

# **Market dynamics driven by the decision making power producers**

D.Ernst, A. Minoia, M. Ilic  
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# Introduction

- Electricity markets are composed of decision making agents.
- We propose an agent based approach to study electricity markets.
- Each agent is modeled by a set of rules and the characteristics of the market are analyzed through simulations.

# Why an agent-based approach to electricity markets ?

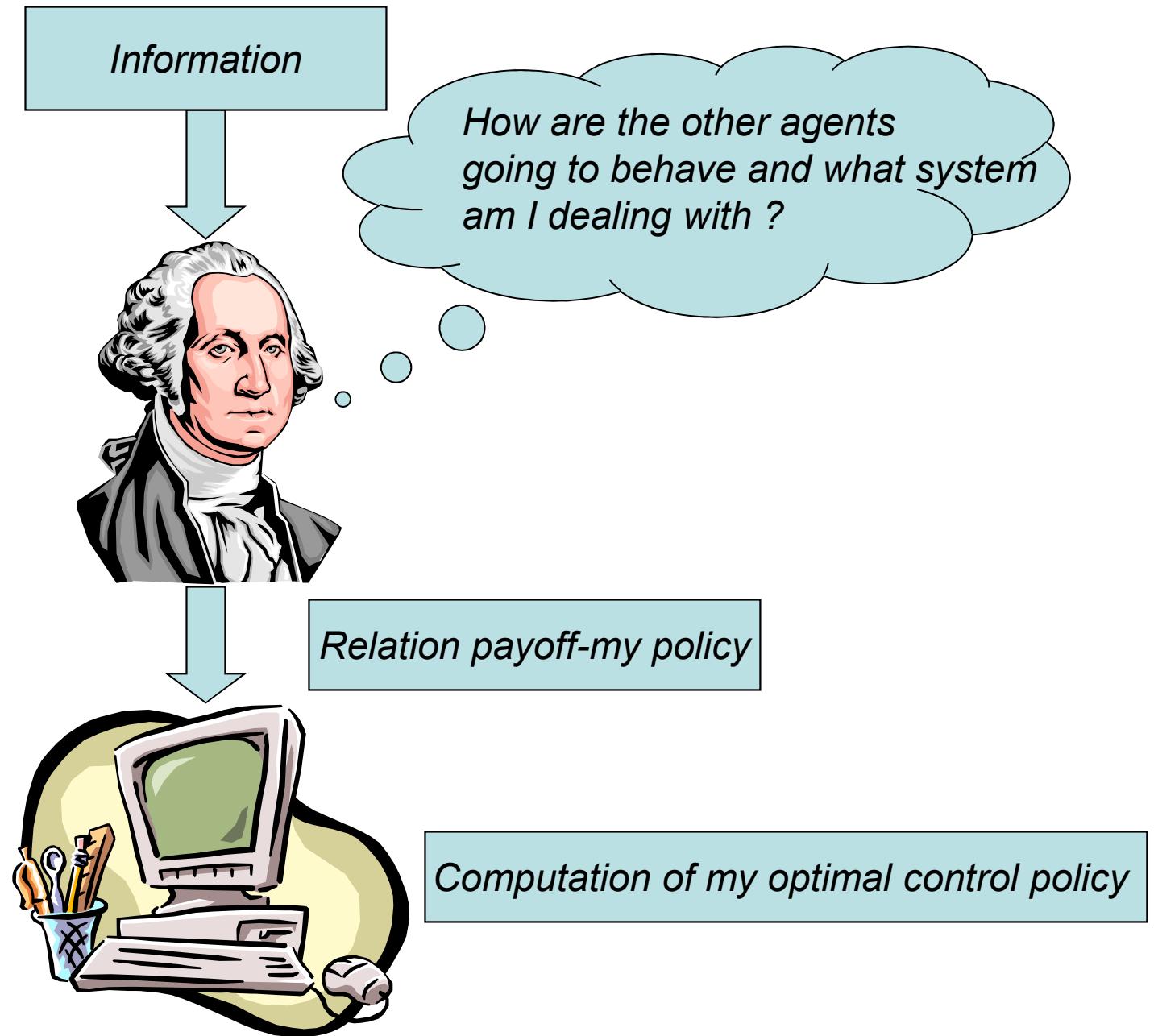
- Can deal with complex market structures (capacity constraints, price caps, etc)
- Can take into consideration the more complex behavior the different market participants may have (willingness to form a coalition, participation in negotiation processes, etc)

