

# Introduction

- **Using a simple example with only two bidding zones, this presentation shows how spot prices and market flows are calculated.**
- **Appendix 1 explains the procedure *curtailment of spot bids*.**
- **In appendix 2, you'll find a list of the terms and acronyms used in this presentation.**
- **Concerning the documents referred to in this presentation:**
  - ❑ **Unless otherwise stated, you can download the documents from [www.houmollerconsulting.dk/facts-findings/](http://www.houmollerconsulting.dk/facts-findings/).**
- **This PowerPoint presentation is animated**
  - ❑ **It's strongly recommended to run the animation when viewing the presentation.**
- **On most computers, you can start the animation by pressing F5.**
  - ❑ **Now the presentation moves one step forward, when you press Page Down. It moves one step backward, when you press Page Up.**



# Market coupling

## Definition



**Market coupling is a day-ahead grid congestion management system:**

**Tomorrow's plans for the cross-border energy flows are calculated using the purchase bids and sales offers sent by the market players to the spot exchanges**

**This system is also called *implicit auction***

# Market coupling and spot price calculation – 1

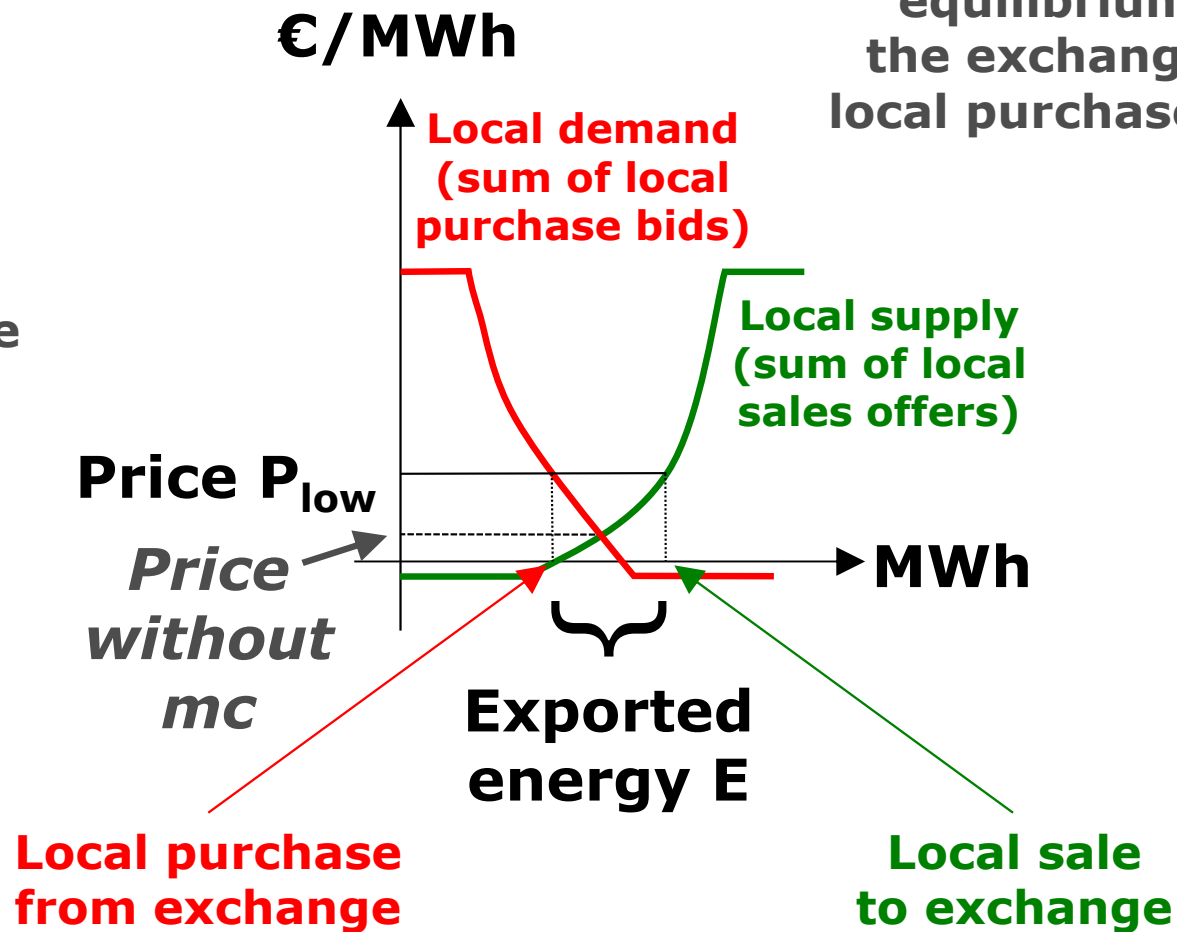
## For one hour. An **exporting zone**

By setting  $P_{low}$  higher than the local equilibrium price, the exchange gets a local purchase surplus.

*mc* means *market coupling*

Without *mc*, the local price is set at the intersection between the local demand curve and the local supply curve.

This is the *local equilibrium price*: at this price, the local sale to the exchange is equal to the local purchase from the exchange



