Brazilian Northeast's

Photovoltaic Market

in 2020

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Distributed Generation dynamics in Brazil and analysis of potential impacts of ANEEL's proposals.

Utility Scale PV plant's investment scenarios - Auctions and Energy Free Market

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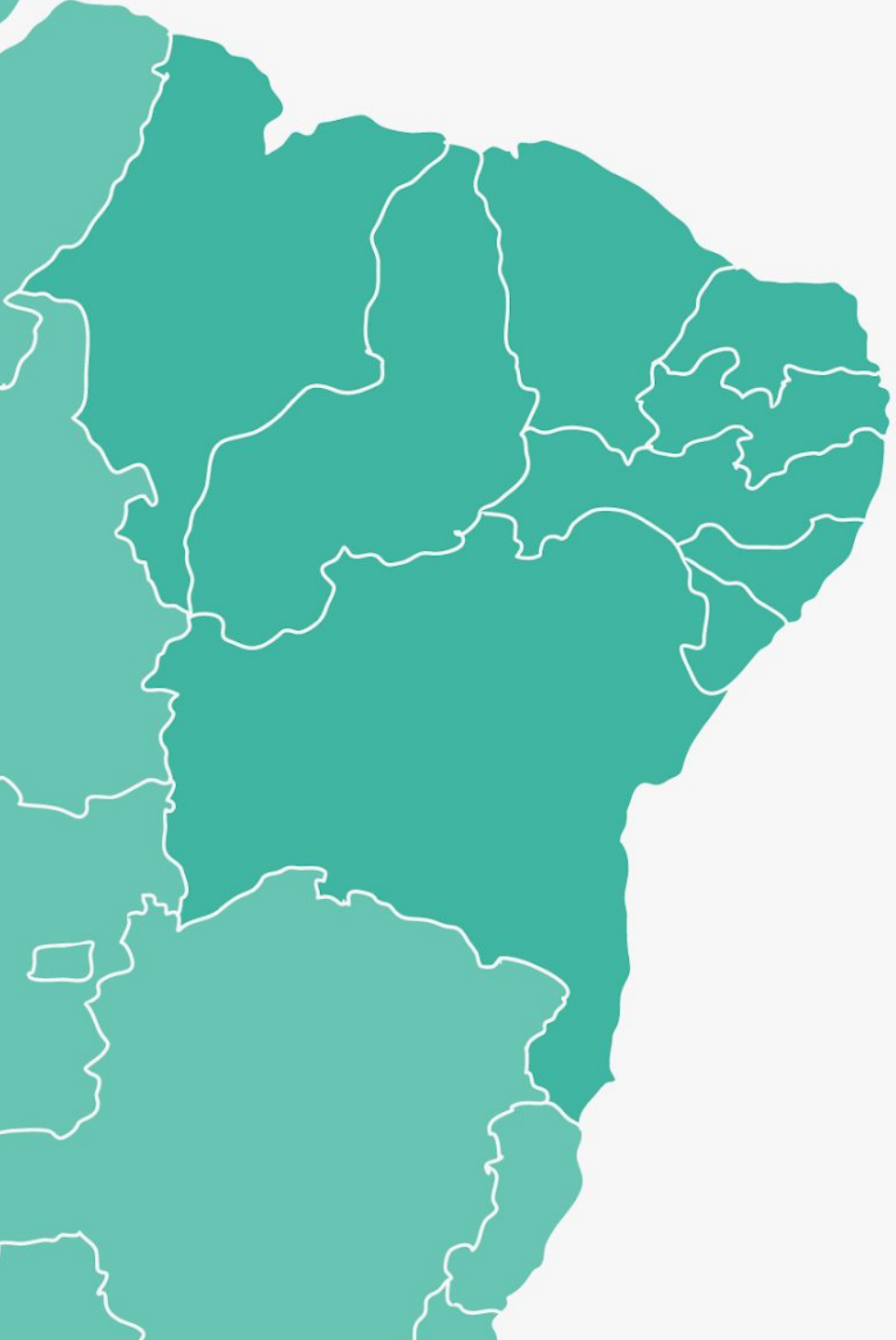

Summary

- Distributed Generation Overview
- State's Overview
- Installed Capacity
- Main Cities, System and Ports
- Impacts of ANEEL's proposals to 482
- Utility Scale PV: Regulated and Free Markets

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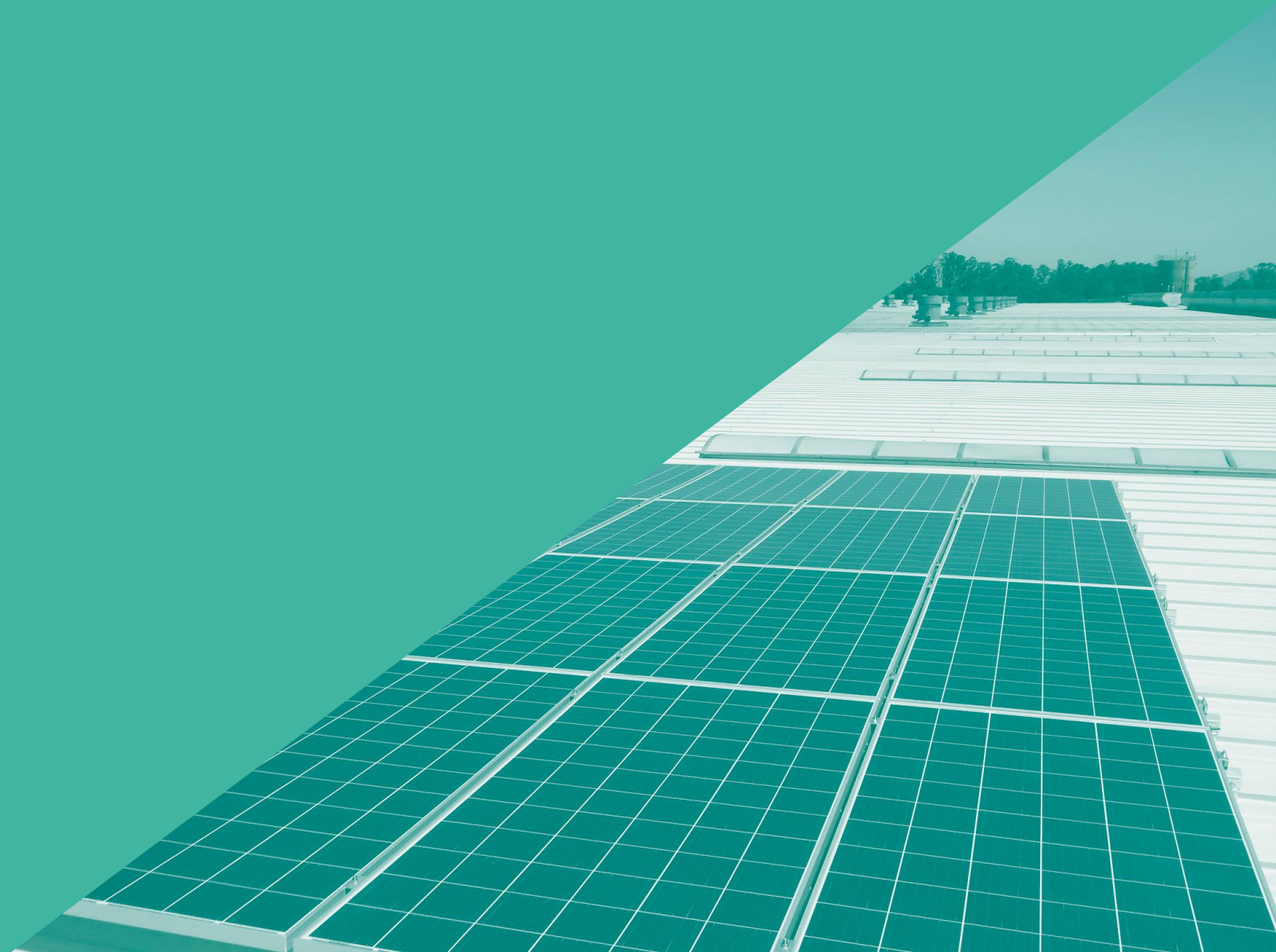
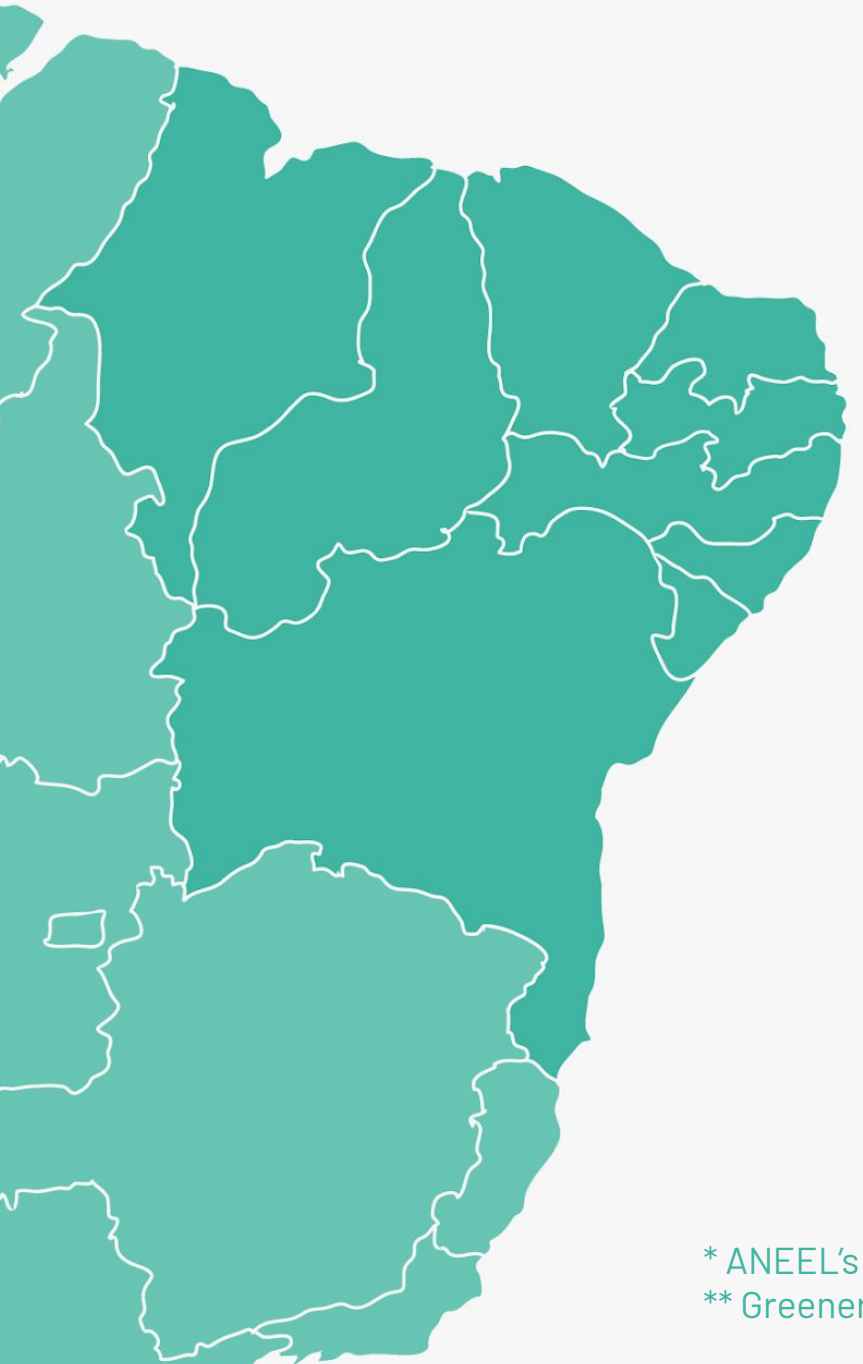
Chapter 01

Distributed Generation Market





16.5%*

of Brazil's installed capacity

14.2%*

of national Systems

15.7%**

of Integration companies

Photovoltaic Distributed Generation in the **Northeast**

The Northeast region is relevant in the PV Distributed Generation national market

* ANEEL's data from November 2019
** Greener's 2º Q/2019 research's data

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PV Distributed Generation in **2019**

15.3%*

Of systems installed in Brazil during 2019 were in the **Northeast**.

