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Methodologies to calculate remunerations for the electricity transmission and distribution

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1. The Monopoly profit in theory

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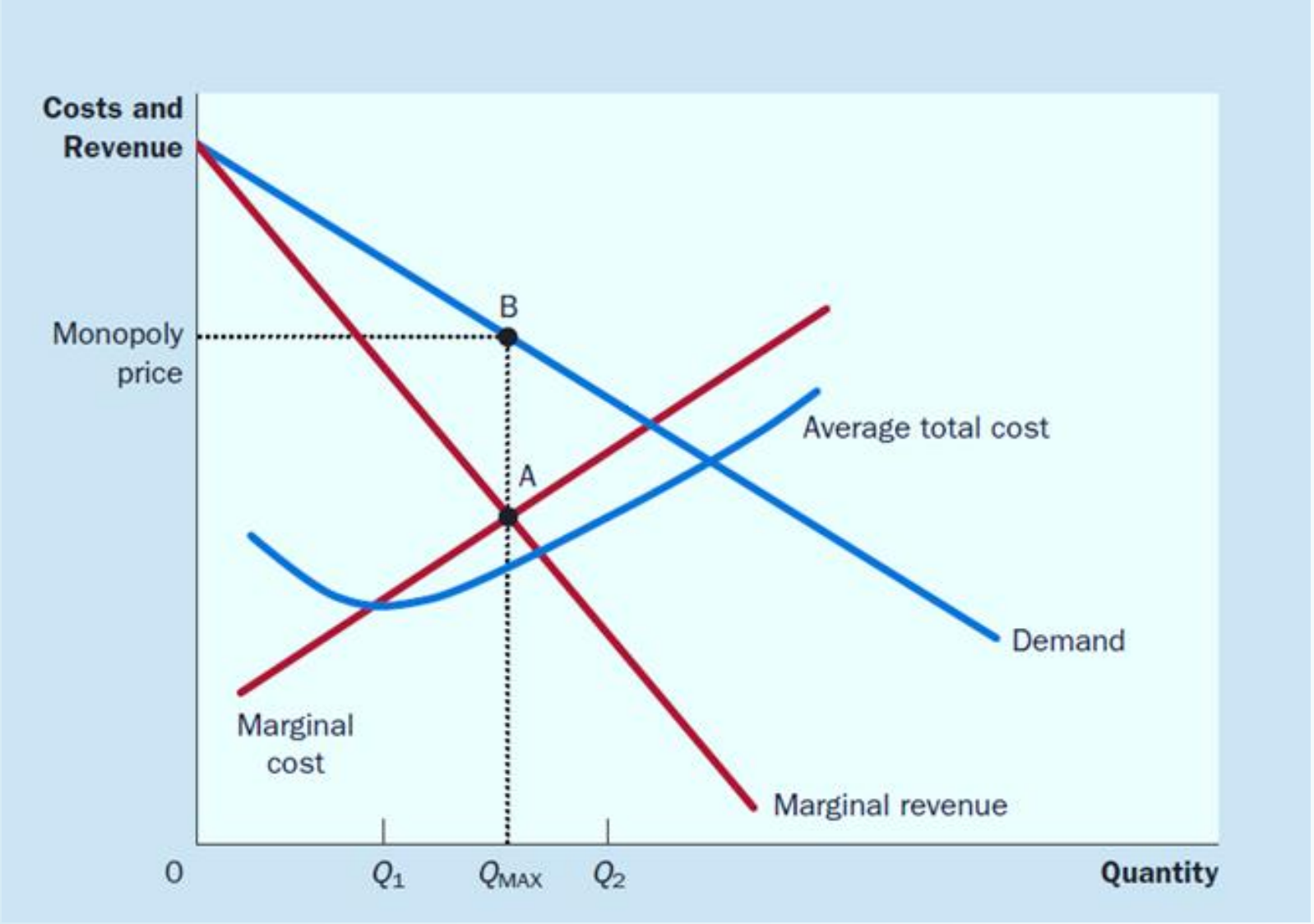

Monopoly profit maximization: choosing the quantity (Q_{MAX}) where marginal revenue equals marginal cost (A). Given Q_{MAX}, the demand curve reveals the Monopoly price (B) that will induce consumers to buy that quantity.

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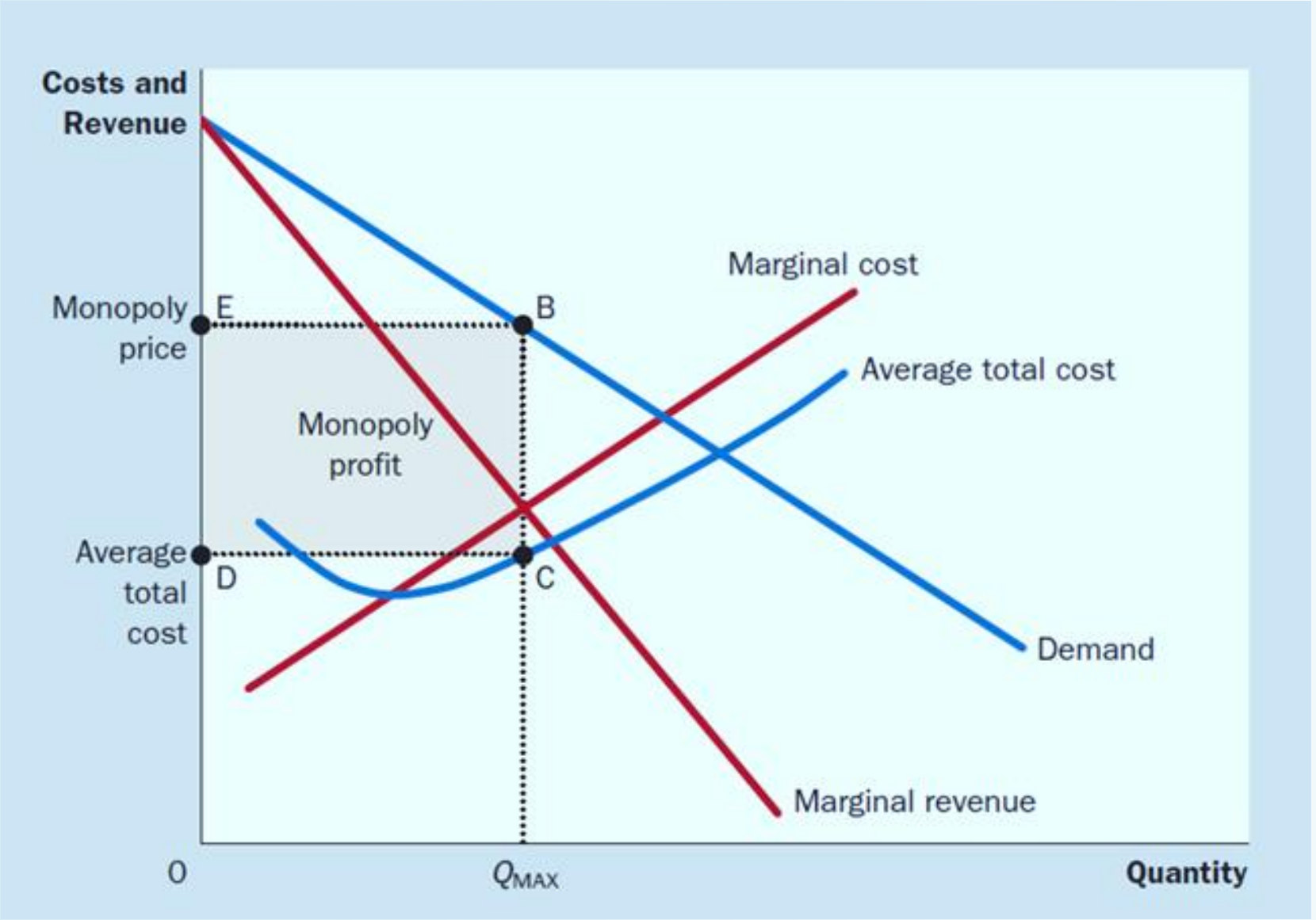

