lecture 10: electricity markets

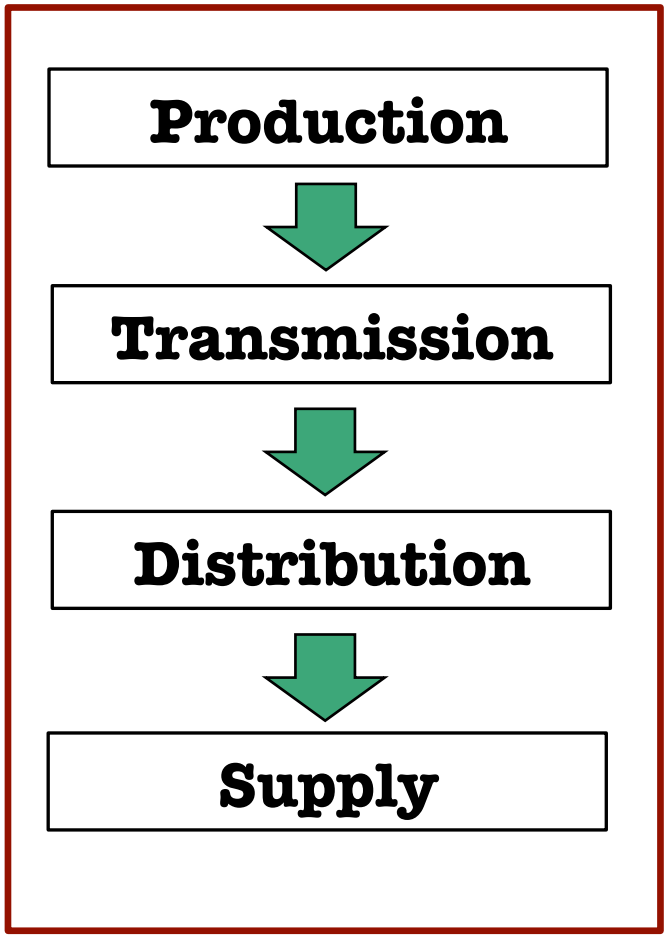
to come

1. electricity sector
    1. generation
    2. transmission and distribution
    3. retail supply

2. regulation in the electricity sector

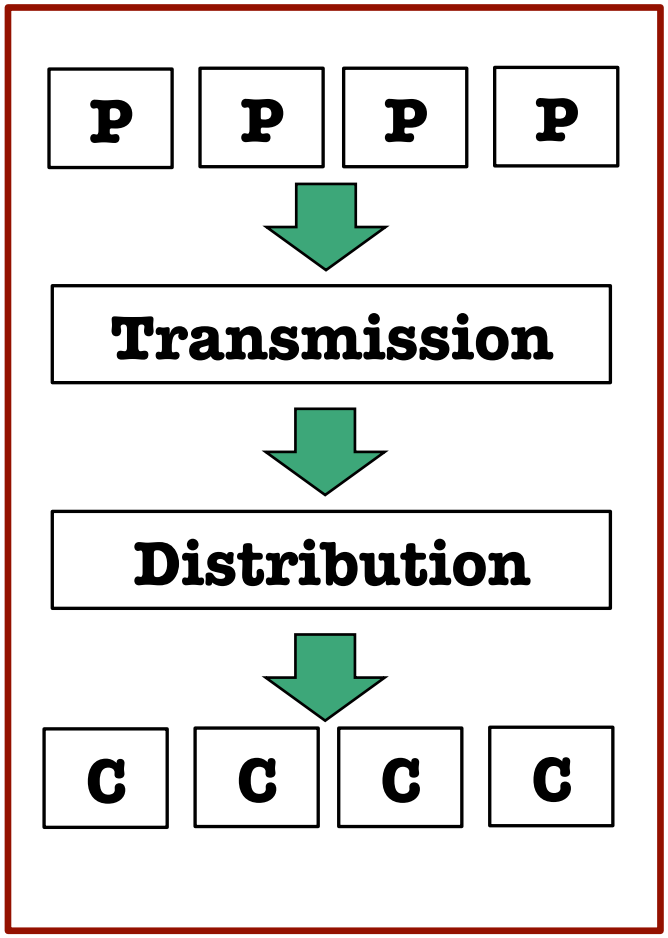
3. MIBEL

electricity sector - past



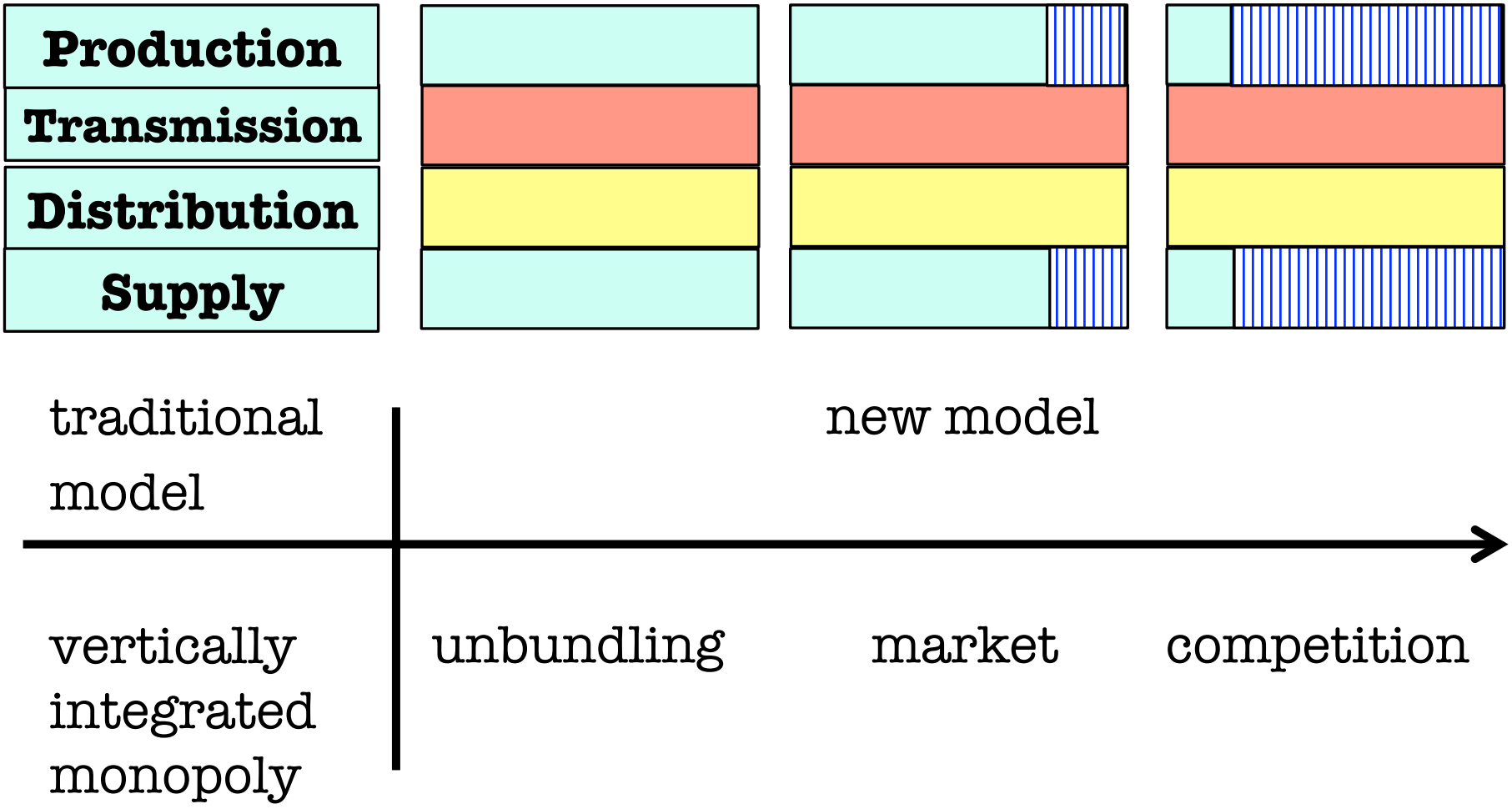
- monopoly
- vertically integrated
- horizontally integrated
- typically owned by the state

