STRATEGIC MARKET RESEARCH 2024

Referring to the year 2023

DISTRIBUTED GENERATION

Photovoltaic Solar Power Market

March 2024

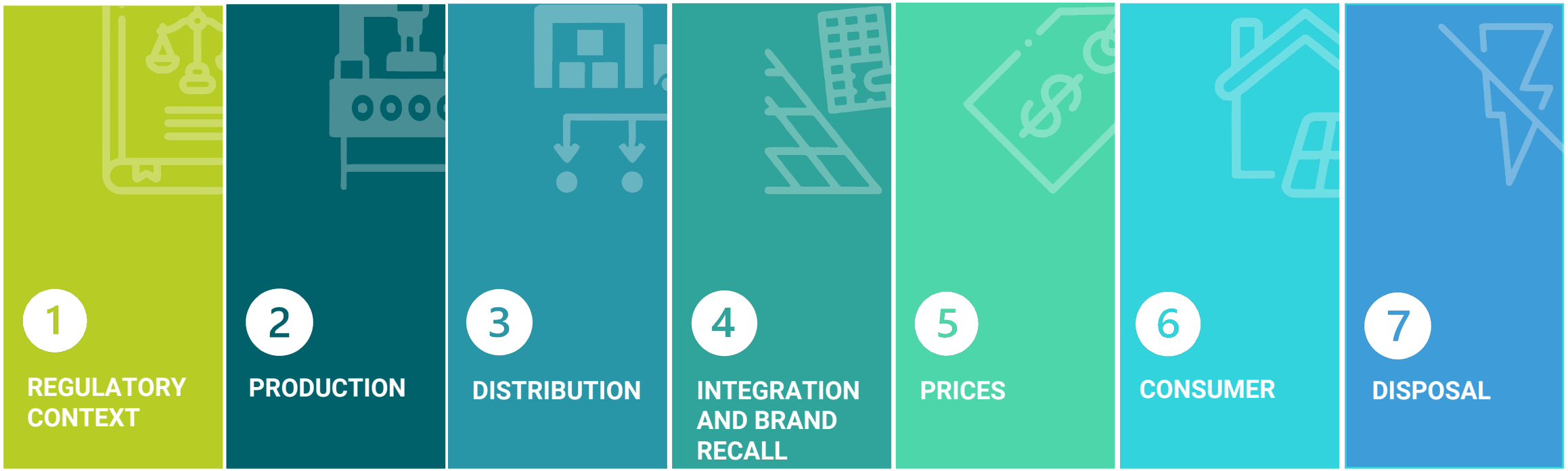
Greener

Highlights of the Report

1. **Brazil demanded 17.5 GWp of PV modules in 2023,** a slight reduction of 1.7% compared to 2022. **Centralized generation and large DG offset** the drop in demand for retail DG (small/residential installations).
2. **Residential customers showed a drop in additional capacity of 20% in 2023** compared to 2022. On the other hand, **commercial customers showed faster growth,** driven especially by the advancement of mini generation projects.
3. **Financing (through loans/banks) recovered in 2023**, supporting **53%** of sales and suggesting a more favourable credit environment for the second half of the year, possibly driven by the reduction in interest rates that started in August 2023.
4. **Prices of PV systems** for **residential and small commercial customers** showed a drop of **30%** in January 2024 compared to January 2023. A sharp reduction in PV module costs was the main factor contributing to this variation.
5. **Return on investment** on PV systems **showed an improvement,** with a 25% **reduction in *payback times*** for local residential installations compared to January 2023, driven by the general decrease in the price of PV systems.

THE RESEARCH

Topics



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DG MARKET ANALYSIS

Launch of the **2024 Distributed Generation** Strategic Study

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Marcio Takata

CEO Greener

Luiza Bertazzoli

Head of Market Intelligence

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Presentation:

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01.
REGULATORY CONTEXT

APPLICATION OF THE NEW LAW'S RULES

- **After the transition period, starting in 2029, the new tariff rules will be introduced** according to guidelines that will be previously established by the CNPE and the valuation of the costs and benefits of Distributed Generation in accordance with ANEEL regulations.

2022

07/01/2022
Publication of the Law 14.300/2022

6 months (07/07/2022) for the CNPE to establish guidelines*.

2023

07/01/2023
Start of Transition Rule, valid until 2028/2030

Up to 18 months (07/07/2023) for ANEEL to publish its calculations regarding valuation of DG costs and benefíts*.

2029

Start of application of the new rules for projects that registered a connection permit request after the 18th month since the publication of the Law.

2031

Start of application of the new rules for projects that registered a connection permit request **between the 13th and the 18th month** since the publication of the Law.

2045

End of legacy rights and start of application of the new rules for all projects that already existed before the publication of the Law and for those that filed connection requests before the start of the Transition Rules.

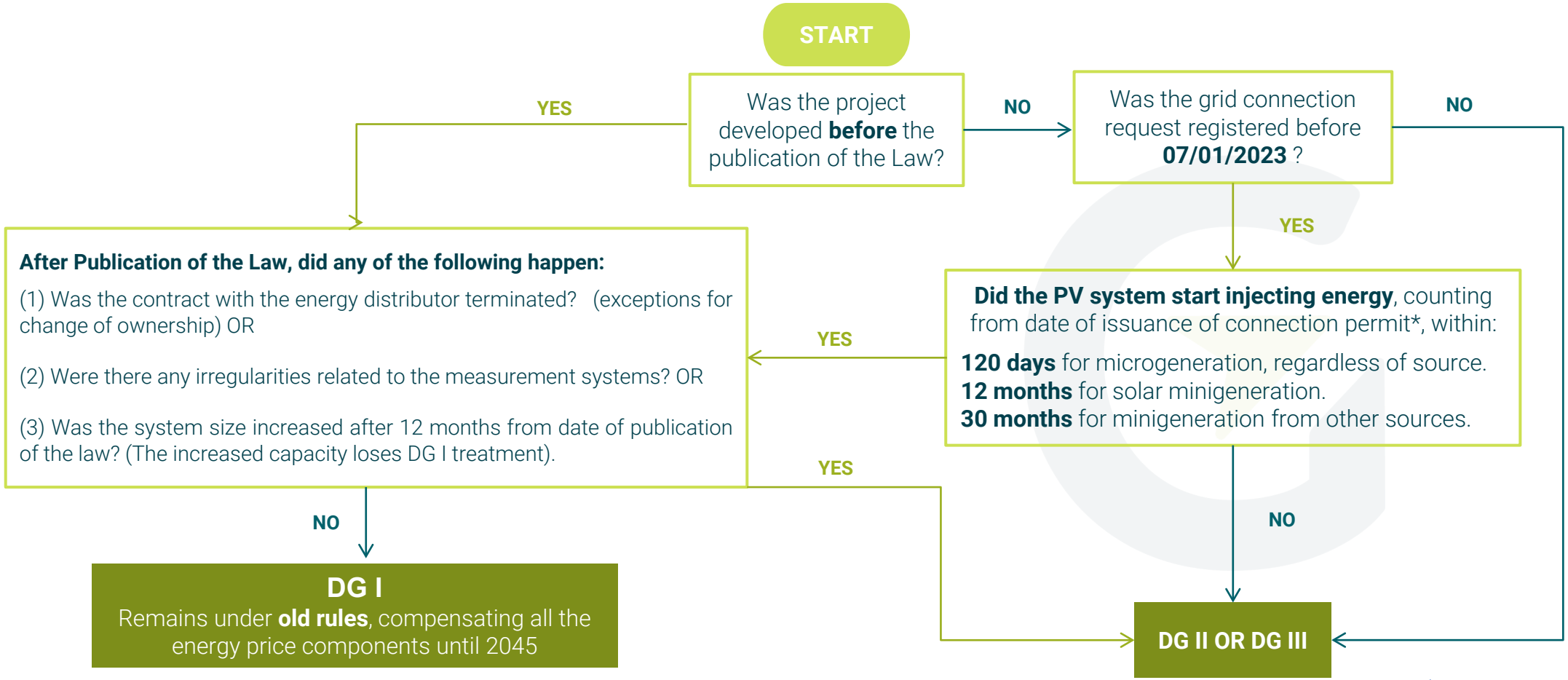
*Up until this moment (March 2024) there was no publication of guidelines or calculations by either CNPE or ANEEL.

METHODS FOR TRANSITION UNDER LAW 14.300/2022

Method	Description	What happens?
GD I	**Existing connections** or **those requested up until 7 January** 2023 (art. 26 of Law 14.300/2022).	Remain under the **previous rules**, with all energy price components being compensated until 2045 (Legacy Rights).
GD II	**Grid connection requests filed after January 7, 2023 that fall under the following categories:** • Local or remote self-consumption of less than 500 kW; • Shared generation of up to 500 kW (where a single beneficiary does not retain 25% or more of the surplus); • Enterprises with Multiple Consumer Units (EMUCs) (caput of art. 27 of Law 14.300/2022).	A gradual, staggered reduction in the compensation of the TUSD Fio B, starting at 15% in 2023 up to 90% in 2028 or 2030*. After the transition period, the units will be subject to the tariff rules established by ANEEL. *Consumer Units that file their access request between the 13th and 18th month from the publication of the Law will remain under this rule until 2030.
GD III	**Grid connection requests filed after January 7, 2023** that fall under the following categories: • Remote self-consumption above 500 kW; • Shared generation over 500 kW (in which a single owner holds 25% or more of the surplus). (§1 of art. 27 of Law 14.300/2022).	Non-compensation, already starting from 2023 until 2028 or 2030*, of: • 100% TUSD Fio B • +40% TUSD Fio A • +100% TUSD P&D • +100% TE R&D • +100% TUSD TFSEE *Consumer Units that file their access request between the 13th and 18th month from the publication of the Law will remain under this rule until 2030.

TRANSITION CATEGORIES OF LAW 14.300/2022

DG I – Legacy Rights



- If it is necessary to carry out grid construction works, the distributor can apply a longer time limit to the plant's connection. Therefore, the longer period of either 12 months or the one indicated by the distributor applies.

TRANSITION CATEGORIES OF LAW 14.300/2022

DG II – Gradual Payment of TUSD Line B

START

Is the project not DG I and does it fall under any of these Compensation Modalities?

(1) Local Auroconsumption or EMUC,
(3) Remote Auroconsumption up to 500 kW,
(4) Shared Generation up to 500 kW *,
(5) Dispatchable energy sources - any modality.

NO → **DG III**

YES → Was the project registered before **07/07/2023**?

YES → **DG II**

2023	2024	2025	2026	2027	2028	2029	2030	2031 to 2045
15%	**30%**	**45%**	**60%**	**75%**	**90%**	90% or to be defined	90% or to be defined	To be defined

Transition Period: Gradual increase in percentage of price components in relation to TUSD Line B.

The rules will depend on Calculations of Costs and Benefits (CNPE and ANEEL)

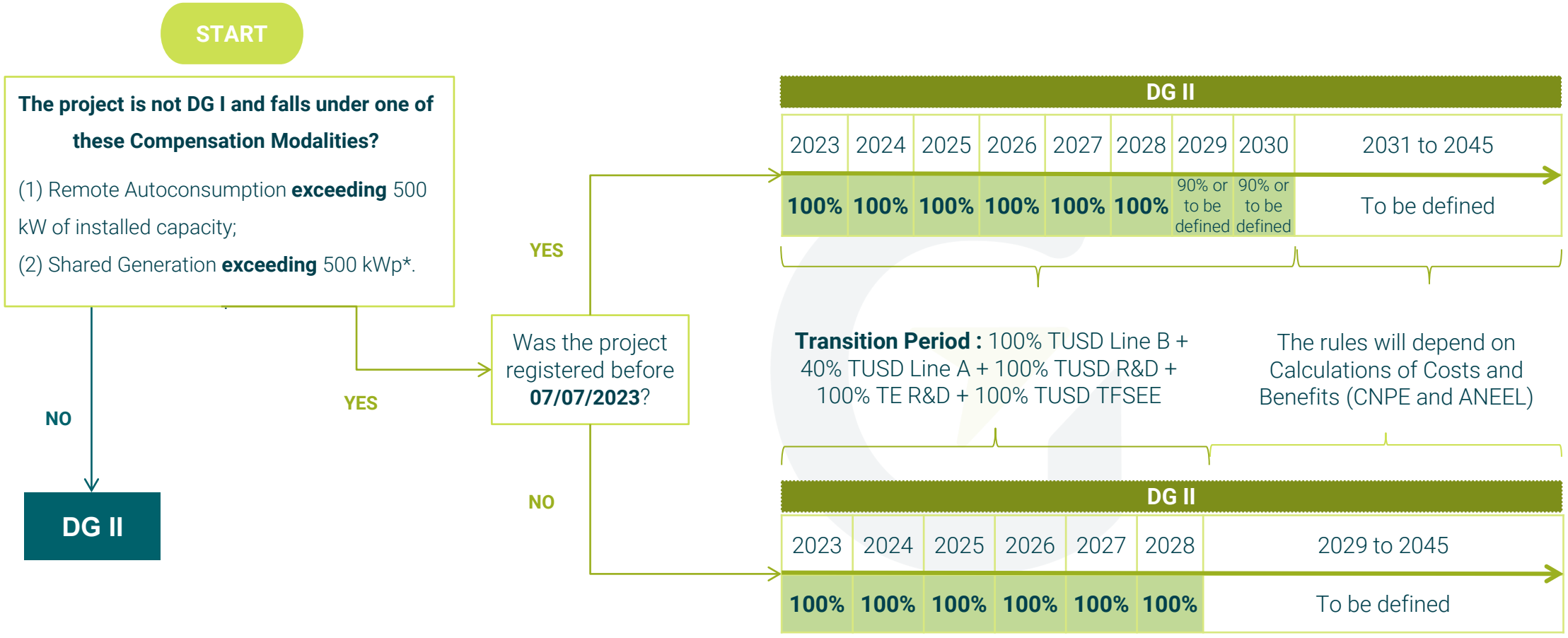
NO → **DG II**

2023	2024	2025	2026	2027	2028	2029 to 2045
15%	**30%**	**45%**	**60%**	75%	**90%**	To be defined

* Provided that a single owner **doesn't** retain 25% or more of the surplus energy.

TRANSITION CATEGORIES OF LAW 14.300/2022

DG III – Gradual Payment of TUSD Line B and other components

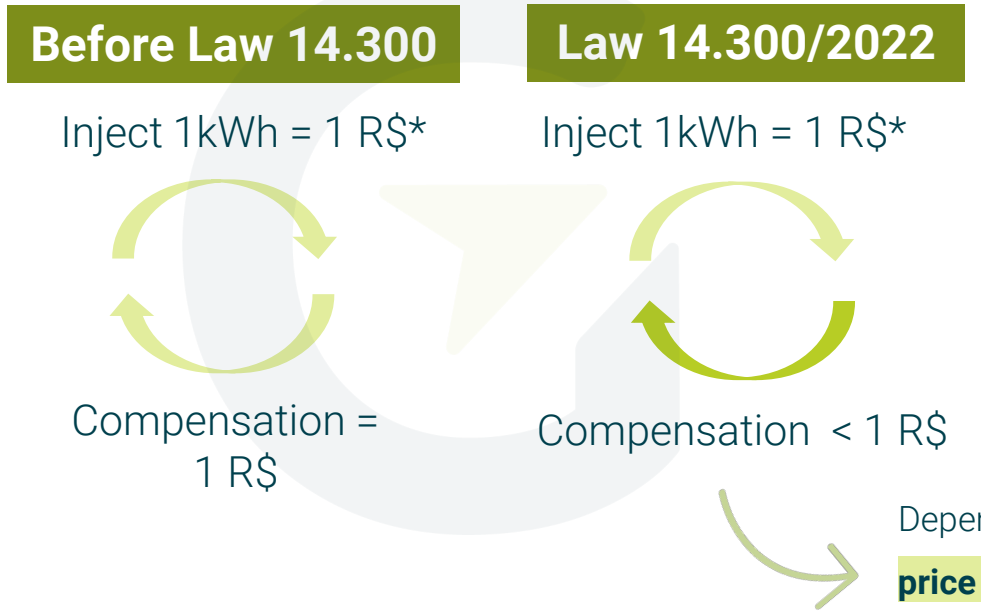


* Provided that a single owner retains 25% or more of the surplus energy.

CHANGES CAUSED BY LAW 14.300/2022

VALUE OF COMPENSATED ENERGY

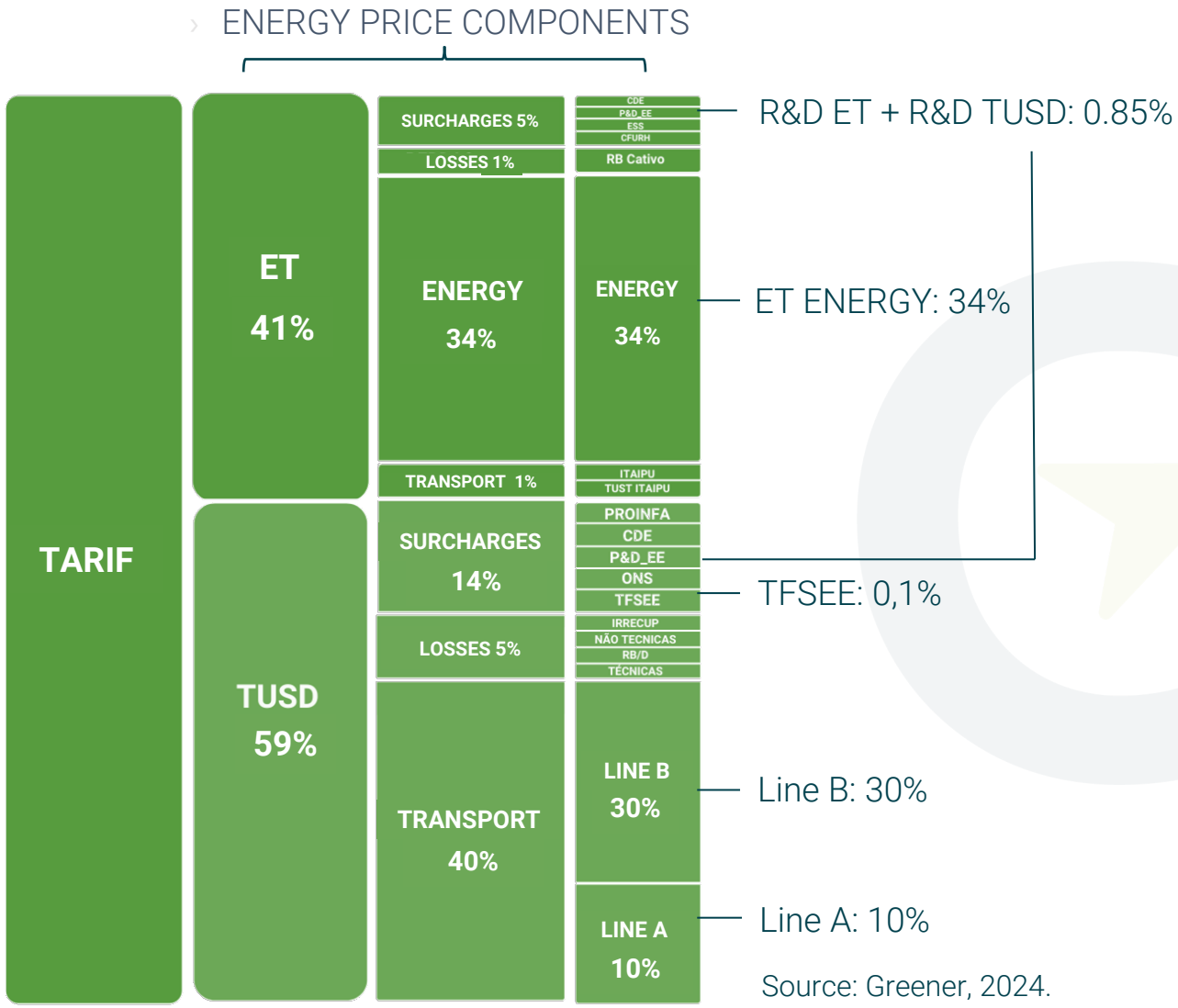
- The **new rule reduces the value of the compensated electricity tariff** for projects that fall under DG II and DG III when compared to DG I. Based on the average reference values of the 52 main energy distributors (updated in Feb-2024), **DG II has a compensable portion approximately 32% lower** (representing 90% of TUSD Line B) and **DG III 37% lower** (representing TUSD Line B, 40% of TUSD Line A, TUSD R&D, TE R&D and TUSD TFSEE), taking into account **scenarios without taxes*.**



Depends on the **compensation method** and on the **weights of the different energy price components, such as TUSD Line B,** in each distributor's pricing structure.

* It should be remembered that taxes applied to electricity tariffs cause financial differences in compensation and these are not taken into account in this analysis.

WEIGHTS OF VARIOUS COMPONENTS OF THE ENERGY PRICE

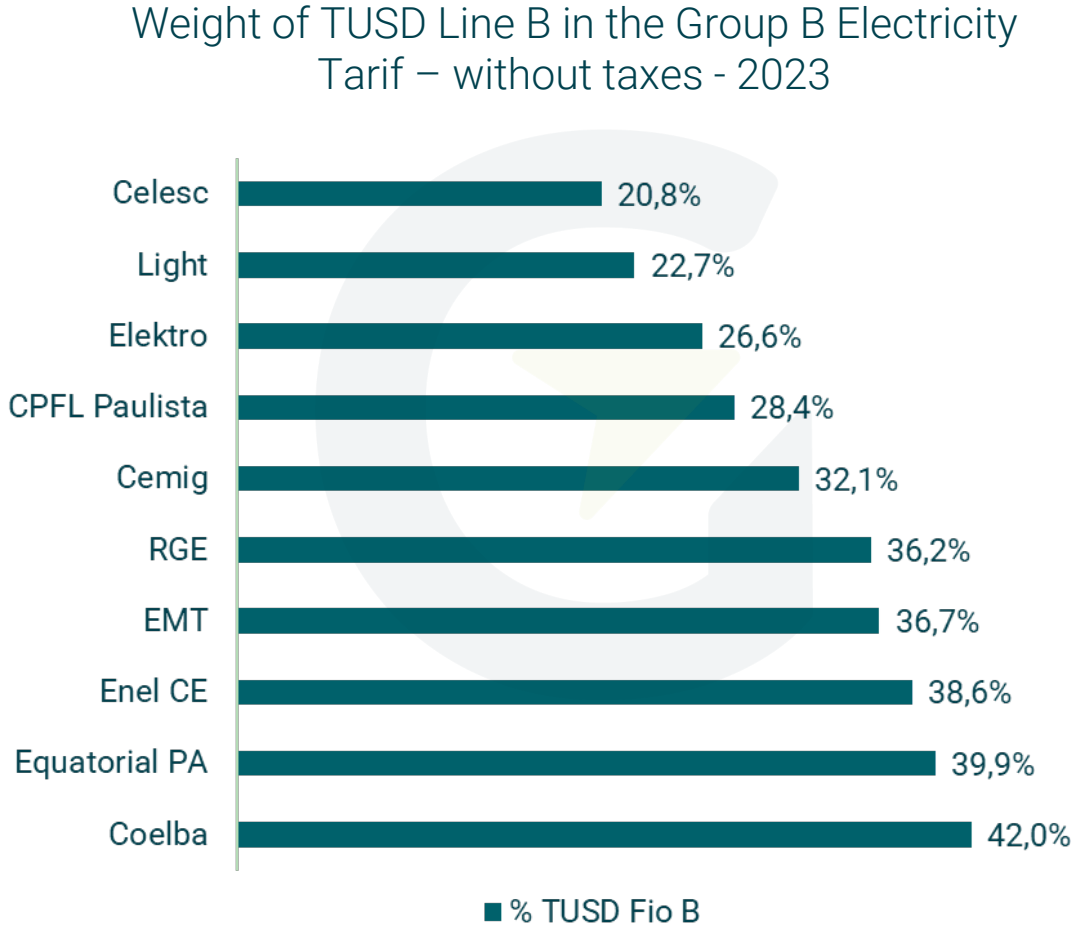


Source: Greener, 2024.

- The percentages shown in the figure represent the average weight of these components in the total energy price, considering the **country's 58 energy distributors** and their respective Group B - Conventional* tariffs.

* Prices updated on 23/02/2024 (ANEEL).

WEIGHT OF TUSD LINE B IN THE ENERGY PRICE



Source: Greener, 2024.

- For this part of the report, the distributors with the largest installed solar photovoltaic MMGD capacity were selected, covering all regions of the country.

- In view of the high variability in the values of the various energy price components in each region, **the need for case-by-case analyses should be emphasised**, taking into account the consumer profile, compensation modality, installed power capacity of the PV plant, and taxes and tariffs in each concession area.

THEMES TO WATCH OUT FOR IN 2024

“Gathering of Accounts” and Power Flow Inversion

“GATHERING OF ACCOUNTS”

CONTEXT: According to Law No. 14.300/2022, ANEEL should have had until 07/07/2023 to **establish calculations for the valuation of DG's costs and benefits**. To perform the calculations, however, it is first necessary to have **guidelines from the National Energy Policy Council (CNPE)** to guide the Agency in the valuation.

IMPACT: Knowing the definitive compensation rules that will **influence the viability of medium and long-term investments** brings legal certainty, predictability and stability to all participants in the Microgeneration and Distributed Minigeneration segments.

STATUS: Up until now (March 2024), **the CNPE guidelines** have not been published and the current situtation is that the sector is still waiting for better definitions from sector bodies and regulators.

POWER FLOW INVERSION

CONTEXTO: Article 73 of REN normative resolution nr 1.000/2021 states that energy distributors must carry out studies to avoid **power flow inversion** when joining new MMGD connections to the grid. However, some connection requests have been rejected under allegations of flow inversion without adequate proof.

POSSIBLE SOLUTION: ANEEL opened **Public Consultation 03/2024** to receive contributions in order to **regulate the proposed improvements related to flow reversal**. The objective is to review article 73 to clarify that distributors can **only apply it if the identified inversion is harmful** to the operation of the network and other assets of the distribution system. Furthermore, in the event of a flow reversal, it is mandatory for the distributor to fully share the corresponding studies.

STATUS: The contributions received from February 8 to February 23 this year are under analysis. The adjustments to the regulation are expected to be completed in the first half of 2024.

THEMES TO WATCH OUT FOR IN 2024

REIDI and Assessment of Subsidies (TS) nr 18/2023 by ANEEL

REIDI

CONTEXT: **Law No. 14.300/2022**, through its article 28, included mini DG projects as being eligible for the Special Incentive Regime for Infrastructure Development (REIDI) with the **benefit of PIS/COFINS relief on acquisitions of goods and services** linked to the project, carried out over a period of 5 years.

CHALLENGE: REIDI is a **benefit that has a series of conditions** for its granting. The effectiveness of the **law depends on prior regulation**, and it is not possible to immediately apply the rule, as the **concession is not automatic**.

IMPACT: impacts the **CAPEX** of a project and, once regulated, could facilitate the viability and raising of investments in mini DG projects.

STATUS: **Evaluation of the contributions from Public Consultation No. 159** of January 17, 2024 (Ordinance 765/GM/MME), which were submitted by February 26 of this year, aiming to **improve the proposed procedures** for requesting the inclusion of distributed mini-generation projects in REIDI.

TS nº 18/2023

CONTEXT: This Assessment was opened by ANEEL to request contributions on the need for **regulatory improvements to mitigate supposed energy trading mechanisms** in the SCEE. The period for contributions was from November 3, 2023 to January 31, 2024.

IMPACT: A **possible change in regulation** could impact the business models practiced in Remote DG, a generating modality that has increasingly gained space and importance in the sector.

STATUS: **Analysis of public contributions** to determine whether a regulatory change applicable to MMGD is necessary. An **Order of the Federal Audit Court (TCU) was published on 13 March 2024**, linked to case 005.710/2024-3, which signals the **possibility of initiating federal monitoring on this topic**.

THEMES TO WATCH OUT FOR IN 2024

Regulation of Taxation Reform

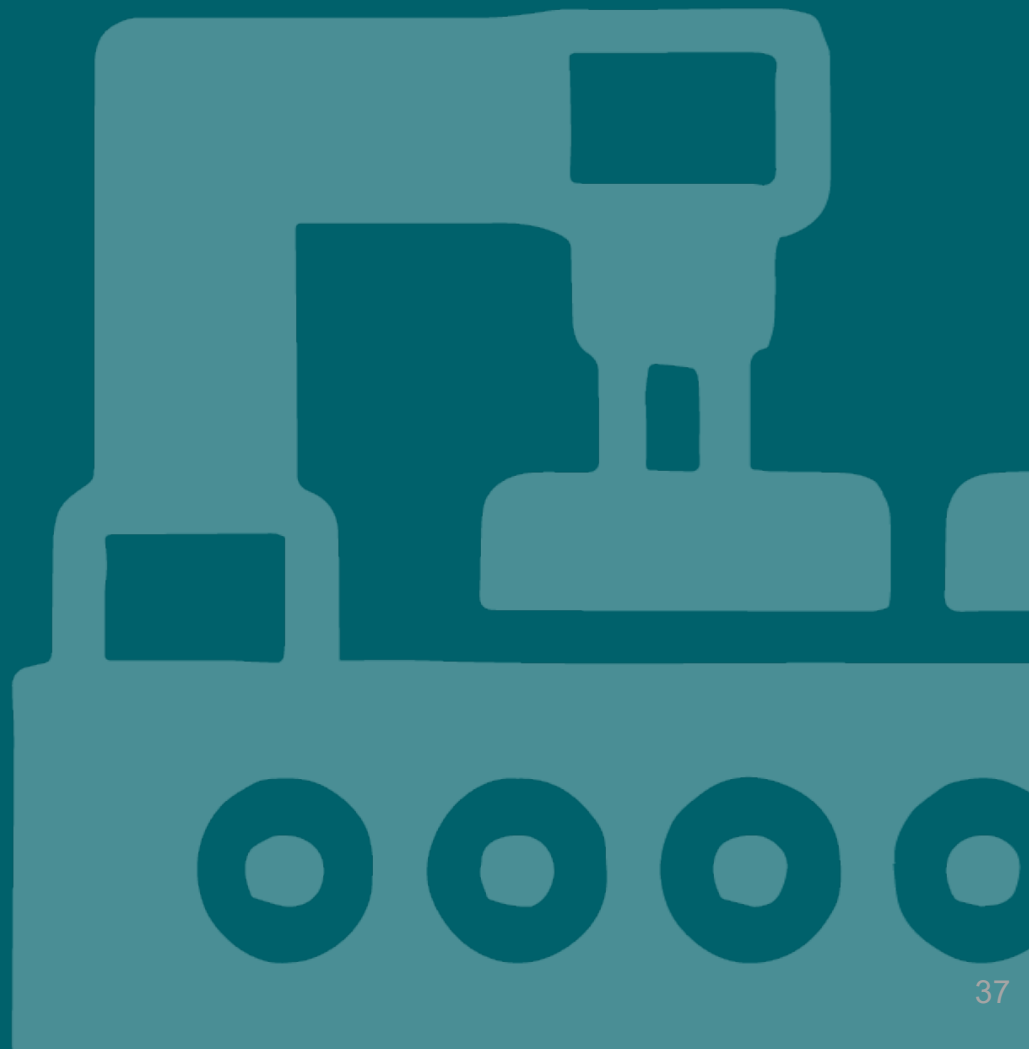
TAXATION REFORM

- **CONTEXT:** On **December 20th, the Tax Reform - Constitutional Amendment nº 132/2023** was enacted, whose main objective is to modify the National Tax System, with an emphasis on simplification. Current taxes **(PIS, COFINS, IPI, ICMS and ISS) will be gradually eliminated** during a transition period, **while two new value-added taxes will be introduced: CBS (Contribution on Goods and Services) and IBS (Tax on Goods and Services)**.

- **IMPACT:** The **restructuring of tax calculations and the elimination of tax incentives** have the potential to influence the DG market, not only at the time of the sale of PV equipment, but also in future energy bills and business viability. However, the tax reform still needs to be regulated in detail and tax exemptions that benefit the sector will need to be renegotiated, which makes it difficult to quantify the impact at this time.

- **STATUS: Awaiting regulation.** Many aspects still need to be elaborated in complementary laws before the impact on the sector can be measured quantitatively. The simplification of tax regulation is one of Congress' priorities in 2024, and it is expected that there will be moves in this regard in the first half of the year.

02.
PRODUCTION



COST STRUCTURE

PV Modules and Inverters

PV Modules

PV **modules represent around 25 to 40% of the total price of a PV system**, meaning they are an important component to be analyzed for market pricing.

As the module's main input is polysilicon, this raw material's price variation directly impacts the price of PV modules. Other inputs are: polymer, glass, aluminum and copper.

Inverters

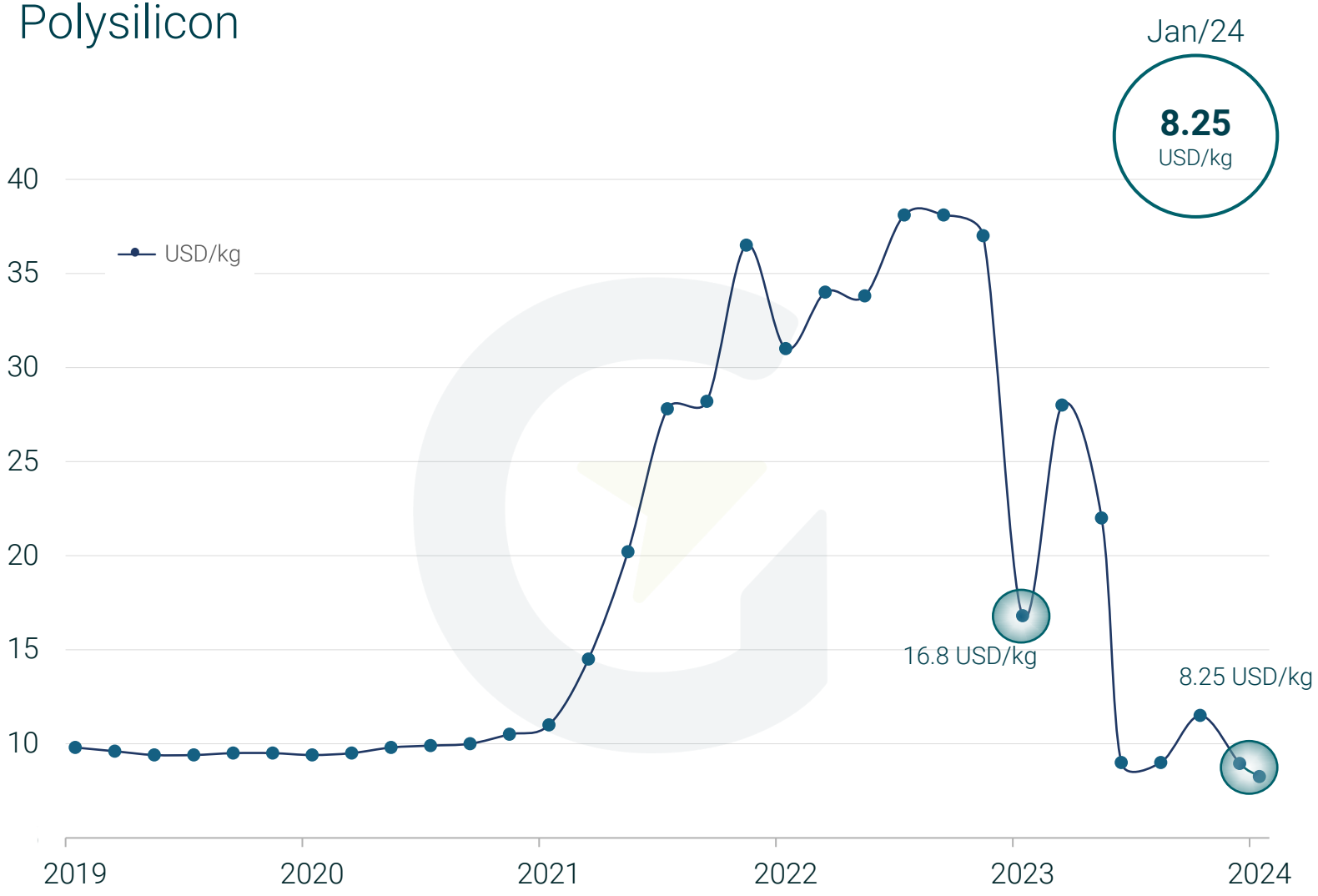
Semiconductors and electronic components represent the largest portion of the cost of photovoltaic inverters.