The exchange's local purchase surplus is the exported energy E

# Market coupling and spot price calculation – 2

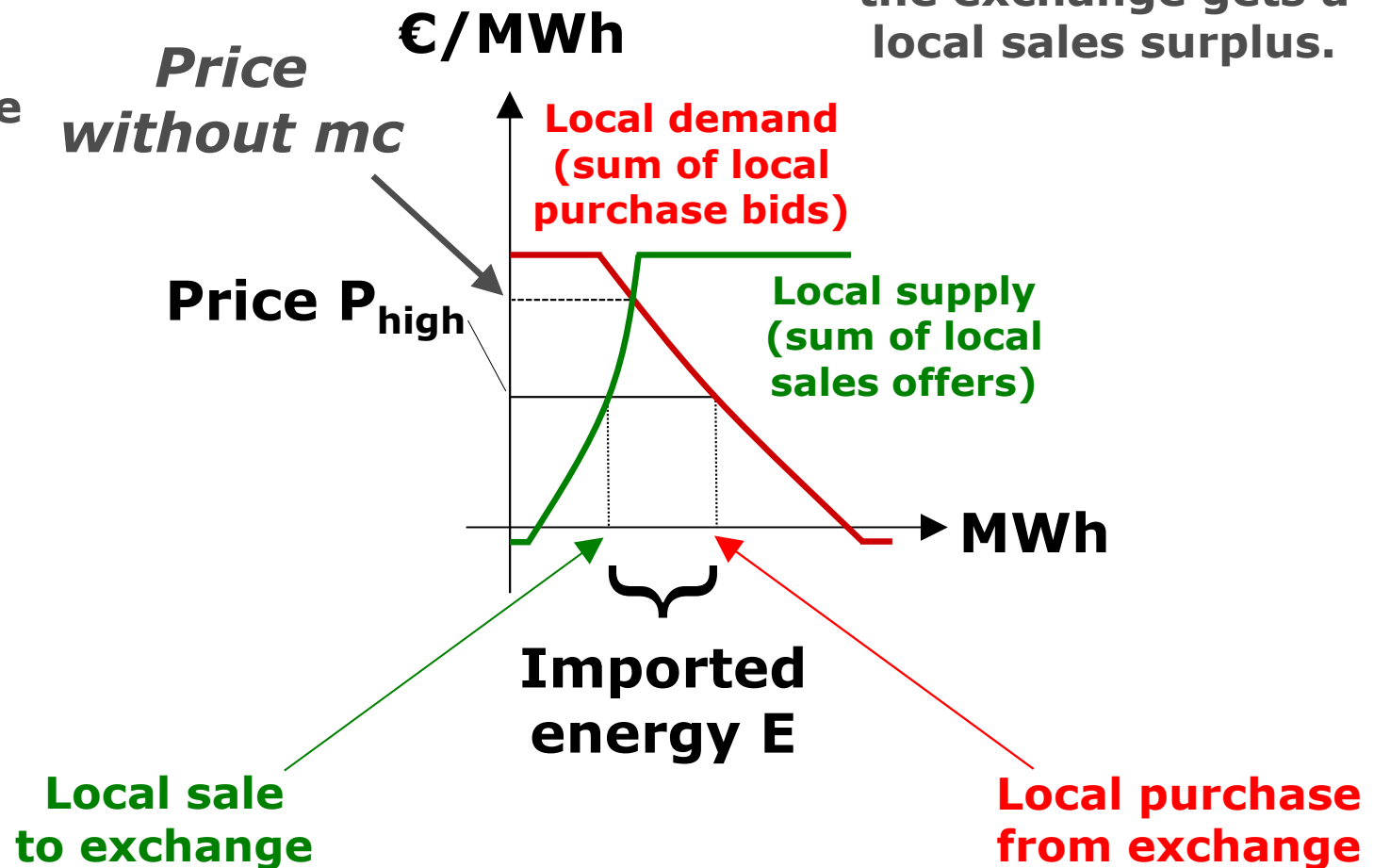
## For one hour. An **importing zone**

*mc* means  
*market coupling*

Without *mc*, the local price is set at the intersection between the local demand curve and the local supply curve.

This is the *local equilibrium price*: at this price, the local sale to the exchange is equal to the local purchase from the exchange

By setting  $P_{high}$  lower than the local equilibrium price, the exchange gets a local sales surplus.