electricity sector - present

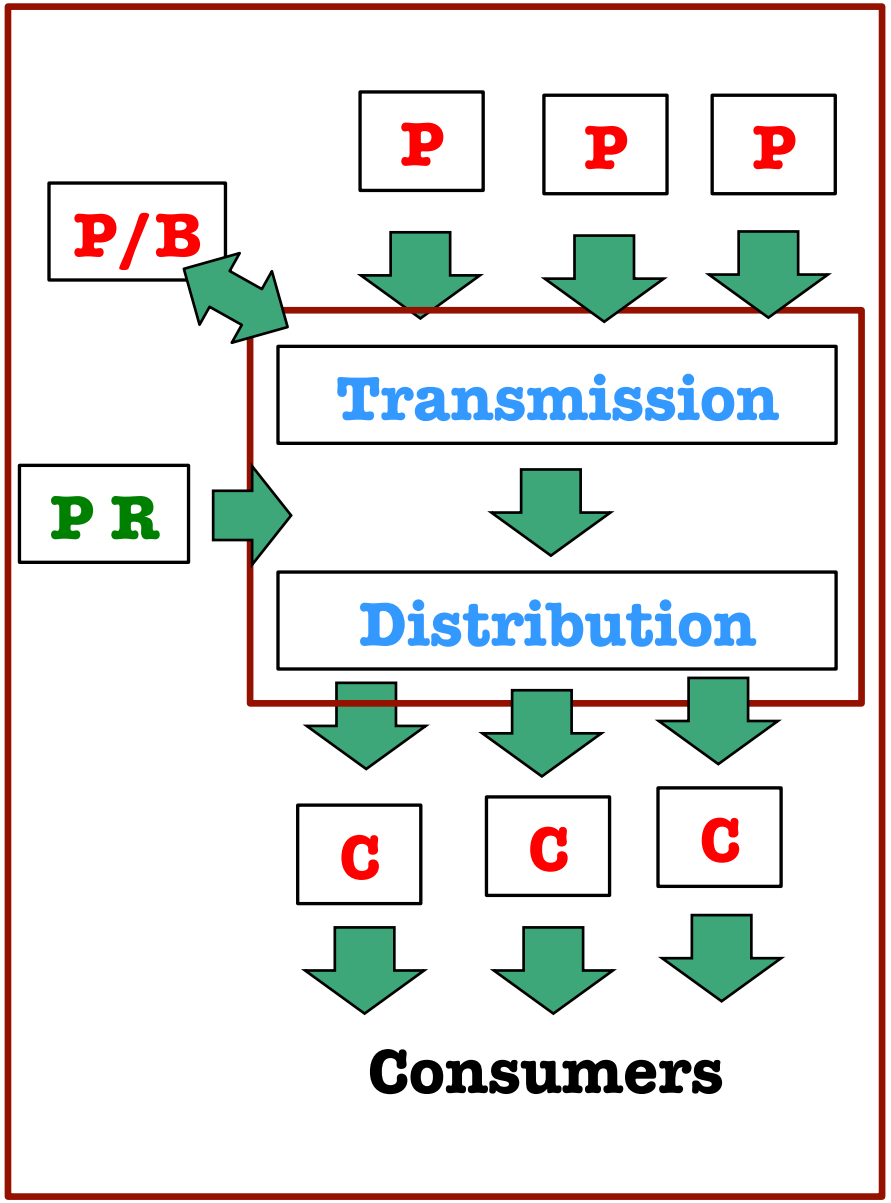


- technological change
- vertical unbundling
- production and supply become potentially competitive activities
- horizontal unbundling

electricity sector



electricity sector - present



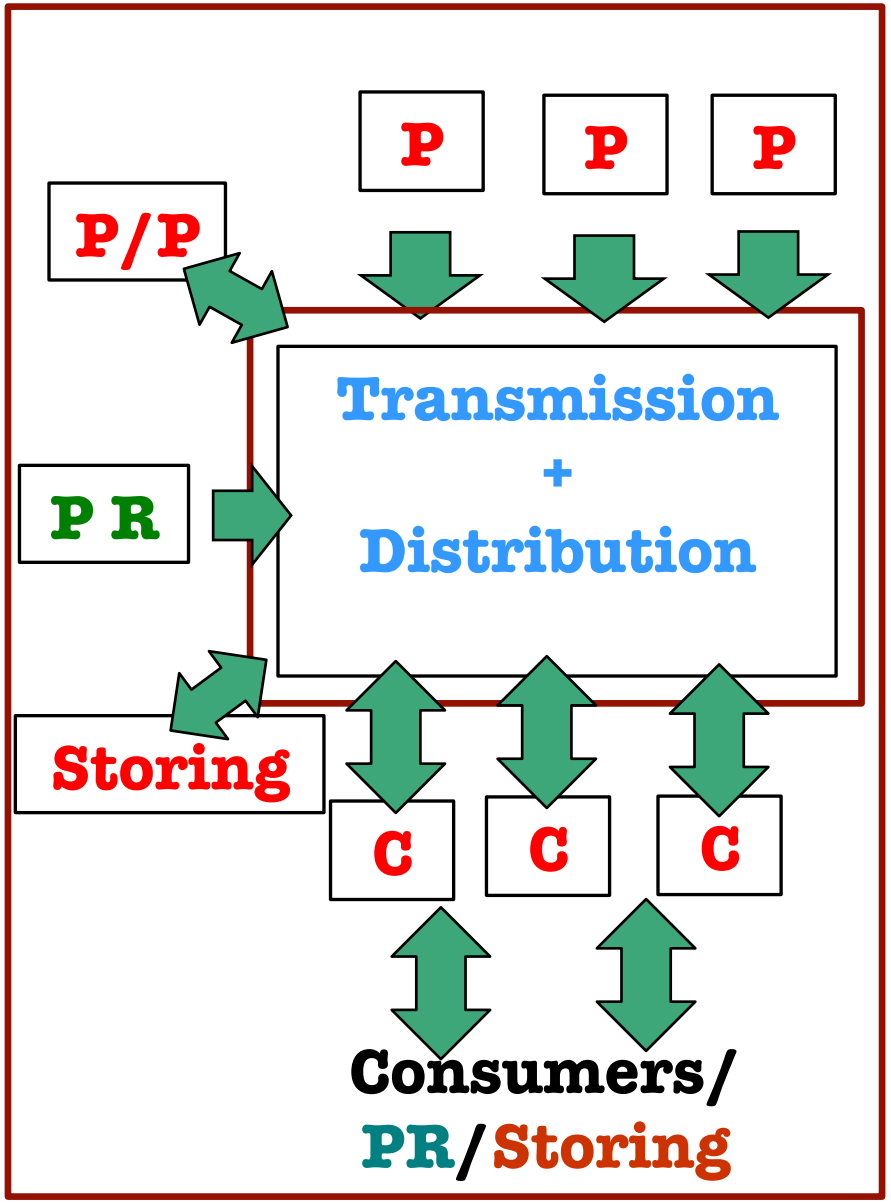
Unbundling

- Competition (few big firms)
- Regulated price (medium firms)
- Regulated monopoly

- Competition (few big firms)

- Free choice (many agents, asymmetric inf, inelastic demand)

electricity sector - future



Unbundling

- Competition (many small firms)
- Regulated price (medium firms)
- Regulated monopoly

- Competition (many small firms)
- Free choice (many agents, elastic demand)

agents in the Portuguese value chain

Production	EDP (50%), Turbogás, Tejo Energia, Iberdrola, Endesa
Transmission	REN
Distribution	EDP Distribuição, small distributors
Supply	EDP SU, EDP Comercial, Iberdrola, Endesa, Union Fenosa, Galp, EGL, Fortia

generation

- electricity generation in Portugal has origin in:
  - thermal (coal, gas, and fuel) and hydro plants – ordinary regime generation (PRO)
  - wind, solar, mini-hydro, biomass, and co-generation plants – special regime generation (PRE)

- liberalized activity
  - EDP (50%), Turbogás (CCGT), Tejo Energia (coal), Iberdrola (hydro - Aguieira), Endesa (CCGT, Pego)

- imports from Spain

generation

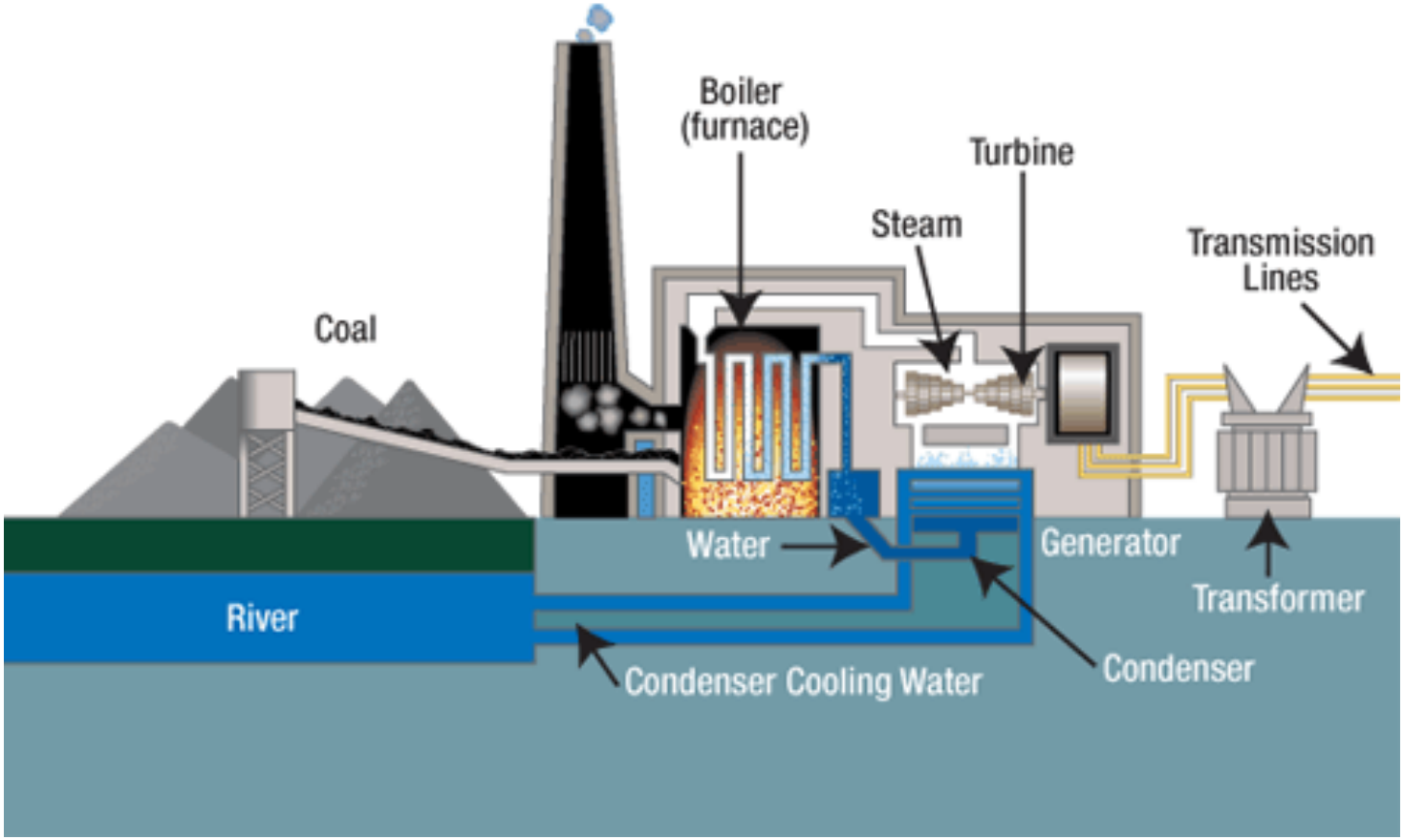
- the cheapest plants (base load) are always used; e.g.: coal plants and mini-hydro

