

# annual wind energy report 2021



ONSHORE OFFSHORE

# ABEEólica

ASSOCIAÇÃO BRASILEIRA DE ENERGIA EÓLICA E NOVAS TECNOLOGIAS

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## MESSAGE FROM THE CEO

“

By the end of 2021 there were a total of 795 plants and 21.57 GW of installed wind energy capacity, a 21.53% growth compared to December 2020, when the installed capacity was 17.75 GW.

110 new wind farms were built in 2021, and 1 was cancelled, totaling 3.83 GW in new capacity, a record for wind energy in Brazil. According to GWEC (Global Wind Energy Council), we are #3 worldwide in installation of wind turbines. The GWEC also announced that Brazil went up a point in Global Installed Capacity: we are now #6.

According to BNEF (Bloomberg New Energy Finance), by year the total invested in wind energy was US\$ 5.15 billion (R\$ 27.81 billion), or 44% of the total investment in renewables (solar, wind, biofuels, biomass, PCHs (small hydro) and other sources) in Brazil.

2021 also marks the year we passed 20 GW in installed capacity, a major

milestone that we want to celebrate. Other good news is that new free market contracts were again responsible for most of the new wind energy contracts during the year.

In 2021 a total of 580 MW in new wind capacity were contracted in three auctions, and we estimate another 3 GW in the free market. These contracts keep the industry investing, working, and creating jobs.

In 2021, energy in general, and wind energy in particular were heavily impacted by discussions around global warming. For the first time ever, the Global Wind Energy Council (GWEC) had a Pavillium at COP, and ABEEólica shared this space, helping and participating in an intense agenda of discussions.

Two weeks prior to COP26, the Global Wind Energy Council and over 90

global leaders in wind energy issued a warning that the number of wind-based generating facilities must increase four-fold if the source is to play a role in helping countries achieve net zero by 2050. Current projections show only half this growth.

By the end of COP26 the warning was even stronger, not only wind energy but all renewables must step up. We are definitely in the right direction, but the energy transition must be much faster. Despite some criticisms of the final agreement, there is reason to celebrate the outcome of COP from the point of view of renewable energy.

I returned from COP26 convinced that we have the capacity to speed up the energy transition as I felt that companies and funding agencies are now heavily engaged. Combining the interests of such diverse nations is a daunting task, but if we want to save the planet for future generations there are no miracles, everyone must make an effort. In the case of the leaders of wind energy in Brazil, I am certain we are fully dedicated to making the industry grow even more, incorporating new technologies such as offshore wind and hydrogen. 2021 was a year to be celebrated, but we also realize there is a lot of work ahead of us.



**Elbia Gannoum**  
CEO

ABEEólica - Brazilian Wind Energy and New Technologies Association

## INSTALLED CAPACITY IN BRAZIL – ALL SOURCES

110 new wind farms were built in 2021, and 1 was cancelled, totaling 3.83 GW in new capacity, and 10 MW of cancelled capacity. This was a record year in new wind energy installed capacity.

By the end of 2021 there were a total of 795 plants and 21.57 GW of installed wind energy capacity, a 21.53% increased compared to December 2020, when the installed capacity was 17.75 GW.

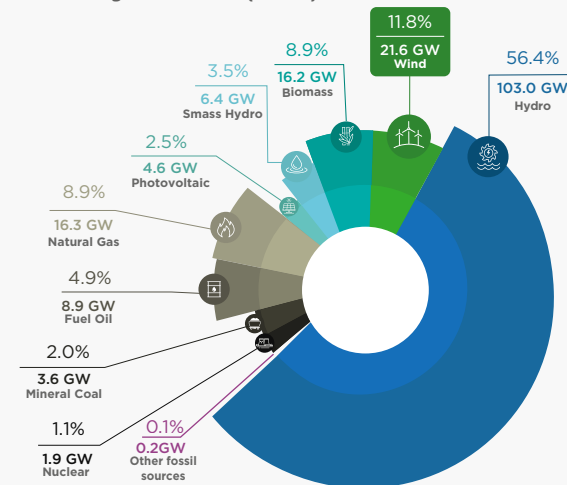
New wind farms were installed in the following states:

### New installed capacity added in 2021 (MW) by state

	Power (MW)	Nº of Wind Farms
RN	1,690.99	42
BA	1,073.40	33
PB	471.24	15
PI	281.40	8
CE	210.00	9
PE	99.00	2
SC	4.20	1
<b>Total</b>	<b>3,830.20</b>	<b>110</b>

A total of 7.5 GW in new power were added to the country's power grid in 2021, with wind growing faster than other sources, accounting for 50.91% of new capacity installed. The second fastest growing source was natural gas, responsible for 17.95% of new capacity. With the additional capacity installed in 2021, wind power now makes up 11.8% of the nation's power matrix, as shown the Chart alongside, which shows the percent contribution from all sources of energy to the electric power grid at the end of 2021.

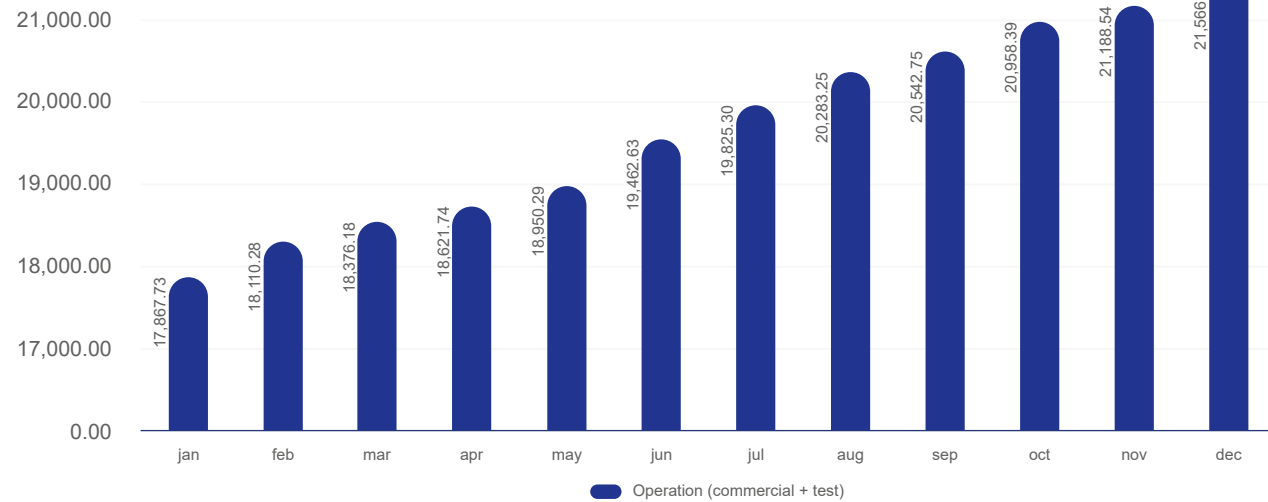
### Brazilian electricity matrix (GW) chart 1



