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Smart metering:
Costs, benefits and international experience

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Electricity Policy Research Group

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EPRG Research Seminar, Cambridge

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Metering

- **Purpose**
  - Information
  - Interaction
- **"Traditional" electromechanical metering (domestic and SME)**
  - Cumulative measurement
  - Ex-post estimated billing
  - One-way interaction

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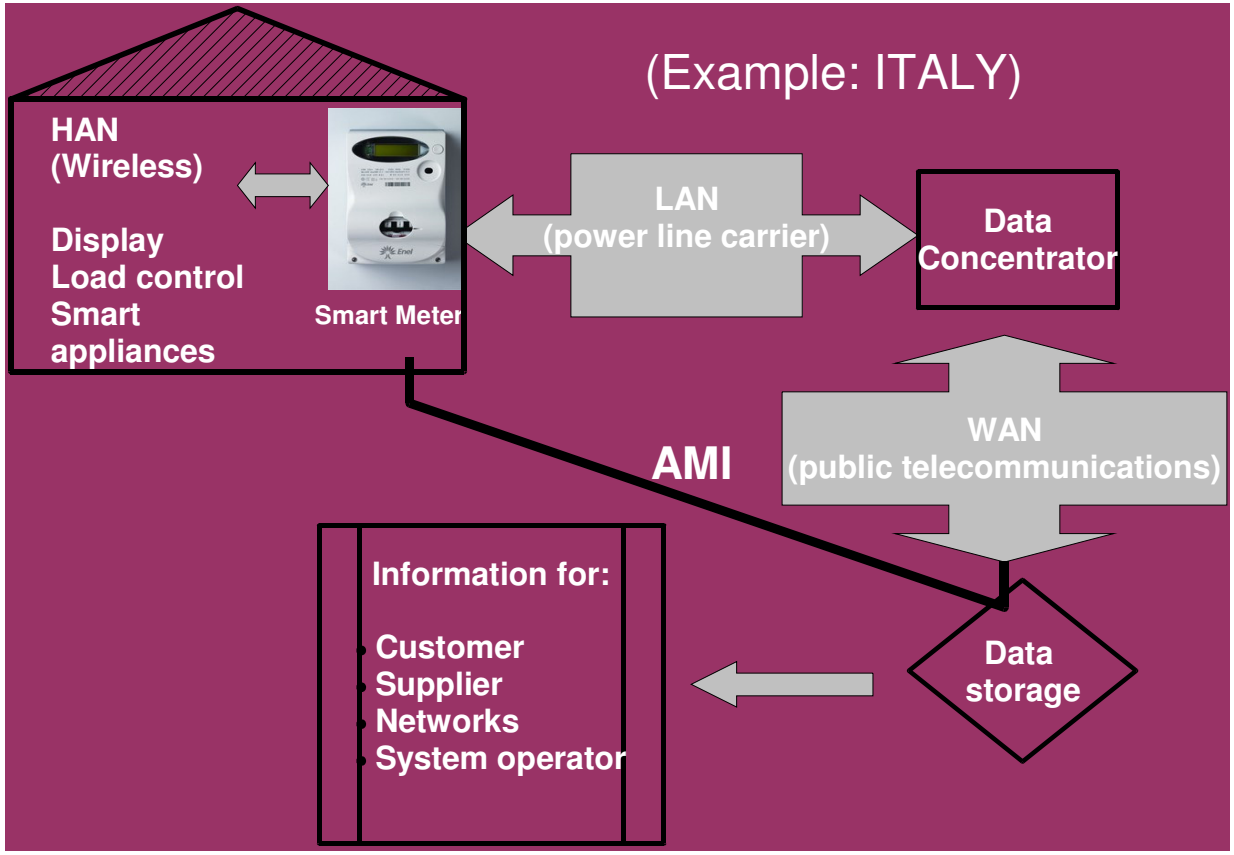
Smart Metering



