

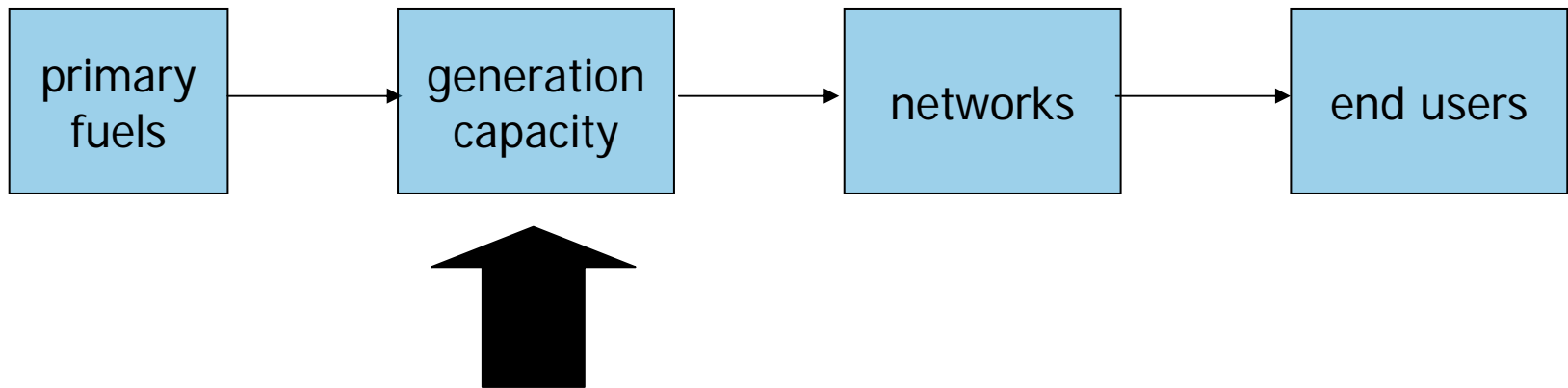
Generation adequacy

Are electricity markets instable in the long run?

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Subject



Background

Crisis in California: more parallels than we would like to admit!

- investment signal provided by price spikes, no capacity mechanism
- concentration in generation market
- large share of imports from less liberalized systems
- dependence upon gas infrastructure
- intransparent market

Outline

- Investment theory
- Market failure
- Risk asymmetry
- Long-term contracts
- Market power
- Summary

Key assumptions

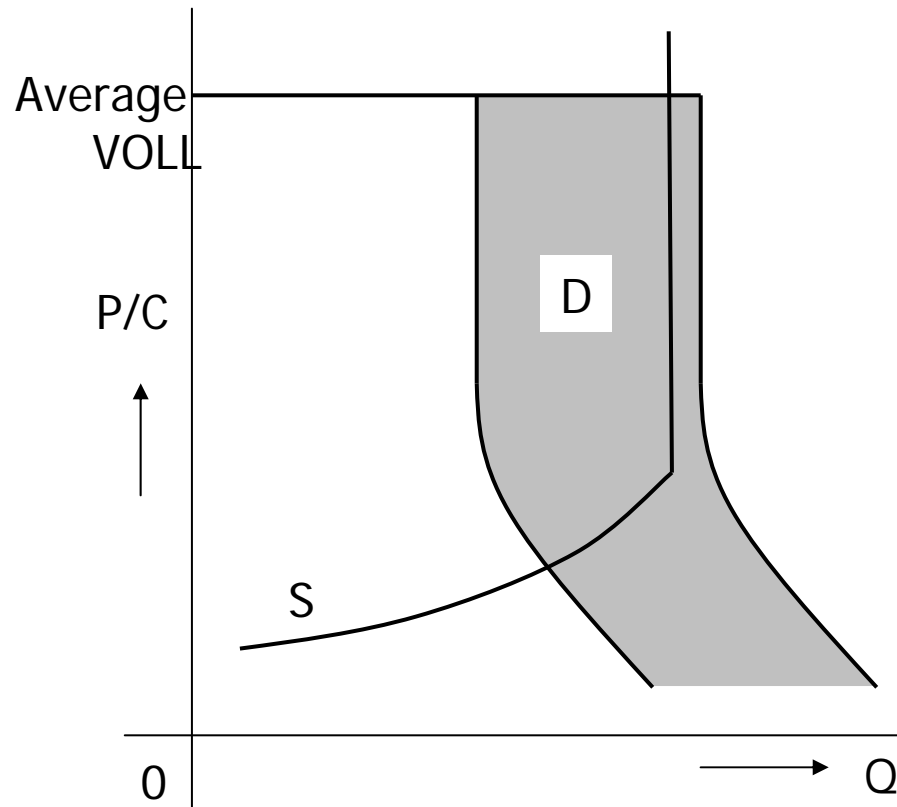
Current state of electricity markets:

- limited involvement of the demand side
- significant lead times for new capacity
- focus on Europe
 - stable general economy
 - markets have sufficiently large scale
- focus on the impact of market design upon investment

