Selecting a capacity mechanism:

What is the problem?

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Outline

- Theory
- Potential causes of market failure
- Criteria and constraints for solutions
- Dynamic performance of capacity mechanisms
- Other solutions
- Policy dilemmas
- Conclusions

Key assumptions

- Limited involvement of the demand side
- Significant lead times for new capacity
- Focus on continental Europe:
  - decentralized markets (no mandatory pool)
- Network aspects are not considered

How the market should work

- Ample capacity: prices near marginal costs.
- Shortage: scarcity prices → high price spikes
- Price spikes allow recovery of investment cost
- Efficient optimum when the total cost of the marginal production unit (LRMC) = the social cost of power outages (VOLL)

→ At the economically efficient equilibrium, security of supply is less than 100%

Reserve capacity as a public good

Due to single network, groups of users have the same security of supply.

- A consumer who is willing to pay more does not receive better security of supply than his neighbor who does not pay more.
- From the point of view of producers: available but unused capacity improves the security of supply, but does not earn any money.

Still the model works…

… due to market power during shortages:

when supply < demand, price is determined by price cap.

→ If price cap is high enough, generators recover their average costs.

→ Price cap is necessary to prevent excessive scarcity rents.

Necessary assumptions

In order for this model to produce a socially optimal outcome…

- there needs to be effective competition,
- generation companies need to know the load distribution curve (the probability and duration of price spikes) and the growth rate of demand,
- the price cap must be firm (politicians may not have week knees during a shortage…),
- generators and consumers are risk-neutral and have a long-term perspective.

So… the theory holds

With a high enough price cap, average prices should cover average generation costs at the optimal volume of generation capacity.

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Imperfect information

Need: accurate projections of supply and demand functions, but

- prices are highly volatile,
- insufficient historical data since liberalization,
- market not transparent enough to make accurate projections based upon fundamentals,
- international dimension even less transparent.

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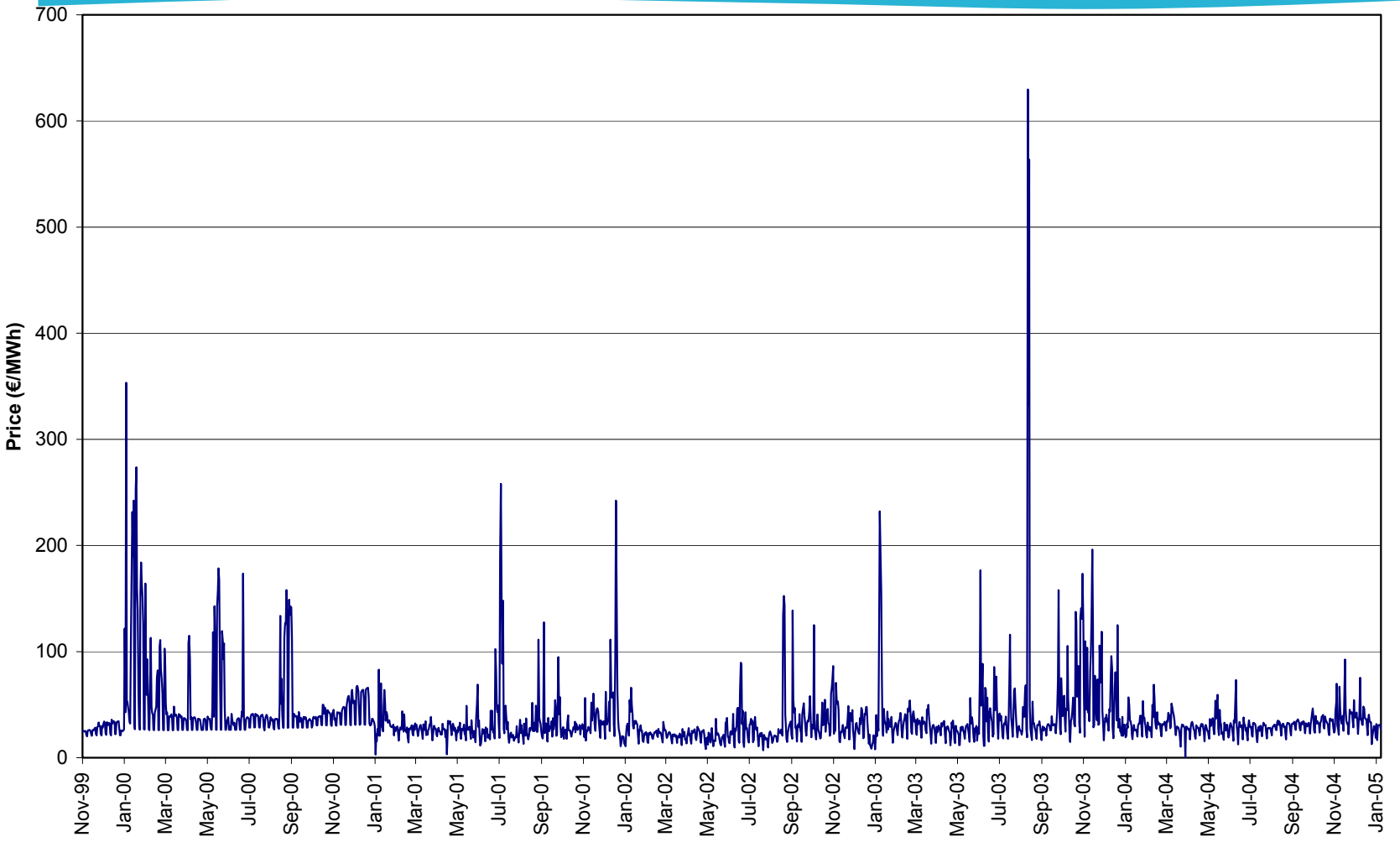
Day-ahead weighted average APX prices



Regulatory failure (1)

- Regulatory uncertainty
  - gas market
  - nuclear phasing-out (e.g. in Germany)
  - CO_2 permits
  - market opening in other EU states
- Regulatory restrictions to investment
  - e.g. permitting requirements