*HAN: Home Area Network

*LAN: Local Area Network

*WAN: Wide Area Network

*AMI: Advanced Metering Infrastructure

- Automated meter reading (AMR): 1-way
- Automated meter management (AMM): 2-way

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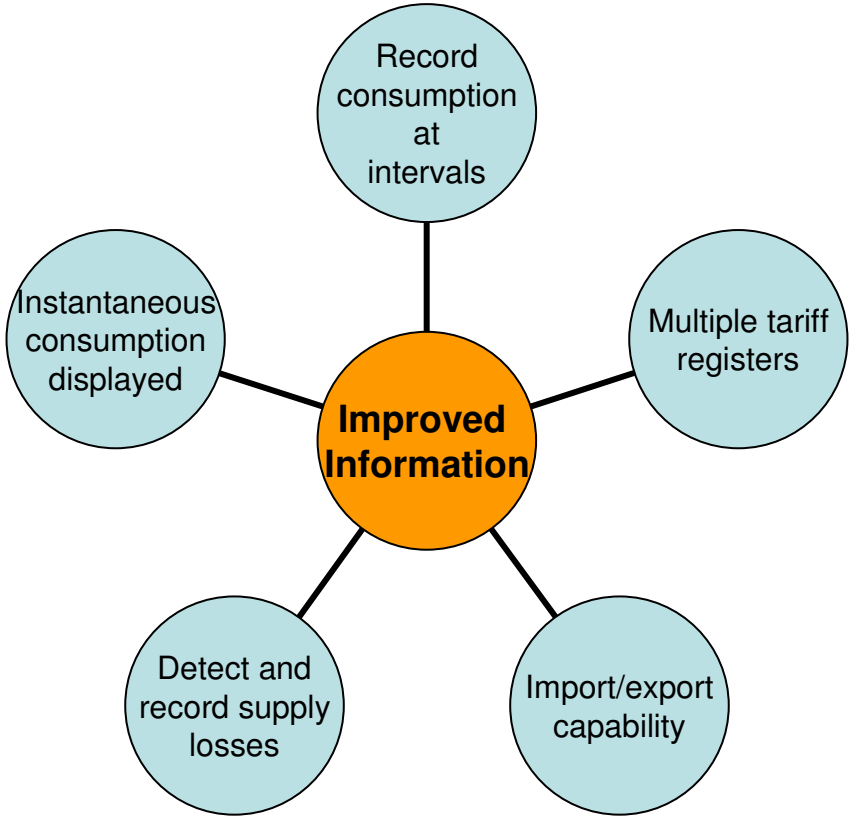
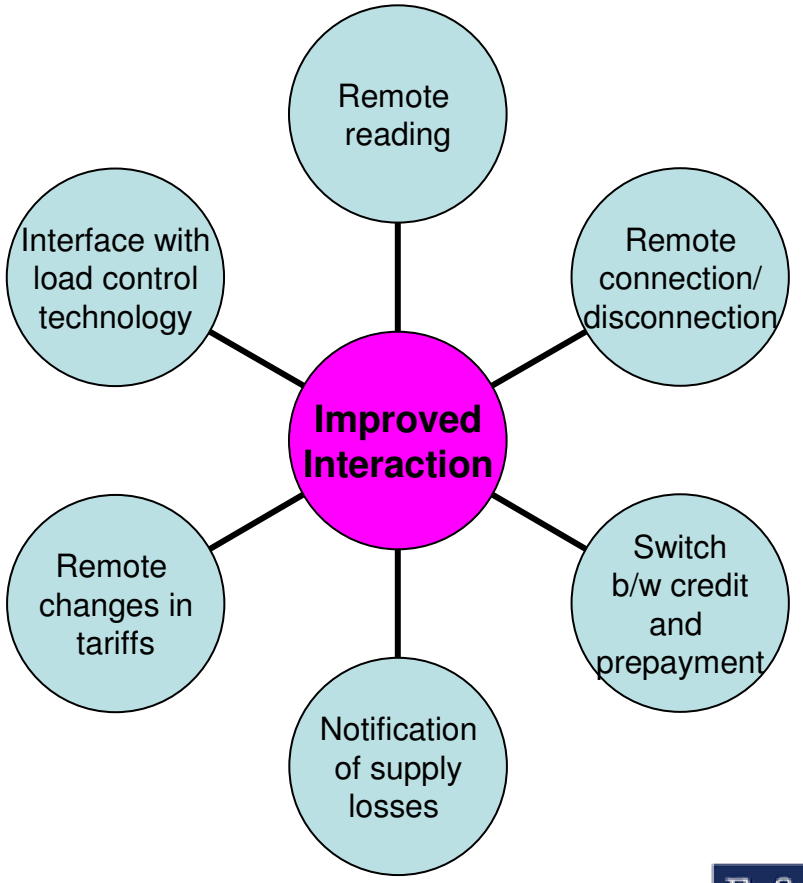
Smart metering Functions (2-way)





