

# Electricity Market Design

Integration of renewable energies and the connected issue of capacity markets

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Université de Genève, 2 Octobre 2014

# Agenda

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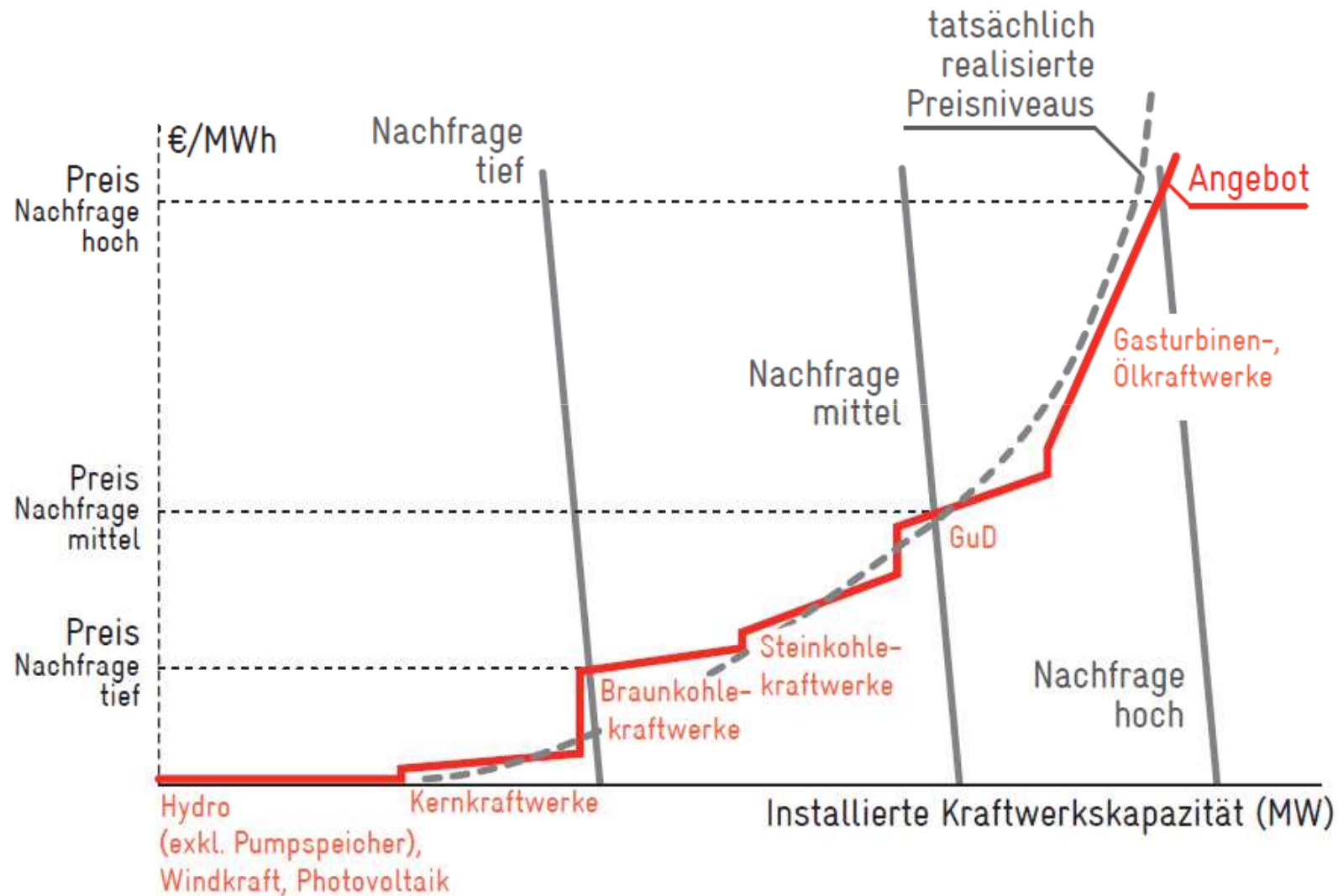
- **The Missing-Money-Problem**
- Stimulating investment incentives
- Cross-border effects of capacity mechanisms
- Conclusion

