

The EU regulation of the power sector

Alberto Pototschnig

Online training as part of the EU Support for Sustainable Energy Connectivity in Central Asia Project
4 February 2025



www.eui.eu

Poll 1 – Опрос 1

How familiar are you with the concept of *incentive-based regulation*?

- a. Not at all, never heard before
- b. I have heard about it, but I am not very familiar with the concept
- c. I am quite familiar with the concept
- d. I am very familiar with the concept and I have been involved in its implementation
- e. Prefer not to say

Насколько Вы знакомы с концепцией *регулирования на основе стимулов*?

- a. Совсем не знаком(а), никогда раньше не слышал(а)
- b. Я слышал(а) об этом, но не очень хорошо знаком(а) с концепцией
- c. Я довольно хорошо знаком(а) с концепцией
- d. Я очень хорошо знаком(а) с концепцией и принимал(а) участие в её реализации
- e. Предпочитаю не отвечать

Poll 2 – Опрос 2

How familiar are you with the concept of the *regulatory weighted-average cost of capital (WACC)*?

- a. Not at all, never heard before
- b. I have heard about it, but I am not very familiar with the concept
- c. I am quite familiar with the concept
- d. I am very familiar with the concept and I have been involved in its implementation
- e. Prefer not to say

Насколько Вы знакомы с концепцией *нормативной средневзвешенной стоимости капитала*?

- a. Совсем не знаком(а), никогда раньше не слышал(а)
- b. Я слышал(а) об этом, но не очень хорошо знаком(а) с концепцией
- c. Я довольно хорошо знаком(а) с концепцией
- d. Я очень хорошо знаком(а) с концепцией и принимал(а) участие в её реализации
- e. Предпочитаю не отвечать

Poll 3 – Опрос 3

How familiar are you with the concept of ***electricity market coupling***?

- a. Not at all, never heard before
- b. I have heard about it, but I am not very familiar with the concept
- c. I am quite familiar with the concept
- d. I am very familiar with the concept and I have been involved in its implementation
- e. Prefer not to say

Насколько Вы знакомы с концепцией ***объединения рынков электроэнергии***?

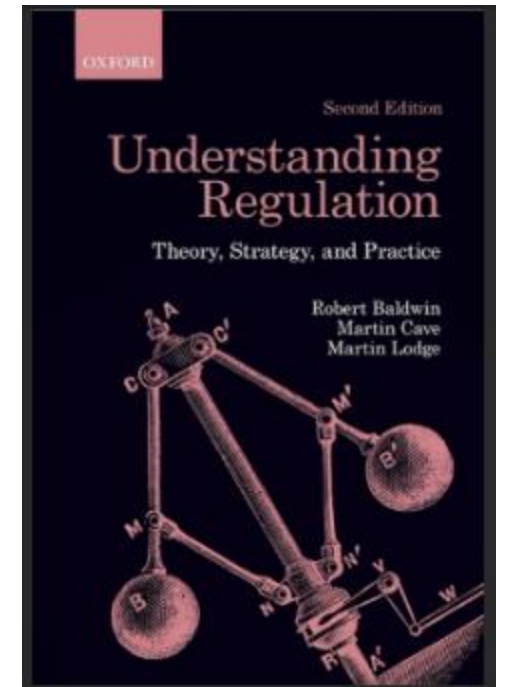
- a. Совсем не знаком(а), никогда раньше не слышал(а)
- b. Я слышал(а) об этом, но не очень хорошо знаком(а) с концепцией
- c. Я довольно хорошо знаком(а) с концепцией
- d. Я очень хорошо знаком(а) с концепцией и принимал(а) участие в её реализации
- e. Предпочитаю не отвечать

- Competition vs Regulation in the electricity sector
- The different regulatory approaches
- Market Coupling in the EU Internal Electricity Market

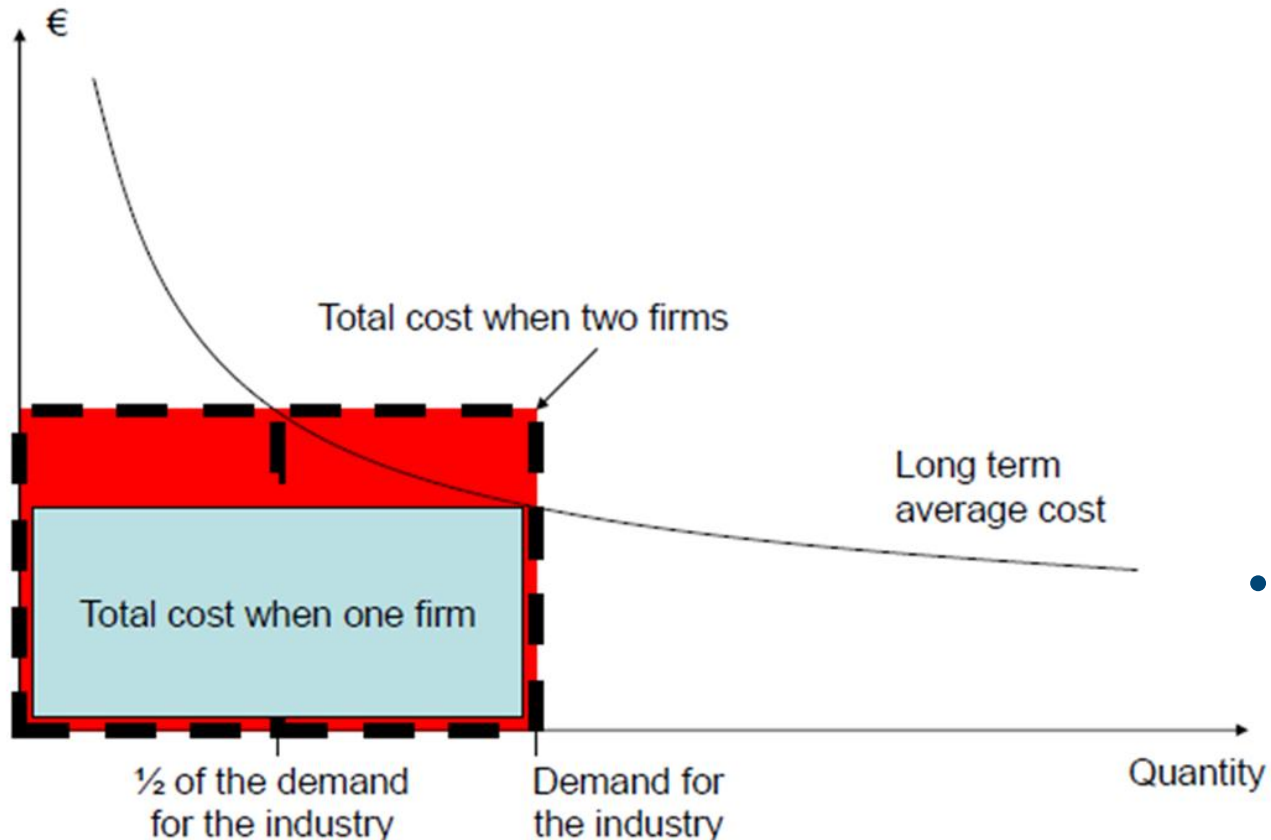
- Competition vs Regulation in the electricity sector
- The different regulatory approaches
- Market Coupling in the EU Internal Electricity Market

What is regulation?

- Often mentioned, but **often only vaguely** or implicitly **defined**
- A **set of principles and rules** used to control, direct or manage the actions of economic actors and institutions
- Usually implementing (more generic) legislation
- Aimed at the **achievement of some societal goal** (e.g., economic efficiency)
- **Form of state intervention** alternative to direct ownership and anti-trust (ex-post) control
- However, **not necessarily the output of public bodies** (e.g., self-regulation by industry)



Competition and regulation: is two better than one?



- If **average costs** are declining (e.g., due to economies of scale):
 - one firm is more efficient than two or more
 - free market entry and competition are **wasteful**
 - **social optimum** is to let a **monopoly company** cover the entire demand in a certain service area
- In this case, regulation is required:
 - **Prices**, through **tariff and quality regulation**
 - **Quantities**, through **third-party access (TPA) requirements**

Competition and regulation in the energy sector

Activities in competition

- Electricity generation
- Commercial activities (supply)

Competition does not happen easily:

- repeal of any legal monopoly (liberalisation) is fundamental, but only a pre-requisite
- conditions for competition are necessary

Monopolistic activities

- Networks are “**essential facilities**”, i.e. infrastructures which are necessary to competitors for serving their customers
- Networks are often a “**natural monopoly**”:
 - cannot be (economically) replicated because of decreasing average costs
 - consequently one producer is socially more efficient than many ... for the relevant amount of demand
- Monopolistic activities needs to be regulated

