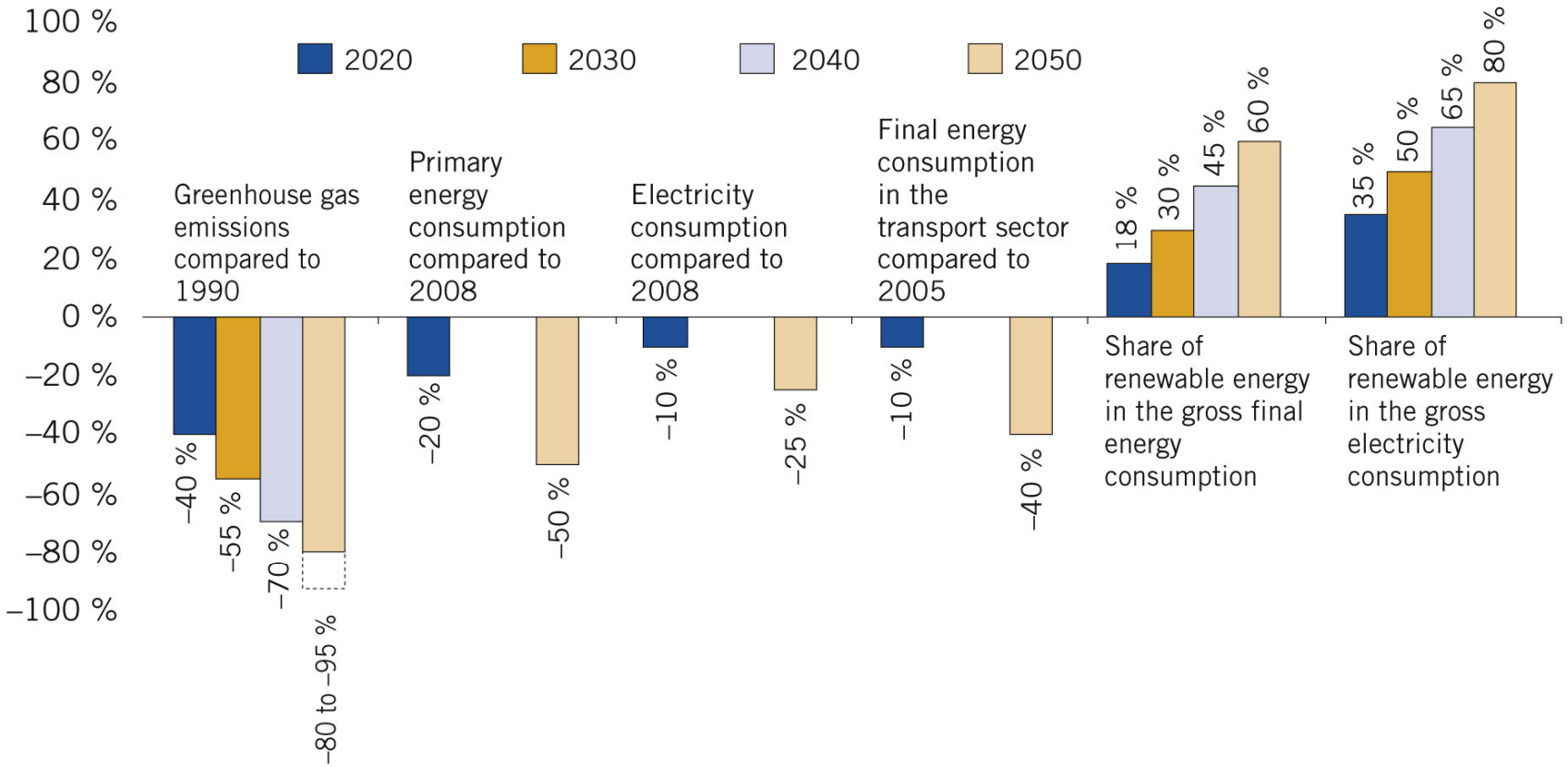
Security of supply with increasing volumes of intermittent energy sources

