2023 | Brazil

Strategy Report
Distributed Generation

Solar Photovoltaic Market

Greener

February/2023

From the Market, for the Market

Every year we carry out our survey about the Distributed Generation solar PV sector. The objective of this survey is to show the reality of the market, in such a way that it can be a strategy guide for all the companies active in the sector.

To achieve this, we count on the collaboration of thousands of PV Integrators, who dedicate some of their precious time to respond to our questionnaire; on Distributors who take some time to provide us with reference prices of their PV kits; on all companies in general (Manufacturers, Distributors, Service providers) who use their time to distribute our questionnaire and incentivize the engagement of their customer bases and completion of the forms, as well as providing us with references and sharing their knowledge with us; and our Sponsors, who make the execution of all this work possible.

This is market research created by our market for our market. Our role is only to collect, concentrate and validate the information that the whole value chain supplies to us, with the best of intentions, since we all have the same objetive: to help the solar PV market grow in a healthy direction.

Our Big Thanks to everyone!
The team at Greener

Research Highlights

1. The **volume of PV Modules** needed to meet the demand for solar energy generation in Brazil surpassed **17 GW** in 2022, requiring investment in excess of R**$ 64 billion** for both Distributed Generation as well as large-scale solar plants. This represents a growth of 73% compared to 2021 (10.3 GW).

2. The strong growth in the solar PV market occurred despite a **fall in the use of bank financing for PV systems**, which was used to support **22% of completed sales** compared to 57% in 2021, as a result of higher interest rates.

3. The **changes in the rules for Distributed Generation** which came into force in January 2023 caused a **slight decrease in the attractiveness** of residential and commercial PV projects. Nevertheless, **solar generation for local consumption use continues to be profitable and advantageous for the end consumer**.

4. **Prices of PV systems showed an average decrease of 12%** in 2022. A drop in module costs and the high level of equipment stocks among wholesalers were two factors that contributed to price decreases for the end consumer.

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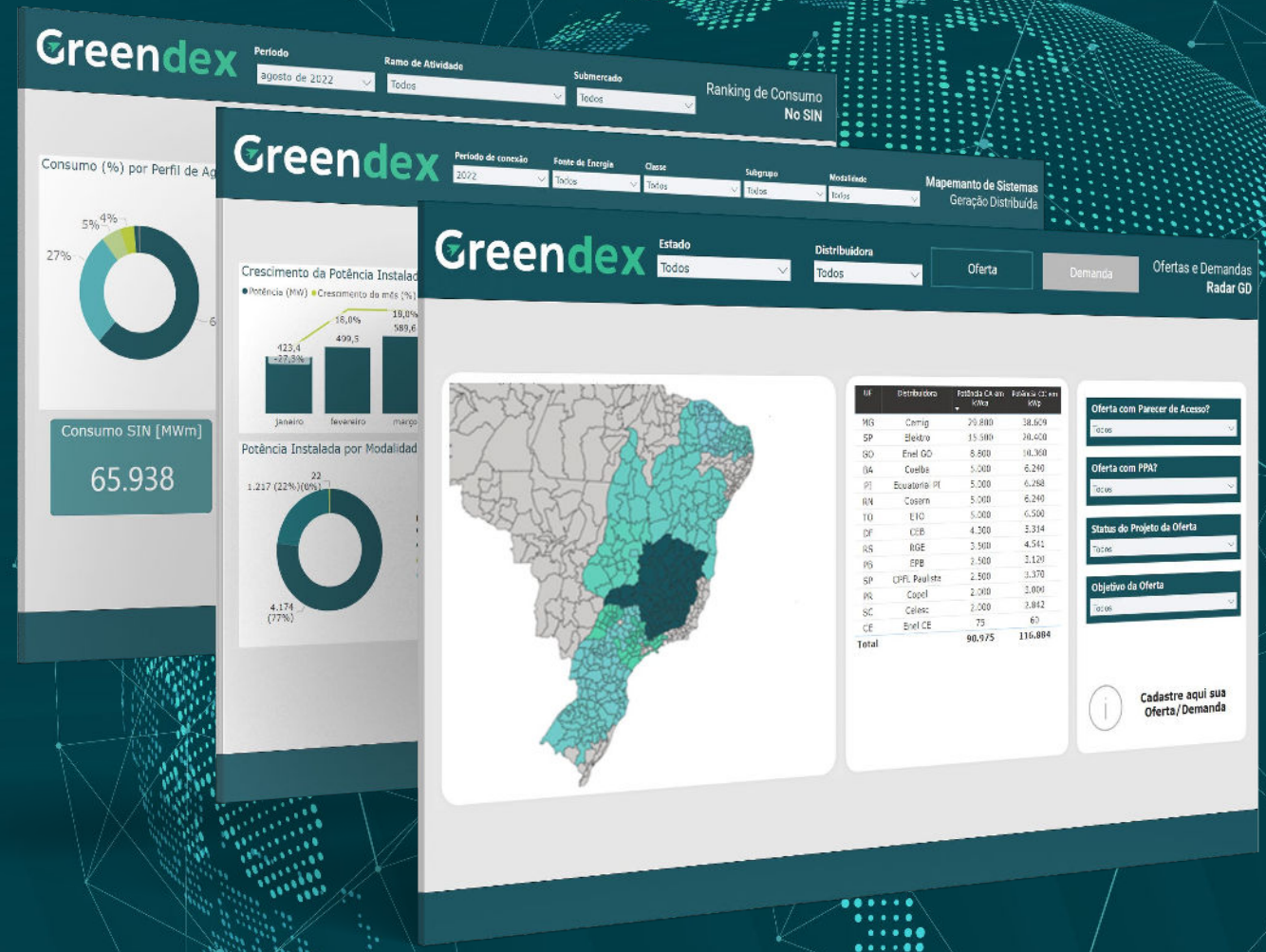

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Contents

Glossary: Distributed Generation

DG	Distributed Generation
MMDG	Micro and Mini Distributed Generation
Distributed Microgeneration	PV System with an installed capacity up to 75 kW
Distributed Minigeneration	PV System with capacity over 75 kW and equal to or less than 3 MW for non-dispatchable solar PV plants
PV	Photovoltaic
Additional Capacity	Quantity of capacity added in a specific period
Cumulative Capacity	Quantity of cumulative capacity created over time
MW	Megawatt
kW	Kilowatt
CU	Consumer Unit

Glossary: Distributed Generation

Relating to Consumer Units, it is important to differentiate between:

Generating Units	Those are Consumer Units where a solar PV system has been installed, and that therefore generate energy. The PV credits generated at this unit can be consumed at the same site and/or in other Consumer Units that receive energy credits.
Consumer Units receiving credits	All the Consumer Units that are benefited by generated PV credits through the SCEE (System for Compensation of Electrical Energy), independent of whether the PV system is installed locally or remotely.

Glossary: Customer Types and Compensation Categories

Customer Types	There are **5 Main Customer Types,** some with subcategories. These types depend on the kind of business that forms the customer entity and were created by ANEEL, the National Agency for Electrical Energy. The Customer Types are distinguished as follows: ▾ **Residential, Commercial, Industrial, Rural, and Public** (Public Lighting, Public Authorities, Public Services)*
Compensation Categories	In Brazil, there are 4 **Compensation Categories**, defined according to the business model chosen by the customer entity. As such, the categories are: ▾ **Local Self-consumption** or **Generation alongside the load** ▾ **Remote Self-consumption** ▾ **Shared Generation** ▾ **Projects with Multiple Consumption Units (PMCU – or EMUC in Portuguese)**

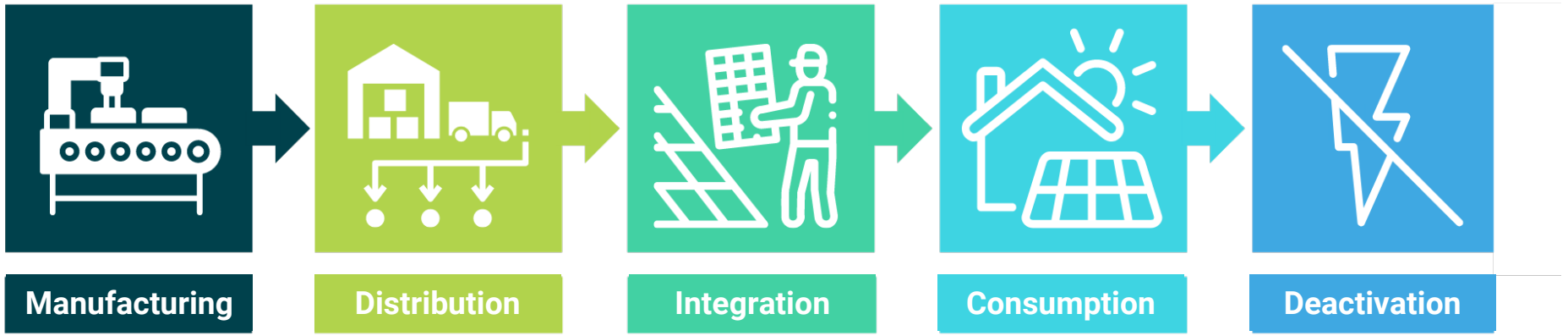
*ANEEL classifies these customer types separately. However, for this report we combined these three types and created the customer type called “Public”.

CHAPTER 1

Value Chain

Value Chain

Distributed Generation



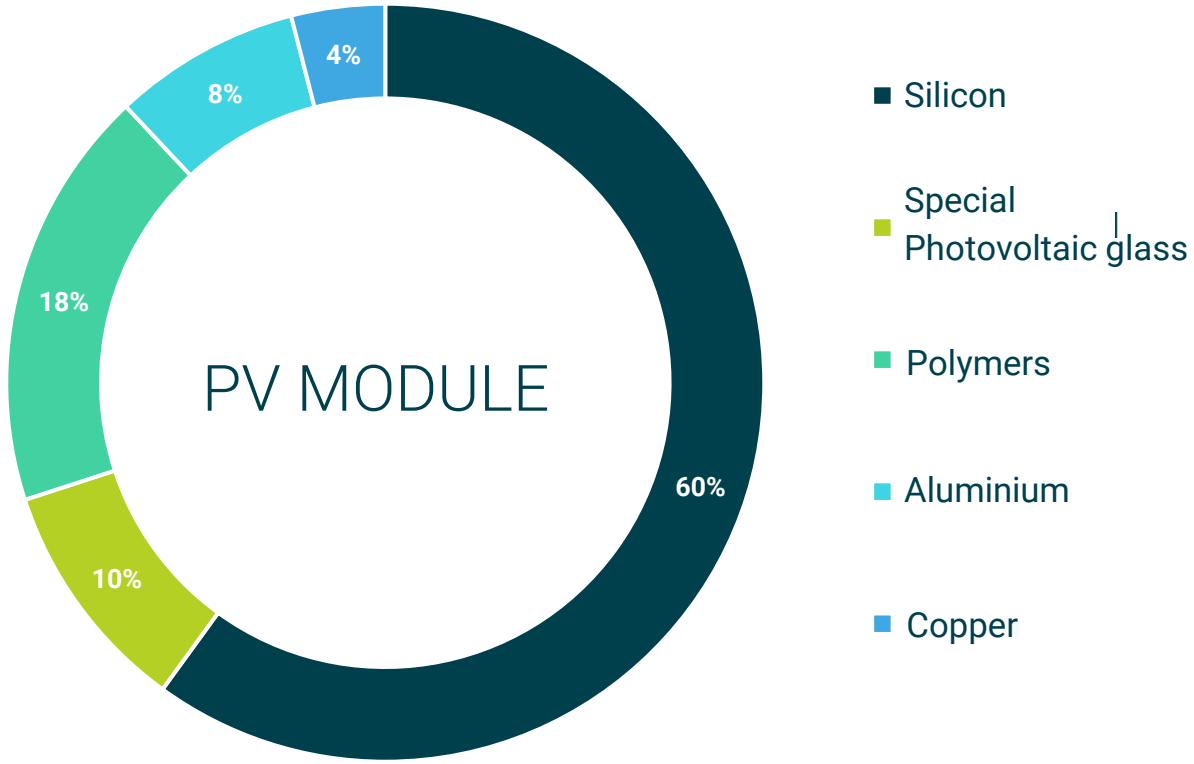
- The **value chain** encompasses all activities carried out by a group of companies and organizations in order to deliver a **PV system** to the end consumer, taking into account the stages of manufacturing, distribution, integration, acquisition of the PV system, and its deactivation at the end of its useful life. For each of these stages, market participants are directly related to the execution of those activities, as well as other companies that operate indirectly in the sector.

- A good understanding of the dynamics in the value chain is fundamental for all different market participants to obtain the **information needed to manage their processes and strategies**, such as **pricing**, amongst others, at the same time while trying to increase and improve their market presence and to spread the use of DG solar technology.

Manufacturing of PV System Components

Photovoltaic Modules

Cost Structure of PV Module



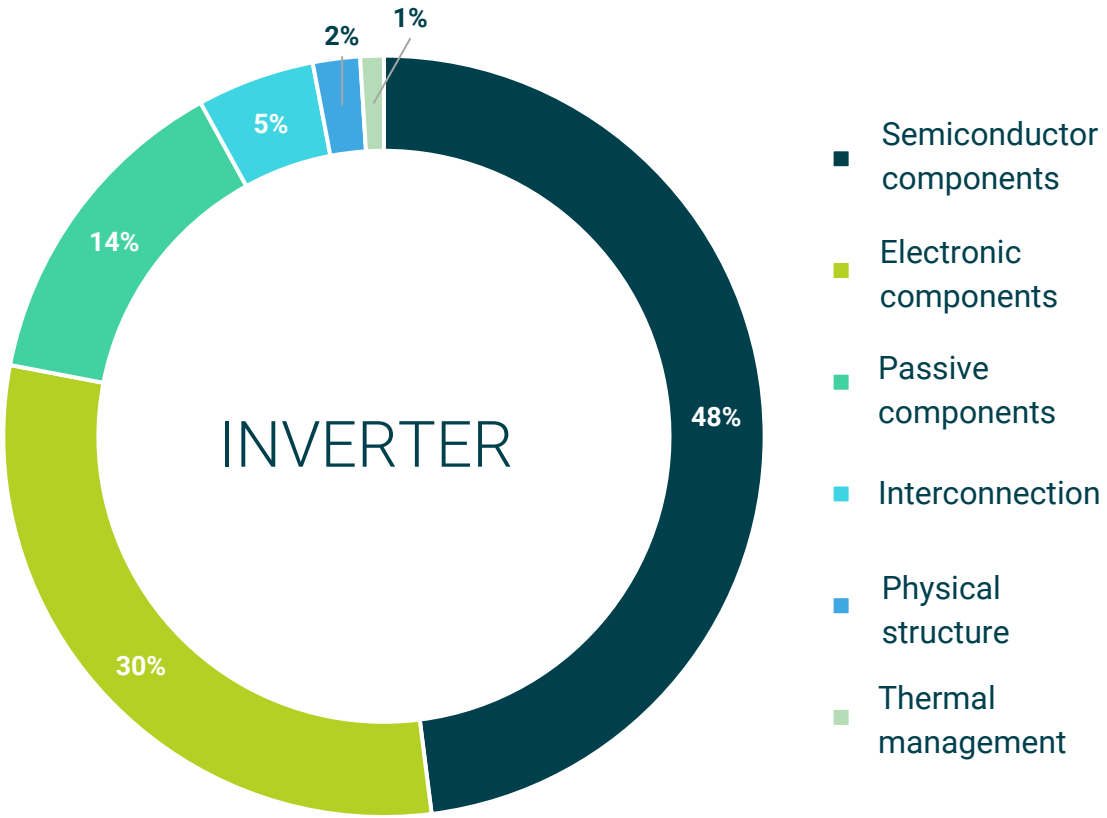
- The **PV modules** represent between 38% and 50% of the total cost of a PV system, making it a crucial component for a detailed analysis of market pricing.
- Since the main input material for each module is metallic silicon (the raw material for the production of **polysilicon**), which makes up 60% of the total raw material cost, variations in the silicon price have a direct impact on the price of PV modules.

Source: Greener, 2023.

Manufacturing of PV System Components

PV Inverters

Cost Structure of Inverter

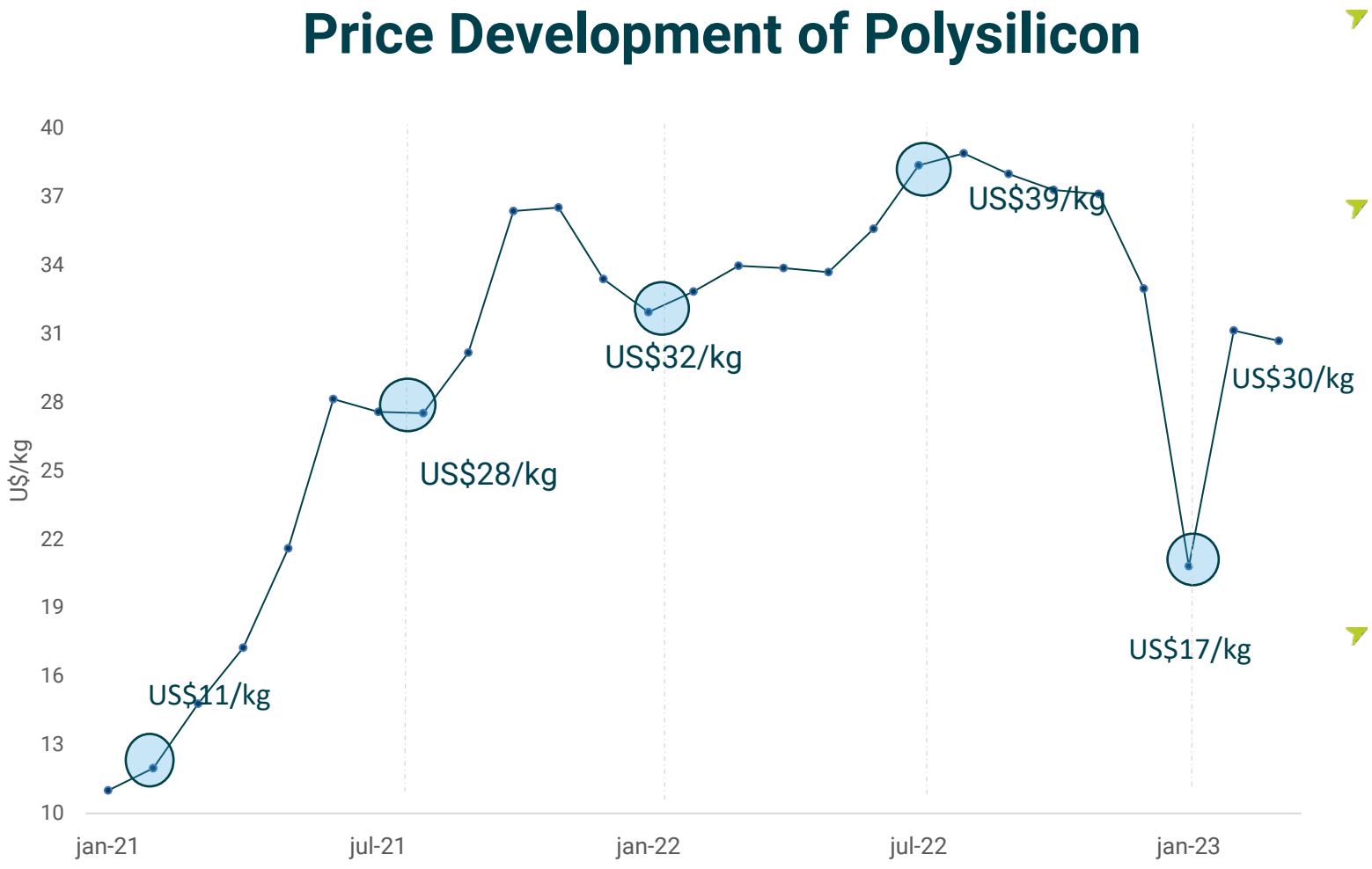


- The **semiconductors and electronic components** represent the bulk of the component costs for PV Inverters.
- In 2022, these components were still experiencing **global supply problems** due to the supply restrictions created by the pandemic. The **expectation is that this scenario will begin to improve in 2023** because of the start of operations of some new factories that can supply part of the increasing demand.

Source: Greener, 2023.

Manufacturing the Components of a PV System

Impact of Price Rise of Polysilicon on the Price of PV Modules



- Between January and August 2022, the price of polysilicon maintained its upward trend **and rose by a further 26%.**
- Between November and December 2022, the global polysilicon price showed an **abrupt decrease of 53%**, reaching U$17/kg at the start of 2023. The start of operations of several new polysilicon factories in 2022 greatly increased the production capacity of this raw material, increasing market supply and suppressing prices (temporarily).
- However, after the sharp adjustment in 4Q2022, the market price for this commodity appeared to be **recovering in January/February** 2023. Despite increased volatility, several analysts expect an average polysilicon (and PV Module) price level that will be lower than in 2022.

Source: https://www.bernreuter.com/polysilicon/price-trend/

Manufacturing of PV System Components

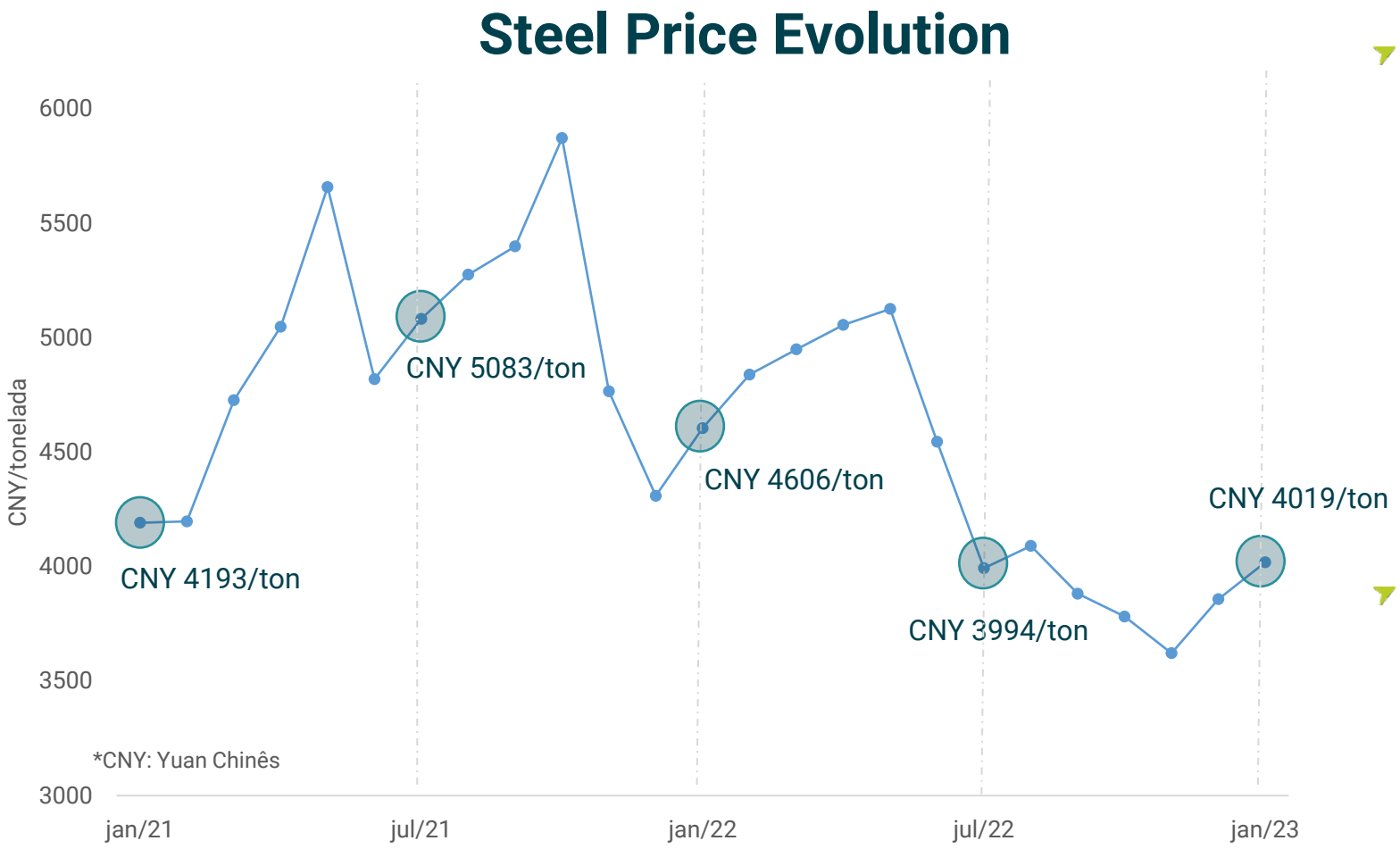
Mounting Structures, Installation Devices, Bidirectional Meters

- The **PV Mounting Structures** are basically made of **aluminum or steel** in order to guarantee the structural flexibility that is required of them and the maximum useful system lifetime. Even though aluminum is produced in substantial amounts in Brazil, its pricing structure is based on the value of the US$ and its quoted price on the London Metal Exchange (LME), meaning that **currency movements can have a significant impact on the final cost** of PV mounting structures.

- The **installation tools and materials** include cables/wiring, system protection, devices for energy conversion, as well as their raw materials such as **copper, aluminum, polymers, and steel.**

Manufacturing of PV System Components

Impact of Commodity Price Rises



- After a series of declines in the past years, the **global price of steel started rising again in November.** However, in January 2023 the rising price should be sustained through the coming year as the general demand for industrial inputs is rising in a number of the world's most important economies.
- The price of steel impacts the manufacturing cost of **mounting structures, in particular for ground-based and larger-scale PV plants.**

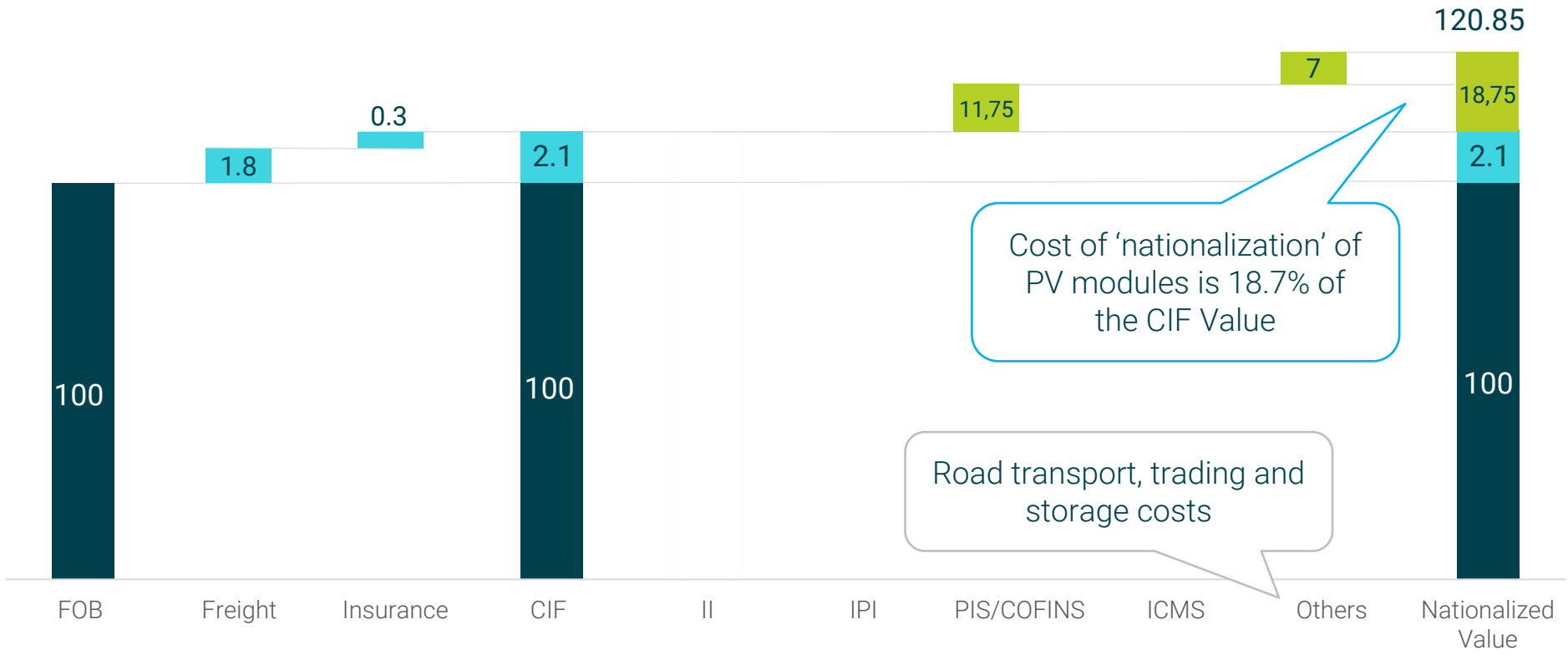
Source: https://tradingeconomics.com/commodity/steel

PV Modules

Costs of importing and preparation for Brazilian market

- **International freight costs showed a reduction of 85% in January 2023** compared to a year earlier, positively impacting importation costs.

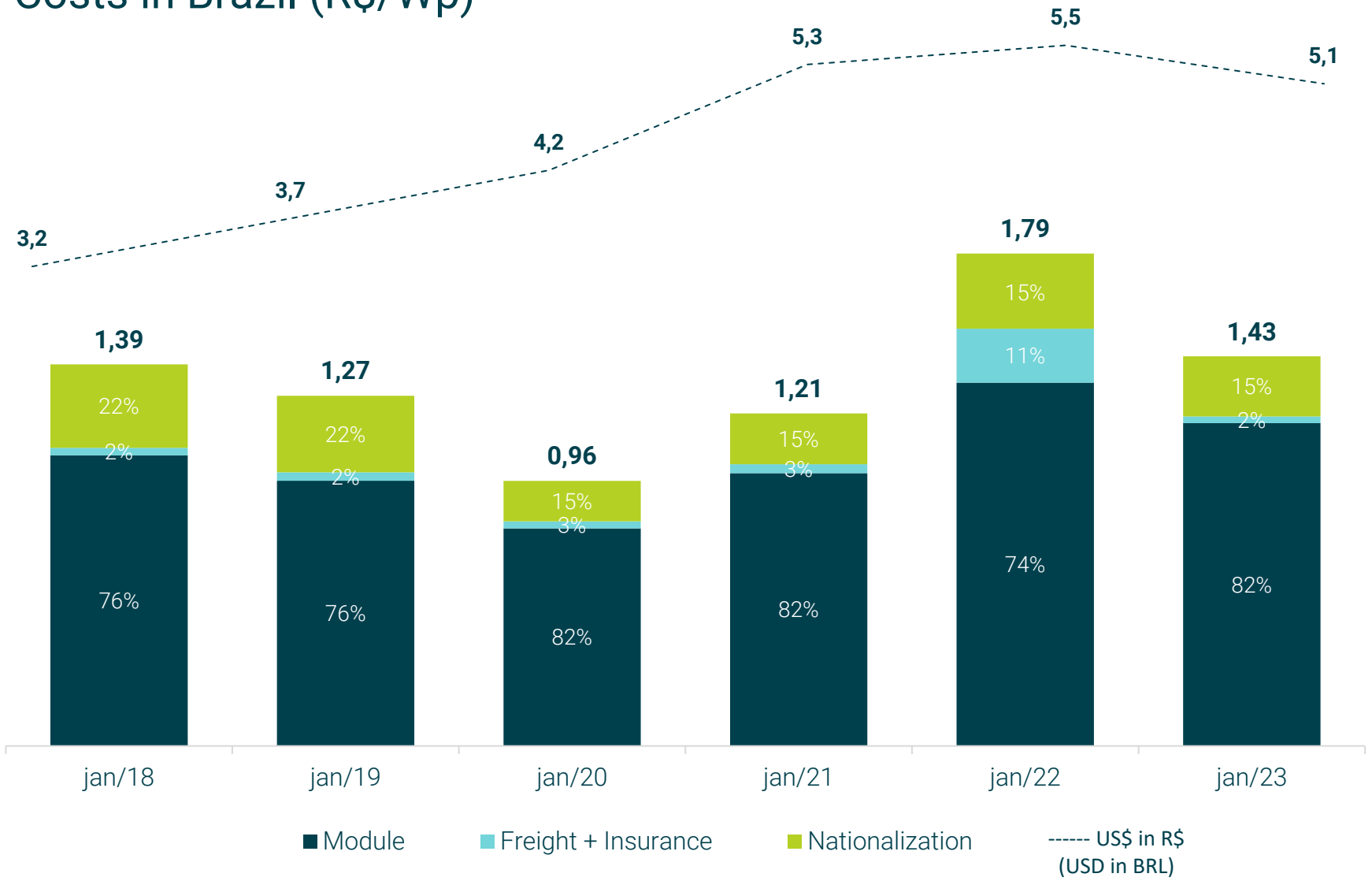
Freight Brazil – China is at USD 1,500.00 per 40 ft container in Jan/2023.



