Electric Challenges
The Energy Transition: Markets and Policies

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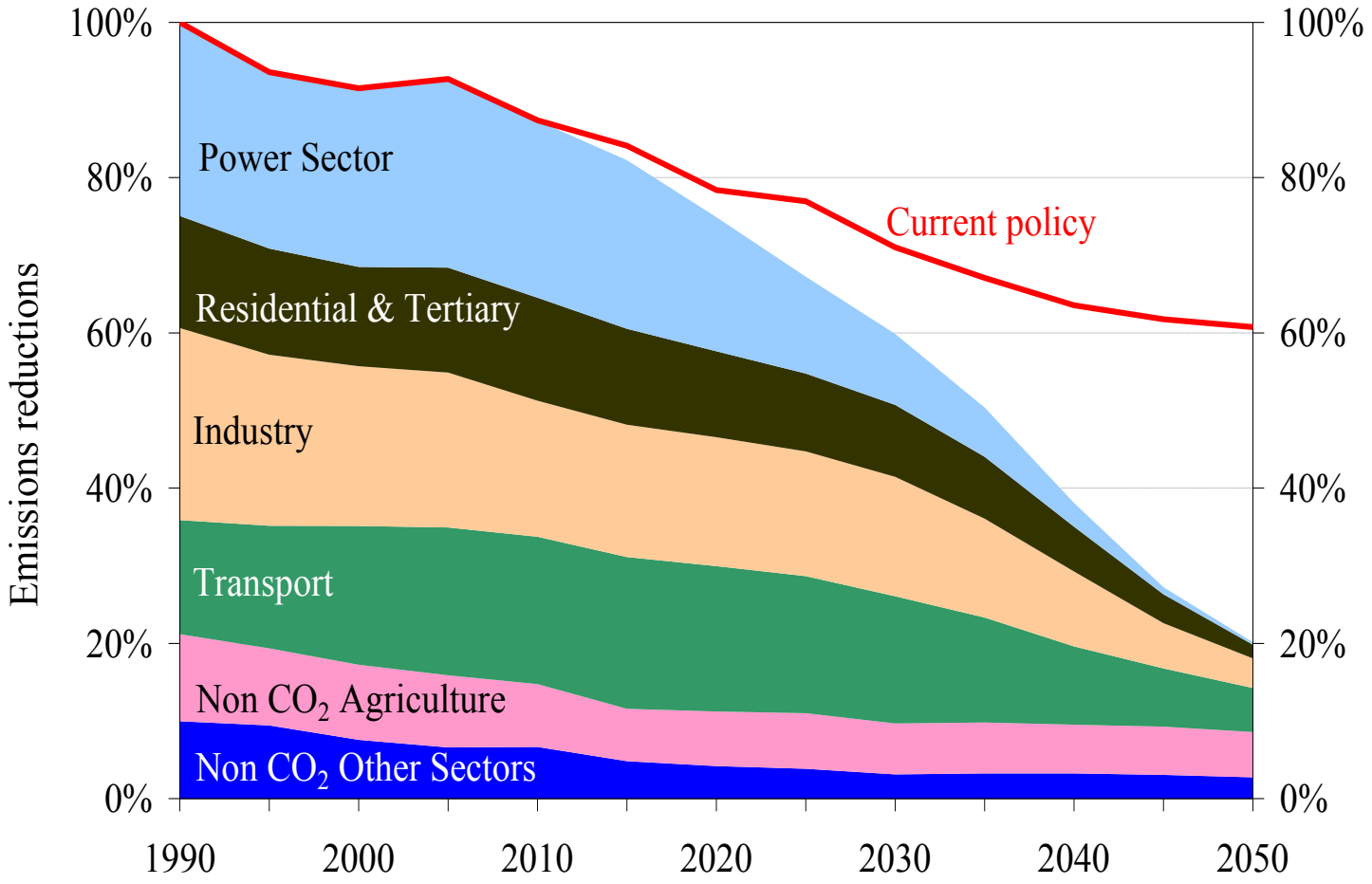
Decarbonizing our economies



Carbon emmissions reductions in Europe, 1990-2050

Source: European Commission. 2050 Energy Roadmap (2012)

2030 EU Climate & Energy Framework

Key targets for 2030:

- 40% cuts in **greenhouse gas emissions** (from 1990)
- 32% share for **renewable energy**
- 32.5% improvement in **energy efficiency**

