Regulation and Policies on Electricity Markets

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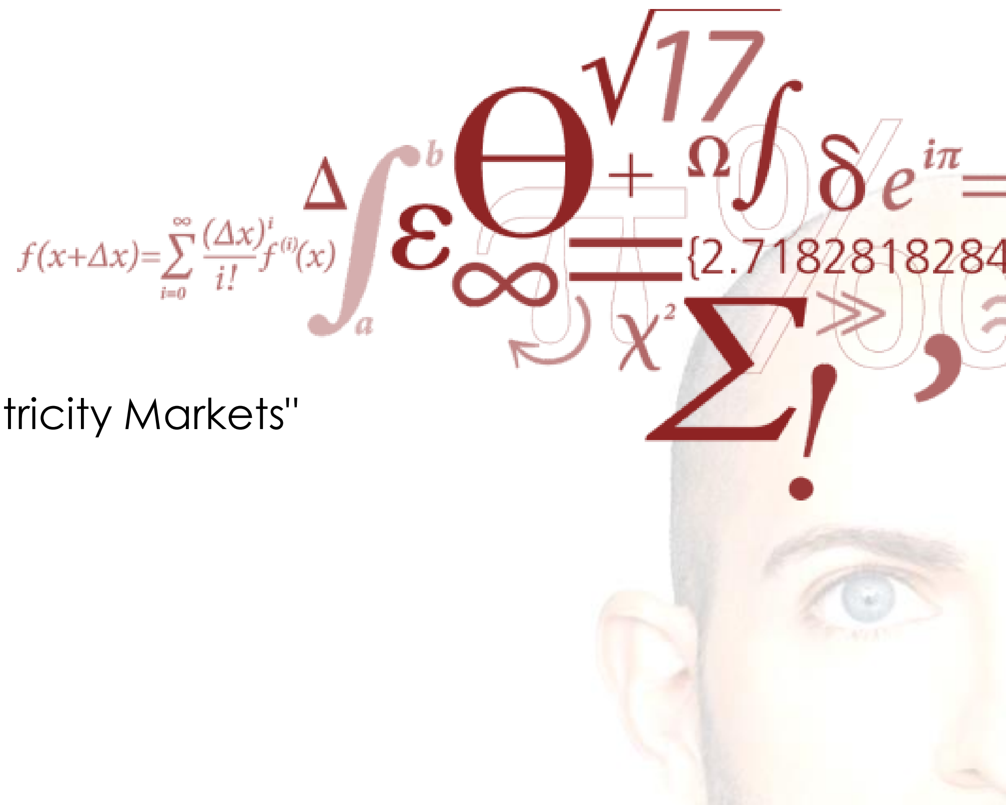

Lecture 3 in "31761 - Renewables in Electricity Markets"
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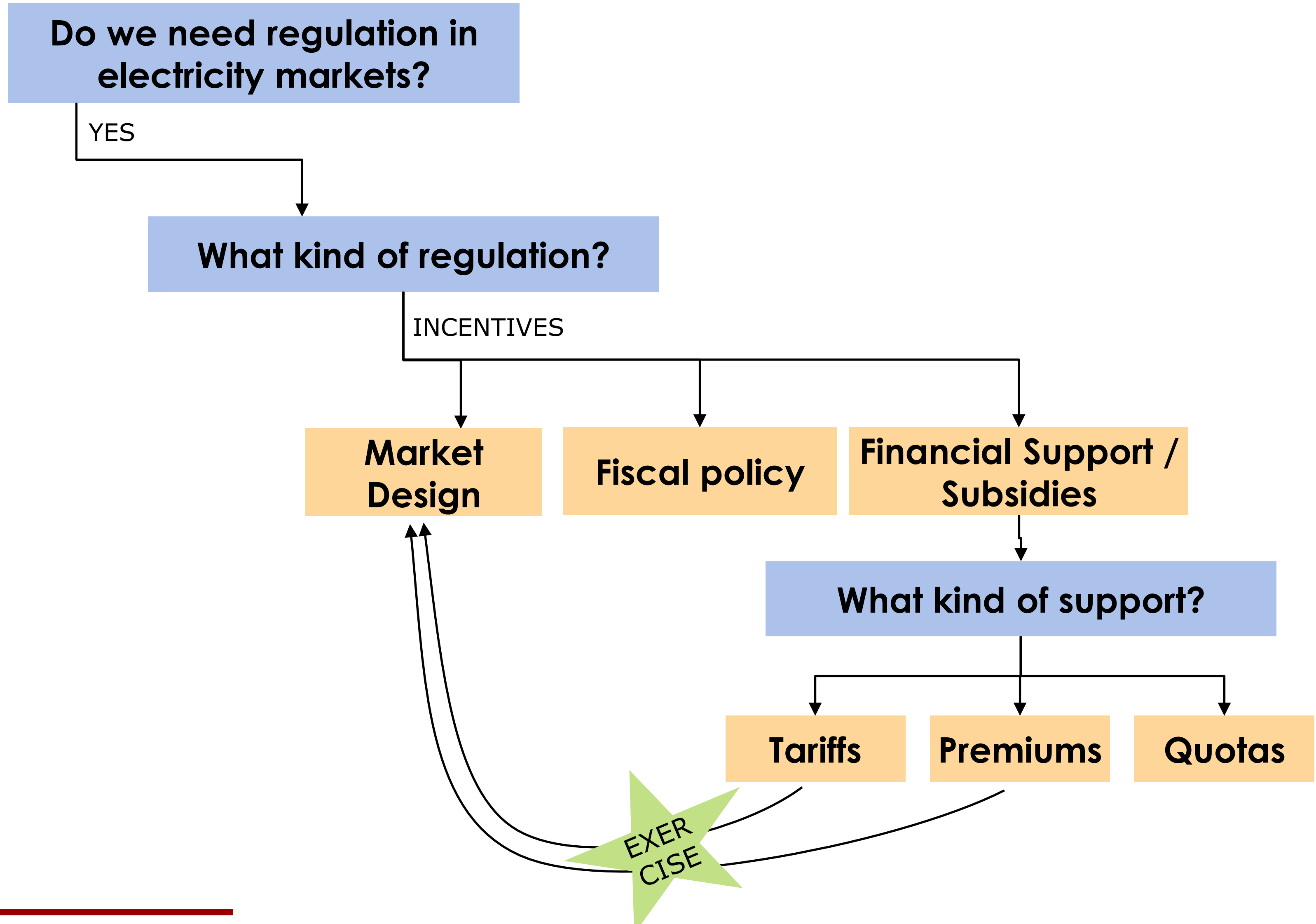
DTU Management Engineering
Department of Management Engineering

AGENDA - The red thread of this session



Regulation in the electricity system

- Until the 1980s, the electricity system was mainly treated as a physical infrastructure system. It should primarily supply the required services.
- In the 1980's and 1990's, energy was treated more and more as a commodity, which could be left to market forces.
- The electricity system was divided into:
  - a natural monopoly part (--> regulated industry)
  - a commercial part (--> market competition)
- Until 2000, most European countries had newly established commercial markets for the electricity system.
- In the view of many economists, the liberalised supply and trade area should operate in an efficient way when left alone.
- From the 2000s, the view on the markets became more pluralistic: New objectives started to become more important and regulation became more important again.

Different approaches: Consumer cooperatives and state-owned monopolies (Denmark) or private-owned monopolies (USA), or a mixture of both (Germany).