2-4-2012

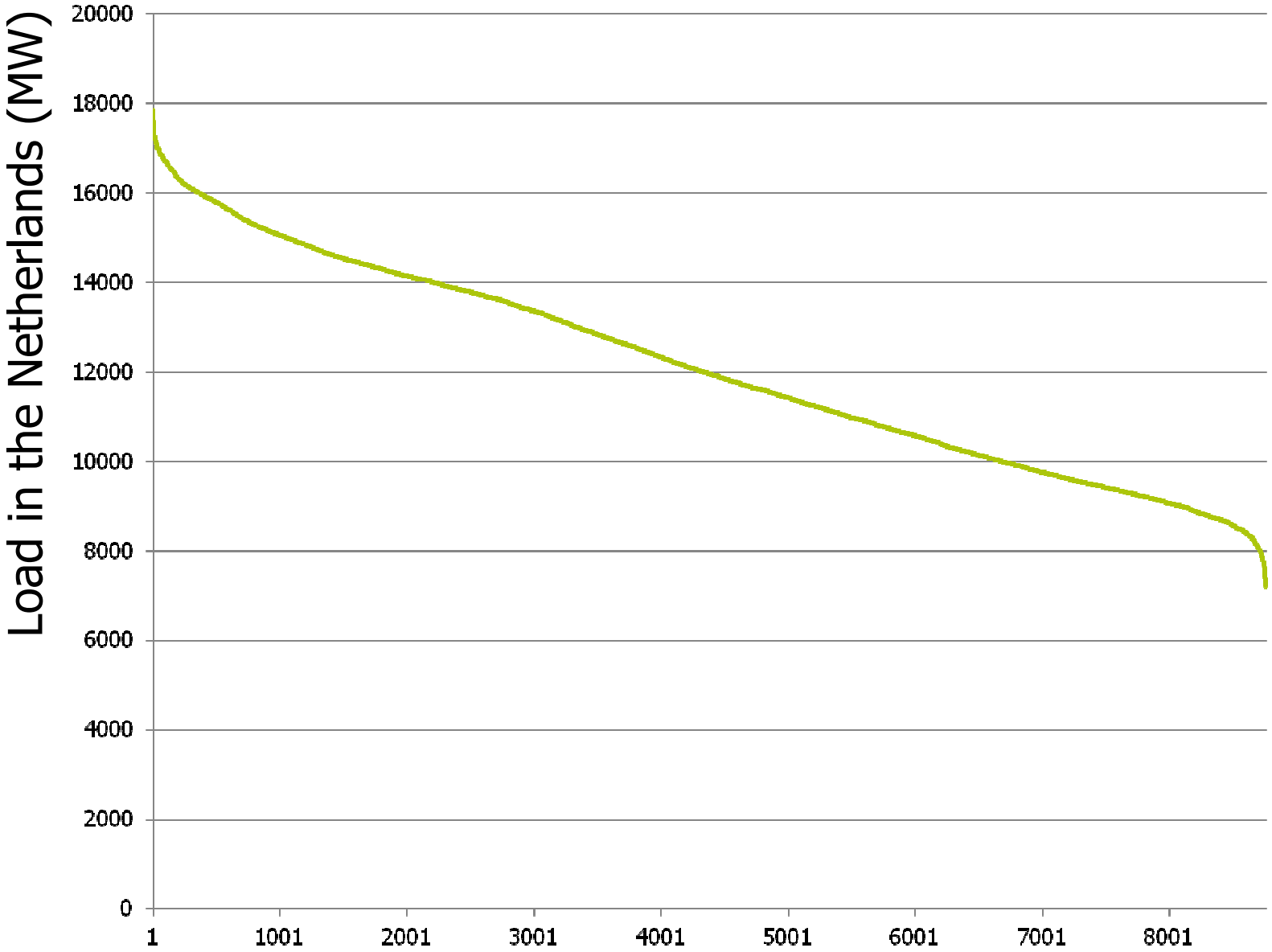
Laurens de Vries

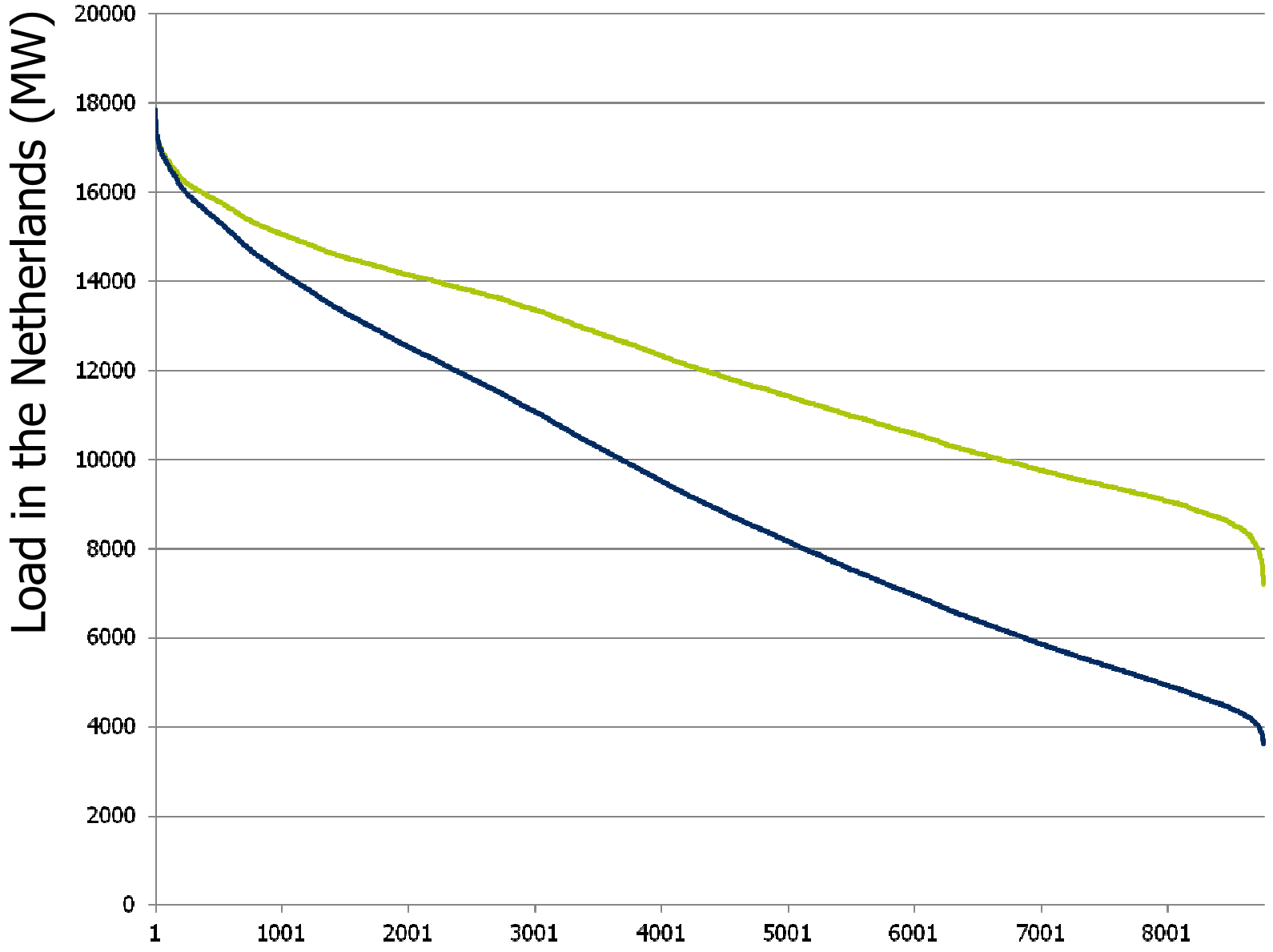
Objectives of the German Energy Concept, 28 September 2010