The Monopolist maximum profit

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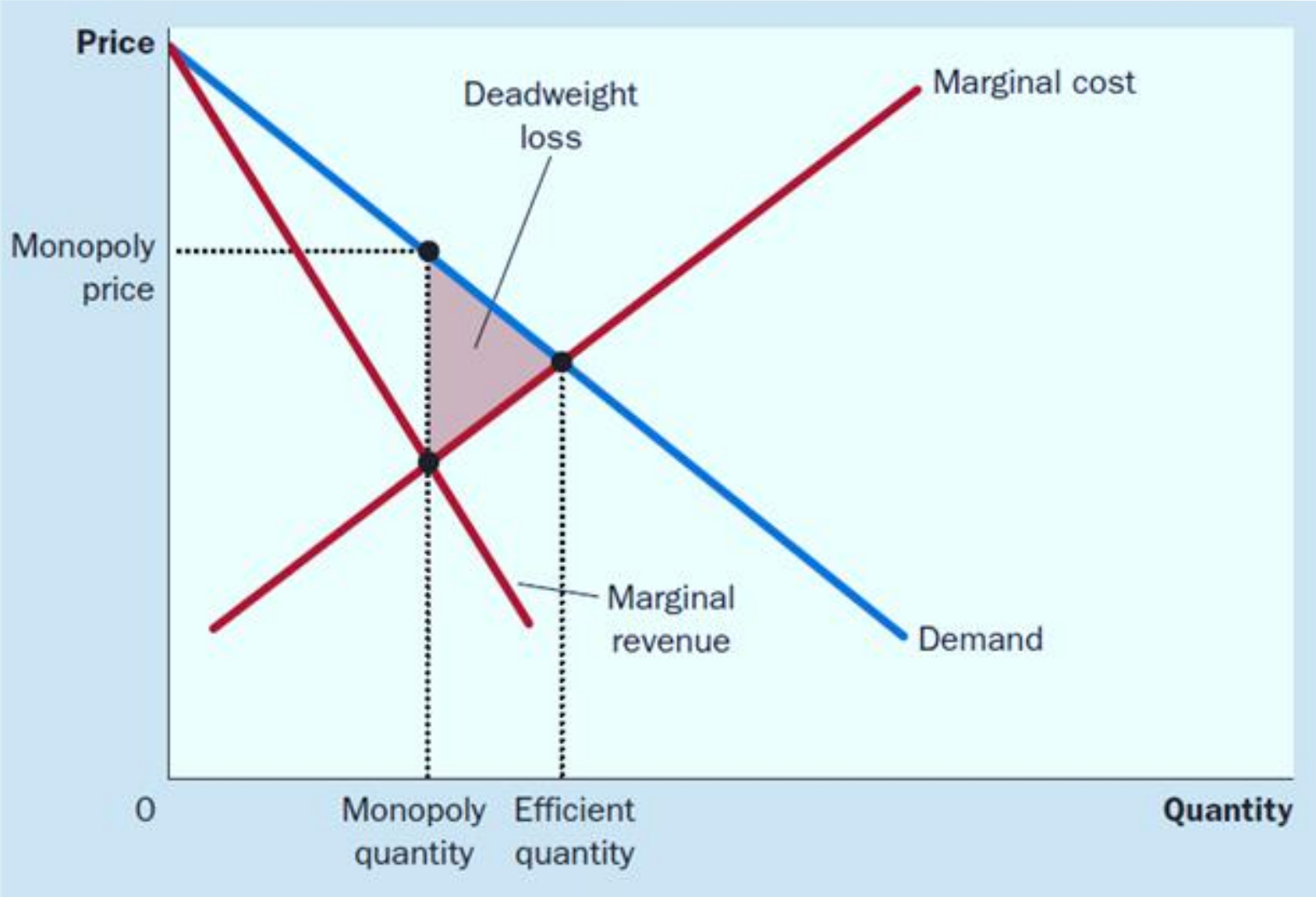

When the Monopoly maximizes its profits, the resulting (Monopoly) price and quantity implies a loss of social efficiency. The inefficiency of the Monopoly can be represented by deadweight loss (also known as the Harberger Triangle). Economic regulation allows to simulating a competitive environment through the application of regulatory methodologies that define the revenues/profits, which are allowed for these activities by the independent regulator.

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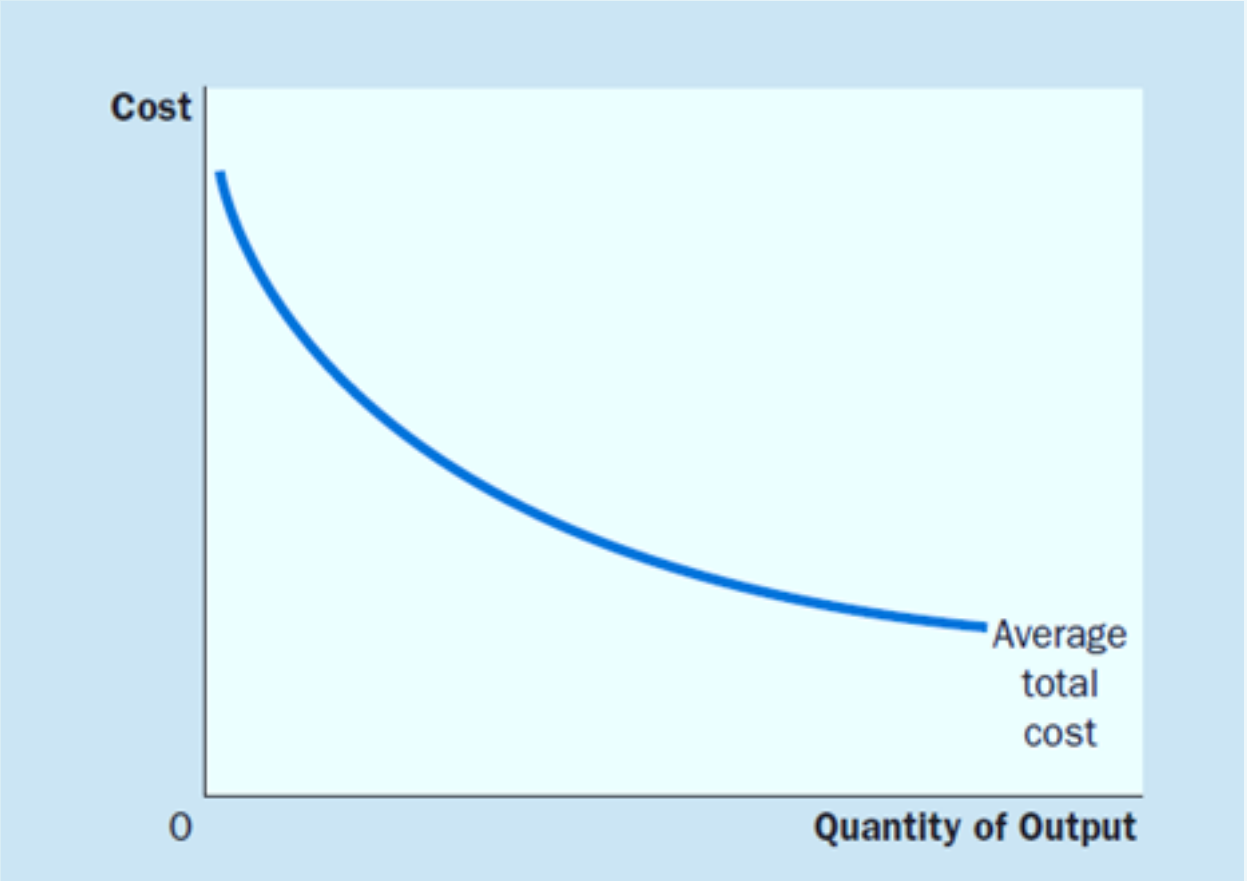

The case of the Natural Monopoly: it occurs when a single firm can supply a good or service to an entire market at a lower cost than could two or more firms. In other words, when the total average cost continually declines, a single firm can produce any given amount at the smallest cost, that firm is a Natural Monopoly (the fixed cost have a very high weight and marginal variable costs are very low).

