The Renewable Energy Industry

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International Industry Analysis

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Introduction

Renewable technology is thriving as innovation reduces prices and continues to live up to the expectations of a world of renewable energy. The news is full of discussions about climate change and how to stop it. Especially, the younger generations tend to be more sensitive to it, movements like Fridays for Future are gaining popularity and the government is also paying more and more attention to the topic.

In the last 150 years, humanity depended heavily on gas, oil, and other fossil fuels to power anything from light bulbs to vehicles to factories. Fossil fuels are found in virtually everything we do and as a result, the greenhouse gasses emitted by the combustion of those fuels have reached historically high levels. As a result, global warming is increasing global temperature, and extreme weather conditions, changing animal ecosystems and environments, rising oceans, and a host of other impacts.

With the integration of renewable energy, the planet may intervene in the worst consequences of global warming. Clean energy has by far more possible outcomes than just being "green". The increasing sector generates jobs, makes electricity grids more efficient, increases energy penetration in developed countries, and help minimize electricity bills. Each of these aspects has led to the revival of green energy in recent years, with wind and solar breaking new milestones for electricity production.

After all, renewables—like every form of energy—have their trade-offs and similar disputes. Each of them reflects on the concept of green energy. Technically accurate, green energy is indefinitely available, or as the U.S. Energy Information Administration put it, "virtually inexhaustible." But "renewable" does not inherently mean permanent, as critics of soybean fuel or massive hydropower plans frequently contend. This also does not include other low-to zero-emission resources that have their supporters, including energy conservation and nuclear power.

This report aims to provide an industry analysis of the renewable energy sector while taking a focus on the demand and supply side, strategic issues, and national competitiveness.

Environmental Analysis

Evaluation of Energy sources

In 2019, total global energy consumption (TEC) was about 14,400 Mtoe, of which about 15% (as shown in Figure 1) came from renewable energy sources. We will break down the individual components of renewable energy further in detail, but renewable energy in general includes energy from hydropower, biofuels, renewable municipal waste, photovoltaic (PV), solar thermal, wind, geothermal, and tidal. Renewable energy sources accounted for about 1900 Mtoe of TEC last year. Below the global primary energy consumption by energy source from 2010 to 2050 in quadrillion British thermal units is shown.

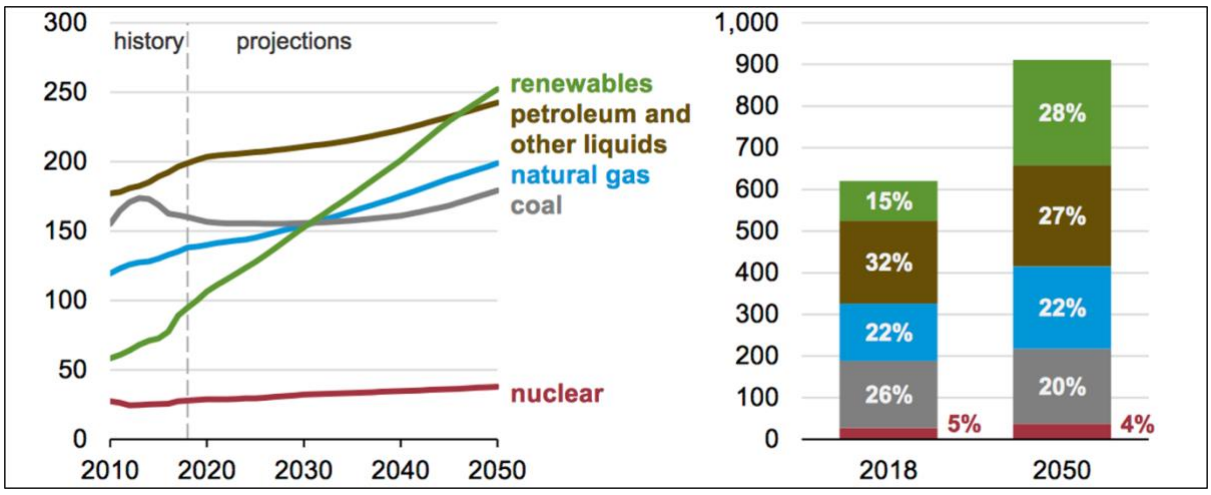


Figure 1 Global primary energy consumption by energy source (from 2010 until 2050)

Source: U.S. Energy Information Administration (EIA), 2019

As clearly visible, the contribution of renewable energies to global energy demand is growing intensively. However, if the equally growing demand for energy is to be met in a sustainable manner and the goals agreed in e.g., the Paris Climate Agreement are to be achieved, the pace of global expansion of the use of renewable energies must be increased significantly. We will discuss this further in Trends and the outlook analysis. In the given scenario by the EIA, renewables will increase its share of global final energy consumption from less than 20 percent today to almost 50 percent in 2050, which corresponds to a doubling of total energy consumption. 86 percent of electricity worldwide could be covered by renewable energies. To achieve this, capacities would have to be significantly expanded: for electricity generation from wind energy from currently 650 gigawatts to over 6,000 gigawatts by 2050 and for photovoltaics to 8,500 gigawatts, currently approx. 630 gigawatts.

As also stated in Figure 1, coal consumption has been declining over the last years and there is an increasing trend by countries, corporations, traders and investors to shy away from coal investment. At the same time, investments in the renewable energy sector are increasing, with Bloomberg New Energy Finance estimating total investments at USD 332 billion in 2019 (IRENA20, 2020). Also, big Oil companies are investing more and more into renewables. A few decades ago, this development would not have been conceivable, therefore we show in the following an overview of the last 2 decades of history in the area of renewable energies:

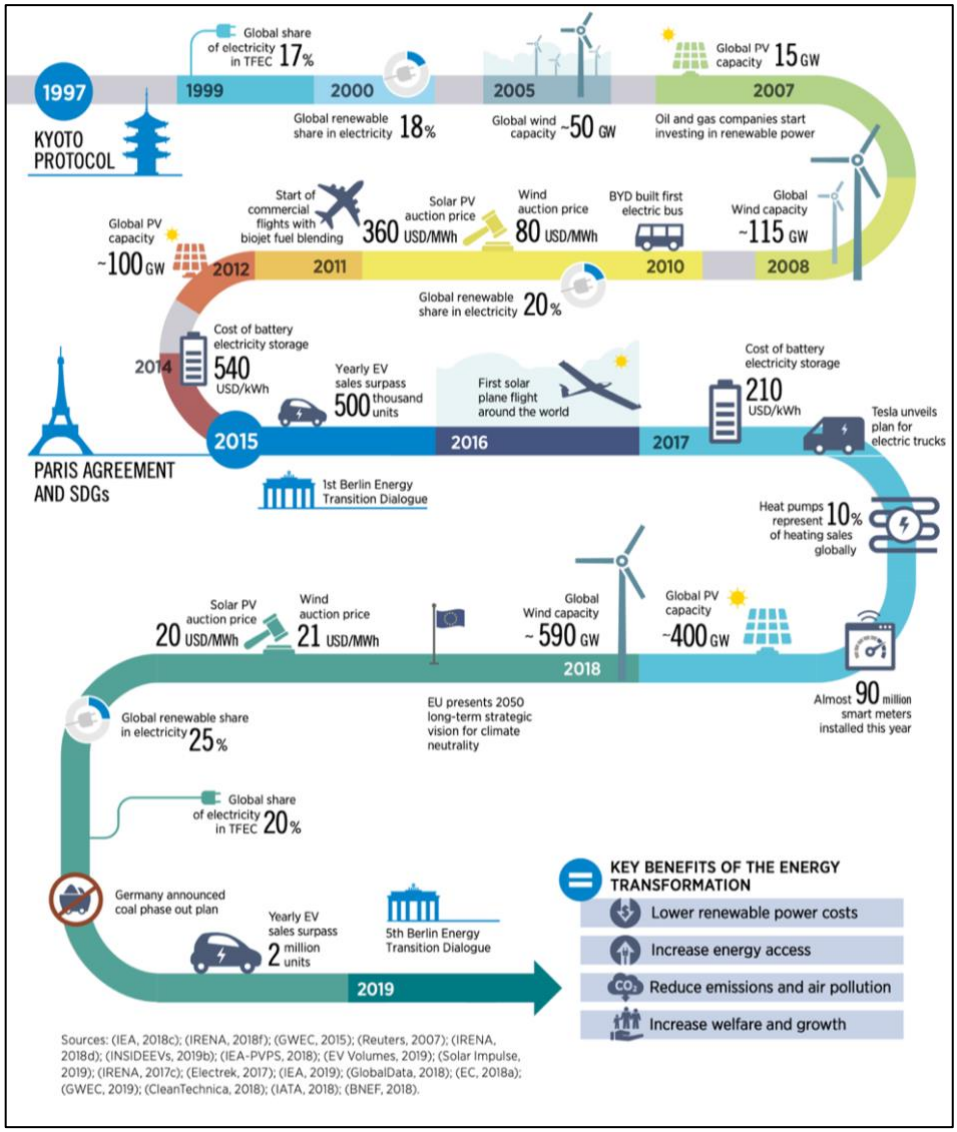


Figure 2 Key milestones over the past 20 years in renewable energies

Source: As stated in Graph: among others IEA, IRENA, GWEC, Reuters)

Initial segmentation renewable technologies

Segmentation via Consumption

Hydroelectric power has by far the highest share of renewable energy generation. As visible below in Figure 3 it accounts for almost 60 percent of the global renewable energy consumption worldwide. Nevertheless, since many potentials are already being exploited and the average cost of electricity has risen slightly in recent years, the pace of new capacity additions has slowed down. There are plans for new projects already ongoing primarily in emerging markets, especially in Asia, South America and Africa, but we will see the segmentation via locations later in chapter 1.2.2.

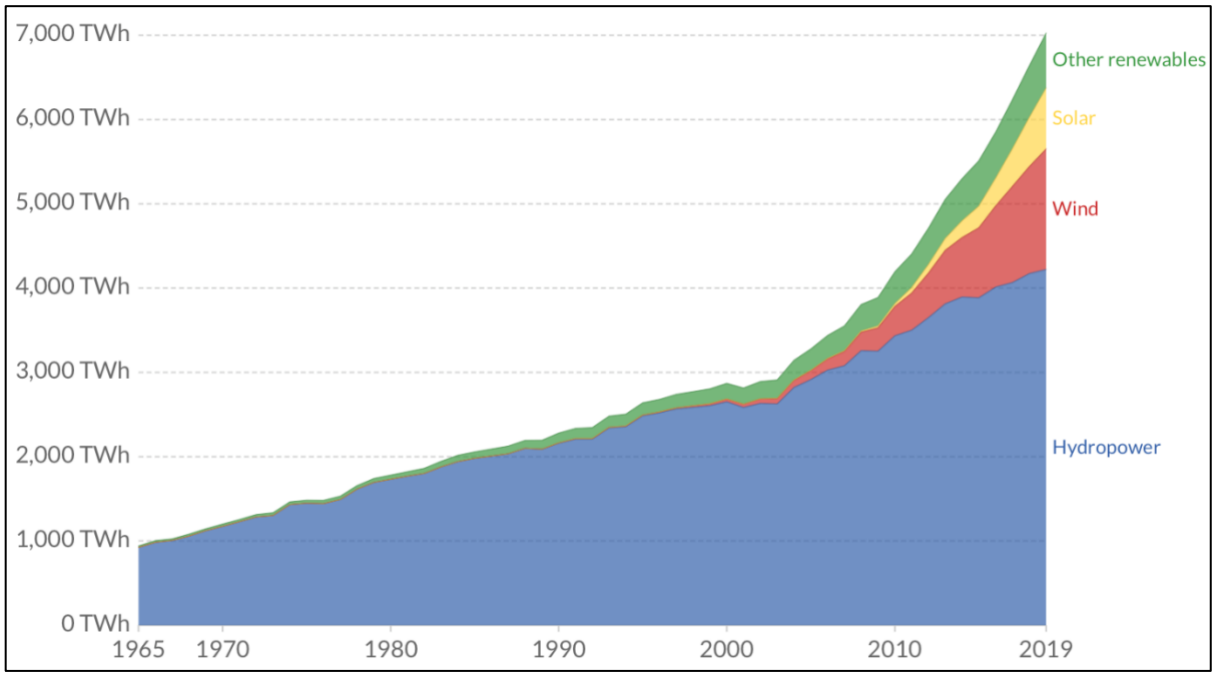


Figure 3 Renewable Energy Split 1965-2019

Source: BP Statistical Review of World Energy (2020)

Renewable energy sources have grown since the 1990´s at an average annual rate of 2.0%. Extraordinary growth rates were displayed in solar PV and wind power, which grew at average annual rates of 36.5% and 23.0% respectively. Looking at the newly installed capacity in the electricity sector worldwide, the trend towards renewable energies becomes clear also. A total of 201 gigawatts of capacity for generating electricity from renewable energies was newly installed in 2019, eleven percent more in comparison to the previous year.

Figure 4 gives a good overview how constant the growth of the renewable's shares exposed in the last decade. With rapid growth in electricity generation, renewables including solar, wind, and hydropower are the fastest growing energy source between 2018 and 2050, surpassing petroleum and other liquids to become the most-used energy source in the reference case. Global renewable energy consumption grows 3.1% per year between 2018 and 2050, compared with annual growth of 0.6% for petroleum and other liquids, 0.4% for coal, and 1.1% for natural gas consumption.

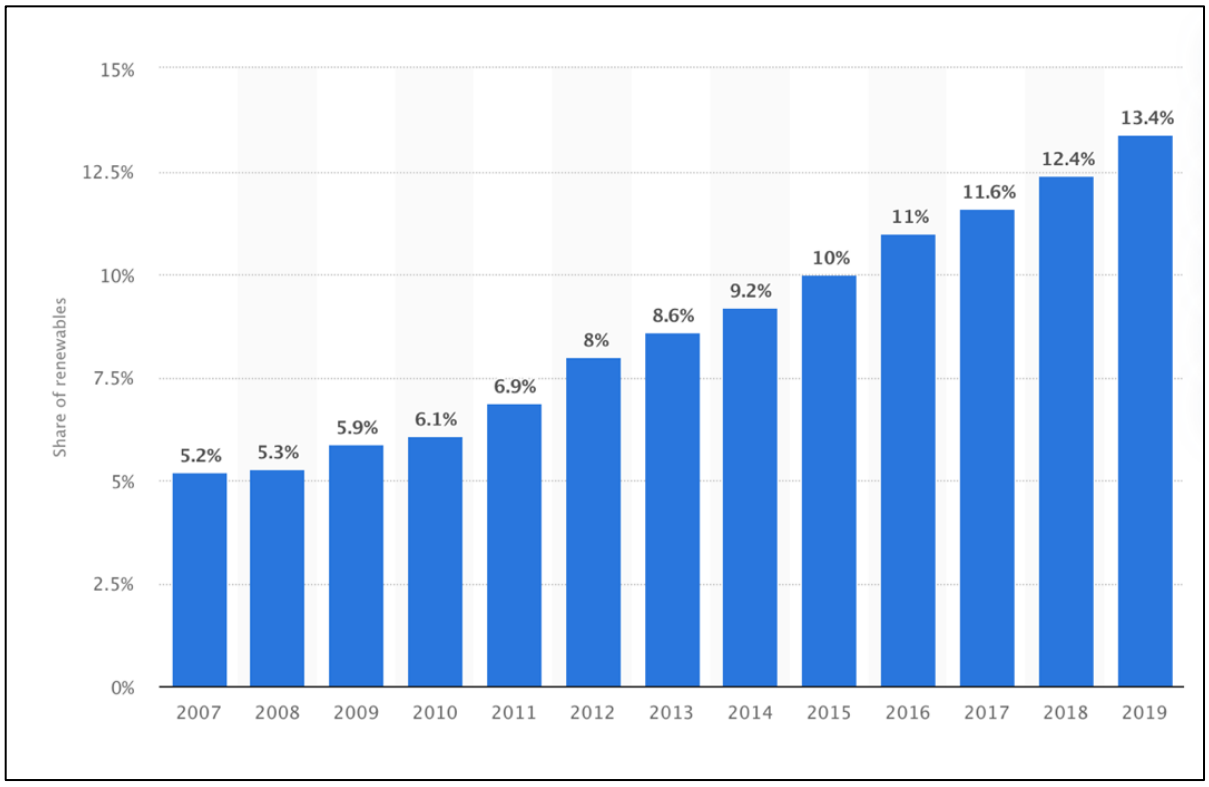


Figure 4 Share of renewable power in energy generation globally from 2007 to 2019

Source: Statista (2020)

Segmentation via Geography

In absolute terms, as we can see in Figure 5 below, China leads the world ranking in renewable energy consumption, followed by the U.S. and Germany. Overall, the particularly dynamic economies are focusing on renewable energies. Per capita Iceland and Denmark are even better off. They are followed by Sweden, Spain and Finland (REN21 2. , 2020).

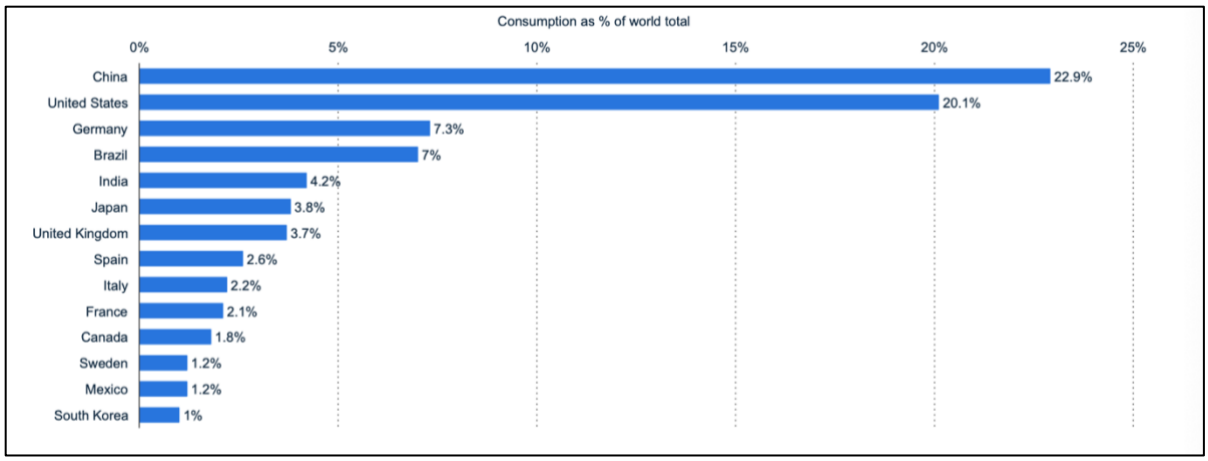


Figure 5 Renewable energy split by consumption within specific country

Source: Statista (2020)

A very interesting fact is that Iceland, Paraguay and the little country Lesotho in Africa already generate their electricity exclusively from renewables, Norway and Costa Rica are on the verge of doing so, and many other countries around the world have significant high shares of renewables in energy generation. Certainly, in the aforementioned countries, this is due to particularly favourable starting conditions, both geographically and geologically, and it is primarily hydropower and geothermal energy that are involved.

However, it is obvious to see that there are already countries today that are fully independent from coal and nuclear energy for power generation. Regardless of whether the studies come from the German Advisory Council on the Environment (SRU) or from the European Climate Foundation (ECF) or consultant firms like McKinsey or the Boston Consulting Group (BCG), many studies have already proven that a full scope of renewable energies is technically and economically feasible in the foreseeable future - also for developed countries like the U.S. or countries in the EU.

Demand and Market Segmentation

Green Electricity Segmentation

For our international industry analysis of the renewable energy sector, we have focused on the main 4 so-called green electricity production technologies. In this section we have analysed in particular the demand side with its overall consumption, growth potential, global but also

energy market share and the most advanced renewable energy offering countries. Four each segmentation

Solar Energy

Due to rapidly falling costs, photovoltaics and battery storage will be the most important pillars of energy supply in the long term. By 2050, the share of photovoltaics in the global electricity mix to rise from 37 percent in 2030 to 69 percent, and then to provide more than two thirds of the world's electricity.

In windy and sunless regions such as Northern Europe and Northern Asia, for example, the study shows that the optimised electricity mix naturally looks somewhat different from that in Africa, where the share of solar power is much higher.

Photovoltaic

After a year of constant demand, the PV solar market grew by 12% in 2019 to a record 115 GW (direct current), or a total of 627 GW.

The decade ended with strong demand in Europe, the United States and emerging markets around the world, more than offsetting a significant decline in China. Excluding China, the world market grew by around 44%. China continued to dominate both the world market and the manufacturing sector and had a significant impact on both.

In most countries there is still a need for support programmes for photovoltaics and an appropriate legal and political framework for grid connection. Nevertheless, interest in purely competitive large-scale installations is growing rapidly and a number of projects are under construction. In 2019, the number of company acquisitions has increased significantly, and own consumption (increasingly with battery storage) has been an important driver for new distributed systems in several countries, including Australia and Germany.

The industry continued to face fierce competition, which, combined with political uncertainties and a lack of confidence in some auctions, resulted in ruthless bids and thin profit margins for some developers and manufacturers, contributing to ongoing consolidation. At the same time, competition led to falling prices and opened up new markets, while pressure from lower prices and the expectation of rising global demand encouraged expanded and more efficient production, the entry of new companies into the sector and the constant drive for innovation.

During the year, photovoltaic energy accounted for around 10.7% of total production in Honduras, and significant shares were also achieved in Italy (8.6%), Greece (8.3%), Germany

(8.2%), Chile (8.1%) and other countries. At the end of the year, there was enough capacity in operation worldwide to generate an estimated 2.8% of global electricity generation.

Concentrated Solar Power (CSP)

Global CSP capacity grew by 11% to 6.2 GW in 2019, with 600 MW of capacity on-grid. Although the average annual growth (24%) of the last decade was well lower, CSP continued to spread to new markets, including France, Israel and Kuwait. China and South Africa also commissioned new plants.

The CSP industry has become geographically more diverse, both in terms of the location of commercial plants and the origin of developers, investors and contractors. The levelled cost of energy from CSP continued to decline in 2018 and 2019, with CSP increasingly being built in parallel with PV and wind power plants to reduce costs and increase the value of capacity. R&D activities during the year invested mostly on further improving the economics of CSP and addressing environmental impacts.

Wind Energy

With around 60 gigawatts (54 gigawatts onshore and six gigawatts offshore), the previous year's figure (51 gigawatts) was exceeded by around 18 percent in 2019 in the expansion of wind energy use. China alone installed 26.8 gigawatts, followed by the USA with 9.1 gigawatts. The United Kingdom and India followed at a distance with 2.4 gigawatts each and Spain with 2.3 gigawatts. Of the total 651 gigawatts of wind power capacity installed worldwide at the end of 2019, 236 gigawatts or 36 percent were accounted for by China alone.

Onshore

In the onshore wind energy segment, a significant increase in new installations was observed again in 2019 after three years of declining new construction. At 54.2 GW, the previous record of 2015 for new installations could not be matched, but growth compared with the previous year was strong at 17 percent. Among the five countries with the highest volume of new installations, two changes were observed in 2019. Germany and Brazil had to give up their positions to Spain and Sweden. As in the previous year, China, the USA and India were able to maintain their leading positions (GWEC20, 2019).

Onshore wind capacity is projected to increase by 57% to 850 GW by 2024. The annual expansion of onshore wind capacity will reach almost 60 GW in 2020, due to a surge in development in the United States before the expiry of the PTC and in China due to the political

transition from FITs to competitive auctions. Global annual installation is expected to be lower (about 50 GW) between 2021 and 2024, as growth will be slower in China and the United States. However, enlargement is accelerating in the European Union as competitive auctions continue to keep costs relatively low. In Latin America, the MENA region, Eurasia and sub-Saharan Africa, the auction schedule ensures strong capacity growth over the forecast period. Grid integration, financing and social acceptance are the main challenges for a faster expansion of onshore wind energy worldwide.

Offshore

Compared to onshore wind power, offshore technology is a young technology. This means that data is only available for some countries.

In 2019, the rising trend in the number of new annual installations in the offshore wind energy sector continued. With around 6.1 GW of installed output, the increase in the offshore sector was 35.5 percent higher than in the previous year and for the first time accounted for 10 percent of the total increase in wind energy. The expansion is still spread over a small number of regions. For example, 59 percent of new installations were erected in Europe, primarily in the countries bordering the North Sea - the UK, Germany and Denmark. 41 percent of new installations were in Asia, almost exclusively in China. Other countries in the region where offshore expansion is on the increase are Taiwan, which has now built its first large offshore wind farm, and Japan, where plans for offshore expansion have been clearly specified (GWEC 2020). The main drivers of expansion are tenders for state compensation systems.

Hydro & Ocean Power

Hydro Electric Power Plants

Hydropower continues to have by far the highest share of renewable electricity generation. However, at 58 percent of renewable electricity generation and 16 percent of total electricity generation, this share decreased slightly compared to the previous year (REN21 2. , 2020). In principle, hydropower is a mature and established technology that has been used to generate electricity since the end of the 19th century. Its advantages lie in its ability to regulate generation in the case of storage or pumped storage power plants, and in the combination with irrigation concepts. At the end of 2019, the global installed capacity of hydroelectric power plants was 1,150 GW (REN21 2. , 2020). China has by far the most hydropower installed, at 326 GW. Other countries with high hydropower capacity are Brazil, Canada, the USA and Russia. This distribution is stable, since such a large capacity cannot be added in the short term. However,

last year's addition was the first time there was a shift: most of the new capacity was added in Brazil, primarily due to the completion of the Belo Monte power station, which now has a capacity of 11.2 GW. China, which in terms of new capacity additions has was in first place, followed in second place. This is followed in decreasing order by the other Asian countries Laos, Bhutan and Tajikistan.

In a world of changing energy systems and priorities, the hydropower industry continued to face a broad, interconnected and evolving web of challenges and opportunities. Some of these are specific to the technical functioning and economic considerations of the industry itself (e.g., the need for modernization and climate resilience).

In addition to less and less untapped potential, the expansion of hydropower is facing further challenges. Electricity production in the run-of-river and storage power plants depends on the precipitation in the respective year. However, due to progressive climate change, precipitation and thus production fluctuate more and more. The damming of rivers can also lead to serious changes in the course of the river, as sediments settle and the water balance changes. In contrast to renewable energies such as wind and solar, where the levelized cost of electricity (LCOE) has fallen sharply in recent years, the cost of electricity from hydropower has risen slightly in recent years. The average LCOE for hydropower in 2019 was 0.047 USD/kWh, an increase of 6 percent over the previous year and 27 percent over 2010

Wave and Tidal Energy

Ocean energy represented the smallest part of the renewable energy market and most of the deployments so far have been small-scale demonstration and pilot projects.

Despite the slow developments in this sector, the maritime power industry started to evolve towards semi-permanent installations and equipment arrangements. The resource potential of marine energy is enormous, but the development path of sea power technologies is unstable, and these resources remain largely untapped.

After a turbulent 2018, the Ocean Energy industry reorganized in 2019 and continued its improvement towards commercialization. Net additions in 2019 were around 3 MW, with an estimated operating capacity of 535 MW at year-end. Significant investments and deployments were planned for 2020 and beyond.

The development of ocean energy was mainly concentrated in Europe, where tidal power plants generated 15 gigawatt hours (GWh) in 2019 (50% more than in 2018). However, ocean energy gained momentum in Canada, the United States and China, which offer generous financial support and ambitious research and development (R&D) programs.