R$ 650 mi**

The estimated total amount of investments in DG is around R$ 650 millions.

** ANEEL's data from November 2019
** Greener's estimate based on ANEEL's data.

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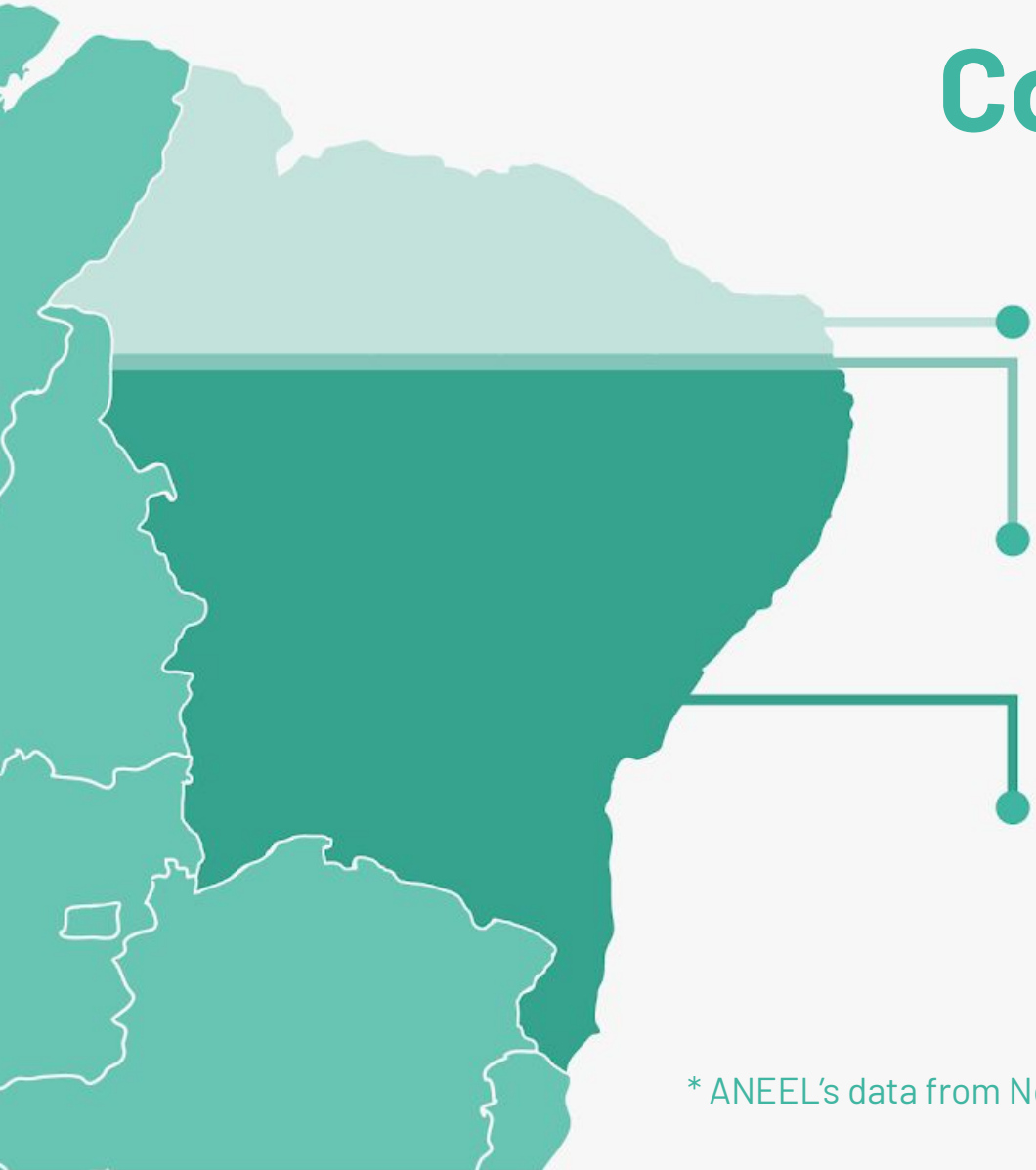

Compensation models

25.8%*

¼ of installed PV is far from the consumer, in the **Remote Generation** modality

0.5%*

A small share is of **Shared Generation** and **Multiple Consumer Units**

73.6%*

Of Northeast installed capacity is located close to the **Consumer Unit**.

* ANEEL's data from November 2019

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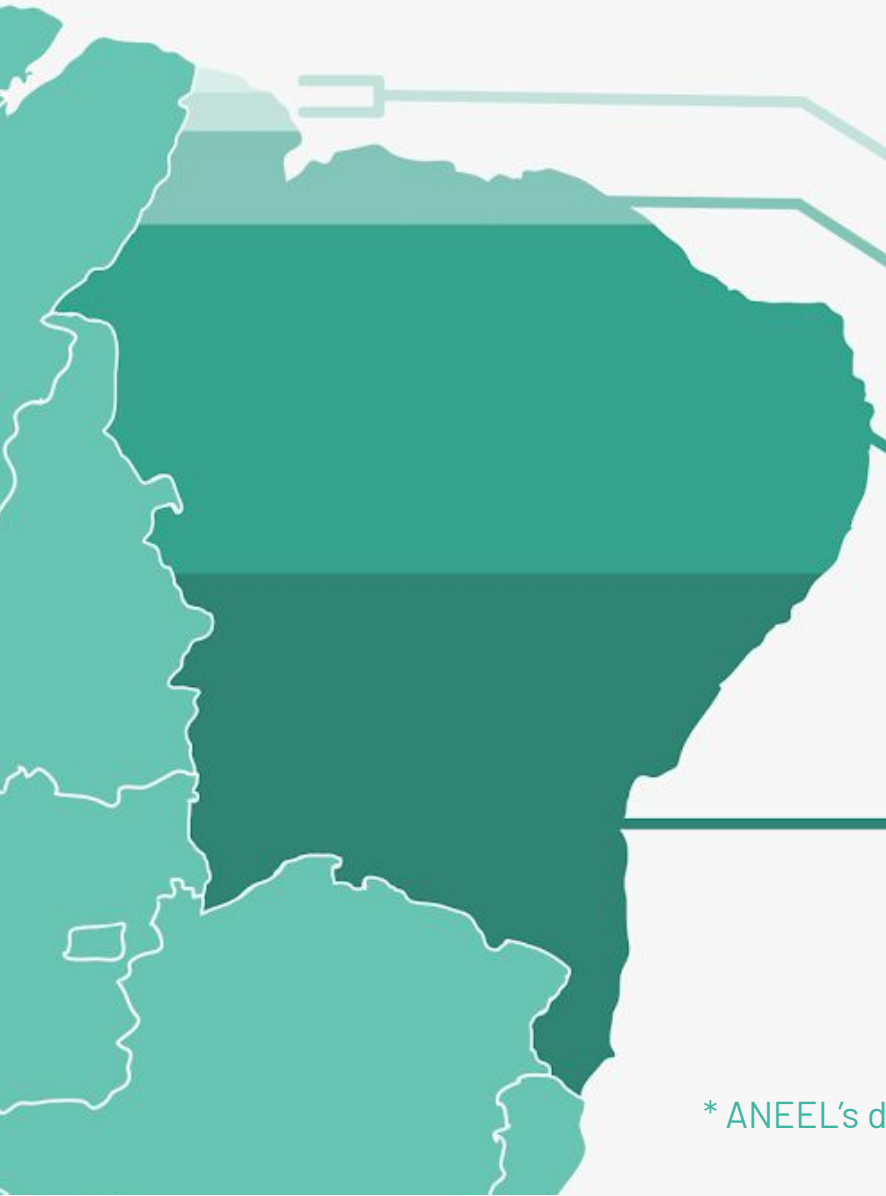
Photovoltaic DG's consumer's profile



7,9% Rural, Public Power, Public Service, Public Illumination

9,7% **Industrial** consumers

36,7% **Residential consumers** in second

45,7% Almost half (45,7%) of Northeast's installed capacity is destined to **commercial consumers**

* ANEEL's data from November 2019

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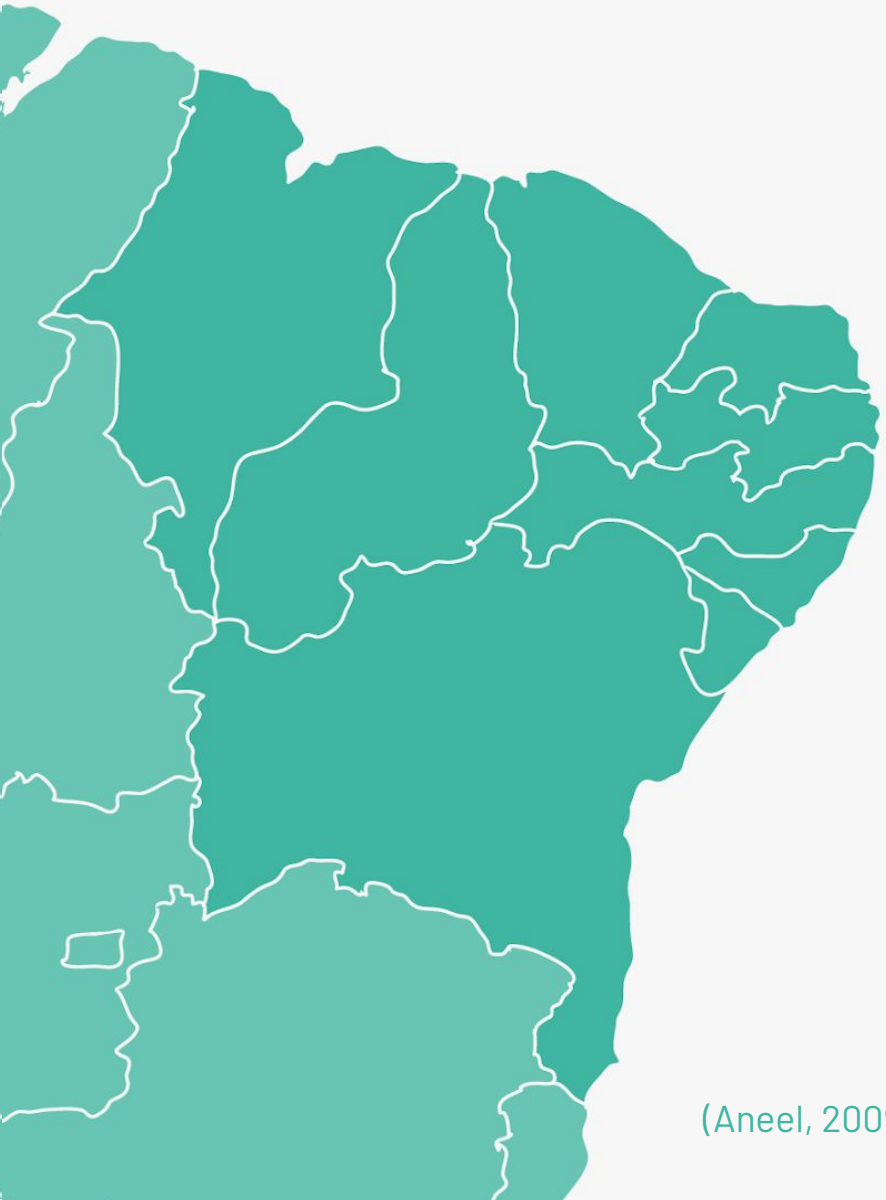