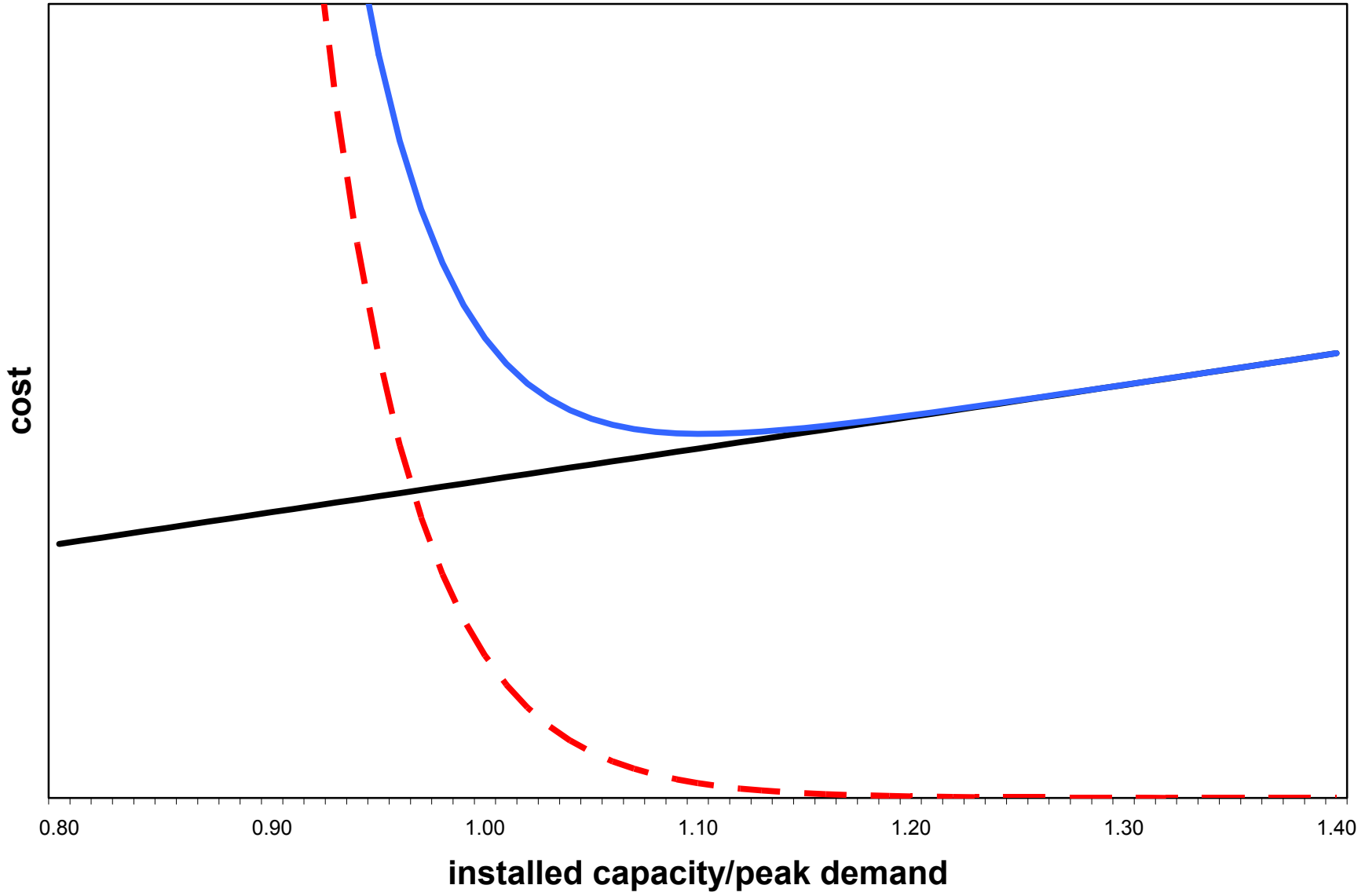
Regulatory failure (2)

- Wrong price cap → wrong investment incentive
  - Problem: VOLL difficult to establish
- Price = VOLL may not be politically acceptable
  - in theory only a few hours per year, in practice many hours once per so many years?

Risk asymmetry

What if investment is not socially optimal?

- What is the social optimum?
- What are the risks to consumers?
- What are the risks to producers?