Hydrogen

Green Hydrogen

In addition to its use in electricity generation, offshore wind energy is also playing an increasing role as a source of green hydrogen. Since 2019, increased ambitions can be observed to combine a potentially fast-growing green hydrogen production sector with the offshore wind industry, as "win-win situations" seem possible in many cases (GWEC20, 2019). Offshore wind energy is a suitable source of electricity for the production of green hydrogen in electrolysers for several reasons. Firstly, the technology is highly scalable, so that large generation networks with a total capacity of up to 2 GW or more can already be set up today. This could also benefit the electrolysis technology, which requires economies of scale to realise cost reduction potential that is still needed. On the other hand, the generation profile of offshore wind energy is relatively constant compared with onshore wind and solar PV, which allows the electrolysis technology available to date to be managed in a way which is advantageous for the plants. Currently, a large number of different concepts for the use of offshore wind energy for the production of green hydrogen are in the conception phase. Some of the ideas envisage electrolysis offshore and the transport of compressed hydrogen by ship on land or include the transport of electricity via a cable connection to electrolysers on land. Alternatively, to the ship Megawatt transport, pipeline connections for hydrogen produced offshore are also being considered (GWEC20, 2019), (Tractebel, 2020). It is not yet clear which systems will become established here in the medium term. However, it can already be shown today that energy transport via pipelines in the form of compressed hydrogen with increasing distance from the coast and rising total output of the connected wind farms can play out economic advantages compared to connection via high-voltage direct current transmission.

Against the background of the growing importance of this market segment, the increasing involvement of oil and gas companies in the development and operation of offshore wind farms has recently been observed. In 2019, Saipem from Italy, ExxonMobile from the USA and Equinor from Norway were particularly active in this area (REN21 2. , 2020) (IRENA20, 2020).

Electricity Utility Distributors

Energy utilities across the world are facing unprecedented change in their industry. These include decarbonisation measures, the decentralisation of the electricity grid, the electrification of large parts of the economy and an increasingly competitive retail market that offers

consumers more choice in who they buy electricity from. Customers and regulators are demanding more from utilities distributors than ever before, and investors are not scaling back their expectations. Key Industry Players such as NextEra from the United States with an annual revenue of 19.2 Billion USD or the German electricity distributor E.ON with a revenue of 42 Billion EUR, need to dramatically increase the share of renewable energy in their electricity offer.

The good news for energy distributors is that this development will create opportunities for new business areas. The bad news is that even competitors from other industries and sectors have recognised this development and with high speed enter into the core business of suppliers. For instance, German car manufacturers with their own energy distribution, in order to offer a holistic service portfolio in the electric mobility from a single source (electricity, charging infrastructure, intelligent loading management, installation, electric vehicles).
For energy companies the question arises of how to adapt to changes in the market and the change in customer expectations. In the past, energy distribution was a necessity to be able to use self-generated and/or sell purchased energy to the end customer. The structures resembled more a reactive management. In modern times electricity and gas are only one commodity of any interchangeable supplier. The often-declining value contribution of the sales value-added stage must be improved, in the future the environment becomes more and more digitalised and the areas of "home" and "mobility" merge. The transformation in the way of thinking of the future lean sales organisation will be focus predominantly on customer centricity. However, the necessary overall transformation must be carefully managed, as many utilities cannot or are not willing to replace their established structures immediately and in their entirety.

The ever-increasing electrical energy system is likely to change the interaction between the electricity sector and demand. By 2050, 86% of electricity generation will come from renewable energies and 60% from solar and wind power. Wind and solar PV will dominate the expansion, with installed capacities of over 6,000 GW and 8,500 GW respectively in 2050.

Matching supply and demand when so much variable renewable energy (VER) is generated requires an increasingly intelligent, digitised and flexible energy system (IRENA19).The electricity supply system will be different than today, with a much higher share of distributed energy sources, electricity trading and demand response.

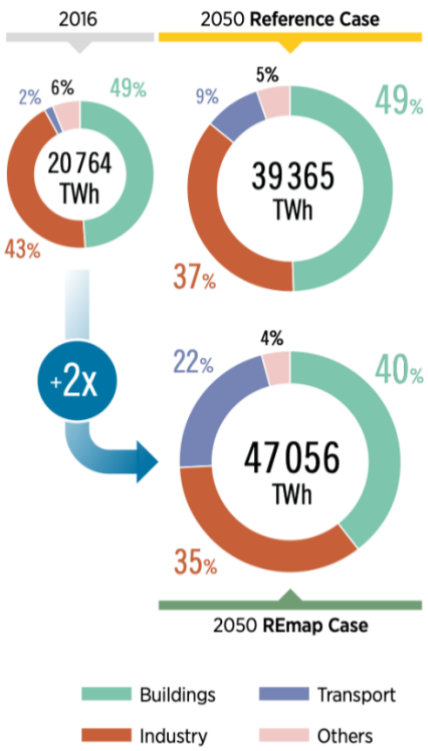


Figure 6: Electricity consumption in end-use sectors (TWh) (IRENA20)

The share of electricity in final energy would increase from only 20% today to almost 50% by 2050. The share of electricity consumption in industry, but also buildings would double. In the transport sector it would have to increase from only 1% today to over 40% by 2050.

So, to be well prepared and able to compensate this massive increase, electricity supplier in general need to invest heavily into their infrastructure and operation. In particular into Power grids extensions, enhanced equipment deployment, electricity storage, reinforcement of existing grid lines, and smart meters.

Wholesale Power Market

Today's electricity mix is evolving in a way that differs significantly from the previous system, in which competitive wholesale markets for electricity were created and developed. As prices have fallen and policies have brought wind, solar and storage to the grid, their share in the resource mix has increased. These resources differ in several important respects from the fuel-based electricity resources of the past.

However, these emerging resources usually have production costs close to zero. Their costs are almost entirely paid in advance and they are very cheap to run once they are built. As the shipping and market transfer prices are usually linked to production costs, this feature represents

a significant departure from the fuel-dependent power plants which in the past made up the bulk of the electrical system.

A second reason is that newer resources tend to have smaller minimum sizes - in the order of tens of megawatts (MW) rather than hundreds or thousands of units. As a result, these resources can be deployed more quickly and in smaller units. Even if each individual wind power plant is less predictable than any traditional coal-fired shippable power plant, a fleet of wind power plants could actually be more reliable than the individual coal-fired shippable power plant. This is because ten uncorrelated units of 100 MW in size are likely to be more reliable than a single 1,000 MW unit that could fail at once.

Furthermore, these natural resources have different production characteristics than many existing ones and are already changing the way network operators manage the grid. For example, the solar yield predictably follows the daily cycle of the sun, so in the evening, when the solar yield drops to zero, the grid operators will have to provide other resources. Planning and operating the grid on the basis of resource availability is not a new concept for grid operators - they have always had to plan for fuel element outages, for example - but when they do this on a daily basis for a large number of resources, it pushes grid operators to consider new rules and tradable market instruments. Newer resources can provide certain services better or cheaper than older ones.

In addition to the new wind and solar installations and storage, the technological barriers which limited flexibility on the demand side are also rapidly disappearing. Intelligent thermostats, water heaters and the "Internet of Things" can turn electricity demand into a resource for network and market operators.

So how does the power market work and how do negative prices occur?

Prices on the electricity market are determined by supply and demand. On the German day-ahead power exchange EPEX Spot SE, for example, power generators offer certain quantities of electricity at a certain price, while buyers register in the order book how much electricity they are willing to buy at a certain price in advance. This happens daily until 12 noon for all hours of the following day. By putting the bids for sale and purchase in order, two curves can be drawn. The point where their paths meet marks the market clearing price - the price paid for all successful bids. Negative electricity prices on the power market exchange are caused by high and inflexible electricity production and low demand for electricity at the same time. This is often the case on public holidays such as Christmas. Especially during hours with (predictably) high renewable electricity supply (a lot of wind and sun), electricity producers

offer their electricity at negative prices on the exchange. This is often done by marketers of renewable electricity, but also by conventional power plants such as nuclear and lignite-fired power stations. In this case, the market clearing price can be set below zero (see *Figure 7*).

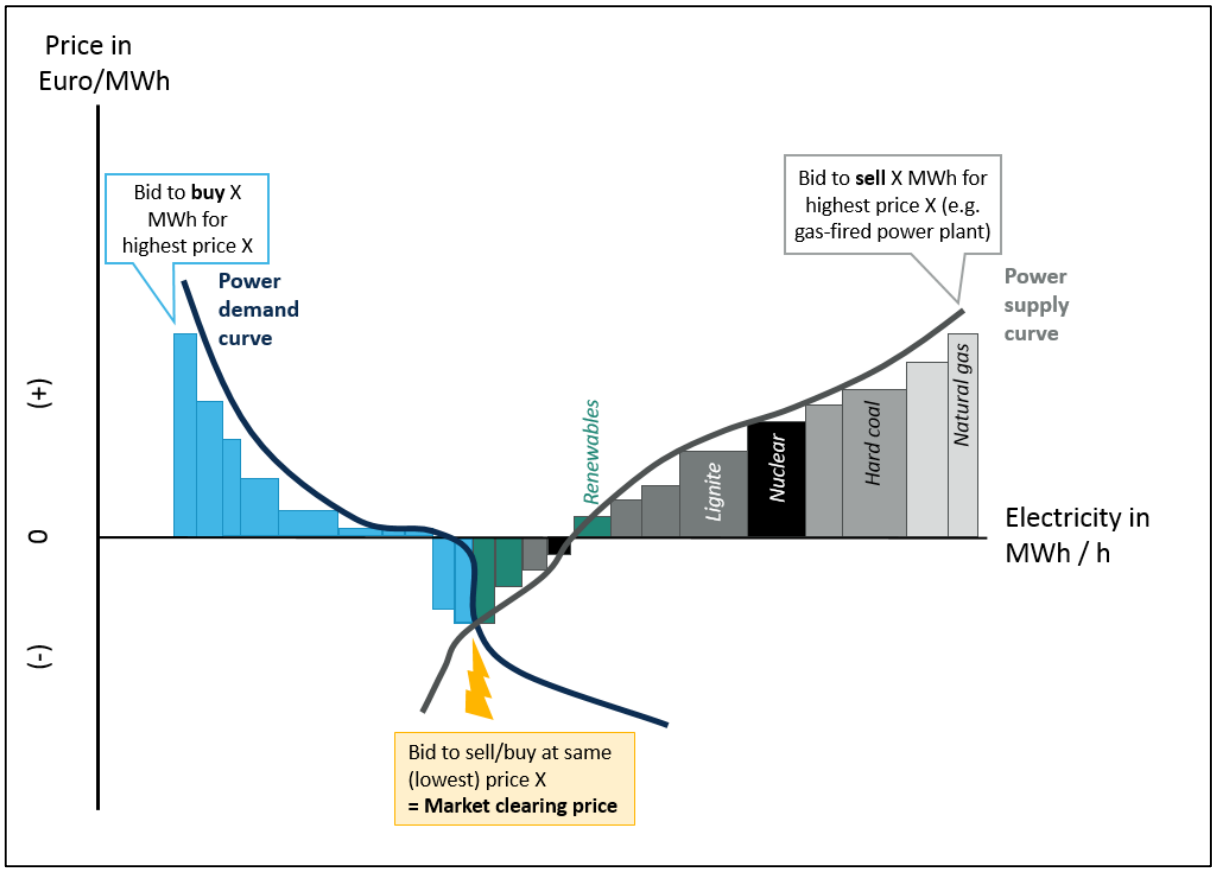


Figure 7: Diagram of power market situation that leads to negative market clearing price.

Electricity can at present not be stored in the electricity grid on a large scale. In order to keep the electricity grid stable at a frequency of 50 Hertz, the amount of electricity being supplied, and the electricity demand must be harmonised.

This balance has to be achieved through a close match between supply and demand - something the electricity market has to do in addition to its other task, which is to set the trading price for electricity. Negative prices are in general not a bad thing. They provide incentives for utilities to better adapt their power plants to the changing conditions in the electricity market and offer new business opportunities to companies by adjusting demand. During periods of high production, producers should be encouraged to shut down capacity, while large consumers can boost demand when prices are low. As negative electricity prices are a sign of very high supply on the market, additional "cheap" renewable electricity is often blamed for bringing electricity prices below zero.

A resilient and centralised unit with a decentralised contracting model supports decarbonisation, short- and long-term efficiency and reliability. It puts network operators in the role they need to ensure reliable and efficient network operation. The model assigns low load companies the role they should play in setting and implementing their resource and risk management objectives. It avoids the political frictions about the centralised model and the overcapacity and stranded costs that this model often leads to. It maximises competition, innovation and flexibility, especially in the critical sectors of responsive demand and distributed resources, which tends to reduce costs in the long run. The main challenge is to build up sufficient creditworthy buyers. Given the rapidly growing share of renewable energy in global electricity markets, this is not a trend that electricity traders can afford to lag behind, as the current capacity gaps will only enlarge over time.

Five Forces of Porter Analysis

Previously we have used Porters Five Forces to evaluate the margin for the overall sustainable value factor. In this part each of the factors have been analysed individually and drawn a conclusion for the Wholesale Power Market [WPM] Segment on one hand side and the Electricity Utilities Distributors [EUD] on the other hand side.

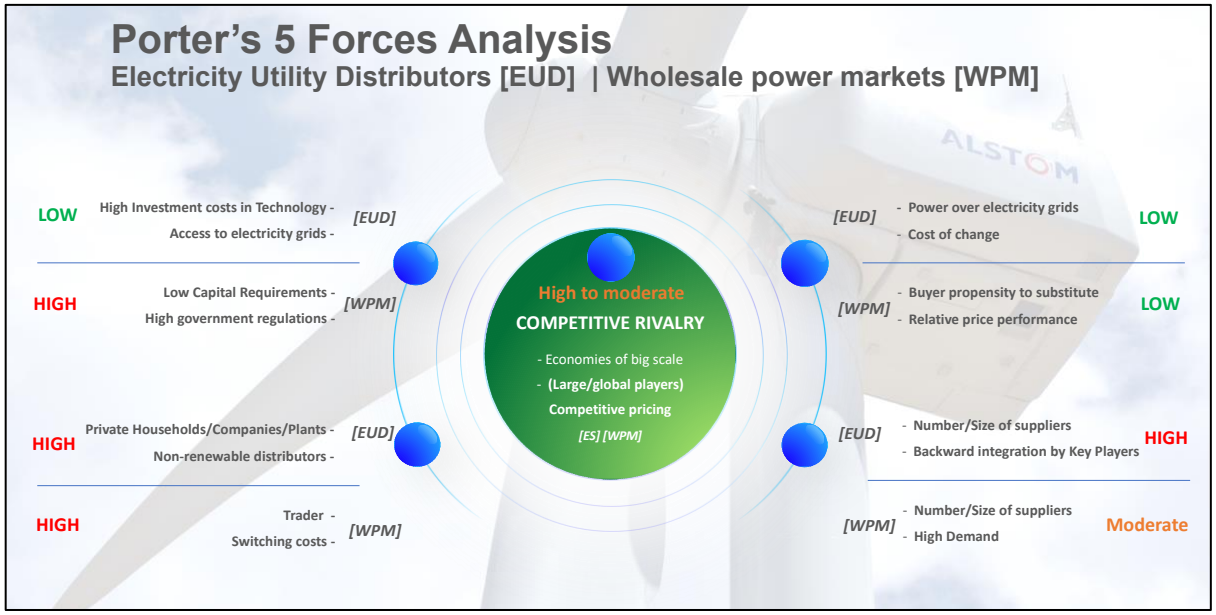


Figure 8: Porter's 5 Forces Analysis

Threat of New Entrants

High investment costs in terms of technology, research and development and material costs pose a rather low threat of new entrants in the EUD Market. As you can see in *Table 1: Score of*

Threat of New Entrants by Segment, the capital requirements are very high and thus again the threat is very low (green line). Same accounts for the knowledge and technological control by the industry and legal restrictions on the entry into the segment.

In addition, regulated and scarce access to electricity grids are hurdles that are very difficult to overcome for the market entrants. Due to a vast majority of strategic locations and the control over the resources, the entrants have some chance to gain momentum in these factors.

For the WPM Segment it's actually a rather moderate to high threat of new entrants into the sector, as you can see in the (orange line) Table 1. The overall low capital requirements and high government regulation helps the new entrants to gain market share.

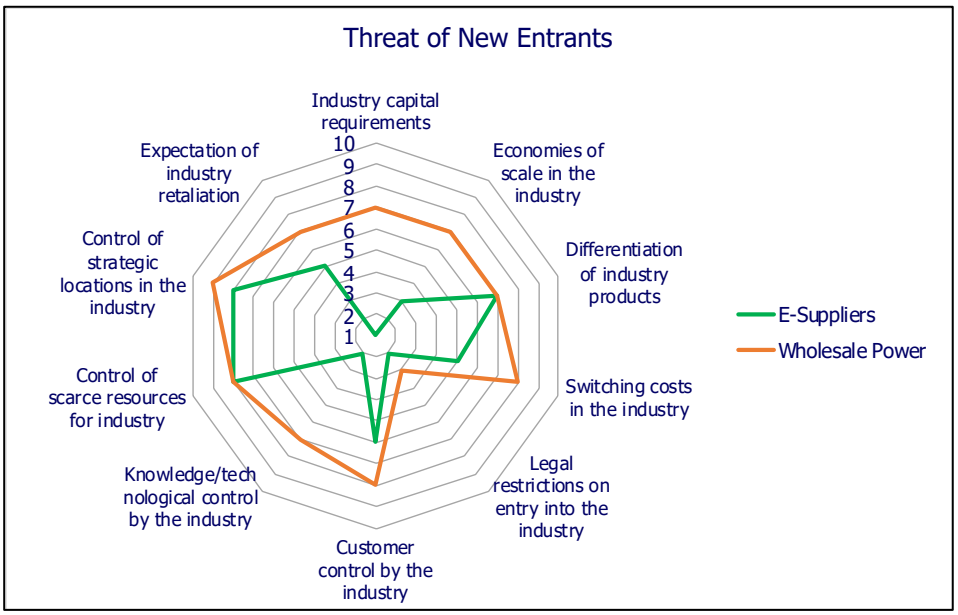


Table 1: Score of Threat of New Entrants by Segment

Threat of Substitutes

For both Segments the threat of Substitutes is quite low. For the EUD there is a very high cost of change if substitutes are even possible and additional, they possess the power over the electricity grids and again for this there is not really possible substitution for that at the moment. In regards of the WPM Segment, they have a small buyer propensity to substitute and a relative price performance. Both markets have similar characteristics of the Substitutes.

Bargaining Power of Substitutes

Due to many and very relevant suppliers the bargaining power of the suppliers is very high for the EUD Segment. Also, more key players of the Utility distributors shift towards a more

resilient backwards integration, thus the influence of the suppliers increase even more and the product they supply will be more unique.
For the WPM Segment the bargaining power is rather moderate as the possibility to quickly switch between supplier is high and the high demand of distribution onto the market is high as well, meaning the bargaining power can only be as high as the demand and reversed.

Bargaining Power of Buyer

Regarding the Bargaining Power of Buyer is high for both Segments. As in both Segments the end-consumers have high impacts on the general electricity price. The Main end consumers for both segments are private households, companies with for example buildings and the industry with producing plants. In the WPM also the traders as buyers can determine the price in advance and thus have a high bargaining power.

Competitive Rivalry

Overall, the renewable electricity environment is highly competitive, but regarding our segments, the competitive rivalry is high to moderate, as the large and global players mainly can determine the price of the industry. Although this is shifting towards more competitive pricing. In a global perspective, the massive investments into the sector increase the competitive rivalry dramatically and this again calls for a stricter and future prove regulatory towards a common goal of decrease the carbon footprint. This can be achieved more easily if the monetary thinking of key players can be shifted into a prosperous and rewarding fair market.

Key Success Factor

In this key success factor analyses of the renewable energy demand side, a separation into 6 different areas took part.

For the Electricity Utility Distributors [EUD] Segment the following key success factors have been identified:

- **Organization and Management** – A Vertical Integration of energy producers and distributors to mitigate supply risk. Also, decentralisation will be a success factor.

- **Technology** – For technology development and investment a key factor will be the improved efficiency of electricity storage. This will enable a much better grid and weather resilience, and a more efficient way of supplying the momentary demand.

- **Social** – Socially a key enabler will be the willingness to pay a more premium price for new renewable energy resources. This will change with the time as the fixed costs for renewable energy are very low once the initial investment is redeemed. But for the near future, this will play a big role in generating a wider but urgently needed acceptance by the public.

- **Government** – Key Success factors in this area are already feed-in tariffs and positive governmental regulations which increases the share of renewable and Green Energy in the overall electricity consumption and zero-emission goals.

- **Environment** – Environmental impacts such as climate change is and will be the biggest key success factor for the Sector. The fact of global warming, scarcity of fossil fuels and humanity's desire for survival forces the old systems to change their way of thinking rapidly.

- **Economic** – Price incentives for end consumers related to cost on the emissions connected to the carbon footprint will be a factor. Another option is to extend the tax benefits in this area.

For the Wholesale Power Market Segment [WPM] the following key success factors are being outlined:

- **Organization and Management** – For the Wholesale Power Market an already existing benefit is the decentralisation, but with an even further improvement in this regard a higher profit can be guaranteed, as this bridges the gaps for the normal Electricity distributors and enables an advanced im- and exporting of electricity, which again cops the resiliency of traditional energy grids and feeds the global rapidly changing demand market.

- **Technology** – From a technological point of view, an even further acceleration of the trading market and network access will help in the future.

- **Social** – Socially the effect of negative prices for the electricity will hinder the broad acceptance, which needs to be overcome.

- **Government** – The already existing governmental regulations for trading will add value even further and will secure the position of the industry and private sector as end-consumers.

- **Environment** – Like in the EUD sector the climate change will be the biggest key success factor, as the increasing relevance of renewable energy will generate a higher demand and need for environmentally friendly electricity.

- **Economic** – Financial support for the wholesale power market is a key factor for success. Enhanced investments in terms of renewable energy certificates (REC) will be needed to generate higher market capitalisation of electricity suppliers.

PESTLE Analysis / Trends

In the following PESTLE analysis, we will give an overview of the most important political, economic, social, technological, legal and environmental influences affecting the renewable energy sector in the future. The goal is to figure out what the different factors are and how they will influence the industry. Enclosed the most important factors are shown as follows:

Political	Economic	Social	Technological	Legal	Environmental
▪ Political instability ▪ G20 – Paris Agreement ▪ EU – 32% share of renewables & (European Grean deal) ▪ China - Renewable Energy Law of the People's Republic of China ▪ Government intervention – E.g. Car/Public Transportation CO2 regulations	▪ Economic instability Growth rate / Inflation / Interest (e.g. COVID) ▪ Infrastructure quality in Oil & Gas Refining & Marketing industry ▪ Economic recession and stagnation due to Covid 19 Effect: Reduction on global demand ▪ Local/foreign investments - Reduction on global M&A ▪ Decrease price of raw material/ supply&demand benefit	▪ Demographic changes (population increase, urbanization) ▪ Rise of global middle class (eg. China and india) ▪ Local energy demand (eg. African hubs/smart cities) ▪ Climate friendly Consumer behavior	▪ Technological breakthroughs within Renewables ▪ Hydrogen ▪ Biotechnology, energy technology, virtual world ▪ Value chain structure - digital transformation	▪ Policies/Laws environment pollution – positive (Air and water pollution regulations) ▪ Implementation rules/Regulatory – negative (e.g. construction wise)	▪ Climate change ▪ Environmental concerns are expected to increase ▪ Zero emission plans ▪ Natural resources/weather volatility ▪ Difficult recycling processes (e.g. windfarms)

Figure 9 PESTLE Analysis Renewable Energy Sector

Source: Presentation held on 04th Dec. 2020, International Industry Analysis Course

Political

In essence, energy system transformation means a system change and the effects of which should not be underestimated from a political perspective. There are many positive factors, like the Paris Agreement and other regulatory (e.g., in China), that will influence and facilitate the expansion of the renewable energy sector.

First, there was adopted the 2030 climate and energy framework by the EU in September 2020 to raise the 2030 greenhouse gas emission reduction target, including emissions and removals, to at least 55% compared to 1990 in all sectors, including increased energy efficiency and renewable energy. The process is starting of making detailed legislative proposals by June 2021 to implement and achieve the increased ambition. This will enable the EU to move towards a climate-neutral economy and implement its commitments under the Paris Agreement by updating its Nationally Determined Contribution (EU, 2020).

Another positive example is the Renewable Energy Law of the People's Republic of China, giving clear standards of necessary energy standards and use of renewable energies. Due to the big public issue of climate change, the politician will further push the renewable energy sector to be increased.

However, the energy transformation dividends face new risks and challenges on a global level. Even the electrification of the energy system is accompanied by considerable risks not only in the area of network stability. A collapse of the power supply would have cascade effects for other critical infrastructures. The geopolitical implications concern the flow processes of "energy ecosystems" and affect the provision and control of networks and energy services, data, technologies and supply chains (Insights, 2020).

Economic

Added to the threats already mentioned from a political perspective, there is the fact that energy transformation is developing very heterogeneously worldwide. The rescaling of global value chains, the reshifting of production clusters to the local level, but also changes in the flow of goods have a direct impact on the international division of labour and the world trade system. Approximately one-fifth of the world trade system's volume is based on products of the extracting industry such as oil, gas and coal. As energy supply becomes more of a technology

and innovation-driven process, the participation of countries in the world trade and energy system shifts. Economic welfare gains are thus recalibrated, and this has profound consequences for the world economic system.

An even more complicated effect has the ongoing COVID 19 pandemics on the expansion of the renewables. Oil prices, already triggered by the price war between Saudi Arabia and Russia in mid-February, went down intensively due to lower demand. Within a month, the oil price slid from US$58 to US$28 per barrel. Today, it is the declining economic output as a result of the Corona crisis that is putting further pressure on the oil price: Currently, the daily global oil consumption averages 83.8 million barrels per day - in 2019 it was still 100.4 million.

On the other hand, with the corona pandemic at hand, the course for future development has been set - new economic stimulus packages are more than just an opportunity to align the economy sustainable and achieve the climate targets for politics – therefore there might be a chance that investments in the sector will increase. This includes that experienced investments in renewable energies for institutional investors receive favourable treatment by regulators - meaning that investors have to keep less equity capital available for the investment than with higher risk classes. The Corona crisis is hurting global growth in renewable power capacity for sure. The number of new renewable power installations worldwide is set to fall in 2020 as a result, marking the first annual decline in 20 years. Nevertheless, given supportive government policies, growth is expected to resume in 2021 again.

Social

As awareness of global warming and climate change in general, surveys find that a growing proportion of consumers worldwide are increasingly concerned about the environmental impact of their consumption. On a global average, CO2 emissions per capita and year are around 4 tons - although the trend is rising sharply in developing and emerging countries.
Among environmentally conscious consumers, there is a correlation between income and energy consumption: Those who can afford it have a large apartment and travel a lot. In addition, energy consumption is largely determined by the infrastructure, e.g., buildings, traffic routes, settlement patterns and energy supply systems. But the social awareness of consumers and the pressure they will create also to governments we assess as one of the key figures why renewables will increase in comparison to conventional energy supply (EU, 2020).

Local value creation and employment in the field of renewable energies - including the development of off-grid value chains – is a priority. Especially in poor and not so far developed areas in the world the local energy demand increases a lot. Considerable socio-economic benefits and a significant innovation potential argue for strong support of the off-grid sector (e.g., in Africa) and will support the renewable energy sector there locally.

