

WIND & SOLAR TECHNICAL EXPERT

Country Overview | Poland Renewable Energy 2020-2040

Market Outlook | Regulatory Framework

Demographics.



Population & Demographics.

Poland has a current population of approximately 37.86 million people [1]. The population decreased by 28,000 people in 2019 alone [2]. The labour force participation rate was 56% in December 2019 (a decrease by 0.7% from September 2019) and the total dependency ratio in Poland is 39.6% [3]. This demonstrates that the pressure on productive population is relatively low as there is a greater percent of labour force than people being dependent on the labour force to cover their expenditure (children and aged persons [4]. By 2050, over 35% of Europe's population will be aged 60 or over [5], and the population is expected to have shrunk by 14% [6]. Furthermore, Poland's population could fall by over 25 percent over the next 80 years, according to new forecasts released by the EU [7]. Additionally, the median age has already seen a 5 year increase since 2000. The table below demonstrates Poland's declining population.

Poland Popul	ation by Year (Histori	cal)			Source	e: World Population Prospects (2019 Revision
Year 👻	Population	% Male	% Female	Density (km²)	Population Rank	± CSV ± JSON Growth Rate
2020	37,846,611	48.45%	51.55%	121.04	38	-0.11%
2019	37,887,768	48.46%	51.54%	121.17	38	-0.09%
2018	37,921,592	48.47%	51.53%	121.28	37	-0.08%
2017	37,953,180	48.48%	51.52%	121.38	36	-0.09%
2016	37,989,220	48.48%	51.52%	121.50	36	-0.12%
2015	38,034,079	48.47%	51.53%	121.64	36	-0.15%
2010	38,329,781	48.35%	51.65%	122.59	33	-0.02%

Demographics	Poland	United Kingdom
Population	37.86 million	67.89 million
Population Density	124 people living in every square kilometre of land (320 people per square mile)	255 people living in every square kilometer of land (660 people per square mile)
Life Expectancy	79.3 years	81 years
Median Age	41.7 years	40.5 years



GEOGRAPHY.

Π



Geography & Climate.

- Poland is located in central Europe and borders Germany to the west, the Czech Republic and Slovakia to the south, Ukraine, Belarus and Lithuania to the east, and the Baltic sea and the Russian enclave of Kaliningrad to the north [8].
- Poland is the 9th largest country in Europe with an area of 312,679 sq km (120,726 sq mi).
- 91% of Poland's territory lies below 300m above sea level, making it a relatively low-lying country.
- Approximately one-fifth of the territory of Poland is maintained as fields, pasture and meadows, and approximately 27% of the total area is covered by forest [9].
- Poland has a moderate climate influenced by both maritime and continental elements. Humid Atlantic air masses collide with dry continental masses. This results in the weather being difficult to predict. Generally, in the north and west part of the Poland the climate is predominantly maritime, with gentle, humid winters and cool, rainy summers, while the eastern and southern part of the country has distinctly continental climate with harsh winters and hotter, drier summers [10].



Source:http://www.operationworld.org/files/ow/maps/Igmap/pola-MMAP-md.png



Geography & Climate.



[11] © 2019 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data: Solargis.

creating value

The map on the left represents daily and world BANKGROUP annual long-term averages of **Global** Horizontal Irradiation (GHI) [kWh/m2].

You can see on the map that the South-East regions of Poland receive more than 1168kWh/m2 of global irradiation annually, with the central and southern averaging 1095kWh/m2 and the Northern areas averaging approximately 1022kWh/m2.

The map on the right shows the photovoltaic power potential. The two maps correlate as the regions with the irradiation, highest alobal horizontal generates higher photovoltaic power potential. However, where alobal horizontal irradiation isn't at it's highest (ie 1095kWh/m2), the photovoltaic power potential its hiahest can reach (1168kWh/kWp). You can see that the photovoltaic power potential averages at approximately 1095kWh/kWp in the Central and Southern regions of Poland, with some regions reaching 1168kWh/kWp. The northwest regions produce the least photovoltaic power potential of 1022kWh/kWp. However, that being said, the regions which averaged 1022kWh/m2 on the GHI map, shows the same regions reaching up to 1095kWh/kWp on the photovoltaic power potential map.