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Smart metering costs

	% of total cost (approx.)*	Sensitive to
Meters	36-59%	Functionality; scale; roll-out
Meter Installation	1-19%	Roll-out schedule; gas/electricity
Communications System (Infrastructure & management)	18-33%	Type; scale; roll-out; gas/electricity

*Based on following CBAs: PG&E California 2006; Frontier 2007 GB study; Ofgem 2006; Victoria Australia CRA 2005

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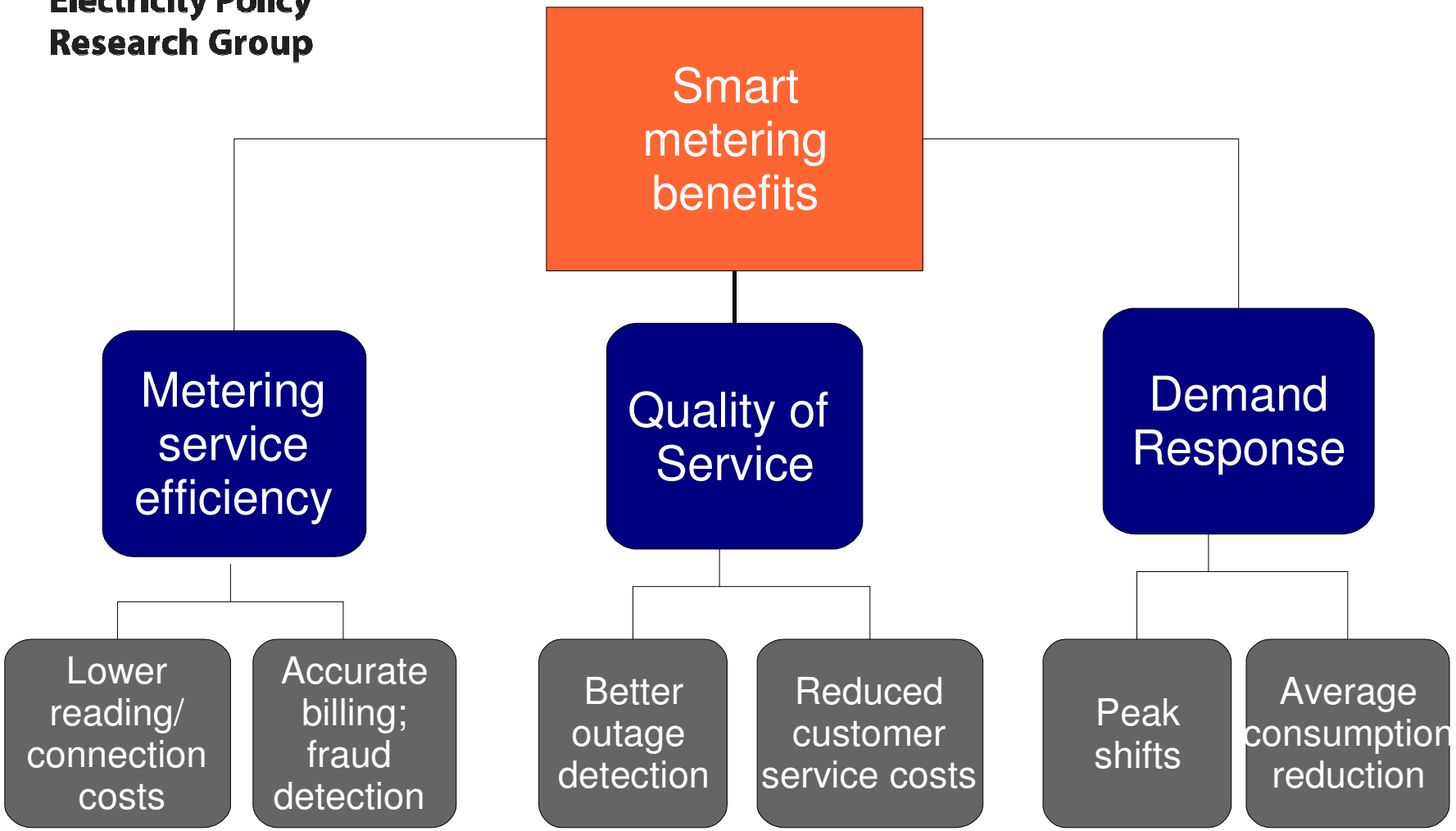