Technological

As technology has already transformed a wide range of industry sectors, it is now transforming the energy sector in a big way. The confluence of smart energy networks, digital solutions that enable better management of energy demand and trade, electrification, and abundant and low-cost renewable energy has the potential to transform the energy sector in ways that seemed unlikely just a few years ago. Developments are already underway in several key areas.
Especially in the hydro area there is a key breakthrough expected. The European Commission's recently published the Hydrogen Strategy 2030 calls for hydrogen capacity to increase from 0.1 gigawatts today to 500 gigawatts in 2050. This is why Goldman Sachs predicted in early 2020 that green hydrogen will become a $12 trillion market by 2050. (Carbeck, 2020)
Furthermore, the digitalization through the energy sector is a technological benefit and will increase the chances for renewables to further develop.

Legal

Climate protection and a secure energy supply are among the most important global challenges facing mankind. Worldwide, 144 countries have set their own targets for the expansion of renewable energies. 138 countries and regions are implementing policies to increase the share of renewables in their energy supply. Renewable energies, energy savings and the use of efficient technologies are key strategies for meeting these challenges. Therefore, there are a lot legal foundations worldwide, European wide and domestic for compliance with certain standards to also ensure pollution rules. Hence, these help the progress and advance for renewable energies in general.

Nevertheless, there are also some - mainly domestic and local - regulations and restrictions for implementation, which complicates the process in some circumstances. An example from Germany shows that there are minimum distances between wind turbines and residential areas. They are lowering the expansion of wind energy and renewables in general. Even a blanket

distance of 1,000 meters would reduce the available areas by 20 to 50 percent. This makes it almost impossible to expand wind power e.g., more sufficiently in Germany. Instead of blanket distances, a site-specific assessment of health and environmental protection concerns would make sense. Legal concerns can thus be assessed positively as well as negatively and tend to have neutral effects on the progress of the renewable energy sector overall.

Environmental

“The world energy system is at a crossroads. Current global trends in energy supply and consumption are clearly not sustainable, environmentally, economically or socially. However, this can - and must - be changed. There is still time to change course” (IEA, 2020). (IRENA20, 2020).

Energy transition, sustainability in energy production and energy use, resource conservation and climate protection are the key words when it comes to initiating the transition from the fossil-nuclear to the solar-efficient age. It is no exaggeration to say that the future well-being of humanity depends on how well we succeed in overcoming the two key energy challenges we face today: Securing a reliable and affordable energy supply and rapidly transitioning to allow-carbon, efficient and environmentally friendly energy system. This requires nothing less than an energy revolution. Renewable energies are at the centre of this and will be playing a key role in the discussion around climate change in general. An energy supply from exclusively renewable sources should be developed according to ecological, social and economic criteria. For the necessary increased use of renewable energies there is a huge common understanding between the worlds community and will lead to an automatic advance and positive impact for the renewable energy sector.

Overall PESTLE evaluation

As overview, we evaluated the individual influences can be seen below as an attachment:

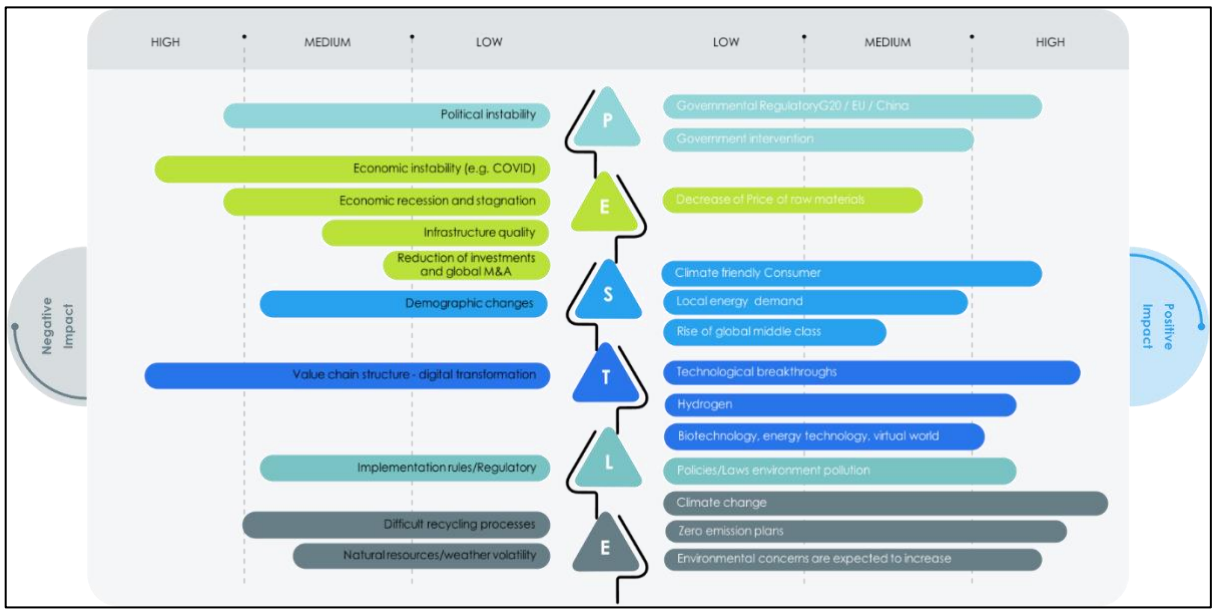


Figure 10 Outcome PESTLE Analysis Renewable Energy Sector

Source: Presentation held on 04th Dec. 2020, International Industry Analysis Course

Demand Outlook

As this report makes clear, capturing the synergy between low-cost renewable energy and end-use electrification is the key solution to cutting energy-related CO2 emissions.

According to expert estimates, global energy demand in 2020 will fall by 5% in the short term and also pandemic related, energy-related CO2 emissions by 7% and energy investments by 18%. The impact varies by fossil-fuels. Estimated declines of 8% in oil demand and 7% in coal use contrast sharply with a slight increase in the contribution of renewables. The decline in natural gas demand is about 3%, while global electricity demand is expected to decline by a relatively modest 2% this year. Earlier this year, renewables already faced challenges in several markets regarding financing, policy uncertainty and grid integration. Covid-19 is now exacerbating these concerns. However, governments have the opportunity to reverse this trend by making investment in renewables an important part of the stimulus packages they are using to revive their economies. This offers the prospect of reaping the structural benefits that increasingly affordable renewables can bring, including opportunities for job creation and economic development, while reducing emissions and encouraging innovation.

The overall demand for clean energy is increasing. As the number of countries taking action on climate change increases, the shift toward low- or zero-carbon technologies such as solar, wind, and hydropower has accelerated. As conventional energy sources are depleted and greenhouse gas emissions increase, countries around the world are drastically shifting their focus to renewable energy sources. Therefore, in perspective, nothing will prevent a much higher share of renewables in the global energy market on the demand side.

Supply Analysis

Industry Lifecycle

The life cycle of the industry reveals the progression of the industry across four phases, based on the different characteristics typically prevailing in each phase. The role within the life cycle is determined by several variables, such as growth, competitiveness, margins, or revenue, and is essential for research to define key success factors and an effective strategy.

The renewable energy sector has been increasingly relevant over the last decade. Ongoing climate change has posed issues for industry and the government, and there is one step in the path of attempting to focus more on clean energies. In the past, this sector has expanded considerably, and even during the present pandemic, it has struggled just a little.

The role in the life cycle of the industry depends of course, strongly on the venue, as seen in the attractiveness study of the various regions. The overall position on the lifecycle would be based on the major regions with the largest effects, in this case, the US and China. Germany and Sweden have been chosen as well to compare "smaller" countries concerning the big players. The figure below shows the various countries and their overall life-cycle status in the clean energy market.

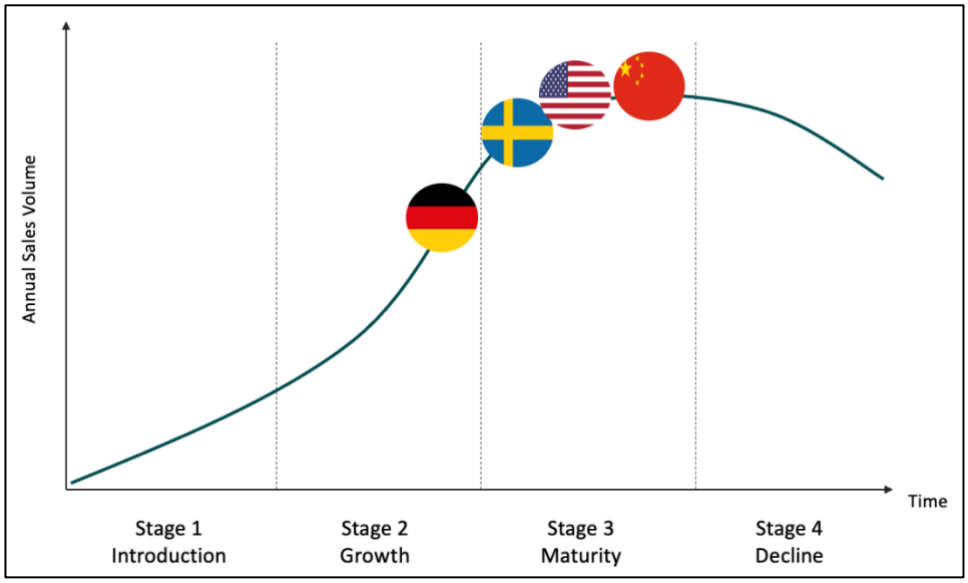


Figure 11: Industry Lifecycle

Source: Own illustration based on course content (International Industry Analysis)

China and the USA, which are also the key players in this market, are now in the maturity process of the industry. In particular, when looking at China, it can be argued that the industry is the most developed. In China, much of the electricity is already produced by renewables, the decrease is not very close due to the digitization of the renewables industry. (Financial Tribune, 2019)

Differences can also be found in smaller nations, such as Sweden and Germany. Sweden uses far more renewables for electricity production than Germany, whereas in general the Scandinavian countries are the leading countries in Europe. Although Germany is seen by the world as an innovative economy, the industry will be more likely to be represented as growing in terms of green energy. (IEA, 2019)

Industry Value Chain

The following chapter covers the topic value chain in the renewable energy industry. First, the overall renewables value chain divided in the two main phases "project development" and "traditional electricity value chain" will be introduced followed by a deep dive of each of these phases and later concluded by giving and example how a traditional value chain looks like in the wind energy case.

Renewable energy value chains slightly differ depending on different kind of sources. Most of them focus more on the project development part (project planning, component manufacturing,

installation of plants, etc.) though and do not include the traditional electricity value chain steps (transmission, distribution and sales of electricity). Since the focus of the supply part of this report is on the energy generation, and thus the focus of the demand part is on the energy distribution, typical electricity value chain steps, including transmission, distribution and sales to end consumers, were included in the value chain that can be seen below.

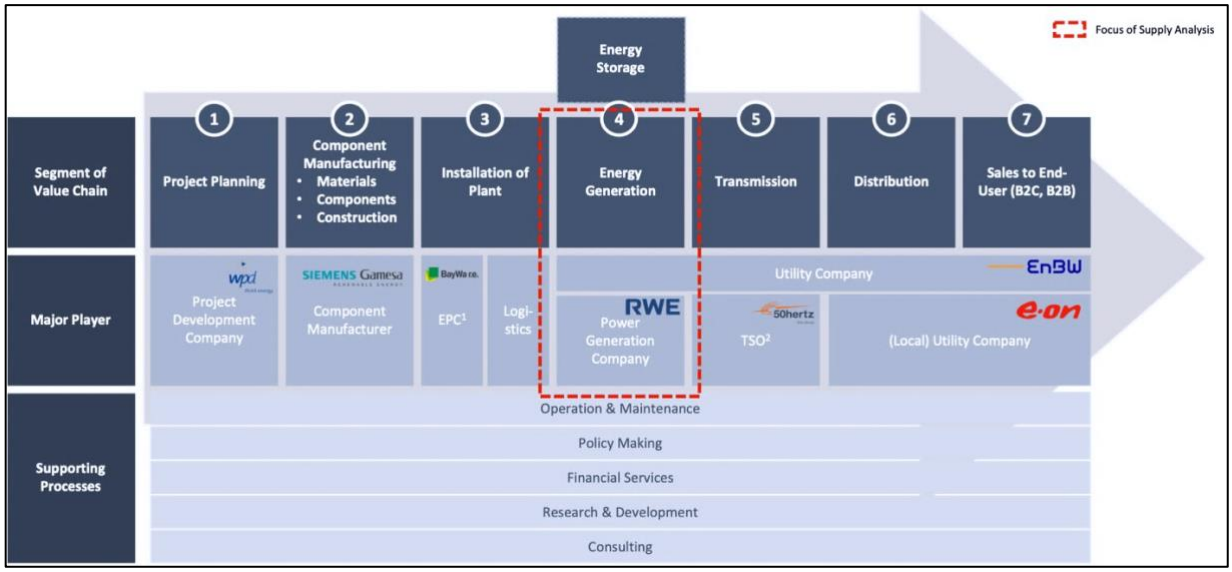


Figure 12 The Renewable Energy Industry Value Chain

Source: Own illustration based on IRENA (2015) and IRENA (2017)

In this report, the focus will be on an energy value chain including the following steps below consisting of main and supporting processes:

1) Project Planning: Pre-development activities of a renewable energy project
2) Component Manufacturing: Manufacturing of raw materials, components and the facility itself
3) Installation of Plants: Infrastructure works and construction of the facility itself, including site preparation and civil works
4) Energy Generation: Generation of electricity which either moves through a complex system afterwards, also known as grid, or can be stored
5) Transmission: High voltage transmission lines carrying electricity long distance through energy networks
6) Distribution: Distribution lines carrying electricity to houses of consumers
7) Sales to End-User: Consumers can usually choose their supplier from competing electricity retailers

8) Supporting processes including operation and maintenance, policy making, financial services, research and development and consulting

Project development and realization phase in the renewable energy value chain (Steps 1 -3)

The overall value chain for renewable energy projects over the whole project lifecycle starts with the project development phase, followed by the project realization phase and last but not least, ends with the operation and maintenance phase (IRENA, Evaluating Renewable Energy Manufacturing Potential in the Meiterranean Partner Countries, 2015).
The project development and realization phase of the value chain includes activities 1 – 3 (Project planning, component manufacturing, installation of plants) of the steps mentioned above.

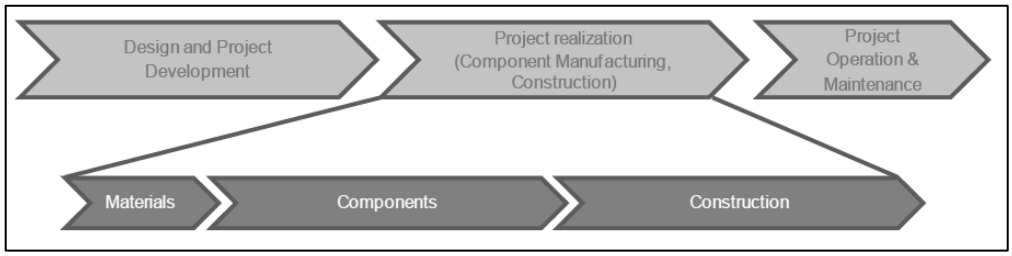


Figure 13 Project lifecycle steps for renewable energy projects

Source: IRENA (2015)

During the project lifecycle (steps 1 – 3) different types of companies operate in different value chain steps. The main key players are project development companies, EPC (engineering, procurement and construction) companies, component manufacturer and logistics and construction companies. Project development companies are responsible for all preliminary works and pre-engineering, from coordination to quality assurance, not necessarily implying that those companies own the project, but they are rather responsible for the project management. An example for a project development company is wpd from Germany is actively engaged in the development of offshore projects and which is one of the most successful offshore project developers in the world. Typical responsibilities of the company include extensive geological, biological and technical investigations. Based on those investigations, individual plans for customers are created which must fulfil extensive testing and certification requirements as they proceed. Interactions between authorities, political decision-makers, the local population and local business, project development companies aim to realize profitable

projects which enjoys a high level of acceptance (wpd, 2020). The second step, component manufacturing, is divded into three different sub-categories: Design and manufacturing of raw material, construction and manufacturing of components and construction of the facility itself. Component manufacturing companies are usually based in different industrial sectors and are either active as a complete product manufacturer (e.g. towers or gearboxes for wind energy) or as sub-supplier for specific parts (e.g. steel tubes for the absorber tubes of concentrated solar power). Main players like Siemens Gamesa (SGRE), Vestas, General Electric (GE), Goldwind and many other manufacturers operate in this step of the value chain. The component manufacturing market in the case of wind turbines is highly concentrated: Just four of the top players (Siemens Gamesa, Vestas, GE, and Goldwind) account for about 57% of the wind turbines manufactured and sold (BloombergNEF, 2019). The same can be applied to solar energy: Here, the top 10 manufacturers have a joint market share of 65 – 70% resulting in a highly concentrated market as well. Major players are Jinko Solar, Canadian Solar, JA Solar and a few more shown in the graphic below (SolarEdition, 2020).

The graphics below shows the major global onshore wind turbine and solar power manufacturers in the recent years.

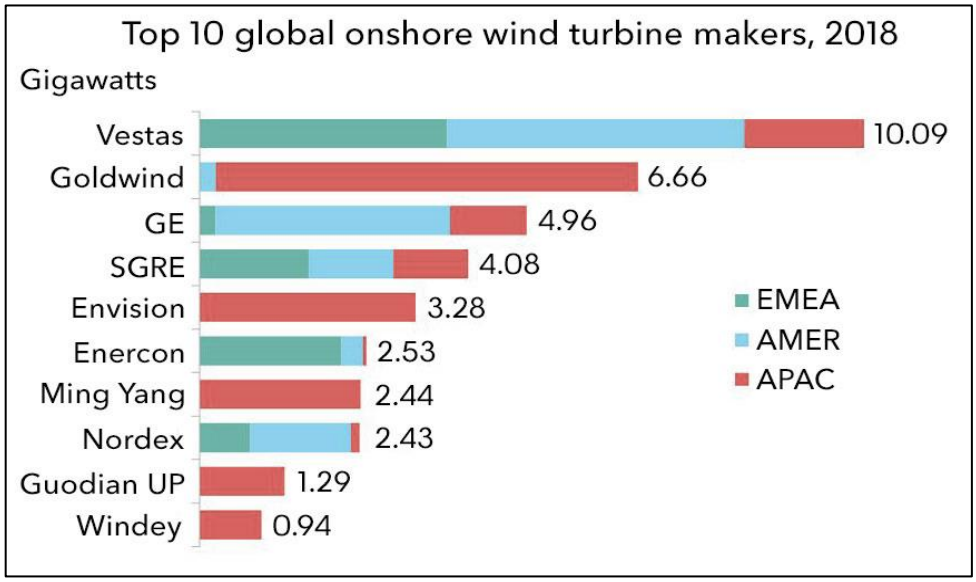


Figure 14 Top global manufacturers of wind and solar

Source: BloombergNEF (2019)

Engineering and procurement companies (EPC) are responsible for the engineering and construction of the power plants. Those companies have to assure quality and performance of

the power plant and choose all component manufacturers for the installation of the plant. In addition to EPCs, logistic companies are also involved in the phase of plant installation. Those companies are required for the preparation of the plant and are responsible for the delivery of raw and semi-finished materials as well as prefabricated components to the site. They should be experienced in logistics and should provide a local know-how. An example for an EPC company is BayWa r.e. from Germany. Typical responsibilities of the company include end-to-end project solutions including initial planning and consultation, project development, construction and technical as well as commercial operations management (BayWa, 2020). BayWa r.e. is an example for a company that operates during more than one step in a renewable energy project lifecycle.

Traditional electricity value chain phase in the renewable energy value chain (Steps 4 - 7)

Now that the project development phase of the value chain has been described in the last chapter, this chapter will focus on the traditional electricity value chain which steps follow after the project development phase. A traditional electricity value chain is displayed below.
Step 4 – 7 in the first illustration cover the steps of a traditional electricity value chain. The steps of an electricity value chain can be seen below. To simplify the value chain, the steps power generation, power transmission, power distribution and power retail will be discussed more in detail in the further step.

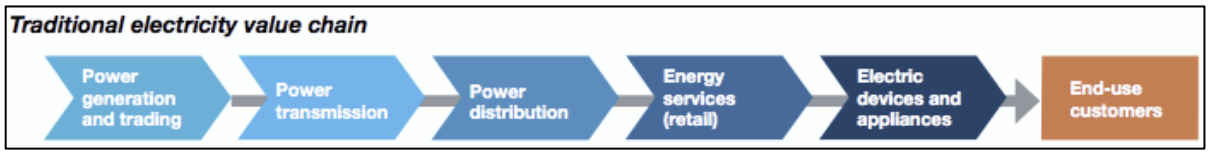


Figure 15 The traditional electricity value chain from power generating and trading, over transmission and distribution to retail

Source: UtilityDive (2014)

The value chain starts with the step of electricity generation. Generation technologies are highly specific to certain fuels. Hydroelectric power generation for example depends of the strength of river networks while solar energy depends on the annual sunshine per square meter in a certain location. This step can further be subclustered in feasibility study and design, construction and installation, and operation and maintenance. The second step, namely transmission, includes the link of generation plants with distribution systems. Transmission

occurs at high voltage level. In the past, transmission lines ran from a single power plant to a single load center, e.g. city or factory. Nowadays, transmission lines are interconnected into vast transmission networks, also known as grids. Transmission is followed by distribution. During this step, distribution networks transport electrical energy from the transmission network to the service location, e.g. individual households. Companies active in this step maintain the distribution network, measure the consumption/ demand of individual consumers, also known as metering, and collect tariffs/ fees from customers (Bamber, Guinn, & Gereffi, 2014; UtilityDive, 2014).

Power generation and utility companies are operating during the steps mentioned above. While some of those companies have a higher vertical integration, meaning they generate, transmit and sell electricity, others only focus on one or two of the steps above, meaning they are more specialized or less vertical integrated. An example of a highly vertical integrated company is the Germany utility company EnBW. EnBW operates during the steps energy generation, transmission as well as distribution and sales and thus has a high power over the value chain steps. In contrast, RWE and E.ON are examples for less vertical integrated companies. While RWE is responsible for the production of electricity and retail services, and thus excluding the transmission part, E.ON only focuses on the distribution of energy, resulting from their asset swap transaction agreed in 2018 as one of the largest restructuring in the power sector in this decade (strategy&, 2019). Companies operating in those steps will be analyzed in the further analysis.

Project development renewable value chain in case of wind energy

The value chain may vary slightly depending on the renewable energy source but the principal view on it remains the same. To better illustrate a renewables value chain, in the following the steps of the value chain will be explained using the example of onshore wind. A typical onshore wind energy value chain including all activities is displayed below.

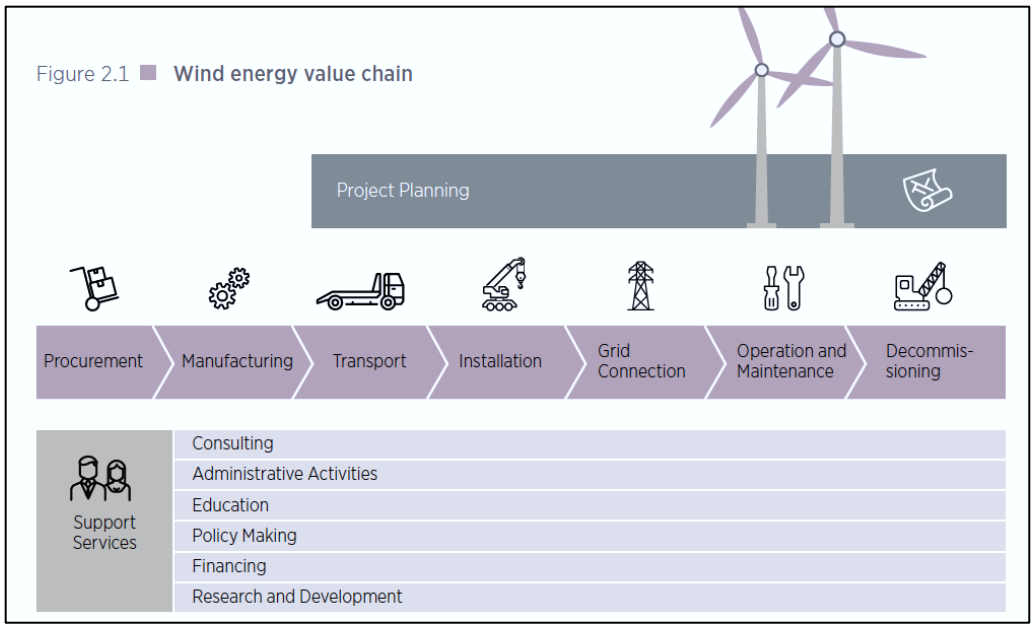


Figure 16 A typical onshore wind energy value chain with its main and supporting processes

Source: IRENA (2017)

The onshore wind energy value chain includes eight phases: Project planning, procurement, manufacturing, transport, installation, grid connection and commissioning, operation and maintenance and decommissioning. The project planning step includes the pre-development activities of a wind energy project, including technical and geological investigations, environmental and social impact assessment, site selection, as well as feasibility studies. The engineering and design of technical aspects of the project (e.g., operation, maintenance and decommissioning of the planning) is also part of this value chain step. In the first step, procurement phase, main components, intermediary products and raw materials are acquired. They are either available locally or are imported by manufacturers. The third step is the manufacturing of components that are needed for the production. In the case of wind energy, the manufacturing and assembly of e.g., nacelles, blades or towers. After the components have been manufactured, the equipment has to be transported from the manufacturing warehouse to the project site, also known as transport phase, usually involving logistics companies. In the fifth step, grid connection, all requirements of the grid operator have to be fulfilled, allowing the facility to begin to produce and sell the electricity followed by the sixth step operation and maintenance. This step includes the commercial and technical control of the renewable energy facilities as well as its monitoring and maintenance activities. Those are being carried out during the operational lifetime of the project. The value chain ends with the decommissioning phase meaning several components of wind plants are uninstalled, disposed or recycled resulting in clearing the site and returning it into its original state. Supporting activities are comprised of

the following services: Consulting, administrative activities, education, policy making, financing and research and development (IRENA, Renewable Energy Benefits Leveraging Local Capacity for Onshore Wind, 2017).

More detailed activities along each value chain phase are displayed below.

SEGMENT OF THE VALUE CHAIN PHASE	ACTIVITIES
Project planning	1.1. Site selection
	1.2. Technical and financial feasibility studies
	1.3. Engineering design
	1.4. Project development
Procurement	2.1. Identification of specifications
	2.2. Assessment of the local availability of materials
Manufacturing	3.1. Nacelle manufacturing and assembly
	3.2. Blades manufacturing
	3.3. Tower manufacturing and assembly
	3.4. Monitor and control system manufacturing
Transport	4.1. Transport of equipment
Installation	5.1. Site preparation and civil works
	5.2. Assembling equipment
Grid connection and commissioning	6.1. Cabling and grid connection
	6.2. Commissioning
Operation and maintenance	7.1. Operation
	7.2. Maintenance
Decommissioning	8.1. Planning the decommissioning
	8.2. Dismantling the project
	8.3. Disposing/recycling the equipment
	8.4. Clearing the site

Figure 17 Activities along the onshore wind energy value chain

Source: IRENA (2017)

Strategic Groups

Five main strategic clusters

During the strategic groups cluster analysis five main clusters of energy generation companies and utilities actively engaged in the renewable energy industry have been identified. Those include the following strategic groups

- Major oil companies
- Big players from the US
- Multinational European utilities
- State-owned Chinese utilities
- Renewable Specialists

and are illustrated below.