The 21.57 GW installed capacity in late December 2021 included 21.13 GW (97.96%) in commercial wind farms, and 0.44 GW (2.04%) in plants in the testing phase. The chart alongside shows how installed capacity evolved in 2021.

### Growth of installed capacity in 2021 (GW)

chart 2



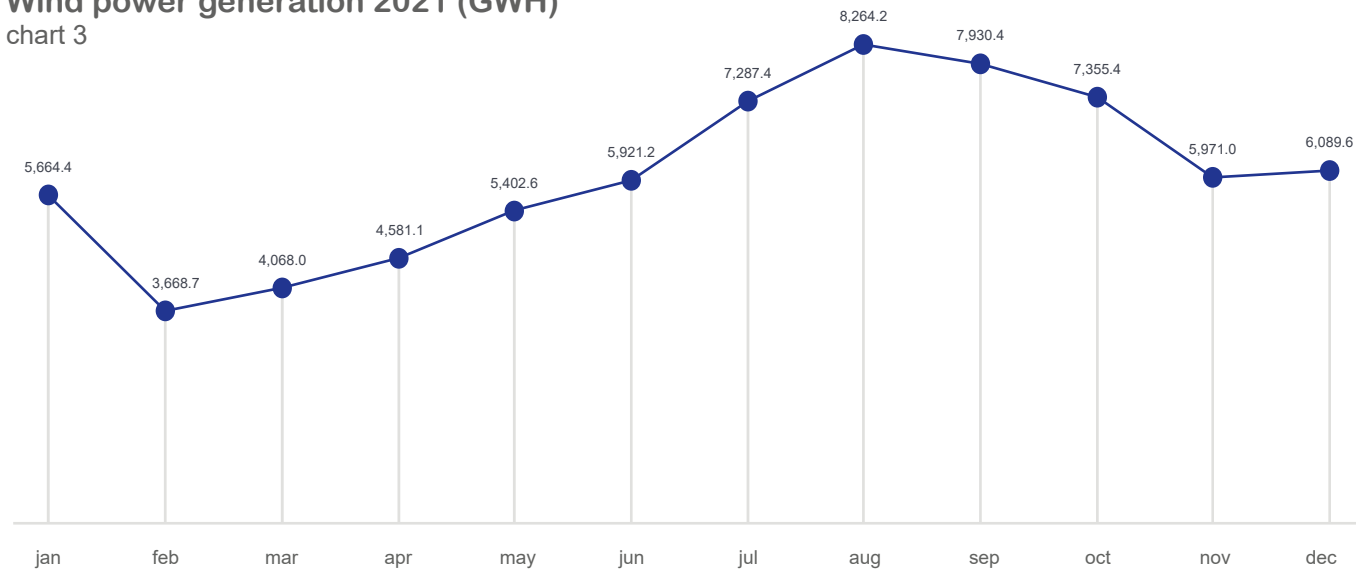
Source: ANEEL/ABEEólica

### GENERATION

An average of 6.017,0 GWh of wind energy were generated in 2021. In total, 72.203,9 GWh were generated last year.

### Wind power generation 2021 (GWH)

chart 3



Source: CCEE/ABEEólica

1-This chart shows wind energy generated by wind farms in test and commercial operations at the connection point.



In terms of percentage and supply, wind power accounted for 12.18% of all the electricity generated and added to the National Interconnected System (SIN) in 2021. Winds peak in the second half of the year, as does wind energy, peaking in August at 16.77% of the SIN generation.

In 2021, wind energy generation broke a number of monthly records in the windier months. Below are the records for the year in each SIN subsystem.

**NORTHEAST 104.70%**

of all energy consumed in the northeast was generated from wind, averaging 11,907 MWavg generated. (08/06/2021)

**SOUTH 16.96%**

of all energy consumed in the south system was generated from wind, with an average generation of 1,796 MWavg. (09/07/2021)

**NORTH 6.70%**

of all energy consumed in the north system was generated from wind, with an average generation of 413 MWavg. (09/04/2021)

**SIN 20.05%**

of all energy consumed in the north system was generated from wind, with an average generation of 13,264 MWavg. (09/07/2021)

Source: ONS

The chart below shows that the northeast subsystem's wind power capacity is close to the total for the system, accounting for 88.7% in 2021.