(Aneel, 2009)

Photovoltaic DG's consumer's profile in **2019**

Residential and commercial classes had a relevant growth in 2019, adding **138 MW** together. This is around **17%** of commercial and residential installations in all country.

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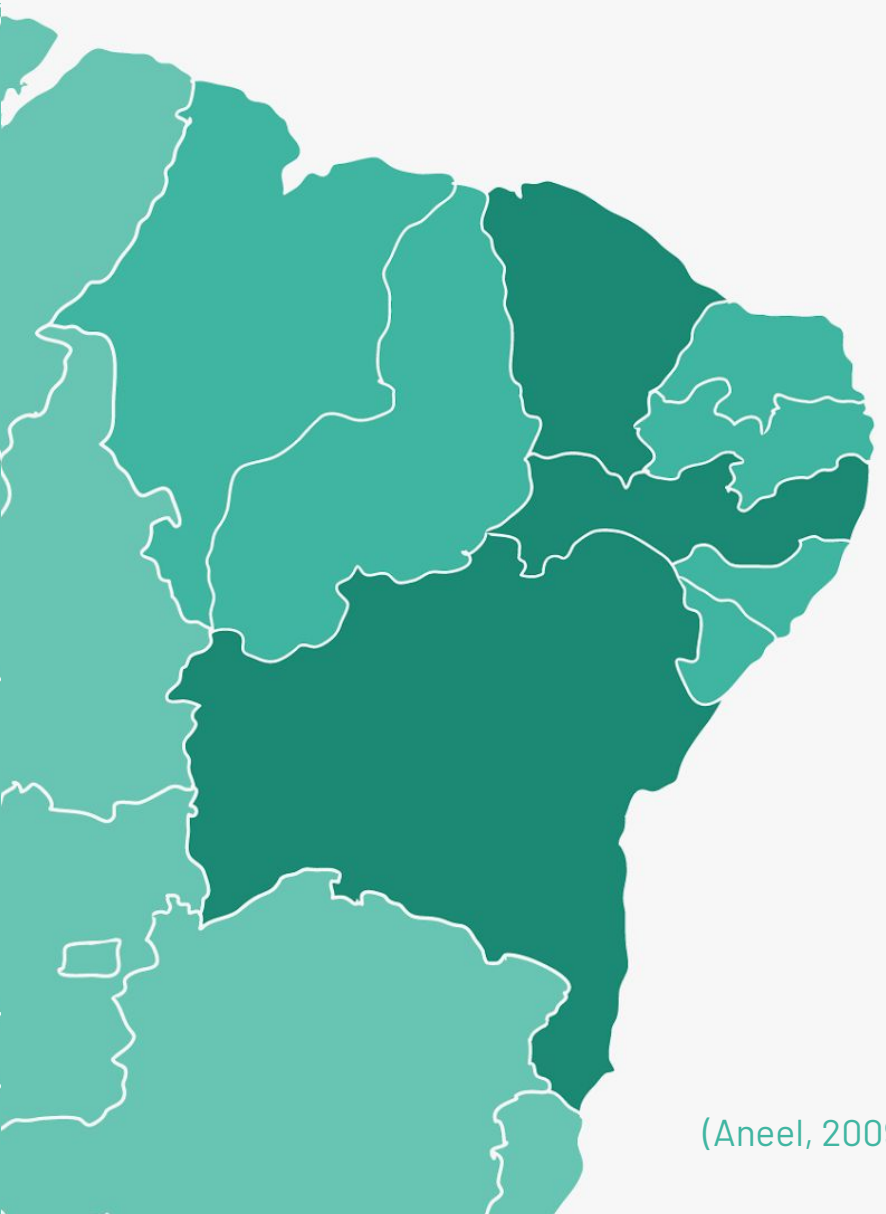

State's **Overview**

Ceará The **first state in terms of installed capacity**, having more than **58 MW** and 3,600 systems.

Pernambuco Is the **second state**, having over **39 MW** and 2,500 systems.

Bahia Is the **third**, with **36 MW** in over 3,400 systems.

(Aneel, 2009)

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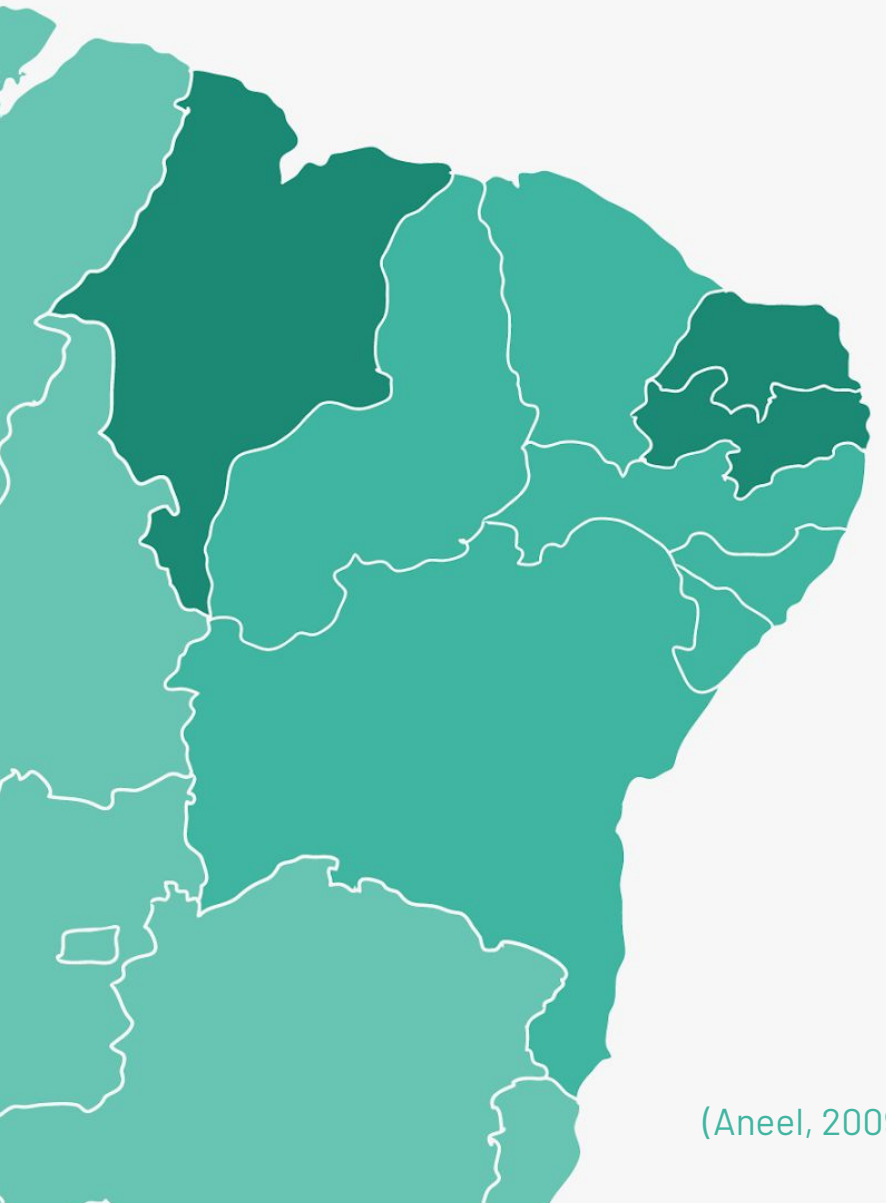

(Aneel, 2009)

State's **Overview**

Rio G. do Norte

Being the **4th most important** state, Rio Grande do Norte accounts for more than **32 MW** in 2,200 systems.

Paraíba

RIght behind as the **5th in Northeast**, with **31.4 MW** and over 2,340 systems.

Maranhão

Is the **6th state** with more than **25 MW** and 2,060 systems.

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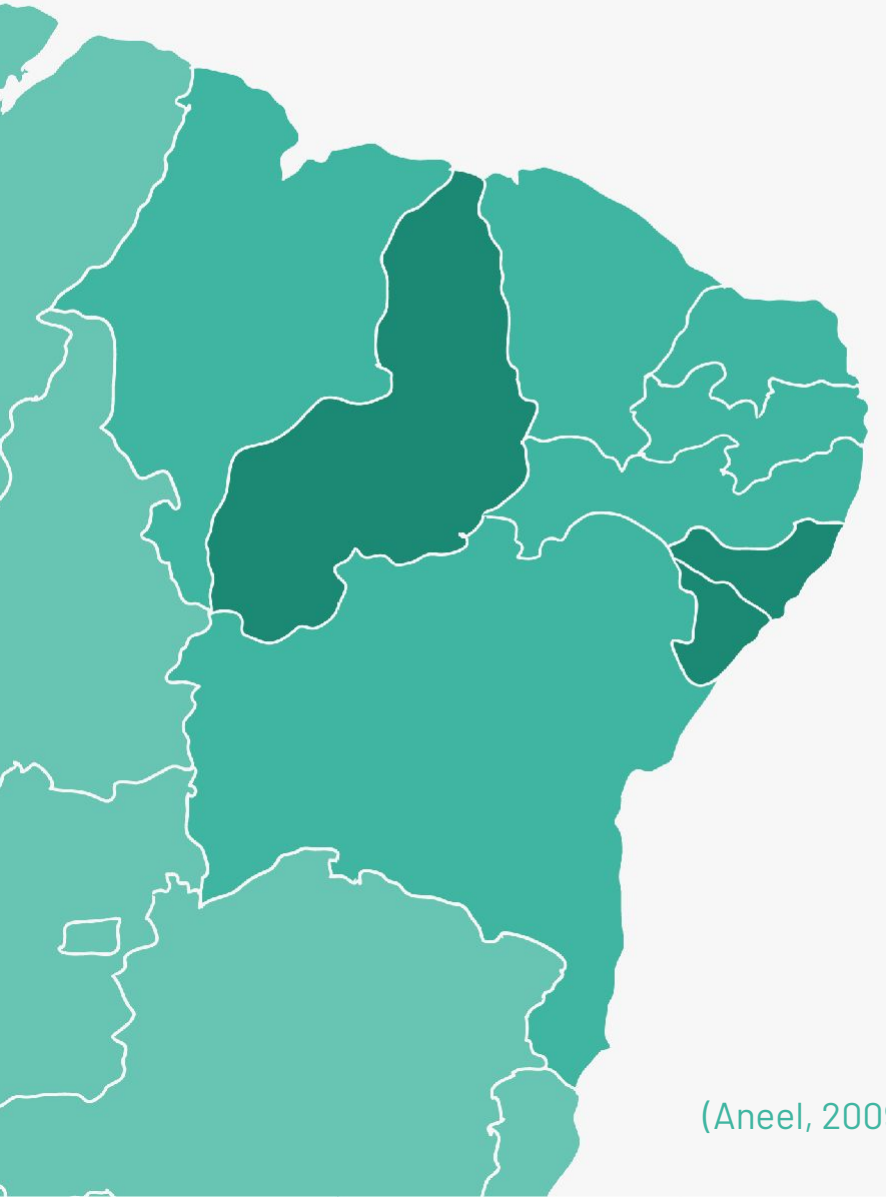

(Aneel, 2009)

State's **Overview**

Piauí Is the **7th**, with **24 MW** installed and over 1,760 systems.