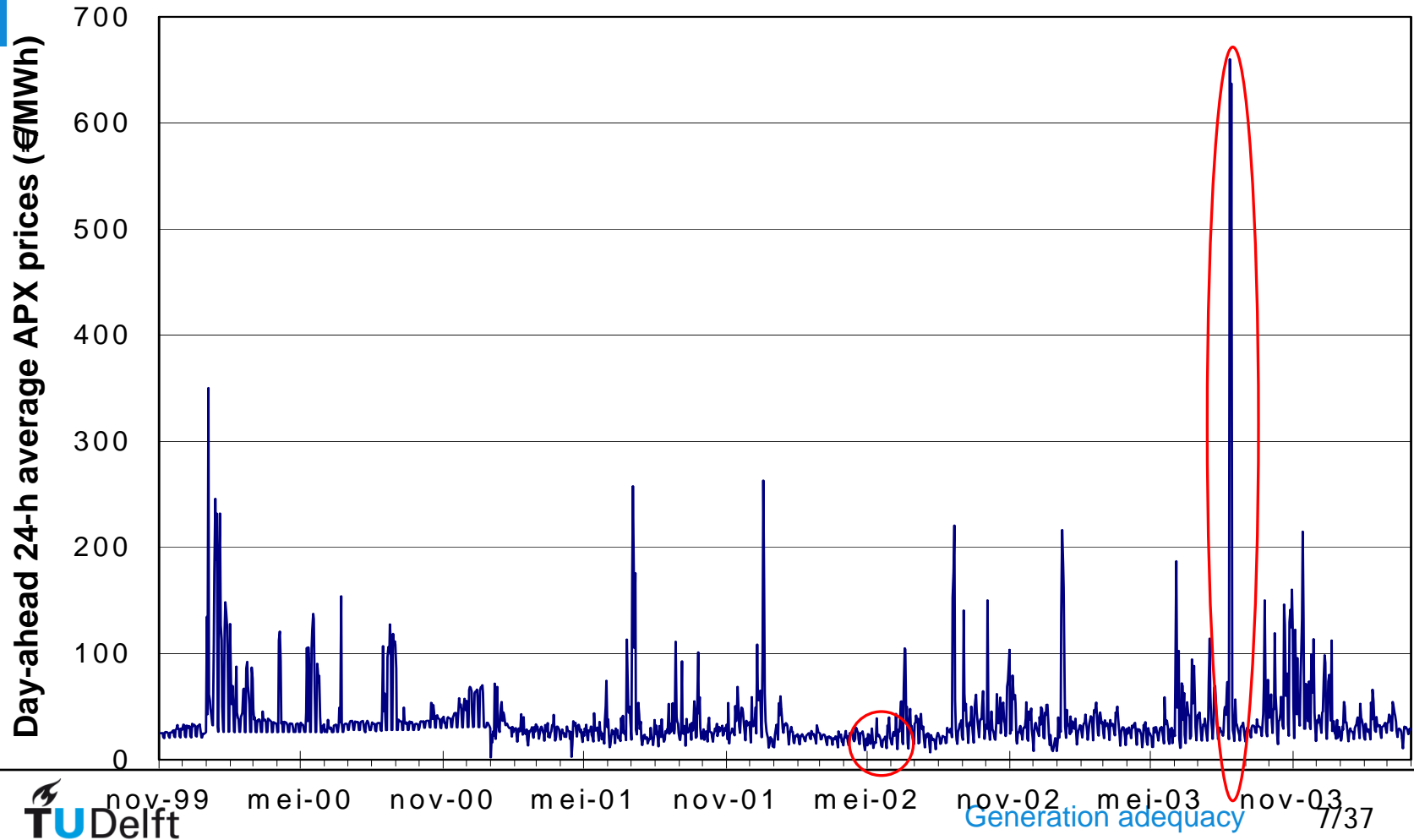
Electricity basics

- Electricity is different:
 - need to balance supply and demand continuously
 - inelastic demand
 - firm limit to supply curve (inelastic end)
- Consequences:
 - price volatility
 - chance of market failure: no match between supply and demand (→ supply interruptions!)

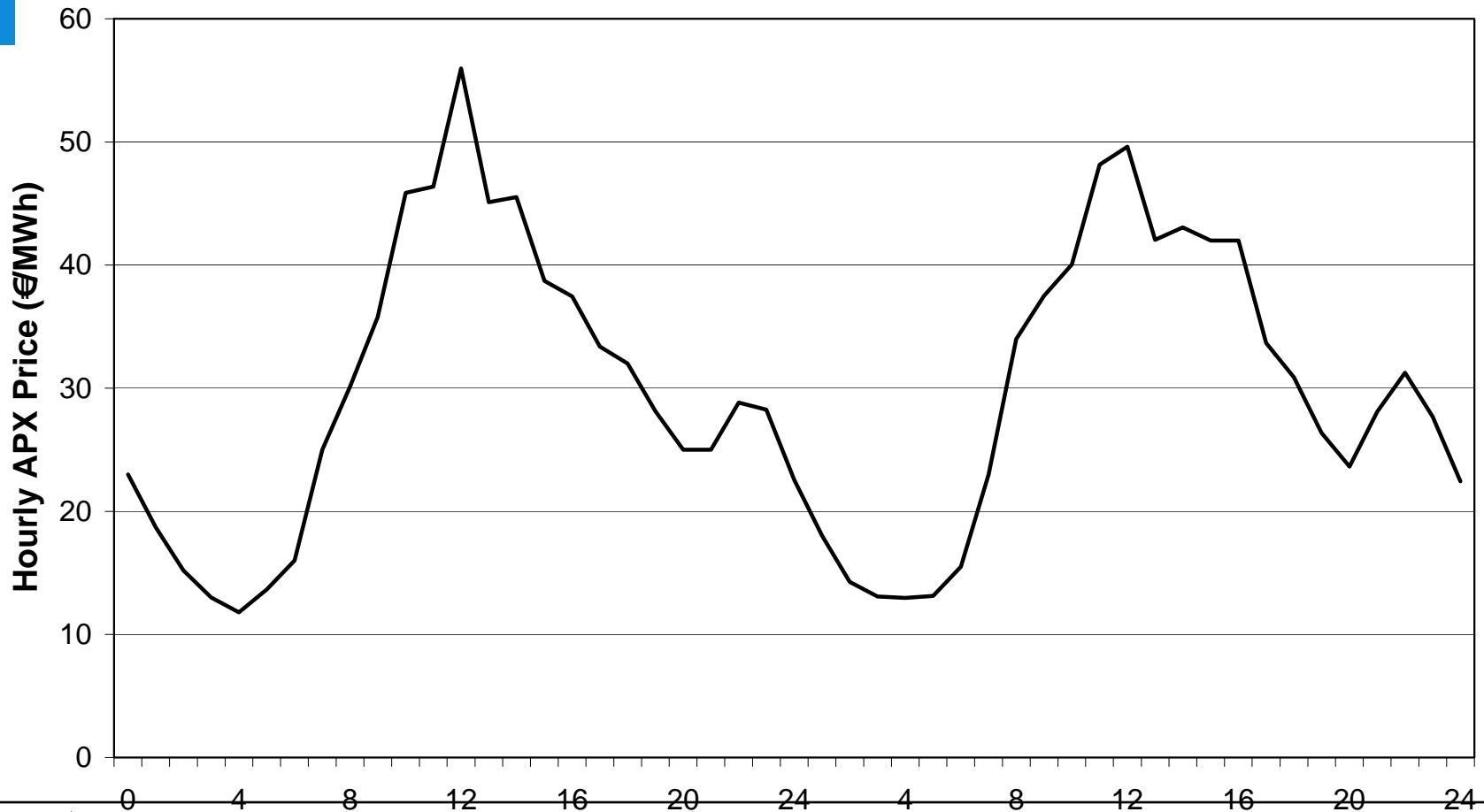
How does the market clear?