### WIND GENERATION AND ITS SHARE OF THE POWER SUPPLY

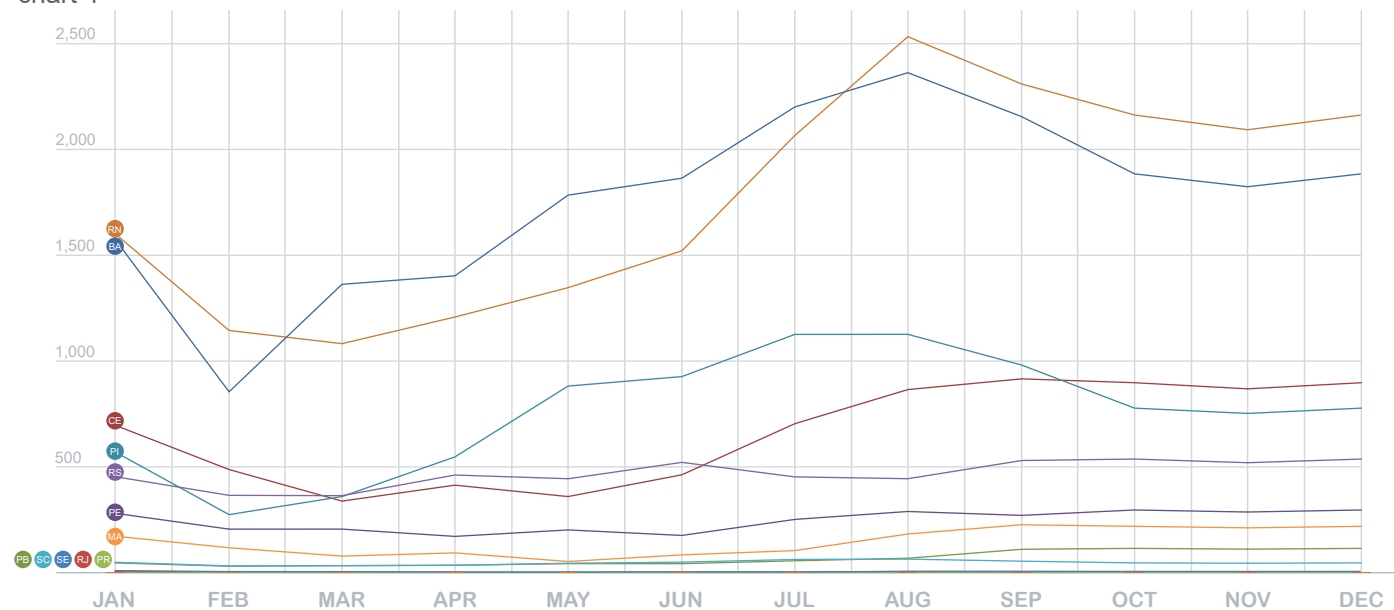
Region	2020		2021		Growth %
	Generation (TWh)	Share	Generation (TWh)	Share	
Southeast	0.05	0.1%	0.06	0.1%	4%
South	6.33	11.5%	6.20	8.7%	-2%
Northeast	47.00	85.6%	63.20	88.7%	34%
North	1.50	2.7%	1.76	2.5%	17%
Total	54.89	100%	71.22	100%	29.7%

Source: CCEE/ABEEólica

2-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.

## Generation by state 2021 (GWH)

chart 4



REGION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RN	1,602.4	1,144.7	1,082.3	1,208.3	1,346.9	1,521.0	2,066.1	2,532.7	2,309.3	2,162.7	2,093.0	2,162.7
BA	1,573.8	854.9	1,362.8	1,402.9	1,784.1	1,864.2	2,200.7	2,362.6	2,155.0	1,884.7	1,823.9	1,884.7
PI	570.7	274.5	358.6	547.3	881.9	926.7	1,126.4	1,126.0	982.3	777.7	752.6	777.7
RS	453.8	365.6	364.0	461.6	443.3	521.4	452.8	444.8	530.1	537.1	519.8	537.1
CE	696.8	487.5	338.4	413.7	361.2	462.6	704.2	865.4	915.9	897.8	868.8	897.8
PE	280.9	205.9	206.1	171.6	202.2	176.1	251.8	289.3	270.9	296.4	286.8	296.4
MA	172.2	117.9	78.4	93.7	53.0	84.3	104.5	182.9	226.6	219.1	212.0	219.1
PB	46.3	30.6	33.3	35.2	42.8	43	56.4	69.6	110.7	115.0	111.3	115.0
SC	49.4	32.4	34.7	36.3	43.4	49.2	61.1	64.2	54.5	46.3	44.8	46.3
SE	5.5	5.3	4.7	2.8	3.5	3.1	3.9	6.0	5.5	6.1	5.9	6.1
RJ	9.9	4.7	3.8	2.2	2.1	2.9	3.2	6.2	6.2	4.9	4.8	4.9
PR	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.3

The five states with the greatest amount of energy from wind in 2021 were Rio Grande do Norte (21.23 TWh), Bahia (21.15 TWh), Piauí (9.10 TWh), Ceará (7.91 TWh), and Rio Grande do Sul (5.63 TWh). The chart below shows the amount of wind power generated in each Brazilian state.



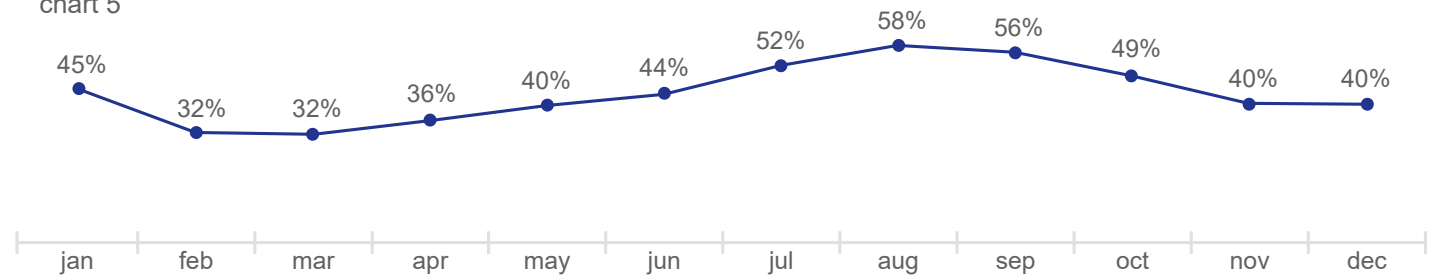


## CAPACITY FACTOR

The capacity factor for wind power is calculated as the ratio of the plant's actual generation to its total capacity over the same period. The average in 2021 was 43.6%, peaking in August at 57.9%.