Alagoas Alagoas is the **8th**, with **11 MW** and almost 1,000 systems

Sergipe In **9th**, Sergipe has **10.6 MW** and almost 1,000 systems

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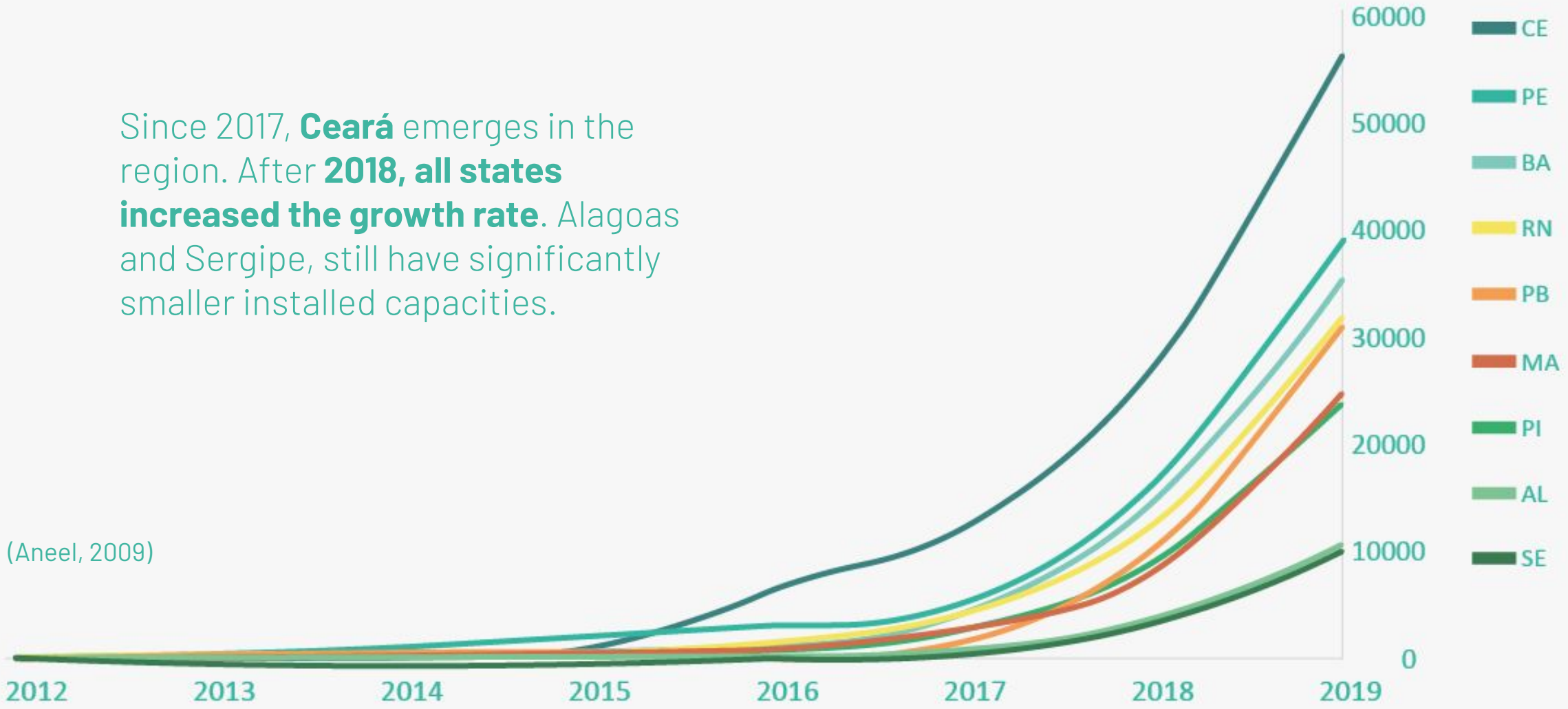
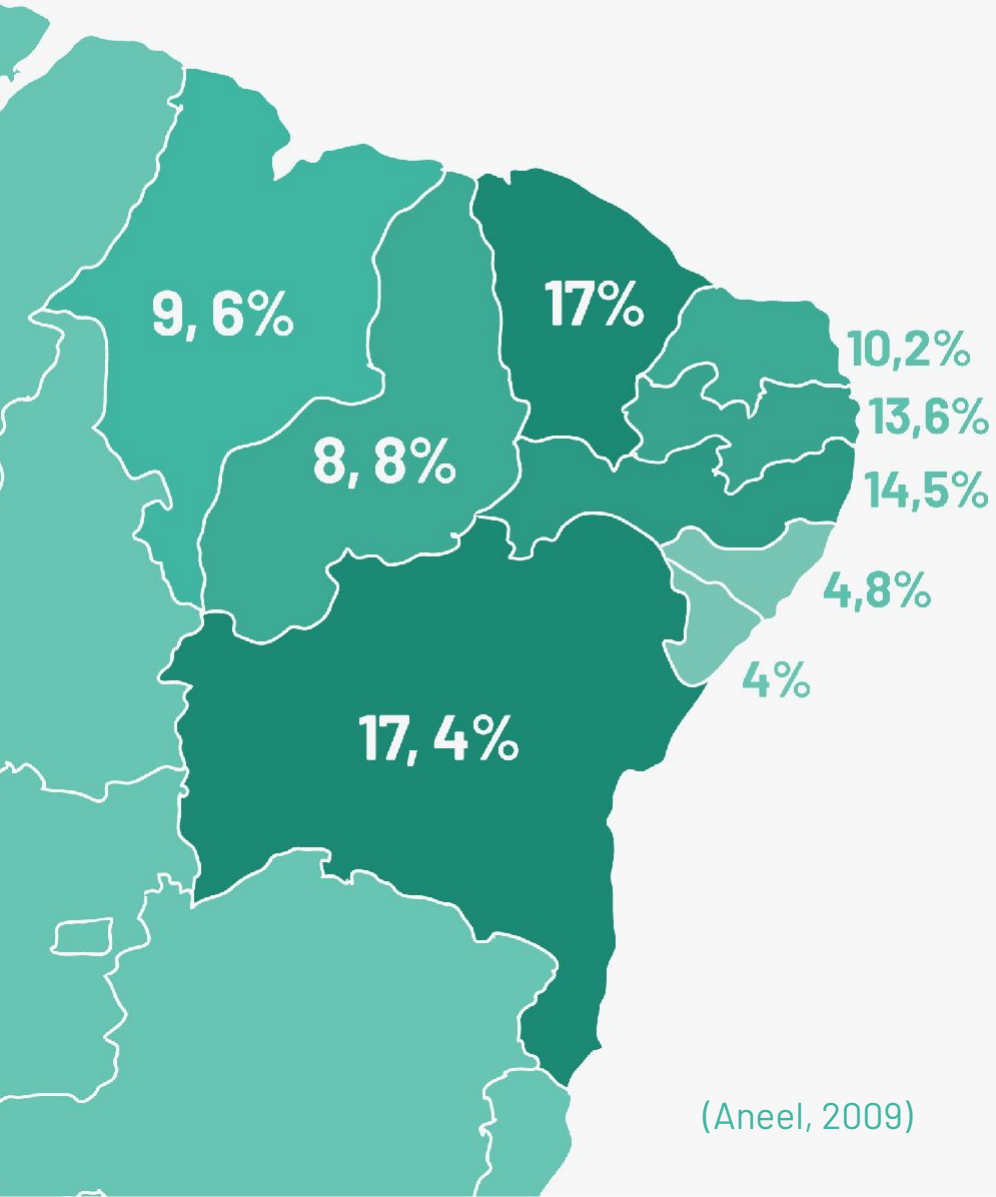
Installed Capacity Evolution

Since 2017, **Ceará** emerges in the region. After **2018, all states increased the growth rate**. Alagoas and Sergipe, still have significantly smaller installed capacities.

(Aneel, 2009)





(Aneel, 2009)

Consumer Units with PV

Bahia Although Bahia is in **third place** in installed power, the state has the largest number of consumer units with PV, around **17.4%** of all systems in the region.

Ceará Ceará, first in installed capacity, is right behind with **17%**.