Competition and regulation in the electricity sector

**Activity in
Competition**

Generation



**Regulated
Activities**

Transmission



Distribution



**Activity in
Competition**

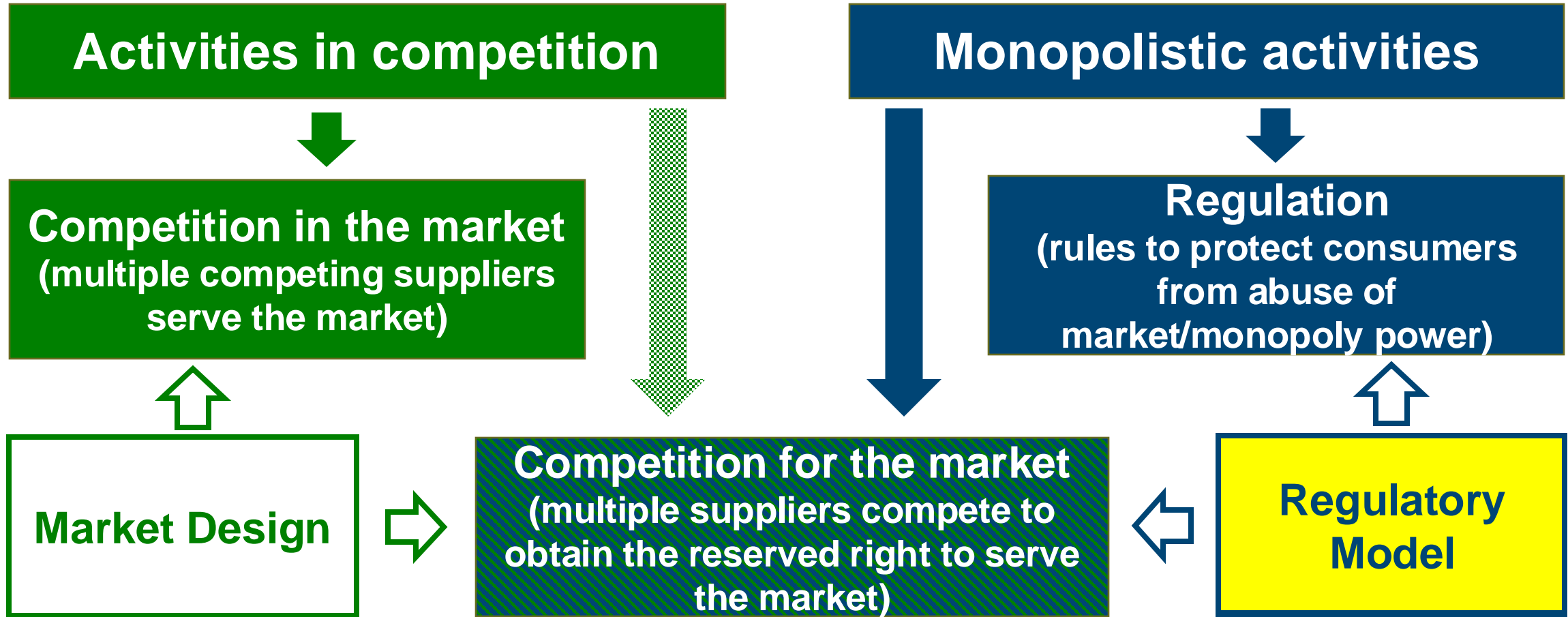
Supply



Conditions for competition

- Size of market
 - Integration of smaller markets
- Structure
 - Unbundling of networks and access rights
 - problem when the incumbent controls the networks
 - Market design: organised markets
 - power exchanges
- Competition policy
 - Different from regulation
 - Deter, detect and punish market abusive behaviour

Competition vs Regulation



- Competition vs Regulation in the electricity sector
- The different regulatory approaches
- Market Coupling in the EU Internal Electricity Market

Models economic regulation (in the energy sector, but not only)

Traditional Regulation

Cost-of-Service (CoS) Regulation

Rate-of-Return (RoR) Regulation

Revenue Cap Regulation

Price Cap Regulation

Profit- sharing Regulation

Yardstick Competition

Performance-based Regulation

Incentive-based Regulation

- Incentive[-based] regulation is the use of **rewards and penalties** to induce the utility to achieve **desired goals** where the utility is afforded **some discretion** in achieving such goals.

Tracy Lewis and Chris Garmon, 'Fundamentals of Incentive Regulation.'
PURC/World Bank International Training Program on Utility Regulation and Strategy, June 1997.

- Incentive-based regulation is often referred to as

RPI - X Regulation

- Prices/allowed revenues annually adjusted for inflation, but reduced by an efficiency factor (X)
- In reality, other adjustments might be included (e.g. for **quality**, unexpected events, ...): $RPI - X + Z$

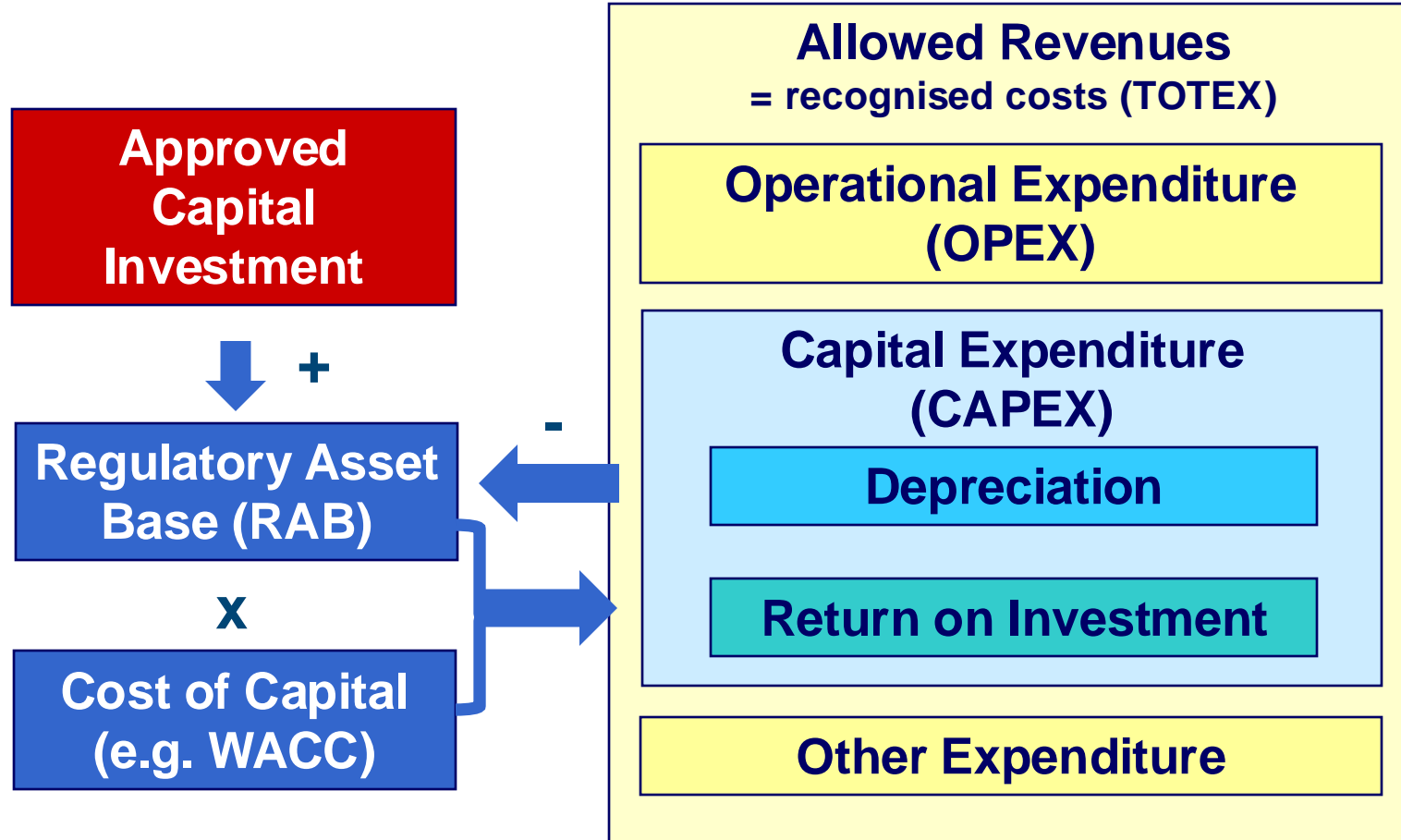
Approaches to economic regulation in the energy sector

- CoS/RoR Regulation most frequent in the US, also for vertically-integrated utilities (non all States have liberalised their electricity sector)
- In the European Union, incentive-based regulation (price or revenue cap) has prevailed, at least since the 1990s, for the regulation of network (monopoly) activities
- The EU preference for Incentive-based Regulation is due to CoS/RoR Regulation being seen as:
 - Providing little incentives for efficiency
 - Promoting over-investment (Averch-Johnson effect)
 - Possibly creating excessive administrative burden
 - Possibly intruding into the operators' management decisions (to allow or disallow certain costs)

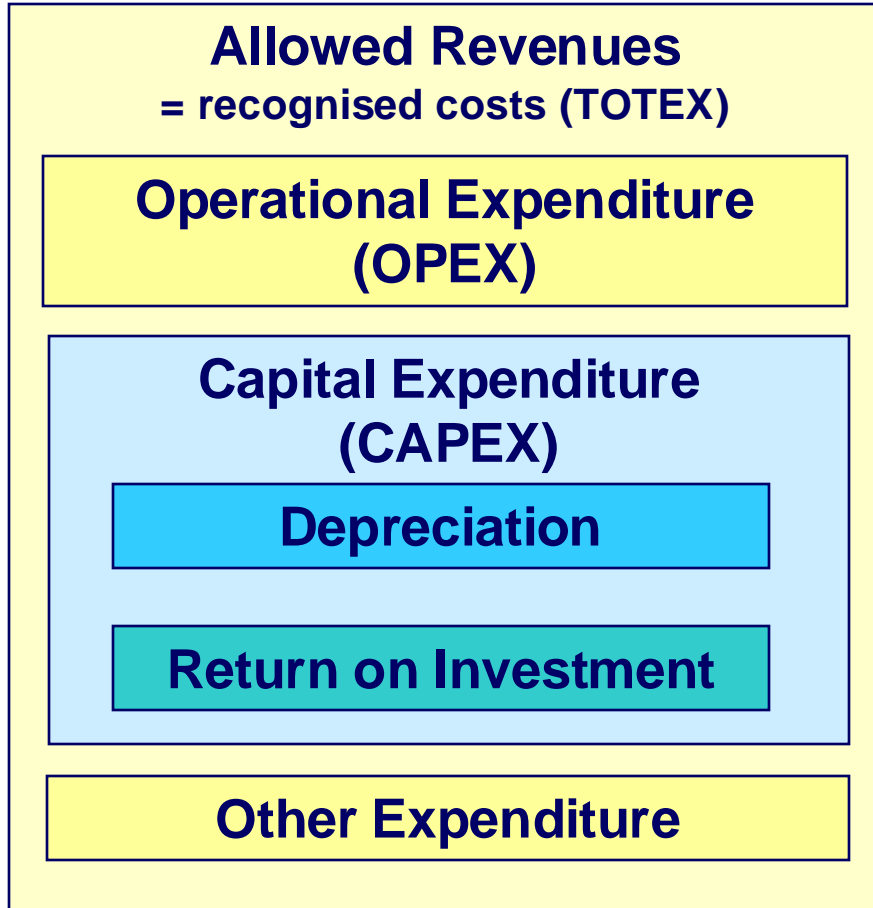
A broad characterisation of price/revenue cap