# Market coupling and spot price calculation – 3

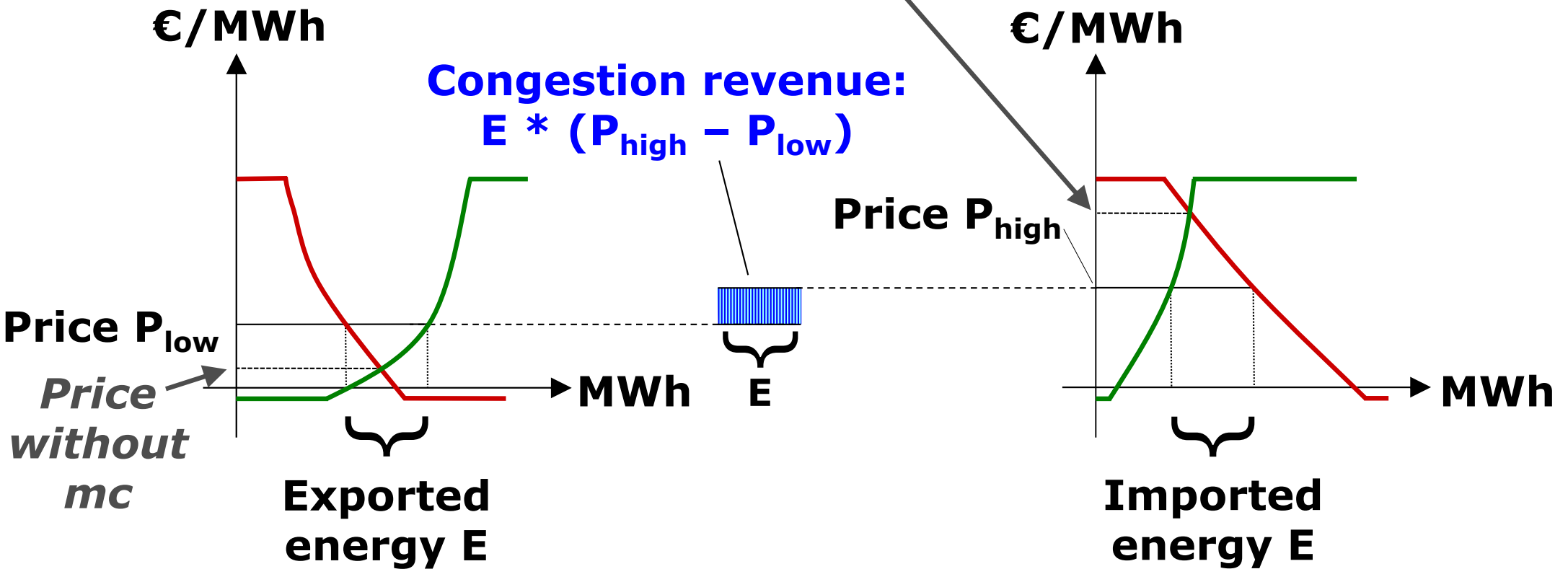
## For one hour. Only two bidding zones

*mc means market coupling*

**Exporting zone**

*Price without mc*

**Importing zone**



# Setting an exchange price

- **To set a price, an exchange needs to have both purchase bids and sales offers.**
- **This is true for any exchange – no matter what the exchange is trading.**
- **However, a spot exchange can set a price in a bidding zone, even if the zone has sales offers only.**
- **And a spot exchange can also set a price in a bidding zone, even if the zone has purchase bids only.**
- **In such cases, setting a price is possible, if another zone has the opposite type of bids.**



# Only sales offers in a bidding zone

- **Assume a bidding zone has sales offers only**
  - ❑ **No purchase bids in the zone.**
- **In this case, the zone becomes an exporting zone.**
- **By means of buyers in other zones, a spot exchange can set a price in such a zone.**



# Market coupling and spot price calculation – 4

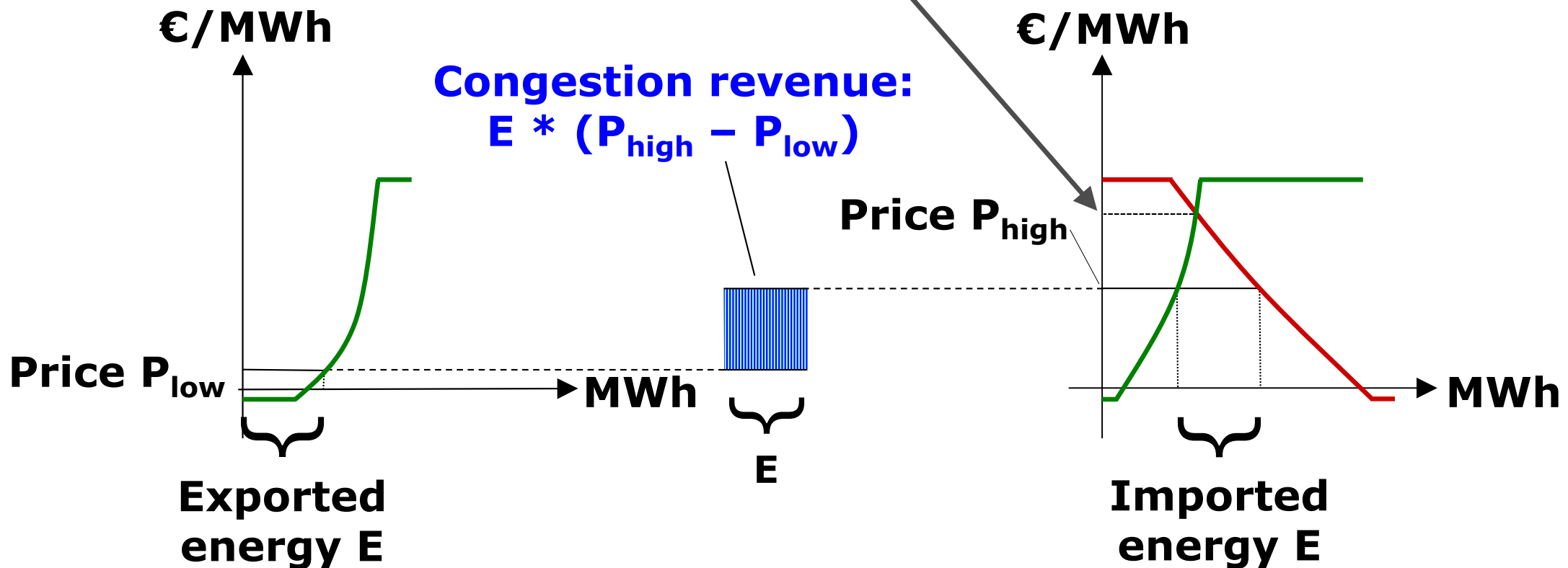
## For one hour. Only two bidding zones

**No purchase bids in exporting zone**

**Exporting zone**

*Price without mc*

**Importing zone**



*mc means market coupling*



# Only purchase bids in a bidding zone

- **Assume a bidding zone has purchase bids only**
  - ❑ **No sales offers in the zone.**
- **In this case, the zone becomes an importing zone.**
- **By means of **sellers in other zones**, a spot exchange can set a price in such a zone.**



