

Simulation of incentive mechanisms for renewable energy policies

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ePolicy project

- ▶ FP7 STREP Project funded under ICT tools for Governance and Policy Modeling
- ▶ AIM: provide decision support systems for policy makers
- ▶ Case study: Emilia-Romagna regional Energy Plan

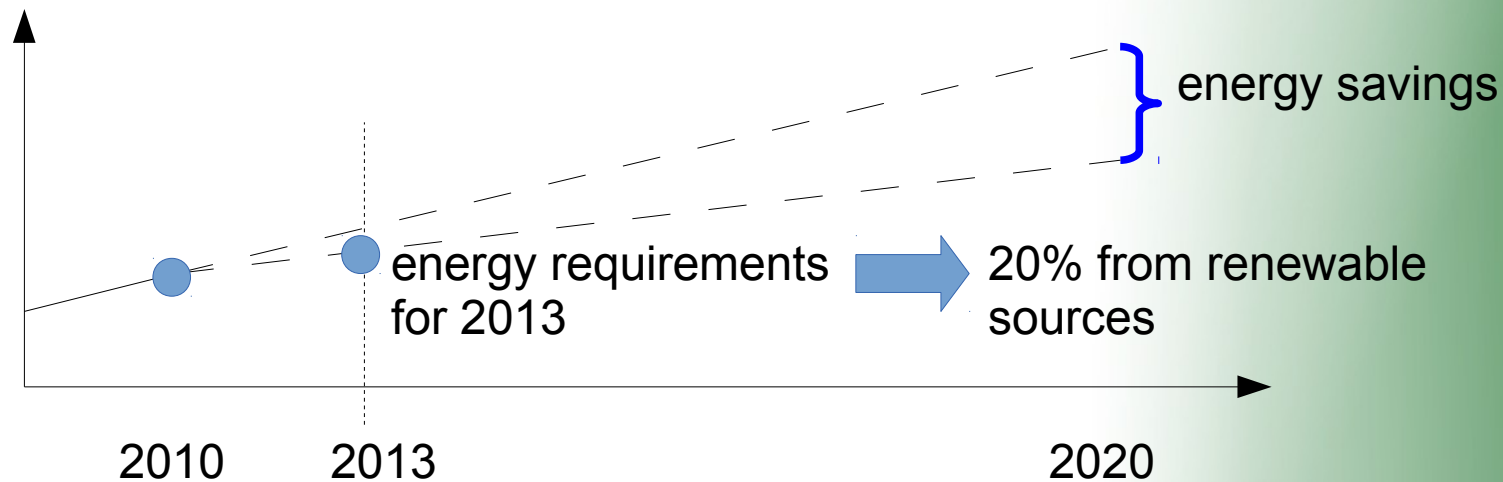


Outline

- ▶ Public Policy Making
- ▶ Context: Subsidies for renewable technologies
 - Focus on photovoltaic (PV) power generation
- ▶ Implementation strategies are needed to enforce plans
- ▶ How can we evaluate the best instruments?
 - Multi-agent simulation

Emilia-Romagna Regional Energy Plan 2011-13

- EU directive 20-20-20: objectives for 2020
 - 20% reduction CO₂ emissions
 - 20% energy comes from renewable sources

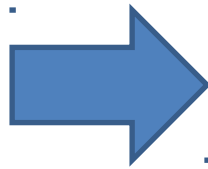


Costs and incentives

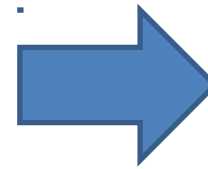
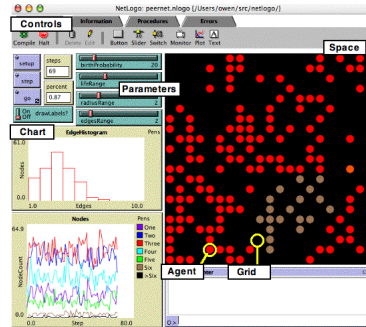
- ▶ Region cannot afford to build the plants
- ▶ Can incentivise private stakeholders
- ▶ What results can be expected?
- ▶ How do people *react* to different subsidy policies?