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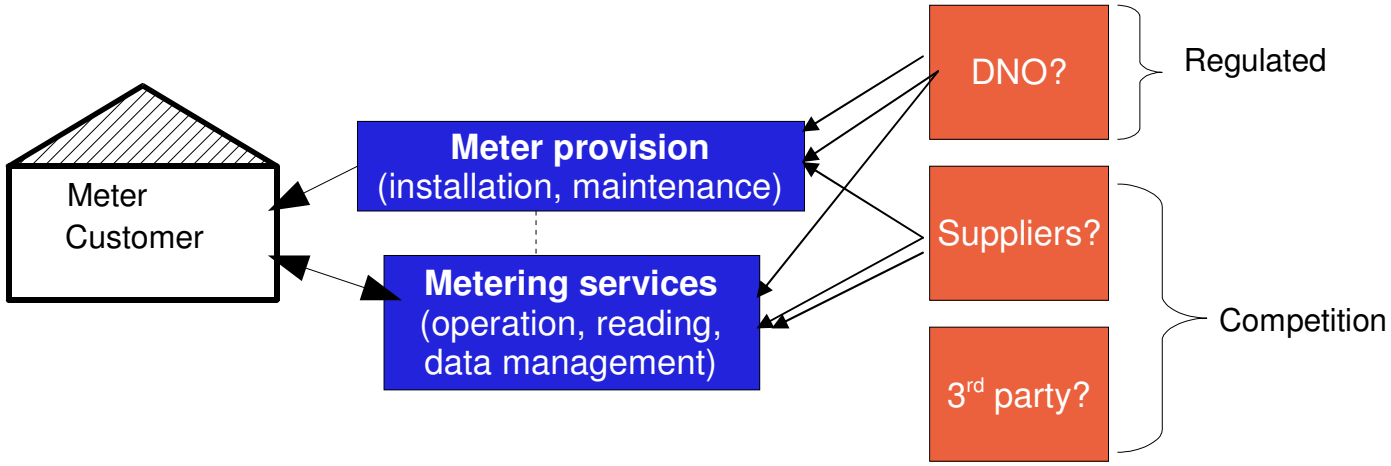
Distribution of costs and benefits



- International differences in market structure
- Implications
  - Variations in how incentives are split

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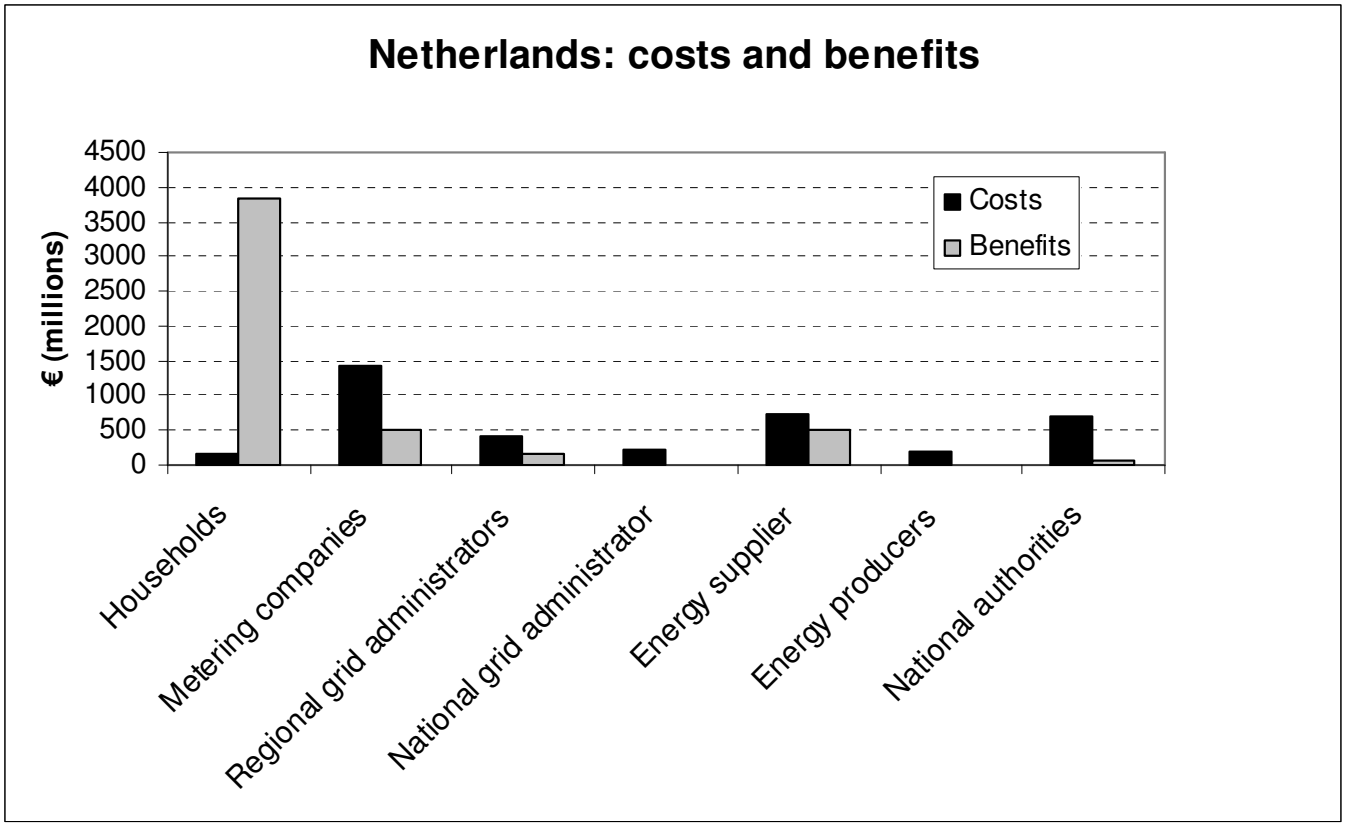
Case study 1: Distribution of costs and benefits