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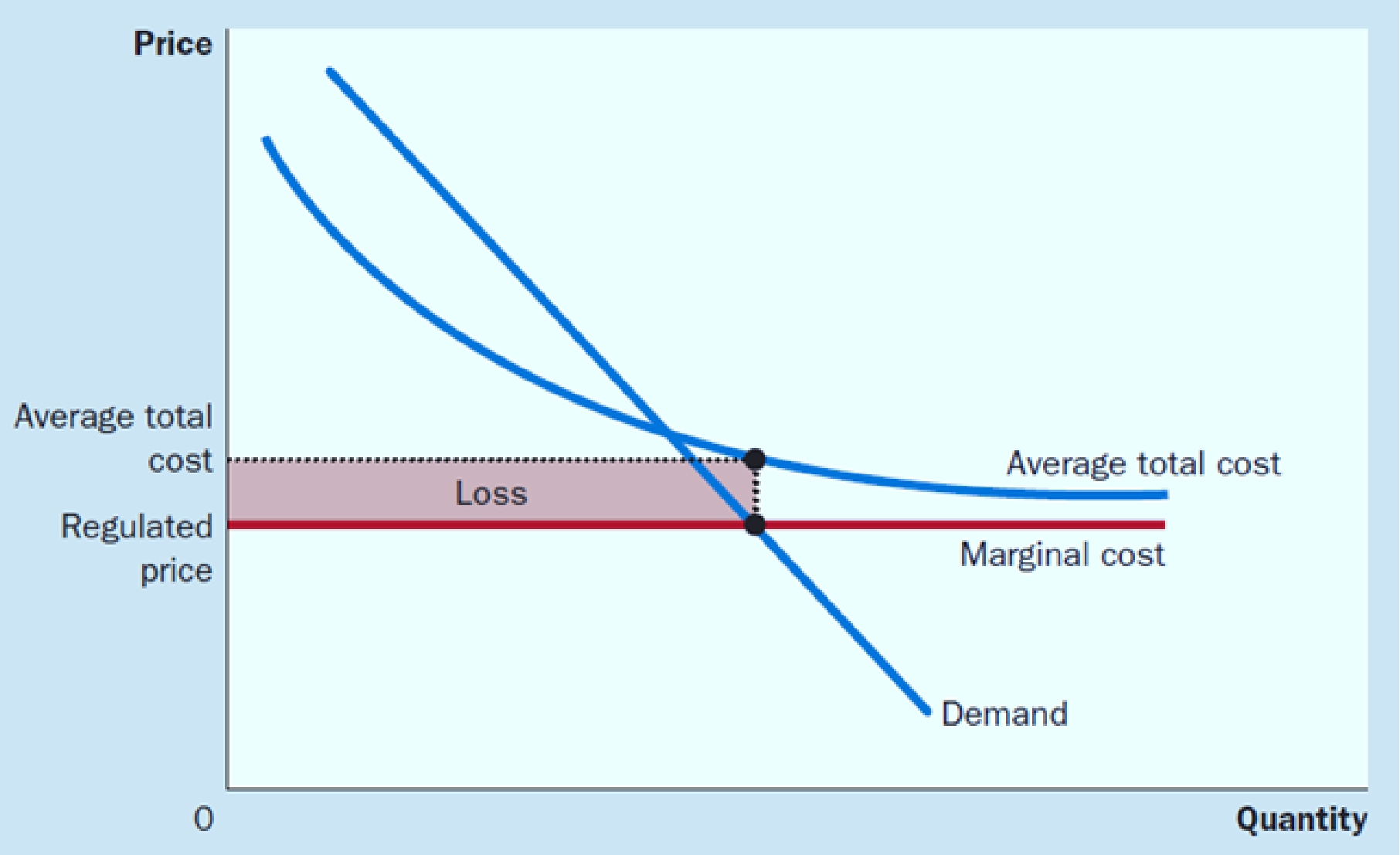

If regulated price is set equal to marginal cost, deadweight is minimized. however, no firm can operate indefinitely at a loss. This poses a dilemma for the regulatory agency: either it must abandon its goal of marginal cost pricing, or the government must subsidize the monopoly forever. Yet to pay for the subsidy, the government needs to raise money through taxation, which involves its own deadweight losses.

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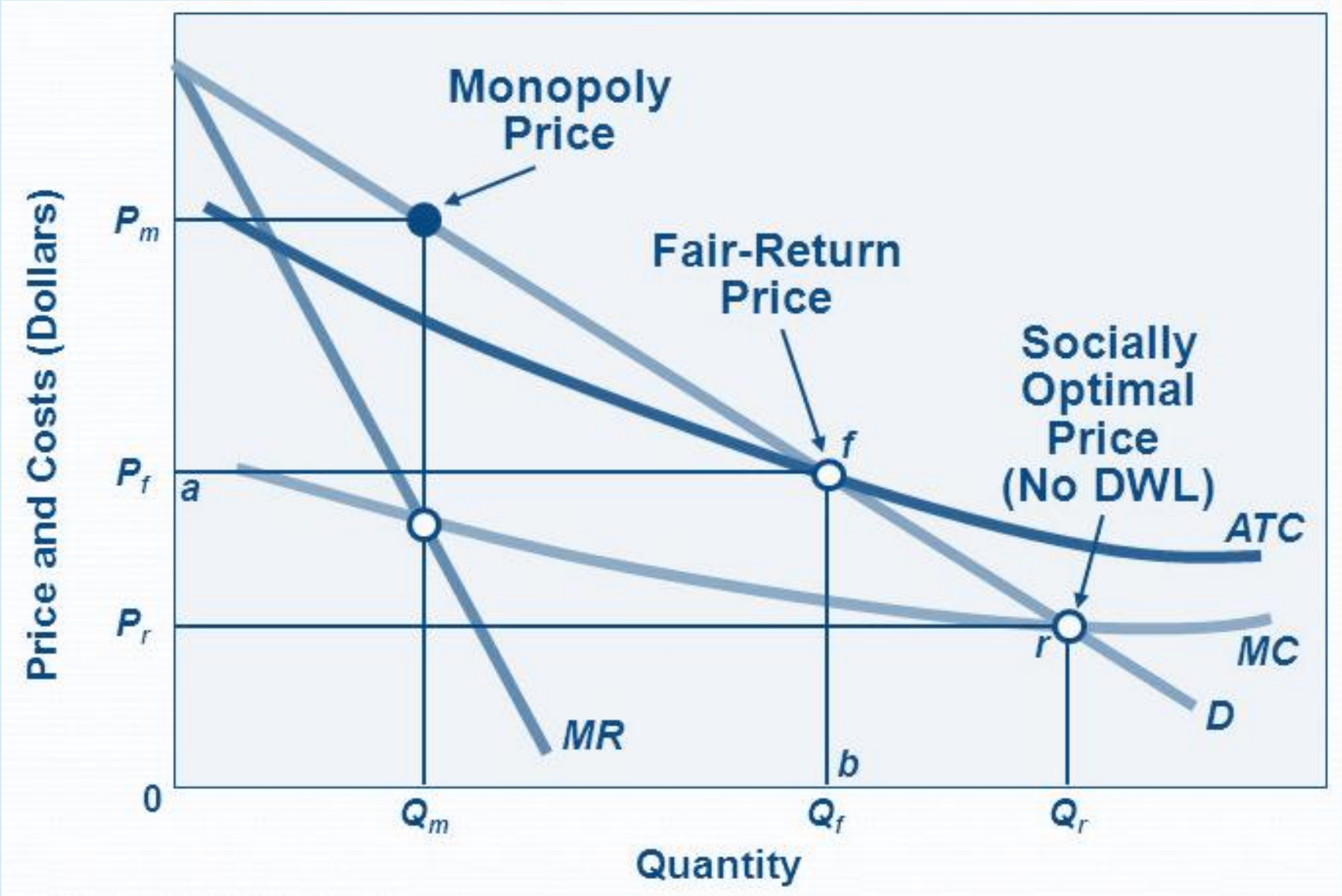

Fair-Return Price = Average Total Costs. Note that the "zero-profit" condition ("Fair-Return Price"), where profit equals total revenue minus total cost, the total cost includes all the opportunity costs of the firm. In particular, total cost includes the time and money that the firm owners devote to the business. In the zero-profit equilibrium, the firm's revenue must compensate the owners for these opportunity costs.

