Smart market designs for smart consumers

Nicolas Astier (nicolas.astier@polytechnique.org)

Thomas-Olivier Léautier (thomas.leautier@tse-fr.eu)

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Main messages

1. Price responsive demand is essential for the future of the electricity industry

2. Current policies subsidize a flawed business model of residential Peak Time Resale

3. Asymmetric information make Peak Time Resale programs complex to implement

4. Concluding observations

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Optimal retail price and capacity – price responsive demand

Price (€/MWh)

On-peak price covers capital (and variable) costs

Off-peak price covers variable cost

Optimal capacity: expected marginal operating profit on-peak equals marginal capital cost

c

P(Q,t)

K

Capacity (MW)

Source: Boiteux (1949)

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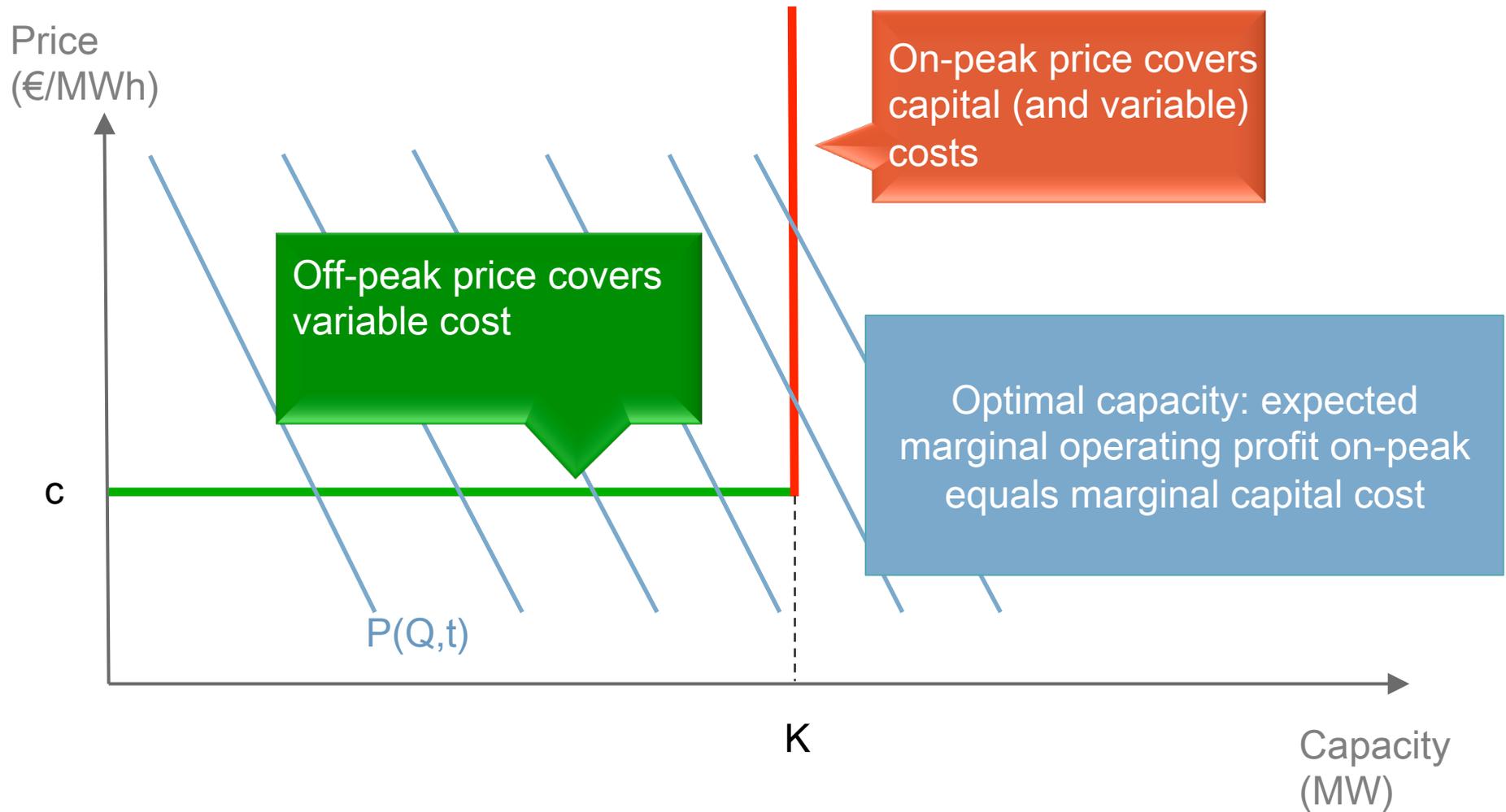
Alas, demand in the XXth century was not price responsive
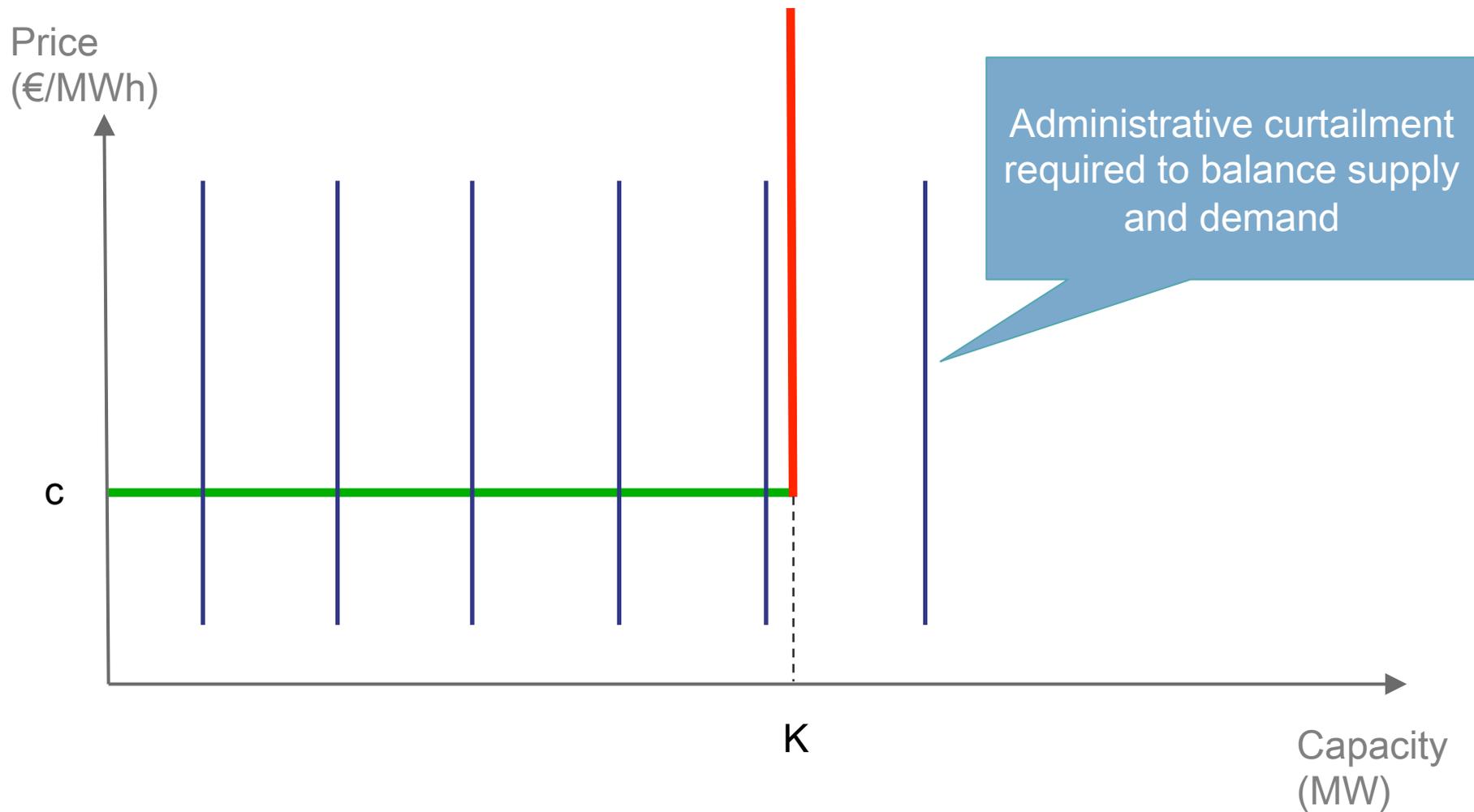
Outage duration – Value of Lost Load

Curtailment hours
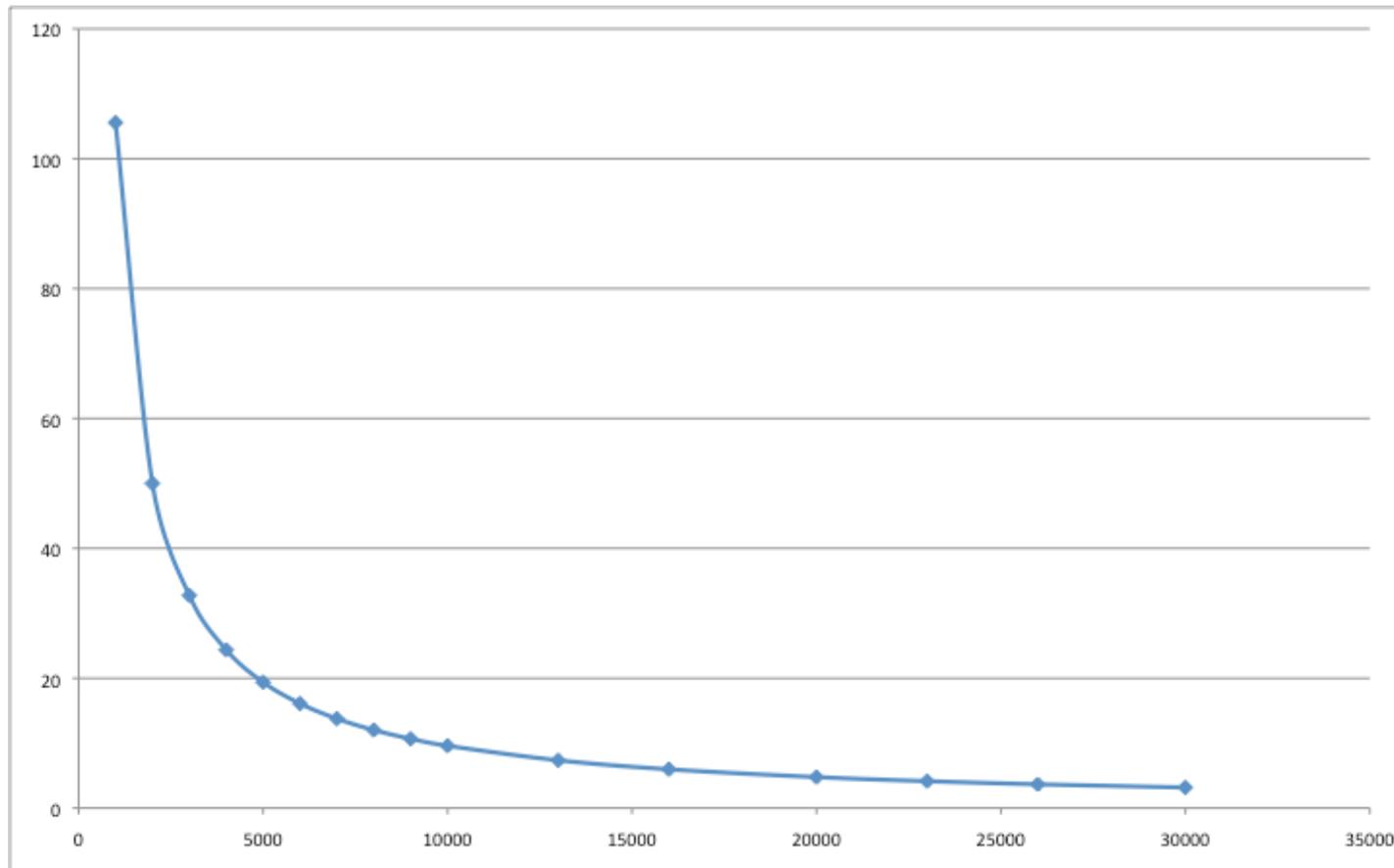
VoLL*
($/MWh)