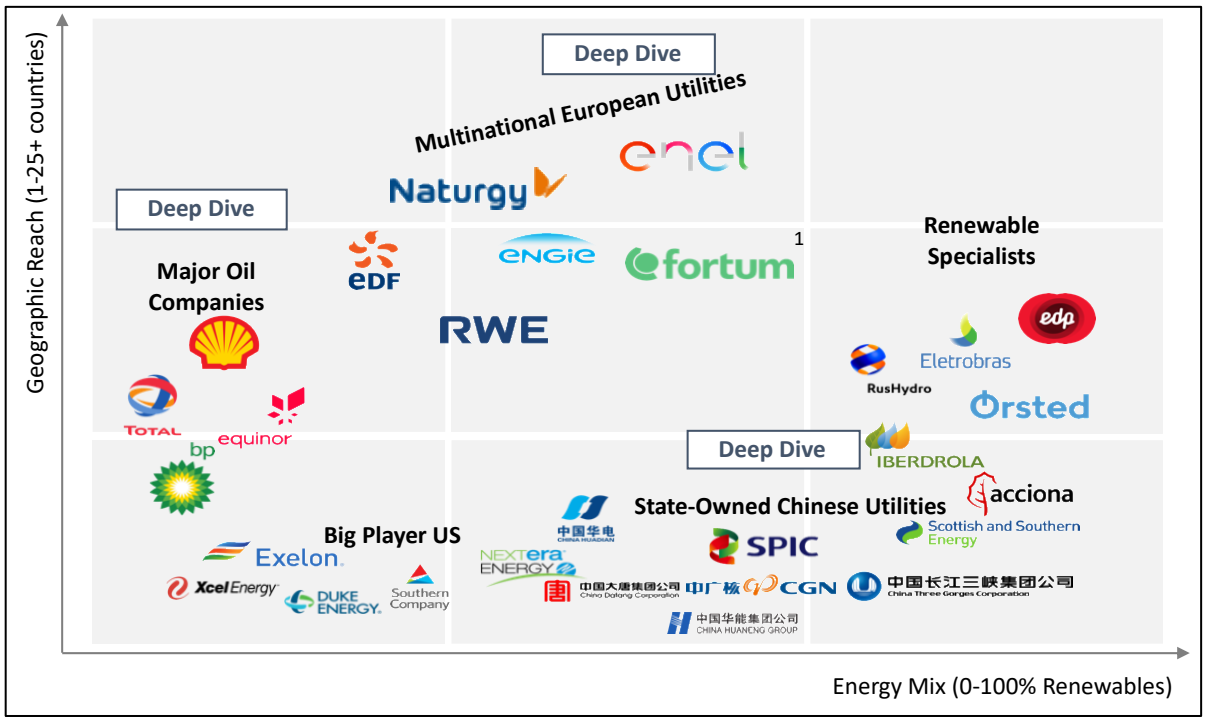


Figure 18 Different strategic clusters in the Renewable Energy Industry

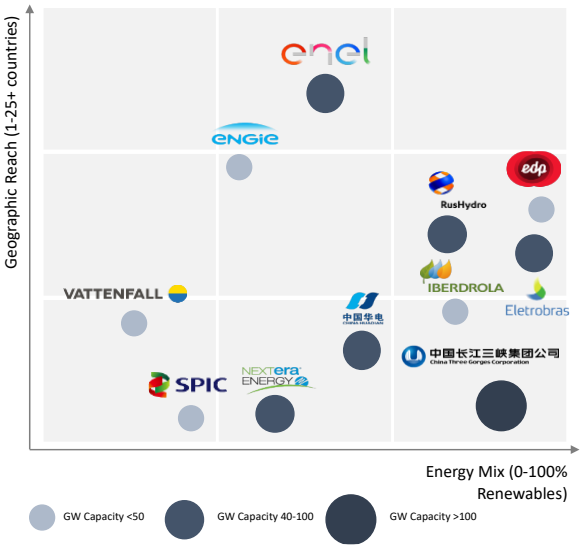
Source: Own illustration

The graphic clearly shows the different positions of the different strategic clusters. The results of the strategic cluster analysis, which was based on research on each company's website as well as industry reports, can be given summarized as follows: Regarding the major oil companies, one can clearly see, that the share of renewables in their power mix (on average 2 – 9%) is significantly lower than the share from international utility or power generation companies. But at the same time, they have a high geographic reach, on average operating in nine to 15 countries. This cluster includes companies like Shell, BP, Equinor and Total. The second main strategic cluster, namely the multinational European utilities, is the one with the highest geographic expansion, with typically being active in more than six and up to 25 countries. They have on average a higher share of renewables in their energy mix than the major

oil companies. Companies like EDF, Enel, Engie, RWE, Naturgy and Fortum[1] are operating in this cluster. Among those companies, Engie, Naturgy and Enel are by far the most geographically diversified players. The second strategic group, big power players in the US, have on average a low geographic reach, mainly operating in their home country, sometimes in nearby countries like Canada as well. Regarding the energy mix, one can say, that US power companies have a similar share of renewables in their power mix as European power companies. This cluster includes big US companies like NextEra Energy, Xcel Energy, and Duke Energy. State-owned Chine utilities, the fourth main cluster, are pretty similar to US companies regarding the two dimensions geographic reach and energy mix. Chinese utilities on average operate in one to three countries but usually have a slightly higher share of renewables in their power mix than US companies have. What clearly separates them from US utilities is the fact that they are mostly state-owned. Companies like China Three Gorges Corporation, China Huaneng Group and China Huadian can be found in this cluster. The last group that could be identified during the analysis are renewable specialist companies. As their name already indicates, companies operating in this cluster, e.g., Iberdrola, Orsted, Acciona, and EDP, have a high share of renewables in their power mix (usually > 80%) and a medium to high geographic reach. Renewable specialists are mainly headquartered in Europe but usually operate worldwide. A deep dive for the strategic clusters major oil companies, multinational European utilities and state-owned Chinese utilities will be given further in the report.

To classify the biggest renewable utilities worldwide, a third dimension, namely GW capacity, was added to the analysis above. Based on the three dimensions energy mix, geographic expansion and GW capacity the following top 10 renewable companies were identified:

[1] Including Uniper



Company	GW Capacity	Energy Mix (%)
China Three Gorges Corporation	124	99
NextEra Energy Resources	48	58
Enel	46	45
China Huadian Corp.	40,5	29
RusHydro Group	40	77
Eletrobas	40	88
State Power Investment Corporation	36	35
Engie	24,8	27
EDP	23,4	90
Iberdrola	19	80
Vattenfall	14,5	35

Figure 19 Top 10 renewable energy companies worldwide

Source: Own analysis

As can be seen in the graphics above China, the US, and European countries are major players in the renewable energy market. The biggest renewable energy companies worldwide are US' NextEra Energy, the Chinese companies China Three Gorges and China Huadian as well as the European majors Enel, Engie, EDP, Iberdrola and Vattenfall. Utilities from Russia (RusHydro Group) and Brazil (Eletrobas) can be found here as well. To conclude, one can say that European utilities usually have a higher share of renewables in their energy mix, while Chinese and US utilities have a higher GW capacity.

For a second strategic cluster analysis, including the dimensions geographic expansion and vertical integration, the following value chain steps were considered:

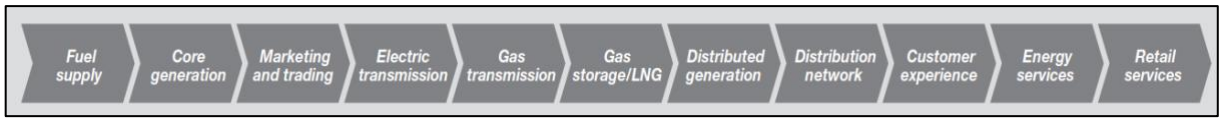


Figure 20 Utility value chain steps

Source: strategy& (2019)

The positions of the clusters and companies slightly changes when replacing the x-axis dimension "energy mix" with "vertical integration". Multinational European utilities almost keep the same position, moving only a bit more to the right side, implying that this cluster is the one with the highest vertical integration. Multinational European utilities usually operate on five to 11 of the 11 value chain steps being used for this analysis. Comparing the big player in

the Asia-Pacific and US area, it can be clearly seen that US players usually have a higher vertical integration (on average five to 11 value chain steps), while Asian utilities specialize more on a few value chain steps (on average two to seven value chain steps. To conclude one can say that Multinational European utilities are the ones with the highest geographic expansion as well as highest vertical integration. This strategic cluster thus is the one with the highest vertical as well geographical power. In contrast, US and Asian utilities operate more domestically with a lower vertical integration, giving them the opportunity to specialize more on their core business.

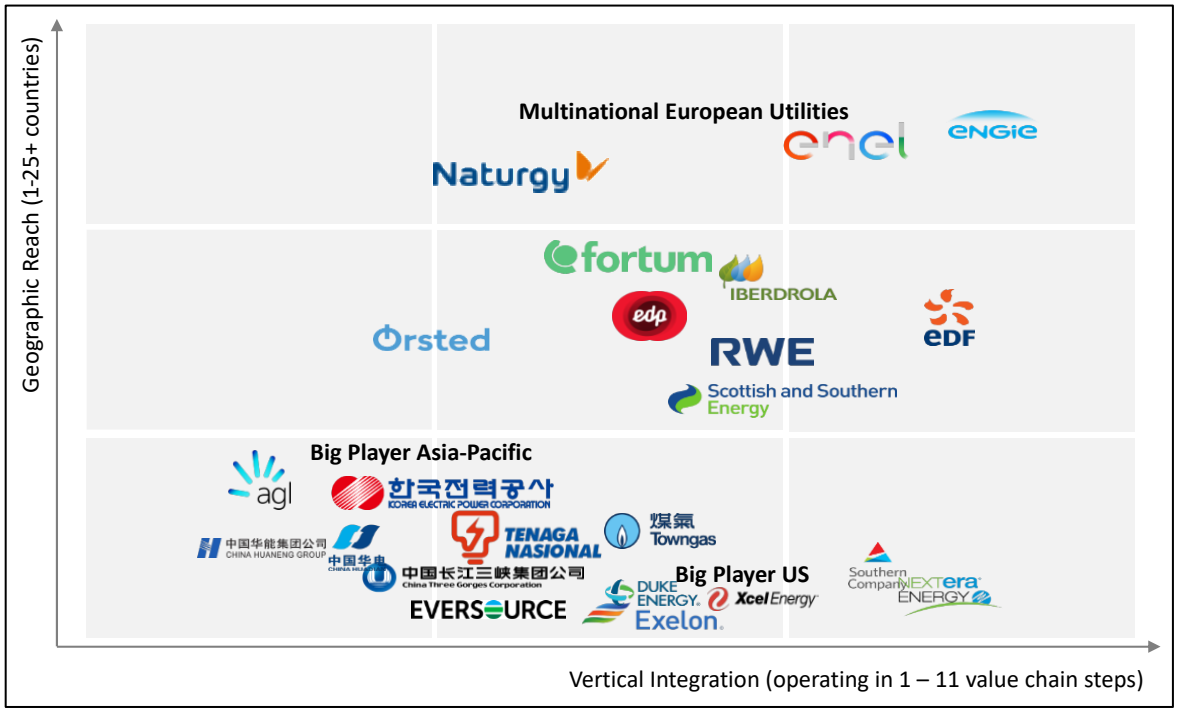


Figure 21 Different strategic clusters in the Renewable Energy Industry

Source: Own illustration

Deep Dive: Major Oil Companies

Regarding the first strategic cluster a deep dive will be given about, major oil companies, the following key trends could be identified during the analysis: Energy transition in the oil and gas industry mainly happens as a strategic response to the growth potential in the renewable energy sector, rising costs of hydrocarbon extraction, declining costs of oil, as well as pressure from shareholders and climate activists. Major oil and gas companies are forced to change their strategy towards a greener and more sustainable one since this shift is pressured and expected by many stakeholders nowadays. Especially European-based oil and gas companies, such as BP, Shell, Total and Equinor, started the process to change their strategy and business model

(Financial Times, 2020). Thus, major oil and gas companies worldwide, can be subclustered into two groups (Pickl, 2019):

- Oil majors that have embarked on their transition from oil to integrated energy companies, such as Shell, Total, BP and Equinor and
- Oil majors that remain rather pure hydrocarbon focused companies, such as ExxonMobil, Chevron and Petrobas

Based on the graphic below, which displays the proportion of oil company capital expenditures invested in low-carbon energy from 2010 to 2018, the four major European oil companies, namely Total, BP, Equinor, and Shell, have been further analyzed in the strategic groups cluster analysis (CDP, 2019).

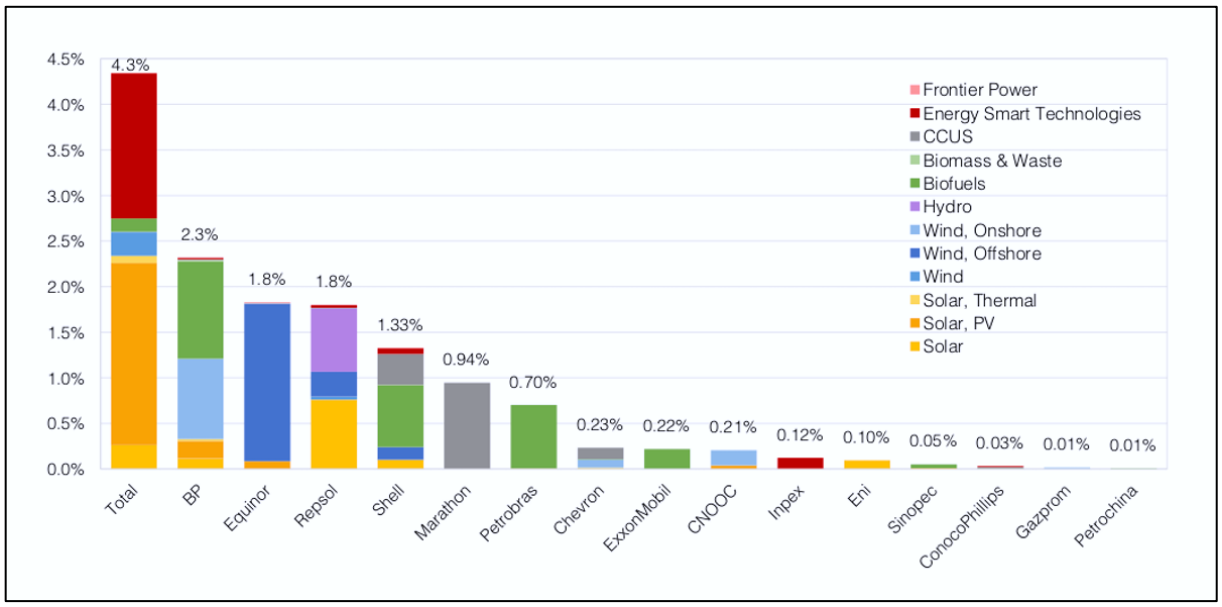


Figure 22 Proportion of oil company capital expenditures invested in low-carbon energy from 2010 to the first quarter of 2018

Source: CDP (2019)

Conducting the strategic cluster analysis based on research on the individual company websites or industry reports, resulted in the following shares of renewables in big oil companies' energy mix (2017 – 2019):

- Total: 9%
- BP: 3 – 4%
- Shell: 2%

- Equinor: Data on energy mix not published, due to similar strategies and operations it can be assumed though, that the share of renewables in the power mix will be similar to the other three major oil companies.

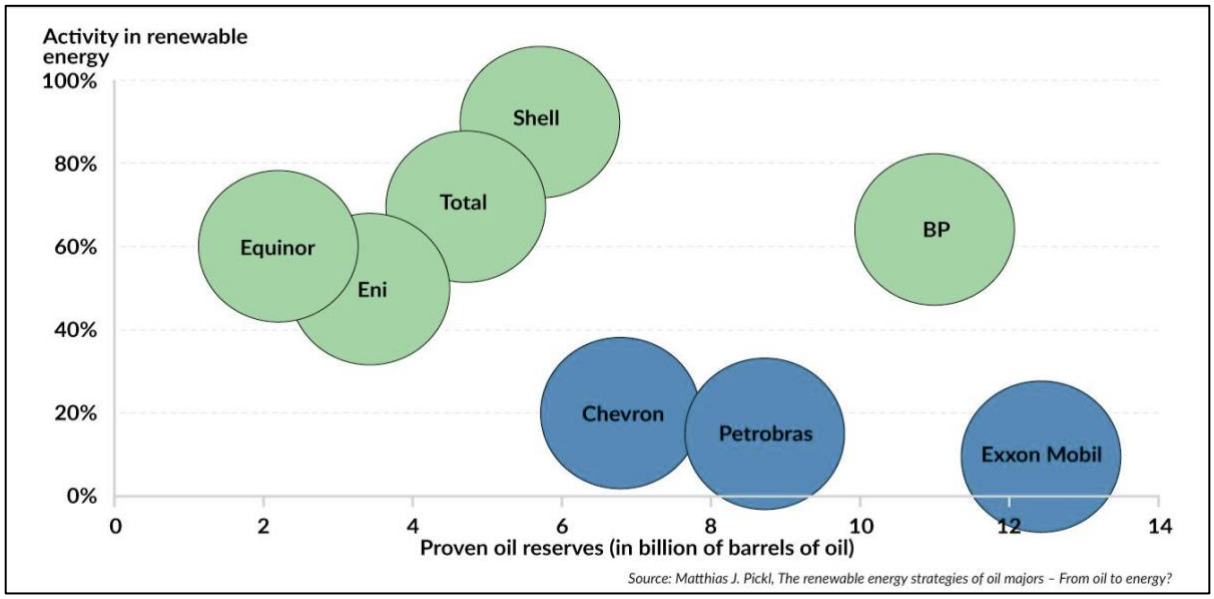


Figure 23 Linkage of renewable energy activity of oil majors with their proven oil reserves

Source: Pickl (2019)

BP's new strategy "from international oil company to integrated energy company" is a recent example for a transition of an oil and gas company towards a less carbon and greener business model. In August 2020, BP decided to announce its new strategy with the main goal to become a net zero company by 2050 or sooner. To reach their goal, the company established detailed measures until 2030 (BP, Our Strategy, 2020):

- "Low carbon electricity and energy": This part of the company's new strategy focuses on renewables and hydrogen. The company aims to increase their generation capacity from 2.5 GW developed in 2019 to 50GW developed in 2030.
- "Convenience and mobility": In the next decades BP will focus more on accelerating the global revolution in mobility by increasing the number of electric vehicles charging points ten-fold from <7,500 to <700,000 in 2030.
- "Resilient and focus hydrocarbons": The third part of the strategy focuses on driving emissions down implying a 40% reduction within the resilient and focused hydrocarbon business by 2030.

Deep Dive: Multinational European Utilities

Regarding the second strategic cluster a deep dive will be given about, namely multinational European utilities, the following key trends could be identified during the analysis: Multinational European utilities more and more accelerate investments in renewable assets with the ambitious target of increasing renewable energy capacity. Furthermore, companies in this cluster highly invest in advance technologies like offshore wind, biogas, and hydrogen. Their goal is to become carbon neutral by 2040/50. Usually, multinational European utilities clearly announce their commitment to the UN Sustainable Development Goals. Their common similarity is medium to high vertical integration that can be found in most of the European utilities as can be seen in the graphic below.

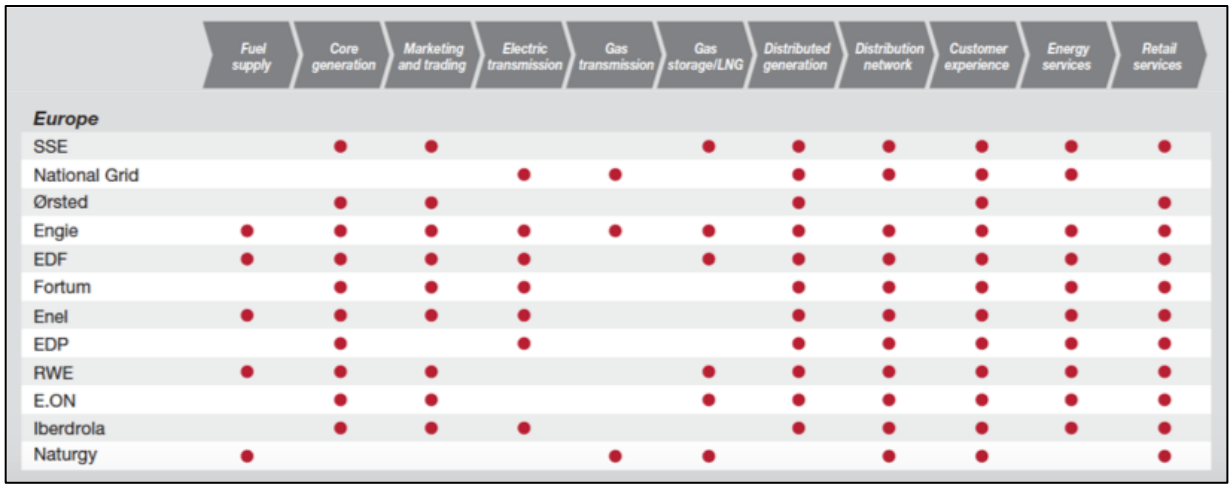


Figure 24 European utilities' value chain presence

Source: strategy& (2019)

As described in the chapter "Industry Value Chain", a value chain is an end-to-end depiction of a utility business' components from fuels and supply to retail commodity and services. The value chain above can be simplified by segmenting the steps into three main clusters: Upstream (activities related to the conversion of fuel sources into outputs), midstream (activities related to the transfer of supply output to the grid and network), the broadest segment in the value chain, and downstream (including customer-related activities). As can be seen in the graphic above some European utilities are fully integrated, e.g., Engie and Enel, by covering the value chain steps fuel supply, generation, transmission, distribution as well as retail. Others on the other hand can only be found on specific value chain steps, e.g., RWE only focuses on energy generation and distribution, outsourcing the transmission part (strategy&, 2019). To conclude

one can say that multinational European utilities are mainly integrated by covering most of the value chain step depicted above.

Another interesting key trend regarding multinational European utilities is the fact that those companies have been more active in repositioning their business models to reflect strategic challenges than utility companies from other parts of the world. Most of the European utilities repositioned themselves for new market opportunities, e.g. e-mobility, storage technologies or smart home, by restructuring their business in the last couple of years (strategy&, 2019). A few examples are:

- Engie: Focus on low-carbon activities, global networks, and client solutions, operation in multiple businesses and labs globally and aim to enter technology-based markets.
- Enel: Establishment of a global solutions entity to offer energy services among others including city and e-mobility solutions and transformation into an innovative entrepreneurial organization.
- Ørsted: Focus on its business activities by building a global portfolio of renewable generation capacity through divestment of conventional generation assets.

One can conclude that innovation has become a common strategic resource for most European utilities. They are also known as innovation leader in the global energy sector resulting in an establishment of innovation labs, R&D centers and startup incubators. As can be seen in the graphic below, European utilities are allocated on the mature side of the innovation progress of utilities worldwide, while US-American and Chinese utilities are rather allocated on the early stage of innovation.

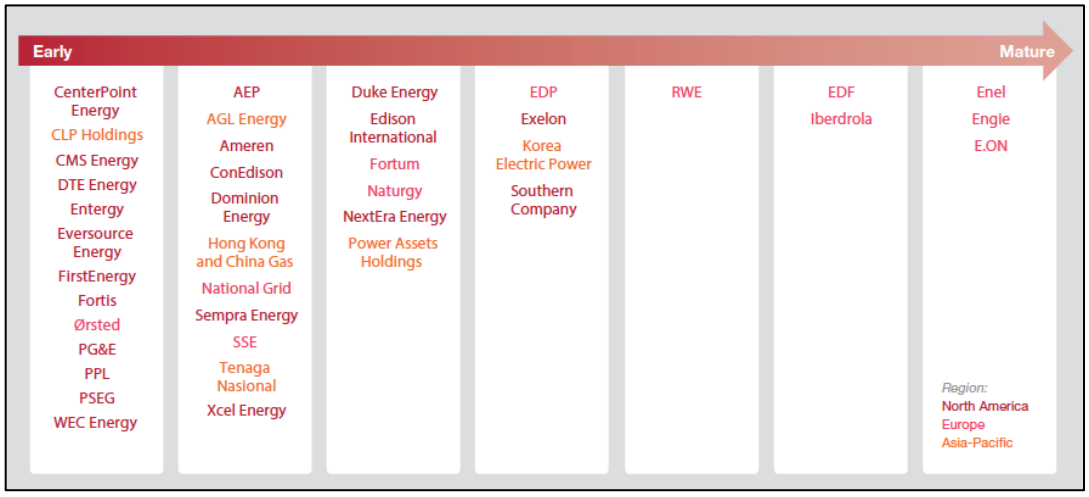


Figure 25 Innovation progress of major utilities worldwide

Source: strategy& (2019)

Enel's new strategy "the road to 2030" is a recent example for a transition of a multinational European utility aiming to accelerate energy transition as core of its strategy. Enel's goal is to invest €190 bn to boost decarbonization, electrification of consumption and platforms in the period of 2021 – 2030. Furthermore, 80% of its direct greenhouse gas emissions per kWh should be reduced by 80% by 2030. Two other main measures include the increase of installed renewables capacity to 120GW by 2030 from around 45GW in 2020 and thee increase of green hydrogen capacity to over 2GW by 2030 (Enel, 2020).

Deep Dive: State Owned Chinese Utilities

People usually think of the two main grid companies China State Grid (SGCC) and China Southern Power Grid (CSG) when speaking of power utilities in China rather than thinking of the power generation companies as it is the case in various European countries, e.g. EDF of France, Iberdrola of Spain and many other cases. This can be explained by the power market reform in 2002 when the vertically integrate State Power Corp of China was decoupled of which five generation firms and two grid companies were created. The grid companies since then have a higher control not only on the grids' system but also in some regions in China are the sole power traders. The power generation utilities thus have a lower influence on the market since they are not directly connected to the retail market. The Chinese power generation market is occupied by major state-owned companies. Those companies can be divided into a three-tier hierarchy structure comprised of tier-1, tier-2 and tier-3 players. The tier-1 players are the five largest power conglomerates which cover almost all power generation sectors. Those conglomerates expanded vertically e.g. by owning coal mines for raw materials needed for coal-fired power production in the past decade giving them huge control over the entire value chain. They include the companies China Energy Investment Corporation (CEIC), Huaneng, State Power Investment Corporation (SPIC), Huadian, and Datang and are also known as the "Big-Five". Regarding the power installed capacity and power production volume the "Big-Five" remain the most dominant players in the Chinese power generation market. The tier-2 are comprised of smaller power generation companies with a higher focus on specialized energy sources (mainly nuclear, hydro and coal). Main players in this category are Huarun, China General Nuclear (CGN), Shenhua, and Sate Development and Investment Company (SDI), which are also known as the "4+N". China Three Gorges (CTG), which is known for its Three Gorge Dam, can also be categorized in the "4+N". Last but not least, there are the tier-3 players,

which are backed by the local government. Those players are the ones that have become more prominent in the renewable energy market – especially in the area of offshore wind - since the local government become highly interested in new energy sources. The "Big-Five" companies are right now in a slow transition into increasing the renewable energy share in their energy mix. Their share in renewable energy is between about 25% and 50.5%. Among those five companies, due to its solar capacity of almost 20GW by the end of 2019 and its clean power portfolio consisting of hydro, wind, and nuclear, SPIC is ahead of its competitors with being the first to achieve over 50% of its power capacity from clean energy sources (hydro, nuclear and renewables). In terms of cumulative capacity though, CEIC is the most important player with an installed wind capacity of 38.3GW in 2018 and hence the largest in the world (Yuki, Energy Iceberg, 2019; Yuki, Energy Iceberg, 2020).