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Economic regulation allows to simulating a competitive environment through the application of regulatory methodologies that define the revenues/profits, which are allowed for these activities by the independent regulator

Promotes **resource allocation** and technical **efficiency**, leading to lower costs	A well design regulation methodology can promote **technological innovation** and the preparation of the sectors for future challenges	Ensures that the **quality of service** is adequate and respects pre-defined standards	Ensures a **fair return** for the companies

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- **The definition of the revenues (company perspective):**

  ✓ Based on the costs of regulated companies, favoring efficient costs. Economic regulation makes it possible to define the amount of income allowed to companies.

- **The definition of tariffs (consumer perspective):**

  ✓ Based on the income allowed to the companies. The methodologies for setting the tariffs must transmit the appropriate economic signals to the consumers.

The main principles are:

- **Non-discrimination between users**, allowing access to be made available on equal terms to all interested parties.
- **Transparency**: the calculation methodology must be established a priori and accessible to all interested parties.
- **Cost-Based Tariffs**: tariffs shall be determined based on the costs of providing the service.
- **Absence of cross-subsidies**: the tariffs paid by each user must reflect the costs that the system incurs for providing the service to that user (a customer must not pay for costs caused by others).

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The main objectives are:

- Providing companies with cost recovery, as long as they are efficient: investment costs (CAPEX) and Operating costs (OPEX).
- Create incentives for the investment in new infrastructures, in order to guarantee the timely availability of supply.
- Attract capital (equity and debt) to the sector.
- Create incentives for the best economic and financial performance of companies.
- Create other explicit incentives, namely to improve quality of service, reduce losses and promote environmental awareness and sustainability.
- Provide users with the appropriate economic signals for an efficient use of resources.

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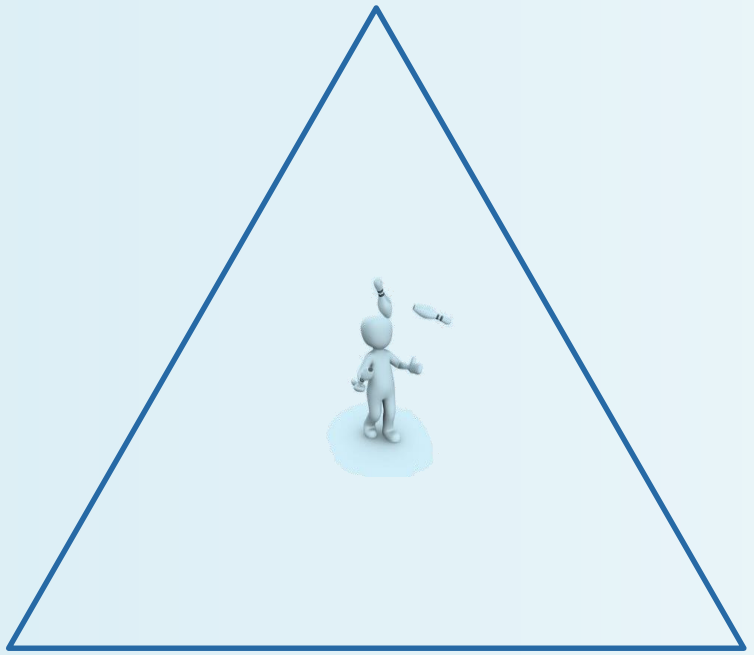
Cost for the consumer



Economic and financial balance of the company

Quality of service

2. The Monopoly profit in practice

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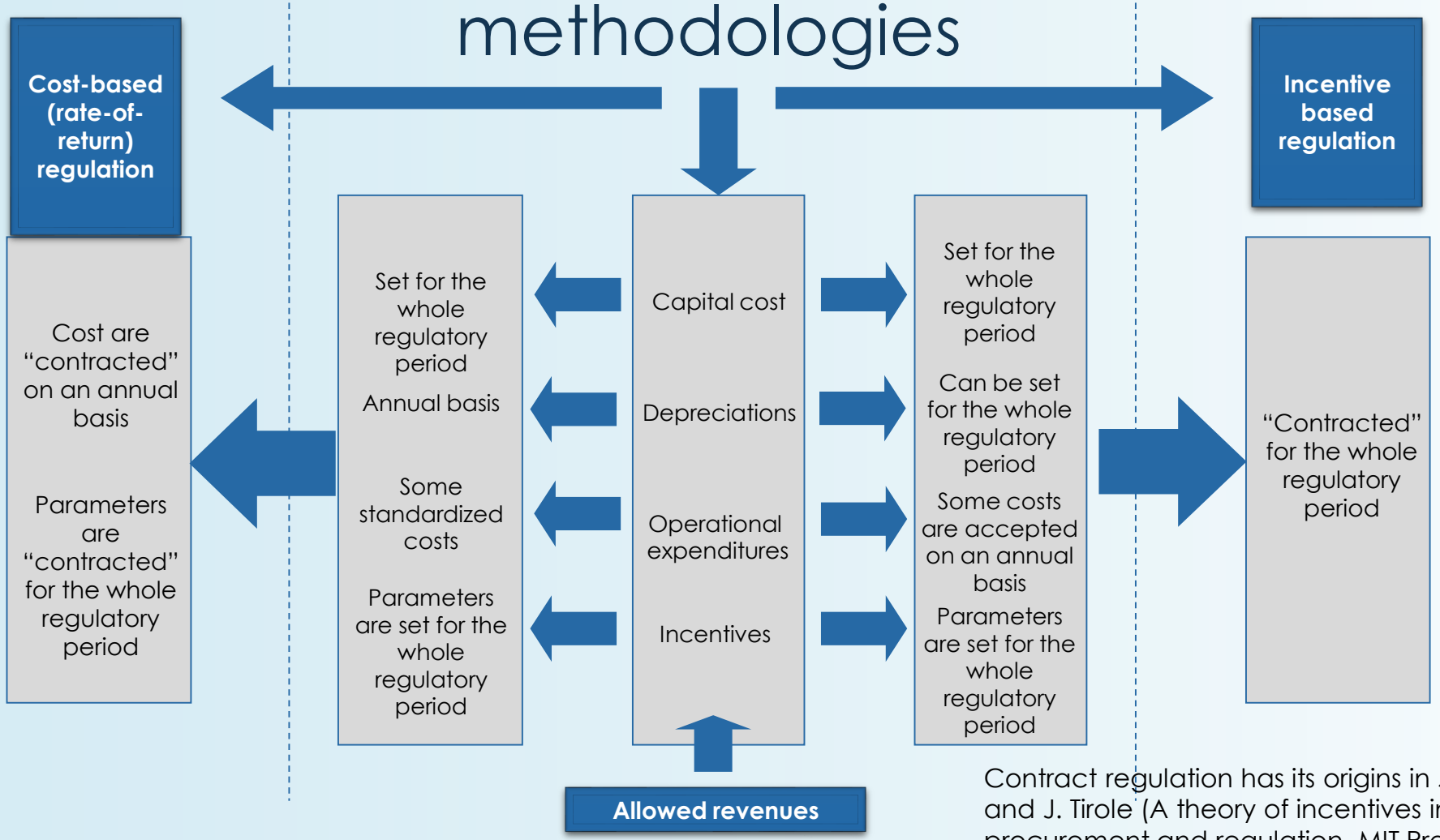
Principles, aims and regulatory methodologies



Contract regulation has its origins in JJ. Laffont and J. Tirole (A theory of incentives in procurement and regulation, MIT Press, 1993)