## Security of supply

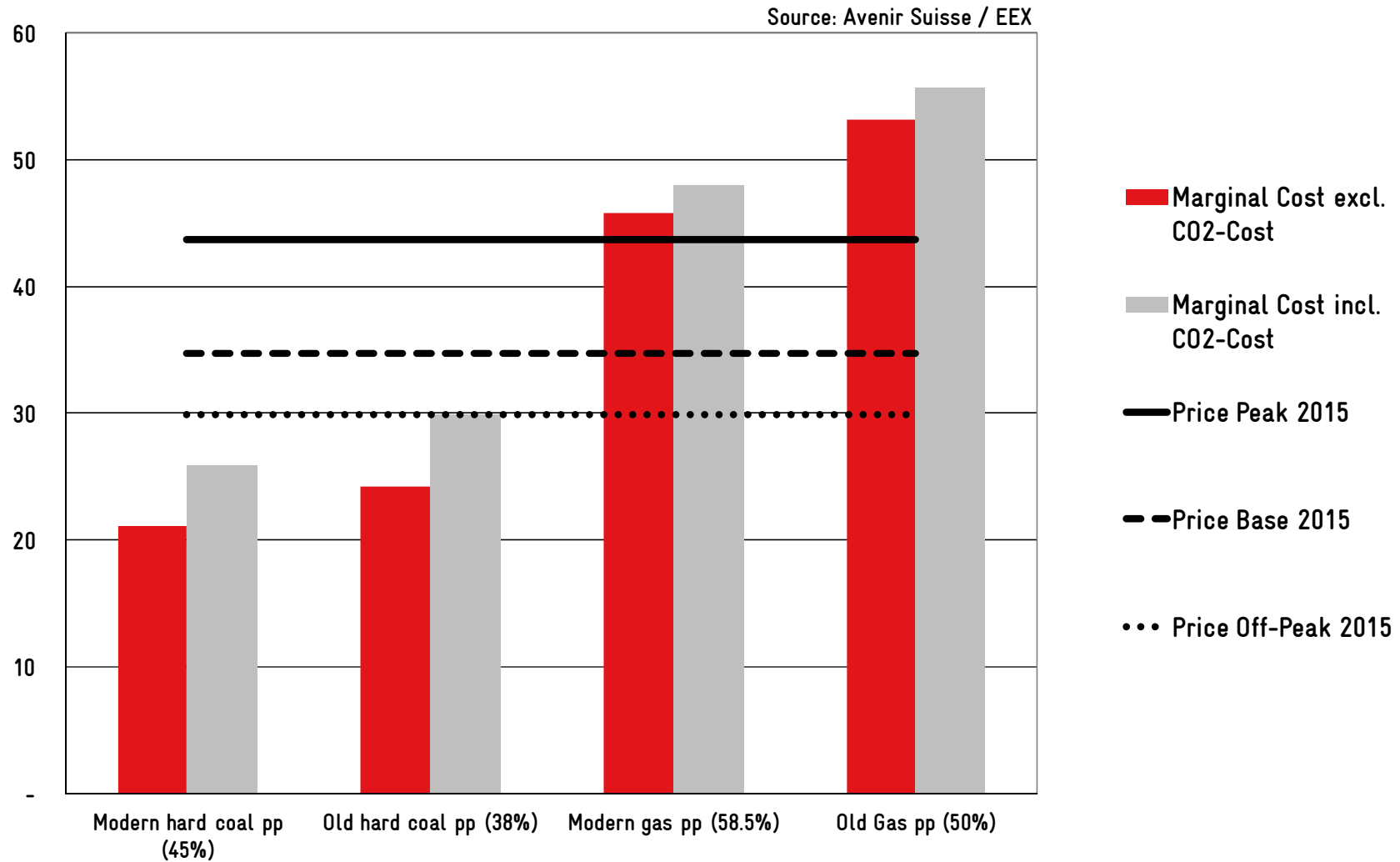
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- **In the short term: Ancillary services of network operator**
  - Power input needs to correspond to extraction at all times
  - No individual willingness-to-pay for higher security of supply: Neighbor uses the same grid and has an identical security of supply
  - *Network operator provides balancing power (separate market)*
- **In the longer term: Market prices give investment incentives**
  - Electricity prices are defined by the wholesale / forward market
  - *Do prices give «enough» investment incentives for sufficient generation capacities?*

## Lack of investment incentives at the right branch of the merit-order-curve



## Lack of investment incentives: Variable power generation costs of fossile power plants vs. market prices (EUR / MWh) in Germany for 2015 – Sept.17th 2014



## The «Missing Money Problem» (I)

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- **Lack of investment incentives for peak load plants?**
  - Base and middle-load power plants profit from higher price during peak load while...
  - ...peak-load power plants never or rarely profit from prices above their marginal costs
  - *If there are sufficient power plants in equilibrium*
    - *Marginal cost prices – even during peak load*
    - *Lack of contribution margins during peak load*

## The «Missing Money Problem» (II)

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- **Investment incentives because of particularly high scarcity prices?**
  - Peak-load power plants may be financed through very high price peaks (*scarcity prices*) during a few hours
  - Scarcity prices as a result of low price elasticity of demand and supply
  - Scarcity prices can be based on the *value of security of supply, respectively the costs of a blackout* (Value of Lost Load, VoLL) – up to 100 or 500 times the usual market price

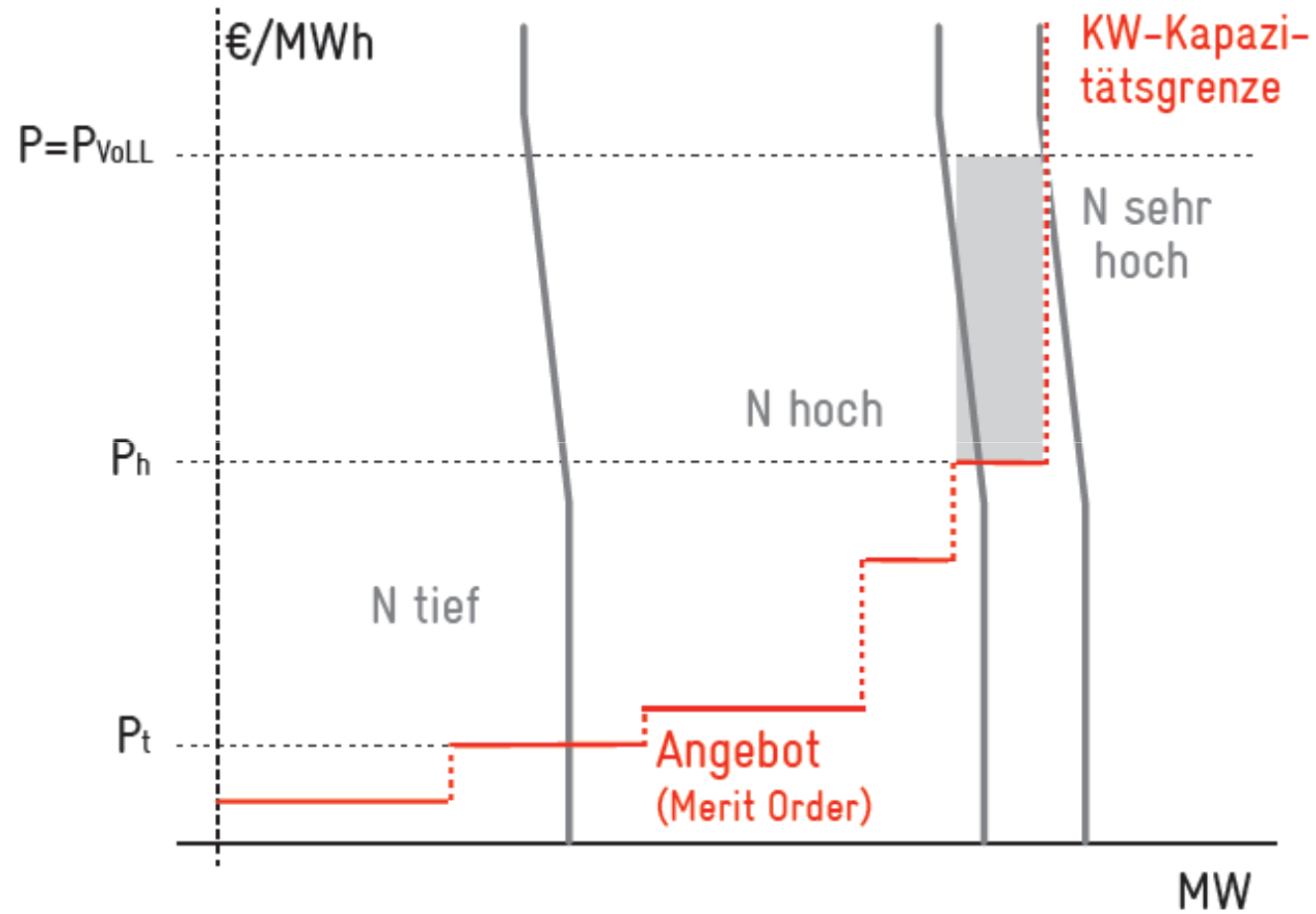
## The «Missing Money Problem» (III)