# Two main contributions of this paper

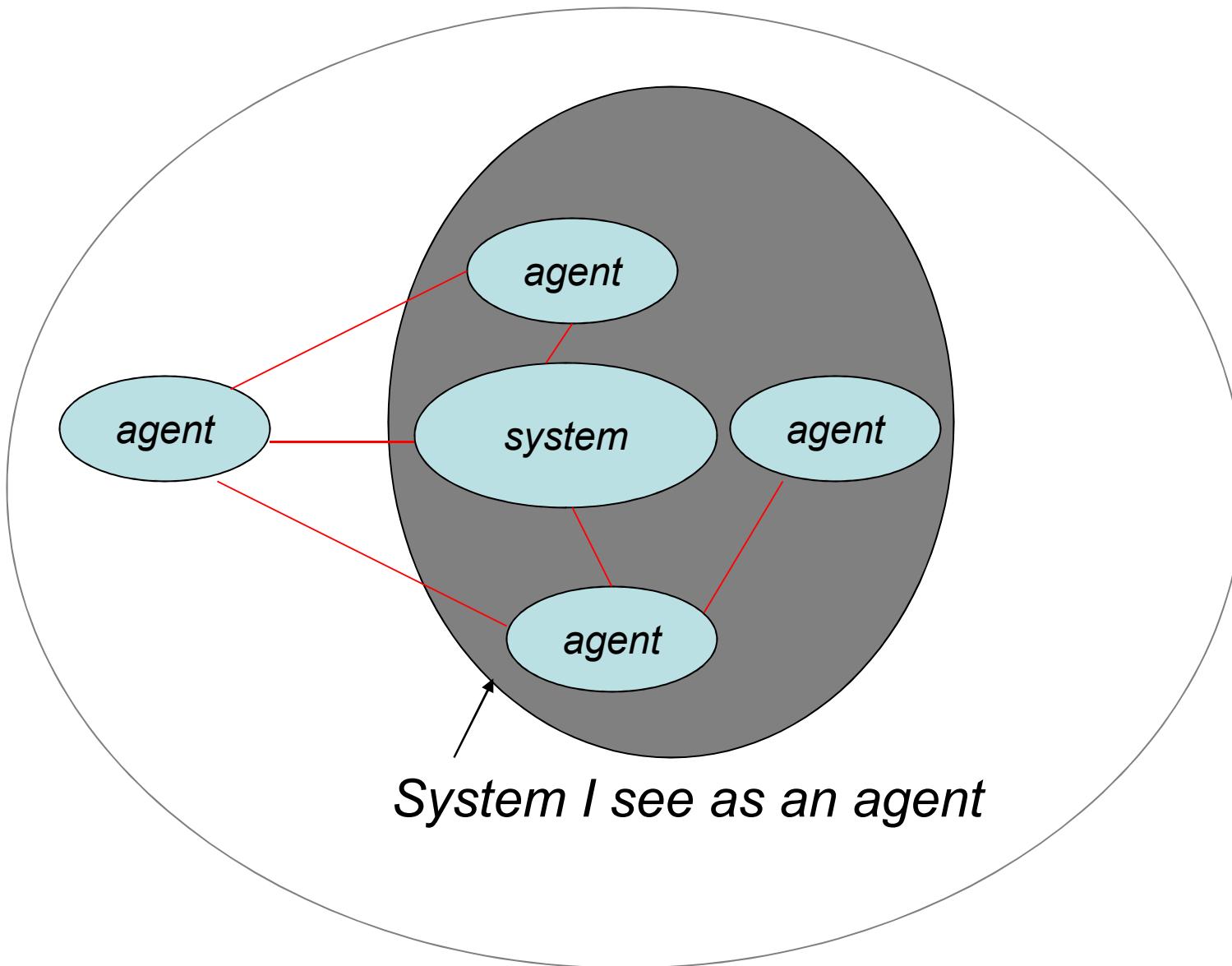
- Propose a new strategy for agent modeling.
- Use these models to simulate and study markets : we compute for each stage of the market the payoff of each agent and study the influence of several factors like congestion, new generation and portfolio on these payoffs.