Other components of the inverter cost structure are: passive components, interconnection, physical structure and thermal management.

Source: Greener, 2024.

PRICE OF RAW MATERIALS

Polysilicon



The price of polysilicon reached 8.25 USD/kg in January 2024, a **51% drop** compared to the same period in 2023.

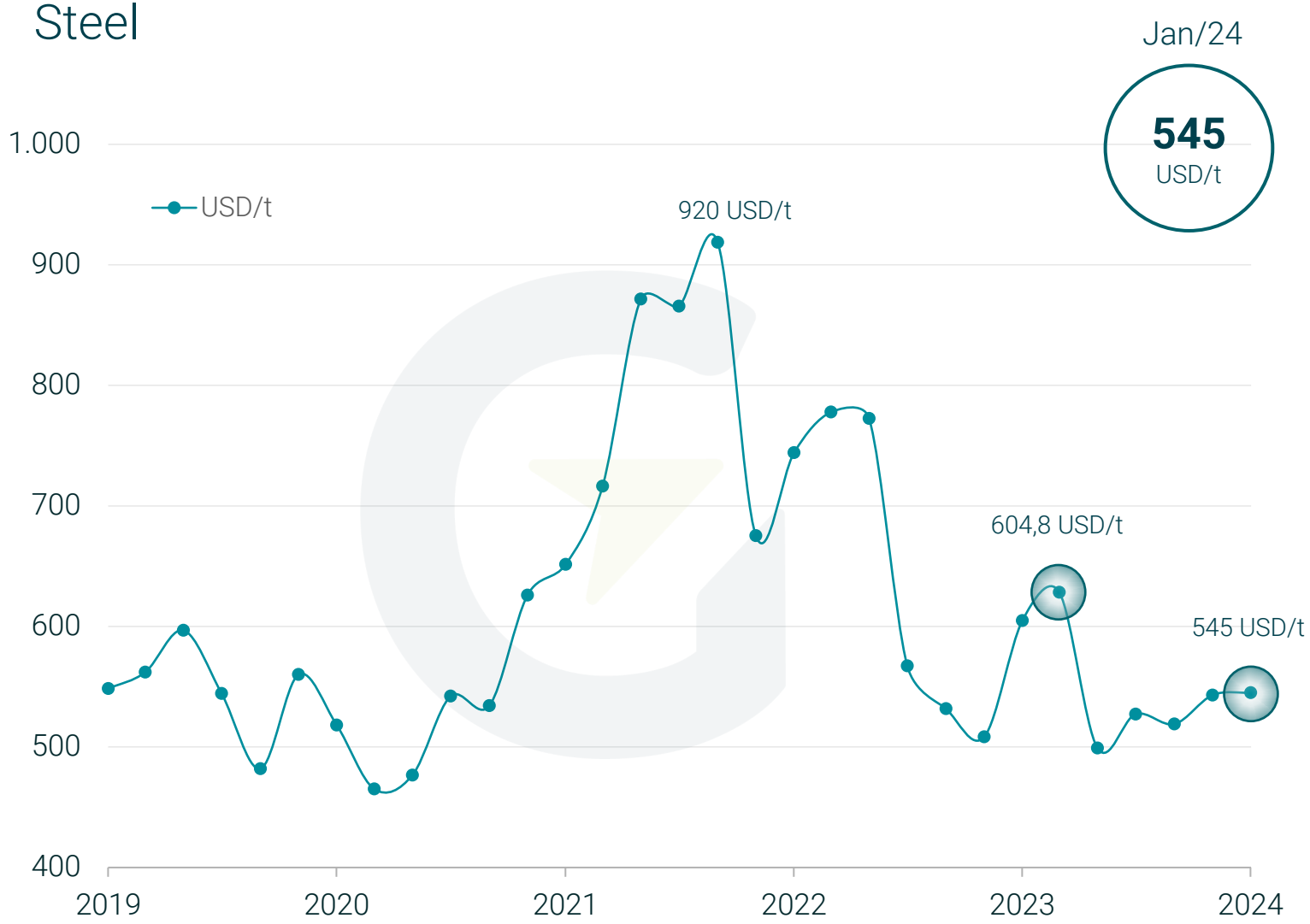
Excess supply, resulting from the **increase in production capacity in China, and the consequent increase in stock levels** contributed to this variation.

The expectation is for prices to **remain at similar levels**, at least in the 1st half of 2024.

Source: Bernreuter Research; OPIS APAC Solar weekly; Sunsirs 2024 (Adapted).

PRICE OF RAW MATERIALS

Steel



The **price of steel fell by 9.9%** compared to January 2023 (620 USD/t), reaching **545 USD/t in January** 2024.

The **decrease in consumption in China,** mainly in the real estate market, has contributed to the devaluation of this key building material. Price stability is expected for the coming year.

The price of steel impacts the cost of **manufacturing mounting/racking structures**, especially for ground-based photovoltaic plants.

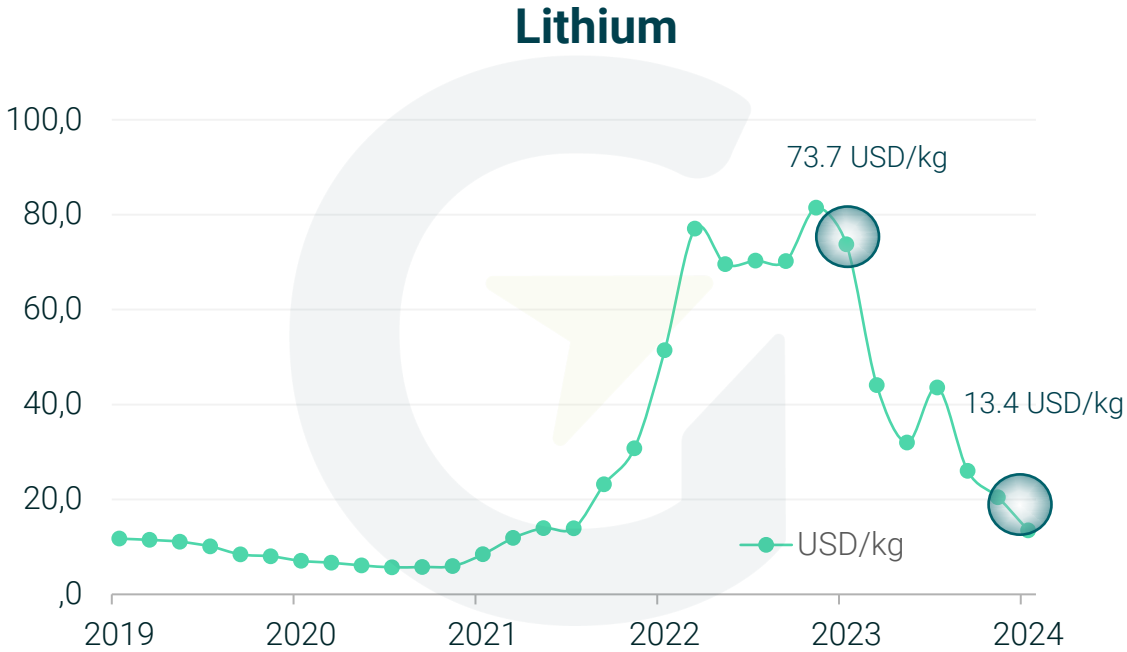
Source: Trading Economics, 2024 (Adapted).

PRICE OF RAW MATERIALS

Copper and Lithium

Since the beginning of 2023, the **price of copper** has fluctuated between 8 and 9 USD/kg, **ending the year at 8.5 USD/kg**. The price of this input can impact the production costs of conductive and electronic components, mainly **influencing the price of inverters**.

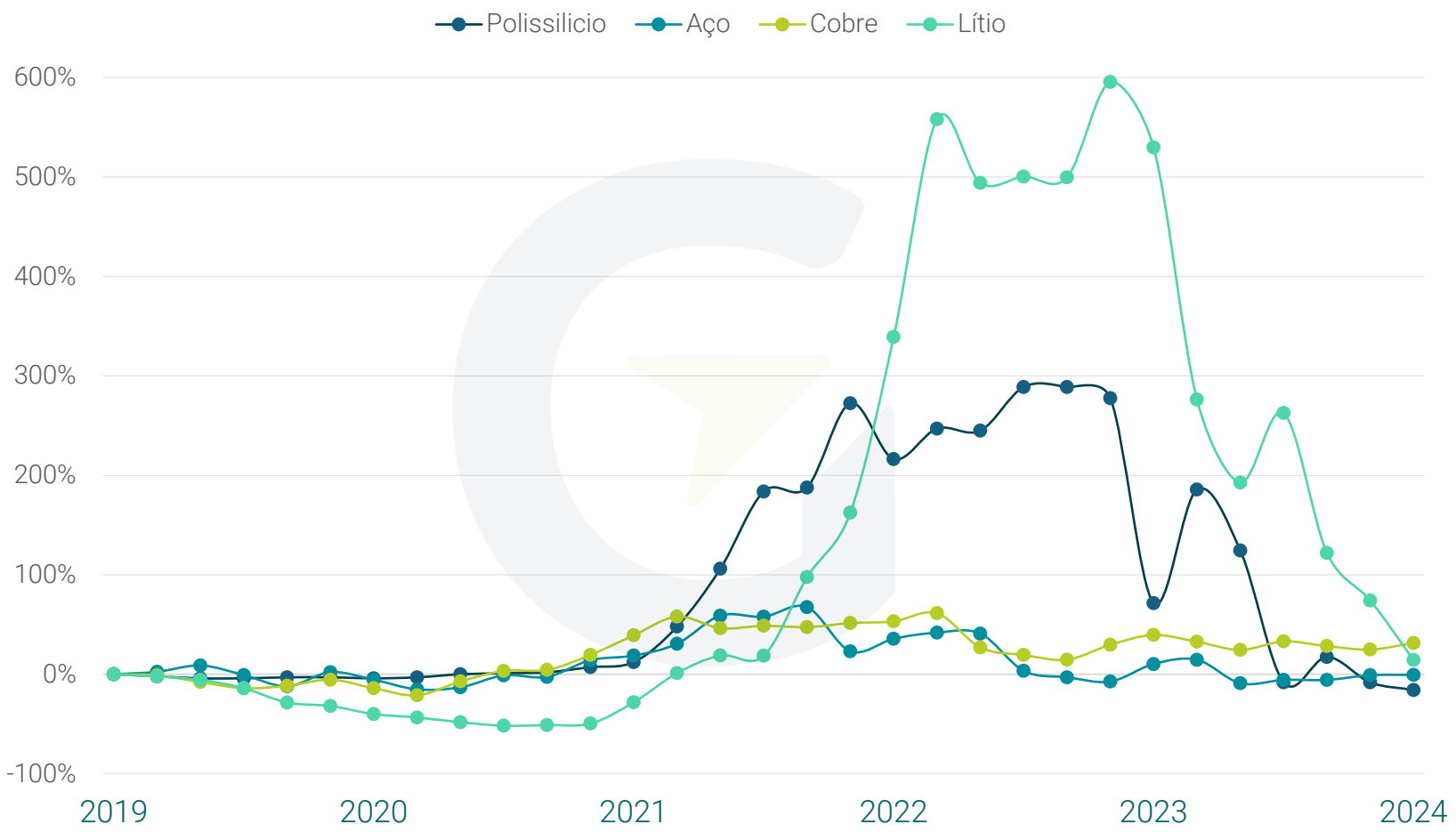
There was an 82% drop in the price of lithium in January 2024 compared to the same month in 2023. The price of this mineral is directly related to the production and demand for **lithium-ion batteries**, thus it is an important **cost driver for the energy storage and electric mobility market**.



Source: Trading Economics, 2024 (Adapted).

VARIATION IN PRICES OF RAW MATERIALS

Based in US$



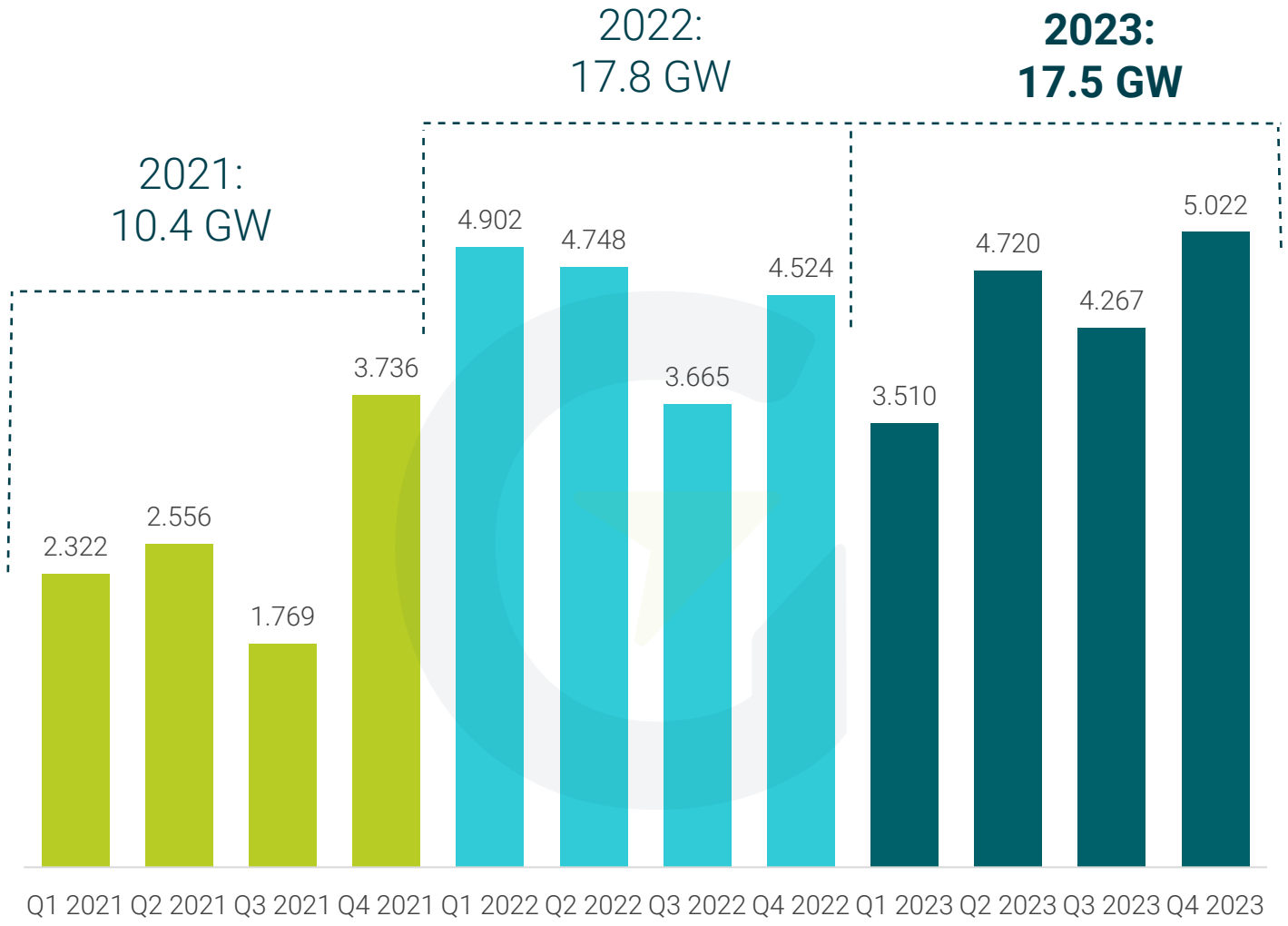
The graph shows the price variations for each of the major PV energy inputs during the past 5 years.

From 2019 to January 2024, **Lithium and Polysilicon showed the biggest variations**, reaching an increase of more than 600% and 300%, respectively.

Source: Trading Economics, 2024 (Adapted); Bernreuter Research, 2024 (Adapted); Greener, 2024.

PHOTOVOLTAIC MODULES

Imported Volume : Distributed Generation and Centralized Generation

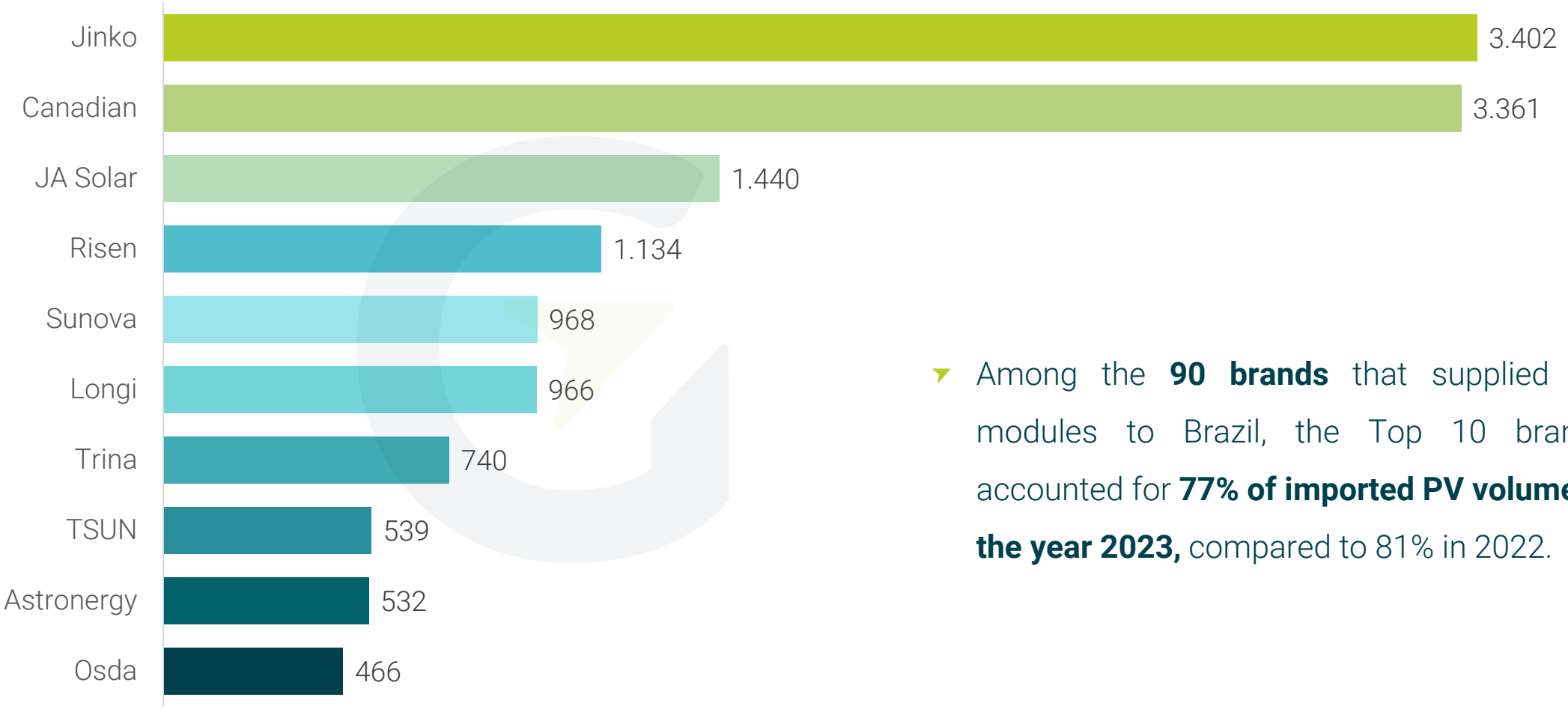


- The **17.5 GW nationalized in 2023** represents a slight **reduction of 1.7%** compared to the previous year, which set a historical record for the Brazilian market.
- Out of the total volume nationalized in 2023, **11.4 GW (66%) was intended for the DG market**, meaning a reduction of 2 GW in relation to the DG capacity demanded in 2022. The remaining **6.1 GW (34%) was destined for the CG market**.
- In the **4th quarter of 2023**, imports reached more than **5 GW, the highest quarterly volume in history**.

Source: Greener, 2024.

TOP 10 – PV MODULES

Imported Volumes [MWp] - 2023



- Among the **90 brands** that supplied PV modules to Brazil, the Top 10 brands accounted for **77% of imported PV volume in the year 2023,** compared to 81% in 2022.

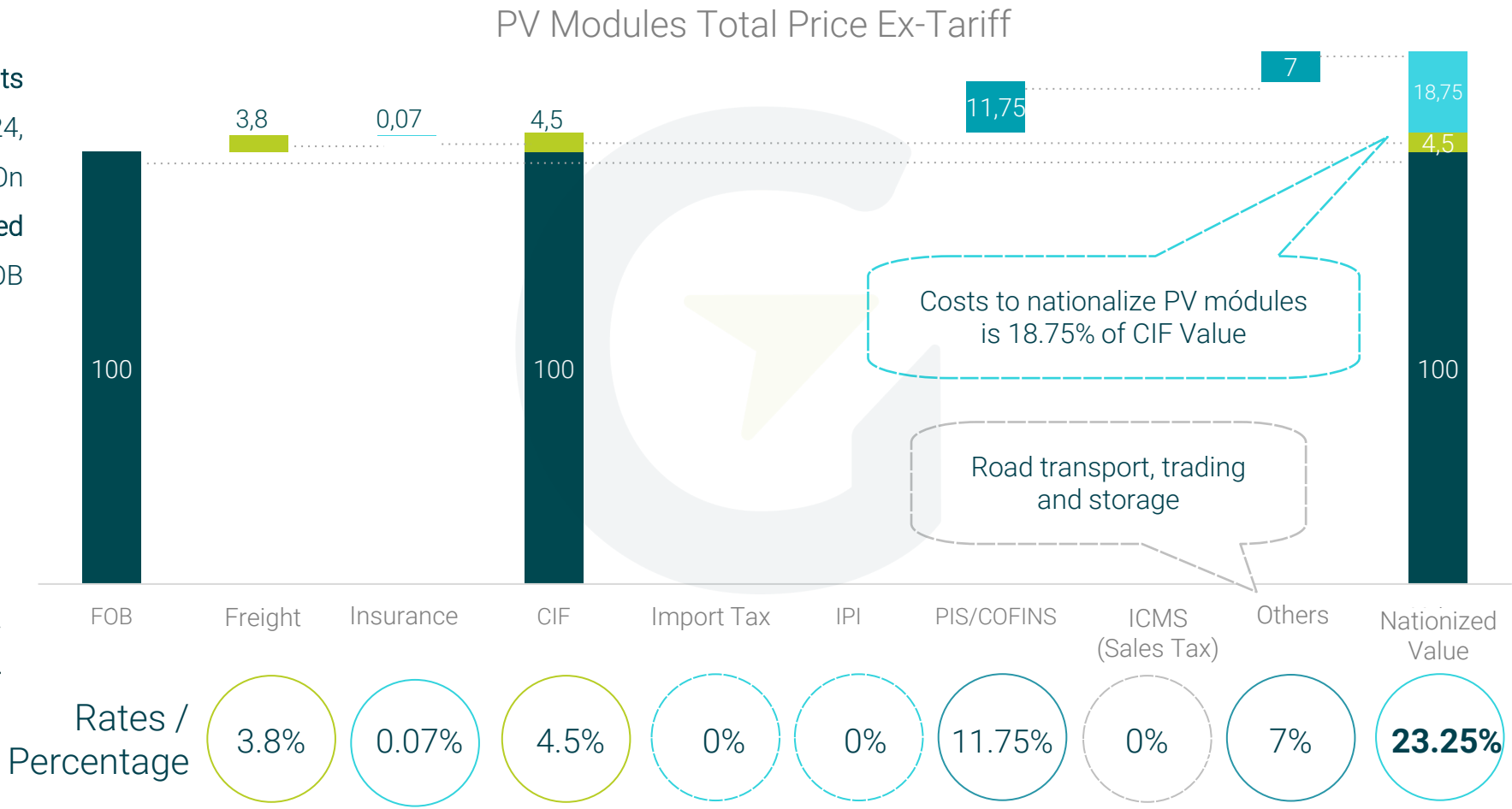
Source: Greener, 2024.

PV Modules

Cost structure for importing and nationalization

- The percentage of **nationalization costs remained stable** in January 2024, representing **18.75% of the CIF price**. On the other hand, **shipping costs increased slightly**, corresponding to 3.8% of the FOB price in 2023, compared to 2.1% in 2022.

Changes in criteria and revocations of the Ex-Tariff may alter the Import Tax (II) rate. PV modules that have qualified for the Ex-Tariff treatment benefit from an II rate of 0%. Otherwise, the current **standard rate of 9.6%** is applied.



Source: Greener, 2024.

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03.
DISTRIBUTION

THE SURVEY

Introduction

Start of Solar Business Activities of Surveyed Companies:

2018 Or before	2019	2020	2021	2022
32%	32%	16%	10%	10%

- Greener carried out its market survey, interviewing **19 companies that distribute** photovoltaic equipment (PV Kits*) in the period between 11 January 2024 and 23 February 2024. The surveyed companies **together account for approximately 23% of PV volume commercialized during the year 2023** through the PV distribution market.

- Out of the 19 distributors, **58% also participated in the 2022 survey**. As such, Greener was able to carry out exclusive analysis covering 2022 and 2023, in order to show the dynamism of the market for this group of market participants.

**The PV Kit is composed of: PV Modules + Inverter + Mounting System + Cabling System + Protection System*

DISTRIBUTORS IN NUMBERS

Year 2023

R$ 4.15 Bn

Total revenue* of 89% of the interviewed companies.

73% of this amount was **raised** by distribuitors **which have been in business for 5+ years**.

R$2.96 Bn was the total **billed** by companies **with 2,000 or more active integrator customers** which completed at least 1 purchase in 2023.

2.45 GWp

Total PV volume invoiced by 95% of surveyed distributors, representing **more than 156,900 sold PV kits**.

1.6 GWp was **sold** by **companies** which reported **2,000 or more active integrator customers** that completed at least 1 purchase during 2023.

2,082

Total number of employees dedicated to the solar PV market, with **63%** of companies employing **up to 100 people** and **21% between 101 and 200**.

Among the **group of companies that participated in the survey in both 2023 and 2024**, there **was an increase of 4%** in the total number of employees.

**Total revenues, including possible comissions paid to PV integrators.*

Source: Greener, 2024.

DISTRIBUTORS IN NUMBERS

Year 2023

744

Total of women dedicated to the solar market in the surveyed companies, representing 41% of their total workforce.

PV distributors with **less than 100 employees** on average have a **45% female workforce.**

22,324

Total number of active PV integrators*, representing **16%** of the total of registered integrators among the surveyed companies.

Distributors that have been **active for 5 or more years**, on average had **1,594 active integrators** registered in 2023.

(This doesn't represent the total number of integrators in the market due to double counting).

9 working days

Average delivery time of PV Kits, based on the responses of 95% of the surveyed distributors.

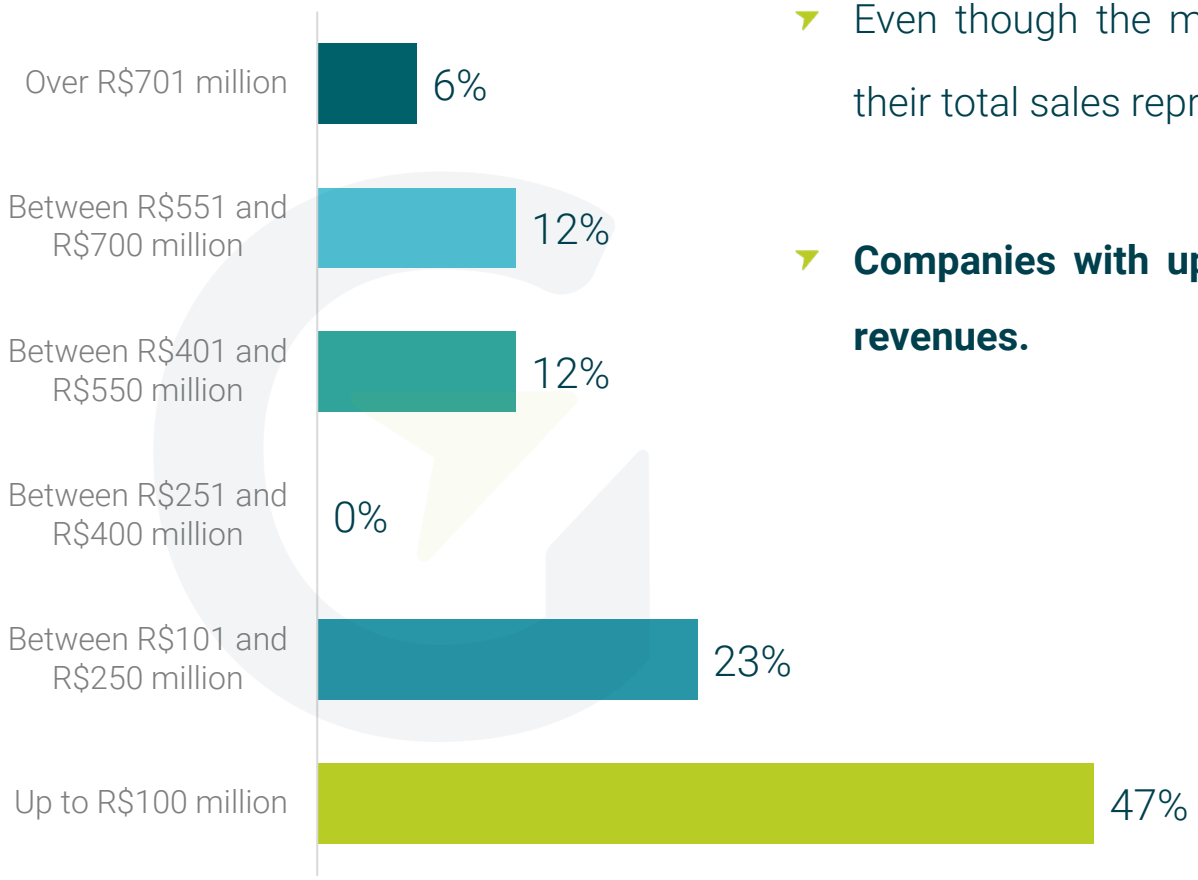
The average delivery time for distributors that started activities in 2021 was 11 days, and they accounted for sales of **58 MWp in 2023**.

**Integrators that completed at least one purchase during the 2023 calendar year.*

Source: Greener, 2024.

REVENUES (R$) FROM PV KITS

% of PV Equipment Distribution Companies



- Even though the majority of distributors billed **less than R$100 mi (47%)**, their total sales represented **only 11%** of total sector revenues of R$4.15 Bn.
- **Companies with up to 50 employees** accounted for **25% of total sector revenues.**

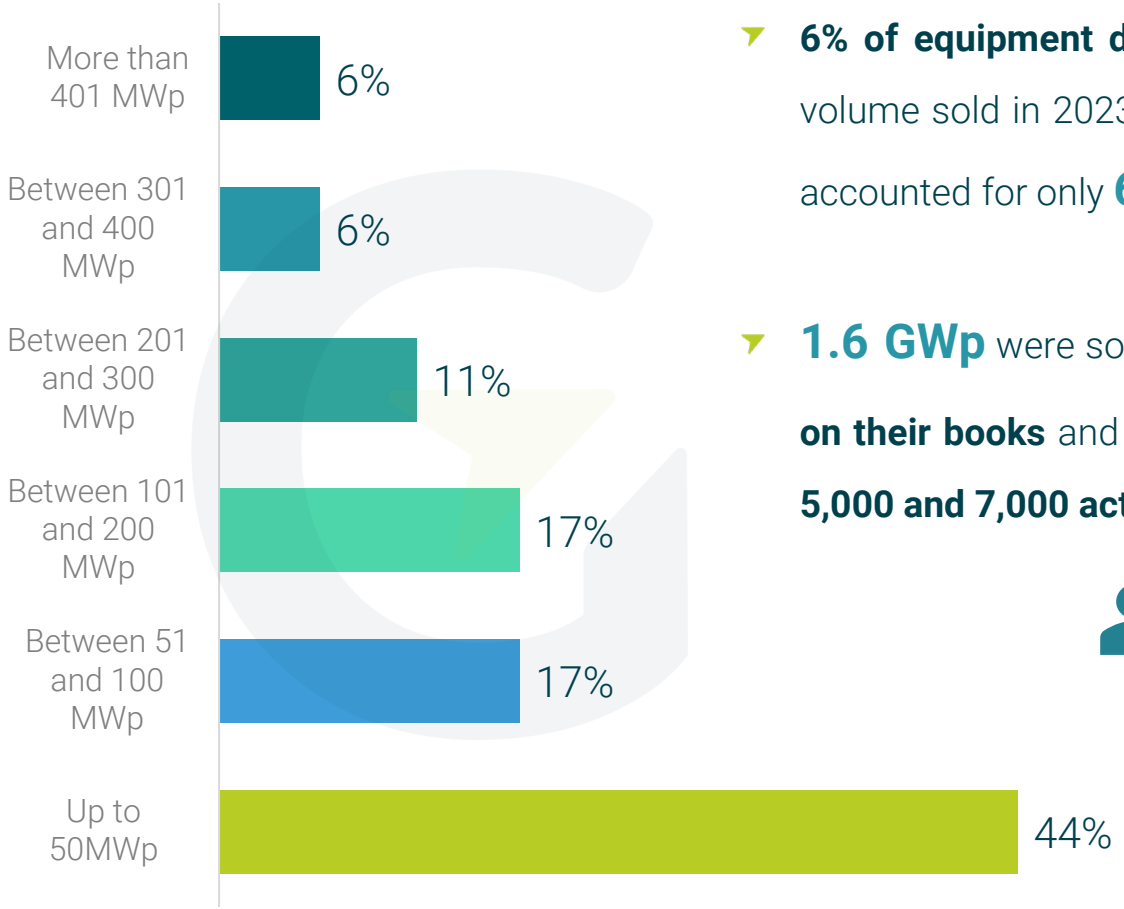
DISTRIBUTORS WITH RECURRING SURVEY RESPONSES IN 2022 AND 2023:

Average drop of 20% in the annual revenue of distributors when comparing 2023 in relation to 2022. **Considering only the distributors that had a reduction in revenue (82%), the average is -41%.**

Source: Greener, 2024. Data take into account 89% of distributors that participated in Greener's 2024 survey.

VOLUME OF PV KITS SOLD (MWp)

% of PV Equipment Distribution Companies



- **6% of equipment distributors** sold more than 401 MWp, **representing 24% of total** volume sold in 2023. In contrast, companies that reported sales volume **up to 50 MWp** accounted for only **6%** of the volume sold last year.

- **1.6 GWp** were sold by companies that have **more than 10,000 registered integrators on their books** and a further **403 MWp** was sold by those companies with **between 5,000 and 7,000 active integrators** on file.

DISTRIBUTORS WITH RECURRING SURVEY RESPONSES IN 2022 AND 2023:

Average Volume drop (MWp) of 11% of PV Kits sold in 2023. When considering only those companies **that registered lower volumes (55% of total),** the **average rediction was -45%**.

Source: Greener, 2024.

Data take into account 95% of distributors that participated in Greener's 2024 survey.