New objectives:

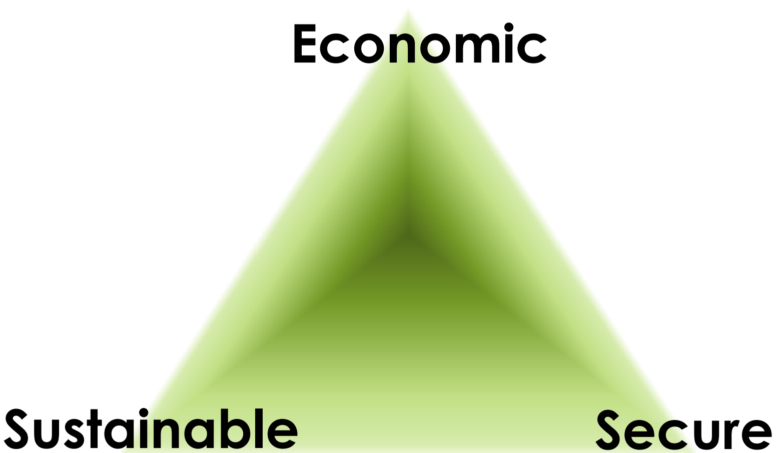
1. Security of supply (independence from fossil fuels)
2. Climate change

Sources: Helm 2007

Objectives of energy policy and regulation

The **'trichotomy'** of energy policy:

Energy supply shall be:



- Only policy makers and regulators can navigate the different objectives for the whole system
- There will always be a trade-off between these three objectives
- The balance also depends on the political convictions of the current policy makers.

Short re-cap: marginal pricing on the market

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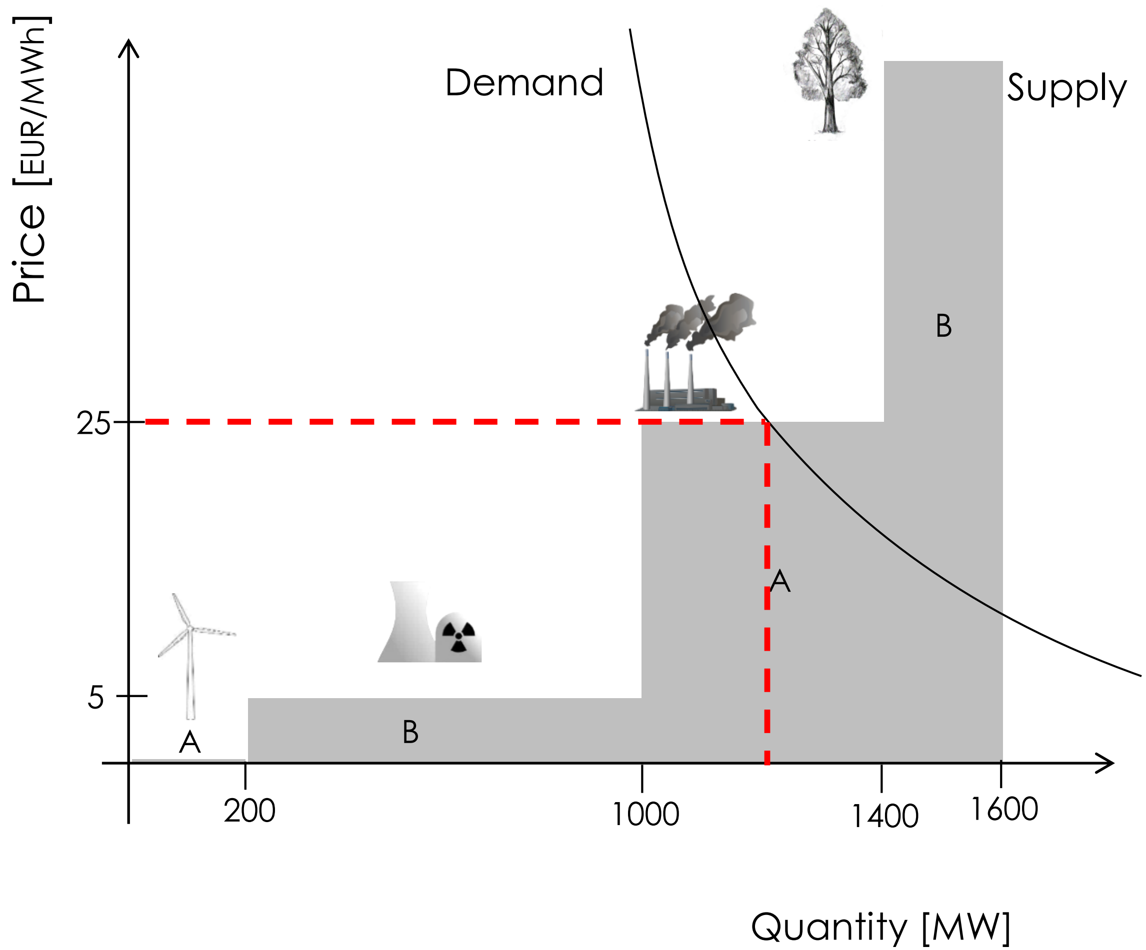
Market bid: Player A

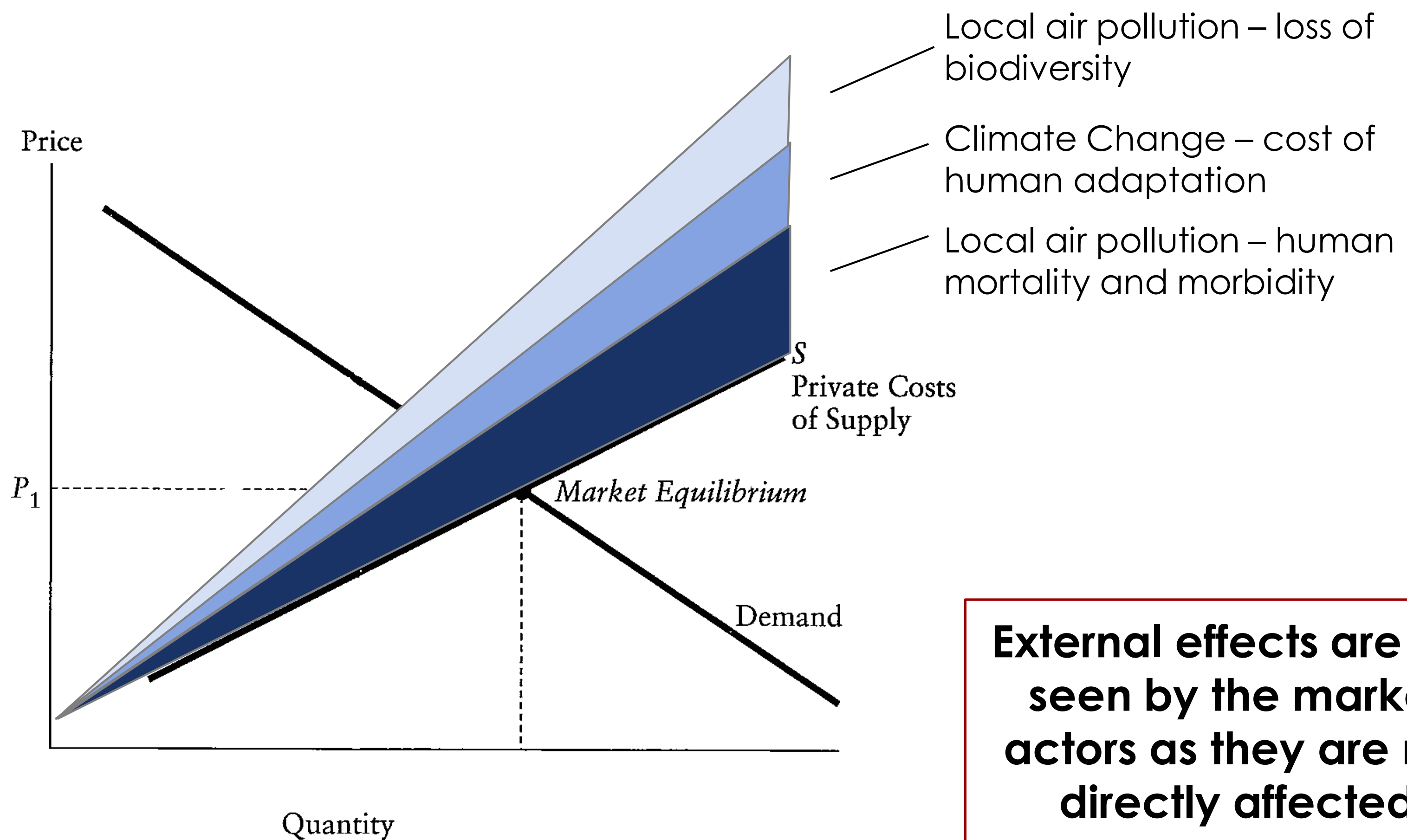
	Volume	Price
	200 MW	0 EUR/ MWh
	400 MW	25 EUR/ MWh