cost
0.80
0.90
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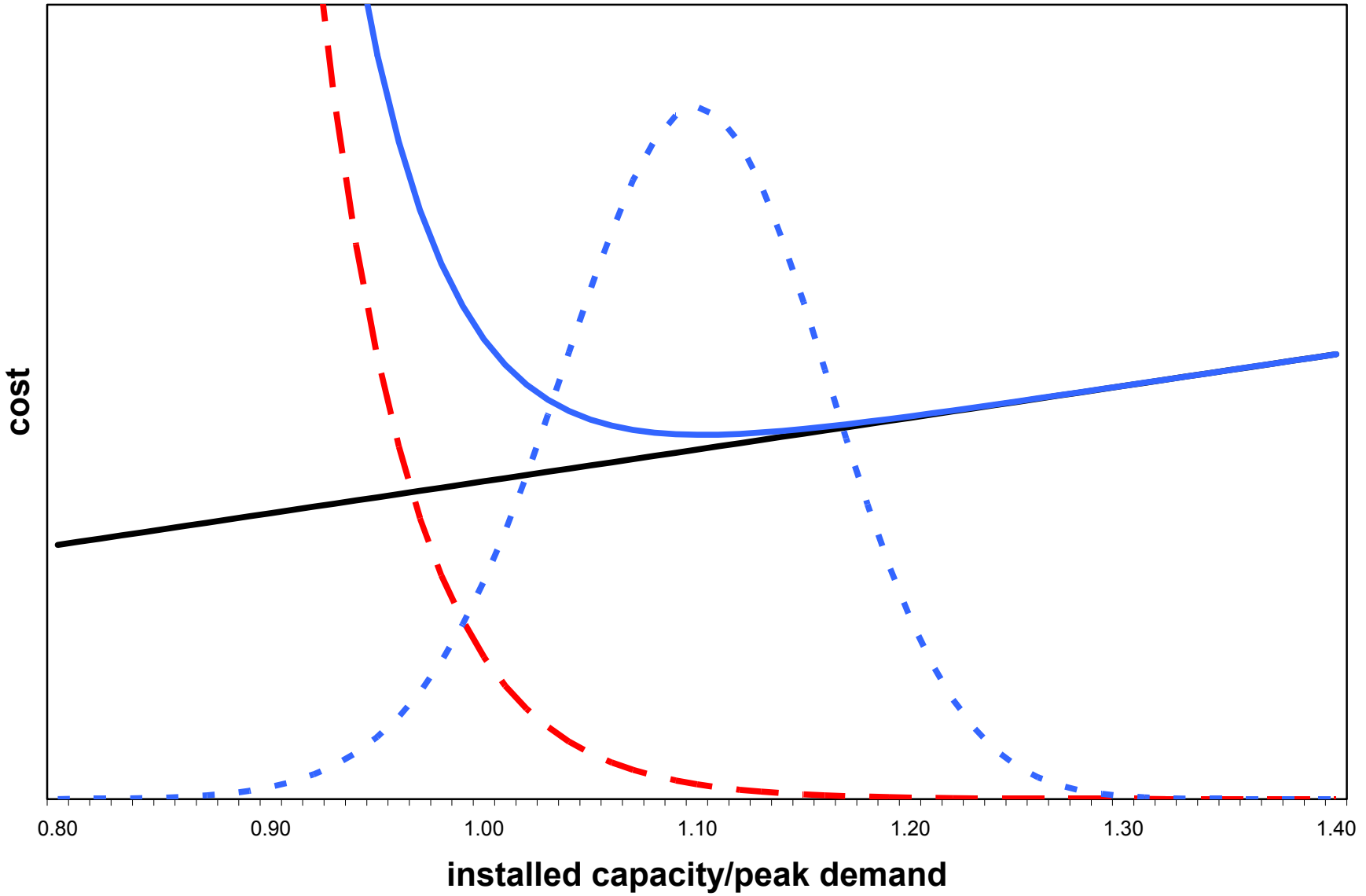
installed capacity/peak demand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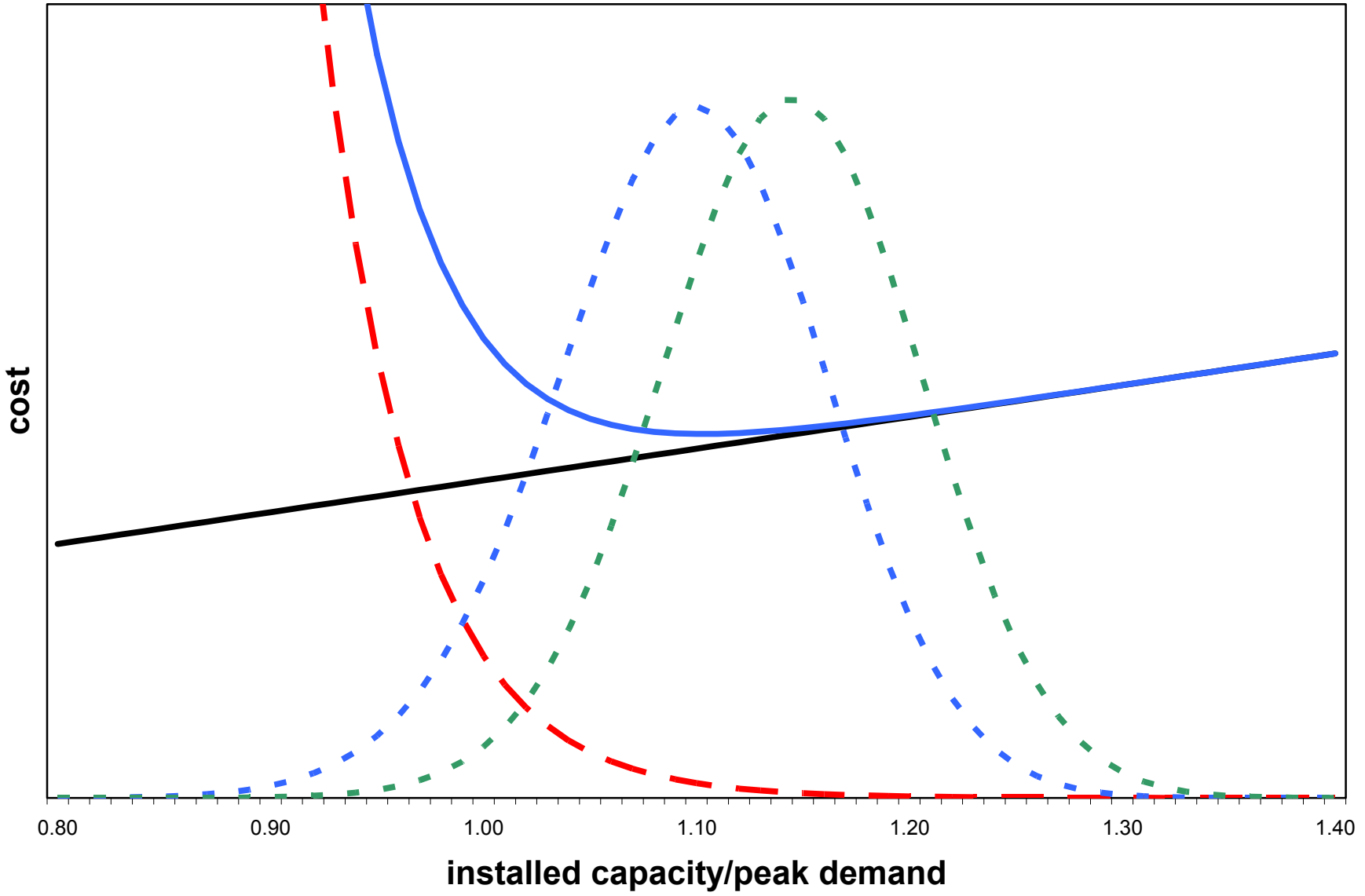
cost
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Risk asymmetry – consumers' view

- Compared to the social optimum, consumers prefer erring on the side of overinvestment:
  - cost of overinvestment small (e.g. 10% extra generation capacity → few % higher electricity cost)
  - cost of underinvestment orders of magnitude higher
    - e.g. shortage in California < 2%
    - social cost of California crisis > 2 times the annual turnover of the electricity industry

→ The cost to consumers of underinvestment is significantly higher than the cost of overinvestment!

Risk asymmetry – producers' side

Compared to the socially optimal level of generation capacity, generators would rather err on the side of less capacity:

- reduced risk of unrecoverable investments
- generators' risk is limited to small loss of market share
- if competitors also invest less: higher chance of high prices → positive effect upon generator revenues
  - facilitated by significant entry barriers

Risk preferences

- Consumers are notoriously risk-averse
- Are generating companies risk-neutral?
  - e.g. regarding politically influenced risks such as gas and CO2 prices?

→ Risk aversion further separates the interests of generators and consumers

Risk asymmetry - conclusion

Under uncertainty, the model breaks down.

Then the private and the public interests do not coincide:

generators can be expected to invest less than consumers prefer.

Market dynamics

What happens during a shortage?

In an ideal market:

- Government does not suppress scarcity prices.
- No abuse of market power.
- Real scarcity prices signal need for new capacity;
  - investment, new plants available after several years.
- But uncertainty about optimal investment level.

Consequence: investment cycles?