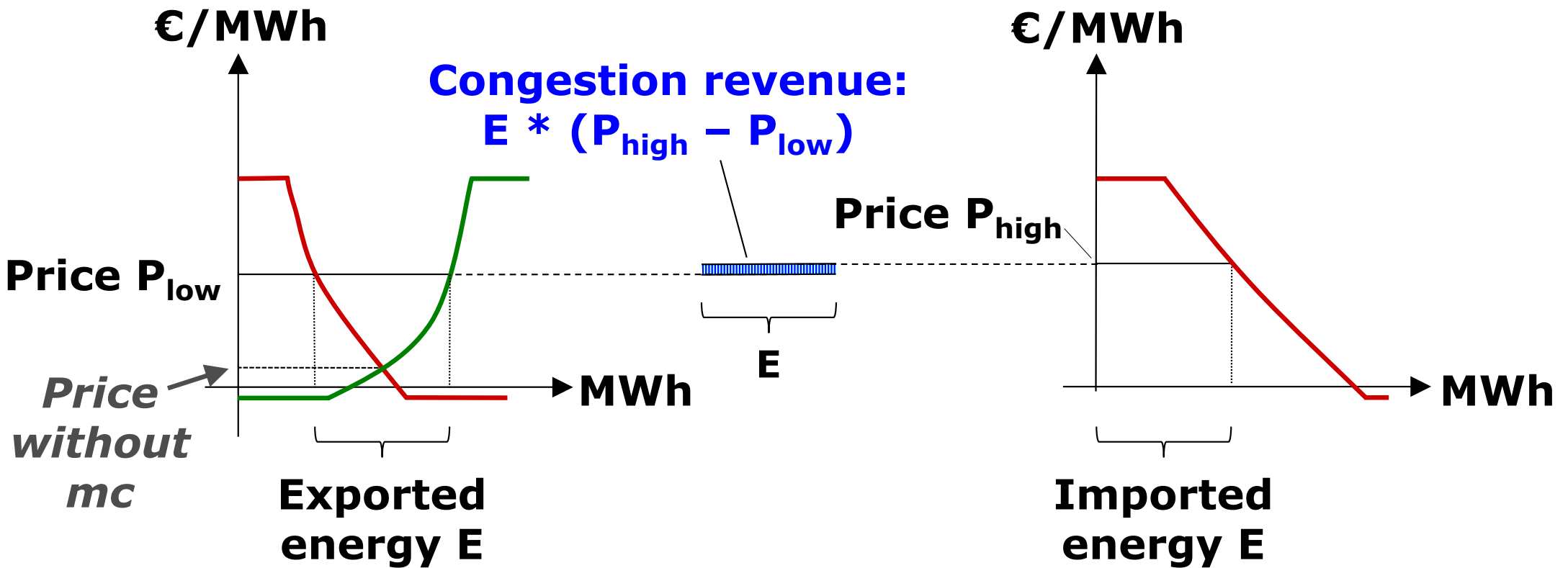
# Market coupling and spot price calculation – 5

## For one hour. Only two bidding zones

**No sales offers in importing zone**

Exporting zone

Importing zone



*mc means market coupling*

# Only two bidding zones

Only one type of bid in each zone

- **Assume one zone has sales offers only.**
- **And the other zone has purchase bids only.**
- **If there's ample cross-border grid capacity:**
  - ❑ **In this case, the two zones will have the same spot price.**
    - ✓ **The common price will be set by the intersection between the exporting zone's supply curve and the importing zone's demand curve.**
  - ❑ **Hence, it will work as if we had one bidding zone only.**
- **If the cross-border grid capacity is not big enough to allow a common price for the two zones:**
  - ❑ **In this case, the prices are set as shown at the next slide.**



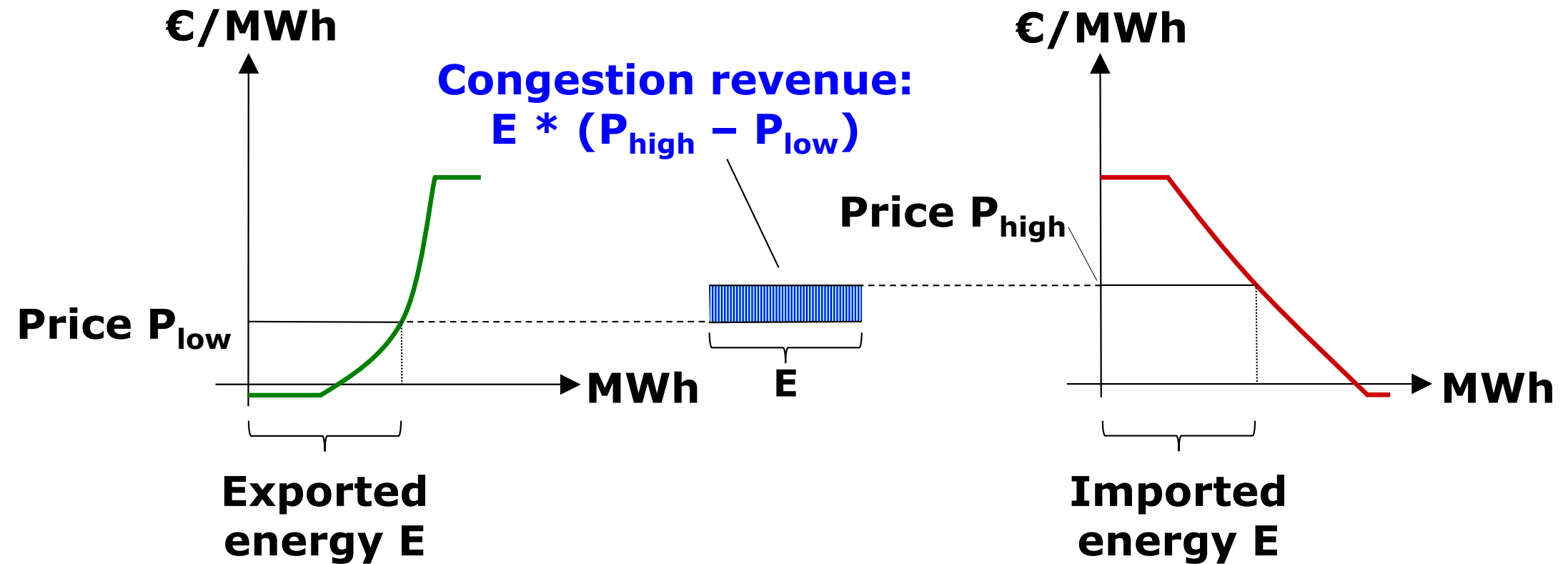
# Market coupling and price calculation – 6