### CAPACITY FACTOR IN 2021

chart 5



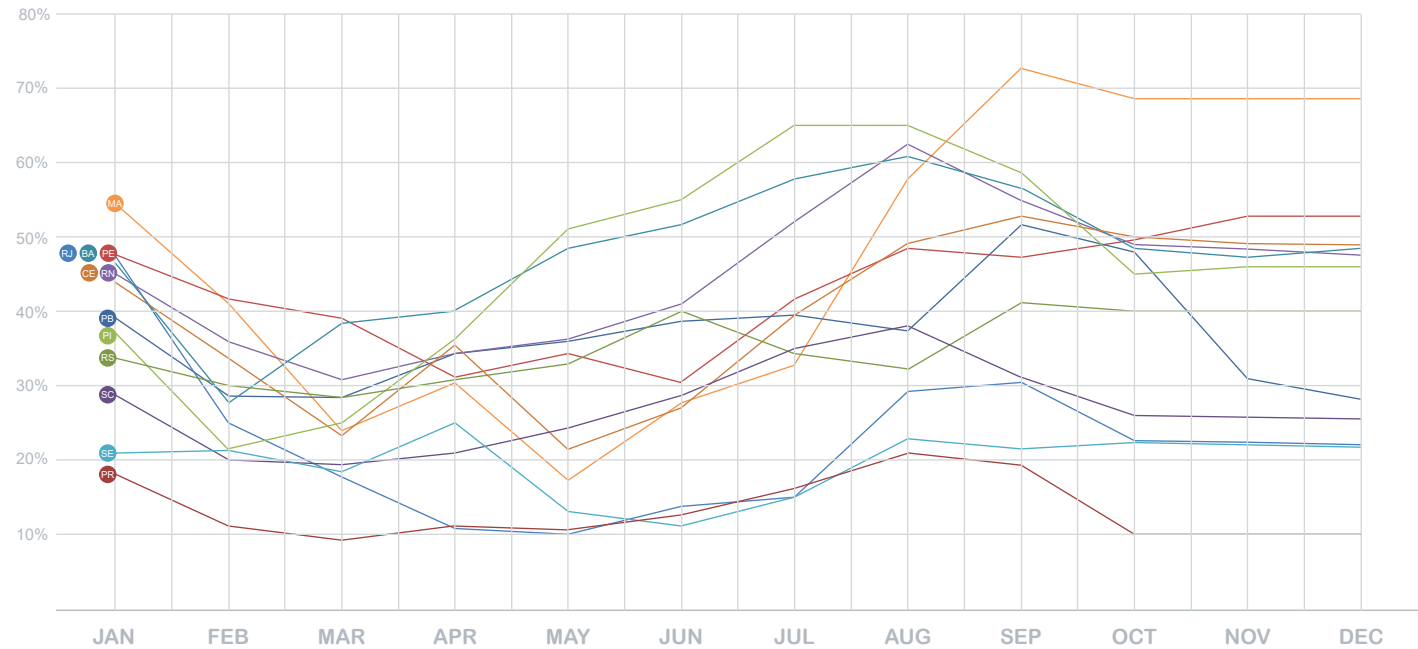
Source: ANEEL/CCEE/ABEEólica





The five states with the largest average capacity factor in 2021 were Bahia (47.7%), Maranhão (47.3%), Piauí (46%), Rio Grande do Norte (45.2%), and Pernambuco (43.6%). The calculated capacity factors for each Brazilian state are shown in the Chart below.

Capacity factors by state 2021  
chart 6



REGION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MA	54.3%	41.2%	24.7%	30.6%	17.9%	27.5%	33.0%	57.5%	73.9%	69.1%	69.1%	69.1%
PE	47.3%	43.1%	39.0%	33.5%	34.0%	30.6%	42.4%	48.7%	47.1%	49.9%	53.6%	53.6%
BA	46.3%	28.2%	38.9%	40.5%	48.4%	51.7%	57.7%	61.0%	56.9%	48.2%	47.0%	48.1%
PI	37.9%	22.1%	25.1%	36.7%	51.8%	55.4%	65.1%	65.1%	58.7%	45.0%	46.1%	43.7%
RN	45.8%	36.3%	31.0%	34.6%	36.7%	41.5%	52.4%	63.0%	55.6%	49.7%	48.6%	47.4%
PB	39.6%	28.9%	28.4%	34.6%	36.6%	38.0%	39.5%	36.3%	52.6%	47.3%	36.8%	29.5%
RS	34.2%	30.5%	27.5%	31.1%	33.4%	40.6%	34.2%	33.5%	41.3%	40.5%	40.5%	40.5%
CE	44.2%	34.6%	24.3%	36.0%	21.6%	27.1%	39.9%	49.0%	53.6%	50.9%	49.2%	48.4%
SE	21.4%	22.8%	18.5%	25.3%	13.7%	12.5%	15.2%	23.3%	22.2%	23.6%	23.6%	23.6%
RJ	47.5%	24.9%	18.1%	11.5%	10.2%	14.2%	15.5%	29.8%	30.9%	23.7%	23.7%	23.7%
PR	17.1%	12.0%	9.5%	12.9%	12.0%	13.9%	16.0%	21.2%	19.1%	15.4%	15.4%	15.4%
SC	28.7%	20.5%	19.8%	21.4%	24.8%	29.0%	34.9%	36.7%	32.2%	26.5%	26.5%	26.5%

Considers wind generation by wind parks in commercial operation, at the center of gravity.  
It considers the value of wind generation and the installed capacity of the wind farms in commercial operation at the connection point.

## WIND POWER CONTRIBUTION TO RESIDENTIAL SUPPLY

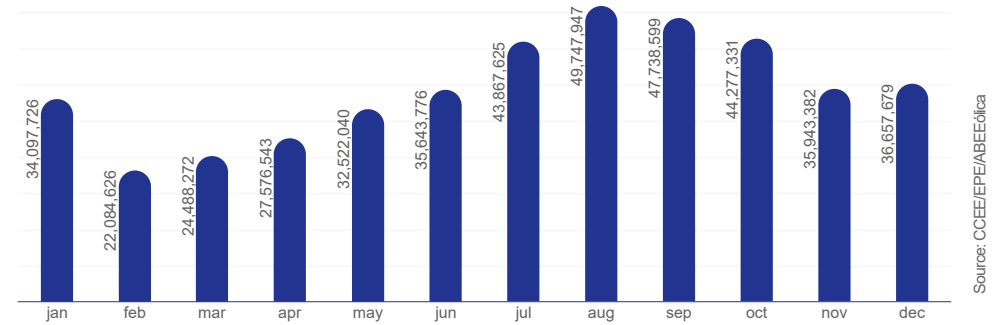
Wind energy can also be represented as generation compared to average home use of electric energy in Brazil. According to the monthly review published by EPE (Empresa de Pesquisa Energética, or Energy Research Company), average residential consumption in Brazil in 2021 was 166 kWh per month.