- Netherlands: Decision to change market structure
  - Electricity and gas; 6.7 million households

Source: Senternovem (2005). “Smart metering for households: Costs and beneits for the Netherlands”.

Case study 2: Demand response

California Pricing Pilot 2003/4

(Interval electricity meter; daily collection; 3 utilities; 2500 customers)

Customer (residential)	**Critical peak pricing shift**	**Conservation**
Average	13%	No change in total energy use observed
Central A/C	17%	
No Central A/C	8%	
Annual Income $100,000	17%	
Annual Income $40,000	11%	

Ontario Pricing Pilot 2006/7

(Interval electricity meter; 2-way; 1 DNO; 373 customers)

	Summer shifts in consumption (entire peak)*	**Conservation effect**
Critical peak pricing (CPP)	12%	5% (n/s)
Critical peak rebate	9%	7%
Time of use pricing	2% (n/s)	6%

*None of the winter shifts were statistically significant

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Lessons

- Information and interaction
- Role of market structure
- Demand response
  - Context and drivers

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Evaluating Government's Policies on Promoting Smart Metering in Retail Electricity Markets via Agent Based Simulation

Tao Zhang, Bill Nuttall
Electricity Policy Research Group
Judge Business School, University of Cambridge

EPRG Spring Research Seminar
Cambridge, 16th May 2008

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Agenda

- The Retail Electricity Metering Market in Britain
- BERR's 2008-2010 Policies on Promoting Smart Metering
- Model Description
- Simulation Scenarios
- Simulation Results
- Conclusions

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The Retail Electricity Metering Market

- Market Size: 22.5 million domestic electricity meters in E&W
- DNOs are traditional dominate meter operators (license obligation)
- Metering competition introduced in 2001, and entered into force in 2003, in order to lower service prices, improve quality of services and encourage innovate (Ofgem)
- Under the current regulatory framework, meter ownership is diversified/ambiguous

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BERR's 2008-10 Policies on Promoting Smart Metering

- "Within the next 10 years, all domestic energy customers will have smart meters with visual displays of real-time information that allow communication between the meter, the energy supplier and the customer" (EWP 2007)
- From 2008-10, real-time visual displays will be available free of charge to any household that requests one
- "Standalone real-time display devices were seen as both an interim measure and as an integral function of a smart meter" (BERR)