## For one hour. Only two bidding zones

No purchase bids in exporting zone and no sales offers in importing zone

Exporting zone

Importing zone



# Two bidding zones only

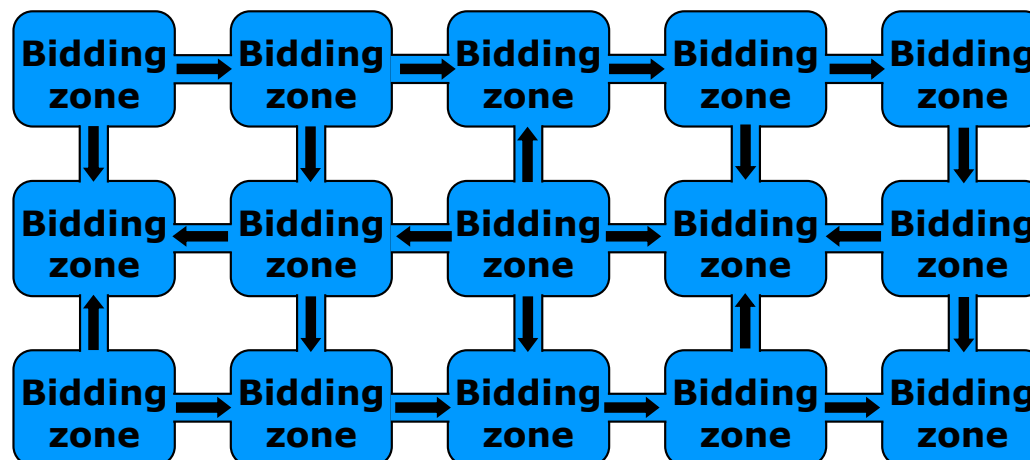
**No bids in one of the zones**

- **Assume one of the two zones has neither purchase bids nor sales offers.**
- **In this case, the two zones get the same spot price.**
- **This common spot price is the price set in the zone having purchase bids and sales offers.**
- **The other zone simply gets this price.**



# More than two bidding zones

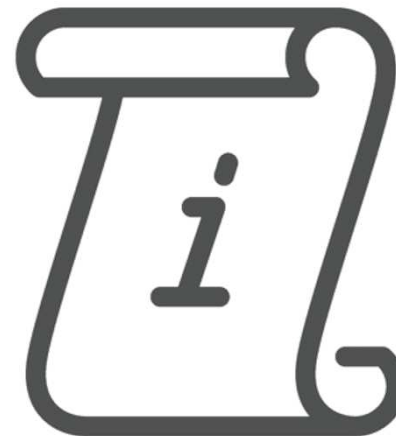
- The slides no. 5-8 in the PowerPoint presentation *Energy island's spot price and market coupling flows* discuss a case, where you have several bidding zones
  - ❑ With no purchase bids in one of the zones.
- In the case, the bidding zone without purchase bids is supposed to be an energy island.
- However, the case applies to any situation, where you have several bidding zones
  - ❑ With one zone having sales offers only.



# More information

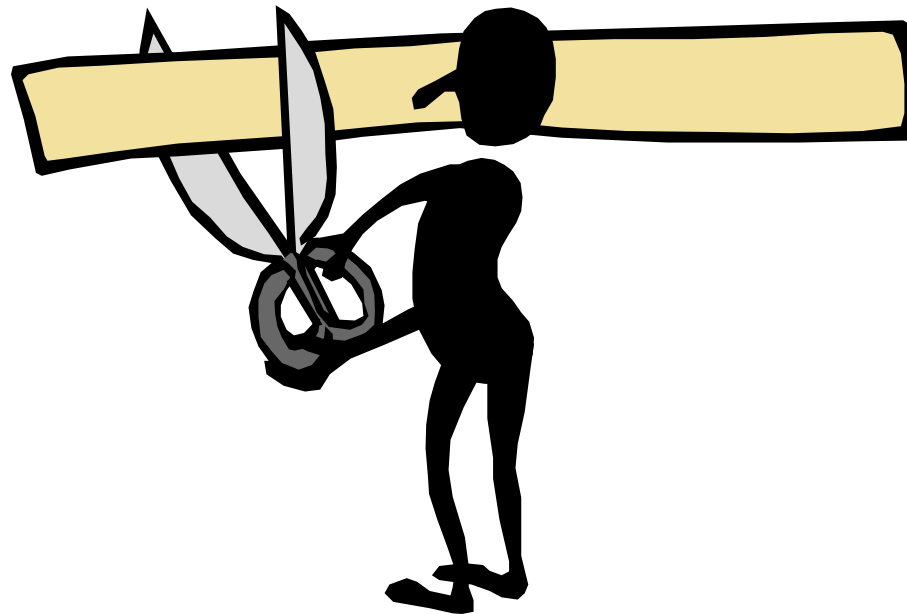
## Spot price calculation without market coupling

- **It's recommended to view the PowerPoint presentation *Spot trading* as a supplement to this presentation**
  - **Appendix 1 of the presentation *Spot trading* shows how the spot price is calculated**
    - ✓ **For a simple example, where you have one bidding zone only**
      - **Consequently, no calculation of market coupling flows.**



# Appendix 1

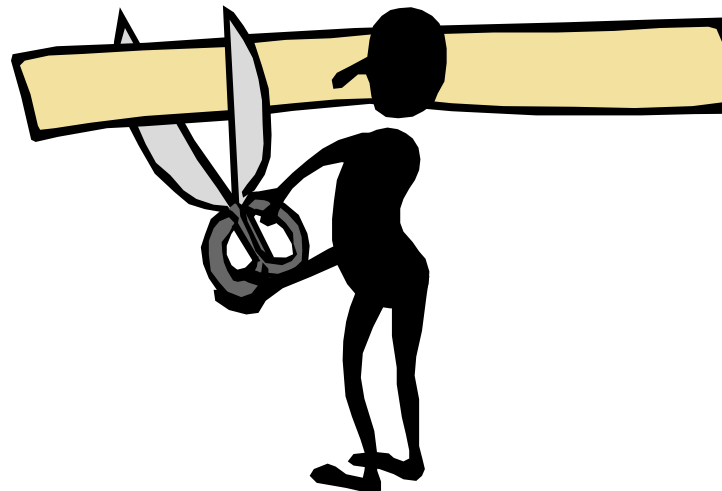
## Curtailment of spot bids





# Curtailment of spot bids

- **This appendix explains the procedure applied if:**
  - ❑ **A bidding zone has too few purchase bids.**
  - ❑ **A bidding zone has too few sales offers.**
- **For simplicity, at the following 4 slides, we'll ignore market coupling**
  - ❑ **Hence, we'll consider an isolated bidding zone.**