Simulation

Incentives,
regional policies,
taxes,
...



simulator



MW of installed
power

- ▶ Agent-based economic and social simulation aids the policy maker to understand the individual perspective

Incentives to renewable: a survey

- ▶ Production-based incentives
 - Feed-in tariffs
 - Feed-in Premium tariffs
 - Quota obligations
- ▶ Investment-based incentives
 - Loan-Interest incentives
 - Loan-Guarantees
 - Fiscal incentives
 - Investment Grants
 - Tax exemptions
- ▶ Compulsion
- ▶ Green Power Marketing

Emilia-Romagna Subsidies

- ▶ Production-based incentives
 - Feed-in tariffs
 - Feed-in Premium tariffs
 - Quota obligations
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Italian Feed-In tariff

Regional Incentives
in Emilia-Romagna
on top of
national incentives

Economic Simulator

- ▶ Agent-based simulation model
 - Relationship between the subsidies and the installed MW power from PV
- ▶ Main focus on economic aspects
 - Better understood, PV plant as investment
- ▶ Two types of agents
 - The Region
 - House owners

Simulation Model

- ▶ The region provides incentives to house owners to foster the installation of PV panels
 - Initial budget plus yearly constant funds
- ▶ House owners perform a feasibility study
 - Agent parameters: surface of roof, budget, energy consumption, obstinacy..
 - Global parameters: price of electricity, average cost of PV plants, yearly increase of energy prices, national and regional subsidies..

