolling body, and a lower temperature rise than general bearings. The extension of the lifetime of lubricant grease is expected, so extending the maintenance period is possible. It is highly valued by the wind power market with high performance requests. It offers not only bearings but also oil seal, which is used with different parts, including main spindles. They also offer bearings of different forms such as pressure proof types including standard entire lubber type and of different materials, meeting the customers' demand.

Jtekt is also working on the development and improvement of the bearings and oil seals which can correspond to not only 1.5MW-2.5MW facilities, the common class of current wind turbines in the market, but also even large-scale offshore wind turbines. Jtekt has also introduced an "ultra-large bearings evaluation test machine", which can evaluate ultra-large bearings for the main spindle of wind turbines of the 3-5MW class, at actual size and it is housed in JTEKT's large scale bearings technology development center in Kashihara, Osaka (Feb. 2012). The data which this test machine accumulates is utilized for improving the accuracy of CAE analysis (simulation analysis) and leads to remarkable reductions of merchandise developing time and developments of new high-value-added merchandise.

Zephyr Co. Ltd. (Japan), www.zephyreco.co.jp

This is a specialized manufacturer providing small scale renewable energy solution, mainly small scale WP generators. More than 5000 have been installed in Japan and abroad.

1997 established as a small scale WP generator-only maker
1998 issued hybrid generation system for individual
2006 issued 1kW WP generator "Air Dolphin"
2013 issued 5kW WP generator Zephyr9000
2015 issued Zephyr9000 for J-FIT for domestic FIT

Features of "Air Dolphin"
a) Due to its ultra-light 20kg body design, it is capable of being installed anywhere, such as rooftops of existing buildings, capable of reducing weight of towers or construction costs
b) Mount specific control functions in the body, and capable of continuous generation while experiencing weak wind to storm winds Zephyr9000 for J-FIT has prominent generation amount among same class. Following this, the Air Dolphin obtained the second domestic type qualification of small scale WP generator. Mounted domestic power conditioner. Installation utilizing FIT went into full-swing in 2015 in Hokkaido and Tohoku.
Features of Zephyr9000
a) High generation efficiency of 9000kWh/year at average wind speed 5m/s
b) Standardized collapsible pole, improving the efficiency of construction and maintenance

Both the Air Dolphin and Zephyr9000 are capable of integrating a hybrid independent power source system which combines solar power and storage battery. They also have a system design which corresponds to weather conditions at installation environment and usage.

came under the jurisdiction of the construction plan report and pre-use self-inspection must now comply with the Electricity Business Act, and the wind project must have been unified to Industrial Safety and Inspection Department of METI. In the future, assuming that the safety of any wind turbine is ensured, simplifying and shortening the processes related to towers are strongly needed by making use of methods such as "general qualification", which had been implemented when tower was an object of the Building Standards Law.

In Japan, there are around 7 domestic factories with about 1.23billion yen in sales with no production abroad. Shipments to overseas are valued at 100 million yen. For wind turbine tower bodies market expansion is difficult, because oversea procurement is increasing as mentioned above.

In addition, even if the exporting of wind turbines increases, each manufacturer is likely to shift base abroad, considering transport cost and maintenance. Cost of the tower accounts for approximately 30% of the cost of 2-3MW class wind turbines among wind power generation facilities. Therefore, improving the economic efficiency of towers can contribute significantly to the cost reduction of wind power generations. The cost is composed of steel material, processing, wielding, flange joint material processing, coating, etc. The ratio of steel material cost is high.

Due to the enlargement of wind turbines and advancements of tower, and increases in diameter and height of towers, challenges such as increasing the wielding line or joint pipes has occured. Especially with respect to large scale wind turbines, it is becoming important to reduce costs by widening material steel plates and suppressing the increase in wielding lines. As one of the methods of drastic cost reduction, towers made from concrete have been experimented with (e.g. Enercon). In Germany, concrete-made high altitude towers, aiming at increase in wind power generation with wind shear have been constructed. Also, there are hybrid versions (with steel and concrete) of towers available.

4.9 Government agencies

Several organizations support R&D activities regarding wind energy in Japan. The main national R&D programs are being carried out by NEDO, METI and MOE which will be further discussed in relation to the following profiles.

Ministry of Economy, Trade and Industry (METI)

The Ministry of Economy, Trade and Industry (METI or Keizai-sangy -sh), is a ministry of the Government of Japan. It was created in 2001 by the Central Government Reform when the Ministry of International Trade and Industry (MITI) merged with agencies from other ministries related to economic activities, such as the Economic Planning Agency. At the height of its influence, it effectively ran much of the Japanese industrial policy, funding research and directing investment. In 2001, its role was taken over by the newly created Ministry of Economy, Trade and Industry (METI). METI has jurisdiction over broad policy areas, containing Japan's industrial/trade policies, energy security, control of arms exports, "Cool Japan", etc. It was commonly called the "human resource agency" for its leading roles in politics, business and academia.

New Energy Development Organization (NEDO)

The New Energy and Industrial Technology Development Organization, also known as NEDO, is Japan's largest public management organization promoting research and development as well as deployment of industrial, energy and environmental technologies. Originally, the New Energy and Development Organization (former NEDO) was founded in 1980 in response to the energy crises of 1973 and 1978, and it was established under the Law Concerning the Promotion of the Development and Introduction of Alternative Energy to develop fossil fuel alternative energy technologies in order to stabilize world energy supplies and reduce Japan's dependency on imported energy sources. However, in 1988, the renewable focus shifted to a broader industrial scope. The organization was reorganized and expanded to include the research and development of industrial technologies. The name changed to New Energy and Industrial Technology Development Organization (acronym remains NEDO). In 2003, NEDO was again reorganized as an Independent Administrative Agency. Today NEDO has approximately 1,000 personnel with domestic offices in Hokkaido, Kansai, and Kyushu and international offices in Washington D.C., Silicon Valley (California), Paris, Beijing, Bangkok, Jakarta and New Delhi. Its budget for fiscal year 2015 was ¥131,900 million, the vast majority of which was provided by Japan's Ministry of Economy, Trade and Industry (METI). Its head office is located just outside Tokyo in Kawasaki City, Kanagawa Prefecture.

In the NEDO Research and Development of Next-Generation Wind Power Generation Technology project severe external conditions such as typhoons, high turbulence by complex terrains and lightning were surveyed in detail, and outcomes in these projects are now proposed as IEC international standards to expand the wind energy market with the aim of securing the safety and reliability of wind turbine generation systems. In the NEDO A3 project, a wind turbine acoustic model was developed and the effectiveness of the model was proved and verified by the field experiments in actual wind farm.

Ministry of the Environment (MOE)

The Ministry of the Environment (MOE) is responsible for the EIA and its improvements. In addition, it launched several programs to promote wind energy.

During the MOE Floating Offshore Wind Turbine Demonstration Project, a small-scale demonstration wind turbine of SUBARU 100-kW machine on spar type floater was installed 1km offshore of Nagasaki Prefecture in June 2012. At this offshore site, the water depth is about 100m, and the extreme significant wave height is 7.7m. The small-scale demonstration wind turbine has been replaced by Hitachi 2-MW full-scale downwind type wind turbine on spar type floater in 2013.

4.10 Wind industry groups and associations

THE JAPAN WIND POWER ASSOCIATION, JWPA, www.jwpa.jp

The JWPA (Nihon Furyoku Hatsuden Kyoukai) was established in 2011 and speaks for the Japanese wind industry with 285 member companies (a yearly growth with an average of 22 companies). It advances wind development in Japan and has distributed the WindVison Report (the last issue was in March 2016), that investigates how Japan can exploit its wind power potential. JWPA is an active GWEC member.

THE JAPAN WIND ENERGY ASSOCIATION, JWEA, www.jst.go.jp

The JWEA was founded in 1977. It has about 700 individuals as members from scholarly and mechanical fields. The principal motivations behind JWEA are to advance the logical and specialized study and development from essential to the connected usage of wind energy, delivering cooperation and closeness amongst individuals and national/global exploration associations.

THE JAPAN SOCIETY OF INDUSTRIAL MACHINERY MANUFACTURERS, JSIM, www.jsim.or.jp

JSIM aims to support the sound development and advancement of the modern hardware industry and related areas and additionally the development of the national economy. JSIM tries to draft and elevate the measures to build the efficiency and justify the production structure in the field of modern apparatus of the industry on; Mining Machinery, Chemical Machinery, Environment Equipment, Tanks, Laundry and Hydraulic Machinery, Material Handling Machinery, Iron and Steel Manufacturing Machinery, et cetera. JSIM records among its individuals somewhere in the range of 174 organizations in the modern hardware industry all through Japan. All are industry pioneers whose organizations compile around 90% of all manufacturing hardware orders processed in Japan.

THE JAPAN ELECTRICAL MANUFACTURERS` ASSOCIATION, JEMA, www.jema-net.or.jp

JSIM aims to support the sound development and advancement of the modern hardware industry and related areas and additionally the development of the national economy. JSIM tries to draft and elevate the measures to build the efficiency and justify the production structure in the field of modern apparatus of the industry on; Mining Machinery, Chemical Machinery, Environment Equipment, Tanks, Laundry and Hydraulic Machinery, Material Handling Machinery, Iron and Steel Manufacturing Machinery, et cetera. JSIM records among its individuals somewhere in the range of 174 organizations in the modern hardware industry all through Japan. All are industry pioneers whose organizations compile around 90% of all manufacturing hardware orders processed in Japan.

Research

The National Institute of Advanced Industrial Science and Technology (AIST), the New Energy Foundation (NEF) and various universities (e.g. University of Tokyo, Kyushu University, and Mie University) have been involved in research and projects related to wind energy.

Case Studies

5. Case Studies

This section details three case studies of European Companies related to wind energy (1) Developer; (2) Offshore demonstration project and (3) Service & Maintenance provider.

5.1 Dossier on developer Juwi Shizen Energy

Corporate history:

1996 Juwi Ltd. established in Germany

2013 Juwi Shizen Energy Inc. established in Japan, as a joint venture with Shizen Energy Inc.

Business:

Shizen Energy Inc. (Japan)

URL: http://www.juwi-shizenenergy.com/

Parent company: formerly Juwi Holdings AG (Germany), today MVV Energy Planning, design and construction of renewable energy plants and other operations. In 2014/2015 Juwi Germany has been taken over by MVV Energy with a 50.1% share.

Details:

In January 2013, German-based Juwi Holdings AG established a joint venture with the Japanese firm Shizen Energy Inc. called Juwi Shizen Energy Inc, located in Tokyo. On January 24th, the companies held a press conference at JETRO IBSC Hall for the establishment of their new joint business. The press conference included a significant media presence, indicating that the entry of the world's leading renewable energy-related company to Japan is drawing keen attention from the press.

Juwi is a leading EPC (Engineering, Procurement and Construction) company in the industry that consistently engages in work ranging from the search for appropriate locations of renewable energy plants to their planning and design, and even construction and management of the facilities. Since its establishment in 1996, the company has steadily expanded its business scale. Currently, the company has 20 subsidiaries worldwide. The total output of wind power generators and solar power plants established by the company so far is 2,500MW and the company provides electricity to approximately 1.3 million households worldwide. The reason for choosing Japan with a full-scale expansion approach is that the country has started a feed in tariffs (FIT) program for renewable energy. In the New Growth Strategy (approved by the cabinet in June 2010), it stated that the government aims to create a renewable energy related market of 10 trillion yen by 2020, positioning the FIT, which began in July 2012, as one of its core policies. By using FIT, renewable energy business operators have a guarantee that electricity generated by renewable energy will be purchased at a fixed price over a long term, considerably reducing the risk of entering the market. As Juwi was already considering full-scale entry into the Japanese market, the implementation of FIT proved a deciding factor.

Key takeaways:

Juwi Shizen Energy has set a goal for itself to develop "global and local business" throughout various regions of Mega solar power plants constructed by Juwi in Japan, utilizing technology which meets global standards. It will take advantage of the strengths of both Juwi and Shizen Energy and allow the companies to supplement one another. The fact that

Juwi Shizen Energy can use Juwi's global purchasing networks and latest construction know-how will serve as a great advantage in entering the Japanese market. Juwi has experience from participation in various projects around the world, which enables the company to select the most appropriate equipment for a given construction project. Furthermore, a great advantage of the company is that it can provide high-quality equipment at competitive prices because it procures the equipment by using its own global purchasing networks. In addition, it will be possible in some cases to shorten work periods and reduce costs by adopting the latest construction methods that other Japanese competitors do not have.

Success factors:

Shizen Energy's record in Japan and know-how are also great assets for Juwi Shizen Energy. When establishing a renewable energy plant in Japan, a foreign operator may face many other problems other than just the language barrier. For example, when a foreign plant operator builds a mega solar power plant, in order to obtain permission to use the land, a high level of negotiation capability and flexibility over a long period of time are necessary. The company must gain an understanding of the local government, relevant bodies and laws and ordinances peculiar to Japan such as the Agricultural Land Act and the Building Standards Act. They must also understand how construction will affect and concern neighboring residents. In order to communicate with residents, it is crucial to conduct local-based activities such as holding continuous briefing sessions and other forms of cooperation with local companies. Furthermore, in the case of a mega solar power plant, billions of yen in initial costs are incurred depending on the transactions and it is therefore essential to have strong negotiation skills and networks for financing. Shizen Energy's partnership in the joint venture ensured smooth communication in Japan while Kuwi was able to take advantage of its own construction know-how and strong purchasing power.

Consortium Members	
Marubeni	Project coordinator, responsible for initial feasibility studies, licensing, O&M and liaising with regional fishing
University of Tokyo	Technical adviser, responsible for measurements, predictions, navigational safety and public relations
Mitsubishi	Overseas grid integration and EIA
Mitsubishi Heavy Industries	Designed V-shaped submersible floater, supplier of 7 MW SeaAngel turbine in phase II
Japan Marine United	Co-designed 66kV floating substation and advanced spar floater
Mitsui Engineering & Shipbuilding	Designed compact semi-submersible floater for first turbine
Nippon Steel & Sumitomo Metal	Supplied advanced steel
Hitachi	Supplied 2 MW and 5 MW turbine, co-designed 66kV floating substation
Furukawa Electric	Supplied undersea and dynamic cables
Shimizu	Responsible for oceanic surveys and construction technologies
Mizuho Information and Research Institute	Responsible for documentation and committee operations
European Companies involved, but not part of the Consortium:	EUROS (Blade design), Germany VICINAY marine innovation (Mooring) by Vicinay Cadenas, S.A., Spain

5.2 Dossier on FukushimaFORWARD offshore demonstration project

Project history:

METI publicized the plan of a Floating Offshore Wind Demonstration Project in 2011 and financed it with with around ¥40.5bn. This project was planned as and is treated as Fukushima's revival act as part of the overall project to reconstruct and recover the affected areas damaged by the 2011 earthquake.
In Phase 1 (FY2011-FY2013), a Hitachi 2-MW downwind type wind turbine on a 4-column semi-submersible floater, and a 66 kV floating offshore electrical substation was installed.
In Phase 2 (FY2014-2016), a 7-MW MHI and a 5-MW Hitachi turbine on a 3-column semi-submersible floater and on an advanced spar type floater were installed. The water depth around this offshore site is between 100 to 150m and the extreme significant wave height has been estimated at 10 to 15m. The annual average wind speed at hub height has been estimated at 7.0m/s or more. In the post-installation phase (2016-2018) the project is supposed to gather data on environmental and climatic conditions for following pilot and commercial projects.

Details:

This program, which gathered the most attention in regard to Japanese offshore technology both domestically and internationally, is a deep water offshore floating concept R&D off the coast of Fukushima: This project has made a mark as the world's first floating substation containing the electrical equipment needed to transfer power from turbines to shore and floaters with different turbine types and total capacity of 14MW. According to METI, the FukushimaFORWARD wind farm is currently the world's largest floating wind farm.

An industry-academia consortium was formed for 11 partners to proceed with this project, including Marubeni Corporation as the project integrator (see Table on the previous page). The main contractors are furthermore the University of Tokyo, MHI, Hitachi, IHI Marin United, Mitsui Engineering & Shipbuilding and so forth.

The project aimed to:

- test three foundation types with three turbine concepts, one floating power substation, component technologies, system technology and to establish O&M techniques for floating offshore wind;
- develop common standards for floating offshore wind;
- provide data on the impact of the turbine on local fisheries, as well as add to Fukushima's typhoon-resistance formation; and
- find a way to balance the existing fishery industry interests, navigational safety, and environmental protection through proper EIA method.

By November 2011, METI had approved a start-up budget of ¥12.5 billion. By November 2013, a 2MW Hitachi downwind turbine mounted on a three-column semi-submersible floating platform built by Mitsui was generating electricity in water depths that range from 100 to 200 meters. A 66kV substation, on an advanced spar floater built by Japan Marine United was also operating successfully. The second phase of the project was scheduled for 2015, with the installation of a 7MW Mitsubishi Heavy Industries (MHI) SeaAngel and a 5 MW Hitachi turbines, one on a semi-submersible foundation, the other on an advanced spar design. No wind turbine of this magnitude, size or weight has been tested on floating foundations before. The demonstration project area is 20 to 40km from the nearest shore. The project was expected to end in 2015, but due to delays (negotiations with fisheries and technical delays), the installation of the last turbine needed an additional year without budget rise since weather conditions have also been considered (installation time in summer has lower construction costs).

Finally, on July 8 2016, the 5-MW Hitachi HTW 5.0-126 wind turbine, mounted on a floating platform, has been successfully sited off the coast of Fukushima prefecture. The turbine will be in operation towards the end of the 2016. The Hitachi HTW 5.0-126 caters for extreme winds and typhoons with the adoption of a downwind design as well as improved protection against electrical storms – a first for offshore wind.

The 5 MW-turbine had been undergoing assembly off the coast of Sumoto Port on Awajishima Island, Hyogo Prefecture. The base for the turbine was constructed in Sakai, Osaka Prefecture. With its completion, tugboats began the slow trip to waters off Fukushima Prefecture. Traveling at a speed equivalent to a human adult walking at a brisk pace, or between six to eight kph, the turbine completed the journey of about 960 kilometers and reached the waters where it was permanently installed on July 8. The project was developed by several companies and research institutes. Japanese company Marubeni acted as project integrator for the consortium. The 62m-blades and design had been supplied by a German company (EUROS). The blade-tip stands about 150m above water at its highest point. The Spanish company VICINAY marine supplied an innovative mooring concept.

The installation and testing of these titans were watched very closely by the global offshore industry. METI has indicated that if the trials continue to progress well, there could be a third phase to the Fukushima project - a utility-scale floating wind farm of up to 1GW. Currently, it has been discussed that this will not happen before 2020.

Backed by Japan's environment ministry MOE rather than METI, another high-powered consortium has successfully installed a massive wind turbine on a floating foundation in deep waters (Kabashima project).

Key takeaways:
Using different turbine models and foundations across the three phases kept with METI`s approach of trialing different technologies and targeting a lower cost of energy for floating wind. The Fukushima project tends to hog the Japanese offshore limelight.