The graphic below shows the Chinese power production in 2018 categorized in the tier-1, tier-2 and tier-3 players.

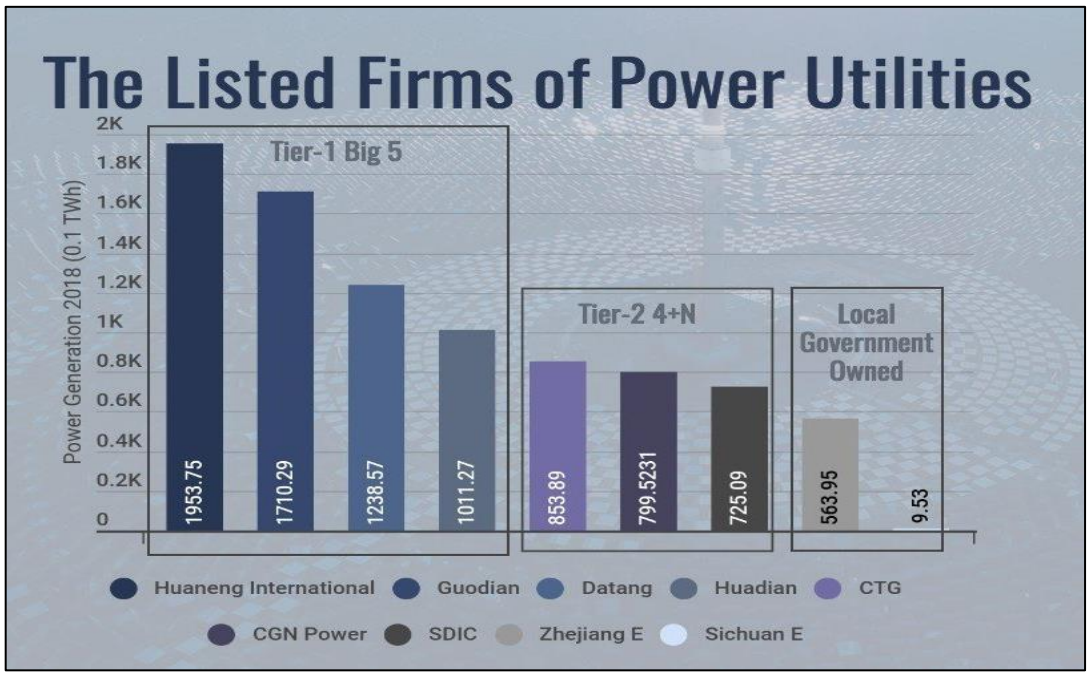


Figure 26 The biggest Chinese utilities separated in "Tier-1", Tier-2" and local government owned companies

Source: Energy Iceberg (2019)

The share of clean power in the "big 5" total power mix are as follows:

- CEIC: 24.9%
- Huaneng: 34%
- Huadian: 40.4%
- SPIC: 50.5%
- China Datang: 35.57%

It is important to mention that clean power in that sense consists of wind, solar, hydro, thermal and nuclear (Yuki, Energy Iceberg, 2019; Yuki, Energy Iceberg, 2020). Since this report only focuses on electricity generation through renewables, the shares of each Chinese company would be lower than can be seen above. Conducting the strategic cluster analysis based on research on the individual company websites or industry reports, in which not only the "Big-Five" but also the "N+4" were considered, resulted in the following shares of renewables in Chinese power generation companies' energy mix (2017 – 2019):

- China Three Gorges Corporation: 99%
- China Huadian Corp.: 29%
- State Power Investment Corporation: 35%
- CGN General Nuclear Power Group: 50%[2]
- China Datang Corp.: 36%
- China Huaneng Group: 25%
- CLP Group: 14%
- China Energy Investment Group 24%

On can conclude that there is a high variation in the shares of renewables in Chinese power generation companies' energy mix. Some companies, like Three Gorges Corporation, are highly specialized in renewables, while others, like the CLP Group, have a lower share in renewables due to their focus on other energy sources.

[2] Data from 2014, no recent data available

Traditional or Digital Industry?

Generally speaking, there are industries whose organizations tend to be more traditional and some organizations that are more digital for instance the computer service sector. Both industries can be managed differently in terms of a strategic cycle, commercial performance, and operational performance.

The renewable energy industry is in the secondary sector, which is between the traditional and digital market. But due to the digital transformation of the energy sector, it can be assumed that is becoming more and more digital in near future.

Looking at the strategic cycle the renewable energy industry has been rather disruptive in the past with a uniquely strategic way of thinking and uncertain developments.
The commercial performance of renewables has rather diverse clients and use omnichannel to communicate with its customers, so using digital media and also physical support.
The locations and opening hours are rather limited, but it is still possible to easily evaluate the products. In the operational performance: the assets are variably used for manufacturing and distribution but are relatively low in the storage technology at the moment.
The scalability is high and most of the Data processed is within a digital information system.

Digital industries are constantly developing new information and communication technologies to support the formulation of disruptive strategies and their agile execution, both in the digital business and in more traditional industries. It is no surprise that with time the traditional and digital industries are converging and adapting more and more to the digital century.

Digitalization in the Value Chain

Digital transformation is one of the driving factors in the clean energy market. The supply chain of green energy is now becoming more digital by digitalization on the market. There are several trends in this segment, five of them are going to be explained in more detail. As the graph is showing, the investments in digitalization are increasing and therefore need to be considered. They are the future of the renewable energy sector.

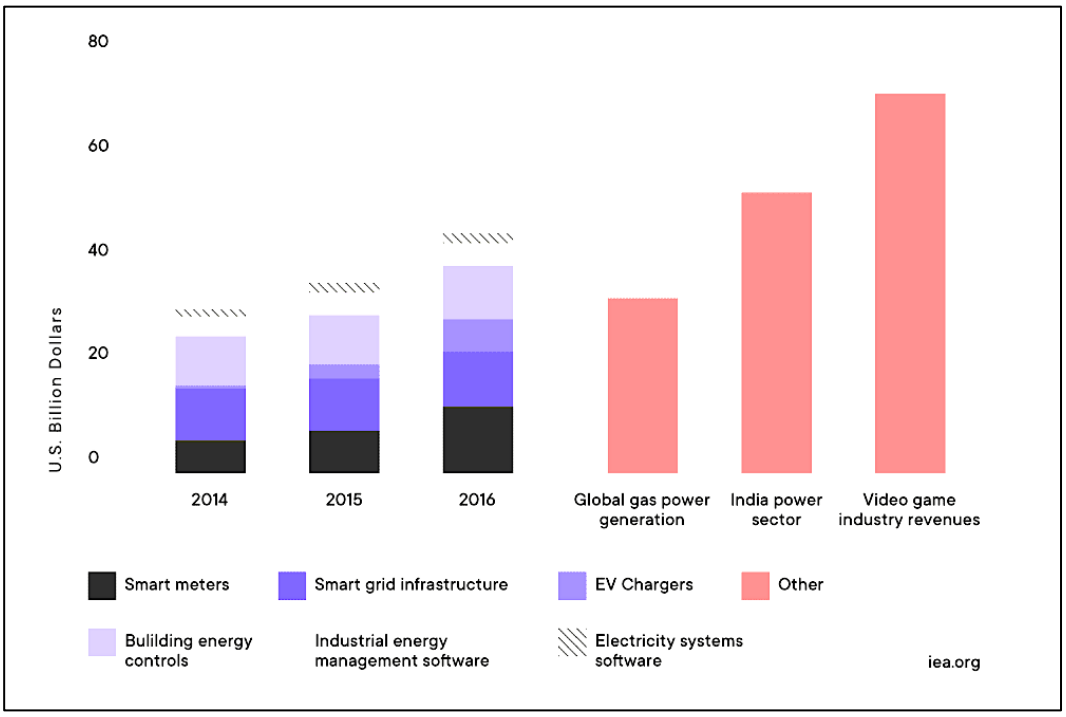


Figure 27: Investments in digital electricity infrastructure and software (2014-2016)

Source: iea.org (2016)

Since the introduction of green energy sources rises, the volume of data produced increases. To maintain leverage of all these new inputs, more is being spent in the development of asset management systems. They are currently in a position to collect, process, and incorporate a vast volume of data (both tangible and intangible) into a centralized system. It allows access to knowledge about assets, their life cycle, and even threats by removing the need to track various software. It will also remove the need to use spreadsheets, which have never been the easiest way to manage results and deep analysis. (Comparesoft, n.d.)

The next development interesting to note is the Industrial Internet of Things or IIoT. It involves the expansion and use of the Internet of things in the industrial field. Industries and businesses are now becoming more effective and secure in their service related to the emphasis on machine learning and connectivity, as well as the process of big data. It provides the intelligence and interconnectivity of assets for businesses, developers, and service providers to work more effectively together. The processes of all supply chain operations (internal and external) are more organized and noticeable, facilitating change in the overall work environment. (Trend Micro, n.d.)

There are many complexes, non-linear correlations with other parameters controlling the integration of renewable energy into the electricity system. Here, artificial intelligence plays a vital role in enhancing.

It is faster interpreting data, getting reliable input, and learning from large volumes of data. Also, it maximizes the precision and reliability of energy systems, as do other patterns. Artificial intelligence cannot only be used further for internal use, as such technologies could boost the product for consumers, e.g., in smart houses or workplaces. The greatest advantage of AI is to automate all operations, resulting in reduced prices for businesses and consumers. (Foulkes-Jones, 2020)

Another development that is not readily related to clean energies is the integration of Blockchain. Blockchains are decentralized, distributed digital ledgers that can be used to monitor transactions through a wide variety of computers. It can hold sensitive information confidentially and helps to avoid corruptible project records. Blockchain enables the process of renewable energy to be optimized and automated to reach a higher degree of traceability. It is important to remember that this factor is important for Power Purchase Agreements (PPAs) as they play a vital role in motivating businesses to use renewable energy. (Iberdola, n.d.)

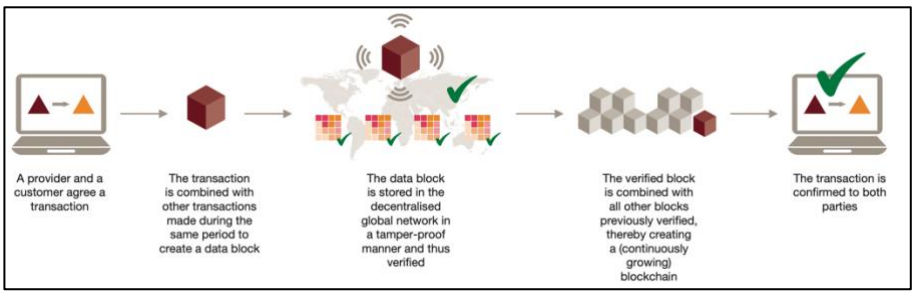


Figure 28: The blockchain process
Source: PWC - Blockchain – an opportunity for energy producers and consumers?(2016)

The last trend is technology in general. There are several technological improvements and ideas which are revolutionizing the renewable energy sector.

Some of the start-ups of the industry are going to be further looked at in the next chapter. Generally, a technological development would be the use of drones. Technology decreases the amount of time staff spent on rooftops, reduces the risk for measurement errors, and simplifies the maintenance of existing installations—all of which can help to minimize the

Figure 29: Use of drones
Source: Ennomotive (n.d.)

installed costs of rooftop solar systems. Further, they can also get 3D images of wind blades which are also reducing the risk of injury for the workers. (Fuelsave, n.d.)

All of those trends can be implemented oftentimes together and also easily integrated at any point of the value chain. They are improving the internal and external work environment by making the processes easier and more accessible for everyone. Soon, more and more of the processes are going to be improved with the development of digitalization.

Unicorns of the Industry

As the need for transformation emerges more companies are demanding ideas that can make their lives easier. One can imagine that there are a lot of start-ups in this industry, more and more of them coming, which are trying to improve the current technology or even create new ways of generating renewable energy. The trend towards a green future and the desire to help prevent global warming is driving this force.

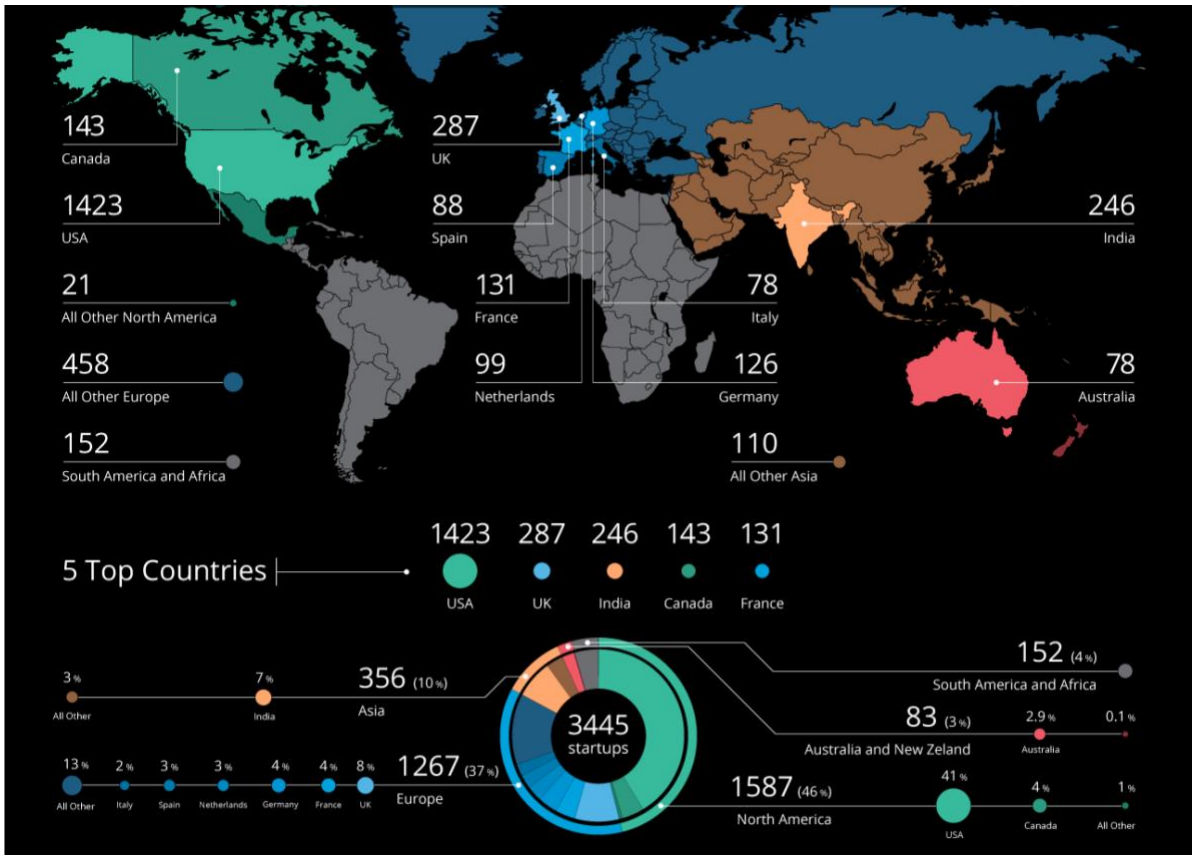


Figure 30: A Global Startup Activity Analysis
Source: StartUs Insights (2019)

North America leads the start-up energy market, accounting for nearly half of the world's renewable energy activity. Throughout the last two decades, China has also promoted solar and

wind energy, constructing large-scale ventures such as a solar farm shaped like pandas laughing, and a scheme to set up solar panels in orbit to beam down to earth. (Nace, 2017)

All over South America, renewables options such as hydroelectricity and bioenergy now make a major contribution to their power generation. In Africa, in which there is a large number of energy resources, geopolitics, and a general lack of cooperation between nations which resulted in countries functioning at various levels of renewable energy adoption. (StartUs Insight, 2019)

Europe represents more than a third of the global operation in the clean energy market. Here too, investment in renewables has slowed over the last few years. India and South-East Asia are indeed ready to expand their reliance on coal and other fossil fuels, prompting aggressive government initiatives aimed at the greater introduction of sustainable power. (StartUs Insight, 2019)

Taking a further glance at the places and markets of these start-ups. Not unexpectedly, most of the start-ups for clean energies are in the United States. Followed by the United Kingdom and India, the US also has a strong majority.

One promising example for the United States is the start-up Bigmoon Power (established in 2008). Bigmoon is creating coastal hydropower plants and tidal energy with it. Tidal Energy is achieved without bringing anything potentially toxic into the water. This process does not require any additives or moving components, such as rotating blades or turbines. Also, there is no mechanical noise, no threat to aquatic life, and no harmful effects on the environment. (BigMoon Power, n.d.)

In the United Kingdom, Oxford Photovoltaics has gained more importance during the last year. The business was founded as a spin-out company from Oxford University in 2010. Oxford Photovoltaics focuses primarily on the production and commercialization of perovskite-based solar technologies. The research and production facility are in Oxford, United Kingdom, and an industrial site in Berlin, Germany. The company is developing the world's first production line for perovskite-on-silicon tandem solar cells. (Oxford PV, n.d.)

Coming to the Asian market. Utilight was established in 2008 and located in the industrial zone of Yavne, near Tel-Aviv, Israel. Utilight has pioneered and is creating a breakthrough printing

technique (patents pending PTP^{TM} – Pattern Transfer Printing) for instant help in the PV metallization cycle of C-Si solar cells, growing solar cell efficiency and minimizing PV production costs. (Utilight, n.d.)

Also, Elfrosun was established in 2018 and is located in India. The mission of Elfrosun Technologies Private Limited is to redirect the unlimited energy from the sun to all feasible and accessible rooftops and land space for the production of solar energy. They are attempting to transform every rooftop into a solar powerhouse of their own and to make significant savings in energy bills for customers. The goal is to extend reducing the use of fossil fuels and to save the earth from any further environmental destruction and to help in the growth of the ISA (International Solar Alliance). (Elfrosun, n.d.)

There are many more start-ups that are seeking to boost the clean renewable energy market and with rising demand for these developments, it can be said that more of them are coming.

PESTLE Analysis- Supply

In the following, the renewable energy will be analyzed using the PESTLE framework to investigate the impact that political, economic, social, technological, environmental, and legal factors have on the industry. PESTEL is a strategic planning tool to better understand the external macroenvironment of the industry. Some of the identified factors to follow are not mutually exclusive and could, for example, be either categorized under environmental or political trends. However, their implications on the supply side remain unchanged and therefore, they will not be discussed twice.

Political

During times of political instability, investors face high risks and uncertainty when they invest in countries where the situation is unstable. According to Dudley (2020), the current pandemic is challenging economic inequality and lays the groundwork for political rumors and demonstrations, thus, will lead to further instability in the affected countries. Instability is no longer only prevalent in emerging countries such as Argentina, Brazil, or Venezuela, but increasingly applies to "Europe, due to more fragmented national and regional politics; and, across the Atlantic and over in Asia, the effects of the more protracted trade tensions" (El-Erian, 2019). Due to the necessity of decentralization of the power generation through renewable sources, the supply in these countries with unstable political situations generates uncertainty and may lead to a decreased supply as it bears high risks for investors.

On the contrary, political decisions and agreements such as the G20 Paris Agreement, the European Green deal and China's renewable energy law are likely to facilitate the capacity building of renewables and have a positive impact on the industry. Furthermore, government interventions like the car and public transport CO_2 regulations will increase supply through the support of green hydrogen as a form of renewable fuel. According to Xu et al. (2019), a key factor for this development is appropriate financial support. However, lobbying activities of fossil fuel providers are possible and may have a negative impact on the supply side. Another factor which will likely increase supply is political support and subsidies for capacity building (Nikkolino & Tavoni, 2017). However, this might also increase competition due to a high number of new entrants as oil and gas majors potentially focus more on renewables in the future.

Economic

On the energy generation side, economic instability limits the supply of renewable energy. This can be further explained by the two-way causal relationship between economic growth (GDP per capita) and renewables (Xu et al., 2019). During times of recession, the supply maintains constant due to a lack of new investments and capacity building. In this context, the ongoing pandemic can be seen as a double-edged sword as electricity demand dropped by 2% in 2020. However, the renewable energy generation increased by 7%, showing a high potential for decision-makers to use the crisis to make the change to more sustainable forms of energy (Carrington, 2020; IEA, 2020). Power generation through renewable energy also depends on its substitutes and competition in general. Xu et al. (2019) Power generation through renewable energy also depends on its substitutes and competition in general. Xu et al. (2019) found a reverse relationship between low oil prices and the generation of renewable energy. The supply, thus, does not only depend on macroeconomic factors, but moreover, on competition and factors within the whole energy industry. Another benefit to the supply side is the decreasing price of renewable electricity over the last years (Xu et al., 2019) which increases the attractiveness investments into capacity building. Figure 31 provides an overview how COVID-19 has affected different renewable energy-related industries. According to the European Commision (2020), its European Green Deal and hydrogen strategy "will be critical in the context of the recovery from the COVID-19 crisis by creating sustainable growth and jobs".

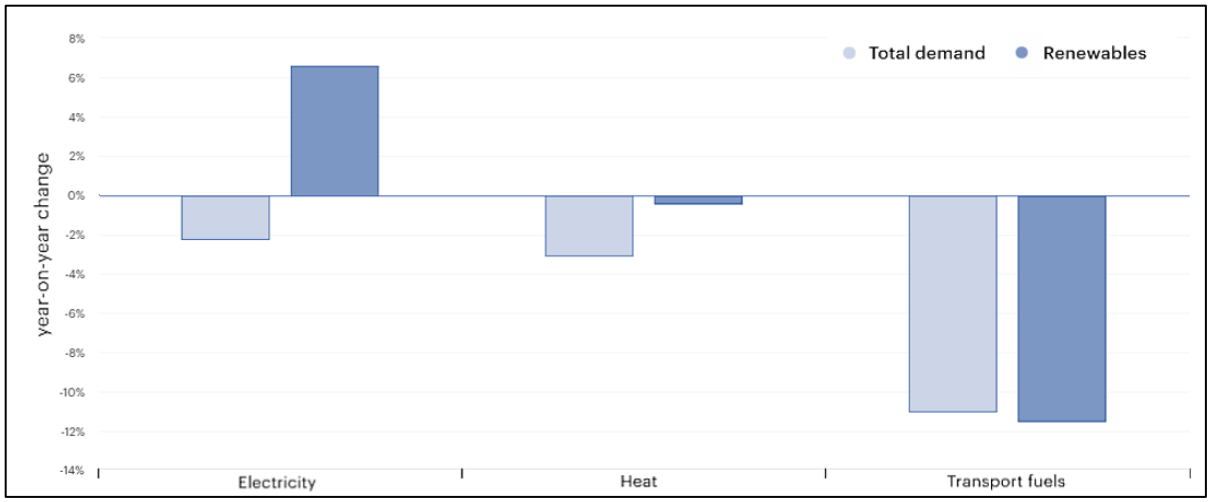


Figure 31: Renewables-based output and total demand change in the electricity, heat and transport sectors, 2019-2020

Source: IEA, 2020

Power generation through renewable energy also depends on its substitutes and competition in general. Xu et al. (2019) found a reverse relationship between low oil prices and the generation of renewable energy. The supply, thus, does not only depend on macroeconomic factors, but

moreover, on competition and factors within the whole energy industry. Another benefit to the supply side is the decreasing price of renewable electricity over the last years (Xu et al., 2019) which increases the attractiveness investments into capacity building.

Social

Within society, sustainability and the prevention of the climate change is becoming increasingly important for consumers, and especially, millennials (Bloomberg, n.d.). This development has helped renewable electricity to achieve social recognition and will, in the future, further increase the capacity of energy generation. The acceptance of renewables has a positive impact on the supply side by facilitating marketing and advertising and increasing capacity, for example, through building and operating additional wind parks. With decreasing prices for renewable electricity and the rise of the global middleclass in countries like China and India (Bloomberg, n.d.), renewables become increasingly accessible for a wider audience. Those opportunity is likely to attract new entrances and can be considered a threat for already established firms in the industry as competition increases.

Furthermore, demographic changes (increasing world population and trend of urbanization) will strengthen the industry's necessity to establish decentralized energy generation. Decentralized energy systems, where electricity is distributed through the grid and additional mini- and off-grid installations, allows for a more optimal balance between local production and energy consumptions. Figure 32 shows how energy is currently distributed (central approach; non-renewables) and how it will be in the future (decentralization; renewable energies). The shift towards decentralized energy systems has also implications for the supply side: Decentralization, as well as the trend of smart cities, may enforce competition and rivalry on a regional level.

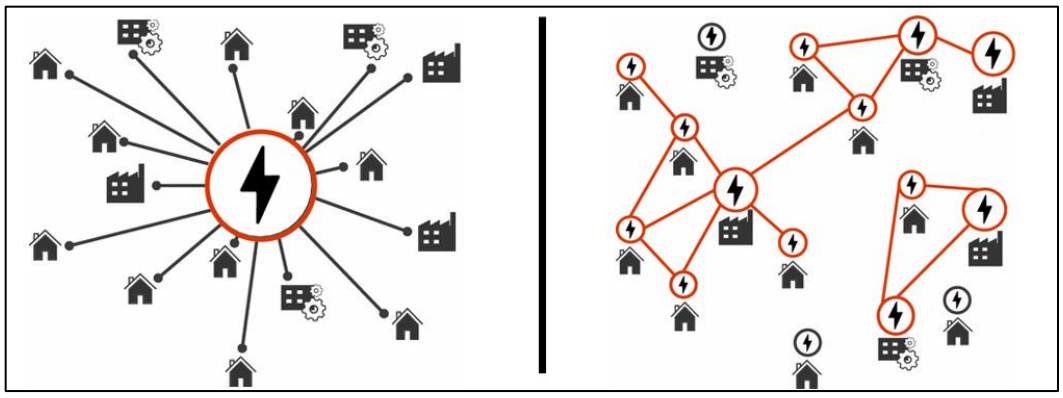


Figure 32: Centralized vs. decentralized energy systems

Source: Vezolli et al., 2018

Technological

According to Rexhäuser and Löschel(2015), renewable energy technologies are essentialy to ensure a secure and sustainable energy supply at competetive costs. Therefore, technological breakthroughs are important to increase the energy generation. New and improved technologies include optimized operation and maintenance activities of wind farms, predictive maintenance processes, alternatives storage options for renewables, new solar PV installations, and most importantly, the use of information technology and data (GlobalData Thematic Research, 2020). The development of these technologies will result in an enhanced supply by decreasing development and maintenance costs, and by improving reliability, applicability, and efficiency within the industry.

Important to mention in this context is the use of information technologies, for example, machine learning and artificial intelligence for non-dispatchable renewable energy sources (wind power, PV) whose available energy is hard to predict and cannot be controlled by the operators. Blockchain technologies will help to achieve fully decentralized energy systems and enable direct and automatic supply contracts between energy producers and consumers. Therefore, “blockchain technology has the potential to radically change energy as we know it, by starting with individual sectors first but ultimately transforming the entire energy market” (PwC, 2017, p.3), and through this, enable greater use of renewable energy. Figure 33 and Figure 34 illustrate how the transaction structure and the industry will change under the strengthened influence of this technology. Benefits of blockchain include, inter alia, decreasing transaction costs by avoiding intermediaries, simplification of transactions, and greater transparency resulting in lower prices (PwC, 2017).

In general, further improvements of the value chain structure and a digital transformation of the industry will lower logistics and contract costs as well as it will facilitate the automatization of processes that are essential for vertical integration.

Another important trend for the supply side are technologies that ensure and secure the energy generation and distribution. Storage opportunities are indispensable to advance the share of renewable electricity and realize the challenging shift from fossil fuel to renewables. As previously mentioned in the PESTLE analysis of the supply side, green hydrogen plays an important role.