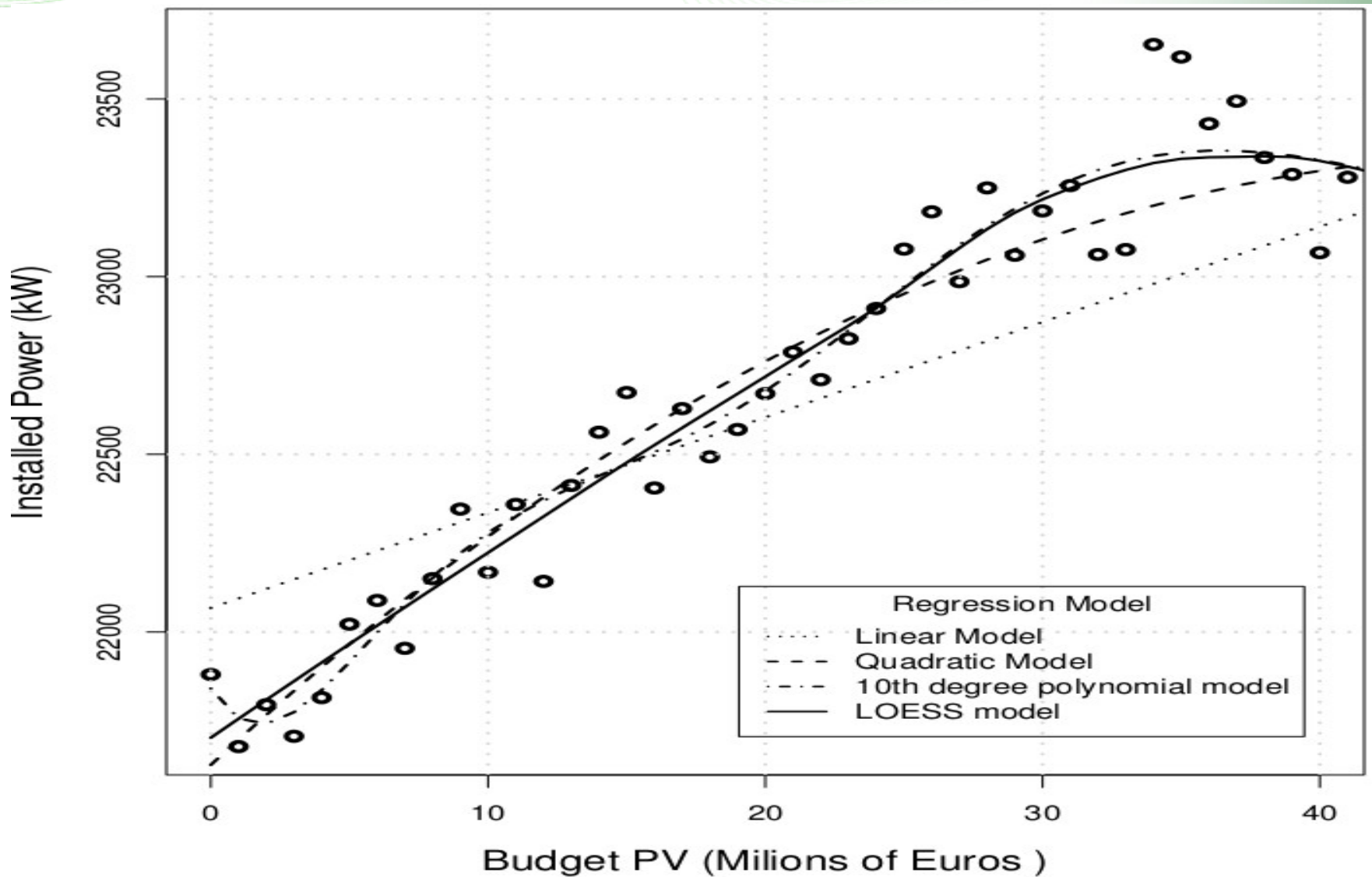
Economic and social aspects

- ▶ The decision is taken considering mainly an economic point of view
 - Is the investment profitable?
- ▶ Preliminary social component
 - Each agent lives in a bi-dimensional world and is influenced by the agents within a predefined range
 - *Obstinacy* parameter increases with the number of neighbours with PV panels

