

THE INVESTOR'S HANDBOOK FOR RENEWABLE ENERGY IN BRAZIL

AN INSIDER'S GUIDE



REA CONSULT

Preface

Favorable geographic conditions, growing electricity demand, progressive regulatory reform, and maturing supply chains, have made Brazil one of the most exciting countries in the world for renewable energy investment.

According to Bloomberg's **2019 Climatescope report**, Brazil ranks third most attractive in the world for clean energy investments. Brazil also ranks third globally in terms of installed capacity from renewable energy sources, after only China and the United States, according to **IRENA** analysis. Despite this, Brazil only ranks 7th in the world for installed wind power capacity and 22nd for solar.

The real renewable power in Brazil comes from hydroelectric, where it is only second to China. Large hydropower plants account for around 80% of domestic electricity generation, providing flexible and low-emission base power supply. However, further expansion is constrained by the remoteness and environmental sensitivity of remaining hydropower resources.

As a result, reforms in the Brazilian energy market over the last decade have focused on diversifying the country's energy mix. While natural gas plays a role in this new power landscape, the key focus has been to promote the development of wind and solar power generation by creating the technical, socio-economic, and political conditions required to encourage investment.

Transmission capacity and technology have improved to account for intermittent supply, new financing mechanisms have been put in place to suit a wide range of projects, and more supportive regulation has been established. From 2017 to 2020 (ytd) the average annual installed capacity growth of centralized solar power was approximately 35%. In the same period, distributed solar power grew by more than 120% on average, benefiting from the world's most progressive net metering regulation. The more mature wind sector saw an average increase in

the generation capacity of 8% per year, while total wind capacity is expected to double between 2017 and 2024.

There is a famous saying here, we say that "Brazil is not for beginners". Despite reform, Brazil is still an emerging market with many of the inefficiencies and cultural hurdles

you would expect of a populous Latin American country. However, those who can navigate Brazil's dense legal and regulatory jungle will discover a renewable energy market that is brimming with potential. Since I began working in the renewable energy sector, I have seen markets peak and stall. The conditions are right, now is the time for Brazil.

The Investor's Handbook for Renewable Energy in Brazil has been developed by REA Consult to support that journey. It serves as an insider's guide for those developing projects renewable energy in Brazil and anyone curious about the inner-workings of this lucrative market. A new chapter will be released every week, all free to read and share. See all the chapters published so far and **follow the evolving story here**



Rachel E. Andalaft

Founding Partner at REA Consult

REA Consult is a management and consulting firm committed to building bridges for international sustainable investments. Born in Brazil with offices in Europe, Asia, and South America, REA Consult has a global track record of supporting successful projects.

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BRAZIL'S RENEWABLE ENERGY SUPPLY CHAIN

IN A NATION HUNGRY FOR ENERGY, RAPIDLY DEVELOPING SUPPLY CHAINS WILL PROMOTE BOTH WIND & SOLAR GENERATION CAPACITY DEPLOYMENT

- △ Wind Energy Ecosystem
- △ Wind Supply Chain

- △ Solar Energy Ecosystem
- △ Solar Supply Chain

Brazil's Renewable Energy Supply Chain

Overview

Both wind and solar power producers have benefited greatly from Brazil's ideal geography, but there is no industry without an effective supply chain.

Efforts made to improve the entire business ecosystem has been critical to the ongoing success of Brazil's wind and solar sectors. The 133 local producers responsible for over 80% of Brazil's turbine components have proved as reliable as the wind that blows across this emerging renewable energy market.

Brazil's solar sector has also succeeded in attracting a number of international manufacturing players to establish a presence in the country. While this was an important factor in the exponential growth the industry has experienced, higher energy prices and a new regulatory framework also played key roles amid a growing climate change agenda.

Wind energy supply chain

By the end of 2019, Brazil had more than 15 GW of installed wind power capacity, and with an average of 15 people hired for each installed MW, the social benefit of wind projects is undeniable. Nine wind energy suppliers stand out for their role in the industry, the following table shows their locations and main products.