Therefore, average wind generation in 2021 (see “Generation”) was equivalent to the average power consumed by 36.2 million homes, or some 108 million inhabitants. In 2021, wind powered

households for more people than the population of the entire northeast (over 108.5 million people).\*

The Chart alongside shows the number of households powered by wind energy in 2021.

Households powered by wind in 2021, month by month  
chart 7

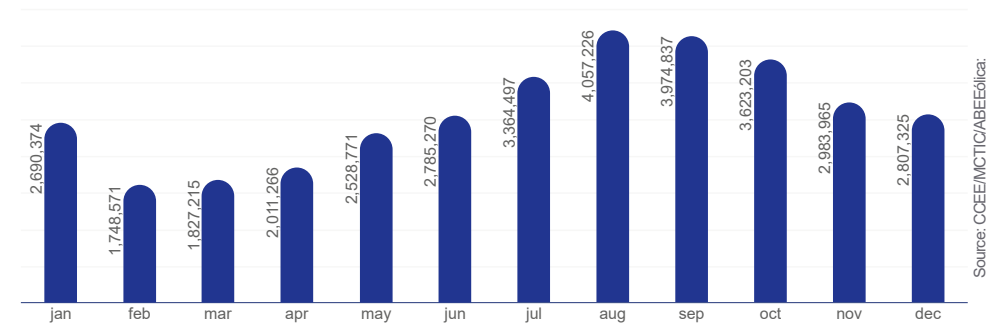


## WIND POWER CONTRIBUTION FOR REDUCING CO<sub>2</sub> EMISSIONS

In addition to very low implementation impact, wind power does not emit any CO<sub>2</sub>, and can replace other CO<sub>2</sub> emitting sources. The chart alongside shows CO<sub>2</sub> emissions avoided each month by using wind energy. A total of 34.4 million tons of CO<sub>2</sub> emissions were avoided in 2021 by using wind

energy, which is equivalent to around 34 million automobiles. For comparison purposes, the city in São Paulo has a fleet of around 19 million automobiles.

Avoided CO<sub>2</sub> emissions in 2021 (Million tons)  
chart 8



Tons CO<sub>2</sub> avoided in 2021: 34.4 million.

\*Considers an average of three inhabitants per household. IBGE Data – Estimates of the Resident Population in Brazil and in each state on the reference date of July 1, 2021.

## SOCIOENVIRONMENTAL CONTRIBUTIONS OF WIND POWER

### Benefits of Wind Energy for the World



Generates income and improves the quality of life of landowners who lease their land for wind tower placement.



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



Wind farms do not emit CO<sub>2</sub>.



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

Wind power is renewable and does not pollute, helping Brazil fulfill its Climate Agreement goals.



Training local labor



Installing wind farms contributes to higher municipal GDP (Gross Domestic Product) and HDI (Human Development Index), as per a study by GO Associates. A group of cities with wind farms was compared to a group of cities without. This is what the cities with wind farms experienced:



A 21.15% increase in GDP (1999 - 2017).



A 20% increase in HDI (2000 - 2010).

Wind energy occupies only a small amount of land, so farmers are able to continue to plant or farm livestock. Turbines occupy some 8% of the land area set aside for wind farms, and this could decrease to around 6%.

Another study by economist Braúlio Borges, associate investigator with FGV-I-BRE, and senior economist with LCA Consultores, reiterates the importance of wind energy for investments and jobs:

Between **2011 and 2020**  
wind farms

injected  
**R\$ 321 billion**

into the economy:

**R\$ 110.5 billion**  
in direct investments to  
build wind farms

**R\$ 210.5 billion**  
as indirect effects.

Every  
**R\$1.00**  
invested in wind farms  
increased Brazil's  
GDP by around  
**R\$ 2.90**

And there are the environmental  
benefits as well.

Between **2016 a 2024**  
wind energy in Brazil will have  
avoided greenhouse gas emissions  
valued at between  
**R\$ 60 and 70 billion.**

Between **2011**  
**and 2020**  
wind farm construction  
created almost

**196 thousand**

jobs, or

**10.7** jobs per  
MW installed.



In addition to the benefits described in this document, wind energy has a positive impact on the communities due to social, cultural, healthcare and environmental projects undertaken for the development of the local population. 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.



Activities to encourage sports, alongside help for schoolwork.



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



Fostering regional tourism, art, gastronomy, and culture with festivals, courses, training, and contests.



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



Encouraging local artisans.



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



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.

## RENEWABLE ENERGY CERTIFICATION PROGRAM

Launched in Brazil seven 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 the 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 this program, the Totum Institute certifies renewable energy generators using the I-REC criteria, and renewable energy generators based on additional sustainability criteria with the additional stamp of approval of REC Brazil. The Totum Institute also issues RECs (Renewable Energy Certificates).