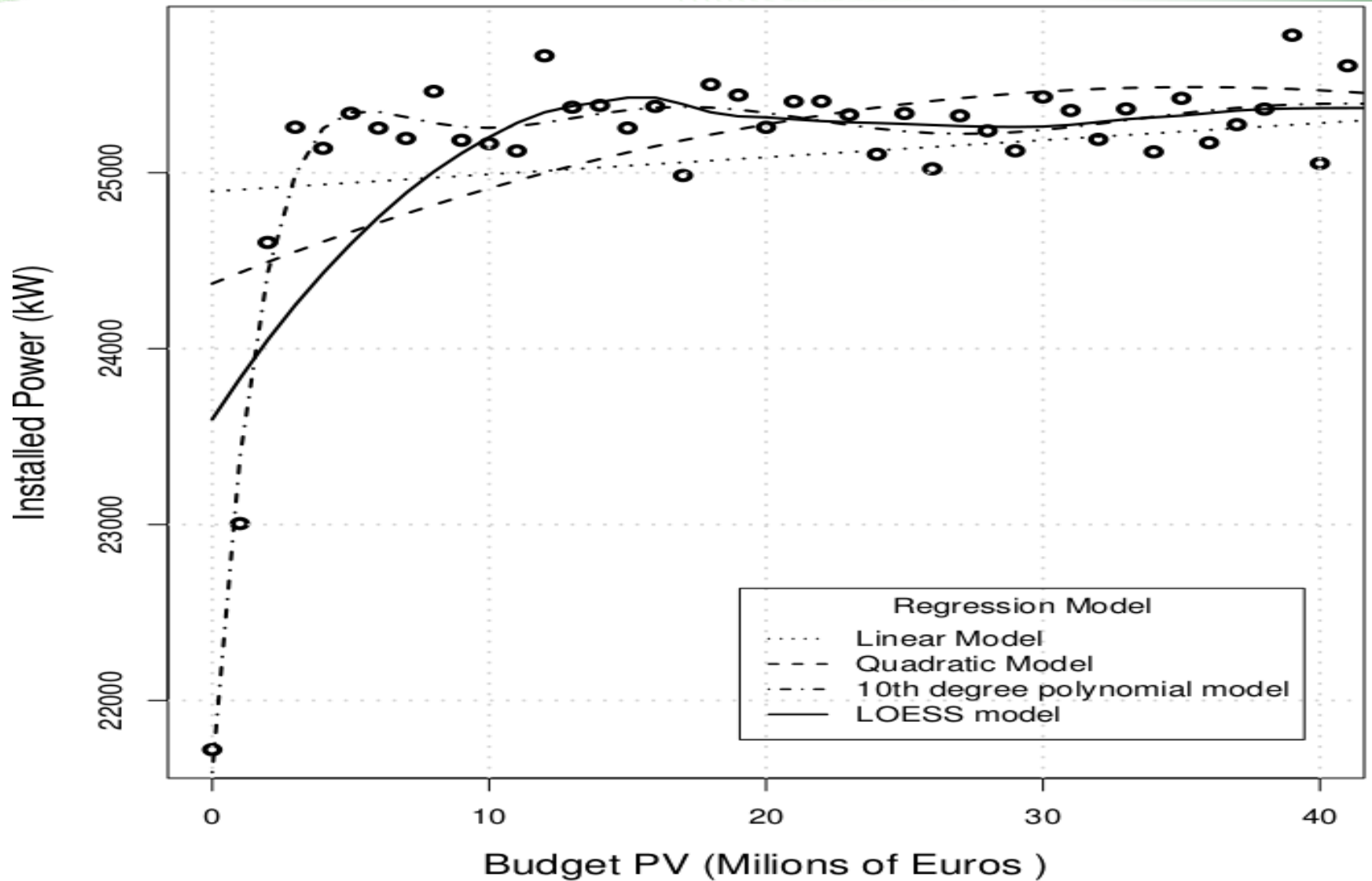
Experimental evaluation

- ▶ Our goal: relationship between installed power and regional incentives
- ▶ 4 incentives treated as independent
- ▶ Statistical significant data from many simulations
 - 12000 runs for each incentive