SIZE OF SOLD PV KITS

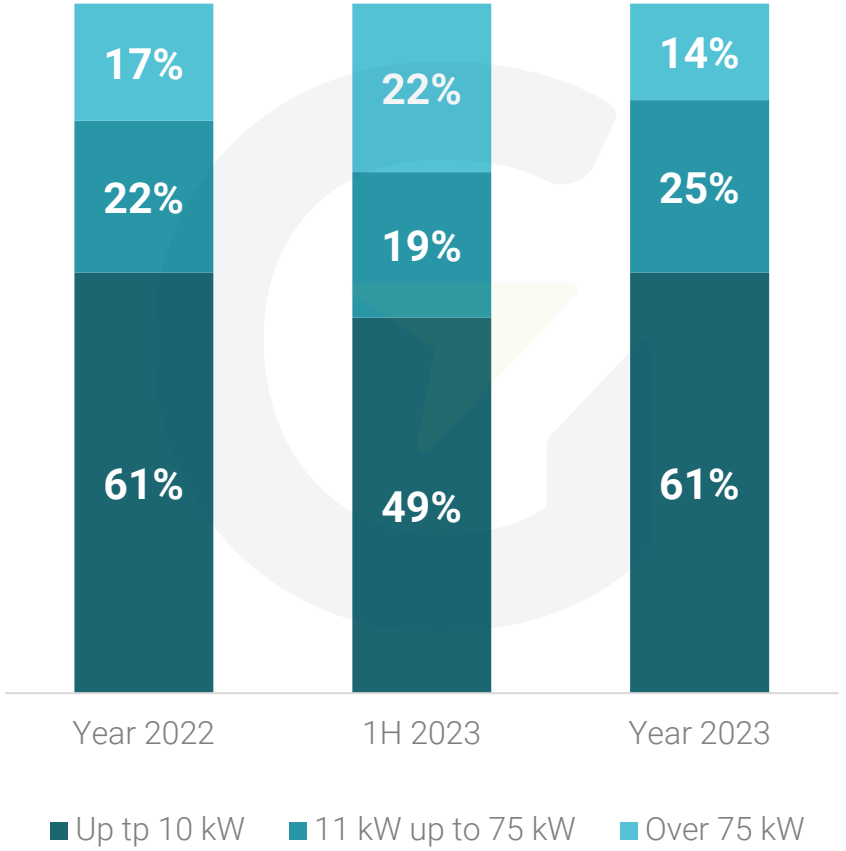
Representation of different sizes of kits

- **Residential and small commercial sizes (up to 10kW) represent the majority** of PV Kits sold by distributors in 2023, as was the case in 2022 as well.

DISTRIBUTORS WITH RECURRING SURVEY RESPONSES IN 2022 AND 2023:

In 2023, 99,100 PV kits were reported sold by survey respondents, **representing a 12% drop** compared to the previous year.

When considering **only distributors that showed a reduction in the quantity of kits sold (73% of respondents),** the drop was **48%** compared to the previous year.

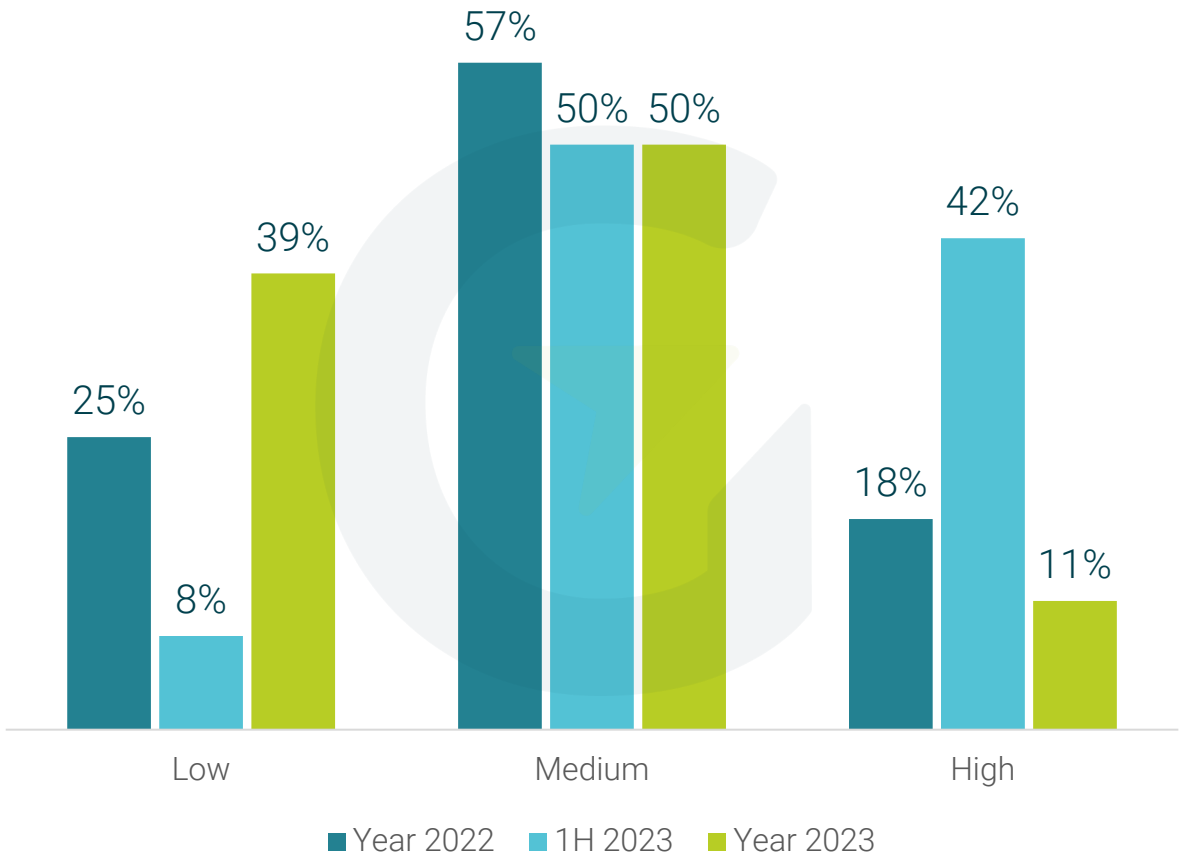


Source: Greener, 2024.

Data take into account 95% of distributors that participated in Greener's 2024 survey.

IMPORT FIGURES X SALES VOLUME

Inventory Levels



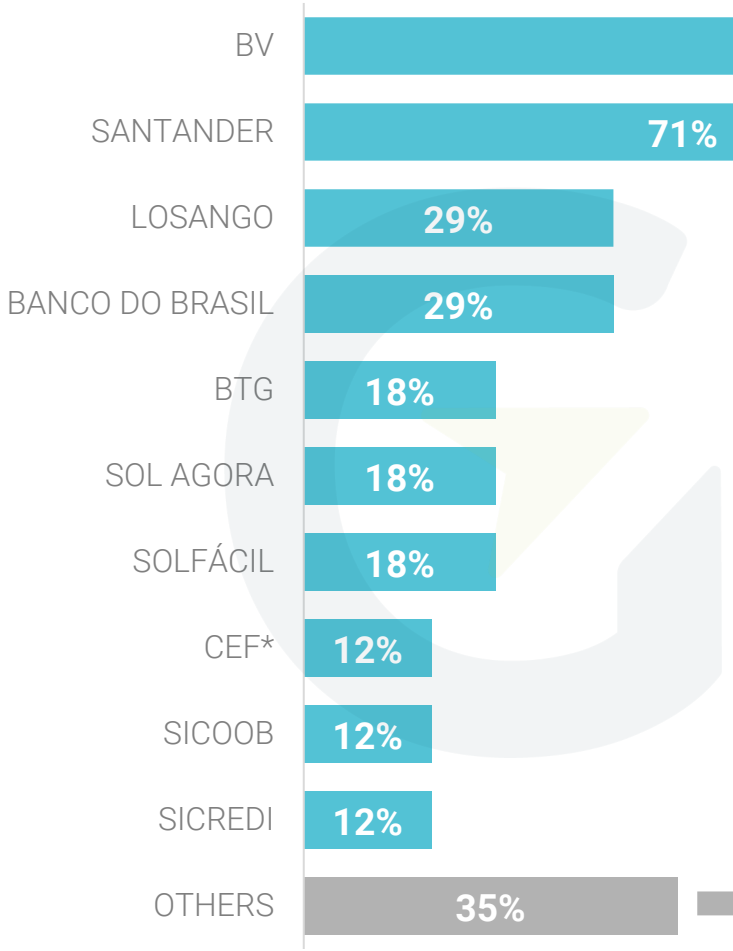
- **42% of equipment distributors** reported **high inventory levels** at the end of the **1st half** of 2023, as a result of the sharp decline in sales in that period.
- The **full-year 2023** figures showed a **lower incidence** of companies with **elevated stock levels (11%)** compared to 18% at the end of 2022.
- Reported inventory levels corresponded to **24%** of **total storage capacity** of the surveyed companies.

Source: Greener, 2024.

Data take into account 95% of distributors that participated in Greener's 2024 survey.

SOLAR FINANCING

Financial institutions mentioned by the surveyed equipment distributors



- During 2023, **32% of PV Kits** were **sold** using some form of **solar financing**.
- **On average**, distributors referenced **3 financing institutions/products**.
- Companies that have **been active in the sector for 5 years or more** named, **on average**, **4 financing institutions**. Conversely, those companies that **initiated their solar PV activities since 2020** only referenced **2 lines of solar financing, on average**.

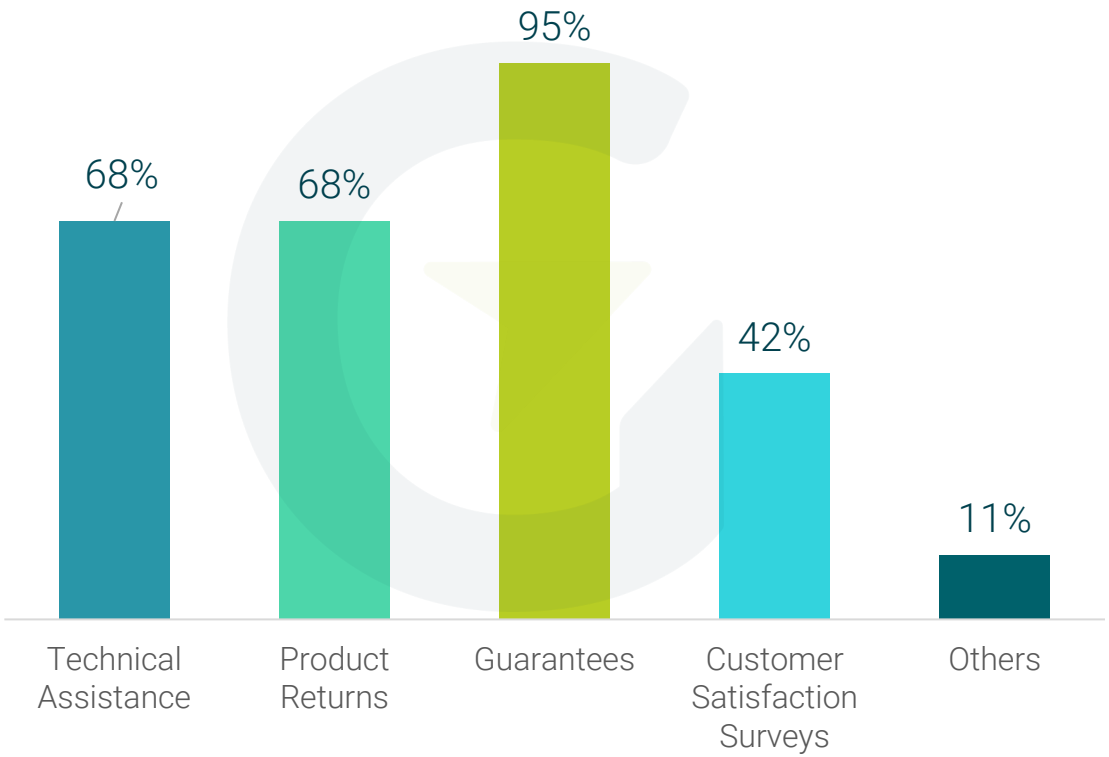
Click here for a full list of financial institutions

Important: *Responses indicate the pulverization of financial agents in the solar PV market and* ***do not represent market share.*** *Data take into account 89% of distributors that participated in Greener's 2024 survey.*

Source: Greener, 2024.

AFTER-SALES SERVICE

Customer support processes



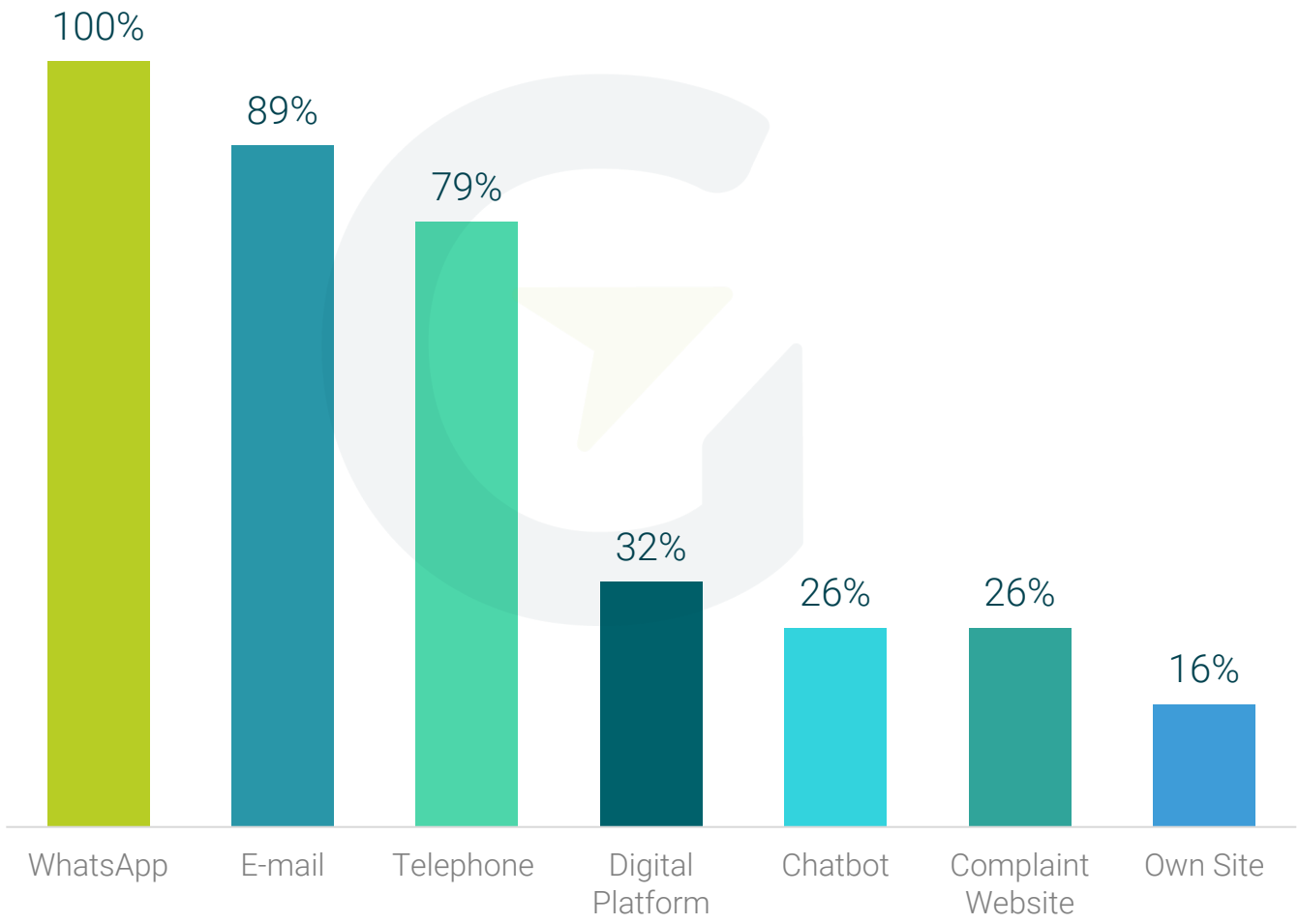
- **Customer Satisfaction Surveys** have still **not been made available by 11 of the surveyed distributors**.
- **32%** of distributors responded that they **possess all the after-sales channels mentioned**, that is, Technical Assistence, Product Returns, Guarantees and Customer Satisfaction Surveys.
- **2 companies** mentioned that they offer **other** services, such as: **Technical Support** and **Inverter Maintenance**.

Source: Greener, 2024.

Respondents could select various options, without any restrictions.

AFTER-SALES SERVICES

SUPPORT CHANNELS FOR CUSTOMERS



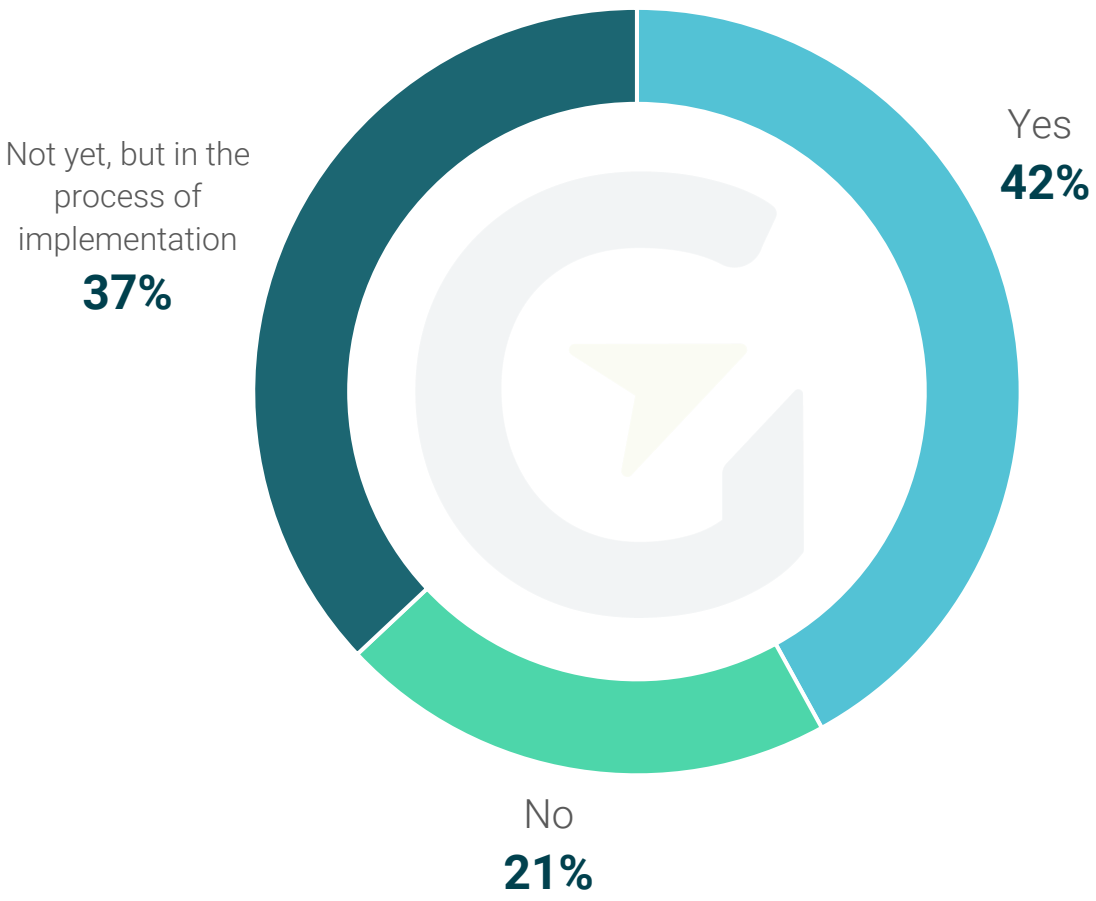
- **WhatsApp, e-mail and telephone** are the most used communication channels for after-sales customer support.
- **WhatsApp and Website** were the channels that **increased in importance most prominently** compared to 2022, being used **simultaneously by 89%** of respondents.
- Only **2** interviewed companies possess **all the after-sales channels** mapped in the survey.

Source: Greener, 2024.

Respondents could select various options, without any restrictions.

AFTER-SALES SERVICES

Space for customers to evaluate their purchases



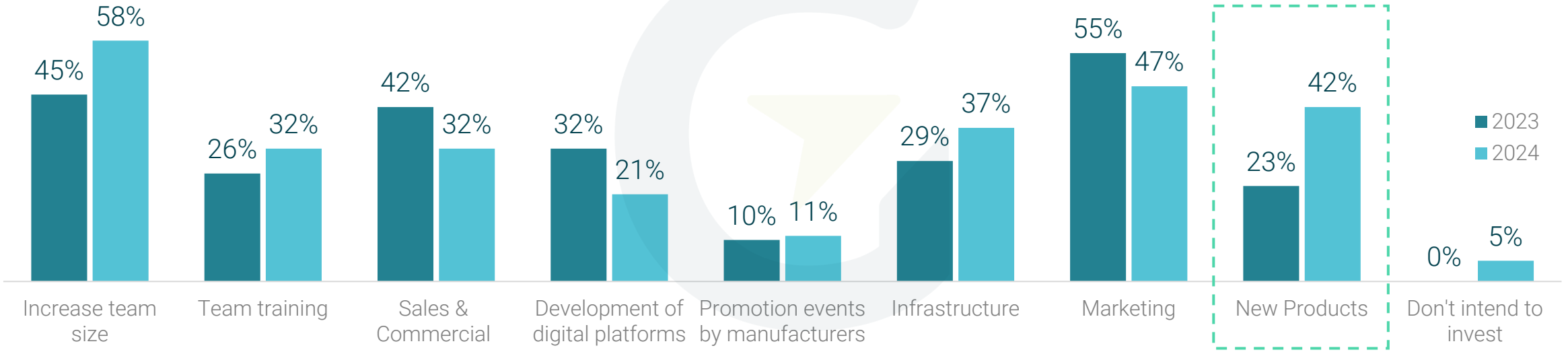
- **21%** of **participating distributors still do not have any space for the customer to evaluate** the product/service after purchase, representing a **drop of 18 p.p. compared to 2022**.
- However, **37%** of companies, are in the process of implementing a solution with this purpose in mind, indicating an **increase of 23 p.p. compared to 2022**.
- **8** distribuitors **have fully functional After-Sales Services,** and **75% of these companies are already active in the PV market for at least 4 years**, reflecting a refinement and continuous improvement in the process of creating positive customer experiences.

Source: Greener, 2024.

INVESTMENT PRIORITIES FOR 2024

Highlighted by PV Distribution companies

- **After greater caution in innovation in 2023,** faced with a challenging market, **42%** of distributors indicated that one of **their biggest priorities is to invest in new products in 2024**..

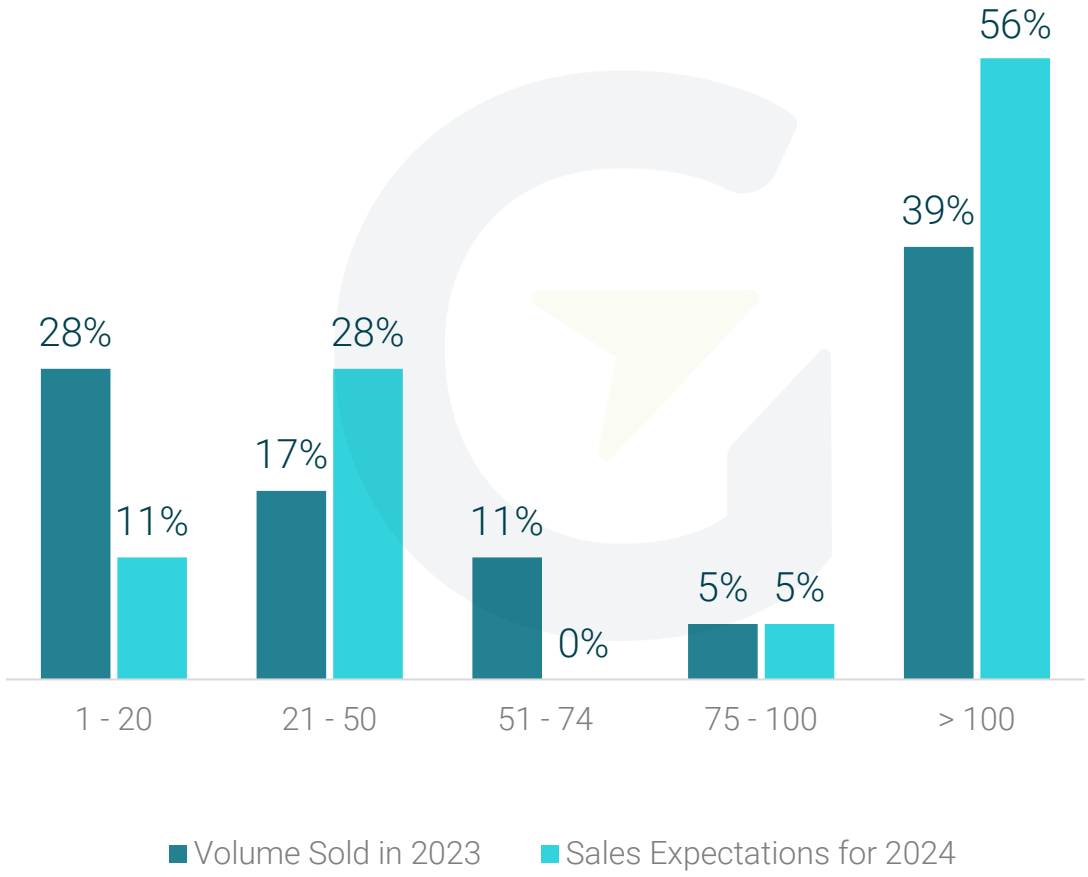


Source: Greener, 2024.

Survey respondents could select up to 3 relevant answers.

SALES SCENARIOS

Volume Sold in 2023 [MWp] x Forecast for 2024 [MWp]



- **Companies with sales exceeding 100 MWp** target an **average increase of 81% for their sales in 2024** when compared to the sales volume in 2023. Those which sold **less than 100 MWp** are looking for an average increase of **70%** in 2024.

DISTRIBUTORS WITH RECURRING SURVEY RESPONSES IN 2022 AND 2023:

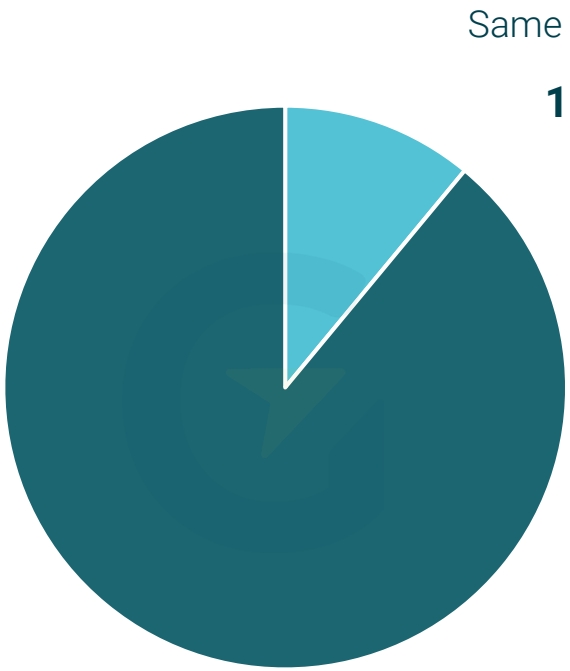
In 2023 an average increase of 74% was expected in relation to sales from the previous year. In contrast, **for 2024 the average is 67%.** The 7 p.p. drop indicates **greater caution when setting goals after the challenging scenario of 2023.**

When **matching expectations for 2023 with the volume sold** in the same year, distributors reached **around 51% of their expected** volume.

Source: Greener, 2024. Data take into account 95% of distributors that participated in Greener's 2024 survey.

EXPECTATIONS FOR 2024

% of surveyed PV distributors



- Distributors who consider a **more optimistic scenario for 2024 (89% of the total number)** have an average expectation of a sales increase of **71%.**
- Among the **distributors that sold in excess of 200 MWp** in 2023, **all** have expectations of a **better scenario for 2024**.

Source: Greener, 2024.

04.

INTEGRATION

AND MOST REMEMBERED BRANDS

THE SURVEY

Estimated Number of active PV integrators

- The **population of PV Integrator companies** is estimated based on crossing data from the survey carried out by Greener with information provided by sector entities and companies active in the sector.

26,150

Active PV Integrators*

* Companies that actually carried out some level of business in 2023. This is a conservative estimate by Greener, therefore, the real market number may be higher.

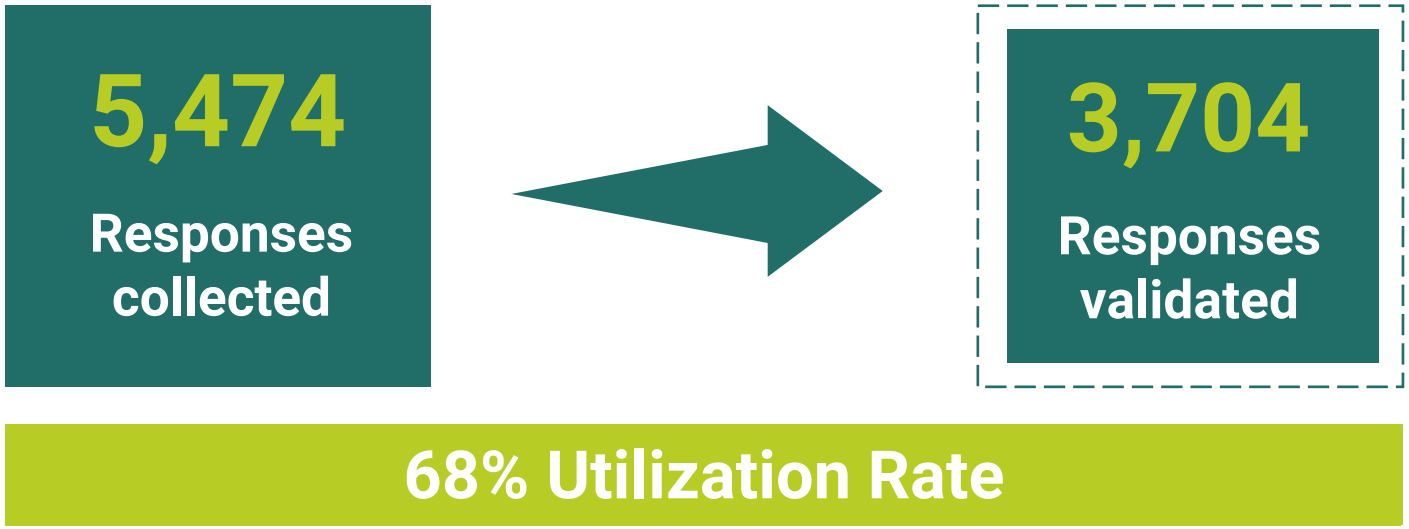
Source: Greener, 2024.

THE SURVEY

Introduction

- Greener conducted a new market survey with integrator companies from **January 4 to 26, 2024,** obtaining a total of 5,474 responses from all regions of the country. These companies vary in size and in age of their solar operations, thus representing a wide diversity in the photovoltaic integration market.

Data Validation



Source: Greener, 2024.

THE SURVEY

Sample used and its statistical properties

Size of Sample: 3,704 Solar Integrators

2%

Margin of Error

This measure **estimates the maximum margin of error** of the research results based on the selected sample. It means that the results **may vary upwards or downwards** with this value.

99%

Confidence interval

The Confidence Interval means that there is a **99% probability** that the real (population) results are **within the adopted margin of error**.

THE SURVEY

Introduction

Start of Solar Business Activities of Surveyed Companies:

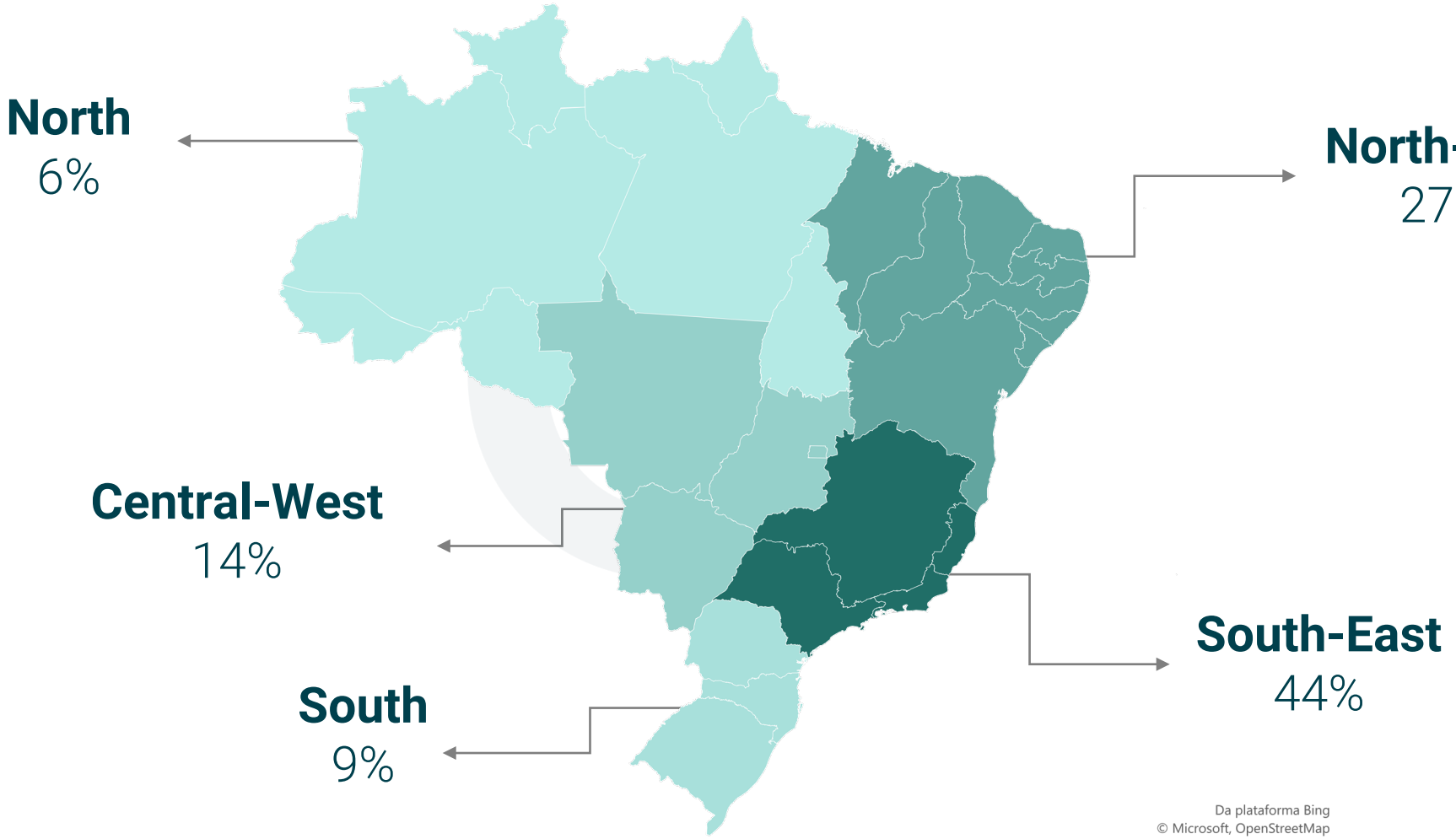
2018 or before	2019	2020	2021	2022	2023
26%	13%	14%	19%	14%	13%

- The percentage values represent the **distribution of the start of business activities** of the integrating companies that participated in the survey in January 2024.
- For example, the 13% figure for 2023 indicates the percentage of participating integrator companies that started their activities in the solar sector in that year.

