



Energy Economics

Renewable Energy and Hydropower projects

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EU framework for energy

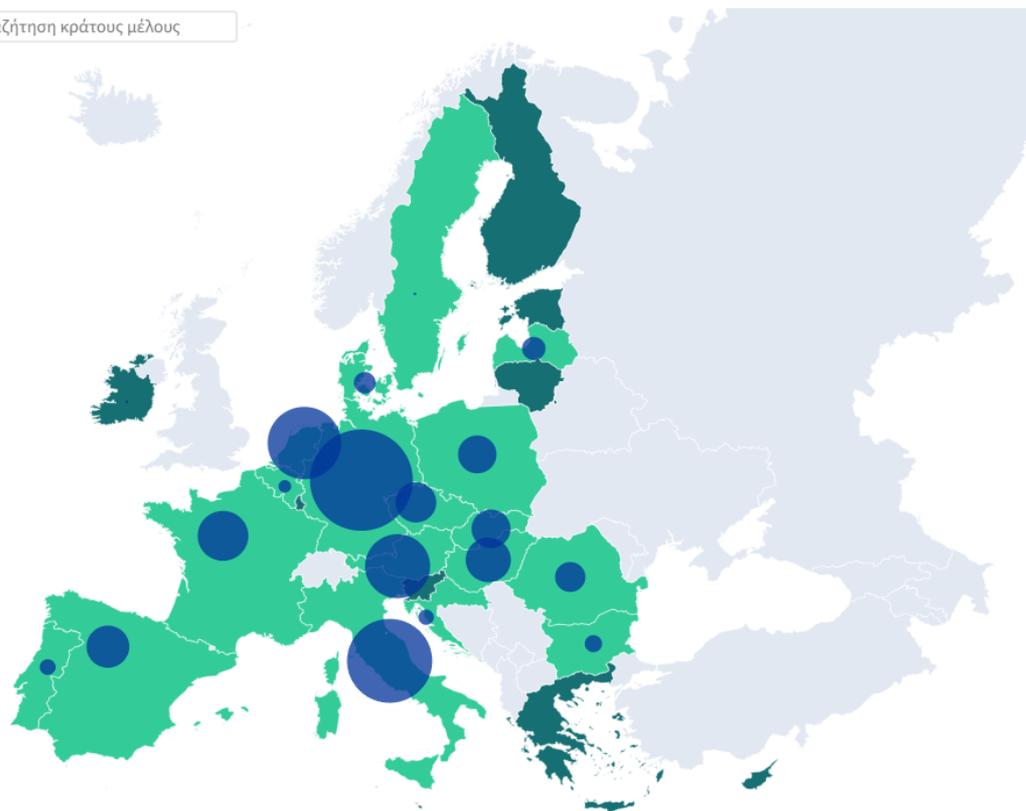
Targets

- ❑ Creating an internal energy market
- ❑ Improving energy efficiency
- ❑ Weaning off carbon energy forms
- ❑ Strengthening competitiveness

Security of supply

■ με δυναμικότητα αποθήκευσης
■ χωρίς δυναμικότητα αποθήκευσης, αλλά με ρυθμίσεις αλληλεγγύης με άλλα κράτη μέλη

Αναζήτηση κράτους μέλους



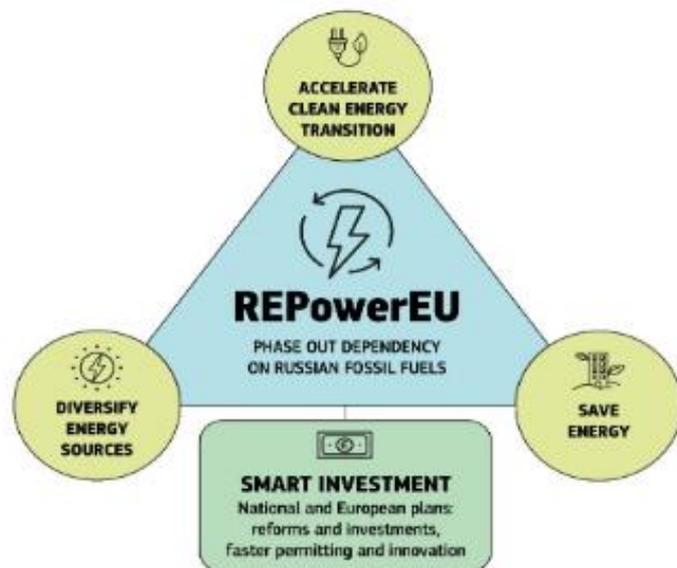
Liberalization of the energy market

- ❑ Directive 1996/92/EC
 - Opening of the production sector to competition
 - Provision for the appointment of a transmission and distribution system operator
 - Priority integration of RES into the grid
- ❑ Directive 2003/54/EC
 - Focus on the liberalization of vertically integrated companies
 - Establishment of national regulatory authorities with a minimum level of competence
- ❑ Directive 2009/72/EC
 - New responsibilities of NRA - institutional autonomy
 - Complete separation of generation, supply, and transmission
 - Cross-border cooperation of operators
- ❑ Directive 2019/944
 - Prosumers, energy communities, smart meters
 - Electromobility
 - Definition of the energy market

Re-Power EU Plan

Development of photovoltaic energy, specifically, the strategy aims to connect over 320 GW of solar photovoltaic installations by 2025, and nearly 600 GW by 2030 (with an obligation to install photovoltaic panels on certain buildings).

Increase of the EU's renewable energy target for 2030 from the current 40% to 45%.



Additional investments of 210 billion euros by 2027 to phase out Russian fossil fuel imports, which cost European taxpayers nearly 100 billion euros annually.

Increase of the total renewable energy production capacity from RES to 1,236 GW by 2030, compared to the projected 1,067 GW (as envisaged in the Fit for 55 plan).

Greece's actions

- ❑ Development of National Energy and Climate Plans (NECPs)
 - Roadmap for achieving specific Energy and Climate Targets by 2030
 - Long-term Strategy for 2050

NECP 2030

- ❑ Share of renewable energy sources (RES) in gross final energy consumption to increase to at least 35%
- ❑ Share of renewable energy sources (RES) in gross final electricity consumption to increase to at least 60%
- ❑ Complete phase-out of lignite units
- ❑ Increased reliance on natural gas

Roadmap 2050

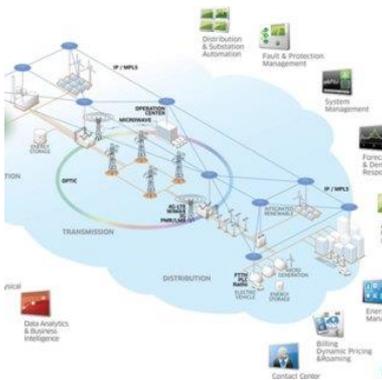
- ❑ Interventions to improve energy efficiency
- ❑ Large-scale implementation of circular economy principles
- ❑ Electrification across all sectors and applications, including transportation
- ❑ Reduction of car usage
- ❑ Development of chemical storage of electrical energy via hydrogen
- ❑ Implementation of carbon capture, utilization, and storage (CCUS)

Special features of the energy market

Limited storage capacity



Obligation of continuous monitoring



Different market structures within the EU.