Relationships Learning Investment Grant

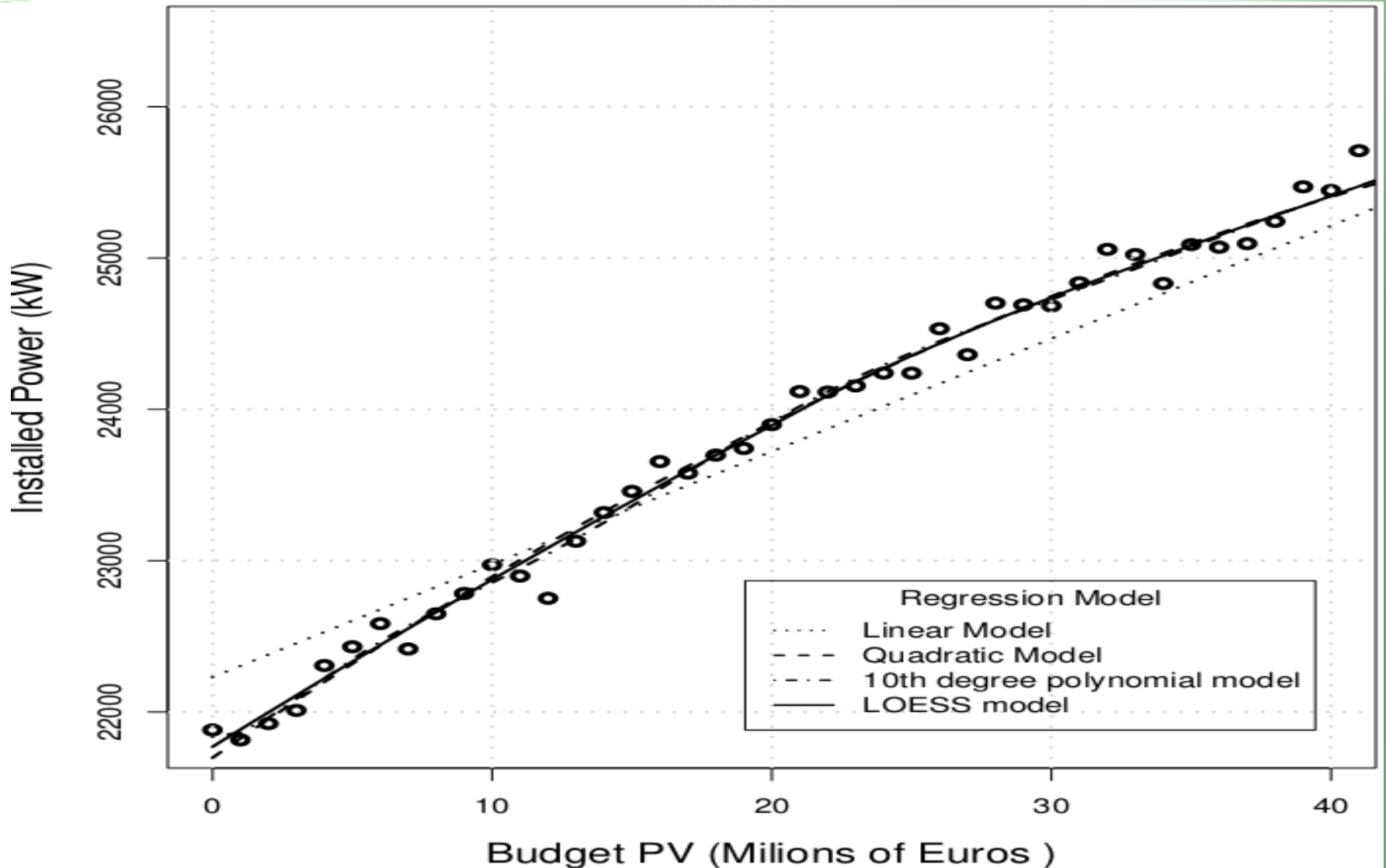


Relationships Learning Interest Fund



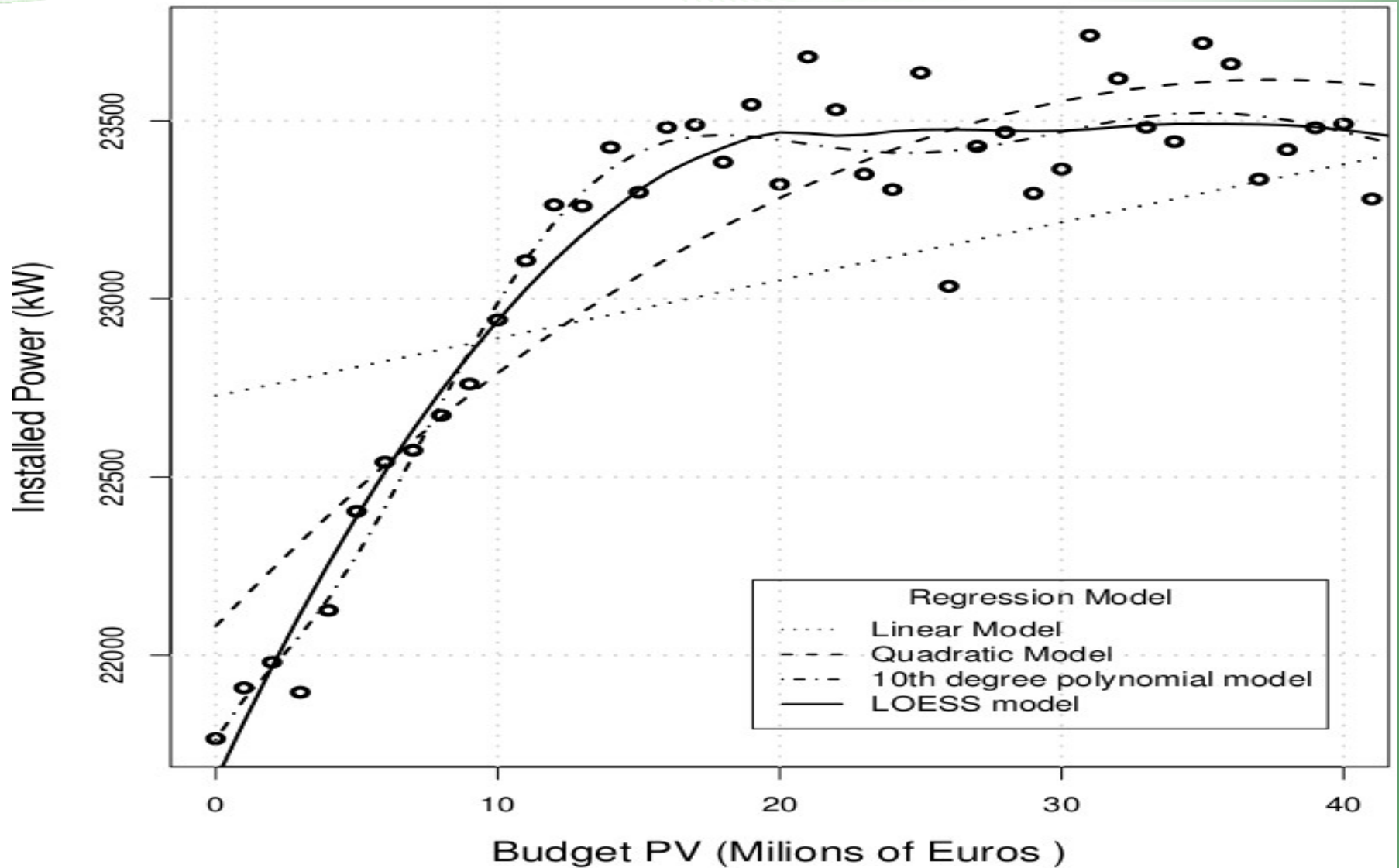
Relationships Learning

Fiscal Incentive

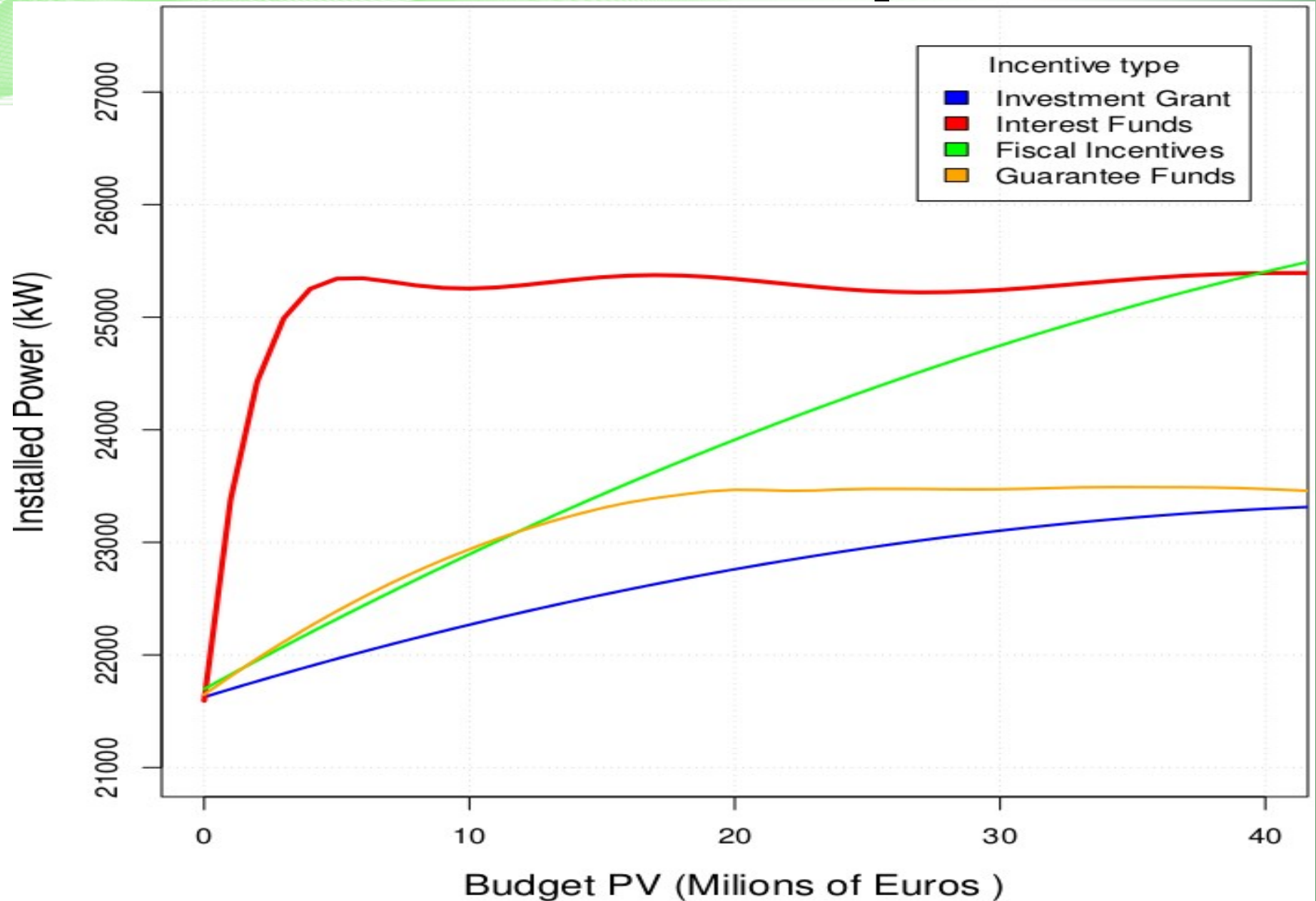


Relationships Learning

Guarantee Fund



Incentives Comparison



Conclusion

- ▶ Problem: understanding the efficiency of different incentive mechanisms
- ▶ Approach
 - Multi-agent based simulation
 - Machine learning techniques

Future Research

- ▶ Simulator extensions
 - Combinations of instruments
 - More complex social interactions
- ▶ Simulator validation
 - Validating the simulator on real data
 - Scalability of results
- ▶ Feedback on policy modeling
 - Mixing regional planning with implementation strategy

Thank you!

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