- Demand projection based on recent experience: extrapolation of the the business cycle
- Reaction to shortage only when prices rise and shortage is imminent
  - long construction time of new capacity → arrives too late!
  - resulting long price spike → overreaction by investors?

Model

- System dynamics
- Two sets of runs: - historic load growth data
  - random walk around 2% growth rate
- Investment = $f($({existing capacity + capacity under construction}, {demand growth trend}$)$.
- In each time step (year), new capacity is added up to the point that it is just expected to be profitable.

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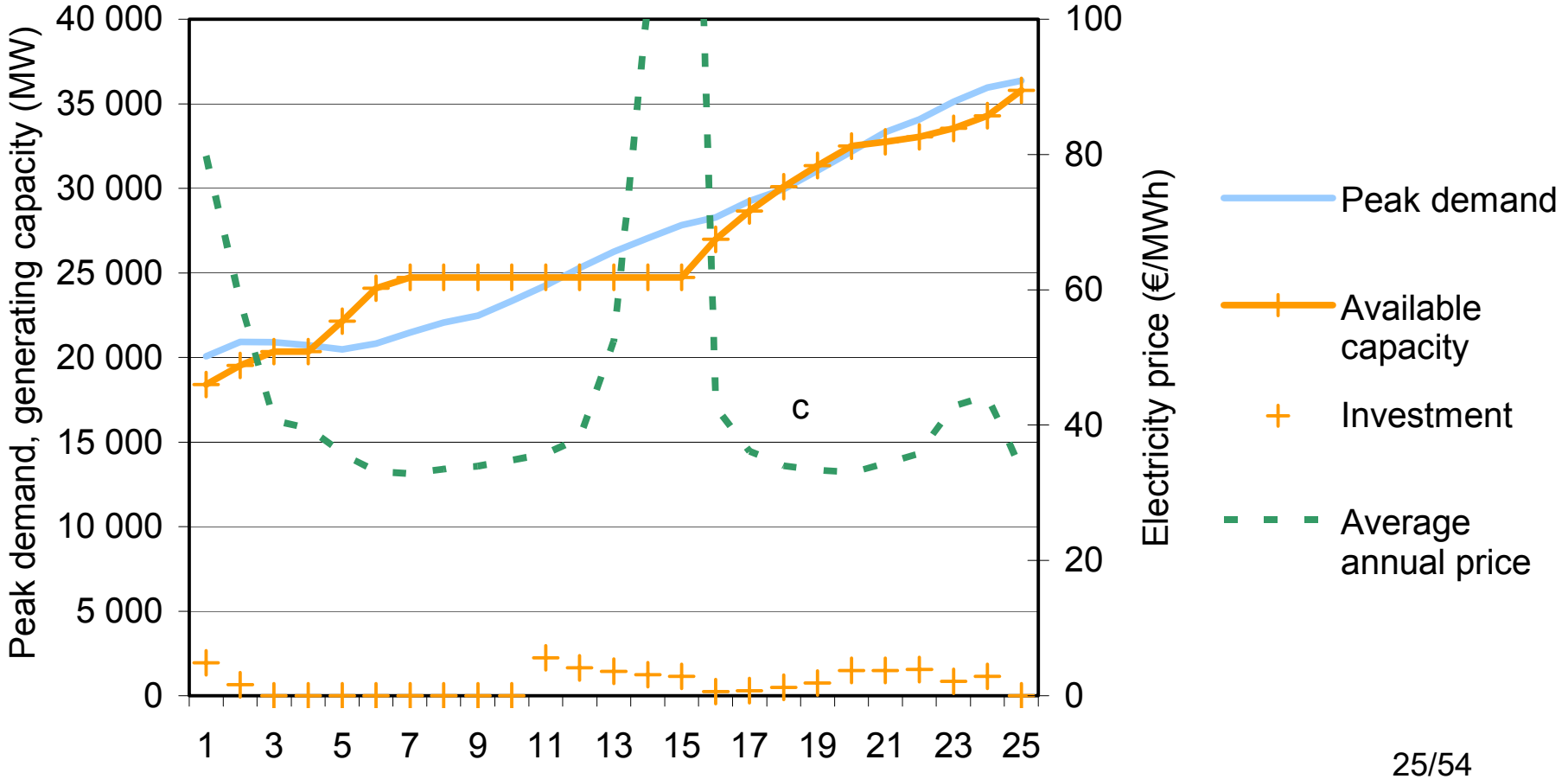
Energy-only market, historical growth rates



Model runs energy only market

Annual average price 49,81 €/MWh (versus average costs of about 40 €/MWh)

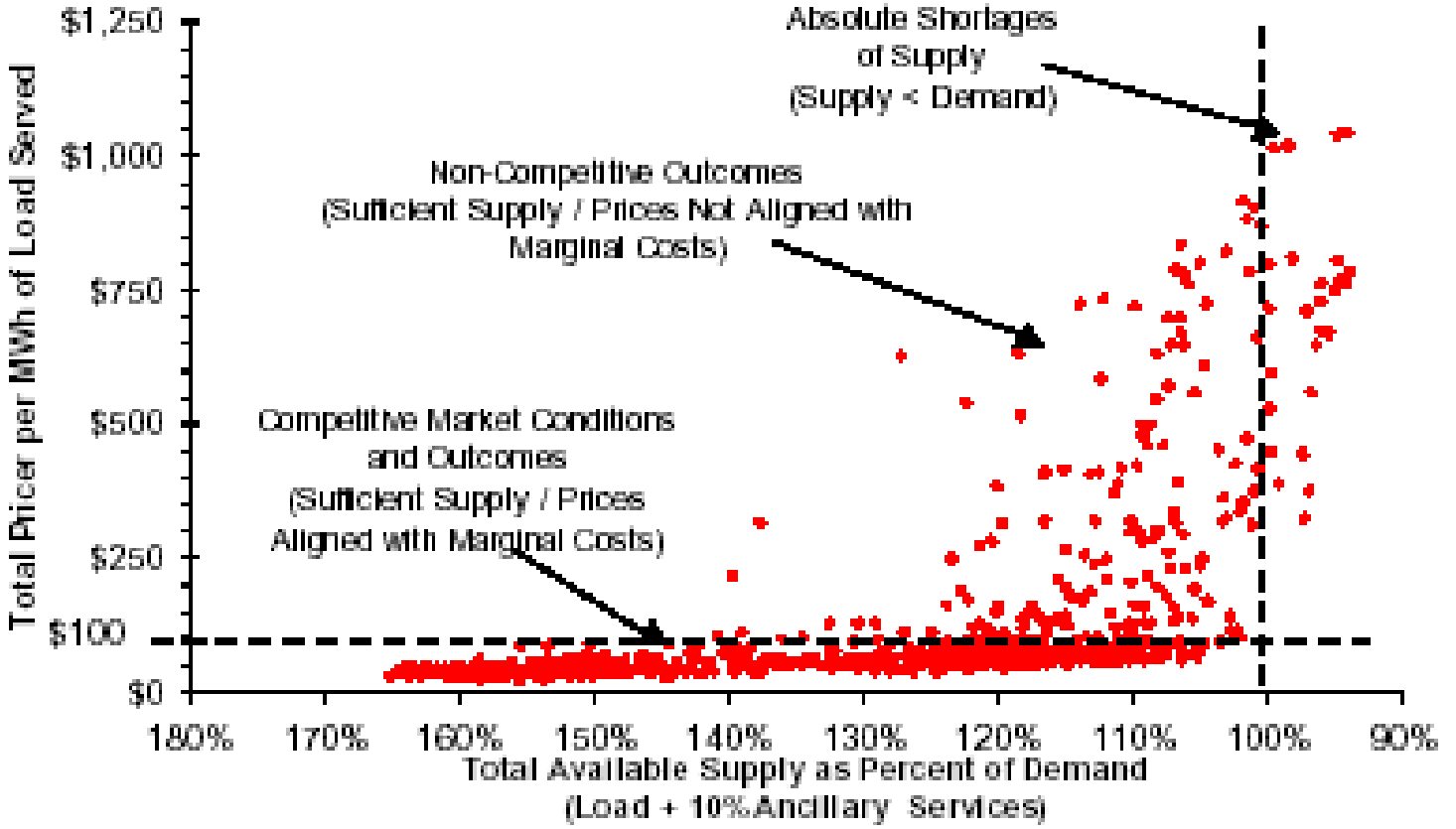
Average capacity shortage 41,2 h/y.