- intermediate-cost plants are mainly used during the day; e.g.: CCGT and some hydro-plants

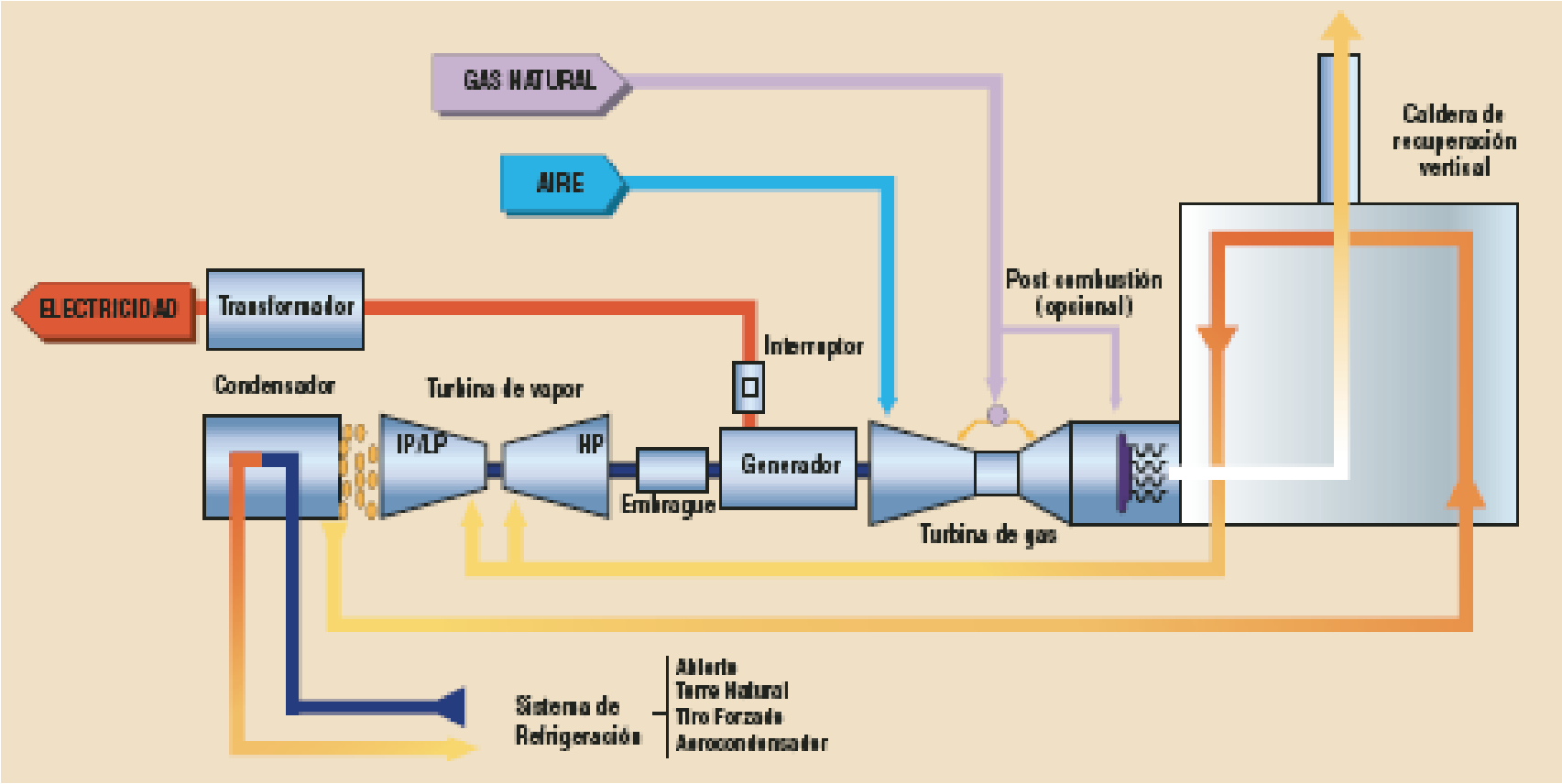
- the most expensive plants are used in periods of high consumption; e.g.: fuel and hydro plants

- PRE generation was assured a feed-in tariff regime:
  - until 2011 it did not enter the supply curve
  - from 2012 on, instrumental offer bid at 0 price

coal thermal power plant

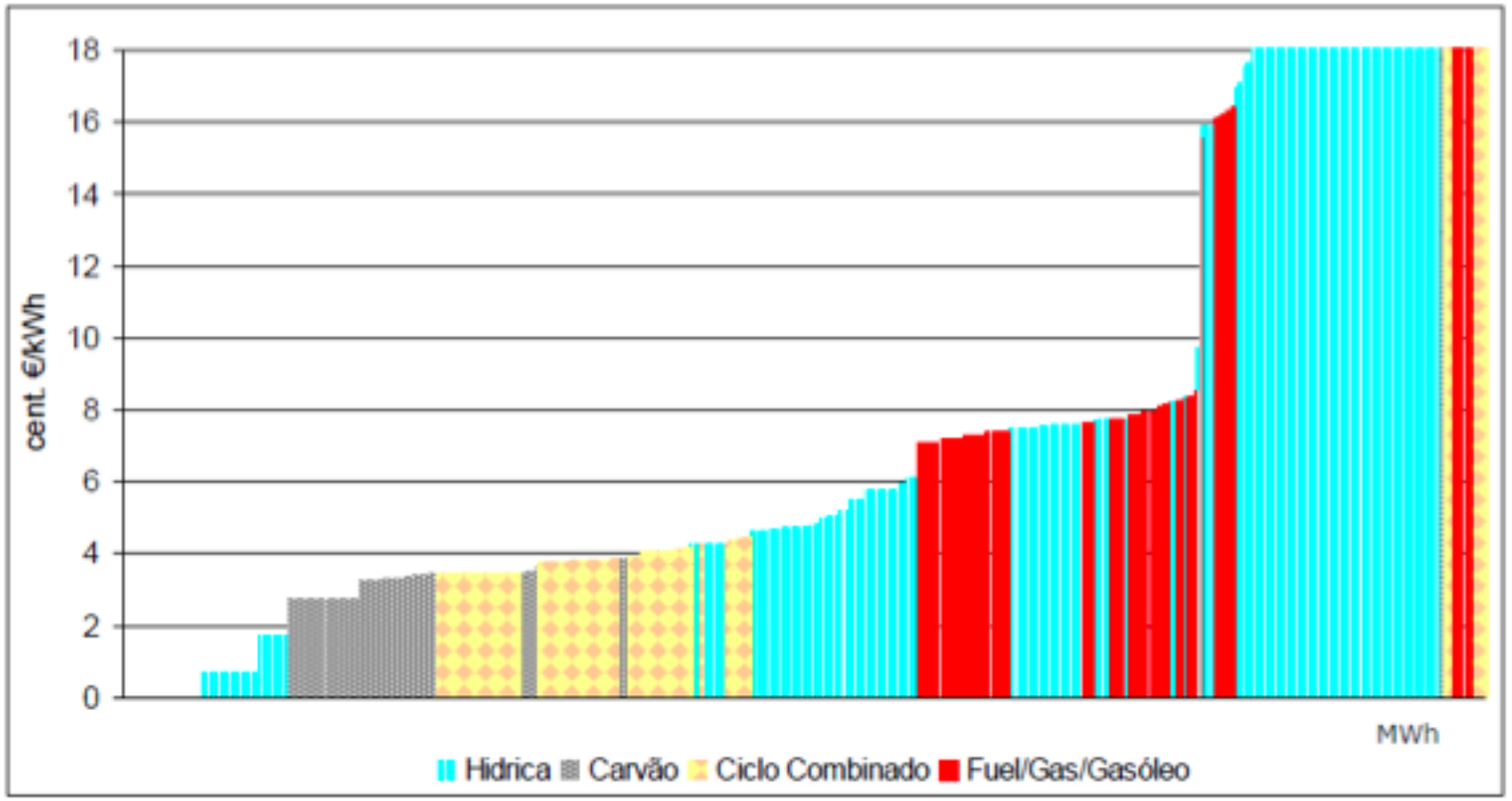


CCGT


GAS NATURAL
AIRE
Caldera de recuperación vertical
ELECTRICIDAD
Transformador
Post combustión (opcional)
Interruptor
Condensador
Turbina de vapor
IP/LP
HP
Generador
Embrague
Turbina de gas
Sistema de Refrigeración
Abierto
Torre Natural
Tiro Forzado
Aerocondensador