- The current level of total costs, possibly split between OPEX and CAPEX is defined
 - This is also the basis of CoS/RoR Regulation
- The length of the regulatory period is determined
 - Typically 4-5 years
- An efficiency factor (X) is defined
 - Alternative interpretation of X exist
- The need for other adjustments is assessed
 - Quality regulation (to ensure that quality is maintained or improved)
 - Different for price cap and revenue cap (e.g. throughput, exogenous factors)
- Define the allowed price/revenue trajectory over the whole regulatory period
- If the operator reduces its costs below the allowed revenues level for the year, it profits from the difference

Components of the allowed revenues



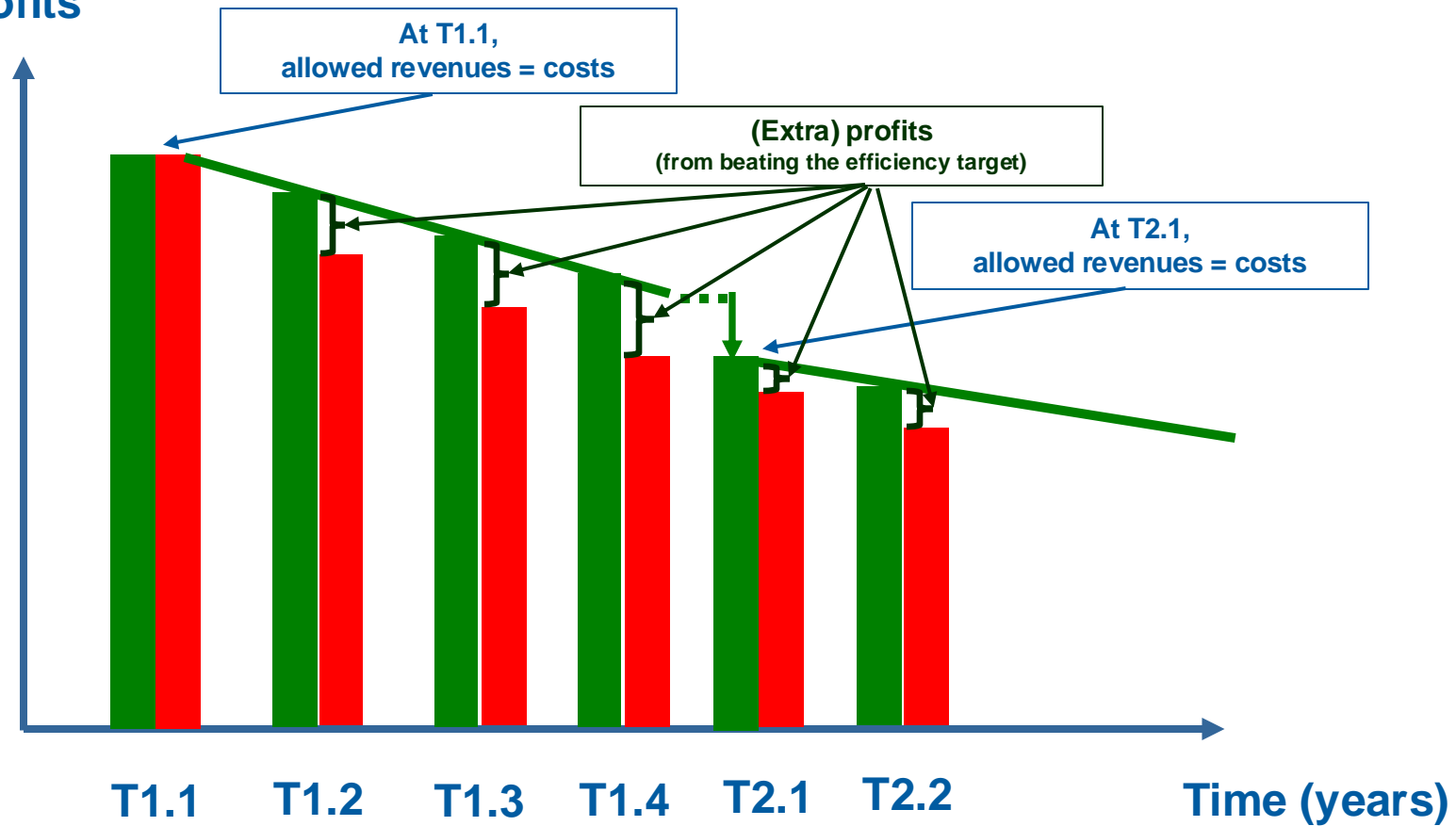
Single or differentiated regulatory approach



- Incentive-based regulation has typically been mainly used for **OPEX**, while CoS regulation has been applied to **CAPEX**
- However, a number of Regulators are now moving to **TOTEX** Regulation (applying the same regulatory treatment to OPEX and CAPEX)
 - This avoids the risk of providing distorted incentives
- Next generation of regulatory schemes to promote more efficient/innovative solutions to system needs

Revenue cap example

Revenues,
costs, profits



Profit-sharing schemes

- Any difference between allowed revenues and actual costs is shared between the operator and its customers
- Lower risk/lower reward/lower incentive to reduce costs for the operator
- The customers participate earlier in efficiency gains achieved by the operator

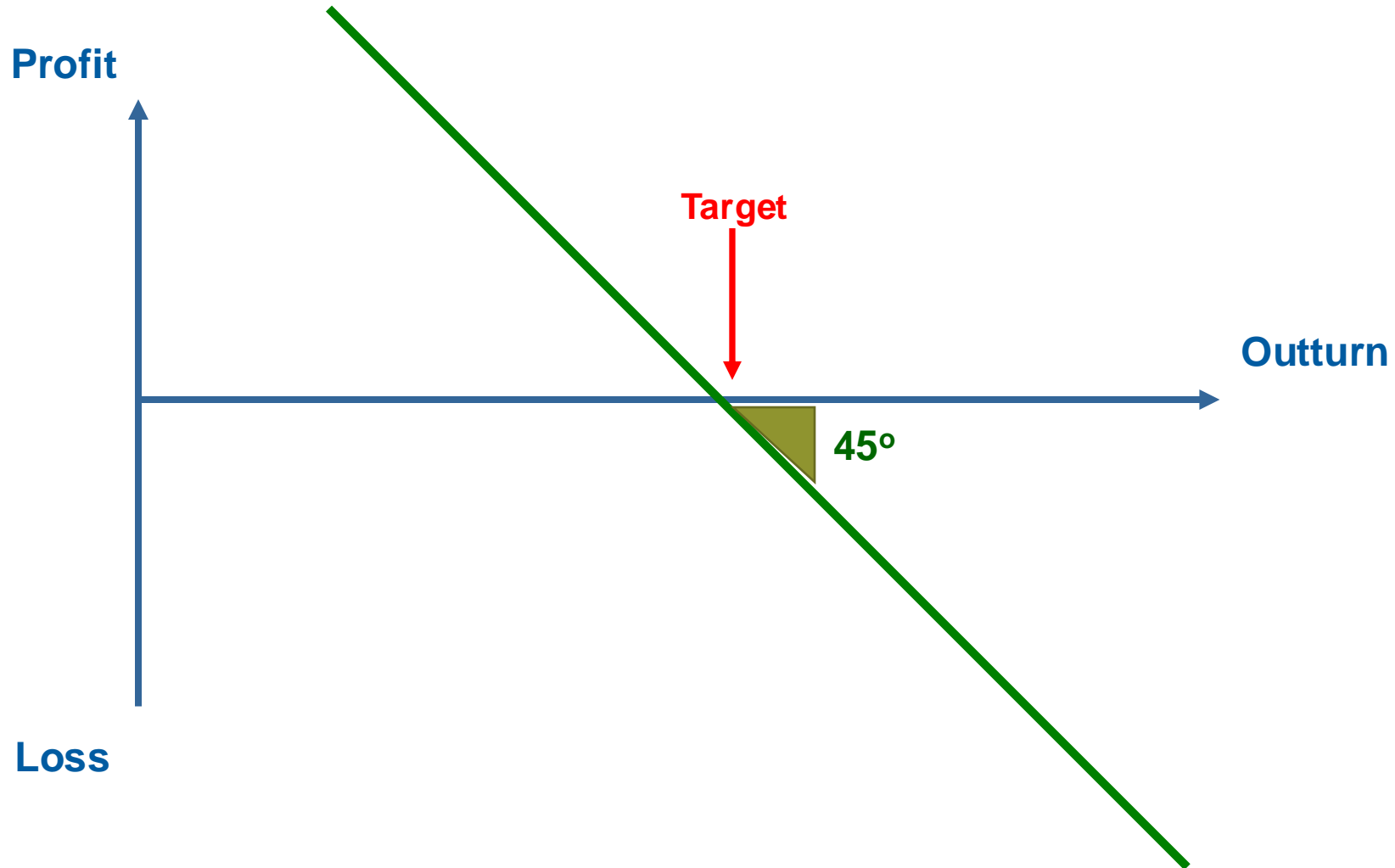
Cap-and-floor schemes

- The operator fully benefits from/absorb the difference between the allowed revenues and actual costs, as long as this difference stays within a cap-floor range. Beyond this range, the difference in excess is passed on to consumers
- The risk for the operator is reduced, but so are the incentive for efficiency