THE ENERGY MIX.

Current Conditions and Growth Outlook



Energy Mix.

Energy mix is essentially the combination of primary energy sources used to meet energy demands in a given country. It includes fossil, nuclear energy, nonrenewable waste and the many sources of renewable energy [12]. Even though Poland has seen a strong growth of renewable energy over the past decade, coal still dominates the power sector. However, according to the draft Energy Policy of Poland to 2040, the share of coal and lignite in electricity generation will be reduced from just under 80% in 2017 to 60% by 2030 and around 50% by 2040 [13]. The graph shows Poland's total primary energy supply with coal dominating the energy mix, followed by oil, natural gas, biofuels and waste and the renewable energy.





Coal Natural gas Hydro Biofuels and waste O Oil Wind, solar, etc.

Energy Mix.



Greensolver

The table shows the total renewable energy (MW) in Poland. It demonstrates that the country has seen a great increase in renewable energy, with a 23% increase from 2010-2019.

The solar industry has seen a particularly rapid growth. In the beginning of 2014 the industry was practically non-existent and by the end of 2019 the country had 1.3GW of installed capacity. The last two years saw a particularly significant growth, with the installed capacity doubling in 2018, and then raising another 131% in 2019. This is expected to grow even further, as demonstrated later on in this paper.

Unlike solar, onshore wind has had a strong presence in the Polish energy mix for over a decade. Following a rapid growth in capacity till 2015, onshore wind experienced steady growth , reaching nearly 6GW in 2019.

Solar & Wind Farms.



A map [15] to the left shows the distribution of wind farms throughout Poland. with them predominately located on the western side of the country.

The Map [16] to the right shows the distribution of current solar farms throughout Poland. Not surprisingly South-East, region with the highest irradiance, is also the region with the highest number in solar PV installations. Despite relatively low total installed capacity of solar PV in Poland, the country has a large number of installation. This is mainly a result of the governmental support scheme where installations over 1MW have not been allowed.





Poland's Draft National Energy Policy.

On the 8th of November 2019, the Ministry of Energy has presented an updated draft of Poland's Energy Policy until 2040 [17]. The Energy Policy of Poland until 2040 (EPP2040) is a response to the key challenges faced by the Polish energy sector sets the strategic directions for the energy sector. EPP is consistent with EU's strategic documents [18].

Poland's draft National Energy Policy by 2040 [19]:

- The rapid diversification and growth of energy generation from low-carbon sources which will lead to a 50% reduction of CO2 emissions in the electricity sector by 2040.
- The decreased share of coal in electricity production to ca. 60% in 2030. The electricity production from coal will fall substantially from 130 TWh in 2020 to 75 TWh in 2040.
- The growth of RES to 27% in electricity production in 2030. The full realisation of off-shore wind and PV potential which can provide up to 30 GW of new power generation capacity in total by 2040.
- The construction of the first nuclear power plant planned for 2033 with a capacity of 1-1.5 GW. 6 nuclear units to be built by 2043 with a total capacity of ca. 6-9 GW.



2020 EU Targets.

National Targets



The national targets for 2020 for RES, are set as follows:

- 1. Contribution of the energy produced by RES to the gross final energy consumption: 20%
- 2. Contribution of the electrical energy produced by RES to the gross electrical energy consumption: at least 40%
- 3. Contribution of the energy produced by RES to the final energy consumption for heating and cooling: at least 20%
- 4. Contribution of the electrical energy produced by RES to the gross electrical energy consumption in transportation: at least 10%.

Expected Growth.