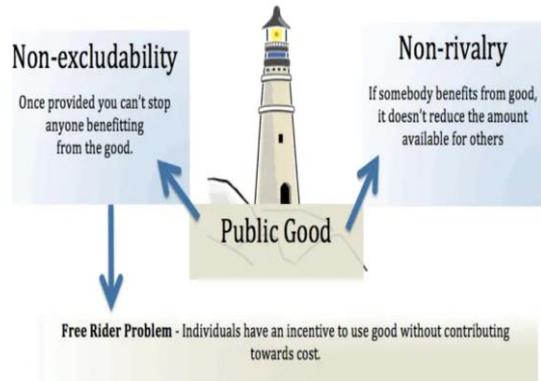
Limited and different technology



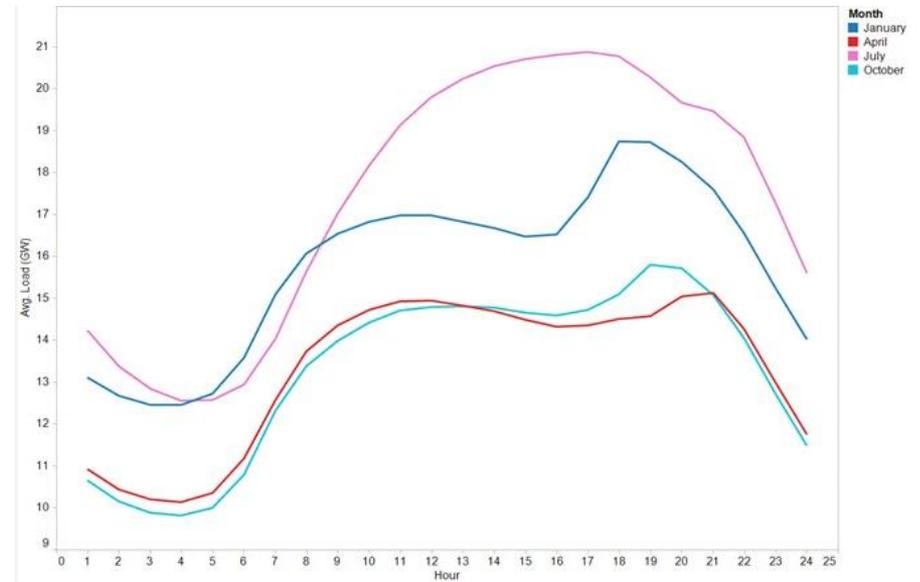
Inability for large private investments

Special features of the energy market

Characteristics of a public good



Fluctuations in demand (across all time scales)"

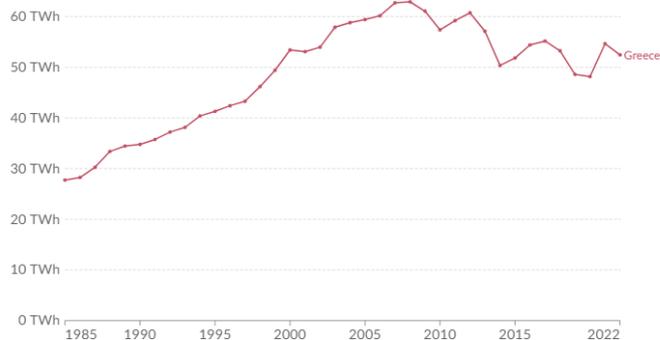


Excess power generation capacity

Electricity generation

+ Add country or region

Our World in Data

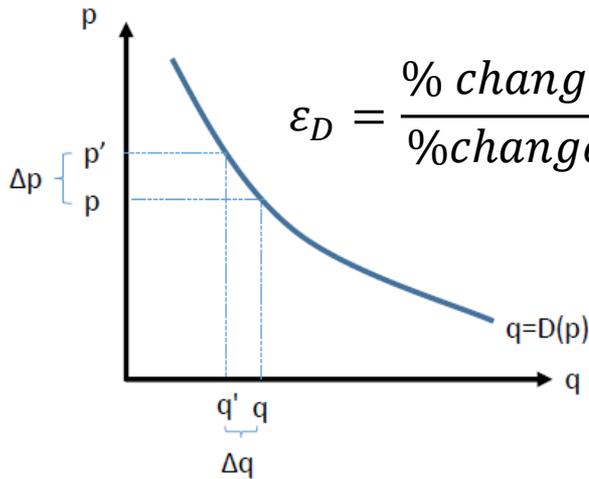


Source: Ember's Yearly Electricity Data; Ember's European Electricity Review; Energy Institute Statistical Review of World Energy OurWorldInData.org/energy • CC BY

▶ 1985 ○ 2022

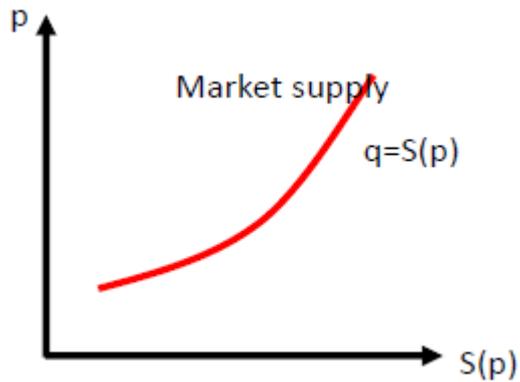
Elasticity of demand and supply

Ζήτηση

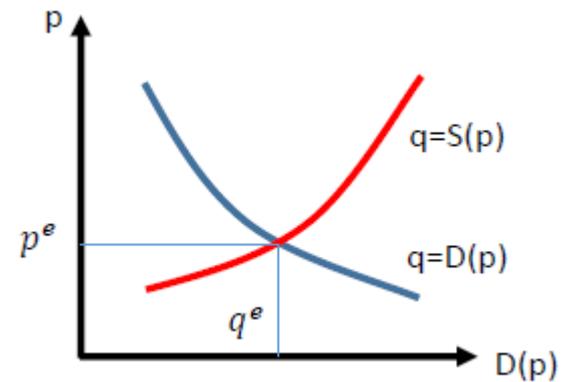


- Elastic demand $\varepsilon_D < -1$
- Anelastic demand $-1 < \varepsilon_D < 0$