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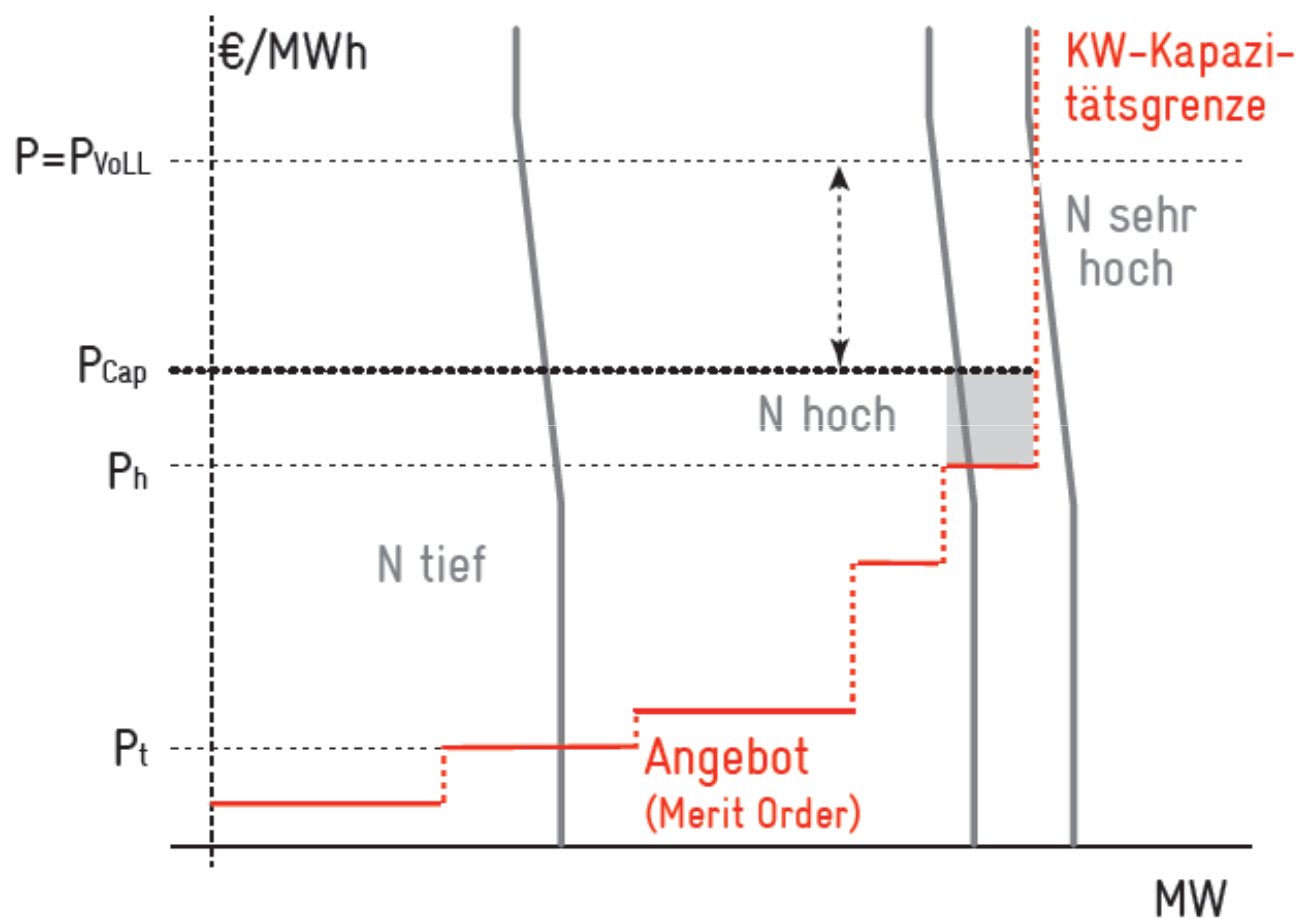
- **High uncertainty in reality– an overview**
  - a. Formation of high scarcity prices in wholesale of electricity:* Extent of the scarcity price / VoLL and how often does it occur?
  - b. Influence of a potential regulation of price limits:* Particularly high scarcity prices may motivate regulators to introduce a price cap – since lower prices under the VoLL-level would still provide sufficient contribution margin
  - c. Influence of subsidized renewable energy:* Intensification of the Missing Money Problem