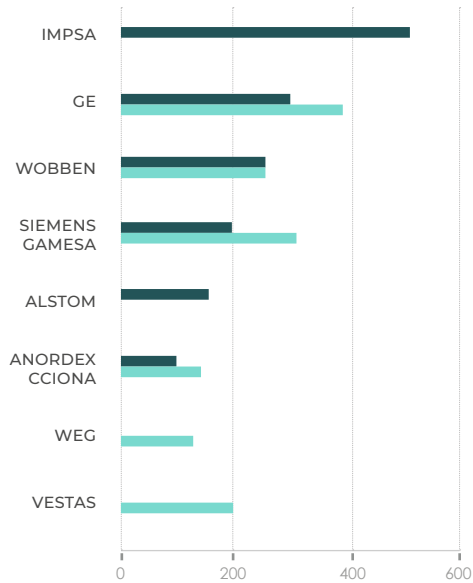


Main National Component Manufacturers in the Wind Industry in Brazil

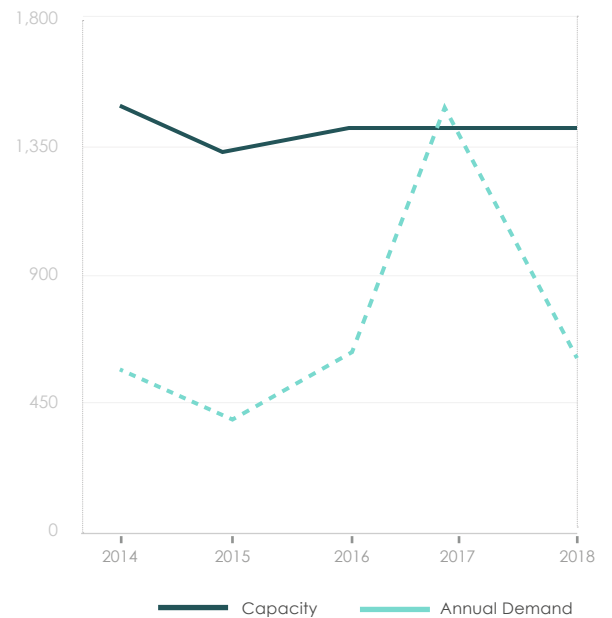
Manufacturer	State	Location	Main Components
Siemens-Gamesa	BA	Camacari	Nacelle
Acciona	BA	Simoês Filho	Hub
	RN	Areia Branca	Concrete Tower
Vestas	CE	Aquiraz	Turbine, Blades
Wobben/ Enercon	CE	Pecem	Blades
	BA	Juazeiro	Tower
	SP	Sorocaba	Turbine, Blades
WEG	SC	Jaraguá do Sul	Turbine
GE	SP	Campinas	Nacelle
TEN - Torres Eólicas do Nordeste	BA	Jacobina	Tower
LM Wind Power	PE	Suape	Blades
Aeris	CE	Pecem	Blades

Below we unpack and explore 2017 data from ABEEólica, the most representative wind association in Brazil, which consolidates data for the national supply chain:

Wind Turbine Producers. Total capacity of 1,428 units



Capacity vs. Demand of Wind Turbines in Units



The table below shows how the most prominent turbine producers in Brazil shape up on the world stage:

Main Producers (Brazil - market share)		World Ranking	
1	GE/ ALSTOM (38%)	1	Siemens
2	Wobben (14%)	2	Vestas
3	Nordex-Acciona (13%)	3	Goldwing
4	Vestas (10%)	4	GE Renewable Energy
5	Siemens-Gamesa (7%)		
6	WEG (1%)		

While rankings remain similar, the scale of the projects themselves are increasing rapidly. In 2019, the average turbine nominal power among the auction winners was 3.2 MW