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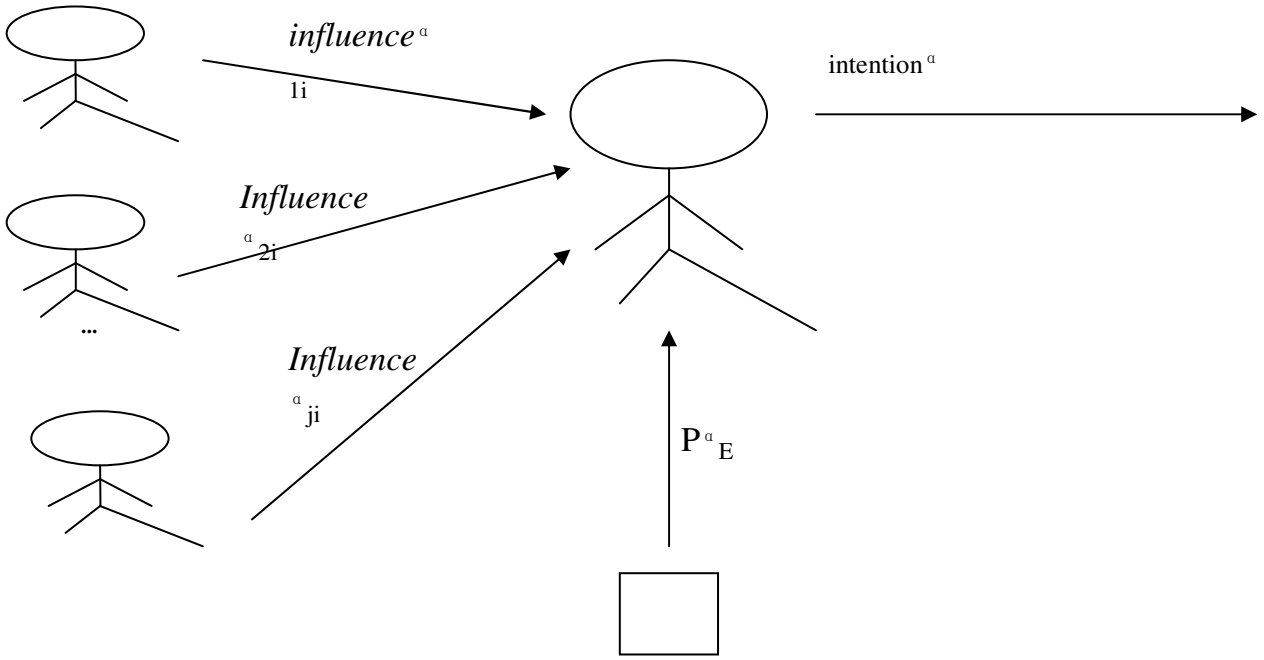
Model Description

- Behaviour of RC agents



RC agent ***i***'s interactions

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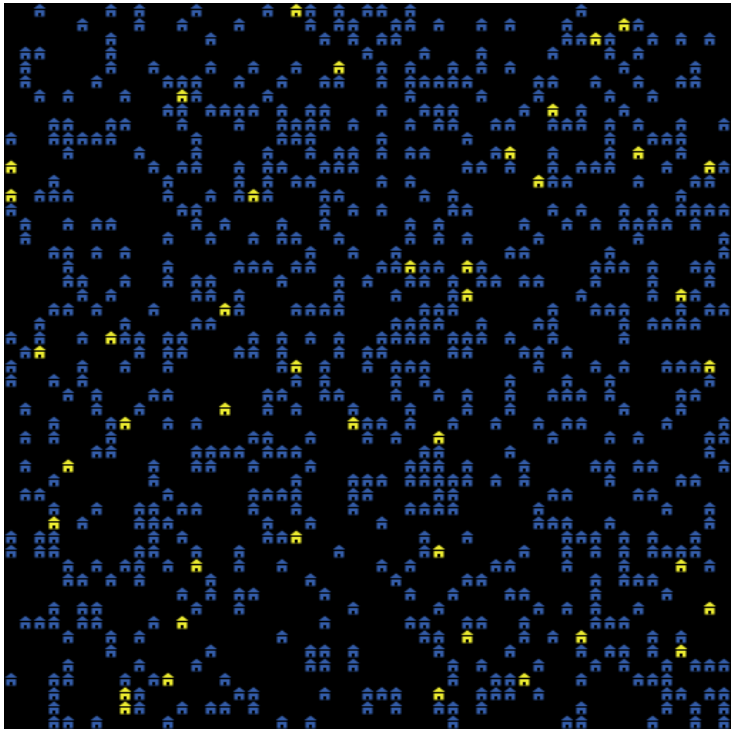
Model Description