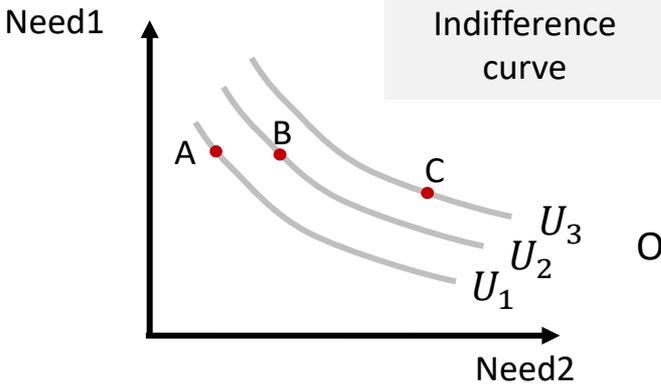
Supply



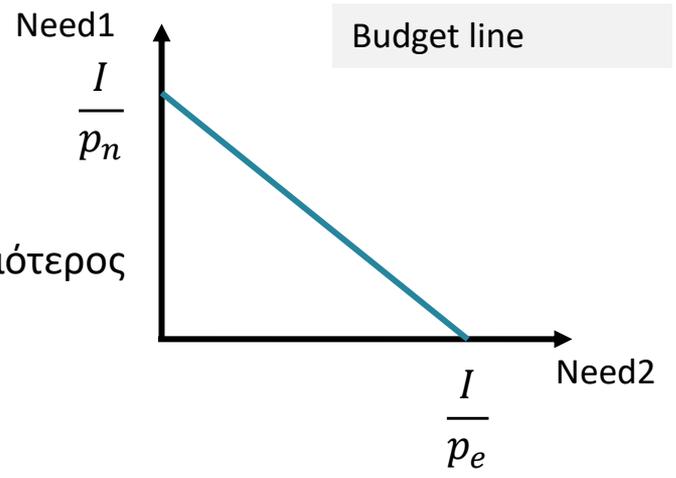
Market equilibrium



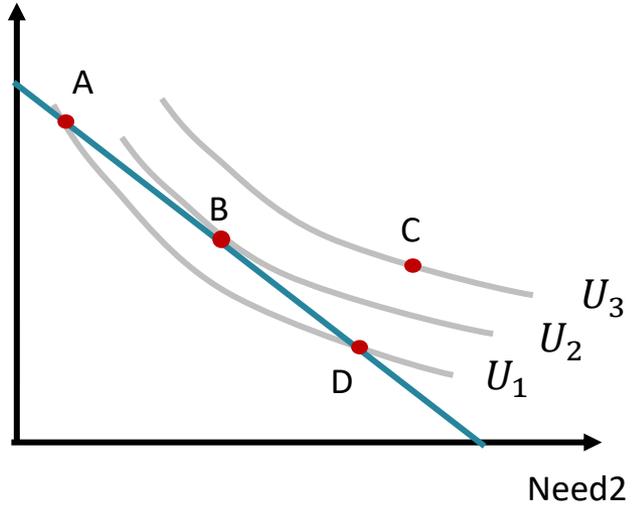
Consumers



$U_1 < U_2 < U_3$
Ο συνδυασμός Γ είναι προτιμότερος από τον Β και Α



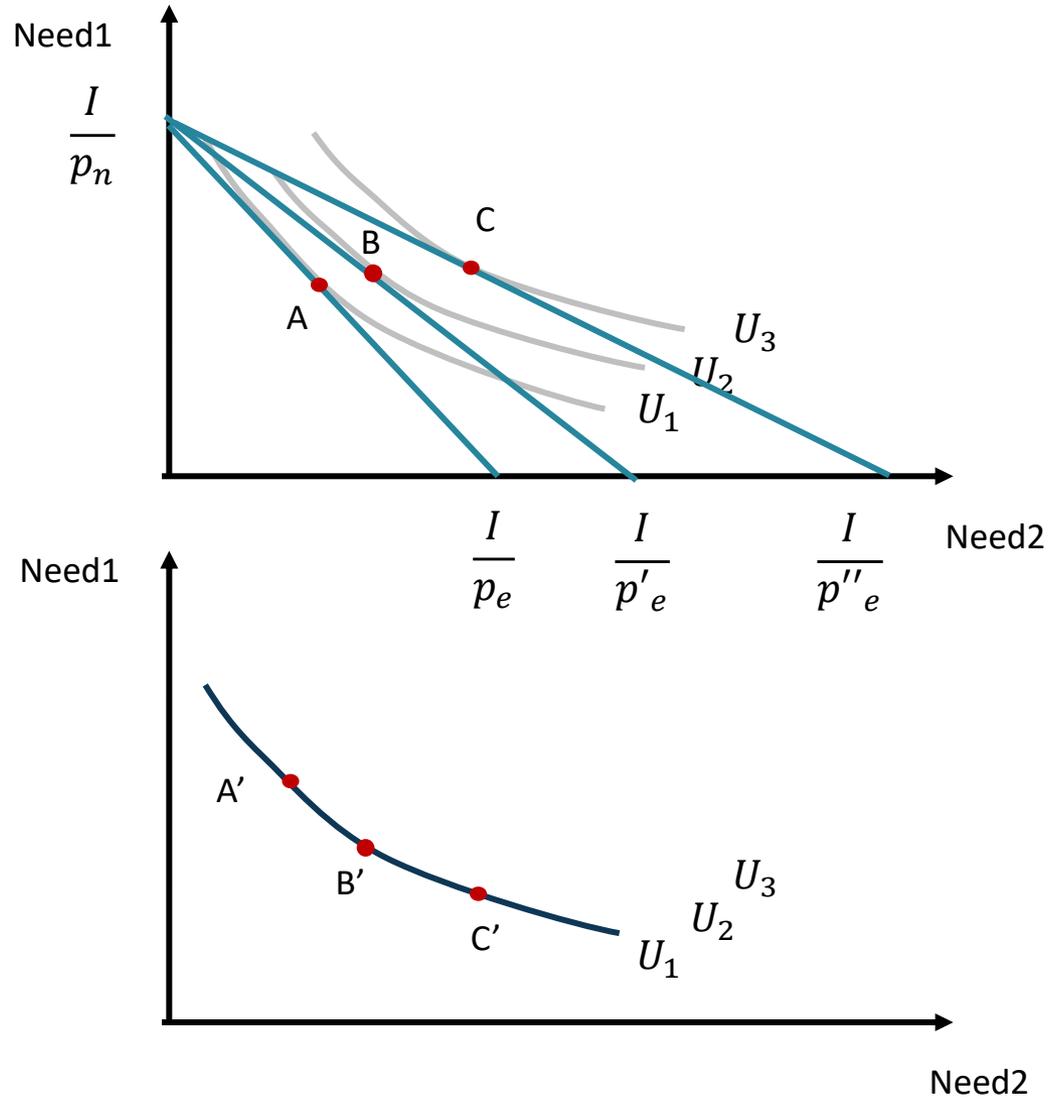
Point B is the **optimal combination**



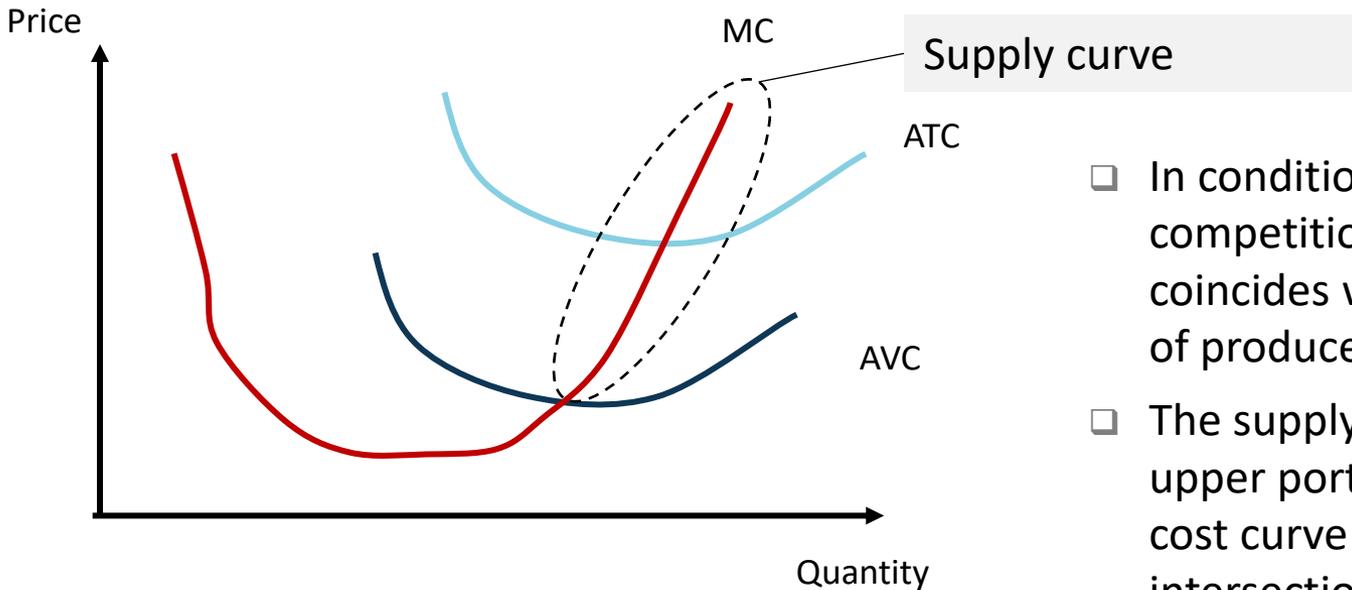
Point C is an **impossible combination**

Points A and D are **indifferent combinations.**

Consumers: creation of a demand curve



Producers: creation of a supply curve