# New modeling approach

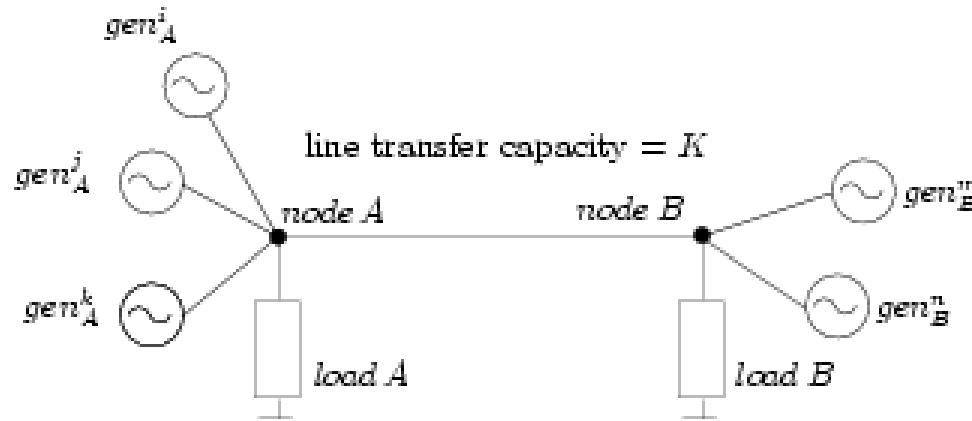
- Each agent makes assumptions about the behavior of the other agents and the system.
- Its behavior is the one which maximizes its payoff if the other agents were indeed behaving according to these assumptions and if the system was correctly modeled.
- It implies for each agent to solve internally a potentially optimization problem.



