Photovoltaic energy diffusion through net-metering and feed-in tariff policies: learning from Germany, California, Japan and Brazil

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SUMMARY

1. BACKGROUND AND MOTIVATION
2. METHODOLOGY
3. ANALYSIS
4. EVOLUTION TRAJECTORIES
5. CONCLUSIONS

1. BACKGROUND AND MOTIVATION

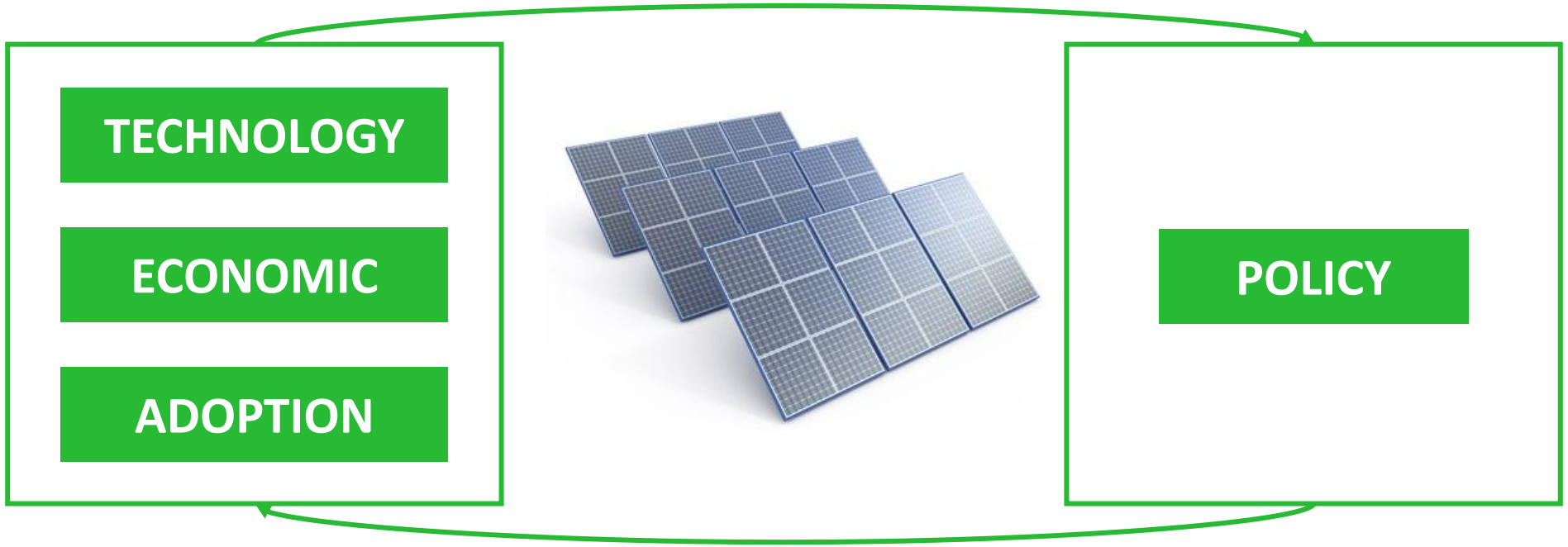
The diffusion of solar PV technology has gained significant momentum as a competitive renewable energy source.

Often as centrepiece on **climate and energy policies** aiming at a transition toward higher levels of **distributed energy resources**.

Alongside its benefits, some **complexities** can arise for the electricity sector as installed **capacity expands**.

1. BACKGROUND AND MOTIVATION

As the techno-economic framework of solar PV evolves, the policy framework is often adapted.



1. BACKGROUND AND MOTIVATION

Through this study we aim to explore

How are solar PV support policies evolving?

This can contribute to:

- Identifying best case practices
- Understanding patterns
- Mapping public policy evolution