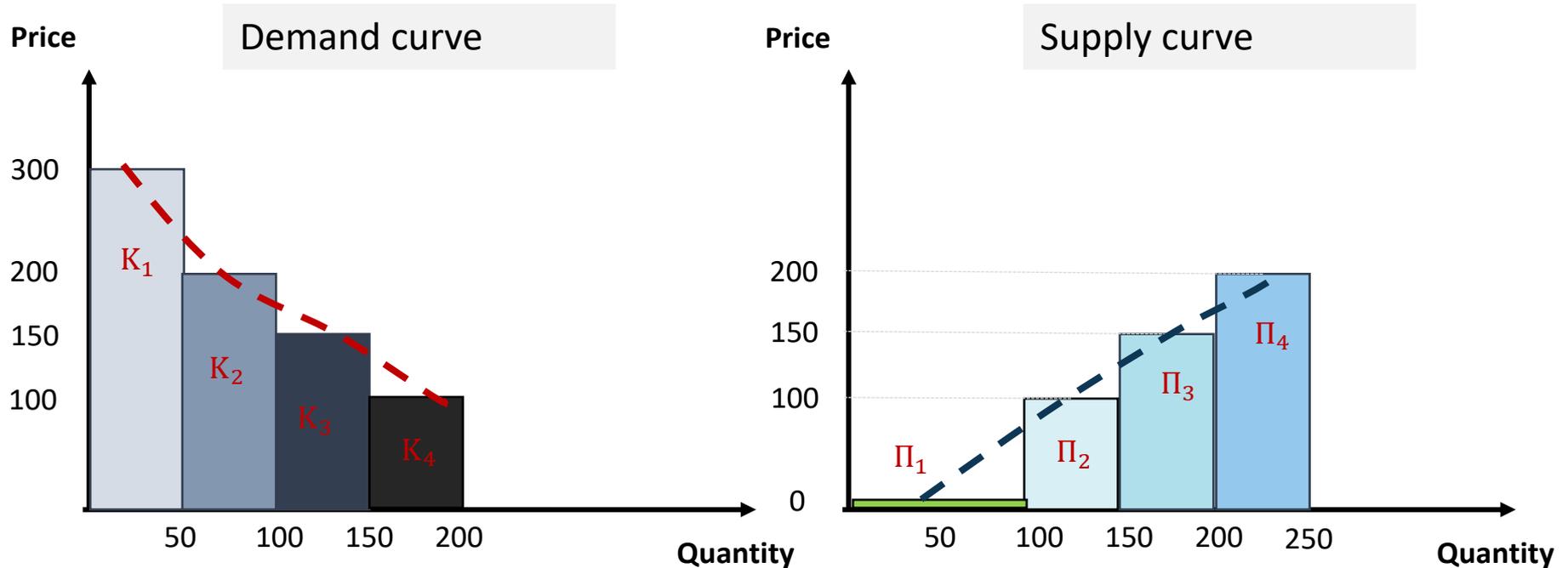


- ❑ In conditions of perfect competition, the selling price coincides with the marginal cost of producers.
- ❑ The supply curve arises as the upper portion of the marginal cost curve starting from the intersection point with the average variable cost.

The **marginal cost** (MC) is the additional cost incurred from producing one more unit of a product.

The **average variable cost** is the per-unit variable cost and is equal to the total variable cost divided by the quantity of the product.