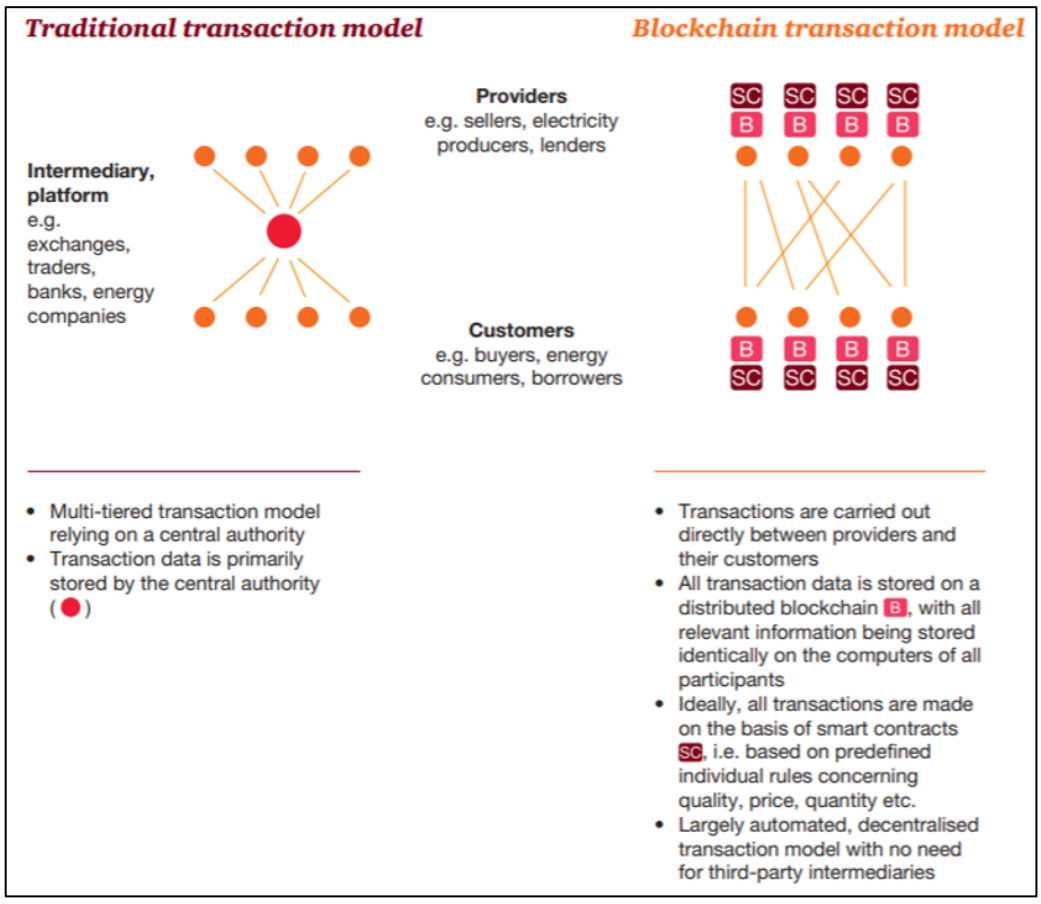


Figure 33: How Blockchain will change the energy sector

Source: PwC, 2017

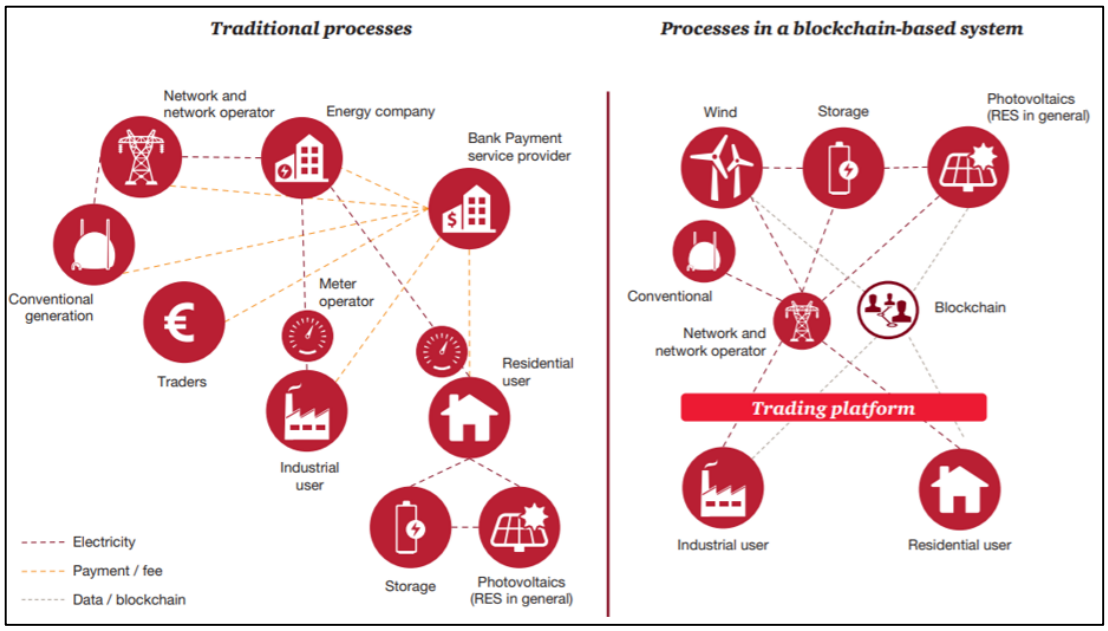


Figure 34: Transformation of market structures for the decentralised transaction model

Source: PwC, 2017

Legal

From a legal perspective, restrictive "regulatory frameworks often simply prevent projects to make sense financially, or in many cases from being built" (Backwell, 2020). In this context, the 1-kilometer minimum distance from buildings in Germany rule for wind parks can be cited as an example for regulations that hinder the supply or capacity building of renewables. Furthermore, current regulations for planning and licensing do have a negative impact on the supply side. Off-shore wind energy generators, for example, must deal with increasingly construction-related disputes as an increasing number of farms are developed at far distance from the coast (De Paor, 2020). To summarize, the current legal framework leads to lower margins and increases and limits the supply accordingly. However, the regulatory framework also offers opportunities to further support the change to renewables when it is adjusted accordingly.

Environmental

Within the last decade, environmental factors and trends have emerged and became increasingly important within society. The current zero emission plans in line with the European green deal or the Paris Agreement, as well as private companies like BOSCH or the Volkswagen group, lay the foundation for a capacity and supply extension for regenerative energy sources. Furthermore, the concept of the circular economy requires sustainable battery that are essential to store power and dependent on the technological breakthroughs. When the technology is

developed, this will further facilitate the transformation to more sustainable energy concepts. Another important point to mention is the difficult recycling and deconstruction process for wind energy. Wind turbines have one major drawback: their life cycle is relatively short, and the mills must be replaced after approximately 25 years. The rotor blades are currently made of fiber reinforced material that requires specialized and laborious recycling processes (Boeslager, 2020). Missing laws and regulations for the dismantling of wind parks and mills, for example in Germany, implies that the energy generators must deal with partial uncertainty. This uncertainty regarding the regulations but also regarding the costs for appropriate recycling will restrict the supply of renewable electricity and the threats of new entrants before more sustainable alternatives have been developed.

Due to the renewables' dependency on natural regenerative resources, natural disaster and the climate change will have a major impact on the security of supply and the smooth operation of wind and solar farms. This means uncertainty for the energy generators and may limit the building of new capacity while simultaneously making new entrances more unlikely. Besides the aforementioned aspects, raising environmental concerns of society, climate activists, governments and companies support the energy shift from fossil fuels towards renewables. This is likely to increase rivalry and competition, especially when oil majors engage and shift their business more towards the renewable energy sector (Murray, 2020).

Overall PESTLE evaluation

Figure 35 shows how we evaluated the individual influences of each trend on the supply side.

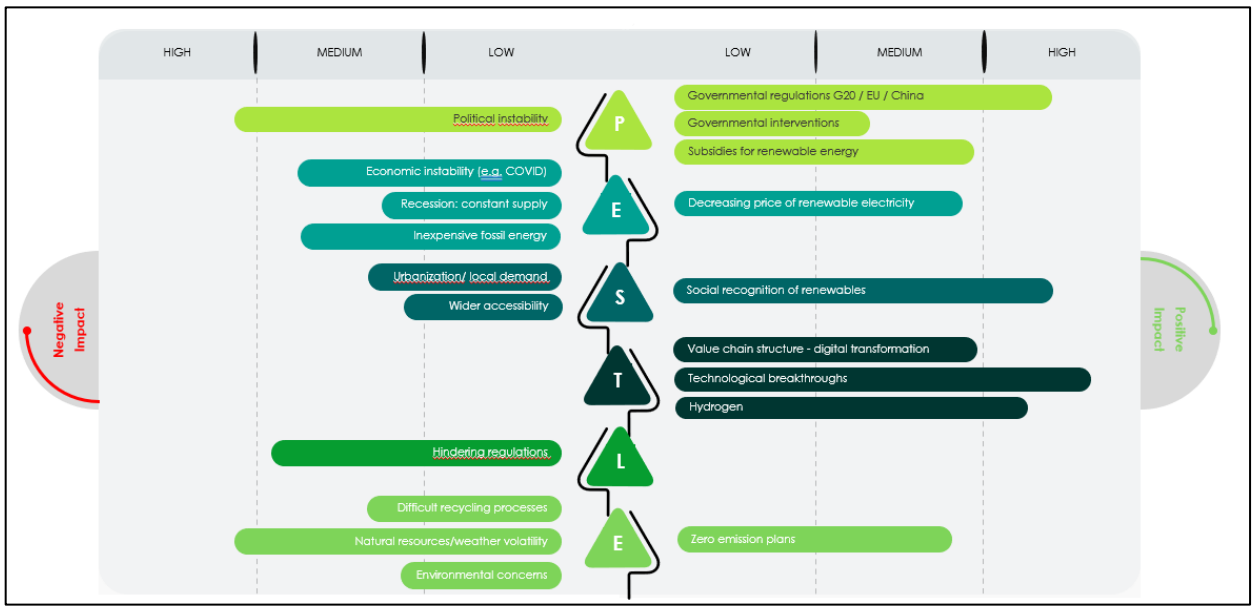


Figure 35: Outcome PESTLE Analysis Renewable Energy Sector: Supply

Source: Presentation held on 04th Dec. 2020, International Industry Analysis Course

Strategic Issues

Products and Markets

Renewable energies	Annual reserve	Consumers			
		Industry	Power	Buldings	Transport
Hydroelectric		°	°°°		°
Wind turbine			°°°		
Solar					
Solar panel			°°°	°	
Thermal energy / water			°°°	°	

Strong valuation
Medium
Low

To date, the consumption of renewable energy in all sectors is low except in the building sector where 36% of the energy used came from renewable energy in 2015. Its expansion will not stop growing. increase in the future due to its high potential in terms of future construction. The building sector in 2015 covered over 150 billion square meters of residential and commercial floor area, and it is estimated that by 2050 this should amount to 270 billion square meters.

In the industrial sector in 2015, renewable energies only provide about 14% of the direct energy consumption of industry (7% biomass and 7% renewable electricity) while in the power sector, 24 % of the energy consumed came from renewable energies. More precisely, 16% from hydrocarbons, 3.5% from wind turbines and 1% from solar energy.

Finally, the transport sector is also lagging behind. The share of renewable energies in this sector is very low and amounted to only 4% in 2015 with 1% coming from hydropower.

Level of speed of the innovation process of technologies for decarbonisation
°°° On track
°° Lagging but viable
° Not viable at current pace

For the future, all energies present good opportunities for the future in the power sector of renewable electricity production with, for example, the modernization of existing installations, planning of hydrographic basins, floating PV, integrated PV. building, floating wind turbine.

Vertical Integration

Vertical integration is a business strategy for internal and external development. In this section of the analysis, the vertical integration on the renewable energy industry will be evaluated.

Introduction

The liberalisation of the electricity market in Europe has been sponsored by various Community directives and has been carried out progressively (López, 2020). The process initially involved the privatization of companies in the sector, followed by the functional separation of vertically integrated activities and the activities of the system operator and the market operator. Since then, the process has been reinforced by regulations that lay the foundations for the integration of European electricity markets. European regulation has provided Member States with various options to meet the objective of liberalisation, which, together with the different natural characteristics or objective elements of the market in each country, have led to uneven results of liberalisation. The fact that electricity is a service of general interest, whose generation can only be stored on a very small scale, with a relatively inelastic demand curve, and that there are barriers to entry, means that regulation is necessary (López, 2020).

In many markets, the vertical integration of companies is seen in a positive light since they can generate pro-competitive effects that affect consumers through lower prices or higher quality services. For example, they reduce transaction or coordination costs derived from the separation of both activities, they generate economies of scope by sharing complex technology and necessary investment, they can avoid anti-competitive opportunistic behaviour.

However, depending on the case, they may entail substantial disadvantages or anti-competitive effects, such as the exclusion or elimination of competitors which will be more problematic when it affects oligopolistic activities, or they may generate certain risk of horizontal collusion between the companies at one of the levels as the integrated company serves as a vehicle for the transmission of information on prices and other strategies (Milla, 2012). Ultimately, it will be the circumstances of each particular market that will determine what advantages and disadvantages vertical integration generates and the intensity of these, and depending on which prevails, competition law will have to be more or less tolerant of them. However, experience shows that when vertically integrated companies have market power, anti-competitive or harmful effects on the consumer prevail (Milla, 2012).

In the case of the electricity market, it is clear that the effects of vertical integration are very harmful because all the circumstances are present for this to happen. On the one hand, in certain activities a natural monopoly rules, and in the free one's substantial investments are required, especially in the case of energy generation, so they are markets with a tendency towards oligopoly. Finally, energy is a good of inelastic demand and of primary need, so those who

consume it have no margin of response to an abusive action by companies in the sector. All this place them in a situation of evident market power, which justifies the prohibition of vertical integration for the good of the consumers. Regulation must maximize the options for effective competition in the activities in which it may exist, as well as eliminate or at least minimize the risks of abuse in which the monopoly rules. The existence of holding companies in the electricity sector that belong to different activities and that apparently must have opposing interests (energy suppliers and demanders, the former wanting to sell at the highest possible price and the latter wanting to buy at the lowest possible price), is highly detrimental.

Vertical Integration in the Renewables Industry

Vertical integration is a business strategy for internal and external development, which addresses growth within the strategic direction of companies and is common in all types of markets. Through Vertical Integration companies enter into activities related to the production cycle of a product or service (Milla, 2012).

For companies in the Renewables Energy sector vertical integration is beneficial for many of them as they operate in the research, generation, distribution and trading market.

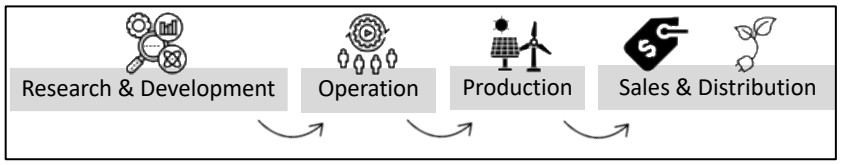


Figure 36 Vertical Integration Renewable Energy companies

(Source: Own illustration)

As a result of this effective control, the entry of new competitors is difficult. This makes it hard for independent marketers to compete with integrated ones, given not only their market power, but above all because the integrated ones have information and control over other activities in the energy market, which gives them competitive advantages that are difficult to overcome.

Companies in the renewable energy sector are growing thanks to the synergy created by the vertical integration between the renewable energy production activity and the energy sales activities. These mergers are very common in this area, thus stimulating the development path of the company, whose objectives imply the consolidation and expansion in all business lines both nationally and internationally. It's also beneficial since they allow them to optimize the investment and generate efficiencies between their activities, but it should also be noted that with a lower degree of vertical integration, the market at the distribution and sales level would be more open and efficient, which would bring down pressure on the price of energy (Milla, 2012).

To ensure transparency, independence and the proper functioning of the market, many countries have introduced laws prohibiting companies from operating in a vertically integrated form and therefore prevent monopolies.

In 2003, the European Union established new regulations with the intention of promoting the creation of an integrated European energy market; the objective of this regulatory change was to strengthen the legal independence and management of networks, as well as to ensure complete transparency and objectivity in the access of third parties to infrastructures and facilities in the energy sector. With these regulations, the EU sought to separate the generation, transport, logistics and distribution of electrical energy, and thus put an end to the situations of vertical integration that until then could be found in state-owned companies.

Vertical Integration Experience

Audax Renovables

Audax Renovables, an energy company dedicated to the commercialization of electric energy and gas as well as the generation of 100% green electricity[3].

The company's gross margin amounted to 103.7 million euros, 53.4 million more than the previous year, while net profit reached 9 million. These results because of the group's expansion strategy, which has enabled it to consolidate its position at national level and to become the fourth largest national marketer (Audax Renovables, 2018).

The company is already an international reference operator with presence in Portugal, Italy, Germany, Poland, Holland, France and Panama.

The efficiencies gained thanks to the vertical integration of marketing activities and generation of Renewable energies have enabled it to increase its client portfolio by 11%, exceeding 350,000, with a total volume of green energy generated of 386.1 Gwh and 10.1 TWh of energy sold, which represents an increase of 27.5% over the previous year. (Audax Renovables, 2018).

When Audax Renovables acquired Audax Energía in 2018, the company grew due to the synergy created by the vertical integration between the renewable energy production activity carried out by Audax Renovables and the energy sales activity carried out by Audax Energía. The merger stimulated the development path of the Group, whose objectives imply the consolidation and expansion in all business lines both at a national and international level. (Audax Renovables, 2018).

[3] closed last year with a record turnover of 987 million euros.

Acciona

Acciona Energy is the global operator in renewable energies with a presence in more clean technologies. It focuses its activity on wind energy, where it is one of the largest promoters and operators in the world and the commercialization of energy. The aim of Acciona is to use renewable resources in a sustainable way to produce clean energy, free of greenhouse effect emissions (Acciona, 2020).

In 2012 41.6% of sales and 82.4% of Acciona´s EBITDA corresponded to businesses considered by Company as green economy (Acciona Agua, Acciona Energy and Acciona Environment). The configuration of Acciona´s businesses and its commitment to vertical and horizontal integration constitute an important distinctive capacity of the Company, a characteristic that is difficult to imitate by its competitors. Vertical integration allows the optimization of investment and the generation of efficiencies between its activities (Acciona, 2020).

The business model of Acciona Energy is committed to being present throughout the entire value chain of the generation and sale of renewable energies, and in the development of the main technologies. The technological diversification allows them to optimize the model of generation in different environments in which it operates, decrease the volatility in the output of the different technologies and facilitate their commercialization. By Moreover, it allows to diversify risks and take better advantage of new opportunities, generating economies of scale, scope and learning (Acciona, 2020).

Additionally, Acciona Energy faces the market from a perspective of vertical integration, present throughout the value chain, as a differential element of competitiveness.

The objective is to contribute incremental value by being present in all phases of the value chain of the sector, from the design and manufacture of wind turbines to project development, construction of facilities, operation and maintenance, or energy marketing. This allows Acciona to optimize the investment and to take advantage of the market opportunities in a more efficient way. The vertically integrated business model gives also the customers confidence, as they are present in all phases of the project and allows us to be diversified and access all business opportunities (Acciona, 2020).

Internationalization

Internationalization is an essential component of business strategy. In this section of the analysis, successful strategies for internationalization on the renewable energy industry will be discussed.

Introduction

Internationalization is a Business Strategy for Internal and External Development. It is an important component of business strategy for many companies, as those operating internationally not only have a competitive advantage in terms of volume and knowledge effect, but also a profitable access to resources. It is not only key factor for business growth (like the Enerland group), but also as a way to diversify commercial and strategic risks. Another benefit of internationalization is that it helps the company to position itself sustainably and strategically in the market in a stable way (Porter, 1986). Entering the foreign market through mode selection is a very important part of the process, where in addition to studying the market entry and production, companies must identify the strategy that can be most successful in the foreign country (Koch & Meckl , 2014).

Companies in the renewable energy sector have suffered ups and downs due to regulatory changes in some countries and as a result, many companies have had to go abroad.

Internationalization continues to be a key factor not only as an instrument for business growth, but also as a way to diversify commercial and strategic risks (Atanes, 2018).

The International Renewable Energy Agency has recently highlighted the fact that in order to meet the objectives of the Paris Agreement, renewable energies will have to grow at six times the current rate, which undoubtedly adds favourable pressure to the energy transition model (Renewables 2019: Global Status Report, 2019).

Internationalization at the Renewable Energy Industry

Within the internationalization strategy, it is necessary to take into account some general precepts, which are at the same time usual in any process of going abroad, such as the study of the demand of the target market and its evolution, the existing competition, the capacity to generate a real competitive advantage, the financial viability of the project and its profitability in time, the regulatory and legislative framework of each country or the country risk itself (Atanes, 2018).

However, at the same time, within the renewable energy sector, it is worth highlighting some specific factors of the internationalization process that have a significant impact, depending on the particular characteristics of each country and its energy map.

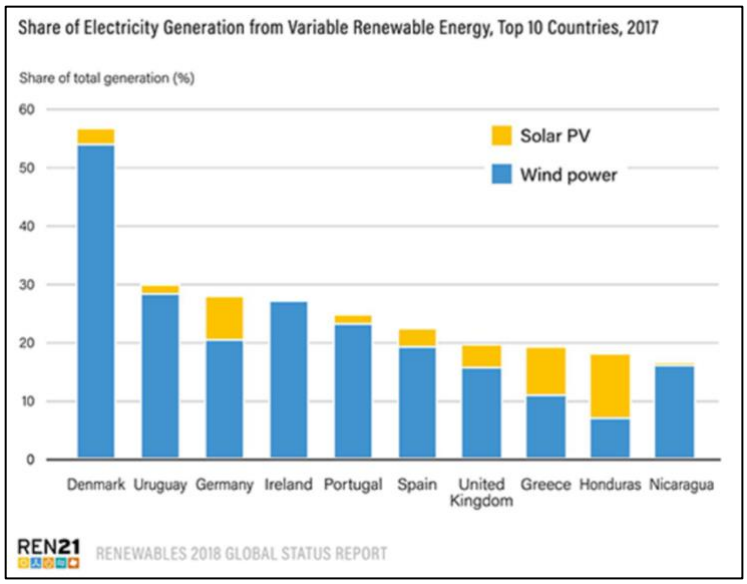


Figure 37: Share of Electricity Generation

Source: (Renewables 2018: Global Status)

From the point of view of energy generation, it is important to know the key data; level of convergence of renewable energies, costs and marketing prices in each country (Steinmetz, Schwens, & Kabst, 2010). It is also essential to know the evolution and future projection in order to have a dynamic vision of the country in question. The previous graph shows the countries that generate and share most solar and wind energy, which tells which countries have good resources for companies that want to enter the market. Denmark would be a good option for wind power generation companies followed by Uruguay and Germany.

On the other hand, other key elements of distribution are its management and marketing models. In this sense, the recommendations are being able to have information on the usual practices in the service level agreements, level of development towards the concept of 'intelligent network', the degree of interconnection of the network by areas and its coverage, the existence of energy storage systems integrated into the network or the positioning of the strong figure of the '"prosumer"[4]. In the following graph the generation capacity of each of the renewable energies can be appreciated. The energy with more capacity of generation is the hydropower but analysing the data during the last years it can be also observed that the wind and the solar energy are also increasing their capacities of generation. Another important element is the management in each market of the phenomenon of intermittence in terms of variability and uncertainty (Jason Frederick & Stacey, 2011).

[4] User who generates energy for self-consumption and has the possibility of injecting the surplus into the network.

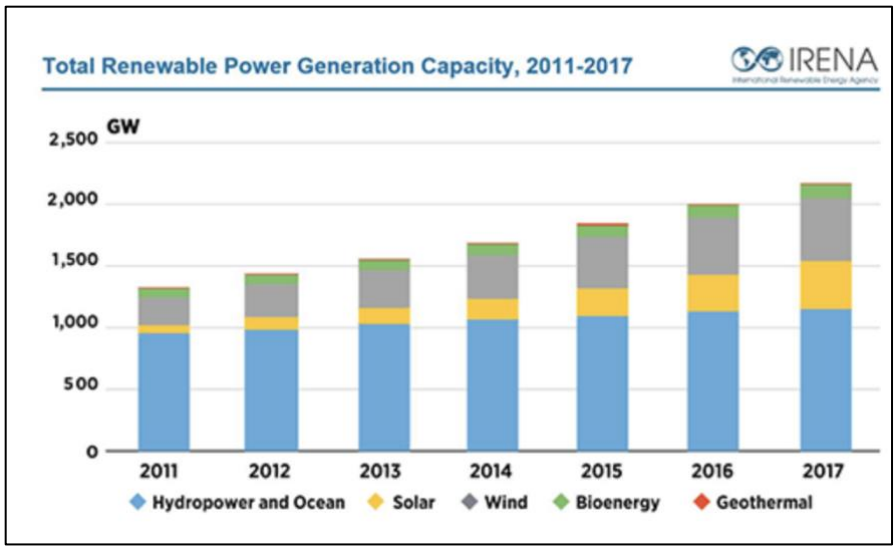


Figure 38: Total Renewable Power Generation Capacity, 2011-2017

Source: (Total Renewable Power Generation Capacity, 2011-2017)

Companies in the renewable energy sector have suffered ups and downs due to regulatory changes in some countries and as a result, many companies have had to go abroad, like for example Iberdrola. The legislative and regulatory framework of each country is very important, we must also highlight other circumstances to be taken into account for renewable energy, such as: the regulation or deregulation of self-consumption, the existence of subsidies in the environment of the energy transition policies of each country, or the role that the State grants to private companies in the field of renewable energy. The Governments play a big role in the internationalization of renewable companies, since they are the keys for regulation and country risk (Koch & Meckl , 2014).

In conclusion companies in the renewables industry that wants to enter a foreign market includes a very important process, where in addition to studying the market entry and production, companies must identify the strategy that can be most successful in the foreign country (Jason Frederick & Stacey, 2011).

Country & Firm Advantages

Attractive Markets for Renewable Energy Companies

In 2005, South America, Africa and Eastern Europe had hardly any policies for renewables (REN21, Renewables 2005: Global Status). At the beginning of 2015, 164 countries in the world have defined objectives (s. graph). Practically every Nation is regulating, promoting investment targets and have defined objectives for renewable energies.