Source: Greener, 2024.

THE SURVEYED INTEGRATORS

Percentage of integrator companies* based in each region



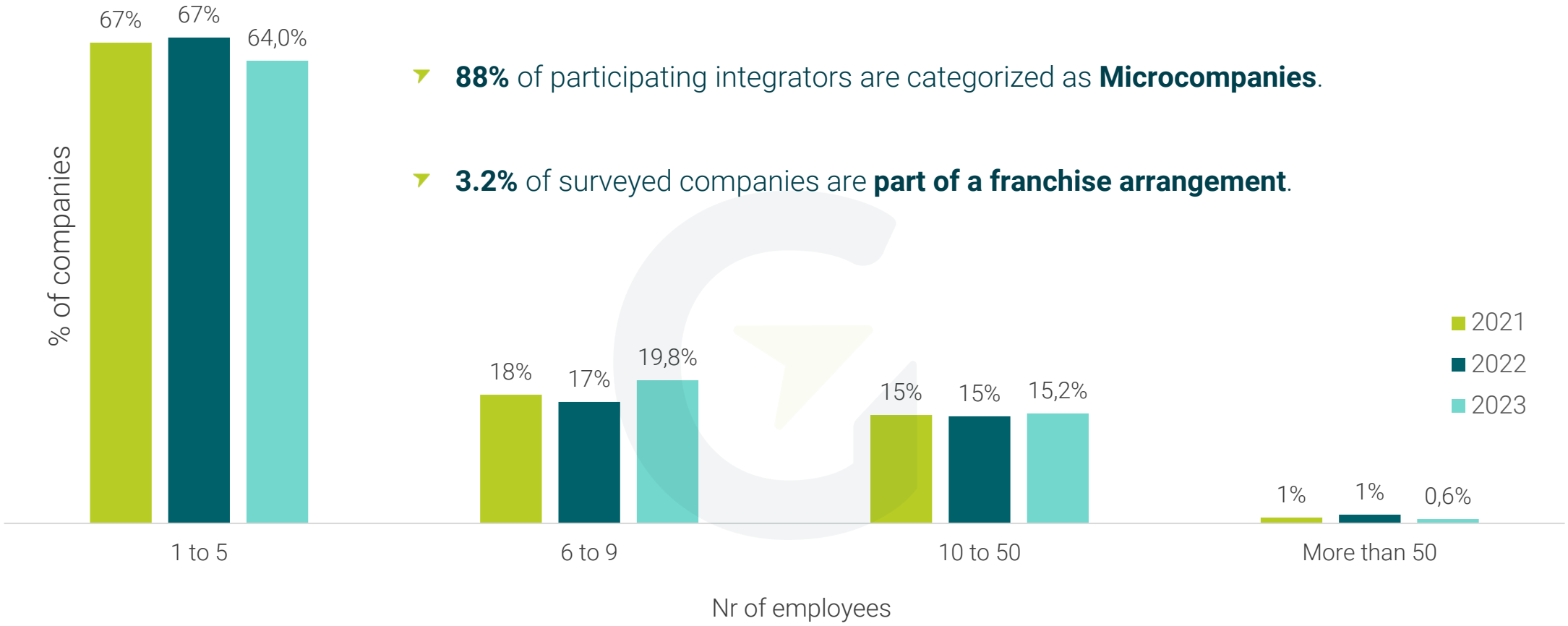
Source: Greener, 2024.

*Integrator companies which participated in the DG Survey carried out in January 2024.

PROFILE OF INTEGRATOR COMPANIES

Number of employees and franchisees

- The **average number of employees per company** remained stable at **7.**
- **88%** of participating integrators are categorized as **Microcompanies**.
- **3.2%** of surveyed companies are **part of a franchise arrangement**.



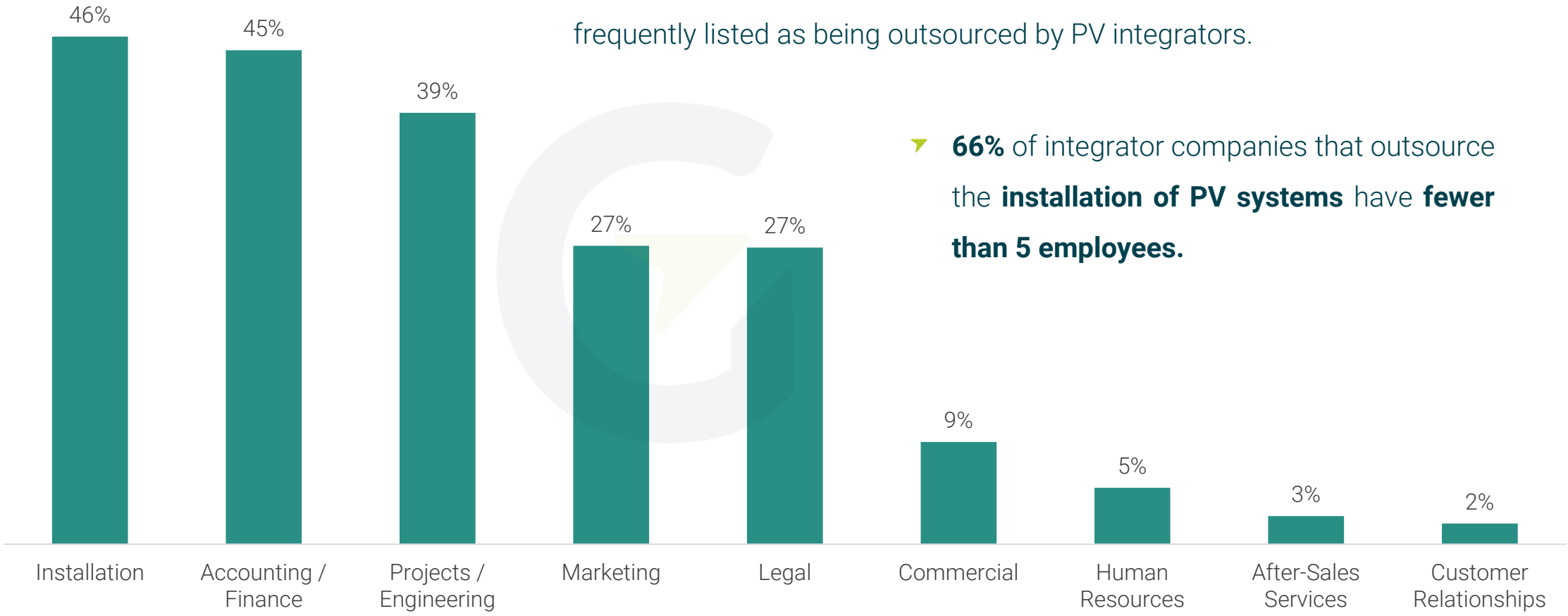
Source: Greener, 2024.

PROFILE OF INTEGRATOR COMPANIES

Business areas/activities that are totally or partially outsourced*

- **Installation and Accounting/Finance** are the services that are most frequently listed as being outsourced by PV integrators.

- **66%** of integrator companies that outsource the **installation of PV systems** have **fewer than 5 employees.**



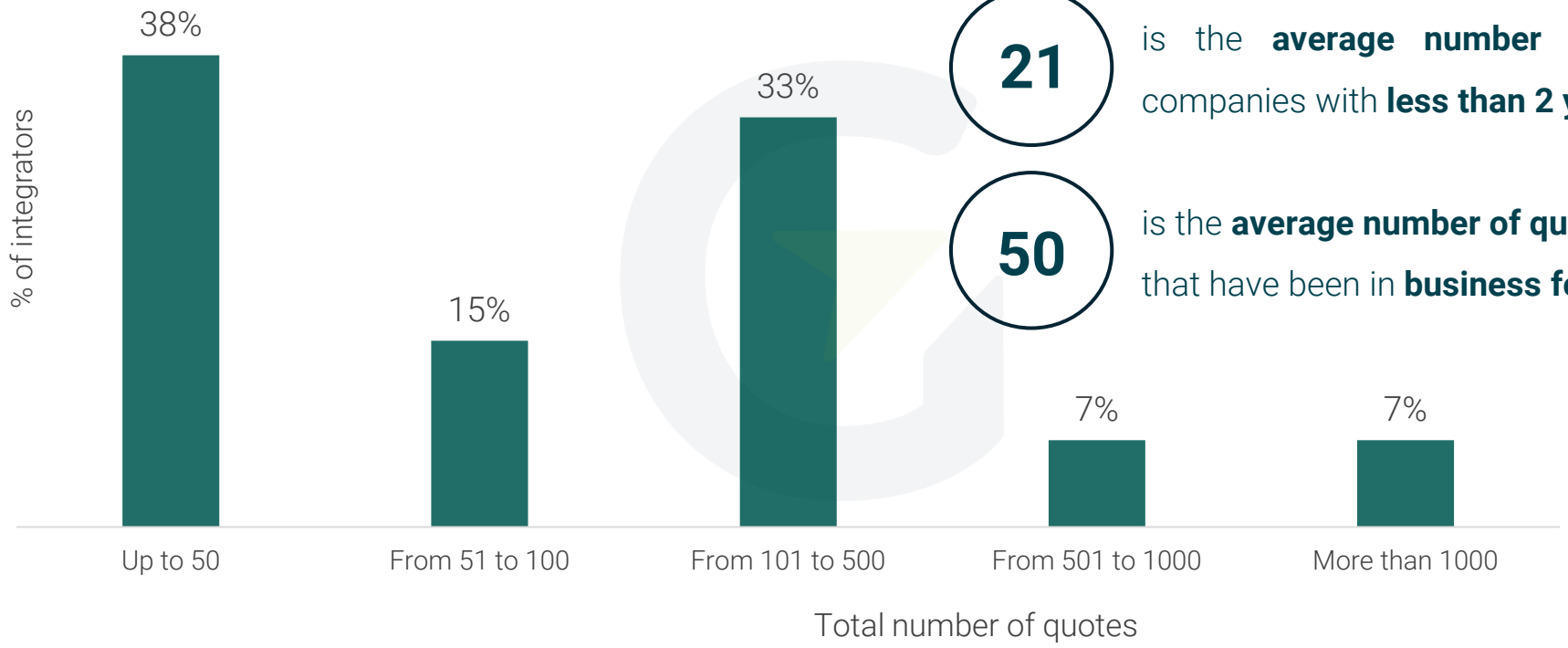
Source: Greener, 2024.

*Every integrator could choose more than one option of outsourced areas/activities.

NUMBER OF COMMERCIAL QUOTES CARRIED OUT

Number of quotes provided to customers in 2023

- The **average monthly number of quotes** showed a **slight increase** from the first to the second half of 2023.
- The year **2023 ended with an average of 43 quotes per month**, compared to an average of 32 quotes per month in the first half of the year, which may indicate increasing demand from end customers for PV systems.



21 is the **average number of quotes** per month for companies with **less than 2 years of market activity.**

50 is the **average number of quotes** per month of companies that have been in **business for more than 2 years**.

Source: Greener, 2024.

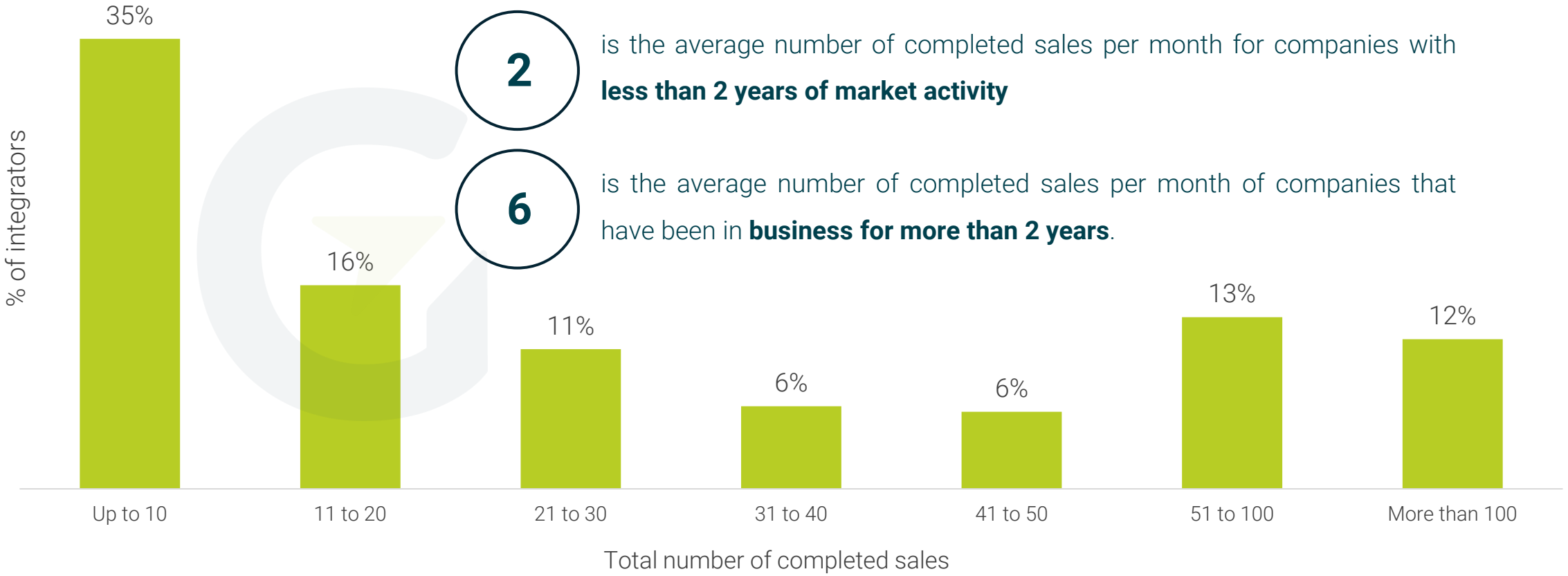
NUMBER OF PV SYSTEMS SOLD

Number of sales completed in 2023

11.6% was **the average sales conversion rate** in the year 2023. In the **first half of 2023**, the rate was **7%**.

2 is the average number of completed sales per month for companies with **less than 2 years of market activity**

6 is the average number of completed sales per month of companies that have been in **business for more than 2 years**.

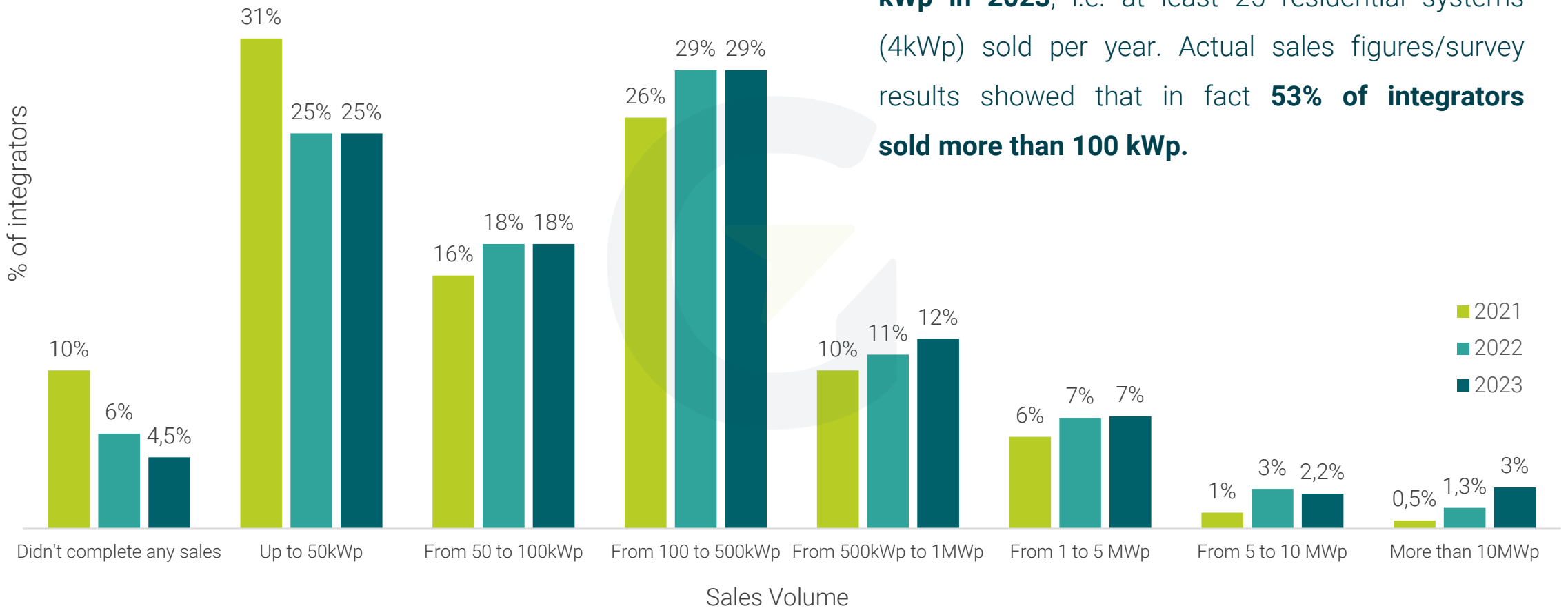


Source: Greener, 2024.

SALES VOLUME

Comparison of Capacity sold (kWp)

- **60% of integrators expected to sell more than 100 kWp in 2023**, i.e. at least 25 residential systems (4kWp) sold per year. Actual sales figures/survey results showed that in fact **53% of integrators sold more than 100 kWp.**

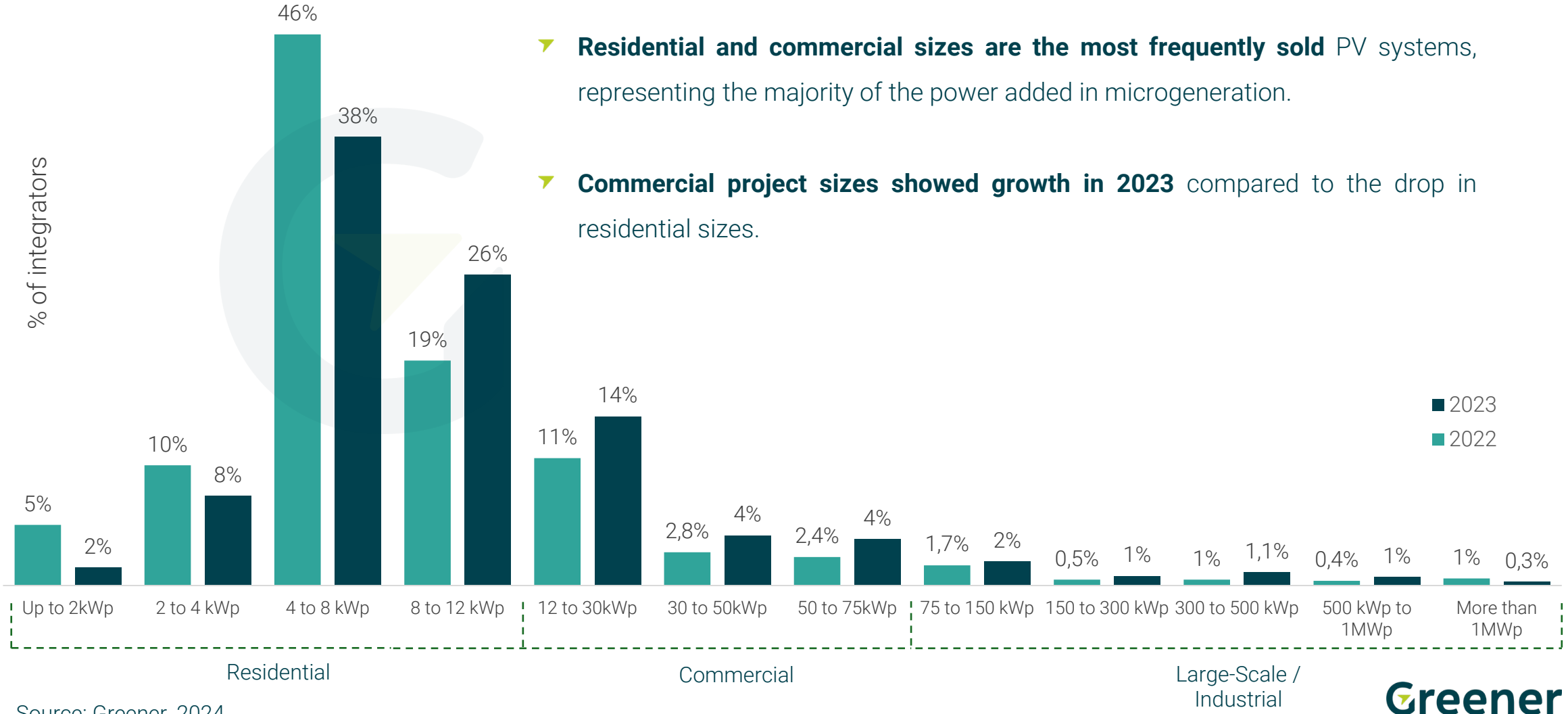


Source: Greener, 2024.

Note: Percentages may not add up to exactly 100% due to rounding of decimal places.

MOST FREQUENTLY SOLD SYSTEM SIZES

By PV Integrators in 2023



- **Residential and commercial sizes are the most frequently sold** PV systems, representing the majority of the power added in microgeneration.
- **Commercial project sizes showed growth in 2023** compared to the drop in residential sizes.

Source: Greener, 2024.

SOLAR FINANCING

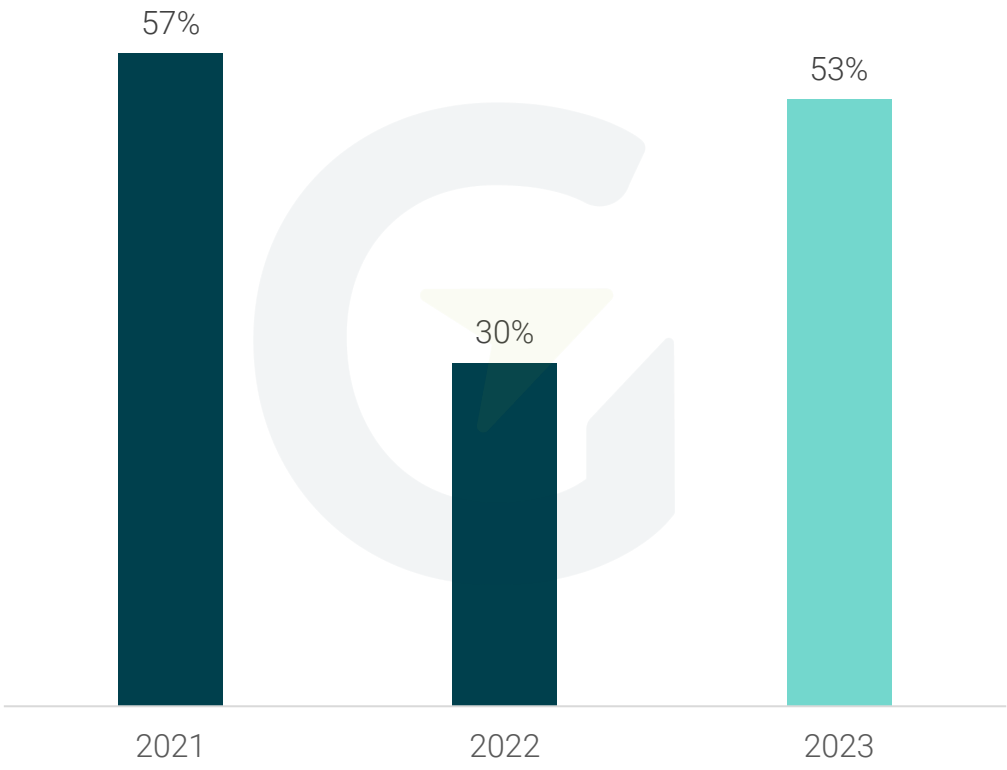
Volume of sales with (bank) financing

53% was the percentage of sales that benefited from **some kind of bank financing** in 2023.

There was an important recovery in the share of financing in sales of photovoltaic systems in 2023 (53%) compared to 2022 (30%), but it was still below the level of 2021 (57%).

Gradually, the **first half of 2023 already showed a recovery** in the use of bank credit for financing, **supporting 48% of sales**. The beginning of the **reduction in interest rates in the second half of the year** created more **favorable conditions for the use of credit**, resulting in the **year ending with 53%** of sales relying on bank financing.

Percentage of sales with (bank) financing

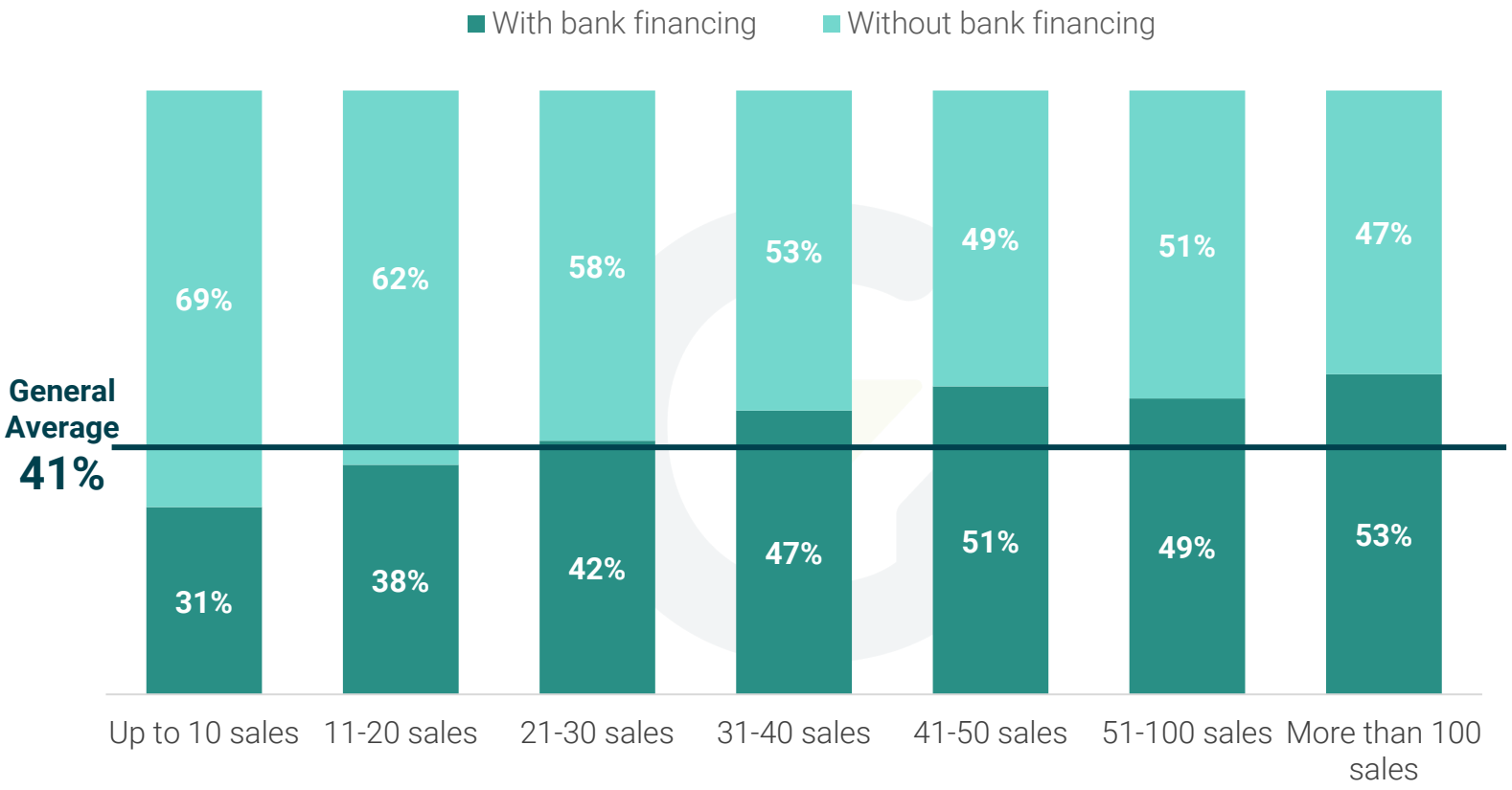


Source: Greener, 2024.

SOLAR FINANCING

Average % of bank-financed sales

- The year 2023 closed with an average of **41% of bank financed sales**, a slight increase compared to the first half of 2023, which showed an average of 38%.



How to read the graphic

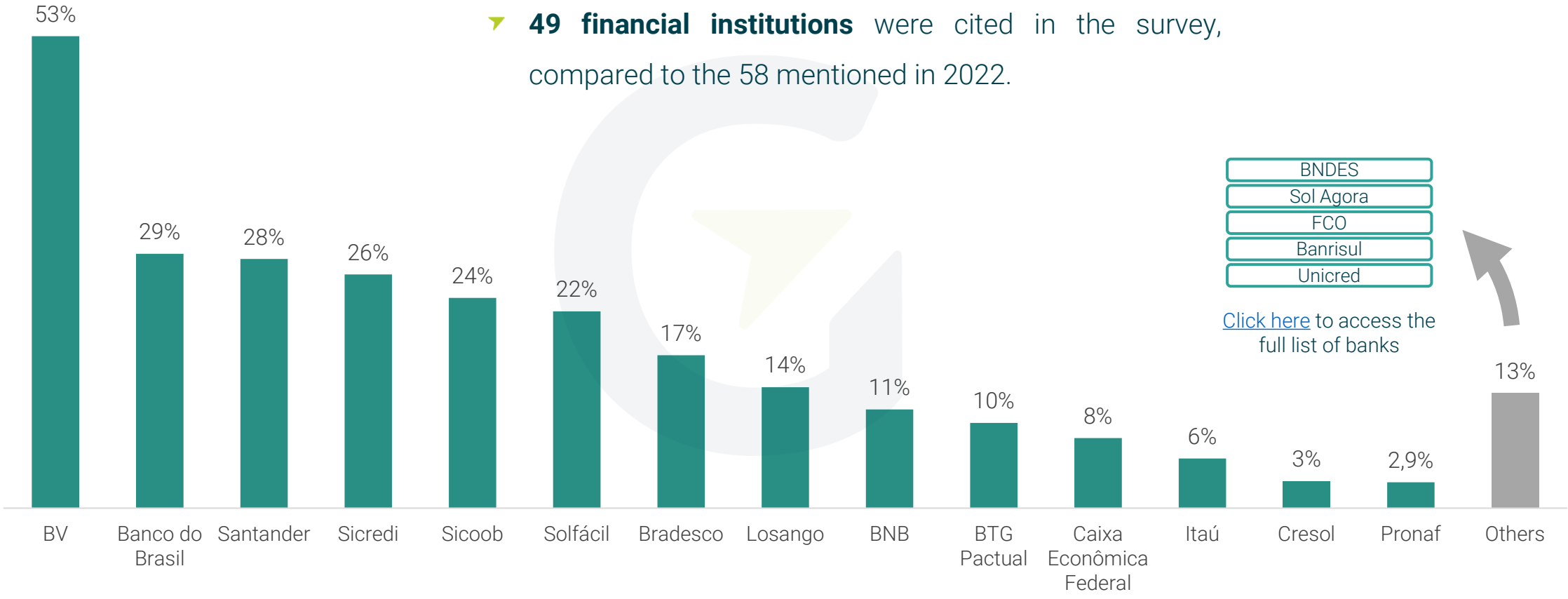
PV Integrators which sold up to 10 PV systems during 2023 reported a percentage of 31% of sales financed with bank credit, while integrators who sold more than 100 systems declared that 53% were through bank financing.

Source: Greener, 2024.

SOLAR FINANCING

Banks/financing lines used tp complete credit-financed sales*

- **49 financial institutions** were cited in the survey, compared to the 58 mentioned in 2022.



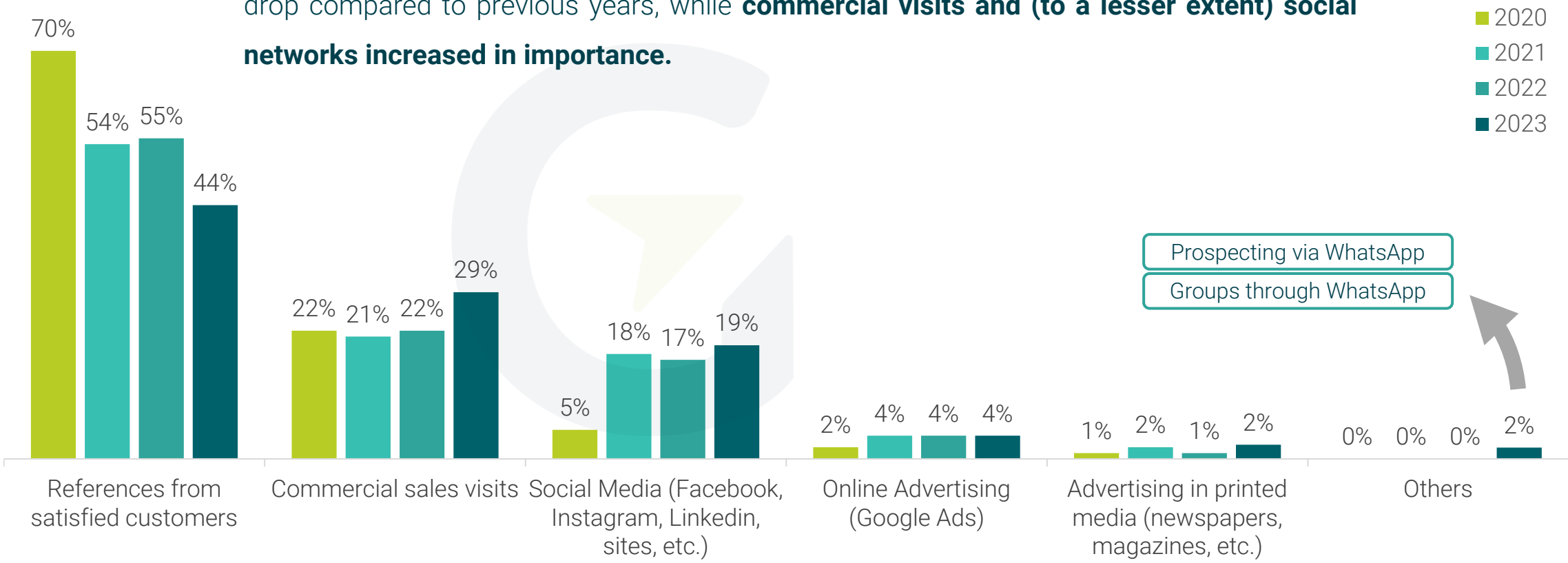
* Responses indicate the pulverization of financial agents in the solar PV market and **do not represent market share.** They show the percentage of companies that completed at least one credit-financed sale through any specific bank. One single company might have completed different project sales using different banks/products.

Source: Greener, 2024.

