ABEEólica
Associação Brasileira
de Energia Eólica

Annual Wind Energy Report 2019

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MESSAGE FROM THE CEO

Elbia Gannoum
CEO ABEEólica –
Associação Brasileira de Energia Eólica

It would be fair to say that 2019 is a milestone in the history of Brazilian wind energy. We celebrated ten years since the first wind-energy only auction, and wind is now the second source in the country's energy grid. In the past decade Brazil went from 600 MW to 15.45 GW of installed wind energy capacity. The coming ten years will also be years of growth. Winds in Brazil will continue firm and strong, and the wind-energy production chain will remain efficient. However, contracting may become much different, meaning the coming period is likely to be completely different from the previous ten years.

First of all, Brazil is moving towards a model with a larger and growing so-called free energy market (ACL). The Ministry of Mines and Energy is discussing new policies to "Modernize the Electric Power Industry", the main goal of which is to add renewable sources, give consumers more freedom of choice and embrace new technology. All of these changes will have, as a background, a deregulated or open market. Increased market freedom will bring with it challenges and insecurities, such as the adoption of hourly pricing.

For wind farms however, the free market has been growing for several years. In 2018 more power was sold in the free market than in the regulated market (ACR) - 1.25 GW sold at auctions and over 2 GW sold to free market clients, and 2019 was no different - 1.13 GW sold in the regulated market and over 2 GW in the free market. Wind farms are thus very well positioned to take advantage of the opportunities that will certainly arise with the "Modernization of the Electric Power Sector". As stated above, the coming ten years will bring with them a freer market, which is excellent news for Brazilian winds.

I believe that, as the economy recovers, we will see increased demand in the regulated market, but this is likely 2-3 years out, or even more depending on how the global economy behaves. A further advantage is that implementation of the new model is likely to further strengthen the free market.

The good winds in Brazil area already taking advantage of this trend. Using hybrid power farms, batteries and new project models that will mitigate the variability of wind as a power source, we will be able to increasingly add different sources to the nation's energy matrix, making it far more secure. As the Brazilian Transmission System is entirely interconnected, renewables can be added to the system quite rapidly, especially as the Government has already taken steps to expand transmission.

Something else that future calls for, but that is already here, is hourly pricing. The industry is very interested in this approach, as it means a significant change in how the sector operates, and we must all be prepared. For this reason, ABEEolica has we created a working group to analyze the impact of hourly pricing on wind energy, taking part in discussions of this topic to fully understand how it will affect wind farms. Our goals is not to fight the arrival of the hourly PLD, but to be well prepared for this new scenario.

Our good winds will continue to blow strong and generate energy for society. Our part is to work hard to take advantage of them in a sustainable manner that is also in line with future changes, some of which are already at our doorstep. I invite all of you to read this Annual Report, with the main results for the year 2019.

INSTALLED CAPACITY IN BRAZIL ALL SOURCES

In 2019, 38 new wind farms were built, adding 744.95 MW of new capacity. The new projects were installed in the states of Bahia, Rio Grande do Norte and Maranhão.
It is important note that, due to the cancellation of auctions scheduled in late 2015 and 2017, this new capacity is below the capacity added in previous years.

NEW INSTALLED CAPACITY ADDED IN 2019 (MW)

State	Power (MW)	Number of Wind Farms
BA	501.90	30
RN	145.85	5
MA	97.20	3
Total Geral	**744.95**	**38**

Source: ANEEL / ABEEólica

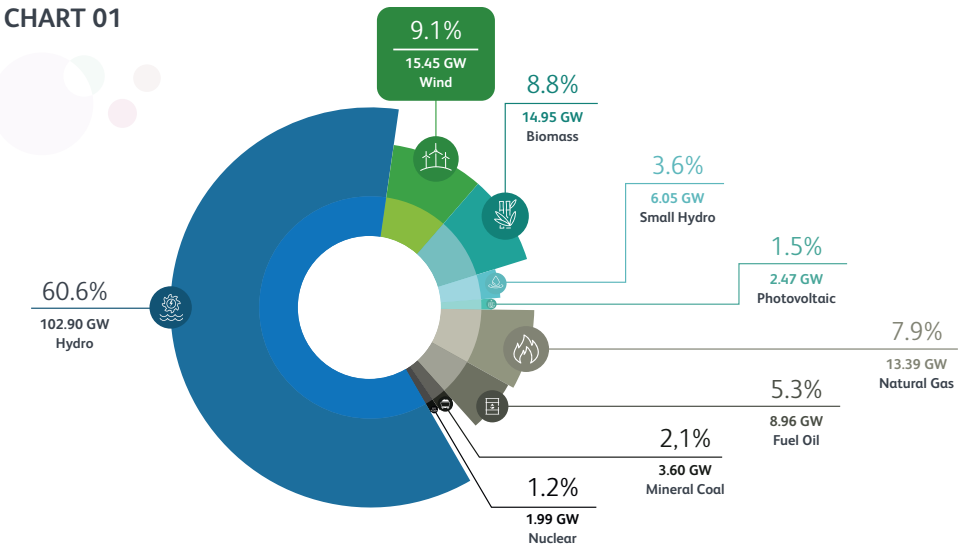
By the end of 2019 there were a total of 620 wind farms and 15.45 GW of installed capacity, a 5.07% growth compared to December 2018, when the installed capacity was 14.70 GW.

Considering all sources of power generation, a total of 5.96 GW of new capacity were installed in 2019, primarily in hydro and wind power, which accounted for 77.40% and 12.50% of the total respectively.

With this additional capacity, wind power now makes up 9.1% of the nation's power matrix, as shown in Chart 1 below, which shows the percent contribution from all sources of energy to the electric power grid in late 2019.