Application within the energy market



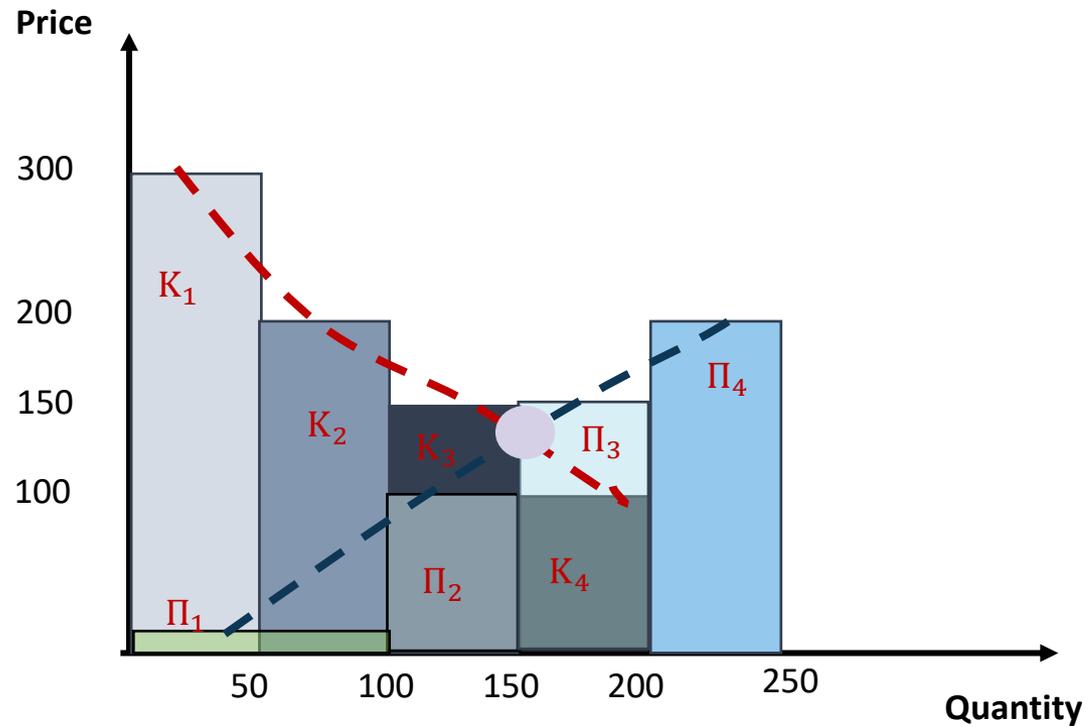
Consumers are ranked in **descending** order (those willing to pay more for the product come first).

Producers are ranked in **ascending** order (those who can sell the product at a lower price come first).