Market bid: Player B

	Volume	Price
	800 MW	5 EUR/ MWh
	200 MW	50 EUR/ MWh



Efficient Markets: Marginal cost and benefits



External effects are not seen by the market actors as they are not directly affected

Market failures and need for regulation

1. **Complementarity** to the rest of the economy
   → societal costs of scarcity (excess demand) are higher than those of excess supply
2. **Just-in-time** requirements: Storage options are extremely limited
   → supply and demand must be kept balanced at all times for technical reasons, economic cycles to adjust demand/supply may become problematic
3. **Natural monopoly** in the network/grid segment
   → shared pool, i.e. a public good to the system as a whole – undersupplied by markets
4. **Positive externalities**, such as innovation processes, job creation, security of supply, social and equity issues,…)
5. **Negative environmental externalities** (emissions from fossil fuels)
   → if not adequately internalised, they cause wrong incentives

Regulation is needed to govern sufficient, stable supply in the interest of society and to internalise externalities

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Do we need regulation in electricity markets?

YES

What kind of regulation?

Setting the right incentives

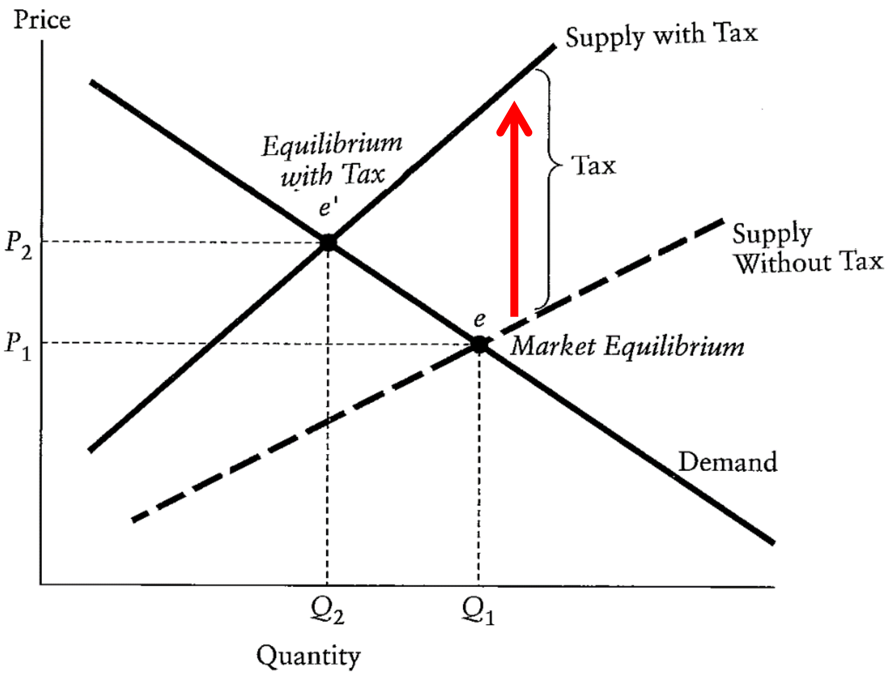
- So, regulation is necessary. How to do it?

- How to deal with external cost?

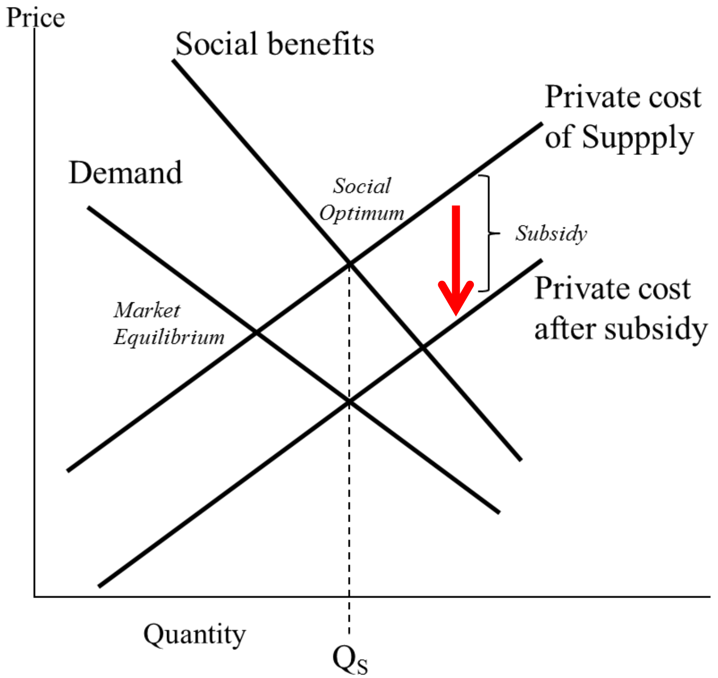
1. Collect fees from the polluters (Tax, Emissions trading,…)
2. Pay subsidy to alternative (non-polluting) technologies

How to deal with external cost?