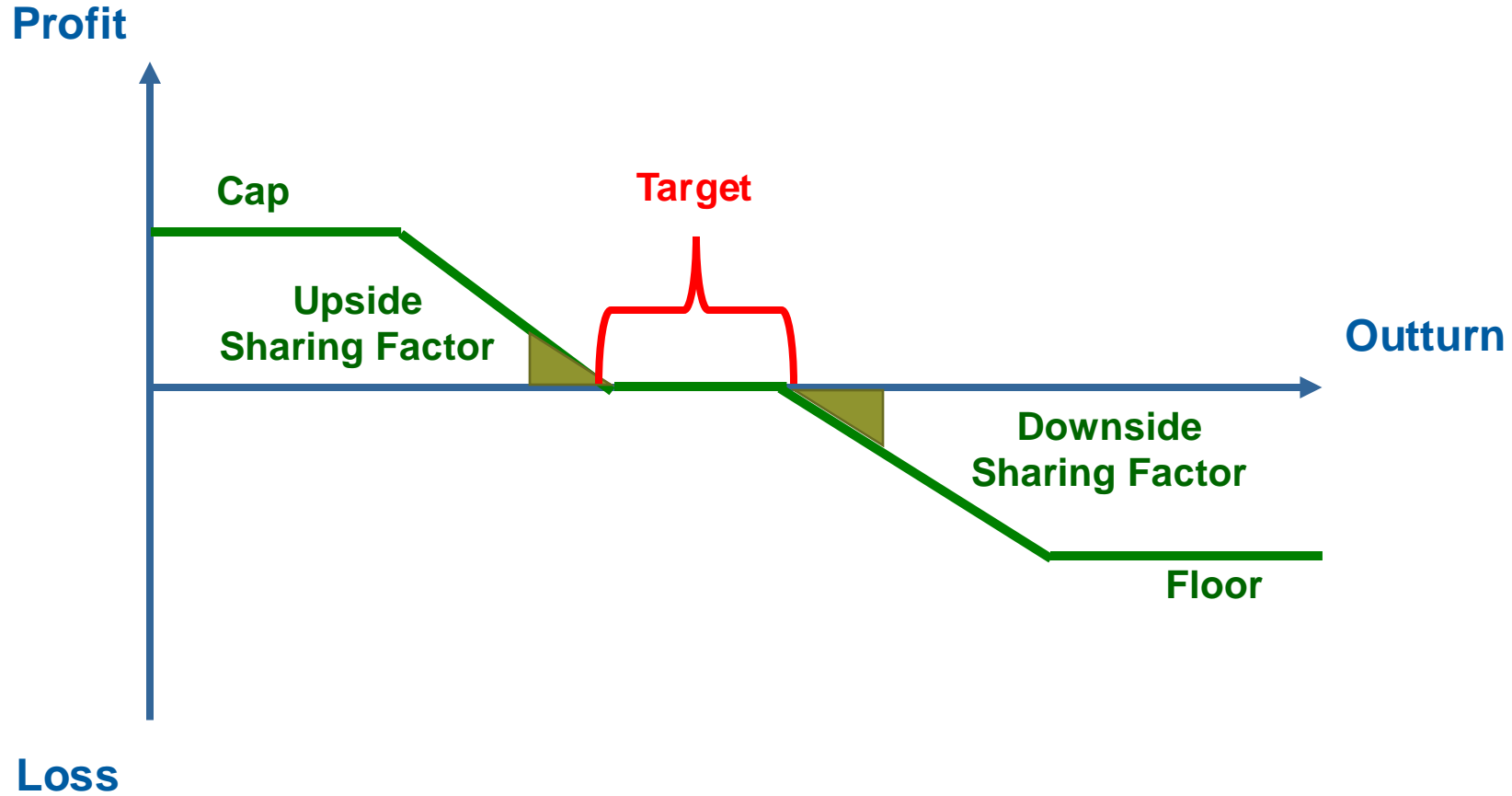
Price-cap, Revenue-cap or Profit-sharing Regulation

- Price-cap Regulation is best fit when costs highly depend on output/throughput (on which the price is charged)
- Revenue-cap Regulation is best fit when costs do not significantly depend on output/throughput (an adjustment to the revenue-cap level might be envisaged)
- Profit-sharing Regulation might be best when there are significant unknowns

A typical Revenue cap scheme (also used for quality regulation)



A typical profit sharing scheme (also used for quality regulation)



System Operation Balancing Services Incentive Scheme (National Grid – UK)

Year	Target (£m)	Sharing factors (%)		Cap (£m)	Floor (£m)	Actual (£m)	NIA (£m)	NG Share (£m)
		Up	Down					
2001/02	382	40	12	46.3	-15.4	263.0	58.2	46.3
2002/03	367	60	50	60	-45	285.6	-51.7	48.6
2003/04	340	50	50	40	-40	280.8	0.43	32.2
2004/05	320	40	40	40	-40	289.2	-11.4	12.2
2005/06	378	40	20	40	-20	427.2	-104	-4.0
2006/07	n.a.	n.a.	n.a.	n.a.	n.a.	495	n.a.	n.a.
2007/08	430-445	20	20	10	-10	451	-128	-1.2
2008/09	530-545	25	25	15	-15	827	-94	-15
2009/10	571.43-601.43	25	15	15	-15	416	-261	15

NIA = Net Imbalance Adjustment

Pros and Cons of Incentive-based Regulation

PROS

- Simple and clear incentives
- Balance between the interests of the operators and of the consumers
- Moderate information requirement
- Robust vis-à-vis accounting systems

CONS

- Requires a cost review to set the starting level (but the same is needed for CoS/RoR Regulation)
- Requires the definition of the efficiency target level (X)
- Political acceptability of extra profits between two reviews
- May lead to degrading performance quality, if quality is not included in the scheme

	AT	BE	HR	CY	CZ	DK	EE	FI	FR	DE	GB	GR	HU	IS	IE	IT	LV	LT	LU	NL	NO	PL	PT	RO	SK	SI	ES	SE	AL	GE	MK	UA
Gas TSO	PC	RC	RC	CP	RC/PC	CP	RR	RC	RC	RC	RC	CP	IR	n.a.	RC	CP/PC	RC	RC	RC	RC	n.a.	RC	RR/PC	RC	BM	RC	IR	RC	PC	CP/IR	RC	IR
Gas DSO	RC	CP	RC	CP	RC	RC	RR	RC	RC	RC	RC	RC	IR	n.a.	RC	CP/PC	RC	RC	RC	PC	n.a.	CP/RC	RR/PC	RC	PC	RC	IR	RC	PC	CP/IR	RC	CP
Elec TSO	CP	RC	CP	RC	RC	CP	RR	RC	RC	RC	RC	RC	IR	RC	RC	CP/PC	RC	PC	RC	RC	RC	CP/RC	RC	RC	PC	RC	IR	RC	PC	CP/IR	RC	CP
Elec DSO	RC	CP	CP	RC	RC	RC	RR	RC	RC	RC	RC	RC	IR	RC	RC	CP/PC	RC	PC	RC	PC	RC	RC	RC	CP/PC	PC	RC	IR	RC	PC	CP/IR	RC	CP/RC

BM = Benchmarking (Yardstick Competition)
 PC = Price Cap

CP = Cost Plus
 RC = Revenue Cap

IR = Incentive Regulation
 RR = Rate of Return

- Competition vs Regulation in the electricity sector
- The different regulatory approaches
- Market Coupling in the EU Internal Electricity Market

Poll 4 – Опрос 4

In your views, would a **greater integration of the electricity markets in Central Asia** provide **benefits to energy consumers** in the region?

- a. Yes
- b. Yes, but only if markets were fully integrated
- c. No, as disturbances in one country could more easily propagate to other countries in the region
- d. No, as it would be more difficult for one country fully to protect its consumers against high prices
- e. Prefer not to say

По Вашему мнению, может ли **большая интеграция рынков электроэнергии в Центральной Азии** принести **выгоду потребителям энергии** в регионе?

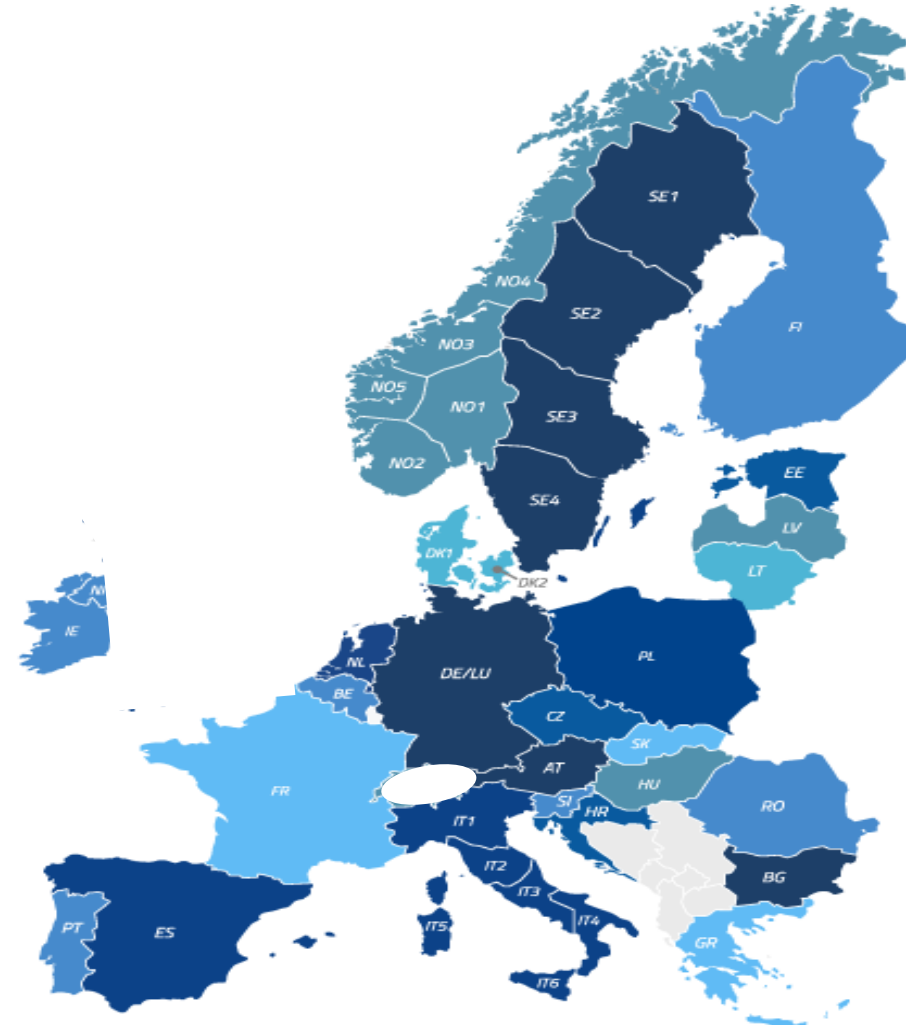
- a. Да
- b. Да, но только если рынки будут полностью интегрированы
- c. Нет, поскольку неполадки в одной стране могут легче распространяться на другие страны региона
- d. Нет, поскольку одной стране будет сложнее полностью защитить своих потребителей от высоких цен
- e. Предпочитаю не отвечать