● Coal ● Renewables and Waste ● Natural gas ● Nuclear

Forecast share of energy sources in gross power production in Poland from 2020 to 2040 [20].

This graph demonstrates that coal is forecasted to fall by 42% from 2020-2040, with renewables increasing by 18% over this period.



Expected Growth.

Renewables at the heart of the Energy Mix

Table 9: Annual average investments needs in 2010-2030 (USD million per year)			
	Reference Case	REmap 2030	
Sector			
Power generation and district heating (including CHP)	1535	3267	
Industry	20	242	
Buildings	358	725	
Transport	129	219	
Total	2 0 4 1	4 4 5 2	
Resource			
Hydropower	29	78	
Wind	650	1578	
Solar PV	209	491	
Solar water heating	286	779	
Geothermal heat	44	123	
Heat pumps	18	54	
Biomass	806	1347	
CHP	442	811	
Power-only systems	135	120	
Heat-only systems	101	198	
Liquid biofuels production	129	219	
Total	2 041	4 4 5 2	



The table [21] demonstrates that Poland requires USD 2 billion investments per year to fulfil the Reference Case, and an annual additional USD 2.5 billion on average to satisfy the Remap Options to meet their 2030 targets, amounting to a total of USD 4.5 billion investments.

- Most of the additional investment needs are in the power sector (USD 1.7 billion per year), in particular for wind (USD 0.9 billion per year). Biomass technologies (including the capacity to produce liquid biofuels for the transport sector) also require an annual addition of USD 0.5 billion beyond the Reference Case.
- Additionally, the European Investment Bank has been investing 4-5 billion euros annually in current years to finance Polish renewable projects. According to Piotr Michałowski, director of the Warsaw office of the EIB in 2019, EIB will also be supporting. Poland takes great advantage of this as Poland has only 2%. shares in the EIB's capital, but the share of all Polish projects in the total EIB investment portfolio is almost 7% [22]

THE AUCTIONS.

A CFD Like system...



The Auction System.

Poland has a Contract for Difference (CfD) system. CfD is based on a difference between the market price and a reference price which is agreed in an auction. Auctions are organised by the Polish government. The government allocates a budget to each auction, decides on technologies allowed to bid and sizes of installations and determines a budget per each basket. In the Polish auction scheme, auction baskets are separated according to [23]:

- 1. Technology
- 2. Size (there are separate auctions for <1MW and >1MW)
- 3. Whether the power plant is new or existing, intending to shift from the green certificate system to the FIP system

Each auction an investor can bid up to a maximum reference price and up to a maximum capacity for each basket and technology. Usually, wind and photovoltaic plants have the biggest budgets as they are key technologies in the renewable energy source. Once auctions have been won, the President of the Energy Regulatory Office announces the results in 21 days.



The 2019 Auction System.

Last auctions were held in Poland at the end of 2019 (25-26 November, 2-6 December and 9-13 December). The most important auctions for investors in wind power and PV took place on 5 December. The auction applied to new installations in this sector, with a capacity above 1 MW [24].

In total, the government allocated PLN 69.6 bn for 12 auctions in 2019 [25]:

- PLN 44.3 bn was allocated to installations which will start generating electricity after the auctions ("New Installations")
- PLN 25.3 bn to installations which started generating electricity before 30 June 2016, enabling them to migrate to the auction system ("Existing Installations").
- Separate auctions were held for installations with a capacity of <1 MW ("Small Installations") and >1 MW ("Large Installations").

However, only 5 of the 12 RES auctions were resolved [26]:

- Two RES auctions were dedicated to onshore wind and PV installations
- Three RES auctions were dedicated for other technologies

The other RES auctions were cancelled as they failed to attract the minimum three offers.



2019 Auction Results.

The 2019 RES auctions were the largest ones announced to date by the Energy Regulatory Office.