Cost/Rate	1.8%	0.3%		0%	0%	11.75%	0%	7%	20.85%

Solar PV Modules

Costs in Brazil (R$/Wp)



- **The cost of a module in Brazil fell** during 2022, declining 20% from January 2022 to January 2023.
- Along with a reduction in the **FOB price of each module,** the **decreasing US$ exchange rate and freight costs** contributed to the overall cost reduction.

CHAPTER 2

Supply Chain

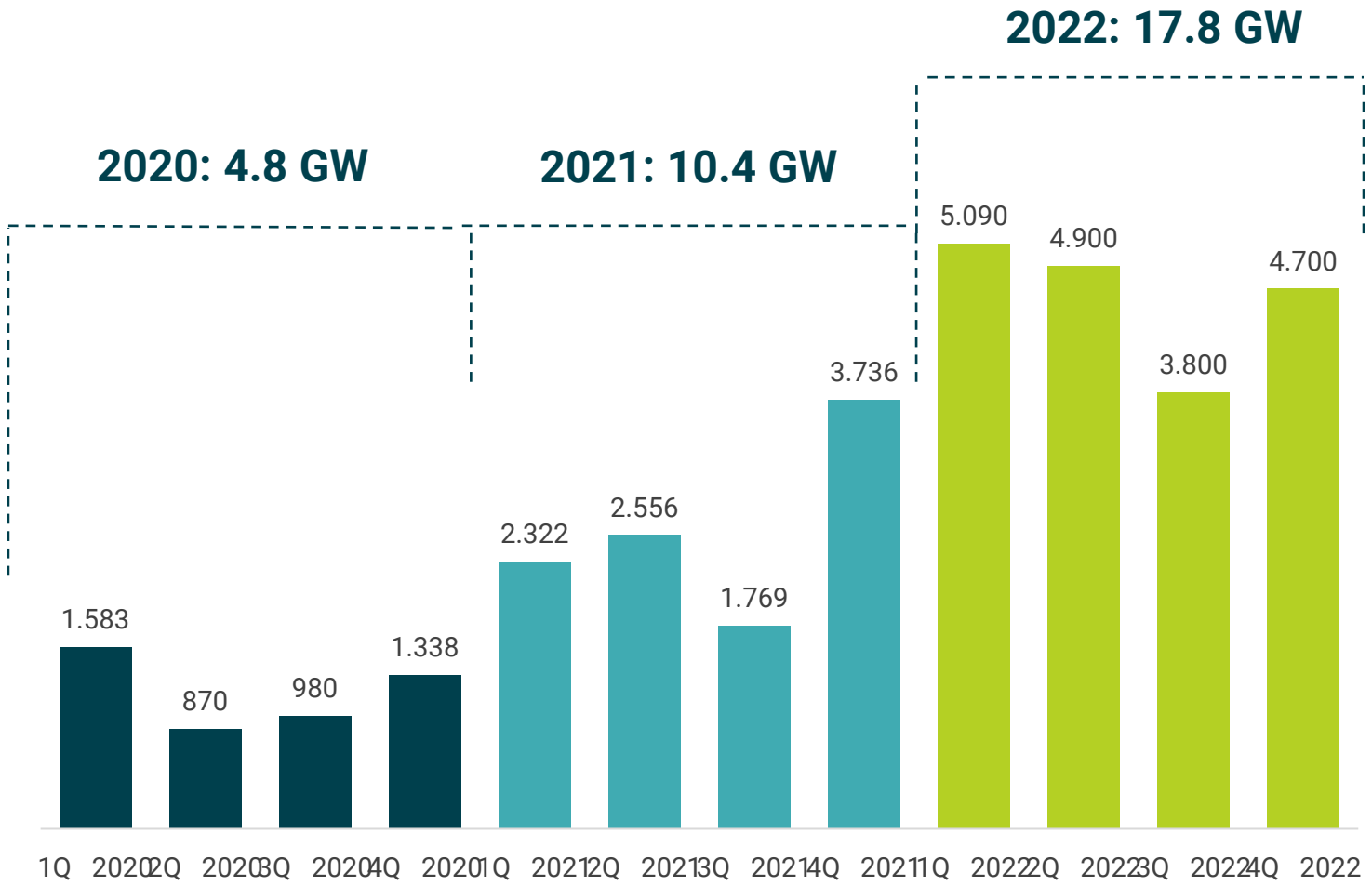
Greener Methodology

- After the Federal Tax Authority discontinued the SISCOMEX system with disaggregated data for imports into Brazil, Greener has adopted the following **methodology** to **obtain imported volumes of PV modules per brand**:

1. Collection of monthly sales volumes through various data partners
2. Data processing and market intelligence to map the exporters and segregate per brand
3. Collection of average monthly prices of PV modules (U$$/Wp) from the main manufacturers
4. Estimate of average monthly import volume per brand/manufacturer
5. Sensitivity Analysis
6. Validation of final volumes with the respective brands

PV Modules – Imported Volume [MWp]

Distributed Generation and Centralized Generation

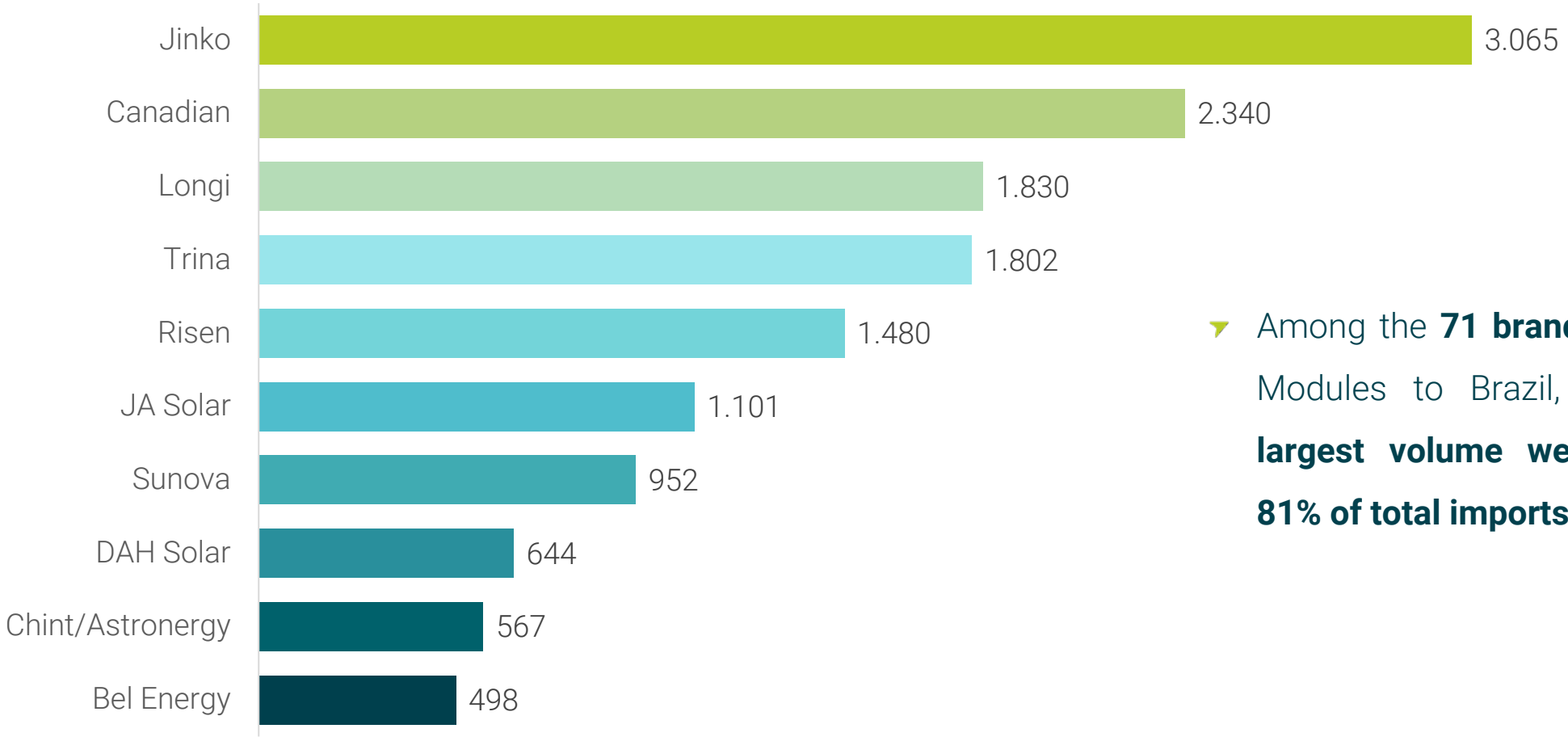


- Full-year 2022 shows a growth of **71% compared to** 2021.
- The imported volume in 2022 indicates investments in excess of **R$ 64 billion** for DG and large-scale solar PV plants.

Source: Greener, 2023.

TOP 10 – Solar PV Modules

Imported Volumes [MWp] - 2022



- Among the **71 brands** that supplied PV Modules to Brazil, the **10 with the largest volume were** responsible for **81% of total imports.**

Source: Greener, 2023.

CHAPTER 3

Top of Mind Brands

Equipment DISTRIBUTORS MOST OFTEN recalled by PV Integrators

*Name up to **3** distributors of PV Kits that you remember:*

TOP 10

1. Aldo
2. BelEnergy
3. Bluesun
4. PHB Solar
5. Ecori
6. Fortlev Solar
7. Sou Energy
8. Genyx Solar
9. Fotus Solar
10. Intelbras

TOP 20

11. Solar Livre
12. Helte
13. Renovigi
14. Serrana Solar
15. WEG
16. WIN Solar
17. Amara NZero
18. Sky Solar
18. Megacomm
19. Esfera Solar
20. Edeltec

TOP 30

21. Sices Solar
22. Foco Energia
23. Mazer Solar
24. Elgin
25. TenBrasil
26. Nexen
26. SolFácil
27. Soollar Distribuidora
28. Loja Elétrica
29. Solar Inove
30. Alumifix Solar

The questionnaire respondents were asked to name 3 equipment distributors and Greener calculated how often each brand was cited.
This data does NOT indicate Market Share nor preference for or reliability of the brand. It shows which were the best remembered brands among the participating Integrators whose responses were validated.

Manufacturers of **PV MODULES** MOST OFTEN recalled by Integrators

*Name up to **3** PV Module brands that you remember :*

TOP 10

1. Canadian Solar
2. Jinko
3. JA Solar
4. DAH Solar
5. Sunova Solar
6. Trina Solar
7. ZNShine
8. LONGi
9. Ulica Solar
10. Risen Solar

TOP 20

11. Leapton
12. BYD
13. OSDA
14. Intelbras
15. BelEnergy
16. Honor
17. TSUN
18. XPower
19. Astroenergy
20. Talesun

The questionnaire respondents were asked to name 3 PV Module manufacturers and Greener calculated how often each brand was cited.
This data does NOT indicate Market Share nor preference for or reliability of the brand. It shows which were the best remembered brands among the participating Integrators whose responses were validated.

Manufacturers of **PV INVERTERS** MOST OFTEN recalled by Integrators

*Name up to **3** PV Inverter brands that you remember :*

TOP 10

1. Growatt
2. Deye
3. SAJ
4. Solis
5. Fronius
6. PHB Solar
7. Sungrow
8. Hoymiles
9. APSystems
10. Sofar

TOP 20

11. GoodWe
12. WEG
13. Canadian Solar
14. Solar Edge
15. Intelbras
16. Solplanet
17. Huawei
18. Livotek
19. BelEnergy
20. Renovigi

The questionnaire respondents were asked to name 3 PV Inverter manufacturers and Greener calculated how often each brand was cited.
This data does NOT indicate Market Share nor preference for or reliability of the brand. It shows which were the best remembered brands among the participating Integrators whose responses were validated.

MOUNTING/RACK SYSTEMS MOST OFTEN recalled by Integrators

*Name up to **3** PV Mounting/Rack Systems that you remember :*

TOP 10

1. Solar Group
2. Romagnole
3. SSM
4. 2P Acessórios
5. PHB Solar
6. NTC Somar
7. Spin
8. IZI
9. Pratyc
10. FotoFix

TOP 20

11. BelEnergy
12. CCM
13. Intelbras
14. Angulo
15. GF2
16. GDFIX
17. K2 Systems
18. GSC
19. Sparkin
19. Modular
19. Tritec
20. Metal Light
20. WEG

The questionnaire respondents were asked to name 3 PV mounting system brands and Greener calculated how often each brand was cited.
This data does NOT indicate Market Share nor preference for or reliability of the brand. It shows which were the best remembered brands among the participating Integrators whose responses were validated.

PROTECTION SYSTEM brands MOST OFTEN recalled by Integrators

*Name up to **3** Brands of PV Protection Systems that you remember :*

TOP 10

1. Clamper
2. Proauto
3. WEG
4. Schneider
5. Steck
6. Siemens
7. Soprano
8. ABB
9. Embrastec
10. PHB Solar

TOP 20

11. JNG
12. Benny
13. Merz Dehn
14. Momberg
15. GE
16. Intelbras
16. Tramontina
17. Chint
18. Sibratec
19. Brum
20. Suntree

The questionnaire respondents were asked to name 3 PV protection systems brands and Greener calculated how often each brand was cited. This data does NOT indicate Market Share nor preference for or reliability of the brand. It shows which were the best remembered brands among the participating Integrators whose responses were validated.

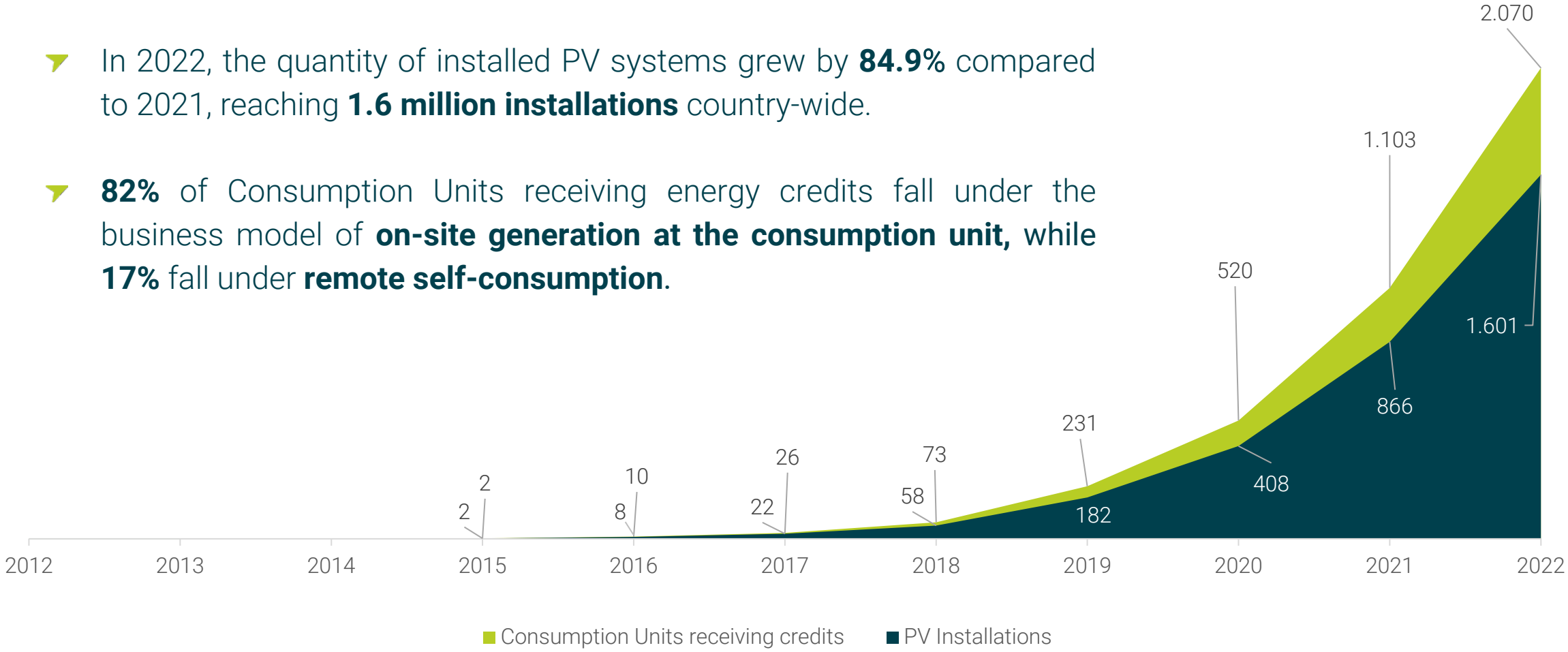
CHAPTER 4

DG PROJECTS

Cumulative Number of Solar PV Systems

Connected to Grid and Consumption Units Receiving Energy Credits (thousands)

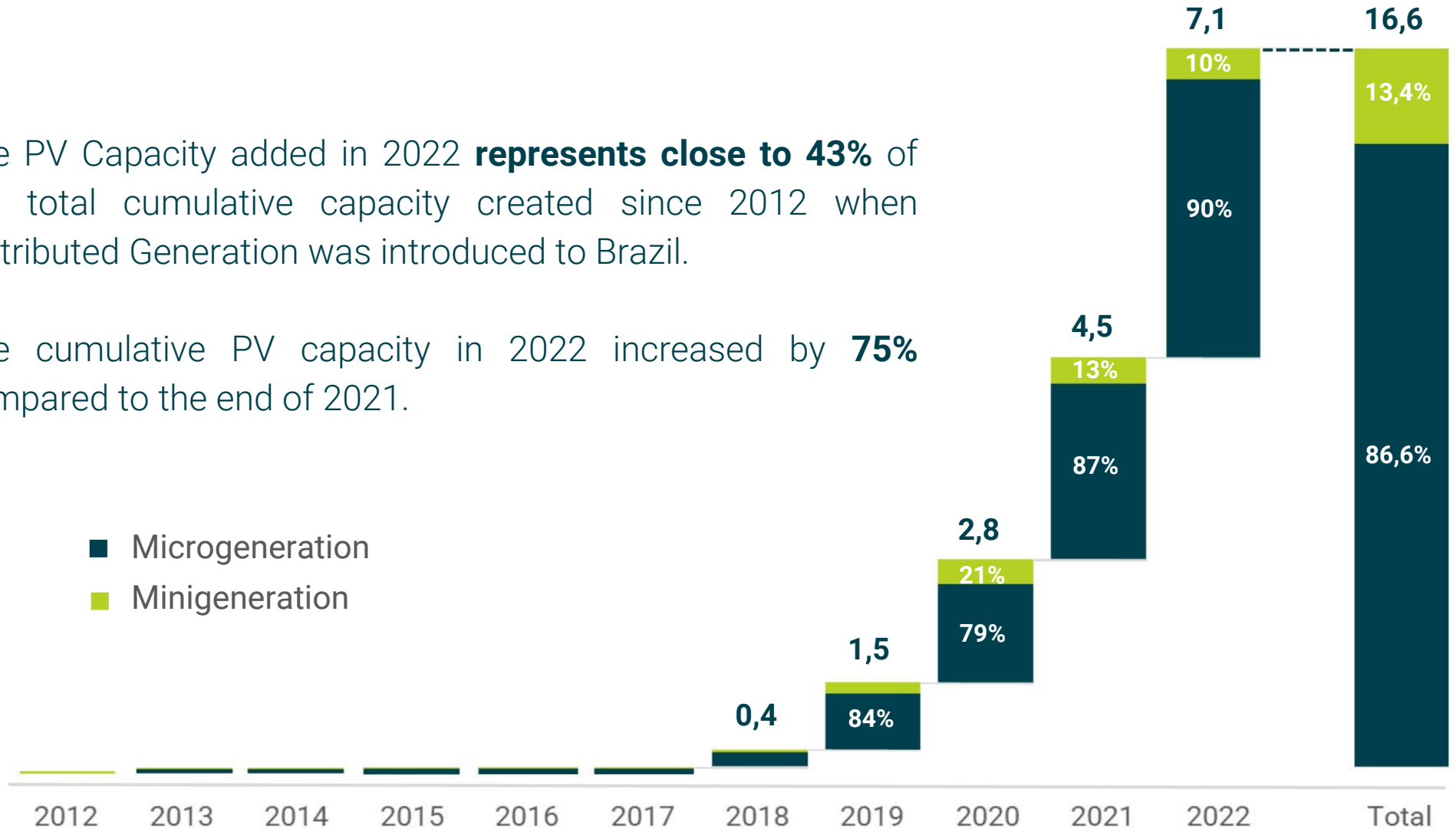
- In 2022, the quantity of installed PV systems grew by **84.9%** compared to 2021, reaching **1.6 million installations** country-wide.
- **82%** of Consumption Units receiving energy credits fall under the business model of **on-site generation at the consumption unit,** while **17%** fall under **remote self-consumption**.



Source: Aneel, 2023 (report downloaded on 17/01/2023)

Additional and Cumulative Volume connected to the grid [GW]

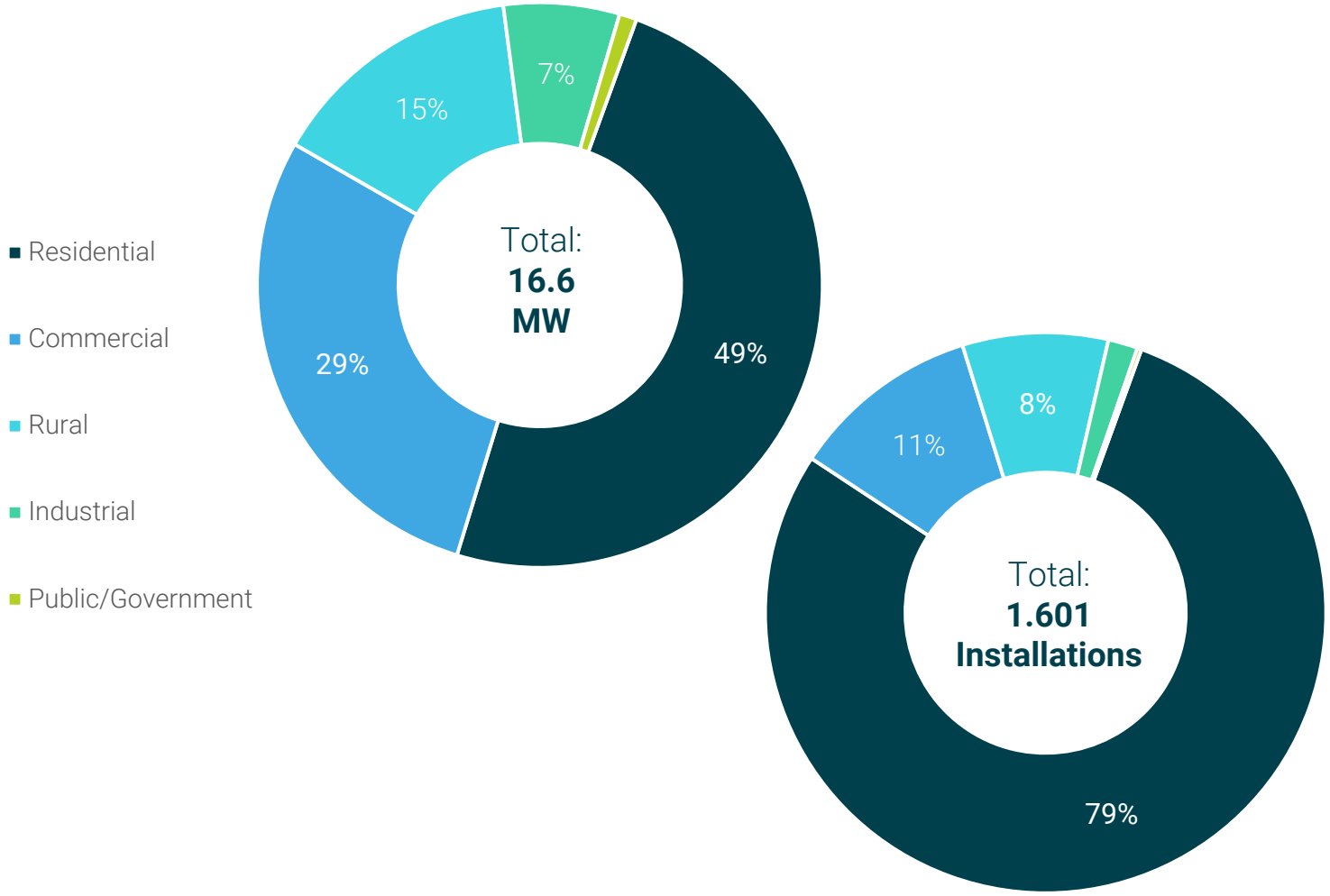
- The PV Capacity added in 2022 **represents close to 43%** of the total cumulative capacity created since 2012 when Distributed Generation was introduced to Brazil.
- The cumulative PV capacity in 2022 increased by **75%** compared to the end of 2021.



Source: Aneel, 2023 (report downloaded on 17/01/2023)

Cumulative Volume per Customer Type

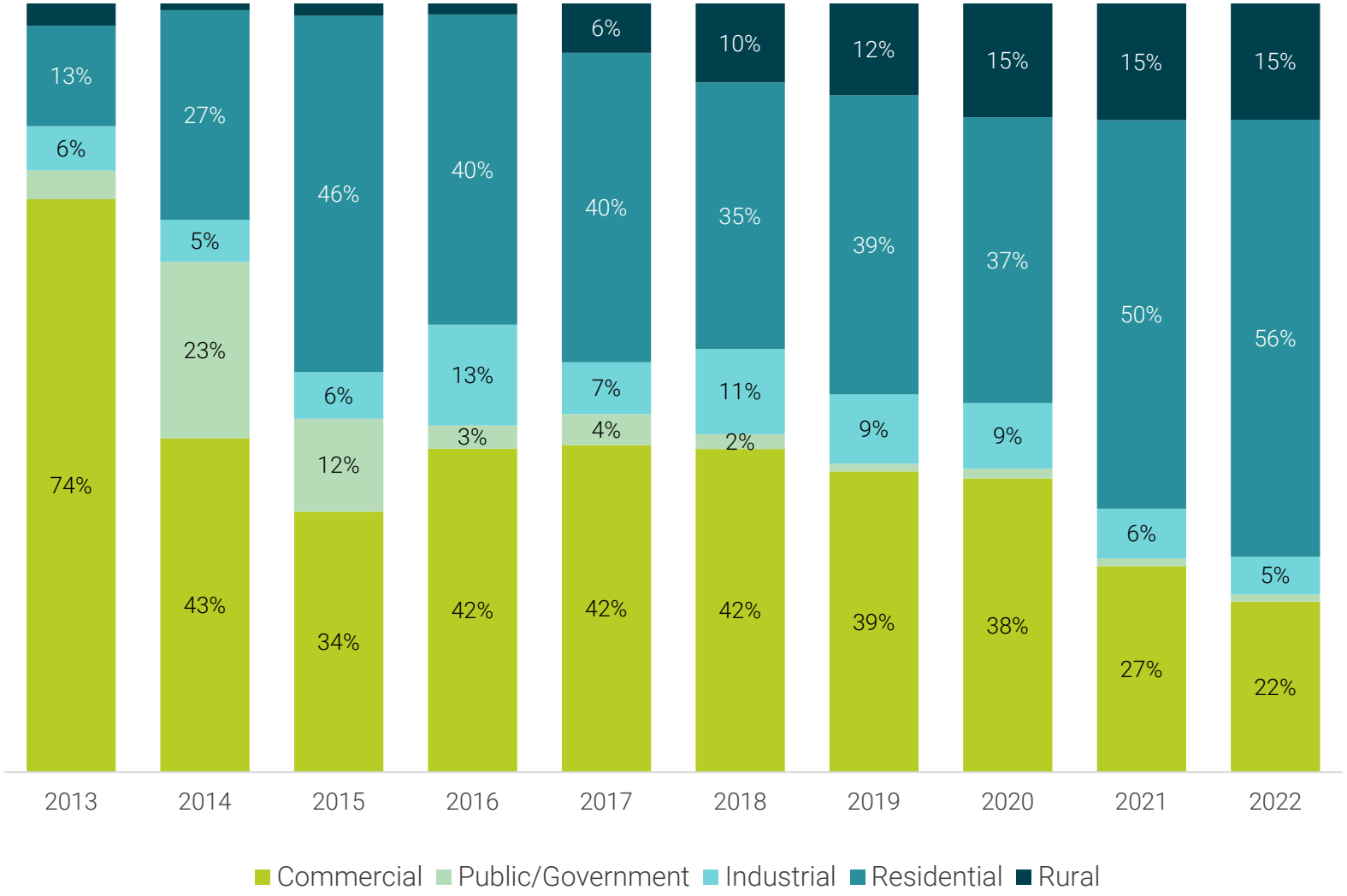
Cumulative PV Capacity (MW) and Cumulative Number of Installations (in thousands)



- **The share of Residential** customers in Brazil's cumulative PV capacity increased from **43% in 2021 to 49% in 2022.**
- Around **90%** of the cumulative number of PV installations belong to individual persons (homes) and the remaining 10% belong to businesses of all types.