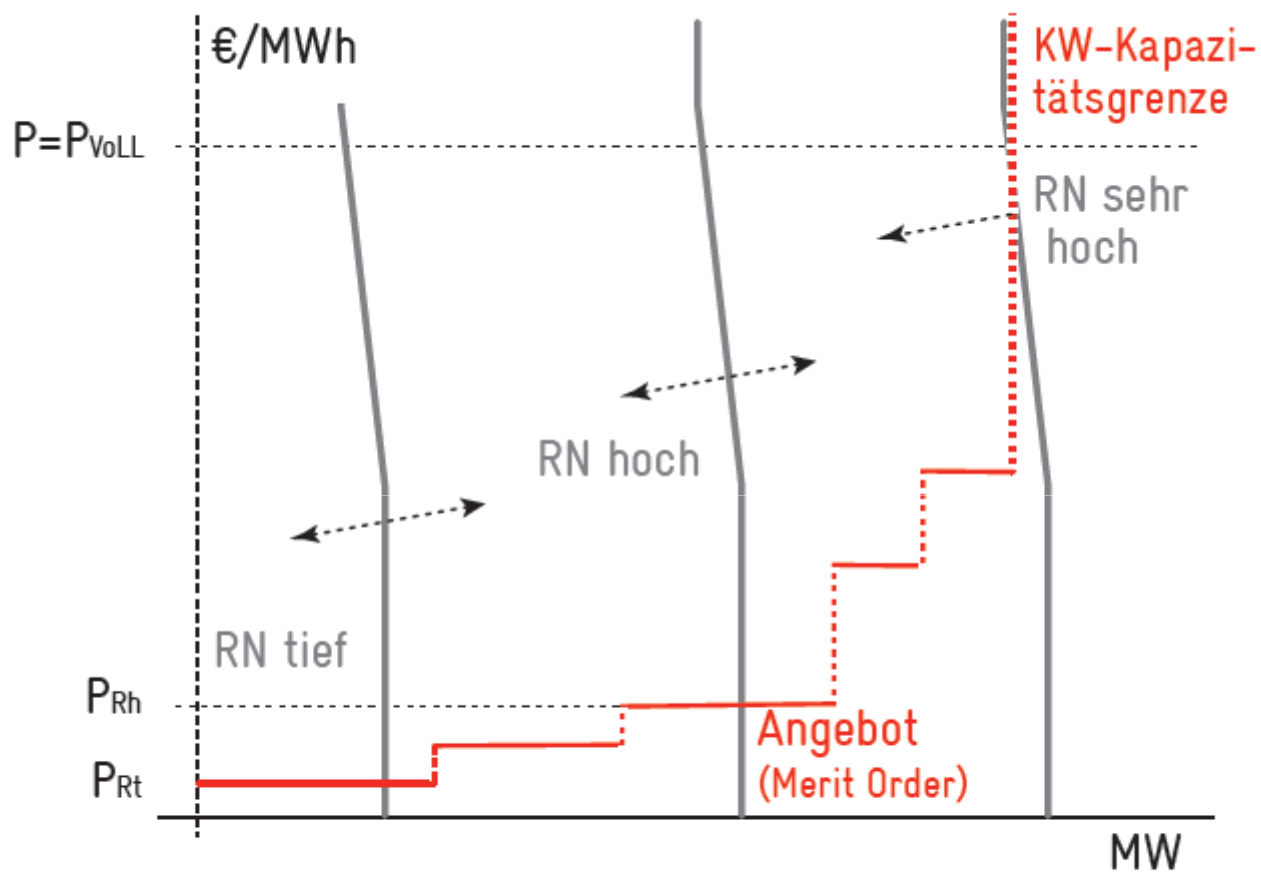
### a) Scarcity prices (VoLL)



## b) Influence of price regulation (price cap)



### c) Influence of renewable energy support (I)



RN = Residualnachfrage = Nachfrage - Produktion Erneuerbare

↔ = Unsicherheit über die Produktion erneuerbarer Energien

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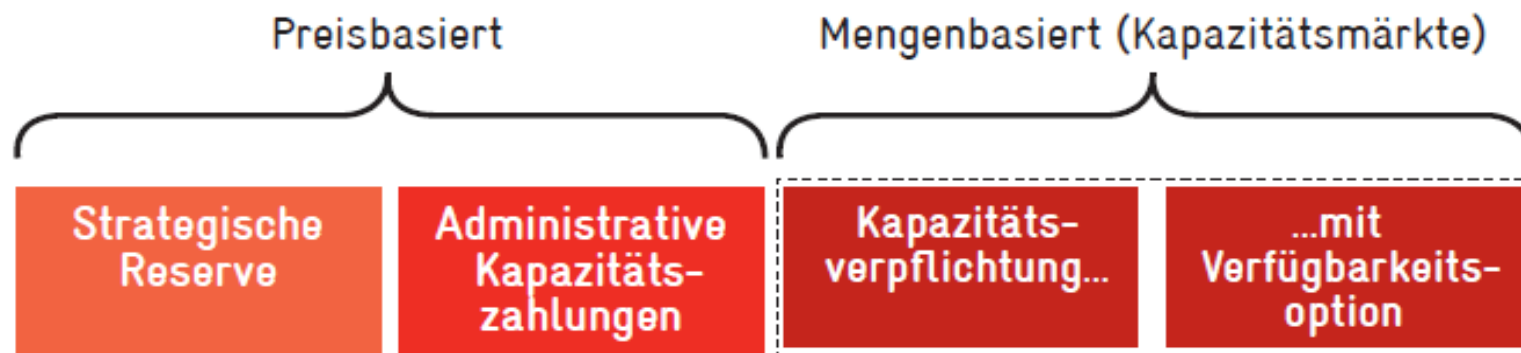
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- The Missing-Money-Problem
- **Stimulating investment incentives**
- Cross-border effects of capacity mechanisms
- Conclusion

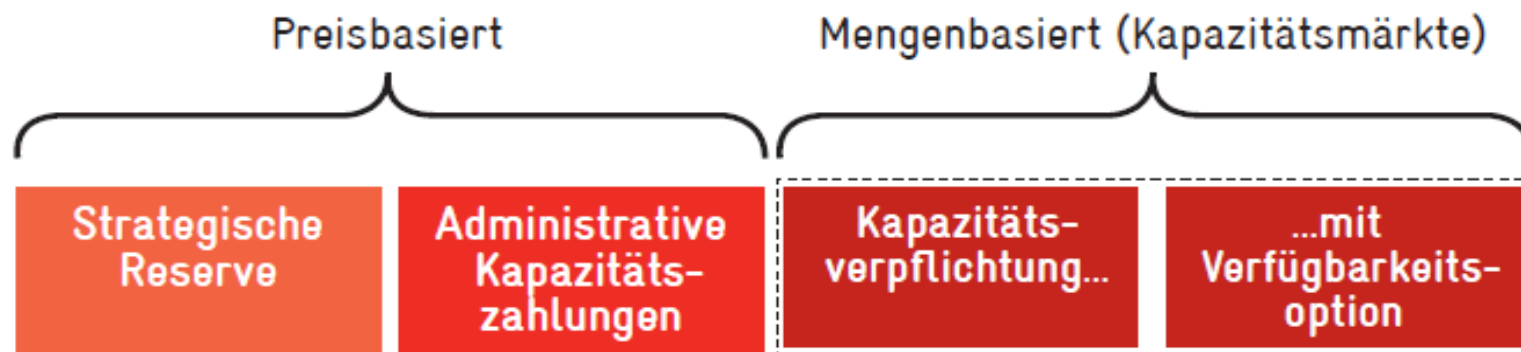
## «Artificial» stimulation of investment incentives