Same final product (energy), why different price

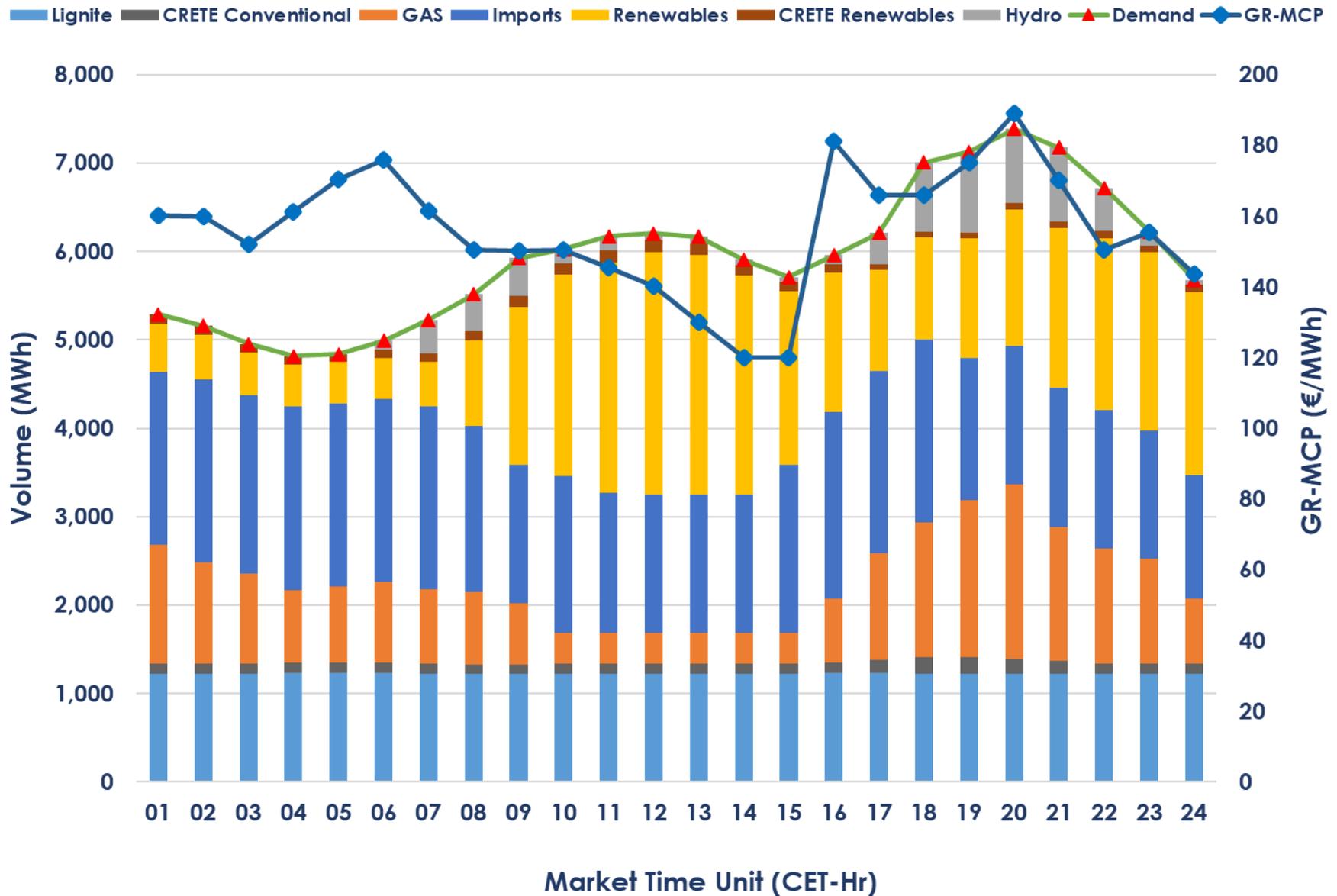
Market equilibrium



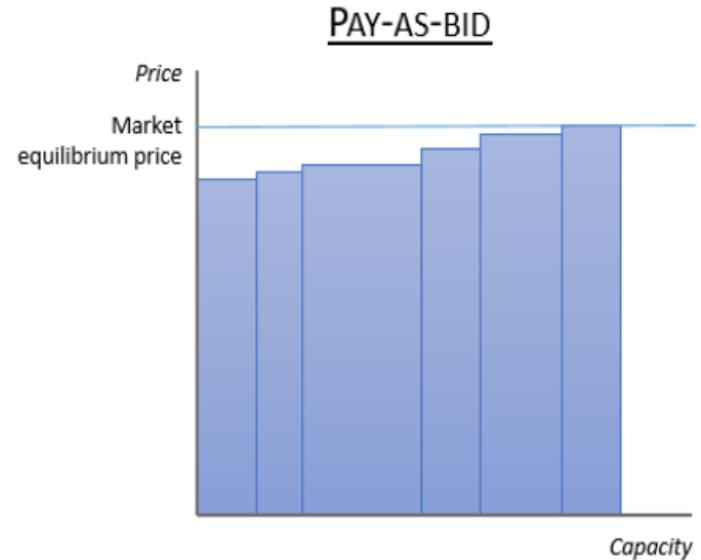
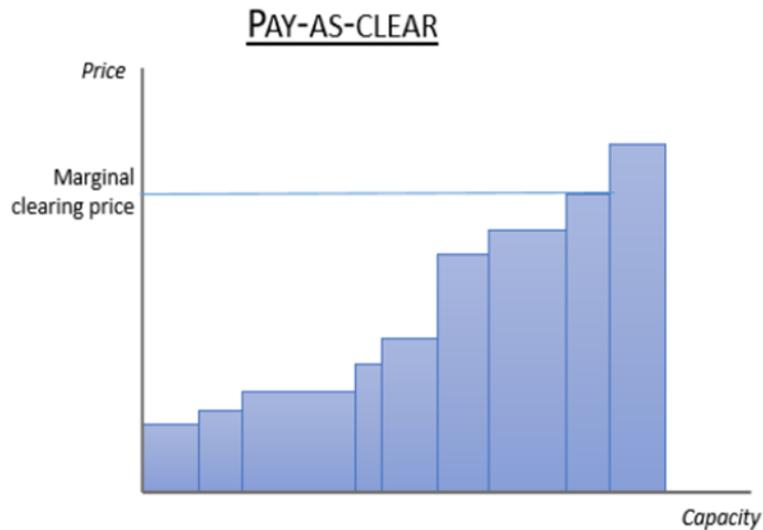
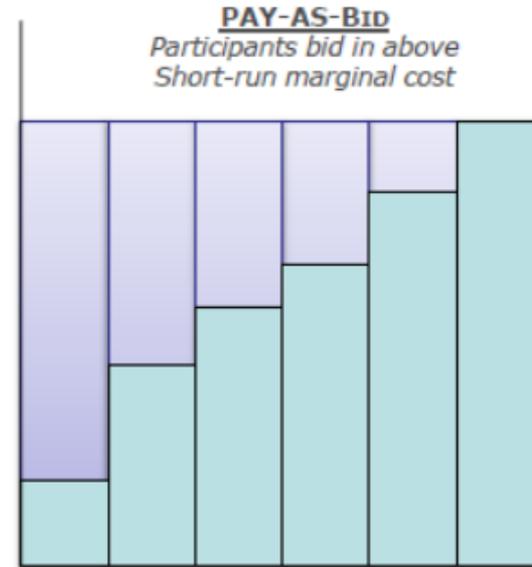
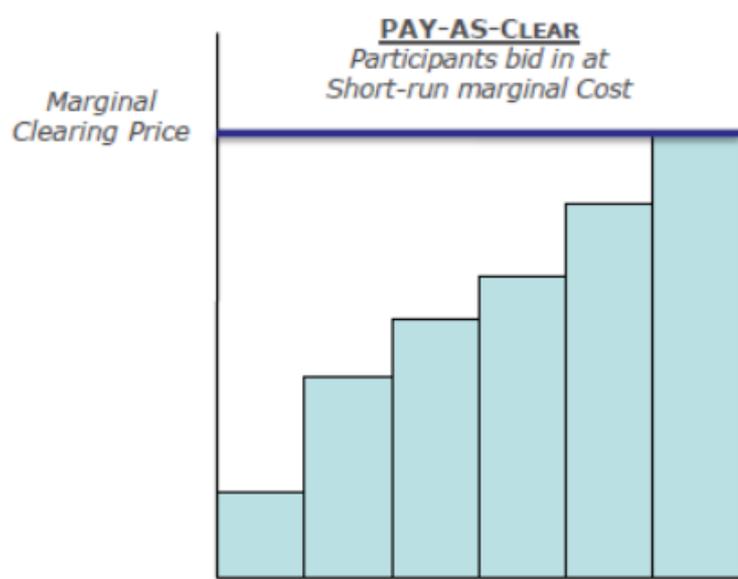
?

At what quantity and price did the market 'close'?

Uniform energy price: is it the best solution?



Uniform energy price: is it the best solution?



Advantages

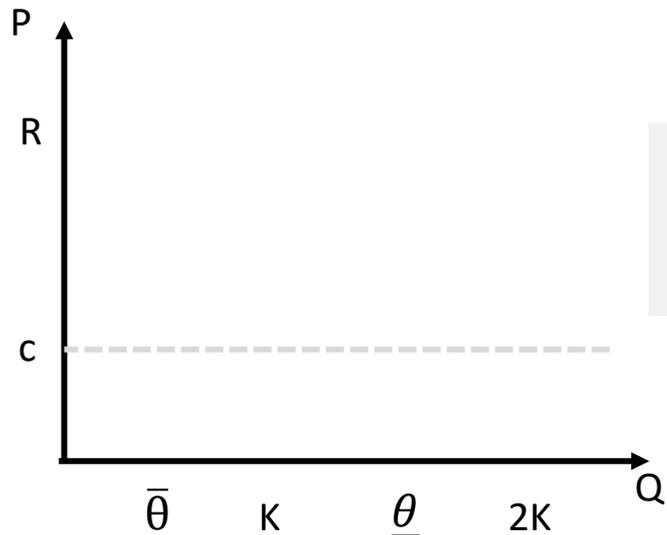
Advantages of uniform price

- ❑ Bidding the actual cost from supplier side.
- ❑ Minimization of consumer and social costs.
- ❑ Equality between all participants.
- ❑ Incentives for innovation of technology and efficiency for being more efficient player.
- ❑ Ease of market power mitigation and monitoring.
- ❑ At last, the UPA has been tested and well functioned over years in different markets.

Advantages of pay-as-bid

- ❑ The PAB pricing mechanism is a price setting; hence, the accepted bids have less flexibility in choosing their offering curve and reduce the possibility of multiple equilibria point.
- ❑ The participants have no information about others' bidding and cost functions, so they would bid near their production cost truthfully.
- ❑ These auctions could reduce the price volatility and market power if there is a sufficient number of producers, and none of them have not complete data about others' offers and final cleared price.
- ❑ The consumers will prefer PABA when the demand is perfectly inelastic.
- ❑ The risk of tacit collusion under PABA is relatively lower than that under UPA.