Source: Aneel, 2023 (report downloaded on 17/01/2023)

Market Participation per Type of Customer [%]



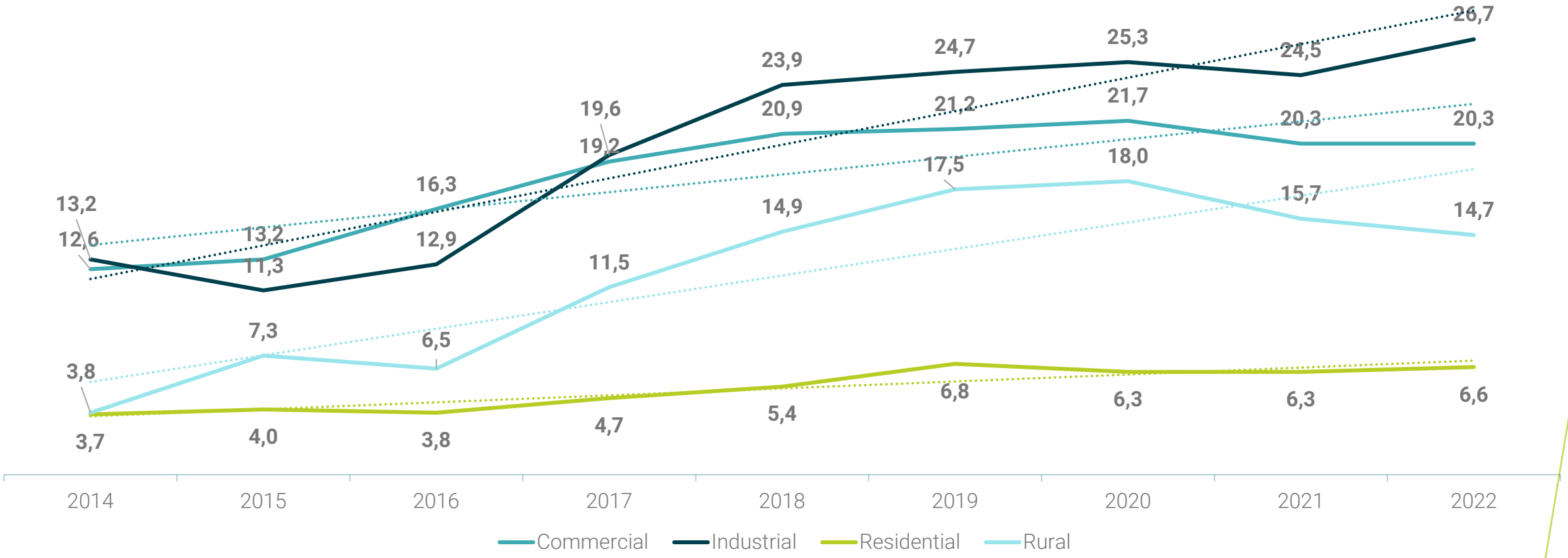
- In 2022, the **Residential** customer group continued its strong growth, representing **more than half of all capacity added during the year**. The consolidation of remote working practices and the rising energy prices for end consumers contributed to this development.
- In contrast, the **Commercial and Industrial customer types** continued to show a **relative decline** in importance.

Source: Aneel, 2023 (report downloaded on 17/01/2023)

Average Size of Additional PV Systems [kW]

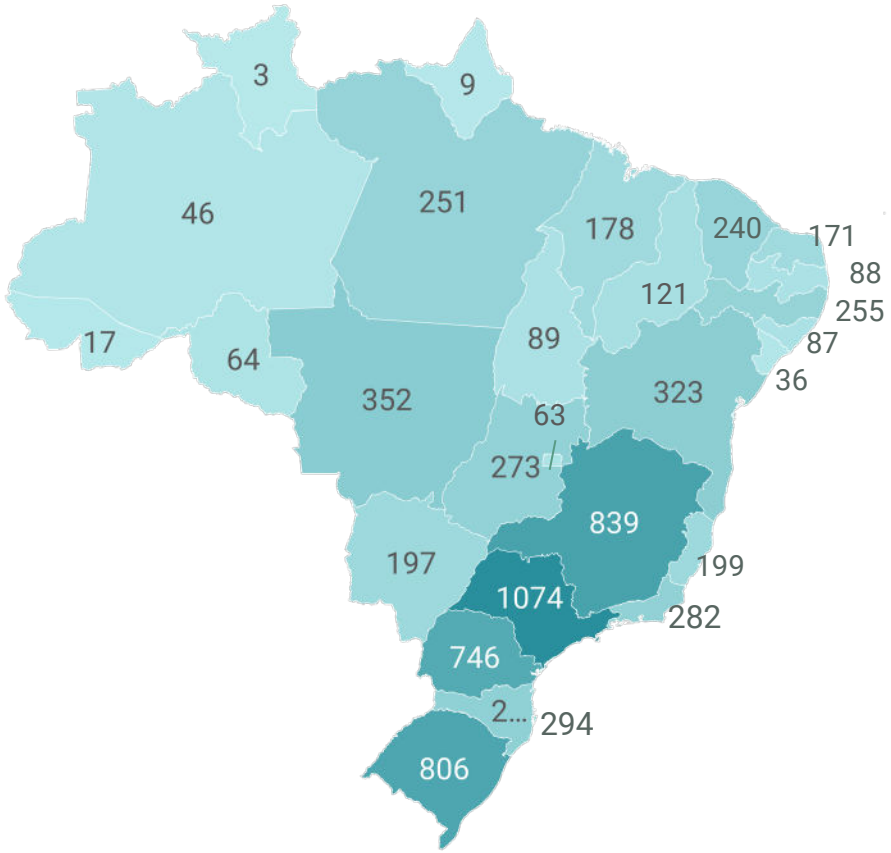
Microgeneration

- The **dotted lines** represent the trends for each customer type. The average project size shows a pattern of almost uninterrupted growth in all customer categories over the years.



Additional Capacity per State [MW]

Total Volume Added between January and December 2022



The **Southeast region** continues in the lead, with investments in excess of R$10 billion and accounting for **34%** of all new capacity installed in Brazil in 2022.

TOP 10 States 2022		
State	**Capacity Added (MW)**	**Investment (R$ Billion)**
SP	1074	4.8
MG	839	3.8
RS	806	3.6
PR	746	3.4
MT	352	1.6
BA	323	1.5
SC	294	1.3
RJ	282	1.3
GO	273	1.2
PE	255	1.1

Find out about the most attractive regions in Greendex – Attractivity Map. Test now <<

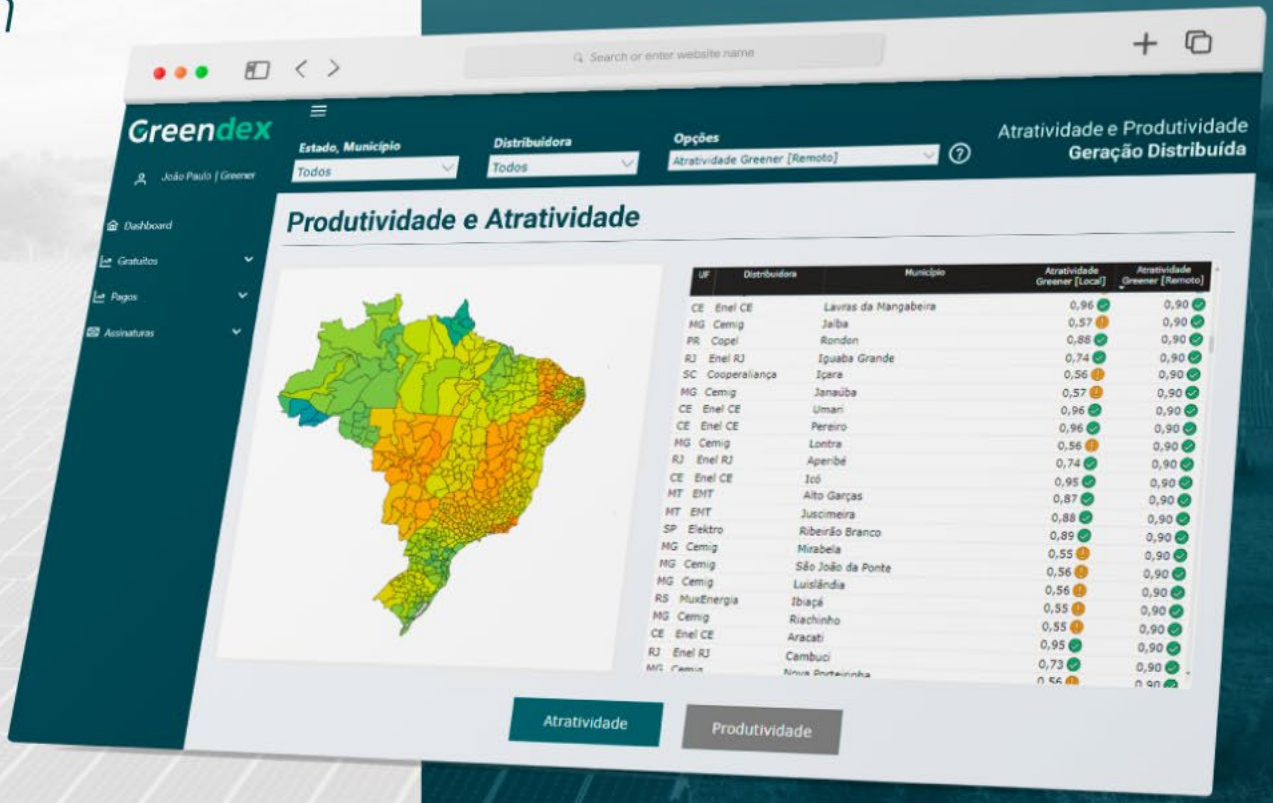
Source: Aneel, 2023 (report downloaded on 17/01/2023).

Productivity and Attractiveness

Identify the most attractive regions in Brazil for your solar PV investments

- This tool uses advanced algorithms and most up-to-date data to evaluate the attractiveness of your PV project in each Brazilian region.
- Get access to this information for ground-based and rooftop systems, with fixed mounting or with trackers.

Try it out now <<



Greendex

CHAPTER 5

Integrators

THE SURVEY

Introduction

- Greener once again carried out its market survey of the Brazilian PV market, interviewing **4,938 PV integrators** in the period between **28 November 2022 and 17 January 2023**. The survey included a representative sample of companies from all over the country, of all sizes and years of experience, therefore creating a heterogenous and reliable view of the market for solar integration in Brazil.

- This year's survey also relied on the collaboration of a number of companies through a **data partnership**, resulting in a higher level of accuracy for some indicators in order to assist the Brazilian PV market with even more realistic and reliable parameters.

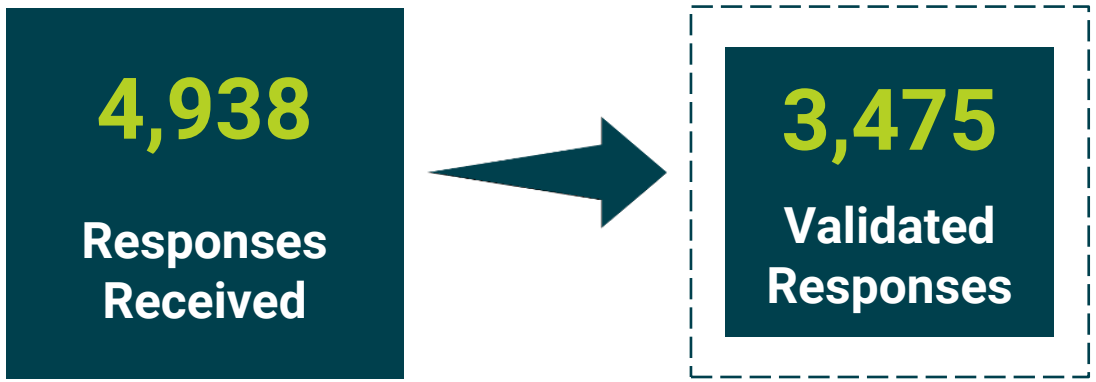
- **Find out more about our data partners here**.

THE SURVEY

Year of start of commercial activities of surveyed companies:

2017 or before	2018	2019	2020	2021	2022
21%	10%	16%	15%	19%	19%

Data Validation



70% of responses utilized

THE SURVEY

Estimated Total Number of PV Integrator Companies in Brazil

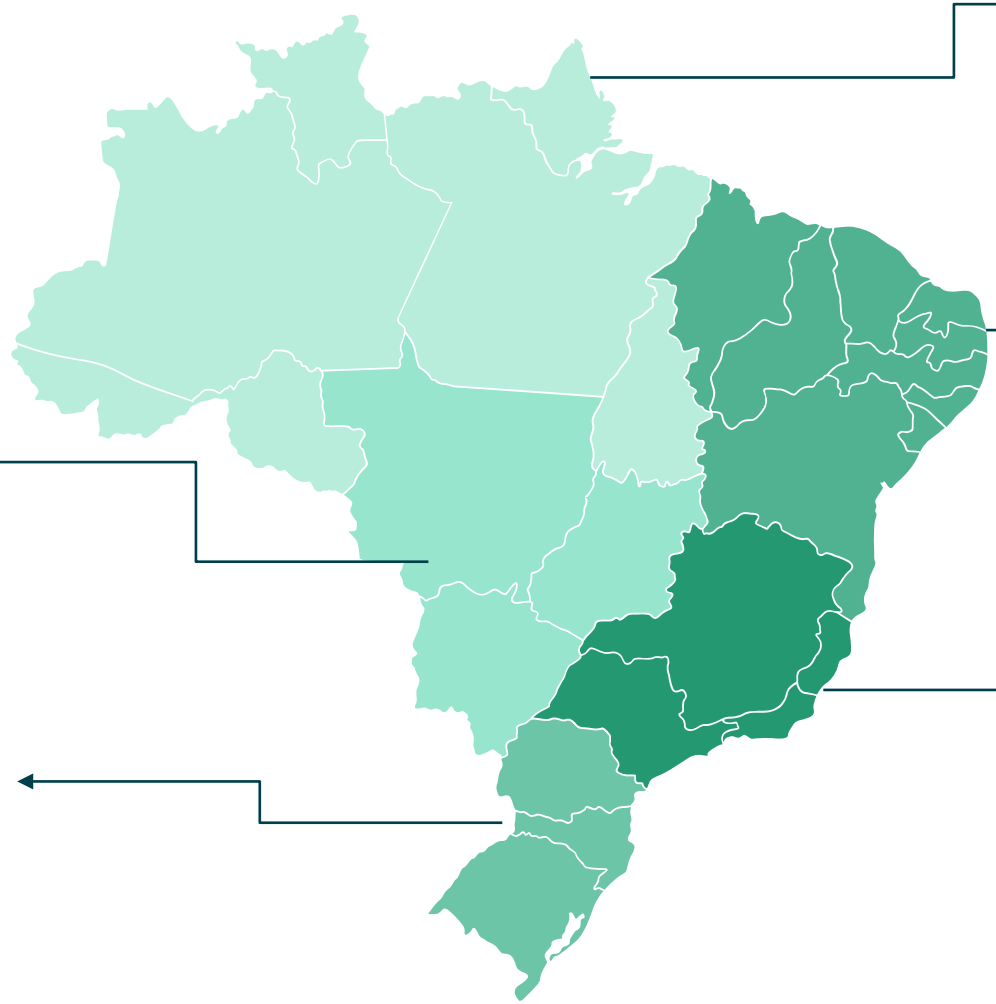
- **The total number of active Integrator Companies** is estimated based on a cross-reference between Greener's survey data and information obtained through Entities and Companies that represent and supply the PV sector.

31,510

№ of Active Solar PV Integrators *

* Companies that completed at least one transaction in 2022. This is a conservative estimate made by Greener, however, the real number of companies active in the market could be higher.

Percentage of Companies per Region



North 6%

NorthEast 22%

Center-West 9%

SouthEast 49%

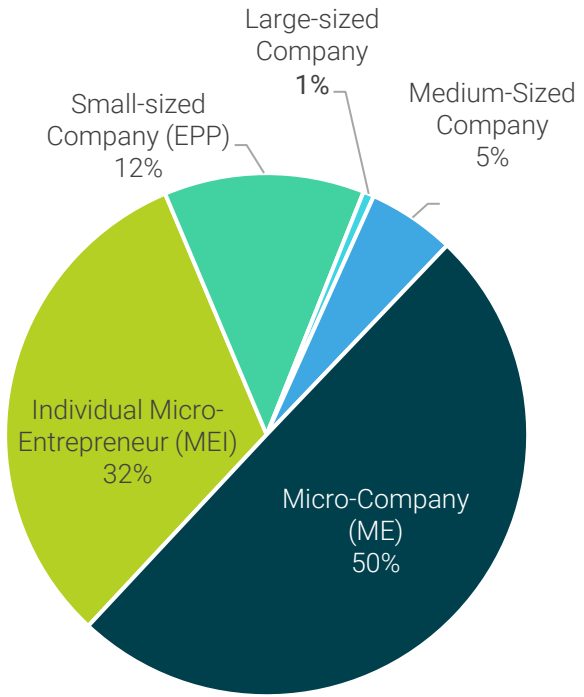
South 14%

Source: Greener, 2023.

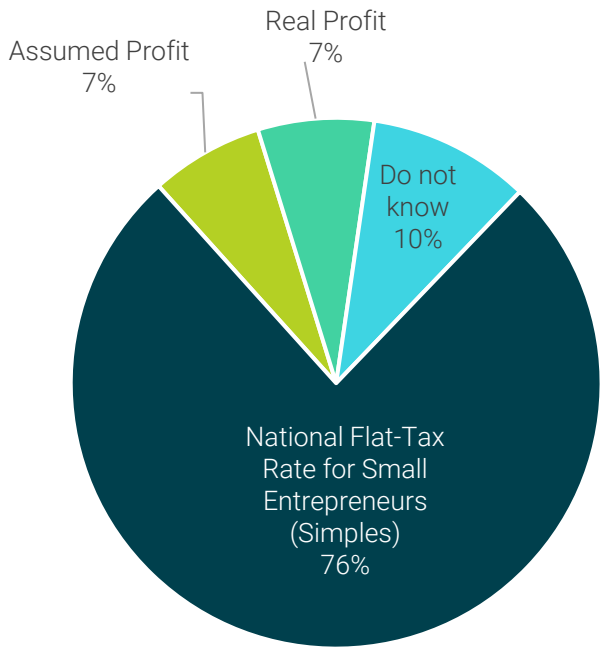
Profile of PV Integrator Companies

Size and Fiscal Regime

Size of Company



Fiscal Regime

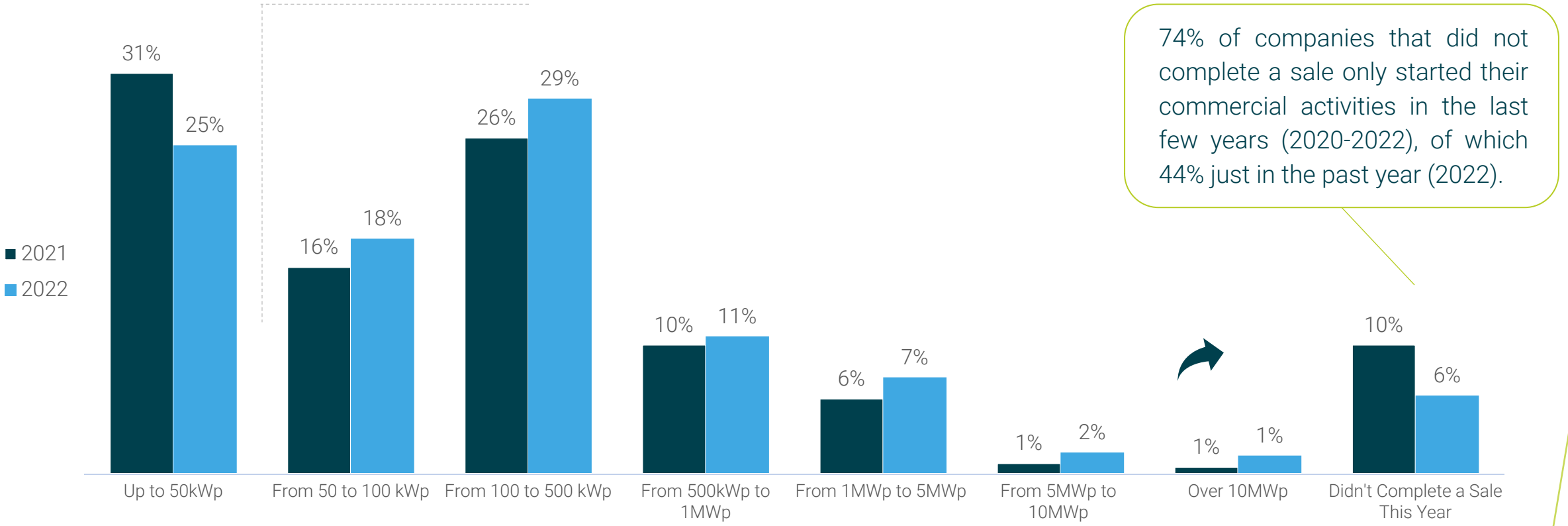


- The size of the company is a technical criterium that classifies companies according to their sales volume or the number of employees (for example).
- Of all the companies responding to the survey, **94% are of a smaller size,** while **medium and large-sized companies** represent only **6% of respondents**.
- The size of the company also influences the choice of the fiscal regime, taking into account the intensity and complexity of its financial activity.

Source: Greener, 2023.

Sales Volume of Integrators in 2022 [kWp]

- In 2022 there was an **increase** in the percentage of companies reporting **in the higher tiers of sales volume (over 50 kWp)** compared to 2021 and a **decrease** in the number of companies that did not complete any sales, indicating a **more dynamic PV market overall**.



74% of companies that did not complete a sale only started their commercial activities in the last few years (2020-2022), of which 44% just in the past year (2022).

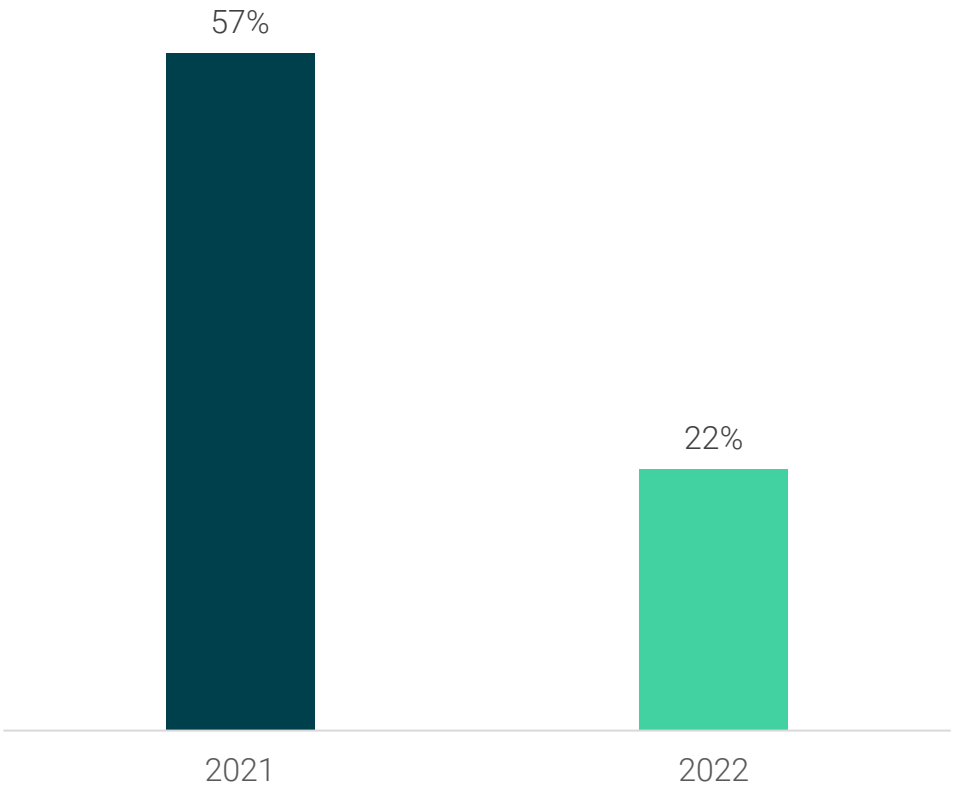
Source: Greener, 2023.

Solar Financing

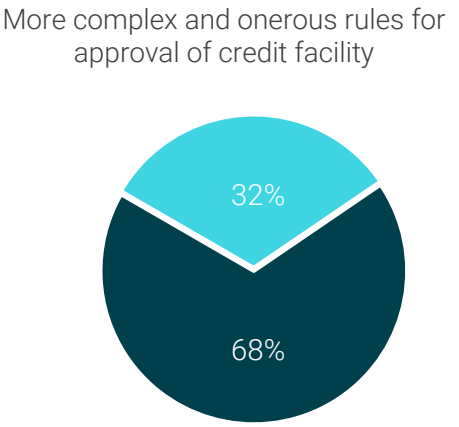
Out of your concluded sales, how many used bank financing?

- **Bank financing fell in 2022,** supporting **22%** of completed sales compared to 57% in the previous year.
- **The high level of interest rates** was the most important factor for this decline in bank financing.
- **Another factor** cited as a reason was the **regulatory and political uncertainty** at the time.

Percentage of sales concluded with the help from bank financing



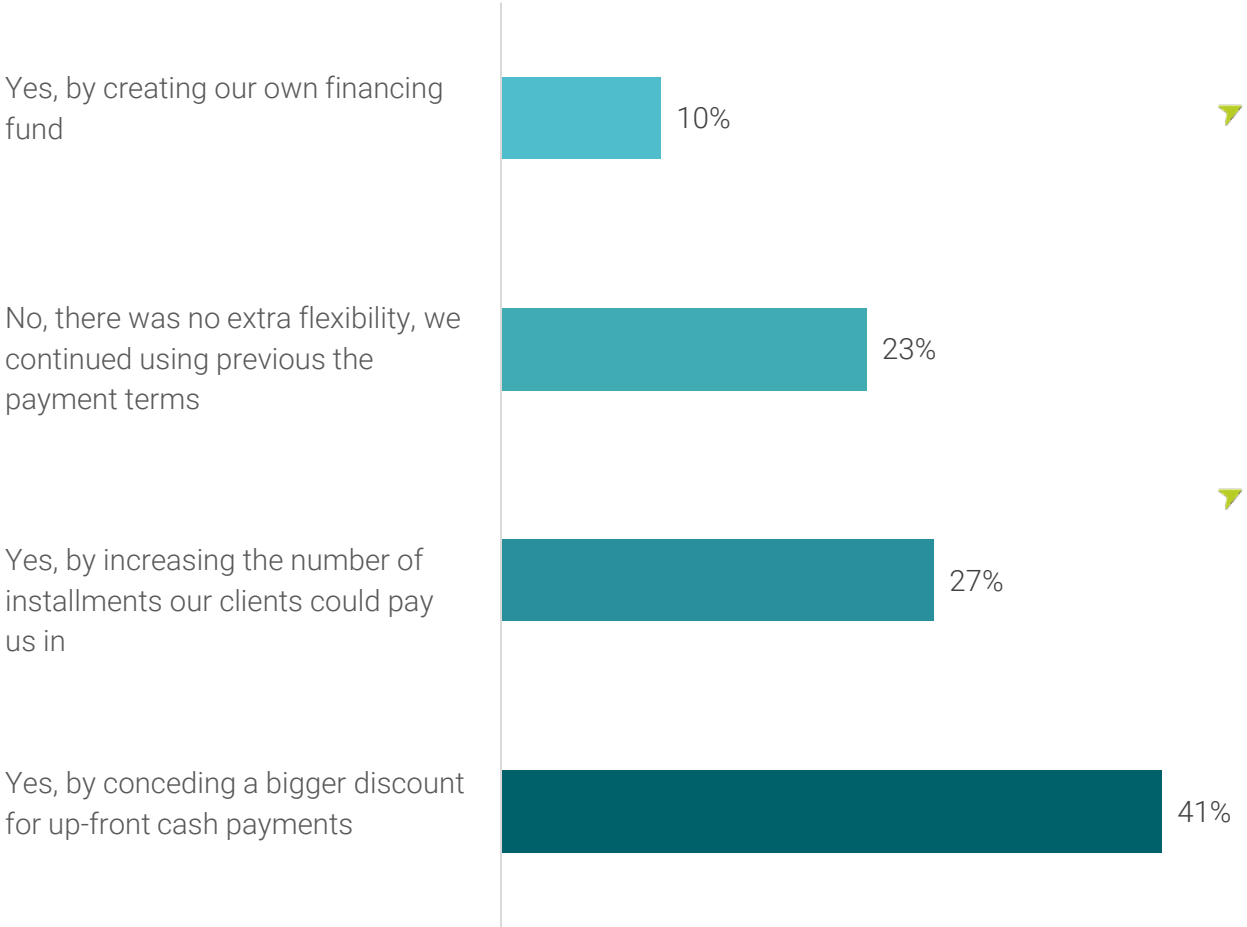
Factor that most influenced bank financing decisions



Source: Greener, 2023.

Solar Financing

Has your company made payment terms more flexible for customers? How?



- As an alternative to bank financing, **78%** of companies **indicated having introduced more flexible payment conditions** for their clients.
- **68%** offered a **larger discount for cash/up-front payments** or increased the **number of installments** that clients could pay in.

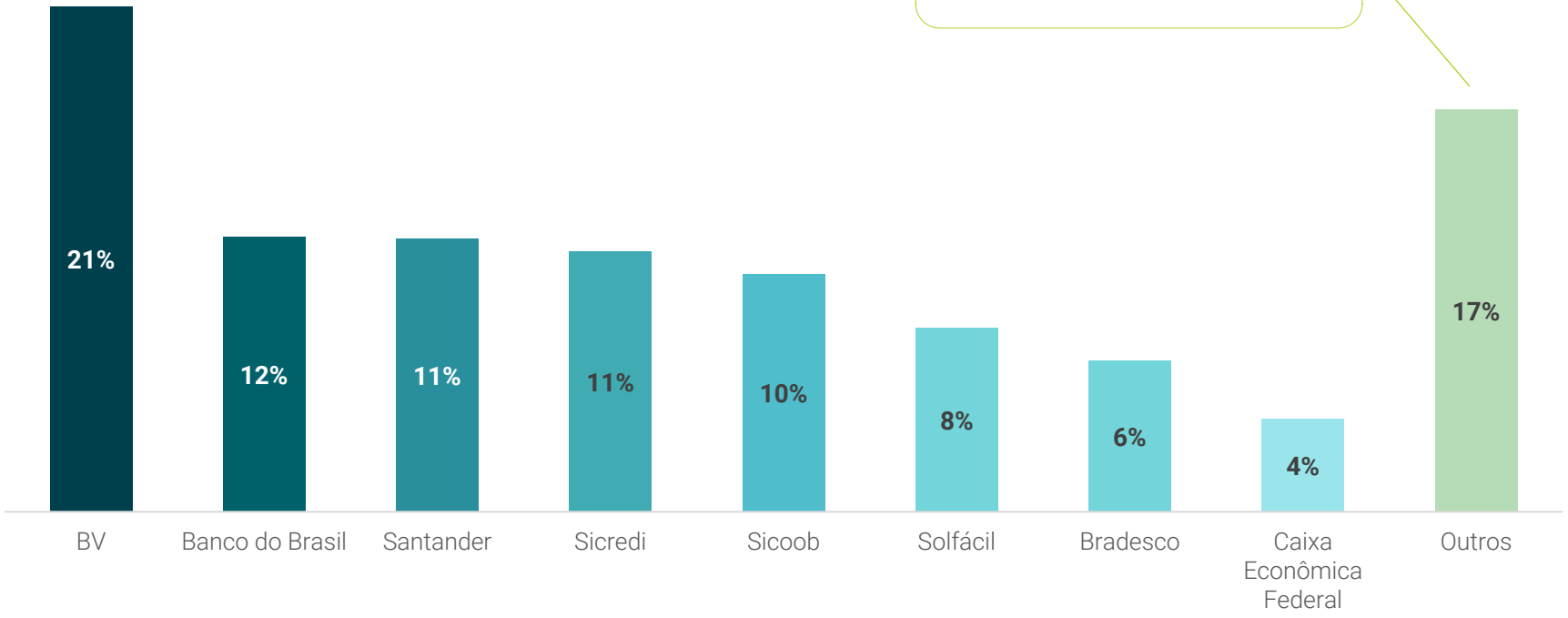
The questionnaire allowed up to 2 answers per respondent.

Source: Greener, 2023.

Solar Financing

For sales concluded in 2022 using bank financing, which banks did you use?

Click here for the complete list of banks.



- The **expansion of financial solutions** for the solar market continues, reaching a new **record of 58 financial institutions** mentioned in 2022, compared to 40 in 2021, meaning an **increase of 45%** in 1 year.