Japan eyes future export technology:
With the finalization of the second and last phase of the Fukushima Forward demonstration, Japan has surely taken a significant step to emphasize its position as a global leader in the development of floating offshore wind technology. However, the development costs were enormous and it took an extra year than planned to install the last turbine (with even a different type: 5 MW Hitachi instead of 7 MW Mitsubishi). Also, the installation has not been easy: on May 9, the 5 MW-floater lost its balancing control and leaned about 45 degrees in the Osaka bay increasing project time and costs. Further challenges remain, such as on the electrical infrastructure, including dynamic cables, floating substations and distribution transformers. However, it's the nature of a pre-commercial projects to act as a testing facility for wake

Facility name	Scale	Form	Floating Form	Phase
Floating Substation "Fukushima Kizuna"	25MVA	66kV Substation	Advanced Spar	First
Floating Wind Turbine "Fukushima Mirai"	2MW Hitachi	Downwind Type	4 Column Semi-Sub	First
Large Floating Wind Turbine "Fukushima Shimpuu"	2MW	Oil Pressure Drive Type	3 Column Semi-Sub	Second
Large Floating Wind Turbine "Fukushima Hamakaze"	7MW Mitsubishi SeaAngel turbine	Oil Pressure Drive Type	Advanced Spar	Second

effects and for optimizing assembly and installation methods, mooring and anchoring systems and maintenance strategies. Many believed that the first commercial pilot with better LCOE could be online in the early 2020s and Japan is a hot candidate to be in the lead and not necessarily Europe. Some other projects are now lining up to be Japan's pre-commercial pilot: the 30MW Hywind Scotland project, was expected to take off in late 2017 or Principle Power's 48MW optimised WindFloat Atlantic array – to be 60% cheaper per MW than the first demonstrator – it should be installed off Portugal in 2018 if all goes according to the plan.

New turbines:
The first phase's MHI's SeaAngel turbine was a rather curious choice for this project. Unlike the 2 and 5MW Hitachi turbine, the SeaAngel is a conventional upwind turbine, considered less suitable for operating in typhoon-prone conditions. A prototype was tested at the Hunterston test center in Scotland, UK, but MHI has said the machine would unlikely to go into full-scale production. The joint venture by Vestas and MHI will concentrates on Vestas' V164-8MW turbine, with only the SeaAngel's digital hydraulic drivetrain system earmarked for further development.

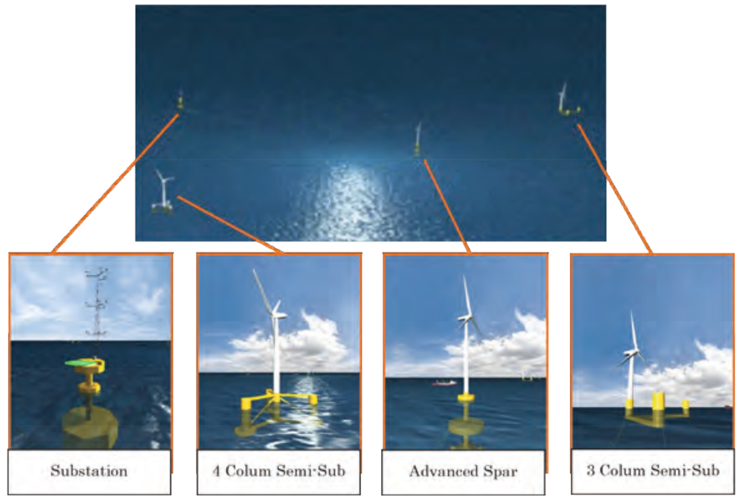
Favorable conditions for the sector in Japan:
For more than 10 years, Japan has been working on the floating technology as the country has limited sites for conventional offshore turbines (limited shallow-water sites suitable for fixed-foundation turbines). Also, high energy costs, as well as good infrastructure, are creating good conditions for the sector. As the world's third-largest economy it has the industrial and technological muscle to drive rapid development and deployment. However, in the last few years, the deployment in Japan was largely government-driven with a strong focus on domestic companies and ambitiously aimed to develop a future commercial technology for export – visible as an exhibition project for the Olympic Games 2020. On the other hand, progress could also slowdown in the next few years if the government is not willing to continue investment. Currently, Japan seems to be more interested in getting its nuclear industry turning again to replace its dependence on imported liquefied natural gas and coal, rather than looking inward for a more renewables-based solution.

A question of costs:
As with all new technologies, development costs are higher than would be expected in a mature market and everything now depends on bringing them down. With offshore work typically costing around ten times than onshore. Operations and maintenance is also key to reducing cost. Due to the plans to present a 1 GW floating farm to feed the Olympic Games in 2020 and the increasing time constraints the reduction of the LCOE is pretty uncertain. Analysts argue that construction costs won`t decrease until 2020 due to the big demand for the Olympics. But a LCOE of ¥8-9kWh potential by 2020 can be reached due to cumulative production expansion effects, improved production technology and innovations. However, the pilot's installation issues and delays could question remarkable lower LCOE for floating technology in the near future.

The market potential for European companies:
Despite cost overruns on the Fukushima Forward demonstration project, the Japanese government has announced that the 2020 Olympics will be partly powered by floating wind turbines. Japan strongly desire an exhibition project for the Olympics, but time is running out. This could open a good window of opportunity for European companies to step in. As an example, the French floating foundation start-up, Ideol and Japanese group Hitachi Zosen Corp have just signed a contract that marked the start of the construction phase of their two floating offshore wind turbines in Japan. The contract follows the completion of the design and engineering phase which commenced a year ago.

Social acceptance issues:
Particularly the local fishery industry, formed a daunting challenge for the FukushimaFORWARD project from the beginning. Negotiations involved the METI, Fukushima Prefecture, the industry consortium and representatives from the local fishery community. The key was to persuade fishermen to relinquish some of their legally protected fishing rights. After one year of negotiations, the breakthrough came on March 29, 2013, as the fishermen agreed to relinquish their rights. For this, the government agreed to a condition stated by the local Fishermen Association that all the offshore facilities installed by the demonstration project will be removed if a new agreement between the concerned parties will not be reached after three years regarding further expansion of offshore facilities. Following this agreement, the government decided to upgrade the functions and infrastructures at the port of Onahamain, Fukushima Prefecture to serve the center of installation for the Demonstration Project. With the removal of this largest concern, the consortium started building the facilities in summer 2013. The Fukushima Prefecture simulated employment effects for such a large offshore wind park with a 1GW. However, that agreement means also that new negotiations with the fishermen have to start for a commercial use and a permit of 20year installation period.

Success factors:
A number of success factors which may be useful elsewhere stand out in this project. Governments, public finance institutions and developers all con-



tributed to mitigating risks and building a strong project. Large-scale renewable energy projects like FukushimaFORWARD require a range of stakeholders from the energy, financial, legal and governmental sector to come together. The consortium created a partnership in which each player took on the roles and risks to which they are best suited. This limited exposure to a single entity and lowered overall project cost.

To sum up, the consortium tackled several challenges successfully:

- Floating technology: 80% of its offshore resources are in depths greater than 100 meters, far beyond the depths of the conventional fixed-bottom foundations that support the offshore projects on northern Europe's continental shelf.
- Tackling the special weather conditions: Climatic conditions - typhoons and tsunamis present formidable challenges to installation and upkeep of wind turbines.
- Early negotiations with stakeholders with openness in the process: Japan's powerful maritime logistics and fishing industries have strongly opposed sharing ocean space with wind developers. By involving the fishermen early in the project and creating room for negotiations represented positive steps to create confidence between them. The consortium even agreed to accept only a temporary approval by the fishermen for the demonstration phase, whereas the pilot phases with around 20 years need new negotiations and new approvals by them.
- Governmental support scheme: The Fukushima disaster provided the catalyst for change in Japan's attitude to wind power. With more than ¥40bn, a generous amount of project funding has been provided by METI.
- By using various types of wind turbines and floating body characteristics, the control effect of various floating wind power generation systems have been revealed and high-performance steel materials durable for corrosion and fatigue have been developed.

5.3 Dossier on TÜV Rheinland

Corporate history:

1978 Asia Office in Tokyo, Japan was established.
1983 Incorporated as TÜV Rheinland Japan Ltd. ("Rheinland Gijutsu Kensa Kyokai Japan" in Japanese) in Minami Aoyama, Tokyo.
1989 Adopted the current triangular symbol as the new corporate logo.
1992 Changed the corporate name in Japanese to "Rheinland Giken".
Osaka Office was established.
Safety testing laboratories in Yokohama and Osaka opened.
1993 Office moved to Shin Yokohama
1995 System Certification Department started.
1996 Kyushu Office established.
FEMAC (Far East Market Access) Business Center opened in Shinyokohama.
2000 Changed the corporate name in Japanese to "TÜV Rheinland Japan Ltd."
2005 Global Technology Assessment Center (GTAC) opened in Yokohama.
2009 Solar Energy Assessment Center (SEAC) opened in Yokohama.
2012 Kansai Technology Assessment Center (KTAC) opened in Osaka.

Business:

TÜV Rheinland Japan

URL: http://www.tuv.com/en/japan/home.jsp

TÜV Rheinland Japan is a subsidiary of TÜV Rheinland Group (Germany), a top global provider of technical services that has been active as an independent third-party test house in Japan since 1978. It offers verification, inspection and certification of various products in accordance with international and national standards as well as audits for management system certification.

One stop service offered by TÜV Rheinland Japan provides access to the Europe, North America, and Asia markets.

Details:

TÜV Rheinland Japan established an office in 1981. In regard to wind energy, it offers services, ranging from planning to decommissioning for wind turbines, such as site analysis and assessments, subsurface investigations, noise emission and emission forecasts, shade projections and damage reports or coordination of the structural analysis and its official review.

TÜV Rheinland works in several partnerships with Japanese entities to increase business: Nippon Kaiji Kyokai (ClassNK) has started building a partnership that aims to internationally deploy wind turbine certification and facilitate related tasks in 2015. The cooperation of TÜV Rheinland Japan and Class NK includes mutual recognition of wind turbine certification and support in testing small wind turbines. Both parties announced that they have agreed to mutually recognize evaluation and inspection results for wind turbine type certification. This shall support manufacturers and shorten the certification process considerably. ClassNK has also appointed the Global Technology Assessment Center (GTAC) of TÜV Rheinland Japan as a certified laboratory. The appointment is in accordance with a worldwide partnership agreement that the two parties entered into in September 2015 to expand their testing and certification services portfolio and to serve their clients better. ClassNK is a leading nonprofit classification society with extensive experience in certification of products, materials and equipment for marine use while TÜV Rheinland is renowned as a product safety testing and certification body. Product safety testing carried out by GTAC of TÜV Rheinland Japan is accredited by worldwide accreditation bodies like DAkkS and JNLA according to ISO/IEC17025.

Success factors:

Partnering in certain sectors with key players: Through the use of technical know-how and experience gained from partnership with well-established Japanese partners in specific sectors (such as ClassNK), TÜV Rheinland can better access the market and share fields of expertise. Also greater efficiency in testing and certification can be achieved by teaming up. Significant cost and time savings as well as knowledge transfer will greatly serve the wind market. Both companies aspire to offer their wind turbine certification services globally and are seeking to contribute to safety, quality and reliability of wind turbines.

Relying on a strong brand already established in Japan: TÜV Rheinland entered the Japanese market in 1978 and became renown for services of DNV GL. With the solar boom in Japan TÜV Rheinland expanded its business to solar related certification and developed several testing facilities in order to offer module certification, customized testing, mega solar technical certification, calibration of secondary reference solar device and performance measurement/long term reliability evaluation of PV modules. Since around three years TÜV Rheinland aims to access the wind market, as growth is expected in this sector, using the brand as a door opener in Japan. So far, the business is still not there and it might be concluded that they are too early as the market hasn't peaked yet.

Key takeaways:

Advances in technology and economic growth mean that more wind related equipment are being designed for both on-shore and maritime installations. Manufacturers aiming to enter the Japanese market with e.g. dual-use equipment face lengthy and costly testing and certification processes before their products can be placed on the market.

Certification reduces the burden for manufacturers by streamlining the testing process and by teaming up with ClassNK, it eliminates the need to attend some testing for type approval certification of automatic devices as well as equipment for both on-shore and maritime installations. The scope of the appointment includes a number of environmental tests, such as dry heat tests, damp heat tests, vibration tests, cold tests, salt mist tests and EMC tests.

TÜV Rheinland, also offers type certification for European markets but has to cope with the competition from several competitors (such as DLV, Deutsche WindGuard etc.), that seem to have established a good customer base in Japan. As Japanese customers seem to follow well-trodden paths it is difficult to enter the market at a later stage and convince customers to stop following of the market leader.

Conclusion

6. Conclusion

It is undisputable that the Japanese market possesses huge untapped potential for committed, diligent and performing European companies with a clear long-term business vision. There are many promising market niches related to the wind sector which are suitable for European companies – from SMEs to large corporations.

6.1 Japanese market potentials for European companies

A lot has been written and said about the protectionism of the Japanese market. However, many respondents from the Japanese side object to this perception, largely basing their opinion on the open nature of the market amidst intense interest in foreign cooperation. The present market size is less attractive in contrast with other emerging regions in the world or the booming Chinese market. As Japan`s topographic, wind speed and economic conditions could offer a much broader potential, there is a strong drive to expand the market from major Japanese (both industry and academic) players. Therefore, the government has set its sights on adjusting the policy framework to those needs. As the full deregulation will take force in 2020, the market could experience a strong surge in 3-4 years. Projects usually take some time, so the opportunity window opens up now:

Japan is at crossroads on the wind industry: Japan was not so enthusiastic about wind power development in the past because there were many hurdles against wind power development in Japan coupled with more challenging natural conditions. But Japan became pro-wind action after the Fukushima accident. Offshore wind is one of the key technologies from a future perspective. The industry and policy makers are trying to remove these hurdles now. However these obstacles will take some years to be fully overcome. Still, if the drive to overcome and change archaic and outdated thinking keeps changing, the business potential in the wind sector is very promising going forward. Japan has not leveraged the full potential of wind power and the market might uptake in the next one to four years. The consensus is that the future of Japanese wind lies in offshore development due to the countries mountainous profile, limited access and space restrictions. Offshore development is even expected to beat other alternatives such as geothermal and solar to serve as an impetus in the industry. The key success factors are to set realistic expectations and visible targets, improve the legislation for offshore constructions (especially the EIA and Buildings Standards Act), rely more on partnerships between manufactures, developers, suppliers and contractors and to develop infrastructures such as port facilities to enable pre-assembling of components onshore (as much as possible) to reduce risks and construction costs. Japanese companies are desirous of benefitting from European experiences in regard to these aspects. Furthermore, METI announced plans during the World Smart Energy Week in March to work on the number one concern of onshore and offshore developers: Japan`s Environmental Impact Assessment (EIA) that remains a major barrier to entry, given the 3-4 years required for completion due to its far more strict environmental impact assessment process than for other power resources.[90]

The newly established funds can ease financial support and drive partnerships forward. Although a growing number of foreign Companies are willing

90 Bloomberg New Energy Finance (2015)

to compete with Japanese players on their own turf, barriers still stand in their way. Access to land and inability to secure contracts at the prefectural and municipal level have been a problem for entry, while major Japanese banks have been wary of lending to foreign firms with no track record.

Offshore industry progress: Japan`s offshore wind industry is underway to step up from its early phase of development – carrying out demonstration projects, testing new technologies and developing a sustainable policy framework in preparation for growth – to a commercial phase that is ready to take shape this year. With 12 MW of offshore installations to start operating in 2016 and another 1,407 MW in the planning phase there are several commercial projects in the pipeline which can add to the relative low offshore amount at present (52.6 MW, 27 turbines).[91] In the coming years offshore is expected to even beat out alternatives such as geothermal and solar[92] and become a growth-oriented industry.

Relying more on partnerships between manufactures, developers, suppliers and contractors: Exchanging experiences with European companies on offshore strategies and floating technology provides good opportunities for EU-Japan partnerships. The sector currently lacks infrastructure development such as port facilities and vessels to enable pre-assembling of components (as much as possible) onshore to reduce risks and construction costs. Major OEMs are eyeing the Japanese market and have increased their presence in Japan in recent months (e.g. the new Senvion office in Tokyo).

Stable policy framework for offshore underway: The new law closes a gap in the permission procedure of offshore wind in Japan in a bid to create and maintain a stable policy framework. The unclear definition of the permit authority for GC delayed several projects and led to uncertainties causing investment risks. Likewise, the recent announcement by METI to publish the Environmental Impact Assessment (EIA) standards for offshore installations by the end of 2016 is another indicator that offshore technology will leave its teething phase in Japan. The new standards will cover the effects on birds, underwater flora and fauna, including the sedimentary environment and are based on the findings from the first pilot projectsIn addition, the Japanese market provides further advantages for setting up a business, such as:

- Tax environment: Taxes are quite low compared to other regions in the world (only corporate taxes are higher in Japan than those in the US and Europe). There are tax-friendly environments for foreign companies (e.g. Special Economic Zone Tohoku or Fukushima area)
- Stable economy is good environment for Asian representation: Japan is an industrialized country with a well-educated workforce (but English competence is rare). It can also serve as a good business hub for Korea and Taiwan.
- Public research and funding: Japan has a strong academic and research community. Public bodies providing funding for research projects. Industry-academic interlinks exist especially in the wind sector.
- Japan favors sustainable and future-oriented technology: Japan remains a major global player in green technology development despite the current economic situation. In particular Tokyo is a hub for innovation and has a more attractive market since the 2020 Olympics are approaching with a vision for a sustainable and hydrogen society. There are of course pitfalls ahead, ranging from financial viability to market uncertainty. Nonetheless, opportunities for EU-Japan cooperation in wind energy development are strong.

91 Onshore wind has reached a cumulative installation of 3,038 MW at the end of 2015.

92 Analysts say that the recent cut of solar FIT is a result of the high backlog of wind onshore and offshore projects that are expected to be commissioned soon.

6.2 Business opportunities available in Japan

According to JETRO, the purchase of wind turbines and parts, as well as maintenance services, is expected to grow from an estimated 300 billion yen a year to 500 billion yen in 2030. In regard to this, international wind generation expertise on wind modeling, construction, transmission, operation and maintenance of wind farms could be of great value to Japan.

Wind turbine supply for domestic projects:
As the government plans to turn Fukushima into a renewable experimental area, there are considerably large areas planned for onshore (2 GW) and offshore (2 GW) projects that shall be installed within the next 25 years. While offshore wind was the focus of recent times with a testing field for Japan`s floating concept with 14 MW already installed, the next phase will be focused on bringing the onshore capacity as quickly and as cost effectively as possible into the grid. Contrary to other regions in Japan, grid issues are no hurdle in the region as a revival of the 8 GW nuclear power plant is unquestionably off the table and grid capacity of 8 GW (4 GW wind, 4 GW solar) can be made up with renewables.

WTG components: A 2MW wind turbine is comprised of around 10,000 to 20,000 components, with a wide variety of parts such as electric control products, iron and steel products, machinery parts, hydraulic equipment and resin moldings. The market in Japan is very competitive with a strong domestic footprint (e.g. bearings). European companies that offer specialized components with (higher) quality and competitive prices can profit from a market growth. However, shipping and service costs need to be calculated.

Maintenance and certification services: European experience with maintenance and service as well as lightning protection technology can create valuable partnerships and foster business relations with Japanese customers.

Repowering: As an increasing amount of turbines will come to the end of their life cycle, the demand for repowering or live-time extensions will increase, with a first peak expected in 2019.

General tailor-made products and first-mover products: Supply for demonstration and pilot projects (see above) often need to transfer technology and design to the Japanese partners and these present opportunities to buy open design codes that can be used for the domestic industry in the future.

R&D opportunities, for new and innovative products, especially offshore related to:

- Involvement in demonstration and pilot projects that are prioritized by the government and receive considerable funding and support from NEDO or METI
- As these projects need to commercialize new offshore technology, they have to bring down costs as much as possible. Either the product is innovative and serves Japanese need or the costs are very competitive and support the goal to reduce LCOE of offshore, as this is a priority. Example: Fukushima-related offshore projects
- Also, Japan's substantial investment in making floating offshore wind a viable technology could also present an excellent learning opportunity for international players

Smart and cross-sector ITC-products:

Hydrogen-related solutions: Hydrogen-related technology and research is strongly funded and supported by Japan`s technology research body NEDO and the combinations of wind-hydrogen technology will meet demand.