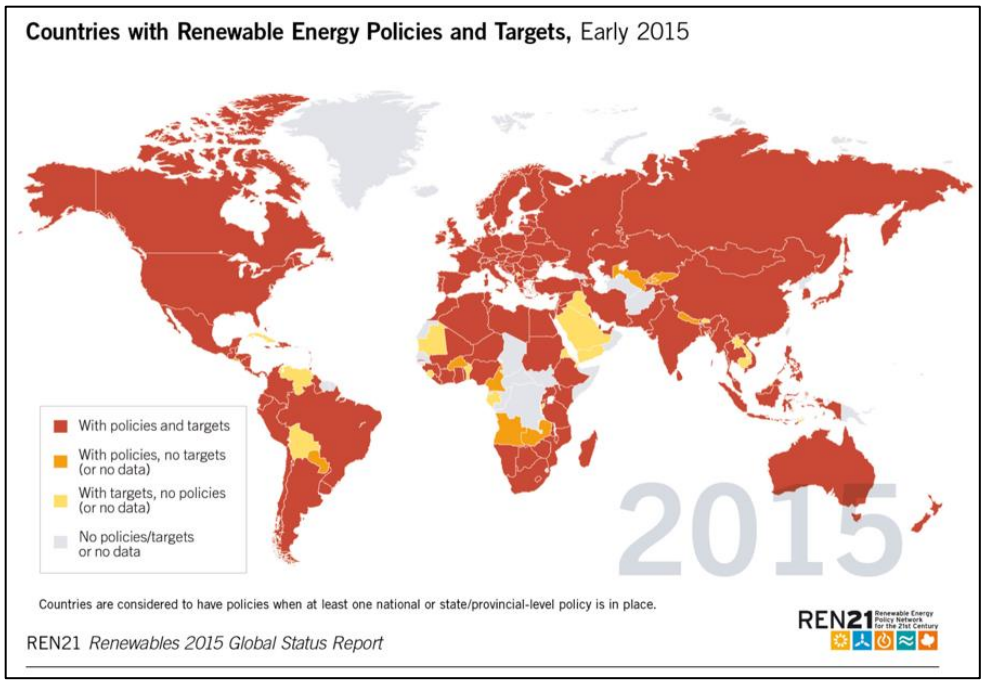


Figure 39: Countries with Renewable Energy Policies and Targets, 2015

Source: (Renewables 2015: Global Status)

Taking as a reference the RECAI index (Renewable energy country attractiveness index), The classification of the most attractive international markets to invest in renewables according to the 2020 RECAI[5] ,The United States leads the ranking, followed by China, France, Australia, Germany, United Kingdom, India, Denmark, Netherlands and Japan (s. table).

					Technology-specific scores							
Rank	Previous rank	Movement on previous index	Country/Market	RECAI score	Onshore wind	Offshore wind	Solar PV	Solar CSP	Biomass	Geothermal	Small hydro	Marine
1	(2)	▲	US	65.8	50.9	57.4	52.2	30.1	40.5	36.8	37.3	19.0
2	(1)	▼	China Mainland	62.4	46.8	50.6	54.0	30.0	43.7	17.1	48.1	15.2
3	(4)	▲	France	60.8	46.9	49.6	48.0	19.7	46.1	30.0	39.8	33.9
4	(5)	▲	Australia	60.7	46.3	27.1	51.2	32.5	31.8	18.5	36.5	28.4
5	(6)	▲	Germany	59.5	41.9	48.2	47.2	15.2	42.9	32.1	39.8	17.5
6	(7)	▲	United Kingdom	59.0	48.8	56.7	40.0	11.4	46.3	24.9	31.1	30.8
7	(3)	▼	India	58.6	43.9	14.1	54.7	29.4	39.8	20.3	39.0	16.4
8	(9)	▲	Denmark	55.0	43.8	46.6	39.7	13.7	41.7	15.0	16.4	22.3
9	(10)	▲	Netherlands	54.9	40.7	43.6	41.8	12.4	33.3	19.5	20.4	12.6
10	(8)	▼	Japan	54.8	41.4	45.9	39.9	14.7	47.7	43.1	41.2	19.7
11	(15)	▲	Spain	53.5	39.9	24.0	44.1	23.2	32.2	14.2	19.0	13.0
12	(18)	▲	Ireland	52.7	40.0	30.3	40.4	16.0	29.2	18.0	25.0	22.2
13	(13)	●	Chile	51.9	42.1	16.9	41.4	29.1	34.2	38.0	37.2	24.7
14	(22)	▲	Israel	51.3	34.8	11.5	47.9	30.6	22.2	12.1	23.1	11.8
15	(16)	▲	Canada	51.2	44.5	23.1	38.5	15.8	38.3	16.5	42.2	22.2
16	(19)	▲	Brazil	50.7	43.5	17.4	44.1	17.4	43.1	11.9	43.4	14.8

Figure 40: RECAI Index 2020

Source: (Renewable Energy Country Attractiveness Index 2020)

[5] Renewable Energy Country Attractiveness Index

International Investments for Renewable Energy

Through country-led support policies, renewables accounted for approximately 27.7% of global electricity generation in 2014, enough to supply 22.8% of global electricity demand. New global investment in electricity generation from renewable sources and in fuels increased by 17% over the previous year. In terms of dollars disbursed, the countries that invested the most were China, the United States, Japan, the United Kingdom and Germany. In terms of per capita investment, the ranking was led by Burundi, Kenya, Honduras, Jordan and Uruguay.

Based on the report REN 21 Renewables 2015 Global Status, the APPA Renovables[6] representative (Santiago Gómez Ramos) detailed how the vast majority of countries in the world already have strategies and initiatives to promote renewables. "Renewables are not only a bet of developed countries, but also of developing countries for a competitiveness issue (Ramos, 2015) and it is also an economically profitable option" (Renewables 2015: Global Status, 2015).

Current Situation

"The nation that wins the renewable energy competition will lead the global economy into the 21st century" (Obama, 2009)[7]. From the beginning of his first term and until the end of his second term, he bet and signed historic international pacts for investment in the development of clean energy[8]. However, the ambitious intentions of the then president were not exclusive to the United States. From the opposite cardinal point, the People's Republic of China also appeared as a power carrying the banner of the green revolution. A decade later, the Asian giant is leading the race for renewable energy and is gaining speed. According to the study Global Trends in Renewable Energy Investment 2018 (United Nations & Bloomberg, 2018), in 2017 China reached 45% of the clean energy market in terms of investment, manufacturing, innovation and consumption. These results were accompanied by a powerful economic injection by the Chinese Communist Party, which announced that it would allocate 360 billion dollars to the sector in the face of 2020. Far from being a coincidence, that same year, US President Donald Trump slammed the door on the advances of his predecessor: he abandoned the Paris Agreement and left the Asian nation free to lead the fight against climate change. "China is a great country and assumes its international responsibility for the Paris Agreement and the UN Agenda 2030," said Chinese Prime Minister Li Keqiang at the time. But replacing its main international competitor, USA, is not its only incentive, but one more reason to

[6] Spanish Association of Renewable Energy Companies (Asociación de Empresas de Energías Renovables)
[7] Obama's Speech on Renewable Energy Policy at the Massachusetts Institute of Technology in 2009
[8] Including the Paris Agreement in 2016, from which they have already retired by order of Donald Trump

accelerate environmental policies aimed at solving some of the most serious national problems. Among them, to put an end to high rates of pollution (United Nations & Bloomberg, 2018), .

As mentioned before, one of the most well-known problems of the internationalization strategy is between the United States and China, since the American country is afraid of the Chinese power (Molina, 2020). Chinese companies have a high level of competitiveness and produce a lot of material for the renewable energy industry, which leads them to have strategic costs through cheaper production. In addition, as we have already mentioned, not only do they have a strong market power, since they are one of the largest energy producers, but also all these companies are supported by the Chinese government, which if it wanted to put pressure of any kind on a country like the United States, it could block the energy supply and it would affect them very much, but not only them but the rest of the world as well (Trevelyan, 2018).

Internationalization Experience

Enerland Group

Enerland Group is a Spanish company leader in Development, Engineering, Construction, and Operation and Maintenance of photovoltaic solar infrastructures.

Currently, Enerland Group develops, builds, operates and maintains solar plants in countries as diverse as Spain, Mexico, El Salvador, Romania, Panama, Italy, Brazil, Costa Rica, Nicaragua or the Philippines through its international companies (Enerland, 2020).

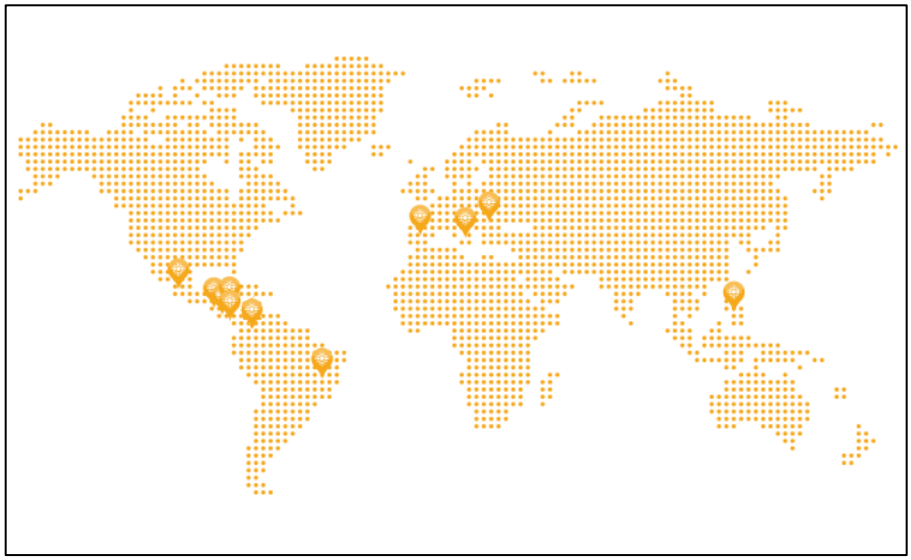


Figure 41: Global Footprint of the Enerland Group, 2020

Source: (Global Representation of the Enerland Group, 2020)

The general delegate of Enerland Group commented in the congress about renewable energy in 2016[9] how was the process of entering in several markets and transmitted some of the advantages and disadvantages.

The company has entered 4 Latin American markets that have some similarities. Most of the countries are dangerous and do not have the political and social stability as in Europe. Besides, the way of working and professionalism is different. But on the other hand, they are virgin markets, where local knowledge (know how) is missing, and they are big markets (Brazil and Mexico are markets with more than 100 and 200 million inhabitants respectively), which pushed them to go abroad.

The negative factors they found in each country according to the general delegate:

- In Mexico for example it is complicated to work because there is an energy reform and regulatory changes regularly (Before it was a monopoly and now they are reforming the laws. There are already private generators and the market is being liberalized. While the rules of the game are not clear it is difficult to make investments and financial conditions and the peso-dollar exchange rate).
- In Brazil, in addition to the bureaucracy, the complicated tax system there are tariff barriers to renewable energy materials.
- In Costa Rica, customs import procedures are very problematic and the market is not liberalized.

The positive factors they found in each country:

- El Salvador is a dollarized market (as part of the products are bought in dollars and it limits the risk of the currency very much, in addition the profit margins are higher than in Spain.
- In Mexico it exist a Free Trade Agreement with Europe and it has a great solar resource.
- Brazil is highly dependent on hydropower (80% compared to the drought of recent years)
- And finally, in Costa Rica the rates are high in the commercial segment and also a serious country when it comes to doing business.

Despite some drawbacks, the company continues to operate in the South American continent taking advantage of its position in the market, with good results.

[9] Congress where it was discussed that the present of the Spanish companies of renewable energies is in the internationalization, organized by the Spanish Association of Commerce. **Invalid source specified.**

Iberdrola

Iberdrola it´s a Spanish multinational that is located in more than 40 countries in Europe, North America and Latin America, counting among its production parks with hydroelectric plants, combined gas cycles, wind farms, nuclear and cogeneration plants (Iberdrola, 2020).

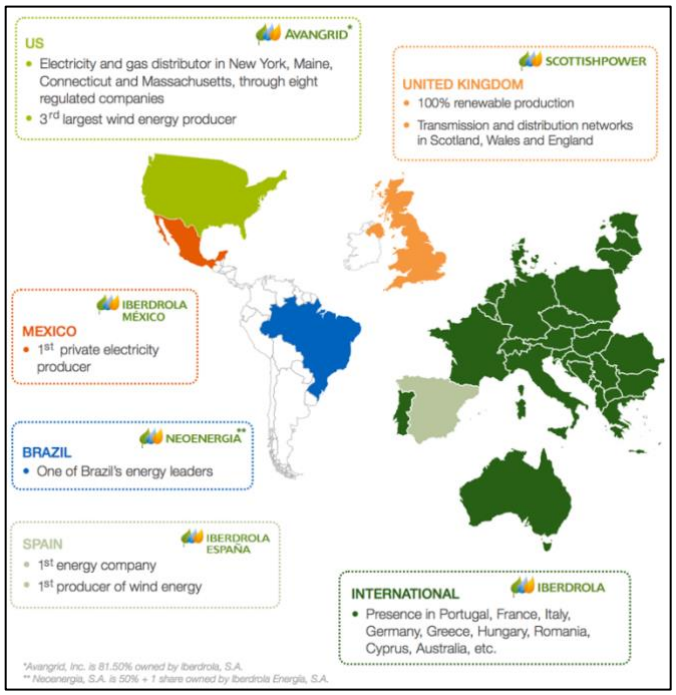


Figure 42: Global Footprint of Iberdrola, 2020

Source: (Global Representation of Iberdrola, 2020)

Iberdrola is focused on the core business (generation, distribution and marketing of electricity and gas), which was approached taking into consideration the agreements signed by the Spanish Government in relation to environmental protection, which determined that the development of clean energy and the use of renewable energy sources should be promoted. The internationalization of the Iberdrola Group has developed over the last 20 years. The transformation that this group has experienced can be defined as almost radical; it has gone from being a local electricity company to a global renewable energy leader (Global Representation of Iberdrola, 2020).

After the Kyoto Protocol[10] was implemented in 1997, which obliged countries to reduce their gas emissions by 15% between 2008 and 2012 (UN, 1997), the pressure on national companies in Spain increased. In addition, through this treaty, the need to increase market share within the

[10] The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change, and an international agreement that aims to reduce emissions of six greenhouse gases.

renewable energy sector began to emerge, which was intended to be the future of energy production.

Furthermore, Spanish energy companies (mainly large groups such as Iberdrola and Endesa) were subject to strong antitrust regulation, which prevented their growth at the national level; therefore, Spanish companies saw the need to enter foreign markets, starting with the Latin American market (López, 2020). Latin America was in the process of privatizing several operators and promoting the entry of foreign direct investment, facilitating the operation of companies in several segments at once (gas, oil, electricity and renewable energy). Renewable energy companies as such did not exist in the continent, so they entered with a great competitive advantage (López, 2020).

Brazil and Mexico, the two main markets in the Latin American region, are the countries in which the Iberdrola Group concentrated its presence in Latin America, combining the advantages of economies of scale, which companies can obtain in markets of such magnitude, with factors associated with the advantages of location and access to energy inputs, projected demand for electrical energy, stability of the regulatory framework and tariff policies that are satisfactory for the interests of investors (Global Representation of Iberdrola, 2020).

Diversification

The energy industry is not a very diversified one in terms of being present in other industries and businesses, usually energy companies are specialized in 2/3 types of energy sources. However, in this industry when we refer to diversification, we are referring to the diversification of the energy sources which is called energy mix.

An investor will diversify its investment portfolio to reduce risk, as a number of different investments are less likely to fail than one large investment. This principle often applies to the use of energy; relying heavily on one source can make a country/company vulnerable to disruptions or shocks. Motives for diversification can either be growth, risk spreading or value creation (through economies of scope and scale, and from internalizing market transactions).

The energy industry is very capital and know-how intensive, hence, is not common that new companies emerge. Usually, well established companies who are in business for quite some time either develop internally the competencies and resources they need to diversify to a new energy source or companies choose external development and merge/acquire or for an alliance with a company whose R&C combined will be able to drive a competitive advantage.

Total energy consumption implies three components, them being, electricity, transport and heating.

Nuclear and renewables account for more than one-third (36.7%) of global electricity. But they account for less than half that figure (15.7%) of the global energy mix. (Ritchie, 2019). Other components of the energy demand – transport and heating – rely much more heavily on fossil fuels.

Electricity is more easily generated through renewables than the other energy components, and transport fuels and heating are harder to decarbonize, therefore, clean electricity is increasing its importance. Part of the solution relies on the electrification of final consumption (electrifying other parts of the energy system) – such as shifting to electric vehicles.

Both companies and countries play a huge role in this energy transition, and they are largely dependent on one other. Governments can give the right incentives and support to companies that have the R&C, and know-how to perform this energy transition.

"To meet sustainability and climate goals, the pace of change must accelerate. We need a vast expansion of renewables, a smarter and much more flexible electricity grid, and huge increases in the numbers of vehicles and other products and processes that run on electricity" (IRENA, Electrification with Renewables: Driving the transformation of energy services, 2019).

Benefits of having Renewables in the energy mix (for companies and countries)

- Reduce environmental impacts – less CO2 and GHG emissions, less air pollution which in turn, improves global health.
- Renewables are increasing share in energy mix - global use increased by about 1.5% According to the international energy agency (IEA, 2020).
    - Electrification across key end uses will lead to a doubling of electricity demand by 2050. (McKinsey, 2019).
    - Given the Global Energy Transformation that is happening, strongly driven by the Paris Agreement, "many governments have strengthened efforts to reduce national energy-related emissions in the last few years". (IRENA, Global Energy Transformation, 2018)
    - According to a McKinsey report on Global Energy, renewables will grow their share of global generation to around 50% by 2035 and to close to 75% by mid-century.

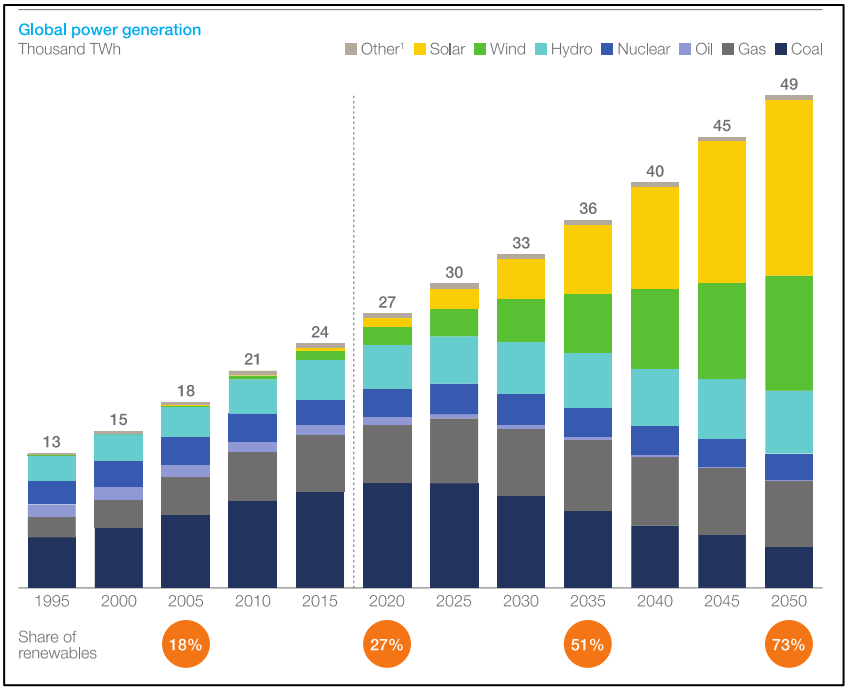


Figure 43: Global Power generation

Source: McKinsey Report, 2019

- Creates more jobs: because the sector is growing and because Renewable Energy Industry is more labor intensive (requires installation, maintenance).
- Helps overcome decline in the use of fossil fuels (mitigate demand risks). Fossil fuels will become scarce and therefore be unable to power our world. International Energy Agency (IEA) suggests that companies build portfolios of multiple energy solutions before transitioning fully to carbon-free renewables.
- Reputation: This goes both ways, as an innovative environmental company in the industry the company will gain good reputation and failing to address this environmental issue as soon as possible this could threaten their long-term social acceptability and profitability.
- According to the International Renewable Energy Agency (IRENA) the payback for accelerating renewables deployment and efficiency measures is many times larger than the costs.
    - In the Transforming Energy Scenario, every USD 1 spent for the energy transition would bring a payback of between USD 3 and USD 8.
    - The cost of building the facilities has decreased over the years with tech and R&D, for example between 2010 and 2019, the cost solar photovoltaic projects fell by 82%, and the source of renewable energy (wind, sun) is free.

- Improves energy security: renewables have unlimited supply and are getting cheaper over the years, so renewables provide an adequate, affordable, and reliable supply of energy at an affordable price. Also, reduces oil dependence (future risks for oil supply disruption) while enhancing energy efficiency.
    - Reliable and resilient: Wind and solar are less prone to large-scale failure because they are distributed and modular.
        - Distributed systems are spread out over a large geographical area.
        - Modular systems are composed of numerous individual wind turbines or solar arrays.

Acquisitions and Alliances

Employing renewables and improving energy efficiency are two tasks needed for this energy transition. They require innovation – Energy companies have extensive know-how and capital; hence they play a critical role in speeding up the implementation of key renewables.

The industry is dominated by "economies of scale"; that is, as overall output increases, the unit cost of production or distribution decreases. This implies that one corporation can provide the goods or service at a lower cost than two or more companies.

The oil industry, electricity industry, gas industry, and public utilities are converging toward an integrated energy industry (Gunnarsson & Gustavsson, 2004). To benefit from scale, the players are active on the merger and acquisition scene to grow. For most companies this means a development towards a more diversified portfolio of businesses.

Recent government incentives and targets (the European Green Deal, the Paris Climate Agreement) and shareholder pressure have driven major players to make big sustainability commitments to reduce emissions or set a target date to reach “net zero”. Ways to meet these commitments include acquisitions of green technologies, expertise and capabilities, moving closer to the end user and decarbonizing energy supply.

In 2020, during the pandemic oil prices hit negative values for the first time in history. Volatility in oil prices will push now more than ever companies towards greener options. The longer the pandemic goes on, the more we'll see the smaller and mid-cap sized oil companies go under or be taken over by the larger ones.

M&A Trends

M&A activity has been increasing in the energy sector → The trend is bigger M&A deals, fewer transactions.

Factors driving M&As in renewables

- Energy transition: Paris Agreement, Environmental policies and incentives.
    - Technological advances in electrical vehicles

- Tech and R&D improvements (project planning/building/maintenance cheaper and faster)
    - So renewable energies are getting more cost-competitive

- The Pandemic showed the volatility in oil prices (lead many companies to rethink their energy portfolios and security)

Governments worldwide are increasing their renewables capacity and making ambitious commitments to renewables, therefore the sector appeal is growing and attracting investors.

- Utility companies, major O&G companies as well as strategics investors are diversifying and growing their renewables business through M&As

- Most M&As are of Dimension I – Bigger firms buying smaller ones (using the bigger company resources to leverage the small firms' innovations)

- Most acquisitions are happening across regions/countries

Major company investments in renewable energy

Bp spent $200 million in 2017 on acquiring a 43% stake in Lightsource, which has rebranded to Lightsource Bp and is Europe's largest solar power project developer.
In 2017, Shell acquired European electric charging pioneer NewMotion. "We recognize that one of the themes of the energy transition is going to be electrification," (Matthew Tipper, Shell's vice-president for new fuels).

Strategic alliances

In order to face the challenges of a dynamic, uncertain and changing environment (Prospects of oil demand and the speed of energy transition) cooperation is essential for the development of skills and knowledge that enable to compete in this environment.

In the energy sector, the formation of strategic alliances has been normal practice, Companies cooperate to build and plan new projects, or to develop/improve technologies → pursuing cooperation is mutually beneficial.

Companies have implemented partnerships and alliances to take advantage of their strengths and generate sustainable competitive advantage while minimizing risks and uncertainty. In the medium to long term, cooperation most likely results in the intensification of competition between allied companies, giving rise to the concept of "coopetition".
When successful strategic alliances increase quality, decrease costs, enhance energy efficiency, allow cross-sharing resources and technology and distributes risks and returns.

Major company investments in renewable energy

BP (British multinational oil and gas company) and Orsted (Danish multinational power company) team up on Green hydrogen project.
Announced in the beginning of November, Bp and Orsted have today signed a Letter of Intent (LOI) to work together in developing a project for industrial-scale production of green hydrogen.
Together the two companies intend to build wind-powered technology that can produce hydrogen from water. This will be powered by renewable energy generated by an Orsted offshore wind farm in the North Sea and the hydrogen produced will be used in bp's refinery. (BP, bp and Ørsted to create renewable hydrogen partnership in Germany, 2020)
Bringing these two companies together will offer the opportunity reduce emissions and "build experience of large-scale green hydrogen production and deployment" (Dev Sanyal, executive vice president, gas & low carbon energy, Bp).

Kotler (2003) describes a joint venture as a company jointly created and owned by two or more parties. He stresses two main reasons to set up joint ventures: risk spreading and to gain access to a market or a resource. TEESS, a 50/50 joint venture company, established by Total and Envision Group, launches its commercial activity to develop combination of distributed solar

energy systems and digital solar energy solutions for B2B customers in China. TEESS will have a combination of distributed solar energy systems and digital solar energy solutions for customers.

A consortium is a group made up of two or more individuals, companies, or governments that work together to achieving a common objective. (Kenton, 2020).
In July 2020, UAE-based Emirates Water and Electricity Company (EWEC) awarded a contract to a consortium led by Abu Dhabi National Energy Company (TAQA) and Masdar and two other partners: EDF and JinkoPower. The partners signed the 30-year Power Purchase Agreement (PPA) with EWEC. The project is called Al Dhafra Solar Project and the goal is to build largest PV (photovoltaic) independent power producer (IPP) in the world with record-low tariff for solar power.
The project is under a public-private partnership (PPP) scheme. EDF Renewables and Jinko Power will hold 20% each. The 60% remaining share will be owned by TAQA and Masdar, the two Abu Dhabi based public-owned major players in the electricity sector. (EDF, 2020)

National Competitiveness

Country Attractiveness

Factor	Weight	China	USA	Germany	Spain
Sales					
Market Size in Volume	5%	10	9	2	1
Average Price Level	3%	2	5	7	6
Access to the Distribution Network	2%	3	5	7	7
Cultural Proximity	2%	3	8	8	8
Other Sales Factors	1%	1	4	2	2
Sales Assessment	13%	0,69	0,9	0,63	0,55
Growth					
GDP Growth Rate	6%	8	3	1,5	2
Population Growth Rate	8%	2	2	1	1
Market Growth Rate	10%	8	7	3	2
Openness to International Trends	4%	3	9	7	6
Other Growth Factors	1%	7	6	5	3
Growth Assessment	29%	1,63	1,46	0,8	0,67
Margin					
Access and Cost of Labor	3%	10	10	1	3
Access and Cost of Qualified Technicians	6%	7	7	6	7
Cost of Land, Materials and Equipment	4%	10	10	2	5
Distribution Margin	3%	7	5	4	3
Financial Costs	2%	9	6	5	4
Barriers to Imports	3%	5	6	5	6
Legal Regulation	2%	5	8	6	6
Bureaucracy	2%	7	8	7	8
Technology	2%	5	10	7	3
Other Margin Factors	1%	6	4	2	2
Margin Assessment	28%	2,06	1,93	1,12	1,36
Risk					
Foreign Exchange Risk	5%	6	7	10	10
Political Risk	4%	3	8	9	7
Competitive Risk	2%	10	9	3	1
Other Risk Factors	1%	5	5	1	2
Risk Assessment	12%	0,67	0,9	0,93	0,82
Sustainability					
Environmental Sustainability	8%	3	10	5	3
Social Sustainability	6%	4	5	6	6
Governing Sustainability	3%	4	5	7	6
Other Sustainability Factors	1%	4	2	5	3
Sustainability Assessment	18%	0,64	1,27	1,02	0,81
Global Assessment	100%	5,69	6,46	4,50	4,21

Figure 44: Country Attractiveness of China, USA, Germany and Spain

Source: Own calculations

Following the global assessment of the various criteria that was analysed in the previous table[11], the most attractive country in the renewable energy sector is the United States, followed closely by China. Compared to other countries competing in the renewable energy market, the United States is the leader in assessments in terms of sales, risk as well as in sustainability.

Specifically, the United States is the leader in the high-tech segment due to the strong investments made by the government in this sector. Investments in renewable energy technologies have increased dramatically from US $ 11.3 billion in 2005 to US $ 59 billion in 2019.