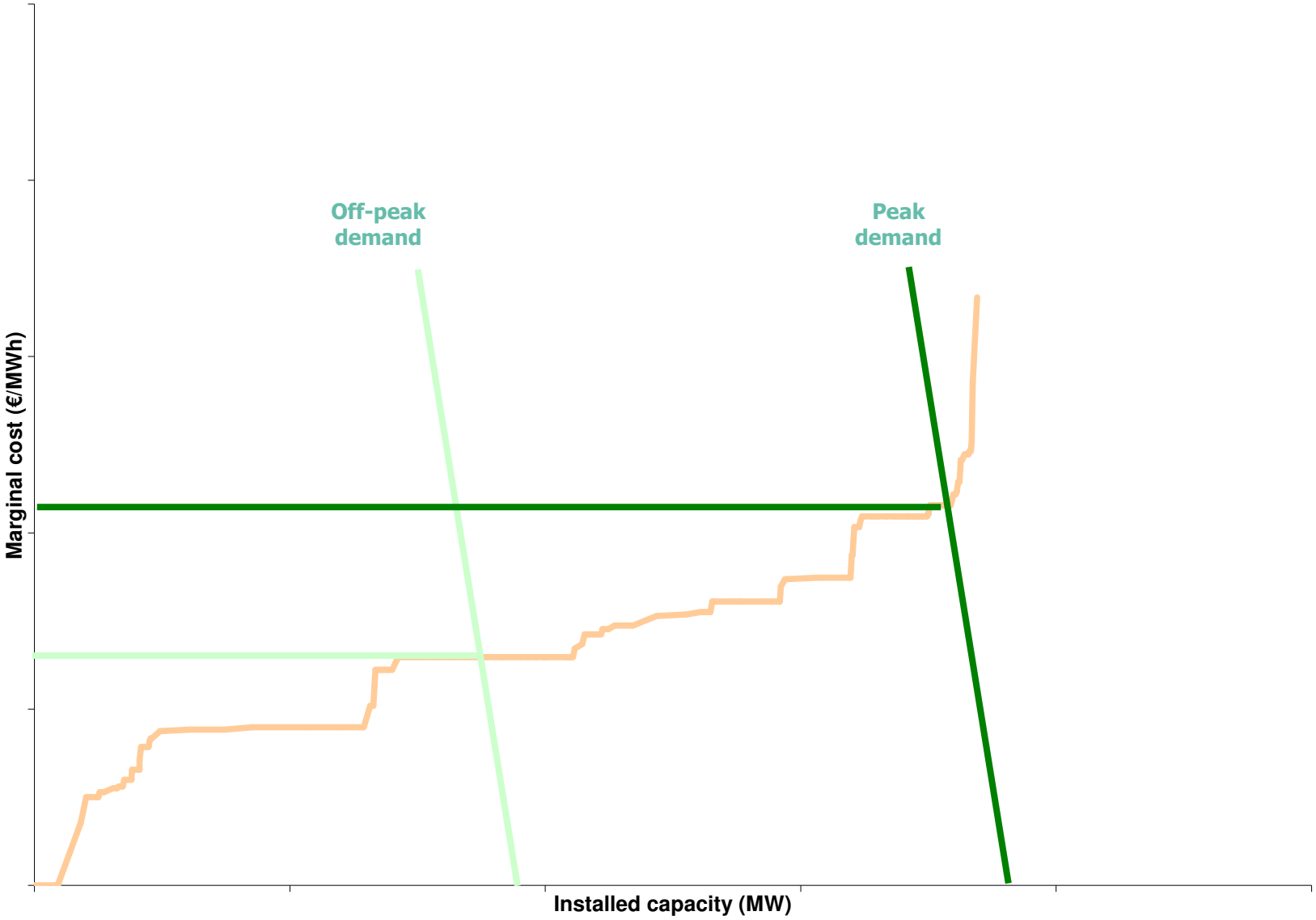


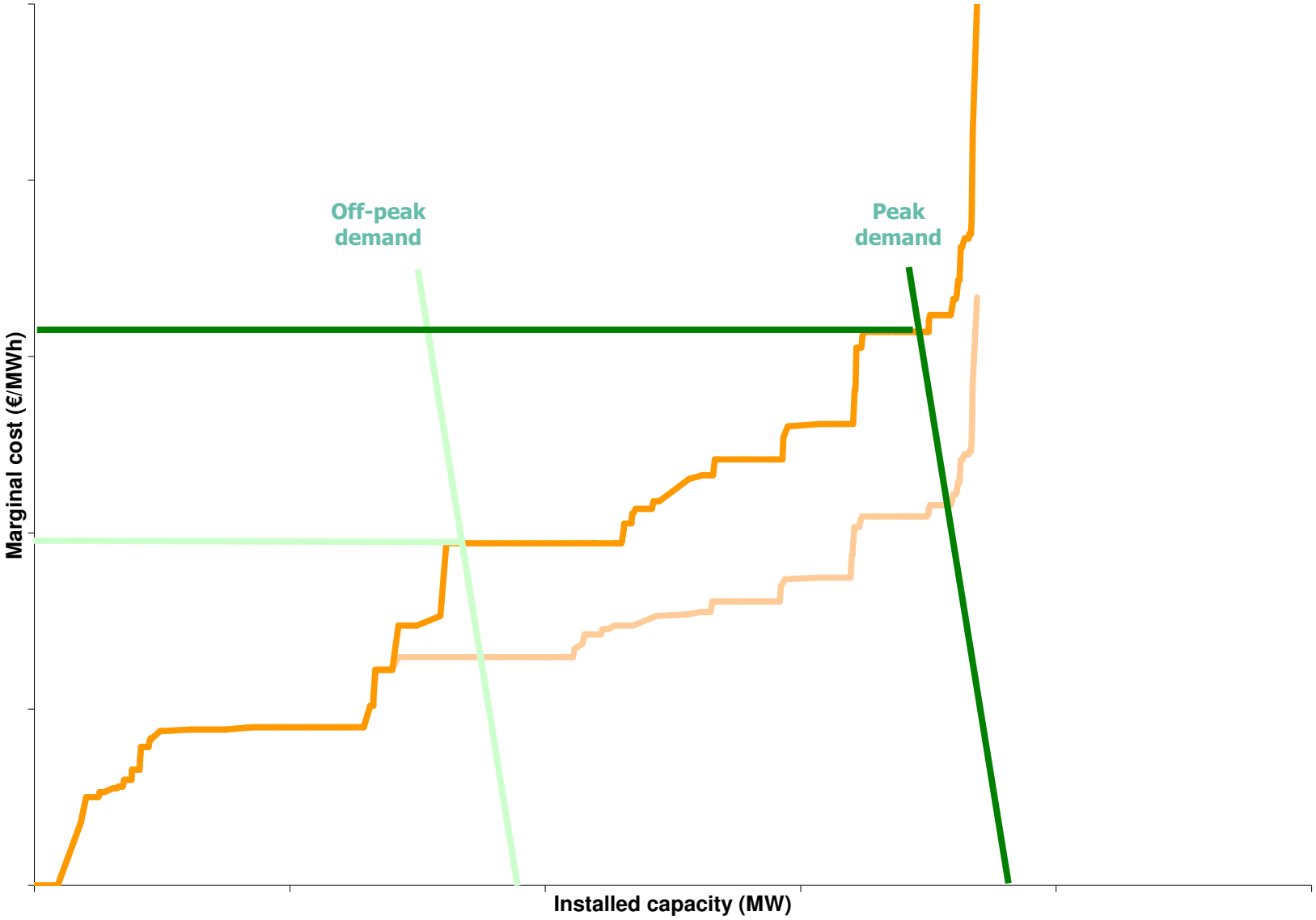
Further objectives: duplication of the renovation rate from the current figure