Additional payments by the polluters



Subsidy payments to alternatives



In Europe, we do both

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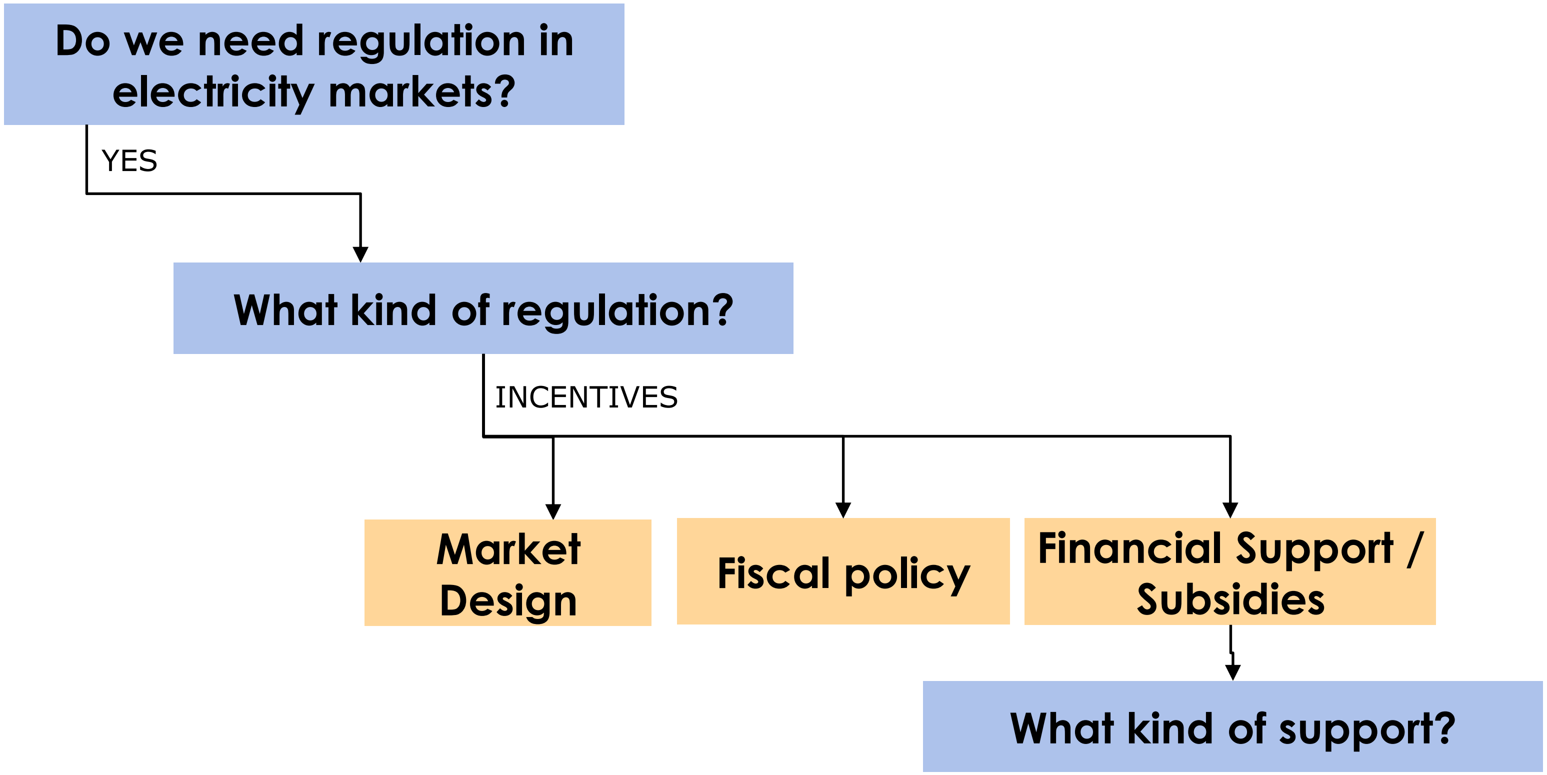


Generation-based RES support

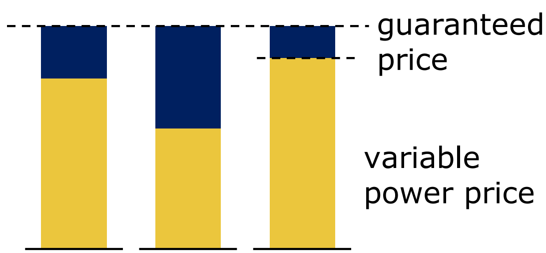
EXERCISE Part 1

(1) Price-based

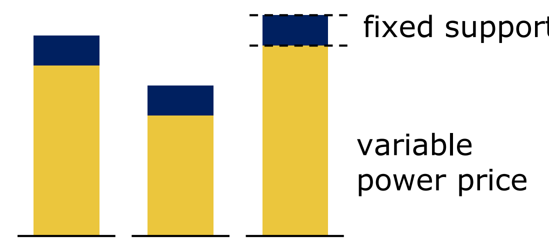
‘Modern’ Feed-in Tariff (FIT)

‘Traditional’ Feed-in Tariff (FIT)

Sliding Premium / Contract for Difference (CfD)

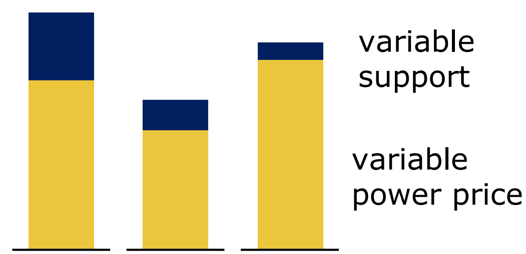


Fixed Feed-in Premium (FIP)



(2) Quantity-based

Tradable Green Certificates Scheme (TGC) / Quota Obligation



EXERCISE PART 1: ”The good old world”

- We are in a ‘traditional’ electricity market with a ‘proper’ merit order dominated by thermal power and no negative prices
- Renewables are only partially integrated in the market, with two support options:
  1) Traditional Feed-in Tariff of 50 EUR/MWh
  2) Fixed Feed-in Premium of 12.5 EUR/MWh

- Open the excel sheet ”LKIT_Lecture3_Inclass-exercise”
- Perform the following tasks (alone or in small groups)

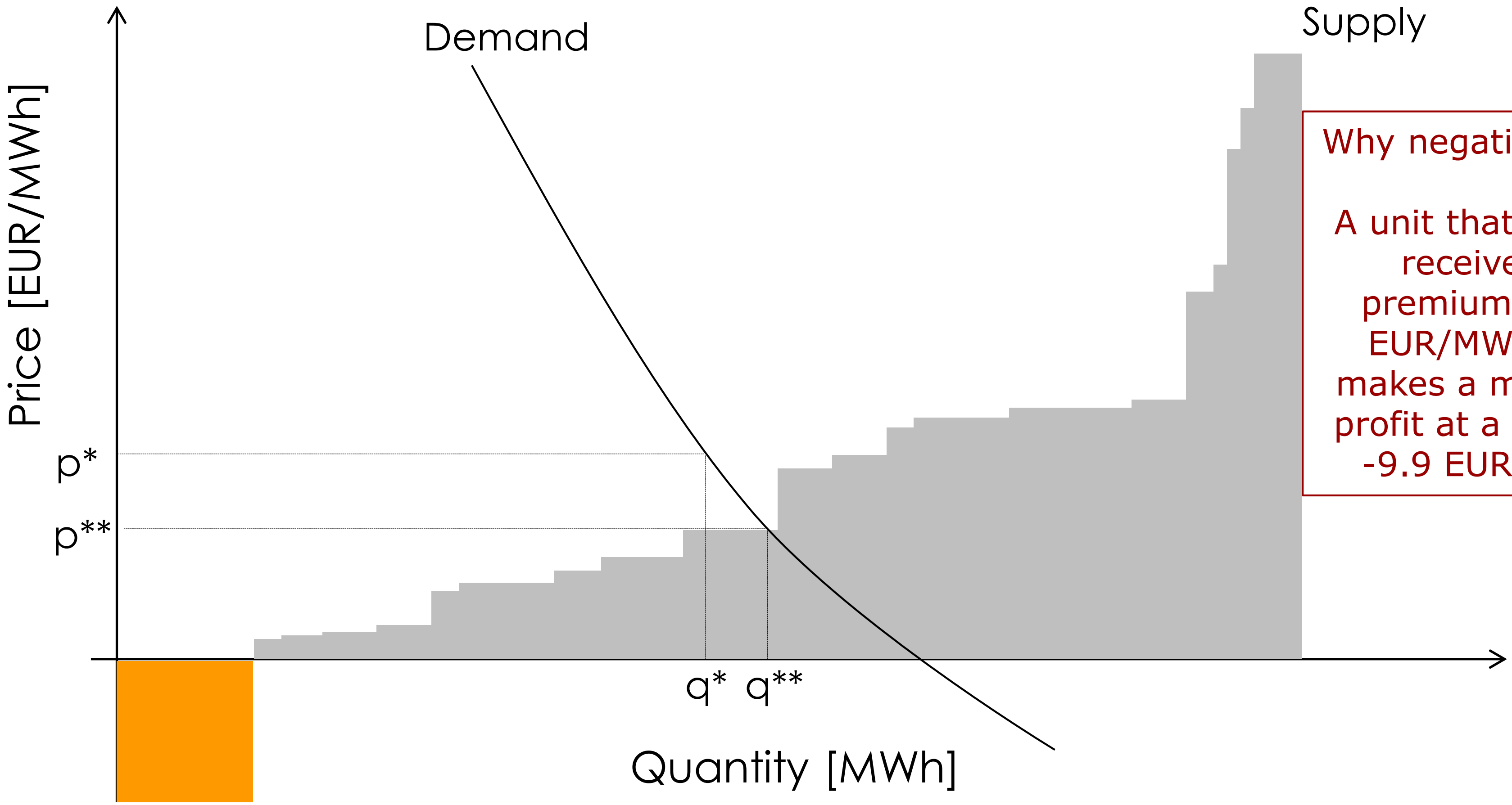
1. Calculate the total revenues in a **'no support'** case
2. Calculate the total revenues in a **'traditional feed-in tariff'** case
3. Calculate the total revenues in a **'fixed feed-in premium'** case
4. Discuss with your neighbour(s):
   - Which option yields the highest revenues?
   - What scheme do you think is less risky and why?
   - Which support scheme option would investors / banks / tax-payers prefer?