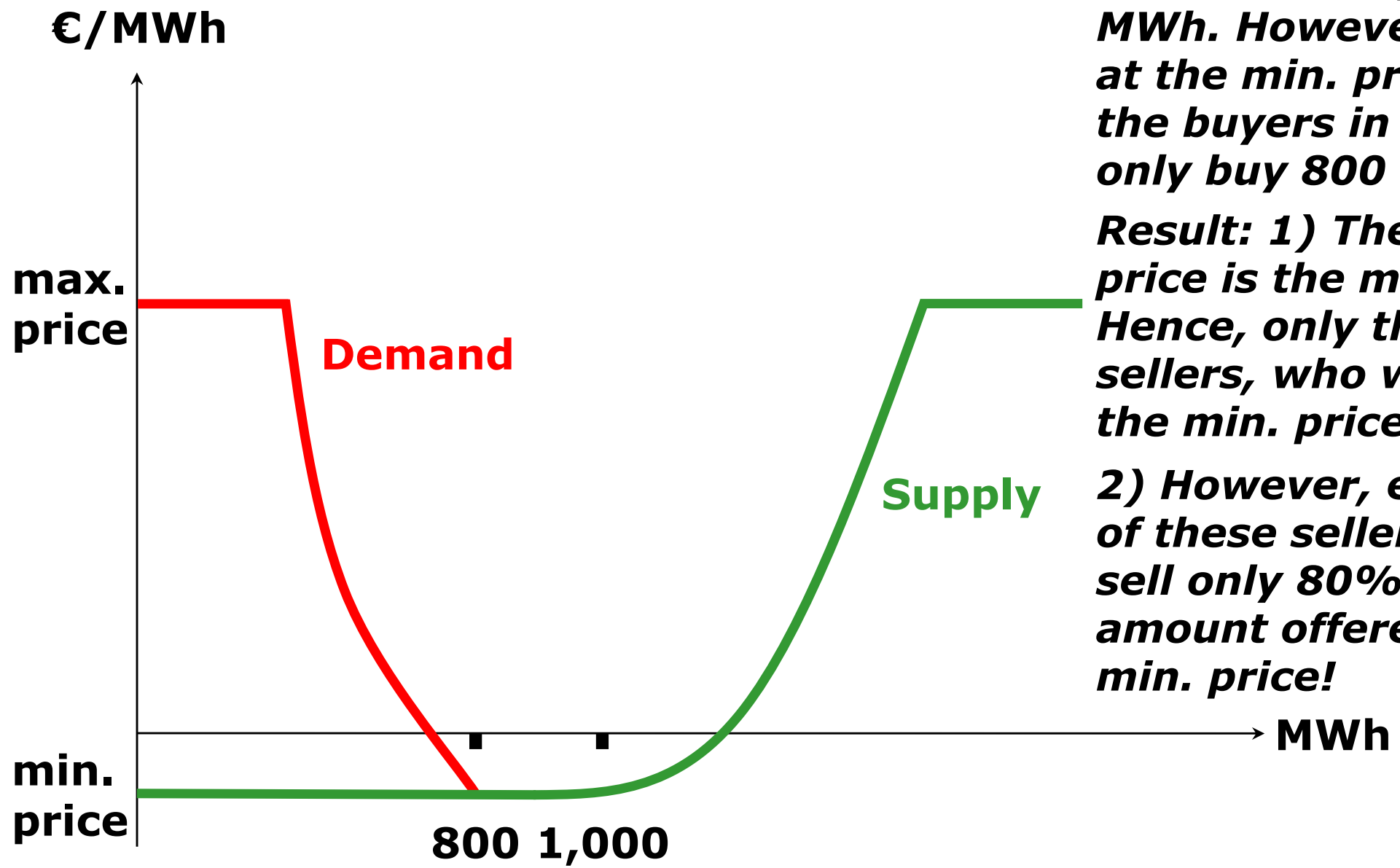


# Curtailment of spot sale offers – 1

Example for one bidding zone for one hour

*Example: At min. price, all the sellers in total want to sell 1,000 MWh. However, even at the min. price, all the buyers in total will only buy 800 MWh.*

*Result: 1) The spot price is the min. price. Hence, only those sellers, who will sell at the min. price, get sale. 2) However, even each of these sellers will sell only 80% of the amount offered at the min. price!*



# Curtailment of spot sale offers – 2

- **This procedure is called "*curtailment of sales offers*".**
  - ❑ **Only sellers willing to sell at the min. price, actually sell anything**
    - ✓ **However, even each of these sellers will only sell a certain percentage of the volume offered at the min. price (as there are not buyers to the whole sale volume).**
  - ❑ **All block sales offers containing the hour in question are rejected**
    - ✓ **As a block bid is an *all-or-nothing* bid**
      - **ie, either the seller sells the whole volume – or the seller sells nothing.**