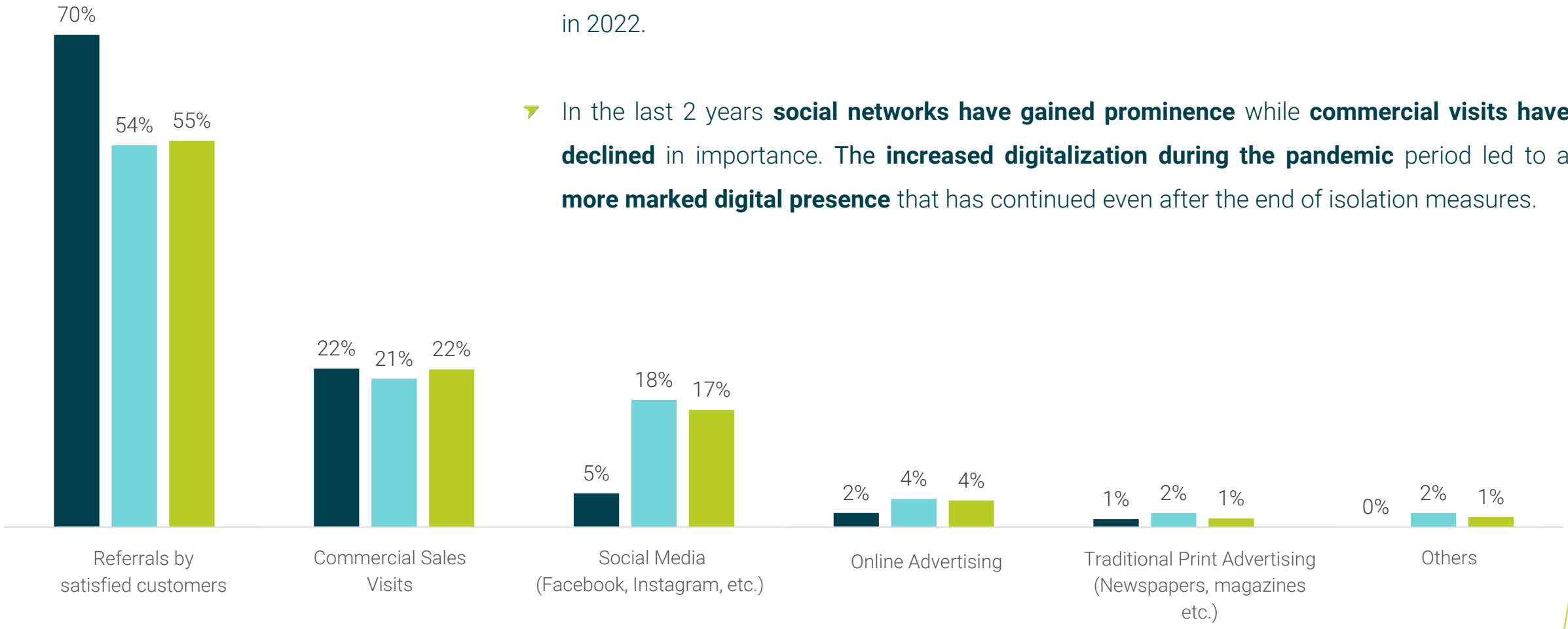
Source: Greener, 2023.

These data give an indication of the distribution of business among financial agents, but, do **not show market share**.
They indicate the percentage of companies that had at least one financing transaction completed through a particular bank.
The same company/integrator might have closed different projects with different banks/financing lines.

Source: Greener, 2023.

Which Sales Channels created most Revenue in 2022?

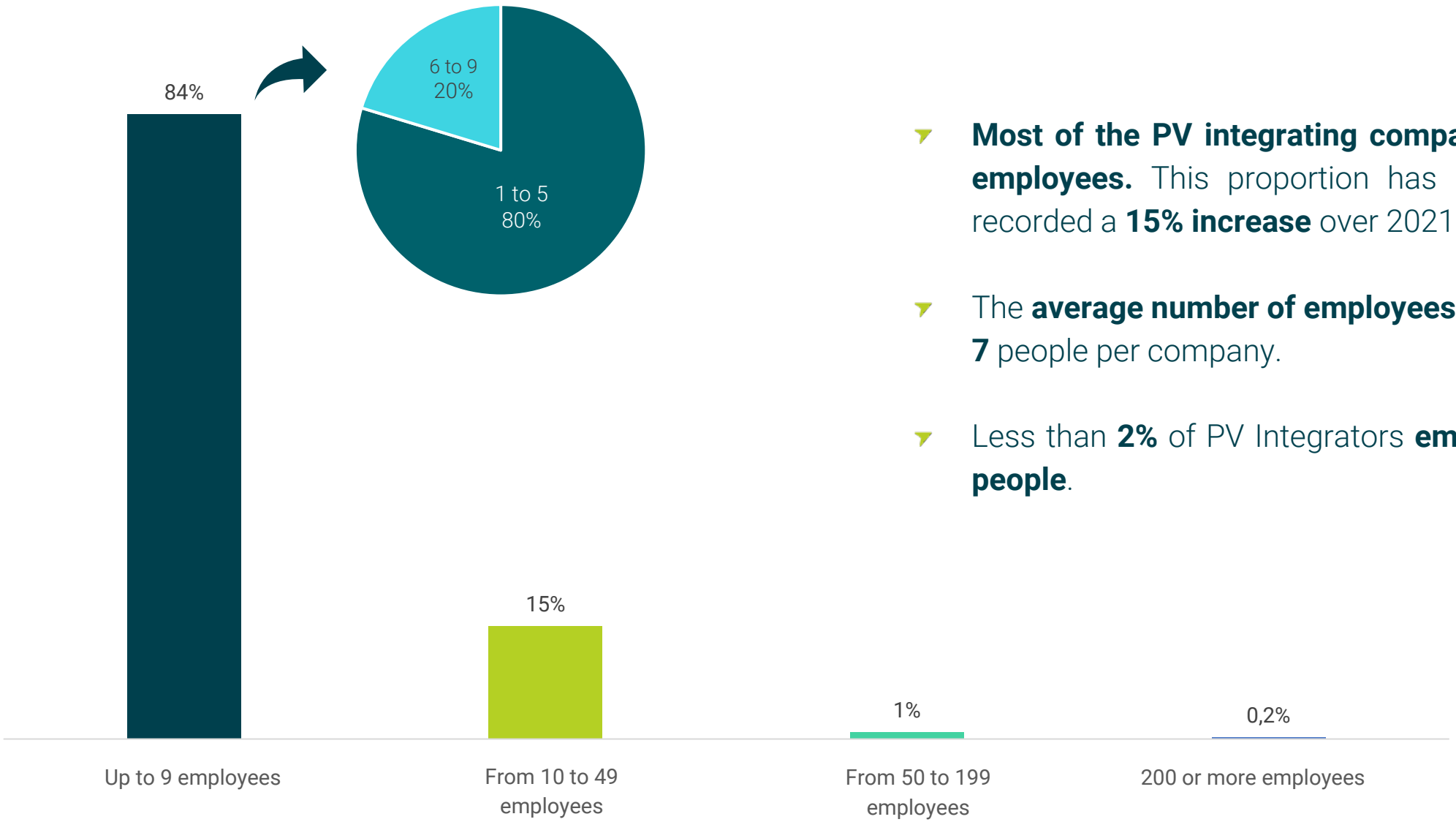
- **Personal referrals by satisfied customers** continue to be the most successful sales channel in 2022.
- In the last 2 years **social networks have gained prominence** while **commercial visits have declined** in importance. **The increased digitalization during the pandemic** period led to a **more marked digital presence** that has continued even after the end of isolation measures.



The questionnaire allowed up to 2 answers per respondent.

Source: Greener, 2023.

Number of Employees at each PV Integrator

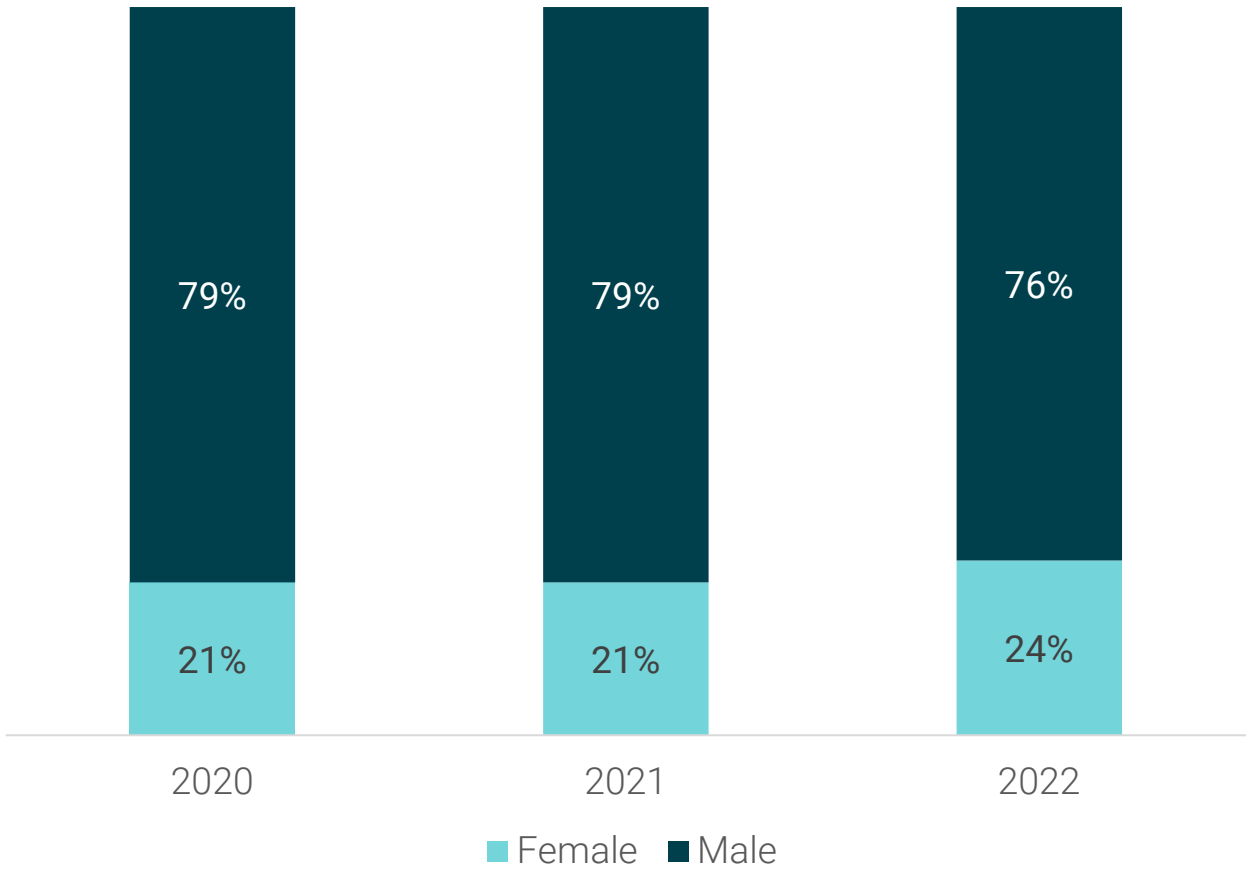


- **Most of the PV integrating companies have up to 9 employees.** This proportion has been growing and recorded a **15% increase** over 2021.
- The **average number of employees** remained stable at **7** people per company.
- Less than **2%** of PV Integrators **employ more than 50 people**.

Source: Greener, 2023.

Female Presence in the PV Integrator market

General Average*



- After two years of stability, in 2022 the representation of female employees **rose from 21 to 24%** in responding companies.
- **6%** of respondents declared not to have **even one female employee** in 2022.

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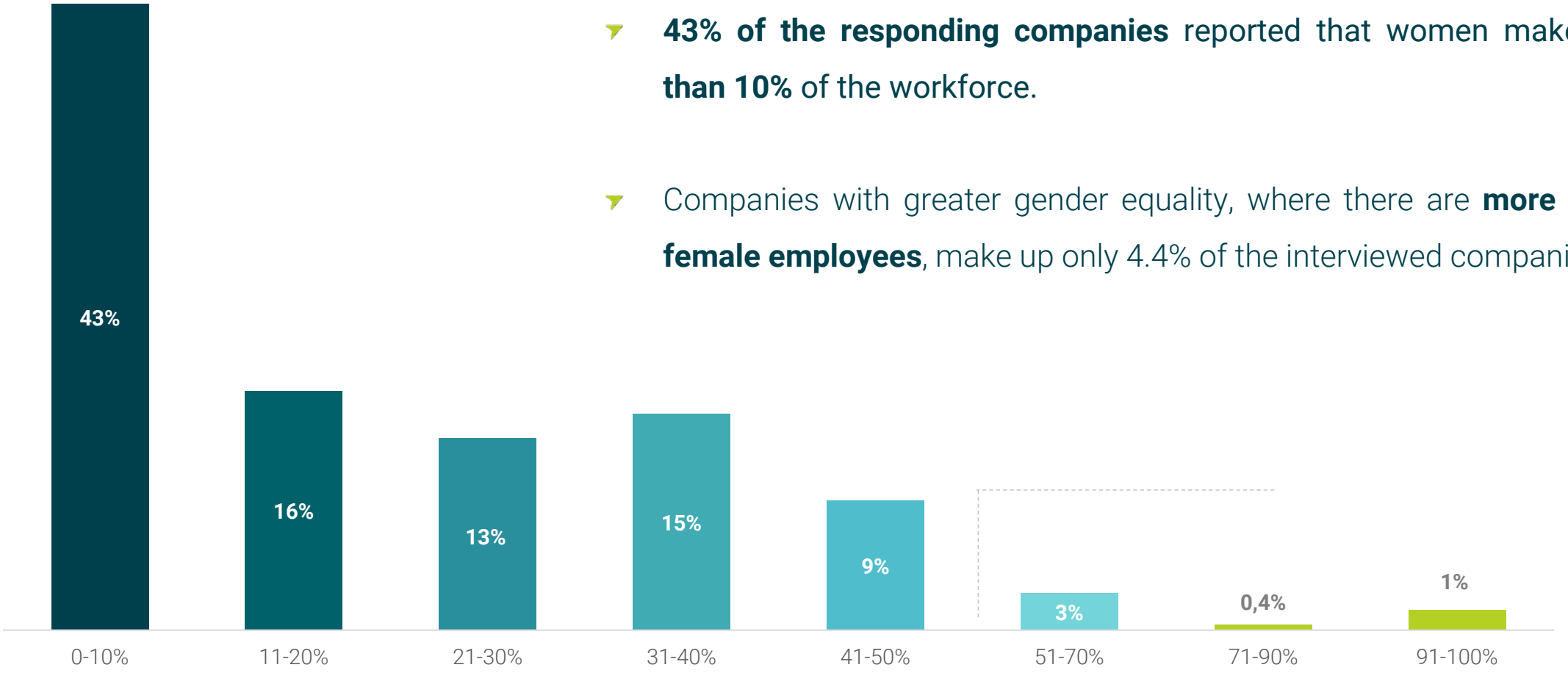
* Percentage of female employees considering the overall average of responses from all companies.

Source: Greener, 2023.

Percentage of female employees at Integrators

What Percentage of employees at the Company is Female?

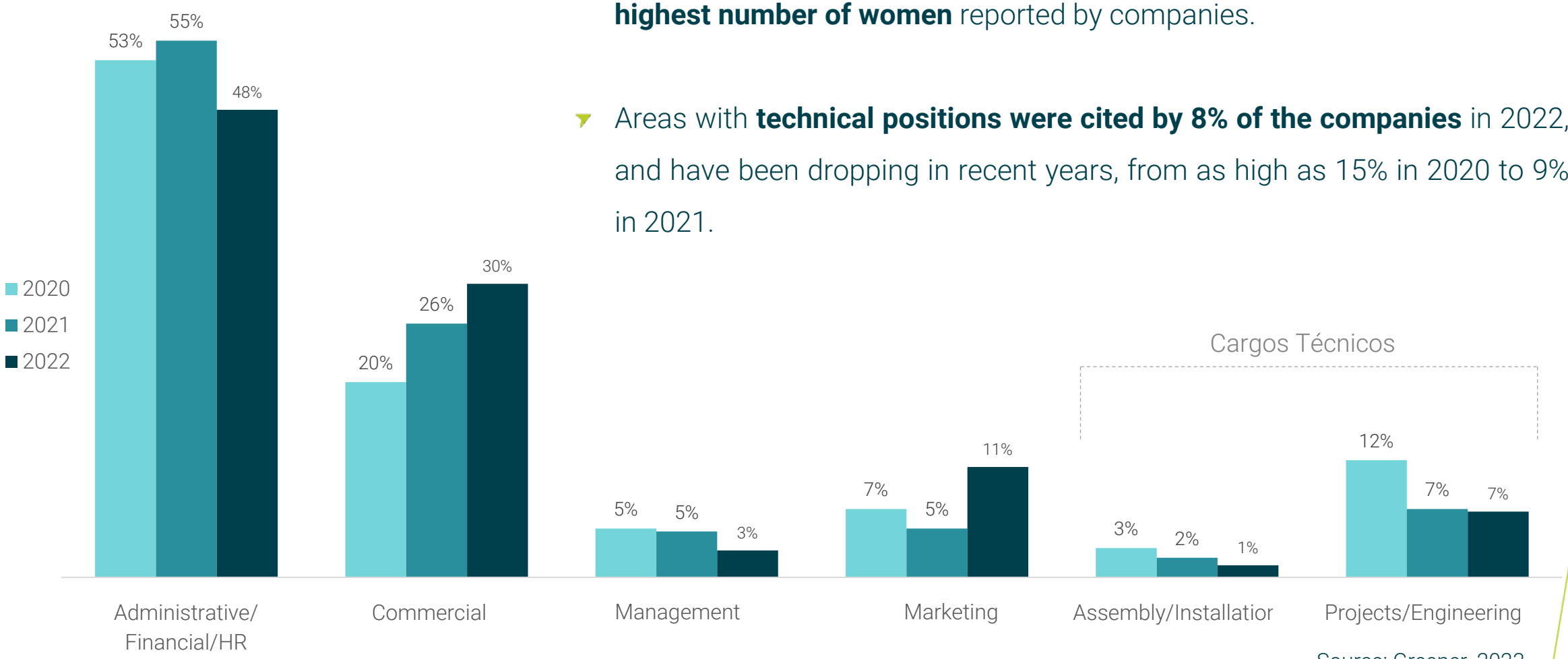


- **43% of the responding companies** reported that women make up **less than 10%** of the workforce.
- Companies with greater gender equality, where there are **more than 51% female employees**, make up only 4.4% of the interviewed companies.

Source: Greener, 2023.

Which Area of your Company has the highest number of women?

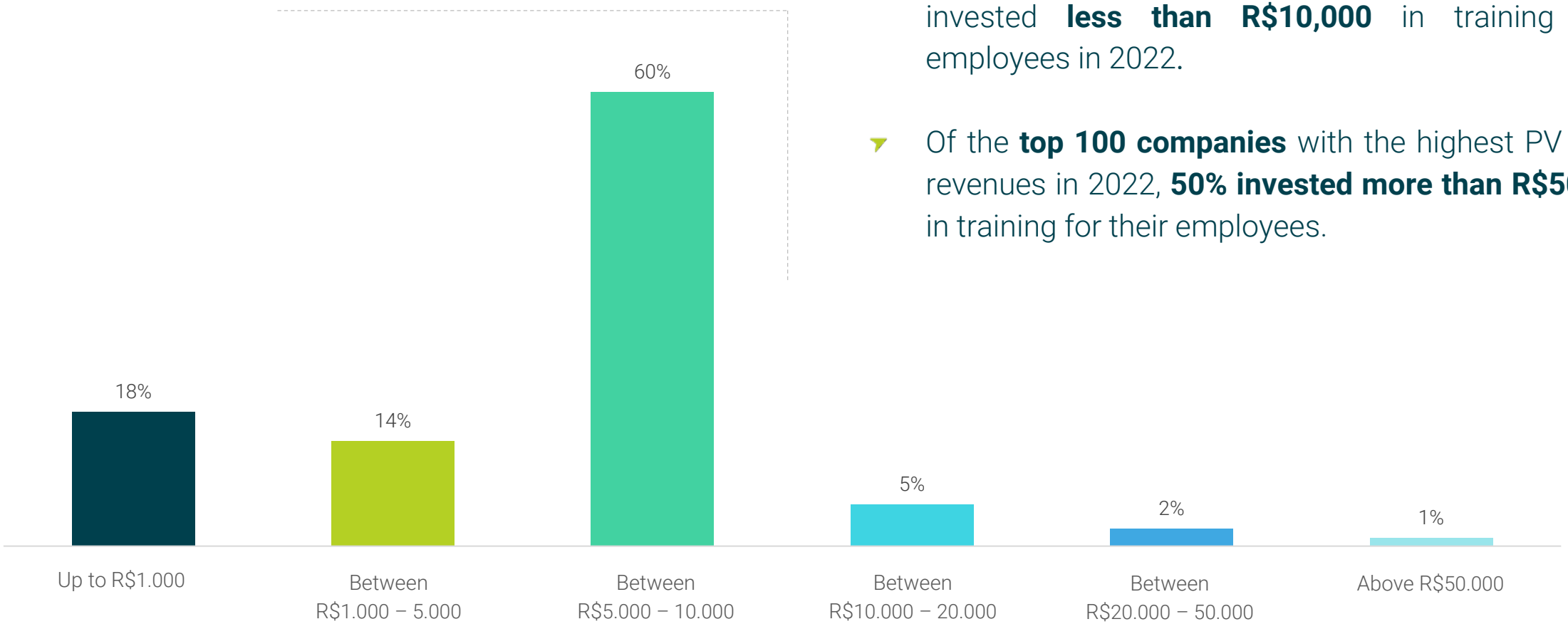
- **Administrative/Financial/HR** continues as the main department with the **highest number of women** reported by companies.
- Areas with **technical positions were cited by 8% of the companies** in 2022, and have been dropping in recent years, from as high as 15% in 2020 to 9% in 2021.



Source: Greener, 2023.

Investment in Training and Qualifications for Employees?

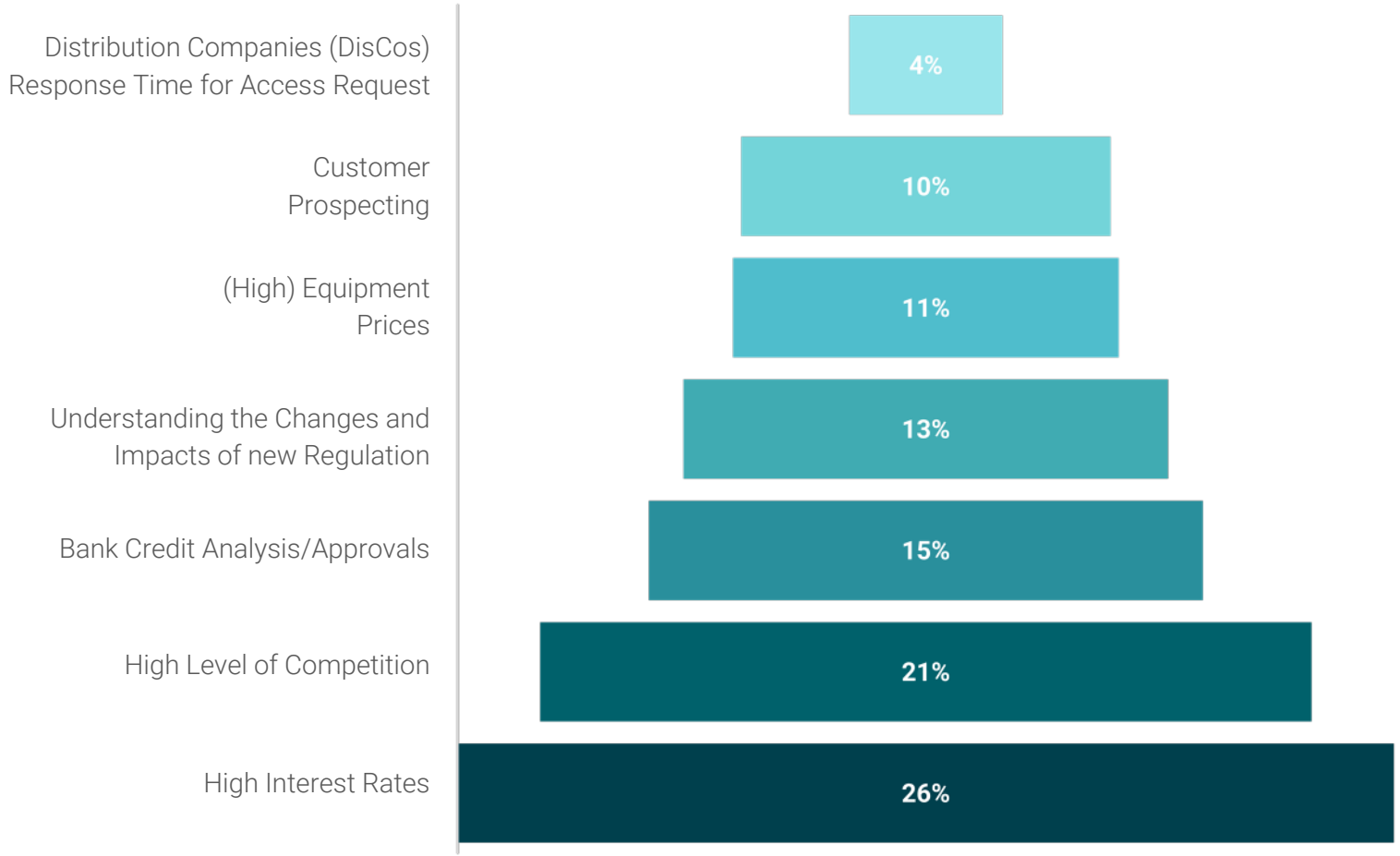
In Reais (R$)



- **92%** of the interviewed PV Integrator companies invested **less than R$10,000** in training their employees in 2022.
- Of the **top 100 companies** with the highest PV sales revenues in 2022, **50% invested more than R$50,000** in training for their employees.

Source: Greener, 2023.

Principal Challenges Confronted by Integrators in 2022

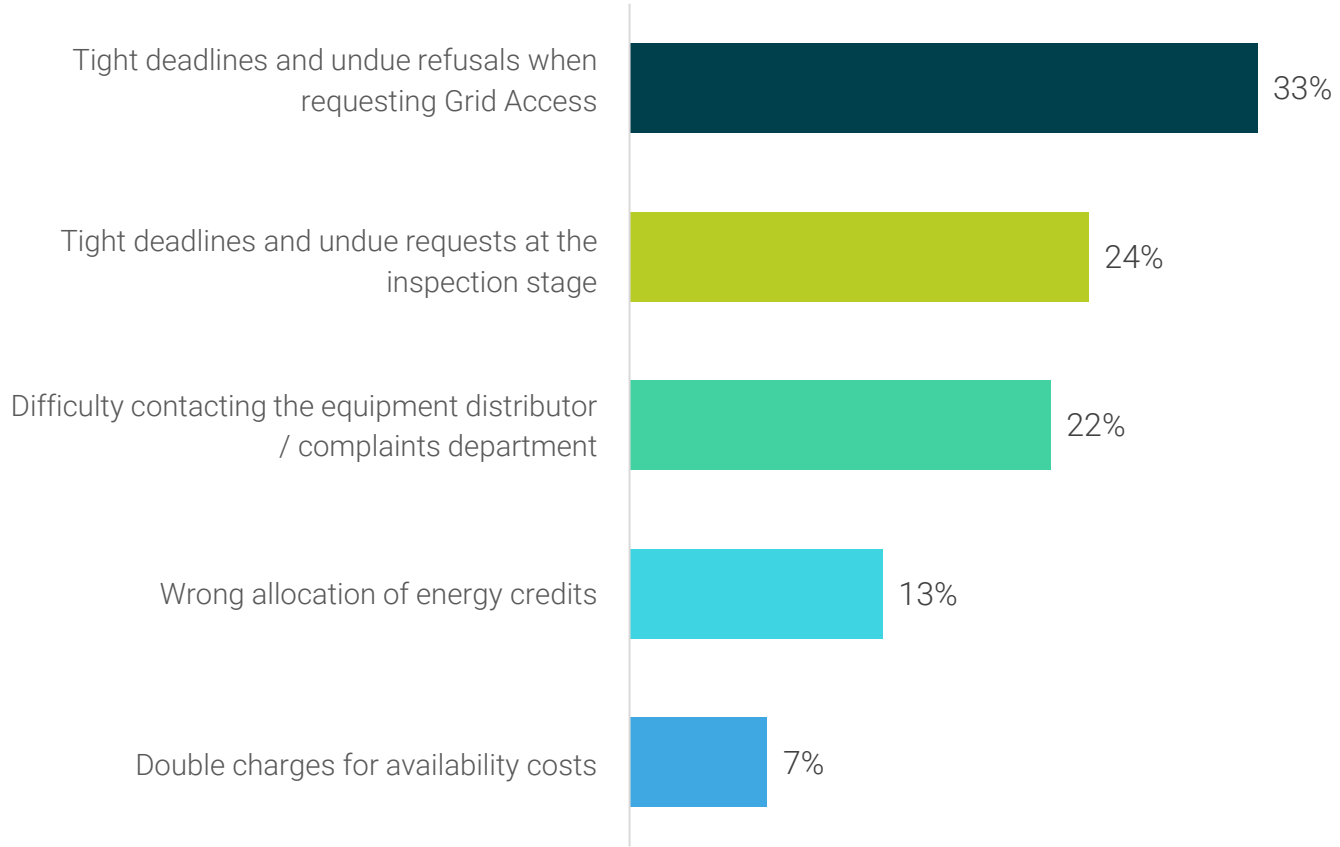


- **Banking challenges stood out in 2022,** adding up to a total of **41%** of responses, including the most cited problem (high-interest rates) and also difficulty in obtaining credit approval.
- With the **inflow of new integrator companies** to the PV market, the **high level of competition** was highlighted as the **2nd biggest challenge** of the year.
- Understanding the **changes in regulation** and their impacts is still a bottleneck for the market.

The questionnaire allowed up to 3 answers per respondent.

Source: Greener, 2023.