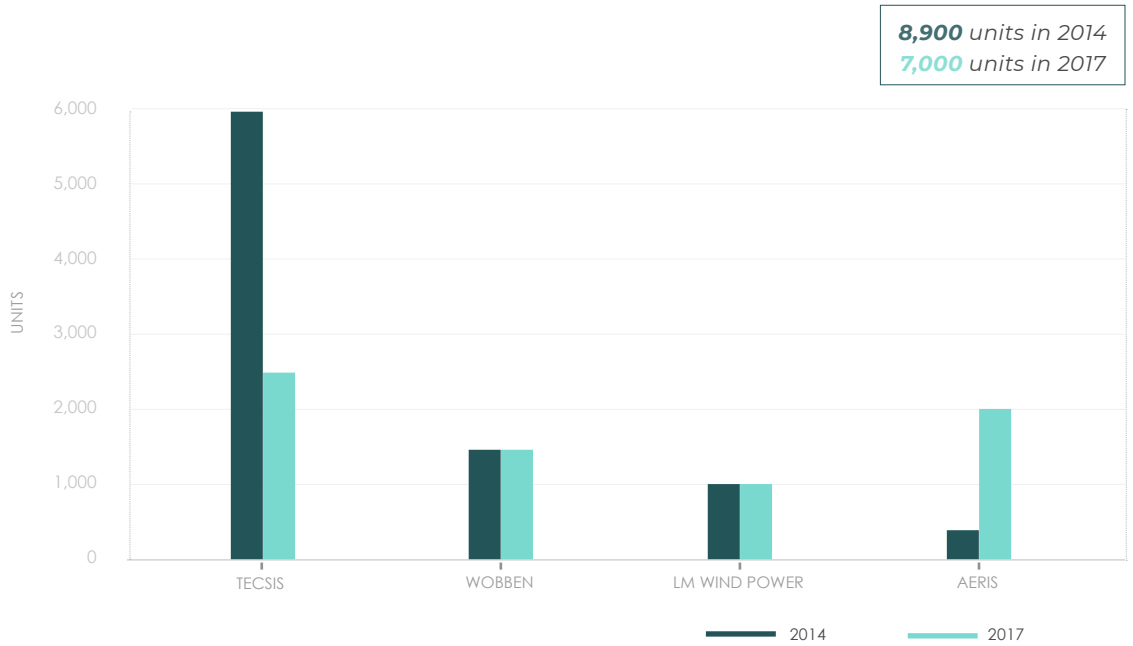
(23% higher than the average from 2018); and the average hub height and rotor diameter were 118 meters and 130 meters respectively.



Wind Turbine Producer Output

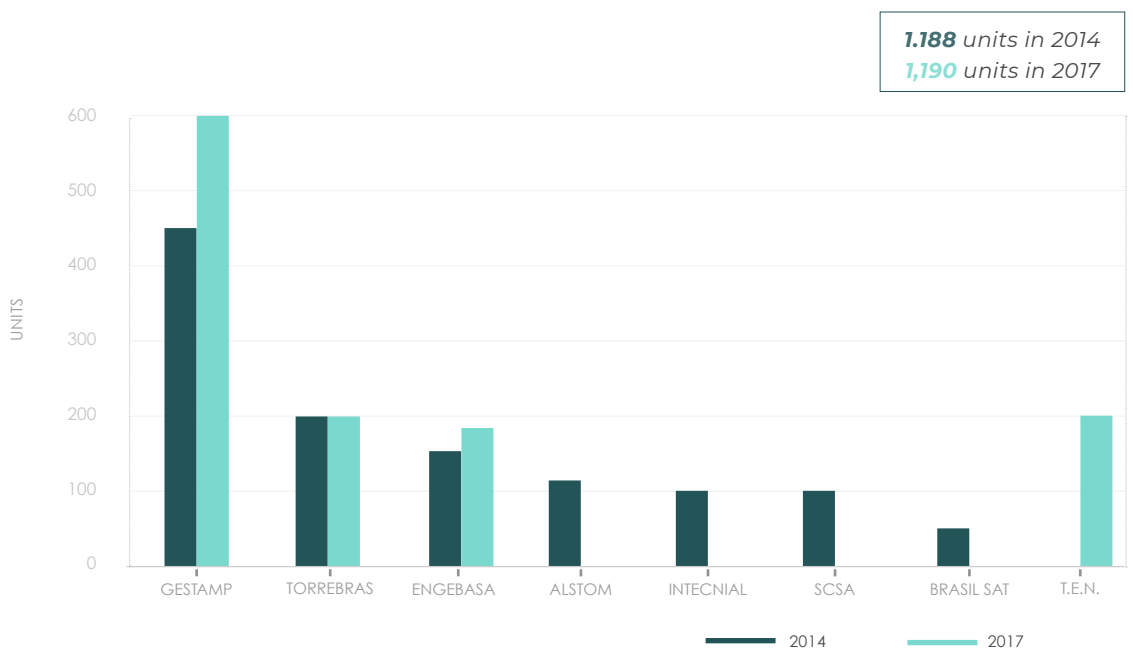
By 2017, Brazil had a total of four turbine blade producers. Major wind turbine blade producers. Their individual output in 2014 and 2017 is shown in the graph below.