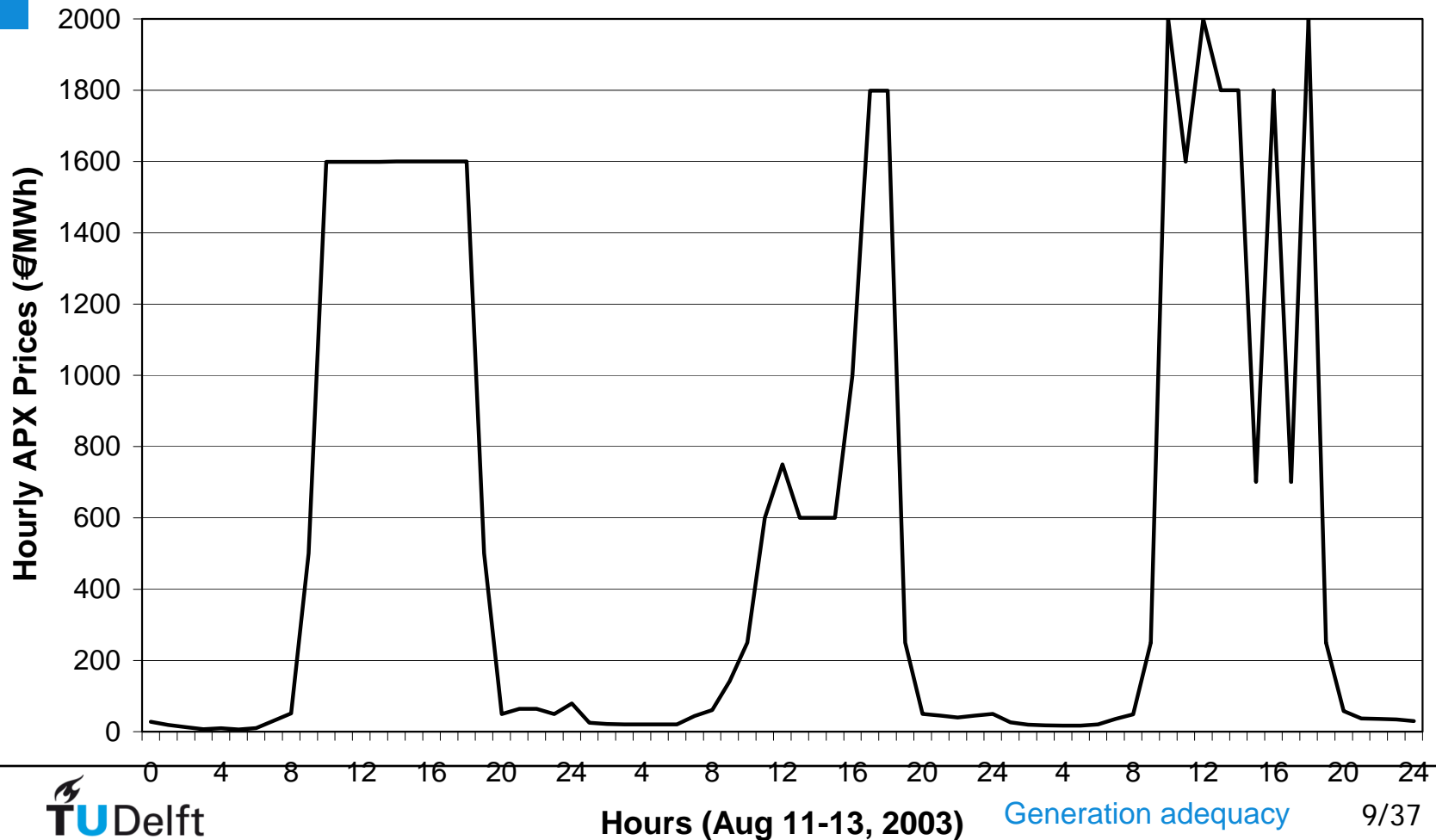
APX prices



APX prices during 2 days in May '03



APX prices during 2 days in Aug. '03

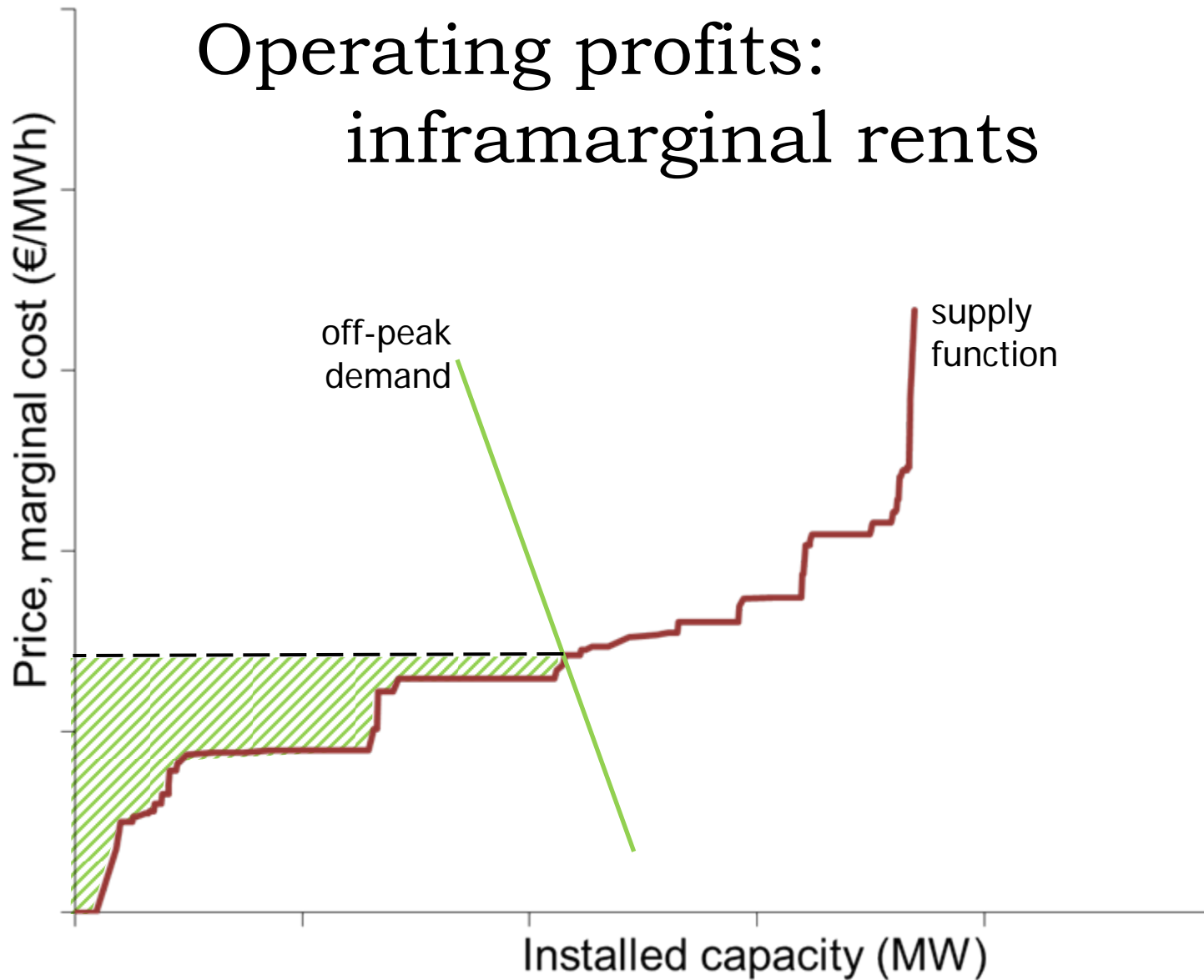


A little exercise...

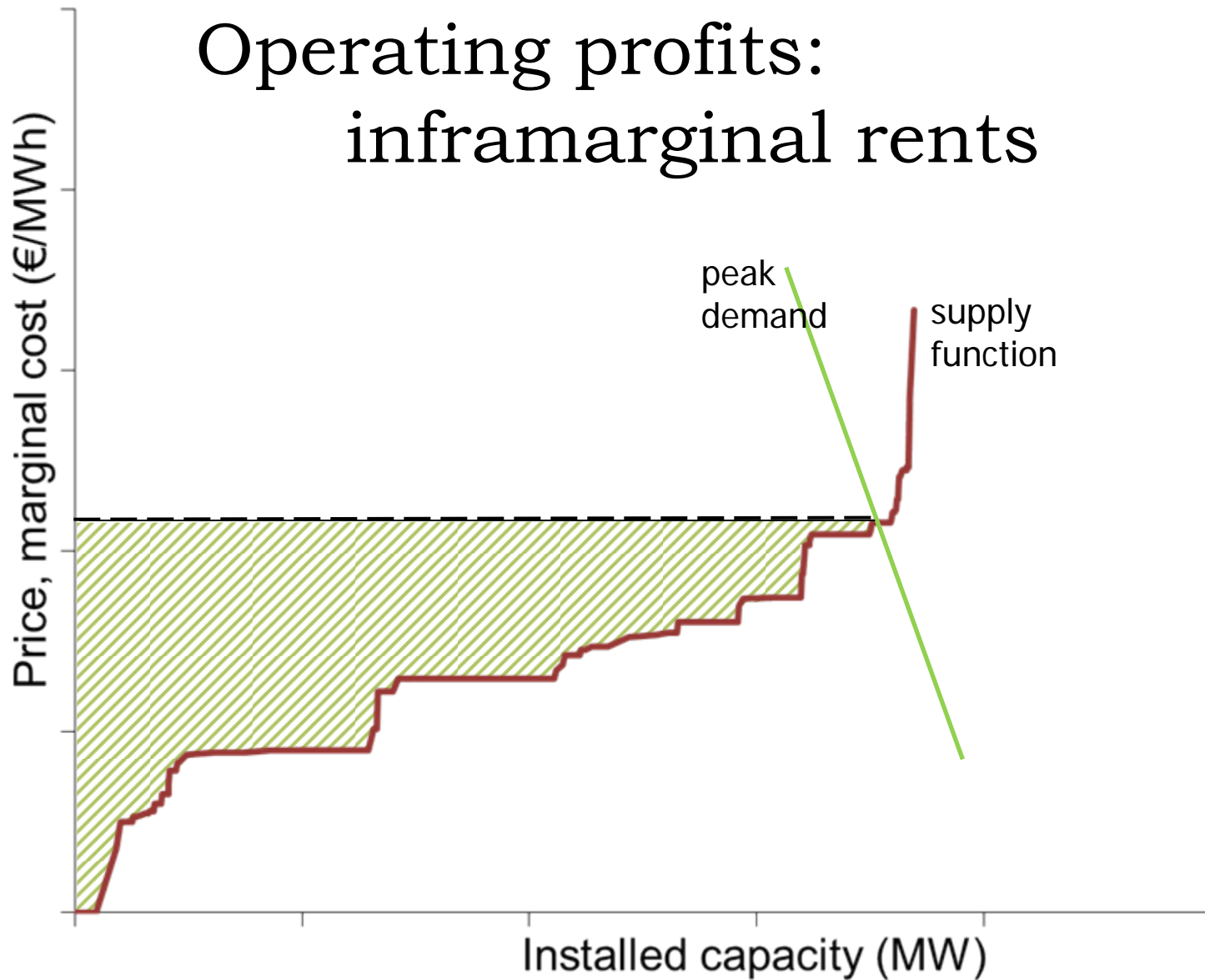
A diesel generator of 1 MW:

- cost: 300.000 €
 - life: 15 years
 - operating costs: 100 €/MWh
 - value of lost load is 5000 €/MWh (= maximum willingness to pay of consumers)
-
- How many hours does this plant need to run annually to break even?
 - (Assume no financing costs)