Principal Challenges in Relation to Energy Distributors



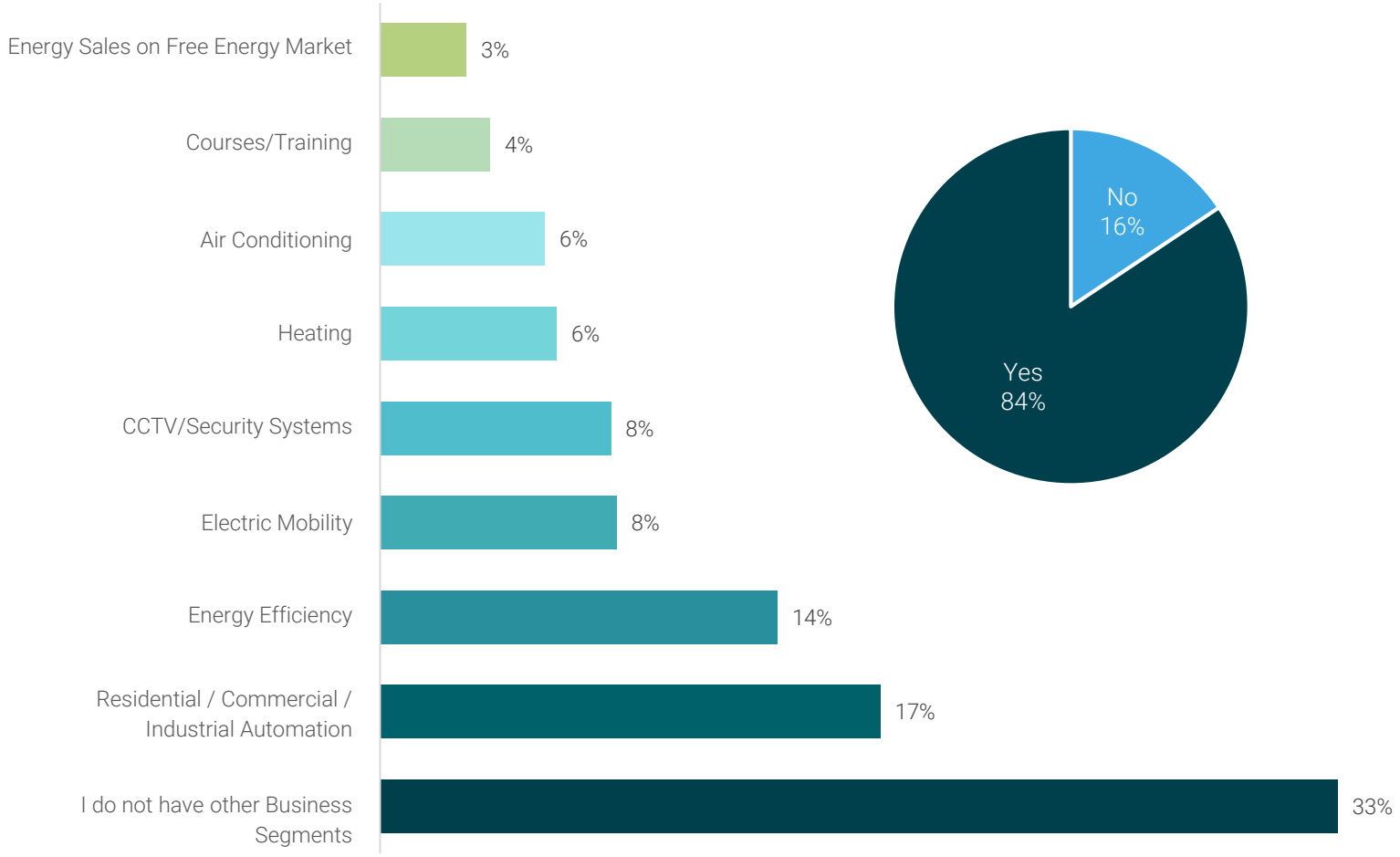
- The two main challenges are related to the energy **distributors' deadlines**, representing **57% of the difficulties** pointed out by the Integrators.
- With the **regulatory changes** brought about by Law 14,300, the distributors received a **large volume of Grid Access Requests** from entrepreneurs to ensure their access to **benefits of the legacy rights** acquired before the changes of the law went into effect.

The questionnaire allowed up to 2 answers per respondent.

Source: Greener, 2023.

Other Segments of Business Activity aside from PV

Did the company achieve any sales in these other services in 2022?

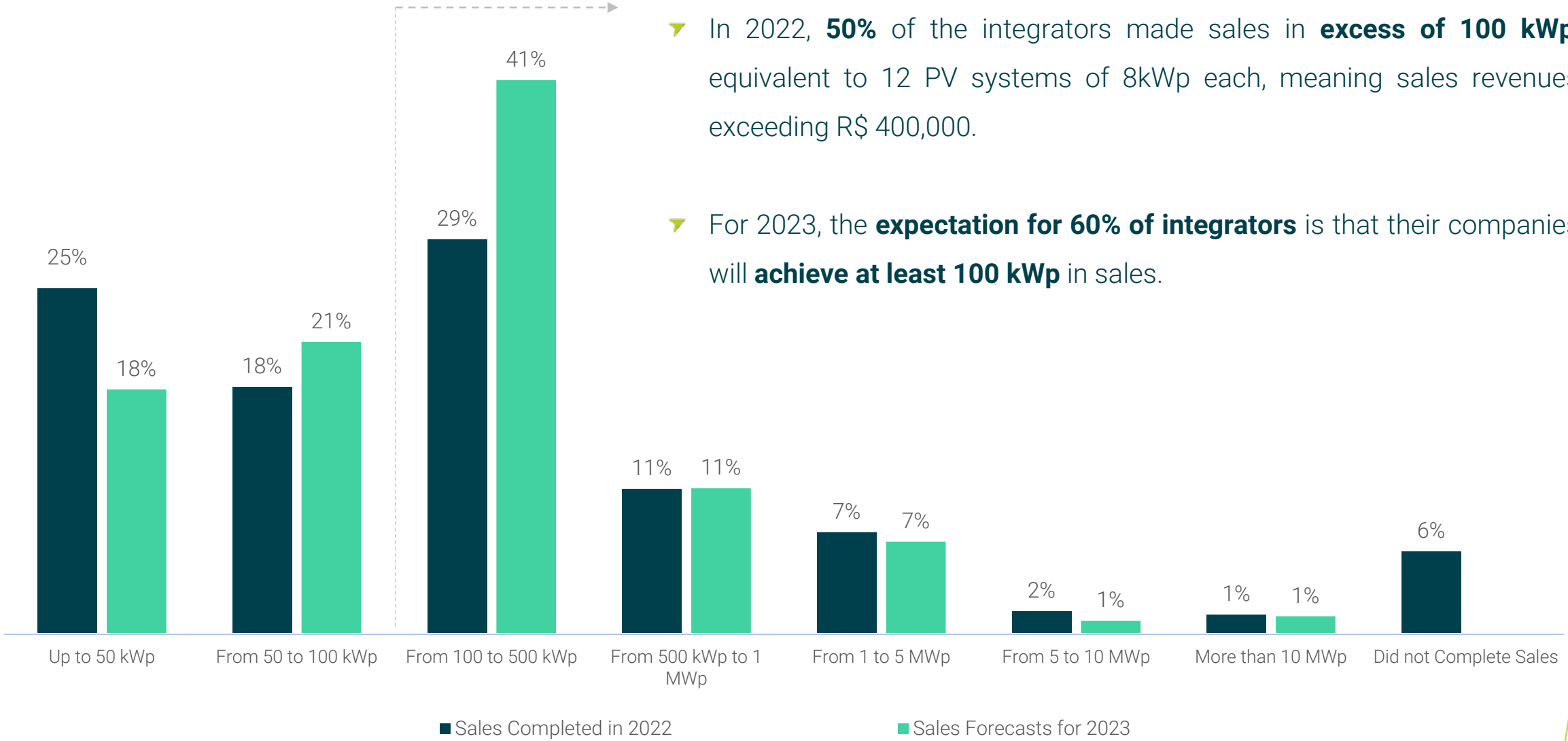


- **66%** of the companies do work in **another segment** besides solar PV, the main ones being: **automation and energy efficiency services,** which represent 50% of all other services.
- Among the companies that provide other services, **84% completed at least one sale** of these services in 2022.
- The **Free Energy Market could become an opportunity** to expand activities in the upcoming years.

The questionnaire allowed up to 2 answers per respondent.

Source: Greener, 2023.

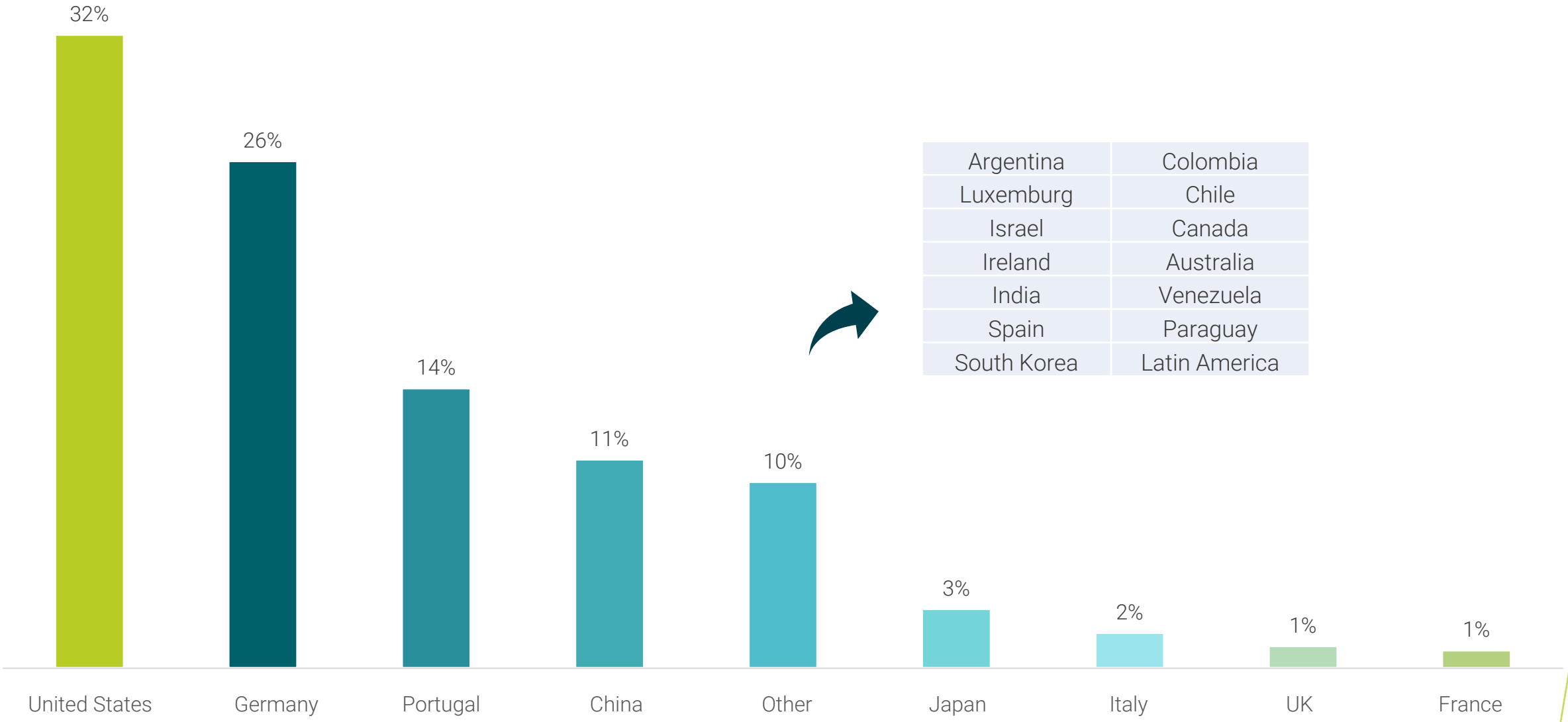
Sales Expectations for 2023



- In 2022, **50%** of the integrators made sales in **excess of 100 kWp**, equivalent to 12 PV systems of 8kWp each, meaning sales revenues exceeding R$ 400,000.
- For 2023, the **expectation for 60% of integrators** is that their companies will **achieve at least 100 kWp** in sales.

Source: Greener, 2023.

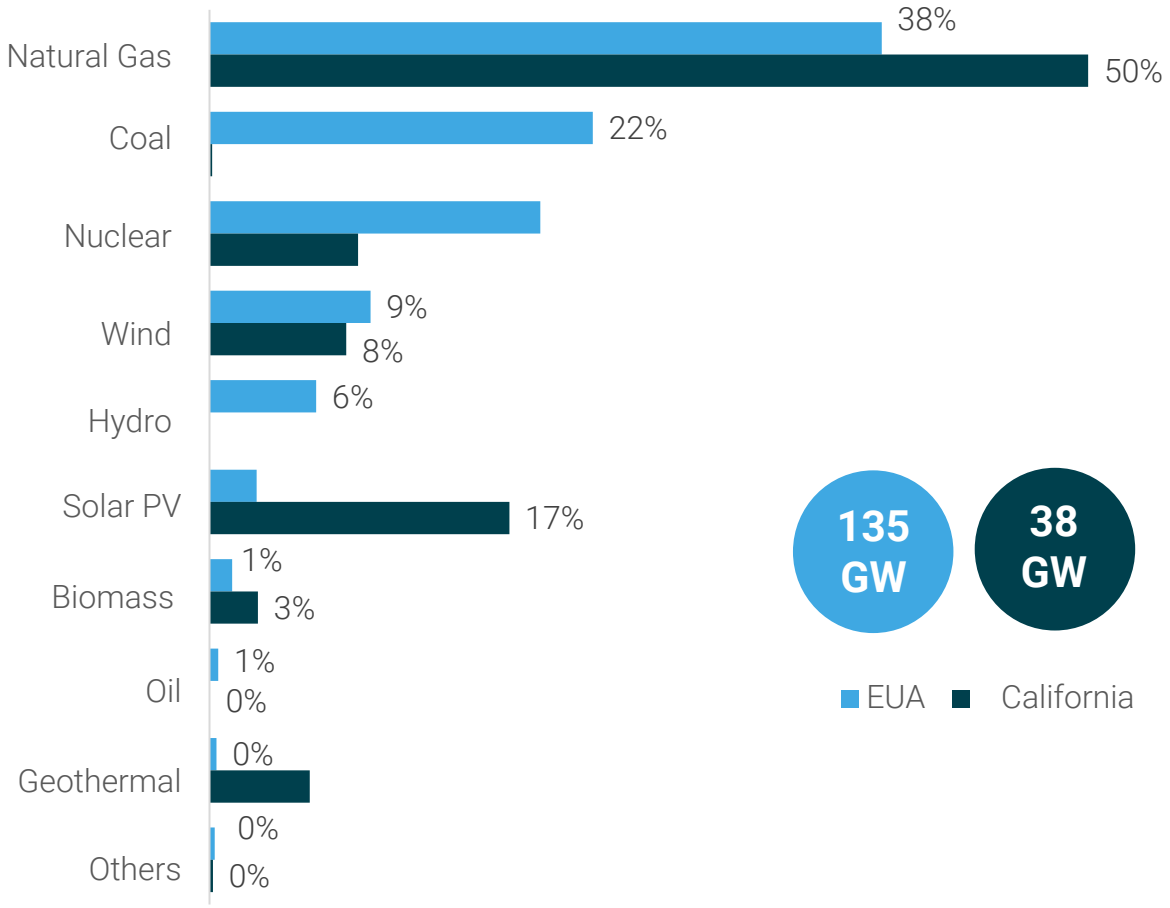
Would you like to learn about the DG market in another country?



Argentina	Colombia
Luxemburg	Chile
Israel	Canada
Ireland	Australia
India	Venezuela
Spain	Paraguay
South Korea	Latin America

International Case Study: California, USA

Electricity Grid Composition

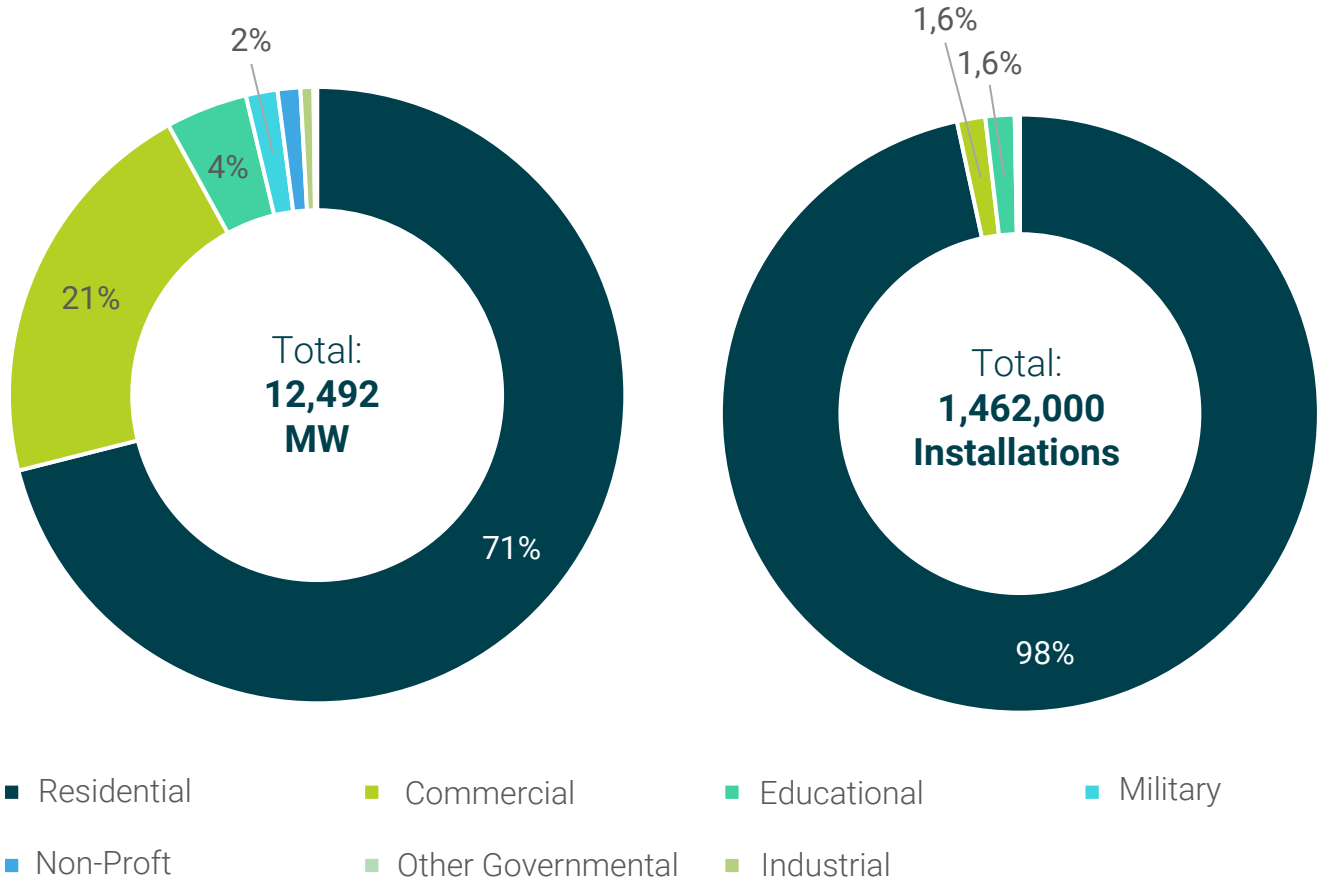


- The United States has the **second largest installed solar PV capacity in the world** after China, reaching 135 GW by the end of 2022.
- California is the **leading State in solar energy installation** in the United States, representing **28%** of all installed capacity in the country, totaling 38 GW in 2022.
- In the **country-wide ranking, solar energy ranks in 7th position** in the electricity generating matrix, while in the State of **California, it is the 2nd largest source** of electricity, second only to natural gas.
- In the USA, decision-making is more decentralized, and each State has its individual policies for the energy sector.

Source: California Energy Commission (2023) and SEIA (2023)

International Case Study: California, USA

Installed Capacity (MW) and Number of Installations



- Similar to the Brazilian scenario, California's main solar energy customer type is **residential**, due to several incentives from the state government.
- The "net-metering" policy (NEM) **allows the consumer to sell the surplus energy** generated.
- The average **payback period** in the USA is 8-9 years, while in **California it is 5-7 years**.

Source: California Energy Commission (2023) and SEIA (2023)

CHAPTER 6

Distributors

THE SURVEY

Introduction

- Greener carried out a further survey, interviewing **31 PV equipment distributors** (which, among other things, sell PV Kits*) in the 5-week period between 10 January 2023 and 15 February 2023. These companies **represent approximately 60% of the PV volume sold in 2022** through the distributor channel.

Year of start of commercial activities of surveyed distributors:

2016 or before	2017	2019	2020
29%	7%	39%	25%

*Kit consists of: PV Modules + Inverter + Mounting System/Rack + Cables and Electrical Connections + Protection System

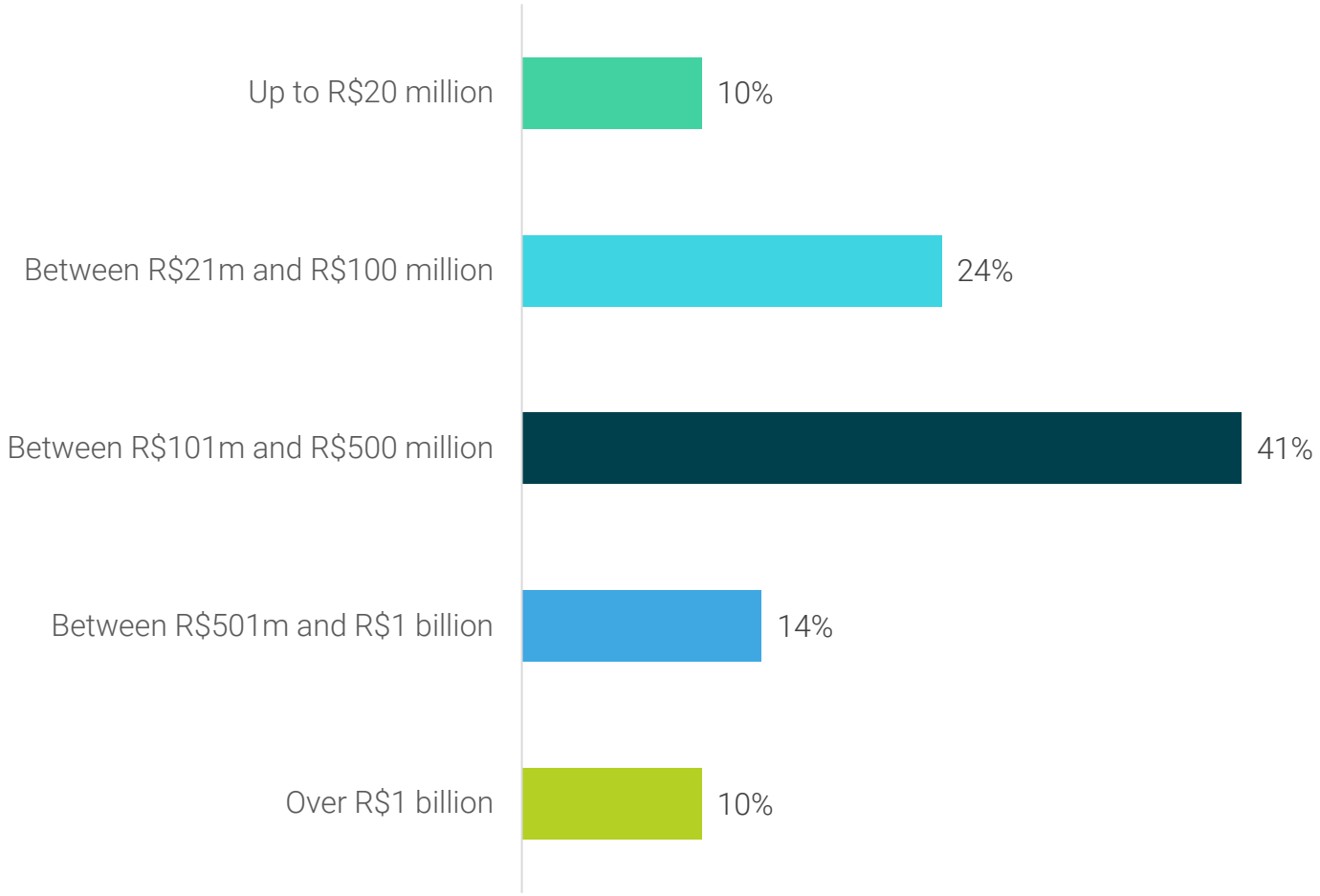
Distributors in Numbers in the Year 2022

R$16.3 billion	Total Sales Revenues of Interviewed Distributors.
6.4 GWp	Total Solar PV Capacity sold through Interviewed Distributors.
3,059	Total Nº of employees dedicated to solar PV in these companies.
50,068	Nº of active Integrators* purchasing through these Distributors. (does not represent the total number of integrators in the market due to double counting)
5.3 years	Average number of years in business of these Distributors.

*Integrators that completed at least one purchase in 2022

Sales Revenues from PV Kits in 2022

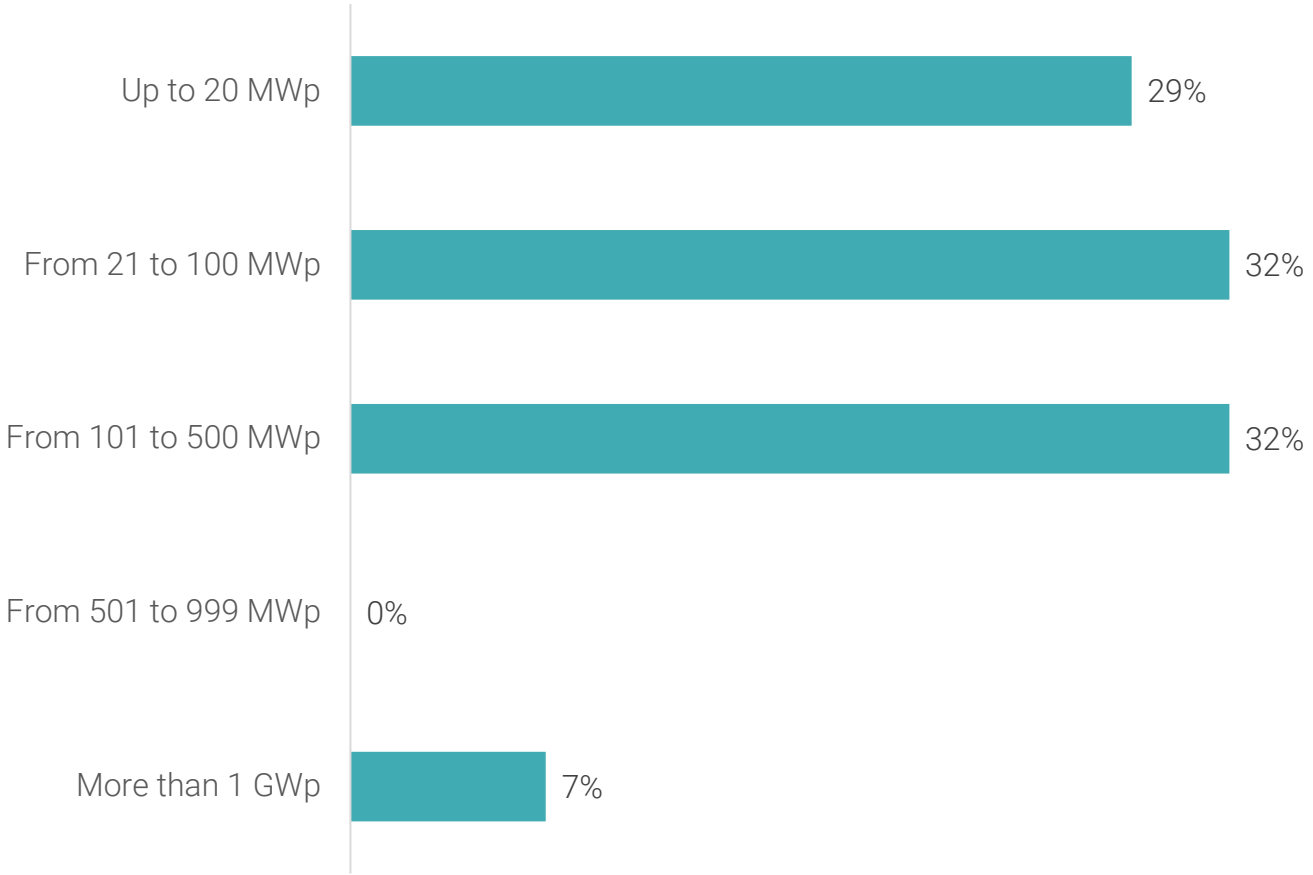
% of Distributor Companies



- Total sales revenue of the interviewed distributors was R$16.3 billion in 2022.
- The elite group of Distributors with revenues over R$1 billion (10%) represent 58% of the total revenues of the interviewed companies.

Volume Sold in 2022

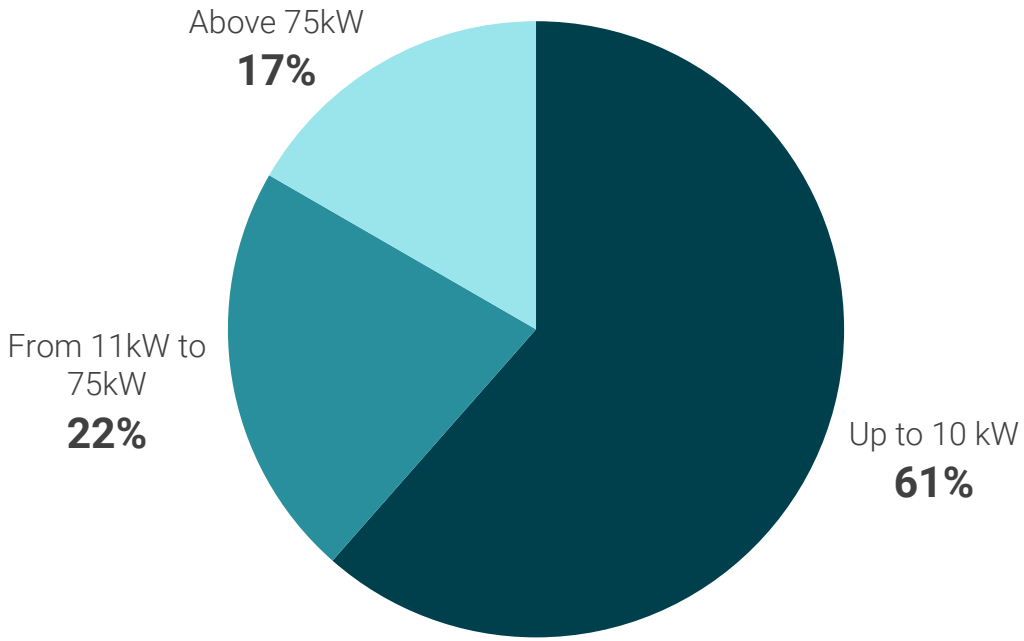
% of companies



- **Total volume** invoiced by distributors in 2022 **was 6.4 GWp.**
- **7%** of the distributors sold **more than 1 GWp** in 2022 and these represented **52%** of the total invoiced by the respondents in the period.

Size of PV Kits Sold

Of the PV Kits that were sold, which sizes were most common?

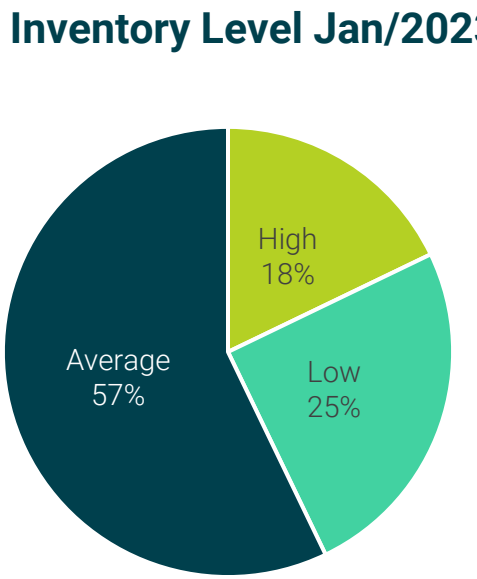


- The **residential PV Kit** represents the largest share of PV kits sold by the distributors in 2022.

Source: Greener, 2023.

Import Volume vs Sales

What do you think about your current inventory level?