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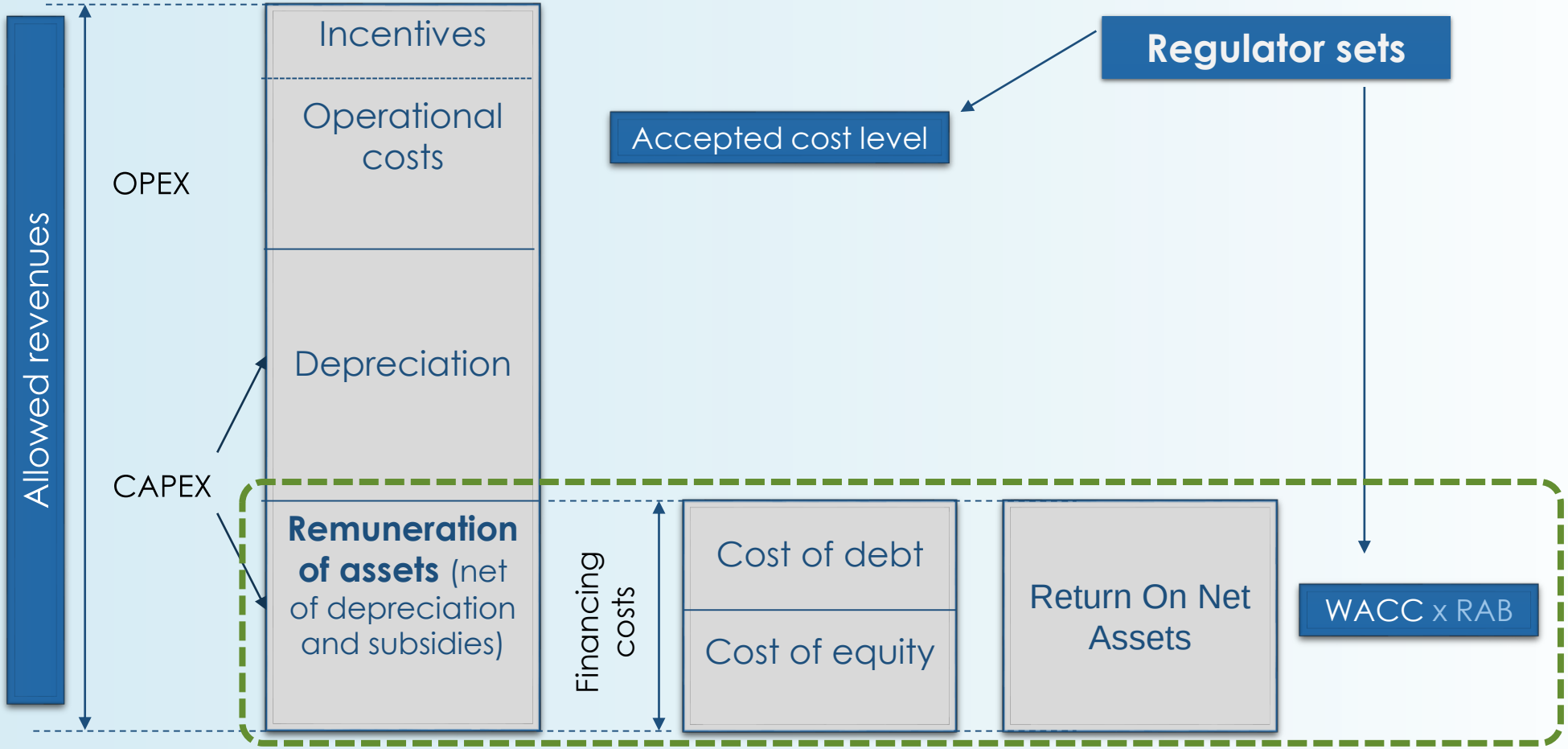
Incentive regulation - block approach (CAPEX+OPEX)



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When defining the revenues, in terms of CAPEX, the main objectives are:

- The adequacy of investments to the evolution of the demand, to the quality of service and to other objectives (environmental, promotion of competition, etc.).
- The efficient realization of investments.
- The return on investments reflects its cost of capital, that is, the risk associated with the activity, as well as the appropriate capital structure.

When defining the revenues, in terms of OPEX, the main objectives are:

- Reflect efficient allocation of resources and a maximization of outputs for a given set of inputs (technical efficiency), that is, a global economic efficiency. In other words, to achieve efficient costs within a framework of economic rationality.
- Ensure the achievement of a wider set of objectives (environmental, quality of service, innovation).

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The revenues are recovered by application of tariffs. Tariffs are set to provide each activity with an amount of allowed revenues calculated in accordance with the applicable Tariff Regulations.

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REGULATED ACTIVITY		REGULATED TARIFF
Global technical system operation	▷	Global technical system operation tariff
Electricity transmission network	▷	Electricity transmission network tariff
Electricity distribution network in HV	▷	Electricity distribution network (HV) tariff
Electricity distribution network in MV	▷	Electricity distribution network (MV) tariff
Electricity distribution network in LV	▷	Electricity distribution network (LV) tariff
Supplier switching operation	▷	Supplier switching operation tariff
Electricity wholesale trading operation	▷	Energy tariff
Electricity supply	▷	Supply tariff

Examples of the link between regulated activities and regulated tariffs

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For consumers who are still in the regulated market, ERSE defines a transitory End-User tariff, applied by the supplier of last resort (SLR). In simple terms, it can be defined as:

The regulated End-User tariff = Energy and supply tariff + Network access tariff

- Energy and supply tariff: includes energy prices and retail supplier (efficient) costs
- Network access tariff includes:
  - ✓ network costs
  - ✓ costs associated with energy policy and costs of general economic interest (CIEG)

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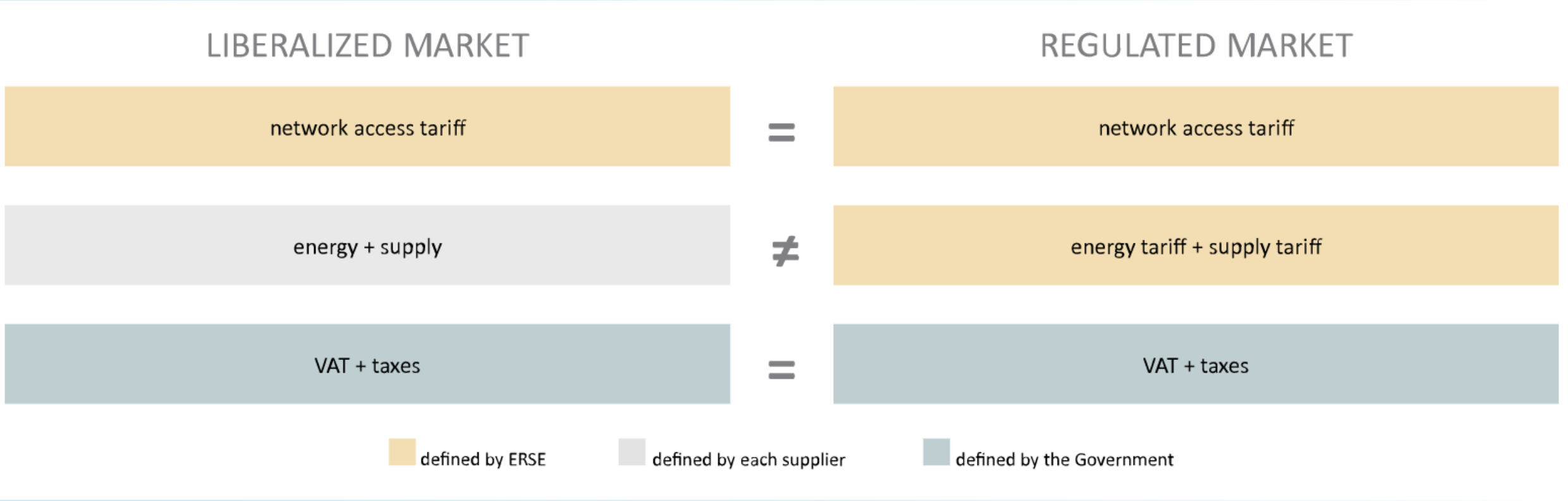

All consumers pay the network access tariff, regardless of whether they are in the regulated market or in the liberalized market. Access tariffs reflect the cost of infrastructures and all services used by all consumers in a collective manner. This tariff results from the sum of the global technical system operation tariff, the transmission network tariff, the distribution network tariffs and the supplier switching operation tariff.