Electricity market coupling in the day-ahead and intraday timeframes

- The EU Internal Electricity Market has a zonal geographical configuration
- The zones are coupled to allow efficient trading among them
- Different approaches to market coupling depending on the trading method
- Auction-based trading – allows the use of market-based implicit allocation of cross-border capacity
- Continuous trading – usually associated with first-come-first-served capacity allocation (or, conceivably, explicit allocation)
- Day-ahead has always been auction based. Intraday has been historically based on continuous trading, with three daily auctions being introduced

EU geographical market structure: bidding zone configuration

Bidding zone configuration of the EU Internal Electricity Market



31

A digression: Electricity Auction-based Market (1)

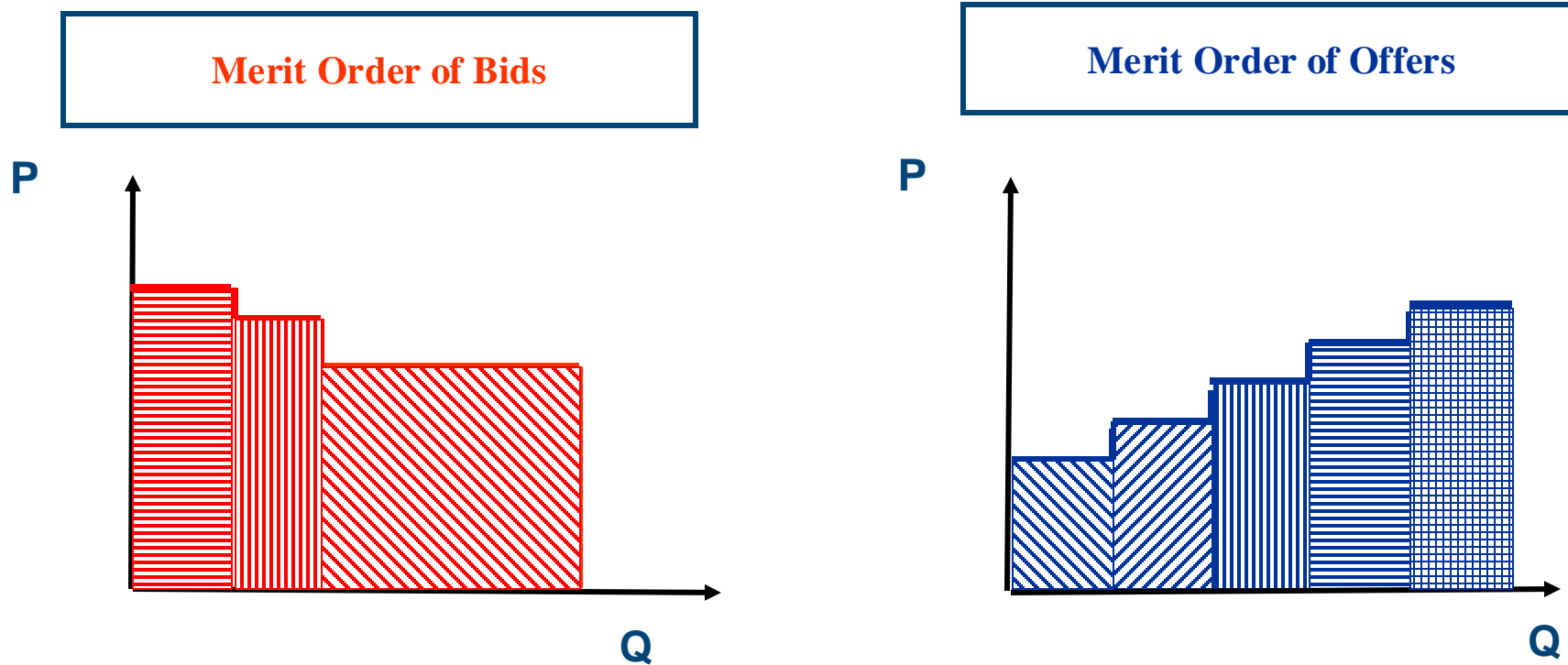
- Bid = price-quantity pair(s) indicating the interest to buy the indicated quantity(ies) at up to the indicated price(s)
- Offer = price-quantity pair(s) indicating the interest to sell the indicated quantity(ies) at no less than the indicated price(s)
- Bids and offers for each delivery period are submitted by a specified deadline
- Merit orders are compiled:
 - Bids are ranked in descending price order
 - Offers are ranked in ascending price order
- ...

A digression: Electricity Auction-based Market (2)

...

- The (equilibrium) market outcome is defined by the equilibrium market price (EP)
- The EP is the price at which the cumulative quantity specified in the merit order of bids is equal to the cumulative quantity specified in the merit order of offers
- Bids specifying a price not lower than the EP are accepted
- Offers specifying a price not higher than the EP are accepted
- Accepted bids and offers are typically valued at the EP (marginal pricing or 'pay-as-cleared' remuneration method)

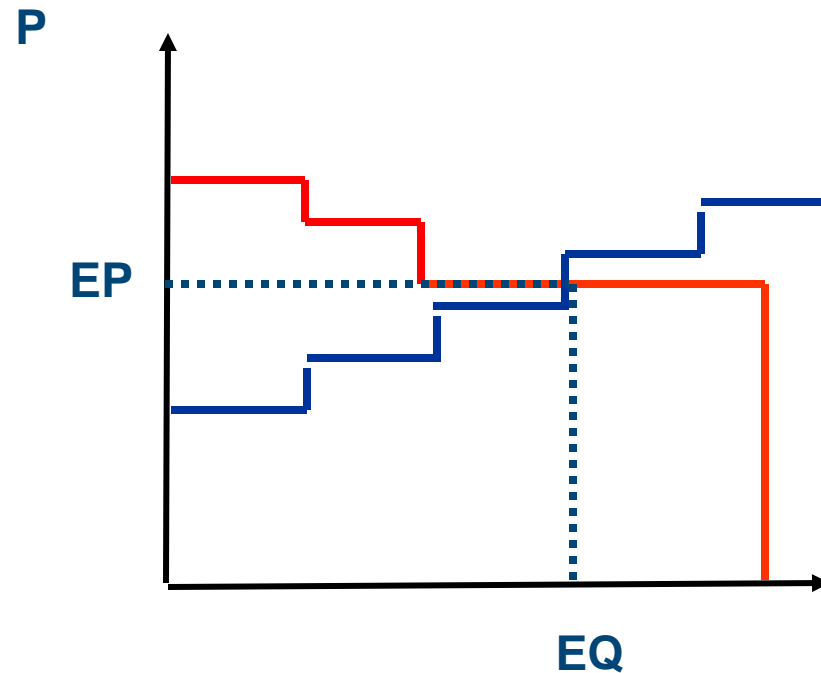
A digression: Electricity Auction-based Market (3): Merit Orders



Merit Orders

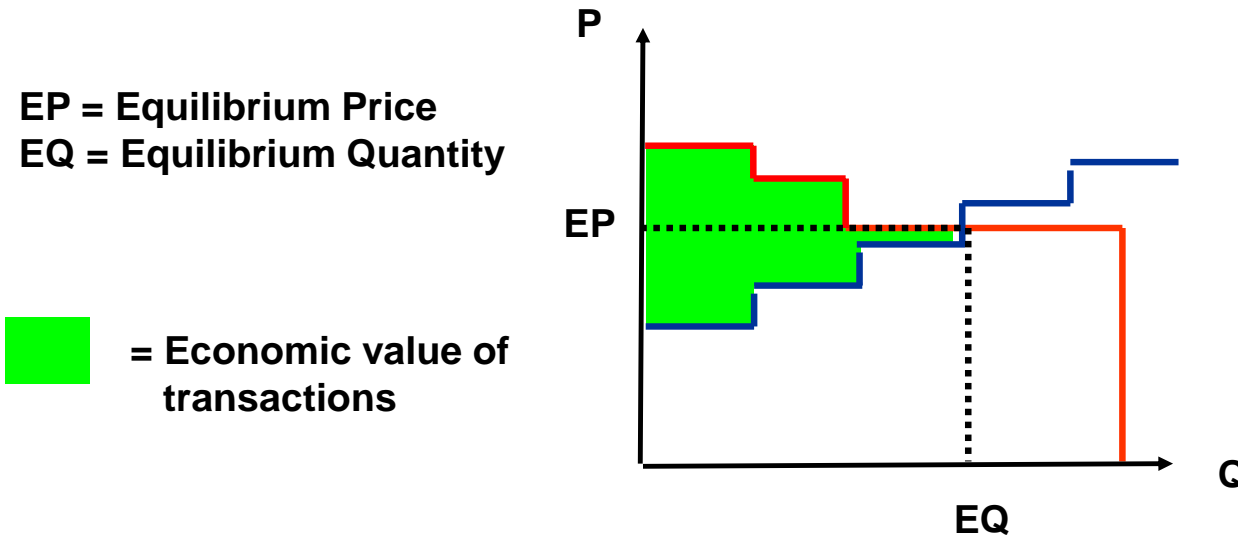
A digression: Electricity Auction-based Market (4): Market Equilibrium