How would a supported wind park bid into the spot market – and what is the effect on market price?

‘Traditional’ Feed-in tariff: *No bidding – production at all prices*

‘Fixed’ Feed-in premium: *Bidding at minus the premium*

‘Sliding premium’ Feed-in tariff: *Bidding at minus the tariff (strike price)**



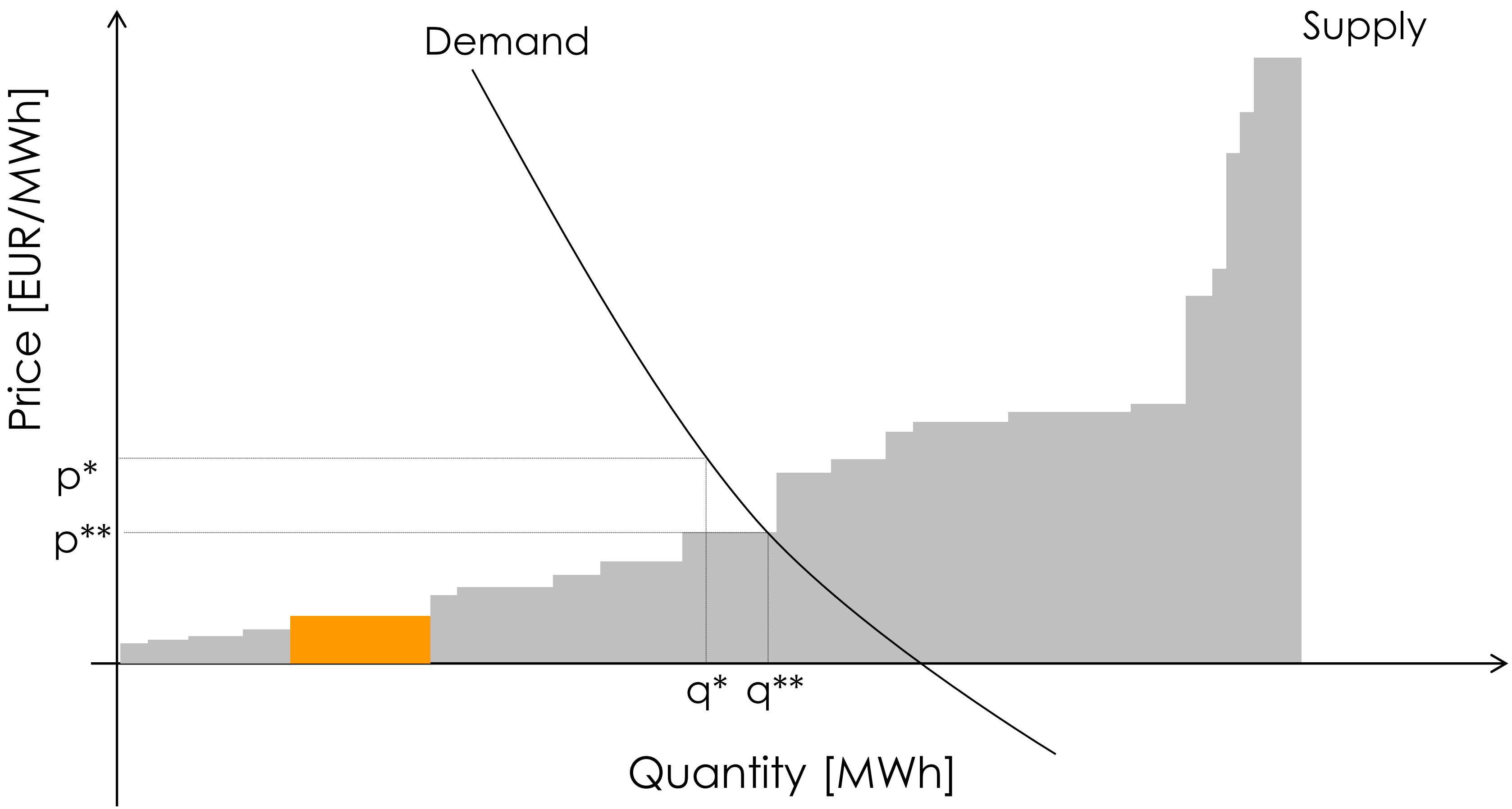
Why negative bids?

A unit that always receives a premium of 10 EUR/MWh still makes a marginal profit at a price of -9.9 EUR/MWh

*in schemes where the units are hourly settled and support is limited to max. the strike price

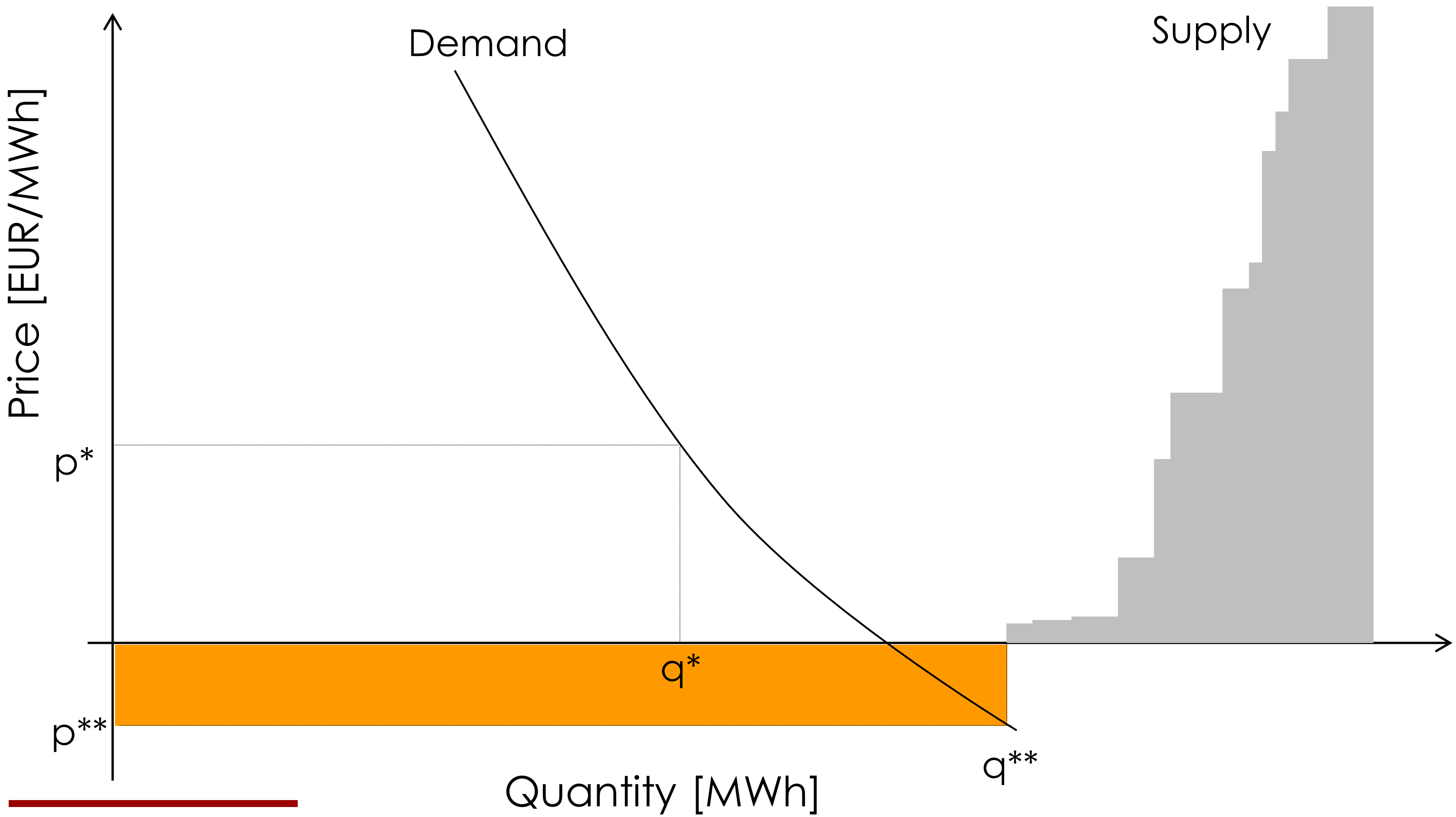
And what is the effect on market price if the park bid at marginal cost?