Positive prospects in the context of the market deregulation: The retail market deregulation in April led to a switch of power providers from more than 622,000 households in the first week, with about 60% leaving their respective Tepco. That might offer some opportunities for new entrants and further increase the pressure on the EPCOs. Their reluctance to integrate wind energy into the grid has not been resolved yet. The full deregulation process with forced unbundling of distribution and generation will be achieved in 2020 and is expected to be a game changer. However, at present, the political support is rather in favor of restarting Japan's nuclear assets (20-22 %, ca. 20 nuclear plants) and coal-fired power plants to cover the majority of Japan`s energy demand in the future.

April 2016`s opening up of Japan`s electricity retail market is a landmark action which may provide new business opportunities for foreign companies. Usually, the Japanese energy industry favored affiliated companies and subsidiaries in procurement and contracting. Forming business alliances with new entrants to the deregulated market will likely make market access easier. Also, the ongoing electricity system reform can boost renewable energy expansion in Japan by breaking the near-monopolies that Japan`s ten utilities have over generation, transmission and distribution in their respective regions alongside their reluctance to bring more renewables into their energy mix. They do not want renewable energy competing with their coal-fired power stations and nuclear assets that are currently on-hold. With the market reform, the government will force legal unbundling in 2020 to break up the old regional monopoly system. However, doubts remain if the market mechanism caused lower prices and better services because the reform has been rather controlled by electric power companies. Their influence in Japan is traditionally very strong and they have an untenable influence over market regulations. It remains to be seen whether renewables will get priority access to the grid and how smoothly the reform process will proceed.

6.3 10 recommendation to prepare successful wind market access

1. **Carefully develop market access and use general access support.**

Since 1975 market entry chances have been increasingly discussed. At that time export congestions with industry players such as Europe were booming dramatically. Make use of the available business and funding support, and get help to be introduced to relevant business networks (Wind Power Associations, Tokyo American Club, Tokyos Traders Club, etc.). Without direct contacts hardly anything works in Japan.

2. **Look for consultancy in Japanese language.**

There are many consulting companies in Japan; to name a few: PMC (www.pmcjapan.com), SBA Consulting Group (http://www.sbaltd.com), Cledasie (www.cledasie.com), and legal consultancies such as Nishimura & Asahi, Arqis (www.arqis.com) etc.

3. **Business partnerships and joint-ventures can make business considerably easier for foreign companies, but they require a specialized product portfolio and a good relationship with the partner company.**

Personal relationships and mutual economic ties play an important role in the Japanese economy, and the wind sector is no exception. This originates from long project timelines. Establishing these networks may take some time, meaning that the strategy for entering the Japanese market should follow a mid to long-term strategy. Frequent business trips to Japan, attendance of professional conferences, and meetings with potential partner companies are ways to build up such networks. Endurance and patience are necessary to be successful ion the market for decommissioning in Japan. Many European companies in the wind sector already maintain business relationships with relevant Japanese companies. The notion of trust means that it will be difficult for newcomers to enter this market without connections to the established organizations.

4. **The current system favors large companies since they can afford regular business trips to Japan and other supporting services such as translation and legal advice.**

SMEs will face more challenges, but they might use their product portfolio to their advantage. Start-ups will likely often lack both the manpower and reputation necessary for gaining the interest of the Japanese side. In some cases, looking among other European companies for potential business partners may be a worthwhile strategy for indirect access to the Japanese wind market, in particular for smaller SMEs without the means to support extensive business activities within Japan. It is also important to carefully consider which Japanese company would be the most promising partner. In general, large multinationals and prime contractors may be easier to approach than companies with a strong domestic focus, but attention should be paid to whether such cooperation would result in conflicting interests or competition with other Japanese companies, which will nearly always be in an advantageous competitive position (keiretsu system).

It is therefore a good idea to market products and services as complementary solutions rather than as a replacement for domestic alternatives. Cooperation with smaller companies with a domestic focus might be accompanied by communication problems. Since wind projects are distributed over many regions of Japan, including Kyushu and the Hokuriku region, looking for partners outside of the Tokyo metropolitan area is also an option. The partner should also be considered carefully. MHI, Hitachi and Toshiba are the most influential companies with strong influence

5. **Don't expect an over-margin market .**

One very common mistake that could be heard from companies wishing to enter the Japanese market is about the retail price. It is true that retail prices in Japan are probably the highest and the premium market is also likely to be the largest. However, the mass market is taking over premium market and retail prices are going down, a mentality of selling 50% or even 100% higher in Japan than in Europe is a mistake. It used to be the norm. But recently, acceptable prices are around 20% higher than in Europe. Japanese B2B clients are well-informed and won't accept an unjustifiably high retail price. As wind deployment in Japan is strongly linked with its LCOE reduction, O&M have to be aware that in a competitive market, the price is equally important as the relationship to the Japanese players.

6. **Offering services (in maintenance, certification etc.) can be sometimes more challenging, and usually needs a branch or partner with a branch in Japan.**

However, currently there is a demand in that area, possibly due to talent shortages and lack of experience in the maintenance and service business. Since the regulatory and industrial standards are different to Europe, relevant regulations and standards, in particular the JSME standards should also be researched during the development of a business strategy for the Japanese market.

7. **When marketing a product to Japanese partners, it is important to emphasize the unique features and advantages of the technology.**

As Japanese procurement officers are mostly interested in acquiring proven technology, being able to show examples on how the technology in question was successfully applied in past decommissioning projects is a valuable asset. Japanese companies are often more interested in designs and single components rather than in foreign manufacturing or the onsite operation and technology by foreign companies, questions of IP protection also need to be considered, especially since design codes and certain knowledge hand-over are often part of the project requirements. Furthermore, the business strategy should also take the persisting risks of the wind project development in Japan into account, such as project delays, regulatory changes and funding shortages. IP protection should also be taken into account.

8. **Showing presence in Japan and in relevant conferences and trade fairs in Asia.**

Now is a good time for positioning in the market. Since a successful business in this field revolves around reputation and the business connections to relevant organizations, it is advisable to strengthen business relations with relevant Japanese companies and organizations. Attendance at industry fairs (in Japan, but also in major fairs worldwide - e.g. many Japanese players participate in wind expos in Hamburg/Husum, Hannover), conferences and frequent meetings with Japanese partners to build personal relationships are some ways to achieve this. Japanese companies and organizations are part of GWEC and different IEA task groups.

9. **Be realistic.**

When planning a business strategy for Japan, European companies should carefully analyze whether a product can be successfully marketed in Japan. This question involves not only technical and economic considerations, but should also consider applicable Japanese laws, regulations and industrial standards. A strong commitment and endurance is necessary to attract the interest of Japanese partners. This may include frequent business trips to Japan and intensive product support.

10. **Be familiar with the Japanese concept of business negotiation and corporate decision-making.**

The term Naniwabushi describes the process to get along with someone in a good personal way, that he is willing to give you a favor when called on. Naniwabushi is usually part of the negotiation and stories had been reported, that wind companies were unsucessful in Japan as they did not pay attention to this culture and showed no efforts towards understanding their Japanese counterparts. It is strongly advised to get familiar with the main concepts. A summary of cultural differences for doing business can be found here: www.hbr.org/11/how-to-negotiate-in-japan

6.4 Challenges and bottlenecks in the Japanese market

As a totality of all the challenges that have been touched upon in the past chapters, there are several bottlenecks that discourage massive installation of inland and offshore energy projects in Japan. These obstacles exist in each value chain which leads to instability with high dangers, expansion of venture lead-time, driving up danger premiums and costs in all periods of activities. Despite the fact that it is difficult to change the natural nature of wind conditions, most bottlenecks are man-made. The grid network confusions and the unwillingness of the EPCOs to give up with electricity from renewable sources remains one of the biggest bottlenecks. However, this will conceivably be comprehended through the unbundling procedure that is in progress. Likewise, a series of legislations makes the approval and permitting process very complicated.

Despite the fact that the deregulation of different laws and administrative systems is in progress, it requires significant investment to deal with the issues identified with the EIA procedure and the need to set up a streamlined yet firm development process, which will be acceptable to the concerned government agencies, local groups and wind industry players. These issues strengthened the way that the local market has remained very small prompting a loss of opportunities to achieve economies of scale in cost reductions, wind turbine production and O&M activities. The market interest and reaction to wind power ventures have been exceptionally frail as a result of all natures of bottlenecks within the system. Resolving the main bottleneck (see following pages), wind power has the potential to be a growth industry. Market excitement over solar is dying slowly as generous incentives have been cut this year, that allows for a more balanced market with a significant share for wind energy. This is the case for onshore and offshore, although offshore surely has more queries over bringing down the costs of these mega projects. But also onshore development and expansion depend strongly on cost reductions and transparency by the WTG industry and O&M sector to point out LCOE curves and pathways to reduce the FIT burden for the government. Current challenges may well we be turned into fruitful opportunities by taking a proactive approach.

Bottlenecks – pathways and status

Category	Bottlenecks	Solutions & Easing the hurdles	Status & Trend
General aspects / Business practices	• **Language barrier:** Still there is no English literacy, and where there is, it is only spoken by a few. The Japanese school and university system do not support English abilities.	• Getting help: Hiring a translator, consultant or agent, that is fluent in Japanese.	→
	• **Lack of human resources:** Difficulties to attract and keep skilled workforce that is willing to work for a foreign company in Japan (as the company system is different).	• Search for alternatives: women, men with greater seniority (or even close to retirement), part-time workers, or foreigners with Japanese language skills. • Improve bankability of company to attract skilled workforce, provide competitive loans.	→
	• **Complex law and multiple layers of local regulations:** It is difficult without legal knowledge and experiences of the policy system to take advantages of policy funding or policy changes.	• Hiring law consultants, monitor policy changes closely.	→
	• **Lack of procurement transparency:** EU companies face coverage barriers, no access to information and practical administrative obstacles during the procurement procedures, in particular because of practical restrictions to access contracts awarded by excessive thresholds for public contracts, utility networks, and lack of exhaustive coverage by local contracting authorities.	• Enabling more transparency and introducing a culture of transparency. More pressure to follow WTO GPA requirements. • Use the services provides by the procurement helpdesk from the EU-Japan Centre for Industrial Cooperation or JETRO services.	↘
Project flow/ value and supply chain	• **Lack of project management skills**, from development to O&M	• Getting help (EU Centre procurement helpdesk and legal consultancies)	→
	• **Lack of proper micro-siting**, and WTG selection	• Improvement of project quality: Potential for knowledge transfer and service by European Companies	
	• **Weak O&M regime**	• Increasing market and economies of scale	↘
	• **High transport costs:** In particular, for wind turbines - as large-scale products - shipping costs are a major cost factor and add risks for handling damages. Domestic manufactures have an advantage in regard to this.	• It is important to get the shipping chain under control and reduce cost from transport handling (e.g. damages). • Japan`s B2B customers are used to additional prices due to shipment costs. However, as the market gets more competitive, companies that have manufacturing facilities in Asia, e.g. China, Korea or Taiwan can reduce shipping costs. Otherwise, streamlining logistics or reducing production costs.	↘
	• Poor supply chain and bottlenecks in supply	• Establishing supply chain of wind industry and promoting domestic wind related industries (bringing-up domestic industries). • Activate wind turbine & components industries in Japan by relying on European players	→
Resource characteristics	• **Severe Climate conditions:** Typhoons, thunder, turbulences, earthquakes and heavy snow but good wind resources in mountainous areas, often far from demand centers.	• Tailor-made R&D opportunities for innovative WTG technology that match Japan's climate and terrains. • Linking generation and demand centers to enable full grid access. • Comply with safety and electricity standards.	↘
	• **High population in narrow land area:** space is limited in Japan.	• Fukushima and Hokkaido regions are less populated areas • Promote offshore wind power as Japan has the world 6th largest exclusive economic zone • Expand wind farm sites candidates all over Japan	↗
Policy and regulations	• **Too many regulations that hinder deployment**, layers of location and development regulations/ lack of proper guidelines and zoning. • The lack of basic nationwide environmental data requires developers to gather a large amount of data over a long period of time.	• Easing regulations against wind power introduction in Japan. • The streamlining of the EIA administrative process (currently about 570 days) to halve the processing time is underway. Simplifying Environmental survey by developers. • Projects have started to gather environmental data onshore and offshore. • As wind development can coexist on agricultural land with good examples in Japan before 2010, wind turbine siting on first class agricultural land should be permitted again.	↘
	• **Poor political support**	• Improve sector understanding and highlight domestic value, such as its job creation impact (WTG industries created ca. 3000 direct jobs in Japan so far)	↘
	• **Lack of Target:** A stable investment framework is needed	• A clear commitment with more ambitious targets for wind energy is needed. National energy goals and strong government support mechanisms (ROCs, Contract for Difference etc.) are important assurances to project developers and financiers as it increases the likelihood of a project's success.	↘

Category	Bottlenecks	Solutions & Easing the hurdles	Status & Trend
Infrastructures	• **Poor Grid infrastructure and restriction, lack of grid integration capacity and wide area of grid operation:** Mismatch of wind resources and electricity demands, lack of grid capacity, clear rules, and operational procedures which integrate wind power projects into the existing grid contribute to high development and grid connection uncertainties and add up to high development costs. • Unclear installation plan	• Attract the necessary direct investment into infrastructure, to support the Government's existing program to generate around ¥310b of private and public investment into grid development on Hokkaido island and across the Tohoku region over the next decade, with the particular aim of stimulating further growth in its wind sector. • Incentivize greater integration between the two grid systems • The energy market deregulation has begun full retail liberalization since April 2016. The reform package forces the 10 regional utilities to spin off their transmission and distribution networks between 2018 and 2020. • Long-tem installation goal (roadmap, ultimate target), establishing social infrastructure (transmission network, port facility for offshore faccilities etc.)	↗ (red)
Data/ technologies	• **Not advanced yet:** "Big" data is not available yet. CMS systems of turbines often not accessible as service and maintenance is often done domestically without WTG manufacturer service contracts. Old turbines are not equipped with it.	• Creating incentives for CMS systems and data bases is in discussion.	↗ (yellow)
	• **Lack of proper simulation technologies:** suitable to Japan's specific wind regime	• Potential for EU cooperation, Geo data and CMS technology.	↗ (yellow)
Cost	• **High project costs**: especially High EIA, permit costs, low feasibility	• In general, bottlenecks need to be reduced to lower development and installation costs and ensure a predictable level of project certainty by resolving uncertainty in EIA and development permits. Policy targets need to be clearly communicated.	↗ (red)
	• **High CAPEX:** Supply chain bottlenecks and costly permitting processes have bloated the CAPEX for Onshore and offshore wind. Generous FITs, which partly reflect high CAPEX, has to come down as costs fall.	• Foster greater competition between power producers and suppliers to help bring down high electricity prices • Stronger involvement of European companies	↗ (red)
	• High public support schemes' NEDO capital subsidies which lasted for more than 15 years until the FIT introduction in 2012, contributed to the **industry's weak business models with lack of risk management ability and cost reduction efforts.**	• Need for more efficient policy to drive down costs: Moreover, although wind energy development costs remain high and feasibility is low with numerous bottlenecks and risks, the FIT is the only measure to alleviate the risks and bottlenecks so far. This is apparently not an efficient policy, as the FIT alone has to compensate high risk premiums derived from the lack of other proper regulatory measures and grid integration capacity.	↗ (red)
	• **High infrastructure and construction costs:** Driving down construction costs and installation risks are important: A key success factor to offshore development in Japan is to reduce its Levelised Cost of Electricity (LCoE). Analysts argue that construction costs won`t decrease until 2020 due to a big demand for the upcoming Olympic game preparation	• Drive down costs through cumulative production and expansion effects, live time extension, improved production technology and technology innovations.	→ (red)
Market	• **Influencial lobby groups** (Keidanren, the "nuclear village" etc.): Challenging the infrastructure and energy market barriers created by the effective monopolies held by the country's 10 regional utilities across the electricity value chain, as well as an extremely fragmented power grid is difficult.	• Unbundle and liberalize the energy market in a sustainable and long-term framework to force utilities to integrate renewables into the grid	↗ (red)
	• **Protective market**	• Knowledge transfer in deregulation: Europe has ample experience on deregulated electricity markets and knows on how to handle renewable energy in the grid, an issue that Japanese utilities are very concerned about.	↗ (red)
	• **Keiretsu-system**	• Being aware of horizontal and vertical Keiretsu. Economic pressure forces Japanese companies to internationalize beyond keiretsu system.	↗ (yellow)
	• **Capital/Finance:** Lack of financial instruments, Weak investment interest	• Stimulating robust investment: Promoting cost-effective and diversified financing sources to sustainable investment. Creating financial instruments and make funds available.	→ (yellow)
Stakeholder relationship	• **Social acceptance is a critical matter:** With some past project failures and poor community engagement records.	• Engage in better and sincere communication practices with local communities and stakeholders: • The new EIA procedure should be perceived as an important opportunity, and seriously engaging in this procedure is an excellent way of communicating with local communities to ensure environmental protection and community satisfaction. • Clearly structured and transparent rules that govern the leasing process for Japanese owned seabeds with strong fisheries rights provided a competitive process to support development of offshore wind for the Fukushima project. Still there been some concern that wind farm leases (especially for the commercial phase) could be amended or terminated due to opposition from new fishermen groups.	→ (red)
	• **Perceived disadvantages:** Bird strikes, noise, low frequency noise and landscape obstruction.	• Information, dialogue and citizens involvement. Standards for consensus building.	→ (yellow)

6.5 Policy Recommendation

As the second biggest wind market in the OECD Pacific district, Japan introduced 130 MW of wind power in 2014, a 160% annual growth rate. In spite of the fact that Japan is vigorously relying upon offshore wind development to meet its future needs, most of the generated capacity was from onshore installations. Over 6GW of wind power installations/projects are at various stages of the Environment Impact Assessment (EIA) process at the moment. It may be necessary for Japan to diminish the substantially bureaucratic-oriented process and formality imposed on wind ventures for the market to completely take off.

To propel wind energy development in Japan, the accompanying suggestions can be made in light of contributions from the interviewees and the energy industry.

JWPA has set up an idea called Wind Vision 20303 to diminish the government FIT responsibilities. This report proposes useful strides to accomplish higher wind power installation and usage. The 10GW goal for wind power in the "2030 Plan" is expected to have been met by the mid-2020s. JWPA has proposed a pathway to introduce 36.2GW of wind generation capacity by 2030 by considering a variety of impetuses for wind power growth in Japan. These are consolidated in the accompanying recommendations based on suggestions from interviewees and industry groups. Wind power development is highly probable to increase tremendously if the contributions raised are given attention.

1. Broad-spectrum goals: The establishment of wind energy market goals and roadmaps with strong wind energy development principles.

The premise of all arrangements is the foundation of a solid and clear wind energy development guideline, including illuminating what source of energy should be included in the energy blend in Japan. The objective of wind energy and the guide to achieve the objective ought to be made by taking into account the guideline. Without it, approaches lose cohesiveness and can't send clear market and social signs. Presently, in Japan, this part is very questionable, adding to the trouble of social reception and understanding. The wind market stakeholders need to work harder with national and neighborhood administrative offices, regional/local groups and different partners to shape the wind energy development guideline.