(But standard deviation of 137,4!)

Short-term market power

- In current market design, investment signal provided by periodic price spikes.
- California experience: price spikes vulnerable to manipulation
  - generation companies have incentive not to offer their full generation capacity during periods of scarcity.
- This results in much higher prices than in a competitive market, plus an increased chance of shortages.

Market prices versus supply adequacy in California in June 2000



Source: California ISO (2000)

Market power in European markets

- The larger the volume of long-term contracts, the smaller the incentive to withhold generation capacity in the short-term market.
- But: duration of long-term contracts is limited (typically < 1 year).
- So *if* a structural shortage develops, many long-term contracts may expire, gradually increasing the incentive to manipulate prices.

Short-term market power - conclusions

- Withholding may be illegal, but difficult to enforce (large 'grey' area).
- Conclusions:
  - the current market structure provides incentives to withhold during shortages;
  - the possibility of withholding undermines the value of the investment signal from price spikes;
  - the suspicion of withholding may provide a political incentive to lower the price cap.

→ The possibility of price manipulation is a fundamental weakness of price-spike based market models.

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Main criteria for a capacity mechanism

- Stabilize volume of generation capacity
- Stabilize prices around LRMC
  - to reduce investment risk
  - to answer to consumers' risk aversion
- Provide incentives for maximizing output (mitigate incentives for capacity withholding)

Secondary criteria

- Feasibility
- Risk of regulatory failure (e.g. due to complexity and novelty of cap. mech.)
- Stimulation of demand elasticity
- Efficient choice of generation technology
- Efficient dispatch

Constraints

- Decentralized markets
- Significant trade between markets with
  - Different market general market design
  - Different or no capacity mechanisms
- Significant market power

Other benefits of capacity mechanisms

- Level of security of supply is explicitly chosen, either by the government or by the individual consumers themselves
- Reduction of price risk for consumers
- Potentially: improved transparency
- Reduction of market power

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Two types:

- Provide financial incentive to build more capacity

  OR

- Regulate capacity, create market-based compensation mechanism

Price-based mechanisms

- capacity payments
- strategic reserve
- operating reserves pricing

  (version with long-term contracts proposed by Dutch Min. of Economic Affairs)