of less then 1 % a year to 2 % of the total building stock.

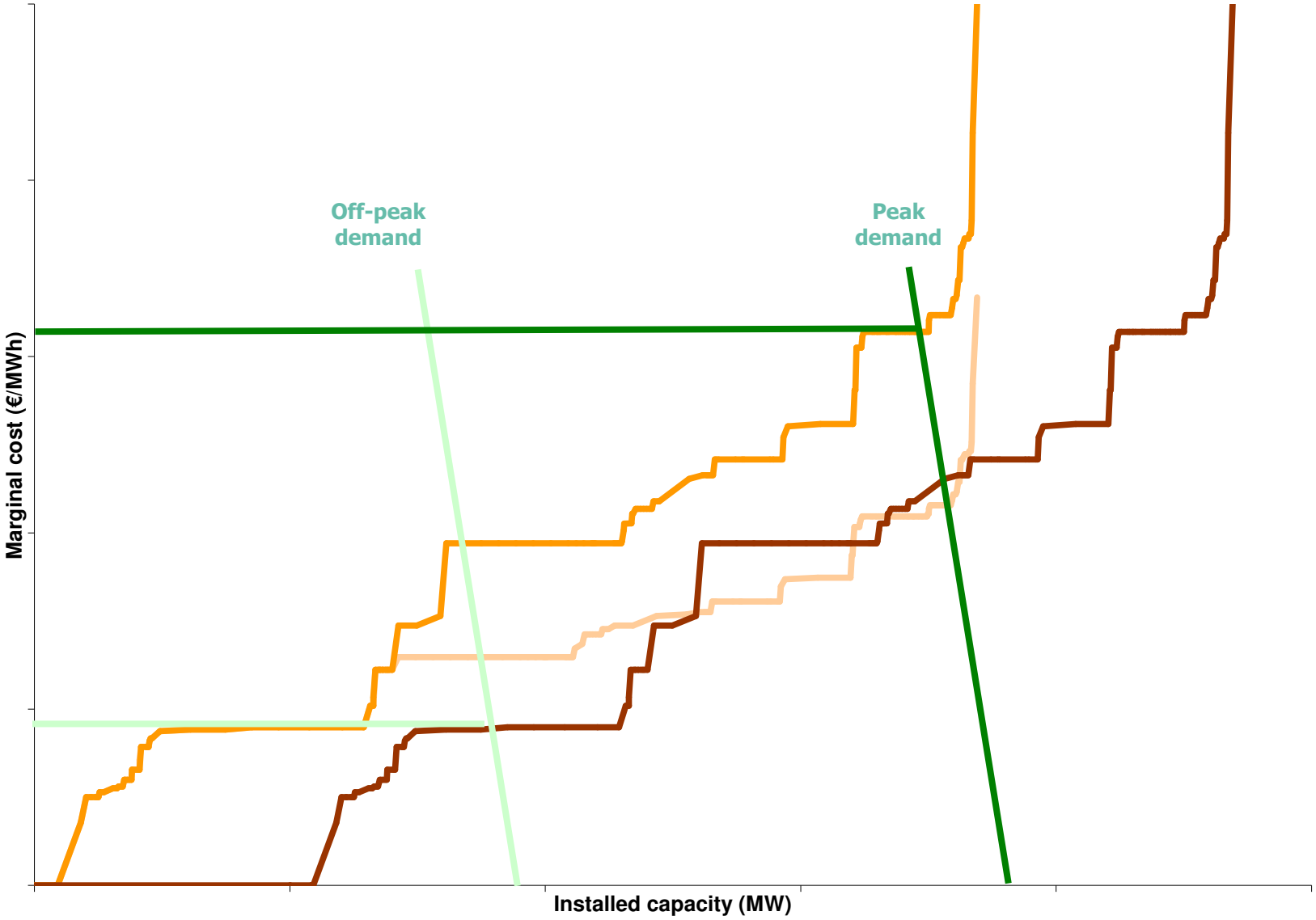
Source: Energy concept of the German federal government