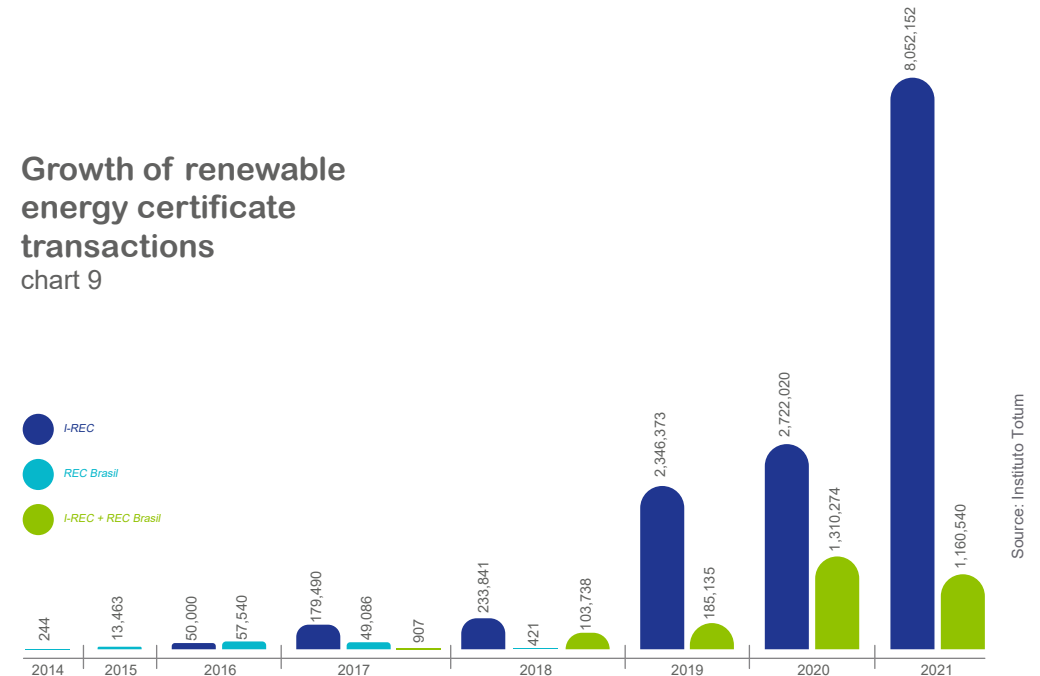
2021 brought good news in terms of Renewable Energy Certificates. This market for I-RECs is growing and Brazil stands out in the global market.

The outlook for the future is bright. The number of Brazilian power plants with Renewable Energy Certificates is growing. By late 2020 there were 148 registered power plants, and by 2021 this number had increased to 266. This places Brazil at the top of the I-REC Platform. The International REC Standard (I-REC) is a global system that enables registered power plants to trade renewable energy certificates. We can also look at the year based on the number of renewable certificates issued.

In 2020 over 4 million certificates were issued. In 2021 9.2 million such certificates were issued, making Brazil the world's second-largest market for I-RECs, behind only China. Almost half the I-RECs issued in Brazil were for wind energy.



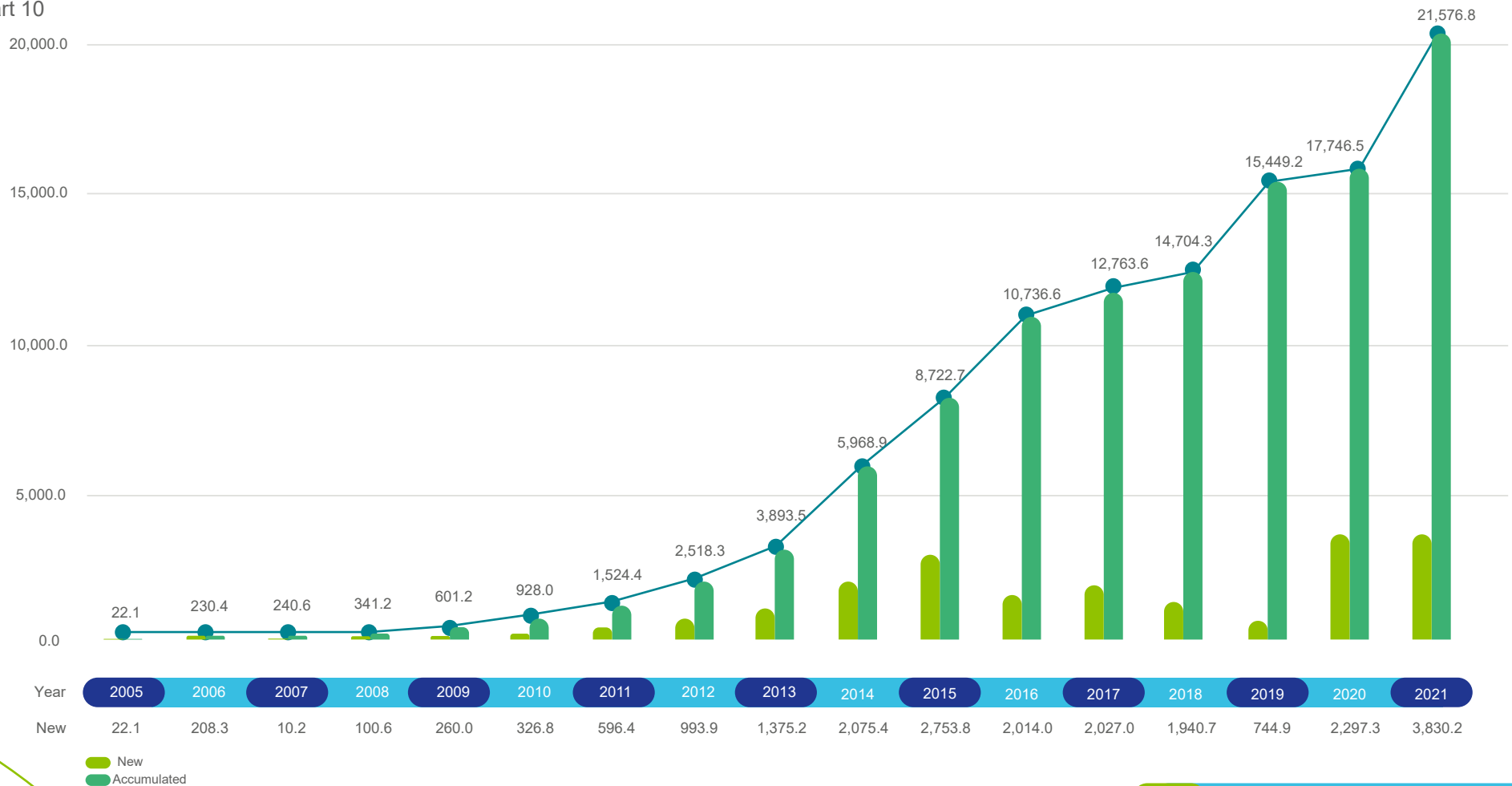
**Growth of renewable energy certificate transactions**  
chart 9



## EXPANSION OF THE INSTALLED WIND POWER CAPACITY

The chart below 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 10



Source: ANEEL/ABEEólica



## GLOBAL FIGURES

In 2021 Brazil went up one position in the world list of wind energy installed capacity prepared by the GWEC (Global Wind Energy Council).