SALES CHANNELS

The sales channels that generated most sales*

- Although it is still the **main sales channel, referrals from satisfied customers** showed a drop compared to previous years, while **commercial visits and (to a lesser extent) social networks increased in importance.**



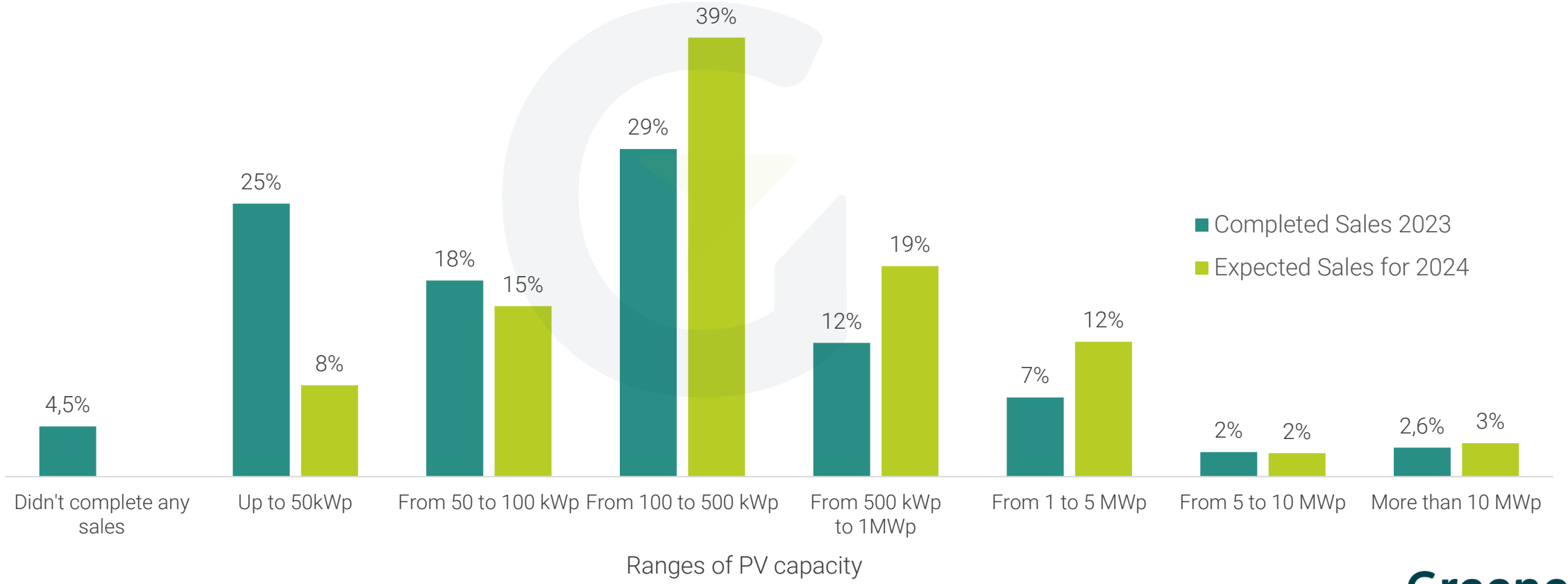
Source: Greener, 2024.

*Each integrator chose two sales channels.

SALES EXPECTATIONS

Completed sales in 2023 and expectations for 2024

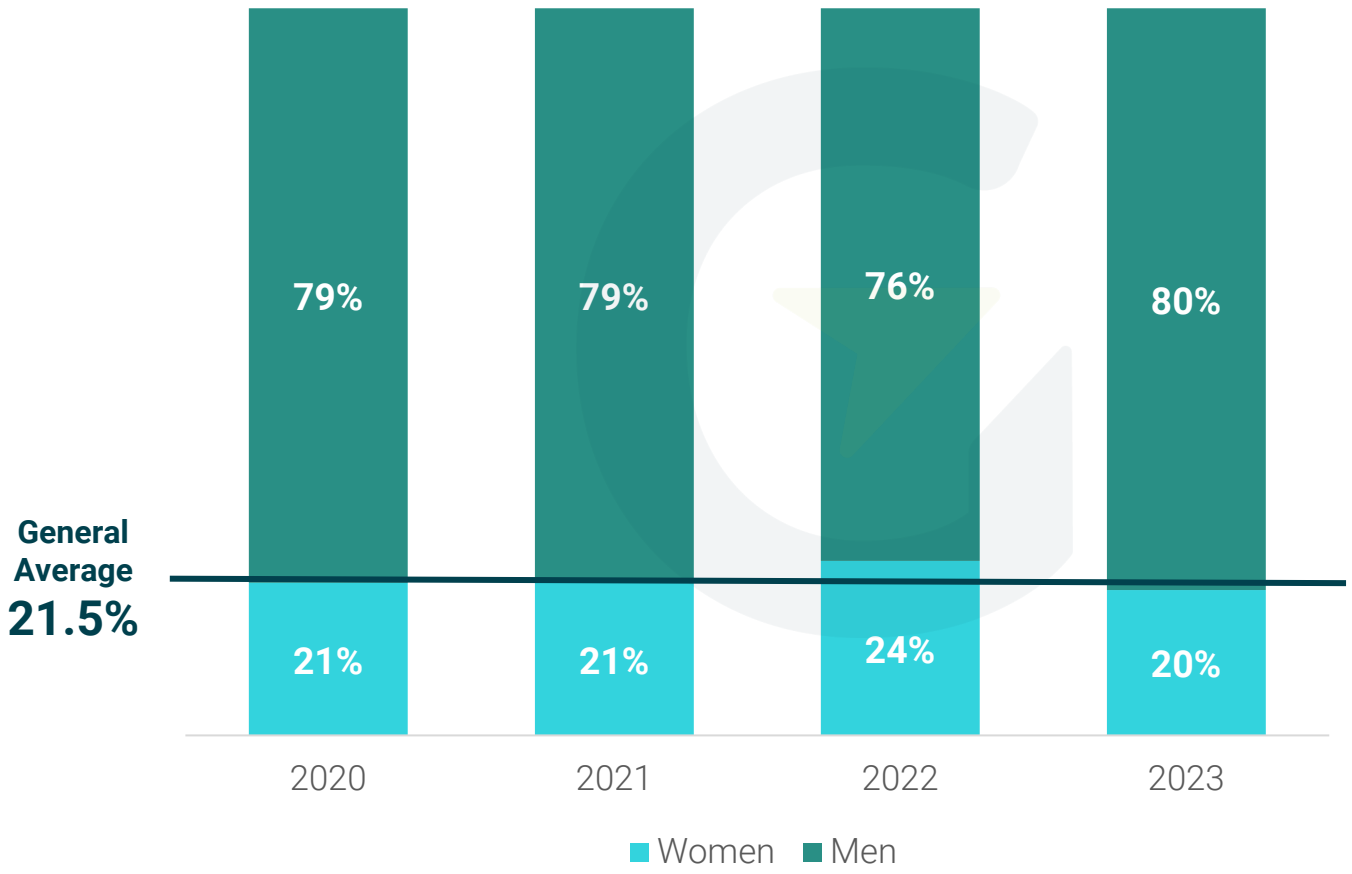
- **Sales expectations for 2024 are optimistic** compared to actual sales levels in 2023. The current scenario of a **reduction in the Selic rate** and, consequently, the interest rate for financing, combined with the **fall in equipment prices**, may be factors that influenced a higher sales expectations for 2024.



Source: Greener, 2024.

FEMALE PRESENCE

PV Integration Market



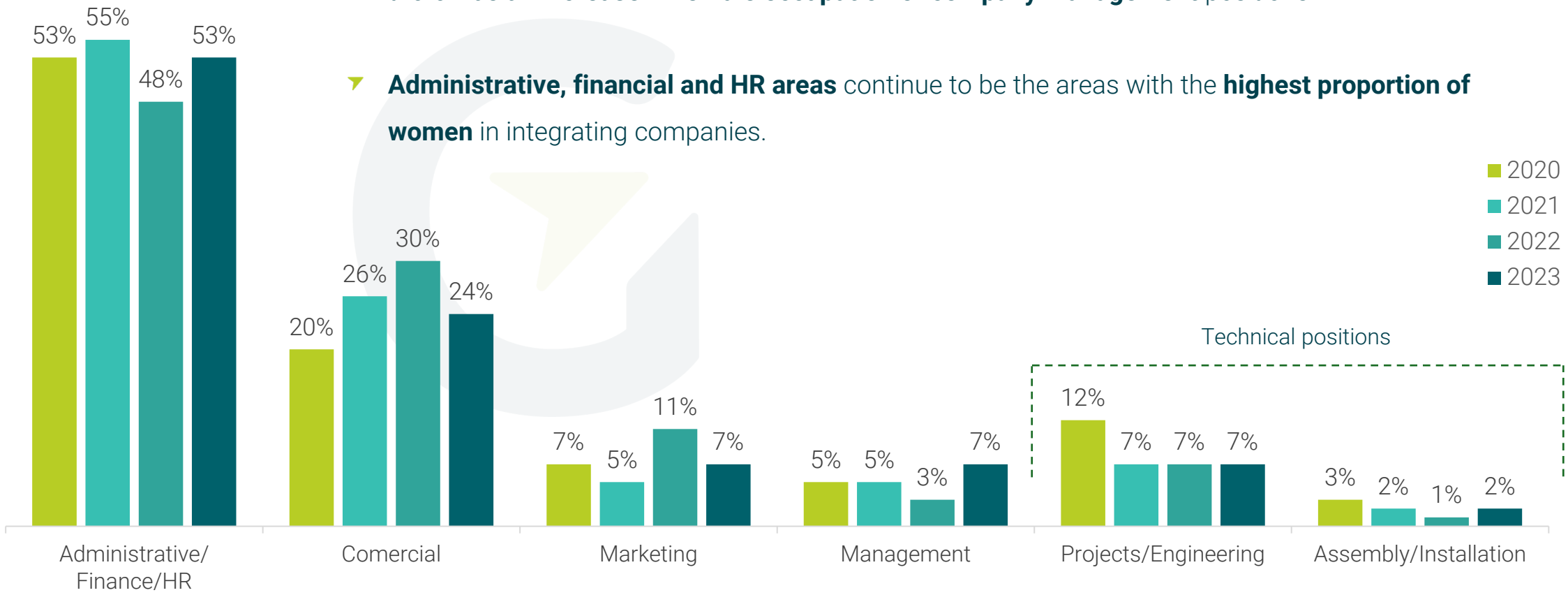
- **2023 saw a drop of 4 percentage points in female participation** in the PV integration market.
- Around **35% of integrating companies do not have female employees**.
- **3.3% of integrating companies have more women than men** in their workforce.

Source: Greener, 2024.

FEMALE PRESENCE

Business Areas with Highest Female Participation Rates

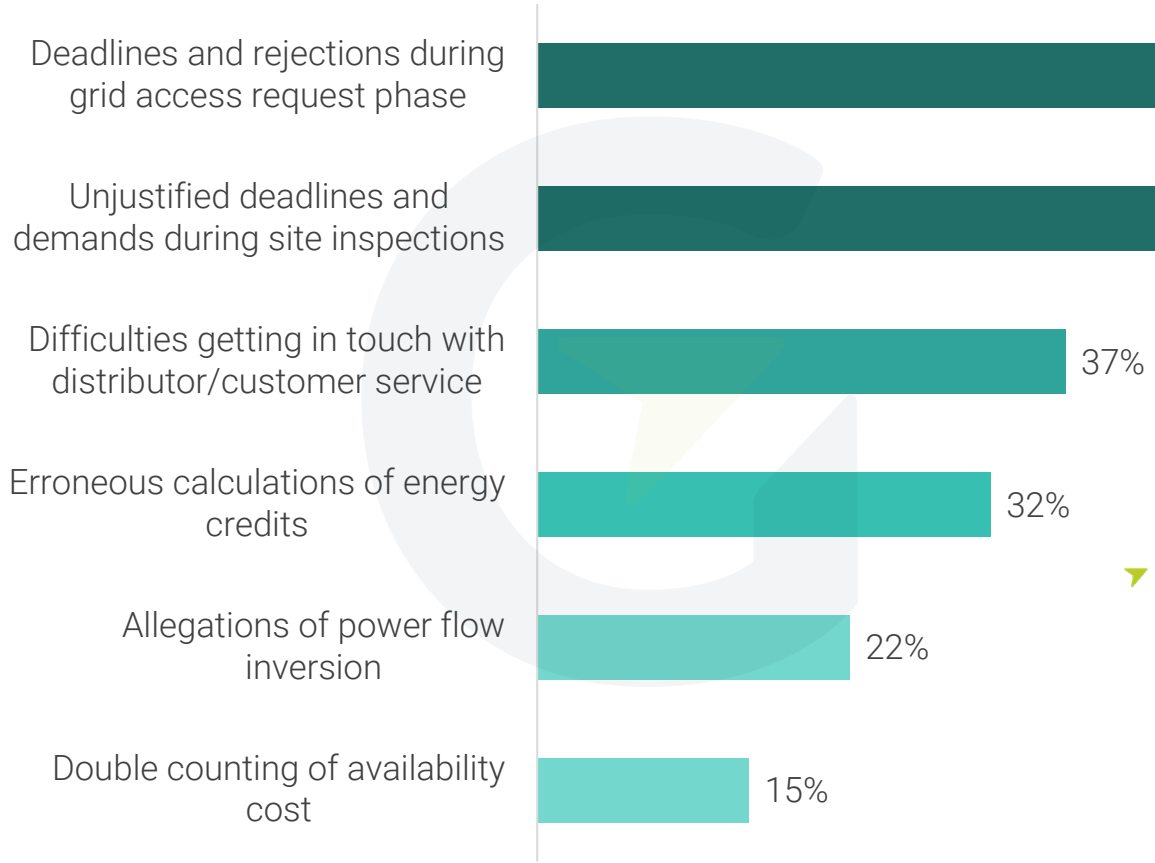
- There was a **drop in the participation of women in the commercial** area in 2023, whereas there was an **increase in female occupation of company management** positions.
- **Administrative, financial and HR areas** continue to be the areas with the **highest proportion of women** in integrating companies.



Source: Greener, 2024.

CHALLENGES ENCOUNTERED

Main challenges faced in relation to **energy distributors** in 2023*



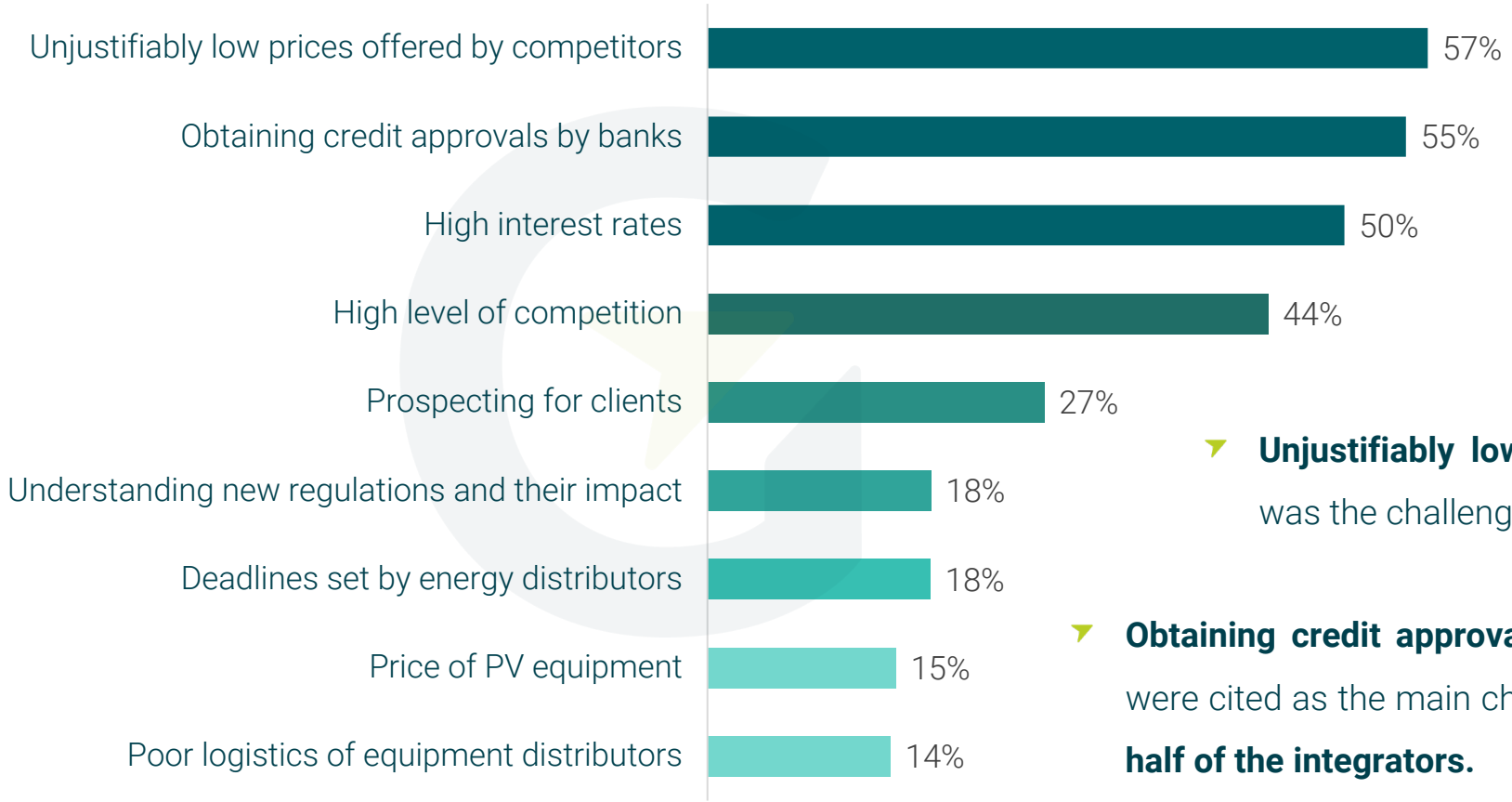
- **25%** of all occurrences took place in **São Paulo state**, followed by **10% in Minas Gerais**.

- For **around half of the integrators**, the **biggest challenges** in relation to energy distributors are **the deadlines**.

Source: Greener, 2024. *Each PV Integrator chose 2 specific challenges.

CHALLENGES ENCOUNTERED

Main challenges overall faced by PV integrators in 2023*

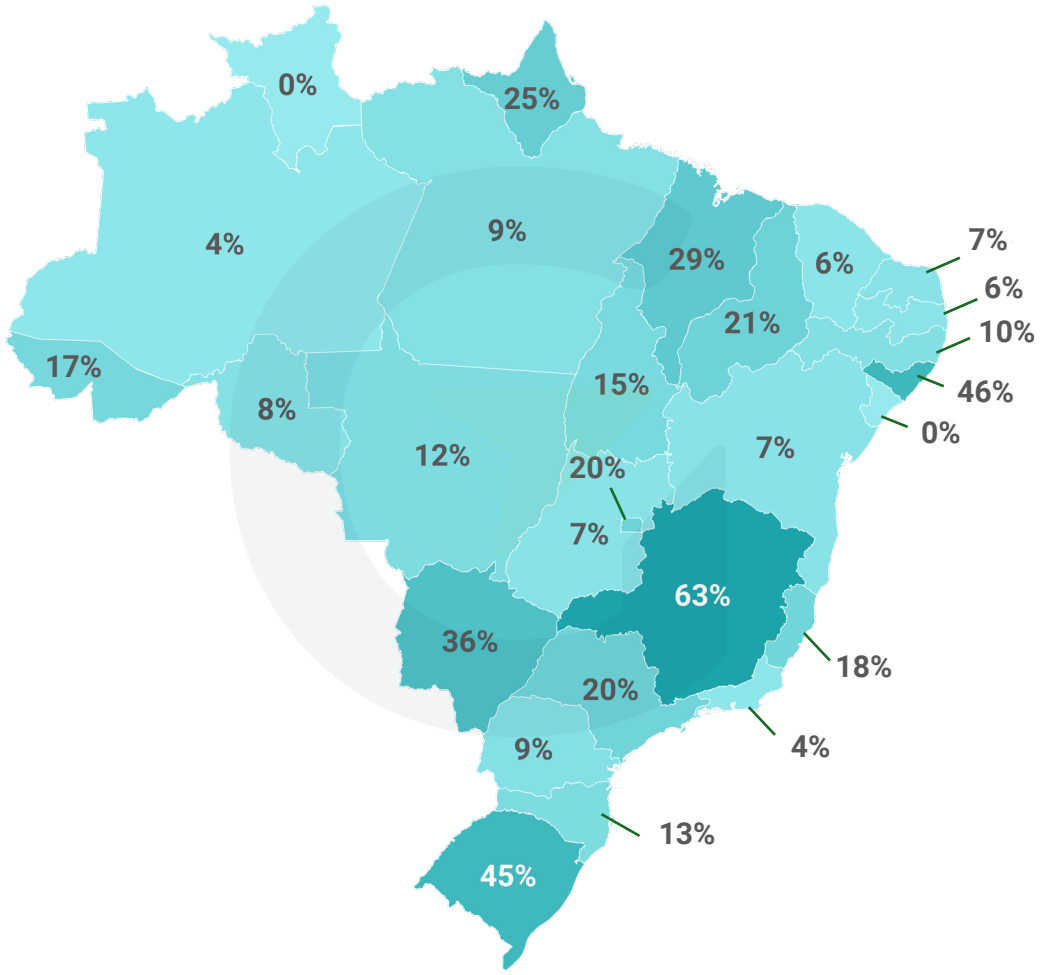


- **Unjustifiably low prices** offered by the competition was the challenge **most cited by integrators** in 2023.
- **Obtaining credit approval by banks** and **high interest rates** were cited as the main challenges faced in 2023 by **more than half of the integrators.**

Source: Greener, 2024. *Each PV Integrator could choose 3 challenges.

TRENDING TOPICS

Power Flow Inversion



- In Brazil, **20% of integrators who made at least one sale faced claims of flow reversal** in the connection budget.
- **Minas Gerais**, **Alagoas** and **Rio Grande do Sul** were the states which, percentage-wise, showed the highest incidence of allegations of power flow inversion by electricity distributors.

How to read the map

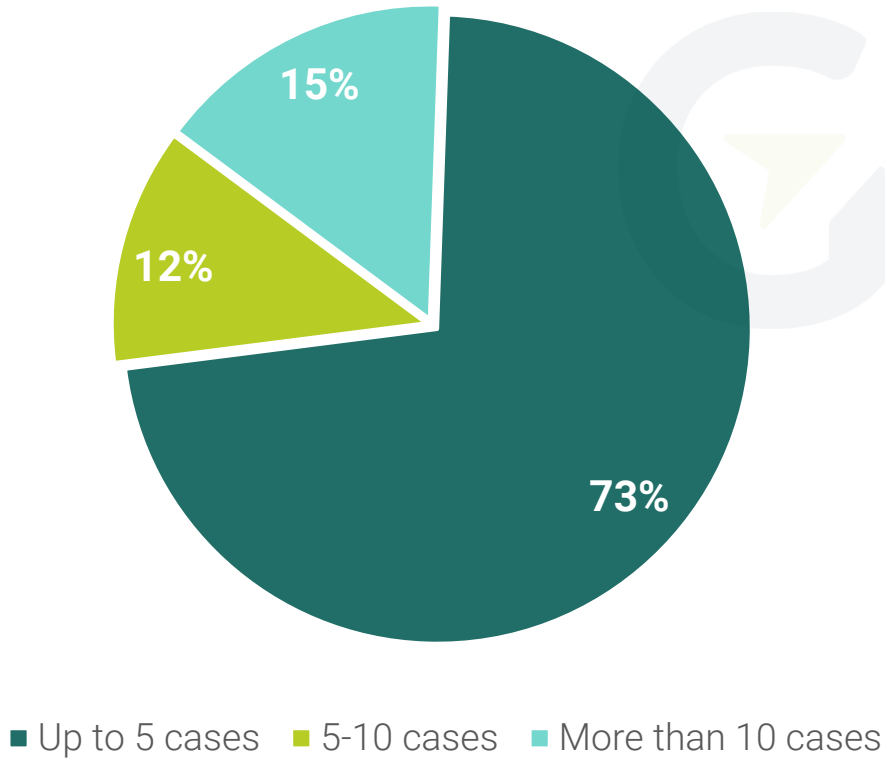
The percentages for each state represent the percentage of integrators who have faced problems with flow reversals. For example: In 2023, 63 per cent of integrators in Minas Gerais who made at least one sale faced problems with flow reversals.

Source: Greener, 2024.

TRENDING TOPICS

Power Flow Inversion

% of Integrators and respective number of cases of power flow inversion



- **44% of the cases** of power flow inversion reported by the integrators who took part in the survey **were resolved. In Minas Gerais,** this percentage is **27%.**

- Of those companies which reported power flow inversion problems, the **national average was 12 allegations**, while in **Minas Gerais** this average was double that number, totalling **24**.

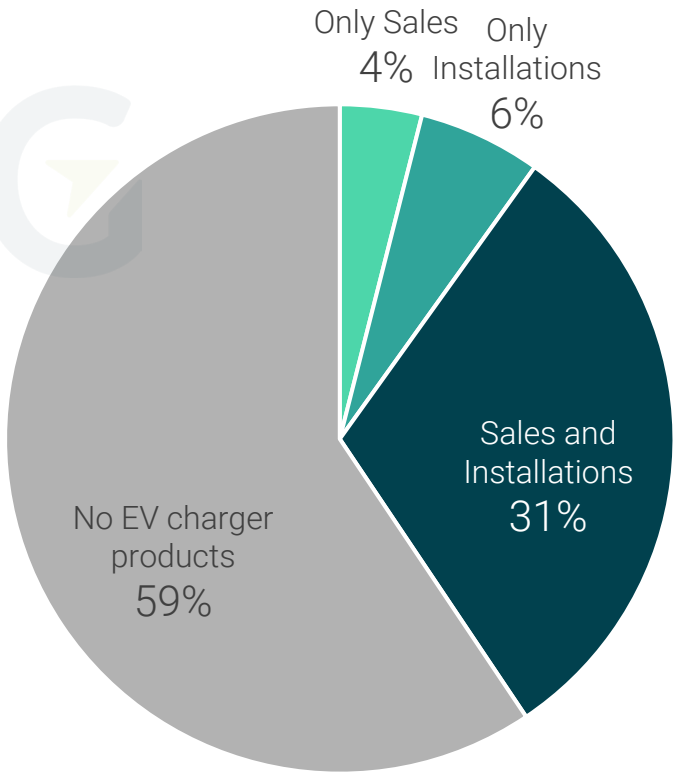
Source: Greener, 2024.

TRENDING TOPICS

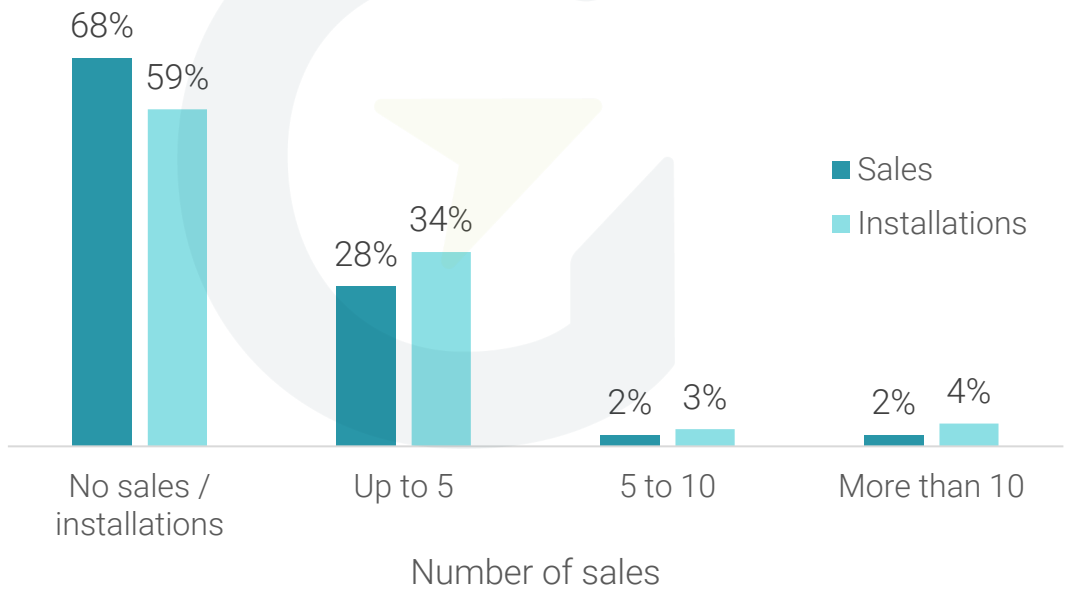
Chargers for electric vehicles

- Out of all PV Integrator survey respondents, **11% sold at least 1 electric vehicle charger and 15% installed at least 1** electric charger in 2023.

Does your company work with sales or installations of electric vehicle chargers?



How many sales/installations did you complete?

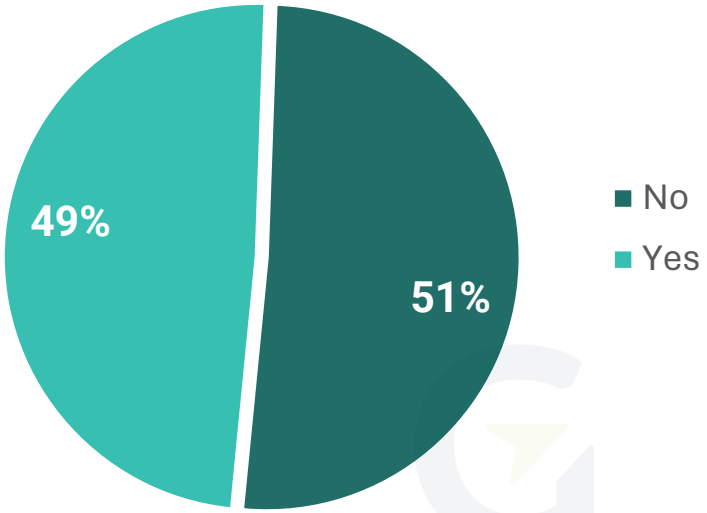


Source: Greener, 2024.

TRENDING TOPICS

Hybrid Systems (Solar PV with batteries)

Does your company offer hybrid systems (Solar PV with batteries)?

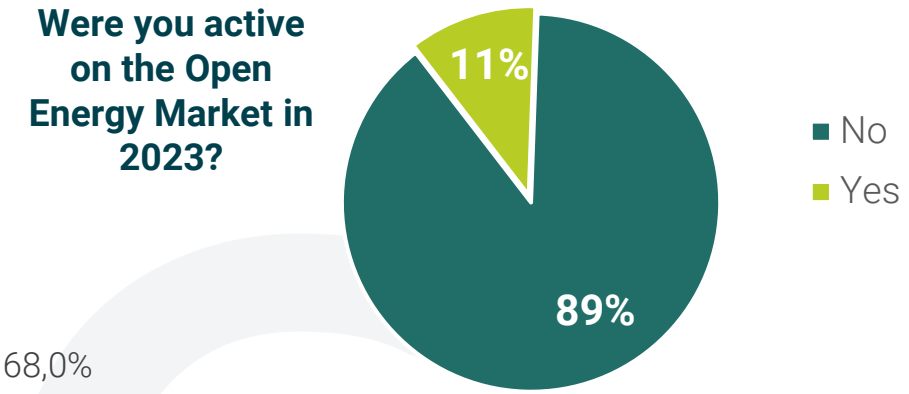


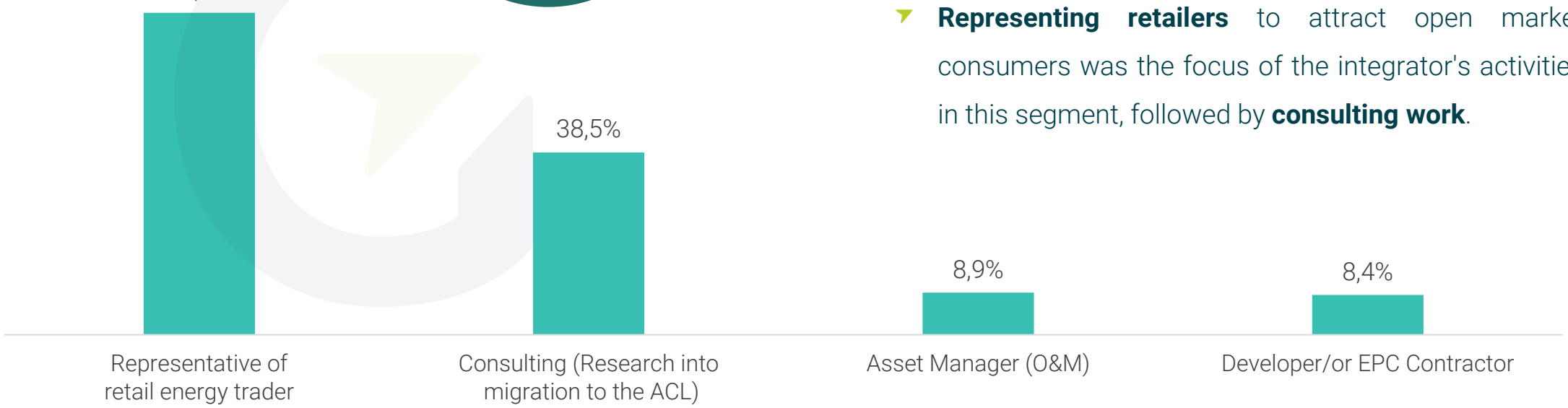
- **Of the 49% of integrators who offer hybrid systems, 25% have sold at least one** hybrid system, i.e. **12% of all integrators** who responded to the survey **have sold at least one hybrid system** with a battery.
- Of the integrators who have sold a hybrid system, **95% have sold less than 5 systems.**
- **São Paulo** is the state with the **highest number of integrators who have sold hybrid systems, representing 27%** of the total sold in Brazil. **Minas Gerais comes second, with 12%** of integrators.

Source: Greener, 2024.

TRENDING TOPICS

Operations in the Open Energy Market (ACL)*





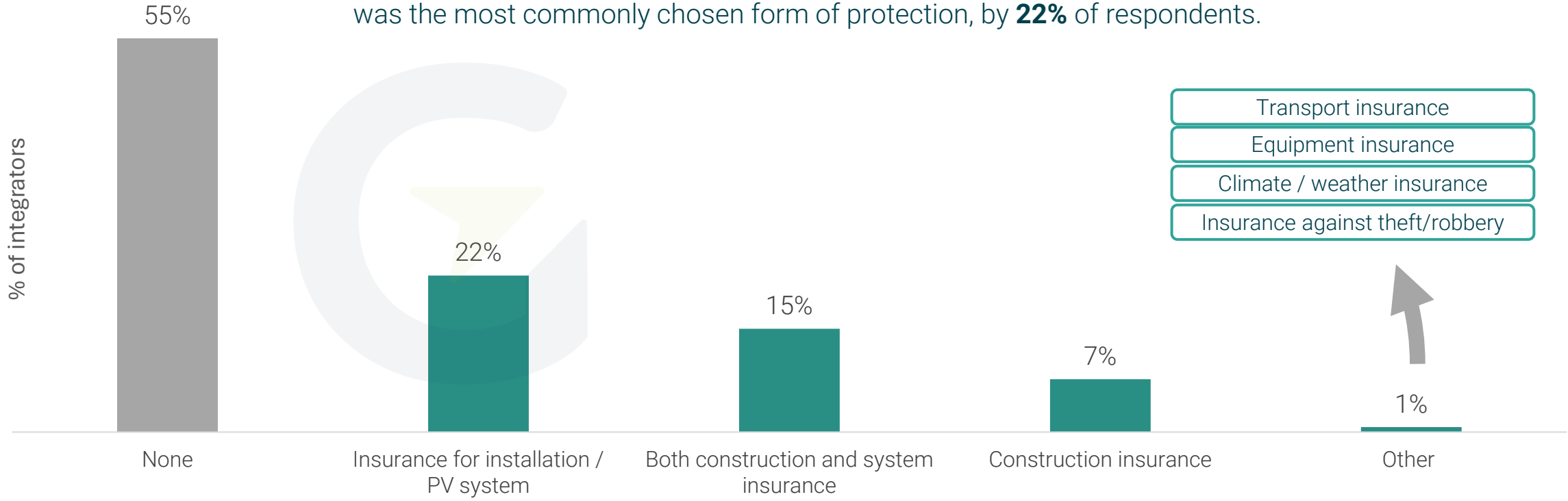
- **89% of integrators are not yet active** in the open energy market. The continuation of the **market opening process from 2024 onwards** could be an **opportunity to expand** the range of activities to other energy solutions.
- **Representing retailers** to attract open market consumers was the focus of the integrator's activities in this segment, followed by **consulting work**.