BRAZILIAN ELECTRIC ENERGY MATRIX (GW)

CHART 01

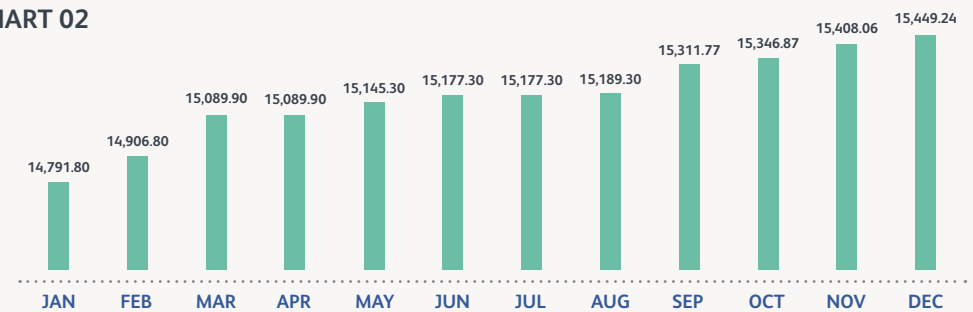


Source: ANEEL / ABEEólica

The 15.45 GW installed capacity includes 15.37 GW in commercial wind farms (99,54%) and 0.07 GW (0.46%) in the final states of operational tests. The following chart shows how installed capacity[1] grew over the year:

GROWTH OF INSTALLED CAPACITY IN 2019 (MW)

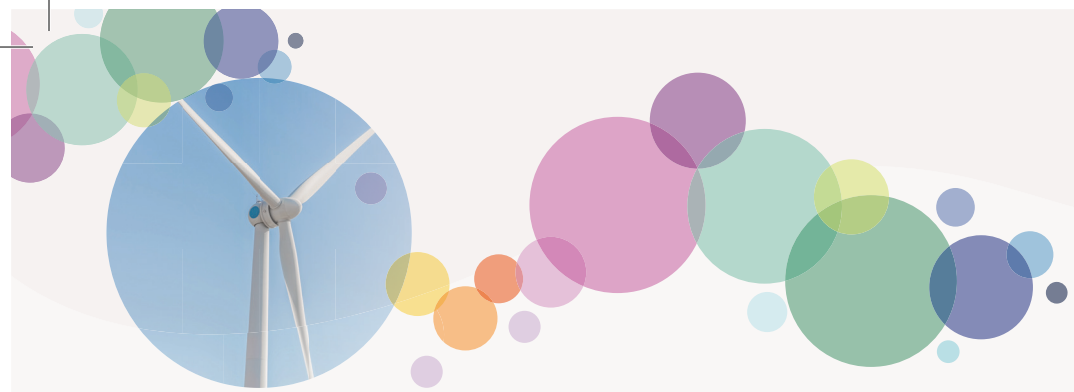
CHART 02



Source: ANEEL / ABEEólica

Total installed capacity in 2019: **744.95 MW**
Accumulated installed capacity in 2019: **15.45 GW**

[1]Considers the installed capacity of generating units in commercial operations and in test as defined in regulation, at the plant busbar. Considers the date of recognition as the date of operation, and the first date of test operations of the first generating unit of the wind park defined in regulation

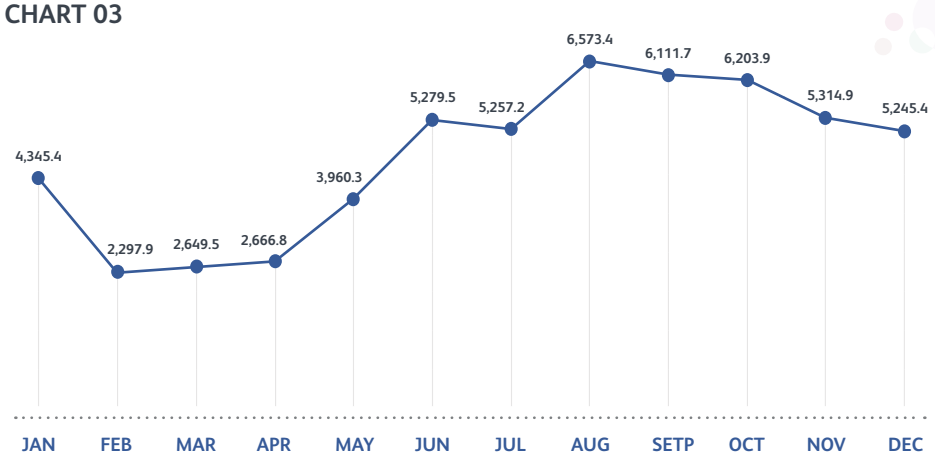


GENERATION

In all, 55.9 TWh of wind energy were generated in 2019. This is a 15% increase compared to 2018. In a monthly average of 2019, 4.658,8 GWh were generated, with a record in August of 6,573.4 GWh. Chart 3 shows average generation in 2019[4].

WIND POWER GENERATION 2019 (GWh)

CHART 03



Source: CCEE / ABEEÓLICA

Total generated in 2019: **55.9 TWh**

In terms of percentage and supply, wind power accounted for 9.71% of all the electricity generated and added to the National Interconnected System (SIN). Wind energy generation peaked in the August (14.17% of SIN generation), as winds are normally better in the second half of the year.

In 2019, wind energy generation broke a number of monthly records. Below are the records of the year for the entire integrated national system (SIN) and its subsystems.[5]

NE 88.8%

of all energy consumed in the northeast was generated from wind, with a capacity factor of 75.1%. *(Sep 06th, 2019)*

S 12.7%

of all energy consumed in the south was generated from wind, with a capacity factor of 78.0%. (*November 12th, 2019)*

N 7.4%

of all energy consumed in the north was generated from wind, with a capacity factor of 95.7%. *(December 21st, 2019)*

SIN 17%

of all energy consumed in the national integrated system was generated from wind, with a capacity factor of 75.5%. *(September 6th, 2019)*

Source: ONS

The chart below shows that the northeast subsystem's wind power capacity is close to the total, accounting for 86.7% in 2019, compared to only 10.3% in the south sub-system. This is because most of the wind farms in this country are located in the Northeast.