EP = Equilibrium Price
EQ = Equilibrium Quantity



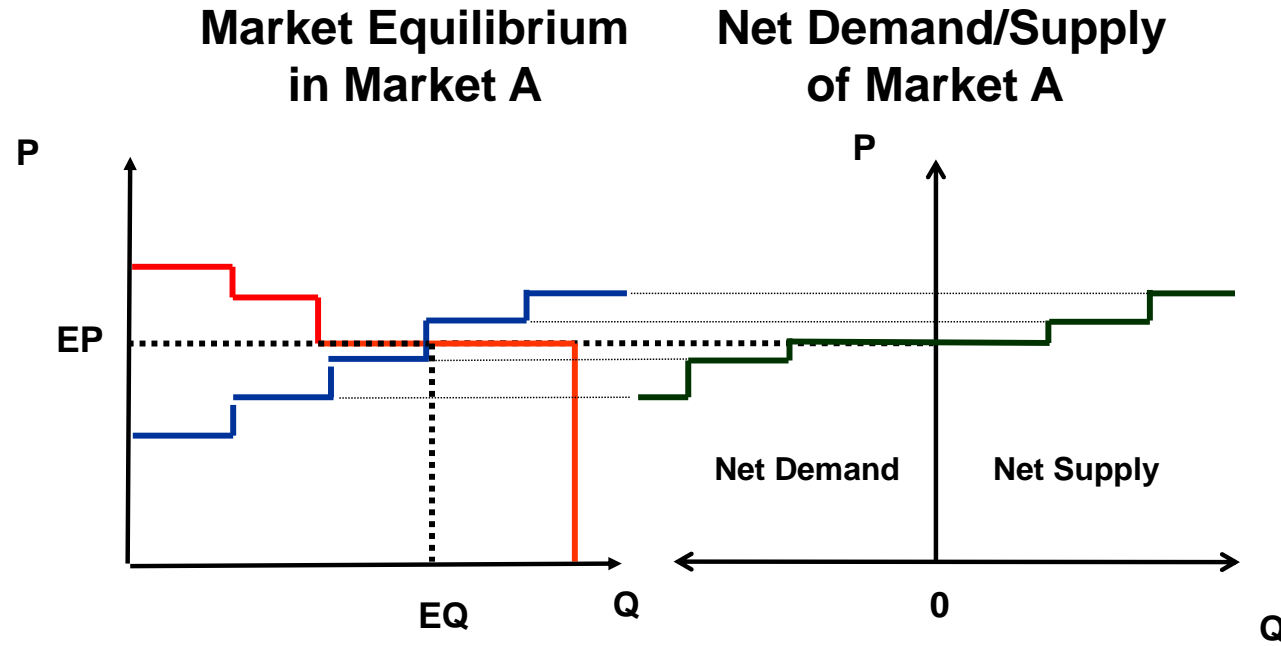
Market Equilibrium

A digression: Electricity Auction-based Market (5): Gains from trading



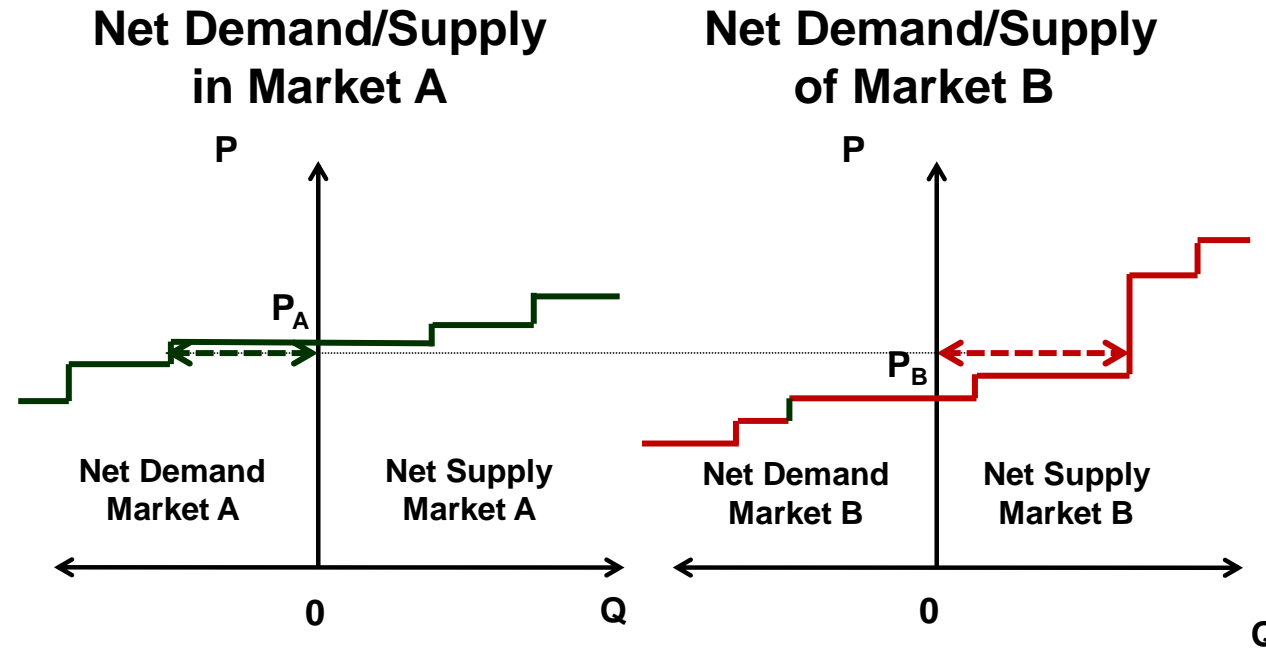
The Market maximises
the economic value of transactions

Electricity Market Coupling (implicit allocation) (1)

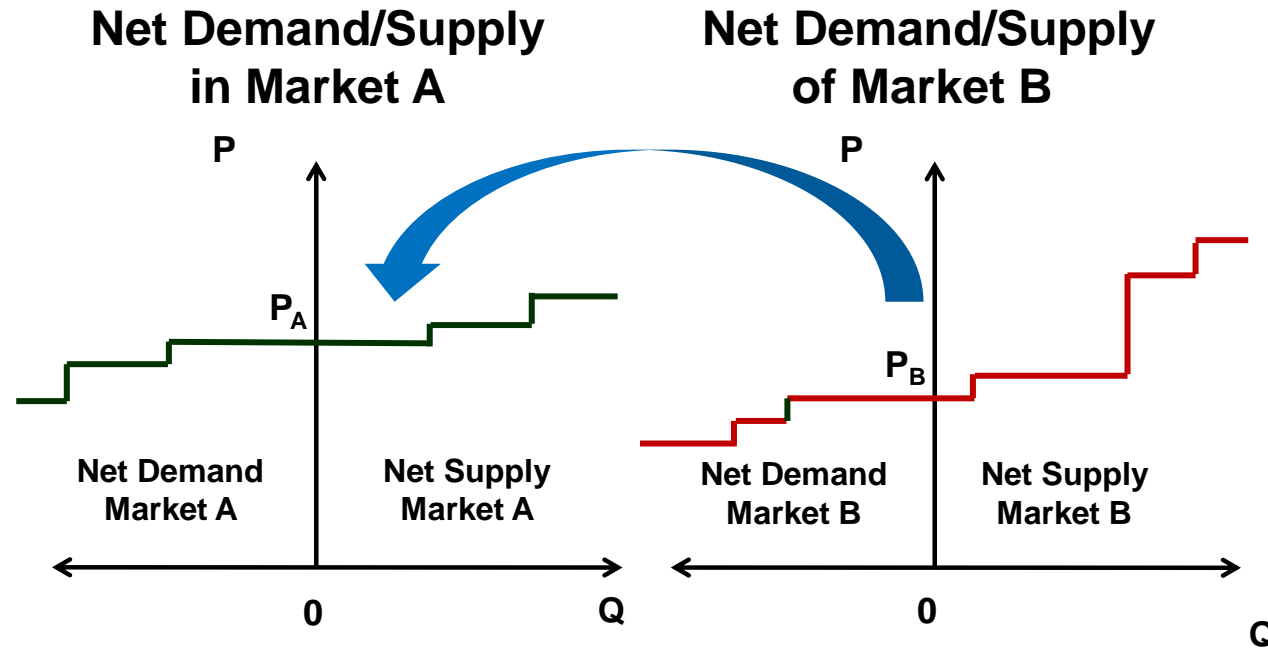


EP = Equilibrium Price
EQ = Equilibrium Quantity

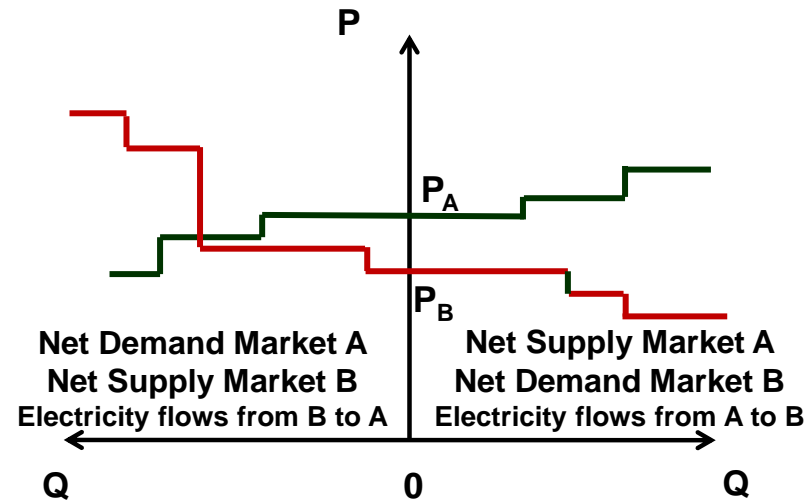
Electricity Market Coupling (2)



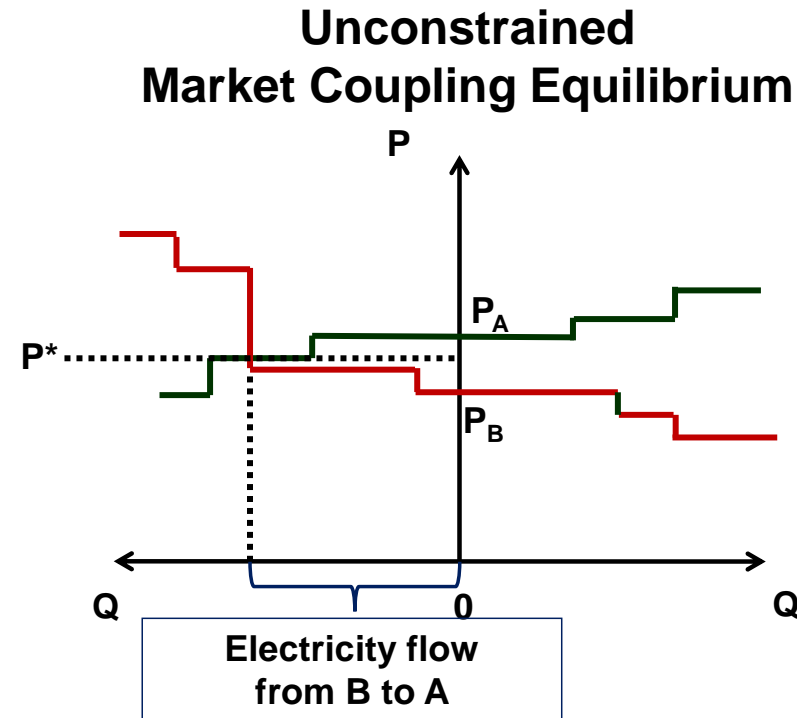
Electricity Market Coupling (3)