Sergipe Sergipe has the smallest share, having only **4%** of consumer units in the Northeast

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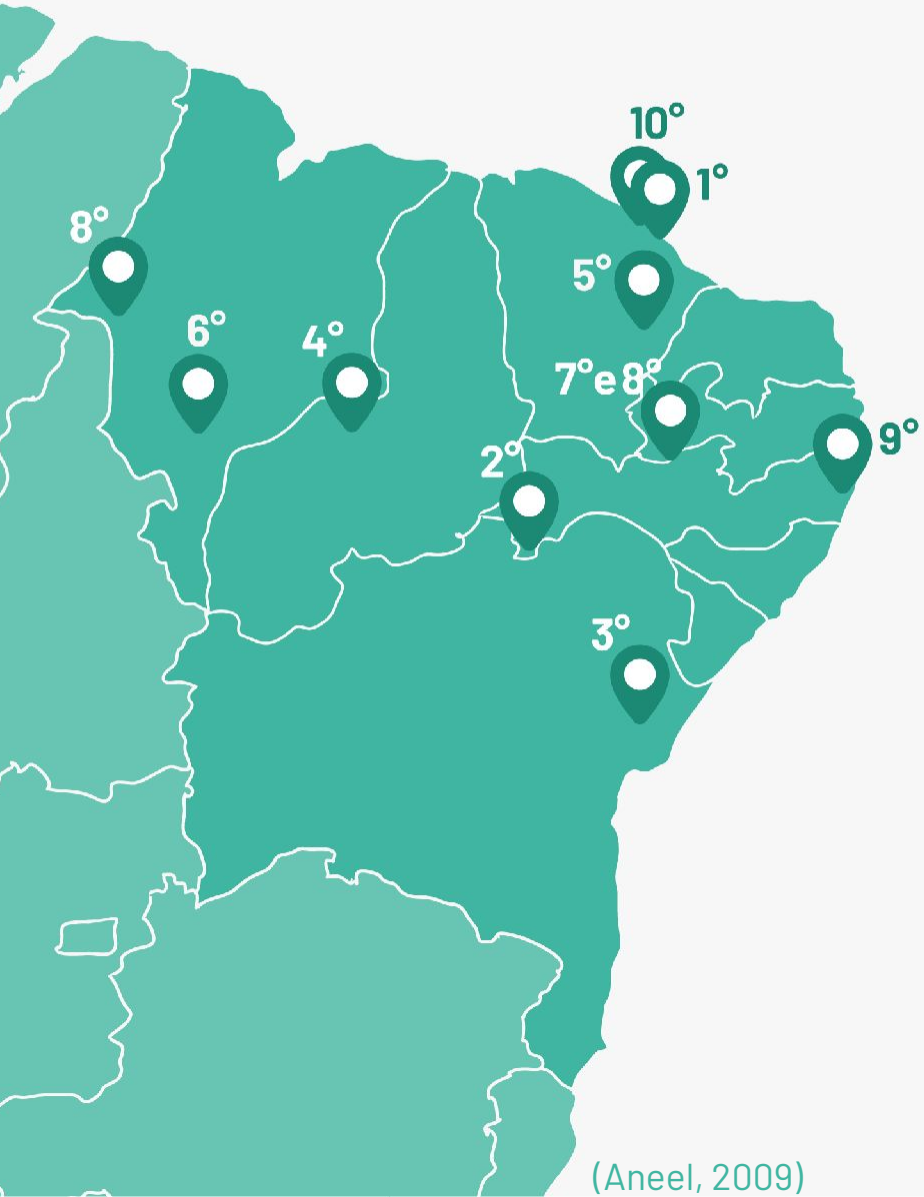
Main Cities *in DG*

(Aneel, 2009)

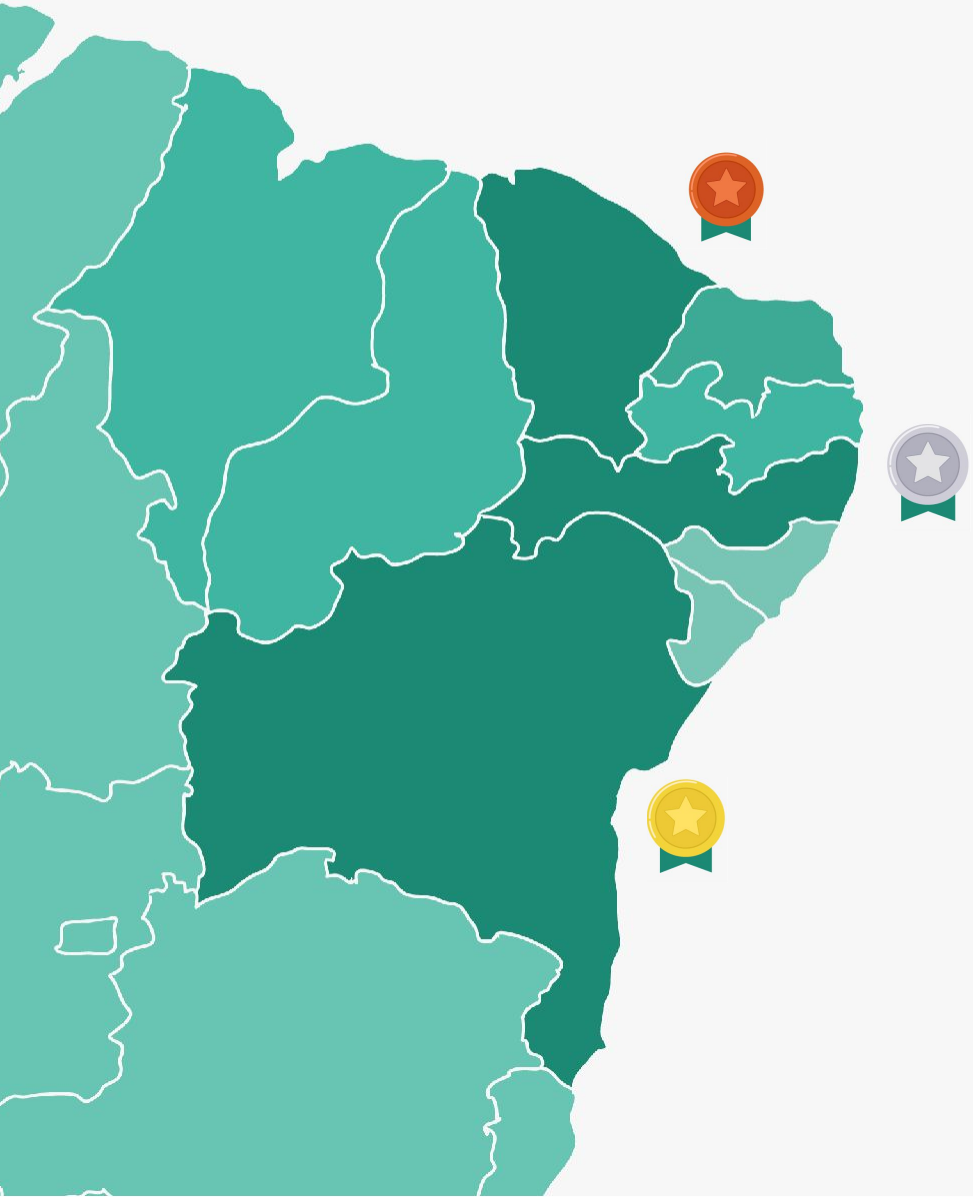
	City	Installed Capacity (kW)	Number of System
1º	Fortaleza (CE)	18,021	1,238
2º	Teresina (PI)	12,115	1,029
3º	Natal (RN)	8,866	598
4º	Petrolina (PE)	8,643	554
5º	Aracaju (SE)	7,781	713
6º	São Luís (MA)	5,989	567
7º	Mossoró (RN)	5,512	424
8º	Imperatriz (MA)	4,565	429
9º	Salvador (BA)	4,289	532
10º	Aquiraz (CE)	4,076	76

Mains Systems *in operation*



(Aneel, 2009)

	Owner	City	Modality	Installed Capacity (kW)
1º	PECÉM AGROINDUSTRIAL LTDA	Aquiraz (CE)	Generation at the CU	2,984
2º	COMPANHIA HIDRO ELETRICA DO SAO FRANCISCO	Petrolina (PE)	Remote Selfconsumpt.	2,400
3º	PKG DO BRASIL IMPORTACAO E EXPORTACAO LTDA	Alagoinhas (BA)	Generation at the CU	1,950
4º	CORNELIO ADRIANO SANDERS	Sebastião Leal (PI)	Remote Selfconsumpt.	1,600
5º	TUBOART IND E COM LTDA	Jaguaribe (CE)	Remote Selfconsumpt.	1,060
6º	ANTIDIO PASQUAL SANDRI	Balsas (MA)	Generation at the CU	1,000
7º	ELETRON POWER GERACAO E COMERCIALIZ	Flores (PE)	Generation at the CU	1,000
8º	CENTRO DE ESTETICA E FISIOTERAPIA (ELETRON)	Flores (PE)	Remote Selfconsumpt.	1,000
9º	Empresa de Turismo de Pernambuco - EMPETUR	São Lourenço da Mata (PE)	Generation at the CU	967
10º	EMPREENDIMENTOS PAGUE MENOS S.A.	Fortaleza (CE)	Remote Selfconsumpt.	918



Module Importation **in 2019** *Main Ports*

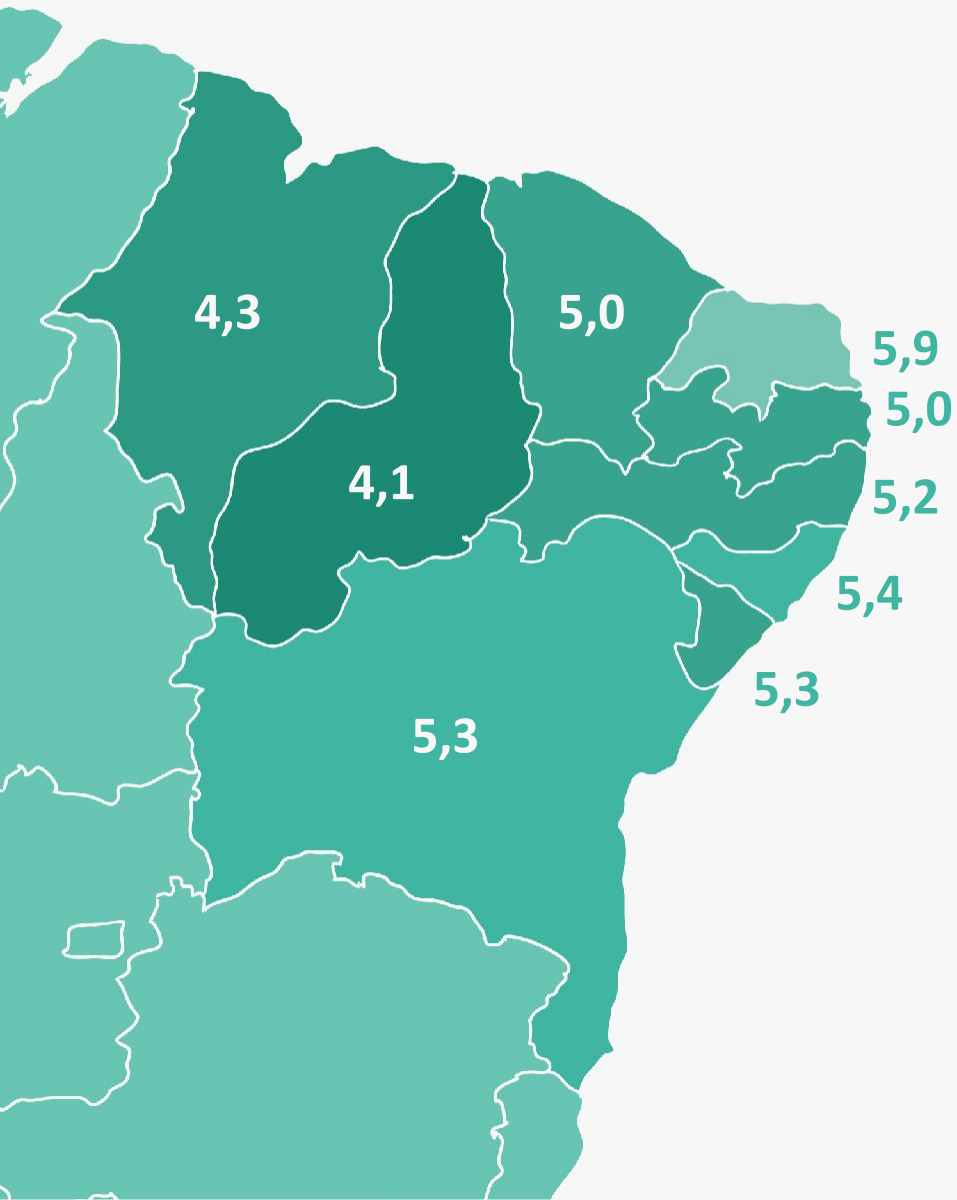
37 MWp
Fortaleza Port

390 MWp
Salvador Port

237 MWp
Suape Port

Around **25% of all national importations** is done by Northeast Ports. Salvador, Suape and Fortaleza's Ports were the most important to receive PV modules in 2019*. In Brazil, those ports are the **4th, 5th** and **6th**, respectively. Together they received more than **600 MWp** that will be destined to the Distributed Generation and Utility Scale plants, demonstrating the region's relevance for the sector.