Transforming electricity demand
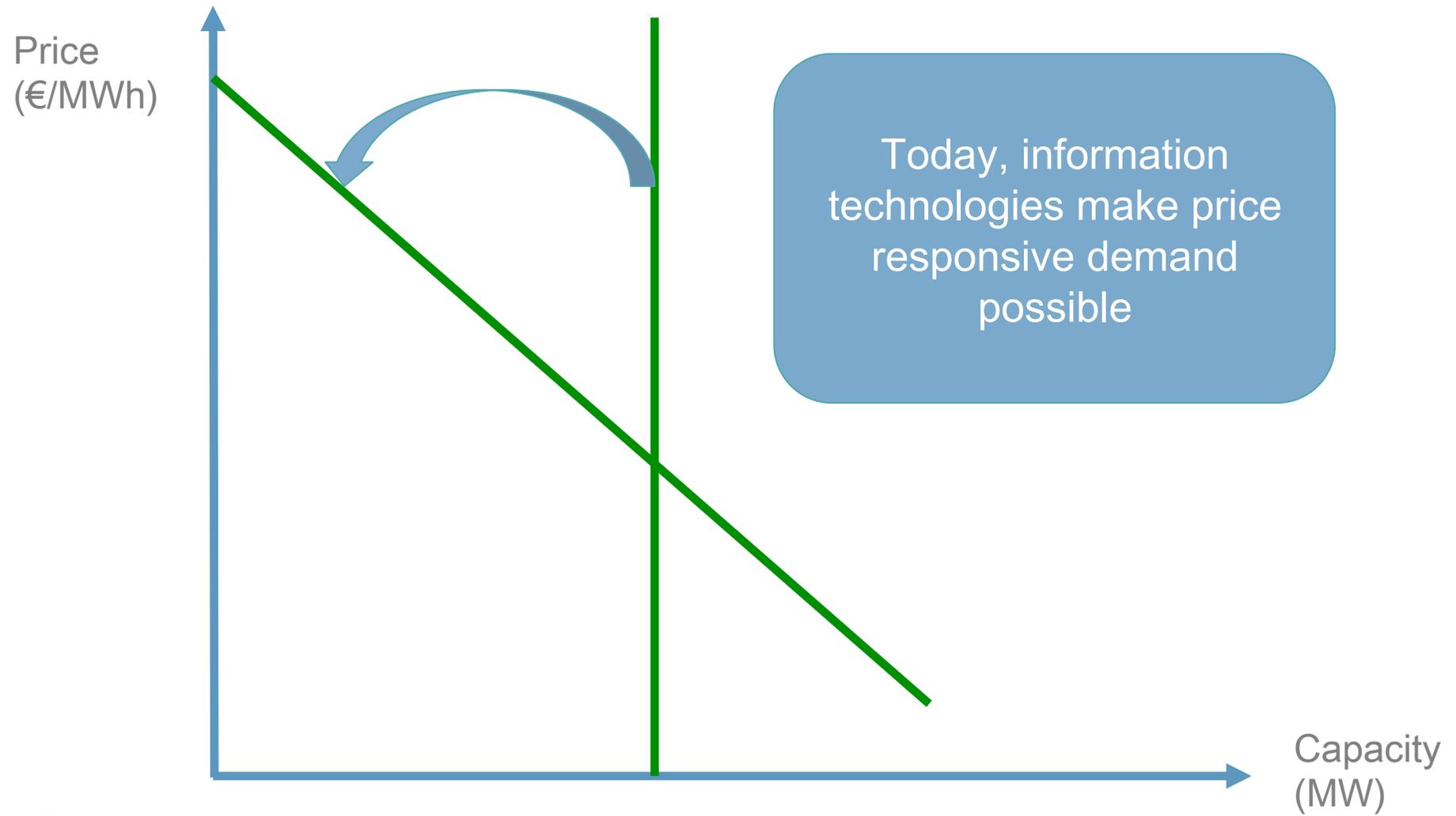
Today, information technologies make price responsive demand possible

Price (€/MWh)

Capacity (MW)

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Gross consumer surplus under standard « full requirements » retail contracts

Price (€/MWh)

p

p^R

$Q(p)$ $Q(p^R)$

Capacity (MW)

Source: Dupuit (1844)
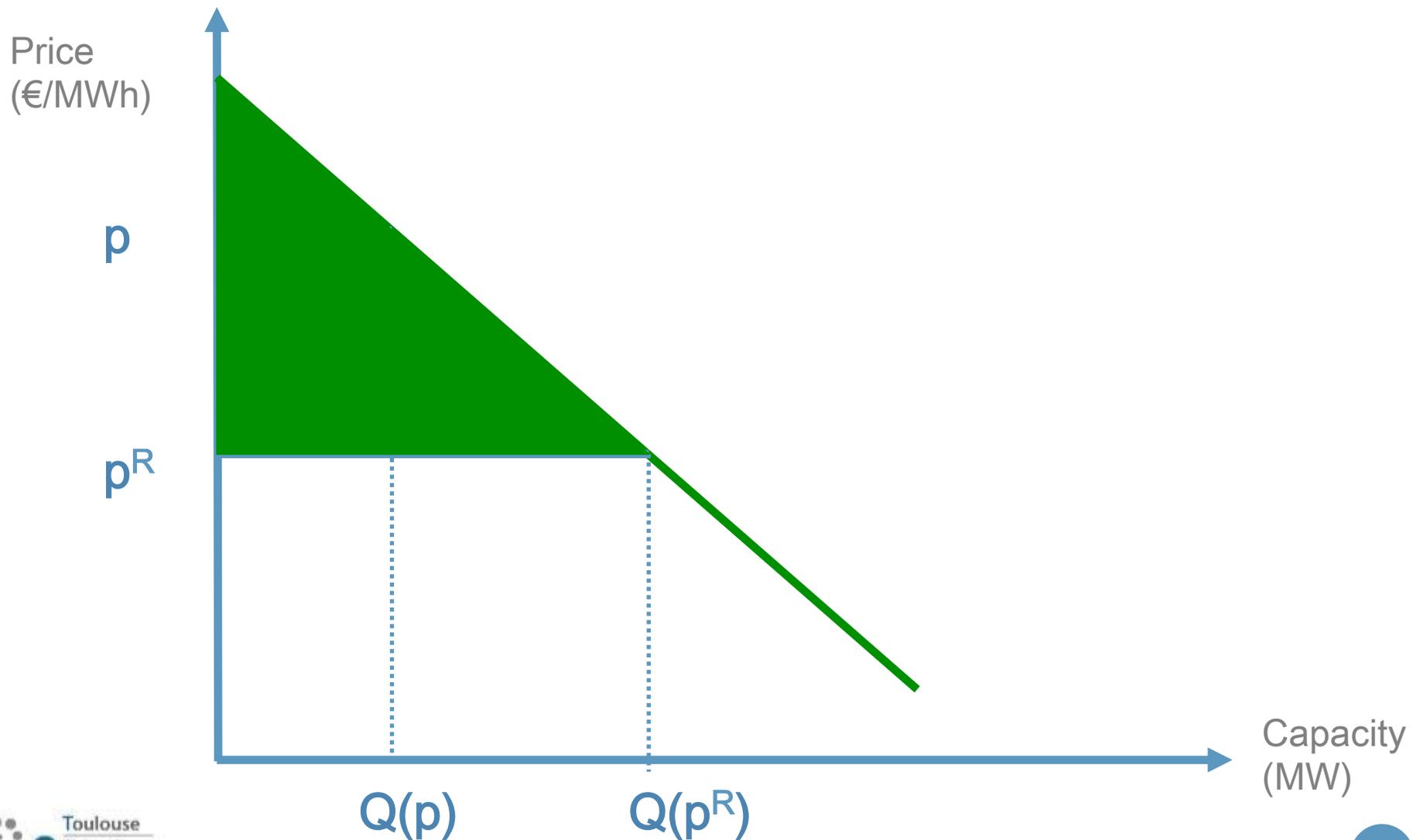
Peak-Time Resale increases consumer surplus