The negative bidding incentives are not problematic when supported units are pure price takers (= at low market shares)



How would a supported wind park bid into the spot market – and what is the effect on market price?

As soon as supported units become price setters (= at high market shares), we need adjustments of support scheme design



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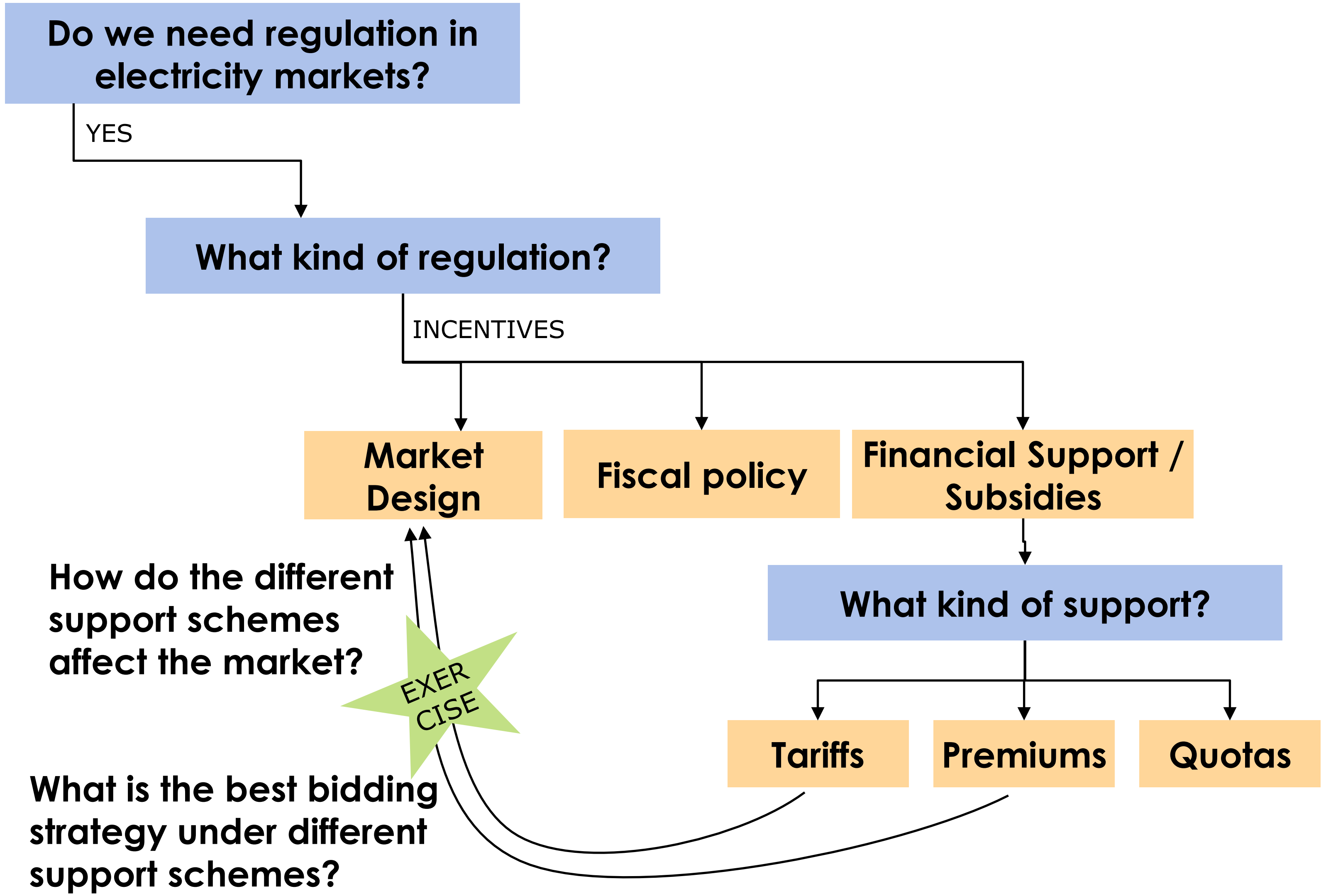


System friendly support schemes

In energy systems with high renewable shares, renewable energy units must be integrated, i.e. active in the market and react to market prices. This way, they contribute to providing system needs for flexibility.

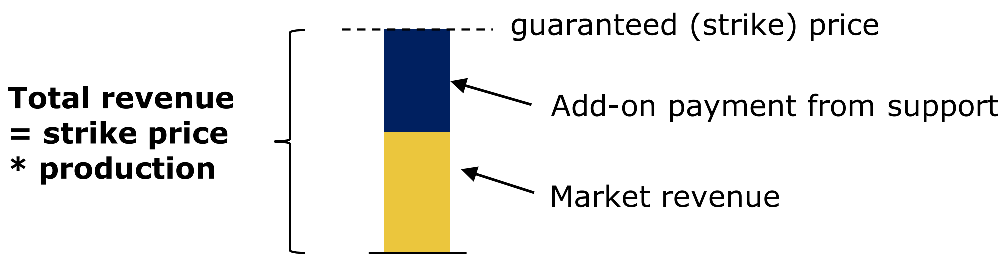
One way of doing this is by curtailing at negative power prices (surplus of supply)

For this, policy makers must ensure exposure to the market signal, at least in periods where it is important