Turbine blades represent the most expensive individual item in wind turbines, around 22% of the total turbine cost, directly impacting turbine's performance. The decrease in capacity from 2014 to 2017 is due to a Tecsis' factory closure.



Steel Tower Producer Output

Throughout the years, some mergers and acquisitions happened in the tower supply chain industry, but the production capacity remains almost the same since 2014, an average of 1.190 towers/year, as shown below.



The list below highlights the major steel tower producers in Brazil:

1. BRASIL SAT
2. ENGEBASA
3. GESTAMP
4. INTECNIAL
5. NTB – Nordeste Torres do Brasil Ltda
6. SCS A
7. TORREBRAS
8. Torres Eolicas do Nordeste (TEN)
9. ALSTOM

The wind power industry has gained efficiency throughout the years, reaching an installed turbine average price of \$22.16 in 2017, and much has been done since then.

A few additional measures are being discussed with the Brazilian government to develop the wind power market :

- △ Improvements in local content regulation
- △ Tax incentives
- △ Increased competitiveness among suppliers
- △ Export incentives for wind turbines components
- △ To develop the national supply chain industry, there are some local content rules in place, which determine the towers should have at least 60% of certain raw materials made in Brazil.

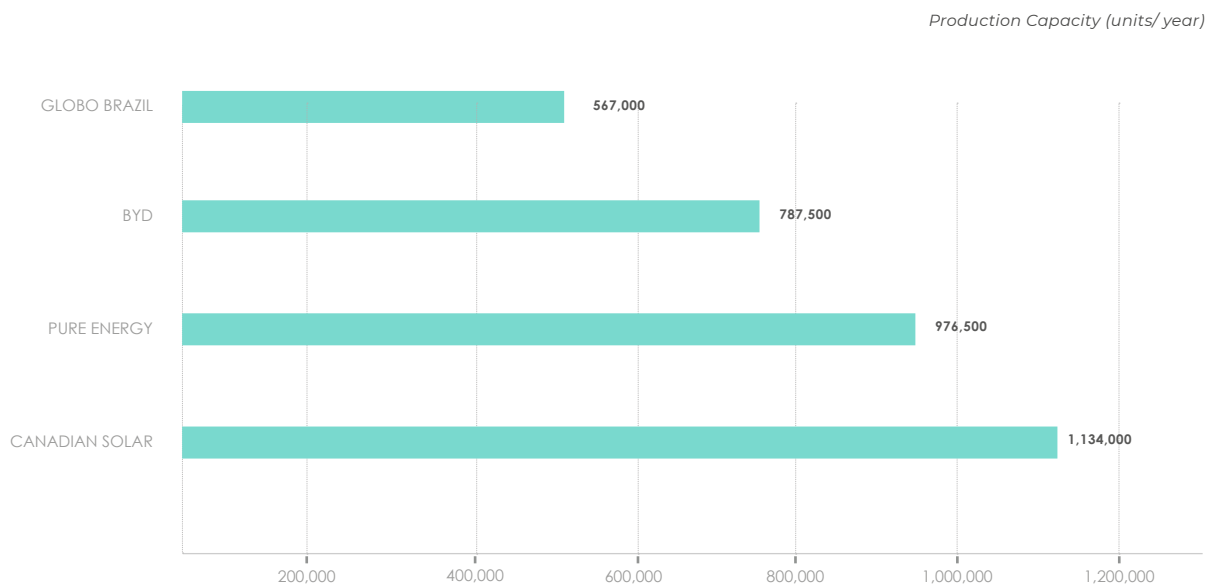
In 2019, the average wind energy bid price in the auctions was below R\$ 98/MWh. The average CAPEX observed in the wind energy auctions was approx. R\$ 4.200 /kW.

Solar Energy Supply Chain

The solar market in Brazil is subject to certain local content rules for participation in the government energy auctions. Qualified suppliers are listed by the National Development Bank within the so called FINAME program (Special Industrial Financing Agency of the BNDES). According to the ABSOLAR, the solar energy association in Brazil, the FINAME listed solar supply chain in country is composed as follows.