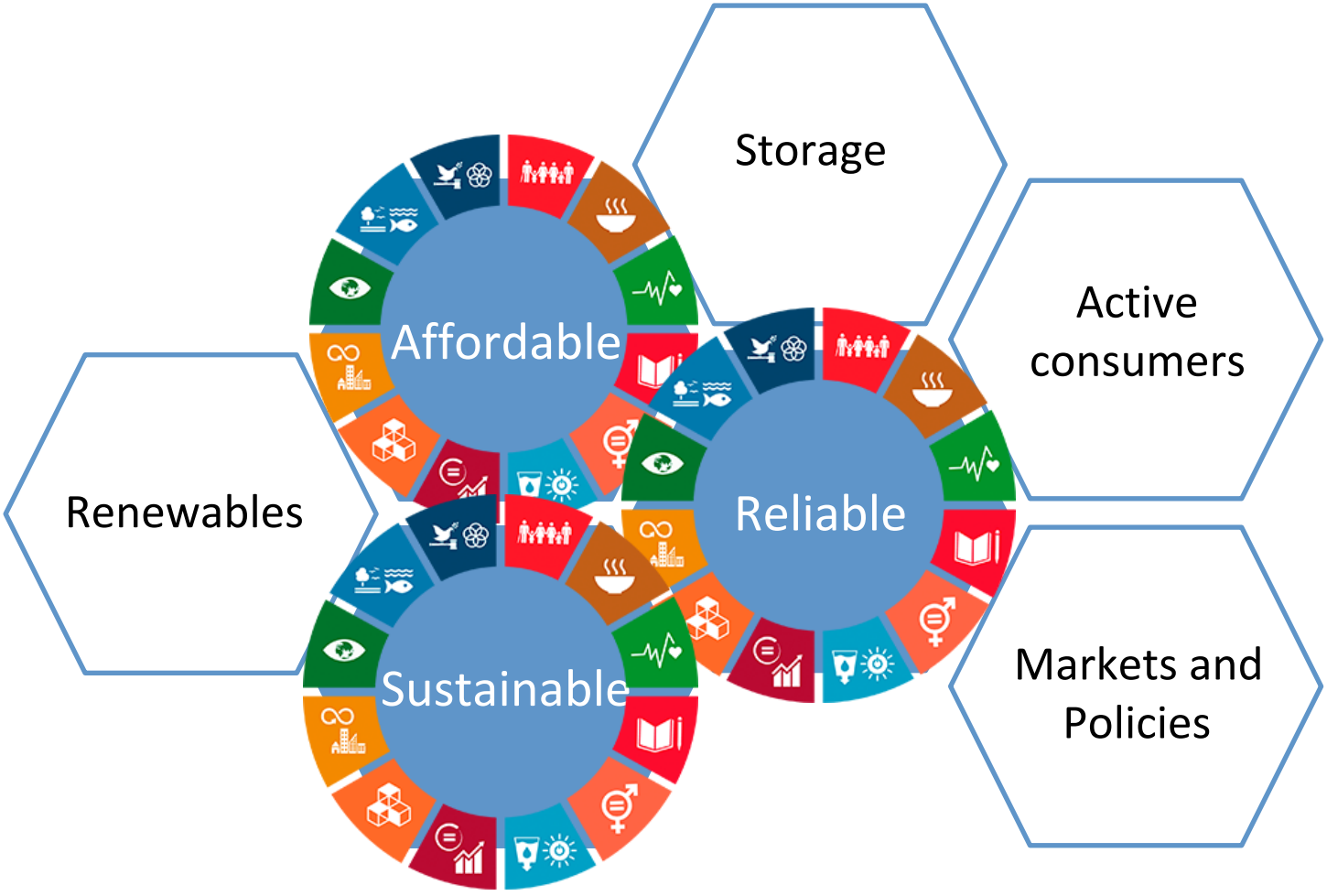
Key benefits:

- **affordable** energy
- **security** of energy supplies
- **reduced dependence** on energy imports
- new opportunities for **growth and jobs**
- environmental and **health benefits**

SDO 7: Ensure access to affordable, reliable, sustainable and modern energy for all

My ERC Consolidator project seeks to understand:

How to achieve these objectives at least cost?



A pletora of research questions regarding….
Renewables

Distinguishing characteristics of renewables:

1. Almost zero variable costs
2. Upfront investment costs
3. Intermittent (seasonal + uncertain availability)

Implications (& research questions):

1. How will 100% renewables markets work?
2. How to induce investments in renewables?
3. How to cope with renewables' intermittency?

How will 100% renewables markets work?

"**Auctions with unknown capacities: understanding competition among renewables**"

(with Gerard Llobet)

- We model **strategic interaction among renewables**
- We have found that….
  - Renewables will bid **prices above marginal costs**
  - Markups will be lower at very windy/sunny hours
  - Market power will enlarge price **price volatility**
  - Average market prices will smoothly go down **towards marginal costs**

Is current electricity market design adequate?