WIND GENERATION* AND ITS SHARE OF THE POWER SUPPLY

CHART 04

Region	2018 Generation (TWh)	2018 Share	2019 Generation (TWh)	2019 Share	% growth
SOUTHEAST	0.05	0.1%	0.06	0.1%	17%
SOUTH	5.75	12.4%	5.62	10.3%	-2%
NORTHEAST	39.69	85.4%	47.13	86.7%	19%
NORTH	0.99	2.1%	1.55	2.9%	57%
Total	**46.47**	**100%**	**54.37**	**100%**	**17.0%**

Source: CCEE / ABEEÓLICA

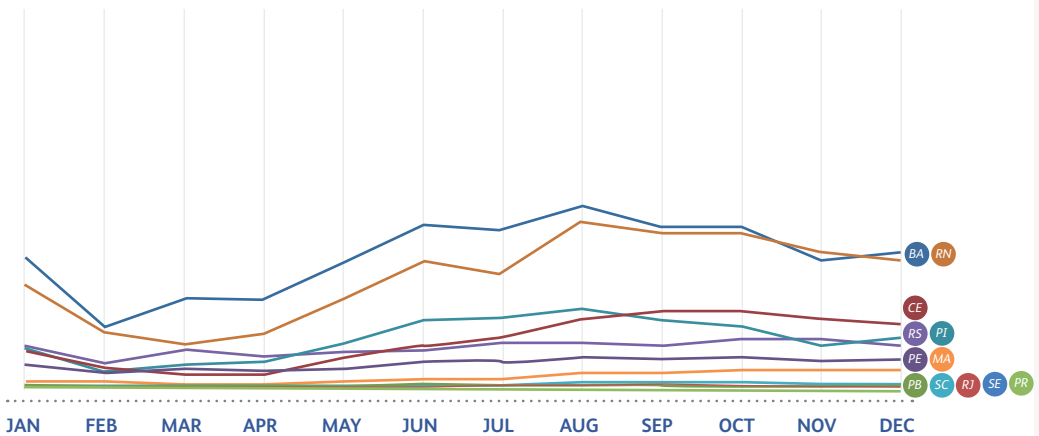
[4]This chart shows wind energy generated by wind farms in test and commercial operations at the connection point.
[5]The SIN is made up of four subsystems: Northeast, North, Southeast/Middle-West and South. The boundaries for these subsystems differ from the geographic boundaries. For wind energy, the north subsystem is comprised of the state of Maranhão.
*Considers wind energy generated by wind-farms in commercial operation at the center of gravity.

The five states with the greatest amount of energy from wind in 2019 were Bahia (16.83 TWh), Rio Grande do Norte (14.09 TWh), Piauí (6.34 TWh), Ceará (6.02 TWh) and Rio Grande do Sul (5.26 TWh).

Chart 5 shows the amount of wind power generated[6] in each Brazilian state.

GENERATION BY STATE 2019 (GWh)

CHART 05



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RN	1,095.4	601.6	469.4	566.8	963.8	1,336.0	1,204.0	1,761.3	1,645.0	1,654.8	1,432.2	1,359.7
BA	1,375.3	653.3	951.1	946.7	1,338.0	1,733.8	1,663.7	1,929.1	1,727.0	1,725.8	1,351.8	1,432.4
PI	427.4	191.7	258.8	284.7	467.6	731.6	739.7	844.2	722.8	656.3	495.1	520.0
RS	454.6	259.4	417.5	339.6	386.5	417.9	489.7	497.8	456.1	521.9	536.0	479.1
CE	419.6	221.1	153.3	162.9	316.9	435.2	539.1	729.7	814.8	808.4	741.7	682.0
PE	266.2	186.9	199.9	185.5	222.6	291.8	269.6	343.9	317.7	343.7	298.5	303.1
MA	89.0	57.6	54.4	43.2	84.1	94.7	118.1	173.5	175.7	204.9	229.8	225.6
PB	44.6	26.1	25.0	25.1	37.2	55.4	52.3	69.9	61.6	61.4	48.3	46.8
SC	14.9	17.3	21.9	17.2	30.0	35.9	38.4	44.4	38.0	38.0	36.9	31.8
SE	5.5	5.3	3.8	3.0	2.0	5.9	7.4	6.7	6.5	7.8	6.7	7.3
RJ	10.0	3.7	2.7	3.0	2.6	2.2	3.8	5.2	7.3	8.9	4.9	6.5
PR	0.2	0.2	0.2	0.1	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.2

Source: CCEE / ABEEÓLICA

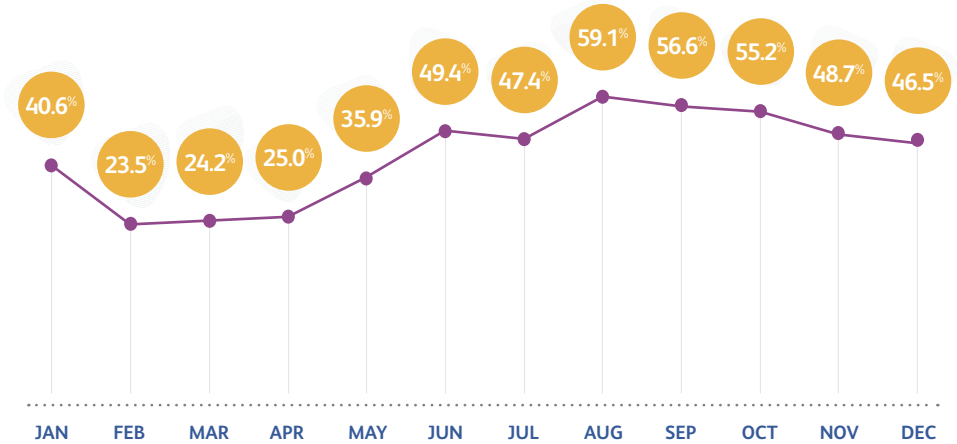
[6]This chart shows wind energy generated by wind farms in commercial operation at the connection point.