Net surplus gain from Peak-Time Resale for consumer
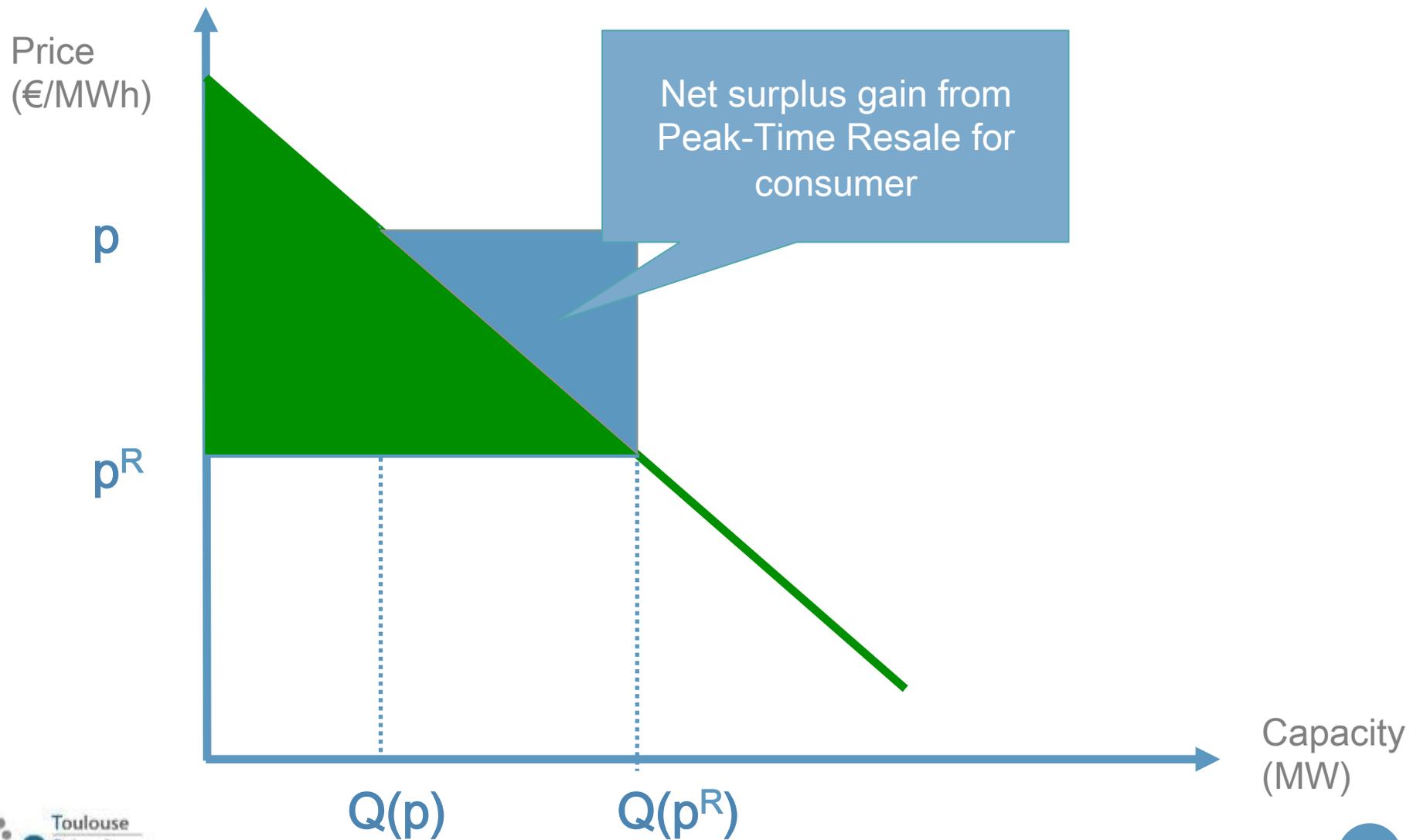
Gross surplus and production cost absent Peak-Time Resale

Price (€/MWh)

p

p^R

$Q(p)$ $Q(p^R)$

Capacity (MW)
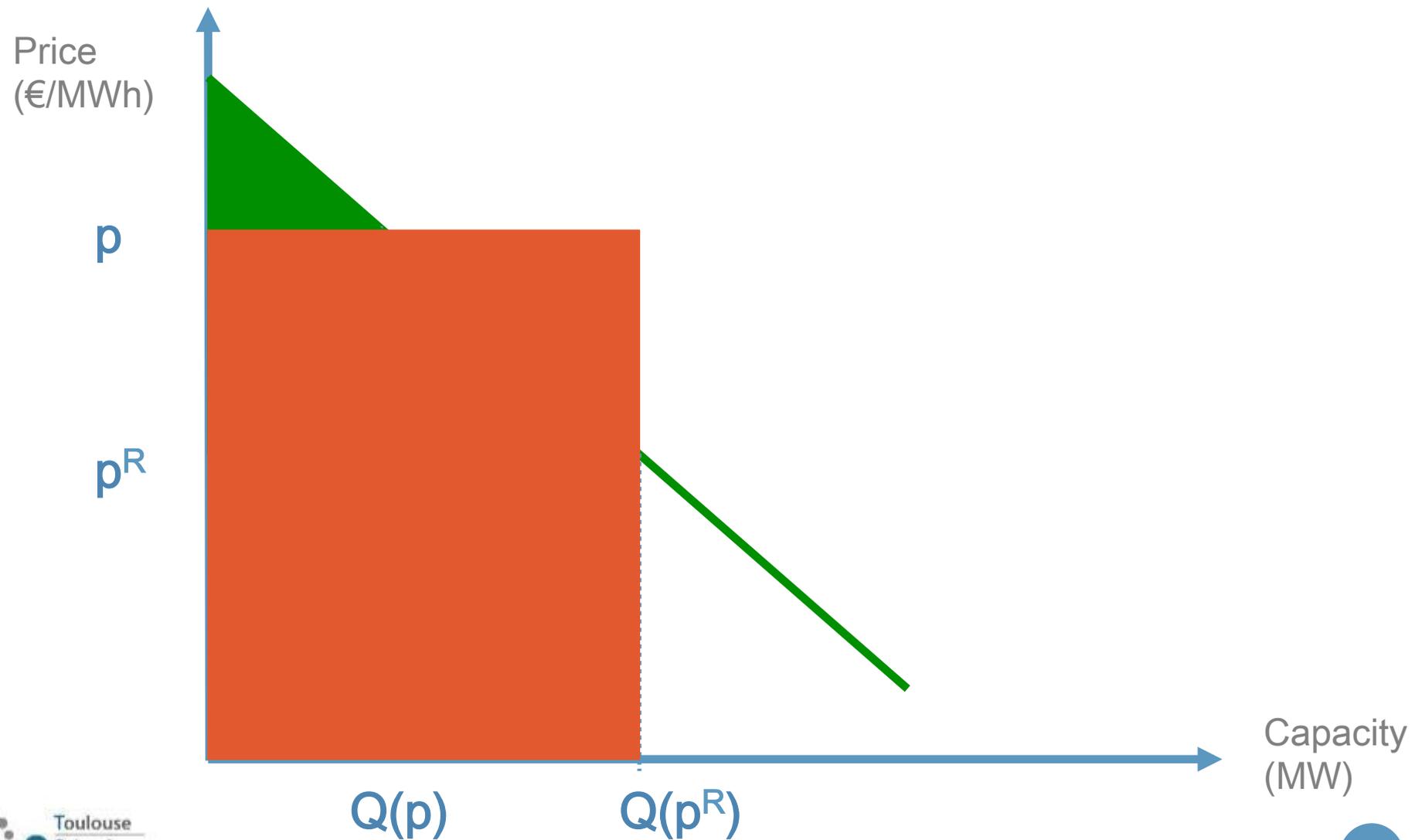
Net social surplus absent Peak Time Resale

Price (€/MWh)

p

p^R

Net surplus social surplus loss from inefficient consumption

Q(p)   Q(p^R)

Capacity (MW)