generation

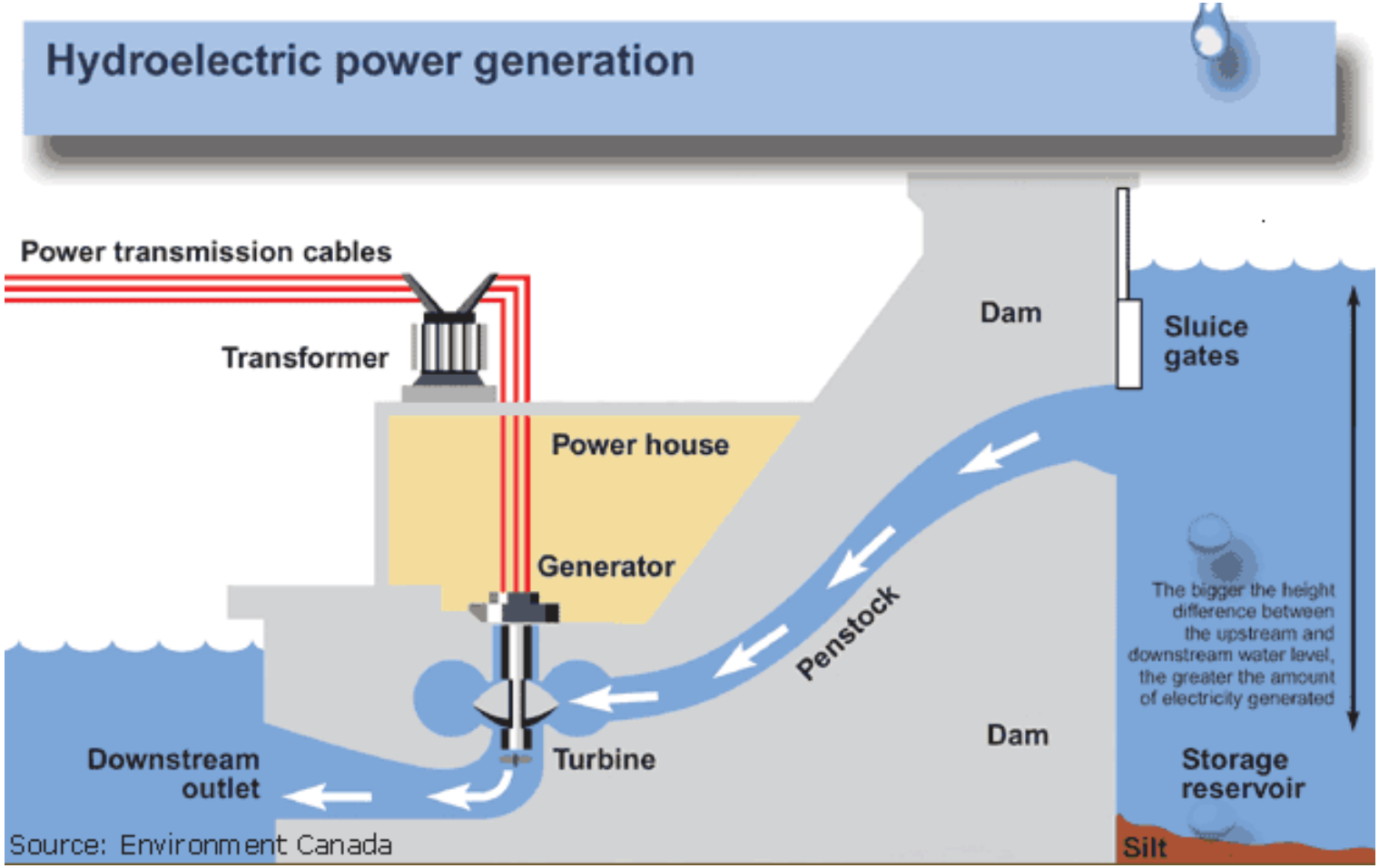
Merit order of the power plants usage



hydro power

- The marginal cost of hydro power plants depends on the type of plant:
  - **Run of the river:** plants have a reduced water storage capacity, therefore its marginal cost is near zero
  - **Hydro dams:** marginal cost depends on:
    - forecasting methods about the raining level
    - storage capacity
    - future electricity prices
- Although its marginal cost is not zero, the storage capacity allows for the inter-temporal management of water

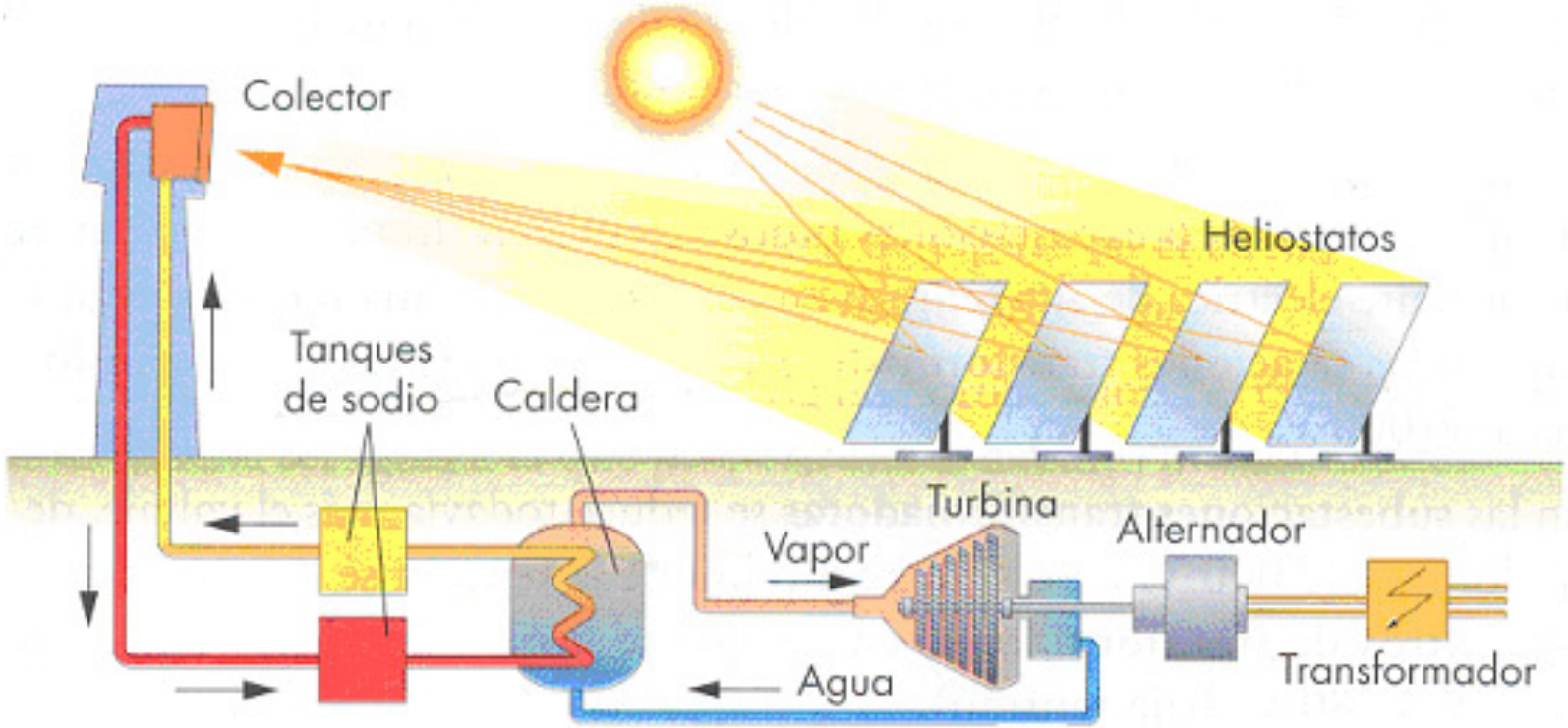
hydro electrical central



PRE

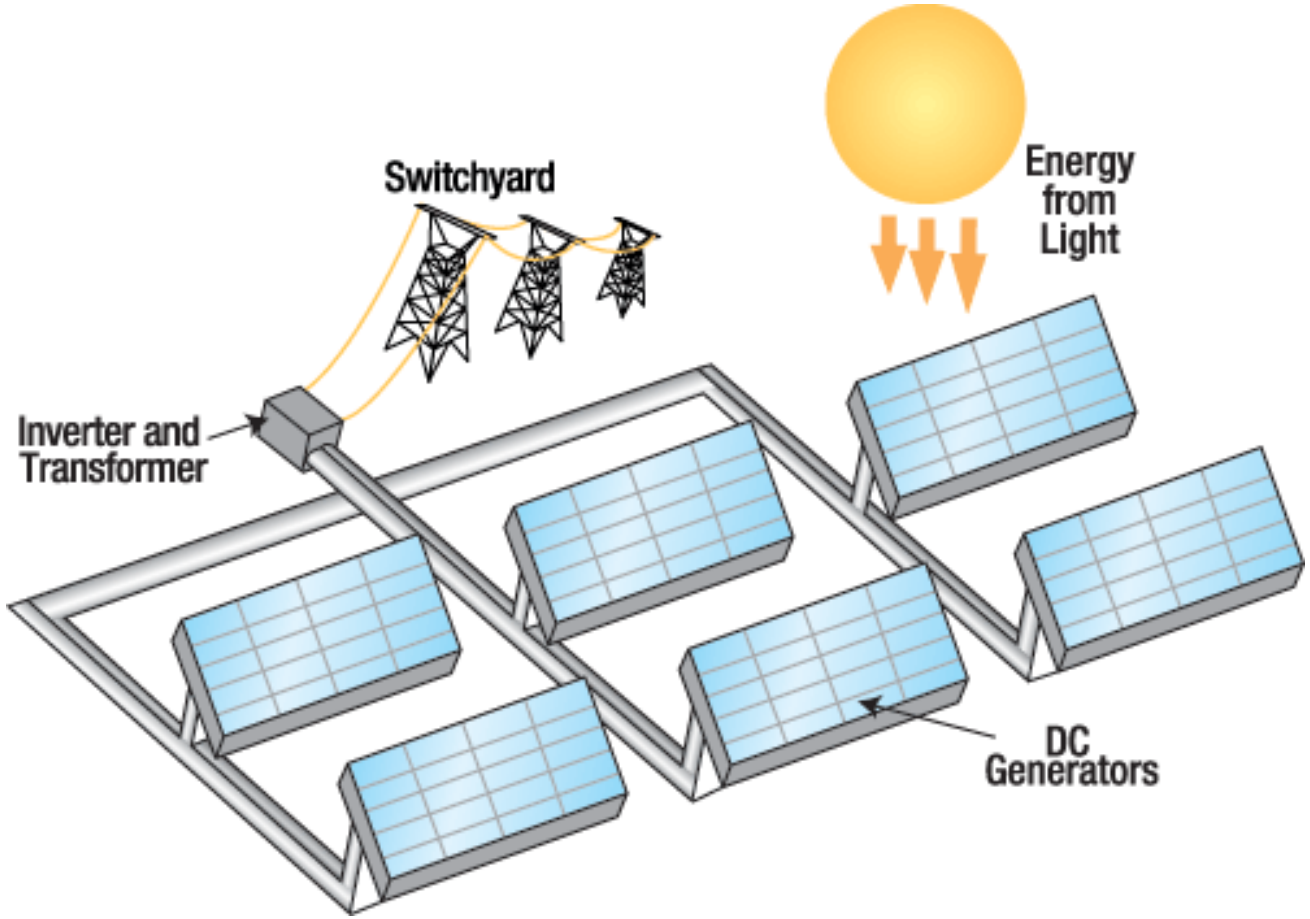
- **Protection regime** that includes the generation of electricity through renewable sources (wind, sun, mini-hydro and biomass) and co-generation
- Models were design in order to turn its entry viable:
  - These ways of generation produce **positive externalities** (reduced emissions of CO2, reduced dependence of oil and increased energy efficiency)
  - In general, present **higher costs**
- In Portugal, PRE is sold according to a **feed-in tariff regime**, i.e. all the electricity generated is bought at regulated tariffs
- In order to assure the financial viability of these plants, tariffs are significantly higher than the wholesale market price,
  - This gives origin to an **over-cost** being supported by consumers