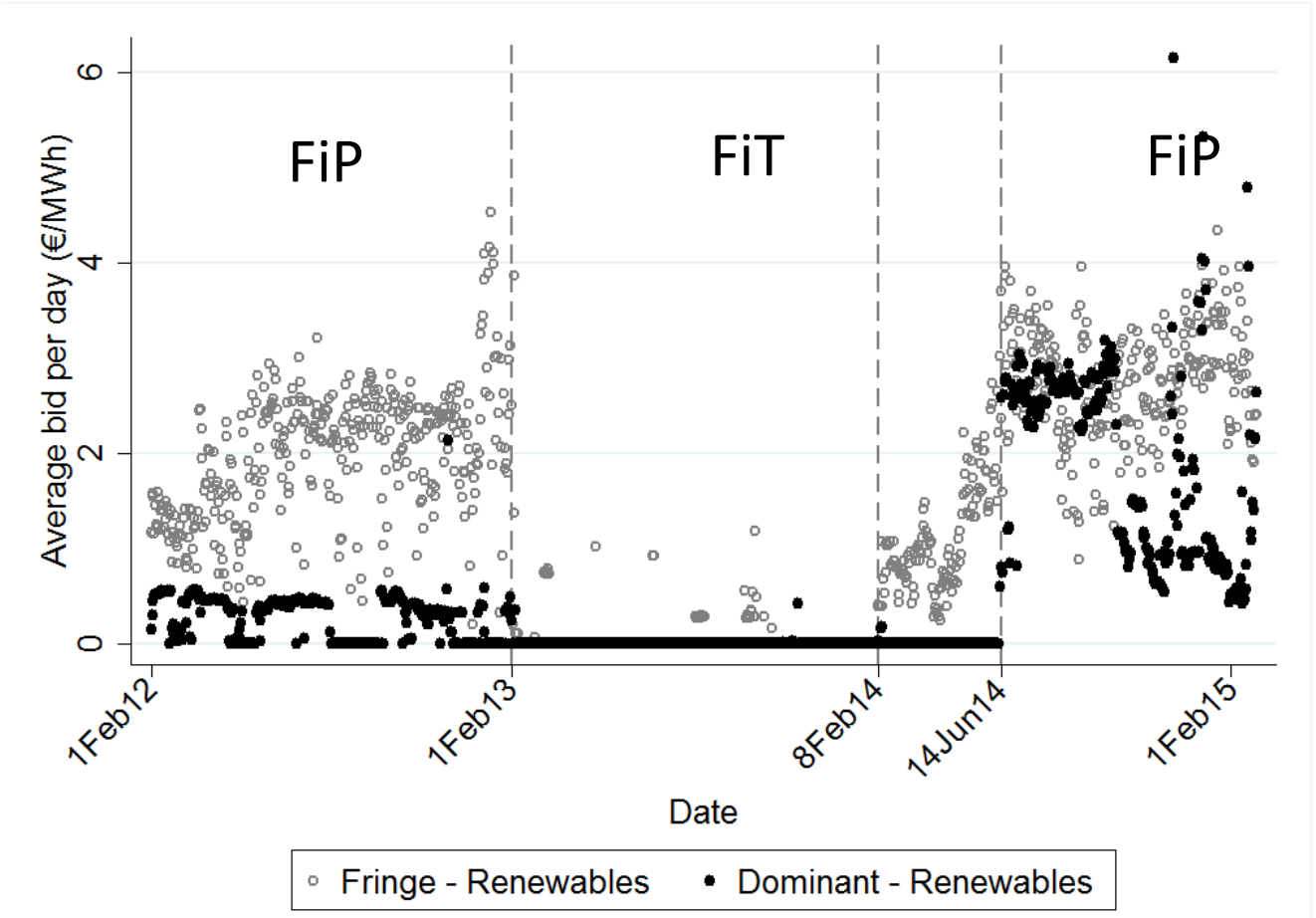
Does market performance depend on how we pay for renewables?

"Pricing Schemes and Market Power: The Role of Forward Contracts and Arbitrage" (with Imelda)

- Two common pricing schemes for renewables:
  - Renewables are exposed to **market prices** (FiP)
  - Renewables receive **fixed prices** (FiT)

- Spanish regulatory experience offers natural experiments:
  - February 2013: from FiP to FiT
  - June 2014: from FiT to FiP

Does market performance depend on how we pay for renewables?