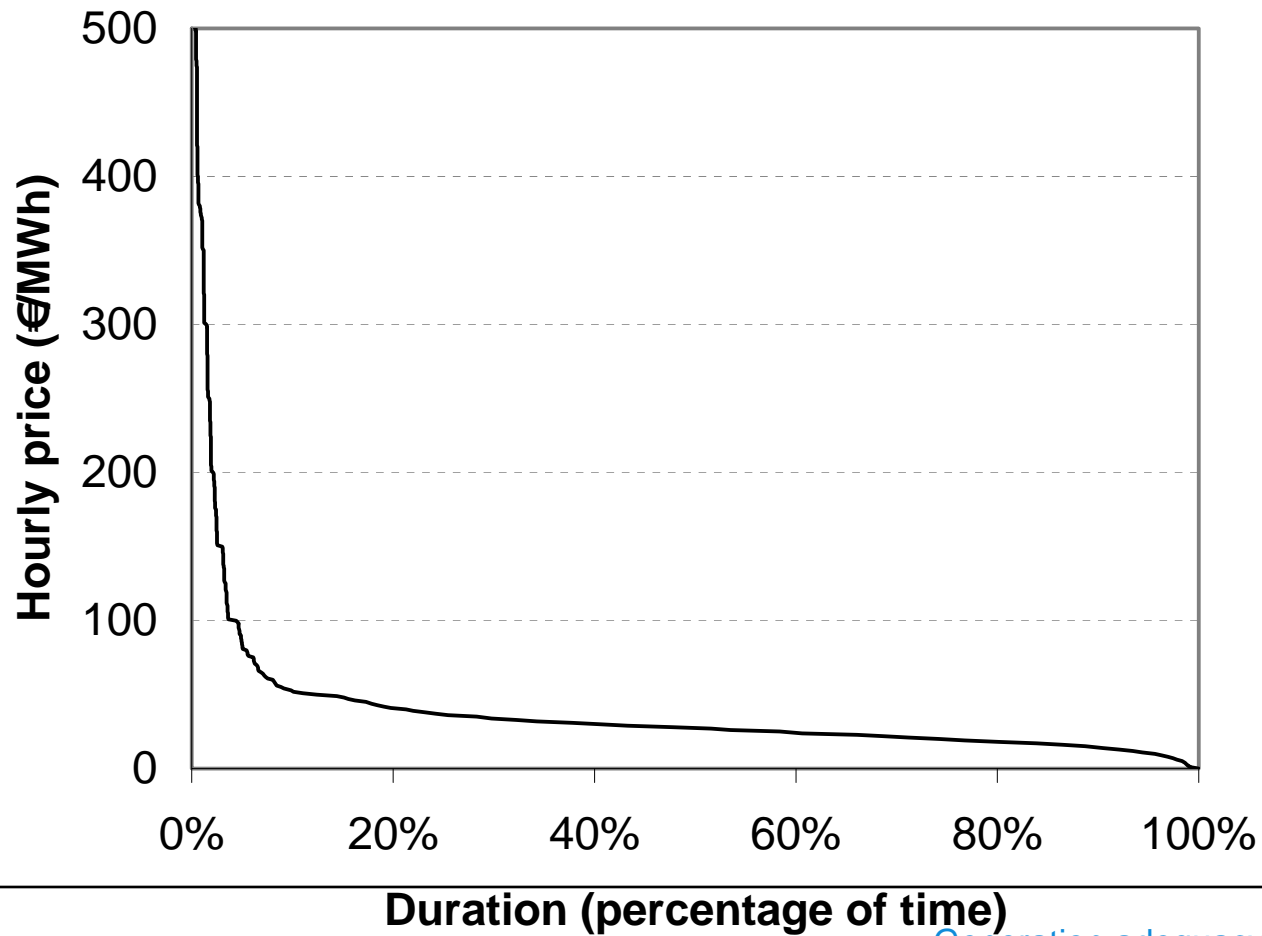
Operating profits: inframarginal rents



Operating profits: inframarginal rents



Price duration curve APX



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 money.

→ Security of supply is not a tradable commodity → no price → no incentive to invest in it.

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%

Maximum price needed

- Retail companies *required* to purchase the electricity that their customers consume
 - scarcity prices may rise above VOLL
- Therefore need of price cap equal to VOLL
- Level of price cap determines investment signal
- This should provide possibility to compensate the reduced investment incentive which is caused by the public good character!

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Possible causes of market failure (1)

- Price restrictions
 - e.g. price cap too low
 - problem: VOLL difficult to establish
- Imperfect information
 - need: accurate projections of supply capacity and demand function, but
 - insufficient historical data since liberalization
 - market not transparent enough to make accurate projections
 - international dimension even less transparent

Possible causes of market failure (2)

- Regulatory uncertainty
 - gas market
 - CO₂ permits
 - market opening in other EU states
- Regulatory restrictions to investment
 - e.g. permitting requirements
- Risk aversion by investors

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Risk asymmetry – producers' side

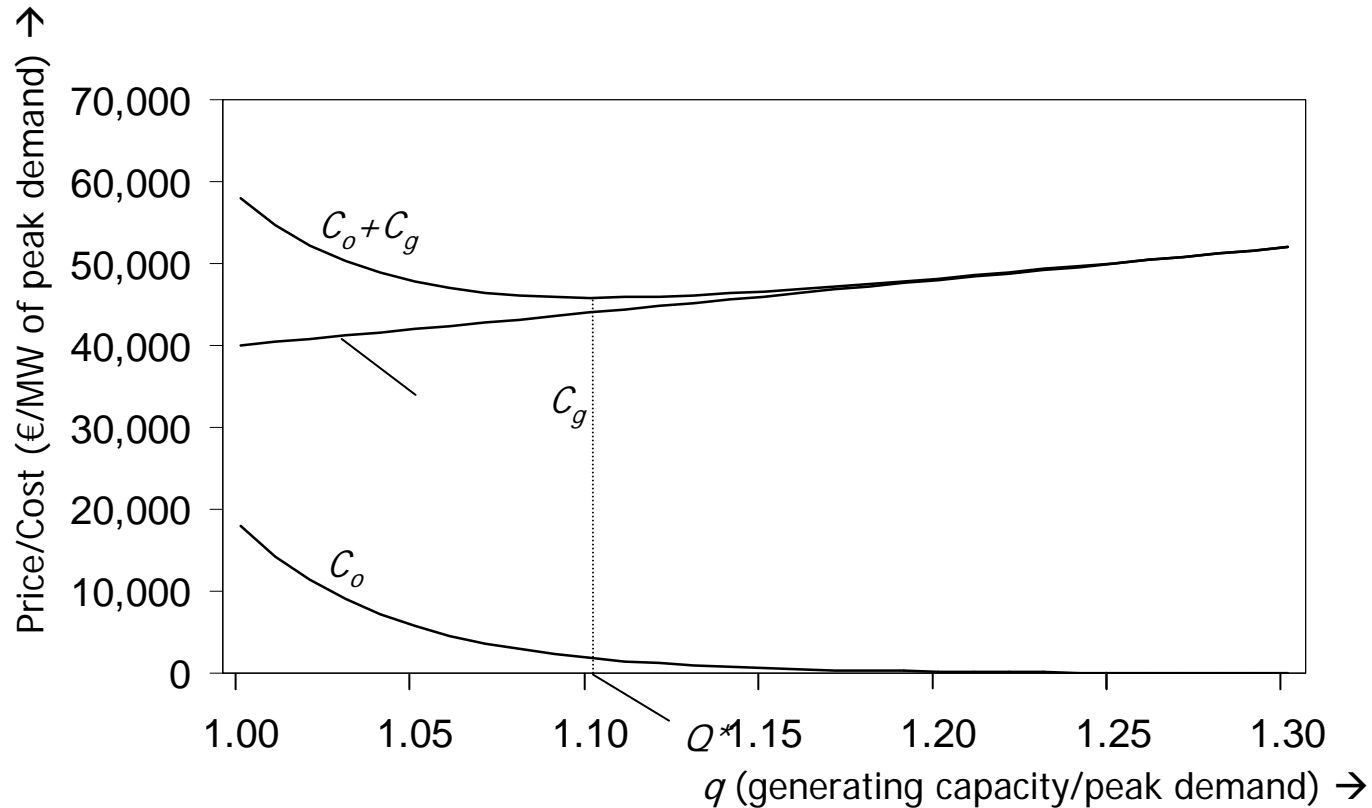
Compared to the socially optimal level of generation capacity, generators would rather err on the side of less capacity:

- reduced risk of unrecoverable investments
- generators' risk is limited to small loss of market share
- if competitors do same: higher chance of high prices → positive effect upon generator revenues!

Risk asymmetry – society's view

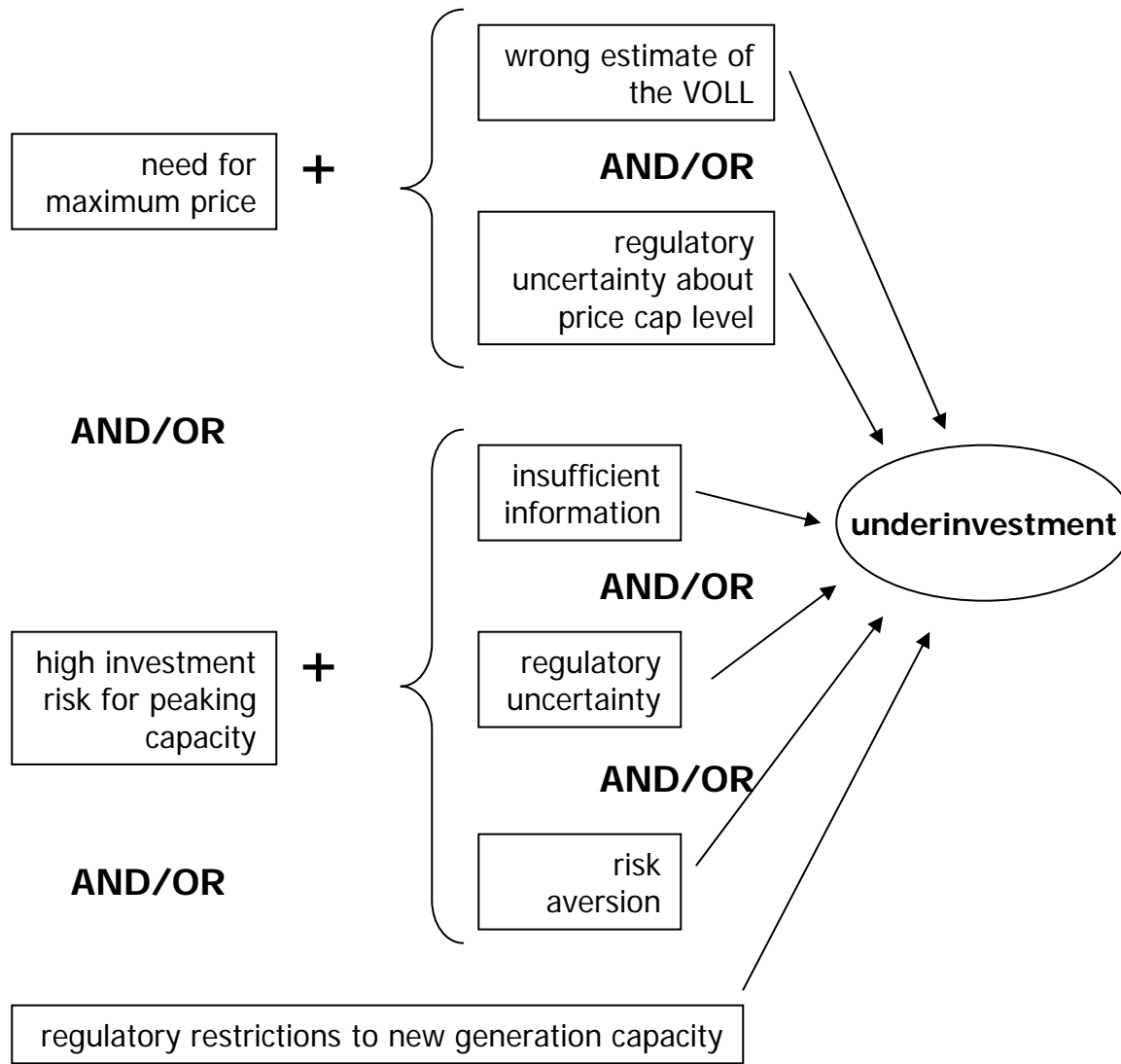
- Compared to the social optimum, society would like to err on the side of overinvestment:
 - cost of overinvestment small (e.g. 10% extra generation capacity → few % higher electricity cost)
 - cost of underinvestment orders of magnitude higher
 - e.g. shortage in California < 2%
 - social cost of California crisis > 2 times the annual turnover of the electricity industry; 3.5% of GDP
- Apparently the social cost of underinvestment is orders of magnitude higher than the cost of overinvestment!
- The private and the public interest do not coincide.