solar plant – thermal

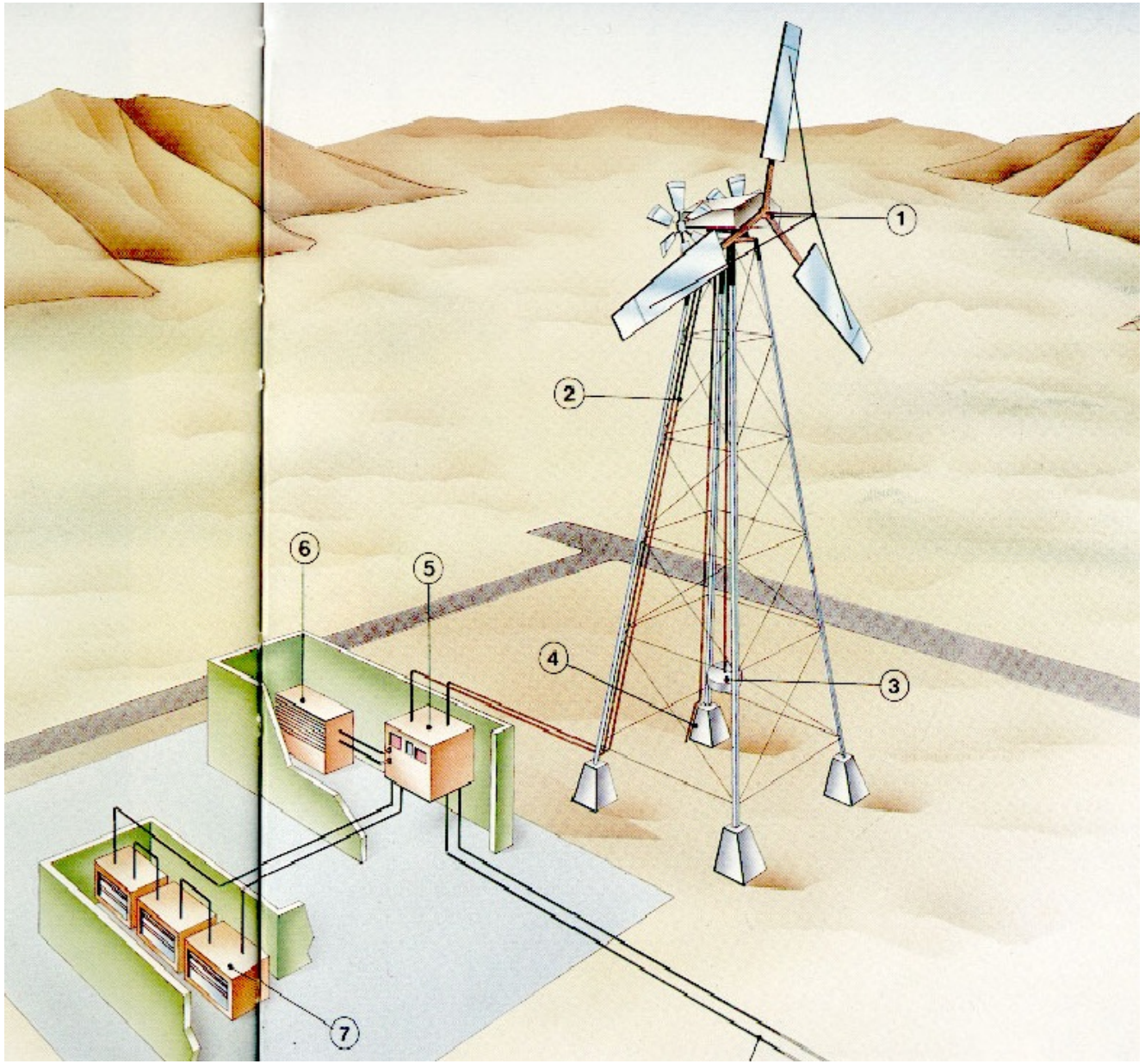


Central solar de alta temperatura.

solar - photovoltaic



wind generator



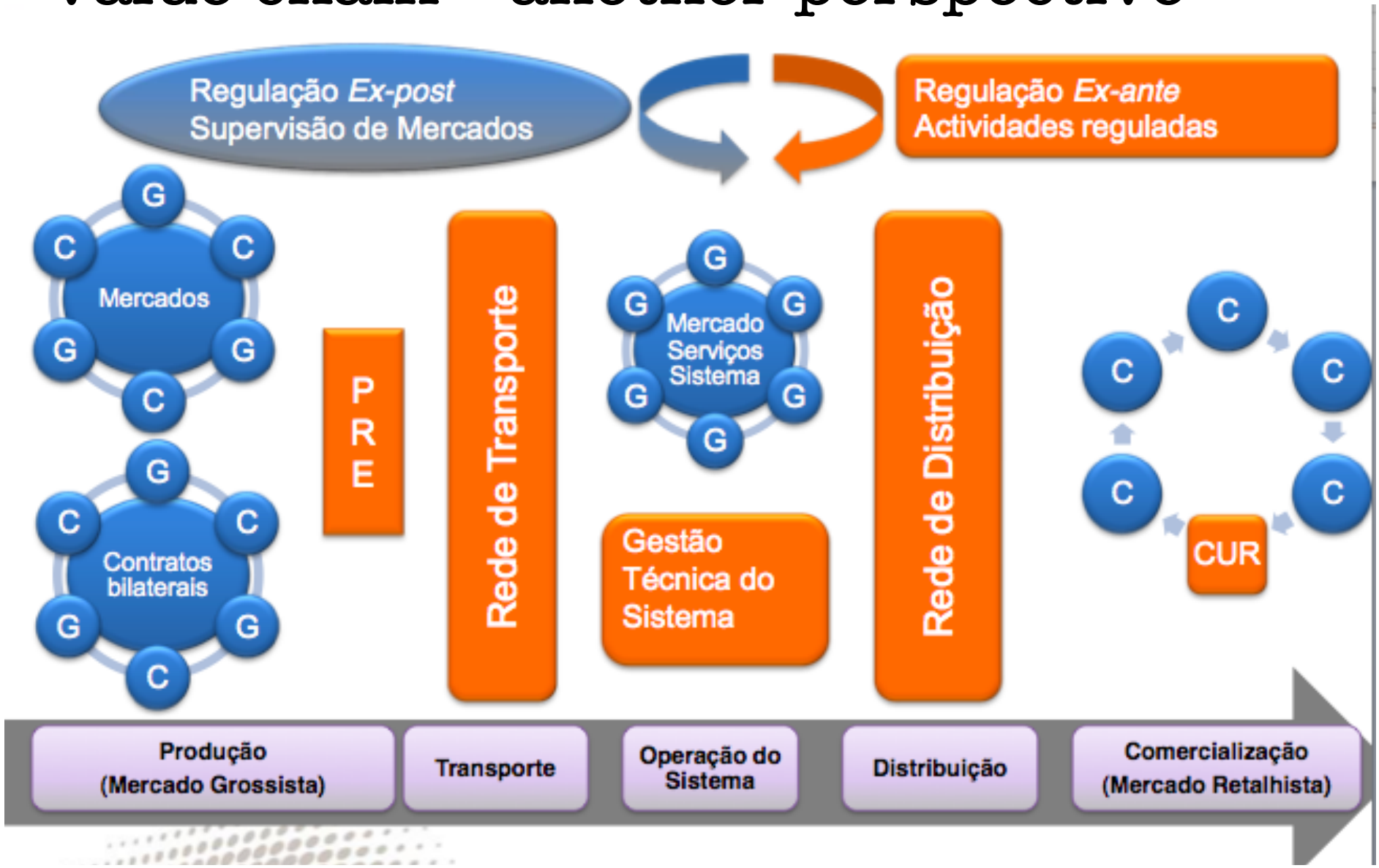
transmission and distribution

- Rede Nacional de Transporte (RNT) assures the **transmission** of the electricity generated in power plants to the distribution network
  - **Regulated monopoly** activity, whose assets are owned and managed by **REN**
- The **distribution** networks allow the delivery of the electricity received from the transmission network to consumers
  - **Regulated monopoly** activity
  - Remuneration of the regulated assets base defined by ERSE
  - The distribution activity is exercised, in a legal and functional separation regime, by **EDP Distribuição**