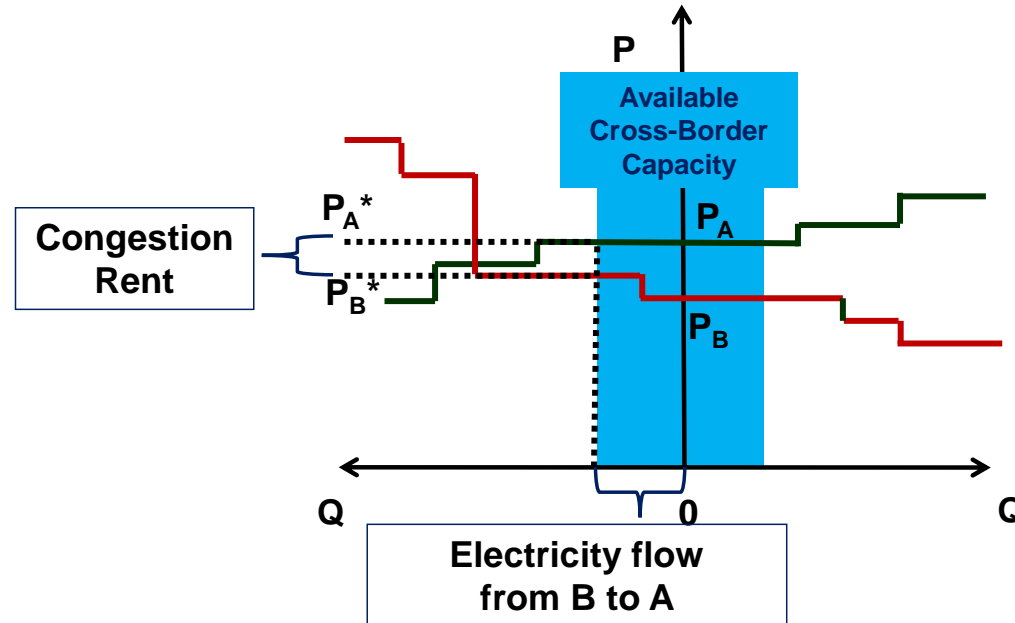
Market Coupling Equilibrium



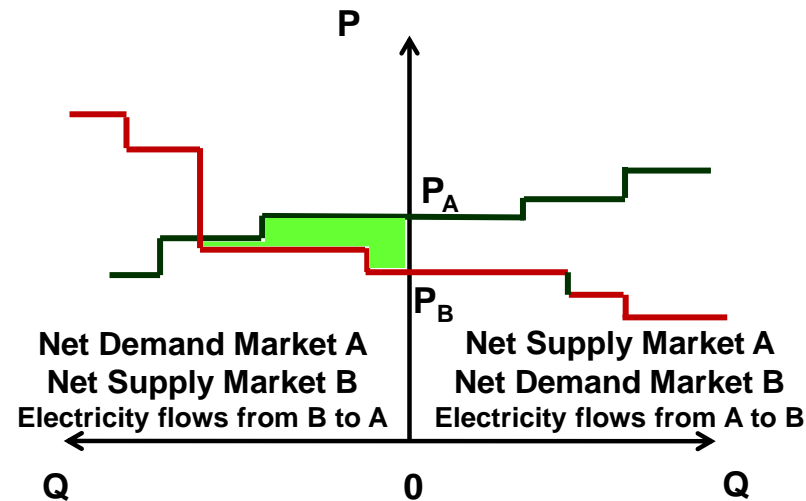
Electricity Market Coupling (5)



Market Coupling Equilibrium with Cross-Border Capacity Constraints



Market Coupling Equilibrium

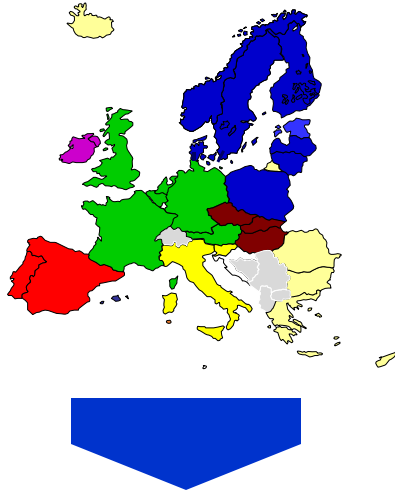


Gains from trading: cross-zonal exchanges provide opportunities for welfare-enhancing trading which are not available within the individual markets

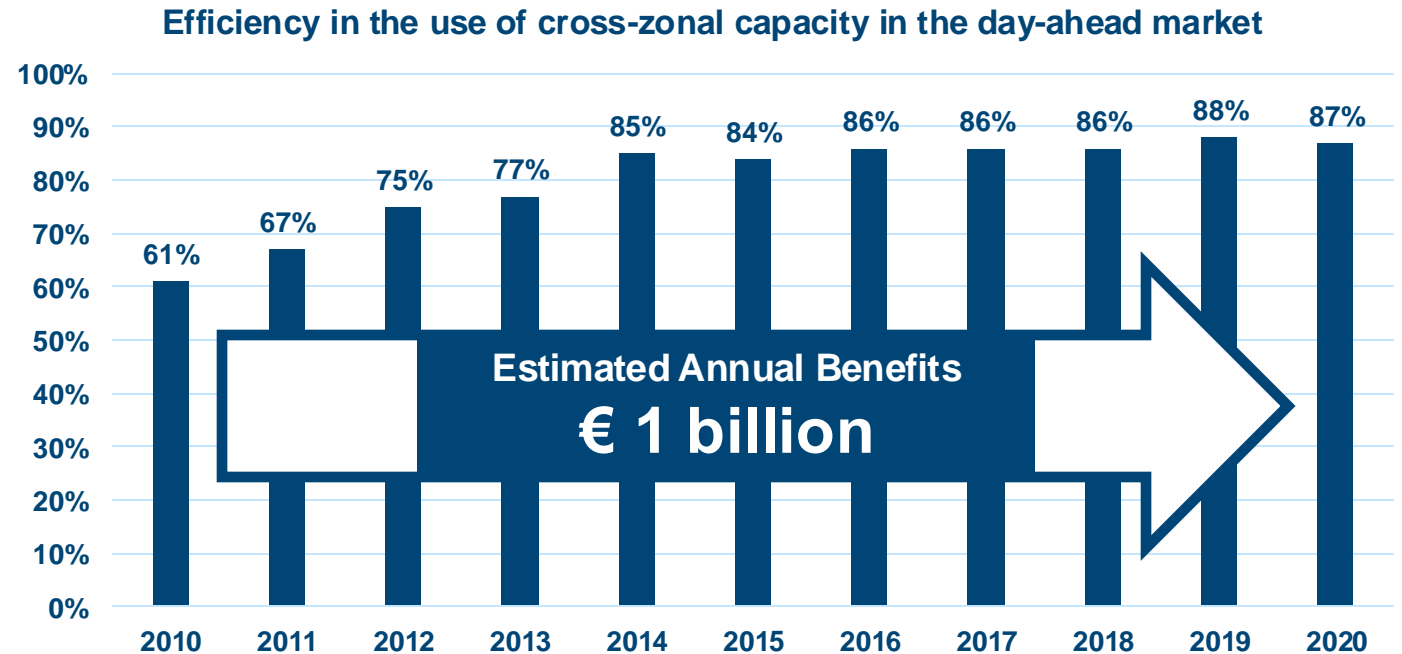
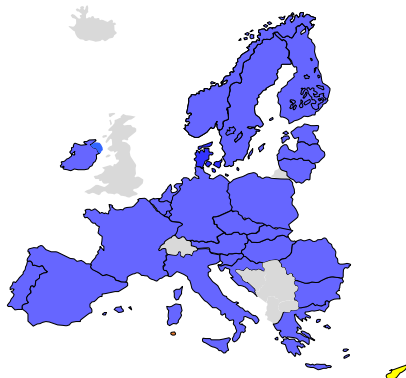
The Internal Electricity Market Day-ahead Market Coupling