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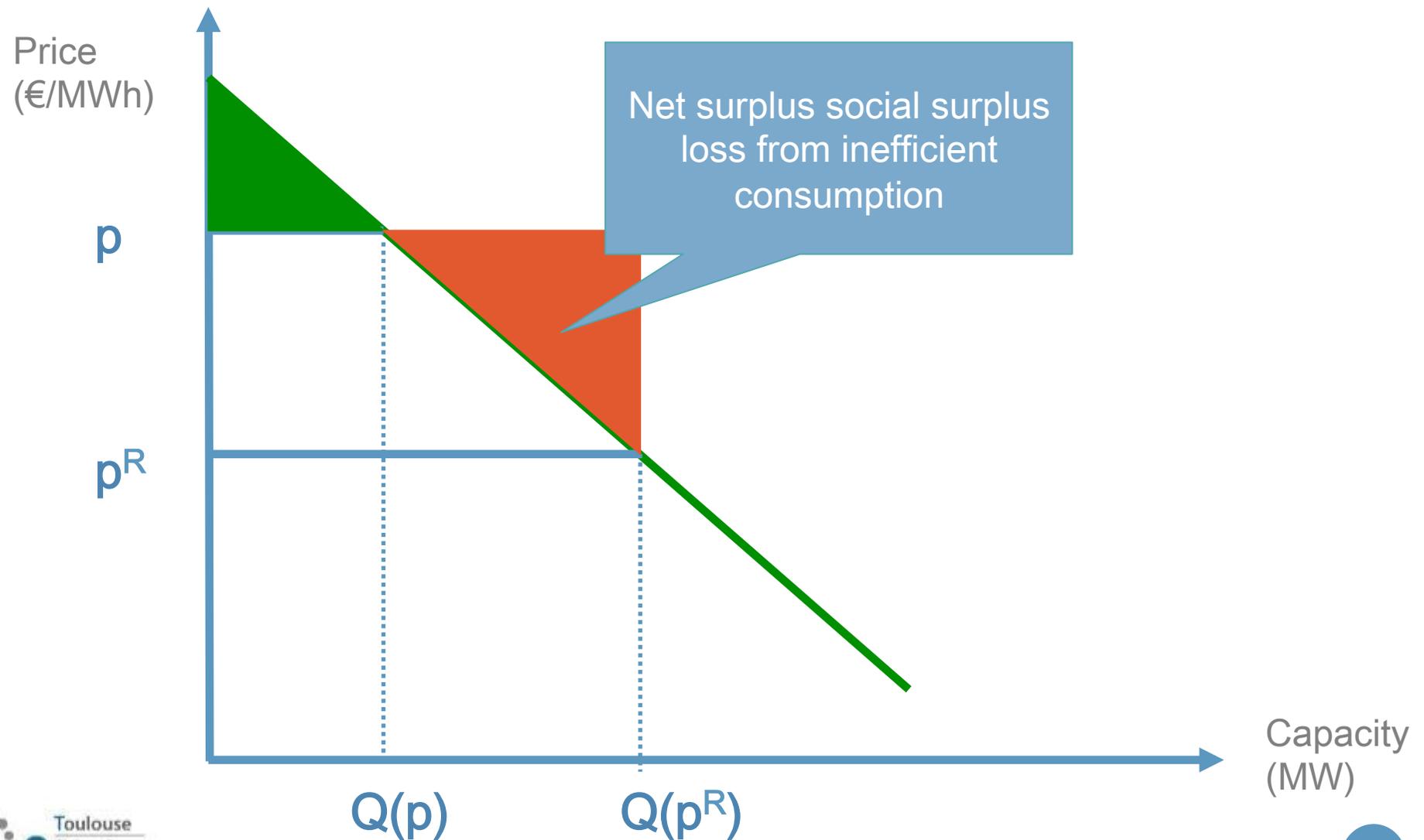
Peak-Time Resale increases net surplus
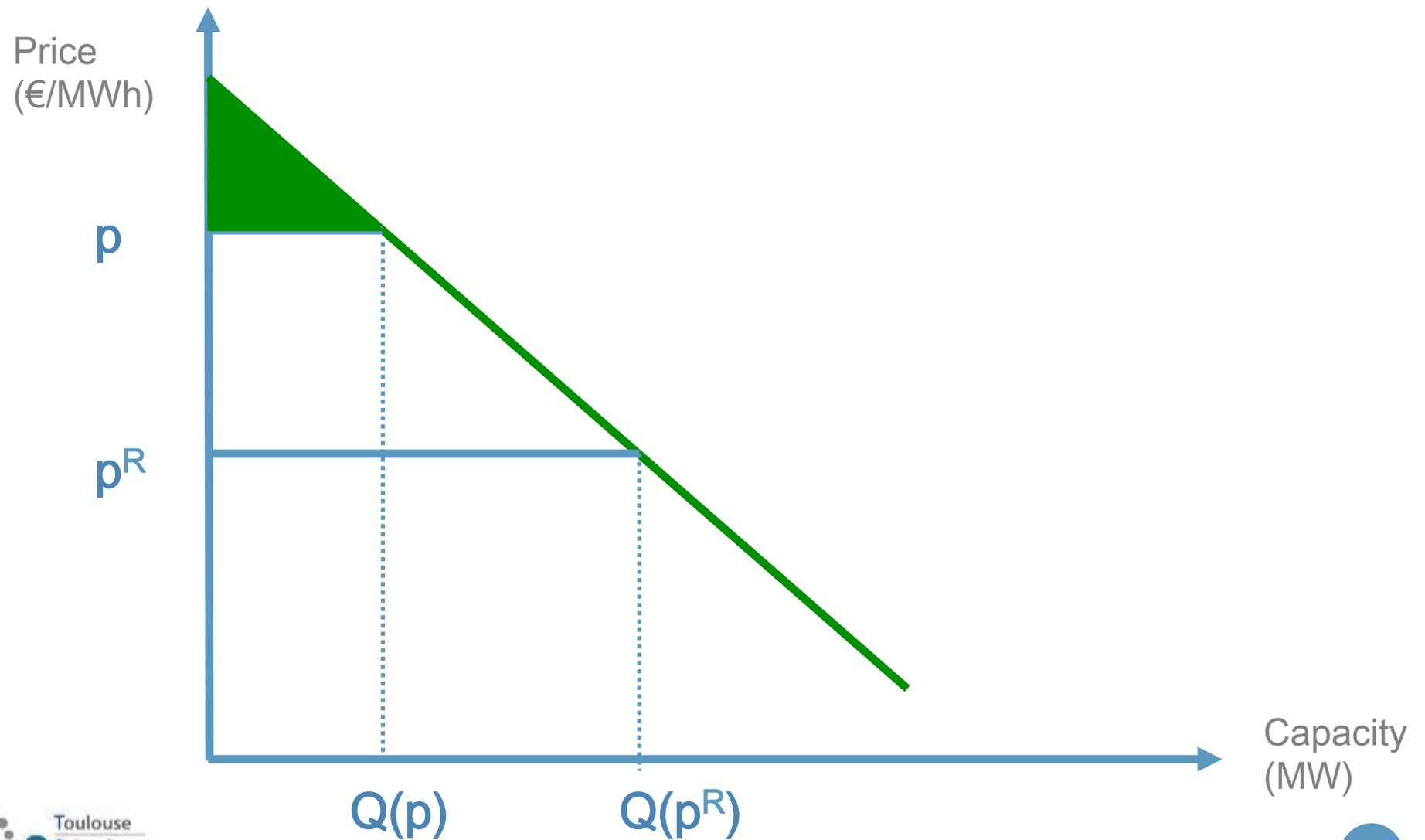
Social and consumer surplus from Peak-Time Resale coincide
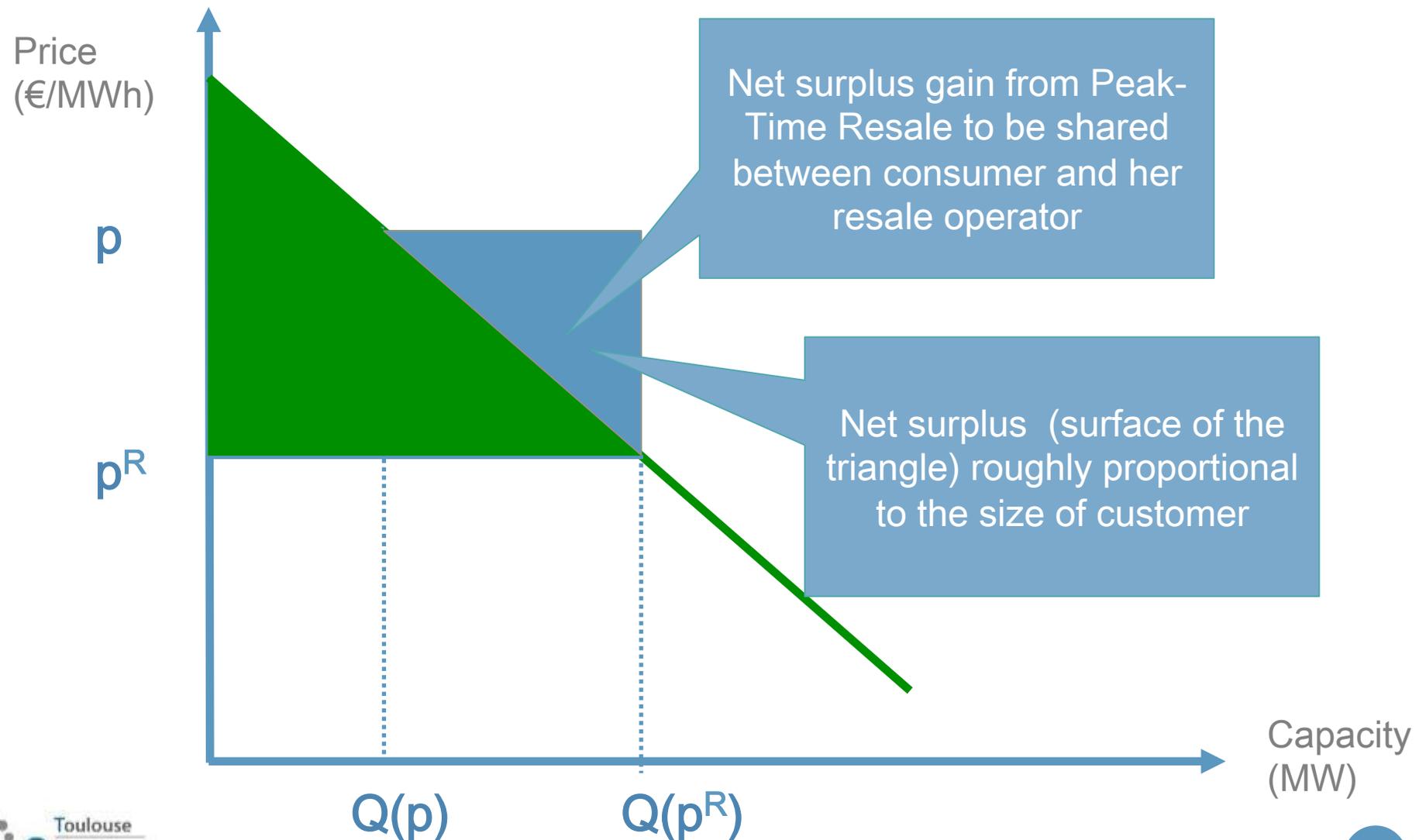
Estimating the size of the triangle

€ millions per year

Source: Léautier (2014)

% of price reactive load
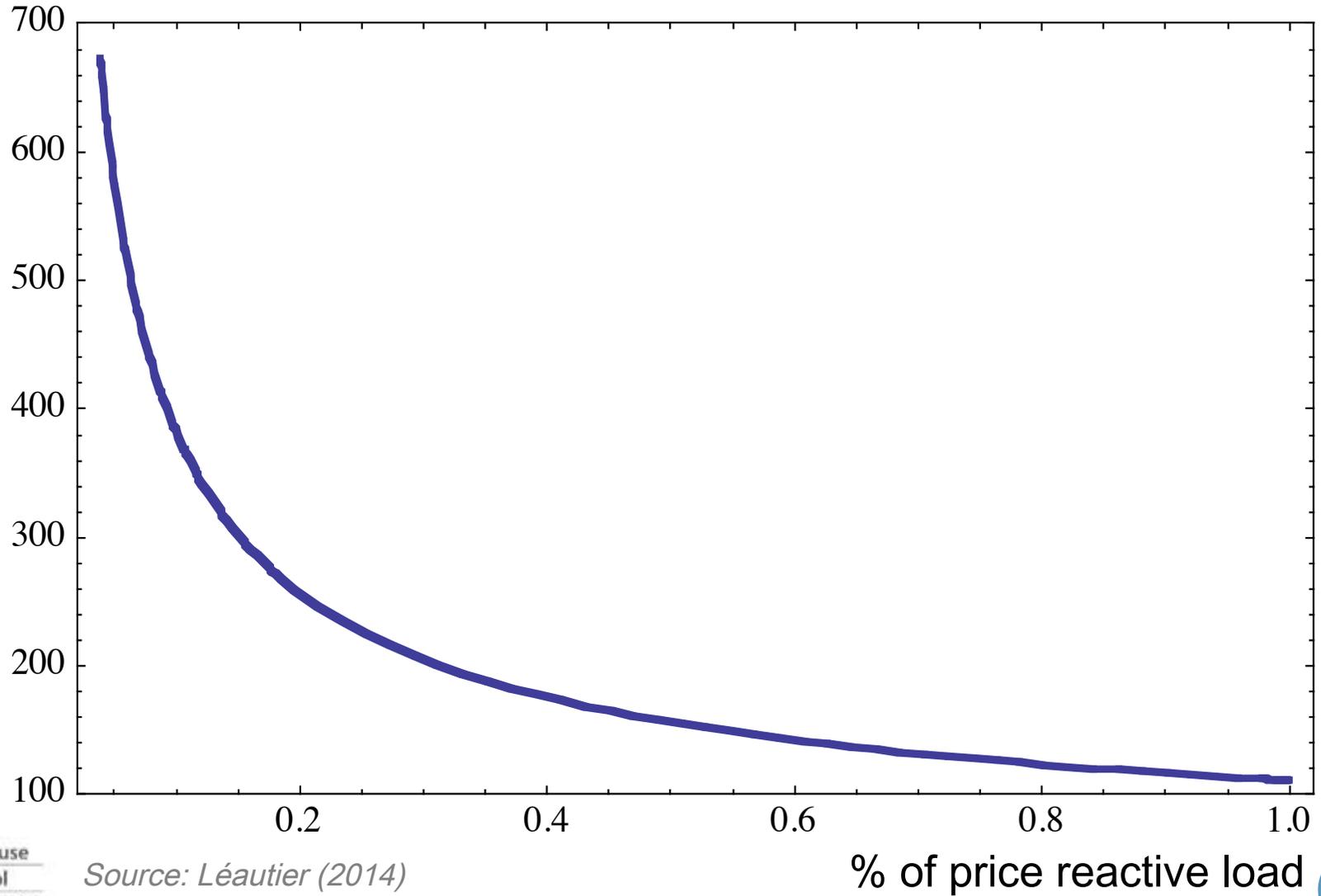
Estimating the size of the triangle per consumer