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- **Modification of existing instruments**
  - *Expanding the support mechanism for renewable energy* (e.g. feed in tariff) to conventional power plants
  - *Expanding the balancing power market* (model of «operational reserve»)
- **Introduction of specific capacity mechanisms**
  - Compensation / trade with (back-up) power plant capacities as a *complement* to the energy market
    - Producers profit from *higher investment* security (→ revenues from capacity mechanism and energy market)
    - Consumers from *higher supply security* und *lower electricity prices* (→ *lower, less frequent price peaks*)
  - Consumers pay a mark-up e.g. via network charges



- TSO procures PP-capacities as a Strategic Reserve, e.g. through an auction mechanism
- Strategic reserve is activated in case of scarcity respectively when a defined strike price (which signals scarcity) is achieved
- TSO offers the strategic capacity at the strike price level in the spot market → the strike price turns into a spot market price cap
- Disadvantages:
  - Explicit price limit (at the level of the strike price) → less incentive to flexibilize demand or to invest in storage facilities
  - Low strike price → higher strategic reserve necessary
  - High strike price → inefficient use of power plants
  - Market distortion, above all through selective application (only new/old facilities) → incentives to extend / shorten lifetime



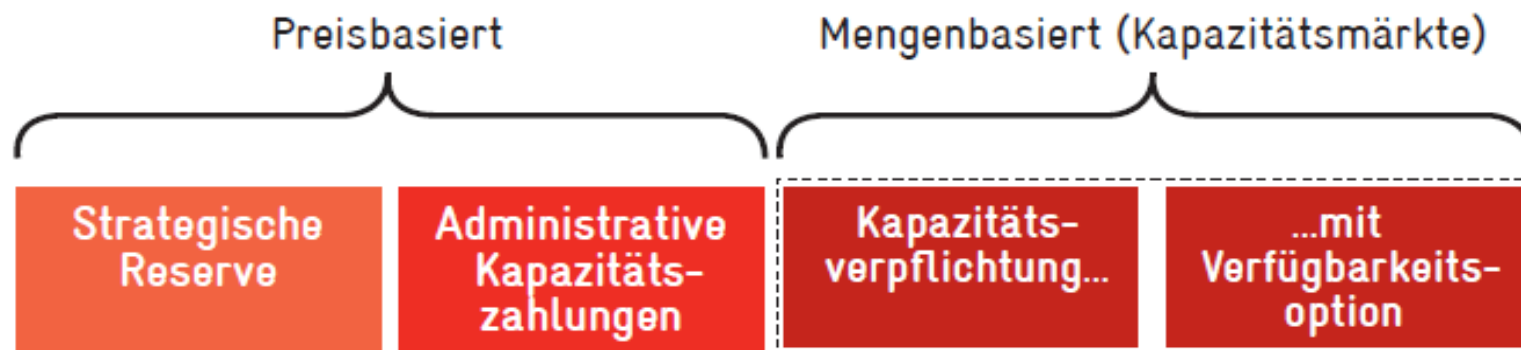
- **Administratively-determined capacity payment for (certain) PP**
- Simple form: fixed payment → Peak-load power plant should cover fixed costs (addressing the missing money problem)
- However: The fixed payment does not give incentives to be available or to produce during scarcity
- Additional payment differentiation according to availability / generation / scarcity situation
- Disadvantages:
  - Danger of an inefficient, too high compensation which becomes rather a subsidy
  - Additional generation incentives lead to distortions or perverse effects...

## Administratively-determined capacity payment

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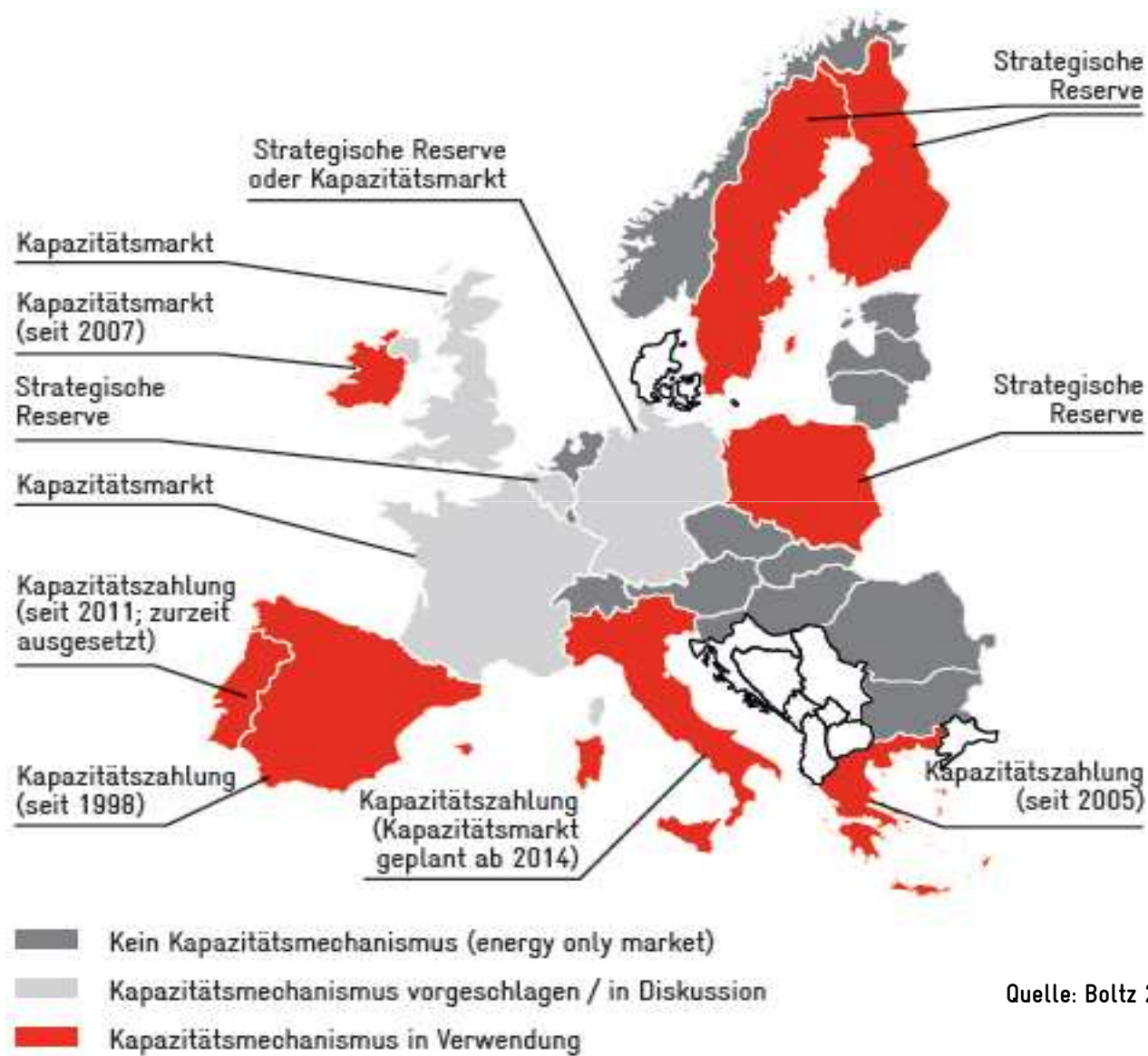
- **Differentiation by availability**
  - Power plants with high technical availability during potential scarcity periods get a higher capacity payment
  - *Problem: No incentives for the power plants to actually produce during scarcity – and for providers to not keep capacities from the market to increase prices*
- **Differentiation by actual generation**
  - The capacity payment is based on the actual generation – e.g. as a premium on the spot market price (e.g. Argentina, Peru)
  - *Problem: Distortive (over-) production incentive, electricity is supplied even with negative contribution margin – similarities to the compensation for electricity fed into the grid (KEV / EEG)*