*Overall system*

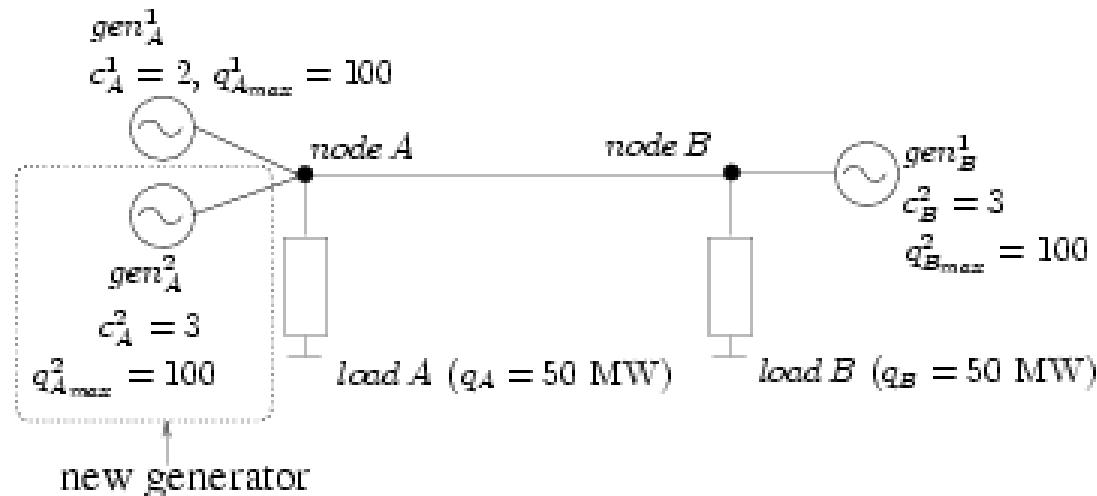


# Application of these concepts

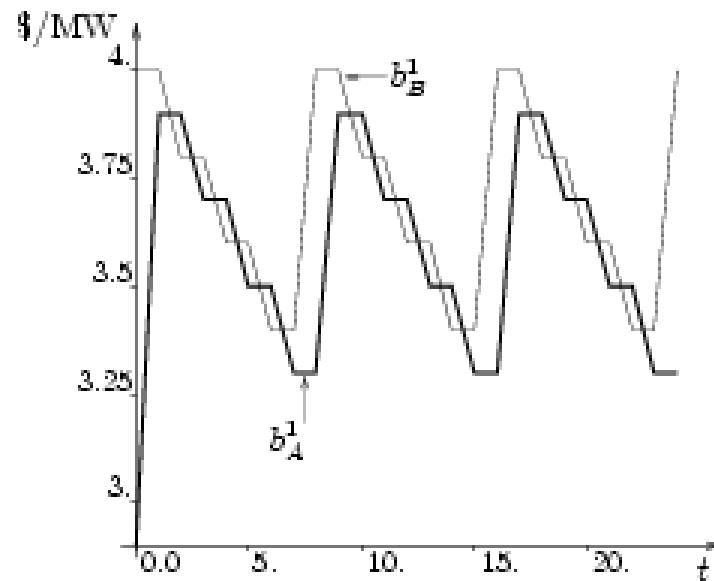


- Each agent supposes that the other agents submit the same bid as at the previous market stage.
- According to these assumptions, each power producer agent determines the value of its own bid.
- Rewards obtained are going to be summed over 25 cycles.