Source: Commission de Régulation de l'Energie (2013)
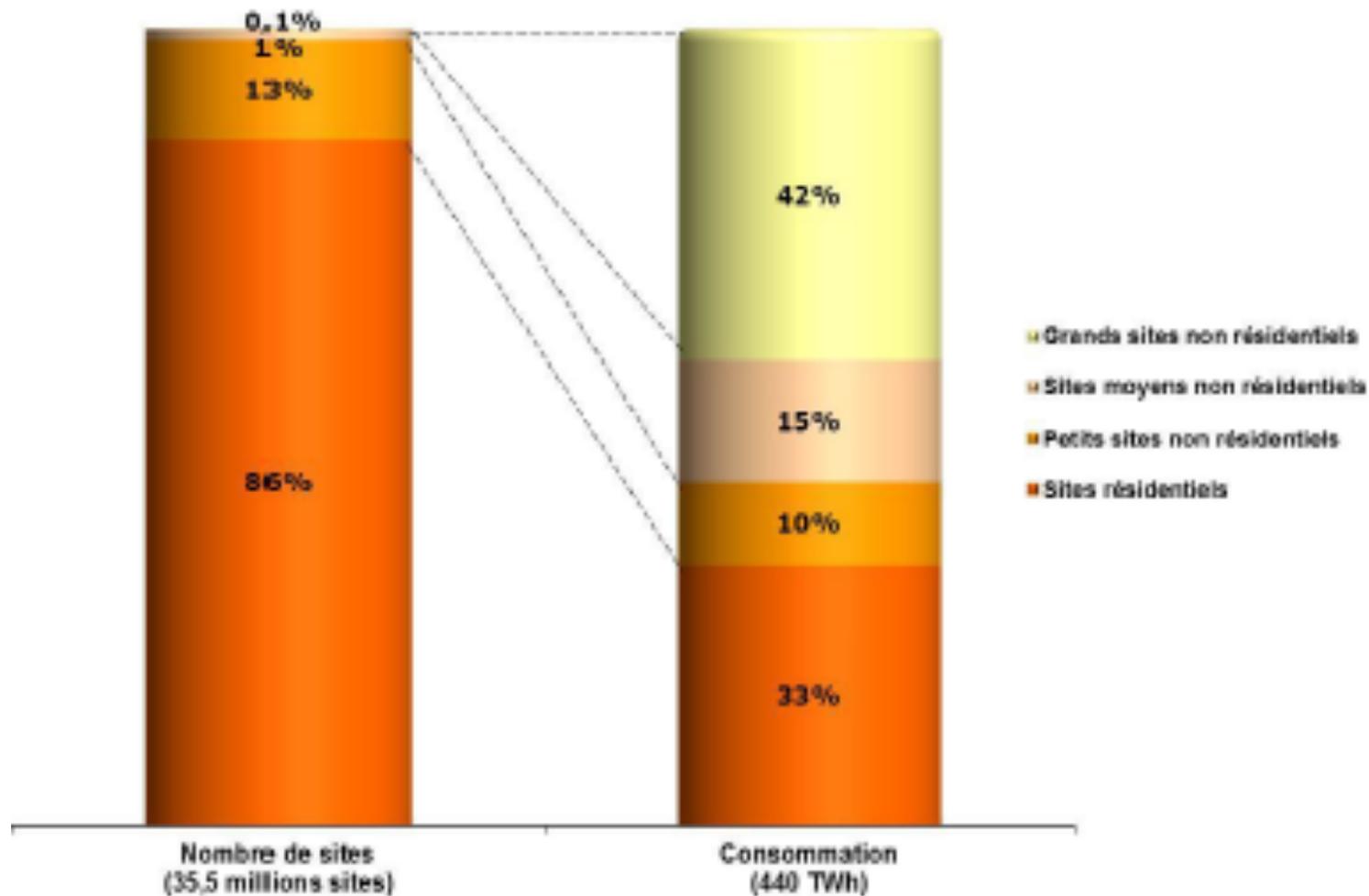
Net surplus very small for residential customers

€ per site per year

% of price reactive load

Source: Léautier (2014)
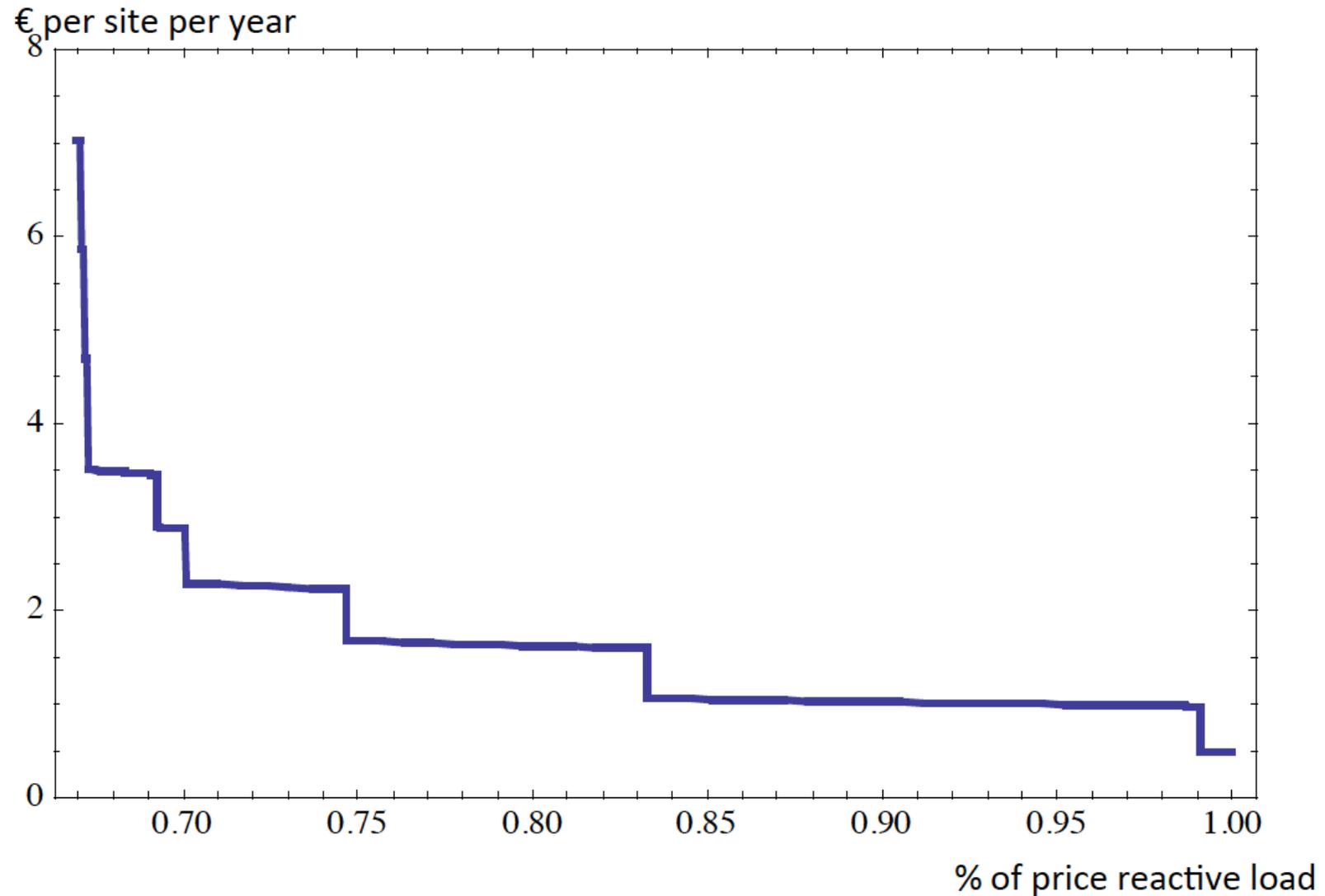
Why are people allowed to sell MWh they have not purchased?

Price (€/MWh)

p

p^R

Peak Time Resale profit, including sale of MWh not purchased

Capacity (MW)

Q(p)   Q(p^R)
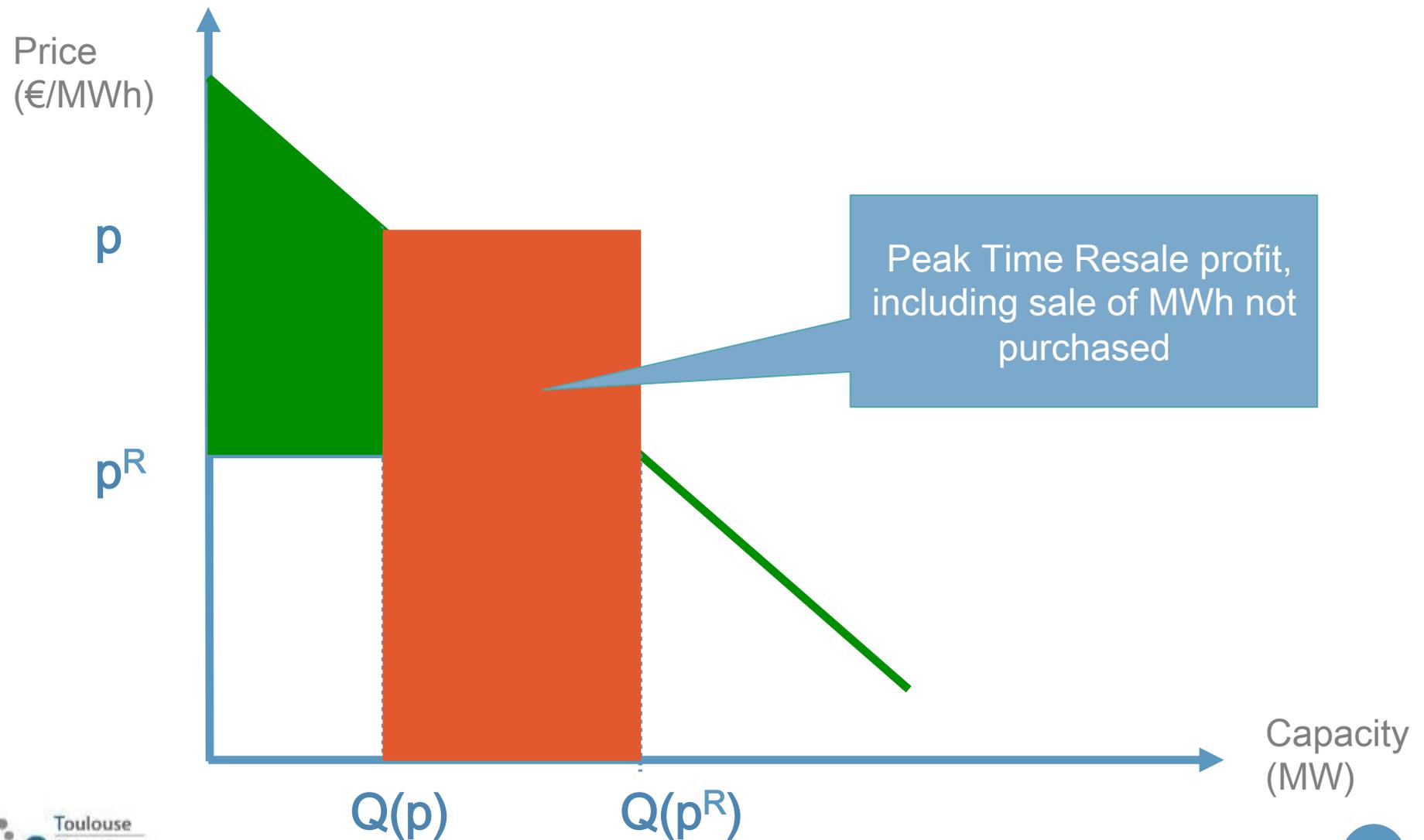
Why is a price premium granted to MWh not consumed?