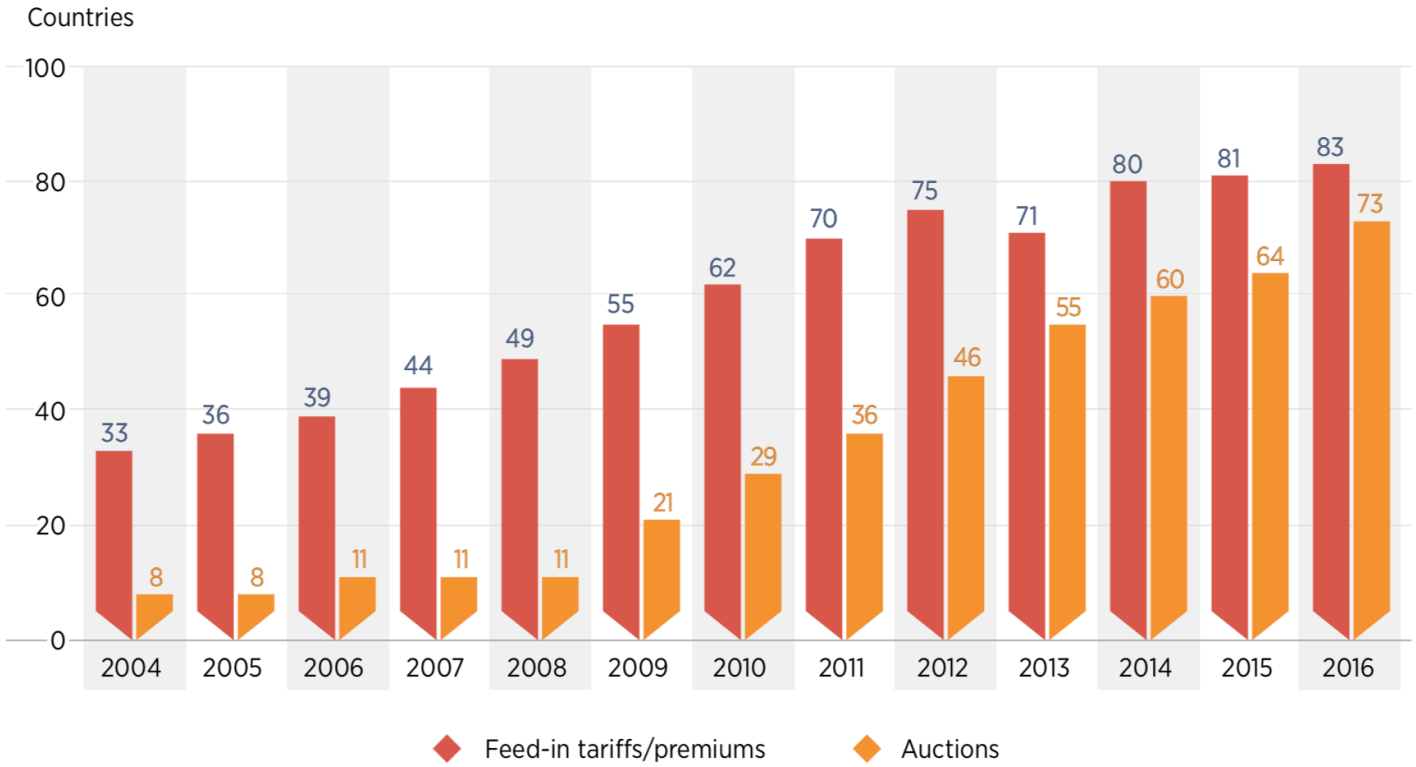


Average daily bids of renewables, Spanish electricity 2012-2014

Source: Fabra and Imelda (2019)

How to induce investments in renewables?

Through price or quantity regulation?
Through technology neutral or specific auctions?