CAPACITY FACTOR

The capacity factor of a wind power source is calculated as the ratio of the plant's actual generation to its total capacity over the same period. The average in 2019 was 42.7%, peaking in August at 59.1%.[7]

CAPACITY FACTOR 2019

CHART 06



Source: ANEEL / CCEE / ABEEólica

Average capacity factor in 2019: **42.7%**

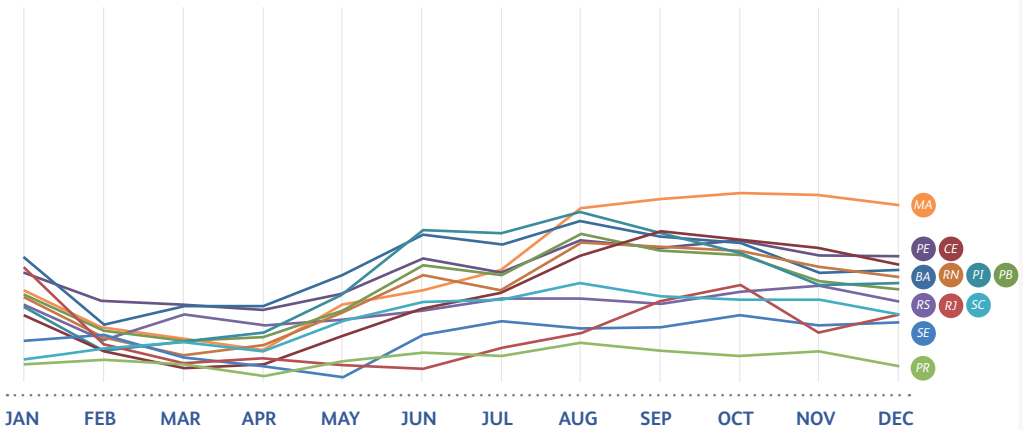
During daily peaks, wind farm capacity factors exceeded 70%, as in the record generation measured in the Northeast and SIN and discussed in the previous chapter.

[7]It considers wind power generated and installed capacitu of the wind farms in commercial operation at the connection point.

The five states with the largest average capacity factor in 2019 were Maranhão (49.7%), Bahia (49.1%), Pernambuco (47.1%), Piauí (44.0%) and Rio Grande do Norte (39.6%). The calculated capacity factor for each Brazilian state are shown in Chart 7 below.

CAPACITY FACTORS BY STATE 2019

CHART 07



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MA	39.7%	26.1%	22.2%	18.2%	34.4%	40.0%	48.3%	70.9%	74.2%	76.3%	75.1%	71.2%
PE	45.8%	35.6%	34.4%	32.9%	38.3%	51.8%	46.3%	59.1%	56.4%	59.1%	53.0%	52.1%
BA	52.1%	26.9%	34.2%	34.0%	45.7%	61.2%	56.8%	65.9%	60.3%	58.0%	46.7%	47.7%
PI	35.1%	17.4%	21.2%	24.1%	38.4%	62.0%	60.7%	69.3%	61.3%	53.9%	42.0%	42.7%
RN	37.5%	22.3%	15.6%	19.4%	31.9%	45.6%	39.8%	58.2%	56.2%	54.7%	48.9%	44.6%
PB	38.5%	25.0%	21.6%	22.4%	32.2%	49.5%	45.2%	60.4%	55.1%	53.1%	43.1%	40.5%
RS	34.4%	21.7%	31.6%	26.5%	29.2%	32.6%	37.0%	37.6%	35.6%	39.5%	41.9%	36.2%
CE	30.5%	17.8%	11.1%	12.2%	23.0%	32.7%	39.2%	53.0%	61.2%	58.8%	55.7%	49.6%
SE	21.4%	22.9%	15.0%	11.9%	7.8%	23.6%	28.7%	26.2%	26.0%	30.5%	26.9%	28.4%
RJ	48.1%	19.9%	12.8%	15.0%	12.5%	11.1%	18.1%	24.7%	36.3%	42.6%	24.1%	30.9%
PR	12.7%	14.2%	12.5%	8.0%	13.5%	16.8%	15.7%	20.4%	17.7%	15.5%	16.9%	11.9%
SC	14.3%	18.4%	21.0%	17.1%	28.8%	35.6%	36.8%	42.6%	37.7%	36.4%	36.6%	30.5%

Source: **ANEEL / CCEE / ABEEólica**

WIND POWER CONTRIBUTION TO RESIDENTIAL SUPPLY

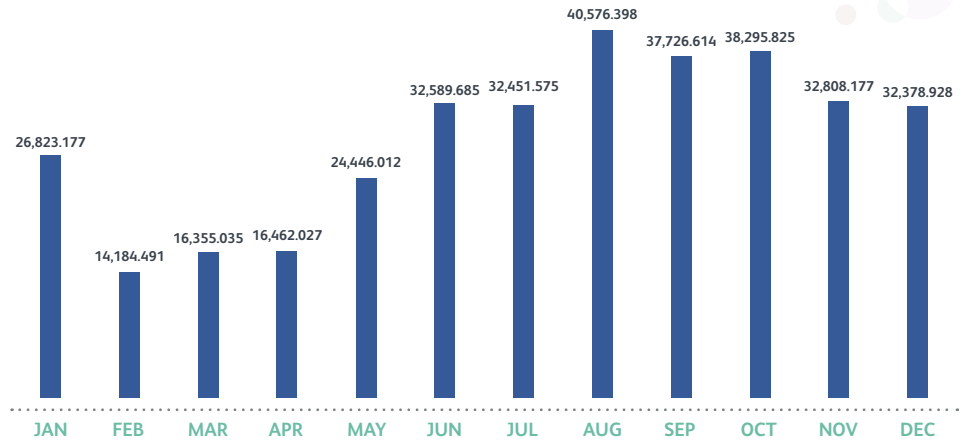
Wind energy can also be represented as generation equivalents compared to average home use of electric energy in Brazil. According to the monthly review published by EPE (Empresa de Pesquisa Energética, or Energy Research Company), average residential consumption in Brazil in 2019 was 162 kWh per month.

Thus, actual average wind energy generation in 2019 was the equivalent to the average energy used by 28.8 million homes, or some 86.3 million people. This is a 12.6% increase compared to the previous year, when wind energy supplied 76.7 million people. In 2019, wind powered households for more people than the population of the entire Northeast (over 57 million people).[9,8]

The Chart below shows the number of households that could have been supplied solely by wind energy in 2019.

HOUSEHOLDS POWERED BY WIND IN 2019, MONTH BY MONTH

CHART 08



Source: **CCEE / EPE / ABEEólica**

[8]IBGE Data - Estimates of the population residing in Brazil and its states on July 1 2019
[9]Considering an average of three people in each household.