Load in the Netherlands (MW)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1
1001
2001
3001
4001
5001
6001
7001
8001
Duration (h/y)

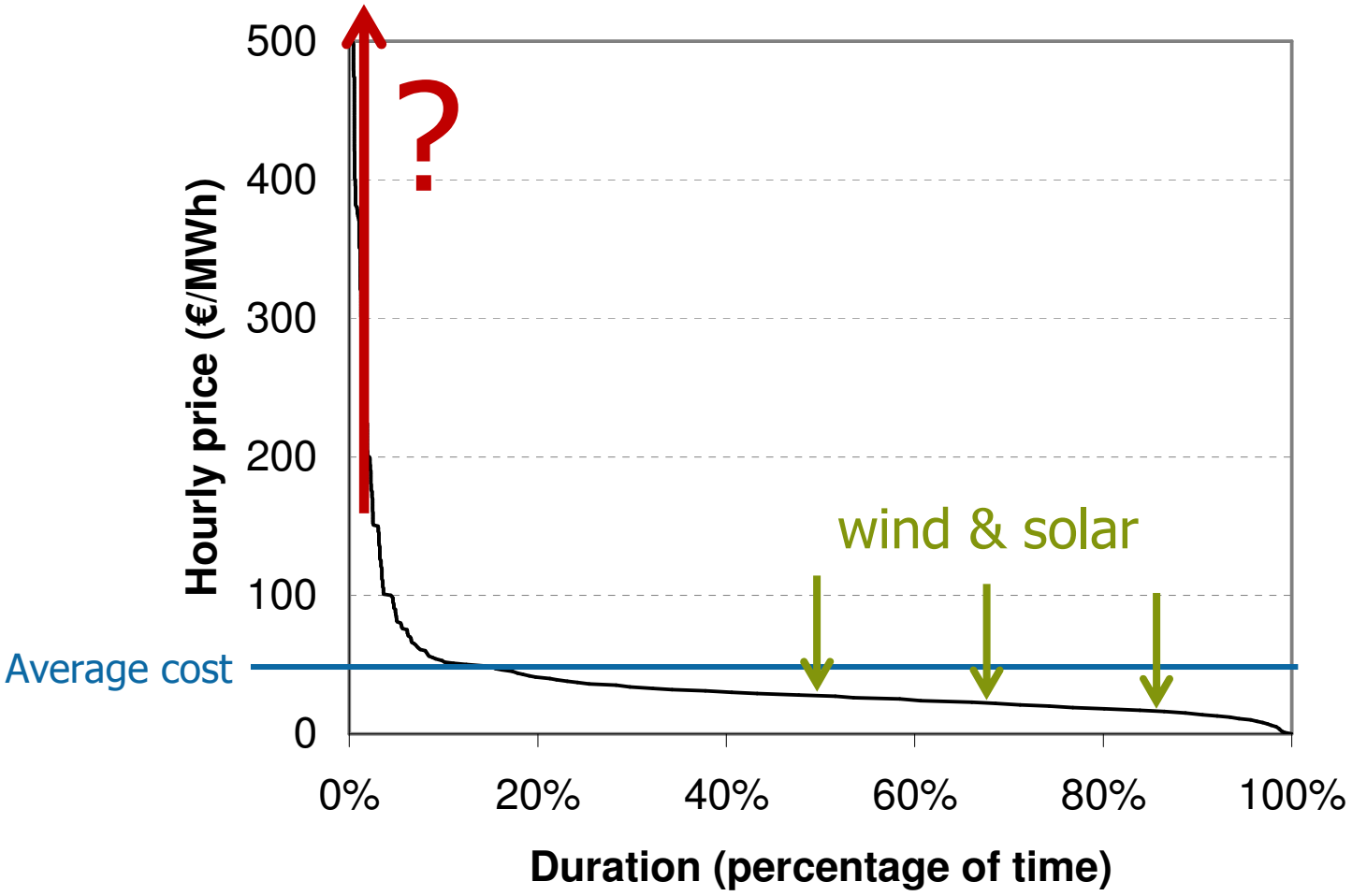

Load in the Netherlands (MW)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1
1001
2001
3001
4001
5001
6001
7001
8001
Duration (h/y)