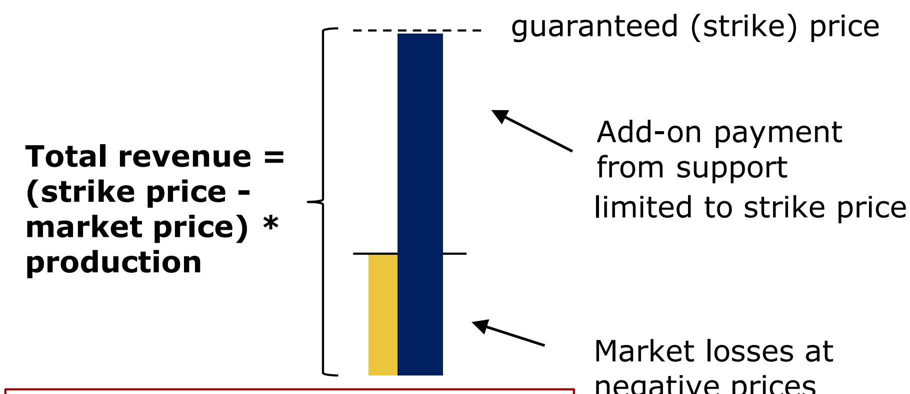
→ no ‘traditional’ Feed-in Tariffs

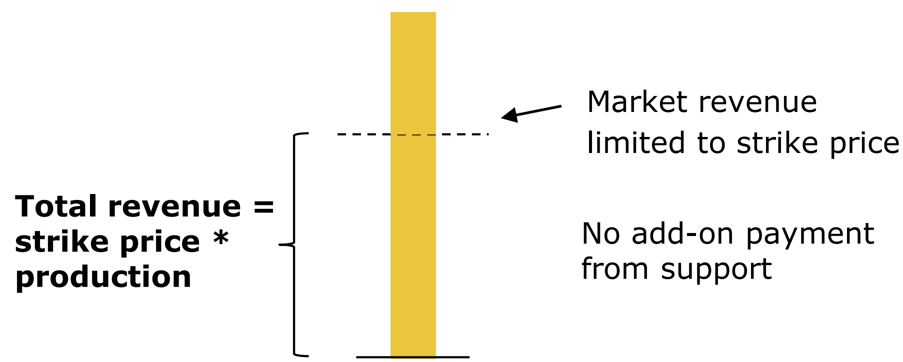
→ limit support at negative prices

Sliding Premiums / Contracts for difference



- What happens at negative prices?
- What happens at high prices?





System-friendly support stops completely at prices <0!

This reflects design choices for actual schemes in Europe, but this could in principle also be different

EXERCISE PART 2: ”System friendly support”

- We are in an electricity market with high shares of renewables, which also become price setters at times
- Renewables should have an incentive to stop production (curtail) at negative prices
- We compare two schemes in a ‘normal’ (always support) and an ‘incentive-improved‘ (no support at negative market prices) design:
  - Fixed Feed-in Premium of 12.5 EUR/MWh
  - Sliding Premium (CfD) with guaranteed (strike) price of 50 EUR/MWh

- Perform the following tasks (alone or in small groups)

1. For comparison, calculate a **'no support' case**, with and without curtailment
2. Calculate 4x revenues under optimal bidding for:

	Normal	**System-friendly**
Fixed Premium	Case 1	Case 2
Sliding Premium	Case 3	Case 4

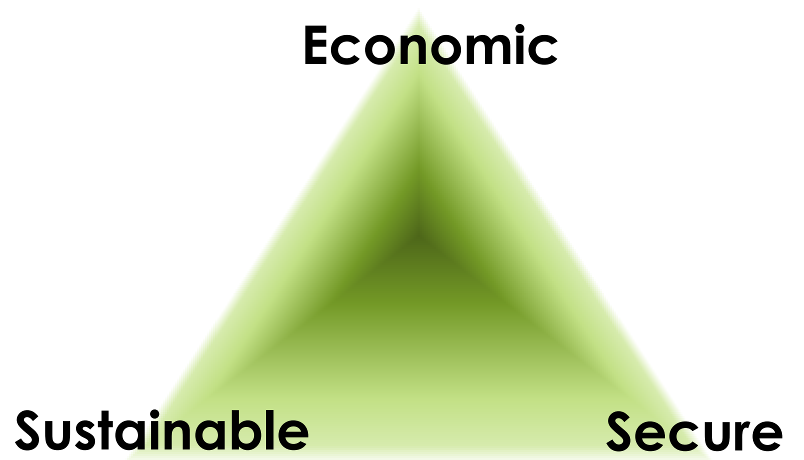
3. Discuss with your neighbour(s):
   - How do the different support options affect the revenues of the investor?
   - How do you assess the different options if you were an investor / a regulator / a tax payer?

DISCUSSION
Choice of support scheme and design elements

- What are the most important features that support schemes should have for complementing future energy markets?

- Whose interests should be considered in what way?

- How can an electricity market dominated by renewables provide adequate investment incentives so that further support becomes obsolete?



Thank you for your interest

Questions ?

References

Kitzing et al. 2012, *Renewable energy policies in Europe: Converging or diverging?*, Energy Policy, Vol 51, 192-102

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CEER 2013, Council of European Energy Regulators, Status Review of Renewable and Energy Efficiency Support Schemes in Europe, C12-SDE-33-03, June 2013.

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Helm, Dieter (ed.), 2007, *The New Energy Paradigm*. Oxford University Press.

IMPROGRES Report (Cali *et al*., 2009), http://www.improgres.org/project-results/

futures-e, http://www.futures-e.org/

Further reading

IPCC SRREN, Special Report on Renewable Energy Sources and Climate Change Mitigation

Chapter 11: Policy, Financing and Implementation

http://srren.ipcc-wg3.de/report/IPCC_SRREN_Ch11.pdf

Kitzing et al. 2012, *Renewable energy policies in Europe: Converging or diverging?*, Energy Policy 51, 192-102, http://dx.doi.org/10.1016/j.enpol.2012.08.064

Lund, Henrik (2000), 'Choice awareness: the development of technological and institutional choice in the public debate of Danish energy planning', Journal of Environmental Policy & Planning, 2: 3, 249-259, http://dx.doi.org/10.1080/714038558