In addition, the renewable energy market continues to grow with electricity production from clean energy which increased from 736.354 THw in 2018 to 755.476 THw in 2019; an annual

[11] Data from (Kai Fang, 2018)

increase of 2.43%. Note, the two most widely used energy sources are wind and hydraulic energy, representing 13.82% of total electricity production in 2019.

Finally, the United States has very favourable values in terms of environmental sustainability; this makes the United States a very attractive country for companies in the renewable energy sector.

As far as China is concerned, it is the second most competitive country in the renewable energy industry sector, not only because of its large global production shares, but also because it produces a lot of materials necessary for industry.

The state is also playing a decisive role in the meteoric growth of the clean energy market and this is possible thanks to its incentive policies and its high investments in the field. According to the report published by the United Nations Program, China has invested 758 billion dollars in investment from 2010 to the first half of 2019, making this country the world's largest investor in renewable energies.

All of these criteria as well as the elements that we study below in the Porter's Diamond part make China a real player with a strong competitive edge.

National Diamond Model

The diamond model, also known as Porter Diamond or Porter Diamond Theory of National Advantage, helps to highlight a nation's competitive advantage in the international market. This model suggests that a country's national advantage varies from industry to industry and is based on six interrelated factors:

- The conditions of the factors of production
- The conditions of the request
- Related and auxiliary sectors
- The country's strategy, structure and rivalry
- Threat / Chance
- Government

In the following step, the national Diamond Model will be applied to China, since it is a very competitive country in the sector.

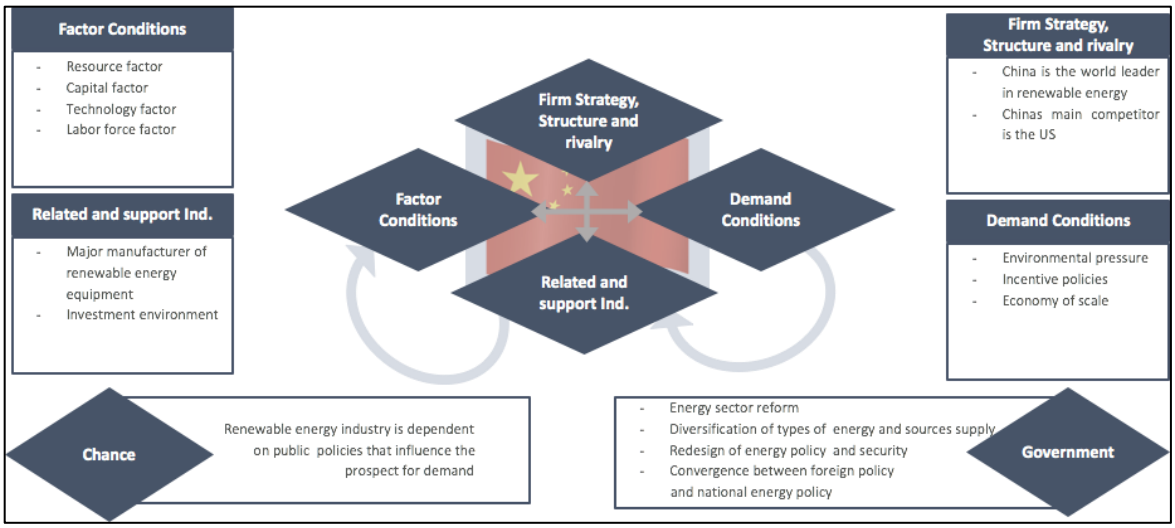


Figure 45: National Diamond Model applied to China

Source: Own illustration

Factor Conditions

Resources

China has a varied and abundant renewable energy, whether in the solar field, biomass, hydropower, wind. Indeed, China has significant resources of biomass and agricultural waste such as straw, which represented around 3 billion tonnes per year in 2018. As an indication, in the first half of 2019, biomass had generated 24,5 billion kilowatt-hours of electricity. Finally, in view of its geographical position, China has great potential in terms of hydraulic energy resources which can be developed on an industrial scale in the long term.

Employment

In the field of renewable energies, China employs 4.1 million workers (Scorecard, 2020), or 39% of total global jobs in the sector (wind power: 510,000 jobs, hydropower: 308,000, the photovoltaic industry: 2, 2 million, field of solar heating and cooling: 670,000 people and solid biomass 186,000).

Capital factor

Wind

Since 2010, China has been ranked 1st in the world for its installed wind power, it reached 236,402 MW at the end of 2019, or 36.3% of the world total. It installed 23,760 MW of onshore wind turbines and 2,395 MW of offshore wind turbines in 2019, representing a market share

that reached 43.3%. In terms of target, the Chinese government wants to reach 1,000 GW from wind power by 2050.
In addition, China ranks third in the world for offshore wind power with 6,838 MW at the end of 2019, or 23.5% of the world's offshore fleet.

Solar

The theoretical solar potential of China is estimated at 1,680 billion Tep (19.5 million TWh) which in 2019 represented 32.6% of world electricity production with a cumulative installed capacity of 204.7 GWp. comparison the United States were at 75.9 GWp and Japan 63 GWp.

Hydroelectricity

Here again, China is ranked 1st in the world in 2019 with an installed capacity representing 27.2% of the world total and 30.2% of production, reaching 1,302 TWh. The same applies to pumped storage systems, China is world leader with 19.2% of the world total.

Technologies

Commercial technologies appear

China shows good development prospects for renewable energies through its new technologies such as small hydropower, solar water heater, mini wind energy generator and geothermal heating. In addition, it can be noted that many technologies were the main stage of commercialization: the large-scale interconnection wind power generator, the medium and large-scale biogas plant.

Mature technology and near Chinese dependence on wind power

In China, solar energy technologies such as wind turbines to micro wind turbines, geothermal heat utilization and generation technologies and tidal generation have matured and can be developed rapidly through capital investment.
In addition, thanks to the many R&D investments on large-scale wind turbines have seen a marked improvement and more than 90% of the components of 600 kW wind turbines can be produced in China.

Demand Conditions

Environmental pressure

For several years there has been an increase in environmental pressure caused by the consumption of energy such as coal which is the main cause of smoke pollution in China, as well as the main source of greenhouse gases. The use of this energy causes significant pollution in the air, which degrades the standard of living of the population and increases disease. The use of cleaner renewable energy is therefore essential to meet the demand of the population.

Incentive policies

In addition to providing incentives for R&D, the Chinese government plays a major role in helping companies through tax incentives. The law on renewable energies provides for granting an advantageous tax for all energy production projects (Yuan, 2020).
These preferential tax policies thus highlight the state's desire to promote renewable energies and to change the world towards a cleaner world.
Regarding the tax rate, the Chinese government has implemented tax relief to encourage companies to invest in the renewable energy industry.

Economy of scale

Finally, demand also comes from the potential of Chinese economies of scale. With the manpower and structural capacities available to China, it is thus able to meet international demand to provide electricity at competitive prices.

Related and support Industries

Major manufacturer of renewable energy equipment worldwide

The spatial proximity of upstream or downstream industries makes it easier to disseminate information and a continuous exchange of ideas and innovations in renewable energy. As a result, for many years the formation and development of the cluster space industry has marked a major point in China's energy transition.

The Shandong Province (Reuters, 2019) cluster represents a typical case of solar energy development. A number of companies have established themselves there as has the Himin company which is the world's largest solar water heater manufacturer.

In addition to this concentration of companies, the province aims to improve cooperation with large companies in order to promote the installation of wind and marine parks as well as wave and tidal energy.

Jiangsu Province is also another case that can be cited because of its great potential in the development of industrial wind power. More precisely, three clusters of this province have surfaced: Yancheng, Nantong and Lianyungang. In these regions, the government plays a powerful role of enabling factor both by initiating the construction of wind farms or by planning industrial parks linked to wind energy.

Investment environment

China is a huge attraction for foreign investors. For example, according to a report by the United Nations Environment Program (UNEP) and its partners, China was the first destination for investments in renewable energies in 2017, with a record amount of 126.6 billion of dollars (104 billion euros), an increase of 31% compared to 2016.

Firm Strategy, Structure and rivalry

China is the world leader in renewable energies

China is the leading country in the world in the production of electricity from renewable energy sources, with more than double the production of the United States with a total capacity of 728 GW of renewable energy, coming mainly from the hydroelectric and wind turbines. For several years the Chinese renewable energy sector has continued to grow and become more and more competitive, thus gradually leaving fossil fuels and nuclear energy aside.

Strategy

The key elements of the Chinese energy strategy put forward the economies by privileging the national renewable resources by encouraging various models of development. It seeks to establish mutual benefit through a science and technology-oriented strategy, while being careful to preserve the environment and international cooperation. It strives to build a stable, economical, clean and secure energy supply system, in order to support sustainable economic and social development with sustained energy development.

In addition, the collaboration between the government and the network companies that is being established makes it possible to facilitate direct purchases of electricity at the national level. As a result of the RPS policies, this has enabled companies to have a more proactive role in the

supply of renewable energy through the voluntary market for a greater integration of renewable energies in the Chinese market.

Rivalry

The main Chinese competitor is the United States. In the US, green energy in the US has experienced strong growth in recent years, it represented around 11% in 2009 against 18% in 2018. The installed generation capacities of wind power are now comparable to those of nuclear and hydroelectricity remains the primary source of renewable electricity. The government also plays a major role in R&D in the renewable sector, investing more than $ 48.5 billion in 2018; this represented an increase of 1.25% compared to 2017.

Threat/Chance

The renewable energy industry is dependent on public policies that directly influence the outlook for demand. It is therefore the government that can mitigate the risks of socio-economic instability, tackle the problem of air and water pollution.
In addition, in terms of accessibility there are geological difficulties to exploit its resources, located in areas of complex geological conditions. The hydroelectric resources are mainly located in the high mountains and deep valleys of the southwest, far from the centers of consumption, causing technical difficulties and high costs.

Government

The main objective of China's energy strategy seeks to combine an economic strategy aimed at safeguarding the structural integrity of the national economy as well as protecting the interests and production capacities of the state (Nature, 2020).

Energy sector reform: infrastructure and supply system to maximize domestic production

The first point of this strategy concerns infrastructure and energy efficiency. The emphasis is on improving energy efficiency by restructuring all infrastructure and closing illegal factories (especially in the coal sector) and those using obsolete, polluting and inefficient means of production.
The government is seeking to modernize equipment in the industrial sector in order to improve energy efficiency. In addition, the strategy aims to improve the energy supply in the interior of

the country by establishing a system of production and transmission of energy from renewable energy to solve the problems associated with climate change.
However, this requires major investments in the development of new technologies: research into energy efficiency, innovation and technological and scientific cooperation. Foreign direct investment thus plays a crucial role.

Diversification of types of energy and sources of supply

The government is trying to reduce internal oil consumption by emphasizing the use of renewable energy by promoting the production of hydroelectricity and solar energy. In addition, its strategy also emphasizes a supply system based on multiple sources and on international cooperation with the aim of securing a supply free from price fluctuations.
In addition, China is seeking to diversify its energy sources in order to decrease dependence on regions outside. At the political level, the country seeks convergence between foreign policy and national energy policy in order to maintain control of internal energy demand and thus stimulate foreign investment and promote employment.

Redesign of energy policy and security

Since 2003, China has entered a so-called period of adjustment to its previous strategy: spending cuts, adjustment of Zou Chuqu's policy and coordination of the energy sector with sustainable development and we are gradually turning to green technologies. .
Thus, we are now talking about security interdependence between the different sectors. Given the increase in Chinese energy demand in terms of greenhouse gas emissions and other pollution related to energy consumption, the new Chinese energy strategy is to turn to renewable energies by investing 360 billion dollars in 2020 and with plans to create 13 million jobs in this sector.

Scenario planning

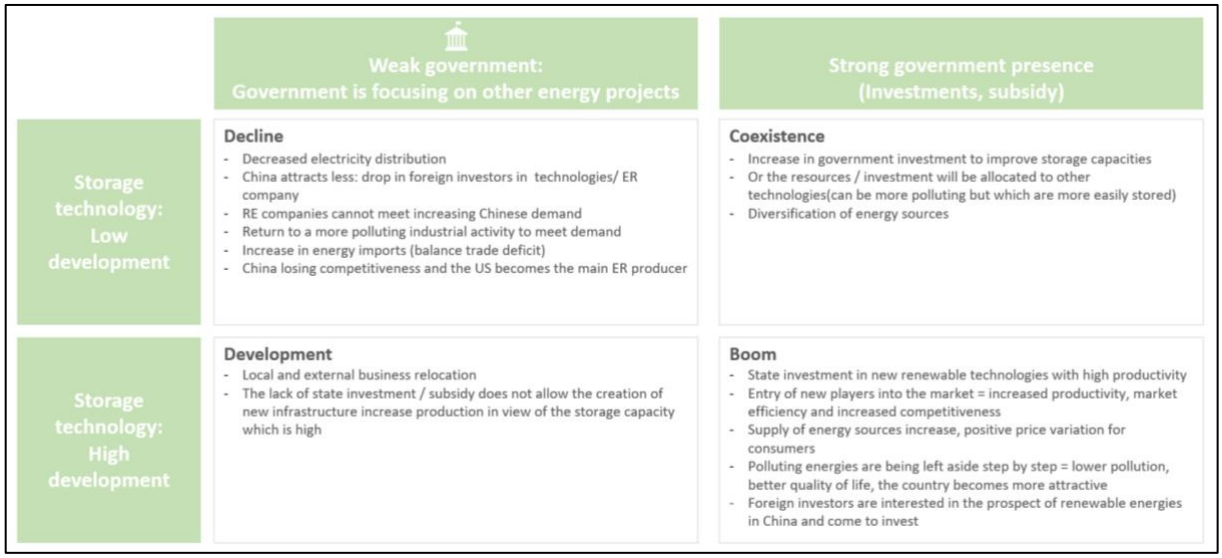


Figure 46: Scenario planning including the two dimensions government and storage technology

Source: Own illustration

The planning scenario highlights the consequences of the degree of government involvement in renewable energies according to the level of development of storage technologies.
Insofar as the government decides to invest little, two scenarios appear: First, with little progress in storage technologies, the renewable energy sector would gradually decline: China will lose its competitiveness and will therefore turn to more polluting activities. If the storage capacity technologies are more advanced, China will be able to provide enough energy to the population but will not be able to create new infrastructure to increase the use of renewable energy.

If the state invests significantly in renewable energies, we also have 2 scenarios; with low storage capacity, the state will either invest in this area to be able to diversify renewable energy sources or the state will prefer to invest in other, more efficient and probably more polluting technologies. Finally, if the Chinese territory is advanced in storage technologies, the role of the government will lead to a real expansion of the field of renewable energies. New infrastructures as well as new investors will appear. This will thus increase the productivity of renewable energies and solve the pollution problem and therefore increase the quality of life.

Conclusion and Future Challenges

The situation in 2020 is very complex: The society is in the middle of a pandemic, an economic crisis and environmental change. One of the solutions for recovery must be led by renewable energies, so that the planet faces both the climate crisis and the post-COVID-19 global economic crisis.

The health, humanitarian, social and economic crises caused by the COVID-19 pandemic have had far-reaching repercussions around the world. To meet the challenge of economic recovery, the International Renewable Energy Agency (IRENA) urges governments to build on the progress made in renewable energy to keep the fight against climate change and the commitment to sustainability on track.

Renewable energy will be the engine that will move the world after COVID-19, as the fight against climate change and the pandemic crisis needs a common roadmap.

The most serious figure of this pandemic has been thousands of human losses, but it has also left very serious and important figures in the global economic society.

The IMF's World Economic Outlook paints a bleak picture: the world economy is projected to contract by 4.9%, indicating a much worse recession than the 2008 crisis.

One of the strongest means to lift the economy is green recovery, in which the European Union has made a clear commitment to the green agenda. Its ambitious green recovery package injects resources into a clean recovery like never before, announcing the creation of one million green jobs and the momentum of green transition.

If governments and businesses work together in this crisis, society can achieve a sustainable future. With the help of the energy transition will drive a broad socio-economic development and at the same time pave the way for achieving the goals set in the Paris Agreement and limit the global temperature increase to 1.5 °C. Moreover, by supporting renewable energy at the expense of fossil fuels, it promises more jobs, higher economic growth, cleaner living conditions, and substantial improvements in well-being. Another very important fact is that it would reduce 70% of energy-related carbon dioxide (CO2) emissions in the world by 2050 (Renewables 2019: Global Status Report, 2019).

IRENA estimates that for every US dollar (USD) invested, between 3 and 8 dollars will be recovered, so it would be a safe bet.

Jobs in the renewable energy sector will increase to 42 million worldwide by 2050, four times more than today. Not to mention that there would be health and environmental benefits, as well as significant improvements in human well-being, in all regions of the world. IRENA estimates that the well-being indicator would be 13.5% higher in 2050.

To facilitate the energy transition and accelerate economic recovery from the COVID-19 pandemic, governments should expand policies that promote and support renewable energy solutions (IRENA, 2020):

- Prioritize renewable energy in any stimulus package and commit to phasing out support for fossil fuels.
- Provide market mechanisms to safeguard industry and mobilize private investment towards renewable energy.
- Increase the role of renewable energy in industrial policies.
- Promote a just transition and assist workers in the shift to renewable energy jobs
- Strengthen international cooperation and action to accelerate the transition
- Renewable energy must play a key role in economic recovery, ensuring sustainability and energy security, creating jobs and strengthening resilience to protect people's health and well-being. No other industry can achieve these goals while reducing global emissions.

In conclusion, companies in the field of renewable energy will have a promising future and are also a clear option to improve the environmental situation that the planet is suffering.

Reference List

Milla, J. L. (2012). Tendencias y aspectos administrativos. In *La integración vertical de los negocios de gas y electricidad: posibles efectos sobre la competencia en los mercados afectados* (pp. 125-137).

Audax Renovables. (2018). *Audax Energía and the listed company Audax Renovables complete the merger process.* Barcelona.

Koch , S. G., & Meckl , R. M. (2014). Internationalization of Renewable Energy Companies: In Search of Gestalts. *International Business Research*.

Atanes, R. (2018). *Solartys*. Retrieved from Internacionalizacion de las soluciones energéticas renovables: https://www.solartys.org/es/internacionalizacion-energeticas-renovables/

REN21. (2019). *Renewables 2019: Global Status Report.*

(2018).*Renewables 2018: Global Status.* REN21.

Steinmetz, H., Schwens, C., & Kabst, R. (2010). Growth and Internationalization: Renewable Energy and New Technology-Based Firms. In *Innovation and International Corporate Growth* (pp. 113-122). Berlin: Springer-Verlag.

Jason Frederick, J., & Stacey, B. (2011). *Análisis de las energías renovables.* Houston: BBVA Research.

(n.d.).*Total Renewable Power Generation Capacity, 2011-2017.* The International Renewable Energy Agency .

REN21. (n.d.). *Renewables 2005: Global Status.*

REN21. (2015). *Renewables 2015: Global Status.*

(2020).*Renewable Energy Country Attractiveness Index 2020.* RECAI.

Ramos, S. G. (2015). *APPA Renovables.*

Obama, B. (2009, October 23). Obama´s Speech on Renewable Energy Policy. *The New York Times*.

United Nations, & Bloomberg. (2018). *Global Trends in Renewable Energy Investment 2018.*

UN. (1997). Kyoto Protocol. *United Nations Convention on Climate Change.*

IRENA. (2015). *Evaluating Renewable Energy Manufacturing Potential in the Meiterranean Partner Countries.* IRENA - International Renewable Energy Agency.

wpd. (2020, December). *Profile*. Retrieved from https://www.wpd.de/en/wpd/profile/

BloombergNEF. (2019, February). *Vestas Leads Break-Away Group of Big Four Turbine Makers*. Retrieved from https://about.bnef.com/blog/vestas-leads-break-away-group-big-four-turbine-makers/

SolarEdition. (2020, January). *Top 10 Module Manufacturers Market Share in the Global Solar Panel Module Market*. Retrieved from https://solaredition.com/top-10-module-manufacturers-market-share-in-the-global-solar-panel-module-market/

B. r. (2020). *About BayWa r.e.* Retrieved from https://www.baywa-re.com/en/about-baywa-re/

Bamber, P., Guinn, A., & Gereffi, G. (2014). *Burundi in the Energy Global Value Chain.* Duke University.

strategy&. (2019). *Global power strategies.* strategy& - Part of the PwC network .

IRENA. (2017). *Renewable Energy Benefits Leveraging Local Capacity for Onshore Wind.* IRENA - International Renewable Energy Agency.

Financial Times. (2020, July). *Financial Times*. Retrieved from https://www.ft.com/content/a7901eae-411e-43d0-8103-1f3c8d3a990c

Pickl, M. (2019). The renewable energy strategies of oil majors – From oil to energy? *Energy Strategy Reviews*.

BP. (2020). *Our Strategy*. Retrieved from https://www.bp.com/en/global/corporate/what-we-do/our-strategy.html

Enel. (2020, November). *Enel's 2030 vision in 2021–2023 Strategic Plan: a decade of opportunities*. Retrieved from https://www.enel.com/media/explore/search-press-releases/press/2020/11/enels-2030-vision-in-20212023-strategic-plan-a-decade-of-opportunities-

Yuki. (2019, September 15). *Energy Iceberg*. Retrieved from China's State-Owned Power Generation Utilities, Who Are They?: https://energyiceberg.com/state-owned-power-utilities/

Yuki. (2020, March 11). *Energy Iceberg*. Retrieved from China's Power Utilities: 2019 Results & Strategy Update: https://energyiceberg.com/chinese-power-utilities-2019/

UtilityDive. (2014). *Is Google becoming an energy company?* Retrieved from https://www.utilitydive.com/news/is-google-becoming-an-energy-company/216848/

CDP. (2019). *Beyond the cycle: which oil and gas companies are ready for the low-carbon transition?* Retrieved from https://www.cdp.net/en/investor/sector-research/oil-and-gas-report

IRENA20. (2020). *Renewable Energy and Jobs – Annual Review 2020*. Retrieved from https://www.irena.org/-/media/ Files/IRENA/Agency/Publication/2020/Sep/ IRENA_RE_Jobs_2020.pdf

REN21, 2. (2020). *RENEWABLES 2020 GLOBAL STATUS REPORT*. Retrieved from https://www.ren21.net/wp-content/uploads/2019/05/gsr_2020_full_report_en.pdf

GWEC20. (2019). *Global Wind Energy Council (GWEC); Global Wind Report 2019*. Retrieved from https://gwec.net/global-wind-report-2019/

Tractebel. (2020). *Tractebel Engie; Offshore-Wasserstoff-Produktion mit 400 MW in neuer Dimension*. Retrieved from https://tractebel-engie.de/de/nachrichten/2019/offshore-wasserstoff-produktion-mit-400-mw-in-neuer-dimension

IRENA19. (2019). *Global energy transformation: A roadmap to 2050 (2019 edition), International Renewable Energy Agency, Abu Dhabi.* Retrieved from https://www.irena.org/publications/2020/Jun/RenewablePowerCostsin2019

Insights, D. (2020). *Global renewable energy trends*. Retrieved from https://www2.deloitte.com/us/en/insights/industry/power-and-utilities/global-renewable-energy-trends.html

EU. (2020). *2030 climate & energy framework*. Retrieved from https://ec.europa.eu/clima/policies/strategies/2030_en

Carbeck. (2020). *Green Hydrogen Could Fill Big Gaps in Renewable Energy*.

IEA. (2020). *World Energy Outlook 2020.* https://www.iea.org/reports/world-energy-outlook-2020.

IEA. (2019, April). Retrieved from Sweden is a leader in the energy transition, according to latest IEA country review: https://www.iea.org/news/sweden-is-a-leader-in-the-energy-transition-according-to-latest-iea-country-review

Financial Tribune. (2019, July). Retrieved from China Remains a Leader in Renewable Energy: https://financialtribune.com/articles/energy/98708/china-remains-a-leader-in-renewable-energy

Comparesoft. (n.d.). Retrieved from How an Asset Management System Enhances a Business: https://comparesoft.com/asset-management-software/blog/why-asset-management-system-good-for-business/
Trend Micro. (n.d.). Retrieved from Industrial Internet of Things (IIoT): https://www.trendmicro.com/vinfo/us/security/definition/industrial-internet-of-things-iiot
Foulkes-Jones, G. (2020, June). Retrieved from The Rise of Artificial Intelligence in Renewable Energy - 2020: https://energycentral.com/c/cp/rise-artificial-intelligence-renewable-energy-2020
Iberdola. (n.d.). Retrieved from How can blockchain be used to certify the source of green energy?: https://www.iberdrola.com/innovation/blockchain-energy
Fuelsave. (n.d.). Retrieved from Why Drones Are 'Game-Changing' for Renewable Energy: https://fuelsave-global.com/why-drones-are-game-changing-for-renewable-energy/
Nace, T. (2017, July). Retrieved from China Just Built A 250-Acre Solar Farm Shaped Like A Giant Panda: https://www.forbes.com/sites/trevornace/2017/07/25/china-just-built-250-acre-solar-farm-shaped-giant-panda/
StartUs Insight. (2019, November). Retrieved from Renewable Energy: A Global Startup Activity Analysis: https://www.startus-insights.com/innovators-guide/renewable-energy-a-global-startup-activity-analysis/
BigMoon Power. (n.d.). Retrieved from Company Website - About Us: http://bigmoonpower.com
Oxford PV. (n.d.). Retrieved from Company Website - About: https://www.oxfordpv.com
Utilight. (n.d.). Retrieved from Company Website - About: https://www.utilight.com
Elfrosun. (n.d.). Retrieved from Company Website - About Us: http://elfrosun.com
Ritchie, H. (2019). *Electricity Mix*. Retrieved from https://ourworldindata.org/electricity-mix
IRENA. (2019). *Electrification with Renewables: Driving the transformation of energy services.*
McKinsey. (2019). *Global Energy Perspective 2019 .*
IRENA. (2018). *Global Energy Transformation.*
Gunnarsson, J., & Gustavsson, J. (2004). *Diversification within the Electricity Industry.*
BP. (2020, November). *bp and Ørsted to create renewable hydrogen partnership in Germany*. Retrieved from https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-and-orsted-to-create-renewable-hydrogen-partnership-in-germany.html
Kenton, W. (2020). *Investopedia*. Retrieved from https://www.investopedia.com/terms/c/consortium.asp
EDF. (2020). *EDF - Jinko Power consortium is awarded the world's largest solar project in Abu Dhabi*. Retrieved from EDF: https://www.edf.fr/en/edf/edf-jinko-power-consortium-is-awarded-the-world-s-largest-solar-project-in-abu-dhabi
Yuan, C. (2020). *3 major policy trends to watch for in China's renewable energy market*. Retrieved from https://www.utilitydive.com/news/three-major-policy-trends-to-watch-for-in-chinas-renewable-energy-market/581344/
Reuters. (2019). *China's Shandong province plans further coal usage cuts over next five years*. Retrieved from https://www.reuters.com/article/us-china-coal-shandong-idUSKCN1TX1AW
Nature. (2020). *China's plan to cut coal and boost green growth*. Retrieved from https://www.nature.com/articles/d41586-020-02464-5
Scorecard, C. (2020). *China Leads Green Jobs in Renewable Energy Sector*. Retrieved from https://www.climatescorecard.org/2020/09/china-leads-green-jobs-in-renewable-energy-

sector/#:~:text=China%20has%20since%20become%20a,%2C%20i.e.%20~510%20000%20jobs
(n.d.).*Global Representation of the Enerland Group, 2020.* Enerland Group.
(n.d.).*Global Representation of Iberdrola, 2020.* Iberdrola.