*Importation data from Jan/19 to Oct/19 gathered in Receita Federal's website.



Payback time for **Residential**

Residential systems' discounted payback in the northeast is estimated between **4,1 (Piauí)** and **5,9 years (Rio Grande do Norte)**. Ceará and Pernambuco, the most important states in installed capacity, have discounted paybacks around 5 years. The calculus considered a 30% simultaneity index.

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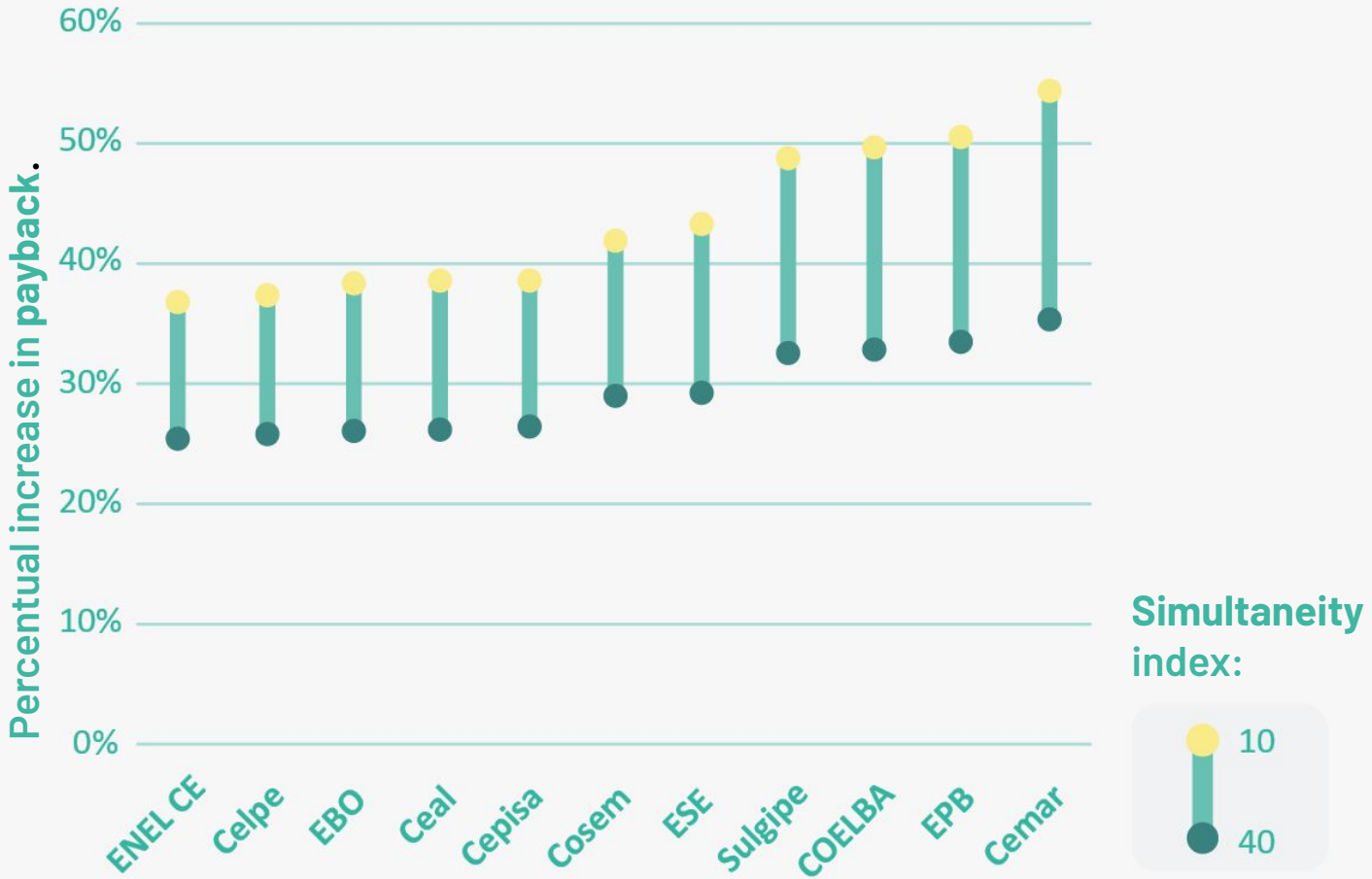
Impacts of **ANEEL's proposals**

Local Generation A2/A0 - Residential



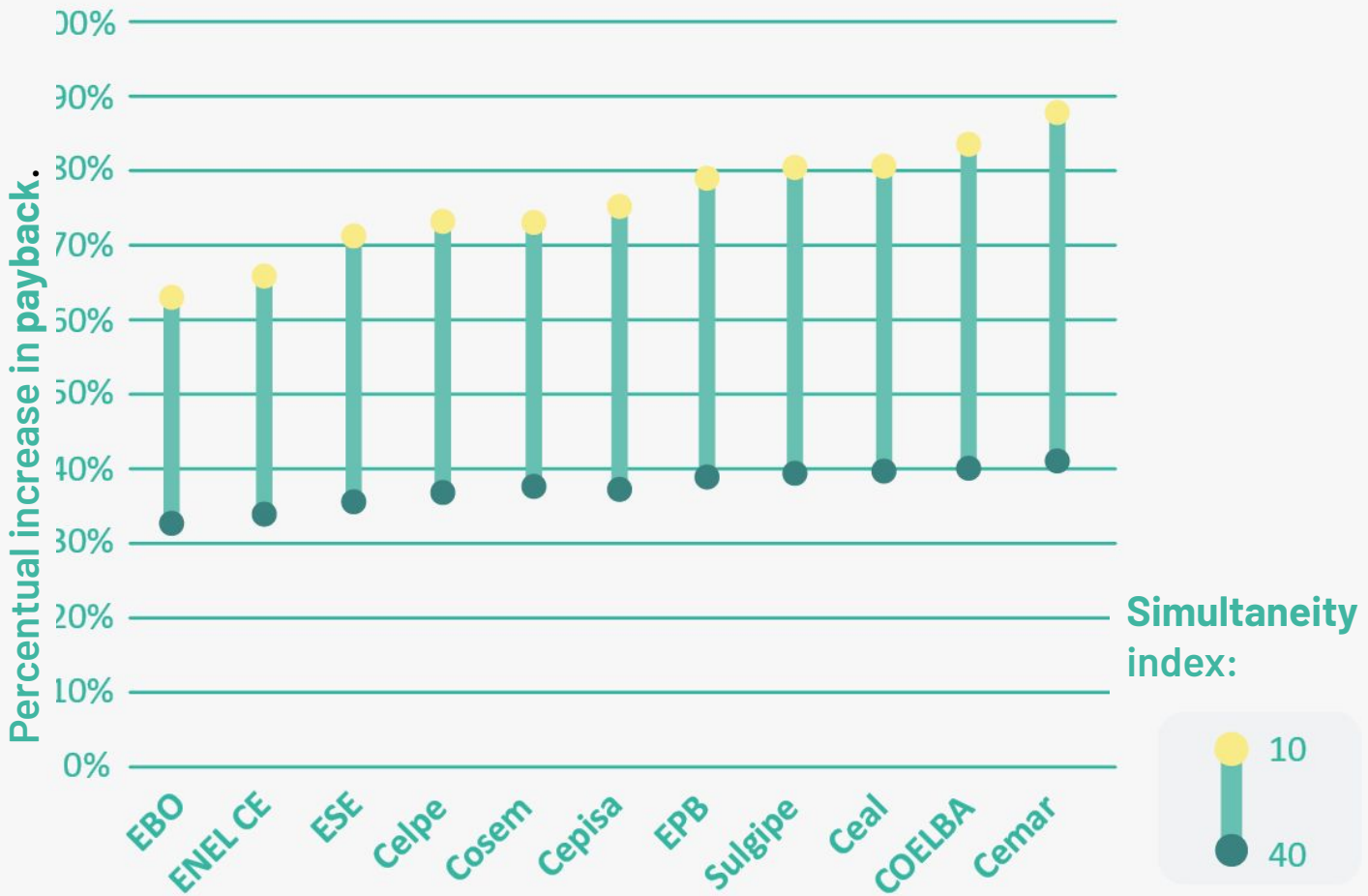
The increase in paybackt depends on drivers as tariff composition and the simultaneity index *. The increase can reach 50% in **Coelba** for customers with low simultaneity.

In the graph on the side, it can be noted that **Maranhão is the state that suffers the most with Alternative 2**. In addition, the State has small installed capacity and may hinder the deployment of Distributed Generation in its territory.

***Simultaneity Index:** Percentage of generation consumed right after generated, in other words, this energy is injected into the grid.