Source: Greener, 2024. *Integrators operating in the open energy market could choose more than one option for their operations

TRENDING TOPICS

Insurance hiring for the solar segment*

- **45% of integrators contracted some form of insurance** for their solar market activities in 2023. **Insurance for the installation/PV system itself** was the most commonly chosen form of protection, by **22%** of respondents.

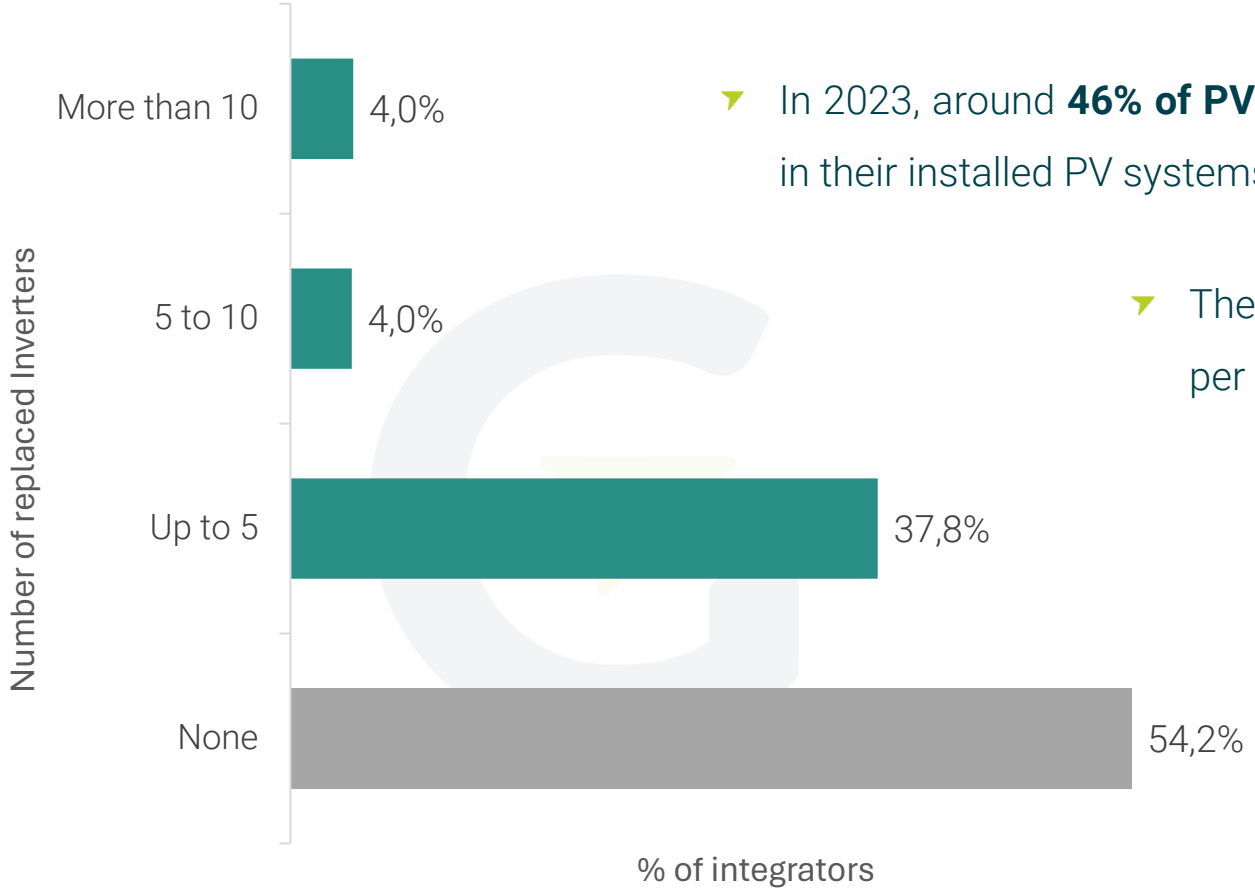


Source: Greener, 2024.

*Every integrator could select only 1 option for type of insurance contracted.

TRENDING TOPICS

Replacement of inverters



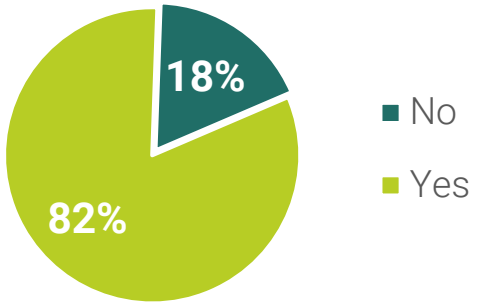
- In 2023, around **46% of PV integrators** had to replace at least one inverter in their installed PV systems.
- The **average number of replaced inverters was 3** per integrator.
- **Integrators who have been in business longer replaced more inverters** in 2023 compared to newer integrators.

Source: Greener, 2024.

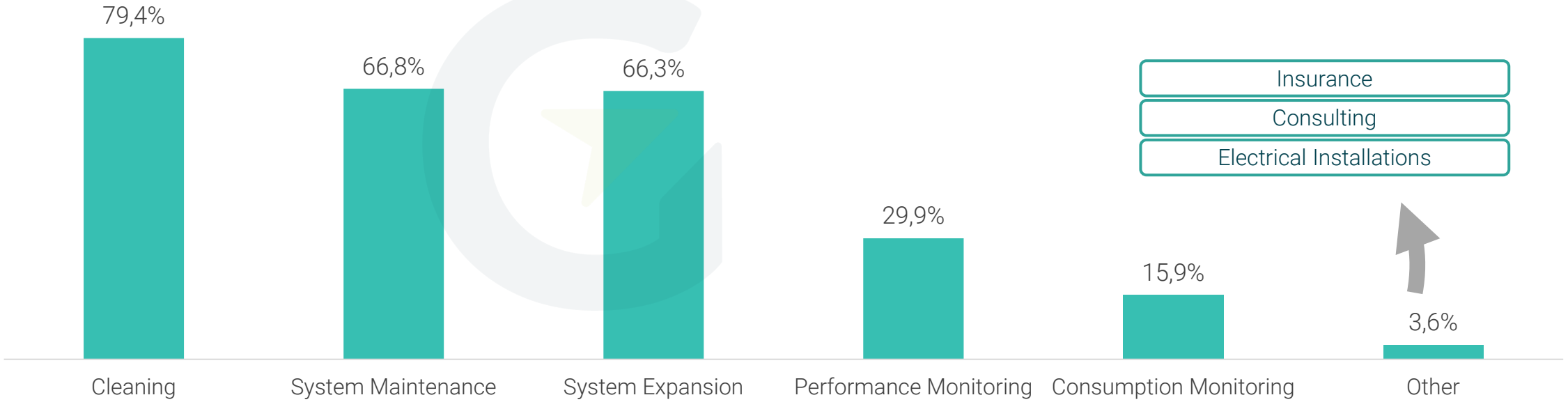
TRENDING TOPICS

Revenues from after-sales*

Does your business generate revenue from after-sales?



- **After-sales** customer contact as a **source of revenue** proved to be a strategy **widely adopted** by integrators in 2023, with **module cleaning being the most cited** by integrators.

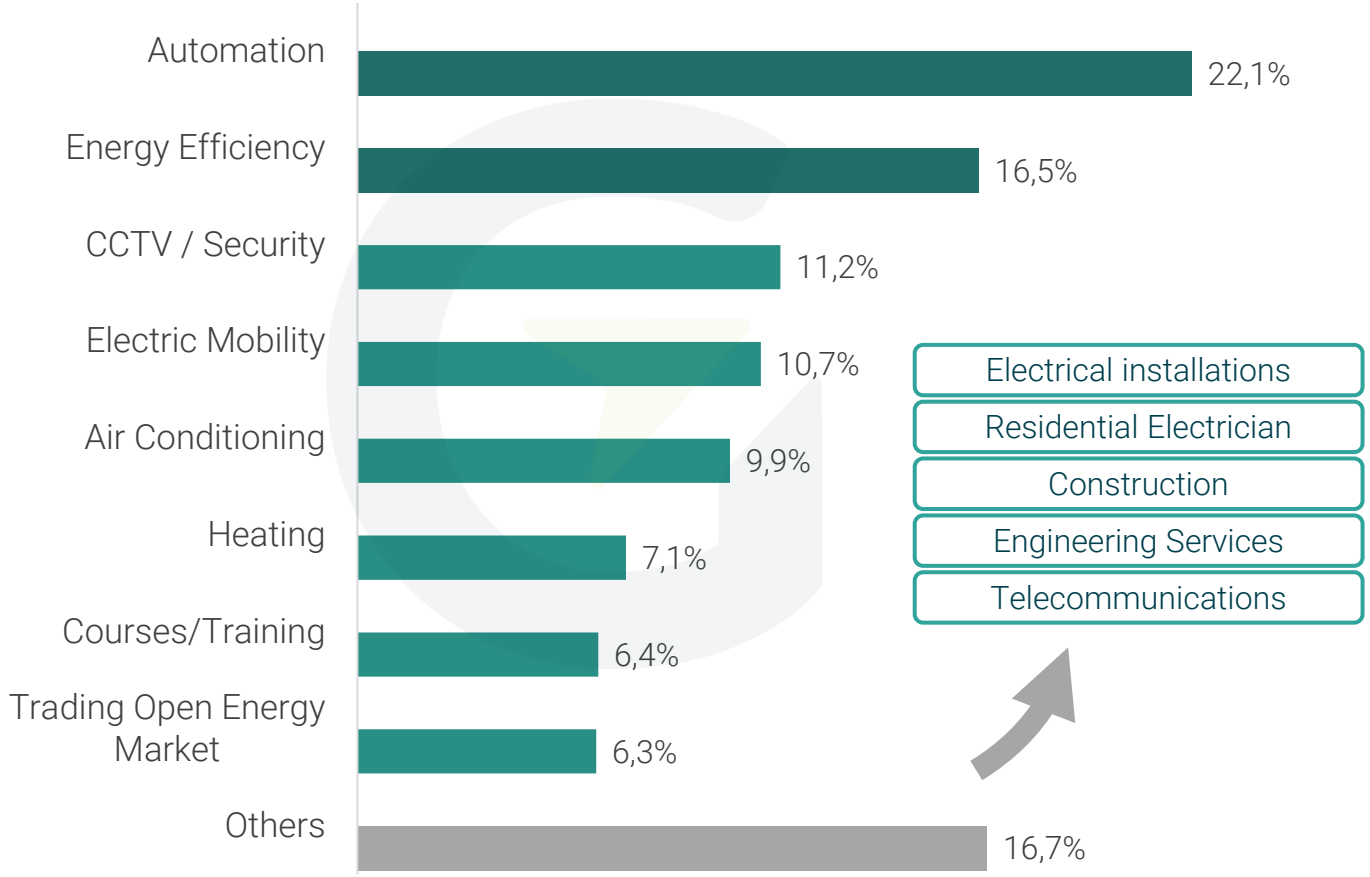


Source: Greener, 2024.

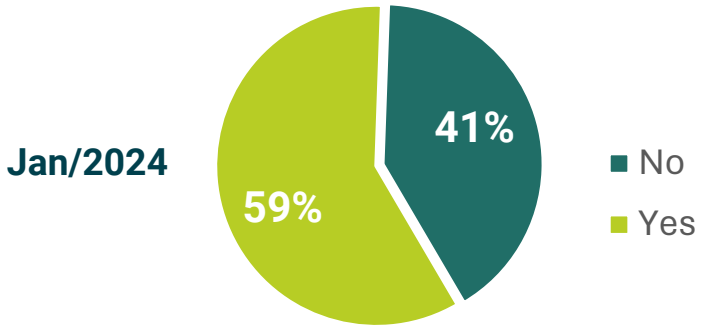
*Integrators which generated such revenue could choose more than one revenue option.

OTHER BUSINESS SEGMENTS

Operations in other markets beyond solar photovoltaics*



Is your business active in any segment other than solar PV energy?



- There was a **decrease in the number of integrators operating in other segments** in January 2024 (59%) compared to January 2023 (84%), indicating a market with more companies dedicated solely to solar PV.

Source: Greener, 2024.

*Integrators which have operations in other markets could choose more than one answer.

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MOST REMEMBERED COMPANIES

Brands related to **DISTRIBUTION** most remembered by PV Integrators

TOP 10

1. Fotus Solar
2. BelEnergy
3. Aldo
4. Bluesun
5. FortLev Solar
6. SouEnergy
7. Ecori
8. Soollar Distribuidora
9. PHB Solar
10. Edeltec

TOP 20

11. Genyx Solar
12. Intelbras
13. Helte
14. Amara NZero
15. WEG
16. GO Solar
17. Megacomm
18. SolMais
19. Cor Solar
20. Foco Solar

TOP 30

21. Solar Inove
22. JNG Solar
23. Nexen
24. AVT Energy
25. Renovigi
26. Mazer Solar
27. Esfera Solar
28. Bold Energy
29. Serrana Solar
30. A.Dias Solar

Source: Greener, 2024.

MOST REMEMBERED COMPANIES

Brands of **PV MODULES** most remembered by PV Integrators

TOP 10

1. Canadian Solar
2. Sunova Solar
3. Jinko
4. JA Solar
5. DAH Solar
6. Trina Solar
7. Pulling Energy
8. Hanersun
9. Honor Solar
10. TSUN

TOP 20

11. OSDA
12. Resun
13. Leapton
14. LONGi
15. Risen Solar
16. ZNShine
17. Astronergy
18. BYD
19. Intelbras
20. Ulica

Source: Greener, 2024.

MOST REMEMBERED COMPANIES

Brands of **PV INVERTERS** most remembered by PV Integrators

TOP 10

1. Growatt
2. Deye
3. Solis
4. SAJ
5. Solplanet
6. Sofar
7. Sungrow
8. Fronius
9. WEG
10. Huawei

TOP 20

11. Hoymiles
12. PHB Solar
13. GoodWe
14. APSystems
15. Canadian Solar
16. Intelbras
17. Solar Edge
18. Livoltek
19. Enphase
20. BelEnergy

Source: Greener, 2024.

MOST REMEMBERED COMPANIES

Brands of **MOUNTING STRUCTURES** most remembered by PV Integrators

TOP 10

1. Solar Group
2. Romagnole
3. CCM
4. FotoFix
5. 2P Acessórios
6. SSM
7. Pratyc
8. BelEnergy
9. NTC Somar
10. Fotus Solar

TOP 20

11. Spin
12. PHB Solar
13. IZI
14. Perfil Solar
15. Intelbras
16. GDfix
17. Polimax Estruturas
18. GF2
19. Sou Energy
20. Angulo

Source: Greener, 2024.

MOST REMEMBERED COMPANIES

Brands of **ELECTRICAL PROTECTION** most remembered by PV Integrators

TOP 10

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

TOP 20

11. Tramontina
12. Beny
13. PHB Solar
14. Brum
15. Merz Dehn
16. GE
17. Intelbras
18. Chint
19. Sibratec
20. Elgin

Source: Greener, 2024.

MOST REMEMBERED COMPANIES

Brands of **BATTERIES** most remembered by PV Integrators

TOP 10

1. Moura
2. Freedom
3. Unipower
4. Deye
5. Huawei
6. BYD
7. Dyness
8. Growatt
9. PHB Solar
10. WEG

TOP 20

11. Solar Edge
12. Intelbras
13. GoodWe
14. Fulguris
15. Elgin
16. Enphase
17. Bosch
18. SAJ
19. SolaX Power
20. Energy Source

Source: Greener, 2024.

*Stationary batteries Applied in hybrid photovoltaic systems (PV System + Batteries).

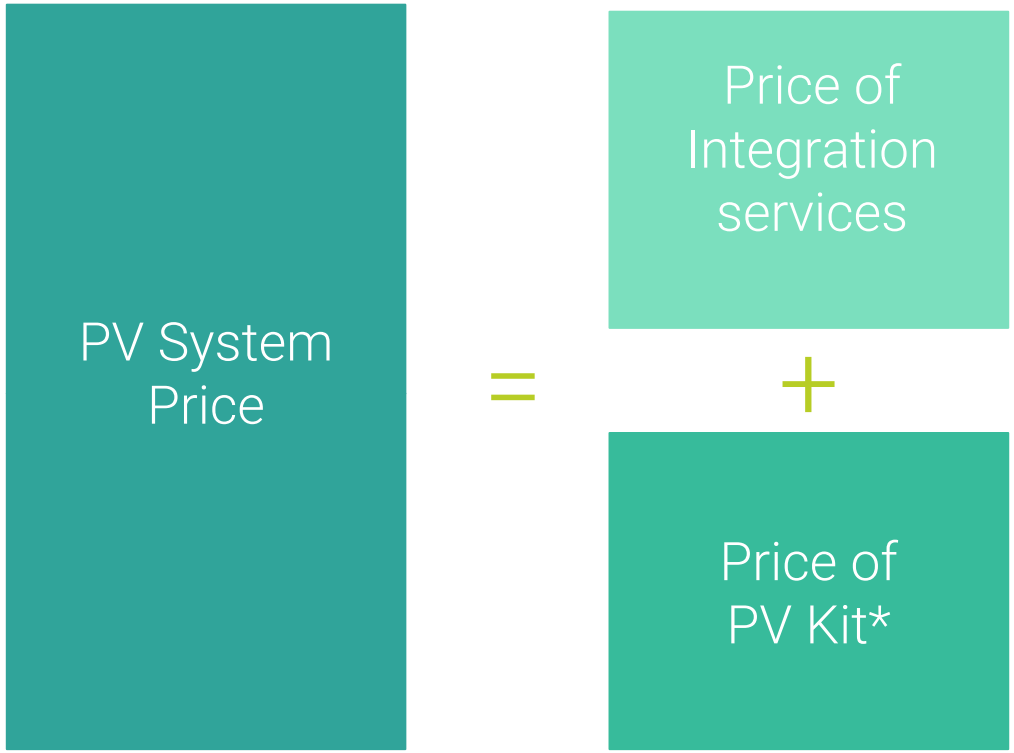
05.
PRICES

PRICING RELATIONSHIPS

Price of Kits + Price of Services = PV System Price

- The **average price of the PV system by size category** is obtained by analyzing the prices provided by thousands of integrators who respond to the DG Surveys that are carried out every six months by Greener.
- The **average price of PV kits** is obtained through price mapping and research with equipment distributors.
- The **average price of the integration service** is the difference between the price of the PV system and the price of the PV kit, and represents the integrator's service charge.

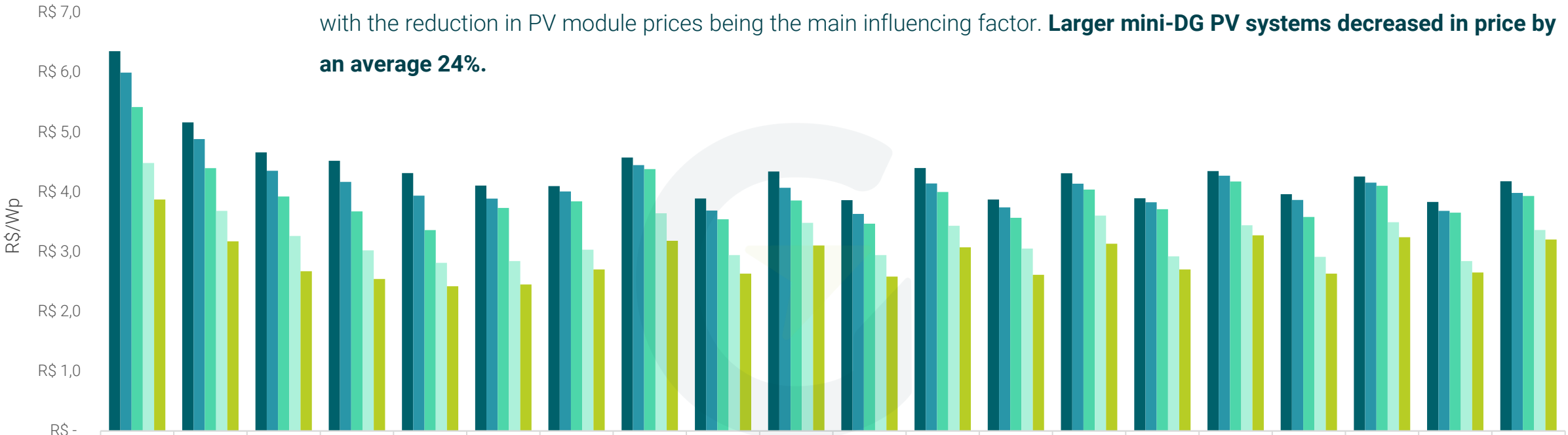
**Kit is composed of: PV Modules + Inverters + Mounting System + Cables and Connectors + Protection System*



Source: Greener, 2023. The relative size of boxes in the diagram is purely illustrative, and doesn't show actual proportions of the components.

PRICES OF PV SYSTEMS

- On average, **prices for end customers of micro-DG systems fell by 30%** in January 2024 compared to one year previously, with the reduction in PV module prices being the main influencing factor. **Larger mini-DG PV systems decreased in price by an average 24%.**



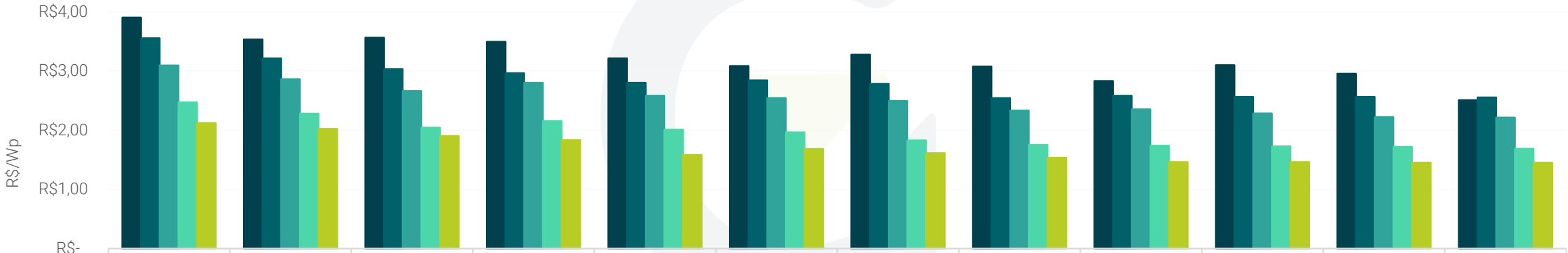
	2kWp	4kWp	8kWp	12kWp	30kWp	50kWp	75kWp	75kWp ground	150kWp	150kWp ground	300kWp	300kWp ground	500kWp	500kWp ground	1MWp	1MWp ground	3MWp	3MWp ground	5MWp	5MWp ground
jan/22	6,35	5,16	4,66	4,52	4,31	4,10	4,09	4,57	3,89	4,34	3,86	4,40	3,87	4,31	3,89	4,35	3,96	4,25	3,83	4,18
jun/22	5,99	4,88	4,35	4,16	3,93	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
jun/23	4,48	3,68	3,26	3,02	2,81	2,84	3,03	3,64	2,94	3,48	2,94	3,43	3,05	3,60	2,92	3,44	2,91	3,49	2,84	3,36
jan/24	3,87	3,17	2,67	2,54	2,42	2,45	2,70	3,18	2,63	3,10	2,58	3,07	2,61	3,13	2,70	3,27	2,63	3,24	2,65	3,20

Residential | Commercial Small Size | Large Scale

Source: Greener, 2024.

PRICES OF PV KITS

- **PV Kit prices in January 2024 were 34% lower than in January 2023**. In addition to the reduction in equipment costs, the fall in retail prices was exacerbated by low market demand and the high volume of stock held by distributors, especially in the first half of 2023.

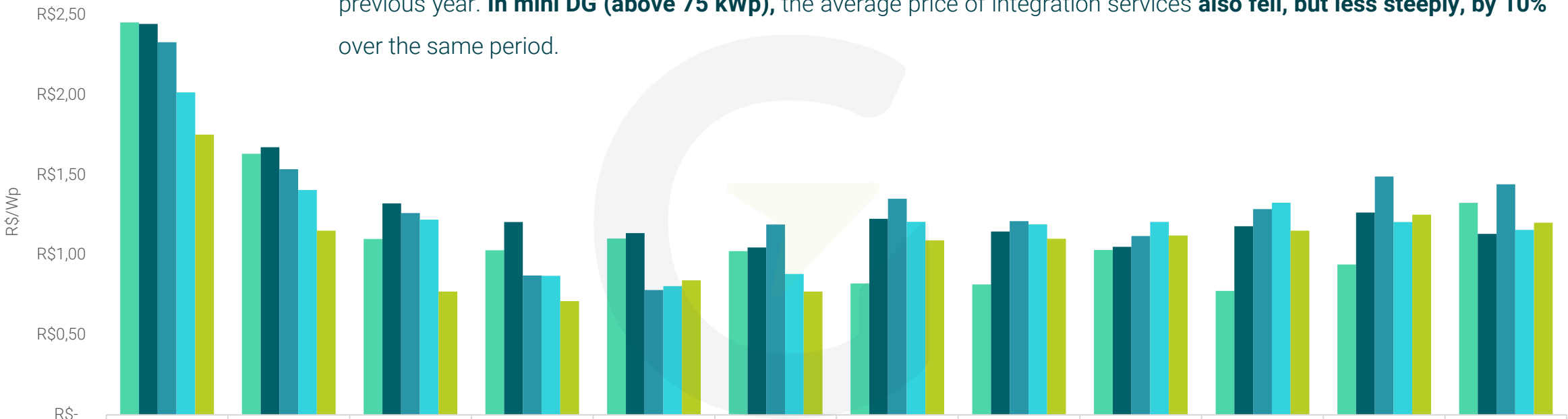


	2kWp	4kWp	8kWp	12kWp	30kWp	50kWp	75kWp	150kWp	300kWp	500kWp	1MWp	5MWp
jan/22	R$3,90	R$3,53	R$3,56	R$3,49	R$3,21	R$3,08	R$3,27	R$3,07	R$2,83	R$3,09	R$2,95	R$2,50
jun/22	R$3,55	R$3,21	R$3,03	R$2,96	R$2,80	R$2,84	R$2,78	R$2,54	R$2,58	R$2,56	R$2,56	R$2,55
jan/23	R$3,09	R$2,86	R$2,66	R$2,80	R$2,58	R$2,54	R$2,49	R$2,33	R$2,35	R$2,28	R$2,22	R$2,21
jun/23	R$2,47	R$2,28	R$2,04	R$2,15	R$2,01	R$1,96	R$1,82	R$1,75	R$1,74	R$1,73	R$1,72	R$1,68
jan/24	R$2,12	R$2,02	R$1,90	R$1,83	R$1,58	R$1,68	R$1,61	R$1,53	R$1,46	R$1,46	R$1,45	R$1,45

Source: Greener, 2024.

PRICES OF INTEGRATION SERVICES

- The **average price of integration services for micro-DG fell by 22%** in January 2024 compared to January of the previous year. **In mini DG (above 75 kWp),** the average price of integration services **also fell, but less steeply, by 10%** over the same period.



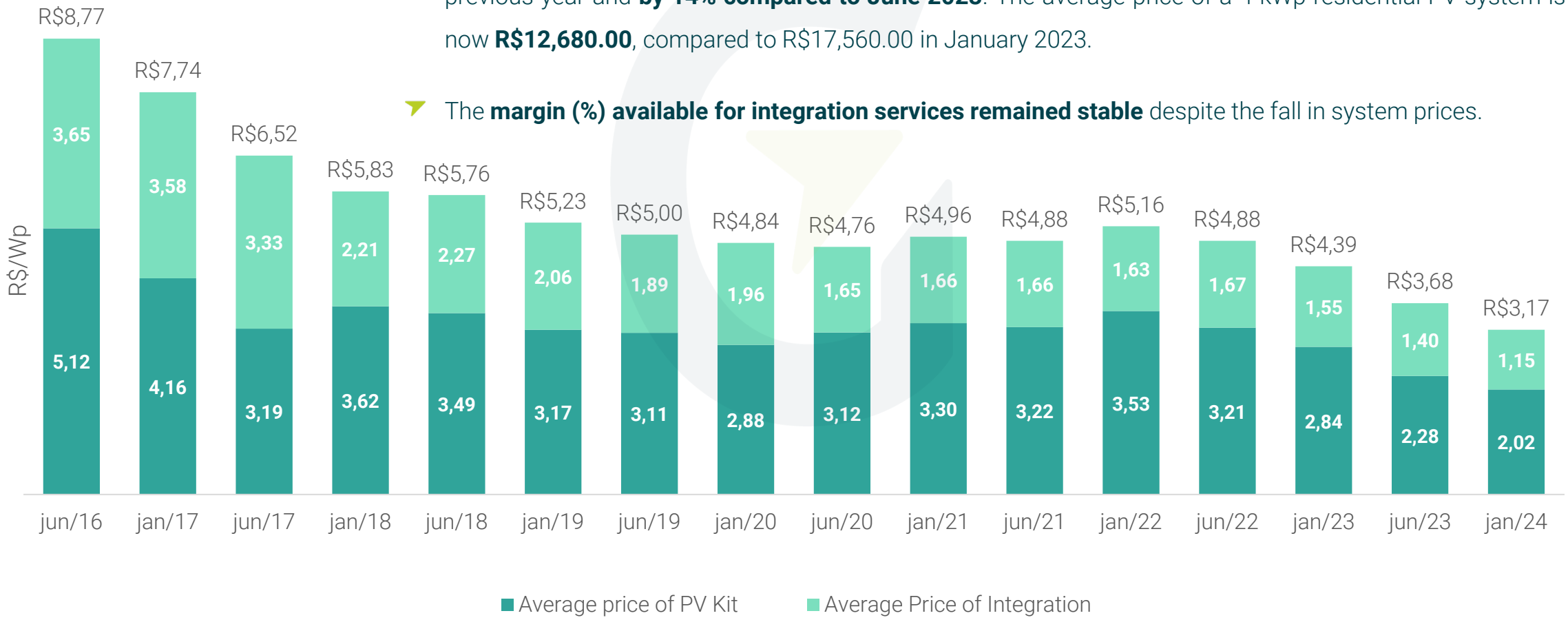
	2kWp	4kWp	8kWp	12kWp	30kWp	50kWp	75kWp	150kWp	300kWp	500kWp	1MWp	5MWp
jan/22	R$2,45	R$1,63	R$1,10	R$1,03	R$1,10	R$1,02	R$0,82	R$0,81	R$1,03	R$0,77	R$0,94	R$1,32
jun/22	R$2,44	R$1,67	R$1,32	R$1,20	R$1,13	R$1,04	R$1,22	R$1,15	R$1,05	R$1,18	R$1,26	R$1,13
jan/23	R$2,33	R$1,53	R$1,26	R$0,87	R$0,78	R$1,19	R$1,35	R$1,21	R$1,12	R$1,28	R$1,49	R$1,44
jun/23	R$2,01	R$1,40	R$1,22	R$0,87	R$0,80	R$0,88	R$1,21	R$1,19	R$1,20	R$1,32	R$1,20	R$1,16
jan/24	R$1,75	R$1,15	R$0,77	R$0,71	R$0,84	R$0,77	R$1,09	R$1,10	R$1,12	R$1,15	R$1,25	R$1,20

Source: Greener, 2024.

PRICE EVOLUTION OF PV SYSTEMS

Residential System (4 kWp) in R$/Wp

- The average **price of a residential PV system in January 2024 fell by 28% compared to January** of the previous year and **by 14% compared to June 2023**. The average price of a 4 kWp residential PV system is now **R$12,680.00**, compared to R$17,560.00 in January 2023.
- The **margin (%) available for integration services remained stable** despite the fall in system prices.

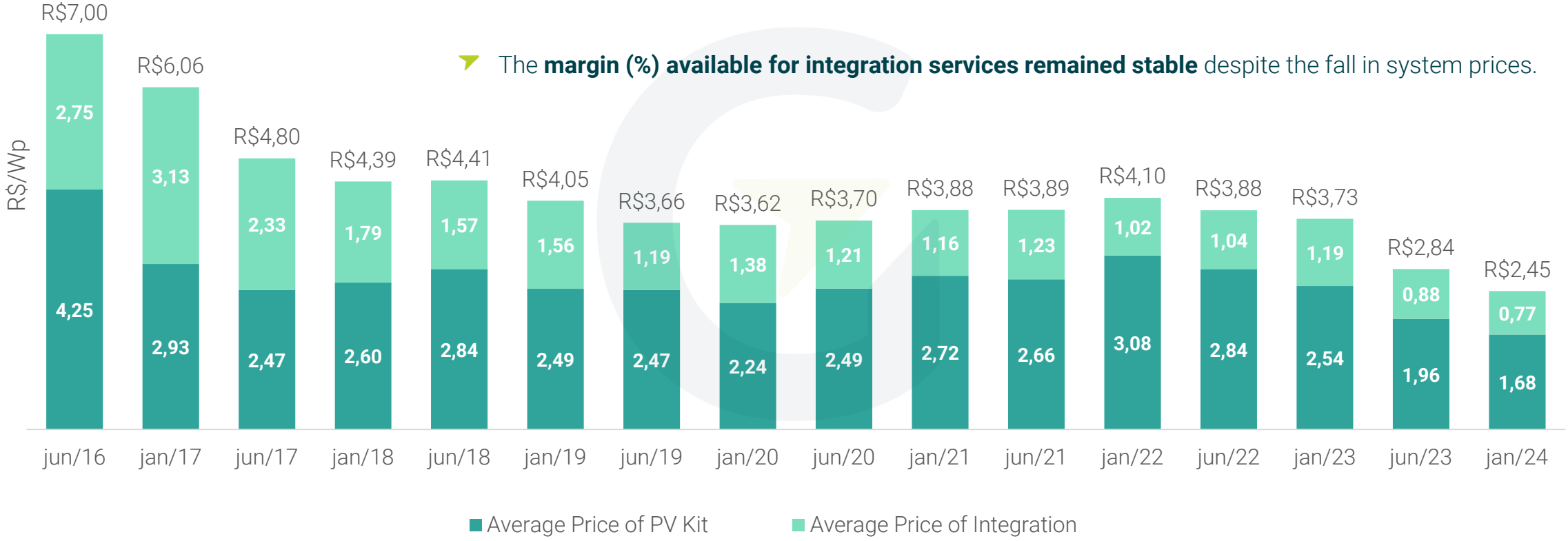


Source: Greener, 2024.

PRICE EVOLUTION OF PV SYSTEMS

Commercial PV System (50 kWp) in R$/Wp

- The average **price of a commercial PV system in January 2024 fell by 34%** compared to January 2023 and by 13.7% compared to June 2023. The most recent average price of a 50 kWp commercial PV system is **R$122,500** compared to R$186,500 in January 2023.
- The **margin (%) available for integration services remained stable** despite the fall in system prices.