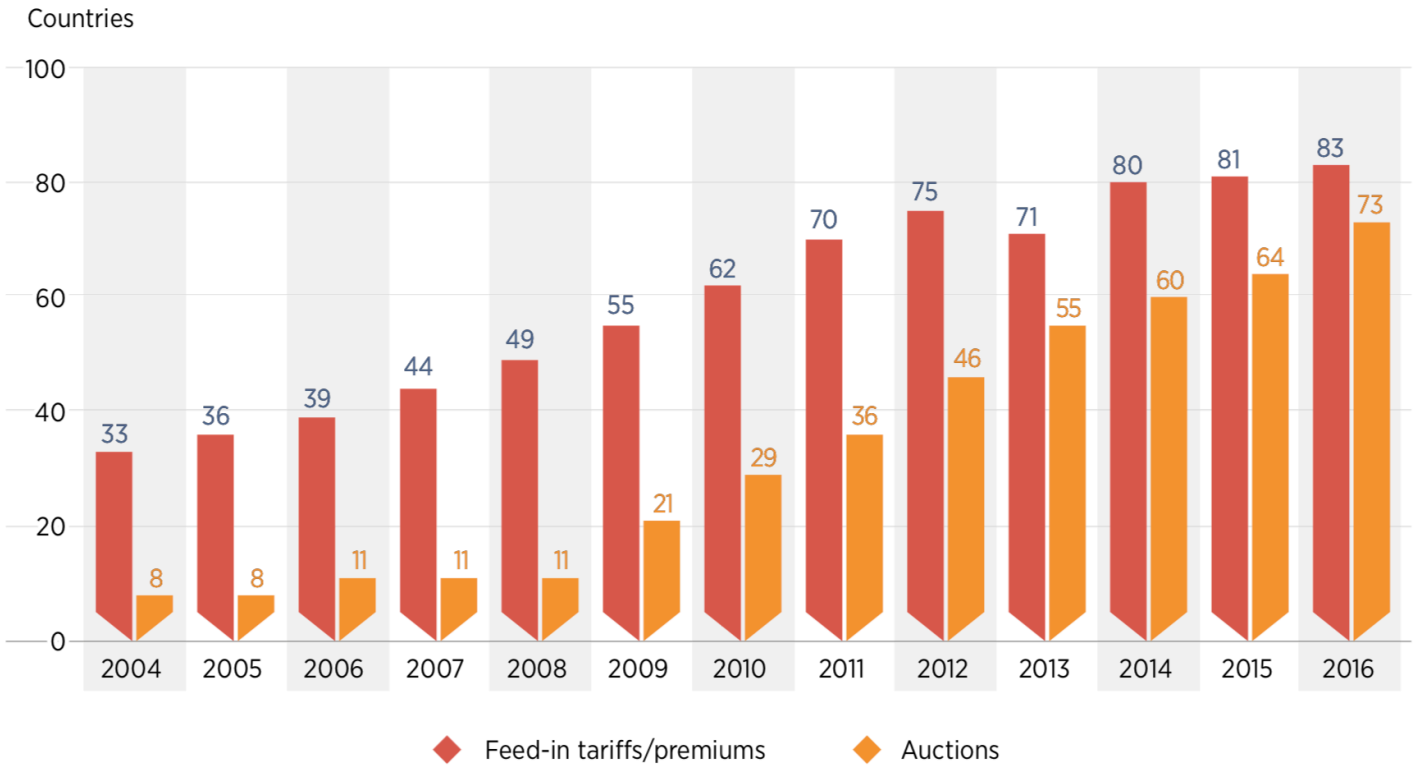
Trends in the adoption of FiT/FiP and auctions, 2004-2016

Source: IRENA, IEA, OECD (2018)

How to induce investments in renewables?

"Price versus quantities with multiple technologies"

(with Juan Pablo Montero)



Trends in the adoption of FiT/FiP and auctions, 2004-2016

Source: IRENA, IEA, OECD (2018)

How to induce investments in renewables?

Key ingredients:

- Asymmetric information regarding costs
- Concerns for rent extraction

We have identified **fundamental trade-offs**:

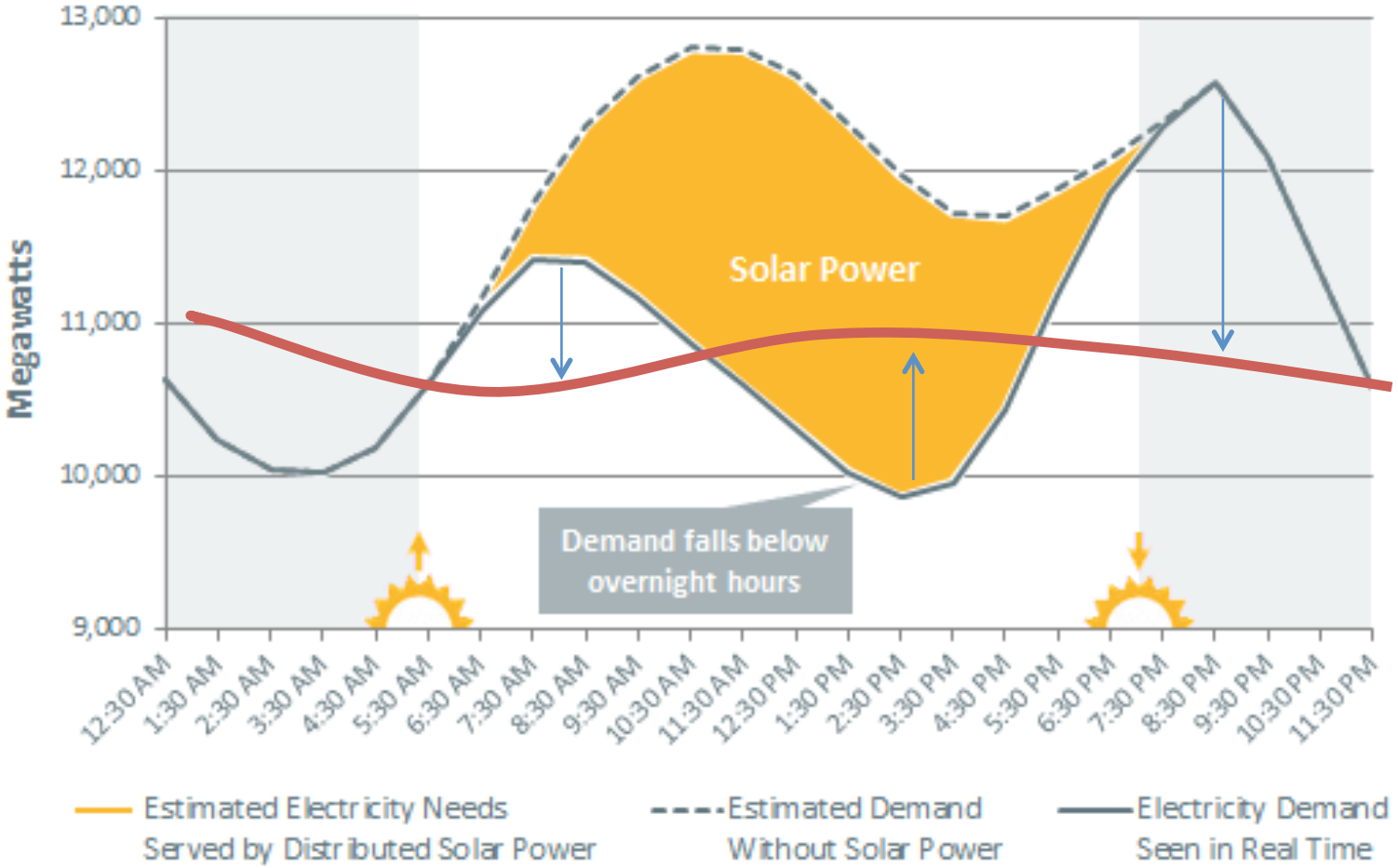
- Prices vs. quantities similar to Weitzman (1974)
- Technology neutral instruments facilitate **cost efficiency**
- Technology specific mechanisms reduce excessive **rents**

Technology neutrality need not always be optimal

(suboptimal if small info asymmetries, cost shocks closely correlated, and techs asymmetric)

How to cope with renewables' intermittency?