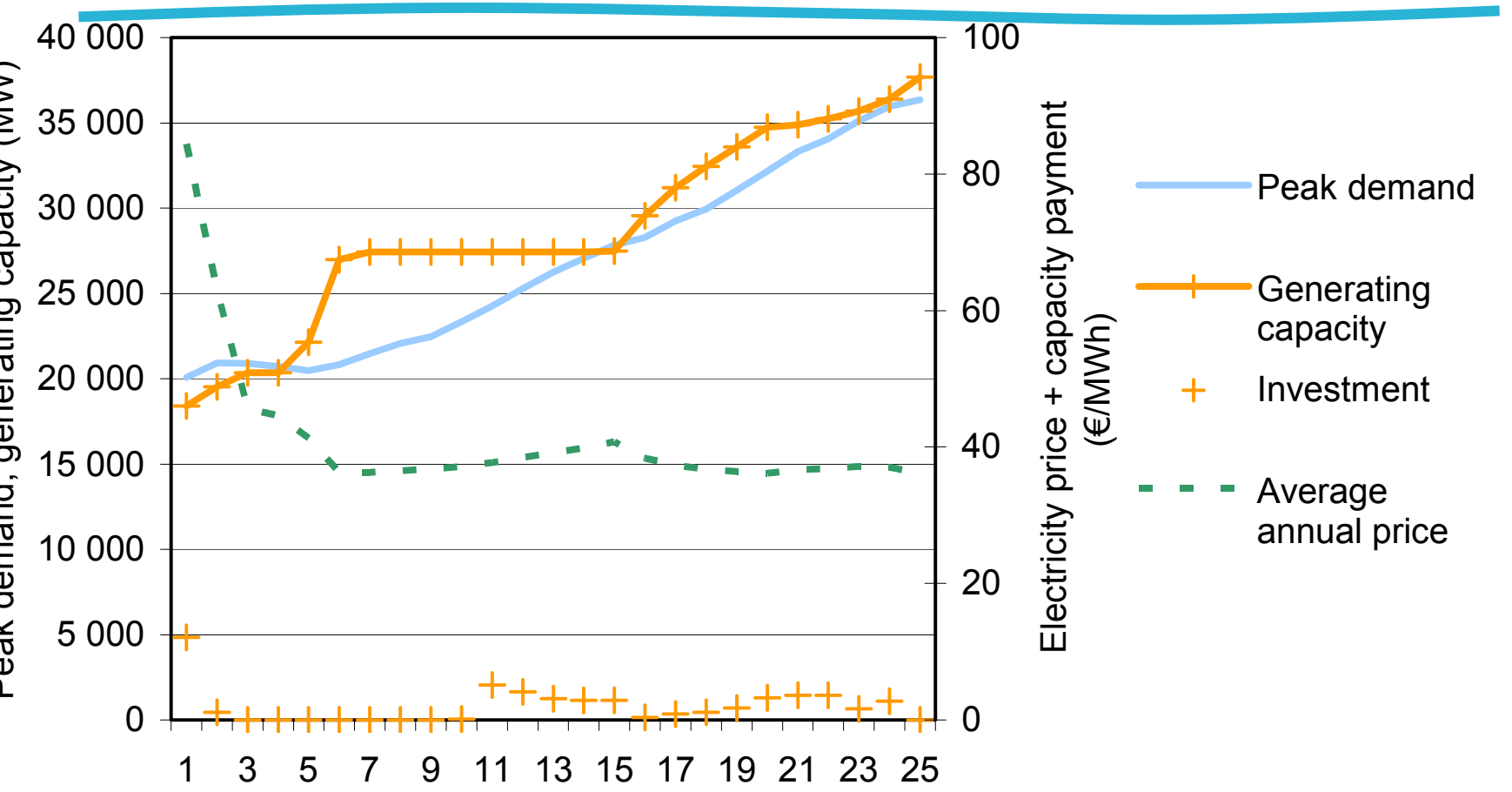
Capacity-based mechanisms

- capacity requirements (ICAP, USA)
- reliability contracts
    - system operator or supply companies buy call options from generators
- capacity subscriptions

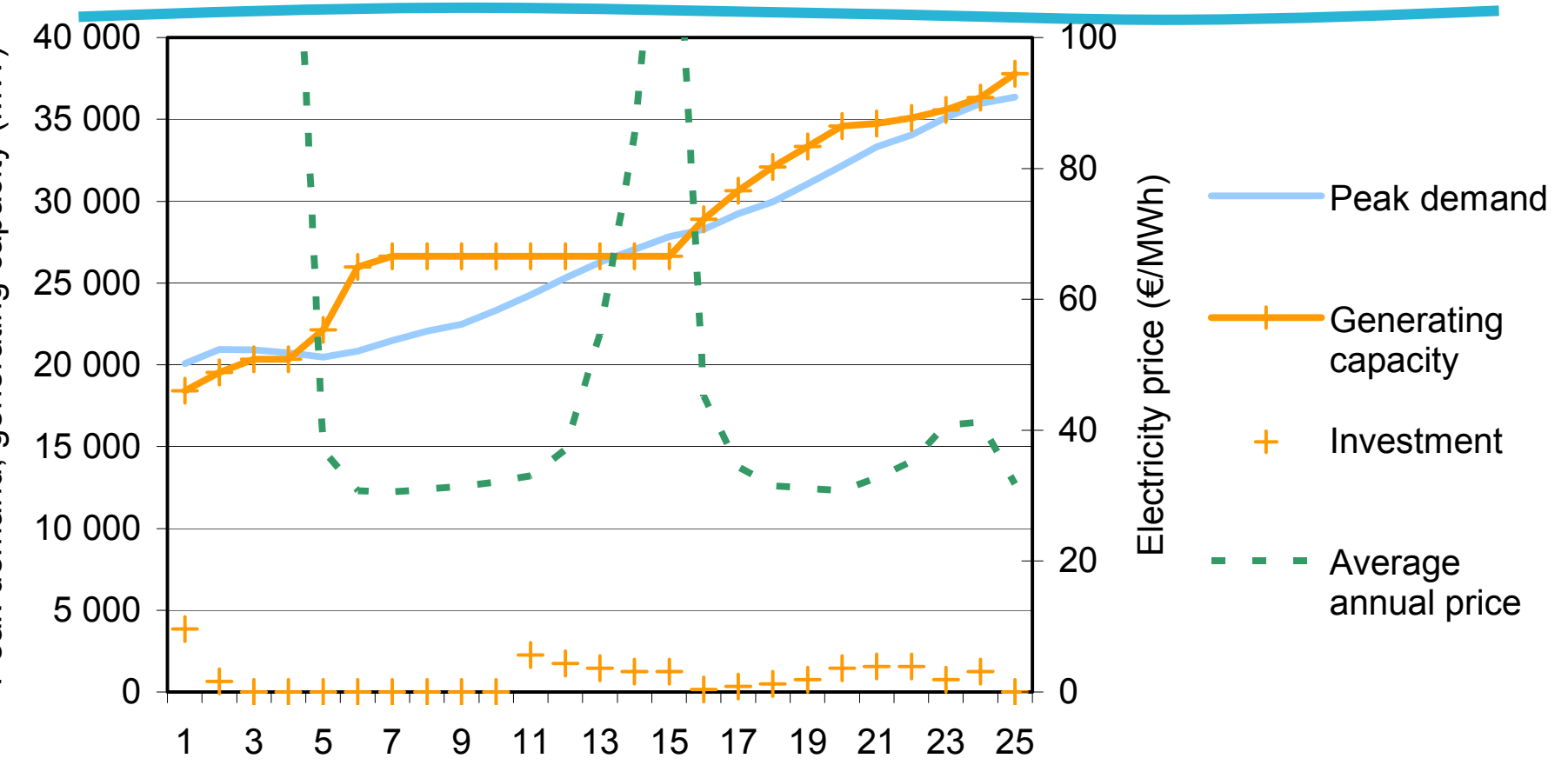
Model results

	Annual average price (€/MWh)	Average capacity shortage (h/y)
Energy-only market	49,81 (42,02)	41,2 (137,4)
Capacity payments	38,11 (1,99)	0,1 (3,5)
Operating reserves pricing	47,72 (31,72)	0,8 (9,7)
Capacity obligations	36,82 (3,90)	0,0 (0,1)