- **Capacity Obligation requires utilities to provide minimal power plant capacities according to peak demand**
- Own power plants, contracts with third parties, demand side management
- Additionally, Availability Option as hedging for consumers and creation of generation incentives
- Producers pay difference between a certain strike price and a higher spot market price (→ no incentives for strategic pp withholding)
- Disadvantages:
  - Complex
  - Liquid (large) market is a precondition

# Capacity mechanisms – developments in Europe



Quelle: Boltz 2013, ACER 2013

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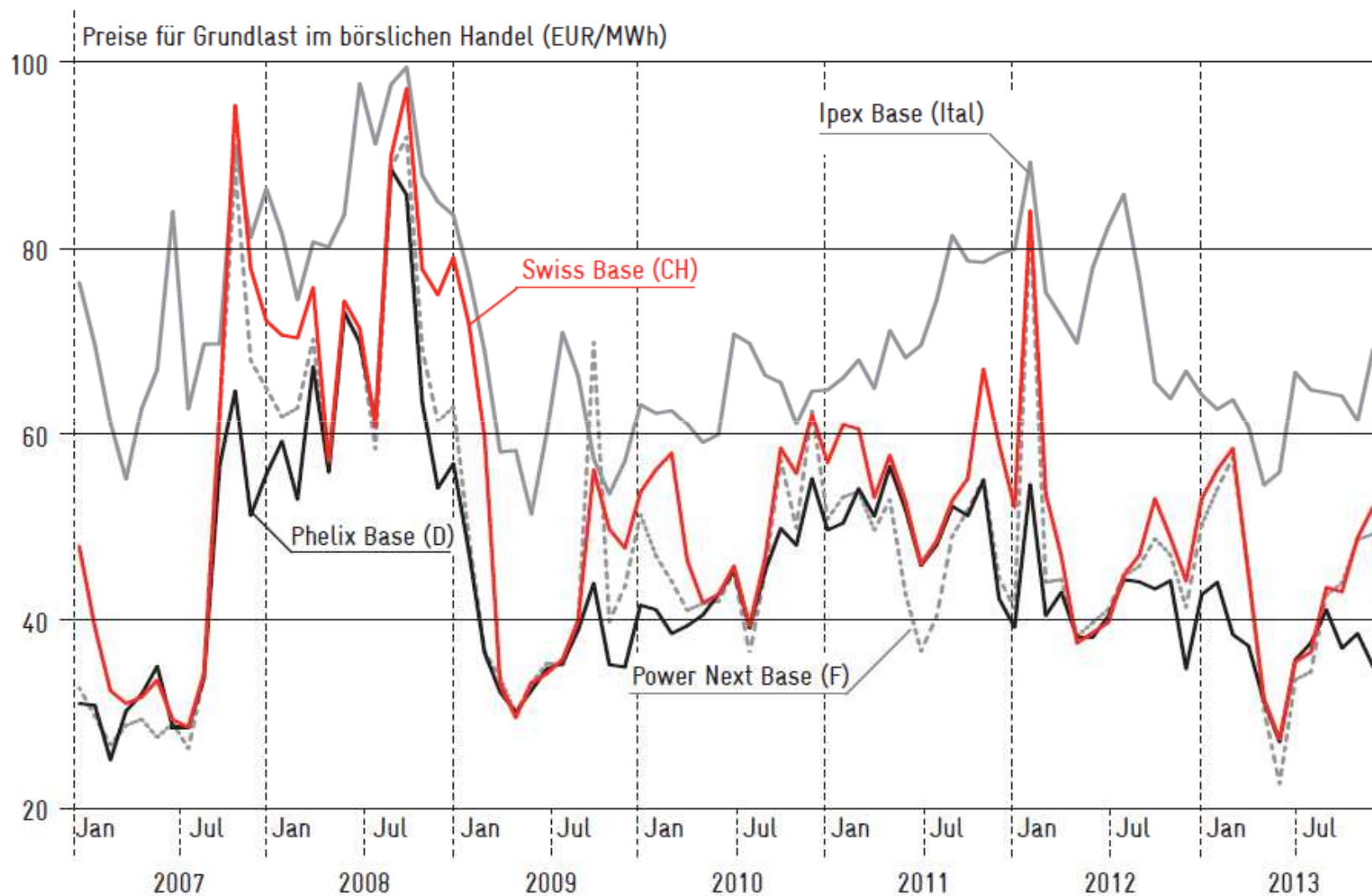
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## External effects