retail supply

- Retailers can freely buy and sell electricity
  - they have the right to have access to the transmission and distribution networks at tariffs set by the regulator
- Consumers can **freely chose their supplier** and change it at 0 cost
  - there's a **supplier of last resort** that serves as a guarantee of the electricity supply to consumers, namely to the most vulnerable ones, under quality and continuity conditions (EDP Serviço Universal)
  - In the **liberalized market** operate EDP Comercial, Iberdrola, Endesa, Union Fenosa, Galp, EGL and Fortia whose offers are freely determined by these agents

value chain – another perspective



players in regulation

- Portuguese Government
- ERSE
- Autoridade da concorrência

ERSE

- (Independent) Regulator of electricity markets with financial autonomy

- Aims:
  - protect the rights of consumers w.r. to prices, information, possibility of choice and quality of electricity supply
  - foster competition to increase efficiency
  - guarantee non-discrimination in the access to transmission and distribution networks
  - guarantee transparency in relations across agents establishing clear rules

ERSE

- Tariff regulation: establishes criteria to compute tariffs and prices of access to the tr. and distr. networks, as well as prices to the final consumer (supplier of last resort)

- Network access regulation: establishes the right to use the tr. and distr. networks

- Quality regulation: defines Q and information disclosure levels

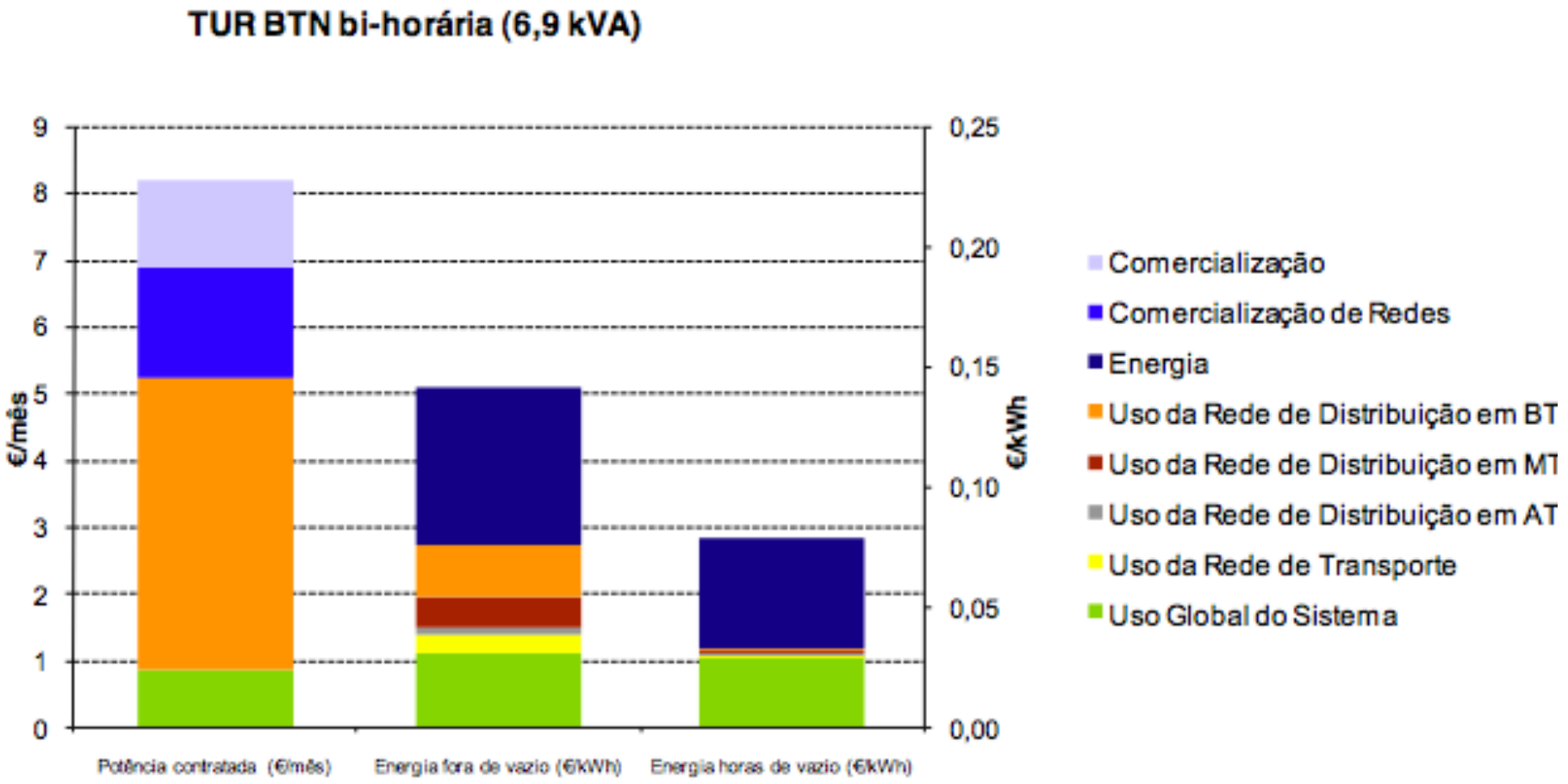
tariff regulation

- In electricity transmission: ROR
- In electricity distribution: price-caps (CPI-X)
- AND incentive regulation to compensate market and regulation failure, e.g.:
  - Promoting the reduction of waste in the trnsmission of electricity
  - Promoting quality of electricity supply* in the distribution network
  - Promoting environmental protection(PPDA - Plano de Promoção do Desempenho Ambiental)
  - Promoting efficiency in the consumption of electricity (PPEC - Plano de Promoção da eficiência no consumo)

retail tariffs

- Tariffs applied to end customers are the result of the **sum of a number of tariff components**, which are related to the different electric system activities
- Access tariffs are paid by all consumers, regardless their supplier is in the regulated or in the liberalized market. These tariffs include:
  - Global System Usage (CMEC, PRE, PPA)
  - Transmission Network Usage
  - Distribution Network Usage
- As a way to give the right incentives, tariffs reflect each activity's costs

additive tariffs

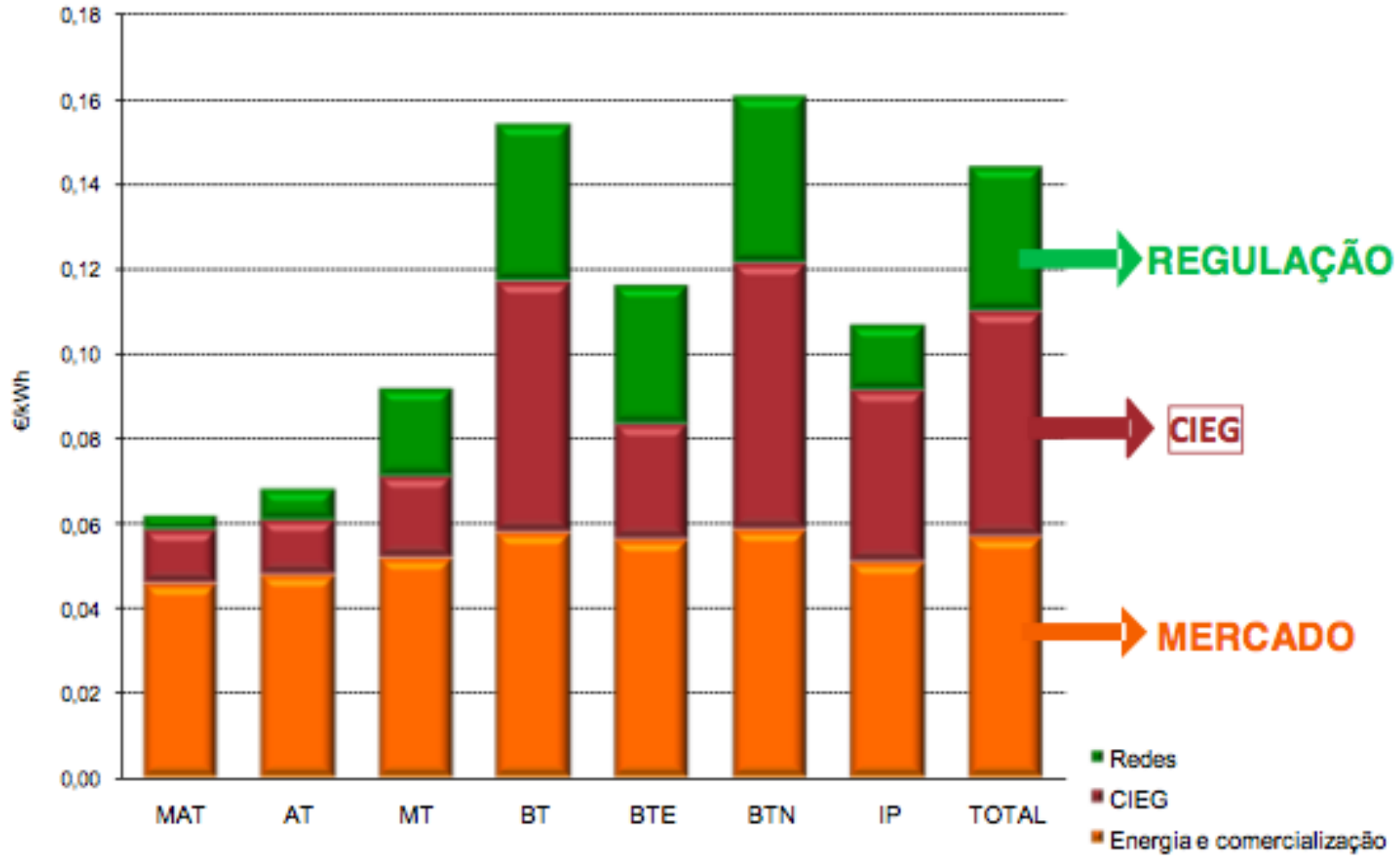


Tarifas 2008 (tarifa aditiva)

retail tariffs

- Retail price = energy + networks + CIEG
- Energy: prices come form the market of electricity
- Networks: prices regulated by ERSE
- CIEG: costs of energy policy and general economic interest
- The relative weight of each component depends on the type of consumer