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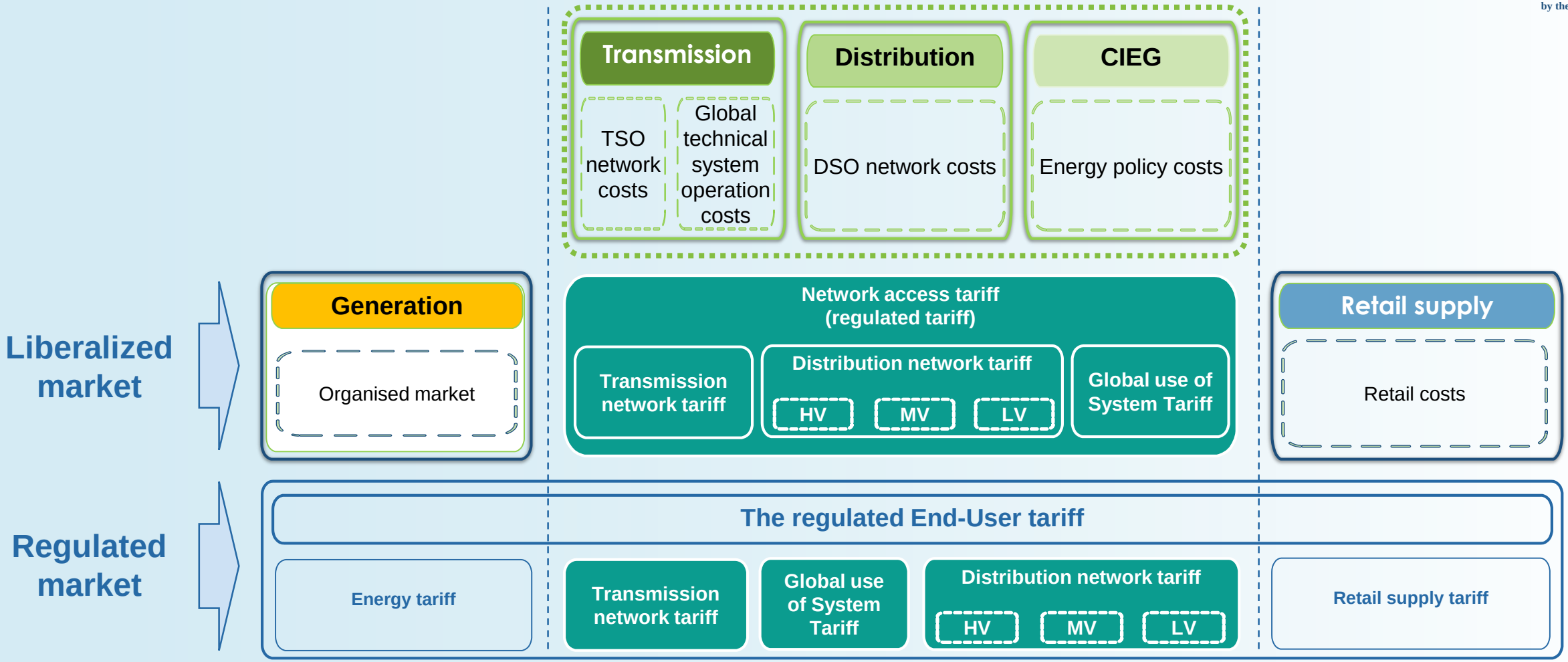
Regulated network access tariffs



Liberalized vs regulated market tariffs and prices

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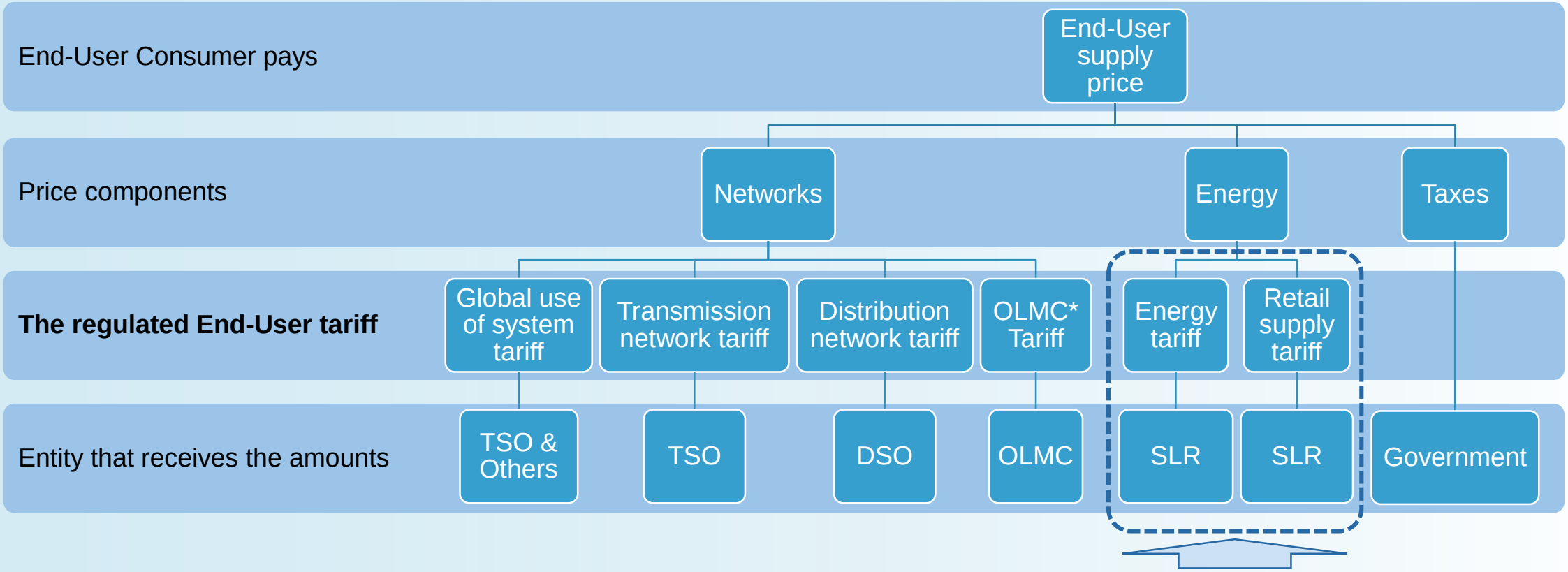

In the liberalized market, each retail supplier defines this amount of energy component to charge to the end user

Liberalized vs regulated market tariffs and prices
***OLMC (Operador Logístico de Mudança de Comercializador): Logistic Operator for Switching Supplier**

Principles, aims and regulatory methodologies

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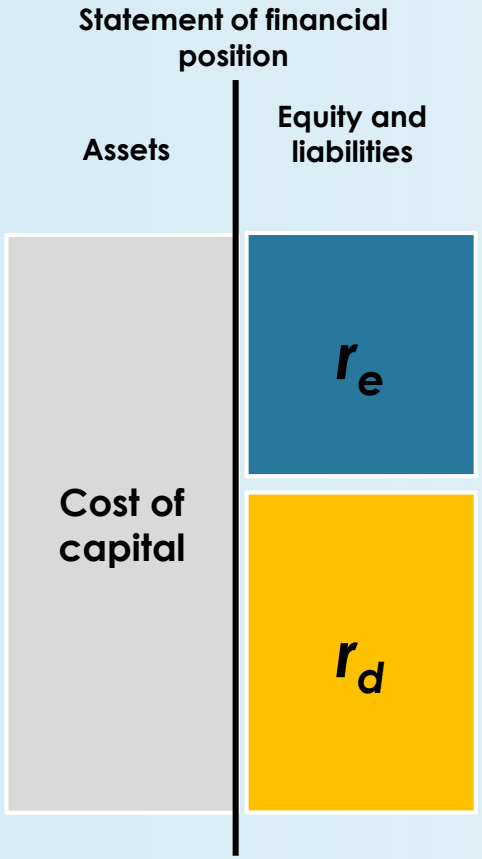

Cost of capital ⌦ WACC (Weighted Average Cost of Capital)

$$\text{Cost of capital} = r_d \times \frac{D}{D+E} + \frac{r_e}{1-t} \times \frac{E}{D+E}$$

r_d – debt interest rate
D – Debt capital
E – Equity
r_e – equity interest rate
t – tax rate

CAPM (Capital Asset Pricing Model)

$$r_i = r_f + \beta(r_m - r_f)$$

r_i - return on the capital asset
r_f - risk-free rate of interest
β – Equity beta
r_m – market rate of return

Definition of the each different variable must be transparent and consistent

$$\underbrace{Profits} = Revenues - Costs \quad => \quad \underbrace{Revenues} = Costs + ER$$

$$= Equity\ Remuneration\ (ER) = "Fair\ Return" \approx Dividends \qquad Allowed\ Revenues\ (AR)$$

$$AR = \underbrace{Costs} + ER$$

$$Personnel(P) + Maintenance\ (M) + Operation\ (O) + Depreciation\ (Dep) + Interest\ (I) + Taxes\ (T)$$