Off-peak
demand
Peak
demand
Marginal cost (€/MWh)
Installed capacity (MW)


Off-peak
demand
Peak
demand
Marginal cost (€/MWh)
Installed capacity (MW)


Off-peak
demand
Peak
demand
Marginal cost (€/MWh)
Installed capacity (MW)

Price duration curve APX



Does the market provide?

- In theory, energy-only markets provide optimal investment incentives.
- Market distortions, e.g.:
  - deep uncertainty regarding fundamentals, e.g.:
    - fuel prices
    - electricity demand
  - regulatory uncertainty
    - CO_2 policy
    - RES-E policy)
    - market (dis)integration
    - technology-specific policies: nuclear, CCS, RES-E

Risk allocation

- In an energy-only market, the investment risk is allocated to producers.
- But the consumers are the ones who benefit from security of supply
  - and, in their role as citizens, who want decarbonization
- Incomplete market: consumers cannot buy reliability

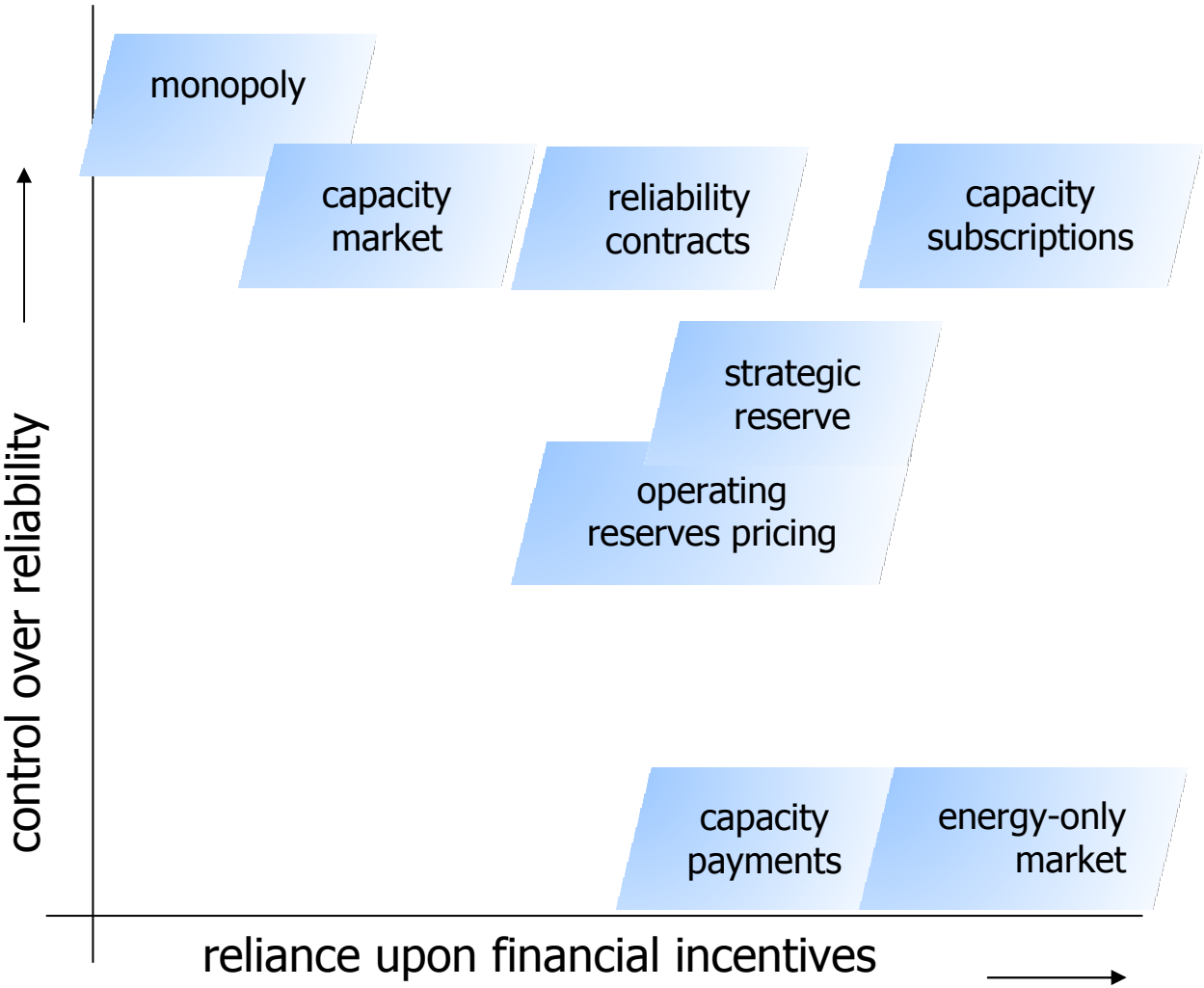
→Implement a capacity mechanism?