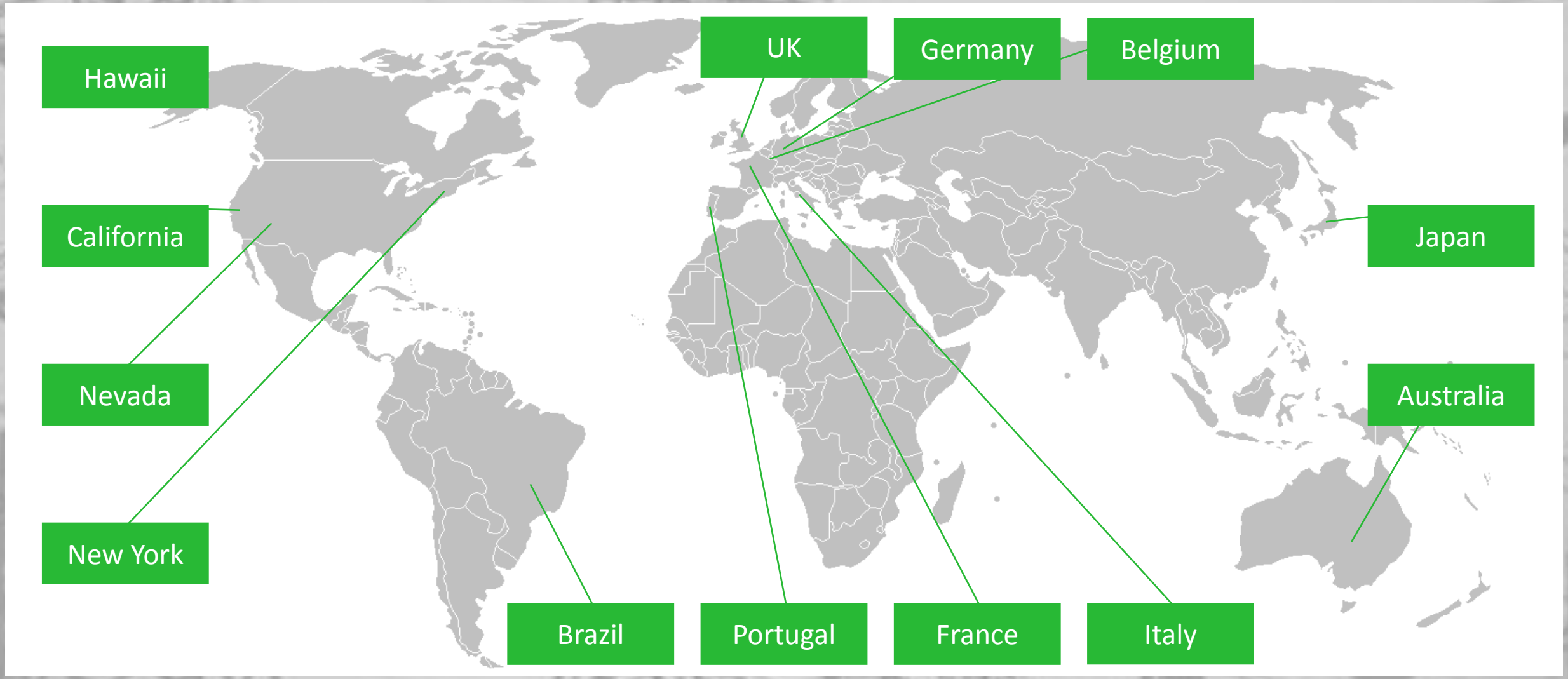
2. METHODOLOGY

1 CASE SELECTION

2 POLICY REVIEW

3 ADJUSTMENTS CATEGORIZATION

3. ANALYSIS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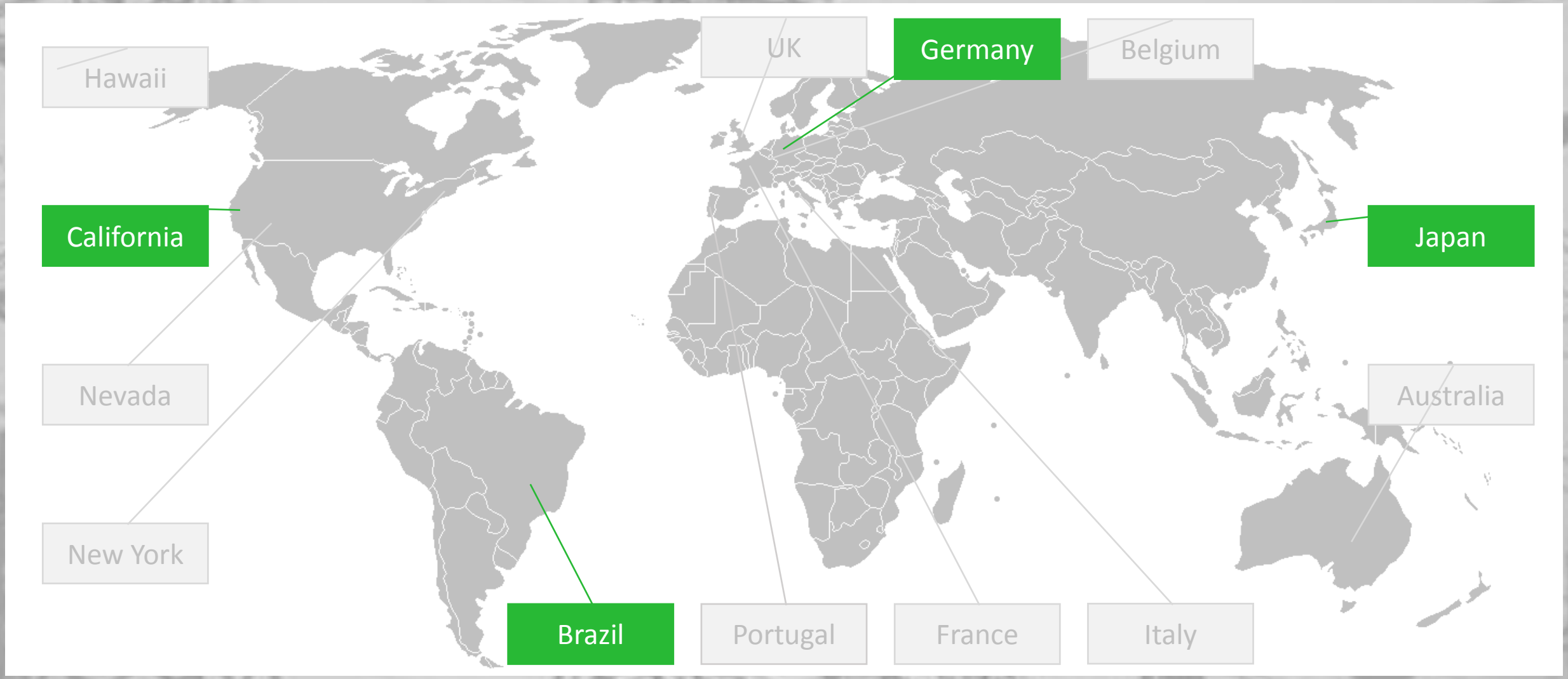
3. ANALYSIS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3. ANALYSIS – THE BRAZILIAN CASE

Policy context (1/2)

2012

In 2012, a **Net Metering** scheme is introduced, through the Normative Resolution no. 482, from ANEEL.

The scheme granted access to **micro** and **mini** generation

Micro generation	Mini generation
≤ 100 kW	**≤ 1 MW**

PV production could be self-consumed or injected into the grid, resulting in energy credits to be compensated over a period of **36 months**.

Two business models were allowed**: remote self-consumption** and **local self-consumption**

3. ANALYSIS – THE BRAZILIAN CASE

Policy context (2/2)

2015

On November, 2015, the 482 Resolution was **amended**, through the Normative Resolution 687.

System capacity caps for micro and mini generation here **redefined**.

Micro generation	Mini generation
≤ 75 kW	≤ 5 MW

Energy credits compensation period extended to **60 months.**

Creation of two new operational models: (1) installation of photovoltaic systems in **apartment block** and (2) creation of a **cooperative** or a consortium to install a PV system.

3. ANALYSIS – THE BRAZILIAN CASE

Solar PV market evolution

482 Resolution

687 Resolution

2012

- 1 785 systems installed until 2015