Impacts of **ANEEL's proposals**

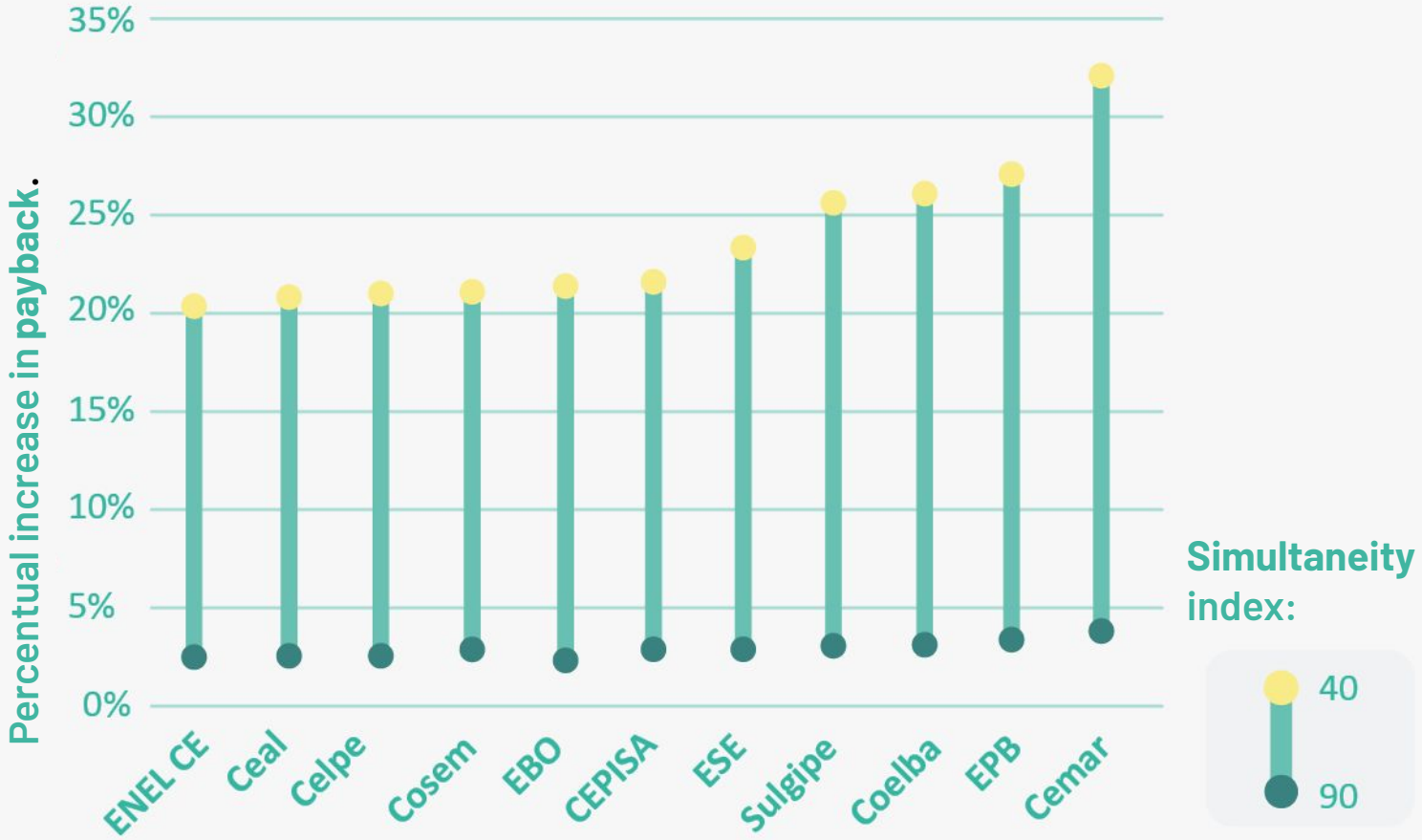
Local Generation A5/A0 - Residential



Alternative 5 imposes greater increases in the payback time of systems. Again, the state of **Maranhão is the most affected**, reaching almost **90%** for places where there is small simultaneity. In **Ceará**, the impact would be more than **65%** under the same condition. **Pernambuco** and **Bahia** would have impacts of up to 70%.

Impacts of **ANEEL's proposals**

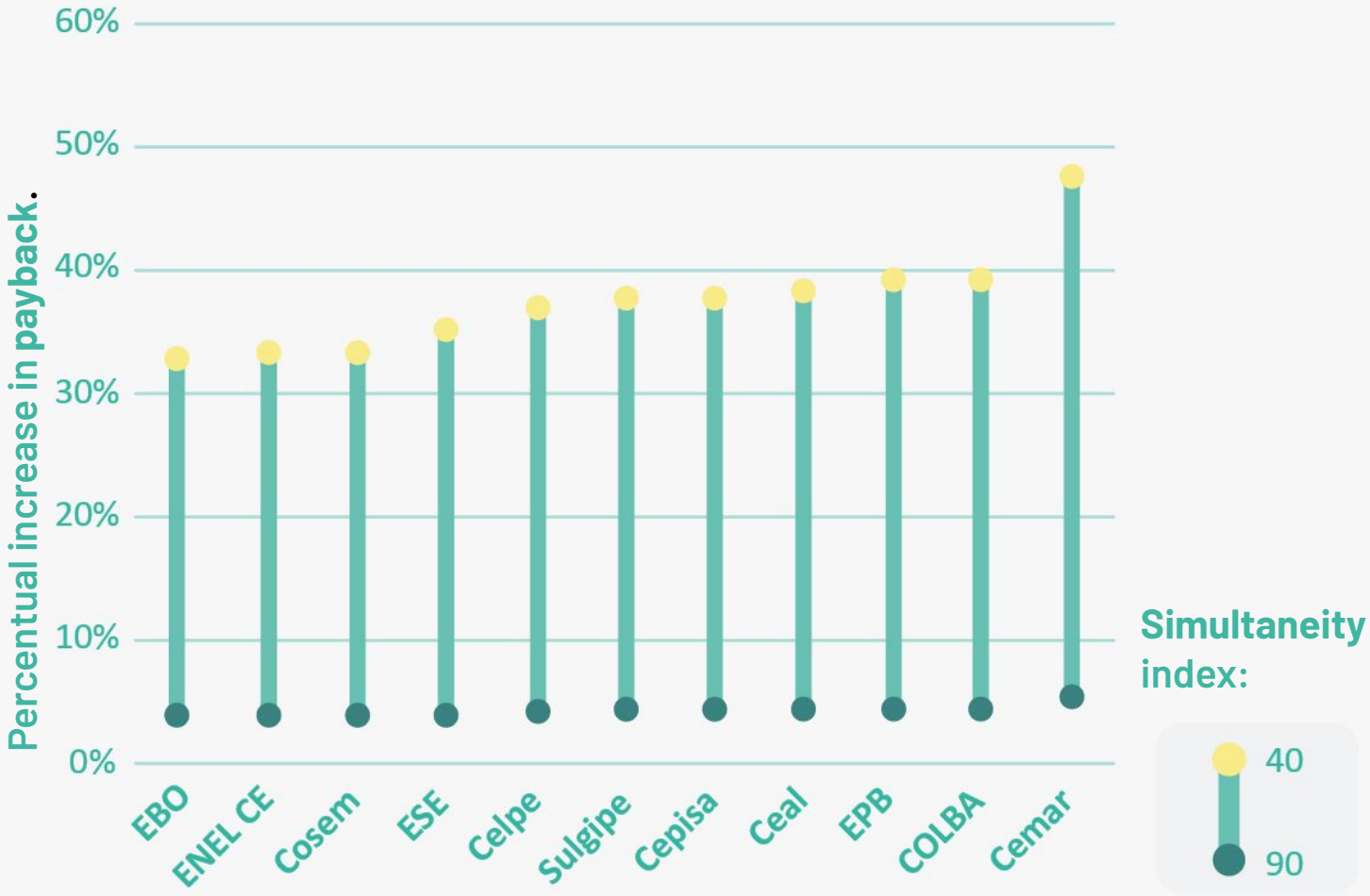
Local Generation A2/A0 - Commercial



For **commercial applications**, the simultaneity interval tends to be longer since consumption sometimes coincide with generation. With **Alternative 2** proposed by ANEEL, again **Maranhão** would be the most impacted, in some cases exceeding **30%** increase in the payback time.

Impacts of **ANEEL's proposals**

Local Generation A5/A0 - Commercial

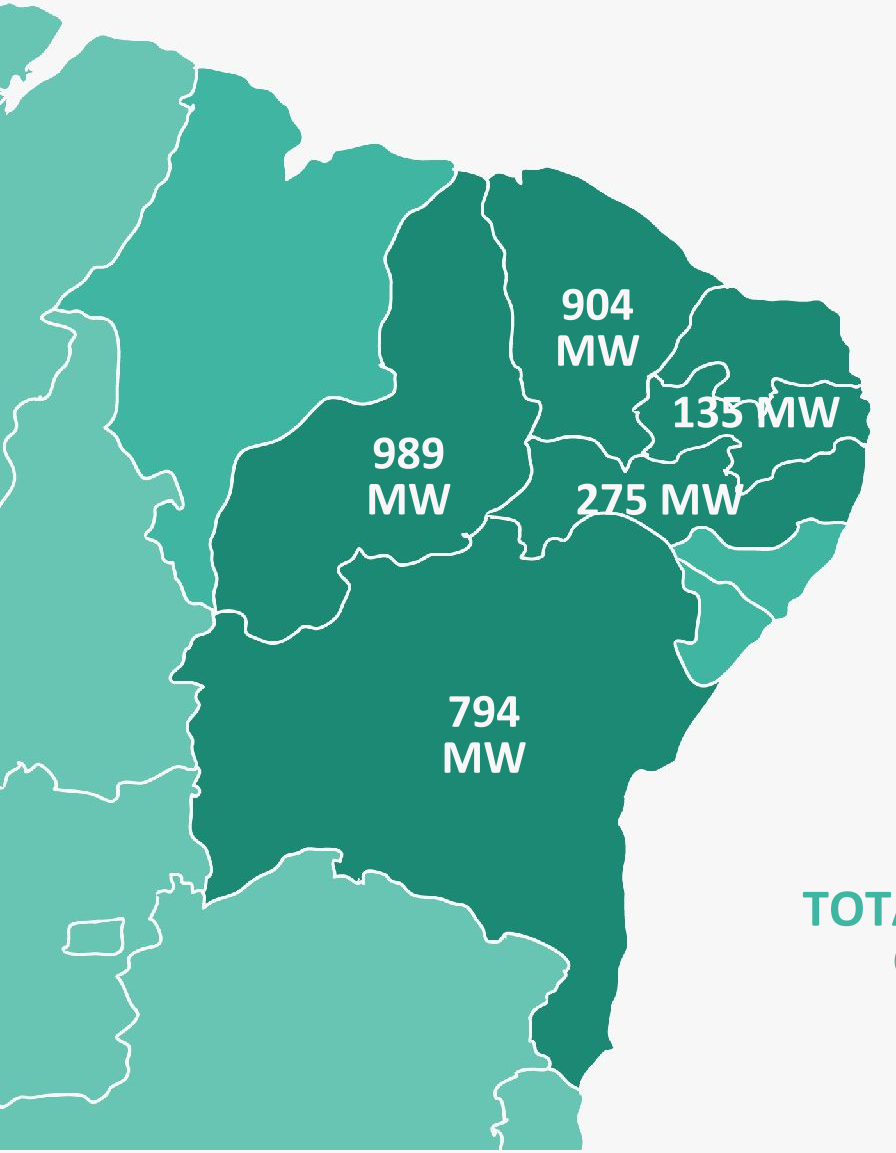


In **Alternative 5** the impacts remain more costly to **Maranhão**.

In general, the **Commercial sector** would be less impacted by changes due to greater simultaneity. However, high values of this variable, close to 90%, are uncommon, with most consumers having an impact **above 10%**.