- Environment design



A square lattice of 62,500 cells (250*250) with periodic boundary conditions

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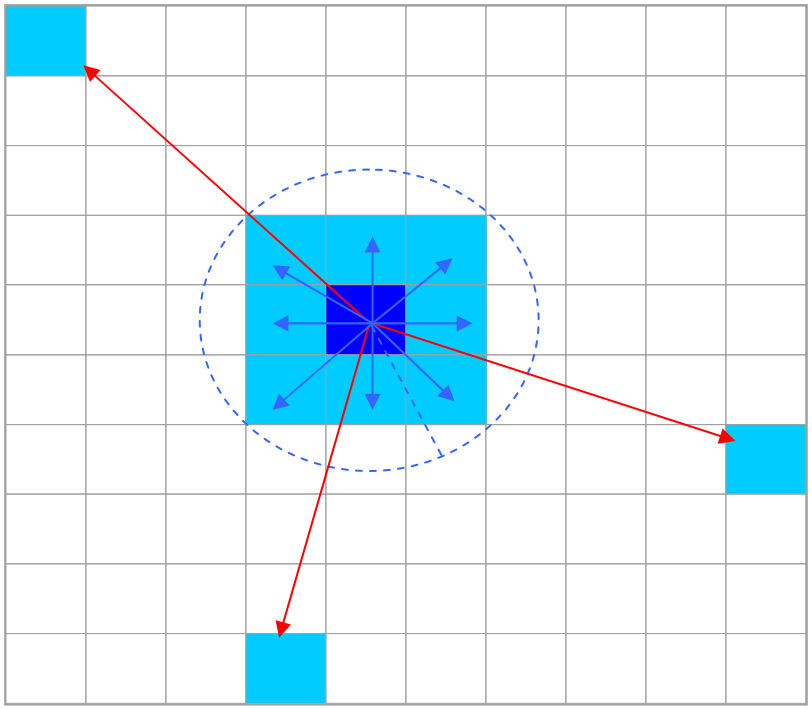
Model Description

- Social network design



An RC agent's regular (blue) and random interactions (red) with other RC agents

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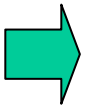
Simulation Scenarios

Group	Dec-02	Jun-03	Dec-03	Jun-04	Dec-04	Jun-05	Mar-06	Mar-07
BGT	22%	23%	24%	24%	23%	22%	22%	22%
Powergen	22%	22%	21%	21%	21%	21%	20%	19%
SSE	13%	14%	14%	15%	15%	16%	16%	18%
npower	16%	16%	15%	15%	15%	15%	15%	16%
EDF Energy	15%	15%	14%	14%	13%	13%	13%	14%
ScottishPowe	10%	10%	11%	12%	13%	13%	13%	12%
Others	0%	1%	1%	0%	0%	1%	0%	0%



ES agent
A
B
C
D
E
F

National market share in electricity (Source: Domestic Retail Market Report, Ofgem, June 2007)

ES agents in the model of market game

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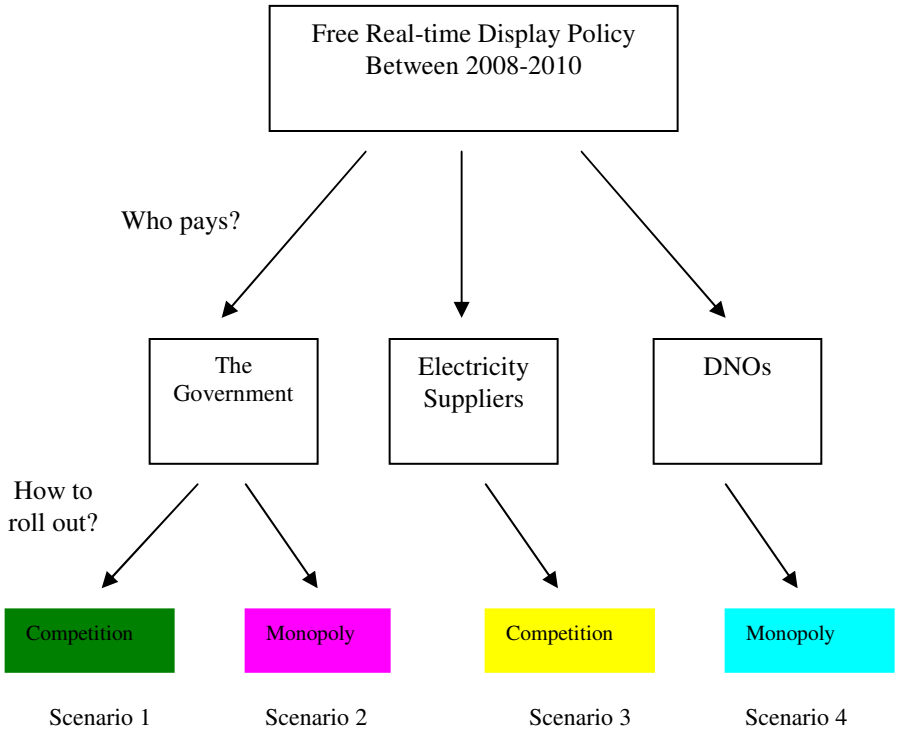
Simulation Scenarios