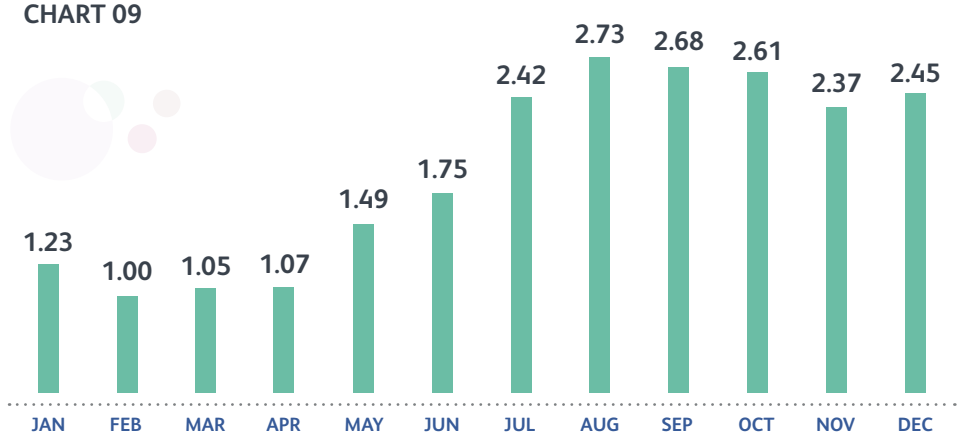
WIND POWER CONTRIBUTION FOR REDUCING CO_2 EMISSIONS

In addition to very low implementation impact, wind power does not emit any CO_2, and can replace other, CO_2 emitting sources. The following chart shows CO_2 emissions avoided due to wind power month by month.[10]

Total avoided CO_2 emissions in 2019 were up to 22.85 million tons, equivalent to the annual emissions of 21.7 million automobiles. For comparison purposes, the city of São Paulo has a fleet of over 6.3 million automobiles, and the state has over 19.4 million automobiles.[11,12]

AVOIDED CO_2 EMISSIONS IN 2019 (MILLION TONS)

CHART 09



Source: CCEE / MCTIC / ABEEólica

Tons CO_2 avoided in 2019: **22.85 million**

[10] Based on the MCTI's (Brazilian Ministry of Science, Technology and Innovation) methodology and data used to calculate emissions avoided due to wind power (75% in power plant operation and 25% in power plant construction).
[11] Considers the indices in the 2017 State of São Paulo Vehicular Emissions Report issued by CETESB, the state of São Paulo Environmental Company.
[12] Detran-SP fleet data, updated in November 2019. The data is for automobiles only, and excludes motorcycles, buses, mini-buses, pickup trucks, utility and other vehicles.

RENEWABLE ENERGY CERTIFICATION PROGRAM

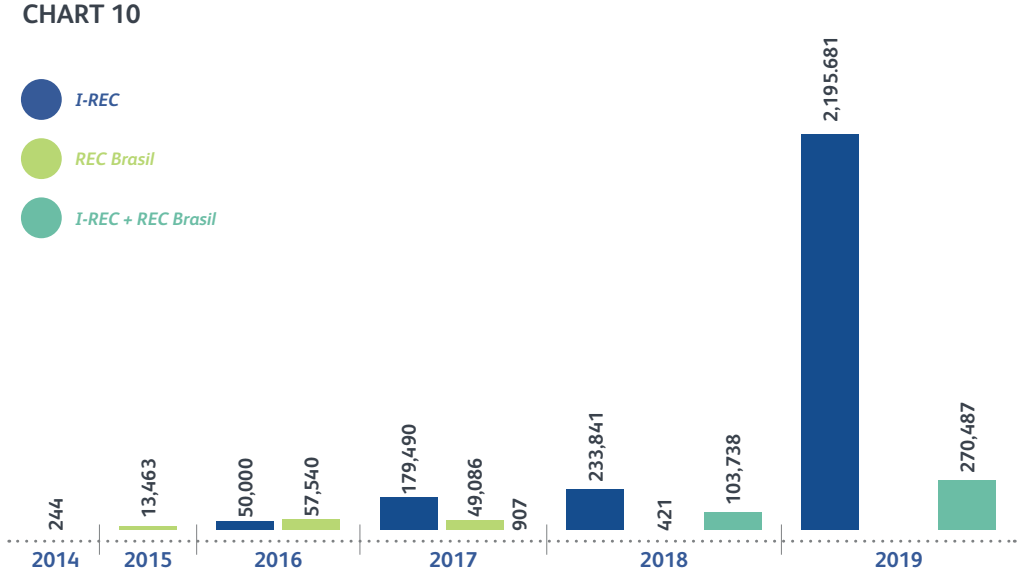
Launched in Brazil six years ago, the Renewable Energy Certification Program has grown consistently ever since. REC Brazil, or the Renewable Energy Certification Program, is a joint initiative of ABEEólica (Brazilian Wind Energy Association) and Abragel (Brazilian Clean Energy Association). It has the support of CCEE (Electric Energy Trading Chamber), ABRACEEL (Brazilian Energy Traders Association), and ABIOGÁS (Brazilian Biogas and Biomethane Association). The goal is to foster energy generated from renewable sources, and those that have a major impact in terms of sustainability.

The program was created in 2011 by a technical group appointed by Abragel and ABEEólica and comprised of experts with experience in energy, sustainability, market and certification, who jointly defined the concepts involved in sustainable ventures.

Within the program, Instituto Totum issues I-REC Standard renewable energy generation certificates. I-REC is an international organization that standardizes the systems used to register renewable energy certificates. Furthermore, renewable power plants in Brazil can receive REC BRAZIL certification, so long as they fulfill the requirements of the UN Renewable Development Goals (RDG). Instituto Totum is also responsible for issuing REC (Renewable Energy Certificates). The first 200 certificate transactions were completed in 2014. So far over 2,400,000 RECs have been issued in Brazil (each REC is equivalent to 1 MWh of renewable energy generated), 11% of them under REC Brazil.

GROWTH OF RENEWABLE ENERGY CERTIFICATE TRANSACTIONS

CHART 10



Source: Instituto Totum

SOCIOENVIRONMENTAL CONTRIBUTIONS OF WIND POWER

Wind power is renewable, non-polluting, has low environmental impact and helps Brazil fulfill its Climate Agreement Goals.

Wind farms do not emit CO_2. In 2019, wind power avoided CO_2 emissions.
In 2019, wind energy avoided CO_2 emissions equivalent to those of about 22.85 million automobiles, over twice the fleet of passenger vehicles in the city of São Paulo.