Decomposição das tarifas de Venda a Clientes Finais (Tarifas 2011)



MAT – Muito Alta Tensão; AT – Alta Tensão; MT – Média Tensão;
BT – Baixa Tensão; BTE – Baixa Tensão Especial (>41,4 kW); BTN – Baixa Tensão Normal (≤ 41,4 kVA); IP – Iluminação Pública

retail tariffs

- Regulated tariffs were discontinued; presently there is a transitory system.
- The tariffs are determined in the year **previous** to the one of its application (n-1) based on an **estimative** about demand and electricity prices
  - If there are forecast deviations, and the returns from the tariffs are lower than the acquisition costs on the wholesale market, then in the following year (n+1) the tariffs are calculated retroactively to recoup these deviations
  - If the tariff returns are higher than the provision costs, there is a devolution in the tariffs of the following year (n+1)
  - Revision every quarter

Autoridade da concorrência

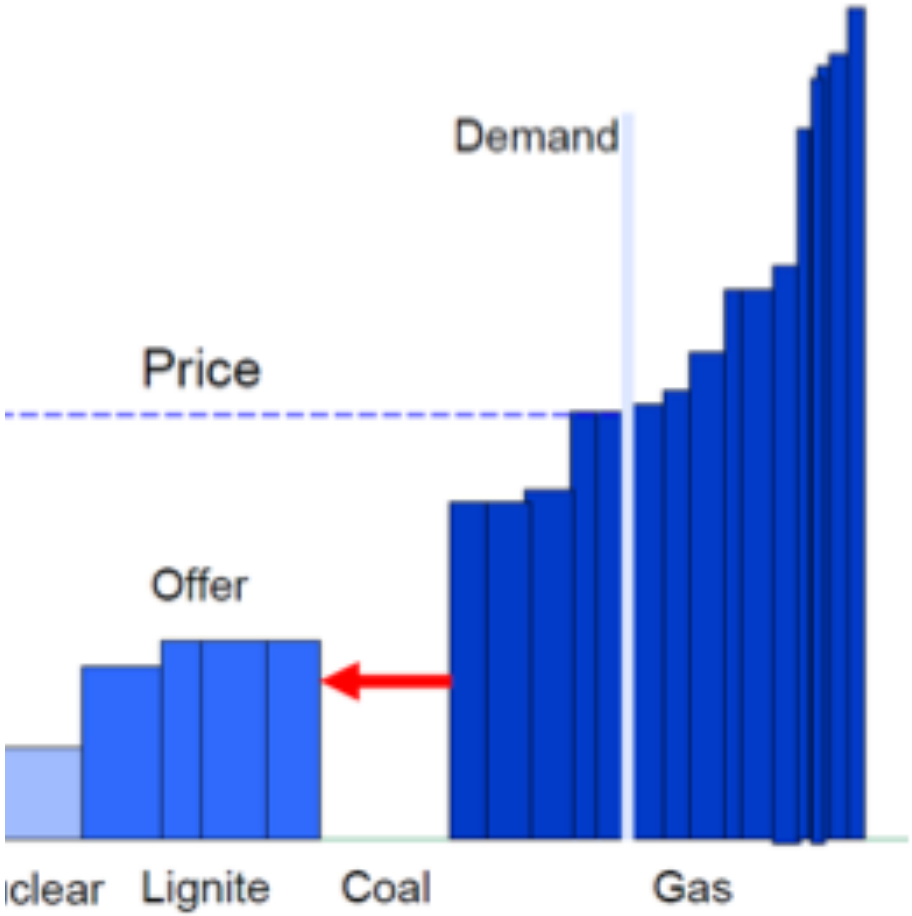
Investigations of energy companies under the antitrust rules – Articles 101 and 102 EC – can be divided into different categories, such as:

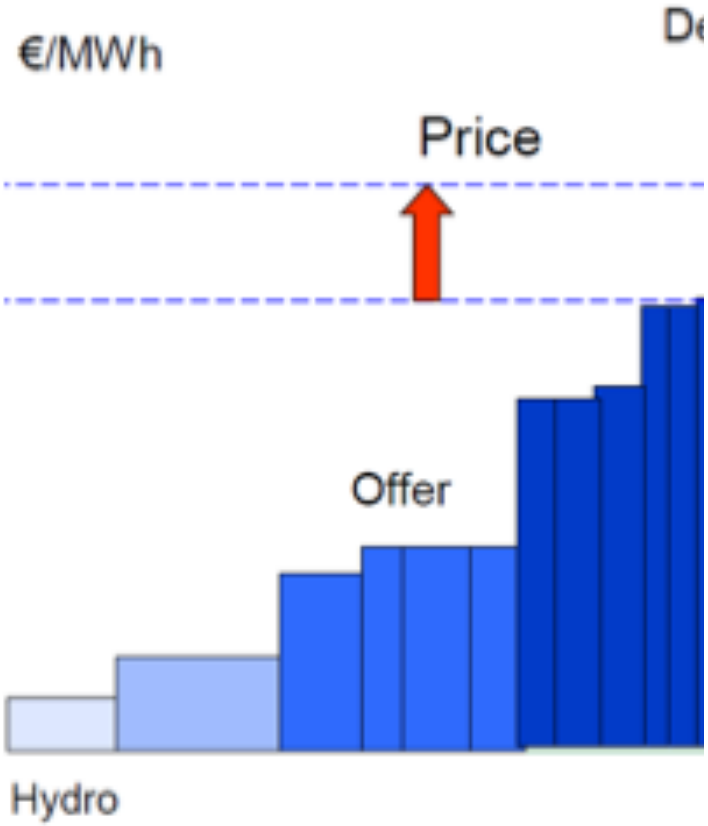
- **exclusionary conduct** by dominant incumbents (such as long-term downstream contracts with customers)
- **exploitative** abuses by dominant incumbents (such as withdrawal of available generation capacity)
- **collusion** between incumbents to share markets

Merger cases: focus on identifying any anti-competitive effects that may result from a transaction, and seeking to ensure that competitive market structures are maintained

EC case: E.ON

- German wholesale electricty market is dominated by E.ON/RWE (and Vattenfall)
- E.ON may have **withdrawn** substantial amounts of profitable generation capacity 2002-2007
- By not offering profitable generators can force recourse to more expensive plants on the merit curve and thereby manipulate market outcomes to the prejudice of consumers