Price (€/MWh)

p

p^R

Peak Time Resale profit, including sale of MWh not purchased and the premium

Q(p) Q(p^R)

Capacity (MW)

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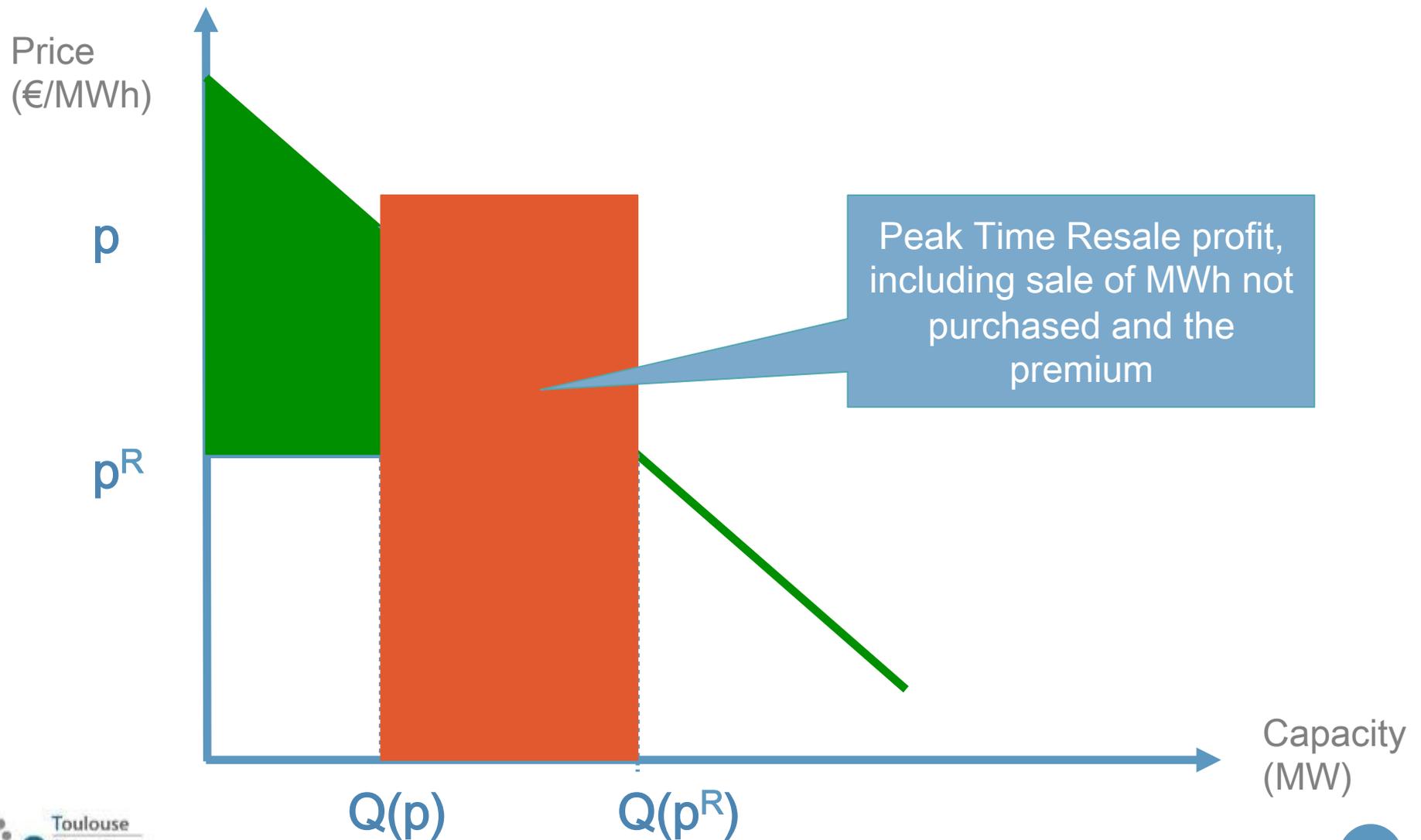
Why is the customer not compensated for surplus loss from lower consumption?
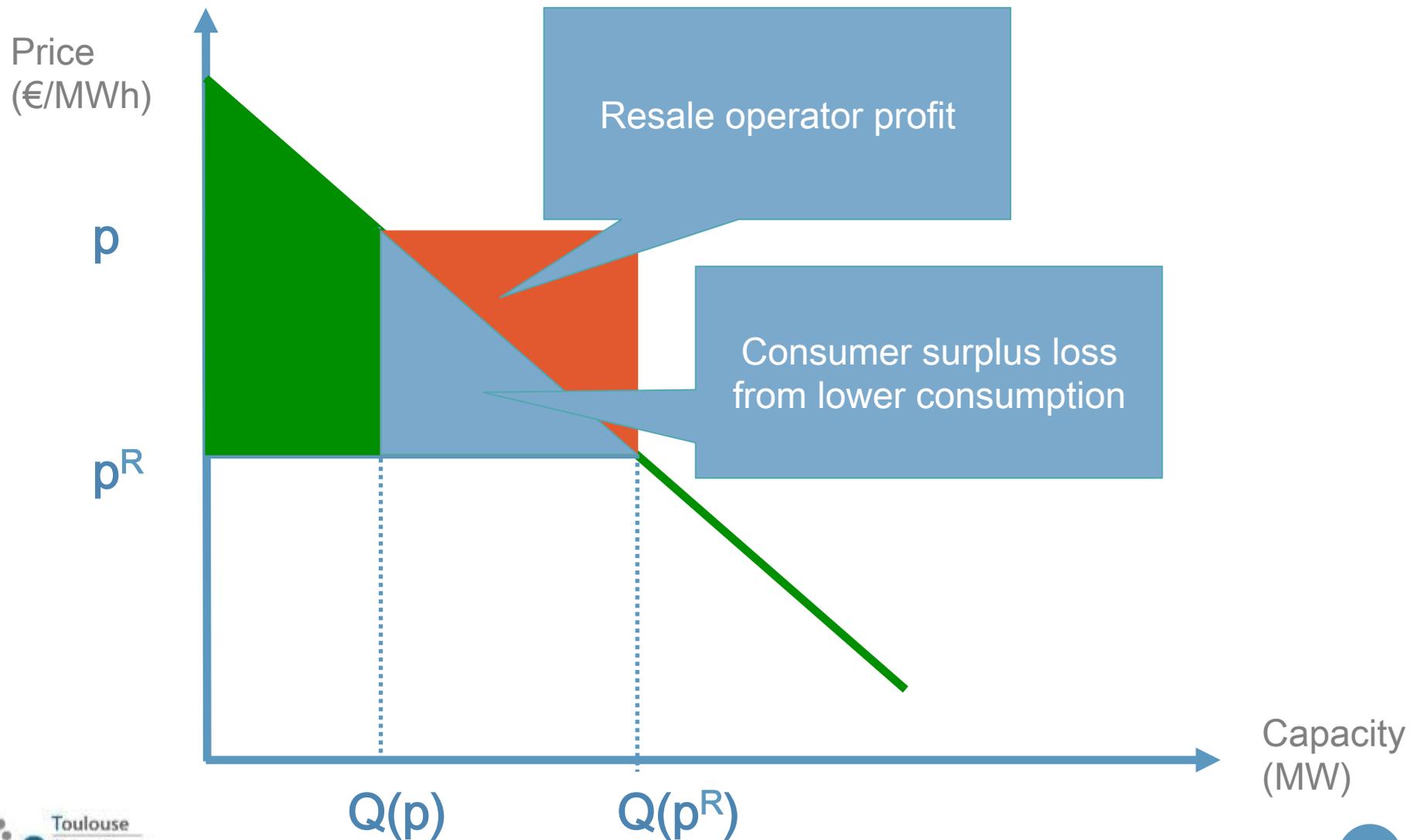
Why should a particular consumer capture the benefit of price reduction?
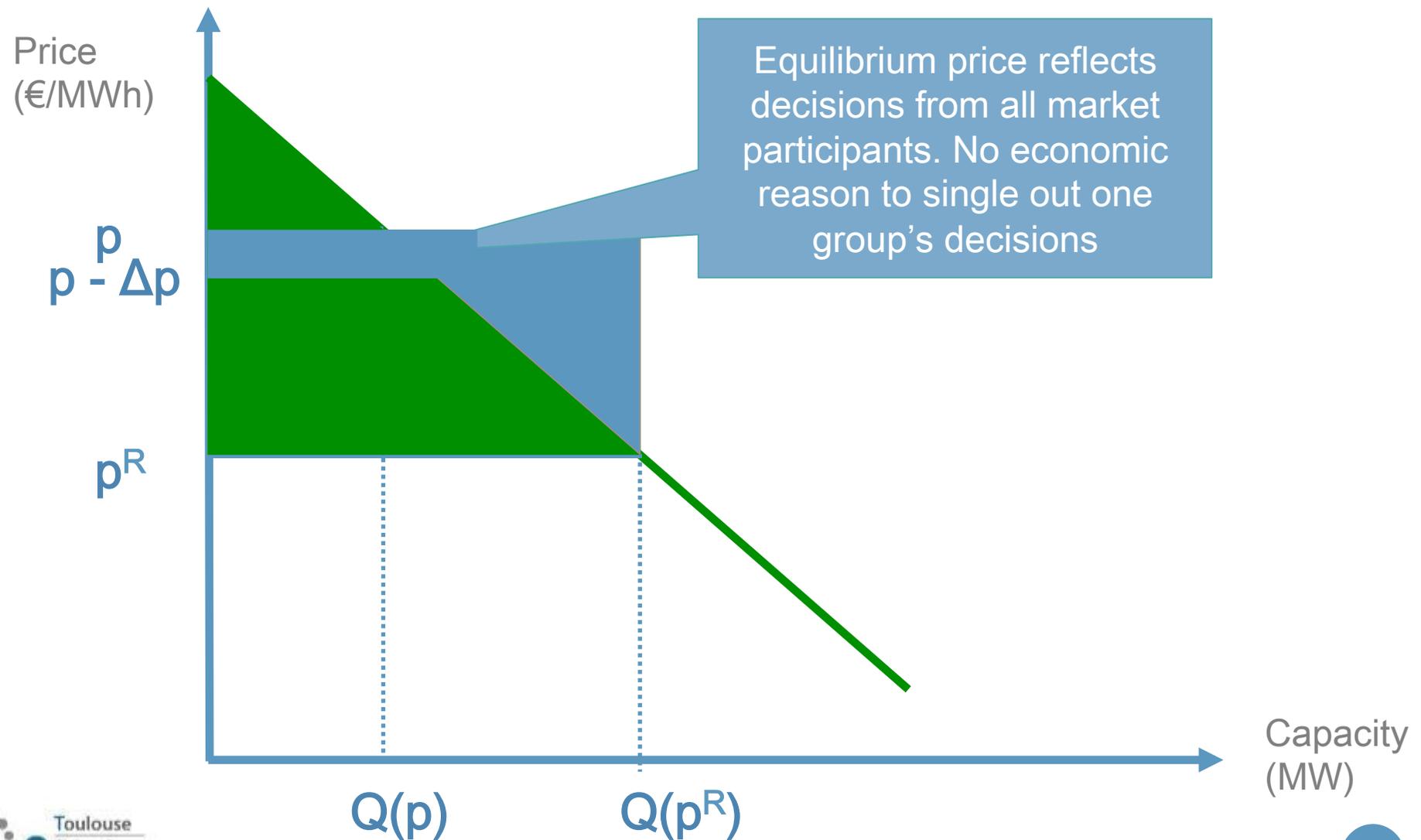
Price (€/MWh)