- may be considered as a social insurance against shortages
- society's risk preference is a political decision

Possible goals for capacity mechanisms

- Reliability
  - Generation adequacy
    - mitigate investment cycle
    - back-up for intermittent sources
  - Operational availability
- Economic efficiency
  - Dispatch
  - Investment (incl. technology choice)
  - Reduce market power
- Welfare effects, price stability

Incentives versus control



Capacity payments

- Subsidy to generators per MW installed capacity
  - Sometimes additional strings attached, e.g. maximum price for electricity
- Examples: Ireland, Portugal, Spain (under revision), Italy (under revision)

Strategic ('Mothball') Reserve

Reserve operated by TSO.

- Old units, also new ones? DSM also possible.
  - Easy to implement
  - Merit order distortion?
  - Unbundling?
- Dispatch criterion:
  - marginal cost plus a margin → reduction of scarcity prices
  - value of lost load
    - high price spikes
    - how to determine?
- Examples: Sweden, Finland, Poland, New Zealand.

Capacity requirements (PJM's ICAP)

Load-serving entities required to purchase capacity credits:

- Capacity requirement equals peak consumption plus fixed % margin.
  - Determined by the regulator.
- Credits can be traded.
  - Interruptible demand may also sell credits.
- Capacity market covers large part of fixed costs; price spikes not necessary → wholesale price cap.

Examples: PJM, New York Power Pool, New England Power Pool

→ Something similar under development in France

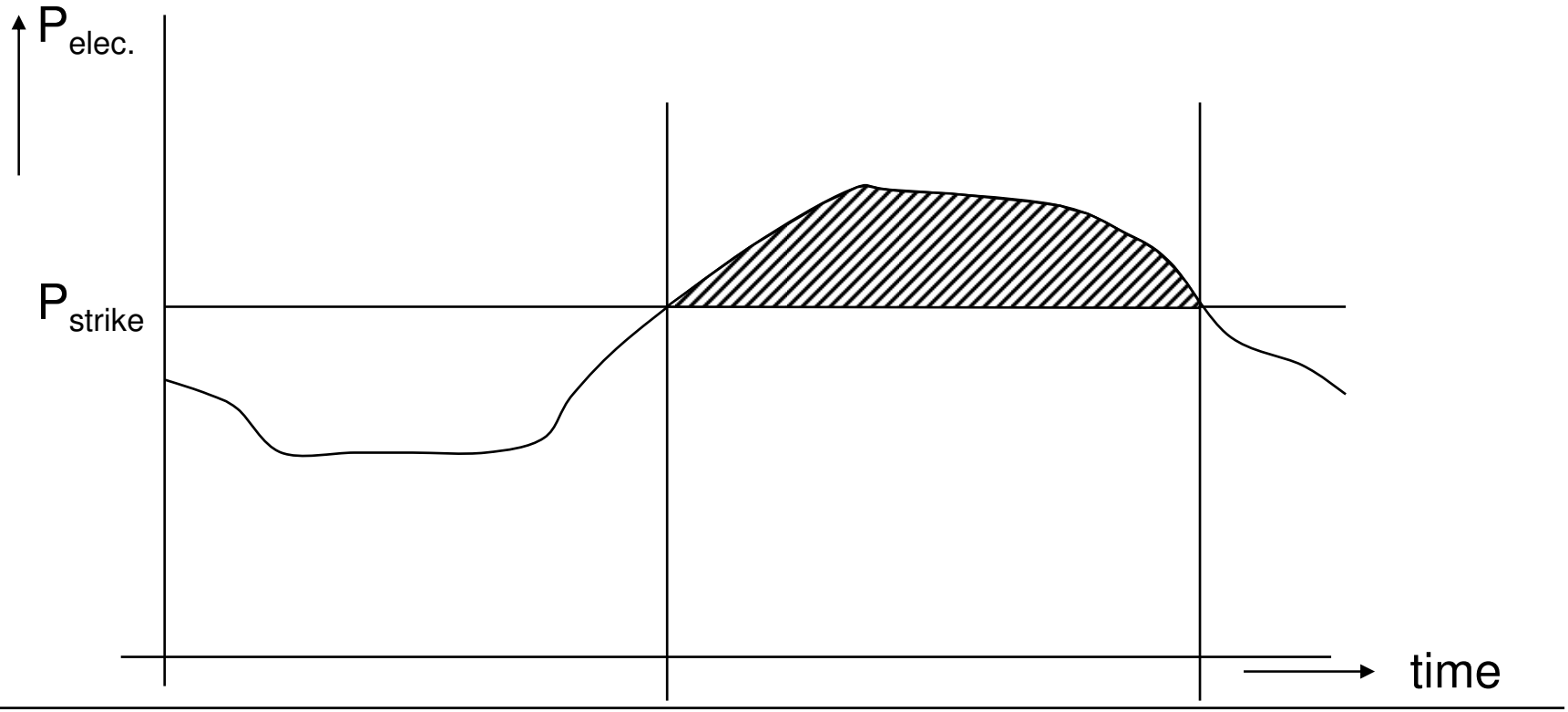
Reliability contracts

- The system operator purchases options from the producers.
- These give him the right to purchase electricity for a certain *strike price*.
- The volume of the options equals the expected demand plus a reserve margin.

- Examples: L.A. Countries, UK (under development)

(Inventors: Pérez-Arriaga, Vázquez and Rivier)

Reliability contracts



Reliability contracts in a decentralized market

- Which reference price for the options? Power exchange, balancing?
- Who buys the options? The TSO?
- Interaction with neighboring markets?

- Bilateral version: place the obligation to buy options on retail companies and large consumers.
  - Consumers call the options when they want to.
  - But: how to deal with vertically integrated electricity companies?