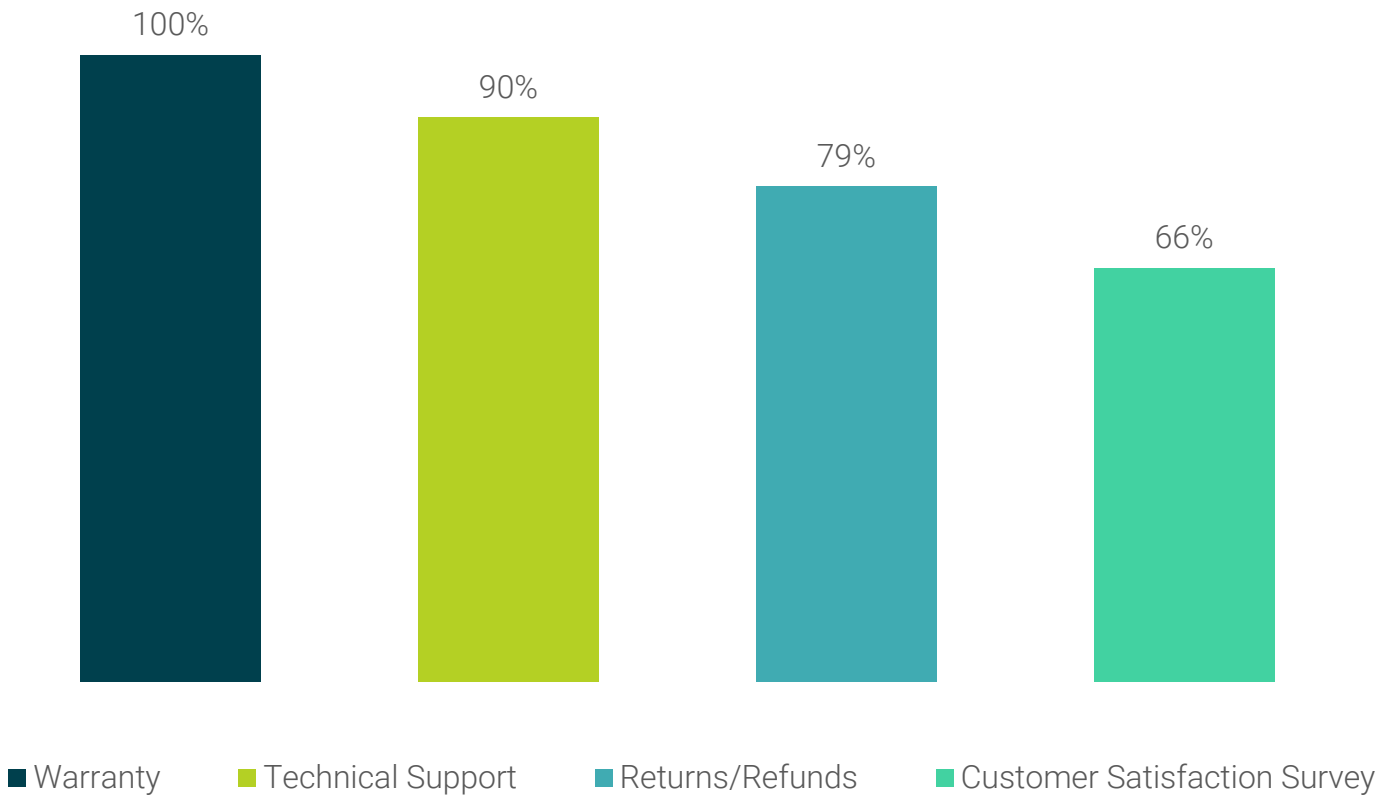
The volume of modules received through imports in 2022 **was 6% higher than the volume invoiced** in the same year, which may indicate an increase in inventory.

Most companies (57%) indicate a medium level of inventory in January 2023. 18% feel they have a high level of stock.

*Volume of imported PV modules received in 2022.

Does the company offer any of the below after-sales services?

Warranty, Technical Support, Returns/Refunds, Satisfaction Survey

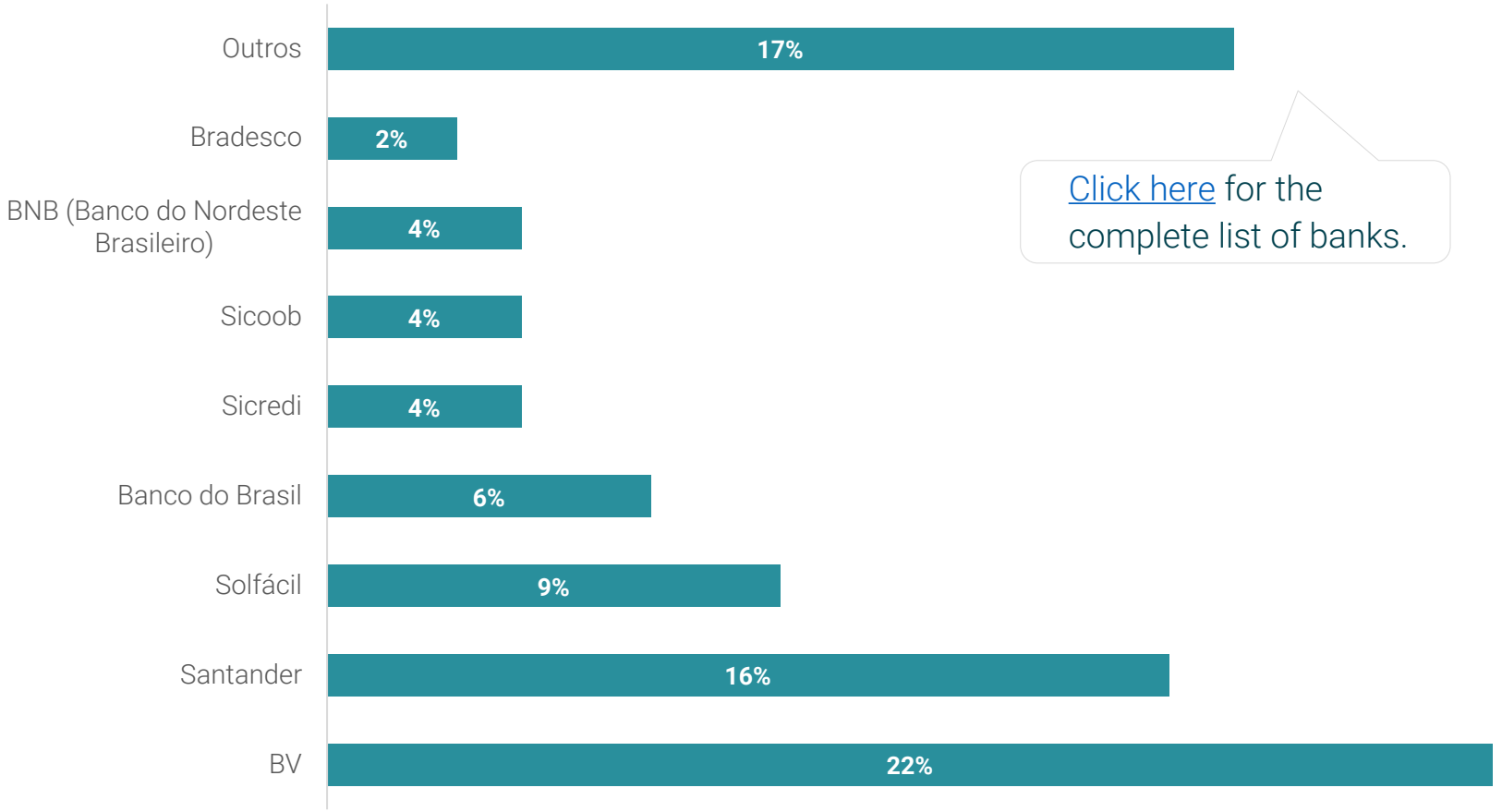


- **Warranty** is provided by all respondents.
- **Satisfaction surveys** are not yet made available by **33%** of the distributors.
- The average **delivery time** for distributors is **11 days**.

The questionnaire allowed more than 1 answer per respondent.

Solar Financing

With which Financing providers did your company work in 2022 to facilitate PV Kit Sales?



Click here for the complete list of banks.

Note: These data give an indication of the distribution of business among financial agents, but, do **not show market share**.

They indicate the percentage of companies that had at least one financing transaction completed through a particular bank.

The same company/distributor might have closed different projects with different banks/financing lines.

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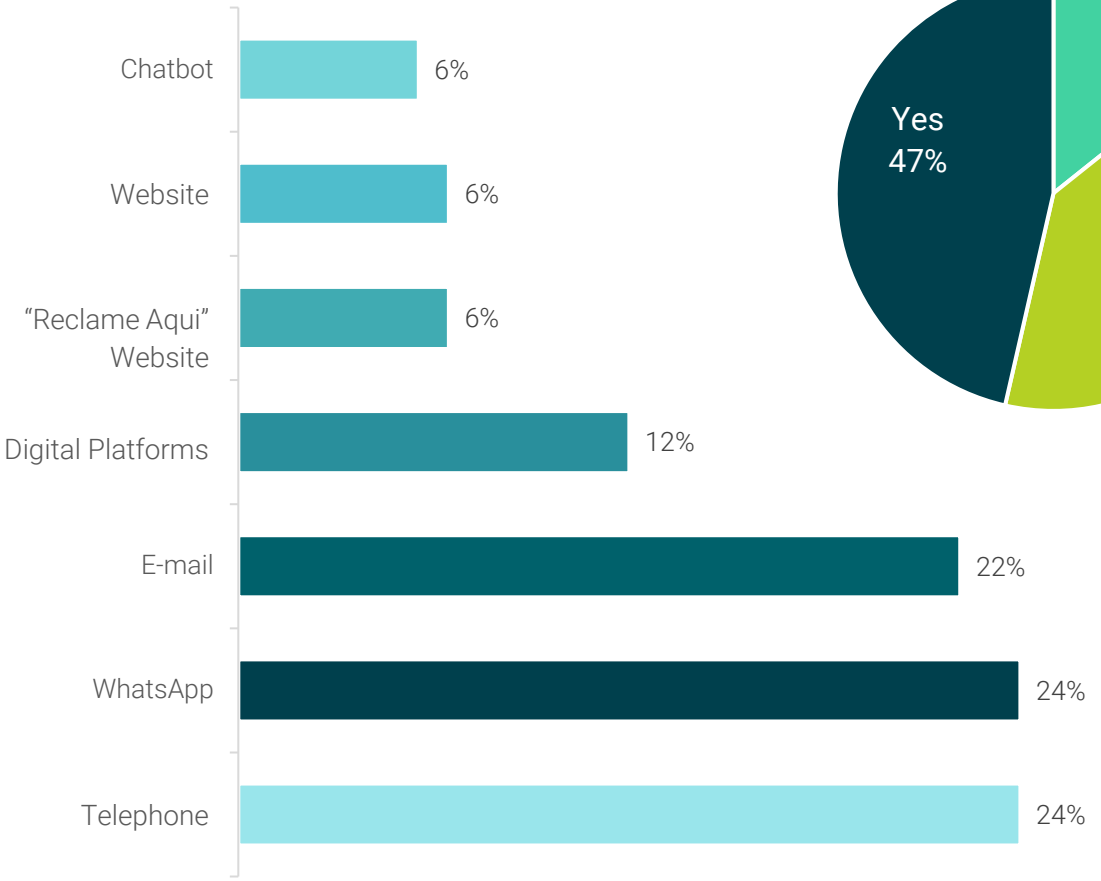
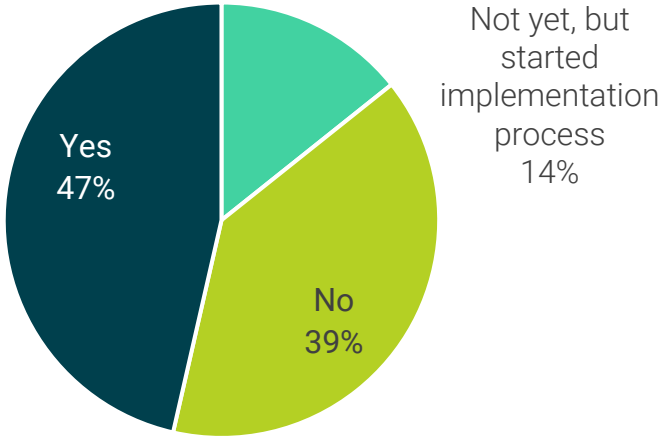
Source: Greener, 2023.

Which channels are used to carry out after-sales processes?

Does your company have a space for Integrators to evaluate product/service after purchase?





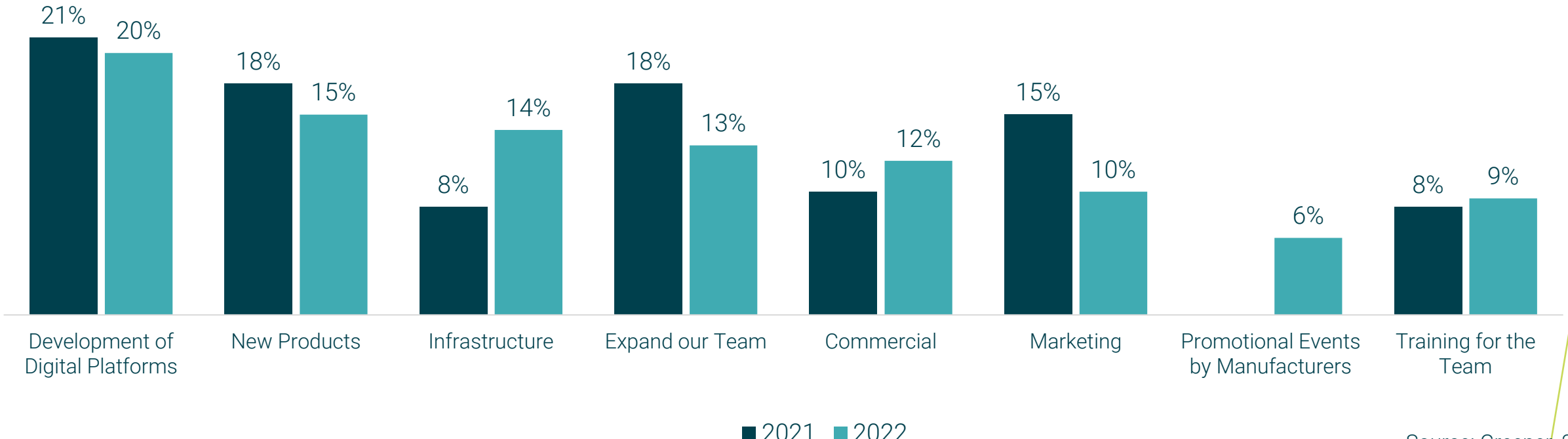
- **WhatsApp, telephone, and e-mail represent 70%** of the channels used in the post-sale customer relations processes.
- **53%** of distributors still **do not have** a dedicated space for the client to evaluate the service or product after purchase.

The questionnaire allowed more than 1 answer per respondent.

What are the 3 priority areas for investment in 2023?

Distributors of PV kits

- As the digitization of the industry accelerates, the **major focus** for distributors for 2022-2023 has been on **investing in digital platforms.**
- In 2022, respondents reported investing an average of **3% of their revenue in staff training**.

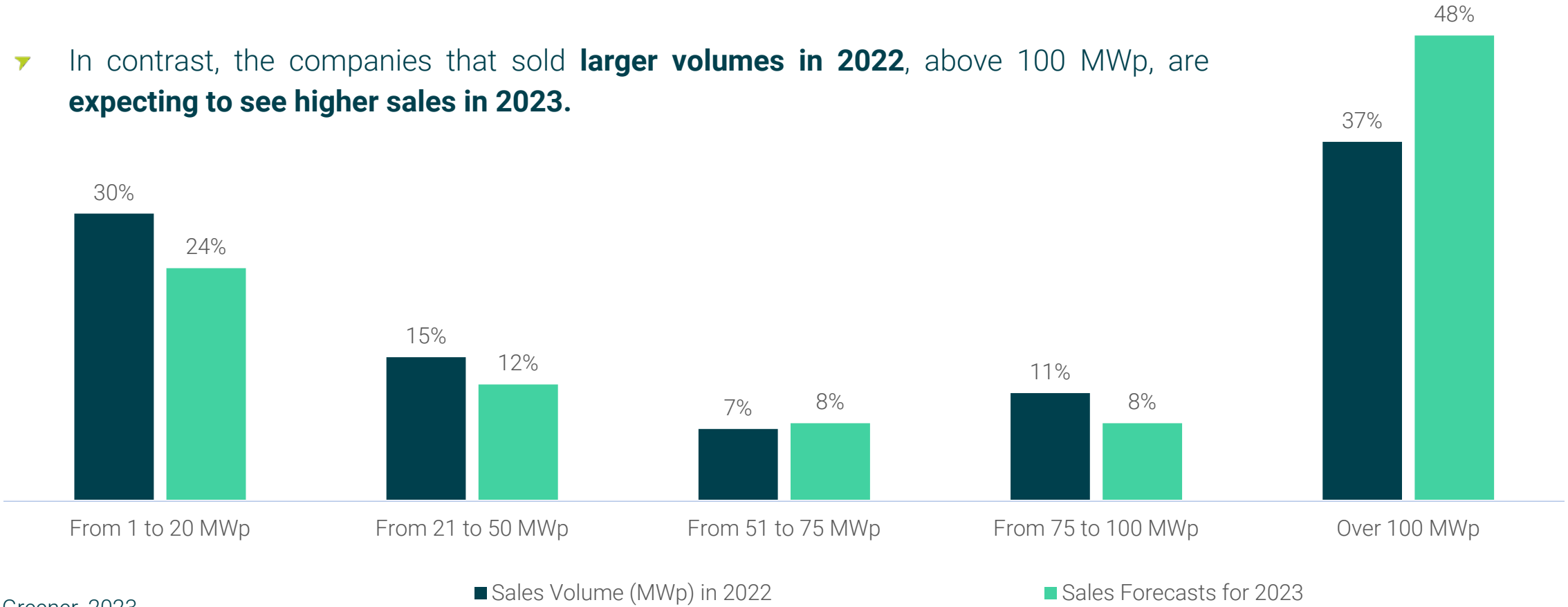


Source: Greener, 2023.

Commercial Expectations for 2023

Sales Volume Forecasts (in MW) for PV Kit Distributors

- The distributors that sold a **smaller volume**, up to 50 MWp, in the year 2022 are expecting to see a **reduction in sales for 2023**.
- In contrast, the companies that sold **larger volumes in 2022**, above 100 MWp, are **expecting to see higher sales in 2023.**



Source: Greener, 2023.

CHAPTER 7

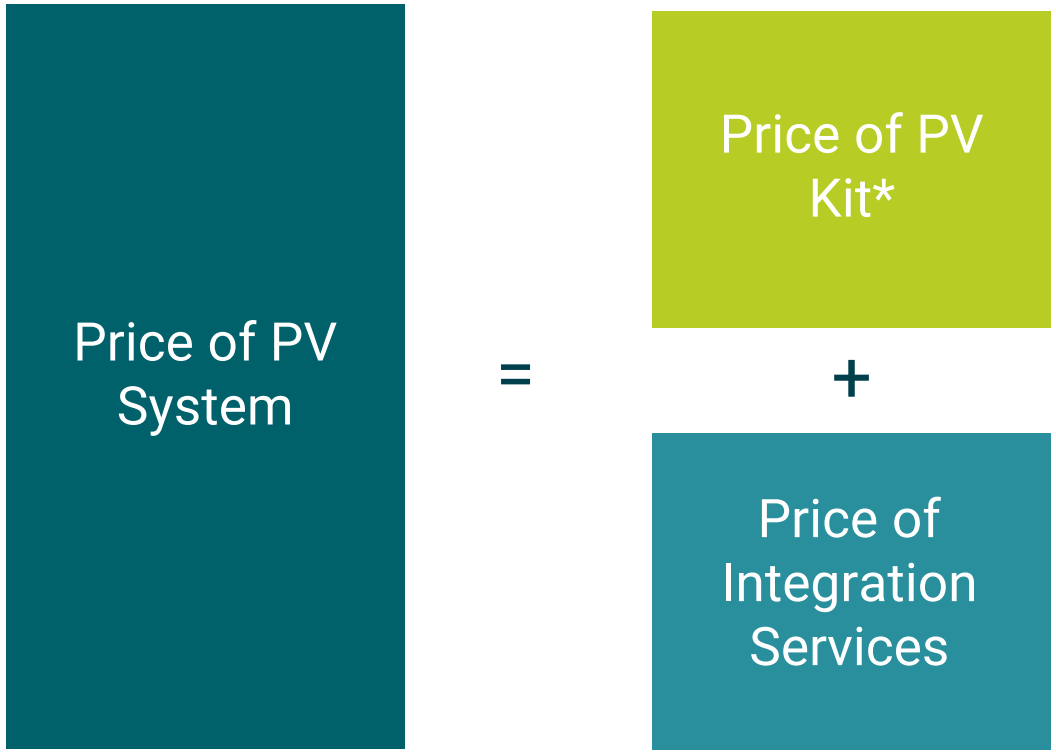
Prices

Relationship Between Prices

Price of PV Kits + Price of Services = Price of PV System

- In the report, **the average price of the photovoltaic system** for each project size is obtained through the average prices provided by thousands of integrators who respond to the DG Survey conducted biannually by Greener.
- The **average price of the PV kits** is obtained through price mapping and detailed research among the PV distributors.
- The **average integration service price is the difference** between the PV system price and the PV kit price, and represents the integrator's service charges.

*Kit is composed of: PV Modules + Inverter + Mounting System / Rack + Cables and Connectors + Protection System

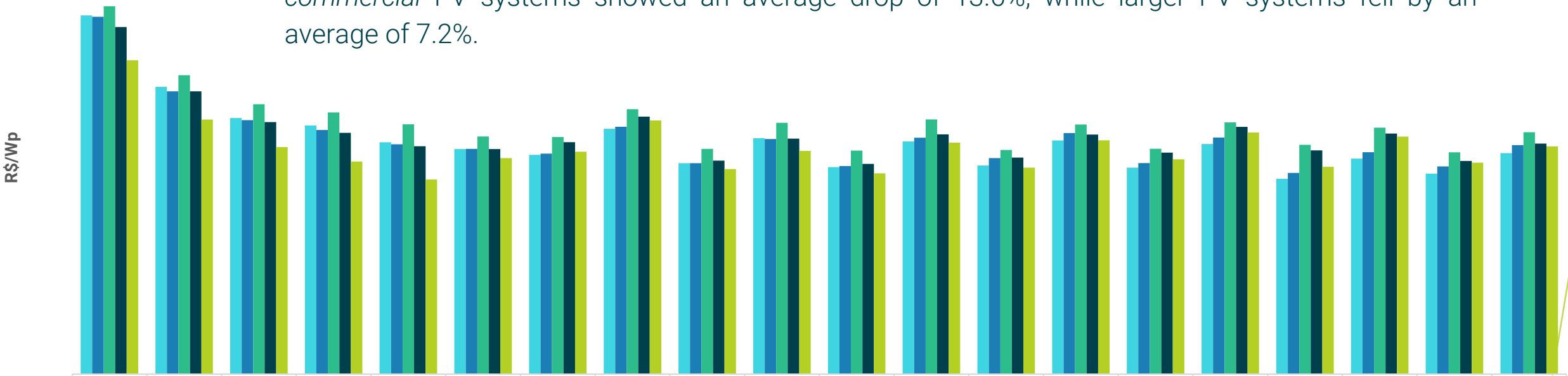


Source: Greener, 2023.

The size of the boxes is purely illustrative, and does not show the relative proportions between the parts.

Prices of PV Systems

- On average, end-customer prices in 2022 **showed a 12% decrease** from 2021. Residential and *small commercial* PV systems showed an average drop of 13.6%, while larger PV systems fell by an average of 7.2%.



	2kWp	4kWp	8kWp	12kWp	30kWp	50kWp	75kWp	75kWp Ground	150kWp	150kWp Ground	300kWp	300kWp Ground	500kWp	500kWp Ground	1MWp	1MWp Ground	3MWp	3MWp Ground	5MWp	5MWp Ground
jan/21	6,19	4,96	4,42	4,29	4,00	3,88	3,79	4,23	3,64	4,07	3,57	4,02	3,60	4,03	3,56	3,97	3,37	3,72	3,46	3,81
jun/21	6,17	4,88	4,38	4,21	3,97	3,89	3,81	4,27	3,64	4,06	3,59	4,08	3,73	4,16	3,64	4,09	3,47	3,83	3,59	3,95
jan/22	6,35	5,16	4,66	4,52	4,31	4,10	4,09	4,57	3,89	4,34	3,86	4,40	3,87	4,31	3,89	4,35	3,96	4,25	3,83	4,18
jun/22	5,99	4,88	4,35	4,16	3,93	3,88	4,00	4,45	3,69	4,07	3,63	4,14	3,74	4,13	3,82	4,27	3,86	4,15	3,68	3,98
jan/23	5,42	4,39	3,92	3,67	3,36	3,73	3,84	4,38	3,54	3,85	3,47	4,00	3,56	4,04	3,71	4,17	3,58	4,10	3,65	3,93
	Residencial							Small Commercial						Large Scale						

Source: Greener, 2023.

Prices of PV Kits

- PV Kit prices in January 2023 showed an **average reduction of 21%** compared to January 2022. In addition to the **reduction in PV kit costs**, the drop in retail prices was enhanced by the low demand for PV systems in early 2023, due to a combination of changes in DG rules and reduced attractiveness of financing on sales.

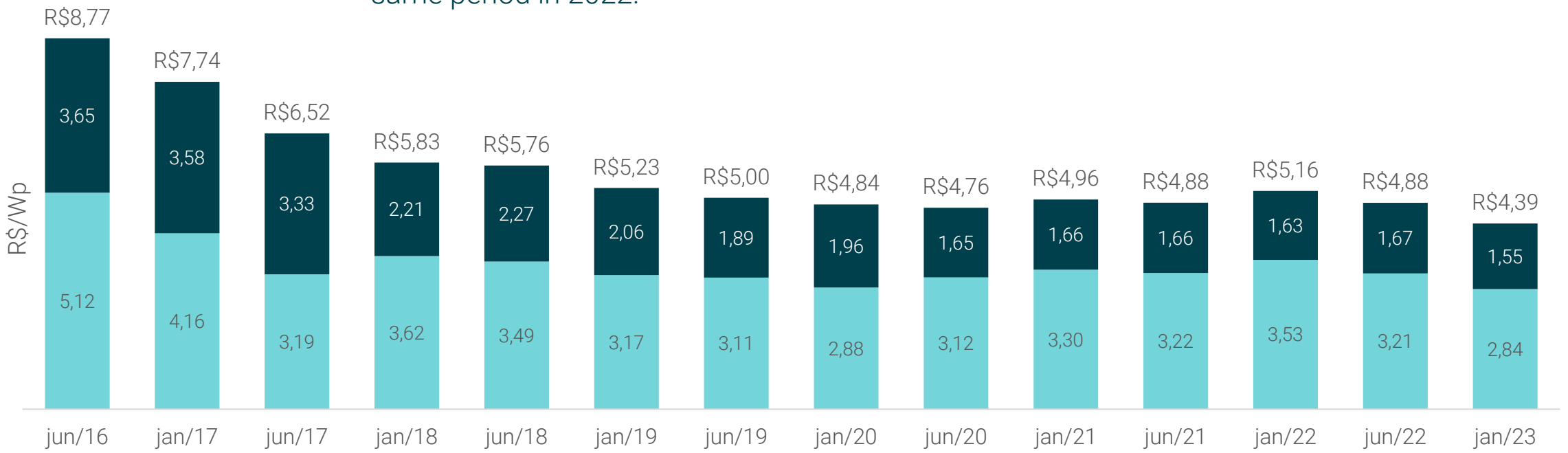
	2kWp	4kWp	8kWp	12kWp	30kWp	50kWp	75kWp	150kWp	300kWp	500kWp	1MWp	5MWp
jan/21	R$3,85	R$3,30	R$3,16	R$3,21	R$2,76	R$2,72	R$2,60	R$2,54	R$2,54	R$2,57	R$2,55	R$2,54
jun/21	R$3,60	R$3,22	R$3,12	R$2,94	R$2,77	R$2,66	R$2,69	R$2,67	R$2,65	R$2,70	R$2,67	R$2,73
jan/22	R$3,90	R$3,53	R$3,56	R$3,49	R$3,21	R$3,08	R$3,27	R$3,07	R$2,83	R$3,09	R$2,95	R$2,50
jun/22	R$3,55	R$3,21	R$3,03	R$2,96	R$2,80	R$2,84	R$2,78	R$2,54	R$2,58	R$2,56	R$2,56	R$2,55
jan/23	R$3,09	R$2,86	R$2,66	R$2,80	R$2,58	R$2,54	R$2,49	R$2,33	R$2,35	R$2,28	R$2,22	R$2,21

Source: Greener, 2023.

Price Evolution for PV Systems

Typical residential system (4 kWp) in Reais

- Residential PV systems have shown a **cumulative 50% reduction in price since 2016**.
- In **January 2023 there was a 15% drop** in prices for the final consumer, compared to the same period in 2022.

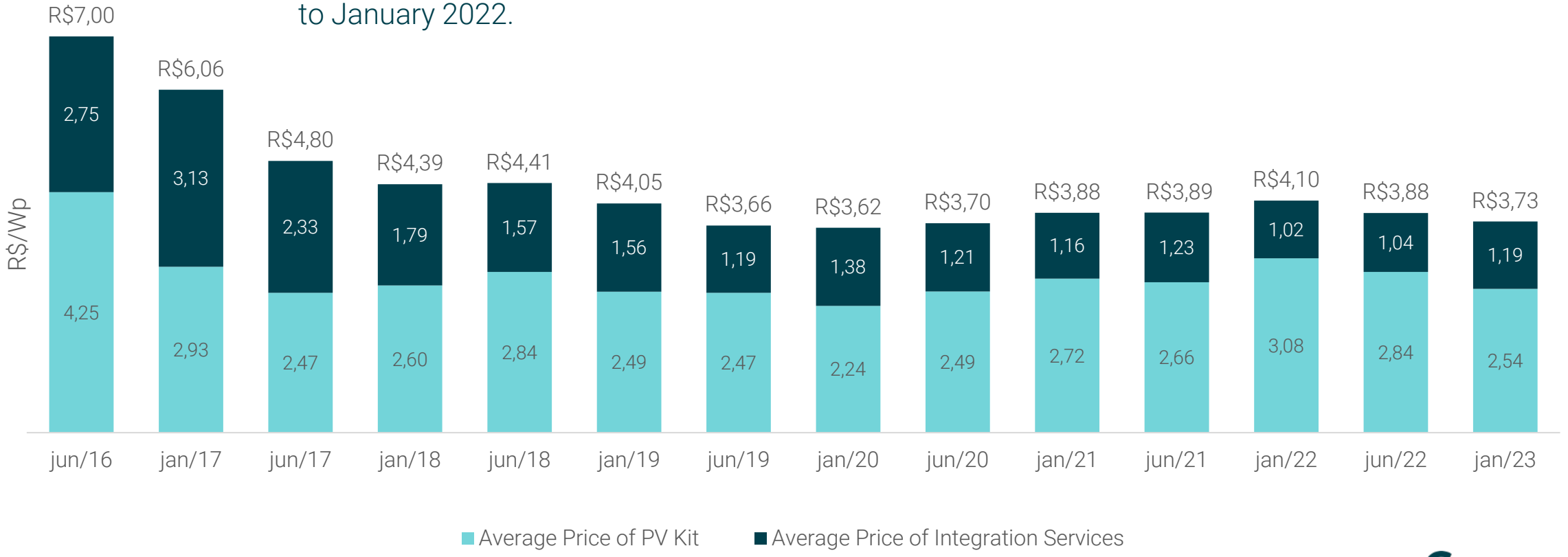


Source: Greener, 2023.

Price Evolution for PV Systems

Commercial System (50 kWp)

- The typical commercial PV system experienced **a cumulative 46% price reduction since 2016**.
- This includes a sharp 10% drop in the price of commercial PV systems in January 2023 compared to January 2022.



Source: Greener, 2022. Access here.