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- **External effects above all through energy trade**
  - Implementation of country-specific capacity mechanisms possible
  - Financing of capacity mechanisms outside of wholesale of electricity, e.g. through a surcharge / mark up on the network charges
  - *No cross-border effect for financing,*
  - *...but for the electricity price in wholesale / spot market*
- **Import and export of the effects of capacity mechanisms**
  - Small, open electricity markets as price takers and importers of the effects
  - Large electricity markets determine prices and export the effects
- **High relevance of trade in the Swiss market...**

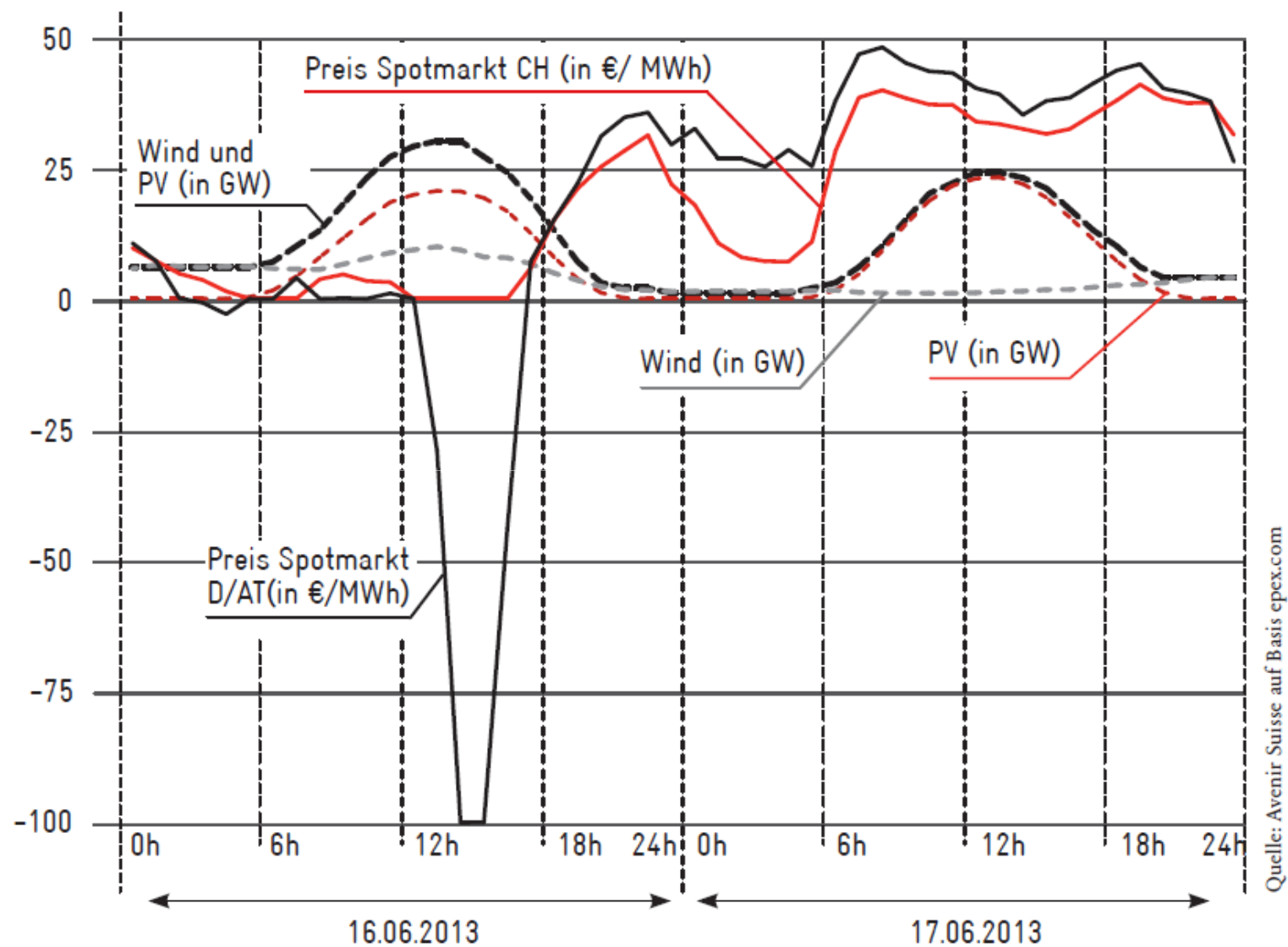
## Development of electricity prices in the spot market (base EUR/MWh)



Quelle: EPEX, GME

Grafik: Avenir Suisse

## Switzerland «imports» low price effects of renewable energy in Germany



## No capacity mechanisms – status quo

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		Neighbouring countries	
		No	Yes
Switzerland	No		
	Yes		

- Support of renewable energies reduces average spot market prices (merit order effect)
- Price peaks during a shortage are transferred to Switzerland
- Switzerland imports Missing Money Problem from neighbouring markets
- **Lack of investment incentives → increasing imports → in the long-term a threat to security of supply**

## Neighbouring countries introduce capacity mechanisms (I)

		Neighbouring countries	
		No	Yes
Switzerland	No		
	Yes		

- Lower average spot market prices, respectively lower price peaks
- Swiss electricity consumers profit from lower wholesale prices...
- ...but only to some extent from higher security of supply
- Lower prices induce lower investment incentives in Switzerland
- **Pressure to introduce a domestic capacity market**