Capacity subscriptions

- Consumers have to buy capacity credits from generators:
  - For the peak capacity that is *reliably* available to them.
  - Consumers can choose this level of capacity.
- When demand is critically high:
  - Consumers need to limit their consumption to their contracted capacity,
  - Generators need to produce the capacity they sold.
- At other times, consumption is not limited.

Hybrid option

- Large consumers:
  - Capacity subscriptions/long-term contracts
  - Mandatory minimum length to assure stability
- Small consumers:
  - Reliability options (purchased by retail companies)

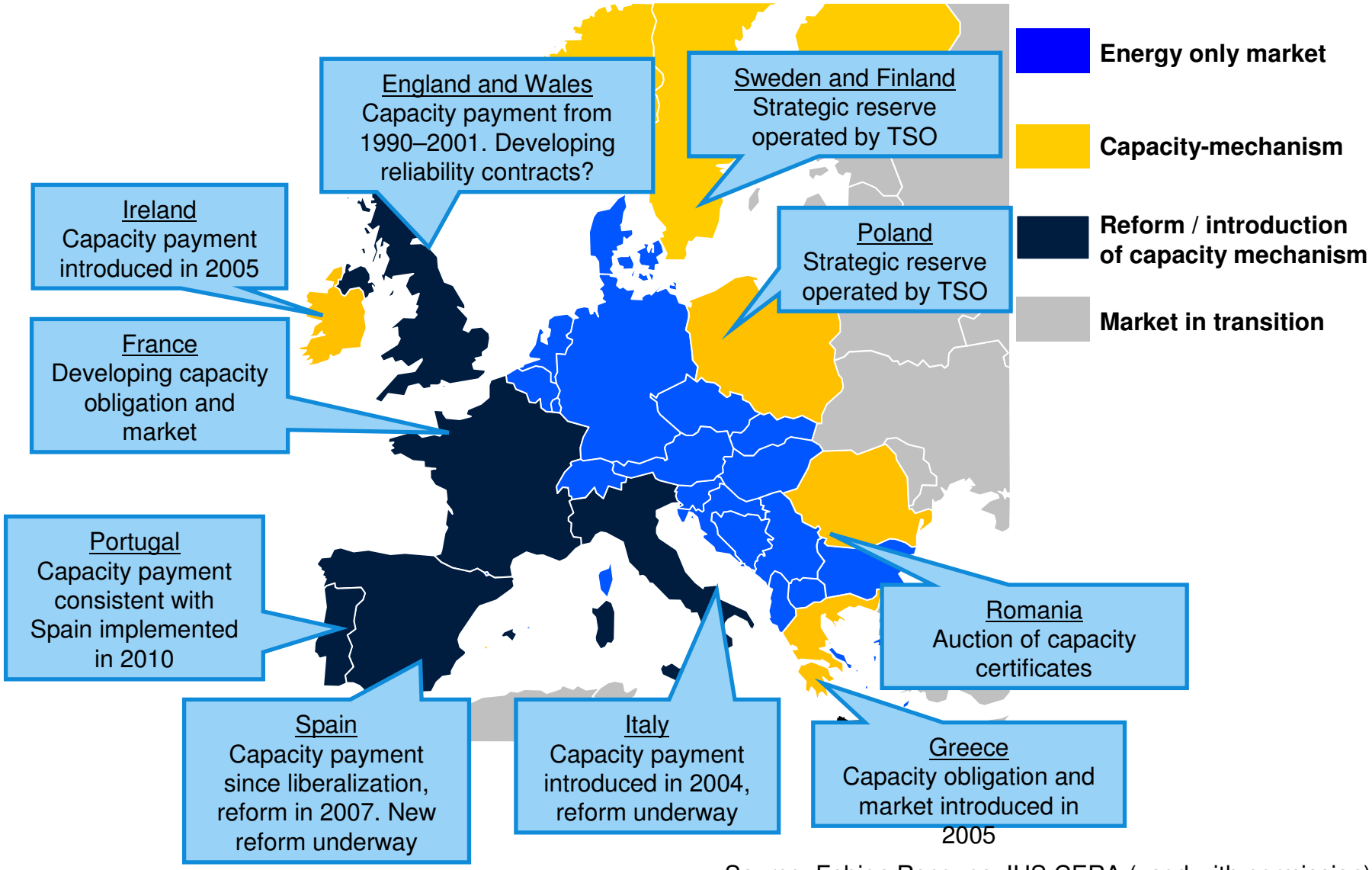
Comparison

	Strategic reserve	Reliability options	Capacity subscriptions
Investment signal	Indirect	Future demand for capacity is explicit	Current demand for capacity is explicit
Incentive for operational availability	0	+	+
Dispatch efficiency	-	0	0
Effectiveness in open market	--	+	+
Feasibility	Easy	Complex	Need smart meters (and cooperative consumers)

Pros and cons…

- Strategic reserve is easy to implement, but less effective
  → still a risk of market failure
- Reliability contracts are complex
  → risk of government failure
- Capacity subscriptions are attractive, but require smart meters and are untested

Capacity mechanisms in Europe



Source: Fabien Rocques, IHS CERA (used with permission)

Dilemmas

- Capacity mechanism necessary?
  - Not now?
  - What about when there are more intermittent electricity sources?
- Other countries are implementing capacity mechanisms now.
  - Market fragmentation due to national solutions?
  - Does waiting mean a lack of control over generation adequacy policy?