Uniform energy price: is it the best solution?



- Let there be two companies with the same marginal cost c , and the same dynamics K .

If the demand forecast is $\bar{\theta}$, what will be the market equilibrium price?

$$b_1 = b_2 = c$$

If the demand forecast is $\underline{\theta}$, what will be the market equilibrium price?

$$b_1 = R$$

$$b_2 = R - \epsilon$$

$$\Pi_1 = (R - c)(\underline{\theta} - K)$$

$$\Pi_2 = (b - c)K$$

$$b_1 = R$$

$$b_2 = c + (R - c)(\underline{\theta} - K)/K$$

If the demand forecast is $\bar{\theta}$, what will be the market equilibrium price?

$$b_1 = b_2 = c$$

If the demand forecast is $\underline{\theta}$, what will be the market equilibrium price?

$$b_1, b_2 < R$$

Futures contracts

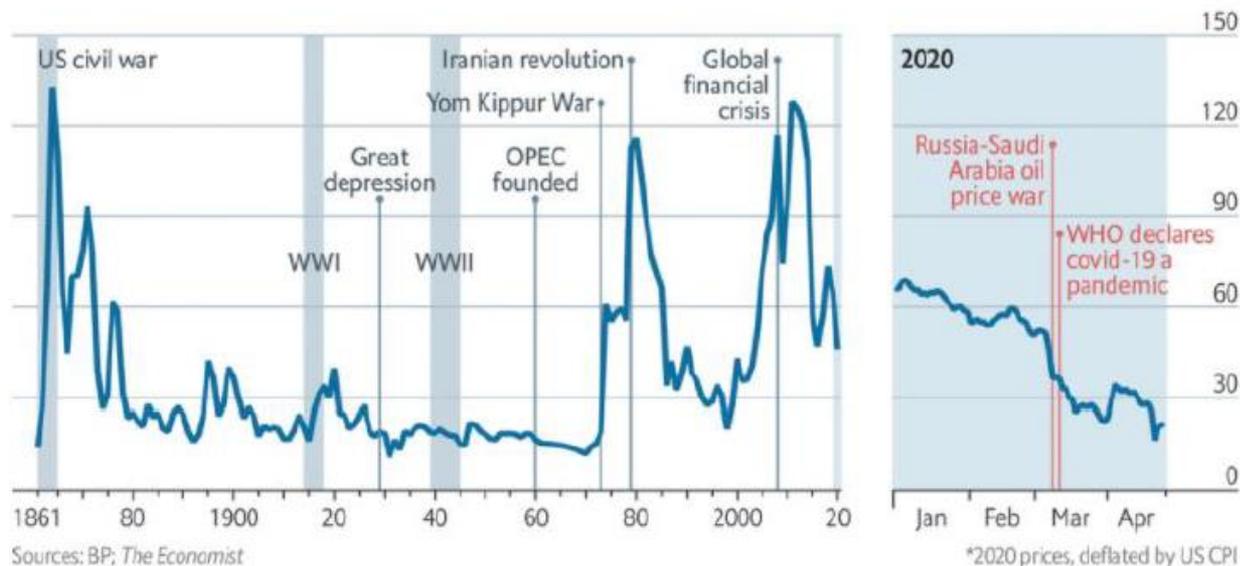
Long-term

- ❑ The buyer expects an increase in prices and hedges the risk.
- ❑ Increasing prices raise the value of the future contract, also increasing procurement costs.

Short-term

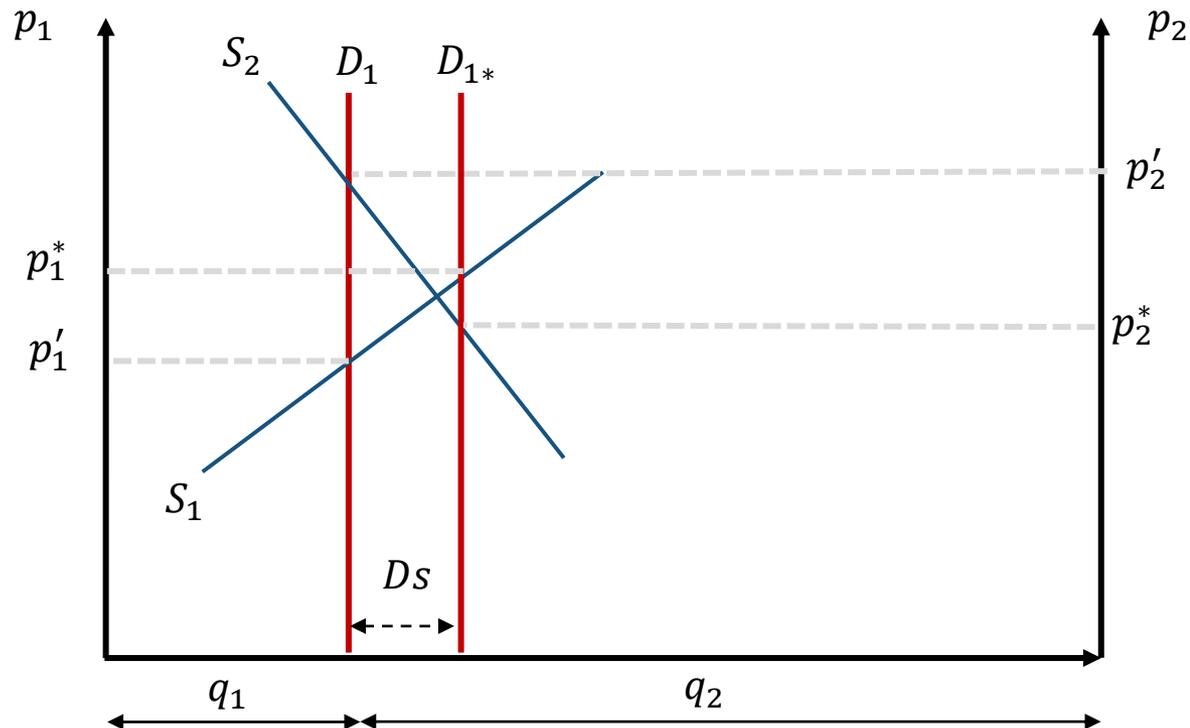
- ❑ The seller anticipates that prices will decrease in the market and takes measures to offset this risk.
- ❑ The decrease in prices increases the value of the position but results in lower profits in the spot market.