- 11 MW

2015

- 5790 systems installed until 2016
- 58.2 MW

March, 2017:

8,832 systems installed

67.7 MW installed capacity

3. ANALYSIS – THE BRAZILIAN CASE

Policy adjustments characterisation

- Increasing system capacity for mini generation
- Bureaucratic burden reduction
- Net metering credits extension
- New operational models for PV installations

The **policy adjustments** in the Brazilian case are within the scope of measures for **diffusion acceleration through incentive policies.**

3. ANALYSIS – THE CALIFORNIAN CASE

Policy context (1/3)

1995

Introduction of a **Net Energy Metering (NEM) scheme** for systems with no more than ***10 kW***, through Senate Bill no. 656/1995.

Micro generation

≤ 10 kW

PV production could be self-consumed or injected into the grid, resulting in energy credits to be compensated over a period of **12 months**.

At the end of the true-up period, net excess generation was purchased by the utilities at the avoided costs.

Aggregate capacity could only reach a maximum of 0.1% of each utility peak demand, as projected to 1996.

3. ANALYSIS – THE CALIFORNIAN CASE

Policy context (2/3)

1998 → 2002

AB 1755/1998: NEM was extended to **small commercial customers,** compensation for NEG eliminated.

AB 918/2000: main change regarding the **method of charging net consumption** at the end of 12-month period.

AB 29/2001: raised **systems capacity cap to 1 MW** and **eliminated utilities territory caps**.