It offers one of the best cost-benefits in terms of energy prices.

Generates income and improves the quality of life of landowners who lease their land for wind tower placement. Furthermore, leases are taxable, thus providing significant revenue for the government.

Enables landowners to continue planting their crops or growing their animals.

Settles people in the countryside.

Training local labor

In addition to the benefits shown in the picture alongside, wind energy has a positive impact on the community due to social, cultural, healthcare and environmental projects undertaken for the development of the local population. We must point out that due to BNDES funding, a percentage of the investment must go to social projects. However, more often than not this goes beyond the required amount and develops extremely important project for the community. Below are a few examples of community projects undertaken by wind energy players:

Measures that promote water security and enable access to water for production and human consumption, reaching isolated communities.

Digital inclusion activities, training youth and adults, fostering employability and enterprise.

Stronger and expanded local production chains such as coconut, manioc, corn, beans, honey, milk and others to improve the population's income and promote sustainable development.

Health promotion projects including oral health and nutrition, for instance.

Activities to encourage sports, alongside monitoring schoolwork.

Activities to encourage tourism, art, gastronomy and regional culture with festivals, courses, training and contests.

Encouraging local artisans.

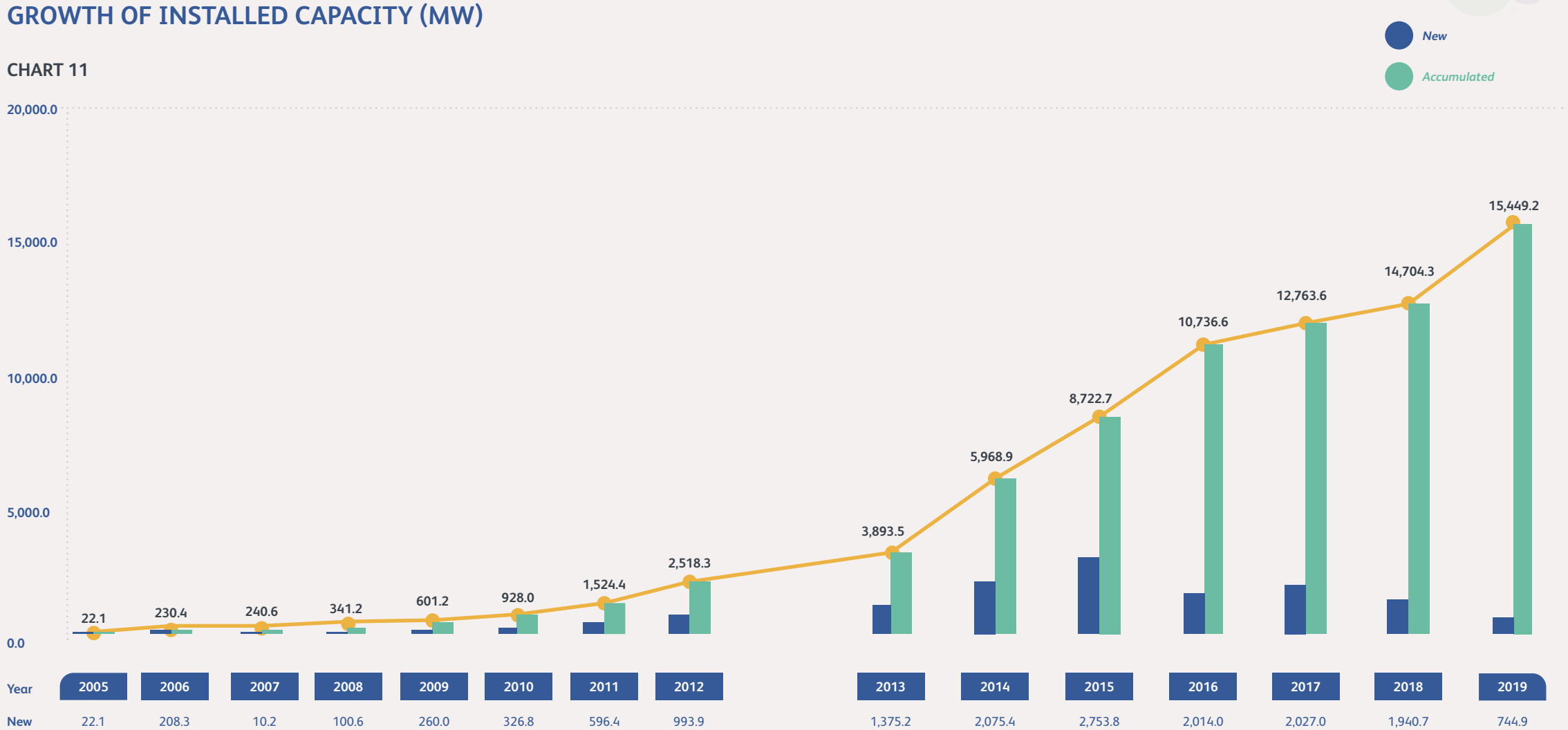
Educational projects such as day-care centers and schools, with initiatives to increase the quality of life of students in public schools, with citizenship activities, educator training and better school environments, promoting discussions on sustainable development and renewable energy.

EXPANSION OF THE INSTALLED CAPACITY FOR WIND POWER

Chart 11 shows the increase in installed capacity and the growth in wind power as a function of previous contracts in regulated auctions and free market agreements.

GROWTH OF INSTALLED CAPACITY (MW)

CHART 11



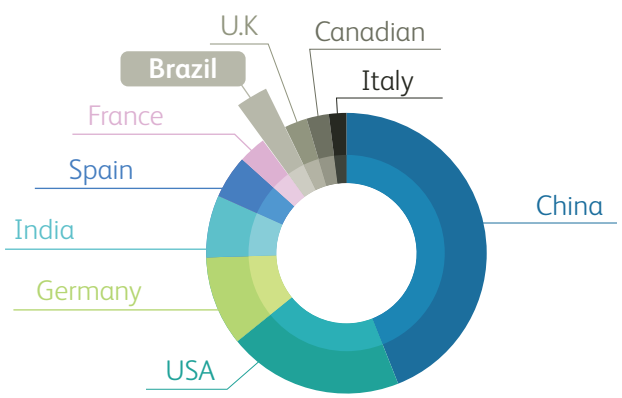
Source: ANEEL / ABEEólica

GLOBAL FIGURES

In 2019 Brazil's rank on the GWEC (Global Wind Energy Council) rank of cumulative onshore wind capacity jumped to #7. In the list that looks specifically at new capacity added in the year, Brazil is ranked #12, dropping seven positions as shown in Chart 13. As explained in this report, new capacity added in 2019 was below what it had been as there were no auction between late 2015 and December 2017. Below is the GWEC ranking.