2. Execute a comprehensive policy to curb several bottlenecks and risks to increase the stake of wind power in Japan's energy blend

Reform of grid network and the overall electricity industry

The on-going Electricity Reform might be a little window of chance as the political and financial powers of the EPCO have been debilitated with the closure of atomic power plants and strict resistance toward their past operations, especially in connection to atomic power. A 50% subsidy for extensions of local grids is currently being put forth by METI. Other than METI, the Fukushima prefecture regional government plans to bolster neighborhood grid network augmentations. In December 2015, the Hokkaido and Tohoku Electric Power Companies requested that wind power developers acknowledge surpluses (previously 30 days) and unpaid curtailment. Negotiations are ongoing with the Electric Power Companies to determine this issue. The fundamental need for regional grid expansion still relies upon the advancement of Japan's Electric Power System Reform which is advancing step by step. The current vertically incorporated and territorially isolated little electricity market structures, additionally with the absence of transparent grid network guidelines, require huge institutional changes which are only possible with the presence and activity of strict and ceaseless political will such that capacity changes require long-term dedication and exertion for change. A corollary to this is the massive investment into the grid network which is crucial to fuel more extensive regional grid operation to ingest the variations in wind generation more efficiently. This must be accompanied with a complete reform of the electricity industry and its market.

To meet the needs for substantial wind energy adoption and better grid networks, particularly from wind-rich zones, with access to renewables are key issues that ought to be wholly incorporated into the reforms. The grid network should be enhanced, with a specific end goal to bolster the business sector and develop capacity which can be introduced in wind-rich regions where collection is viewed as an important control of grid operation that preferably is better between regional areas in a set up meant to permit a yield figure.

Grid capacity strengthening and wide-region operation of the grid is a way to expandthe wind framework and to settling the territorial imbalance of wind energy free market activity. This must be done in conjunction with the electricity reforms and long-term wind energy target goals. The complete business sector progression will likewise advance wind energy by realizing market interest for wind energy. Additionally, the change needs to assign clear obligation of grid administration and venture.

Lawful unbundling through regulation of conduct

Forced unbundling as the most relaxed method for nations like Japan, where power organizations are operated as private-division structures, is inadequate as auxiliary control as far as advancement of the of the grid network is concerned. Guardian organizations that own the plants keep up responsibility for transmission backups, a motivation for anti-competitive conduct. Keeping in mind the end goal, it's imperative to acquaint conduct directions with securing the autonomy of transmission divisions. Specifically, measures regarding serving directors of both the holding and its subsidiary operations such as trademarks, company names, marketing and PR, and buildings/IT systems, HR and transactions need to be separated to keep the transmission business completely unbiased. This is something Japan must learn from other nations, for example, Germany, where this is still an issue. Public agencies that screen these practices require the separate powers against sanctions to be unbiased, e.g. when choosing whether licenses ought to be allowed to a candidate and so forth.

Unbundling of ownership and future considerations for structural arrangements: From the perspective of economy of scale which is characteristic of the transmission administration, ten transmission organizations (general transmission administrators) working together with two distinctive transmission frameworks (50/60Hz) appears to be wasteful. Particularly to acquire more noteworthy impacts between local transmission operations, transmission organizations ought to consolidate together or take joint measures for large-scale operations. In Germany, the Federal Network Agency works for the through usage of conduct control, which is one of the bodies which made ownership of transmission companies less alluring. This leads power companies to choose to offer their transmission divisions for sale (possession unbundling).

The pressing need to stop transmission operators from rejecting connection of renewable electricity to national grid network: New standards presented for the FIT in 2015 permit power companies (grid administrators) with no impediments to smother the yield from renewable power sources without paying remuneration, throwing a dull shadow over any new interest in wind energy (as well as other renewable sources).

Streamlining of development permit process

In the short term, clear operational tenets of managerial strategy of development directions should be concurred and connected to administrative bodies and the wind energy industry. In the more drawn out term, the foundation of a database which can be utilized for wind development planning and/or siting ought to be made, there is one in creation and some databases already available.[93][94] The information base ought to have wind asset information and a database as well as the natural information and social information of every region.

Furthermore, the further alteration of the EIA Act ought to be to this degree: SEA of regional project siting and/or local wind development strategy and arrangement which completely adjusts to global SEA can lessen the vulnerability and perception by wind designers on the present SEA. Doling out supervision duty of regulatory methodology of development approvals to one organization, for instance, to the METI, likewise diminishes the present many-sided quality of exploring the procedure for engineers. Innovation and undertaking authentications which consider Japan-particular wind asset attributes, financial pragmatism and social reception can be incorporated into the streamlined development license technique to stop low-quality technology and engineers from having a hold in the industry.

Enhancement of the EIA

The ecological law had been stretched out to incorporate wind ranches from October 2012 after public outcry against its antecedent environmental issues. The mandatory EIA is mind boggling, costly and lengthy and having the support of the local population is a vital necessity for wind ranch development (up to three times required) and incorporating participation with neighborhood fisheries is also important, for instance, for offshore development. The issue with the EIA is that similar measures with respect to an atomic power plant are being taken for a wind turbine installation. Updates are predicted still this yearwhich the wind industry has intensely requested for and made contributions regarding essential changes. In respect of severe criticisms, METI has been attempting to shorten the approval process of the EIA for wind development by:

- Limiting potential damage to bird populations in

93 MOE (2016): EIA Status (In Japanese). www.env.go.jp/policy/assess/3-1procedure/ (accessed 25/07/2016)

94 MOE (2016): Information database for EIA Database. (In Japanese). Available online: https://www2.env.go.jp/eiadb/ebidbs/Service/LiteratureGuidelinesSearchResult (accessed 14/08/2016)

certain areas

- Establishing a local and national EIA and a fractional supplementary appraisal on a case by case premise for every site (which would hypothetically reduce the process by two years)
- Test ventures under this rearranged EIA have been propelled to encourage usage of a deliberate ecological appraisal to supplant or side line the strict regulations

Concise classification of Feed-in Tariffs

The present FIT has a single classification for all inland wind energy, which does not fit the truth of cost distinction. LCOE of wind energy fluctuate for different reasons such as over venture proprietorship, size, and area. Specifically, capital and O&M costs in hilly and remote areas are higher than in flat-plane locations although capacity generation may be higher because of better wind assets. To advance the usage of a greater amount of these better wind assets, FIT classifications based on particular qualities and venture scale ought to be made, for instance, with FIT premium or higher FITs for uneven and remote area projects considering an increase in installation expenses and O&M costs. Additionally, communal and regional projects have a tendency to be much smaller to achieve economies of scale in wind turbine purchase, establishment and O&M. These ventures ought to be dealt with uniquely in contrast to other large-scale and privately financed projects in FIT applications. To advance offshore development, a different FIT class ought to be made for offshore projects. These require a great cost information base and unbiased analysis. As of now, the METI does not reveal the cost information accumulated from project developers under the FIT administration and the past NEDO-sponsored ventures. Information ought to be open to advance autonomous examination, transparent debates and cost reduction efforts by the industry.

Towards a prosperous business environment for investors

Investment opportunities must also be created for foreign companies: The project environment should be invigorated by strategy policies other than the FIT. Venture fund plans using an extensive variety of private financial specialists needs to supplant the current corporate financing framework for wind energy in Japan with a specific end goal - to augment the investment base and additionally expand the project proficiency and returns. This additionally sustains industry competitiveness. Arrangements to incentivize wind energy investments, for example, tax holidays to private project investment and finance initiatives as well as soft loans from government would be far more compelling.

3. Adoption of global technical, safety standards and practices

Better arrangement of globally specialized and safety models and practices: the existing and rigorous requirements for safety and approvals create r major obstructions of access into the Japanese market. With focus on the PCS, the absence of English reports and the way that JET is the sole body ready to provide market access is regularly seen as an obstacle by foreign market players.

4. Technology policy

Policies on technology for inland wind ought to e give consideration to social benefits, on the grounds that coastal energy innovation is moderately developed. This incorporates a natural and social database set up and innovations which improve grid reconciliation of wind energy. Technological practices and accreditations must also be critical to support the utilization of cutting edge advancements to decrease and cushion the impacts of natural mishaps/accidents.

5. Transparent Communication about benefits and current bottlenecks

6. Requests to the government from the WTG industry in Japan

Building modern bunches of wind energy-related production and subordinate administrations including finance, venture execution and sustaining framework must be considered to decrease expenses and expand social advantages through the creation of employment opportunities. This should be an integral wind energy strategy and development arrangement, alongside household market extension, local wind zoning, trade opportunity improvement, human resource & capacity building and regional financial development. Consequently, inland and offshore ought to be viewed together, as locales with high coastal wind have a tendency to have great wind assets for offshore projects.

The following is the summary of request items to the government from the WPG industry.

- It is concerned that the economic effect of introducing renewable energy (employment expansion, cost reduction, trade profit) decreases, in the case where the government fails to develop industries because of unclear policy about long term installation goals or viable economic incentives.
- It is concerned that the economic effect of introducing renewable energy (employment expansion, cost reduction, trade profit) decreases, in the case where the government fails to develop industries because of unclear policy about long term installation goals or viable economic incentives.
- To reduce LCOE in conjunction with the industry, steps must be taken to:
  - Balance grid competitiveness and quality
  - Mass generation results into volume discounts
  - To enhance capacity and accessibility.
  - Setting ambitious mid and long term installation goals directed by the government
- Clarifying the diffusion scenario every five years until 2030, which is necessary for facility investment and business judgement. Example: set clear goal like “Round 3” of UK (develop 32 million kW of offshore wind power by 2020, create employment of 70 thousand people by investing approximately 13 trillion yen)
- Implementing proper economic incentive based on long term installation scenario.
- Appropriate and flexible implementation of FIT (setting purchase price and period)
- Establishing infrastructure and supporting for it necessary for long-term installation goal amount
- Establishing transmission networks, port facilities for offshore wind turbines (developing port area, transport ship, large scale operation ships), supporting establishment of factories, supporting human resource development, etc. EX: in Germany, there is a similar problem of establishing transmission lines connecting proper place for power plants (Northern region) and power demand areas (Southern region). Reflecting on previous challenges is also necessary.
- Deregulation of domestic industry: Deregulation of location of wind power plants in farmlands, forests, national parks, and etc, simplification of each examination process, application of deregulation special measure, preferential taxation, etc
- Supporting technology development: Development of technology for high efficiency, development of technology related to offshore WP generation, components technology development (blades, generators, bearings, remote monitoring)
- Technology development related to cross-regional operation of transmission lines which installs weather forecast system, empirical research on output leveling effect by assembling, advancing wind state observing technology by doppler lidar or something
- Establishing test facilities for WPG and supporting use of international certification system
- Supporting R&D, developing competitiveness of domestic companies, improving safety and reliability of domestically-installed wind turbine
- In addition, especially in development of offshore Wind farm, involvement of the government into the arrangement between business operators and stake holders is believed to contribute to reducing time for developing candidate areas.
- Repowering efforts must be renewed to advance new and extensive superior wind turbines rather than old ones.

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List of Abbreviations

Abbreviation	Meaning
B2B	Business to Business
CAPEX	Capital expenditures
EPCO	Electric Power Companies
FY	Financial Year
FIT	Feed-in-Tariff
GW	Gigawat
IPP	Independent Power Producer
JEPX	Japan Electric Power Exchange
JV	Joint Venture
LCOE	Levelized Cost of Electricity
METI	Ministry of Economy, Trade and Industry, Japan
MOE	Ministry of Environment
MW	Megawatt
NEDO	New Energy and Industrial Technology Development Organization
OCCTO	Organisation for Cross-regional-Coordination-of-Transmission-Operators
OEM	Original Equipment Manufacturer
R&D	Research & Development
RES	Renewable Energy Sources
ROI	Return on Investment
RPS	Renewable Portfolio Standard
SME	Small-and-Medium-sized-Enterprise
TIER	(First, Second, Third) Suplier
WEU	Wholesale Electric Utility
WTG	Wind Turbine Generator

Annex

Events and Trade Fairs	
7-Sep-2016 to 9-Sep-2016 at Osaka	Osaka World Smart Energy Week 2016 FC EXPO Osaka 2016 - 1st Int'l Hydrogen & Fuel Cell Expo Osaka PV EXPO Osaka 2016 - 4th Int'l Photovolta- ic Power Generation Expo Osaka PV SYSTEM EXPO Osaka 2016 - 4th Int'l Photovol- taic Power Generation System Expo Osaka 2nd Energy Market Liberalisation Expo Osaka BATTERY Osaka 2016 - 3rd Int'l Rechargeable Battery Expo Osaka 3rd INT'L SMART GRID EXPO Osaka
8-Sep-2016 to 9-Sep-2016 at Kobe	The International Industrial Fair 2016
19-Oct-2016 to 20-Oct-2016 in Koryama/ Big Palette Fukushima	Renewable Energy Industrial Fair 2016
26-Oct-2016 to 29-Oct-2016 in Nagoya	Messe Nagoya2016
26-Oct-2016 to 28-Oct-2016 in Tokyo	SMART ENGINEERING TOKYO 2016
26-Oct-2016 to 28-Oct-2016 in Tokyo	The 1st ECO Plant Engineering Show 2nd Hydrogen Energy Techno Fair
31-Oct-2016 to 2-Nov-2016 in Tokyo	WWEC 2016, World Wind Energy Conference
8-Nov-2016 to 9-Nov-2016 in Tokyo	Energy Storage Summit Japan 2016
15-Feb-2017 to 17-Feb-2017 in Tokyo	ENEX 2017 / Smart Energy Japan 2017 / En- ergy Supply & Service Showcase
1-Mar-2017 to 3-Mar-2017 at Tokyo Big Sight	World Wind Expo in the Scope of the World Smart Energy Week
5-Jul-2017 to 7-Jul-2017 at Pacifico Yokohama	The 12th RENEWABLE ENERGY 2017 EXHIBITION
July15, 2017	Global Wind Day (usually seminars and workshops are organized around that day, check www.jwpa.jp)
Helpful source to search for relevant events:	https://www.jetro.go.jp/j-messe/?action_top=true

EIA PROCESS

https://www.env.go.jp/en/focus/docs/files/20120501-04.pdf

List of projects subject to the Environmental Impact Assessment Law

	Class-1 project (EIA is always required)	Class-2 project (The necessity of EIA is judged by project)
1. Road		
national expressway	all	–
metropolitan expressway	4 lanes or more	–
national roads	4 lanes or more, 10km or longer	4 lanes or more, 7.5km–10km
large-scale forest road	width: 6.5m or wider, 20km or longer	width: 6.5m or wider, 15km–20km
2. River		
dam, weir	reservoir area:100ha or larger	reservoir area:75ha–100ha
diversion channnel, lake-related development	area of land alteration:100ha or larger	area of land alteration:75ha–100ha
3. Railway		
shinkansen(super express train)	all	–
railway, track	length:10km or longer	length:7.5km–10km
4. Airport	runway:2,500m or longer	runway:1,875m–2,500m
5. Power plant		
hydraulic power plant	output:30,000kw or over	output:22,500kw–30,000kw
thermal power plant	output:150,000kw or over	output:112,500kw–150,000kw
geothermal power plant	output:10,000kw or over	output:7,500kw–10,000kw
nuclear power plant	all	–
wind power plant	output:10,000kw or over	output:7,500kw–10,000kw
6. Waste disposal site	area:30ha or larger	area:25ha–30ha
7. Landfill and reclamation	area:exceeding 50ha	area:40ha–50ha
8. Land readjustment project	area:100ha or larger	area:75ha–100ha
9. New Residential area development project	area:100ha or larger	area:75ha–100ha
10. Industrial estate development project	area:100ha or larger	area:75ha–100ha
11. New town infrastructure development project	area:100ha or larger	area:75ha–100ha
12. Distribution center complex development project	area:100ha or larger	area:75ha–100ha
13. Residential or industrial land development by specific organizations	area:100ha or larger	area:75ha–100ha

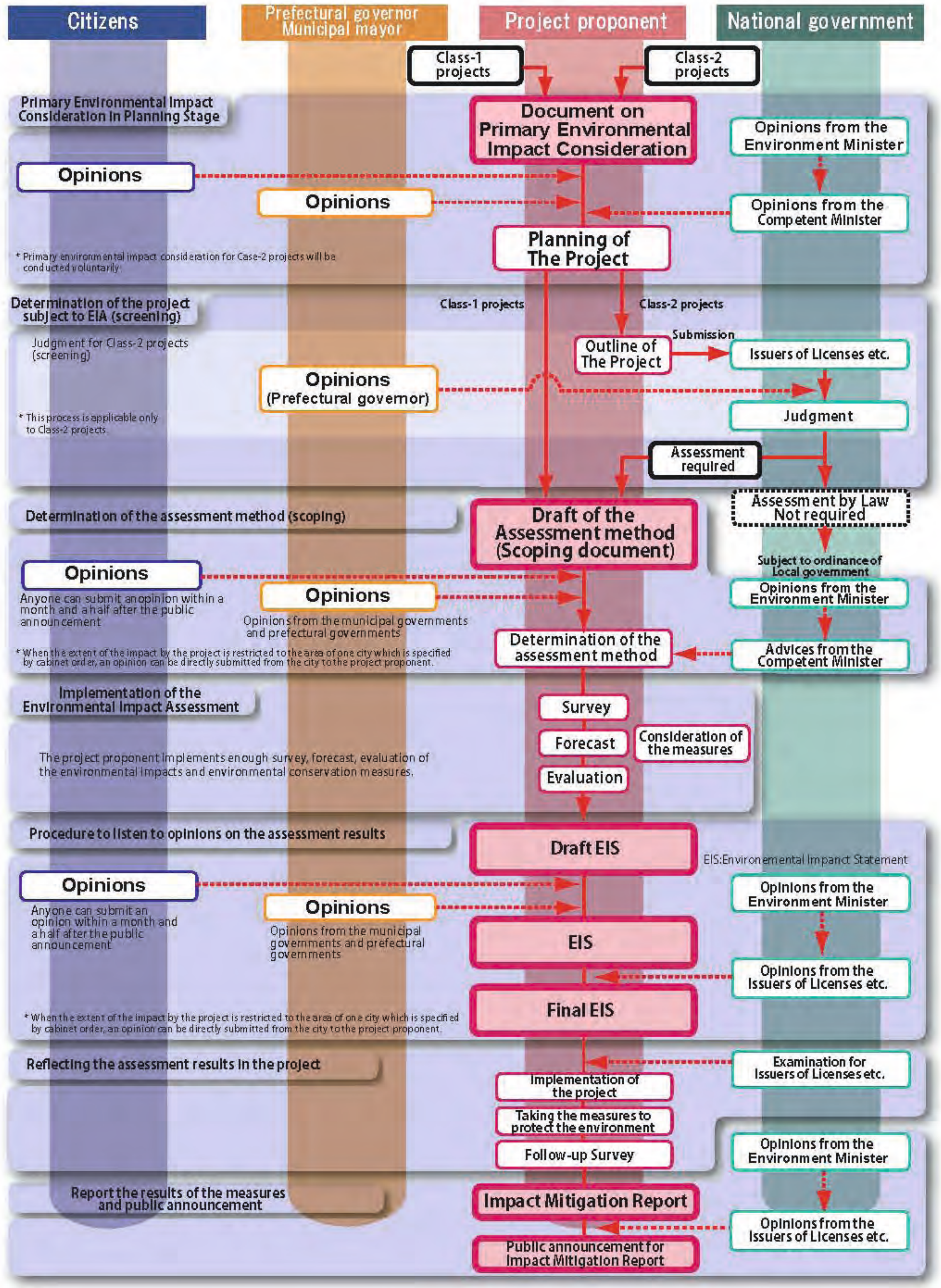
Port and harbor plannning	Total reclaimed and excavated land: 300ha or larger

(4) Who implements EIA?

Project proponents implement EIA by themselves. This is because EIA is the process for putting environmental considerations into the project design through exchange of views and information among the entities concerned and because project proponents know best about proposed project and have the best position to modify/adjust the project.