AB 58/2002: established a **ceiling of 0.5%** per IOU (**270 MW** for the three IOUs) for total net-metered capacity.

3. ANALYSIS – THE CALIFORNIAN CASE

Policy context (3/3)

2009 → 2016

AB 920/2009: NEG remunerated by the **net surplus compensation (NSC)** (a 12 months electricity retail rate moving average).

AB 327/2013: redefined **system level capacity cap to 5%** of the IOUs peak demand.

NEM 2.0/2016: eliminated the **1 MW maximum system size**, introduced **interconnection fees** and **Non-bypassable charges**, determined the migration to ToU tariffs.

3. ANALYSIS – THE CALIFORNIAN CASE

Solar PV market evolution

3,019 systems installed in 2002 to **594,685** in 2016

12 MW installed capacity in 2002

4,697 MW installed capacity in 2016

3. ANALYSIS – THE CALIFORNIAN CASE

Policy adjustments characterisation

- Increasing system's capacity cap
- Increasing aggregate installed capacity caps
- Transition from new rules to align the costs of NEM 2.0 customers to those of customers who don't have photovoltaic systems

The **policy adjustments** in the Californian case are within the scope of measures of transition for **supporting sustained growth and also mitigate cost shifting issue.**

4. NET METERING POLICIES EVOLUTION TRAJECTORIES

California net energy metering does not exist in a vacuum, since California implemented many other strong support policies that are not verified in the case of Brazil.

The Brazilian case analysis unveils an early stage public policy support framework.

The identified adjustments aim at increasing policy support.

The California case revels a maturing public policy support framework.

The identified adjustments aim at transitioning from policy support to supporting sustained growth and also mitigate cost shifting issue

3. ANALYSIS – THE GERMAN CASE

Policy context (1/2)

1991 → 2004

Introduction of a **Feed-In Tariff scheme** in 1991, defining a tariff of **€ 0. 08/kWh**

2000 reform**: FIT** for PV systems increased to **€ 0. 51/kWh.**

2004 reform:

- **Sub-categories for photovoltaic installations** (with a differentiated remuneration based on capacity installed)
- Automatic **annual 5% regression** mechanism for remuneration
- **Remuneration** for photovoltaic installations was **increased** to **€ 0. 57/kWh.**

3. ANALYSIS – THE GERMAN CASE

Policy context (2/2)

2009 → 2014

2009 reform:

- **Digression** rate **increased** to **8-10%**
- **Self-consumption** premium scheme

Remuneration rates were progressively reduced through theses reforms

2012 reform:

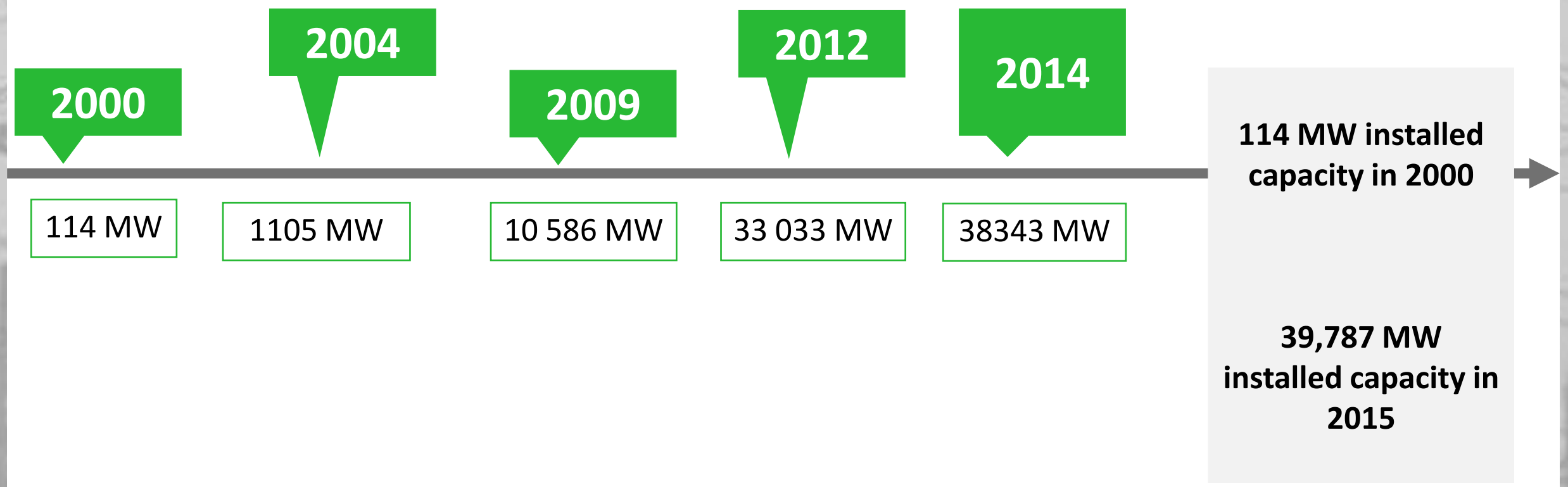
- Created an alternative model to the feed-in tariff called **feed-in premium.**
- Cancelled the extra remuneration for self-consumption