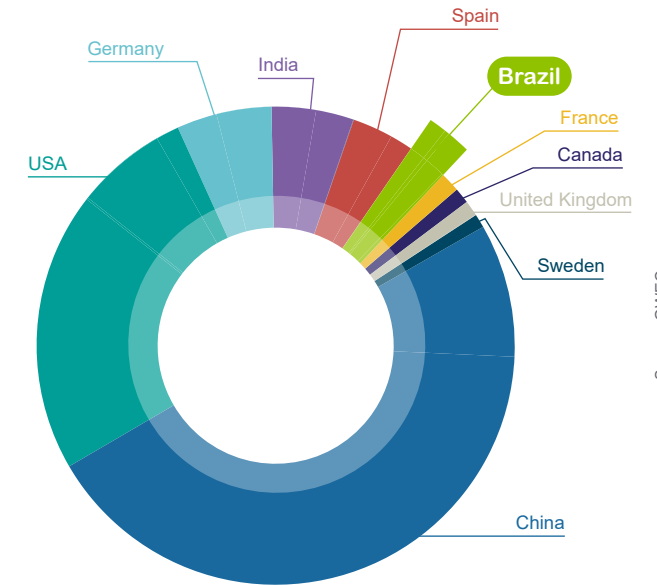
In the year's new installed capacity list Brazil ranks third, for the second consecutive year.

Below is the GWEC ranked list:

### Top 10 cumulative capacity 2021

chart 11

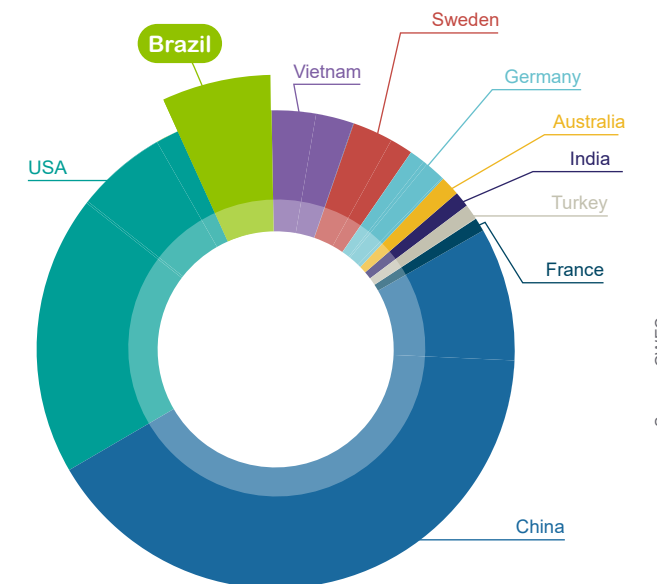
RANKING POSITION	COUNTRY	Power (GW)
1	China	310.6
2	USA	134.3
3	Germany	56.8
4	India	40.0
5	Spain	28.3
<b>6</b>	<b>Brazil</b>	<b>21.5</b>
7	France	19.1
8	Canada	14.2
9	United Kingdom	14.0
10	Sweden	10.0



### Top new installed capacity 2021

chart 12

RANKING POSITION	COUNTRY	Power (GW)
1	China	30.7
2	USA	12.7
<b>3</b>	<b>Brazil</b>	<b>3.8</b>
4	Vietnam	2.7
5	Sweden	2.1
6	Germany	1.9
7	Australia	1.7
8	India	1.5
9	Turkey	1.4
10	France	1.2

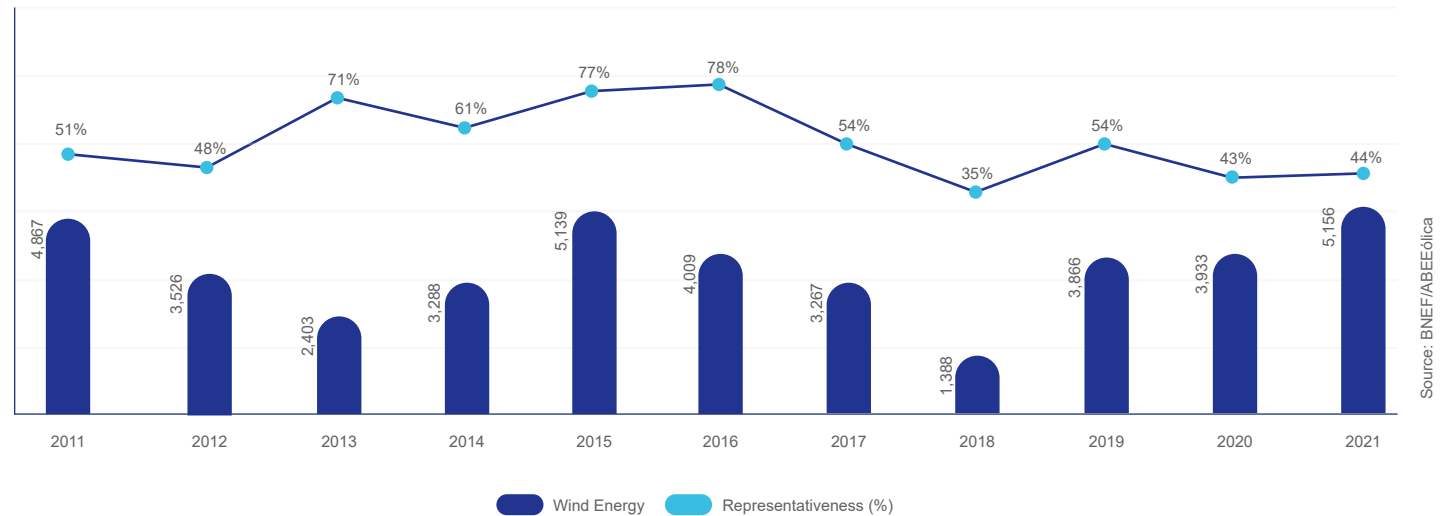




## INVESTMENTS IN WIND POWER

US\$ 5.15 billion (R\$ 27.81 billion) were invested in wind power in 2021, or 44% of the total investment in renewables (solar, wind, biofuels, biomass, PCHs (small hydro) and other sources) in Brazil. If we look at 2010 through 2021, the total was around US\$ 42.36 billion. The next Chart below shows investments in renewable energy and the amount invested in wind energy since 2010, as calculated by Bloomberg New Energy Finance - BNEF, which also publishes an analysis of this data.