p
p - Δp

p^R

Equilibrium price reflects decisions from all market participants. No economic reason to single out one group's decisions

Q(p)   Q(p^R)

Capacity (MW)

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Customers have incentives to increase "baseline"

Price
(€

Capacity
(MW)

Q(p)   Q(p^R)

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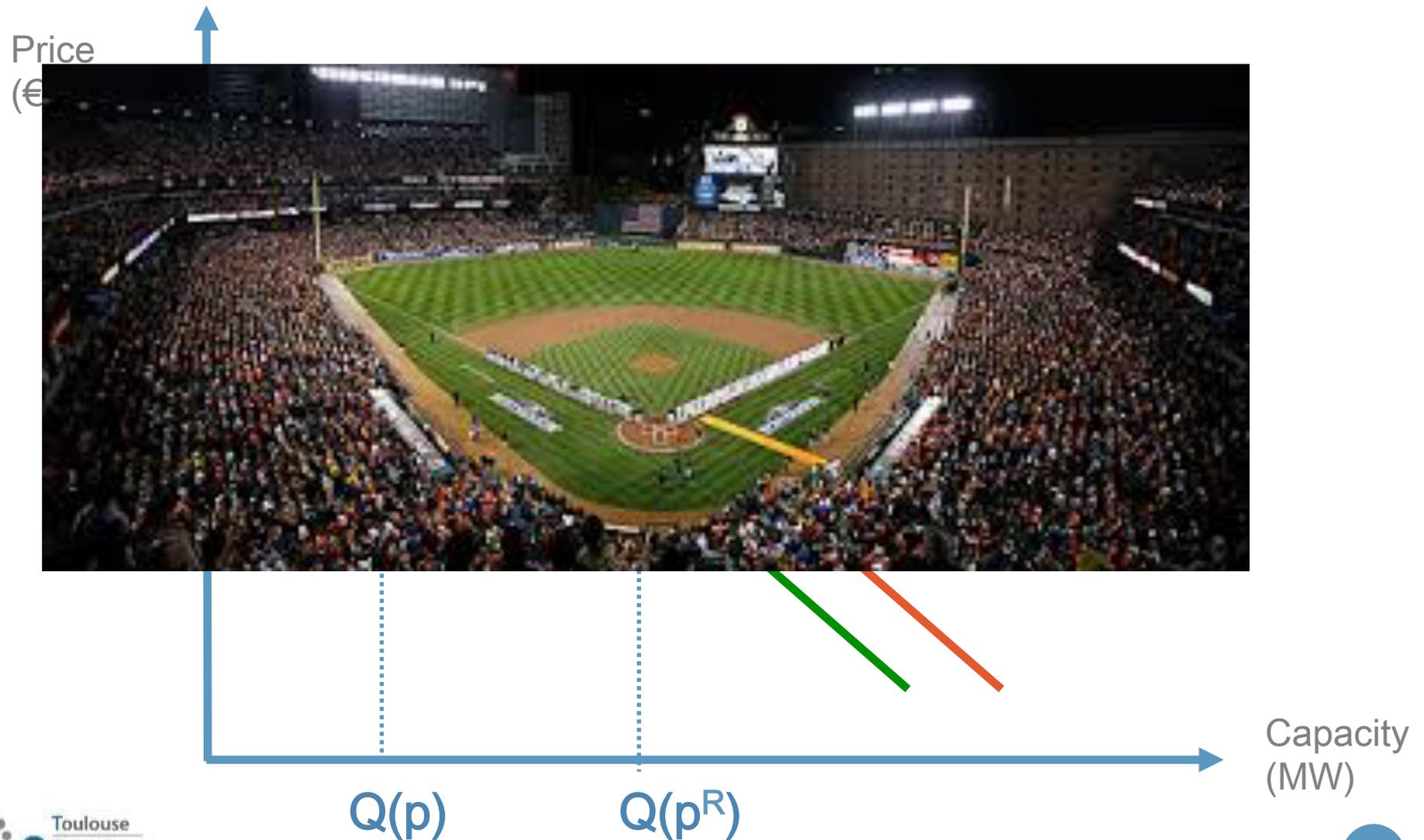
Two approaches to handle the unobserved baseline

1. **Statistical estimation of consumption "that would have occurred":**
   - Eliminate the information asymmetry
   - Various statistical approaches are tested: before and after, panel of comparable consumers

2. **Offer incentive compatible contracts**
   - Recognize that consumers will always have private information on their baseline
   - Develop contracts such that truthful reporting of the baseline is optimal for consumers

Incentive compatible retail contracts

- Customers choose among a menu of retail contracts that specify
  - A single retail price for every MWh in every state of the world
  - A maximum consumption in every state of the world
  - A fixed payment, increasing in the maximum consumption profile
- In every state of the world, they resell unused power (measured against their maximum consumption profile) into the spot market

Source: Astier and Léautier (2015)

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Optimal Incentive Compatible contract
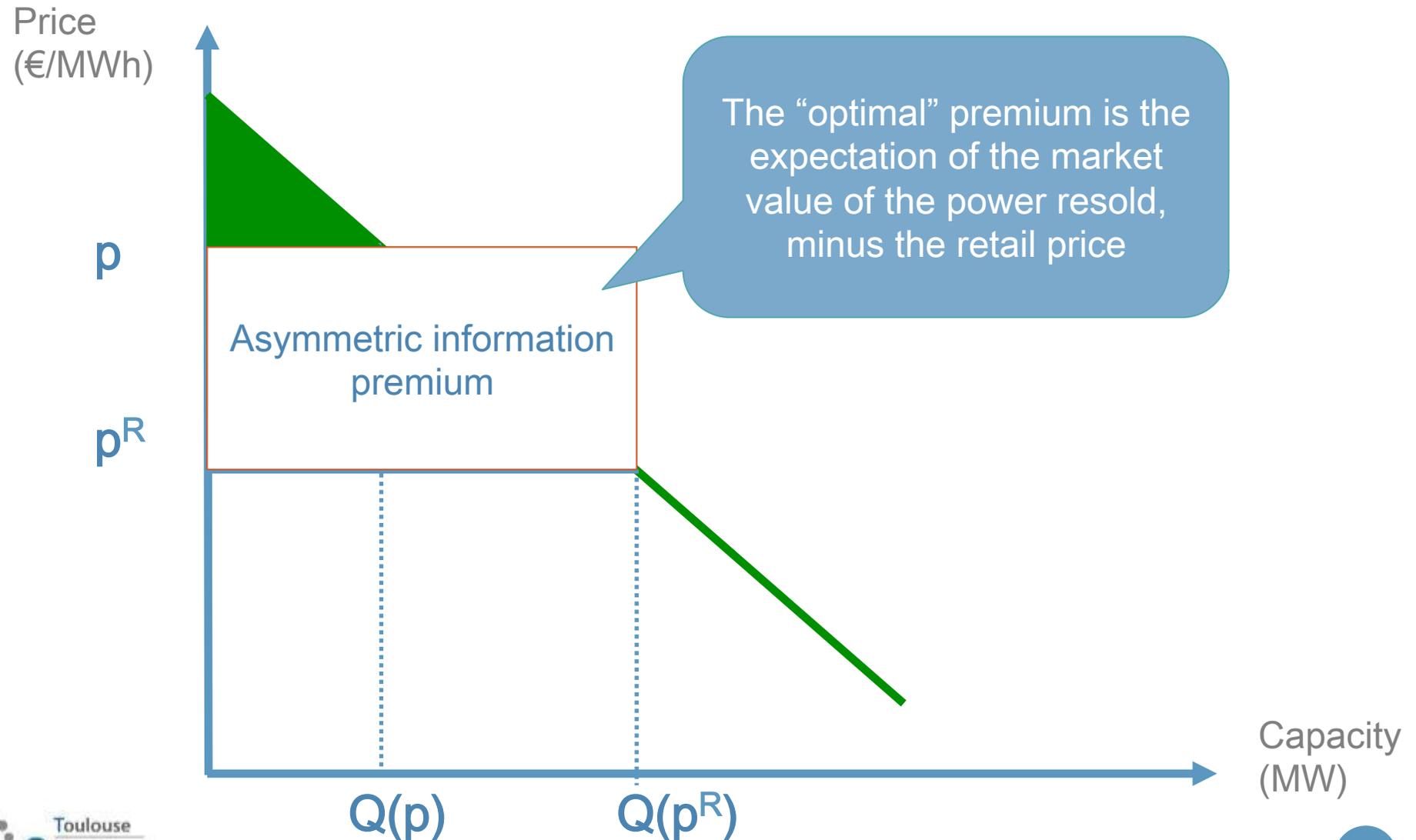
Source: Astier and Léautier (2015)