Source: [27]

Large onshore wind farms and PVs auction 2019 results				
80 producers entered the market	101 offers were submitted	78 TWh being offered to sell (68% of the maximum volume) for 3.6 billion euros (PLN16.2 billion)and constituted 50% of the funds	The most expensive offers amounted to more than last year's auction prices, yet still lower than current average energy prices on the commodity market in Poland	
Highest winning bid was PLN233.29/MWh (approximately €55/MWh).	The lowest accepted bid was PLN162.83/MWh (approximately €38/MWh	20% of the most expensive offers were automatically rejected	The large onshore projects entering the auction failed to use up the entire pool of funds offered	

The total connection capacity of the wind farm projects, which won the auction may even exceed 3 GW which, after their construction, will increase the installed capacity of onshore wind farms in Poland from approximately 6 GW at present to approximately 9 GW [28].

	1 MW PVs Auctior	n 2019 Results	
260 producers entered the auction	1,044 offers were submitted	759 won offers were won	A maximum of 11.45 TWh had been anticipated to be sold for no more than PLN4.2 billion



2018 Auction Results.

Comparison

Results in 2018				
The maximum price at which electricity produced from renewable energy sources was "sold" at auction in this basket amounted to PLN 216.99/MWh [30].	The minimum price at which electricity was produced from RES was "sold" at auction was PLN 157.80/MWh, an weighted average price from all of the winning bids was PLN 196.17/MWh [31].	The weighted average price from all of the winning bids was PLN 196.17/MWh [32].		
The highest bid was PLN327/MWh (approximately €76/MWh) and the lowest accepted bid was PLN269/MWh (approximately €63/MWh	We anticipate that the energy volume bought at the auction will translate into construction approximately 800 MW of new PVs.	The entire energy volume was used, while the prices offered were below the average reference prices		
By way of a comparison, 2018's auction prices ranged from PLN289,99/MWh (approximately €68/MWh) to PLN364/MWh (approximately €86/MWh).	The energy total sold was 11.43 TWh at the price of PLN3.6 billion (approximately €847 million).	The number of bids which won the auction at the time was 31 (and according to market information theses were only wind projects).		

Source: [29]



2020 Auctions.

Prices and capacities

Although dates of 2020 auctions have not been announced yet, the government published information on budgets, baskets and reference prices. [33]

The wind and photovoltaic power plant prices manage the biggest budgets for the 2020 auctions.

For wind power plants up to 1 MW, the maximum price is PLN 320/MWh and above 1 MW it is PLN 250. For installations >1MW, this price is lower than 2019's auctions, where it was PLN 285/MWh.

In the case of photovoltaic power plants up to 1 MW, the reference price is PLN 360/MWh, and for PV power plants with a capacity of more than 1 MW, the price is PLN 340/MWh. Both prices are lower than last year's reference prices, which were PLN 385/MWh and PLN 365/MWh respectively.

Investors winning this year's auctions will be given the right to sell energy at the reported price (through the right to cover the so-called negative balance) for a period of 15 years, with the price expected to be indexed by inflation every year.

Additionally, this year's wind and photovoltaic auctions for projects with a capacity of more than 1 MW are projected to purchase energy from wind farms with a capacity of up to 800 MW and from 700 MW photovoltaic power plants. This was signed by the Prime Minister on 31 December 2019.



THE MARKET CHANGES.

Simplifying and clearing the system from speculative investments...



Market Drivers.

The key drivers for the development of the renewable energy sector in Poland are [34]:

- Dynamic economic growth in recent years, growing number of businesses and a domestic market of 38 million consumers.
- Growing demand for green energy due to energy policies: RES increase in final energy consumption up to 15.5% in 2020 (19.3% for electricity, 17% for heating and cooling, 10.2% for transportation fuels).
- Obligatory reduction of the percentage of municipal biodegradable waste that is landfilled down to 35% by 2020, and building waste-to-energy plants.
- Favourable wind conditions and a large potential for obtaining biomass and biogas.
- Investment incentives for renewable energy producers



GREENSOLVER ABOUT US.