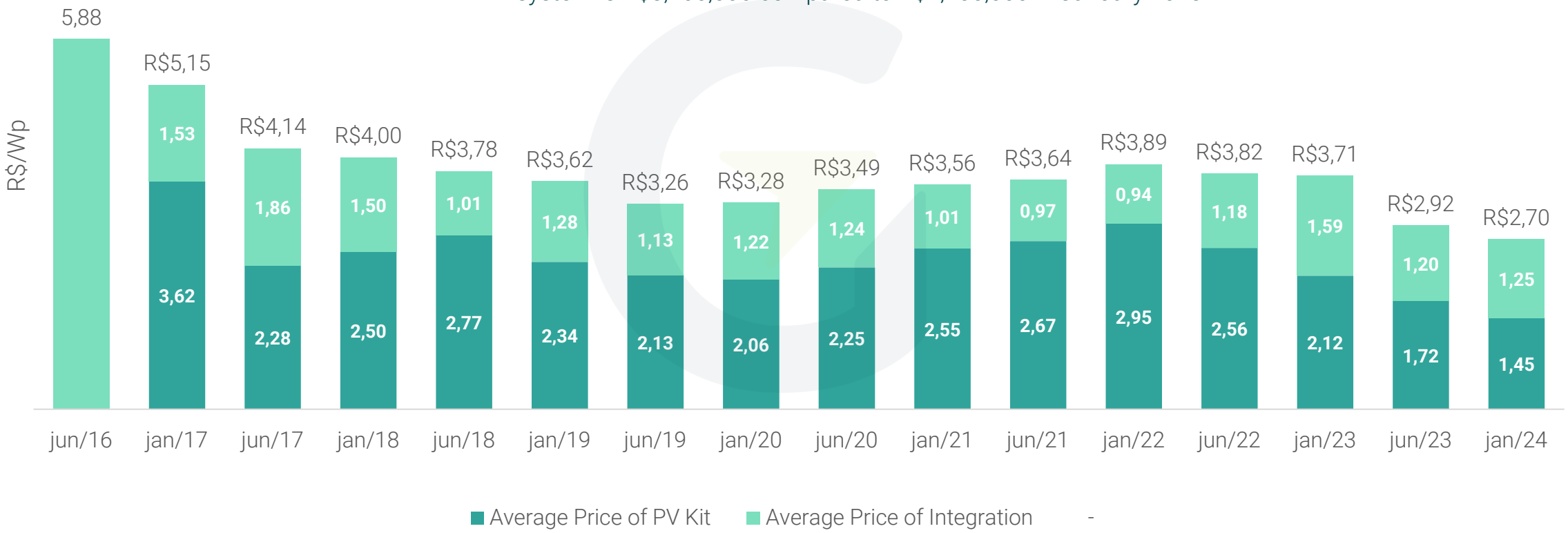


Source: Greener, 2024.

PRICE EVOLUTION OF PV SYSTEMS

Large-Scale Rooftop Industrial PV System (1 MWp) in R$/Wp

- The **average price of an industrial PV system in January 2024 fell by 27%** compared to January 2023 and by 8% compared to June 2023. The average price of a 1 MWp residential PV system is R$3,700,000 compared to R$2,700,000 in January 2023.



Source: Greener, 2024.

AVERAGE PAYBACK PERIOD PER STATE

Assumptions

- **DG II scenarios were analyzed from January 2023 to January 2024**, considering only changes in construction time, start of operation, energy tariff adjustments and equipment prices.

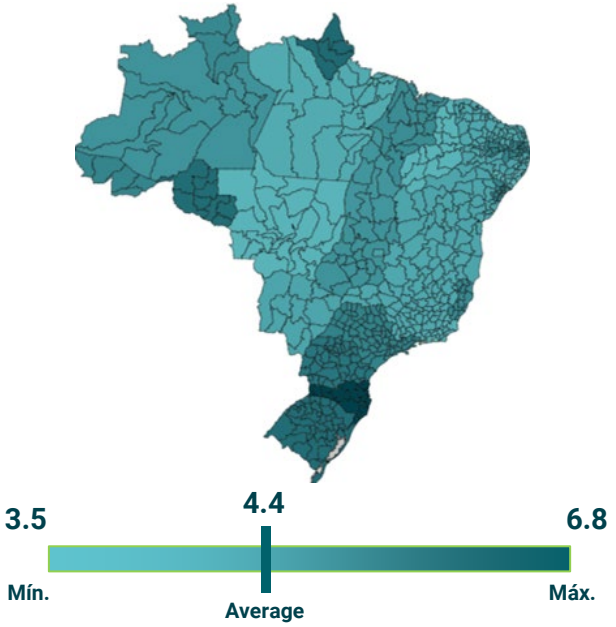
- The payback period is calculated for the **4 kWp, 50 kWp and 300 kWp** sizes with the following **assumptions**:

4 kWp (Low Voltage)	50 kWp (Low Voltage)	300 kWp* (Medium Voltage)
Cost of the PV system in January/2023 of 4.39 R$/Wp, in June/2023 of 3.68 R$/Wp and in **January/2024 of 3.17 R$/Wp.** The calculation takes into account average productivity, energy tariffs*, a **PR of 75% and a simultaneity factor of 30%.**	**Cost of the PV system** in January/2023 of 3.73 R$/Wp, in June/2023 of 2.84 R$/Wp and in **January/2024 of 2.45 R$/Wp.** The calculation takes into account average productivity, energy tariffs*, a **PR of 75% and a simultaneity factor of 70%.**	**Cost of the PV system** in January/2023 of 3.47 R$/Wp, in June/2023 of 2.94 R$/Wp and in **January/2024 of 2.58 R$/Wp**. The calculation takes into account average productivity, energy tariffs, a **PR of 75% and a simultaneity factor of 50%.**
*Three-phase consumer	* Three-phase consumer	*PV Capacity lower than Contracted Demand. Customer doesn't pay TUSDg.

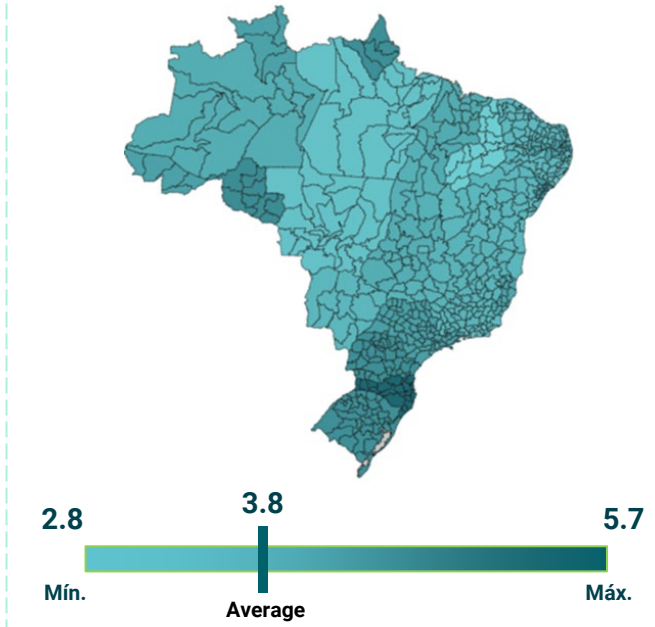
AVERAGE PAYBACK PERIOD PER STATE (in years)

Residential (4 kWp) – Low Voltage

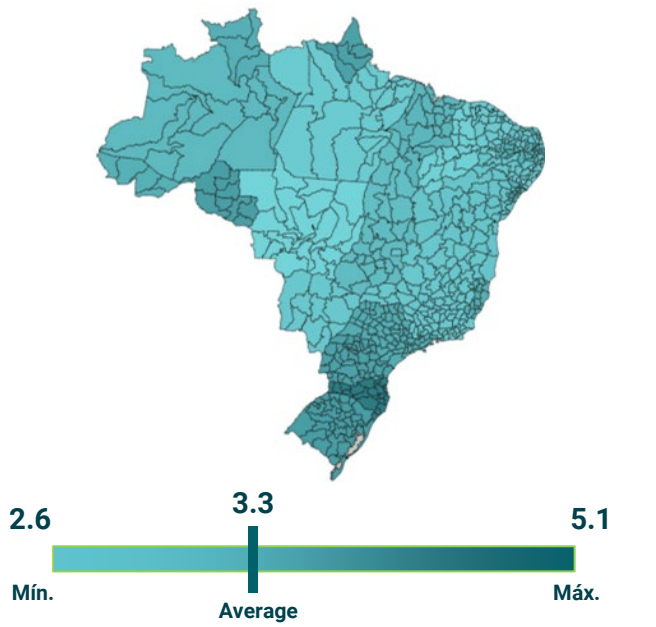
DG II in January 2023



DG II in June 2023



DG II in January 2024



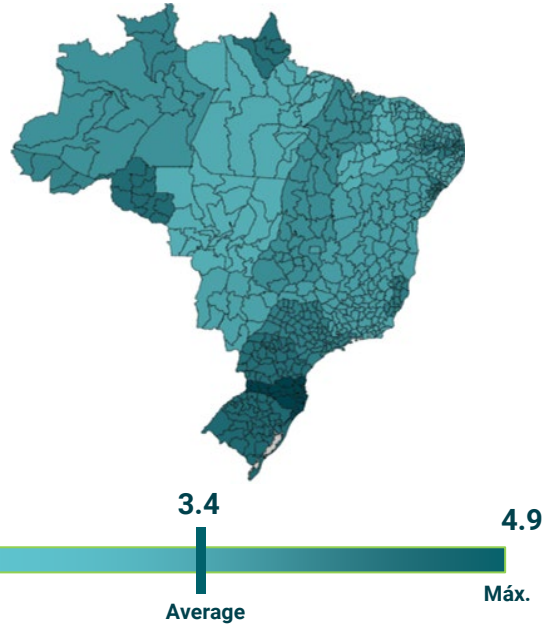
- **Improvement** in the return on investment, with a **25% reduction** in the ***payback period*** when comparing Jan/2024 to Jan/2023, with the **drop in required CAPEX** the **main factor** for this variation. **Reduction of 13%** in the half year between Jan/2024 and Jun/2023.

**Values different from the DG Report launched in September 2023 due to some changes in the assumptions that were simulated.*

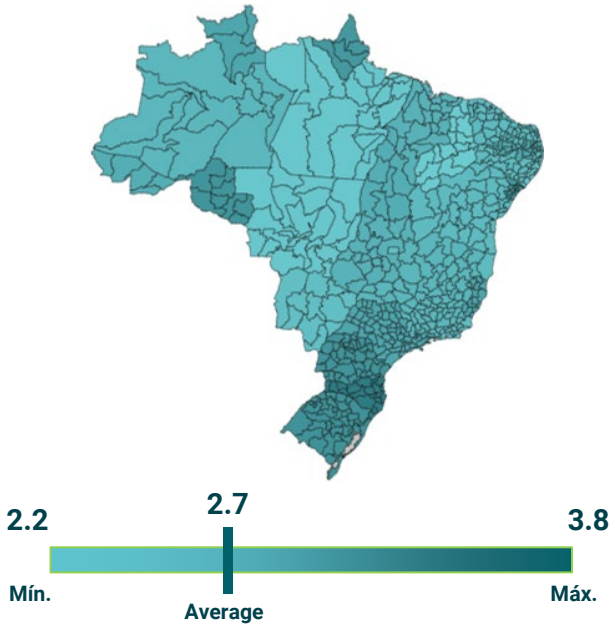
AVERAGE PAYBACK PERIOD PER STATE (in years)

Commercial (50 kWp) – Low Voltage

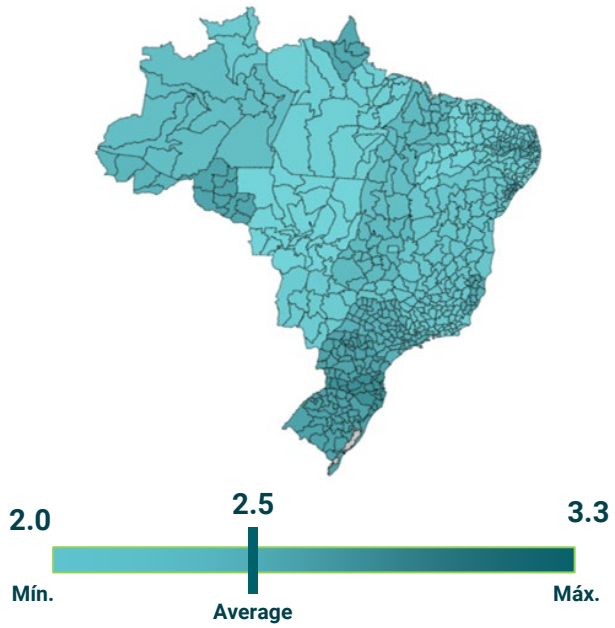
DG II in January 2023



DG II in June 2023



DG II in January 2024



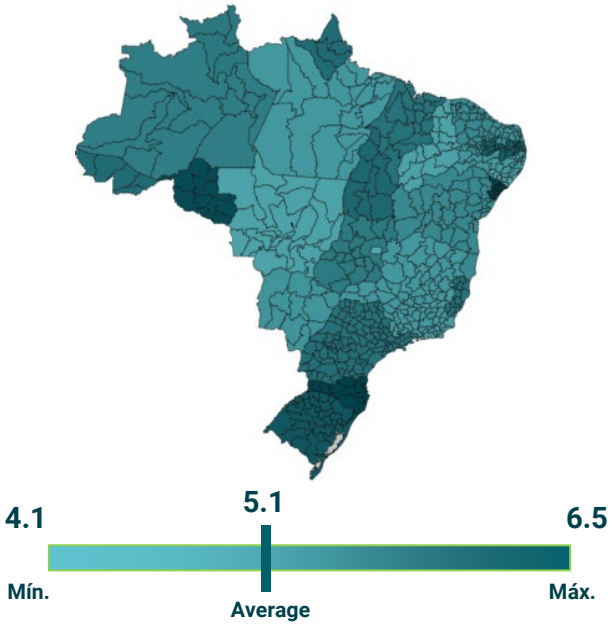
- **Improvement** in the return on investment, with a **26% reduction** in the ***payback period*** when comparing Jan/2024 to Jan/2023, with the **drop in required CAPEX** the **main factor** for this variation. **Reduction of 7%** in the half year between Jan/2024 and Jun/2023.

**Values different from the DG Report launched in September 2023 due to some changes in the assumptions that were simulated.*

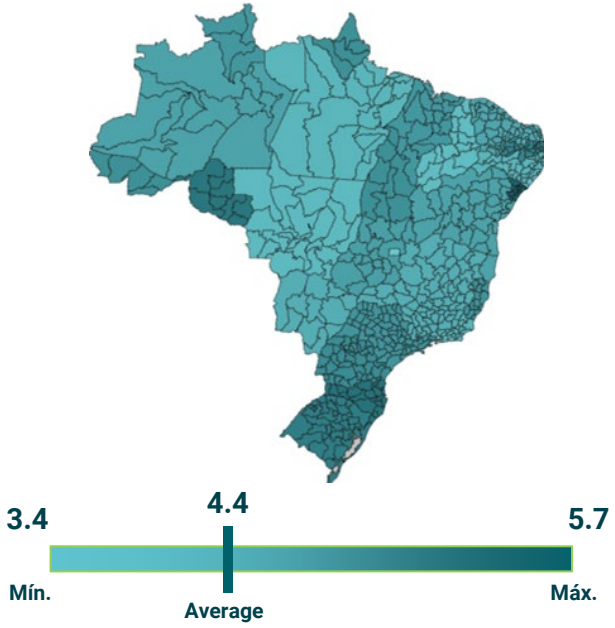
AVERAGE PAYBACK PERIOD PER STATE (in years)

Commercial (300 kWp) – Medium Voltage

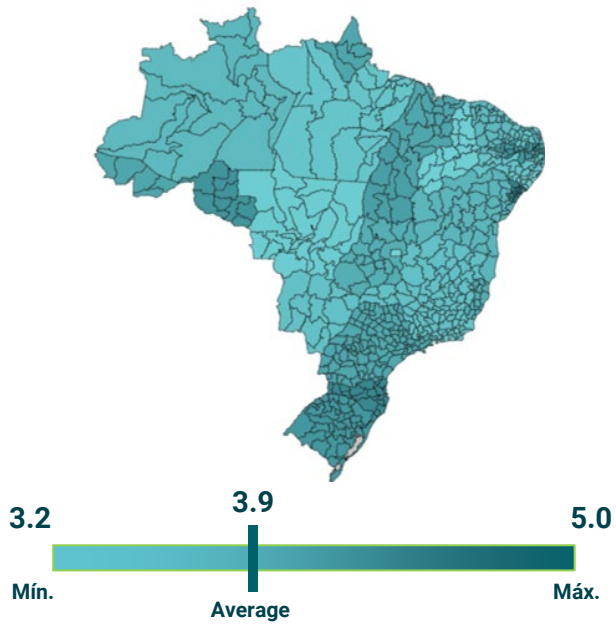
DG II in January 2023



DG II in June 2023



DG II in January 2024



- **Improvement** in the return on investment, with a **24% reduction** in the ***payback period*** when comparing Jan/2024 to Jan/2023, with the **drop in required CAPEX** the **main factor** for this variation. **Reduction of 11%** in the half year between Jan/2024 and Jun/2023.

**Values different from the DG Report launched in September 2023 due to some changes in the assumptions that were simulated*

06.
DG ENERGY CONSUMPTION

EVOLUTION OF DISTRIBUTED GENERATION

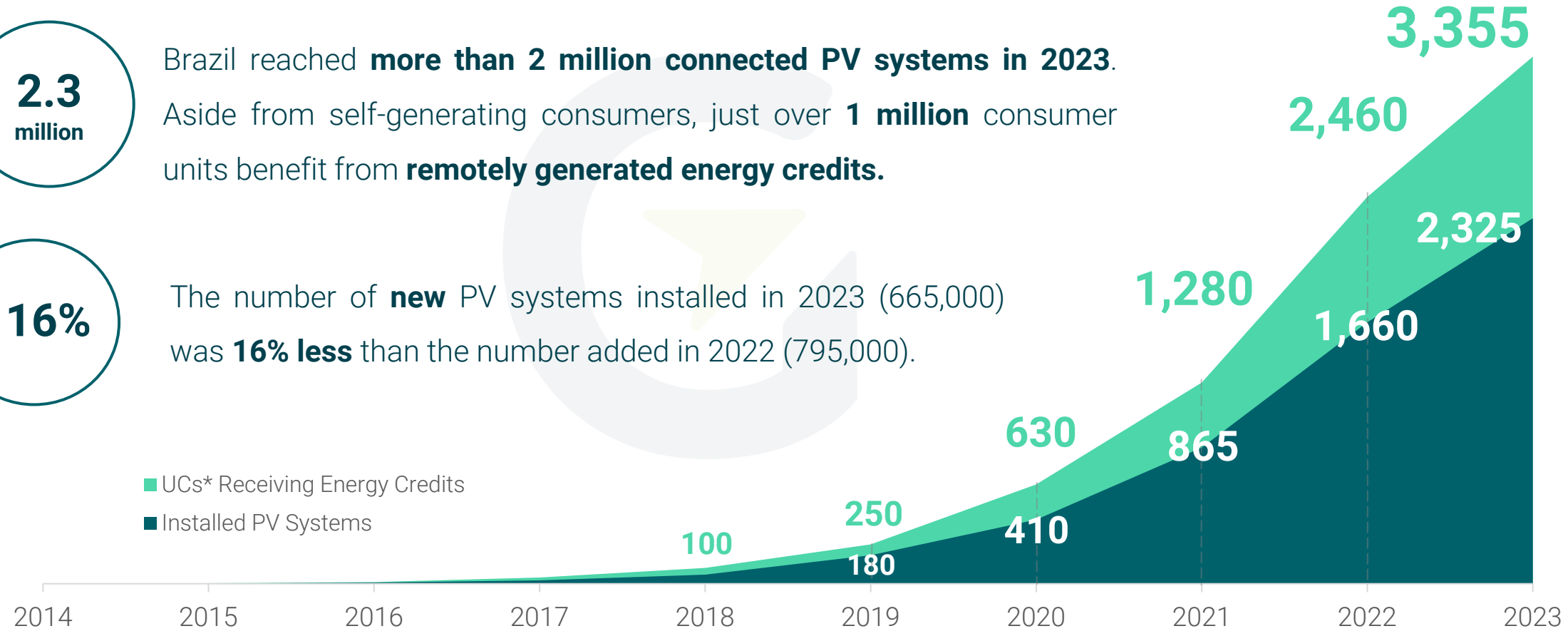
Accession of Consumers and Receipt of Energy Credits (in thousands)

2.3 million

Brazil reached **more than 2 million connected PV systems in 2023**. Aside from self-generating consumers, just over **1 million** consumer units benefit from **remotely generated energy credits.**

⬇16%

The number of **new** PV systems installed in 2023 (665,000) was **16% less** than the number added in 2022 (795,000).



*UCs: consumer units

Source: ANEEL, 2024; Greener, 2024.

EVOLUTION OF DISTRIBUTED GENERATION

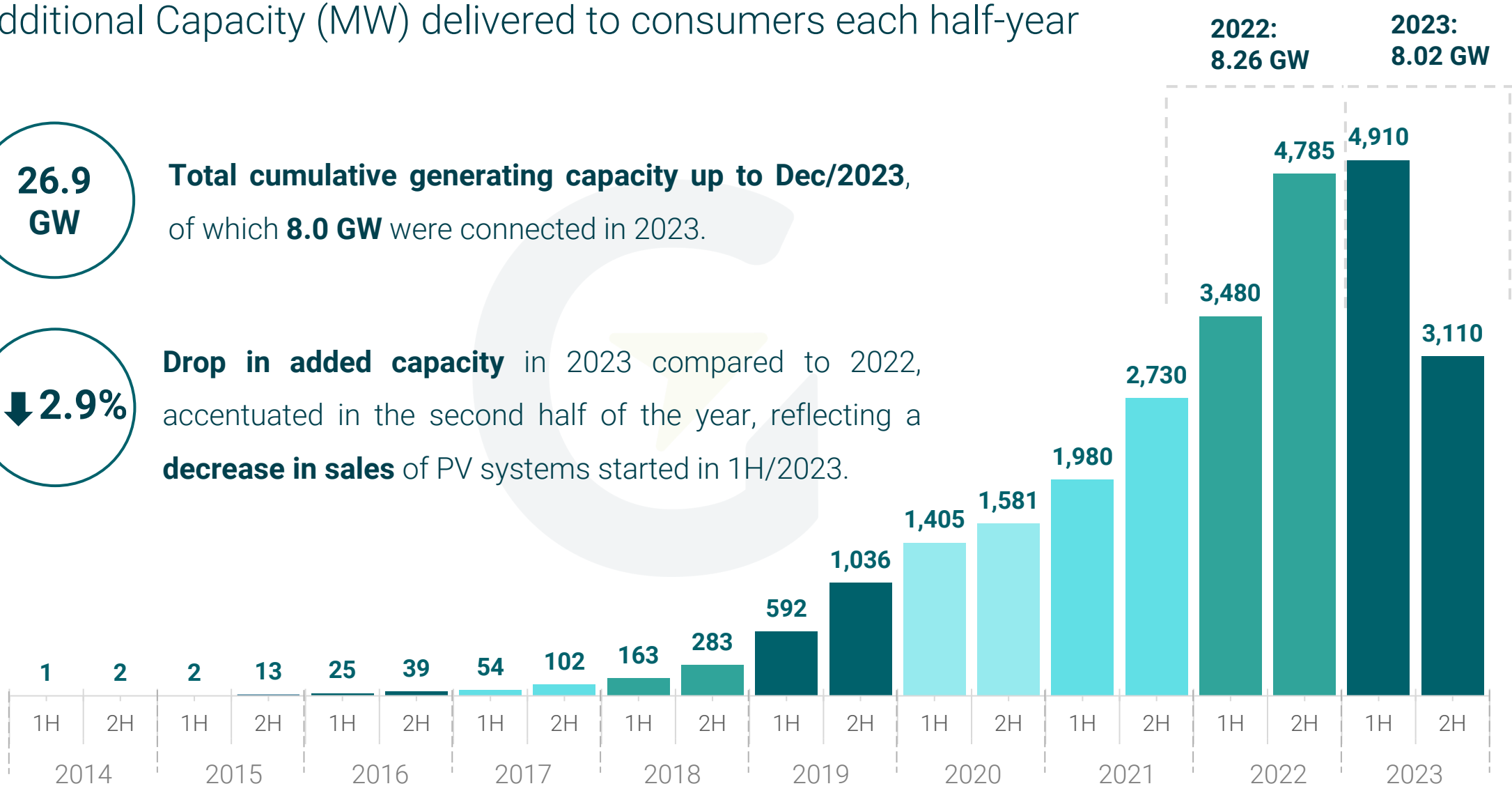
Additional Capacity (MW) delivered to consumers each half-year

26.9 GW

Total cumulative generating capacity up to Dec/2023, of which **8.0 GW** were connected in 2023.

⬇2.9%

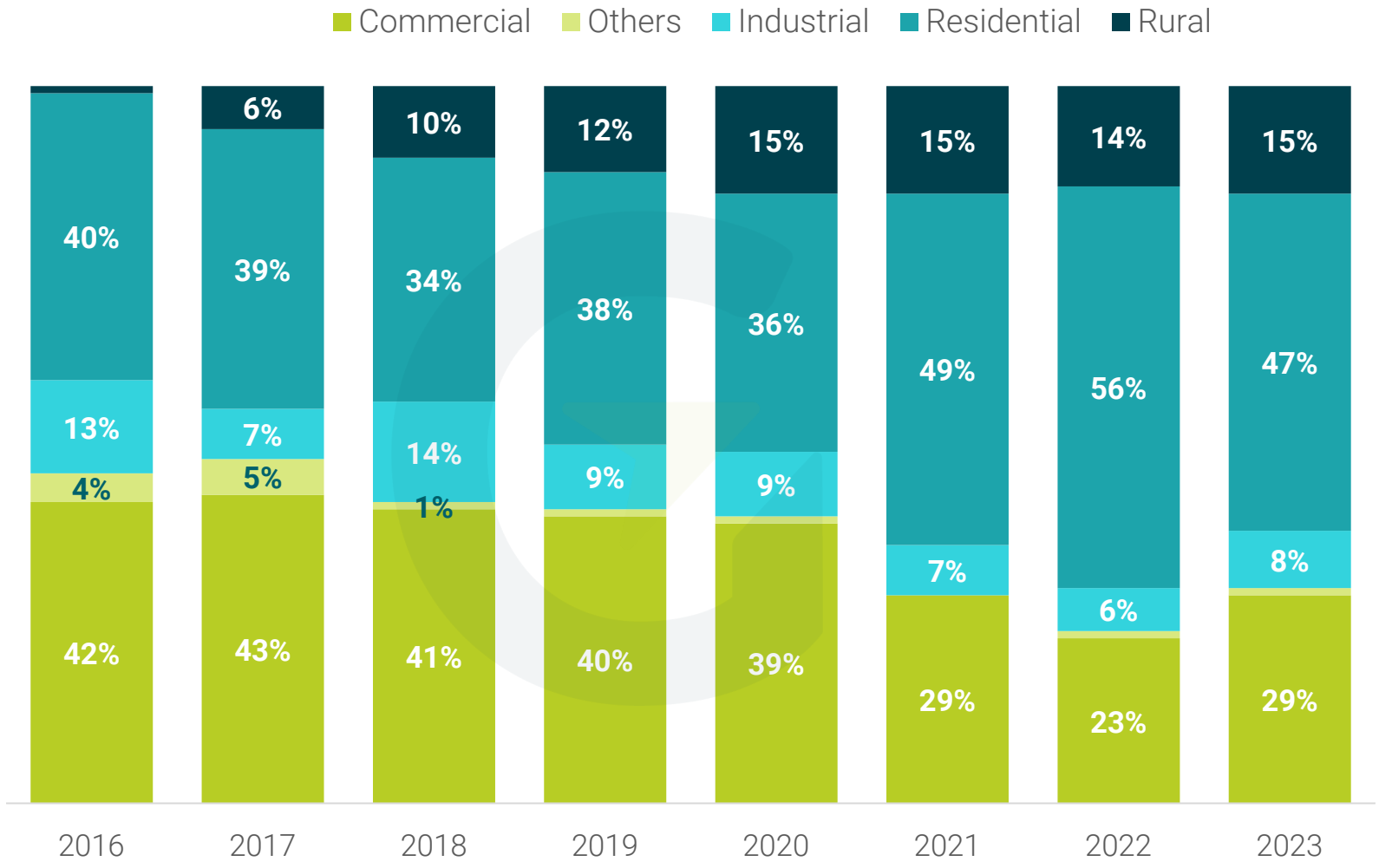
Drop in added capacity in 2023 compared to 2022, accentuated in the second half of the year, reflecting a **decrease in sales** of PV systems started in 1H/2023.



Source: ANEEL, 2024; Greener, 2024.

CONSUMPTION PROFILE OF DG

Share (%) of added generating capacity by year and type of consumer



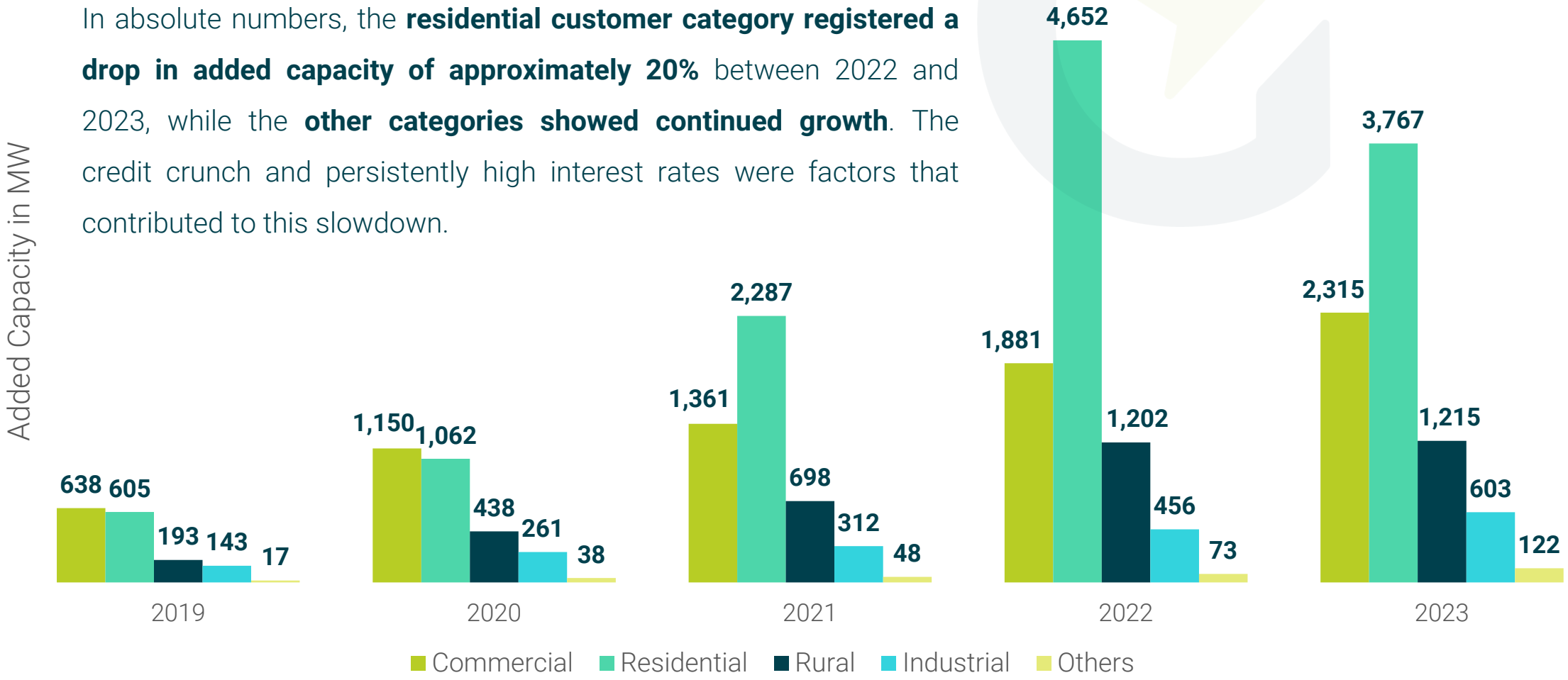
Residential customers saw a decrease in their share of added PV capacity of 9 percentage points (p.p.), while commercial customers enjoyed an increase in their relative share of 6 p.p. over the course of 2023 compared to 2022.

Source: ANEEL, 2024; Greener, 2024.

CONSUMPTION PROFILE OF DG

Absolute Capacity (MW) added per year by each consumer type

In absolute numbers, the **residential customer category registered a drop in added capacity of approximately 20%** between 2022 and 2023, while the **other categories showed continued growth**. The credit crunch and persistently high interest rates were factors that contributed to this slowdown.

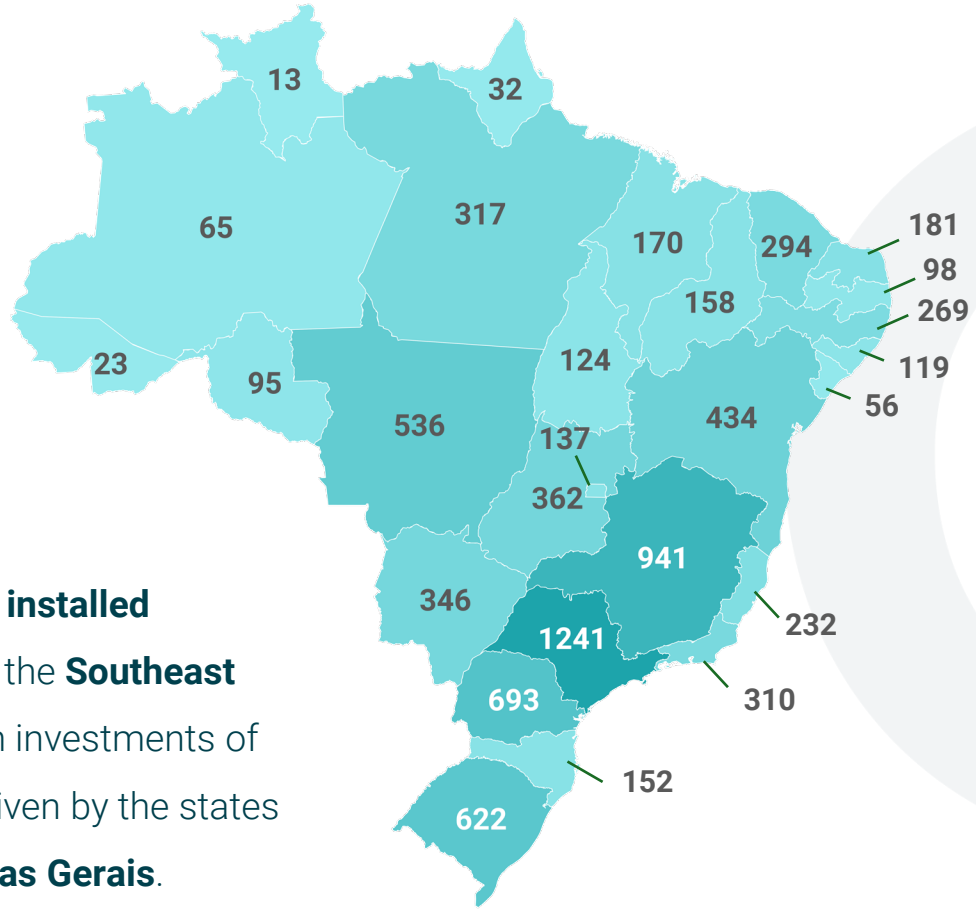


Source: ANEEL, 2024; Greener, 2024.

DG PER STATE IN 2023

Additional Capacity (MW) and estimated investment per State

Additional Capacity in 2023 (MW)



With **2.7 GW of newly installed capacity** during 2023, the **Southeast** leads the regions, with investments of around **R$9 billion**, driven by the states of **São Paulo and Minas Gerais**.

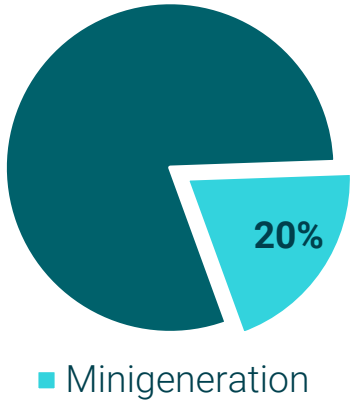
TOP 10 States in 2023

State	Additional Capacity (MW)	Estimated Investment (R$ Bilions)
SP	1,241	4.1
MG	941	3.1
PR	693	2.3
RS	622	2.0
MT	536	1.8
BA	434	1.4
GO	362	1.2
MS	346	1.1
PA	317	1.0
RJ	310	1.0

Source: EPE, 2024 (Adapted); ANEEL, 2024 (Adapted); Greener, 2024.