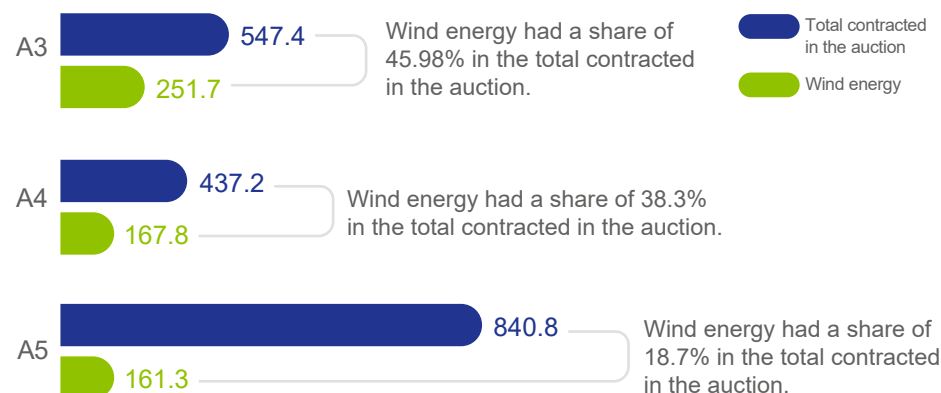
**Investments in new wind energy project (US\$ Million)**  
chart 13



Source: BNEF/ABEEólica

## AUCTIONS

580 MW of installed capacity were contracted in three auctions in 2021. The table shows the total contracted per auction, and how much of this was wind power:



We also had a good year in the free market. These numbers are not consolidated in any database as these transactions are not necessarily public, however we estimate that in general wind farms sold some 3 GW to the free market in 2021. More wind energy was sold in the free market than in the regulated market for the fourth consecutive year.

## CLOSING REMARKS

As shown in this document, 2021 was a good year for wind energy, despite the difficulties of such an atypical year due to the lingering effects of the pandemic. I am completing this Bulletin in early 2022 when the vaccine has arrived for a good percentage of our population, most of which is already moving to its third dose or fourth.

I am also full of plans, soon we will hold the 1st Brazil Offshore Wind Summit in Rio de Janeiro, together with GWEC. And Brazil Windpower will once again be an in-person event. Slowly we will return to such events and meet each other face-to-face.

Our new plans include hard work in offshore wind energy. Decree 10,946 was signed in early 2022 and regulates the assignment of use of physical spaces and the use of natural ocean resources to generate electricity in offshore ventures. This decree was a critical move to enable Brazil to embark on building offshore wind farms in a

manner in which the investor, government, and society feel secure.

We believe this decree not only meets public and collective interests but is also an important platform for companies to work in an organized and cohesive way. In an industry that is in its infancy, this security is essential so that companies, society, and the government know the technical criteria and demands, whether or not studies are required, and the agencies in charge of analyzing, approving, and formalizing the progress of each step in these projects. Offshore wind energy is more complex than onshore. It is worth remembering that, as of April 2022, IBAMA was already analyzing over 100 GW in wind projects, which is a reflection of investor interest.

And speaking of the future, you have likely noted that we have a new logo. In April 2022 our name changed to Associação Brasileira de Energia Eólicas e Novas Tecnologias [Brazilian

Association of Wind Energy and New Technologies], so we added the words onshore and offshore to the logo. This new logo reflects changes that have been maturing over a long period, and we felt the need to change it to reflect our day-to-day activities. As an example, I mentioned that we have been discussing offshore wind energy at events for more than five years and have had a dedicated working group for more than four years. We were actively involved in all of the public discussions that culminated in Decree 10,946. All this work is the result of market interest and technology developments.

Numerous global offshore companies have joined Abeeolica in recent years. Given all this, it was only a matter of time until our logo reflected what we already are in practice: an association that addresses onshore and offshore wind energy. And finally, together with this change, we decided to add “new technologies” to our logo as we have seen major complementarity in

developing offshore with green hydrogen, along with storage systems, and want to work more closely with other associations that are already dedicated to these new technologies. We have a new logo and are ready for the future.

Elbia Gannoum  
CEO  
ABEEólica - Brazilian Wind Energy and  
New Technologies Association

## CORPORATE INFORMATION

### CEO

Elbia Gannoum

### Technical Board

Sandro Yamamoto

André Themoteo  
Carolina Kimura  
Gabriele Benfatti  
Matheus Noronha  
Riomar Merino Jorge

### Institutional Relations

Selma Bellini  
Felipe Vieira

### Administrative-Financial Coordination

Laudicea Andrade  
Vanessa Santos

### Executive Secretary

Ariane Silvério Monteiro  
Ieda Klinger

### Editing and Review

ABEEólica

### Photos

Acervo ABEEólica, Shutterstock e Unsplash

### Graphic Project and Layout

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## ABOUT ABEEÓLICA

Established in 2002, ABEEólica, Brazilian Wind Energy and New Technologies Association is a non-profit organization that brings together and represents the wind power sector in Brazil. Since it was created, ABEEólica has actively 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 statutes on the ABEEólica website at "Join Us", or send an e-mail to: [comunicacao@abeeolica.org.br](mailto:comunicacao@abeeolica.org.br)

## CONTACT

Av. Paulista, 1337, 5º andar, Conj. 51  
Bela Vista, São Paulo, CEP 01311-200  
Tel: 55 (11) 3674-1100

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