By considering all environment-related issues and necessary measures in advance through information gathering and disclosure on possible impacts of the project, environmental issues are better addressed during the construction and operational phases of the project.

(5) Procedure of EIA



Topic identifier:	**LCE-13-2016**
TOPIC :	Solutions for reduced maintenance, increased reliability and extended life-time of off-shore wind turbines/farms
Publication date:	14 October 2015
DeadlineModel:	single-stage
Deadline:	08 September 2016 17:00:001
Types of action:	IA Innovation action
Planned opening date:	11 May 2016
Budget:	10,000,000 Euro
Horizon 2020 H2020 website	Pillar: Societal Challenges Work Programme Year: H2020-2016-2017 Work Programme Part: 'Secure, Clean and Efficient Energy' Call : H2020-LCE-2016-2017
Scope:	Offshore wind turbines, both fixed bottom and floating, are subject to high loads in form of vibrations from wind and waves, as well as from rotation of the turbines. The focus is to reduce the need for maintenance of wind turbines/farms and to develop measures for life-time extension, demonstrating innovative solutions and tools, and thereby the levelised cost of wind energy. The action can include the development of tools for doing predictive maintenance, hereunder models of component/soil degradation, and establishment a database with operational and failure data for validation of tools. The actions should consider not only the wind turbines but also the substructure and the soil conditions. Participation of wind turbine manufacturers and large wind farm operators is expected. TRL 7 shall be achieved at the end of project activities (please see part G of the General Annexes). Opening the project's test sites, pilot and demonstration facilities, or research infrastructures for practice oriented education, training or knowledge exchange is encouraged. The Commission considers that proposals requesting a contribution from the EU of between EUR 7 to 10 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Topic identifier:	**LCE-14-2017**
TOPIC :	Demonstration of large >10MW wind turbine
Publication date:	14 October 2015
DeadlineModel:	single-stage
Deadline:	07 September 2017 17:00:002
Types of action:	IA Innovation action
Planned opening date:	11 May 2017
Budget:	25,000,000 Euro
Horizon 2020 H2020 website	Pillar: Societal Challenges Work Programme Year: H2020-2016-2017 Work Programme Part: 'Secure, Clean and Efficient Energy' Call : H2020-LCE-2016-2017
Scope:	The development of large scale (>10MW) turbines will have intrinsically logistical requirements regarding handling, installation, operation and maintenance, constituting a large part of the levelised cost of energy (LCOE). Improved handling (storage, loading, transport, etc.) on land, in the harbours and/or at sea, as well as improved logistics around operations and maintenance have to be taken into account in this innovation action. TRL 7 shall be achieved at the end of project activities (please see part G of the General Annexes). Opening the project's test sites, pilot and demonstration facilities, or research infrastructures for practice oriented education, training or knowledge exchange is encouraged. Activities to engage and involve local communities in the innovation action, to further improve social acceptance are encouraged. The Commission considers that proposals requesting a contribution from the EU of between EUR 20 to 25 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts

Topic identifier:	**LCE-06-2017**
TOPIC :	New knowledge and technologies
Publication date:	14 October 2015
DeadlineModel:	two-stage
Deadline:	29 November 2016 17:00:003 22 August 2017 17:00:00
Types of action:	RIA Research and Innovation action
Planned opening date:	29 July 2016
Budget:	20,000,000 Euro
Horizon 2020 H2020 website	Horizon 2020 H2020 website Pillar: Societal Challenges Work Programme Year: H2020-2016-2017 Work Programme Part: 'Secure, Clean and Efficient Energy' Call : H2020-LCE-2016-2017
Scope:	One of the following technology-specific challenges has to be addressed:

New renewable energy technologies: Developing the new energy technologies that will form the backbone of the energy system by 2030 and 2050: Excluding wind energy and sustainable fuels addressed in the other bullet points, and photovoltaic new materials addressed in topic NMBP-17-2016 ('Advanced materials solutions and architectures for high efficiency solar energy harvesting') of the work programme part 'Leadership in enabling and industrial technologies – 5.ii Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing', the challenge is to scale up energy technologies currently in development at laboratory scale. It is crucial that these new, more efficient, and cost-competitive energy generation and conversion technologies, demonstrate their potential value in the future European energy system. Developments in sectors other than energy may provide ideas, experiences, technology contributions, knowledge, new approaches, innovative materials and skills that are of relevance to the energy sector. Cross-fertilisation could offer mutually beneficial effects.

Wind energy: Improved understanding of the physics of wind as a primary resource and wind energy technology: For an improved design of large-scale wind rotors a better understanding of the underlying physics is needed. The challenge is to increase understanding of the underlying physics and to significantly improve the simulation capability for multi-scale wind flows, loads and materials failure. Significant high-performance computing (HPC) resources will be needed for this challenge. It is expected that further research towards this challenge will continue after the project, therefore the data retrieved in this project should be with open access. Research results could contribute to IEA Wind and for that reason cooperation with IEA partner countries is expected. International cooperation with leading groups outside Europe is encouraged. This research will contribute to making wind energy fully competitive, through a better design of the wind turbine and having an impact on the turbine efficiency and therefore on the cost of energy produced.

Sustainable Fuels: Diversification of renewable fuel production through novel conversion routes and novel fuels: Novel technologies for sustainable fuel production and novel fuels having a potential value in our future transport energy system should be developed at laboratory scale. The specific challenge is to diversify the sustainable fuel production taking into account long-term dependencies on fossil fuels of particular transport sectors by developing novel fuels and processes that in the long-term can bring down substantially transport fuel costs while overcoming sustainability constraints and feedstock limitations. While biofuels produced from starch, sugar and oil fractions of food/feed crops are excluded, this research shall enable novel fuel production addressing one of the following pathways:

Development of novel microorganisms, enzymes and catalysts or a combination of these systems with improved performance for obtaining paraffinic biofuels or higher alcohols from lignocellulosic biomass;

Development of renewable alternative fuels from CO2 in industrial waste flue gases through chemical catalytic conversion;

Development of renewable alternative fuels from H2O, CO2 and energy from renewable, autonomous sources through micro-organisms, synthetic molecular systems or chemical synthesis, or a combination of these processes;

Development of middle distillate range biofuels (i.e. diesel and jet fuel) from liquid organic or lignocellulosic waste streams through advanced thermochemical conversion processes.

Aside from the technology-specific challenges mentioned above, potential environmental, resource efficiency and safety concerns, issues related to social acceptance or resistance to new energy technologies, as well as related socioeconomic and livelihood issues also should be addressed, where relevant. This may require a multi-disciplinary perspective with contributions also from the social sciences and humanities, which then should be integrated into the research process from the outset. A methodology that permits a sustainability assessment of the environmental (notably in terms of GHG performance), as well as economic and social benefits with respect to current technologies should be included.

Novel technology solutions for grid integration, storage, fuel cells and hydrogen – other than integral to the technology solution developed, energy efficiency and smart cities will not be supported under this topic but in the relevant parts of this work program.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 to 4 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts**.**

Topic identifier:	**LCE-21-2017**
TOPIC :	Market uptake of renewable energy technologies
Publication date:	14 October 2015
DeadlineModel:	Single-stage
Deadline:	05 January 2017 17:00:004
Types of action:	CSA Coordination and support action
Planned opening date:	20 September 2016
Budget:	15,000,000 Euro
Horizon 2020 H2020 website	Pillar: Societal Challenges Work Programme Year: H2020-2016-2017 Work Programme Part: 'Secure, Clean and Efficient Energy' Call : H2020-LCE-2016-2017

Scope:	One of the following technology-specific challenges has to be addressed:

Photovoltaics: Tackling the bottlenecks of high penetration levels of PV electricity into the electric power network: PV electricity is not necessarily generated when mostly needed. Furthermore, small distributed PV systems feed into the grid possibly all at the same time challenging grid stability. To enable the effective and efficient integration of growing shares of PV power into the grid, the idea of PV producers becoming "prosumers" – both producers and consumers of energy – is gaining ground while "self-consumption" is becoming a major driver for the installation of small distributed PV systems. To facilitate this to happen, the following sub-challenges need to be addressed:

Development of solutions for innovative system-integration and power-management for households/larger buildings (in general small distributed PV systems) including storage, particularly addressing the impact of self-consumption on the operation of the grid and the value of PV electricity when aggregated and offered to the wholesale market;

Based on these solutions, elaboration of business and management models, including cost-benefit analysis and assessing economic feasibility for the European urban landscape.

Heat Pumps: Accelerate the penetration of heat pumps for heating and cooling purposes: Heating and cooling represents almost 50% of the final EU energy consumption and cooling demand is increasing. The cost associated with the purchase and installation of heat pumps remains an obstacle for a wider penetration on the market. In order to accelerate the penetration of heat pumps for heating and cooling purposes, proposals should address the following challenges:

identification of the most promising cost reduction options for CAPEX, installation costs, and OPEX as well as development of EU wide scenarios of deployment; proposed prioritisation of R&I investments;

development of solutions for innovative system integration and integrated power management for household/industrial buildings.

CSP: Facilitating the supply of electricity from CSP plants in Southern Europe to Central and Northern European countries - By means of CSP Southern European countries could supply renewable electricity on demand to the entire European energy market, including Central and Northern European countries – in particular, the Renewable Energy Directive foresees cooperation mechanisms to this end to allow Member States to meet their national targets cost-efficiently. The exploitation of this possibility would greatly facilitate the market uptake of CSP, but this has not happened so far. The challenge is to identify all issues (technological, legal, economic, political, social, financial, etc.) that may constitute an obstacle to the supply of renewable electricity on demand from CSP plants to Central and Northern European countries (other than those bottlenecks related to building new physical interconnections), and to identify possible solutions and propose options for addressing the issues in the context of a concrete project case.

Wind energy: Increasing the market share of wind energy systems: One of the following specific sub-challenges need to be addressed: i) Develop spatial planning methodologies and tools for new onshore wind and repowering of old wind farms taking into account environmental and social impacts but also the adoption of the latest developments in wind energy technology; ii) Identify the bottlenecks for further deployment in Europe and the regulations which limit the adoption of technological innovation and their deployment possibilities; iii) Increase the social acceptance and support for wind energy in 'wind energy scarce regions' using, with solid involvement of social sciences and humanities and local communities and civil society to understand best practices and to increase knowledge about social and environmental impact of wind energy.

systems: Geothermal energy suffers from a level of penetration that is limited compared to its

TECHNICAL STANDARDS[1]

Japanese Standards Association http://www.jsa.or.jp
Japanese Industrial Standards Committee http://www.jisc.go.jp

standard number	JIS / TS / TR number	Standard name	Emphasis follow (the Japan of the environment reflected in the standard)
61400-1 IEC (Ed.3- 2005-08)	C1400-1 JIS (2010)	Wind turbines - Part 1: Design requirements windmill - Part 1: Design requirements	○
61400-2 IEC (Ed.3-2013-12)	C1400-2 JIS (2010)	Wind turbines - Part 2: Design requirements for small wind turbines wind turbines - Part 2: Small windmill design requirements	
61400-3 IEC (Ed.1-2009-02)	C1400-3 JIS (2014)	Wind turbines - Part 3: Design requirements for offshore wind turbines wind turbines - Part 3: offshore wind turbine design requirements	○
IEC 61400-3-2 [unpublished]	(JIS unissued)	Wind turbines - Part 3-2: Design requirements for floating offshore wind turbines wind turbines - Part 3-2: floating offshore wind turbine design requirements	○
61400-4 IEC (Ed.1-2012-12)	(JIS unissued)	Wind turbines - Part 4: Design requirements for wind turbine gearboxes windmill - Part 4: gear box of the design requirements of the wind turbine	
IEC 61400-5 [unpublished]	(JIS unissued)	Wind turbines - Part 6: Rotor blades windmill - Part 5: windmill blade design requirements	
IEC 61400-6 [unpublished]	(JIS unissued)	Wind turbines - Part 5: Tower and foundation design windmill - Part 6: Tower and the basis of design requirements	○
61400-11 IEC (Ed.3.0-2012-11)	C1400-11 JIS (2005)	Wind turbine generator systems - Part 11: Acoustic noise measurement techniques windmill - Part 11: Noise measurement methods	
61400-12-1 IEC (Ed.1-2005-12)	C1400-12-1 JIS (2010)	Wind turbines - Part 12-1: Power performance measurements of electricity producing wind turbines wind turbines - Part 12-1 Part: Performance measurement method of grid-connected wind turbines	
61400-12-2 IEC (Ed.1-2013-3)	(JIS unissued)	Wind Turbines - Part 12-2: Power performance of electricity producing wind turbines based on nacelle anemometry windmill - the first 12-2 Part: performance measurement method of the wind turbine by the nacelle anemometer	
IEC 61400-12-3 [pause]	(JIS unissued)	Wind turbines - Part 12-3: Wind farm power performance testing wind turbines - Part 12-3: of wind farm performance measurement method	

1 https://www.jema-net.or.jp/Japanese/res/wind/kikaku.html

IEC TR 61400-12-4 [unpublished]	(JIS unissued)	Wind turbines - Part 12-4: Wind Turbines - Part 12-4:. Power performance verification of electricity producing wind turbines based on numerical site calibration windmill - the first 12-4 Part: wind speed estimation method by numerical site calibration	○
TS61400-13 IEC (Ed.1-2001-06)	C0035 TS (obsolete)	Wind turbine generator systems - Part 13: Measurement of mechanical loads windmill - Part 13: mechanical load measurement method	
TS61400-14 IEC (Ed.1-2005-03)	(TS unissued)	Wind Turbines - Part 14: Declaration of apparent sound power level and tonality values of wind turbines wind turbines - Part 14: Display of the sound power level and tonality evaluation value of the wind turbine	
IEC TS61400-15 [unpublished]	(JIS unissued)	Future IEC 61400-15: Assessment of site specific wind conditions for wind power stations wind turbines - Part 15: site assessment on the wind conditions of the wind power plant	
61400-21 IEC (Ed.2-2008-08)	C1400-21 JIS (2005)	Wind turbine generator systems - Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines wind turbines - Part 21: Measurement and assessment of power quality characteristics of grid-connected wind turbines	
61400-22 IEC (Ed.1-2010-05)	C1400-22 JIS (2014)	Wind Turbines - Part 22: Conformity testing and certification windmill - Part 22: windmill certification system	○
TS 61400-23 IEC (Ed.1-2001-04)	C 0040 TS (obsolete)	Wind turbine generator systems - Part 23: Full-scale structural testing of rotor blades windmill - Part 23: actual wing structure strength of the wind turbine test	
61400-24 IEC (Ed.1-2010-06)	C1400-24 JIS (2014)	Wind turbine generator systems - Part 24: Lightning protection for wind turbines wind turbines - Part 24: Lightning protection of the windmill	○
61400-25-1 IEC (Ed.1-2006-12)	(JIS unissued)	Wind turbines - Part 25-1: Communications for monitoring and control of wind power plants: Overall description of principles and models windmill - the first 25-1 Part: Wind power plant of monitoring and controlling communication: principles and model general description of	
61400-25-2 IEC (Ed.2-2015-06)	(JIS unissued)	Wind turbines - Part 25-2: Communications for monitoring and control of wind power plants: Information models windmill - the first 25-2 Part: Communication for monitoring and control of wind power plants: Information Model	
61400-25-3 IEC (Ed.2-2015-06)	(JIS unissued)	Wind turbines - Part 25-3: Communications for monitoring and control of wind power plants: Information exchange models windmill - the first 25-3 Part: Communication for monitoring and control of wind power plants: information exchange model	

61400-25-4 IEC (Ed.1-2008-08)	(JIS unissued)	Wind turbines - Part 25-4: Communications for monitoring and control of wind power plants: Mapping to XML based communication profile windmill - the first 25-4 Part: Mapping to XML-based communication profile of
61400-25-5 IEC (Ed.1-2006-12)	(JIS unissued)	Wind turbines - Part 25-5: Communications for monitoring and control of wind power plants: Conformance testing windmill - the first 25-5 Part: conformance testing
61400-25-6 IEC (Ed.1-2010-11)	(JIS unissued)	Wind turbines - Part 25-6: Communications for monitoring and control of wind power plants: Logical node classes and data classes for condition monitoring windmill - the first 25-6 Part: logical node classes and data classes for condition monitoring
61400-26-1 IEC (Ed.1-2011-11)	(JIS unissued)	Wind turbines - Part 26-1: Time base availability for wind turbines wind turbines - Part 26-1 Part: windmill available rate by the time reference
61400-26-2 IEC (Ed.1-2014-6)	(JIS unissued)	Wind turbines - Part 26-2: Wind Turbine Capacity Based Availability windmill - the first 26-2 Part: available by output reference of windmill rate
IEC 61400-26-3 [unpublished]	(JIS unissued)	Wind turbines - Part 26-3: Wind Turbine System Time Based / Capacity Based Availability windmill - the first 26-3 Part: windmill available rate by the time reference and output reference
61400-27-1 IEC (Ed.1-2015-02)	(JIS unissued)	Wind turbines - Part 27-1: Electrical simulation models for wind power generation wind turbines - Part 27-1 Part: electrical simulation model of the output rating of the wind turbine
IEC 61400-27-2 [unpublished]	(JIS unissued)	Future 61400-27-2: Wind turbines - Part 27-2 : Electrical simulation models for wind power generation - Wind power plants windmill - the first 27-2 Part: electrical simulation model of the output rating of the wind power plant
60050-415 IEC (Ed.1-1999-4)	C 1400-0 JIS (2005)	Wind power generation systems - Part 0 Part: Wind power generation term
-	C TR 0045 (2006)	Guidance for the safe introduction of the small windmill