EVOLUTION OF MINI DG

Evolution of Capacity (MW) of mini DG power plants (> 75 kW)



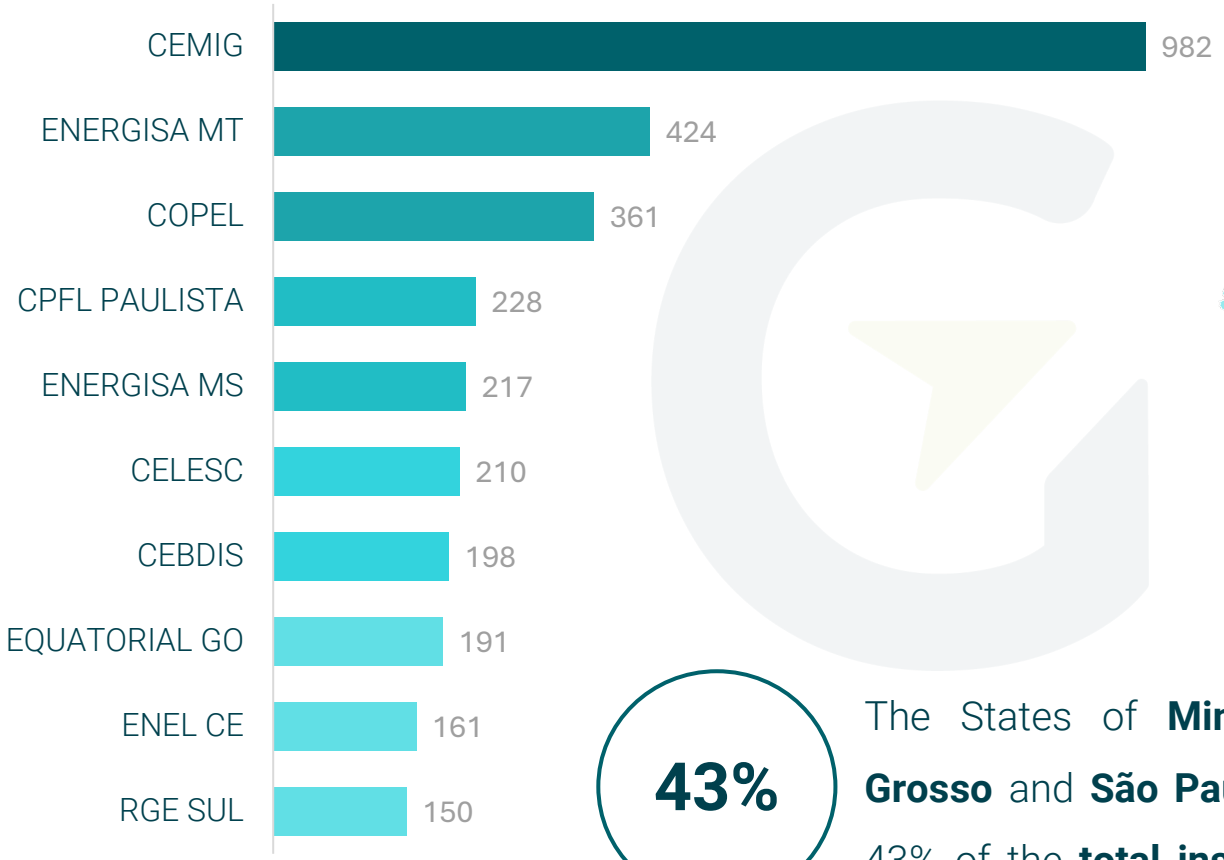
Mini-generation accounts for 20% of installed DG power and **added 1.56 GW to the grid** in 2023, a **36% increase** on 2022, **driven by the commercial sector.**

Source: ANEEL, 2024; Greener, 2024.

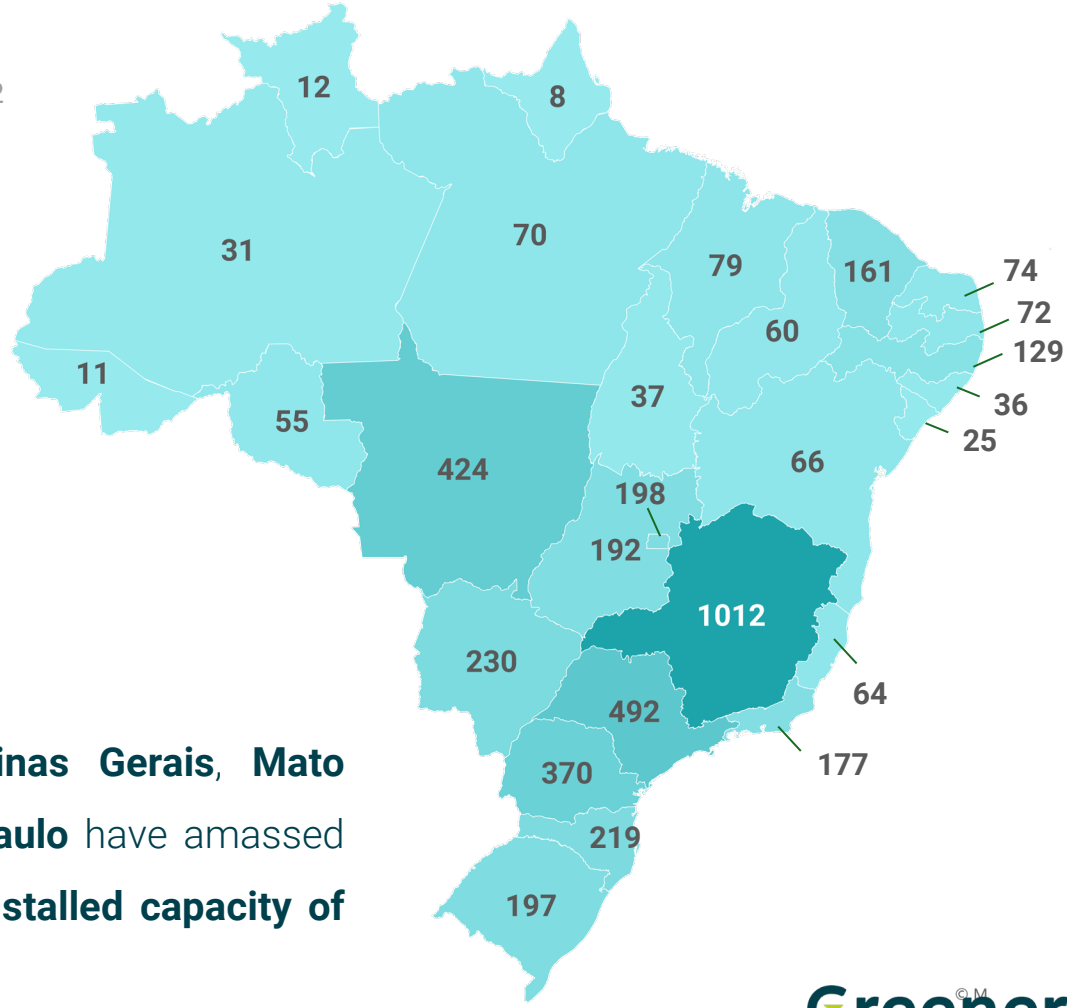
MINI DG PER STATE UP TO 2023

Cumulative Capacity (MW) of mini DG power plants (> 75 kW)

10 most accessed energy distributors (MW)



Cumulative Capacity per State (MW)



43%

The States of **Minas Gerais**, **Mato Grosso** and **São Paulo** have amassed 43% of the **total installed capacity of mini DG.**

Source: ANEEL, 2024 (Adapted); Greener, 2024.

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Research Report

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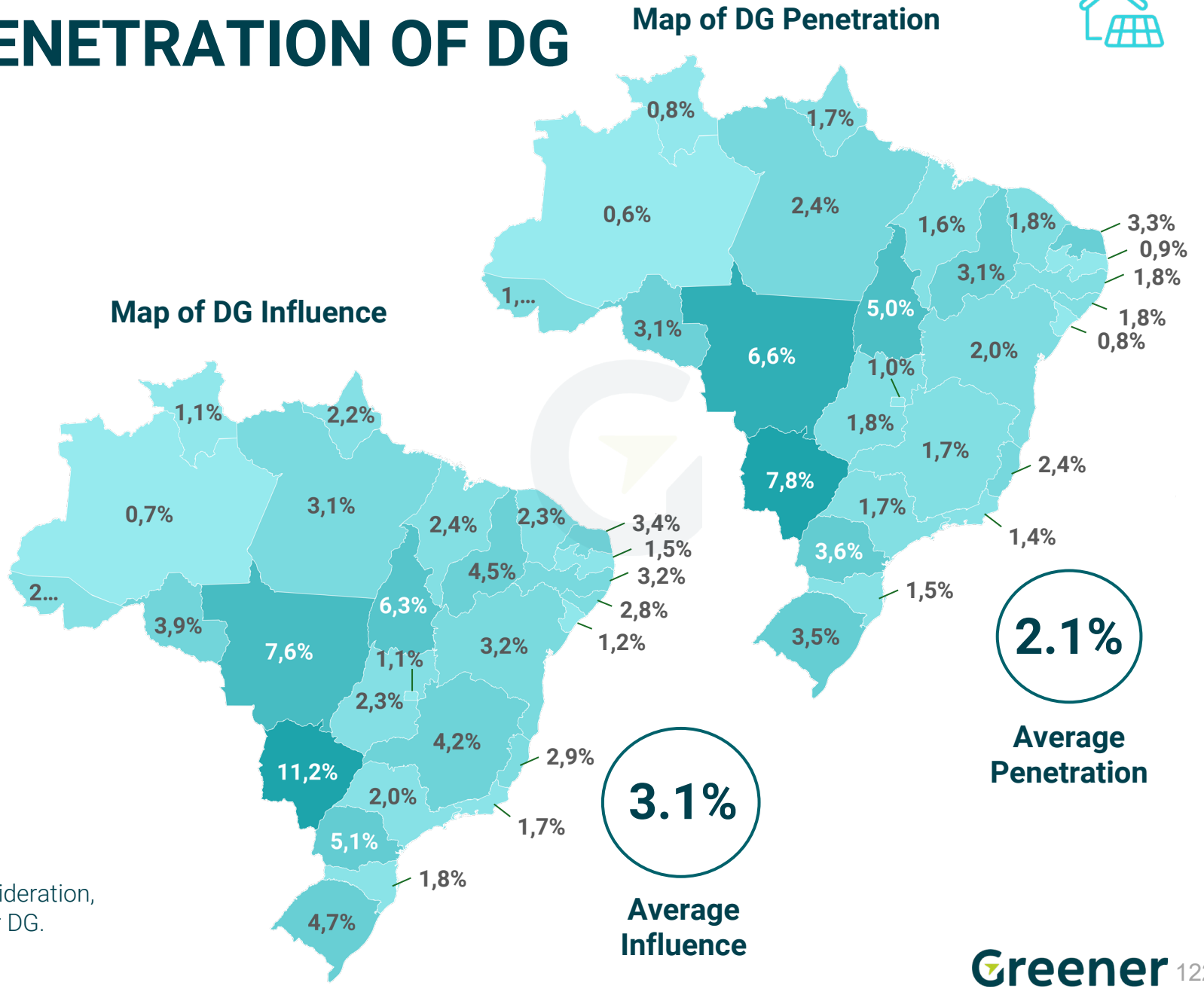
INFLUENCE AND PENETRATION OF DG

Up to December 2023

The **Penetration Map** represents the number of consumer units (UCs) with **PV systems in relation to the total number of UCs** in Brazil.

The **Influence Map** represents the number of UCs that **benefit from DG remotely (credits) OR with an on-site PV system** installed in relation to the total number of UCs.



All consumer units are taken into consideration, without any filter for the potential market for DG.

Source: ANEEL, 2024 (Adapted); Greener, 2024.

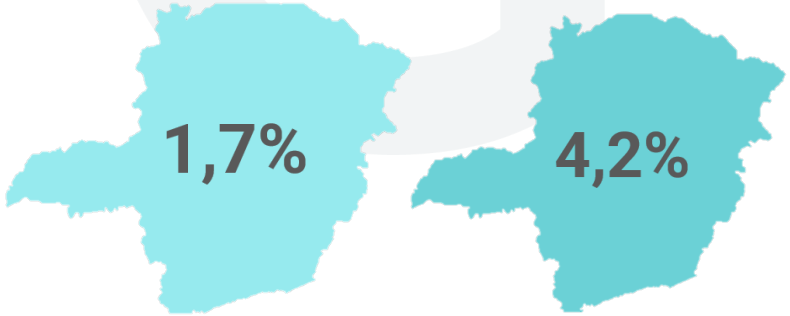
INFLUENCE OF DG PER STATE

Up to December 2023

Mato Grosso do Sul

MS stands out as the state with **the greatest DG influence**. One of the main reasons is the **higher electricity price**, which results in one of the **shortest payback periods** for PV investments. **MS has a payback period of 2.9 years** for residential systems, compared to the Brazilian average of 3.3 years. In addition, due to the Confaz Agreement, there is **ICMS compensation** for the TUSD and TE tariff components, which also helps to boost solar energy in the state.

Minas Gerais



Penetration of DG

Influence of DG

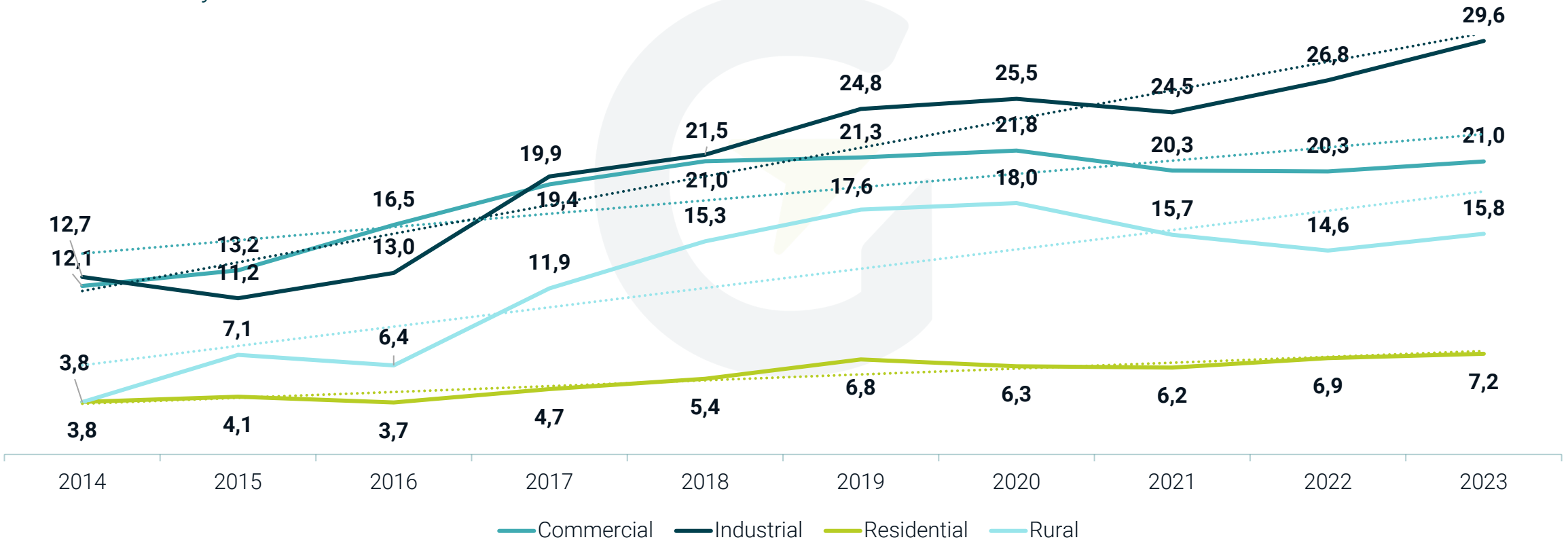
MG is the state with the **biggest difference between the penetration of DG**, which only considers consumer units with installed PV systems, **and the influence of DG**, which also considers units receiving credits remotely. The state is the **leader in sharing credits between consumer units**, reflecting the progress of the shared generation model.

Source: ANEEL, 2024 (Adapted); Greener, 2024.

AVERAGE SIZE OF PV SYSTEMS IN DG

Microgeneration

The **average system size shows a pattern of growth in all categories** over the years. The significant reduction in kit prices in recent years and the maturity of the market are factors that contribute to the upward trend in the average system size installed each year.



Source: ANEEL, 2024 (Adapted); Greener, 2024.

The dotted lines represent the trends for each customer type.

07.
DISPOSAL

PROCESSES FOR DEACTIVATION AND DISPOSAL

General Context

DISPOSAL

- **The process of discarding one or more materials from a solar photovoltaic plant,** which can be sent to a variety of destinations, from disposal in landfill sites**, appropriate disposal to specialized disposal companies,** or even conscious sustainable disposal with **recycling companies.** In some cases, the latter allows for the *retrofitting* of the inputs that make up the modules, for example.

- **This process doesn't only occur after a plant has been decommissioned.** Materials can be **damaged** and become unfit for use **during the natural process of the value chain,** be it transport, assembly or maintenance of the plant.

DEACTIVATION

- **Deactivation usually takes place after the end of the useful life of a solar photovoltaic plant.** It basically consists of the **process of removing a photovoltaic system and its entire structure,** as well as remediating the land with the possible stabilization and revegetation of the site. **This procedure includes the disposal of materials on a large scale.**

- Because the plants have only recently started operating here, IRENA (International Renewable Energy Agency) estimates that over the **next three decades around 550,000 tonnes of modules** will have to be disposed of in Brazil.

OVERVIEW IN BRAZIL AND WORLDWIDE

WORLD

- **The European Union has a regulation in this regard, called the "Waste Electrical and Electronic Equipment (WEEE)** Regulations".
- **European countries also have their individual regulations**, such as Germany's Electrical and Electronic Equipment Act (ElectroG), which requires the collection and recycling of electrical and electronic equipment.
- The photovoltaic industry has set up **PV CYCLE, a voluntary programme to recycle photovoltaic modules** and other types of electrical and electronic waste.

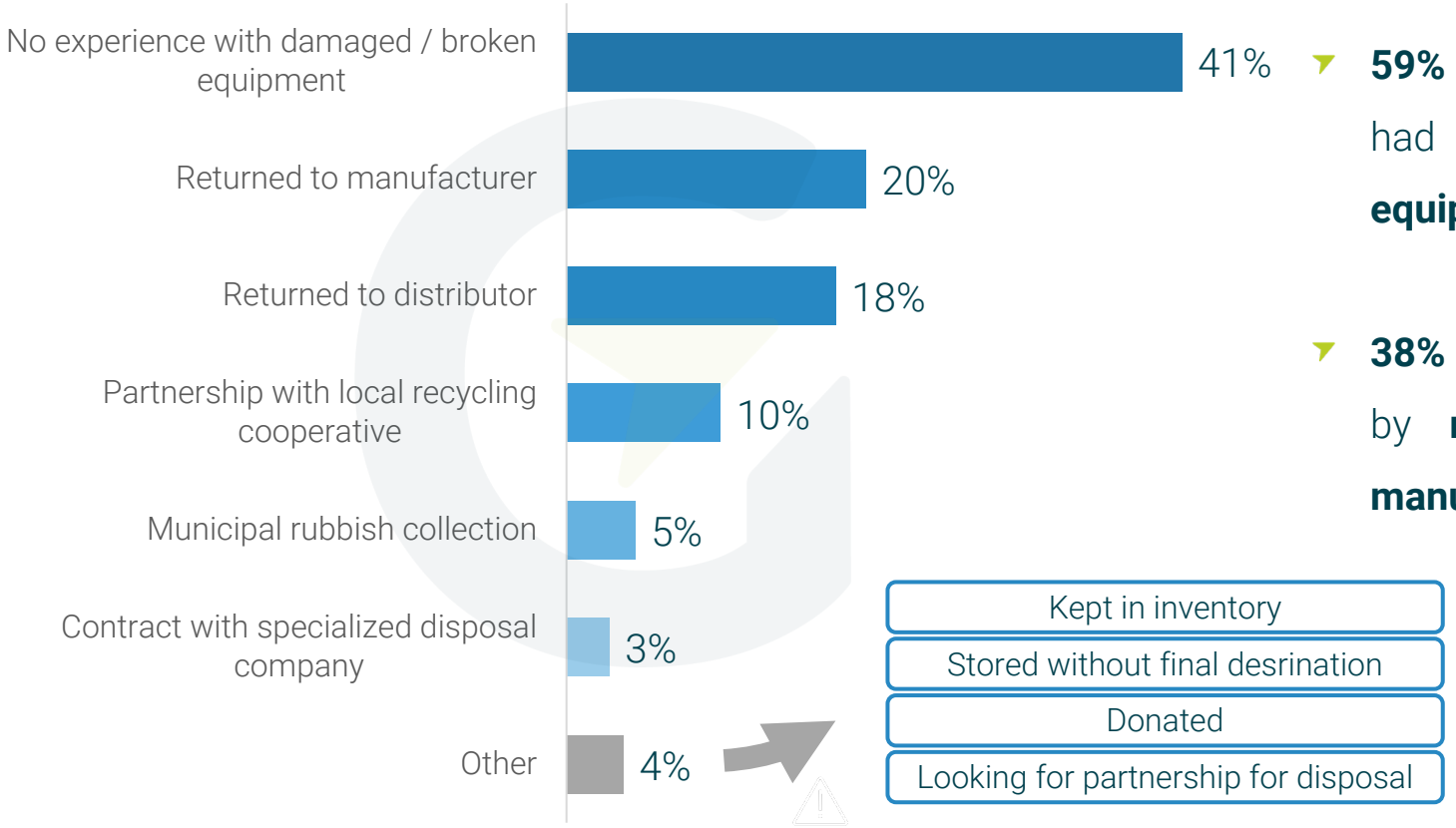
BRAZIL

- Although Brazil does not yet have legislation to deal with the end of the lifecycle of the components of a solar photovoltaic plant, **Law 12.305/2010** instituted **the National Solid Waste Policy (PNRS).** It requires the public and private sectors to manage solid waste in order to prevent these materials from being disposed of incorrectly in rubbish dumps, and **provides incentives for selective collection and recycling;**
- Talks are currently underway to discuss with the market the **regulation of reverse logistics for solar panels and battery storage**, which is expected to be enacted in 2024. In addition, Bill 3.784/2023 was presented, with the aim of **including item "VII - PV Solar Panels" in Law 12.305/2010**, which has been awaiting public hearings since October 2023.

END OF EQUIPMENT LIFECYCLE

% as experienced by **Integrators** included in our Survey

- PV Integrators were asked about the disposal procedures they adopted when PV equipment is damaged or broken.

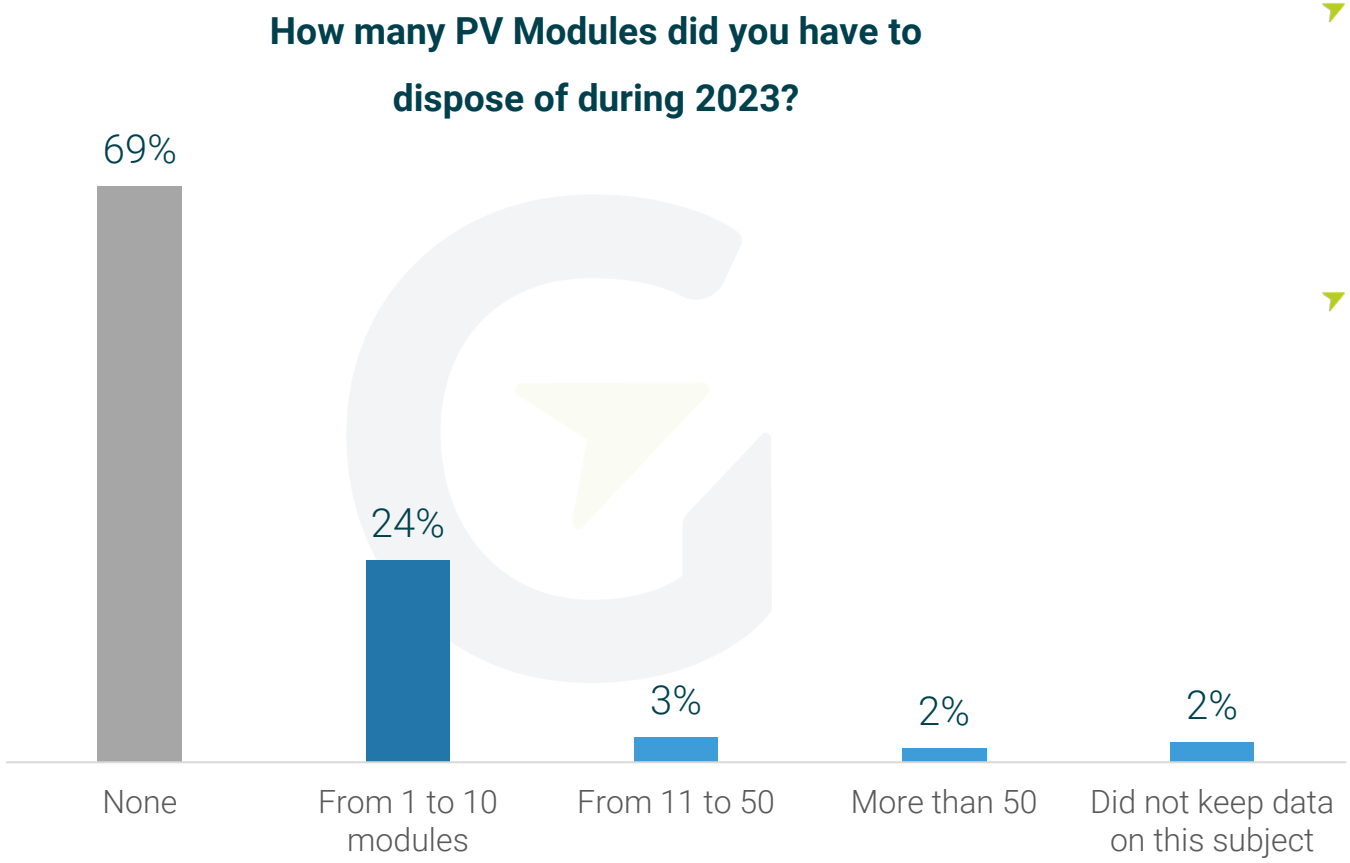


- **59%** of responding integrators have already had **experience with damaged or broken equipment.**
- **38%** of integrators dispose of the equipment by **returning it to the distributor or manufacturer.**

Source: Greener, 2024.

END OF EQUIPMENT LIFECYCLE

% as experienced by **Integrators** included in our Survey



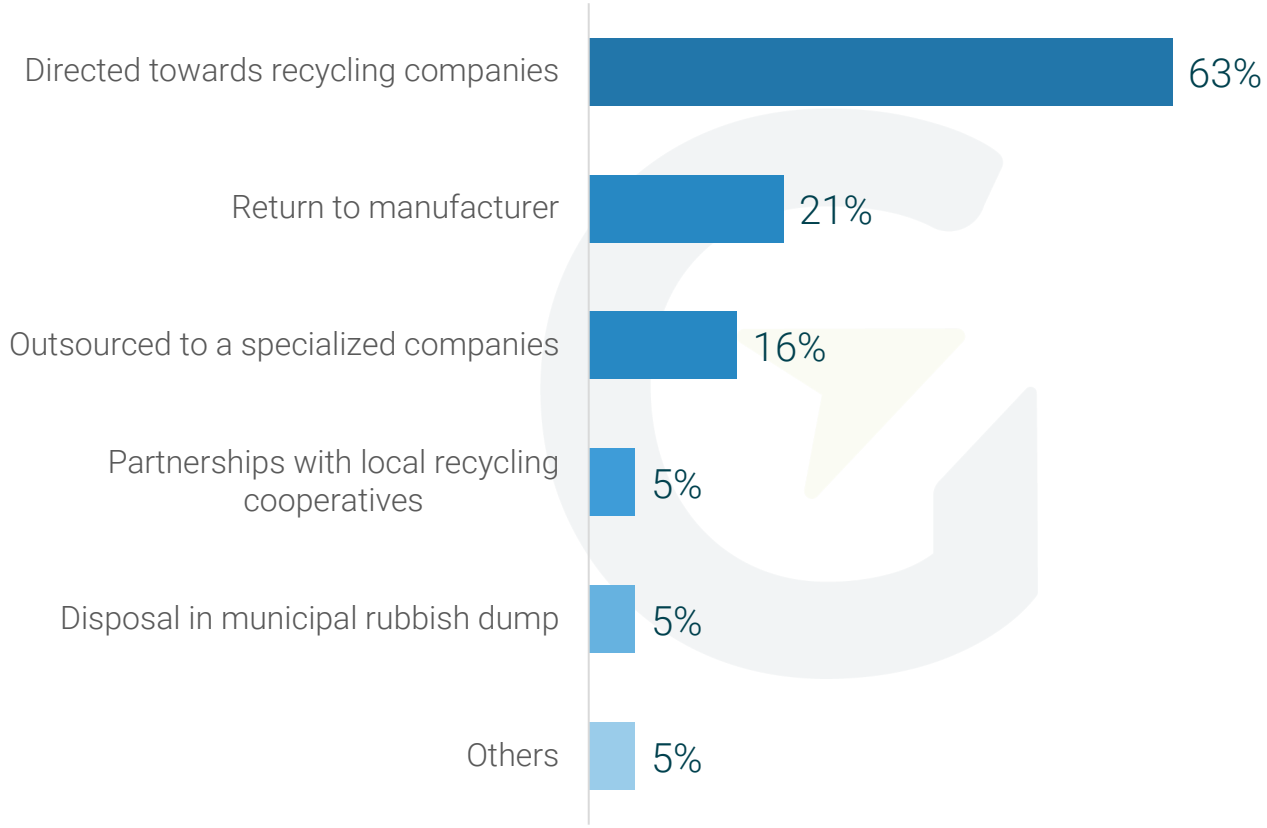
- **29% of PV integrators** who took part in the survey had to have **at least 1 module discarded** during 2023.
- In mid-2023, approximately 5.5% of integrators **had not carried out any data collection** on this subject. However, **over the course of the year, this percentage fell to 2.4%,** indicating a possible intensification of analyses by integrators during the second half of 2023.

Source: Greener, 2024.

END OF EQUIPMENT LIFECYCLE

% as experienced by **PV Equipment Distributors** included in our Survey

- **PV Equipment Distributors** were asked about the **disposal procedures** they adopted when **PV equipment is damaged or broken.**



- Compared to the data for the first half of 2023, there was an **increase of 17 p.p. in the option of having products sent to recycling companies.** On the other hand, the **option to return damaged equipment to manufacturers decreased by 21 p.p.**

- **25%** of the companies interviewed, which **return equipment to the manufacturer,** also said they **outsource the service to specialized companies.**

- Only 1 PV distributor mentioned adopting "**other" procedures, namely storage for future disposal.**

Source: Greener, 2024.

Respondents were allowed to select more than one option.

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Insights and conclusions

1. Brazil demanded 17.5 GW of PV modules in 2023, down 1.7% from 2022. **66% of the total nationalised volume,** equivalent to **11.4 GW**, was needed for the **distributed generation (DG) market**, a reduction of 2 GW compared to 2022.

2. **PV equipment prices fell by an average of 34%** in 2023. The fall in the price of polysilicon, driven by the expansion of global production capacity, added to the appreciation of the Real against the US Dollar, directly influenced the reduction in local PV module costs in 2023.

3. In the same vein, **prices of PV systems for end customers fell by an average of 30%** in January 2024 compared to January 2023. In addition to the reduction in (imported) equipment costs, distributors' high inventory levels also contributed to the fall in prices for end consumers.

4. Even with the gradual payment of 15% of the TUSD Line B distribution charge in 2023, remunerating the grid, PV systems showed a **25% improvement in payback times** in January 2024 compared to January 2023, with the **reduction in CAPEX** (prices of PV systems) being the most significant reason.

Thus, from the point of view of return on investment, **PV systems remain attractive to the end consumer for on-site PV** generation systems, which account for 75% of installed capacity. For remote generation projects, the negative impact on financial attractiveness is greater.

5. On the other hand, the **higher level of interest rates** and high degree of risk perception by financial agents contributed to a **restriction in the credit markets,** especially in the first half of 2023.

6. **Residential solar installations showed a drop in added capacity of approximately 20%** in 2023 compared to 2022. This slowdown was attributed to the credit crunch and **high interest rates**, which continued at high levels throughout the year, especially during the first half of 2023. Even so, **bank financing supported 53% of PV system sales** in 2023, and is an important means of making new solar PV developments viable.

7.

Insights and conclusions

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DG MARKET ANALYSIS

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DAH Solar is a Chinese solar manufacturer actively exploring the international market and has established a sales network in more than 50 countries, with Brazil as one of its main markets. With a projected production expansion of 12GW by 2024, it invests continuously in R&D and already has more than 30 patents. The intelligent solar module and the cloud performance monitoring platform are DAH's highlights in the solar industry.

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Growatt is a leading global provider of distributed energy solutions specialising in sustainable energy generation, storage and consumption, as well as energy digitalisation. The company designs, develops and manufactures photovoltaic inverters, energy storage products, EV chargers, intelligent energy management systems and more. Growatt is among the largest manufacturers in the Brazilian photovoltaic market.

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The MTR SOLAR Group is a multinational company specialising in the distribution and manufacture of equipment and solutions for solar power plants, and its focus is on meeting all the plant's project specifications. To this end, the Group has companies in its portfolio that specialise in the main needs of the photovoltaic market: trackers, fixed structures, electrocentre, skid, solar panels, inverters and integrated plant management systems.

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WEG

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Beyondsun is a pioneer in the manufacture of photovoltaic modules. The group is highly experienced with more than 37 years of history and more than 12 GW sold in more than 50 countries in the last 15 years. It achieves an annual production of 2 GW of solar cells and 5 GW of photovoltaic modules including P-type and N-type TOPCon. Beyondsun's goal is to bring clean energy to the whole world.

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eluan@era.com.cn

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JA SOLAR

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

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daniela@longi.com

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Hopewind (Shenzhen Hopewind Electric Co., Ltd., Stock Code: 603063) focuses on R&D, manufacturing, sales and service of renewable energy and electric transmission products, with the main product lines of wind power generation, photovoltaic generation products, energy storage products, power quality control and electric drive products.

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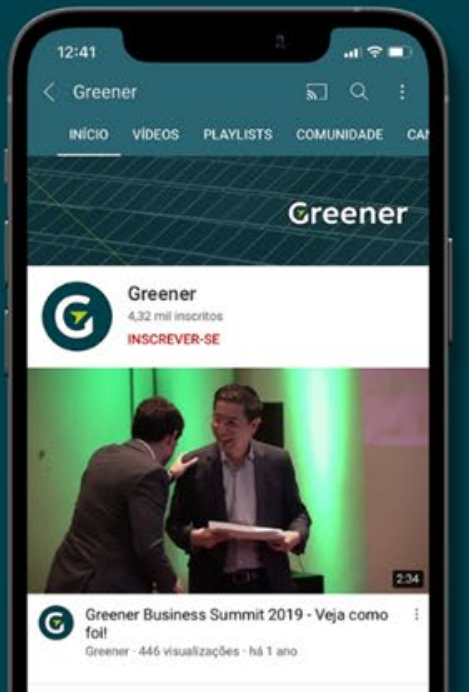

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