Price signals: demand response + storage



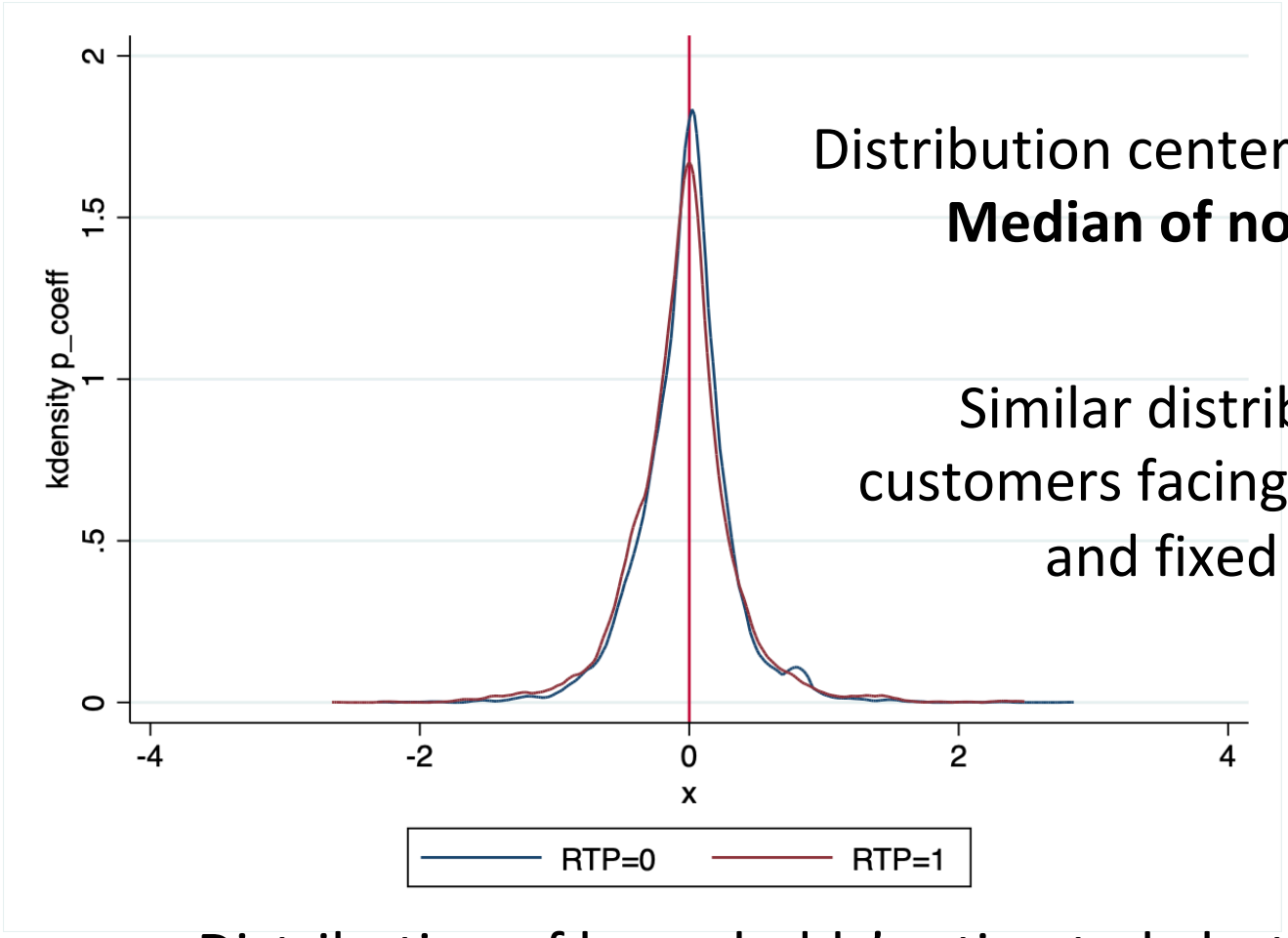
Will consumers respond to price signals?

"**Real-Time Pricing for Everyone**"
(with David Rapson and Mar Reguant)

- Spain, only country with **Real-Time Prices by default**:
  - **Unique data set**: >3M households, hourly electricity consumption over 2 years + socio-economic characteristics

- Do consumers respond to hourly prices? If so, how? Who?
  - Price **elasticities**?
  - **Heterogeneous effects**? Distributional impacts?
  - What role for **information**?
  - Who **opts out** of hourly prices?

Will consumers respond to price signals?