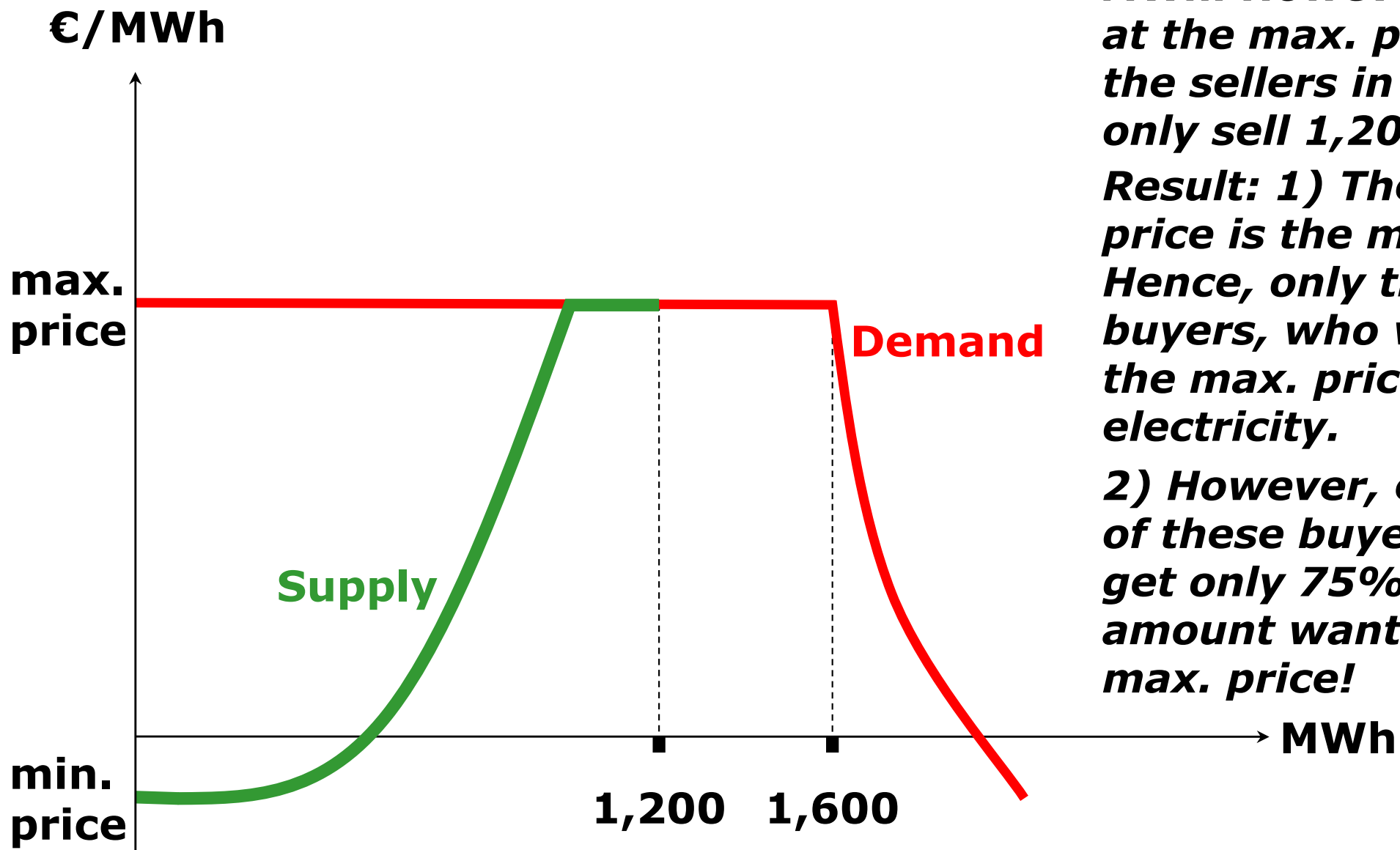
# Curtailment of spot purchase bids – 1

Example for one bidding zone for one hour

*Example: At max. price, all the buyers in total want to buy 1,600 MWh. However, even at the max. price, all the sellers in total will only sell 1,200 MWh.*

*Result: 1) The spot price is the max. price. Hence, only those buyers, who will buy at the max. price, get electricity.*

*2) However, even each of these buyers will get only 75% of the amount wanted at the max. price!*



# Curtailment of spot purchase bids – 2

- This procedure is called "*curtailment of purchase bids*".
  - ❑ Only buyers willing to buy at the max. price, actually get purchase
    - ✓ However, even each of these buyers will only get a certain percentage of the volume wanted at the max. price (as there are not sellers to the whole purchase volume).
  - ❑ All block purchase bids containing the hour in question are rejected
    - ✓ As a block bid is an *all-or-nothing* bid
      - ie, either the buyer buys the whole volume – or the buyer buys nothing.
- "*Curtailment of bids*" is the common term for curtailment of sales offers and curtailment of purchase bids.

# Market coupling and curtailment of spot bids

- **With a bit of luck, market coupling can prevent curtailment of spot bids.**
- **If a zone has too few purchase bids:**
  - ❑ **Export of energy created by market coupling may remove the surplus of energy**
    - ✓ **Thereby providing a spot price higher than the minimum price.**
- **If a zone has too few sales offers:**
  - ❑ **Import created by market coupling may eliminate the deficit of energy**
    - ✓ **Thereby providing a spot price lower than the maximum price.**
- **However, this is not always the case.**
- **During the summer 2023, in large parts of Europe, we had hours with minimum spot prices.**
- **In Western Denmark, some years ago, we had two hours where the spot price was at the maximum.**