Improving the efficiency in the use of the interconnection capacity

2013



2022

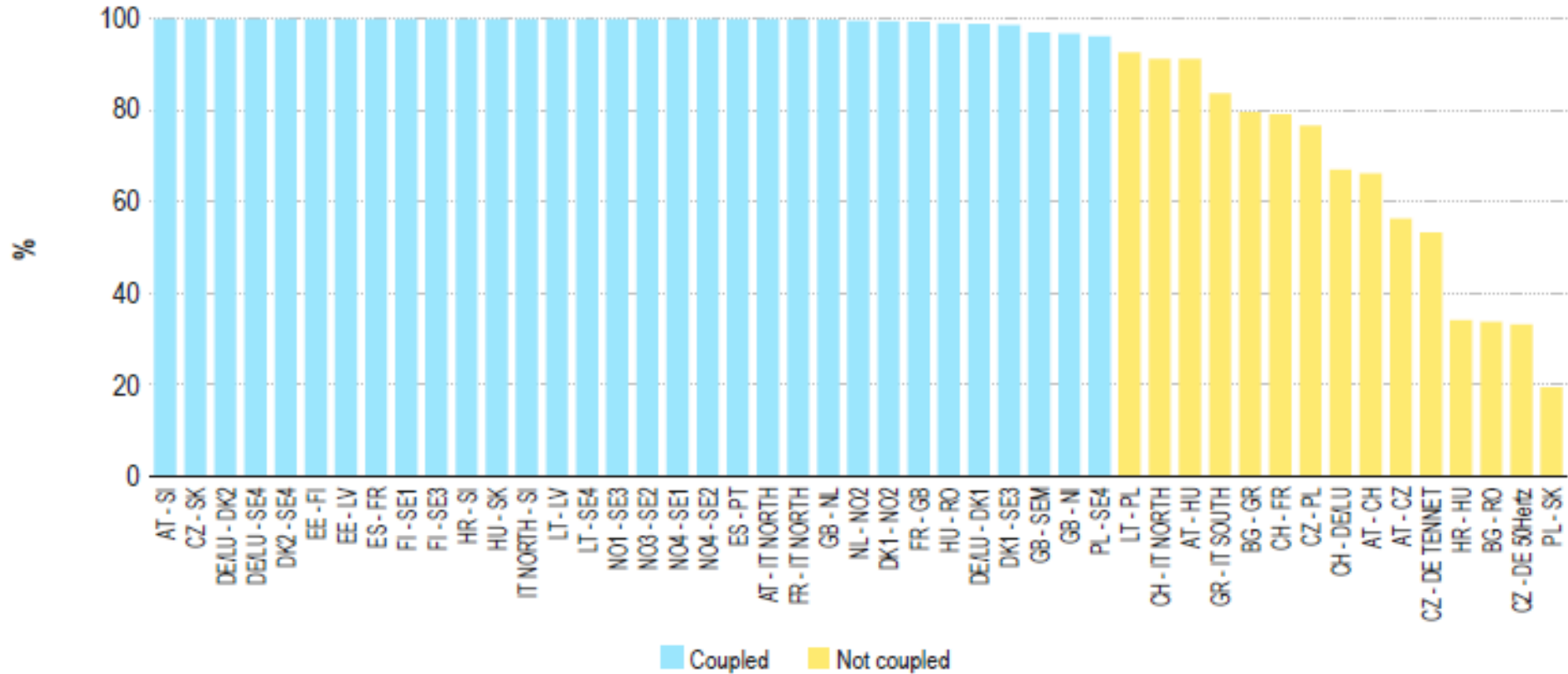


Source: ACER/CEER MMR 2020

EU Regulation on Capacity Allocation and Congestion Management

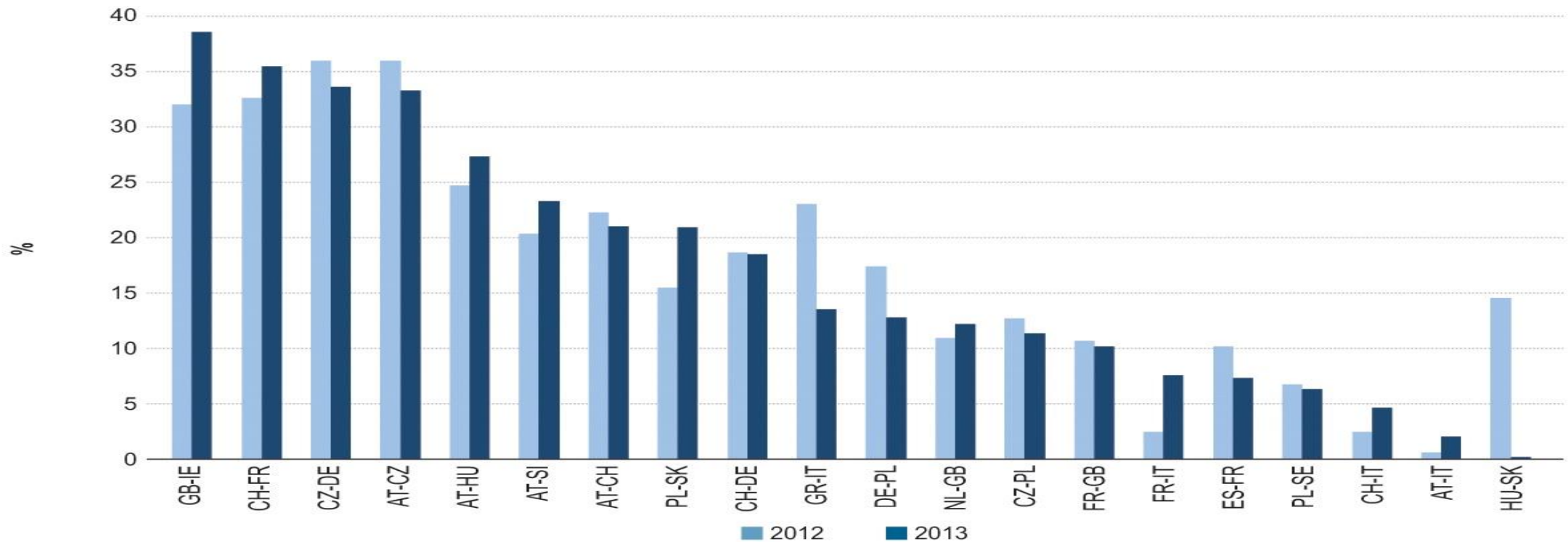
The Internal Electricity Market Day-ahead Market Coupling

Efficiency level in the use of cross-zonal capacity in the day-ahead market in 2020



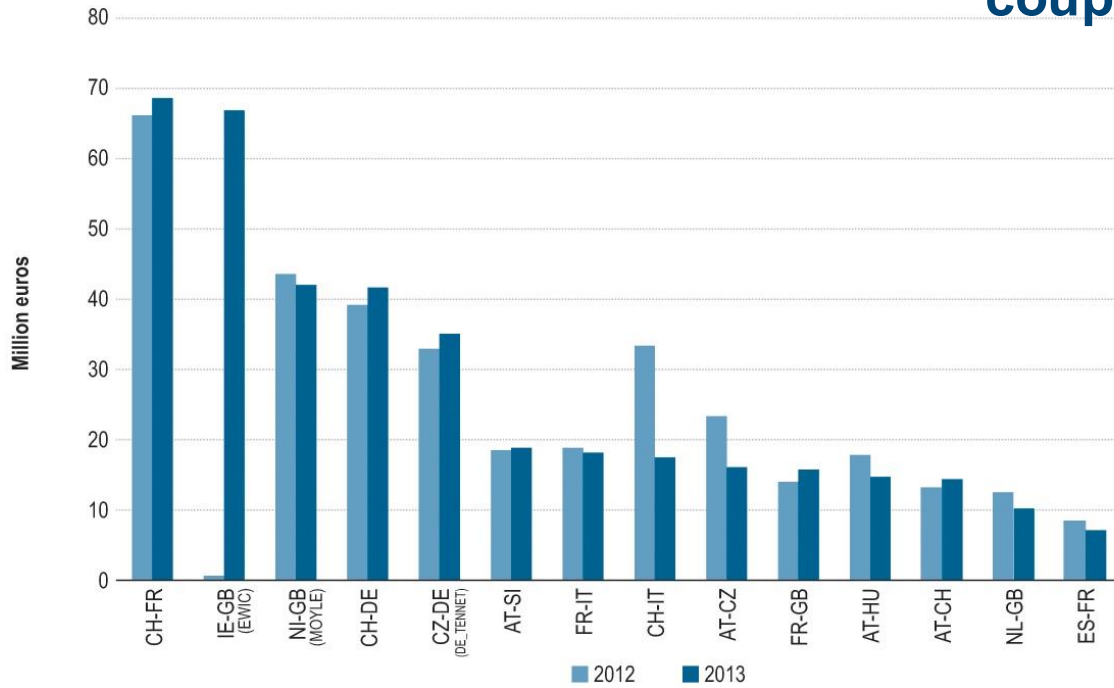
Without market coupling, electricity might move in the “wrong” direction ...

Percentage of hours with net day-ahead nominations against price differentials per border
2012-2013 (%)



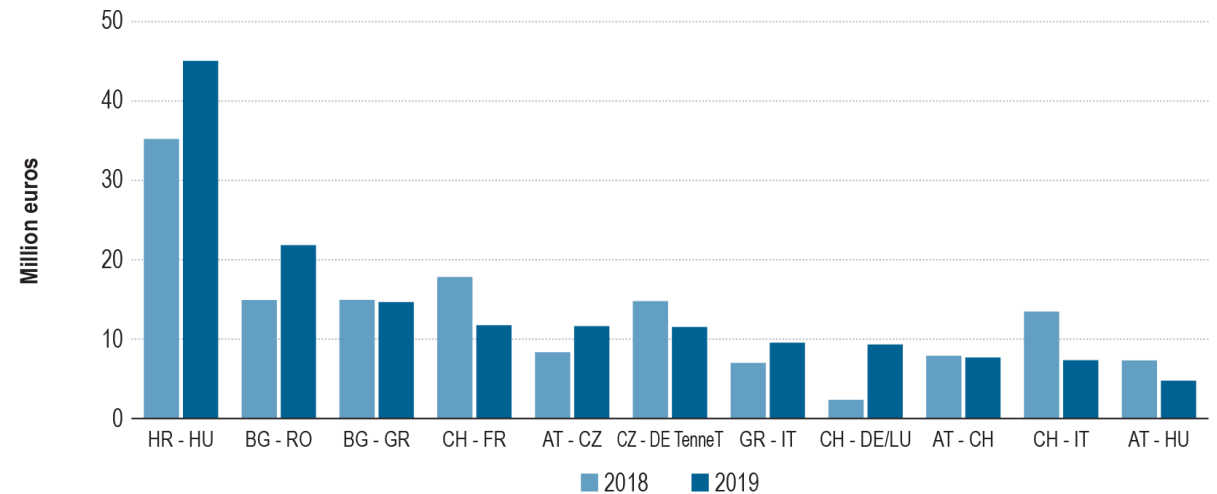
Welfare losses from the inefficient use of cross-border capacity

Estimated social welfare gains still to be obtained from further extending day-ahead market coupling per border (€m)



2012-2013 ≈ € 300-350 million

2018-2019 ≈ € 150-180 million



Poll 4, again – Опрос 4, снова

In your views, would a *greater integration of the electricity markets in Central Asia* provide *benefits to energy consumers* in the region?

- a. Yes
- b. Yes, but only if markets were fully integrated
- c. No, as disturbances in one country could more easily propagate to other countries in the region
- d. No, as it would be more difficult for one country fully to protect its consumers against high prices
- e. Prefer not to say

По Вашему мнению, может ли *большая интеграция рынков электроэнергии в Центральной Азии* принести *выгоду потребителям энергии* в регионе?

- a. Да
- b. Да, но только если рынки будут полностью интегрированы
- c. Нет, поскольку неполадки в одной стране могут легче распространяться на другие страны региона
- d. Нет, поскольку одной стране будет сложнее полностью защитить своих потребителей от высоких цен
- e. Предпочитаю не отвечать

The EU regulation of the power sector **That's all!**

Thank you for your attention!