TOP 10 CUMULATIVE CAPACITY 2019

CHART 12

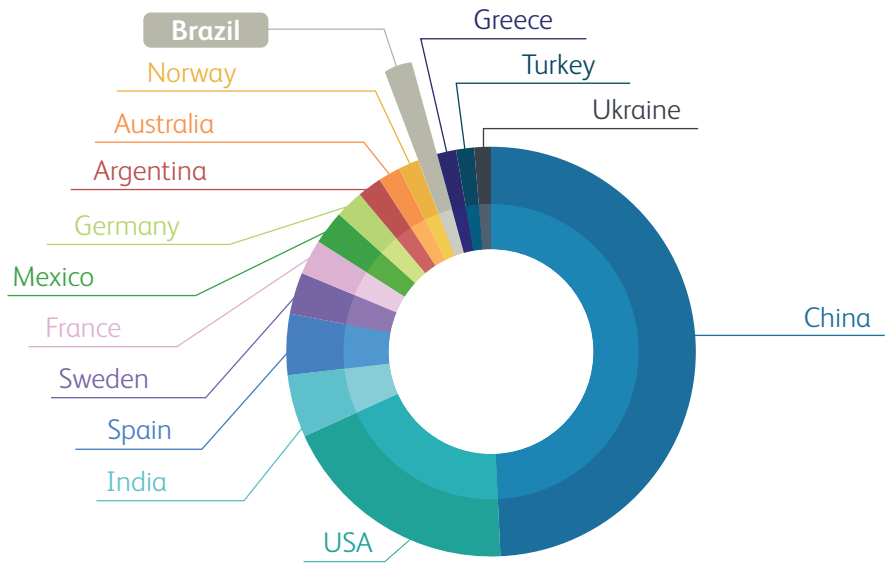


	COUNTRY	MW
1	China	229,564
2	USA	105,436
3	Germany	53,913
4	India	37,509
5	Spain	25,803
6	France	16,643
7	Brazil	15,449
8	U.K	13,617
9	Canadian	13,413
10	Italy	10,512

Source: GWEC

TOP NEW INSTALLED CAPACITY 2019

CHART 13



	COUNTRY	MW
1	China	23,760.00
2	USA	9,143.00
3	India	2,377.2
4	Spain	2,319.0
5	Sweden	1,588.0
6	France	1,336.0
7	Mexico	1,281.0
8	Germany	1,078.0
9	Argentina	931.2
10	Australia	837.0
11	Norway	780
12	Brazil	745
13	Greece	727.7
14	Turkey	686
15	Ukraine	637

Source: GWEC

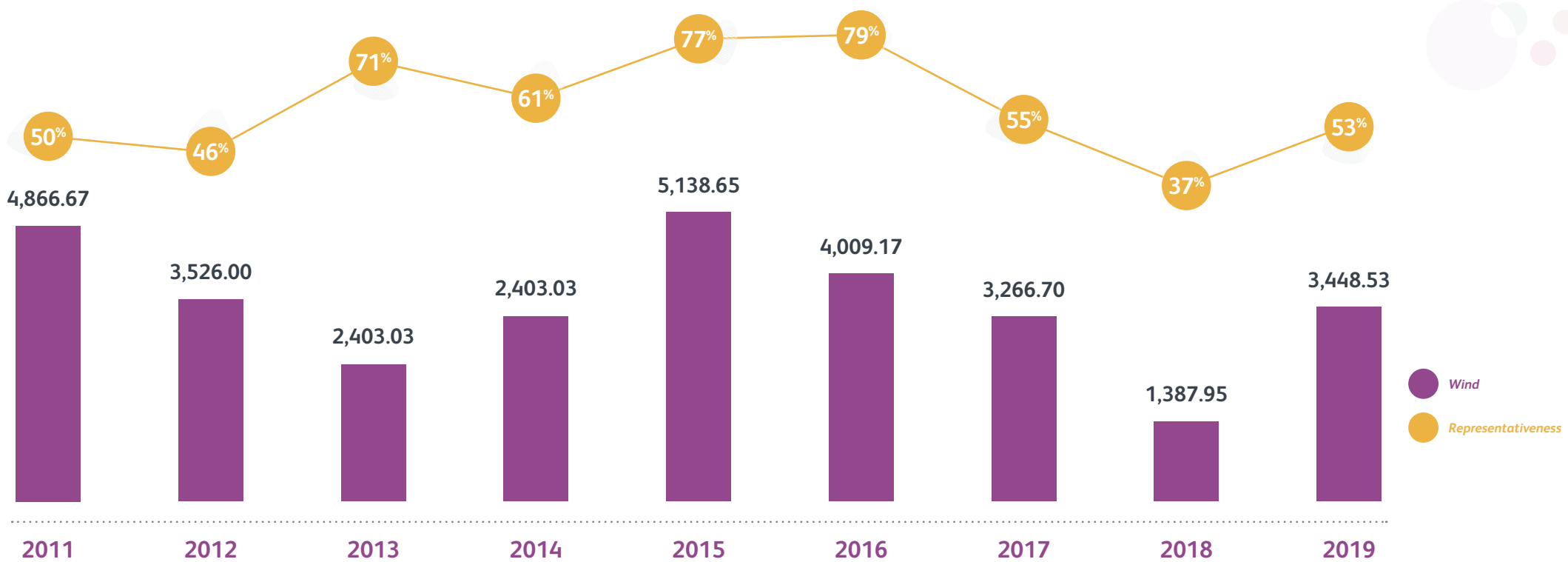
INVESTMENTS IN WIND POWER

US$ 3.45 billion (R$ 13.6 billion) were invested in wind power in 2019, or 53% of the total investment in renewables (sun, wind, biofuels, biomass, waste, PCHs (small hydro) and other sources) in Brazil. If we look at 2011 through 2019, the total was US$ 31.3 billion. Chart 14 shows investments in renewable energy and the amount invested in wind energy since 2011, as calculated by Bloomberg New Energy Finance - BNEF, which also publishes an analysis of this data. For 2019, the BNEF analysis states that:

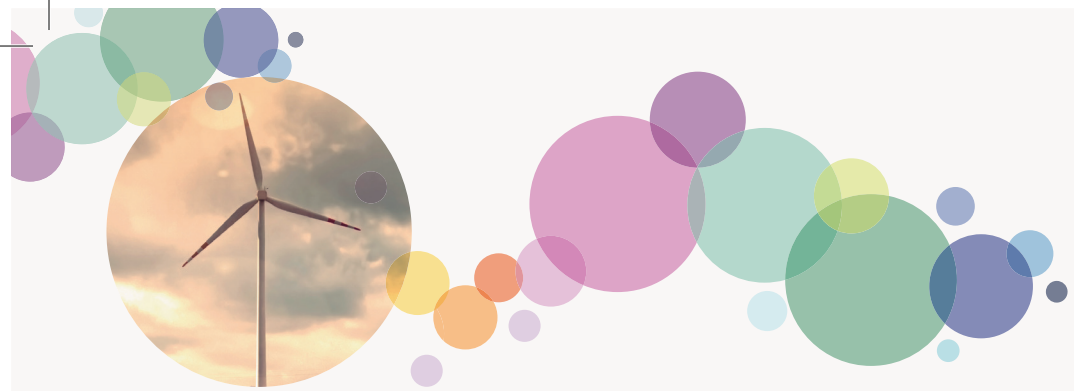
"Brazil invested US$ 6.5 billion in new clean energy projects in 2019, this is the largest annual investment since 2015. This is a 74% growth compared to 2018 and is the result of a recovery in wind and solar energy, and the boom in distributed photovoltaics, which accounted for some 30% of the total invested in 2019. Wind energy accounted for over half the investments in the year, or US$ 3.4 billion, 148% of the amount invested in the previous year".

INVESTMENTS IN NEW PROJECTS IN THE WIND ENERGY SECTOR (US$ MILLION)

CHART 14



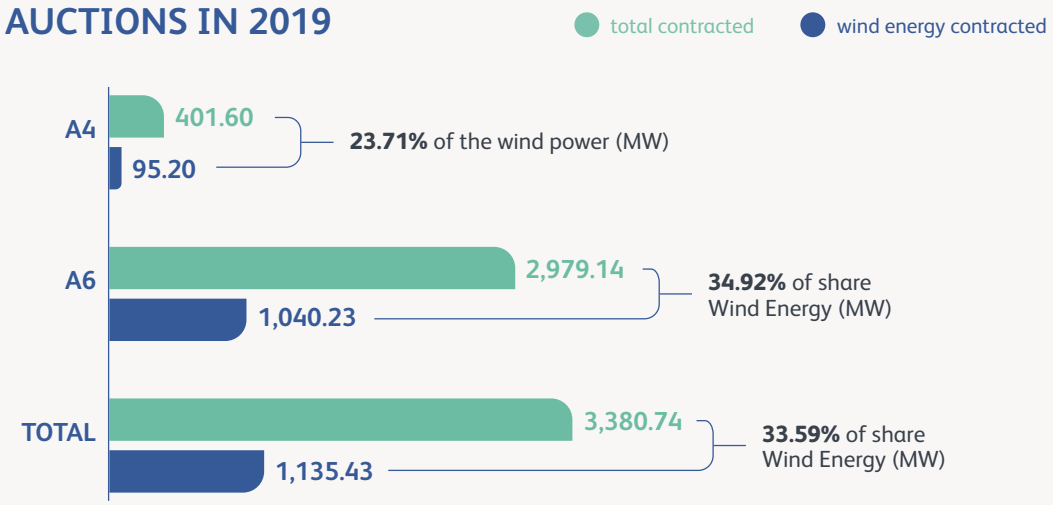
Source: BNEF



AUCTIONS

In 2019, 1.13 GW in installed capacity (47 wind farms) were contracted at two auctions - one A-4 and one A-6. The table below shows the total contracted in each auction and how much was in wind energy.

AUCTIONS IN 2019



Source: CCEE / ABEEólica

It is also worthwhile noting this was also a very good year for the free market. Although sources have not disclosed the numbers, we estimate that wind energy companies sold some 2 GW in installed capacity to the free market in 2019, showing this market is growing in importance for wind energy.
For the second consecutive year wind farms sold more power to free market customers than to those in the regulated market.

CLOSING REMARKS

As shown in this document, in 2019 wind energy achieved important milestones in the nation's power matrix, becoming the second most important source (>15 GW of installed capacity). It also went up one point on the Ranking of Onshore Wind Capacity. It should certainly be celebrated. However, major challenges remain ahead. These closing remarks are being penned in March 2020, at the start of the Covid-19 pandemic in Brazil. This has led to quarantine and an absolute stop to much of the economic activity in attempts to contain the spread of the virus and enable the healthcare system to care for all who need it.

Although we have questions regarding the coming weeks and months, we know that this is a unique situation for power generation, leading to heretofore unimagined challenges. We do not know the depths of the economic recession we will face, nor how this will reflect on energy contracts. At this point, we do not even know how long quarantine will last.

Right now, we have far more questions than answers. What we do know is that the ABEEólica team and its Board will work together to discuss and come up with solutions for the various new problems that we will emerge. We have already created a Crisis Management Committee as a sub-group of our themed workstreams and have a lot of work ahead of us. We move forward certain that we will emerge from this crisis and that wind energy will be ready for when the nation resumes its economic activities, which is inevitable.

.....

Best regards, *Elbia Gannoum*

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ABOUT ABEEÓLICA

Established in 2002, ABEEólica, the Brazilian Wind Power Association is a non-profit organization that brings together and represents the wind power sector in Brazil. Since it was created, ABEEólica has e ectively contributed to the development and recognition of wind energy as a competitive, clean, renewable, low-impact source of energy, and a strategic element of Brazilian electrical matrix.

JOIN US

Learn of the advantages of being a member and read the association statues on the ABEEólica website at "Join Us", or send an e-mail to **comunicacao@abeeolica.org.br**

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