Participation constraint

The incentive compatible retail contract does not meet the participation constraint: customers never opt for Incentive Compatible Peak Time Resale

Price (€/MWh)

p

p^R

Q(p) $Q(p^R)$

Capacity (MW)

Source: Astier and Léautier (2015)
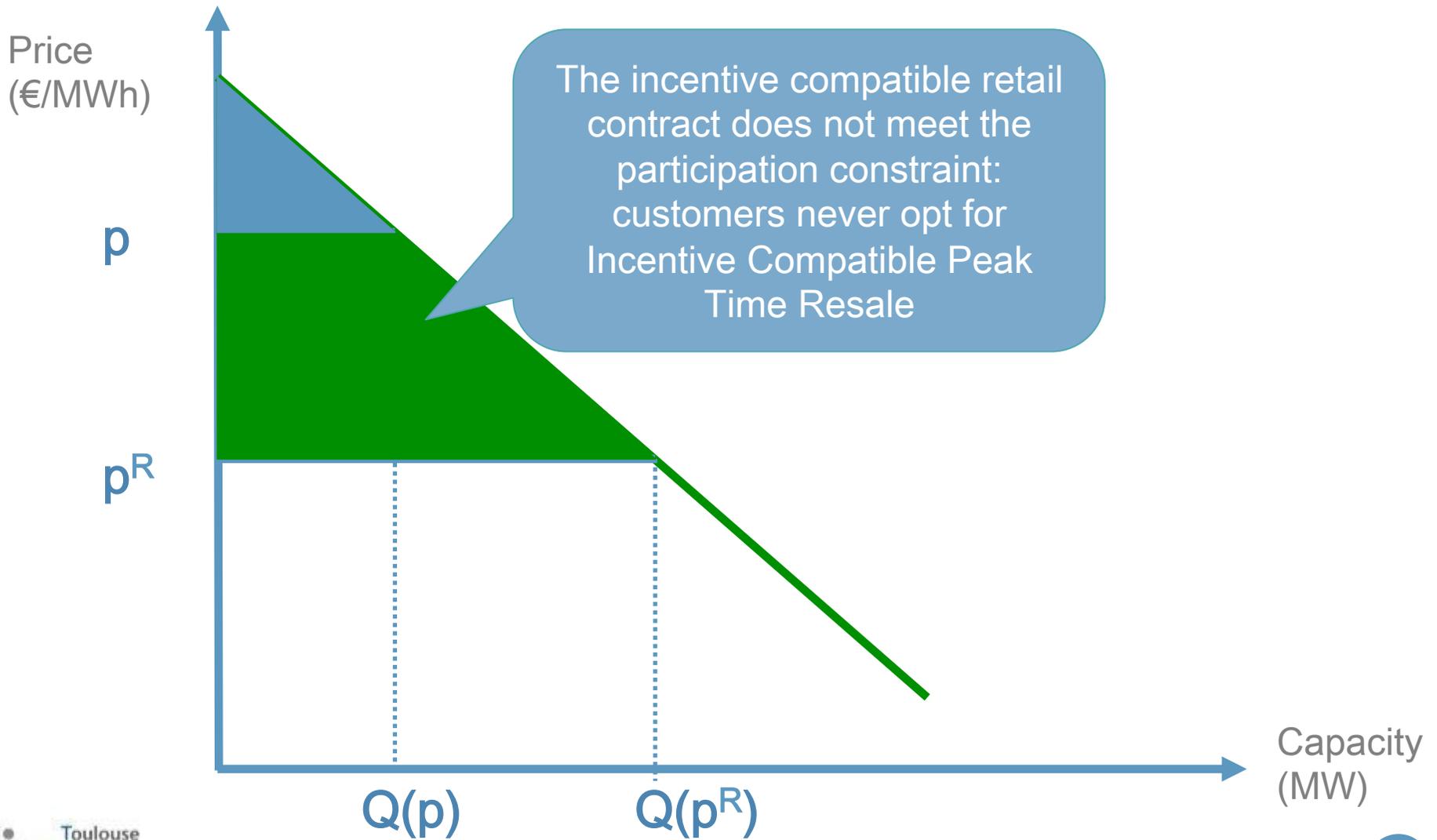
Incentive compatible contract meeting the participation constraint

A lower retail price recovers the participation constraint

Source: Astier and Léautier (2015)
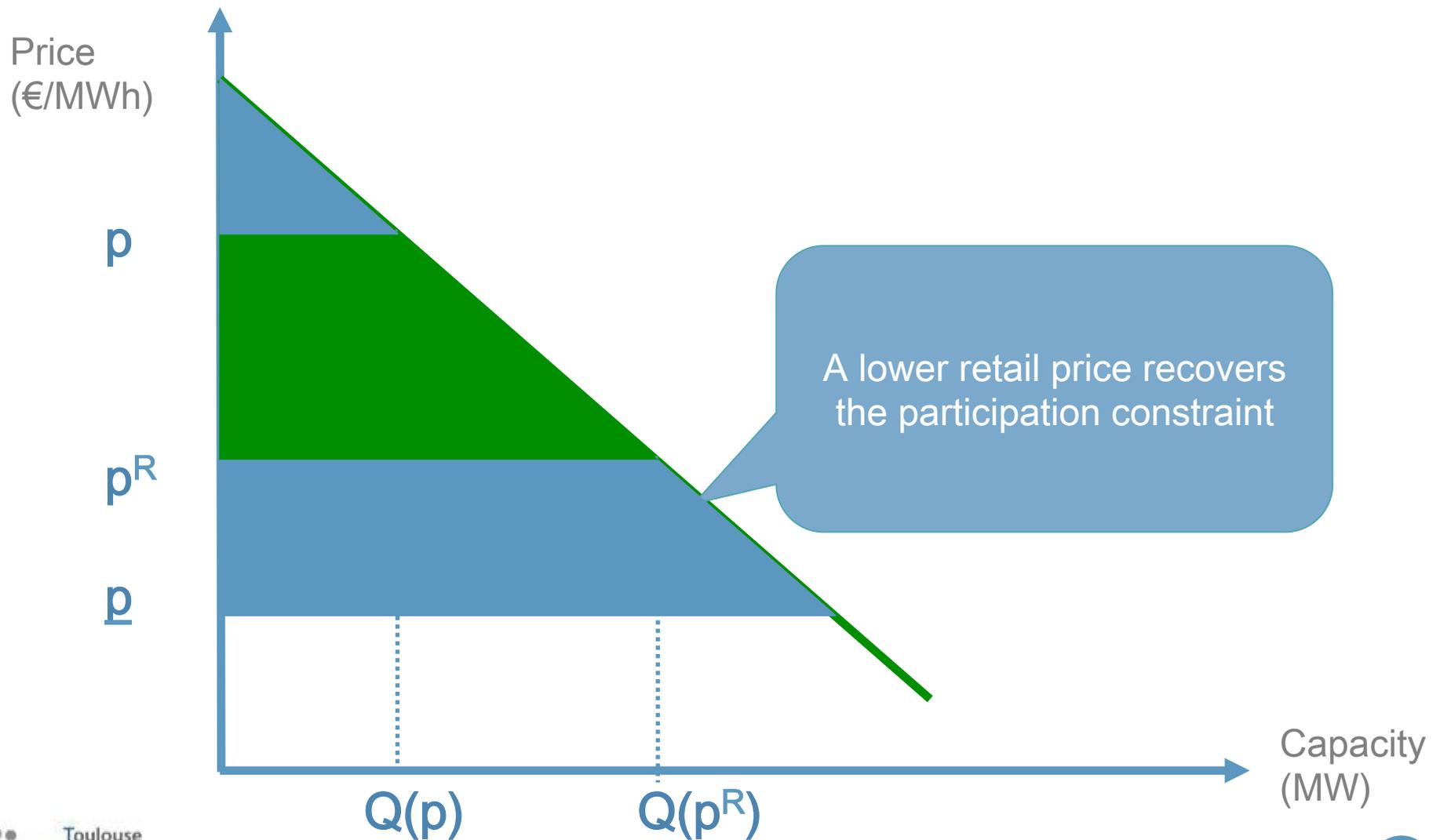
Optimal "Peak Time Resale compatible" retail contracts

Suppose consumers on "standard" retail contract are not subsidized:

- Optimal contract characterized by:
  - Retail price for Peak Time Resale (PTR) consumers $\underline{p}$ lower than the "standard" retail price p^R
  - Effective price faced by consumers equal to the spot price on peak
- Optimal contract mix of
  - Critical Peak Pricing (EJP): pay a predetermined high price during peak hours
  - Real Time Pricing: pay spot price at the margin
- If retail price for PTR consumers $\underline{p}$ is low enough, full adoption occurs
- If competition is perfect, PTR contracts converge towards Real Time Pricing

Source: Astier and Léautier (2015)

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The Peak Time Resale dilemma

1. Eliminating information asymmetry between consumers/ resale operators and suppliers requires very costly statistical analysis, and may or may not be possible

2. Offering standard retail contracts while consumers/resale operators have private information on their baseline creates arbitrage opportunities, which are unfair and can be costly for society

3. Offering PTR compatible retail contracts solves the asymmetric information problem, but these contracts

   — are more complex than standard contracts (retail price lower than standard retail price, consumption profile, fixed fee that increases with the consumption profile), and

   — expose consumers to spot price risk

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The "price responsiveness of demand" dilemma

- Economists have long argued that retail contracts should optimally incorporate Real Time Pricing at the margin

- However,

  — policy makers and consumers are reluctant (or opposed) to accept exposure to spot prices for a variety of reasons: (real or supposed) risk aversion, fear of market power (post California), other cognitive biases, desire to keep existing subsidies

  — similarly, customers do not embrace other approaches, such as Critical Peak Pricing

- Therefore, policy makers support Peak Time Resale, which

  — is often unprofitable

  — creates a risk of arbitrage

  — hence is very costly and cumbersome to implement

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Policy recommendations

Peak Time Resale

- Stop subsidizing flawed business models!
- Facilitate the inclusion of Peak Time Resale energy in energy markets
- Evaluate the extent and the cost for society of asymmetric information for different classes of customers

Other "price responsiveness of demand" approaches

- Encourage suppliers to offer Real Time Pricing (with energy management) contracts and (menus of) Critical Peak Pricing contracts, at least to their largest consumers

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Appendix

Industrial and commercial users are a prime target for Peak Time Resale

- Net surplus (size of the triangle) for large industrial between € 8000 and € 2000 per site per year

- Non residential consumers represent 80% of the total net surplus from Real Time Pricing

Source: Léautier (2014)

A fraction of demand price-responsive is sufficient to avoid curtailment

Price (€/MWh)

v

c

P(Q,t)

K

Capacity (MW)

Sufficient demand response: 4.0% (or more) customers price responsive if price elasticity = 0.01, (14% or more if elasticity = 0.1)
No administrative curtailment required

Source: Léautier (2015)