COMPANIES AND STAKEHOLDERS RELATED TO THE WIND INDUSTRY IN JAPAN

Name	Business	Website	Address	Telephone
ABB LTD	Electrical equipment and electrical system equipment	http://www.abb.co.jp	26-1 Sakuragaokachi, Shibuya-ku, Tokyo-to 150-0031	03-4523-6000
AGC ASAHI GLASS	Civil engineering and construction, maintenance	http://www.agc.com/	1-5-1 Marunouchi Chiyoda-ku Tokyo 100-8405 JAPAN	03-3218-5040
AGC COATTECH CO.LTD.	Others	http://www.agccoattech.co.jp	2-9 Kanda Nishikicho Chiyoda-ku Tokyo 101-0054 Japan	03-5217-5102
AIR WATER INC.	Industry	http://www.awi.co.jp/english/	12-8, Minami Semba 2-chome, Chuo-ku, Osaka, 542-0081, Japan	
AKATSU INDUSTRY CO., LTD	Industry	http://nejiakatsu.co.jp/en/aboutus/index.html	1-3-15, Benten-cho, Hitachishi Ibaraki, 317-0072 Japan	+81 294 21 6255
AKEBONO BRAKE INDUSTRY CO., LTD.	Machine Equipment	http://www.akebono-brake.com/english/	19-5, Nihonbashi Koamicho, Chuo-ku, Tokyo 103-8534, Japan	81-3-3668-5171
AON HOLDINGS JAPAN CO. LTD.	Finance and insurance	http://www.aon.com/japan/	100-0014 Chiyoda-ku Tokyo Nagatacho 2-chome 10 3	03-4589-4137
ASAHI AERO CORPORATION	maintenance, consultancy	http://www.aeroasahi.co.jp/	136-0082 Koto-ku Tokyo Shinkiba chome 7 41	03-3988-1013
ASAHI KASEI ENGINEERING (AEC)	maintenance, consultancy	http://www.asahi-kasei.co.jp/aec/	Chiyoda-ku Tokyo Kanda Jimbocho chome 105	044-382-3637
ASHAI GLASS COMPANY (AGC)	Blade materials	http://www.agc.com/english/index.html	1-5-1, Marunouchi,Chiyoda-ku, Tokyo 100-8405 JAPAN	
ASIA AIR SURVEY CO. LTD. (AAS)	consultantancy	http://www.ajiko.co.jp/	6-14-1 Nishi-shinjuku Shinjuku-ku Tokyo 160-0023 Japan	044-967-6410
ASIA MARINE CO. LTD. (OCEAN WORKS ASIA INC.)	civil engineering and construction, transportation and construction, maintenance	http://www.owa.co.jp/	104-0032 Chuo-ku Tokyo Hatchobori 3-25-9	03-3553-3286
BAKER & MCKENZIE (GAIKOKUHO JOINT ENTERPRISE)	Others	http://www.bakermckenzie.co.jp/	Ark Hills Sengokuyama Mori Tower 28F 1-9-10 Roppongi Minato-ku Tokyo 106-0032	03-6271-9441
BENTLEY SYSTEMS CO. LTD.	others	https://www.bentley.com/	1-13-23 Minami Ikebukuro Toshima-ku Tokyo 1710022	03-5992-7747
BOSCH REXROTH CORPORATION	Industry	http://www.boschrexroth.com/en/xc/	14001 South Lakes Drive Charlotte, NC 28273	1-800-739-7684
CARBON FIBER	Blade materials	http://zoltek.com/company/locations/	3101 McKelvey Road Bridgeton, MO 63044	+1 (314) 291-5110
CHINA WIND POWER CO. LTD.	Wind power generation business (Development Operation etc.)	http://www.chinawindpower.com.hk	16 Harcourt Road, Queensway, Hong Kong Room 390 139 F, Far East Finance Centre	+852 37661066
Chubu Electric	Onshore operator	http://www.chuden.co.jp/english/price/index.html?ceid=gn	1 Higashi-shincho, Higashi-ku,Nagoya, Aichi 461-8680, Japan	052-951-8211
CHUDEN KOGYO	Onshore operator	http://www.chudenkogyo.co.jp/	Yubinbango460-0008 Nagoya, Naka-ku, Sakaeni chome No. 2 No. 5 electric Cultural Center on the 12th floor, 13th floor	052-223-0810
CITY-YUWA PARTNERS	Others	http://www.city-yuwa.com/	2-2-2 Marunouchi Chiyoda-ku Tokyo 100-0005 Japan	03-6212-5500
CIVIL ENGINEERING AND ECO-TECHNOLOGY CONSULTANTS CO. LTD.	consultantancy	http://www.kensetsukankyo.co.jp/	170-0013 Toshima-ku Tokyo Higashi-Ikebukuro 2-23-2	03-3988-2643
CLEANEN. FUND	Onshore operator	http://www.cleanfund.com/	CleanFund Commercial PACE Capital, Inc.2330 Marinship Way, Suite 100 Sausalito, CA 94965	(415) 256-8000
COSMO ENGINEERING CO. LTD	Civil engineering and construction, electrical construction, transportation and construction	http://www.cosmoeng.co.jp/	2-5-8 Higashi Shinagawa-ku Tokyo Japan	03-5462-0164
COSMO OIL	Onshore operator	http://coc.cosmo-oil.co.jp/eng/company/office.html	1-1-1, Shibaura, Minato-ku, Tokyo105-8528	03-3798-3211
C-TECH CORPORATION	Wind power generation business (Development Operation etc.)	http://www.ctechcorp.co.jp	4 Chome-45 Sugumoch Mizuho-ku, Nagoya-shi, Aichi-ken 467-0804	052-852-6983
DAI NIPPON TORYO CO.LTD.	Others	http://www.dnt.co.jp/	1-124 Nishikujo 6-chome Konohana-ku Osaka 554-0012 Japan	0287-29-1915
DAIDO SOLDERLESS TERMINAL MFG.CO.,LTD.	Industry	http://www.daido-tanshi.jp	ZIP Cpde 689-1121 15-3, Minamisakaecho Tottori Tottori Prefecture	0857-53-1212
DAIHEN Corporation	Industry	http://www.daihen.co.jp/english.html	2-1-11 Tagawa, Yodogawa-ku,Osaka, 532-8512, Japan	
DAIWA ENERGY	Small wind turbines	http://www.daiwa-energy.com/	ABENO HARUKAS 33F, 1-1-43 Abenosuji, Abeno-ku, Osaka	81-6-4703-3208
DENYO CO.,LTD.	Industry	http://www.denyo.co.jp/english/company/profile/	2-8-5, Nihonbashi-horidomecho, Chuo-ku, Tokyo 103-8566, Japan	81-3-6861-1111
DIC	Blade materials	http://www.dic-global.com/jp/en/index.html	DIC Building, 7-20, Nihonbashi 3-chome, Chuo-ku, Tokyo 103-8233, Japan	

Name	Business	Website	Address	Telephone
DNV GL GROUP	consultantancy	https://www.dnvgl.com/energy/index.html	1-1-8 Sakuragi-cho Naka-ku Yokohama 231-0062	045-305-6560
E&E SOLUTIONS INC.	consultantancy	http://www.eesol.co.jp	14-1 Sotokanda 4-chome Chiyoda-Ku Tokyo 101-0021 Japan	03-6328-0110
EBARA CORPORATION	JVs foreign	https://www.ebara.co.jp/en/	11-1 Haneda Asahi-cho, Ohta-ku, Tokyo 144-8510, Japan	81-3-3743-6111
ECOPOWER	Wind power generation business (Development Operation etc.), maintenance	http://www.eco-power.co.jp/	1-6-1 Osaki Shinagawa-ku Tokyo Japan #141-0032	03-5487-8560
ENERGY PRODUCTS Co., Ltd.	Industry	http://www.enepro.jp/	"Yubinbango102-0072 Chiyoda-ku, Tokyo Iidabashi 1-chome No. 3 No. 2 Akebonosugikan 8F"	03-5211-3811
ENVIRONMENTAL MANAGEMENT CENTER INC.	consultantancy	http://www.kankyo-kanri.co.jp/	3 Chome-7-23 Sandamachi Hachi ji-shi, T ky -to 193-0832	03-6206-4321
EOS ENGINEERING & SERVICE CO. LTD.	maintenance, consultantancy	http://www.eos-es.co.jp/	1-4-14 Nishi-Shimbashi Minato-ku Tokyo 105-0003 Japan	03-3519-3911
EURUS ENERGY	Onshore operator, Wind power generation business (Development Operation etc.)	http://www.eurus-energy.com	Hulic Kamiyacho Building 7th Floor, 3-13, Toranomon 4-Chome, Minato-ku, Tokyo 105-0001, Japan	81-3-5404-5300
EX RESEARCH INSTITUTE LTD. ENVIRONMENTAL REGIONAL	consultantancy	http://www.exri.co.jp/	17-22 Takada 2-chome Toshima-ku Tokyo 171-0033 Japan	03-5956-7503
FRANKLINJAPAN	others	http://www.franklinjapan.jp/	252-0212 kanagawa Chuo-ku 1-1-12	042-775-5656
F-TEC	Small wind turbines	http://www.ftech.co.jp/en/company/	19, Showanuma, Shobucho, Kuki, Saitama 346-0194 JAPAN	0480-85-5211
FUJI ELECTRIC	Electric Equipment, Converter	http://www.fujielectric.com/company/offices/index.html	1-1, Tanabeshinden, Kawasaki-ku, Kawasaki-shi, Kanagawa 210-9530, Japan	81-3-5847-8000
FUJI ELECTRIC FA COMPONENTS & SYSTEMS CO. LTD.	Wind power generation business (Development Operation etc.), Electrical equipment and electrical system equipment	http://www.fujielectric.co.jp/index.html	103-0011 Chuo-ku Tokyo Nihonbashidai Tenma-cho	03-5435-7048
FUJIKURA	Electric Equipment	http://www.fujikura.co.jp/eng/corporate/philosophy/index.html	1-5-1, Kiba, Koto-ku, Tokyo 135-8512	

Name	Business	Website	Address	Telephone
FUJITSU GENERAL LIMITED	Industry	http://www.fujitsu-general.com/global/corporate/locations/jp.html	"3-3-17, Suenaga, Takatsu-ku Kawasaki, Kanagawa, 213-8502 Japan "	81-44-866-1111
FURUKAWA BATTERY CO., LTD.	Industry	http://www.furukawadenchi.co.jp/english/company/profile.htm	2-4-1 Hoshikawa, Hodogaya-Ku,Yokohama City,Kanagawa Prefecture 240-0006 JAPAN	81-45-336-5034
FURUKAWA INDUSTRIAL MACHINERY SYSTEMS CO.,LTD	Industry	http://www.furukawa-sanki.co.jp/english/access/index.html	2-3,MARUNOUCHI 2-CHOME,CHIYODA-KU,TOKYO 100-8370 JAPAN	81-3-3212-7803
GAS AND POWER	Wind power generation business (Development Operation etc.)	http://www.gasandpower.co.jp	541-0047 Awaji-cho 4-4-11	06-6205-4557
GE JAPAN	Turbine Manufacturer, maintenance	http://www.ge.com/jp	Akasaka Minato-ku Tokyo 107-0052 5-chome 2-20	03-5544-4496
GH CRAFT	Blade, Small wind turbines	http://www.ghcraft.com/about%20us/contuct%20us/contact_us.html	733, Itazuma Gotenba-shi, Shizuoka Zip 412-0048 Japan	81-550-89-8680
GREEN POWER CO. LTD.	Wind power generation business (Development Operation etc.)	http://gp-greenpower.jp	Ota-ku Tokyo Kamata 5-30-11 Tokyo	03-5711-2468
GREEN POWER INVESTMENT CORPORATION	Wind power generation business (Development Operation etc.)	http://www.greenpower.co.jp/index.html	Akasaka Minato-ku Tokyo 107-0052 1-11-44	03-4510-2100
HAMANAKA CHAIN MFG. CO., LTD.	Industry	http://www.hamanaka-chain.co.jp/English/gaiyo/	Ko-770, Shirahama-cho Himeji 672-8023 Japan	81-79-245-5151
HAMAX	Turbine components mechanical system equipment	http://www.hama-x.co.jp	2 Chome Shikamaku Tokura, Himeji-shi, Hy go-ken 672-8046	095-856-2024
HIRADO WIND POWER PLANT LTD.	Wind power generation business (Development Operation etc.)			095-860-0395
HITACHI	Turbine Manufacturer, Generator, electrical construction, electrical equipment and electrical system equipment, turbine components mechanical system equipment, maintenance	http://www.hitachi.co.jp/	1 Chome-18-13 Sotokanda, Chiyoda-ku, T ky -to 101-0021	03-4564-9191
HITACHI (INCL. FUJI HEAVY INDUSTRIES)	Large wind turbines	http://www.fhi.co.jp/english/outline/inoutline/index.html	Ebisu Subaru Bldg. 1-20-8, Ebisu, Shibuya-ku, Tokyo 150-8554	81-3-6447-8000

Name	Business	Website	Address	Telephone
HITACHI CHEMICAL CO. LTD. CHEMJAPANESEINDEX.HTML	Electrical equipment and electrical system equipment	http://www.hitachi-chem.co.jp/japanese/index.html	100-6606 Marunouchi Chiyoda-ku Tokyo chome No. 9 No. 2	03-5533-6963
HITACHI ENGINEERING & SERVICE	JVs foreign	http://www.hitachi-power-solutions.com/	"3-2-2, Saiwai-cho Hitachi-shi, 317-0073 Japan "	81 2 9422 7111
HITACHI INDUSTRIAL EQUIPMENT SYSTEMS CO.,LTD.	Industry	http://www.hitachi-ies.co.jp/english/inquiry/index.htm	AKS Building, 3, Kanda Neribei-cho, Chiyoda-ku, Tokyo, 101-0022, Japan	‹81›(3) 4345-6067
HITACHI MITSUBISHI ELECTRIC	Electric Equipment	www.mitsubishielectric.com	Tokyo Building 2-7-3, Marunouchi, Chiyoda-ku, Tokyo 100-8310, Japan	+81 (3) 3218-2111
HITACHI POWER SOLUTIONS	Wind power generation business (Development Operation etc.), Turbine Manufacturer, electrical construction, maintenance	http://www.hitachi-power-solutions.com/	300 0037 , 4 Chome-3-18 Sakuramachi, Tsuchiura, Ibaraki Prefecture 300-0037	0294-55-7187
HITACHI ZOSEN CORPORATION	Wind power generation business (Development Operation etc.), electrical construction, others	http://www.hitachizosen.co.jp	559-8559 Osaka Suminoe-ku Nankokita 1-chome No. 7 89 No.	06-6569-0214
HOKKAIDO GREEN FUND	Onshore operators, Wind power generation business (Development Operation etc.), others	http://www.h-green-fund.jp/	7 Minami 1 Chuo-ku Sapporo Hokkaido JAPAN 061-0061	011-280-1870
HOKURIKU ELECTRIC CO.,LTD.	Industry	https://www.hdk.co.jp/english/prfile_e/prfo01_e.htm	3158 Shimo-okubo, Toyama City, Toyama Pref. 939-2292 Japan	(076)467-1111
HOKUTAKU CO	Wind power generation business (Development Operation etc.), maintenance	http://hokutaku-co.jp/	4 Chome-1-19 Midorigaoka Higashi 1 Jo, Asahikawa, Hokkaido Prefecture 078-8801	0166-60-8225
HUNTSMAN JAPAN CORP.	Industry	http://www.huntsman.com/corporate/Locations?p_countryid=107	Huntsman Japan KK Kobe Head Office KIBC South Building 6F 5-5-2, Minatojima Minamimachi Chuo-ku Kobe 650-0047 Japan	+81 78 304 3900
HYDAC Japan	Turbine components mechanical system equipment, others	http://www.hydac.co.jp/	Chuo-ku Tokyo Hatchobori 3-25-7	03-3537-3620
IDEA CO. LTD. / IDEA CONSULTANTS INC.	consultantancy	http://ideacon.jp/	Setagaya-ku Tokyo Komazawa 3-15-1	03-4544-7606
IHI CORPORATION	Industry	https://www.ihi.co.jp/en/	TOYOSU IHI BUILDING., 1-1, Toyosu 3-chome, Koto-ku, Tokyo 135-8710, Japan	81(3) 6204-7800
IHI PLANT CONSTRUCTION CO. LTD.	Turbine Manufacturer, transportation and construction, maintenance	http://www.ipc-ihi.co.jp/	1-1 Toyosu 3-chome Koto-ku Tokyo 135-8710	03-4553-1033

Name	Business	Website	Address	Telephone
INBENAJI JAPAN LLC COMPANY PROFILE	Wind power generation business (Development Operation etc.)	http://www.invenergyllc.com	5 Chiyoda-ku Tokyo Nibancho 5	03-6261-4456
INOUE JIKUUKE KOUGYOU CO., LTD.	Industry	http://www.ijics.co.jp/	No. 1640-1, Oazasabi Tondabayashi Osaka, 584-0052 Japan	81 721 35 1551
ISHIBASHI MANUFACTURING CO. LTD.	Turbine components (Gear), mechanical system equipment, maintenance	http://www.ishibashi-mfg.com/	4636-15 Kamitonno Nogata City Fukuoka 822-0003 Japan	0949-26-3711
ISHII IRON WORKS CO., LTD	Industry	http://www.ishii-iiw.co.jp/en/company/branch.html	26-11, 3-Chome, Tsukishima, Chuo-ku, Tokyo 104-0052 JAPAN	81-3-4455-2505
ISHIKAWAJIMA-HARIMA HEAVY INDUSTRIES (IHI)	JVs foreign	https://www.ihi.co.jp/en/company/outline/index.html	TOYOSU IHI BUILDING., 1-1, Toyosu 3-chome, Koto-ku, Tokyo 135-8710, Japan	81(3) 6204-7800
ITH GMBH & CO. KG	Turbine components mechanical system equipment	http://ith.co.jp/	276-0046 Chiba Prefecture Yachiyo Owadashinden 355-92-101	047-406-4300
ITOCHU TECHNO-SOLUTIONS CORPORATION	consultantancy	http://www.ctc-g.co.jp	Chiyoda-ku Tokyo Kasumigaseki 3-chome No. 2 No. 5	03-6203-7483
IWASA TECH. CO., LTD.	Industry	http://www.iwasa-tech.com/profile/about-us.php	62 4 Takase-cho Funabashi-shi Chiba 273-0014 JAPAN	81-47-420-103
JAPAN MARINE UNITED CORPORATION	Transportation and construction	http://www.jmuc.co.jp	36-7 Shiba 5-chome Minato-ku Tokyo 108-0014 Japan	03-6722-6722
JAPAN METEOROLOGICAL CORPORATION	consultantancy	http://n-kishou.com	2-7-6 Saiwai-cho Naniwa-ku Osaka	06-6567-2222
JAPAN RAILWAY ELECTRICAL DESIGN CO. LTD. (NDS)	Electrical equipment and electrical system equipment, consultantancy	http://www.ntds.co.jp/	"114-0004 Kita-ku Tokyo Horifune chome No. 29 No. 13 "	03-5902-3020
JAPAN RENEWABLE ENERGY CORPORATION	Wind power generation business (Development Operation etc.)	http://www.jre.co.jp	"6-2-31 Roppongi Minato-ku Tokyo 106-0032 Japan"	03-6455-4910
JAPAN STEEL WORKS JSW	Large wind turbines, Blade	http://www.jsw.co.jp/en/index.html	Gate City Ohsaki-West Tower, 11-1, Osaki 1-chome, Shinagawa-ku, Tokyo 141-0032, Japan	
JAPAN U-PICA. CO. LTD.	Blade materials	http://www.u-pica.co.jp/en/company/location	"Madre Matsuda Bldg., 4-13, Kioi-cho, Chiyoda-ku, Tokyo 102-0094, Japan"	81-3-6850-251
JEM OFFW DEMOPROJECT TRUSTEE GROUP	Offshore operators			

Name	Business	Website	Address	Telephone
JENEX	civil engineering and construction, Electrical construction	http://www.jenex.jp/	447-0871 Hekinan Koyomachi 4-79	0566-91-4131
JFE (JFE) STEEL CO. LTD.	Others	http://www.jfe-steel.co.jp/	Chiyoda-ku Tokyo 100-0011 Uchisaiwaicho chome No. 2 No. 3	03-3597-3892
JFE ENGINEERING (LICENCE)	JVs foreign, Wind power generation business (Development Operation etc.), Turbine Manufacturer, maintenance	http://www.jfe-eng.co.jp/en/group/	"Marunouchi Trust Tower North, 1-8-1 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan"	632-633-2751
J-POWER/ELECTRIC POWER DEVELOPMENT CO.LTD	Onshore operator, Wind power generation business (Development Operation etc.)	http://www.jpower.co.jp/	15-1Ginza 6-ChomeChuo-ku-Tokyo104-8165 Japan	03-3546-9622
JR EAST JAPAN ENERGY DEVELOPMENT CO. LTD.	Wind power generation business (Development Operation etc.)	http://www.jr-energy.jre-group.ne.jp/	010-0001 Akita Akita Prefecture Nakadori 2-4-15	03-6206-6076
JRCS MFG. CO., LTD.	Industry	http://www.jrcs.co.jp/ja/about/profile/	Yubinbango750-8515 Shimonoseki, Yamaguchi Prefecture Higashiyamato-cho 1-chome, 2-14	083-261-0200
JTEKT CORPORATION	Turbine components (bearing), mechanical system equipment	http://www.jtekt.co.jp	4 Chome-7-1 Meieki Nakamura-ku, Nagoya-shi, Aichi-ken 450-0002	072-977-1102
JUWI SHINZEN ENERGY	Wind power generation business (Development Operation etc.)	http://www.shizenenergy.net/	4-9-22 Hongo Bunkyo Ward Tokyo 113-0033	092-753-9834
JWD (JAPAN WIND POWER DEVELOPMENT)	Wind power generation business (Development Operation etc.), maintenance, Onshore operator	http://www.jwd.co.jp/english/access.html	"Bussan Building 1-4-14 Nishi-shimbashi, Minato-ku, Tokyo"	81-3-3519-7250
KAIYO ENGINEERING CO. LTD.	consultantancy, others	http://kaiyoeng.com/index.html	110-0016 Taito-ku Tokyo Taito 4-chome 28th No. 11	03-5846-0772
KAIYOU KAIHATSU KOUGYOU	civil engineering and construction, transportation and construction	http://www.kaiyoukaihatsu.com/index.html	551-0003 Osaka-shi Osaka Taisho-ku Kuril 1-chome No. 12 No. 12	06-6555-3678
KAIYOU KAIHATSU KOUGYOU	Wind power generation business (Development Operation etc.), Civil engineering and construction, transportation and construction, maintenance, consultantancy	http://www.n-kokudo.co.jp/	107-8466 Akasaka Minato-ku Tokyo 9-9	03-5410-5889
KAJIMA CORPORATION	Civil engineering and construction, consultantancy	http://www.kajima.co.jp/	3-1 Motoakasaka 1-chome Minato-ku Tokyo 107-8388 Japan	03-5544-0750