From the accounting perspective to the financial Pre-tax WACC definition

$$AR = \underbrace{P + M + O}_{OPEX} + Dep + I + \underbrace{T + ER}_{Equity\ remuneration + taxes\ =\ Pre\ Tax\ Equity\ remuneration\ =\ ER/(1-t)}$$

$$AR = OPEX + Dep + \underbrace{I}_{I = Debt\ value\ (D) \times Interest\ Rate\ on\ Debt\ (r_d) = D \times r_d} + \underbrace{ER/(1-t)}_{ER = Equity\ value\ (E) \times Return\ on\ Equity\ (r_e) = E \times r_e}$$

$$AR = OPEX + Dep + D \times r_d + E \times \frac{r_e}{1-t}$$

$$AR = OPEX + Dep + \left[D \times r_d + E \times \frac{r_e}{1-t}\right] \times \frac{D+E}{D+E}$$

$$AR = OPEX + Dep + \underbrace{\left[\frac{D}{D+E} \times r_d + \frac{E}{D+E} \times \frac{r_e}{1-t}\right]}_{Pre\ Tax\ WACC} \times \underbrace{(D+E)}_{RAB}$$

$$AR = OPEX + \underbrace{Dep + WACC_{PreTax} \times RAB}_{\downarrow} \\ CAPEX$$

$$AR = OPEX + CAPEX$$

$$AR = OPEX + CAPEX + Incentives$$

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$$\underbrace{AR - OPEX - Dep}_{EBIT} = \underbrace{\left[\frac{D}{D+E} \times r_d + \frac{E}{D+E} \times \frac{r_e}{1-t}\right]}_{WACC_{PreTax}} \times RAB$$

$$EBIT = WACC_{PreTax} \times RAB$$

$$\frac{EBIT}{RAB} = \left[\frac{D}{D+E} \times r_d + \frac{E}{D+E} \times \frac{r_e}{1-t}\right] = WACC_{PreTax} \quad \text{Or} \quad \frac{EBIT}{RAB} = \left[G \times r_d + (1-G) \times \frac{r_e}{1-t}\right] = WACC_{PreTax}$$

$$Where\ G(Gearing) = \frac{D}{D+E}$$

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$$AR = \underbrace{P + M + O}_{OPEX} + Dep + I + T + \underbrace{ER}_{ER = Equity\ value\ (E) \times Return\ on\ Equity\ (r_e) = E \times r_e}$$

$$AR = OPEX + Dep + I + T + (E \times r_e) \times \frac{(D+E)}{(D+E)} = OPEX + Dep + I + T + \left[\underbrace{\frac{E}{D+E}}_{(1-G)} \times (r_e \times RAB)\right]$$

Or

$$AR = OPEX + Dep + I + \left[(1-G) \times (r_e \times RAB) \times \left(\frac{1}{1-t}\right)\right]$$

Return on Equity (RoE) approach

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The approach to calculate the remuneration can be different, with the regulator defining the most appropriate methodology, which can depend, among other factors, on the information available, on the number of operators, on the ownership of the companies and on the maturity of the regulated sector:

- Pre-tax WACC = $r_d \times G + \frac{r_e}{1-t} \times (1 - G)$
- After-tax WACC = $r_d \times G \times (1 - T) + r_e \times (1 - G)$
- Plain-Vannila WACC = $r_d \times G + r_e \times (1 - G)$

The WACC defined can also be in nominal or real terms, with the corresponding nominal or real RAB. If the RAB is not revaluated (the RAB value is the historical nominal value), the applied WACC will be the nominal value. If, on the other hand, the RAB is revaluated every year with an inflation index, the applied WACC will be discounted of inflation, resulting in a real WACC value.

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The remuneration in practice: the transparency perspective and the Portuguese application case

Methodology for pre-tax nominal WACC calculation

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Component	Formula	Methodology
$Cost\ of\ Debt\ (r_d)$	$[R_f + RP_d] \times G$	Default Spread Model
$Cost\ of\ Equity\ (r_e)$	$[R_f + \beta_E\ (RP_m)] \times (1 - G) \times 1/(1 - T)$	Capital Asset Pricing Model (CAPM)

Variable	Description
R_f	Risk free rate
RP_d	Debt risk premium
G	Gearing = $G/(D + E)$, where $D = Debt\ and\ E = Equity$
β_E	Equity beta
RP_m	Market risk premium
T	Marginal tax rate

Key variables and impact on nominal pre -tax WACC

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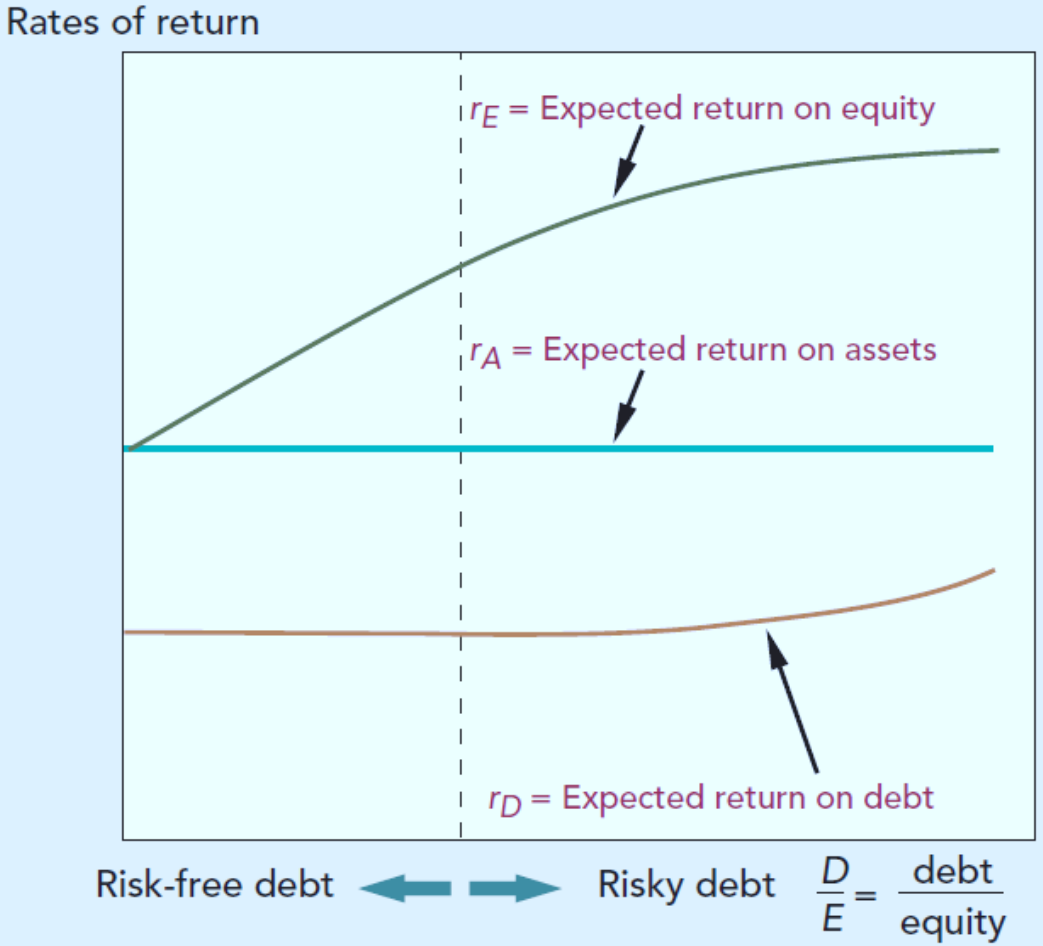
$$CCMP = \underbrace{[R_f + RP_d]}_{r_d} \times G + \underbrace{\left[R_f + \overbrace{\beta_A \left[1 + (1-T)\frac{G}{(1-G)}\right]}^{\beta_E}(RP_m)\right]}_{r_e} \times (1-G) \times 1/(1-T)$$

Variable	Impact on	Comment
Gearing (G)	r_d and r_e	Indirect impact on cost of debt (r_d), since higher leverage can increase debt risk, and on the cost of equity (r_e), since higher leverage increases equity risk and the expected equity return.
Marginal tax rate (T)	r_e	Impact on equity return, through equity beta ($\uparrow T \Rightarrow \downarrow \beta_E \Rightarrow \downarrow r_e$)
Risk free rate(R_f)	r_d and r_e	Direct impact on r_d and on r_e. Can also have an indirect impact on r_e via RP_m, depending on the sensitivity of the return of risky (efficient) portfolios and risk free assets to changes in interest rates.
Debt risk premium (RP_d)	r_d	In this methodology it has an impact only on r_d.
Asset Beta (β_A)=>Equity Beta (β_E)	r_e	Impact only on r_e.
Market risk premium (RP_m)	r_e	Impact only on r_e.