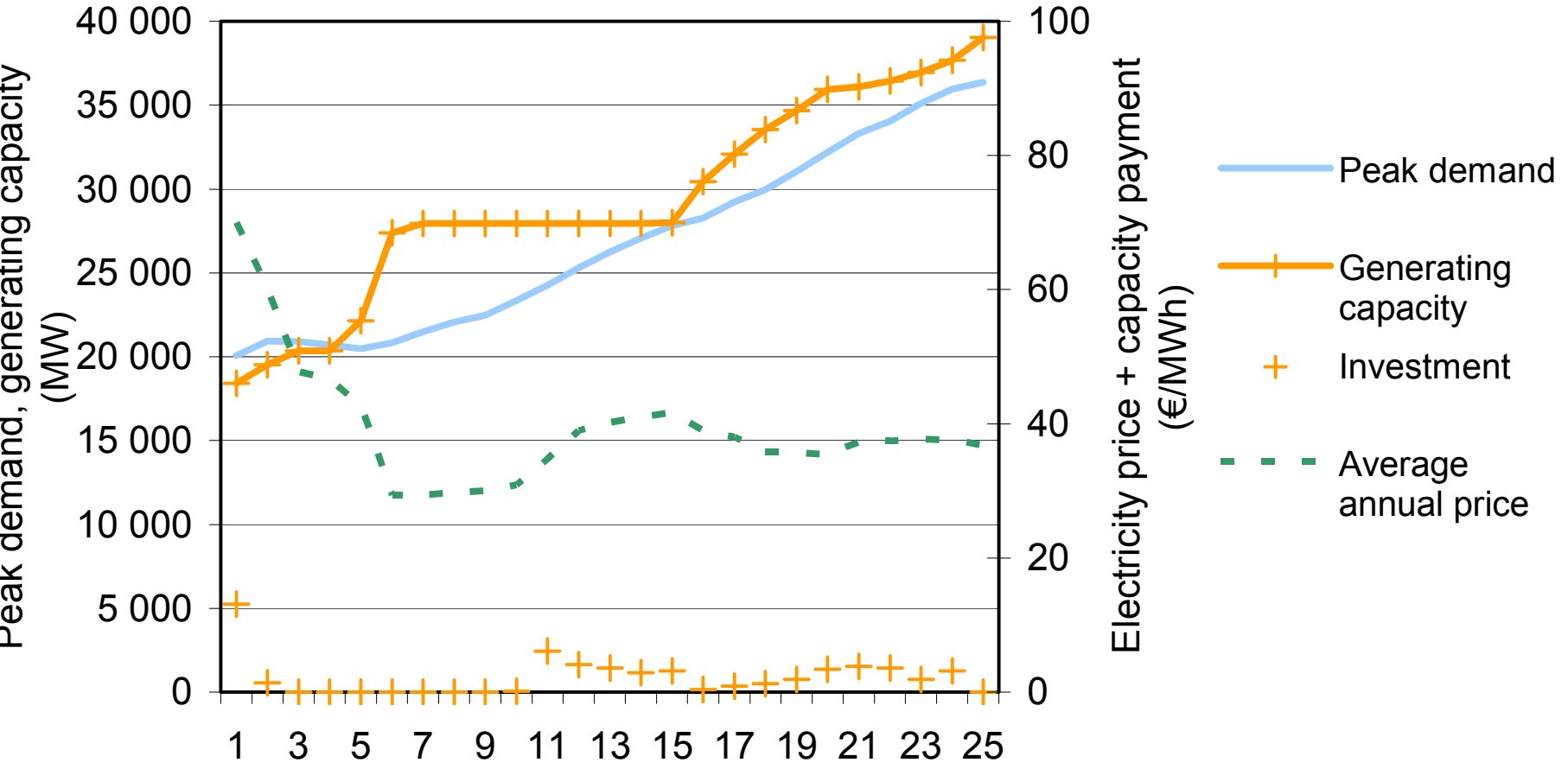
Capacity payments



Operating reserves pricing



Capacity obligations



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Strategic use of market power

An oligopoly may choose a strategy of limited over-investment

- to prevent the political attention and intervention that follows every shortage
- to deter new market entrants

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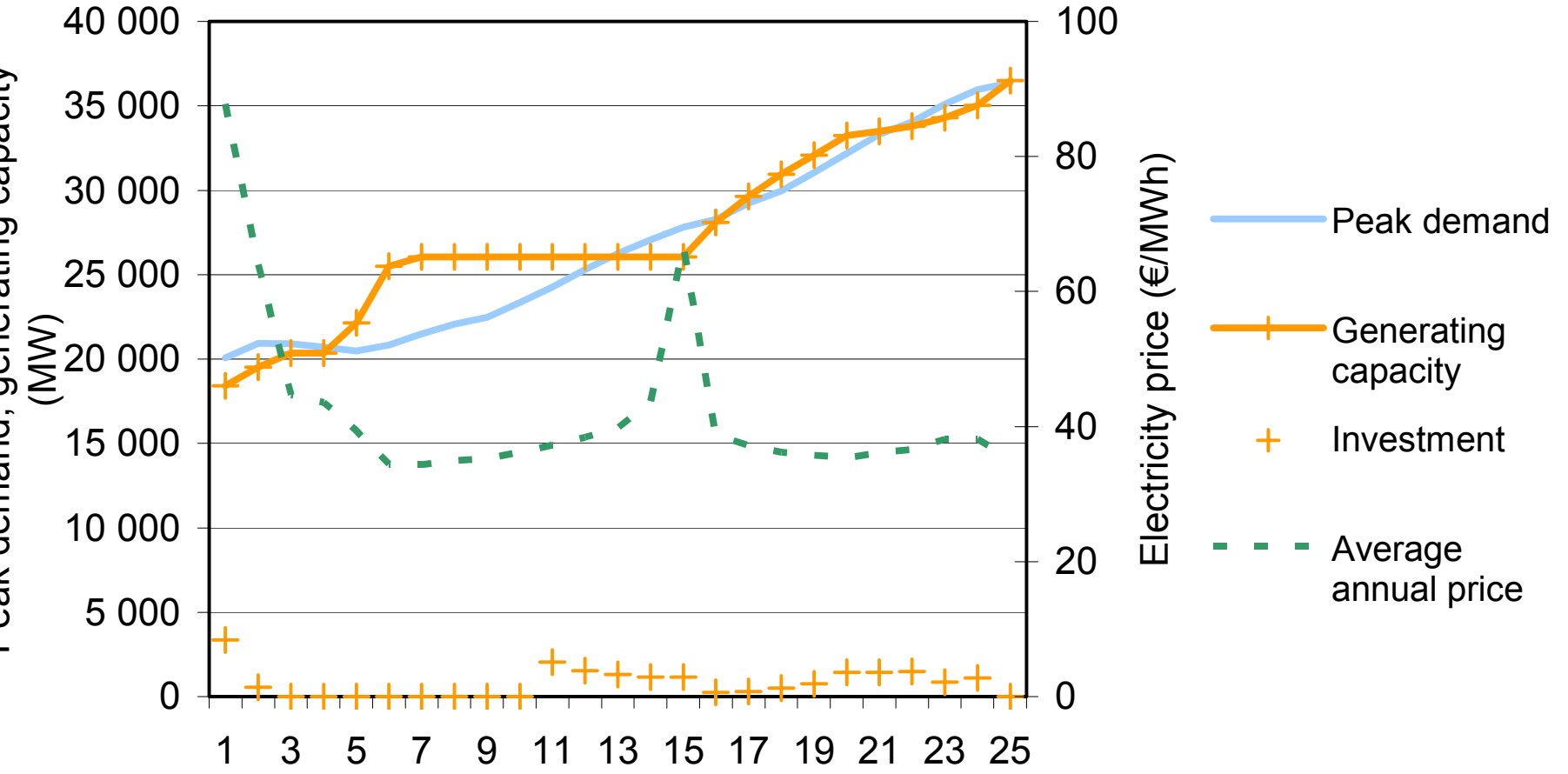
Market power simulation