Real crude oil price*, \$ per barrel



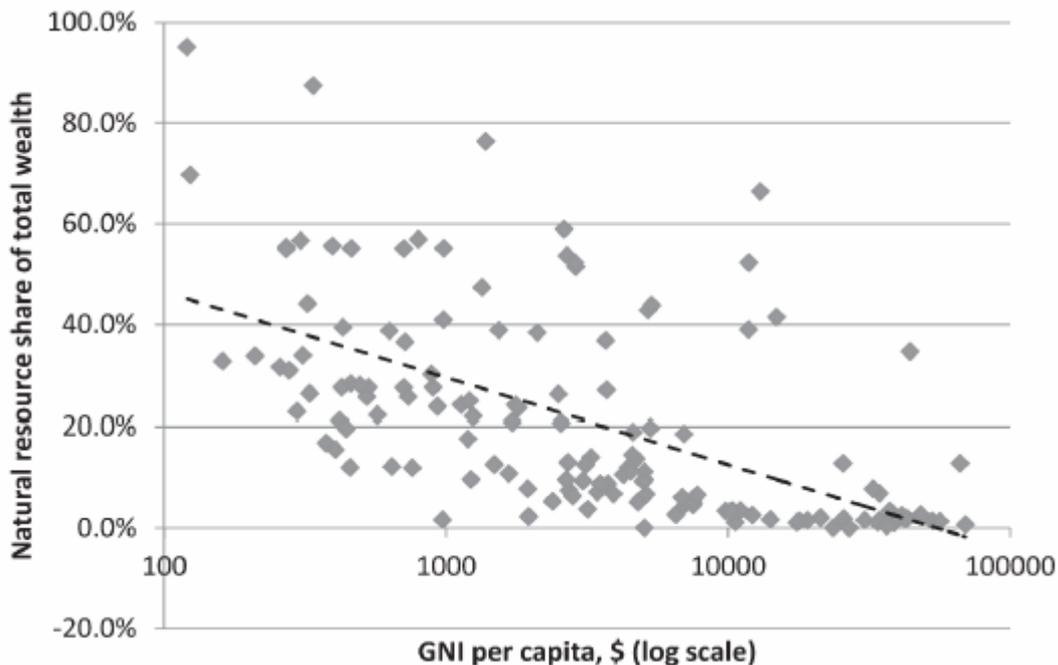
Energy storage

- ❑ The **structure** and **regulation** of the market affect investments.
- ❑ Social value:
 - Reducing production costs
 - Enhancing energy autonomy
 - Facilitating the penetration of renewable energy sources (RES)
 - Supporting network management
 - Reducing investments in networks.



Resource curse

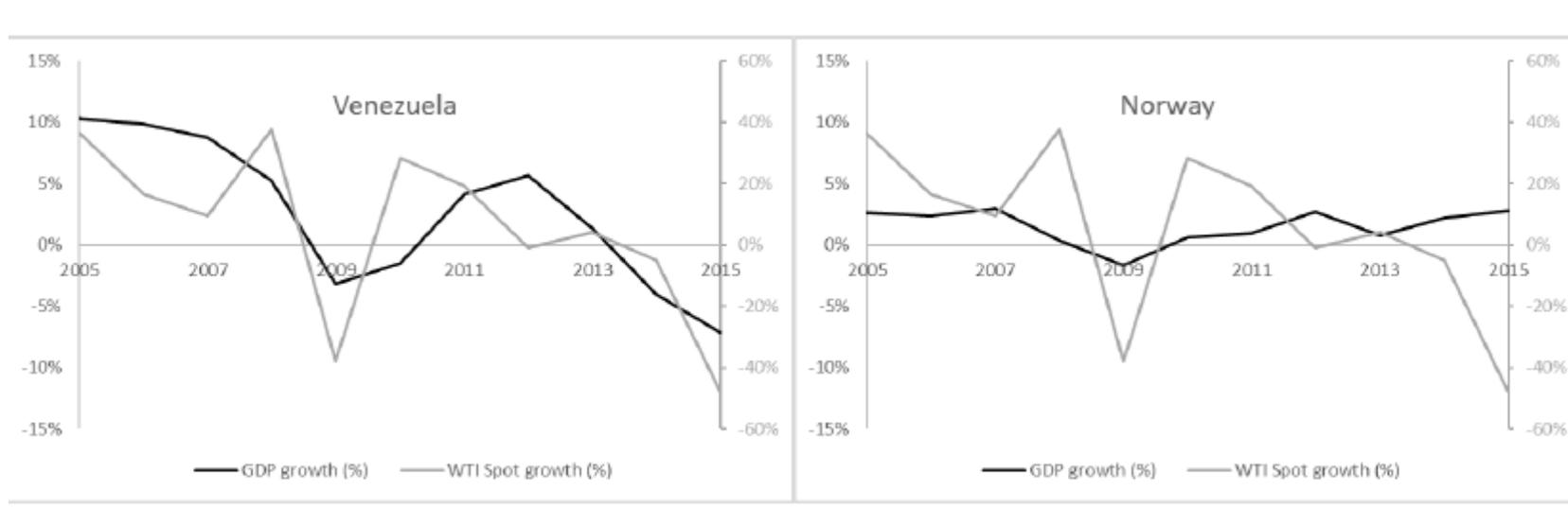
- The negative economic consequences of anything that generates a sudden inflow of foreign currency:
 - Large discovery of natural resources
 - Sudden rise in the international price of an exportable commodity
 - Large foreign aid/capital inflows



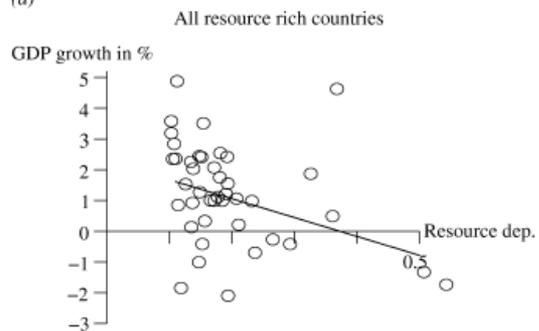
Dutch disease

- ❑ This introduced by "The Economist" in 1997, which refers to the negative economic consequences experienced by a country due to anything that causes a sudden appreciation of its currency exchange rate, such as the discovery of large oil reserves.
 - Consequences:
 - Rapid appreciation of the national currency
 - Shift in production factors
 - High inflation/unemployment
- ❑ Ways to address it:
 - Inflation reduction: Restriction of government spending, tax increases, investments in government investment funds
 - Currency depreciation reduction: Currency purchases by the central bank (where feasible), gold purchases, increased investments in foreign currencies
 - Strengthening other sectors and diversifying the economy: Investment in education, development of specific infrastructure, subsidies to affected sectors

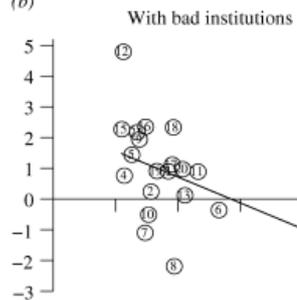
Dutch disease: Examples



(a)



(b)



(c)