PV Systems Prices

Follow the Price Developments of PV Systems in your region and State.

- Evaluate the pricing trends for each part of different PV systems and obtain a reliable dataset on which to base the pricing of your PV Projects.
- Compare trends and take strategic decisions to boost your business based on data from more than 5000 companies.

Try it out now <<

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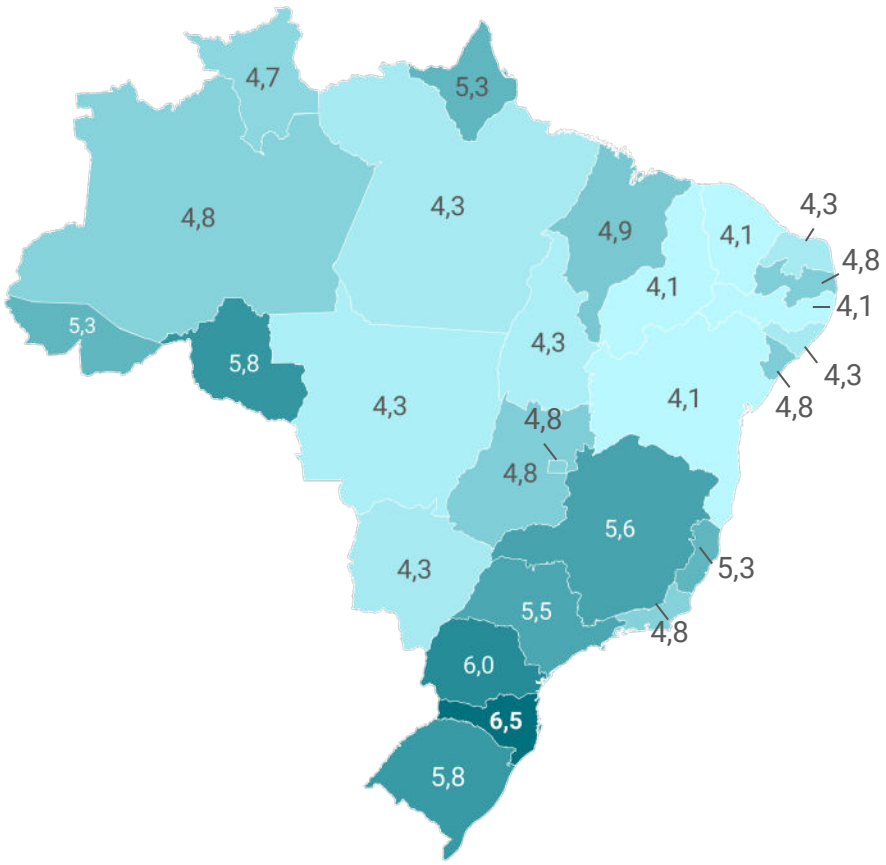
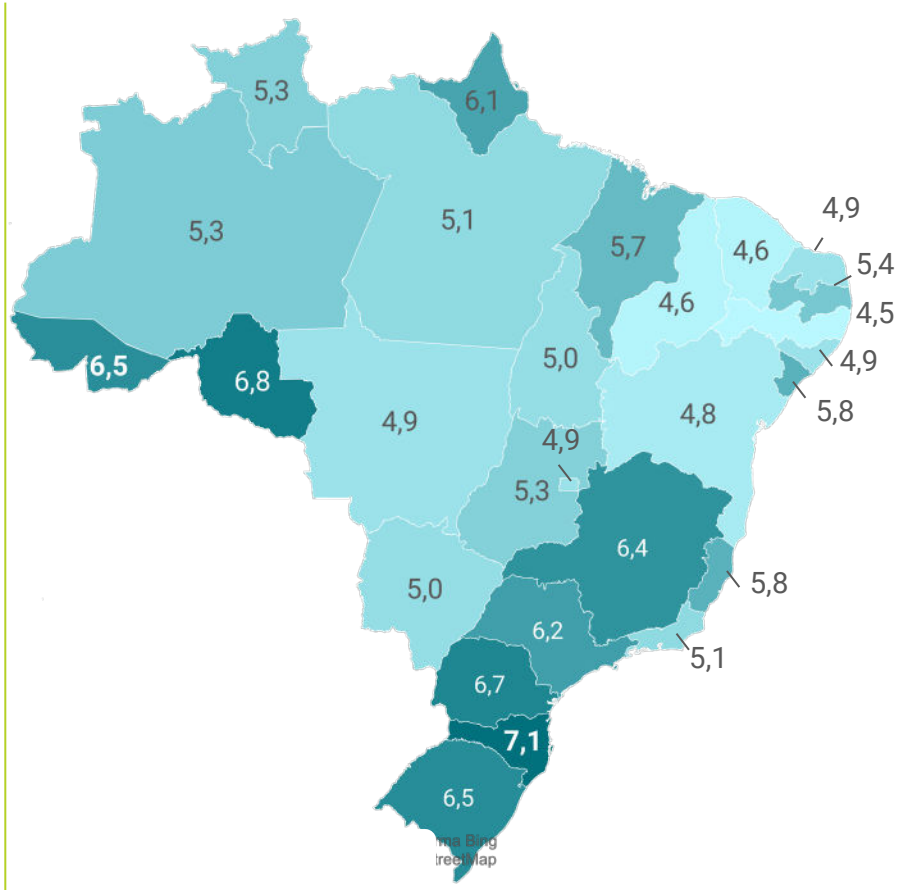
Average Payback Period per State (in years)

Residential System (4kWp) – Low Voltage



Legacy Rights
(Registered before 07/01/23) 4,1 6,5



Transition Rules
(Registered after 07/01/23) 4,5 7,1

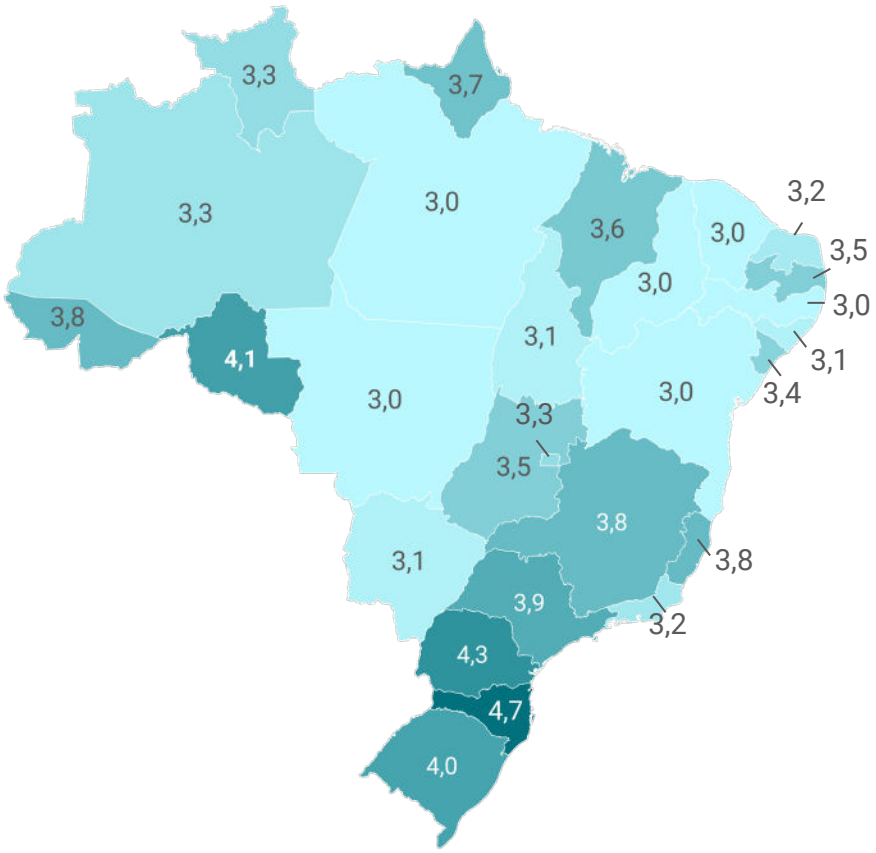
- The average **price of this size of commercial PV system was R$ 4.39/Wp.** The payback calculation takes into account the site productivity, the utility's energy tariff (including the availability cost), a PR of 75%, and a simultaneity factor of 30%.
- Because of the **low simultaneity factor**, one can see that the **payback period has increased by about 8 months**, on average.

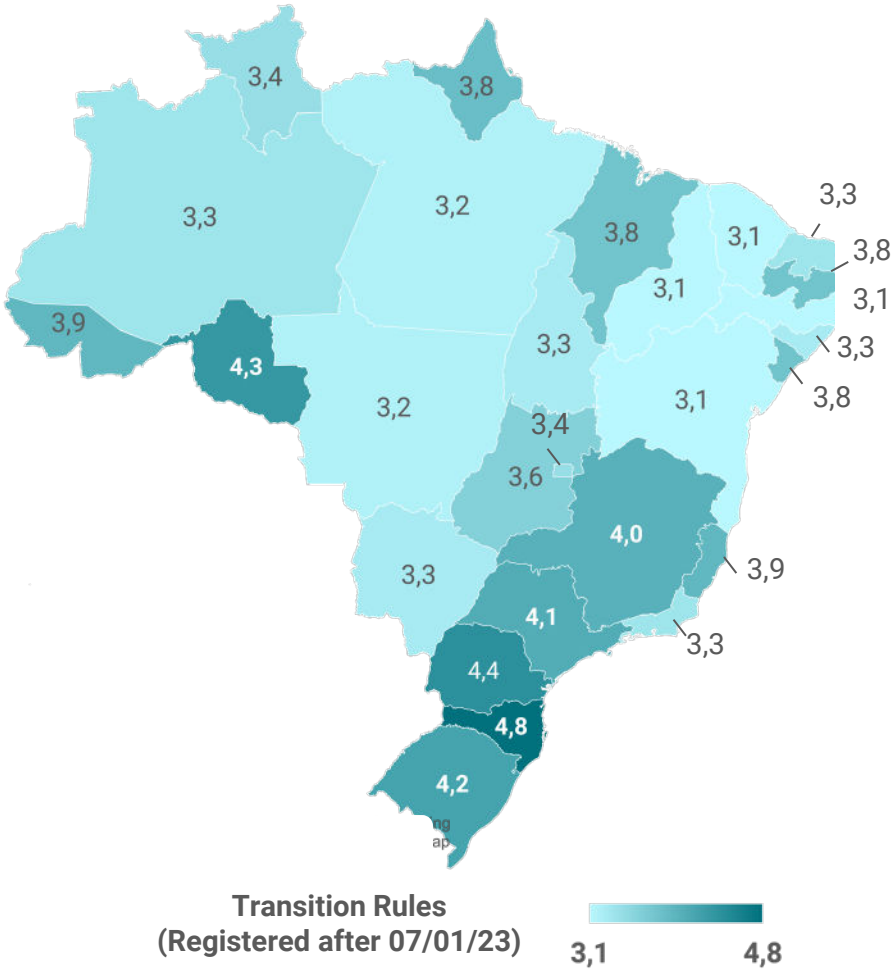
**PR = Performance Ratio*

Carry out your own Analyses using our DG Calculator from Greendex. Test it now <<

Average Payback Period per State (in years)

Commercial System (50kWp) – Low Voltage





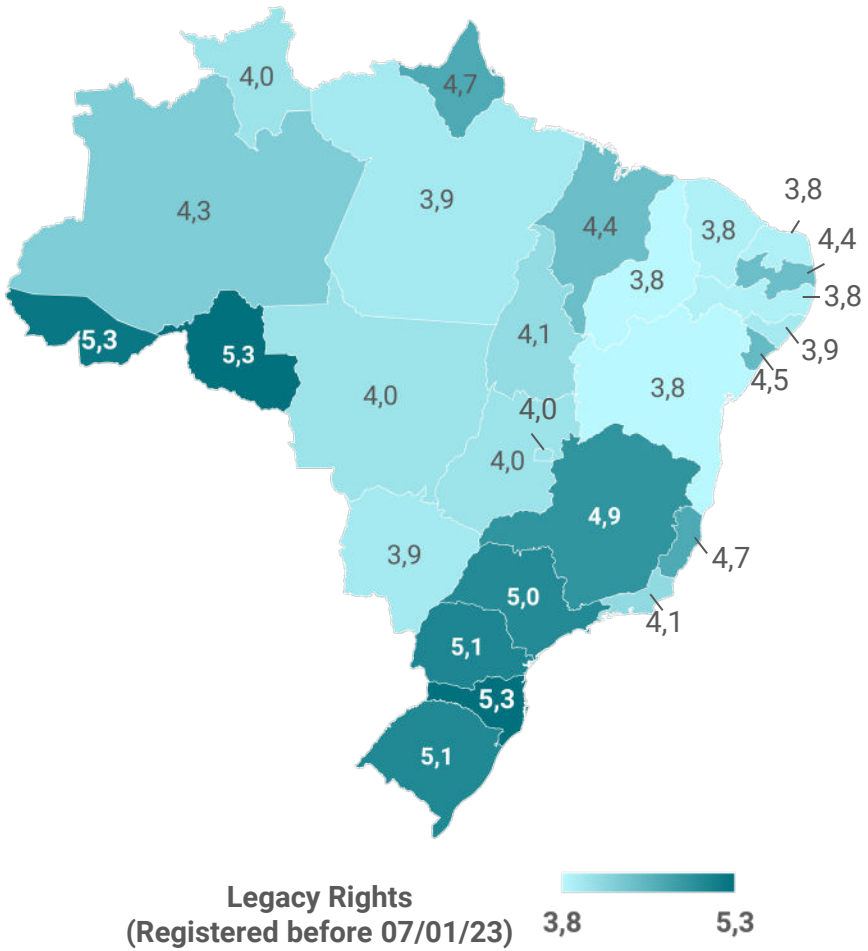
- The average price for this size of commercial PV system was **R$ 3.73/Wp**. The payback calculation takes into account the site productivity, the utility energy tariff (including the availability cost), a PR of 75%, and a simultaneity factor of 70%.
- Because of the **higher simultaneity factor**, one can see that the payback period suffers only a **marginal increase of 2 months**, on average.

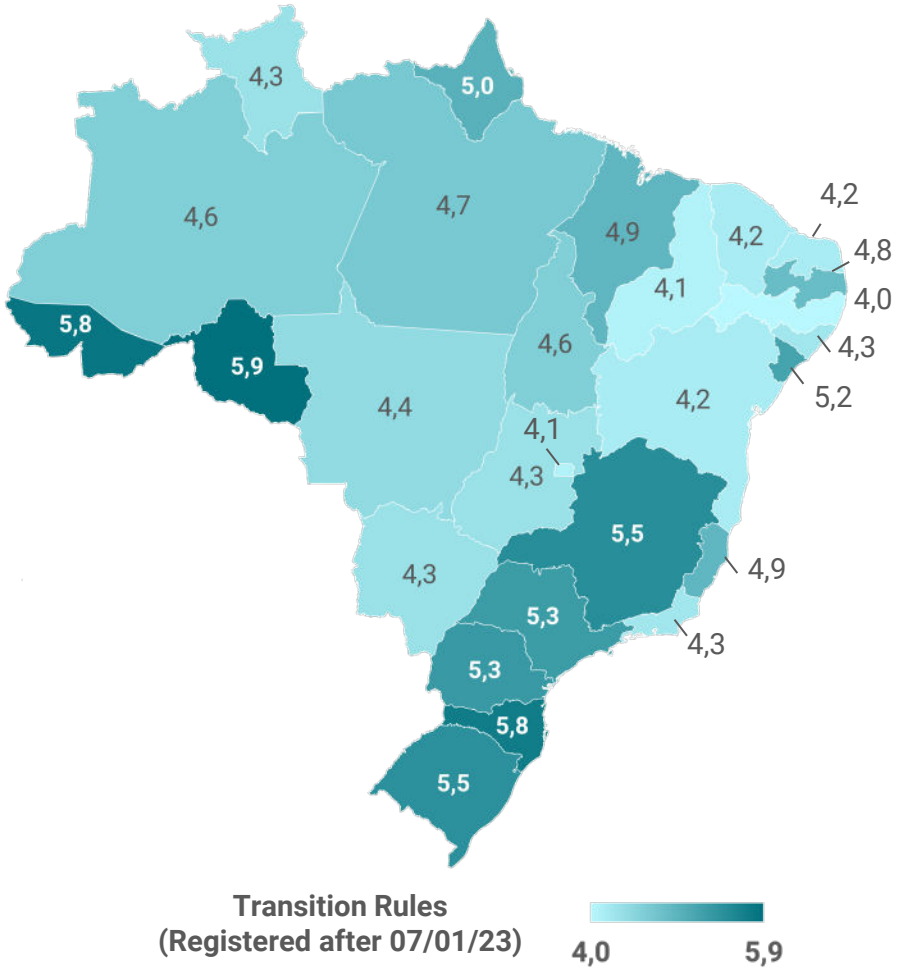
**PR = Performance Ratio*

Carry out your own Analyses using our DG Calculator from Greendex.. Test it now <<

Average Payback Period per State (in years)

Industrial System (300kWp) – Medium Voltage





- The average price paid for this type of industrial PV system was **R$ 3.47/Wp**. The payback calculation takes into account the site productivity, the utility's energy tariff (including the availability cost), a PR of 75%, and a simultaneity factor of 50%.
- Because of the middling simultaneity factor, one can see that the payback period experiences a moderate increase of 5 months, on average.

**PR = Performance Ratio*

Carry out your own Analyses using our DG Calculator from Greendex. Test it now <<

DG Calculator

Profitability Analysis of your PV Project

- Obtain a precise forecast of the profitability of your project, taking into account the current market conditions and future trends.
- Check out all the relevant indicators in a simple, dynamic and visual interface and carry out as many simulations as needed.

Try it out now <<

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CHAPTER 8

Regulatory Context

Context

- Normative Resolution No. 482 dated April 17, 2012 **(REN 482/2012) regulated the Electric Energy Compensation System (SCEE)** through MMDG.
- Between 2018 and 2019, through public consultations involving different segments of society, several debates took place on the proposal presented by ANEEL for the **revision of REN 482/2012**.
- As a result, it became clear that there was a need to assure the MMDG market that it would be constituted via Federal Law, i.e., by the creation of a **Legal Framework for MMDG in Brazil, through Bill 5.829/2019**.
- **In parallel**, ANEEL proceeded with its internal work for the **revision of REN 482/2012** and at the end of March 2021 it published a **draft of the new Normative Resolution** that would amend the current REN 482/2012.

National Congress:
Legal Framework for MMDG in Brazil
PL 5.829/2019

ANEEL:
Draft of the new Normative Resolution which adapts the current REN 482/2012

Context

- On **18/08/2021, PL 5.829/2019 advanced in the National Congress**, passing through the approval vote in the House of Representatives with 476 votes in favor and 3 votes against.

- **PL 5.829/2019** was approved by the **Federal Senate, on 16/12/2021**, with 15 amendments, 2 of which were accepted by the House, which approved the Final Report on the following day.

- On January 05, 2022, the President of the Republic sanctioned Bill 5.829/2019, which **establishes the Legal Framework for Distributed Microgeneration and Minigeneration through Law 14.300/2022.** The law was **created on January 06, 2022,** and published in the Official Gazette on January 07, 2022.

DIÁRIO OFICIAL DA UNIÃO

Publicado em: 07/01/2022 | Edição: 5 | Seção: 1 | Página: 4

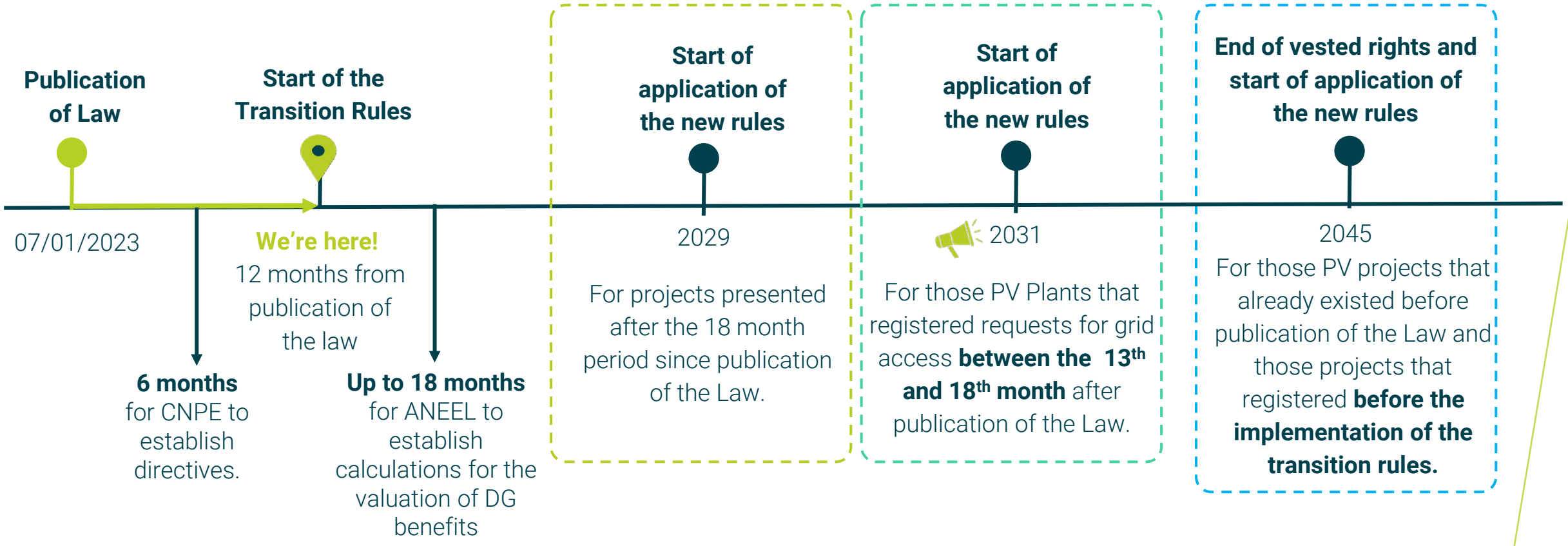
Órgão: Atos do Poder Legislativo

LEI Nº 14.300, DE 6 DE JANEIRO DE 2022

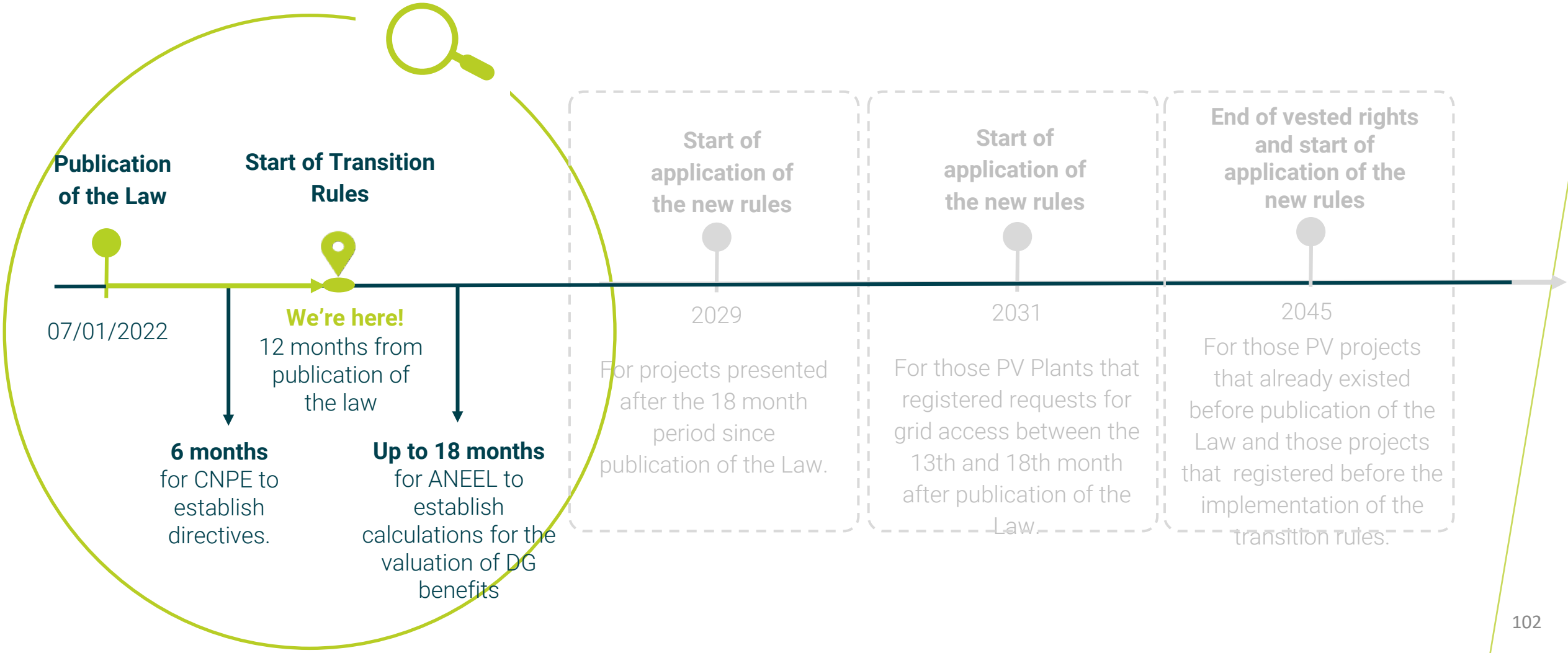
Institui o marco legal da microgeração e minigeração distribuída, o Sistema de Compensação de Energia Elétrica (SCEE) e o Programa de Energia Renovável Social (PERS); altera as Leis nºs 10.848, de 15 de março de 2004, e 9.427, de 26 de dezembro de 1996; e dá outras providências.

Application of the new Rules – Transition Timeline

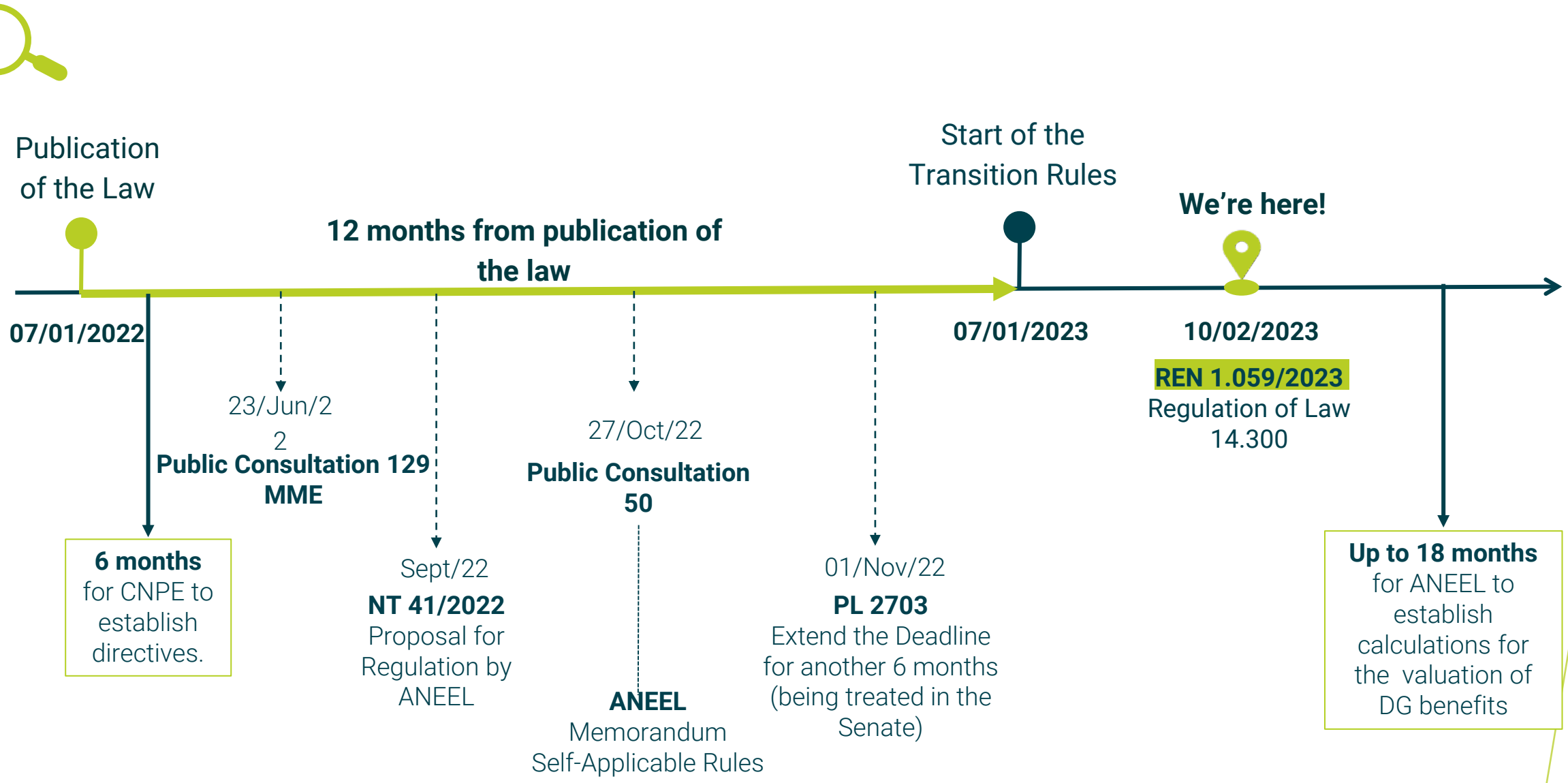
- From 2029 onwards, after the transition period ends, the new tariff rules will be defined according to a guideline by the CNPE and a valuation of DG benefits in accordance with ANEEL regulations.



Most Recent Regulatory Updates



Most Recent Regulatory Updates



Comparison of Law 14.300/2022 with REN 482/2012

Item	REN 482/2012	Law 14.300/2022
Installed Capacity	Distributed Micro-generation: less or equal to 75 kW Distributed Mini-generation: greater than 75 kW and less than or equal to 5 MW	Distributed Micro-generation: less or equal to 75 kW Distributed Mini-generation: greater than 75 kW and less than or equal to 5 MW for easily dispatchable energy sources* **and less than or equal to 3 MW for not easily dispatchable sources****

*** Easily dispatchable sources:** hydro-electric systems (including those run-of-river systems that have the ability for variable control over the amount of power generation); eligible co-generation; biomass; biogas; and solar PV systems with battery storage systems whose volumes of despatched energy for end customers can be modulated by at least 20% of the plant's total Monthly generating capacity through the use of the battery storage, with modulators that can be activated through a local or remote control system.

**** Non-dispatchable sources:** Solar PV without Battery storage, and Other sources not listed above. In Other words, for these Other energy sources, the new law suggests a reduced limit of 3 MW of installed capacity to qualify as a mini-Generation. For this reason, the rule change could provoke a reduction of the potential market and scaleability of Mini DG for these energy sources.

Comparação da Lei 14.300/2022 com a REN 482/2012

Item	REN 482/2012	Lei 14.300/2022
Basis for Compensation	Compensation/credits take into account all the components of the energy price*	• **DG II:** Compensation takes into account all the components of the energy price **except** the TUSD Line B (distribution charge) in a gradual manner, starting with 15% in the year 2023 and up to 90% in 2028. • **DG III:** In the remote self-consumption business model with a capacity exceeding 500 kW, or with shared generation**, compensation will take into account all electricity price components **except:** TUSD Line B, 40% of TUSD Line A, TFSEE (regulator's operational fee), and R&D.

*Here we are considering energy tariffs without tax, however, one should remember that taxes applied to electricity rates can result in differences in the rate of compensation.
**Shared Generation in which one single owner retains more than a 25% participation in the surplus of produced electrical energy.