Optimal volume of capacity



C_o : total social cost of outages

C_g : social cost of generation capacity

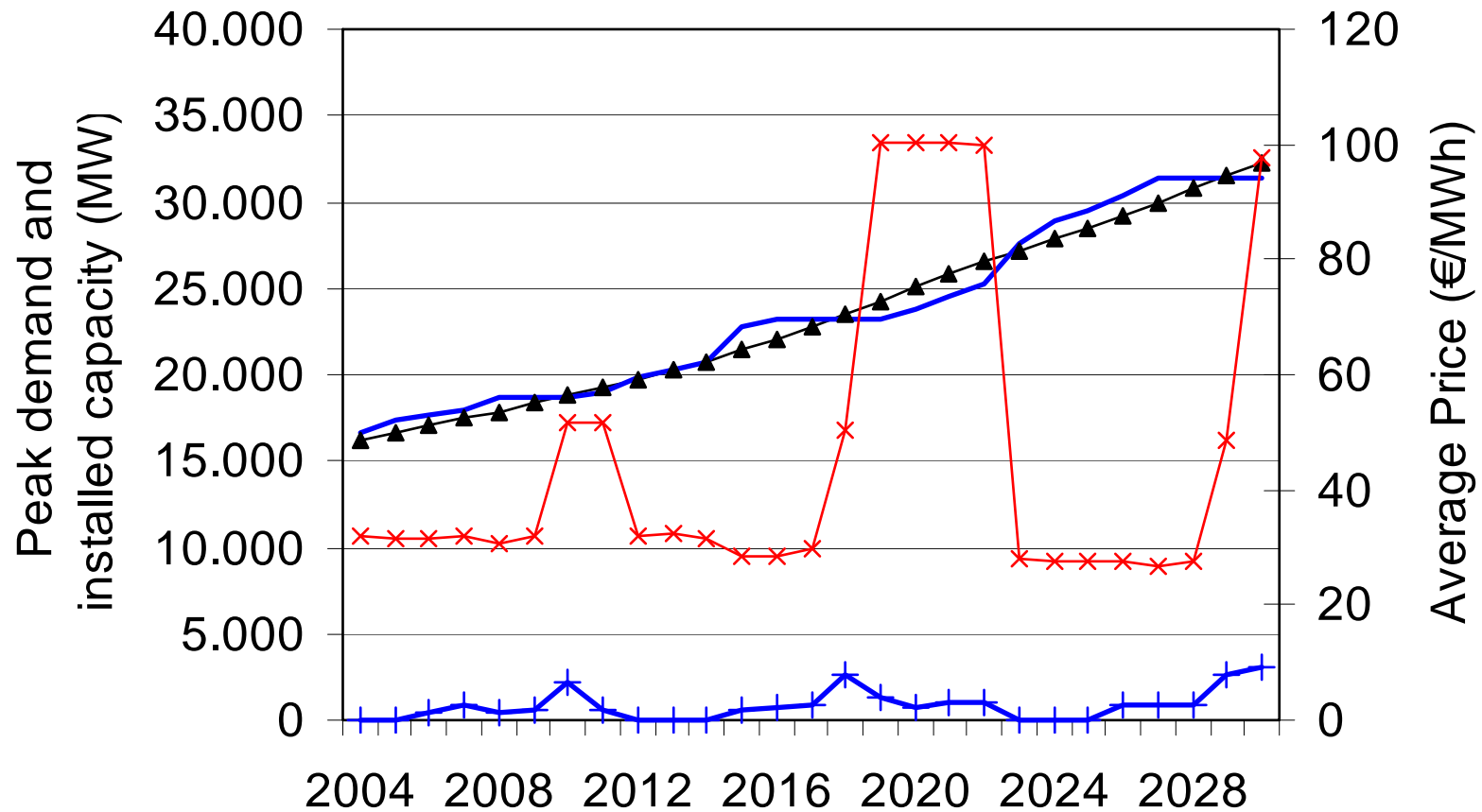


Investment cycles?

Due to incomplete information and risk aversion:

- investors base their decisions upon recent experience in the market
 - delay investment until need is clear
- Demand projection based on the current phase of 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 run: investment cycle



- ▲ Peak Demand
- Installed Capacity
- + Investment
- × Average Price

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Long-term contracts (1)

- Classic solution to coordination problem
 - method for allocating risk between producers and consumers

In the case of separate production and retail companies, consumers can free-ride:

- choose cheap retailer (with insufficient LT contracts) under normal circumstances,
- leave it to 'solid' retailers (with full contract portfolio) to provide security of supply – for everyone!

Long-term contracts (2)

In the case of vertically integrated production-retail companies consumers can also free-ride:

- due to the public good aspect mentioned before:
consumers free-ride on each other (leave it to the others to choose company with enough peaking capacity)

→ Long-term contracts do not develop sufficiently for peaking capacity.

Long-term contracts (3)

Additional issues:

- Required time horizon at least one business cycle (> decade): too long for market parties
- Consumers need to learn the value of security of supply before they are willing to pay for it
 - the cost of learning through trial and error is high, as it requires at least one 'California'
 - but if such a crisis occurs, the market structure likely is adjusted and the learning curve needs to be started over!

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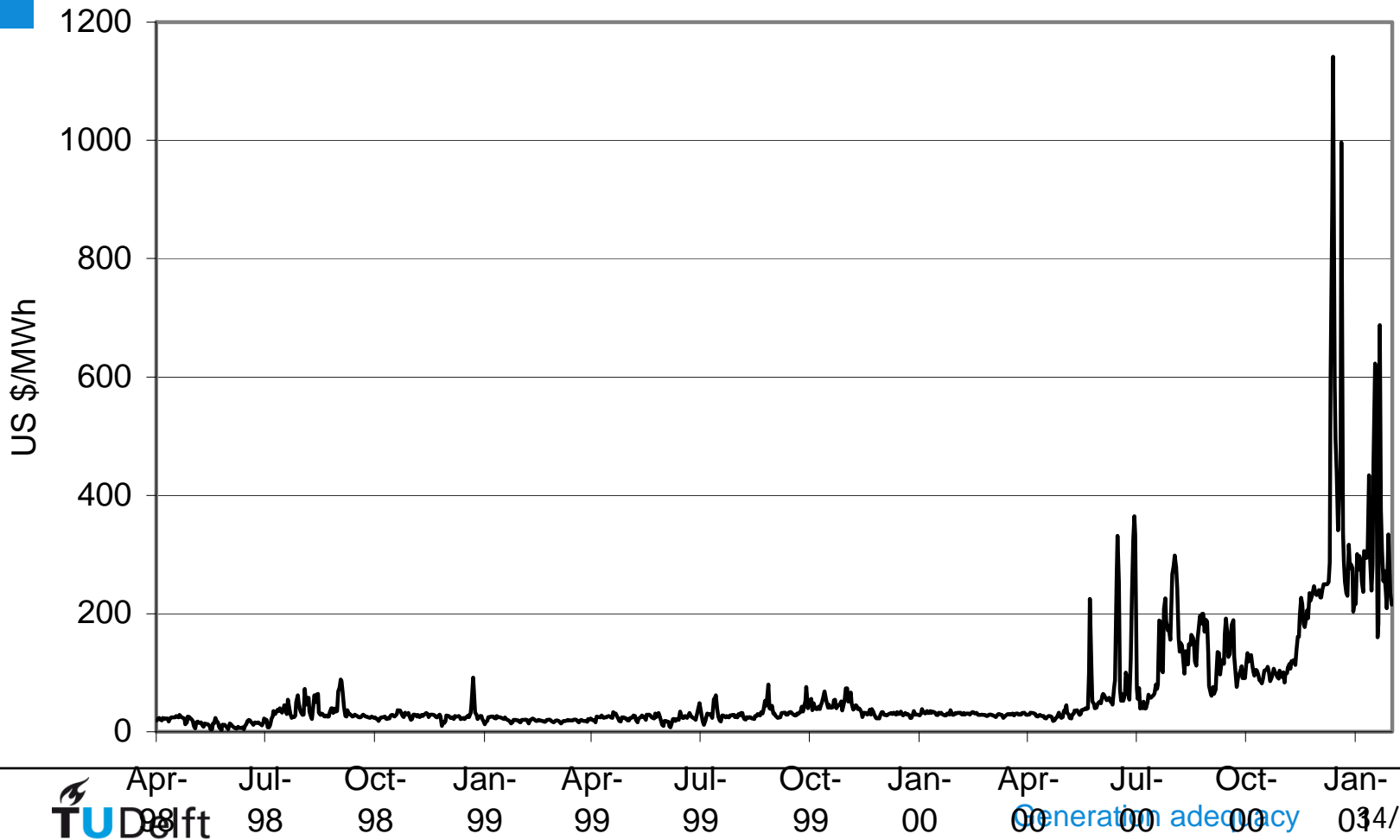
Market power during scarcity