Name	Business	Website	Address	Telephone
KANDENKO	civil engineering and construction Electrical construction, transportation and construction, electrical equipment and electrical system equipment, turbine components mechanical system equipment, maintenance	http://www.kandenko.co.jp	108-8533 Shibaura Minato-ku Tokyo chome No. 8 No. 33	03-5476-3754
KANSAI ELECTRIC ENERGY SOLUTIONS (KENES)	Wind power generation business (Development Operation etc.)	http://www.kenes.jp/	530-0005 Kita-ku Osaka Nakanoshima 2-chome 3 18	050-7105-0147
KASHIFUJI WORKS LTD.	Industry	http://www.kashifuji.co.jp/eng/	28 Kamota, Kamitoba, Minami-ku, Kyoto 601-8131, Japan	81-75-661-5271
KAWAMURA ELECTRIC INC.	Industry	http://www.kawamura-global.com/	489-8611 3-86, Akatsukicho, Seto-City, Aichi-Pref.	81-561-86-8172
KAWASAKI HEAVY INDUSTRIES	Hydraulic	https://global.kawasaki.com/en/corp/profile/division/hydraulic/	Kobe Crystal Tower, 1-3, Higashikawasaki-cho 1-chome, Chuo-ku, Kobe, Hyogo 650-8680, Japan	81-78-371-9530
KAWASAKI HEAVY INDUSTRIES, PRECISION MECHINERY COMPANy	Industry	https://global.kawasaki.com/en/corp/profile/division/hydraulic/	1-14-5, Kaigan, Minato-ku, Tokyo 105-8315, Japan	81-3-3435-2111
KI HOLDINGS CO., LTD.	Industry	http://www.koito-ind.co.jp/english/	100, Maeda-cho, Totsuka-ku, Yokohama, Kanagawa, Japan	81-45-826-6850
KIKUKAWA	Small wind turbines	http://www.kikukawa.com/en/	2-18-12 Kikukawa, Sumida-ku, Tokyo 130-0024, Japan	81-47-492-3411
KIMURA CHEMICAL PLANTS CO., LTD	Industry	http://www.kcpc.co.jp/en	"2-1-2, Kuiseterajima, Amagasaki, Hyogo 660-8567 Japan"	81-6-6488-2501
KINDEN	Wind power generation business (Development Operation etc.), Electrical construction	http://www.kinden.co.jp	2 Chome-1-21 Kudanminami, Chiyoda-ku, T ky -to 102-0074	06-6375-6108
KITO CORPORATION	Industry	http://www.kito.co.jp/en/	SHINJUKU NS Building 9F, 2-4-1, Nishi-Shinjuku, Shinjuku-ku, Tokyo 163-0809, JAPAN	
KKC	consultantancy	http://www.kkc.co.jp/	102-0085 Tokyo address 2 Chiyoda-ku Rokuban cho	03-6316-4203
K-NETSUREN	Gear	http://www.k-neturen.co.jp/	Oval Court Ohsaki Mark West, 2-17-1 Higashi-Gotanda, Shinagawa-ku, Tokyo 141-8639	
KOKUBU ELECTRIC CORP.	Industry	http://www.kkd.co.jp/english/corporate.html	2-7-18 Higashigotanda, Shinagawa, Tokyo 141-0022	81-3-5449-8585

Name	Business	Website	Address	Telephone
KOMAIHALTEC	(small) wind turbines	http://www.komaihaltec.co.jp/english/	1-19-10, Ueno Taito-Ku, Tokyo, 110-0005 Japan	81-338335101
KOMATSU INDUSTRIES CORP.	Machine Equipment (Gear)	https://sanki.komatsu/	1-1 Onomachi-Shinmachi, Kanazawa-shi, Ishikawa 920-0225, Japan	81-76-293-4201
KURIMOTO, LTD.	Industry	http://www.kurimoto.co.jp/worldwide/en/product/	2-16-2, Konan, Minato-ku, Tokyo108-0075, Japan	+81 3 3450-8523
KUWAHATA	Industry	http://www.kuwahata.co.jp	5-6 6-CHOME IZUO TAISHYO-K OSAKA JAPAN	81-665520951
KYB CORPORATION	Industry	https://www.kyb.co.jp/english/company/information.html	"World Trade Center Bldg. 11F, 4-1, Hamamatsu-cho 2-chome, Minato-ku, Tokyo 105-6111, Japan"	81-3-3435-3511
KYORITSU CO. LTD.	GEAR, Finance and insurance	http://www.kyoritsu-ins.co.jp/	2 Chome-6-2 Bessho, Minami Ward, Saitama, Saitama Prefecture 336-0021	03-5962-3075
LOOPWING	Small wind turbines	http://www.loopwing.co.jp/	5th Floor K.Y Bldg 3-16-14 Roppongi Minato-ku Tokyo, 106-0032 Japan	81 3 6682 4253
MARUBENI CORPORATION (MARUBENI CO. LTD.)	Onshore operator, Wind power generation business (Development Operation etc.), others	http://www.marubeni.co.jp/	100-8088 Otemachi Chiyoda-ku Tokyo chome No. 4 No. 2	03-3282-2759
MATSUI CORPORATION	Turbine components mechanical system equipment	http://www.matsui-corp.co.jp	4-7 Azabudai 2-chome Minatoku Tokyo 106-8641 Japan	011-733-2022
MATSUMURA MACHINERY MFG. CO.,LTD.	Industry	http://www.matsumurakikai.co.jp/	5-4-22, Tajima, Ikuno-Ku Osaka, Osaka, 544-0011 Japan	276572060
MATSUURA JUKI CO.LTD.	civil engineering and construction, Transportation and construction, maintenance	http://www.matsuura-j.com/	847-0831 Saga Karatsu Chichika 626-1	"0955-78-2055 022-388-9710"
MECARGO	Small wind turbines			
MEIDENSHA	Wind power generation business (Development Operation etc.), Turbine Manufacturer, electrical equipment and electrical system equipment, Turbine components (Generator), mechanical system equipment, maintenance, Electric Equipment	http://www.meidensha.co.jp	2 Chome-1-1 saki Shinagawa-ku, T ky -to 141-0032	03-6420-7316
MHI	Wind power generation business (Development Operation etc.), Turbine Manufacturer	http://www.mhi.co.jp/products/category/wind_turbine_plant.html	Tokyo Konan Minato-ku 2-16-5	045-285-0146

Name	Business	Website	Address	Telephone
MHI VESTAS OFFSHORE	Large wind turbines	http://www.mhivestasoffshore.com/about-mhi-vestas-offshore/	MHI Vestas Offshore Wind A/S,Dusager 4,8200Aarhus N Denmark	+45 88 44 89 00
MITANI CORP.	Onshore operator	http://www.english.mitani-corp.co.jp/	1-3-1, Toyoshima FUKUI-SHI FKI 910-8510	81776,20311
MITSUBISHI HEAVY INDUSTRIES, LTD.	Industry	https://www.mhi-global.com/company/location/contents/index.html	16-5 Konan 2-chome, Minato-ku, Tokyo, 108-8215, Japan	81-3-6716-3111
MITSUBISHI RAYON	Blade materials	https://www.mrc.co.jp/english/corporate/	1-1, Marunouchi 1-Chome, Chiyoda-ku, Tokyo 100-8253, Japan	81-3-6748-7500
MITSUI & CO. LTD.	Wind power generation business (Development Operation etc.), others	https://www.mitsui.com/jp/ja/	1-3 Marunouchi 1-chome Chiyoda-ku Tokyo 100-8631 Japan	03-3285-3987
MITSUI ENGINEERING & SHIPBUILDING CO. LTD.	Civil engineering and construction, transportation and construction	http://www.mes.co.jp/	6-4 Tsukiji 5-chome Chuo-ku Tokyo 104-8439 Japan	043-351-9262
MITSUI MIIKE MACHINERY Co., Ltd	Industry	http://www.mitsuimiike.co.jp/english/company/profile/index.html	Nihonbashi-Muromachi 2-1-1, Chuo-ku, Tokyo 103-0022, Japan	81-3-3270-2001
MITSUI SUMITOMO INSURANCE COMpany Limited	Finance and insurance	http://www.ms-ins.com/	9 Kanda-Surugadai 3Chome Chiyoda-ku Tokyo Japan	03-3259-6684
MITSUUROKO GREEN ENERGY CO. LTD.	Onshore operator, Wind power generation business (Development Operation etc.)	http://www.mitsuurokogreenenergy.com/	103-0023 Nihonbashi Chuo-ku Tokyo Honcho 3-7-2	03-3665-6311
MIURA DENKI LTD.	Electrical construction, consultantancy	http://miura-den.co.jp/	097-0022 Hokkaido 1-5-44	0162-23-3483
MIZUHO BANK LTD. (MHBK)	Finance and insurance	http://www.mizuhobank.co.jp/index.html	1-5-5 Otemachi Chiyoda-ku Tokyo 100-8176 Japan	03-5220-8933
MOOG JAPAN	Hydraulic	http://www.moog.co.jp/products.html	Yubinbango254-0019Hiratsuka, Kanagawa Prefecture west loam 1-8-37	0463-55-3615
MORIYAMA DIESEL CO.	Turbine components mechanical system equipment, maintenance	http://www.moriyama-d.jp/	038-0001 Aomori Aomori Prefecture Nitta 3-11-1	017-766-1344
MUTSU-OGAWARA PORT OFFSHORE WIND DEVELOPMENT CO. LTD.	Wind power generation business (Development Operation etc.), civil engineering and construction, maintenance, consultantancy	http://mutsuogawara-pow.co.jp/		0178-20-3266

Name	Business	Website	Address	Telephone
NABTESCO	Machine Equipment	https://www.nabtesco.com/en/company/profile.html	JA Kyosai Bldg., 7-9, Hirakawacho 2 chome,Chiyoda-ku,Tokyo 102-0093, Japan	81-3-5213-1133
NAGOYAGEAR Co.,Ltd	Industry	http://nagoyagear.co.jp/	9, Takiharu-cho Minami-ku Nagoya City, Japan	81-5-2612-1230
NAKANISHI METAL WORKS CO., LTD.	Industry	http://www.nkc-j.co.jp/eng/company/c_gaiyo.html	3-3-5, Tenmabashi, Kita-ku, Osaka 530-8566	06-6351-4832
NASU DENKI TEKKO CO., LTD.	Small wind turbines	www.nasudenki.co.jp	YAMADA BUILDING 1-1-14 SHINJUKU 160-0022, TOKYO	+81 03 3351 6131
NIHONKAI PR GER	Onshore operator			
NIKKO	Small wind turbines	http://www.nikko-company.co.jp/	383 Ainoki-cho Hakusan, 924-8686 Japan	81 7 6276 2121
NIPPI CORPORATION	Industry	http://www.nippi.co.jp/e/overview/profile.html	3175 Showa-machi, Kanazawa-ku, Yokohama 236-8540, JAPAN	81-45-773-5100
NIPPON ELECTRIC GLASS	Blade materials	http://www.neg.co.jp/en/company/office/	7-1, Seiran 2-chome, Otsu, Shiga 520-8639, Japan	(81) 77-537-1700
NIPPON ENGINEERING CONSULTANTS CO. LTD.	civil engineering and construction, consultantancy	http://www.ne-con.co.jp/	3-23-1 Komagome Toshima-ku Tokyo 170-0003 JAPAN	03-5394-7604
NIPPON PILLOW BLOCK CO., Ltd.	Industry	http://www.jbia.or.jp/e/members/26/	2306 Hirao, Miharaku Sakai-city, Osaka, 587-0022 Japan	81-72-361-3750
NIPPON REINETSU	Blade materials	http://www.nippon-reinetsu.co.jp/corporate/	Nagasaki Kaminoshima-cho 1-chome, 367 address 21	095-865-4222
Nippon Roballo Co. Ltd (Thyssen Krupp)	Machine Equipment, Turbine components mechanical system equipment	http://www.roballo.co.jp/	15-1 Akasaka 4-Chome Minato-ku Tokyo Japan 107-0052	03-5572-0686
NIPPON STEEL & SUMIKIN ENGINEERING CO. LTD.	Wind power generation business (Development Operation etc.), Civil engineering and construction	http://www.eng.nssmc.com/	1 Chome-5-1 saki, Shinagawa-ku, T ky -to 141-0032	03-6665-2109
NIPPON WIND ENERGY K.K.	Wind power generation business (Development Operation etc.)	http://www.nipponwind.com/	" 4-1-28 Toranomo Minato-ku Tokyo 105-0001 Japan "	03-6452-9678
NISHIMURA & ASAHI	others	http://www.jurists.co.jp/ja/	100-8124 Otemachi Chiyoda-ku Tokyo 1-1-2	03-6250-6515

Name	Business	Website	Address	Telephone
NITTOCORP.	Industry	http://www.nittocorp.co.jp/	3268 Nagaoka Ibarakimachi Higashi Ibaraki-Gun Ibaraki, 311-3116 Japan	81 29 292 1221
NKC	Small wind turbines	http://www.nkc-j.co.jp/eng/company/c_gaiyo.html	3-3-5, Tenmabashi, Kita-ku, Osaka 530-8566	06-6351-4832
NKE	Electrical equipment and electrical system equipment	http://www.nkeco.co.jp/nkei/	8-288	0562-45-5035
NMK	maintenance, consultantancy	http://www.nissui-marine.co.jp/	Kitakyushu Fukuoka Prefecture Tobata-ku Ginza 2-chome No. 6 No. 27	093-884-2020
NOF METAL COATINGS GROUP	Others	http://www.nofmetalcoatings.com	3-3 Chidori-cho Kawasaki-ku Kawasaki Kanagawa 210-0865 Japan	044-280-3017
NS ENVIRONMENT CO. LTD.	consultantancy, others	http://www.ns-kankyo.co.jp	105-0011 Tokyo Minato-ku Shiba Park 1-chome 2-9	03-3432-5451
NSK	Bearing	http://www.nsk.com/company/profile.html	Nissei Bldg., 1-6-3 Ohsaki, Shinagawa-Ku, Tokyo, 141-8560, Japan	81-3-3779-7111
NTN	Turbine components (Bearing), mechanical system equipment	http://www.ntn.co.jp	550-0003 saka-fu, saka-shi, Nishi-ku, Ky machibori, 1 Chome–3–17	03-6713-3617
OBAYASHI CORPORATION	Civil engineering and construction, electrical construction, transportation and construction	http://www.obayashi.co.jp/	2 Chome-15-2 K nan Minato-ku, T ky -to 108-0075	03-5769-1857
OCEAN DEVELOPMENT KOGYO CO. LTD.	Wind power generation business (Development Operation etc.)	http://www.chartkorea.com/english/about3.html	KODCO B/D 502, Jungang-daero, Dong-gu, Busan, Korea	+82-51-996-9500,
OGAWA KENKI	Transportation and construction	http://ogawa-kenki.co.jp	350-1213 Saitama Prefecture Hidaka Takahagi 193 - 1	042-985-0901
OHATSU	Industry	www.tohatsu.co.jp	3-5-4, Azusawa Itabashi-ku TokyoJapan	81-3-3966-3111
OKAMOTO KOKI Co.,LTD	Industry	http://www.okamotokoki.co.jp/company/profile.html	Yubinbango500-8439 Gifu, Gifu Prefecture towns cho address 69	81 58 2715323
OKUBO GEAR Co.,LTD	Industry	http://www.okubo-gear.co.jp/e/company/index.html	3030, Kami-echi, Atsugi-shi, Kanagawa-ken 243-8652,JAPAN	046-285-1132
ONEX CORPORATION	Industry, Gear	http://www.onex.com/About_Onex.aspx http://www.onexmike.org/landing-gear.html	Onex Corporation 161 Bay Street,P.O. Box 700Toronto, ON M5J 2S1	416.362.7711

Name	Business	Website	Address	Telephone
ORGANO CORPORATION	Industry	http://www.organo.co.jp/english/index.html	1-2-8 Shinsuna, Koto-ku, Tokyo,136-8631	81-3-5635-5100
ORIX CORPORATION	Wind power generation business (Development Operation etc.), Finance and insurance	http://www.orix.co.jp/	2-4-1 Hamamatsu-cho Minato-ku Tokyo 105-6135 Japan	03-5730-0183
ORRICK	consultantancy, others	http://www.orrick.com	6-1 Roppongi 1-Chome Minato-ku Tokyo 106-6028 Japan	03-3224-2926
OSAKA GAS	Onshore operator	http://www.osakagas.co.jp/en/aboutus/index.html	2-37, Chiyozaki 3-chome-minami, Nishi-ku, Osaka 550-0023	0120-0-19424
OSAKA GENSOKUKI SEISAKUSHO CO., LTD.	Industry	http://www.ogsrg.co.jp/aramasi.html	"Yubinbango578-0984 Osaka Higashi Hishie 4-chome No. 5 No. 14 "	072 (962) 1151
OSAKA SEIMITSU KIKAI CO., Ltd	Industry	http://www.osk-corp.co.jp/en/pages/gaiyou.html	6-5-16, Mikuriya, Higashi-Osaka, Osaka,577-0032	81-6-6782-646
OSHIMA SHIPBUILDING CO., LTD.	Industry	http://www.osy.co.jp/english/company/	1605-1,Oshima-cho,-Saikai city,Nagasaki Prefecture 857-2494	(0959)34-2711
OTOWA ELECTRIC CO. LTD.	Electrical equipment and electrical system equipment	http://www.otowadenki.co.jp/	501-7 Miyanomae Fukushima Sanda Hyogo 669-1313 JAPAN	06-6429-5951
OZAKI GEAR CO., LTD.	Industry	https://www.ozaki-sk.co.jp/profile/index_e.html	641-1 Yamashina Tadotsu-cho Nakatado-gun Kagawa-pref JAPAN	81-877-33-3567
PANASONIC CORP. ECO SOLUTION	Industry	http://www.panasonic.com/global/corporate.html	1006, Oaza Kadoma, Kadoma-shi, Osaka 571-8501, Japan	81-6-6908-1121
PASCO CORPORATION	consultantancy	http://www.pasco.co.jp/	1-1-2 Higashiyama Meguro-ku Tokyo 153-0043 Japan	03-6412-2101
PENTA OCEAN	Wind power generation business (Development Operation etc.), Civil engineering and construction	http://www.penta-ocean.co.jp	2-2-8 Koraku Bunkyo-ku Tokyo 112-8576	03-3817-7579
POWERMAX JAPAN	Wind power generation business (Development Operation etc.), civil engineering and construction, electrical construction	http://powermax-japan.jp/	108-0074 Tokyo	03-6452-9160
PREC INSTITUTE INC.	consultantancy	http://www.prec.co.jp/	3-7-6 Kojimachi Chiyoda-ku Tokyo 102-0083 Japan	03-5226-1102