Distribution centered around zero

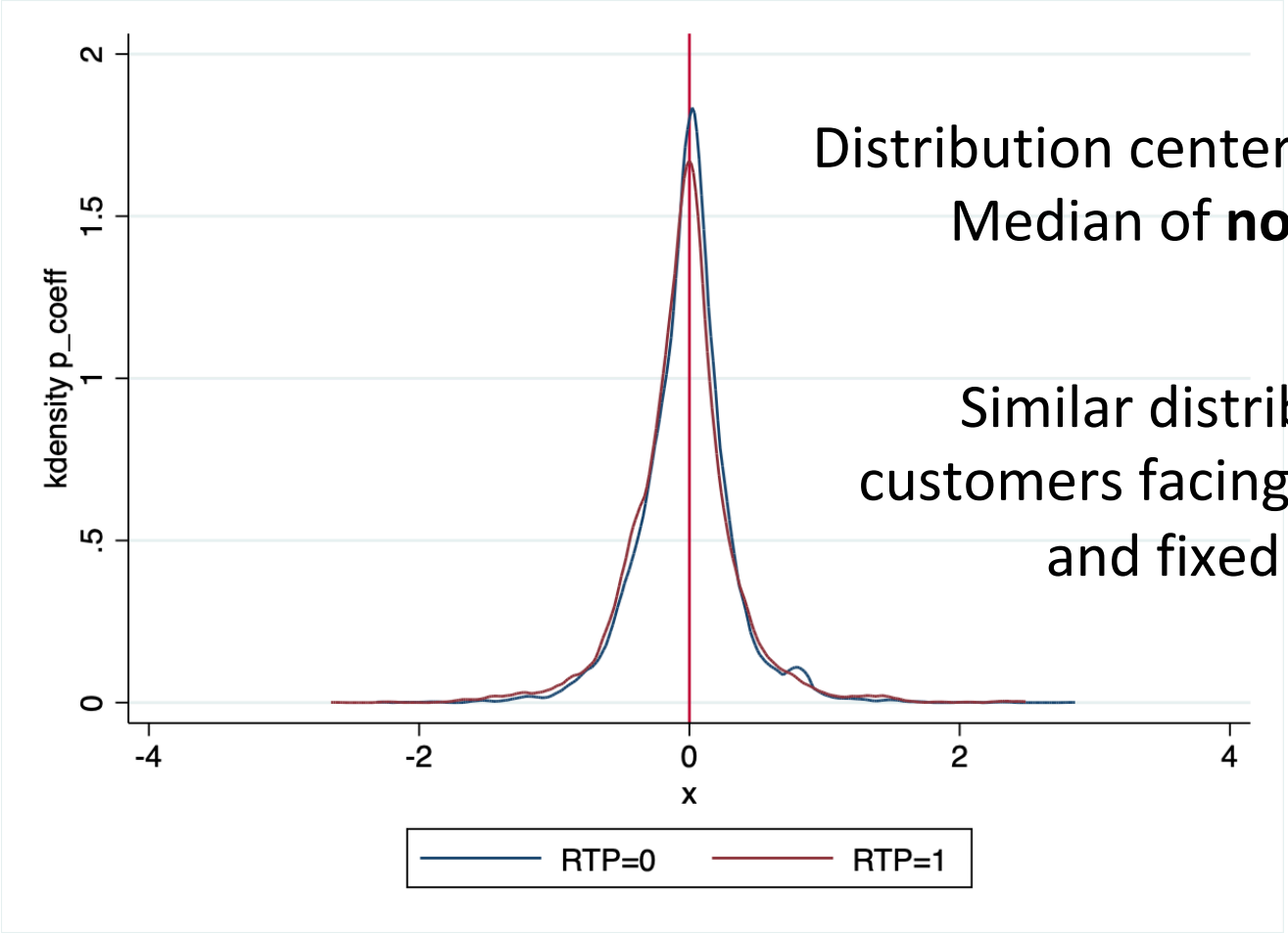
Median of no response

Similar distribution for customers facing hourly prices and fixed prices

Distribution of households' estimated elasticities

Source: Fabra, Rapson and Reguant (2019)

Will consumers respond to price signals?



Distribution centered around zero
Median of **no response**

Similar distribution for customers facing hourly prices and fixed prices

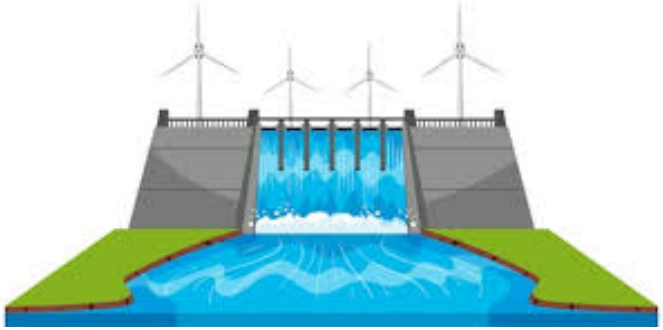
Pricing not enough: other drivers needed (e.g. technology)

Source: Fabra, Rapson and Reguant (2019)

Will storage be managed efficiently?

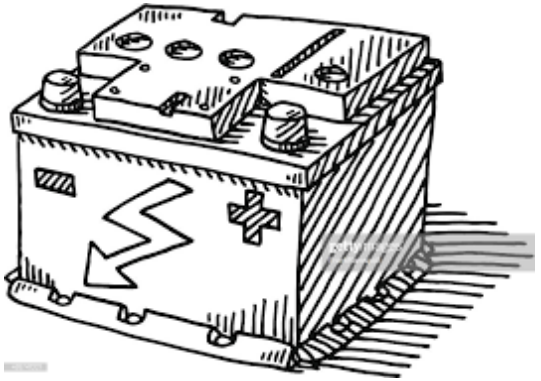
"**Storing Power: Market Structure Matters**"

(with David Andrés-Cerezo)



Concentrated and vertically integrated

Fragmented



Concentrated?

Will storage be managed efficiently?

Key role for storage:

- Flattens production, reduces production costs, makes use of excess renewables, reduces demand peaks…

But it all depends on market structure…

- **Market power in storage**: under-utilization under under-investment
- **Market power in generation** may lead to over-investment

Vertical integration btw generation-storage leads to the worst outcome

Final Remarks

- How we **design the energy transition** is key for its success
- **Renewables are a game changer**, which requires:
  - Rethinking market design of electricity markets
  - Rethinking how we pay for renewables
  - Rethinking how we price electricity for consumers
  - Rethinking how we manage/invest in storage facilities

The energy transition implies a big challenge, but also a big opportunity

Exciting area of research!

A Big Thank You to the ERC

questions? comments?

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