- 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.

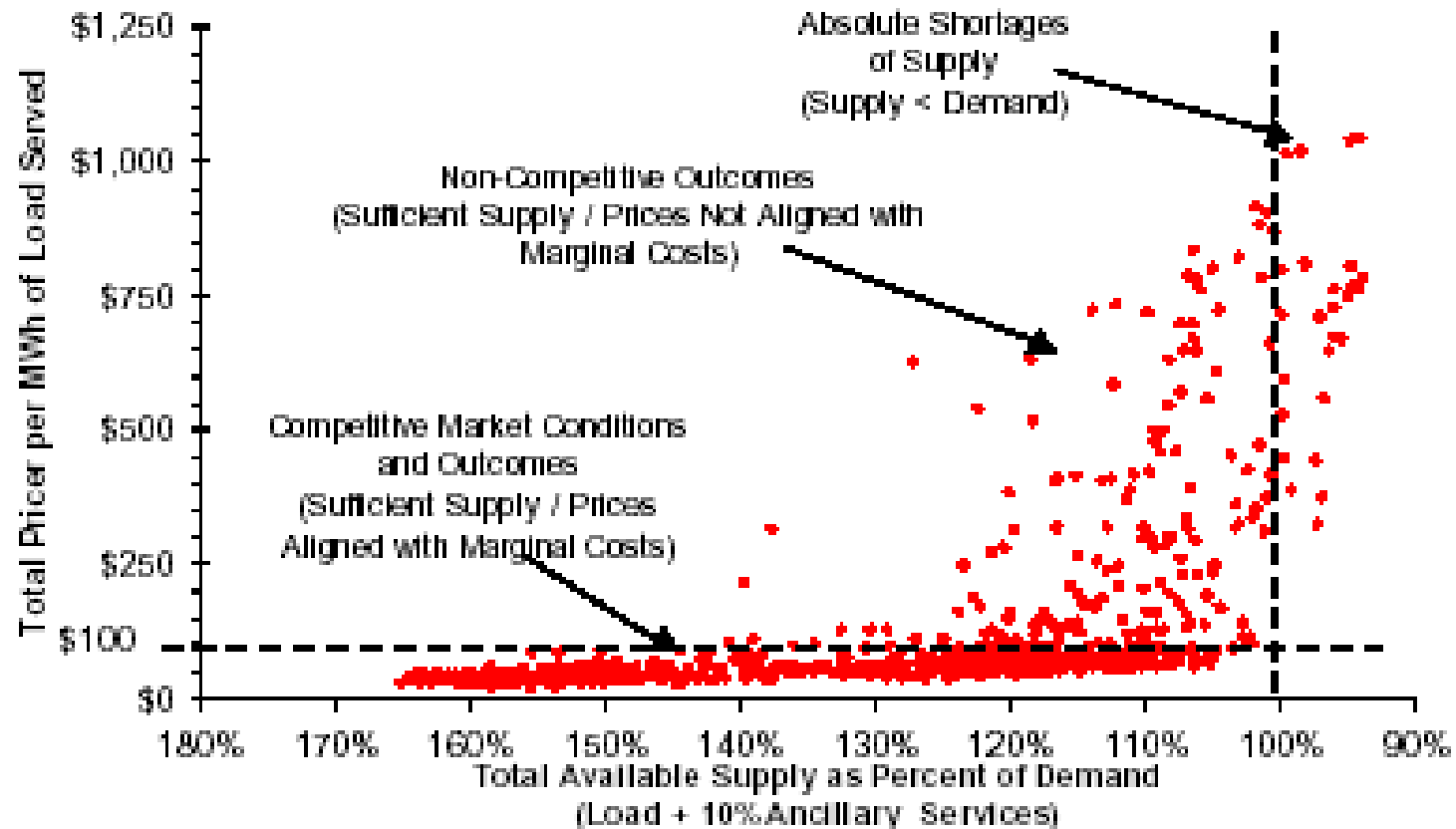
Market power (2)

- Withholding may be illegal, but difficult to enforce (wide 'grey' area).
 - Conclusions:
 - the current market structure provides strong incentives in the wrong direction
 - the possibility of withholding undermines the value of the investment signal from price spikes
- The possibility of price manipulation is a fundamental weakness of price-spike based market models.

Prices in the California power pool



Price manipulation in California



Market prices versus supply adequacy in California in June 2000

Source: California ISO, 2000

Market power in our 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.

Market power – alternative strategy

- Abuse during crisis may lead to severe repercussions (California):
 - legal measures
 - market reform
- Alternative: 'fly below the radar' (ab)use of market power
 - moderate price increases
 - make it possible to limit price spikes
 - make it possible to invest enough
- Consequences:
 - limited political attention
 - limited opportunities for newcomers

→stable strategy

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Summary

- Theory: price spikes signal investment.
- Even perfectly competitive markets may develop investment cycles as a result of:
 - insufficient information
 - regulatory failure
 - risk asymmetry between producers and consumers.
- Market power during scarcity aggravates problems
 - and may cause the model to become economically and politically unstable.
- Solutions have been proposed which stabilize the market
- Market power may be default solution