- △ 45 solar energy system kit producers (distributed generation)
- △ 11 solar tracker producers
- △ 10 solar inverter producers
- △ 8 solar panel producers
- △ 2 string box producers
- △ 1 battery producer

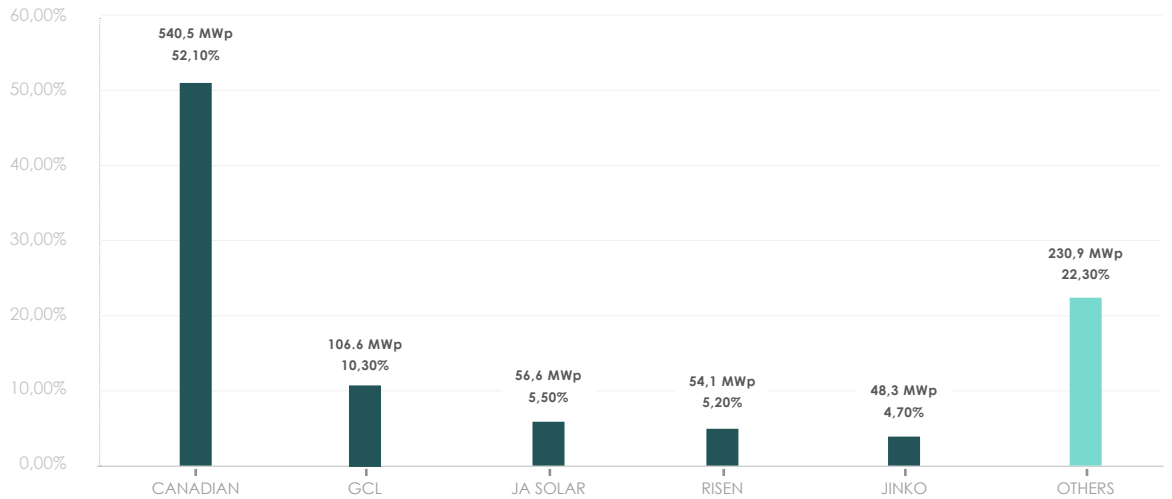
The main PV module manufacturers producing in Brazil, are shown in the table below:



How the most prominent turbine producers in Brazil shape up on the world stage:

Most used modules among auction winners in Brazil		World Ranking	
1	JinkoSolar	1	JinkoSolar
2	Canadian Solar	2	Yingli Solar
3	BYD	3	Kyocera Solar
4	Trina	4	Canadian Solar
5	Chint	5	Komaes
6	GCL	6	GCL
7	JA SolarFirst Solar		
8	Longi		
9	Risen		
10	Suntech		

Market Share of PV Module Manufacturers in Brazil 2018



How the most prominent turbine solar inverter producers in Brazil shape up on the world stage:

Most used inverters among auction winners in Brazil		World Ranking	
1	GE	1	Sineng
2	Ingeteam	2	Huawei
3	Fimer	3	Sungrow
4	Sungrow	4	CMA
7	WEG		
8	Huawei		
9	Power Eletronics		
10	Siemens		

* For distributed generation single-phase inverters, SolarEdge, with a market share of 4%, is the main supplier.

Brazil also relies on a national inverter industry, the main manufacturers are:



EPC Providers

There are some engineering, procurement and construction (EPC) enterprises that provide these services to solar plants. The main suppliers in this industry are: Biosar, Prodiel, Motrice, Tozzi, SNEF, Enerray, WEG, and Elecnor. Jointly, they are responsible for most of the operating projects in Brazil.

In 2019, the average solar bid price in the auctions was around 78 R\$/MWh and the average CAPEX was 3.200 R\$/kW. Like anywhere, the local Brazilian solar industry benefits from cost optimization and technological development, and the CAPEX of solar plants has been decreasing consistently, both due to economic scales and to local regulation and incentives.

If you are interested to know more, contact **RECONSULT** for a complete study on electricity price and CAPEX realized in the local solar sector.

In conclusion, Brazil has a well-prepared industrial base to supply both wind and solar energy technologies. Huge renewable energy projects are playing important roles in an expanding free market and, as a result, it will entice new suppliers and increase the overall competitiveness of a blossoming industry.



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Please note that the energy field is dynamic, and the material and data presented herein could change.

Sources

ABDI	BlueSol	CNJ	Iberdrola
ABEEólica	Brazil Government	CTGAS-ER	Instituto Acende
ABSOLAR	Canal Energia	EPE	MME
ANEEL	CBFT	EXAME	ONS
BDNES	CCEE	IBD Group	Valor Sectorial Energia

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