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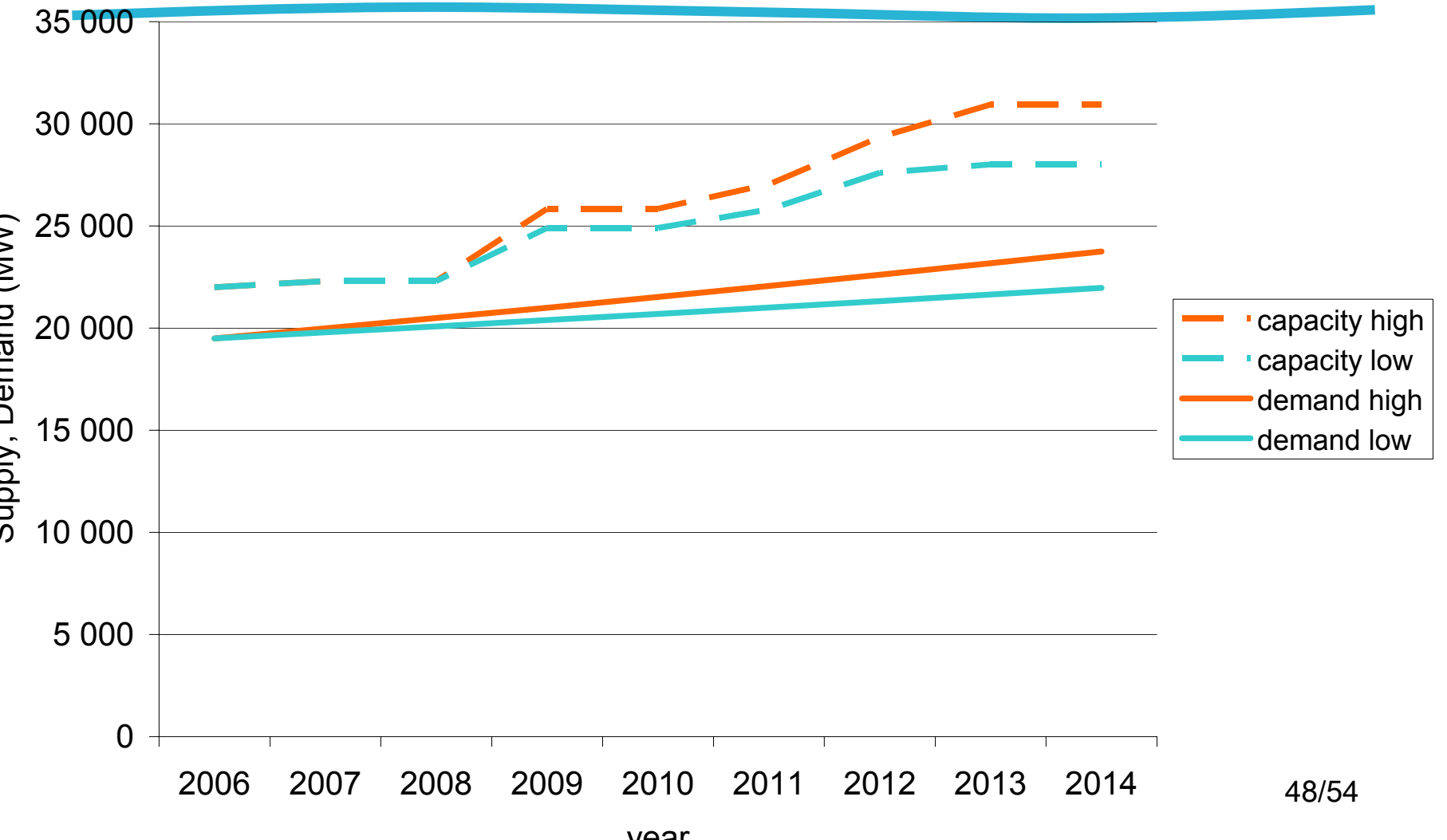
Operating reserves pricing	47,72 (31,72)	0,8 (9,7)
Capacity obligations	36,82 (3,90)	0,0 (0,1)
Market power	39,77 (11,42)	4,4 (32,0)

The Netherlands



The Netherlands

- About 8 companies have investment plants
  - All the Dutch incumbents
  - Large foreign companies
- Apparent modest over-investment:
  - Above scenario?
  - Struggle over market share?
  - Is the Dutch market more open to new entrants than other European markets?
  - Shareholder pressure to grow?

Reinstate the consumer franchise?

- Consumers do not appear interested in retail competition
- Without retail competition distribution companies can engage in long-term contracts for generation capacity
- Side benefits:
  - no need for unbundling
  - lower transaction costs
  - more stable prices for consumers

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Policy dilemmas - causes

- The UCTE projects shortages in NW Europa by early next decade. Time is pressing.

- There is no ‘silver bullet’:

  The most feasible capacity mechanisms are not so good; the most promising mechanisms are complex and have not been tried in practice.

Policy dilemmas (1)

1. There is no consensus about the need for intervention, but if it is true that intervention is necessary, the time to act is now.

2. Implement a ‘light’ mechanism that is easily feasible but has limited effect, or a mechanism that performs better in theory, but is more complex?

Policy dilemmas (2)

3. A solution at the national level is complex; seeking a joint international solution is more elegant but may take too long.

4. A capacity mechanism that is implemented nationally may not be compatible with European measures that may come later.

5. How to maintain the investment signal while allowing regulations to evolve as we learn?

Conclusions

- Main problem for consumers is not reliability but high prices during shortages.
- Regulating the volume of generating capacity safer than price incentives
- Cost of modest overcapacity is small, offset by reduced market power
- Need for uniform market design in interconnected regions.