2014 reform:

- **Feed-in premium** model mandatory for all systems bigger than 100kWp
- Tax on self-consumption

3. ANALYSIS – THE GERMAN CASE

Solar PV market evolution



3. ANALYSIS – THE GERMAN CASE

Policy adjustments characterisation

- Decreasing FIT compensation
- Increasing incentives for non-residential installations

The **policy adjustments** in the German case are within the scope of measures of transition for **incentivizing non-residential installations (>10kwp)** and **controlling policy costs.**

3. ANALYSIS – THE JAPANESE CASE

Policy context (1/1)

2009 → 2015

Introduction of a **Feed-In Tariff scheme** in 2009.

2009 reform**:**

- **Sub-categories for photovoltaic installations** (residential/non-residential)
- Limit to capacity size eligible for FiT of **max. 500kWp**
- FiT exclusively for **excess energy** generated
- Remuneration rate guaranteed for **10 years**

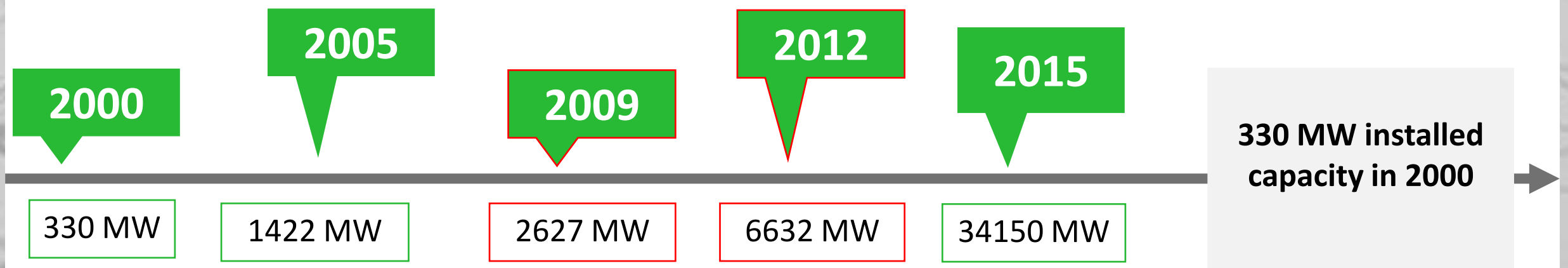
2012 reform:

- Categories changed to **≤10kWp (residential)** and **>10kWp (non-residential)**
- Remuneration rate guaranteed for **20 years** for non-residential installations
- FiT applicable to all energy generated in the case of non-residential installations

Residential	Non-Residential
≤ 10 kWp	**>10 kWp**

3. ANALYSIS – THE JAPANESE CASE

Solar PV market evolution



3. ANALYSIS – THE JAPANESE CASE

Policy adjustments characterisation

- Decreasing FIT compensation
- Increasing incentives for non-residential installations

The **policy adjustments** in the Japanese case are within the scope of measures of transition for **guaranteeing a cost effective remuneration rate** and **reduce policy costs.**

4. FiT POLICIES EVOLUTION TRAJECTORIES

Japanese and German cases analysis revels maturing support framework, which faces similar challenges.

The policy adjustments in the both cases address the need of guaranteeing a cost effective remuneration rate and reduce policy costs

Japan, as a “late comer”, incorporated some lessons from the German case.

- Encouraging self-consumption
- Defining remuneration according to the system installed capacity

5. CONCLUSION

- **NEM** (Brazil and California) **and FIT** (Germany and Japan) incentive evolutions where presented as flexible mechanisms for distributed generation support

- Especially in the case of FiT schemes, growing policy costs are a major concern and motivating factor for reform

- In the case of Net-Metering, there is growing concern over the need of mitigating cost shifting, and recent reforms and discussions (in Brazilian case), reflect this goal.

- The success of FiT and Net-Metering schemes depend on wider policy framework, which must be considered.

- The effectiveness of photovoltaic penetration as a measure of success must be questioned.

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