What do we currently do and what are we going to do in Greece...



About us.

Greensolver was created in 2008, by technical experts, for investors and asset owners. We felt there was a real need in the market for an experienced and independent service provider catering to the infrastructure investors to deliver professional, world class services.

Experienced service provider

Greensolver has an extensive experience of Technical and Commercial Management (TCM), Construction Supervision (AMO) and Advisory, being on the market since 2008.

Our experience relies on:



Construction 1.68 GW+



Operation
1.4 GW+



Consulting & Advisory 15.5 GW+

We are proud to be amongst the market leaders in France and the largest Asset Management company (in total operational asset capacity MWp) in the Netherlands.



About us.

Quality

Greensolver understands the requirements of the financial community. Our number one objective is to help you achieve your financial goal, whilst taking away the burden of daily operations. Our job is to be your technical arm so you can focus on other issues that occur.

Greensolver is certified ISO 9001, ISO 14001 and OSHAS 18001 standards equipped with state of the art analysis tools and processes developed from its experience, that each of our customers benefit from. Greensolver is also the first asset manager in France to be certified with ISO 55001 standard dedicated to asset management. Greensolver has been certified as RRM (Registered Reporting Mechanism). That means that under the REMIT regulation, we are officially in a position to act as your representative and are allowed to send records of Wholesale Energy market transactions to the ACER (Agency for the Cooperation of Energy Regulators).



About us.

Innovative Tools

We launched **Greensolver Index** in early 2014, an innovative operation benchmarking tool enabling independent asset owners to compare themselves across a set of more than 45 KPI's.

In September 2015, we also launched **GreenBoost**, in cooperation with Newgreen. GreenBoost® is a unique service on the market which guarantees both the wind resource and the availability of a wind farm.

In 2016, we launched **Bladesolver**, an offer that enable the project owner to avoid risk and underperformance link to a damaged blade.

International services

We currently manage assets in nine European countries (Cyprus, France, Italy, Ireland, The Netherlands, Portugal, Spain, Sweden & United Kingdom), from our three European offices (Paris, London & Groningen).

We have been active in most parts of the world since the beginning, performing technical due diligences or construction assignments from Australia to Mexico, Poland, USA ...

Our team is multi-national and speaks 9 languages.



OUR SERVICES.



Project Origination & Structuring

Being one of the pioneer investors in renewables gives us access to high quality assets, allowing you to benefit from our unique network of developers, investors and offtakers to close bilateral deals and deploy your capital. The Greensolver team will support you throughout the process to de-risk your investment and maximise your return.

Our wind & solar experts asses the project sellers capabilities and track-records and we tailor our offers to your investment strategy and your technical capabilities where our technical and financial experts support you during the acquisition, pre-construction, construction and operation phases.

Experience

- •Certified by Climate Bond Initiative as Approved Verifier •Management of Eolfi, the first investment fund specialized in renewables in France
- •Acquisition of 30 operational or RTB wind and PV projects totalling 288MW in France and Greece
- Acquisition of Ridgeline, a US based development company with 6 GW of projects under development
 Structuring of co-development agreement in Poland for
- 100 MW of wind project
- Sale of 15 wind and PV projects totalling 134 MW
 Sale of Ridgeline and Eolfi development platform
 Involvement in the acquisition or sale process of 12.7 GW as technical advisor



Greenbond: Certifying your Greenbonds to raise more capital	Origination: Deploying your capital	Structuring: Negotiating the best conditions for your contacts
Pre-Issuance certification	Market study	Co-development agreement structuring
Post-Issuance certification	Land Selection	PPA structuring
Greenbond report framework design	Project Pipeline	Project feasibility
	Development Platform	Risk assessment
	Ready to build or turnkey project	Suppliers selection
	Operational asset suitable for repowering	EPC and O&M contract negotiation



Advisory & Consulting

We have been managing assets on a daily basis for the past 12 years, which gives us a unique understanding of potential issues that can happen with an asset. This intimate knowledge is not a standard in the industry, and something you benefit from as a Greensolver customer.