Scenarios of strategies in the simulation

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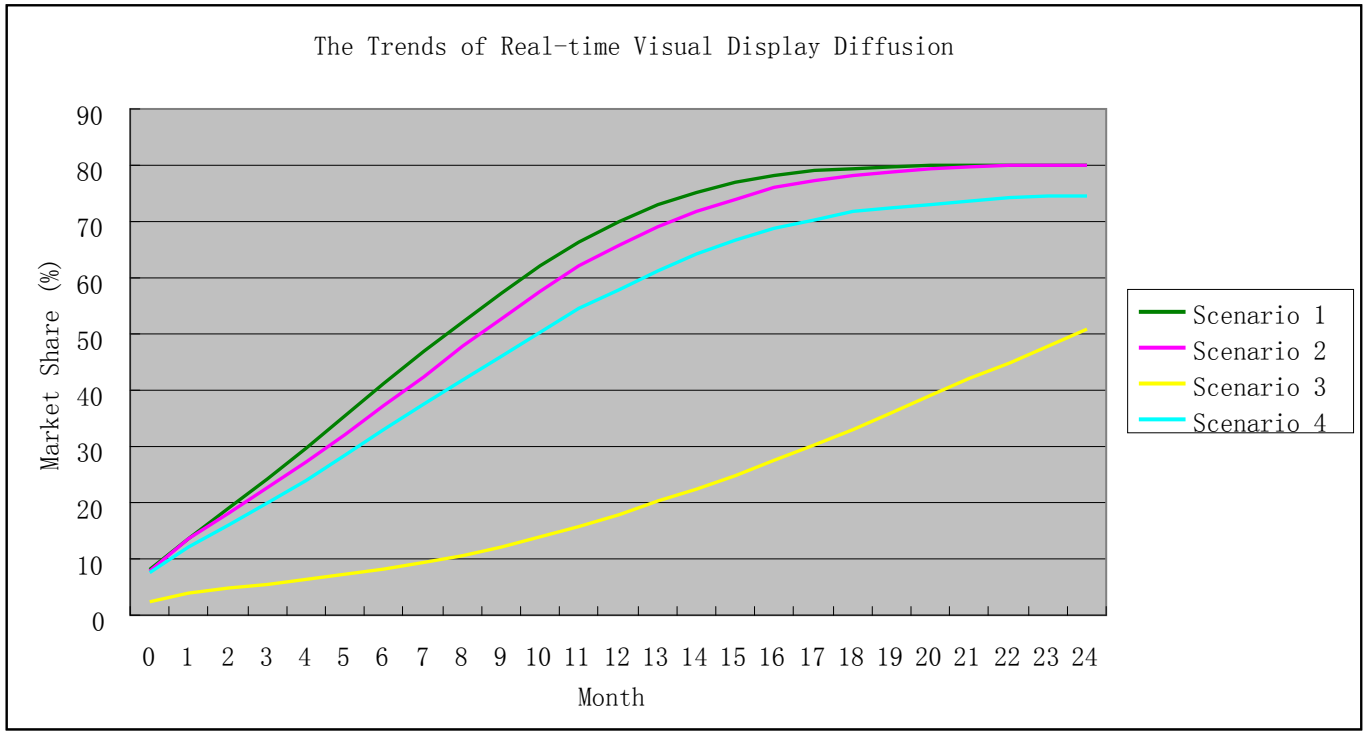
Simulation Results



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Conclusions

- Policy Implications
  - Mandated free real-time visual display policy will be very effective
  - Under the mandated free real-time visual display policy, government subsidizes the promotion of smart metering and meanwhile imposing an obligation on electricity suppliers so as to force them roll out real-time visual display through competition
- Methodological Contribution
  - Agent-based simulation as a new approach for policy assessment

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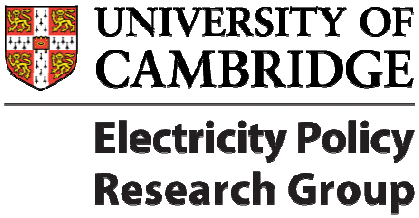

Thank You For Your Attention