Name	Business	Website	Address	Telephone
RENEWABLE ENERGY INSTITUTE	others	http://www.renewable-ei.org	2-18-3 Higashi Shinbashi Minato-ku Tokyo 105-0021 Japan	03-6895-1020
RENEWABLE ENERGY TECHNOLOGY CO. LTD. (REETECH/RITEKKU)	Wind power generation business (Development Operation etc.), consultantancy	http://www.reetech.co.jp	Chiyoda-ku Tokyo Uchikanda 2-15-9	03-5289-0710
RENOVAINC	Wind power generation business (Development Operation etc.), consultantancy	http://www.renovainc.jp/	1-7-2 Otemachi Chiyoda-ku Tokyo 100-0004 Japan	03-3516-6270
RES JAPAN	Wind power generation business (Development Operation etc.), consultantancy, others	http://www.res-japan.com/jp/	104- 0045 Chuo-ku Tokyo Tsukiji 2-15-19	03-5148-7303
RISHO	Converter	http://www.risho.co.jp/english/kaisha_e/kaisya.html		
ROMAX TECHNOLOGY LIMITED	Turbine components mechanical system equipment, maintenance, consultantancy, and others	http://www.romaxtech.com/		03-5767-9400
SAN-AI OIL CO.LTD.	turbine components mechanical system equipment, maintenance, others	http://www.san-ai-oil.co.jp/	5 Chome-22-5 Higashioi, Shinagawa, Tokyo 140-0011	03-5479-3281
SANKOSHA CORPORATION	Electrical equipment and electrical system equipment	http://www.sankosha.co.jp	4-3-8 Osaki Shinagawa-kuTokyo	042-770-0256
SANOYAS HOLDING CORPORATION	Industry	http://www.sanoyas.co.jp/en/corporate/outline.html	Nakanoshima Daibiru Bldg.9F, 3-3-23 Nakanoshima, Kita-ku, Osaka 530-6109, Japan	(06)4803-6161
SANSHA ELECTRIC MANUFACTURING CO.,LTD.	Industry	https://www.sansha.co.jp/user_data/company/network.php	3-1-56, Nishiawaji, Higashiyodogawa-ku, Osaka 533-0031,Japan	81-6-6321-321
SANWAKOUKI CORP.	Industry			
SASEBO HEAVY INDUSTRIES CO., LTD.	Industry	http://www.ssk-sasebo.co.jp/ssk/us/home/index.html	1, Tategami-cho, Sasebo, Nagasaki 857-8501, Japan	81-956-25-9111
SAWAFUJI ELECTRIC CO., LTD.	Industry	http://www.sawafuji.co.jp/english/	3, Nittahayakawa-cho, Ota City, Gunma,JAPAN 370-0344	+61 8 9455-5099
SB ENERGY LTD.	Wind power generation business (Development Operation etc.)	http://www.sbenergy.co.jp/	Tokyo Minato-ku Higashi-Shimbashi 1-chome 9 2	03-6889-2724

Name	Business	Website	Address	Telephone
SEISA GEAR, LTD.	Industry	http://www.shigearbox.com/	16-1, Wakihama 4-chome, Kaizuka-shi, Osaka 597-8555 Japan	(81)-72-431-3021
SEKISUI CHEMICAL	Others	http://www.sekisui.co.jp/	2 Chome-3-17 Toranomon, Minato-ku, T ky -to 105-0001	075-662-8620
SENVION	Wind power generation business (Development Operation etc.), maintenance	https://www.senvion.com/global/en/	1-12-1 Dogenzaka Shibuya-ku Tokyo 150-0043 Japan	03-4360-5427
SESA	Gear	http://sesa.co.jp/	2-21-10 KANDA-TSUKASA-MACHI,CHIYODA-KU,TOKYO ,101-0048;	81-3-5282-3625
SGS JAPAN INC.	consultantancy, others	http://www.sgsgroup.jp/		045-330-5027
SHIMADZU LIMITED (Kagoshima)	Wind power generation business (Development Operation etc.)	http://www.shimadzu-ltd.jp/mce/	892-0871 Kagoshima Yoshino-cho 9700-1	099-246-0373
SHIMIZU CORPORATION	Civil engineering and construction	http://www.shimz.co.jp	2-16-1 Kyobashi Chuo-ku Tokyo 104-8370	03-5441-4300
SHIN-ETSU CHEMICAL CO. LTD.	Others	http://www.shinetsu.co.jp	6-1 Ohtemachi 2-chome Chiyoda-ku Tokyo 100-0004 Japan	0778-21-8142
SHINKURUSHIMA TOYOHASHI SHIPBUILDING CO., LTD.	Industry	http://www.skdy.co.jp/english/company/toyohashi.html	22 Akemi-cho, Toyohashi-city, Aichi-pref. 441-8577	0532-25-4111
SHINTOSHIN AGENCY	Finance and insurance	http://www.shintoshin-ag.co.jp	160-0023 Tokyo Nishi-Shinjuku Shinjuku-ku 6-6-3 Shinjuku	03-3345-7682
SHIRAKAWA ELECTRIC & CIVIL CO.,LTD.	Wind power generation business (Development Operation etc.), Electrical construction, electrical equipment and electrical system equipment	http://www.shirakawa-ec.co.jp/	466-0855 Aichi-ken, Nagoya-shi, Sh wa-ku, Kawanahonmachi, 5 Chome	052-882-1271
SHOWA DENKO K.K. CORP.	Industry	http://www.sdk.co.jp/english/about/network/boja.html	13-9, Shiba Daimon 1-Chome, Minato-ku, Tokyo 105-8518 Japan	81-3-5470-3235
SHOWA HIGHPOLYMER Co. Ltd.	Blade materials	www.cnfrp.jp	No.8333, Songze Road, Qingpu Industrial Park,Shanghai City, P.R.C. postal code 253000	86-0534-2220163
SIEMENSANSWERSJPJA	Turbine Manufacturer	http://www.siemens.com/answers/jp/ja/	11-1 Osaki 1-Chome Shinagawa-ku Tokyo 141-8641 Japan	0120-071-387
SINFONIA TECHNOLOGY CO., LTD.	Industry	http://www.sinfo-t.jp/eng/index_a.htm	Shiba NBF Tower, 1-30, Shibadaimon 1-chome, Minato-ku, Tokyo,105-8564, Japan	81-3-5473-1807
SOGEN.INC.	Others	http://www.sogeninc.co.jp/	285 - 0923 Chiba Prefecture inba district Shisui Higashishisui 1-1-358	03-5833-2751

Name	Business	Website	Address	Telephone
SOKEN TECNIX CO., LTD.	Industry	http://www.soken-tecnix.co.jp/english/	Takada 3-29-5,Toshima-Ku,Tokyo,171-8531 Japan	81-3-3983-3177
SOMPO JAPAN NIPPONKOA INSURANCE INC.	Finance and insurance	http://www.sjnk.co.jp/	1 Chome-26-1 Nishishinjuku Shinjuku-ku, T ky -to 160-0023	03-3349-5402
SOMPO SQUIRREL CARE MANAGEMENT CO. LTD.	consultantancy, finance and insurance	http://www.sompo-rc.co.jp/	1 Chome-24-1 Nishishinjuku, Shinjuku-ku, T ky -to 160-0023	03-3349-5478
SUMITOMO HEAVY INDUSTRIES MARINE & ENGINEERING Co.,Ltd.	Machine Equipment Offshore operators	www.shi.co.jp	ThinkPark Tower, 1-1 Osaki 2-chome, Shinagawa-ku, Tokyo 141-6025, Japan	81-3-6737-2620
SUMMIT ENERGY CORPORATION	Wind power generation business (Development Operation etc.)	http://www.summit-energy.co.jp/	1 8 11 Harumi Chuo ku Tokyo	03-5166-8681
SWCC SHOWA CABLE SYSTEMS CO.,LTD.	Industry	https://www.swcc.co.jp/eng/inquiry/form.php	Shiroyama Trust Tower 3-1, Toranomon 4-chome Minato-ku Tokyo, 105-6012 Japan	81 3 5404 6961
SYMPHONIA TECHNOLOGY	Small wind turbines	http://www.sinfo-t.jp/eng/index_a.htm	Shiba NBF Tower, 1-30, Shibadaimon 1-chome, Minato-ku, Tokyo,105-8564, Japan	81-3-5473-1807
TAIYO ELECTRIC CO., LTD.	Industry	http://www.taiyo-electric.co.jp/english/corp/index.html	1-16-8 Uchikanda, Chiyoda-ku, Tokyo 101-0047	03-3293-3061
TAKENAKA SEISAKUSHO	turbine components mechanical system equipment	http://www.takenaka-mfg.co.jp	14-9 Nihonbashi Kodenma-cho Chuo-ku Tokyo 103-0001 Japan	03-5643-0780
TAMAGAWA. SUIRYOKU.KENSETSU CO. LTD	civil engineering and construction, transportation and construction	http://www.tamagawa.biz	578-0931 Osaka Prefecture Higashi Hanazono-higashimachi 2-4 26	092-481-8470
TEIJIN FRP	Blade materials	http://www.teijin.co.in/about/company/	Teijin Building 6-7, Minami-hommachi 1-chome, Chuo-ku,Osaka 541-8587, Japan	81-6-6268-2132
THE BANK OF TOKYO-MITSUBISHI UFJ LTD.	Finance and insurance	http://www.bk.mufg.jp	2-7-1 Marunouchi Chiyoda-ku Tokyo Japan	03-6259-2375
THE JAPAN STEEL WORKSLTD. JSW	Wind power generation business (Development Operation etc.), Turbine Manufacturer	http://www.jsw.co.jp	11-1 Osaki 1-chome Shinagawa-ku Tokyo Japan	03-5745-2061
THE KEIHIN CO.LTD.	Transportation and construction	http://www.keihin.co.jp/	4-20 Kaigan 3-chomeMinato-kuTokyo 108-8456	03-3456-7890
THE SHIPBUILDERS' ASSOCIATION OF JAPAN (SAJ)	Others	http://www.sajn.or.jp/	105-0001 Toranomon Minato-ku Tokyo 1-15-12	03-3580-1563

Name	Business	Website	Address	Telephone
TMEIC	Electric Equipment (Generator)	https://www.tmeic.com/India/886-TMEIC%20We%20Drive%20Industry-390	1015 Nan Fung Commercial Centre, 19 Lam Lok St Kowloon Bay, Hong Kong	852-2243-3221
TOBISHIMA CORPORATION	Wind power generation business (Development Operation etc.), Civil engineering and construction, transportation and construction, consultancy	http://www.tobishima.co.jp/	3-2-1 Sakado Takatsuku Kawasaki City Kanagawa 213-0012 Japan	044-829-6717
TODA CORPORATION LTD.	Civil engineering and construction, transportation and construction	http://www.toda.co.jp/	1 Chome-7-1 Ky bashi, Ch -ku, T ky -to 104-0031	03-3535-2641
TOHO TENAX Co.,Ltd.	Industry	http://www.tohotenax.com/about-us/company-overview/	Kasumigaseki Common Gate West Tower 3-2-1 Kasumigaseki, Chiyoda-ku 100-8585 Tokyo Japan	+81 3 3506 6829
TOKUSYU KOUSYO	maintenance	http://www.tokusyu-kousyo.co.jp/	601-8319 Minami-ku Kyoto Kisshoinsan'nomiya-cho 1	044-948-8592
TOKYO KEIKI INC.	Industry	http://www.tokyo-keiki.co.jp/e/	2-16-46, Minami-Kamata, Ohta-Ku, Tokyo 144-8551 JAPAN	81-3-3732-2111
TOKYU LAND CORPORATION	Wind power generation business (Development Operation etc.)	http://www.tokyu-land.co.jp/	2-6-21 MINAMI-AOYAMA, MINATO-KU, TOKYO 107-0062	050-3377-4230
TORAY	Blade materials	http://www.toray.com/index.html	Nihonbashi Mitsui Tower, 1-1, Nihonbashi-Muromachi 2-chome, Chuo-ku, Tokyo 103-8666, Japan	81-3-3245-5111
TORISHIMA ELECTRIC WORKS LTD.	Industry	http://www.torishima.eu/about/about-tsse	2-3-1, Yagura Kusatsu, 525-0053 Japan	81-775620891
TORISHIMA PUMP MFG. CO., LTD.	Industry	http://www.torishima.co.jp/en/au/overview.html	1-1-8, Miyata-cho, Takatsuki-city, Osaka 569-8660, Japan	8172,695055
TOSHIBA	Electric Equipment, Wind power generation business (Development Operation etc.),Turbine Manufacturer	http://www.toshiba.co.jp	135-0061 T ky -to, K t -ku, Toyosu, 5 Chome−6	044-331-0567
TOSHIBA PLANT SYSTEM	JVs foreign	http://www.toshiba-tpsc.co.jp/english/contact/index.htm	36-5 Tsurumichuo 4-Chome, Tsurumi-ku, Yokohama 230-8691, Japan	81 45 500 7050
TOYO KANETSU CONSTRUCTION LTD	Civil engineering and construction	http://www.toyo-const.co.jp/	2-4-24 Aomi Koto-ku Tokyo 135-0064	03-6361-5464
TOYOOKI	Machine Equipment	http://www.toyooki.jp/en/	PostCode 444-3592 45 Kaizan, Hachi-cho, Okazaki-city, Aichi-pref,japan	81-564-48-2211

Name	Business	Website	Address	Telephone
TOYOSK	consultantancy	http://www.toyosk.co.jp/	91-0013 2715	03-3237-7549
TOYOTA TSUSHO INSURANCE MANAGEMENT CORPORATION	Finance and insurance	http://www.toyotsu-ins.co.jp/	450-0002 Aichi Prefecture Nakamura-ku Nagoya Meieki 4-10-25	03-4306-8087
TSUBAKI NAKASHIMA CO., LTD.	Industry	http://www.tsubaki.com/en/company/group.html	19, Shakudo, Katsuragi, Nara, Japan	0745-48-2891
TSUKISHIMA KIKAI CO., LTD.	Industry	http://www.tsk-g.co.jp/en/company/data/jigyosho.html	3-5-1, Harumi, Chuo-ku, Tokyo	+81-(0)3-5560-6511
TSUNEISHI SHIPBUILDING Co., Ltd.	Industry	http://www.tsuneishi.co.jp/english/corporate/outline/	1083, Tsuneishi, Numakuma-cho, Fukuyama city, Hiroshima 720-0393, Japan	81-84-987-1101
TÜV RHEINLAND JAPAN LTD.	Others	http://www.jpn.tuv.com	3-19-5 Shin Yokohama Kohoku-ku Yokohama 222-0033 Japan	045-470-1850
UL JAPAN	consultantancy, others	http://www.ul.com/japan/jpn/pages/	516-0021 Ise City, Mie Prefecture Asama -cho, 4383 No. 326	03-5293-6030
UNION DATA	consultantancy	http://www.union-data.co.jp/	003-0024 Hokkaido Sapporo Shiroishi-ku Hongodori 13-5-9	011-862-7330
UNYTITE CORPORATION	civil engineering and construction, turbine components mechanical system equipment	http://www.unytite.com	3 Chome-1-12 Takatsukadai Nishi-ku, K be-shi, Hy go-ken 651-2271	078-991-3034
USAMIKOYU LDT.	Turbine components mechanical system equipment	http://usa-mi-net.com	Aichi Prefecture Tsushima City Umeda-cho 1-chome 8	075-325-4681
UTSUNOMIYA ELECTRIC MFG Co., Ltd.	Industry	http://www.utsunomiya-el.co.jp/	5-1, Higashi Shinagawa 3-chome, Shinagawa-ku, Tokyo Zip: 140-0002	(03)3471-2791 (+81-3-3471-2791)
UZUSHIO ELECTRIC CO., LTD.	Industry	http://www.bemac-uzushio.com/en/index.html	105 Noma, Imabari-city, Ehime Pref.794-8582 JAPAN	81 8 9853 6111
VAISALA KK	consultantancy, others	http://www.vaisala.com	Kanda- Jimbocho 1 Chome 105 Chiyoda-ku Tokyo 101-0051 Japan	03-5259-5962
VESTAS JAPAN	Turbine Manufacturer, maintenance	http://www.vestas.com	1-20-9 Kita Shinagawa-ku 140-0001 Tokyo	03-4588-8600
WAKACHIKU CONSTRUCTION CO.,LTD.	Industry	http://www.wakachiku.co.jp/en/corporate/data.html	2-23-18, Shimo-Meguro, Meguro-ku, Tokyo, 153-0064 Japan	81-3-3492-271
WIND ENERGY INSTITUTE OF TOKYO INC.	consultantancy	http://www.windenergy.co.jp/	1-5-8 Nishi-Shimbashi Minato-Ku 105-0003 Tokyo Japan	03-6457-9801

Name	Business	Website	Address	Telephone
WINDLENS CO., LTD.	Industry	http://windlens.com/	ZIP Cpde 818 0041 103, Creation Core Fukuoka, 3 2 16, Kamikoga Chikush-ino Fukuoka Prefecture	092-555-2500
WINPRO CO.LTD.	Industry	http://www.winpro.co.jp/global/eng/company/niigata/index.html	Publicity Flex Building-Shinko-cho 19-8, Chuo-ku, Niigata-shi,Niigata 950-0965 JAPAN	81-25-284-2240
YAMAZAKI GEAR INDUS-TRY CO., LTD.	Industry	http://www.ya-matech.co.jp/	674, Toda Atsugi, 243-0023 Japan	81-46-228-2239
YASKAWA ELECTRIc	Generator	http://www.yaskawa-glob-al.com/compa-ny/profile/data	2-1 Kurosakishiroishi, Yahatanishi-ku, Kitaky-ushu 806-0004 Japan	81-93-645-8801
YASKAWA ELECTRIC COR-PORATION (ELECTRIC ENGINEERING CORPORATION)	Electrical equipment and electrical sys-tem equipment maintenance, others	http://www.yaskawa.co.jp/	2-1 Kurosakishiroishi Yahatanishi-ku Kitaky-ushu 806-0004 Japan	03-5402-4535 04-2931-1816
YONDEN EN-GINEERING COMPANY IN-CORPORATED	Wind power generation business (Develop-ment Operation etc.), civil engineering and construction, Electrical construction, transpor-tation and construction, electrical equipment and electrical system equipment, mainte-nance, consultantancy, finance and insurance	http://www.yon-e.co.jp/	3 Chome-1-4 Kamino-cho, Takamatsu, Kagawa Prefecture 761-8064	087-867-1748
YOSHIMOTO POLE CO., LTD.	Industry	http://www.ypole.co.jp/en/outline.html	Yurakucho Building 1-10-1 Yurakucho Chiyoda-ku Tokyo 100-0006 JAPAN	03-3214-1551
YURTEC CO.,INC.	Industry	www.yurtec.co.jp	1-1 983-8622 Sendai Miyagino district Tsut-sujigaoka 4-chome	+81 222962111
ZEPHYR	Small wind turbines	https://www.zephyreco.co.jp/en/about/vision.jsp	4F, 1-9-18 Kaigan, Minato-Ku, Tokyo, Ja-pan 105-0022	81-3-5425-2566

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