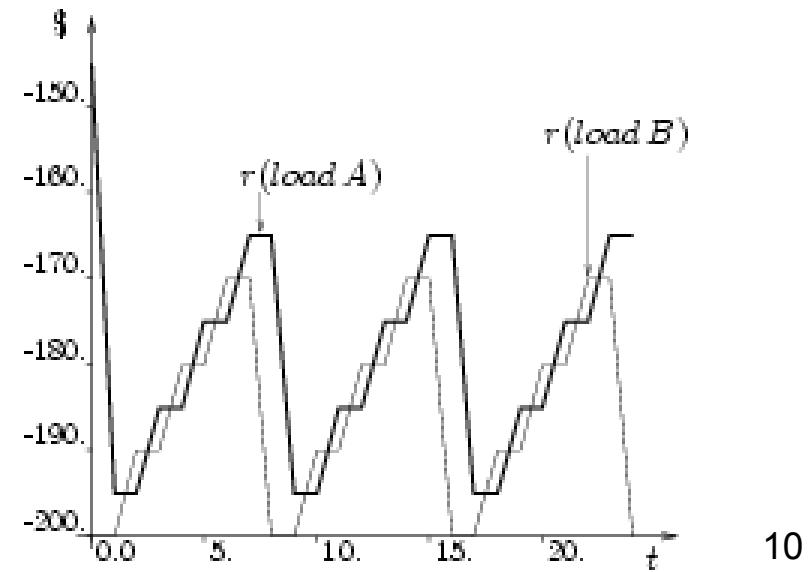
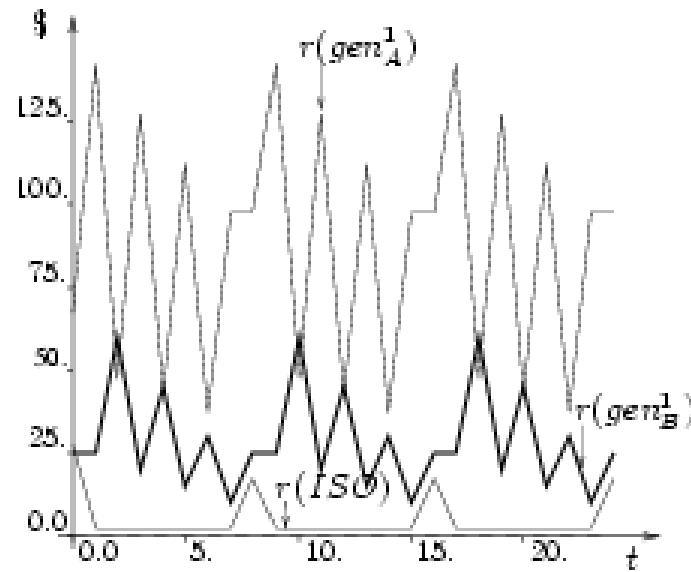
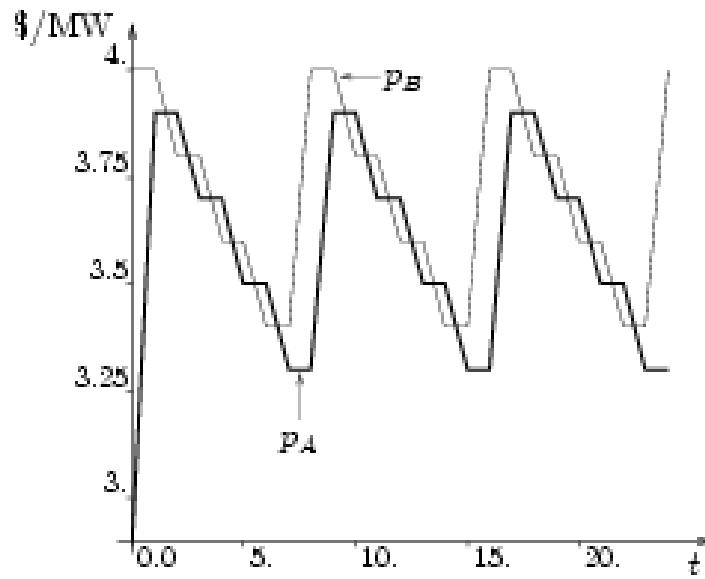
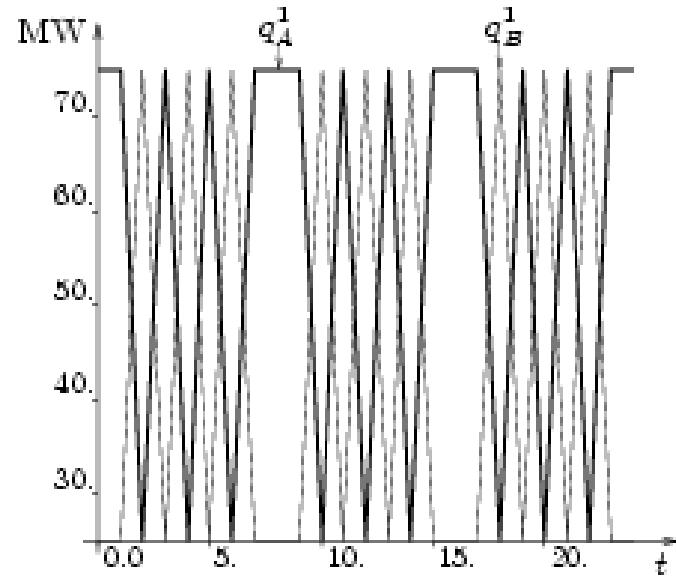
# Influence of a new generator



Input of the market (the bids):



## Output of the market (nodal prices, quantities, rewards):



*Two generators and different values for K :*

		<i>Rewards obtained over 25 stages</i>				
K	gen <sup>1</sup> <sub>A</sub>	gen <sup>1</sup> <sub>B</sub>	ISO	load A	load B	
25	2,182	715	132	-4,465	-4,640	
50	2,250	0	0	-3,625	-3,625	

*Three generators and different values for K :*

		<i>Rewards obtained over 25 stages</i>				
K	gen <sup>1</sup> <sub>A</sub>	gen <sup>2</sup> <sub>A</sub>	gen <sup>1</sup> <sub>B</sub>	ISO	load A	load B
25	0	0	625	1,250	-2,500	-5,000
50	0	0	0	0	-2,500	-2,500

# Conclusions

- Agent approach to electricity markets analysis and design is the right approach.
- Designing models for these agents is feasible.
- It will provide a tool to **compute** what are going to be the characteristics of a market rather than **guessing** them.