# Spot prices Sunday 2 July 2023

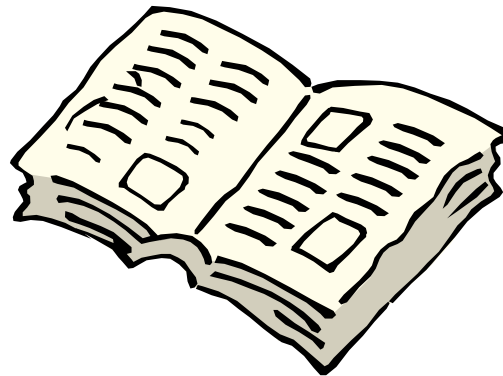
## In €/MWh

**This day had high production from both wind and solar**

Hour (CEST time)	Albania	HU	Croatia	Greece	AT	BE	DE-LU	FR	NL	UK	EE	LV	LT
00 - 01	95,25	16,45	16,45	111,75	16,45	16,45	16,45	16,45	16,45	29,10	16,45	16,45	16,45
01 - 02	87,17	3,17	3,17	107,92	3,17	3,17	3,17	3,17	3,17	18,66	3,17	3,17	3,17
02 - 03	85,55	0,01	0,01	105,69	0,01	0,01	0,01	0,01	0,01	2,44	0,01	0,01	0,01
03 - 04	85,02	0,00	0,00	101,39	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00
04 - 05	83,24	-0,01	-0,01	100,49	-0,02	-0,03	-0,03	-0,03	-0,03	0,01	-0,03	-0,03	-0,03
05 - 06	80,36	-0,05	-0,05	104,55	-0,05	-0,05	-0,05	-0,05	-0,05	0,00	-0,05	-0,05	-0,05
06 - 07	78,59	-0,02	-0,02	168,35	-0,03	-0,05	-0,05	-0,05	-0,06	-0,01	-0,02	-0,02	-0,02
07 - 08	81,24	-0,15	-0,18	120,31	-0,29	-0,49	-0,50	-0,47	-0,51	-2,90	0,00	0,00	0,00
08 - 09	67,35	-0,95	-1,11	20,12	-1,75	-2,90	-2,95	-2,75	-2,97	-10,06	-0,10	-0,10	-0,10
09 - 10	55,71	0,00	-0,71	0,00	-6,42	-13,70	-15,07	-12,92	-16,90	-13,82	0,01	0,01	0,01
10 - 11	48,61	0,55	-3,91	3,00	-11,08	-23,07	-37,00	-23,01	-60,00	-16,10	0,01	0,01	0,01
11 - 12	37,38	0,99	-7,38	0,01	-23,54	-6,46	-98,11	-19,17	-252,92	-6,48	0,00	0,00	0,00
12 - 13	39,49	0,05	-12,35	0,20	-38,68	0,00	-167,96	-23,78	-449,57	-4,49	0,00	0,00	0,00
13 - 14	36,06	-34,00	-45,76	0,00	-86,93	-17,00	-266,92	-20,00	-500,00	-14,23	0,00	0,00	0,00
14 - 15	31,26	-500,00	-500,00	0,00	-500,00	-100,00	-500,00	-55,66	-500,00	-41,95	0,00	0,00	0,00
15 - 16	35,33	-32,88	-64,34	0,00	-134,94	-120,00	-399,00	-134,94	-500,00	-47,53	-0,08	-0,08	-0,08
16 - 17	48,04	2,59	-12,65	49,89	-36,61	-100,00	-124,21	-79,44	-172,39	-30,37	0,00	0,00	0,00
17 - 18	69,42	37,96	32,63	80,00	0,08	-32,74	-35,18	-27,38	-35,18	-0,01	-0,03	-0,03	-0,03
18 - 19	95,26	50,83	47,77	101,69	19,18	-3,86	-6,01	-0,01	-6,01	3,07	0,00	0,00	0,00
19 - 20	117,19	86,24	80,93	109,30	40,76	7,94	4,83	13,37	4,88	30,81	4,97	4,97	4,97
20 - 21	134,2	89,24	87,27	110,75	77,30	69,80	69,09	71,04	69,10	72,15	28,47	28,47	28,47
21 - 22	127,25	90,06	89,37	112,47	86,72	85,70	85,61	85,91	85,58	85,68	28,28	28,28	28,28
22 - 23	114,75	94,90	94,90	102,62	94,90	94,90	94,90	94,90	94,90	90,66	21,33	21,33	21,33
23 - 00	104,19	86,08	86,08	123,84	86,08	86,08	86,08	86,08	86,08	81,47	16,83	16,83	16,83
Min	31,26	-500,00	-500,00	0,00	-500,00	-120,00	-500,00	-134,94	-500,00	-47,53	-0,10	-0,10	-0,10
Max	134,20	94,90	94,90	168,35	94,90	94,90	94,90	94,90	94,90	90,66	28,47	28,47	28,47
Average	76,58	-0,37	-4,58	72,26	-17,32	-2,35	-53,87	-1,20	-89,02	9,42	4,97	4,97	4,97
	Albania	HU	Croatia	Greece	AT	BE	DE-LU	FR	NL	UK	EE	LV	LT

# Appendix 2

## Terminology and acronyms





# Terminology and acronyms – 1

## As used in this presentation

- ***Bidding zone*** A geographical area, within which the players can trade electrical energy day-ahead without considering grid bottlenecks.
- ***Block bid*** See appendix 1 of the PowerPoint presentation ***Market coupling – European price coupling***.
- ***Flow*** Short for market coupling flow.
- ***Market coupling*** See the PDF document ***The Liberalized Electricity Market*** and the PowerPoint presentation ***Unbundling and EU's Single Electricity Market***.
- ***Market coupling flow*** Plan for the next day's cross-border energy flows calculated by the spot calculation system. See also market coupling.
- ***Maximum price*** At the time of writing, for most spot exchanges in the SDAC area, the maximum price is 4,000 €/MWh.
- ***Minimum price*** At the time of writing, for most spot exchanges in the SDAC area, the minimum price is -500 €/MWh.

# Terminology and acronyms – 2

## As used in this presentation

- **SDAC** Single Day-Ahead Coupling. See [https://www.entsoe.eu/network\\_codes/cacm/implementation/sdac/](https://www.entsoe.eu/network_codes/cacm/implementation/sdac/)
- **Spot calculation system** In this document, this means the system, which calculates both the spot prices and the market coupling flows.
- **Spot exchange** an exchange where players can do spot trading.
- **Spot price** See the PowerPoint presentation *Maximizing the economic value of market coupling and spot trading*.
- **Spot trading** In this document, this means trading electrical energy day-ahead with an exchange.

“Day-ahead” means the players are selling & buying electrical energy, which is produced & consumed the next day.

The prices, at which the players trade, are set by using the demand and supply curves created by the players’ bids.

# **Thank you for your attention!**

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