AURES a European research project on auctions for renewable energy support

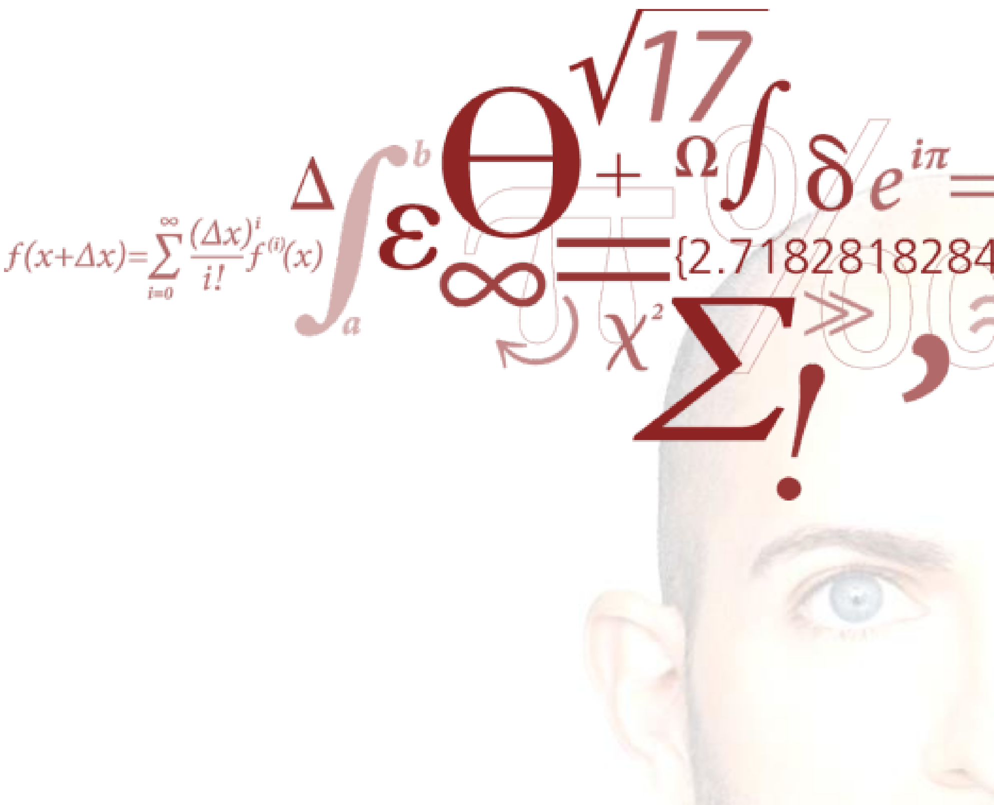
http://www.auresproject.eu/

Flex4RES a Nordic research project on flexible Nordic Energy Systems

http://www.flex4res.org/

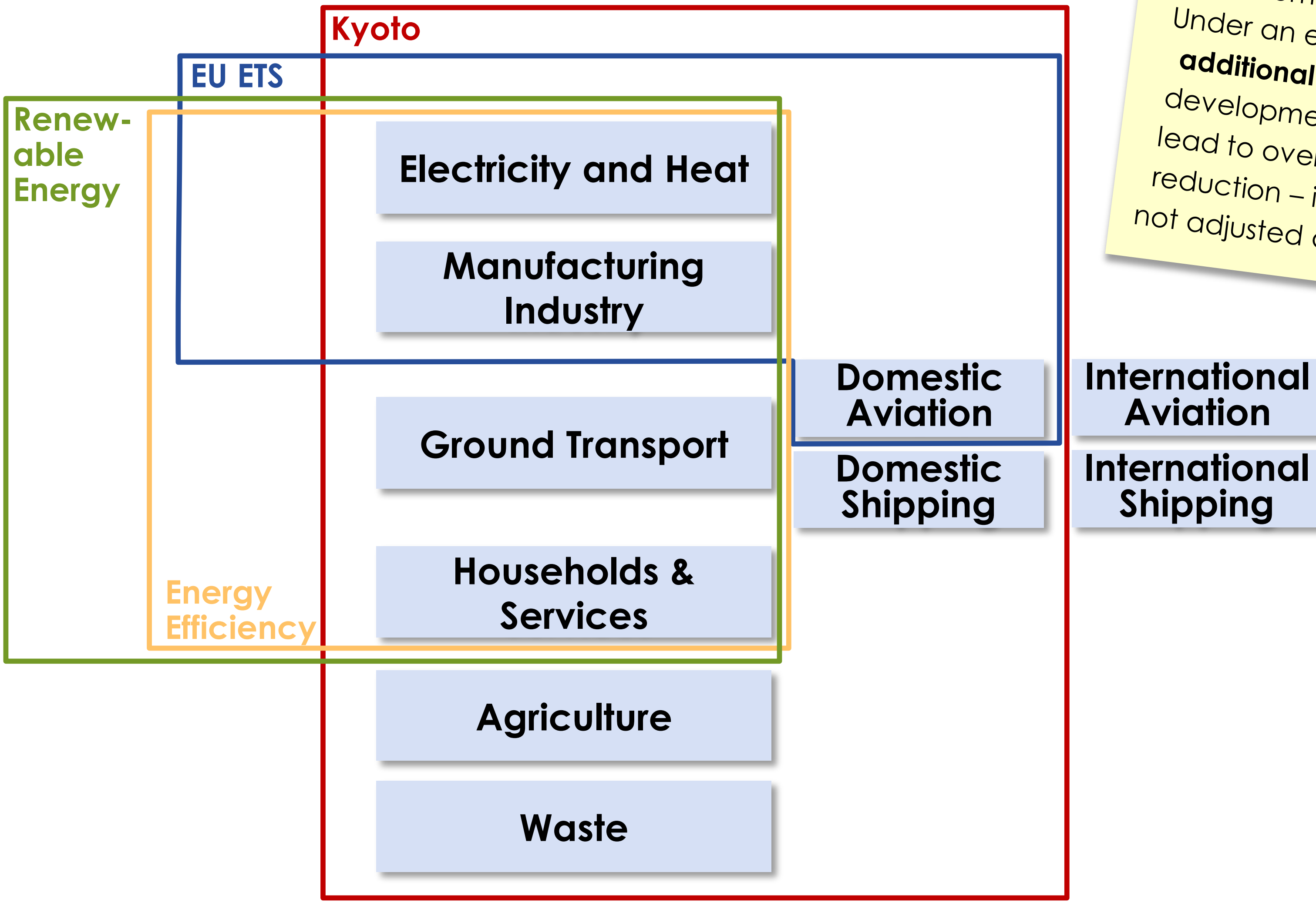
Jensen & Skytte 2003, Simultaneous attainment of energy goals by means of green certificates and emission permits, Energy Policy, Vol 31(2003) pp. 63–71

APPENDIX



Side issue: Emission Trading System in Europe and overlap of targets and policies

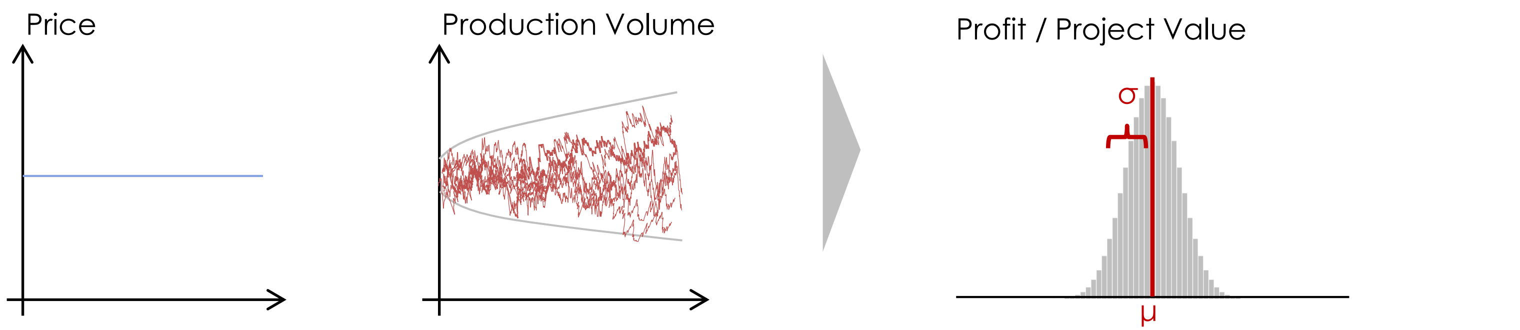
Remember:
Under an emission cap, **additional** renewable development does not lead to overall emission reduction – if the cap is not adjusted accordingly



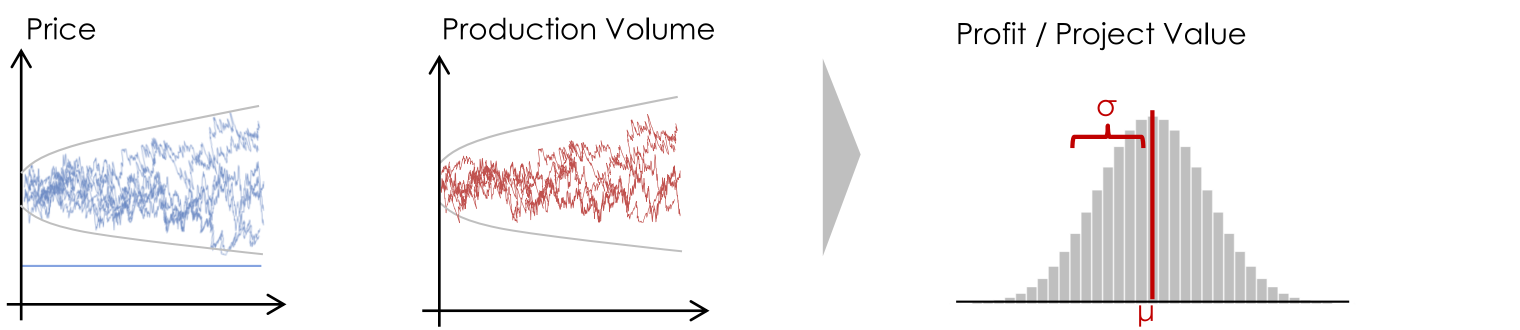
Source: based on the futures-e final report

Risk characteristics of support instruments

Feed-in tariff (FIT)



Feed-in premium (FIP)



Quota system (TGC)