Chapter 02

Utility Scale Market



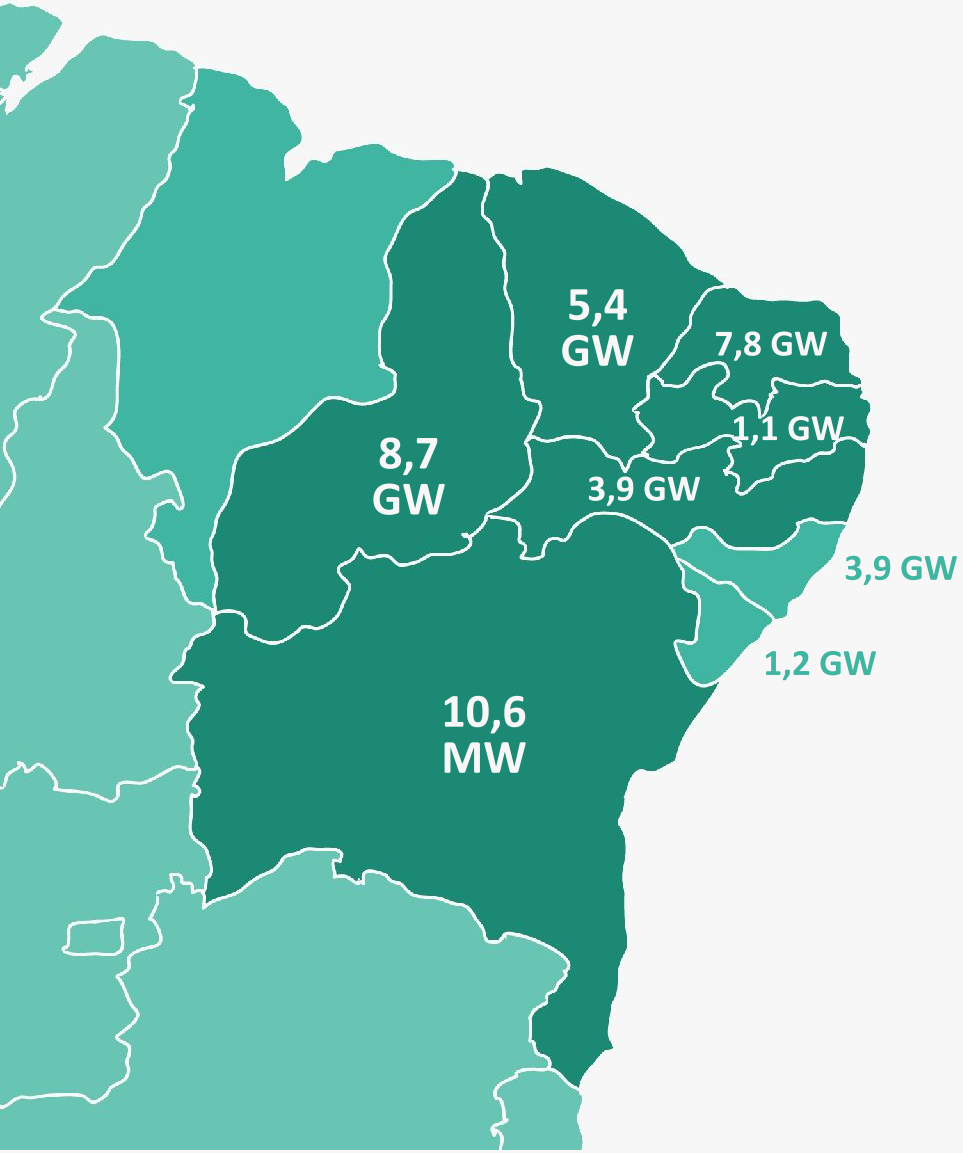
TOTAL = 3.3 GW

Auction Winners Utilities

75% Of auction winner utilities are located in the Northeast. **2.2 GW** will be constructed until **2023**.

Capacity per State in the Regulated Market
Consider PV plants with DRO, construction not started or in operation

Source: ANEEL, CCEE, Greener. Update: 10/2019.



Capacity per State in the Regulated Market
Consider PV plants with DRO, construction not started or in operation

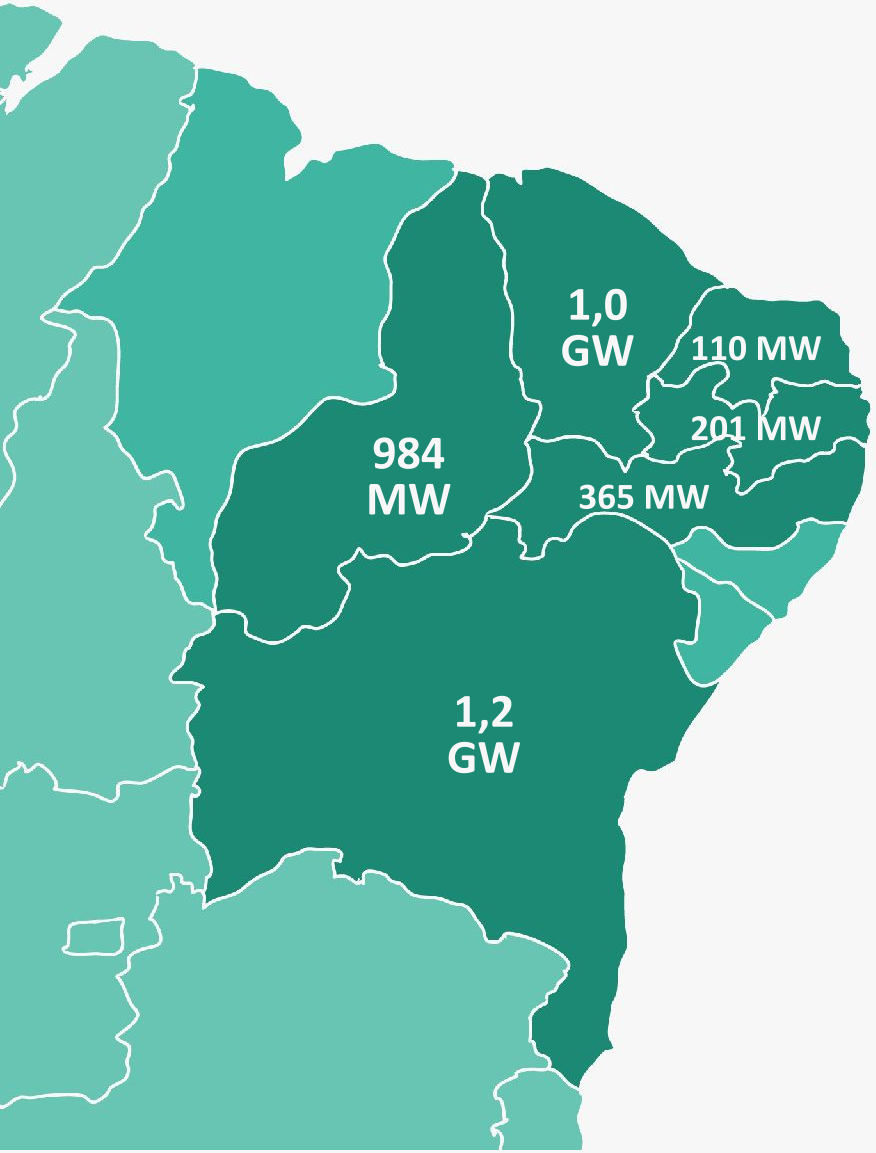
Source: ANEEL, CCEE, Greener. Update: 10/2019.

Solar projects in **initial or intermediate** development stage

Utilities destined to Free and Regulated Environments

39 GW of solar projects in initial or intermediate stage of development in the northeast.

76% of the country's developing capacity is located in the northeast.



Capacity per State in the Regulated Market
Consider PV plants with DRO, construction not started or in operation

Source: ANEEL, CCEE, Greener. Update: 10/2019.

Solar projects in advanced stage of development

Project Status: Granted Projects

3.9 GW of utility scale plants are Granted in the Northeast. **Bahia, Ceará and Piauí** stand out in this scenario. Most of these projects were winners of **Energy Auctions**, being able to operate part of the **Free Market**, besides the projects that should operate exclusively in the **Free Market**.

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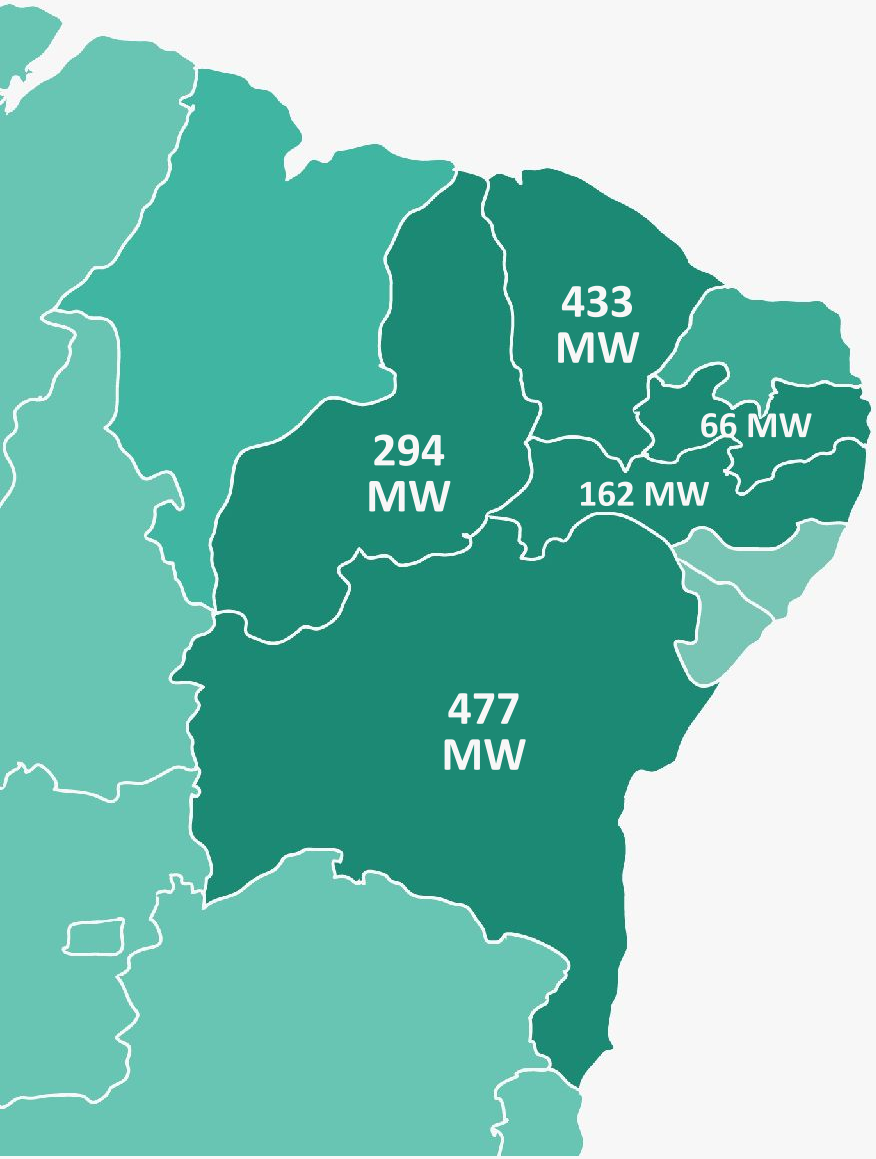
Free Market likely projects



Capacity per State in the Regulated Market
Consider PV plants with DRO, construction not started or in operation

Source: ANEEL, CCEE, Greener. Update: 10/2019.

1.4 GW in advanced stage of development with likely operation in the **Energy Free Market**.

*Granted projects with no PPAs in the Regulated Market was categorized as "likely to operate in the Free Market".

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