## Neighbouring countries introduce capacity mechanism (II)

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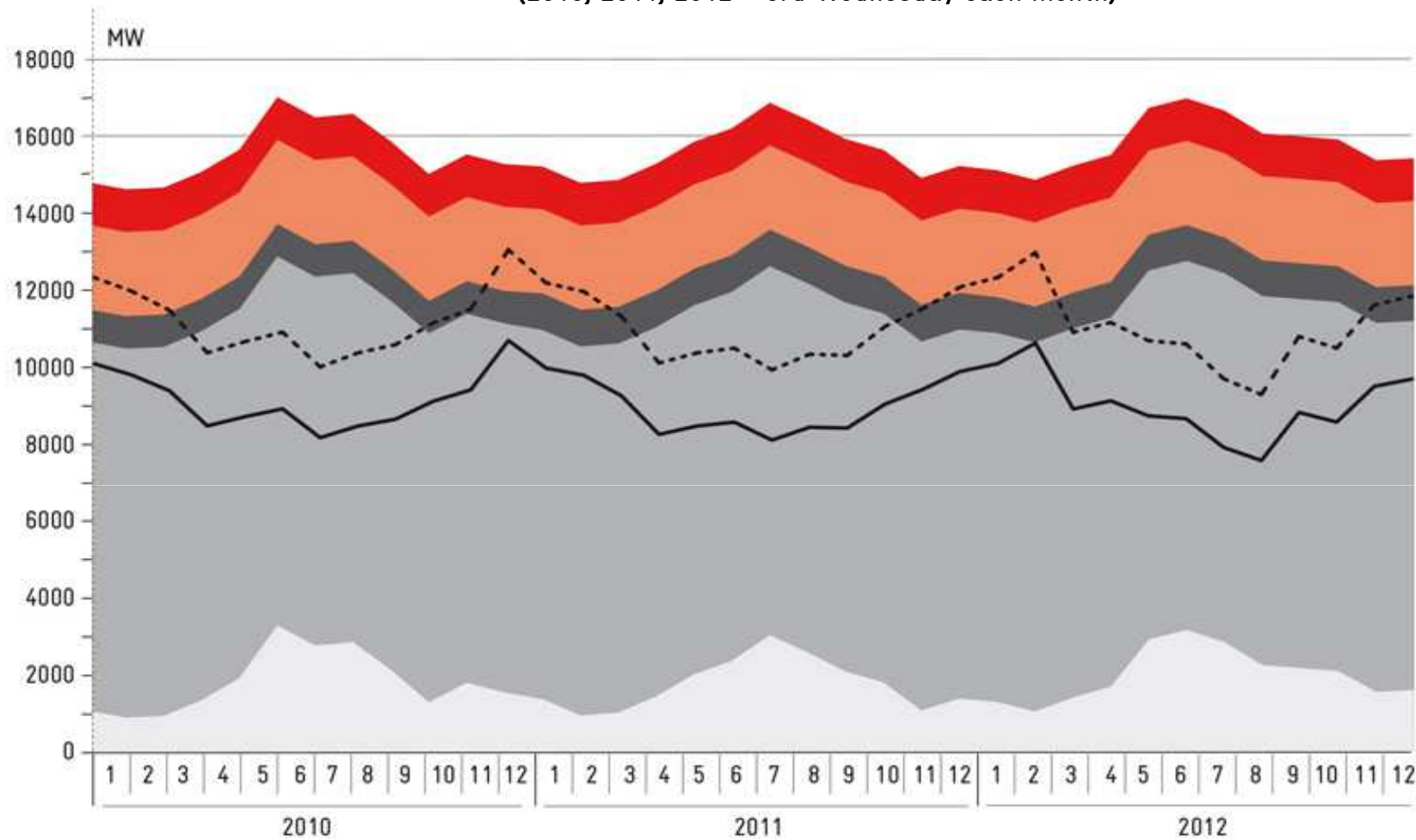
- **Incentives to participate in the foreign capacity mechanism**
  - New precondition for domestic PP: Lower energy prices at spot market, lack of a domestic capacity mechanism (and related income)
  - Providing PP-capacity in the foreign capacity market
- **But there are significant obstacles**
  - Reservation of *cross-border network capacities* necessary / possible?
  - Potentially *negative impact on domestic security of supply* (power plant availability should address foreign needs)
  - Necessity of a *bilateral electricity agreement?*

## Inefficient unilateral capacity market

		Neighbouring countries	
		No	Yes
Switzerland	No		
	Yes		

- Limited effectiveness as consequence of the high importance of trade
- Import of scarcity prices – independent of the domestic capacity mechanism
- Domestic consumers pay for the capacity mechanisms but do not profit from lower prices
- **Does Switzerland has a generation capacity problem...?**

# Available generation capacity and consumption in Switzerland (2010, 2011, 2012 – 3rd Wednesday each month)



Quelle: Avenir Suisse auf Basis BFE 2011, 2012b und 2013

# Capacity mechanisms in Switzerland and neighbouring countries

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		Neighbouring countries	
		No	Yes
Switzerland	No		
	Yes		

- **Coordination of capacity markets is necessary**
- **More competition in cross-border capacity markets**
- **Minimization of externalities**

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## Energy-only market as theoretically best solution

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- **Weaknesses of capacity mechanisms**
  - Artificial limitation of price / reduction of price volatility
  - Declining incentives for more flexible consumption and storage
  - ***Market-distorting implementation*** of capacity mechanisms
    - *Selective promotion either for old facilities or new facility*
    - *Mechanism may become a subsidy when applied in reality*
  
- **Useful capacity market**
  - Technology-neutral, ***market-based***, capacity price is zero with persistent over-capacities
  - Closest is the model of ***capacity obligation***

## A capacity market for Switzerland?

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- (For the time being) sufficient generation capacities
  - Power plant portfolio with *high generation capacity* – but partially only available for a short time (storage power stations)
  - System stability threatened, above all by the decommissioning of younger, big nuclear power plants
- **Relevance of interaction with foreign markets**
  - Extraordinarily *high share of international trade*
  - Swiss prices considerably determined by foreign countries
  - Capacity markets lead to *externalities*

## Alternatives to capacity mechanisms

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- **Flexibilizing demand**
  - Alleviation of Missing Money Problem through *flexible demand*
  - Smart-Metering / Smart-Pricing
  - More resolute market opening
- **Promotion of renewable energies closer to the market**
  - KEV aggravates Missing Money Problem
  - Correlation of domestic generation and foreign exports (PV)
  - Promotion of renewable energies closer to the market – *e.g. quota model*



# Avenir Suisse Study Capacity Markets

[http://www.avenir-suisse.ch/wp-content/uploads/2013/04/dp\\_kapazitaetsmarkt\\_as\\_2013.pdf](http://www.avenir-suisse.ch/wp-content/uploads/2013/04/dp_kapazitaetsmarkt_as_2013.pdf)

Diskussionspapier

## Keine Energiewende im Alleingang

*Wie die Schweiz mit Ökostrom und Kapazitätsmärkten umgehen soll*

*Urs Meister*

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