We adapt our offer to your needs, especially concerning deliverables expected and our audits are made step by step (red flags, midterm report, final report) to give you clear, and simple indications.

Additionally, our team is experienced & multiskilled as we have 10+ years of expertise with 12.7GW of technical advisory performed, where only experienced engineers work on due diligence (5+ years).

Technical Due Diligence: Negotiating the best conditions for your contracts	Performance Optimisation: Enhancing your asset performance	Contract Negotiation: Negotiating the best conditions for your contracts	Cash-flow Assumption Review: Providing expert feedback on key assumptions
H&S: Compliance, Audits & Management	Lifetime optimisation	Equipment Supply Agreement	Revenues
Cybers ecurity			
Plant design (optimisation & HSE requirements)	Bladesolver	Balance of Plant	OPEX
Feasibility studies	Yaw alignment	Operation & Maintenance	CAPEX
Permits	Maintenance optimisation	Electricity contracts	Financing
Contracts			
Construction & commissioning schedule			
Grid connection issues			
Acoustic studies (if wind)			
Yield Assessment			



Operation

We deliver under time pressure and can adapt our deliverables to your needs; format, data to be included, and periodicity: monthly, quarterly, annually. We have multiple control rooms, based in Paris/UK/Groningen for localised rapid handling of alarm messages (10 minutes prompt). We run 24/7, 365, and we handle issues as soon as they are identified, dealing with them either remotely or through our local site managers and the site's O&M providers.

Technical Management: Supervising & controlling asset's production & performance	Commercial Management: Managing your SPV's
On a daily basis, our experts work with WIS & Breeze software. Each software allows them to have access from one single platform to monitor every wind & solar asset, enhancing our productivity.	We manage more than 80 SPV (including 880MW under operation) for our customers.
One of our experts has also developed a unique software which connects to assets' telecommunication networks and which sends alerts when communication is lost.	Greensolver Finance is a successful joint venture between Greensolver and Premier Monde, chartered accounting firm.
24/7 operation & monitoring	Greensolver Finance allows investors, developers and asset owners to benefit from an in-house commercial & administrative management service.
Monthly reporting	In-house accountants
Site visits	Tax declarations
Site access monitoring	Payment processing
Maintenance management & optimisation	Debt management
Asset performance optimisation	Land lease management
HSE Compliance	Cash flow management
RRM declaration	Electricity sales invoicing





Development & Construction Management

Being in the market since 2008 allows us to have various processes, methodologies tools, regularly improved and and enriched. Through those processes we ensure your wind or solar assets are built intime and on budget. We are a team of engineers that have a deep understanding of investor and lenders expectations and constraints. We have seen projects develop; we have done financial closings. We talk the same language even though our focus is technical. With 12+ years' experience, 1662MW of wind & assets have been built and 250MW were built between 2016-2018 alone.

Pre-financing technical Due Diligence: Reviewing the project bankability	Pre-construction: Planning and preparing the construction stage	Construction supervision: Acting as your main point of contact for the construction of your asset	Commissioning review Managing taking over & commissioning
Yield assessment	Technical Due Diligence	Coordination of suppliers & subcontractors	Technical documentation
Plant design (optimisation & HSE requirements)	Technical solutions evaluation	Quality review	Equipment / EPC
Feasibility studies	OPEX & CAPEX determination	Transport management	Balance of Plant
Permits	Call for tenders management	Costs & budget management	Grid substation
Contracts	Suppliers selection	Schedule monitoring	
Construction & commissioning schedule	HSE plan elaboration	HSE compliance review	
Grid connection issues		Procedure compliance review	
Acoustic studies (if wind)			



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