Value of Compensated Energy

The new rule **reduces the value of the compensated electric energy.** On average, considering the 58 main electricity distributors and their tariffs for Group B – Conventional – under Law 14,300 the compensation suffers an **average gradual reduction of 31%** (if the applicable rule only affects TUSD Line B) or an average reduction of **36%** (if it affects TUSD Line B, 40% of TUSD Line A, and TUSD R&D and TE R&D), depending on the characteristics of the compensation category.

REN 482/2012

Inject 1kWh = 1 R$*

Compensation 1 R$

Lei 14.300/2022

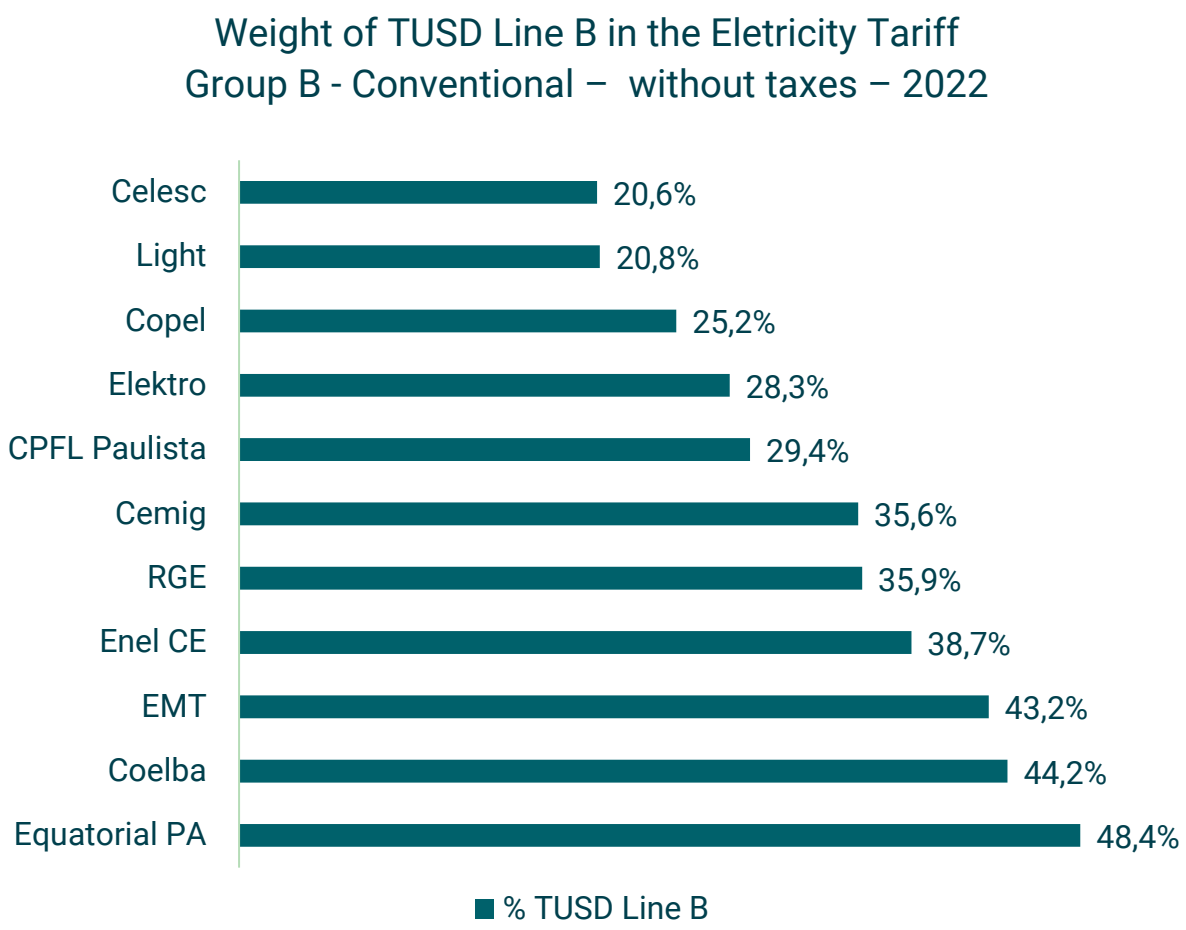
Inject 1kWh = 1 R$*

Compensation < 1 R$

Depends on the **compensation category and the weight of the TUSD Line B component** in the final energy price charged by the utility/concession holder.

*Values cited are ficticious and don't take into account taxes, merely for illustrative purposes.

Relative Weight of TUSD Line B in the electricity tariff



- For this study, the distributors with the highest installed Mini and Micro DG capacity sourced from solar PV were selected, covering all regions of the country.
- Given the high variability in the values of the tariff components in each region, it reinforces the need for case-by-case analysis, taking into account the consumer profile, compensation modality, installed capacity of the PV plant, taxes and tariffs of each concession area.

Understand the weight of TUSD Line B in your region's energy tariffs and make your own analyses considering the different scenarios.

Get to know the Greendex Tariff Map. Test it now <<

Energy Tariffs Updated in 2023.

Mapping of Tariffs

Follow the electricity pricing trends in all regions of Brazil

- Access precise and up-to-date information on all electricity tariffs applicable in Brazil, follow market trends and stay informed about changes in pricing due to the new laws.
- Understand the impacts of regulatory changes on the consumer prices of electricity.

Try it out now <<

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Availability Cost

It is a **minimum rate that remunerates the energy distribution concessionaires for the availability of the electric grid** to low voltage (LV) consumers, according to the type of connection of the Consumption Unit (single-phase, two-phase, and three-phase). Thus, the availability cost is the **value in the local currency equivalent to**:

30 kWh	50 kWh	100 kWh
Single-Phase	Two-Phase	Three-Phase

If a consumer, for example, has not consumed energy in a given month, or has consumed an amount of energy below the availability cost benchmark, he must pay this minimum amount for his electricity bill to the utility.

(REN 1000/2021, article 291)

Comparison between Law 14.300/2022 and REN 482/2012

Item	REN 482/2012	Lei 14.300/2022
Availability Cost	For consumers in Group B, the cost of availability represents the minimum that each consumer must pay for their energy bill, with the following reference values: Single phase connection: 30 kWh Two-phase connection: 50 kWh Three-phase connection: 100 kWh	The cost of availability will continue with the minimum reference values for 30, 50, or 100 kWh, with the following rules of implementation: For projects with previously acquired (vested) rights (DG I): • If the measured consumption **is higher than the reference value,** compensation will occur only up to the reference value and the reference value is charged on the bill. • If the measured consumption **is lower than the reference value,** the consumer will pay the cost of availability. For projects in the transition period:(DG II): • If the compensation for Line B **is higher than the reference value,** the value referring to Line B is paid. • If the compensation for Line B **is lower than the reference value,** the reference value is paid. **Exception:** the minimum billable value that will be applied to microgenerators with na installed capacity of up to 1.2 kW with compensation due at the same location as electricity generation will receive a reduction of up to 50% compared to the minimum billable value that will be applied to other equivalent energy consumers.

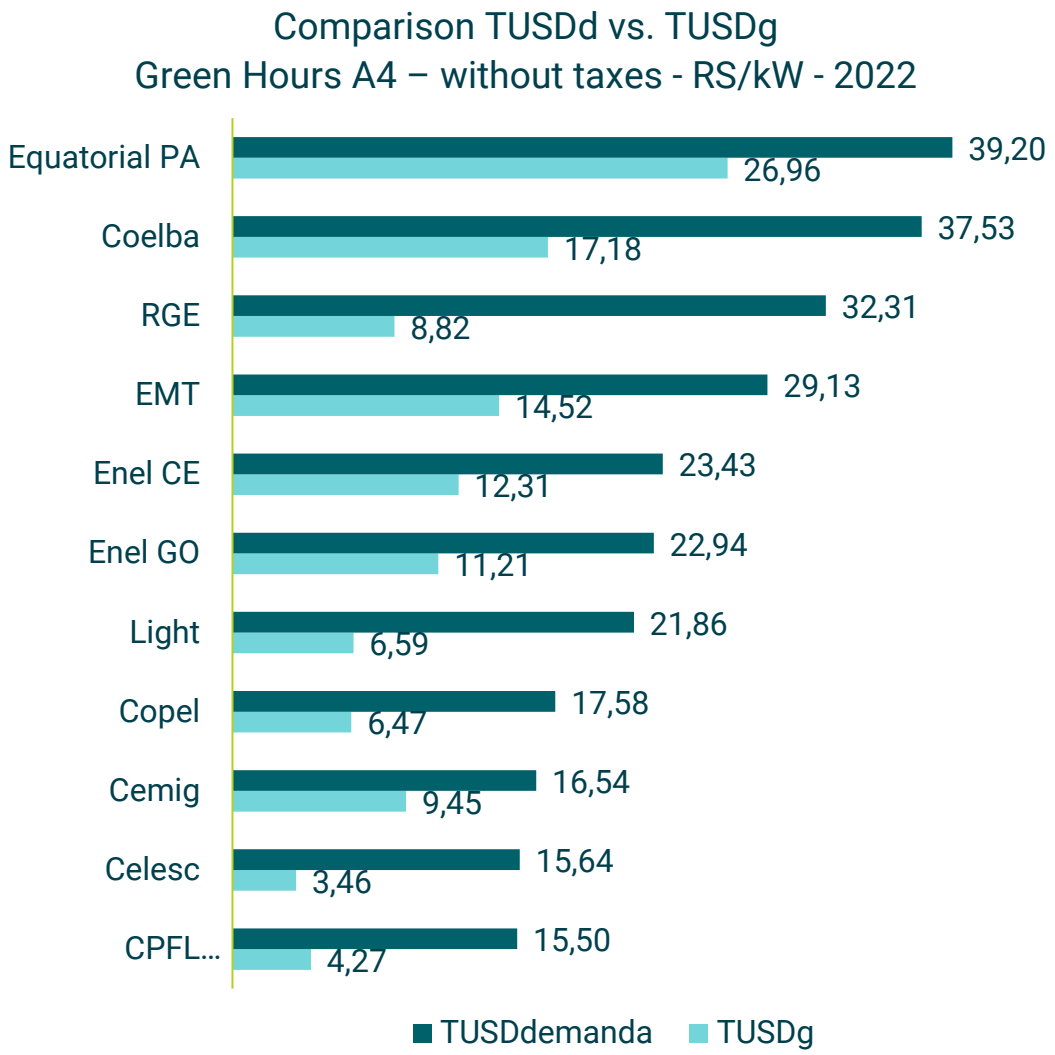
* Metered consumption is the total consumption at the meter at the end of the month before any compensation is applied to the electricity bill.

Comparison between Law 14.300/2022 and REN 482/2012

Item	REN 482/2012	Law 14.300/2022
Contracted Demand	For Consumers in Group A with Mini DG, the reference tariff that is applied for billing the contracted demand is **TUSDdemand** (TUSDd): Contracted Demand (kW) x **TUSDd* (R$/kW)** *TUSDdemand (TUSDd): Tariff for Use of the Distribution System applied to Contracted Demand	For remote generation DG solar PV plants belonging to Group A, the reference tariff for billing of the contracted demand (MUSD**) **will become known as TUSDgeneration (TUSDg):** Demanda contratada (kW) x **TUSDg (R$/kW)** For micro and mini DG plants belonging to **Group B,** where there is no contracted demand, **TUSDg will be applied to the excess portion of injected energy**. That is, when the difference between the electric energy injected and the energy consumed by the Consumption Unit is positive*. Injection - Consumption (kW) x **TUSDg (R$/kW)**

ATTENTION: The charge **can only be levied** on Consumption Units in which the metering system is capable of determining the required and injection demands. That is, it can **only be charged if the meter installed in the CU has the capacity to measure the demands** in kW of consumption and injection.

How big is the difference between TUSDdemand and TUSDg?



- The difference between TUSDd and TUSDg can mean a reduction of up to 78%, depending on the local energy utility:

Utility/Concession Holder	Reduction
Equatorial PA	31%
Cemig (MG)	43%
Enel CE	47%
Energisa MT	50%
Coelba (BA)	54%
Copel (PR)	63%
Enel GO	51%
RGE (RS)	73%
CPFL Paulista (SP)	72%
Celesc (SC)	78%
Light (RJ)	70%

- For this analysis, we selected the energy distributors with the highest installed MMDG capacity sourced from PV plants, covering all regions of the country.

Comparison between Law 14.300/2022 and REN 482/2012

Item	REN 482/2012	Lei 14.300/2022
Guarantee of Faithful Completion	N/A	**Requirement** for a Guarantee of Faithful Completion for distributed Minigeneration for projects **above 500 kW:** ▸ 2.5% of total investment for PV power plants with an installed capacity between 500 kW and 1,000 kW; ▸ 5% of total investment for PV power plants with an installed capacity larger than or equal to 1,000 kW; **Projects that are exempted** from this obligation: shared micro- or mini-generation projects through a consortium or cooperative that employ the "energy use in multiple consumption locations" business model. The Law provides a framework and guidance for executing this guarantee*.
Permission Holders	N/A	The credits created through surplus volumes of energy generated at PV plants belonging to customers that are served by Permission Holders **can be allocated to their respective Distribution Concessionaires** in the same area where the Permission Holder is located..

* The consumer may opt, exclusively, for one of the following options for the execution of the guarantee: cash deposit; public debt securities issued in book-entry form, through registration in a centralized system of settlement and with custody authorized by the Central Bank, or a bank guarantee issued by a bank or financial institution duly authorized to operate in the country, in which case the energy distributor must indicate at least four banks or financial institutions among which the minigenerator is allowed to choose.

Comparison between Law 14.300/2022 and REN 482/2012

Item	REN 482/2012	Lei 14.300/2022
Grid Access Request and title transfer	The title transfer of a Grid Access Request was permitted.	Transfer of ownership of the Grid Access Request or change in corporate control is allowed **after the request for inspection** of the connection point has been sent.
Opt-in for Billing as a Category B Customer	N/A	Consumption Units with **local generation** of up to 112,5 kVA may opt to be billed in the same way as consumption units under low voltage (Group B).  Doesn't include consumption units with remote generation.
Procurement of Ancillary Services	N/A	The concessionaire or permission holder for electrical energy distribution **will be allowed to contract ancillary services** (through a public notice) **for distributed micro- and minigeneration**, whether using despatchable power sources or not, to benefit their networks or distribution microgrids, by compensating such services in accordance with the ANEEL regulations. The more specific criteria and requirements for the procurement of these services were not defined yet, but will be regulated by ANEEL.

Comparison between Law 14.300/2022 and REN 482/2012

Item	REN 482/2012	Lei 14.300/2022
Floating Solar Plants*	Floating solar plants allowed with a limit of 5 MW per municipality and reservoir	More than one floating solar PV plant allowed under Distributed Generation up to 5 MWp capacity in the same municipality/reservoir.
MMDG Projects as Infrastructure*	N/A	MMDG projects will be considered electricity generation infrastructure projects, and may be eligible for: the Special Regime of Incentives for Infrastructure Development (REIDI); investments through an Infrastructure Investment Fund (FIP-IE); and debentures incentivized through a special purpose vehicle (SPV), real estate receivables certificates (CRI), and quotas from the issue of a creditor rights investment fund (FIDC).

The articles that deal with these 2 topics had been struck down by presidential vetos, however the National Congress defeated both vetos through an agreement among Congressional leaders, thus reinserting both articles into the Law 14.300.

Transition Rule for the Legal Framework

- The rules for transition to the new legal regime will depend on **two principal factors**:

DATE OF THE ACCESS REQUEST

Those who files access request **BEFORE** the start date →	Remains in current rule **until 2045 (acquired rights)**
Those who files access request **AFTER** the start date →	Will enter the **transition rule**

When is the start date of the rule in the Law?

Publication date of the Law → **Rule start date**

+ 12 months

COMPENSATION MODALITY

• Generation Next to Load • Shared Generation • EMUC • Remote self-consumption limited to 500kW of installed power →	**Enters the transition rule:** gradual payment up to 100% TUSD Wire B
• Shared generation* • Remote self-consumption **above** 500kW of installed power →	**Enters the transition rule:** payment 100% TUSD Wire B; 40% of TUSD Wire A; 100% TFSEE and R&D

*Shared generation in which a single holder holds more than 25% of interest.

Transition Regime: gradually increasing payment of TUSD Line B

- The consumer who requests grid access after the entry into force of the new law and who fits into the compensation categories listed on the right, enters into the transition rule, which means:

  - The new rule regarding Availability Cost applies.
  - The new rule for billing the Contracted Demand of the PV plant applies, meaning TUSDg will be applicable from the date of tariff adjustment of the energy distributor.
  - Compensation: **partial and gradually increasing payment of the TUSD Line B component** of the energy price during a period of **6 years** until **90% of full payment is reached,** in accordance with the schedule below.

- Generation close to loads
- Shared Generation
- Multiple Consumption Locations
- Remote Self-consumption **limited to up to** 500 kW of installed capacity

2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
15%	**30%**	**45%**	**60%**	**75%**	**90%**	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%

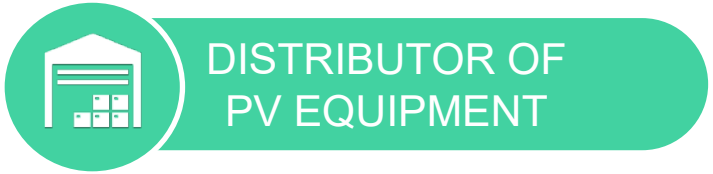
Transition Period: gradual increase in percentage due of tariff components related to TUSD Line B.

The compensation rules as of 2029 will depend on a study to be carried out by Aneel, and will not necessarily stick to the 100% charge for Line B.

What reflections do the rule changes have for the DG market?

How do I explain to clients what is happening? How will the viability of my projects be impacted? How do I prepare for the rule change?

Is it worth investing in Solar DG right now? What changes might occur in terms of my ***payback period***?



How will the **demand for DG solar equipment** behave in the short, medium and long term ? Under the new rules, what **importance does equipment cost have** for the viability and profits of a project?

Will my product or my **technology** become **more or less competitive** under the new rules? Which **opportunities** do I see to differentiate the company and product in the new scenario?

Is my **Return on Investment** from current projects still **guaranteed**? Which kinds of PV projects will be **more or less financially attractive?**

CHAPTER 9

Conclusions

Insights and conclusions

1. The **prices** for PV systems **showed an average decrease of 12%** in 2022. The increased global production capacity of polysilicon which helped to supply the growing demand for modules, as well as the sharp drop in international freight prices, directly affected the cost of PV modules in 2022. Furthermore, the high stock levels among equipment wholesalers also contributed to a price drop for end consumers.

2. On the other hand, the **high-interest rates** during the year 2022 caused a **sharp decline in the use of bank financing** for sales of PV systems. Given this scenario, PV Integrators sought to use payment terms to their advantage by giving larger discounts for up-front payments or by increasing the number of payment installments.

3. There was an **acceleration in the volume of PV projects under development in 2022** despite the higher cost of capital, with the main driving factor being the change in the compensation criteria (payment for TUSD Line B) for those projects that request grid connections from 2023 onwards.

Insights and conclusions

4. Along with higher interest rates, integrators pointed to the high level of competition in the market as one of the main challenges in 2022. The solar integration market nowadays comprises an estimated **31,510 active integrators**, a rise of around 10,300 in just the past 12 months.

5. Even though the **start of the transition rule** sets out a gradual increase in payment of TUSD Line B, compensating grid operators, in general, PV systems continue to be attractive for the end consumer given the **low impact on the return on investment** for systems that use **on-site/local generation**, which represent 81% of currently installed capacity. For remote generation projects the negative impact on financial attractiveness is larger.

6. The **residential customer group** continues to be the highlight in the fast development of DG, representing **56% of the volume added in 2022**, whereas the commercial segment was responsible for 22% of the additional volume.

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The A.Dias Solar company is part of the A.Dias Air Conditioning Group, with more than 50 years of existence celebrating its leadership in the sector of air conditioning distribution in Brazil, and recently positioning itself as a distributor of solar energy. We have a team specialized in sales and training, besides offering the main brands to the Brazilian market and always searching for the most modern and appropriate products.

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Foco Energia is a distributor of photovoltaic components for all of Brazil with more than 5 years of activity in the market. It is located in the city of Maravilha/SC and works with national and imported products, which meet the strict standards and requirements of the energy utilities in general.

contato@focoenergia.ind.br

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Distributors

Fotus, one of the largest importers and distributors of photovoltaic equipment in Brazil, is located near the coast of Espírito Santo, close to the BR's 101 and 262, serving small to large projects throughout the country. With a logistics infrastructure of more than 40,000m² and a bold pricing strategy, Fotus has a business model that makes solar energy more accessible and contributes to a more sustainable world.

contato@fotus.com.br

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Founded in 2018, in southern Brazil, our purpose is to bring clean energy to everyone. We bring new ways of doing business and thinking, so that everyone gains their autonomy. Thus, we help create a future in which everyone can generate their own energy. To this end, we work with photovoltaic energy solutions for homes, commercial establishments, industries, and also for agribusiness.

marketing@nexen.com.br

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Distributors

PHB Solar is on a trajectory of innovation, credibility and respect. Since 1984, the year the company was founded, a search for innovation and quality, with seriousness and development of Brazilian technology, which have been remarkable and important factors in the trajectory of PHB Solar. Always in front, PHB is a 100% national industry with a pioneering attitude and technological competence, developing solutions for Distributed Generation as a whole.

contato@phb.com.br

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With 15 years of history, Serrana Solar is positioned among the largest distributors of complete Photovoltaic Kits in Brazil. With On and Off Grid Kits, Micro Inverters, Solar Pump drives and wallbox Vehicle Chargers, it offers high power generation products along with exclusive commercial advantages. In constant development, it follows Quality processes and is certified ISO 9001 since 2014.

serrana@serranaenergia.com.br

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Distributors

Sou Energy is among the six largest distributors of photovoltaic equipment in the country and is the largest in the North/Northeast, with more than 6,500 active resellers throughout Brazil.

sol@souenergy.com.br.

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Founded in 2003, with 100% national capital, WDC NETWORKS has become a leader in the technology market, structuring a network of sales channels throughout Brazil. With 20 years of experience and professionalism, WDC brought its distribution expertise to the solar energy market, becoming one of the largest and most solid companies in the segment.

contato@wdcnet.com.br

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Distributors

Founded in 1961, WEG is a global company of electro-electronic equipment, operating mainly in the capital goods sector with solutions in electrical machinery, automation and paints, for various sectors. WEG stands out in innovation through its constant development of solutions to meet the major trends in energy efficiency, renewable energy and electric mobility.

automacao@weg.net

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Sponsors

PV MODULES

PV Modules

DAH Solar innovates every day, with 4 state-of-the-art factories, our products are sold to more than 100 countries and regions worldwide. Achieving an annual output of 1.5 GW of solar cell capacity and 2 GW of photovoltaic modules. To achieve our goal, we invest more than 60 million RMB per year in research and development. Meet DAH Solar and change your world!

dcp.garcez@dh-solar.cn

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Intelbras is a Brazilian publicly traded company (INTB3) with 46 years of history, it is a reference throughout Brazil in the segments of security, communication, energy, and solar energy. Intelbras acts with the purpose of making technology accessible to improve and simplify people's lives. It is recognized as a highly renowned brand by INPI and its portfolio includes high-tech solutions and artificial intelligence that allow a wide range of applications.

grupo.negocios_ongrid@intelbras.com.br

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PV Modules

JA Solar is one of the leading and largest photovoltaic module manufacturers in the world. It has over 1100 patents in the cell and module segment, highly verticalized production (manufacturing wafers, cells and modules), production capacity of 75 GW/year (by the end of 2023) and over 120 GW shipped to date.

fernando.castro@jasolar.com

Access Site >>

Since 2005 RESUN is specialized in manufacturing solar modules, counting on almost 20 years of market experience. RESUN SOLAR is able to produce panels from 5W to 705W using state of the art technology in markets such as Mono Perc, Topcon, Monofacial and Bifacial. We have a manufacturing capacity of 5GW with which we strongly serve the European, African, Australian, Asian and Latin American markets. Today RESUN SOLAR is differentiated in the market with its sell out policy, where its customers have advantages in working with Resun and building a long lasting partnership.

info@resunsolar.com

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PV Modules

SUNOVA SOLAR
Leading one-stop PV Supplier

Founded in 2016, Sunova Solar is a multinational integrated systems solutions provider focused on R&D and manufacturing of globally distributed solar products and the development of photovoltaic power plants.

info@sunova-solar.com

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Trinasolar

Trina was one of the pioneers in manufacturing photovoltaic modules, with more than 25 years of experience and more than 100GW sold worldwide, we have more than 2,000 patents on products. We offer solutions for all markets.

daniel.pansarella@trinasolar.com

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Sponsors

INVERTERS

PV Inverters

The #1 three-phase inverter in the US for the last seven years in a row has now arrived in Brazil. CHINT is a world leader in low voltage products, with 11 GW of power plants and over 20% of the residential market in China.

contato.cps@chint.com

Access Site >>

Deye specializes in solar inverters and arrived in Brazil in 2017. Headquartered in Mogi das Cruzes, it has a highly skilled team of over 50 employees. The technical support team is a reference in the market and offers personalized service. By 2022, Deye had established over 48 partnerships and was third in overall rank, as the only manufacturer in the world to offer complete solutions in 3 lines of inverters: string, micro and hybrid.

comercial@deyeinversores.com.br

Access Site >>

PV Inverters

FoxESS is a global leader in the development of inverters and energy storage solutions. Designed by some of the world's leading experts in batteries and inverters, our products are innovative, offering our customers the most advanced features available today and unmatched performance and reliability.

giulia.di.sipio@fox-ess.com

Access Site >>

As a leading global provider of distributed energy solutions, Growatt offers an extensive portfolio of products and solutions, including photovoltaic inverters, energy storage systems, electric vehicle chargers, and intelligent energy management solutions.

info@ginverter.com

Access Site >>

PV Inverters

Huawei Digital Power is a leading global provider of digital power products and solutions. We are committed to developing integrated power electronics technologies, developing clean energy, and the digitalization of energy to drive the energy revolution for a better, greener future. With 6,000 employees, Huawei Digital Power serves one-third of the world's population in over 170 countries.

michele.elkabets@huawei.com

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Hello, and welcome to HYPONTECH. We are committed to creating a smart, sustainable future for humanity so that we can have a better future. We are energizing the future, for everyone, everywhere in the world. HYPONTECH is moving the world forward with an efficient portfolio of photovoltaic string inverters and storage inverters and intelligent energy management solutions.

info@hypontech.com

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PV Inverters

KSTAR

Founded in 1993, KSTAR is a leading brand in power electronics and new energy products, UPS, data center, PV (String and Central Inverters), ESS and Vehicle Chargers. According to the latest IHS report, Kstar ranked 5th in the global UPS market and among the top 10 in inverters. KSTAR has more than 3,000 employees (over 600 R&D engineers), 18 overseas branches, serving more than 100 countries worldwide.

thomas@kstar.com

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SAJ

With 18 years of dedication and professionalism, SAJ has established itself as a pioneer in the renewable energy industry. Committed to providing reliable products and services in the smart home and commercial power sectors, portable power plants and industrial automation sectors. SAJ has obtained more than 250 patents. Its products are welcomed in more than 80 countries and regions with professional marketing teams supporting them.

brasil@saj-electric.com

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PV Inverters

SOFAR is a global leader in photovoltaic and storage solutions, with a comprehensive portfolio of photovoltaic inverters up to 255 kW, hybrids from 3 kW to 20 kW, and storage. Present in Brazil since 2017, SOFAR already has more than 3GW commercialized in the country, reaching 3rd place in Greener's Ranking in single-phase inverters. In 2023 SOFAR opens its office in Brazil, with technical support, sales and marketing teams.

service.br@sofarsolar.com

Access Site >>

SolaX Power was established in 2012 and quickly developed its products, which include on-grid PV inverters, hybrid inverters, storage batteries, management systems for PV energy storage and more. SolaX offers the world's most diverse product line and has the broadest application coverage, securing the company's position as a global leader in the field of intelligent photovoltaic energy storage systems.

contato@solaxpower.com

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PV Inverters

Founded in 2005, Solis (Stock code: 300763.SZ) is one of the largest and oldest manufacturers of solar inverters. Our proven bankability has attracted the support of the world's leading financial institutions, ensuring solid long-term investment returns as we work with our stakeholders to accelerate the world's journey towards a more sustainable future.

sales@ginlong.com

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Sponsors

STRUCTURES

Mounting Structures

Founded in Brazil in 1975 in the city of Criciúma, Santa Catarina, by the engineer Ayrton Egídio de Mattos Brandão, Brametal was initially created to serve the civil construction market. Currently the company is considered the largest factory in the Americas for the manufacture of metal structures for power generation and transmission of electricity and telecommunications, with an industrial capacity of 200,000 tons/year.

contato@brametal.com.br

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Romagnole Produtos Elétricos S.A. is one of the largest manufacturers of electrical products in Brazil. Operating in this market since 1962, the company offers a wide range of distribution, industrial and power transformers, input, measurement, transformation, sectioning and protection boxes, electro-technical hardware, structures for solar power plants, Smart Grid, street lighting poles and other concrete artifacts used in electrical networks.

marketing@romagnole.com.br

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Mounting Structures

Solar Group is the leading brand for roof mounting structures in the photovoltaic industry. To offer the highest quality, our products are made from 6063-T5 aluminum and stainless steel. Our products are developed specifically for the characteristics of Brazilian roofs and slabs and undergo rigorous testing to ensure quality and safety for our customers.

contato@solargroup.com.br

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Sponsors

CABLES & BATTERIES

Cables and Batteries

CLAMPER - a 100% Brazilian company, innovative, specialized in solutions for equipment and systems protection against lightning and electrical surges. Its focus is directed to the research, development, and manufacturing of Surge Protection Devices, and it has become a national leader in the segment, with more than 40 million devices sold in over 22 countries.

fotovoltaico@clamper.com.br

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Sunwoda Energy Technology Co., Ltd. is a high-tech enterprise and world leader, subsidiary of Sunwoda Group (SZ300207). With the integration and applied technology of lithium batteries for energy storage, Sunwoda Energy is dedicated to storage, network energy and smart energy solutions for residential, commercial and industrial purposes.

info@sunwoda.com

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Sponsors

SERVICES

Services

Intersolar South America - Latin America's largest solar power exhibition - will be held at São Paulo's Expo Center Norte from August 29 to 31, 2023, focusing on photovoltaics, PV production and thermosolar technologies. Simultaneously, at the Intersolar South America congress, renowned experts will shed light on current industry issues.

info@intersolar.net.br

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Greener

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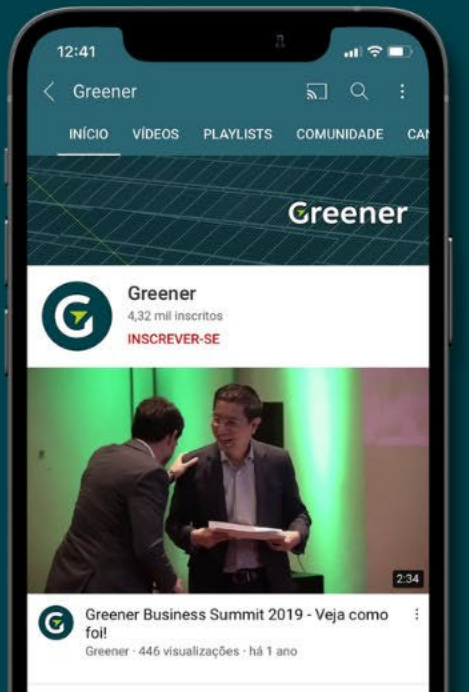

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