Demand
Price
Offer
clear
Lignite
Coal
Gas


€/MWh
Price
Offer
Hydro

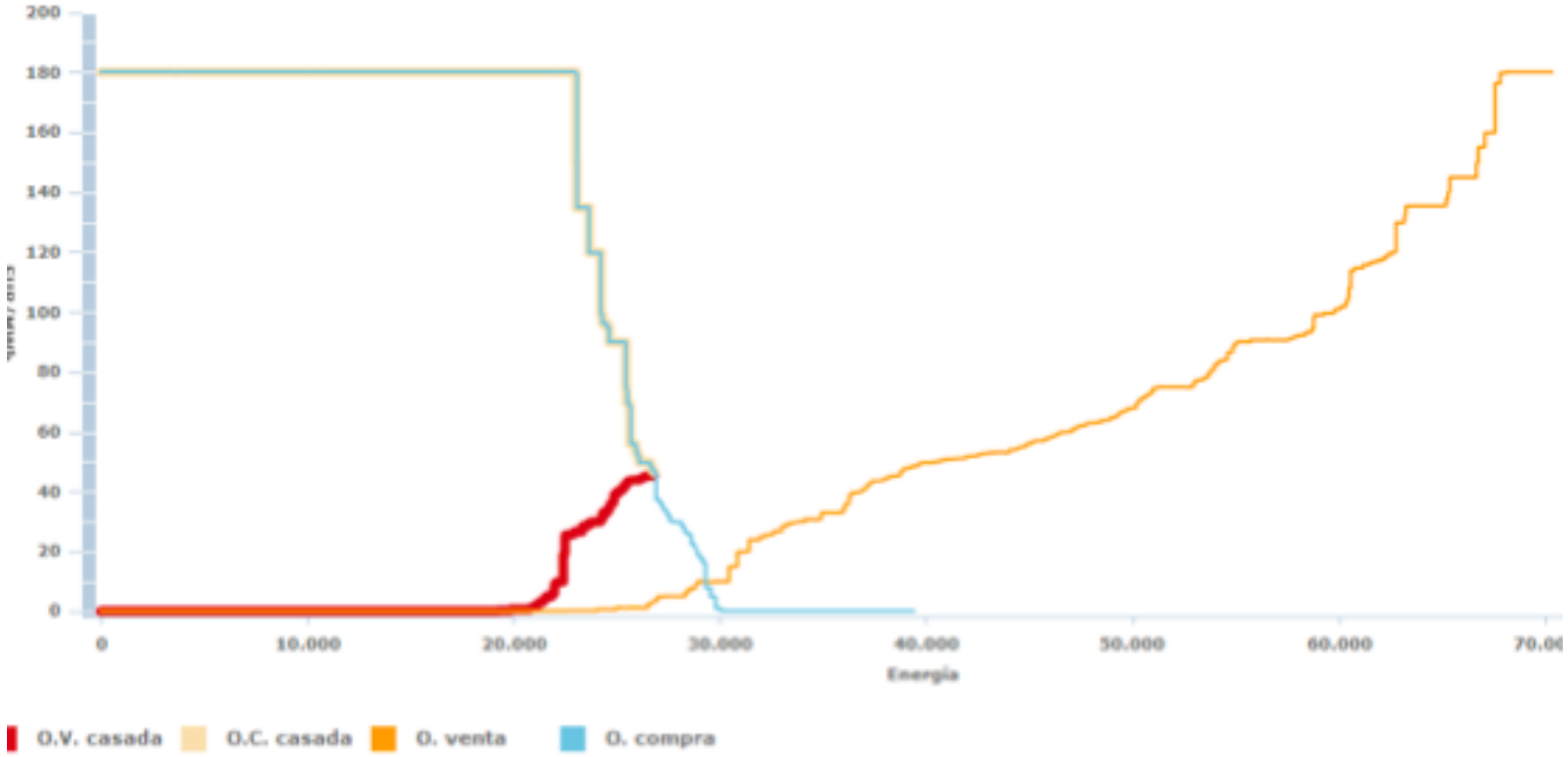
MIBEL

- On the 1st of July 2007 the wholesale market of the **Iberian Market of Electricity** (MIBEL) started working
- The MIBEL is composed by the set of transactions derived from the participation of economic agents in the following markets:
  - Day-head market
  - Intra-day market
  - Forward market
  - Ancillary services market
- The day-head and intra-day market are managed by OMIE located in Madrid, while the forwards market is managed by OMIP located in Lisbon
- The ancillary services markets take place in both countries

day-head market

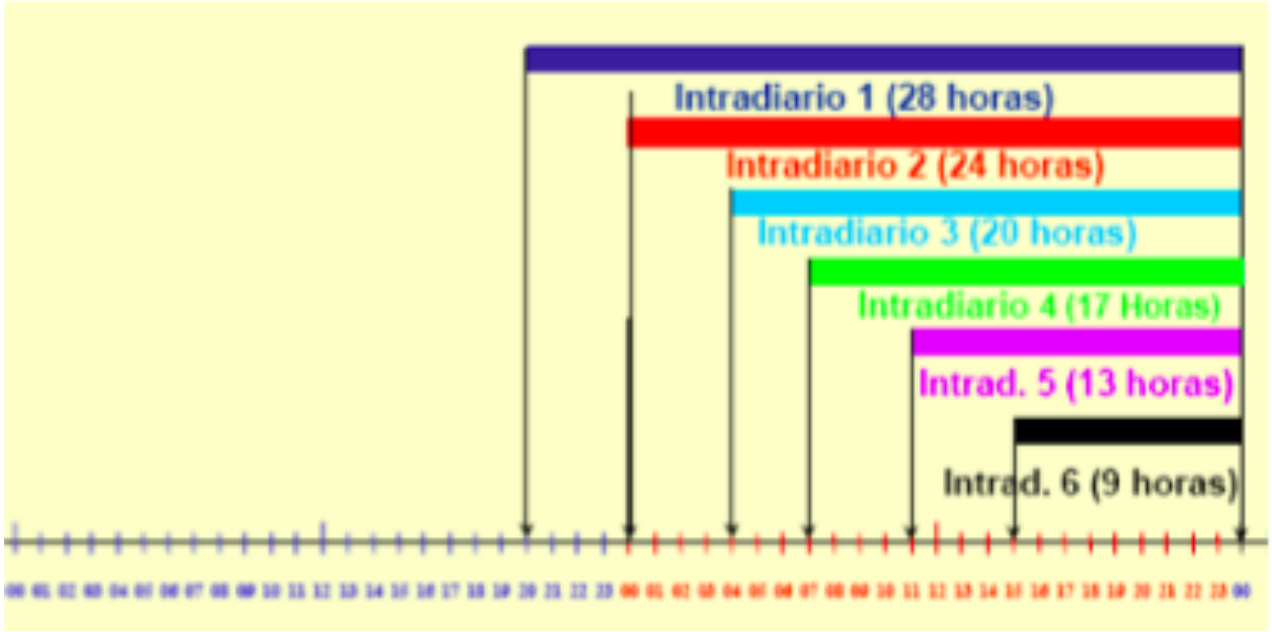
- Wholesale market where **most of the transactions** take place
- Occurs, every day, at 10 am of the day previous to the electricity delivery
  - From the **supply side**, each producer, for each hour, submits supply offers composed by a pair of price and quantity
  - From the **demand side**, for each hour, retail suppliers submit their buying offers
- The equilibrium price, for each hour, is given by the **marginal supply offer** - the one with the highest price - needed to satisfy demand
- For each hour, a **unique price** is defined, which is received by all the supply offers selected to produce in the competitive auction

day-head market



intra-day market

- **Fitting market** that incorporates demand forecasting errors and the generation programming adjustments
- Composed of 6 daily sessions, in approximation to the delivery moment



ancillary services market

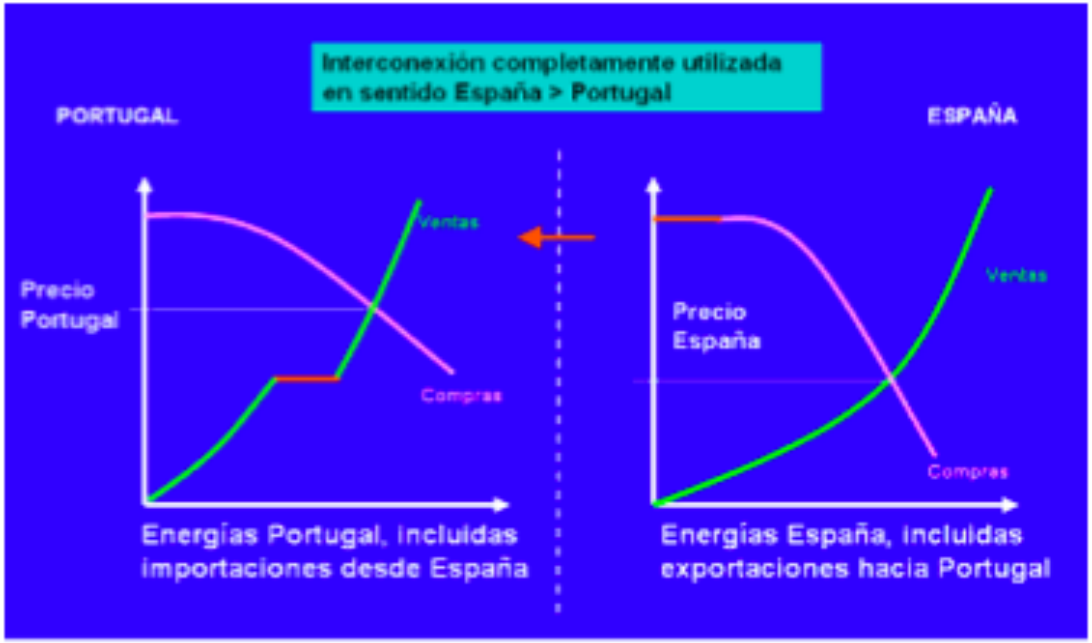
- Allows the system operator (REN) to guarantee the **permanent equilibrium** between the electricity generated and the electricity consumed
  - **manage all the deviations** that can happen between electricity contracted in the day-head and intra-day market and the one that is needed to satisfy demand in real time
- If any deviation occurs, there is a degradation on the quality of supply which can result in an interruption of the distribution to consumers
- To manage deviations, REN **reduces or increases generation**, recurring to the ancillary services contracted to the power plants

congestion management

- The interconnection management mechanism of the Iberian Market consists on a mixed model which includes:
  - a **market splitting** mechanism applied to the day-head market
  - + **capacity auctions**, previous to the day-head market, for the attribution of physical rights of interconnection capacity
- In the day-head markets operations, price formation is based on the market splitting mechanism
  - Absent of congestions, the wholesale price is the same in both countries
  - The market splitting in **different price zones** occurs when the **interconnection capacity is insufficient** to totally arbitrage the differences of prices
  - In this case, prices reflect each region supply and demand conditions, taking into account the maximum usage of the interconnection capacity

congestion management

- If there's congestion from Spain to Portugal,
  - In Spain there's an increase in D (= export capacity)
  - In Portugal there's an increase in S at the Spanish equilibrium price



congestion rent

- The market operator, REN, buys the electricity coming from Spain to Portugal at the Spanish price, and re-sells it, in Portugal, at the Portuguese price, necessarily higher

- The existence of congestions generates a rent - **congestion rent** - which is equal to the difference of prices multiplied by the imported volume

- This congestion rent **reverts to the owners of the interconnection lines**
  - it is equally divided between REE and REN

- As concerns the congestion rents received by REN, the Portuguese regulator decided that it should:
  - be invested in interconnection lines
  - revert to the tariffs

capacity auctions

- In these auctions, physical rights to capacity are attributed that allow agents to program **bilateral contracts** between the two countries

- In the day-head market, the integration of the market splitting mechanism and the rights to capacity is based on the principle of "**used or re-compensated**"

- EDP, as a consequence of being a Dominant Operator in Portugal, is not allowed to buy interconnection capacity in these auctions