Key variables on WACC calculation: the G

Variable	Impact on	Comment
Gearing (G)	r_d And r_e	Indirect impact on cost of debt (r_d), since higher leverage can increase debt risk, and on the cost of equity (r_e), since higher leverage increases equity risk and the expected equity return.



The Modigliani–Miller (MM) propositions for the costs of debt and equity and the weighted-average cost of capital: As the firm borrows more, the risk of default increases and the firm is required to pay higher rates of interest. if leverage increases the risk of the debt, debtholders demand a higher return on the debt. This causes the rate of increase in r_E to slow down. If taxes are left out, the weighted-average cost of capital equals the opportunity cost of capital and is independent of leverage.

Methodologies for the G variable in Portugal

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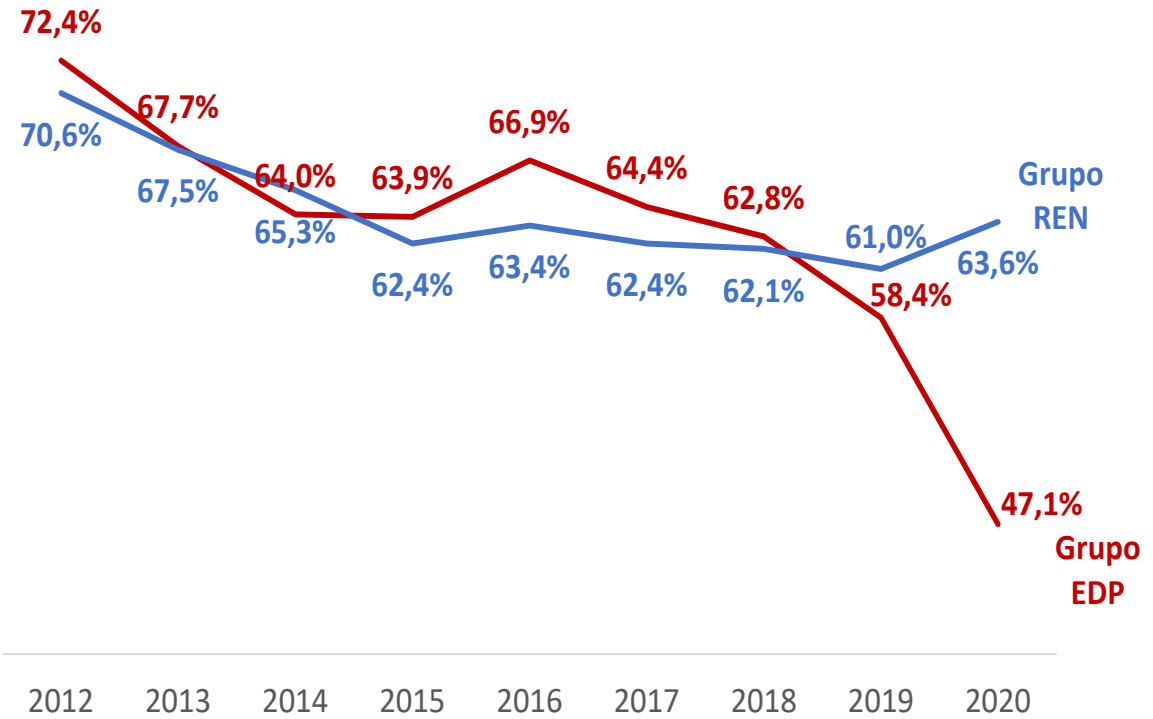
Variable	Electricity Regulatory Period 2018-2020	Natural Gas Regulatory Period 2020 a 2023	Electricity Regulatory Period 2022 a 2025
Gearing (G)	Theoretical optimal value based on analysis on regulated companies' capital structure	Theoretical optimal value based on analysis on regulated companies' capital structure	Theoretical optimal value based on analysis on regulated companies' capital structure the and the regulatory gearing ratio applied by other European regulators



Gearing CEER Regulatory Frameworks Report		2013	2016	2021
Average	ORT	53,2%	50,5%	52,9%
	ORD	53,9%	42,4%	52,8%
Minimum	ORT	30,0%	32,0%	40,0%
	ORD	30,0%	39,0%	44,0%
Maximum	ORT	70,0%	67,0%	78,0%
	ORD	80,0%	45,8%	65,0%
Median	ORT	55,0%	50,0%	50,0%
	ORD	55,0%	42,4%	50,0%

G = Theoretical optimal value of **50%**

Key variables on WACC calculation: the R_f

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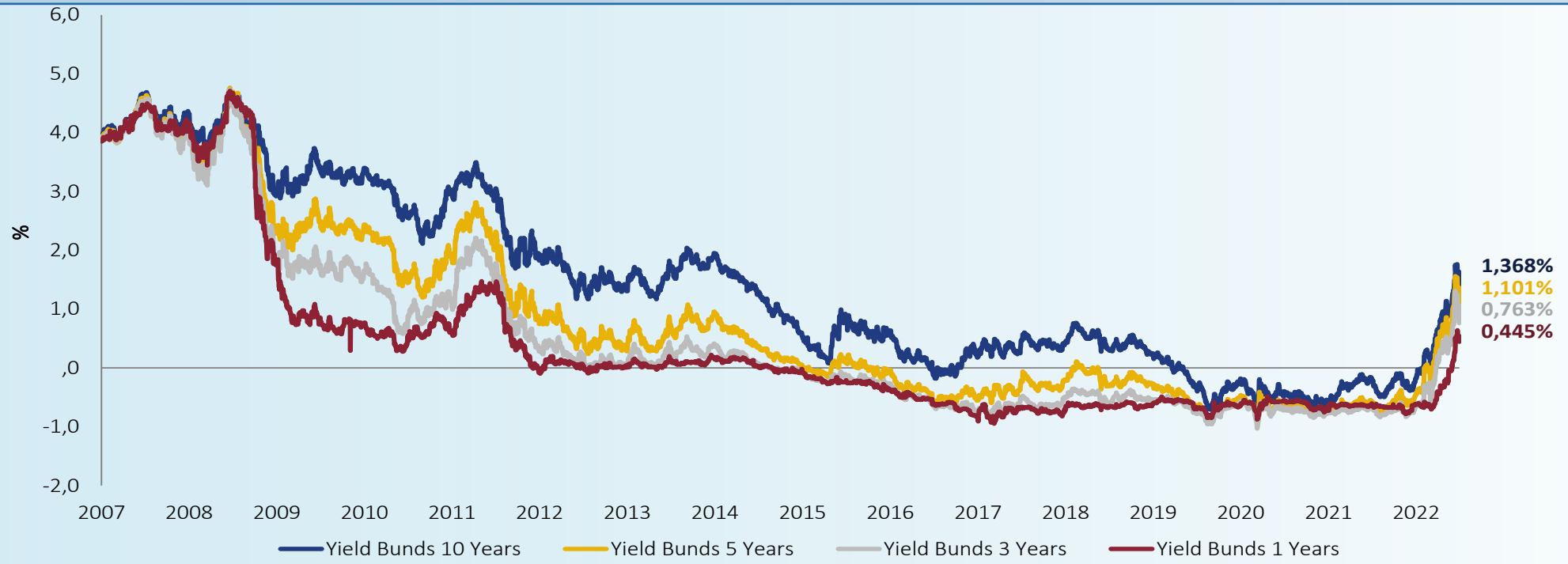
Variable	Impact on	Comment
Risk free rate(R_f)	r_d and r_e	Direct impact on r_d and on r_e. Can also have an indirect impact on r_e via RP_m, depending on the sensitivity of the return of risky (efficient) portfolios and risk free assets to changes in interest rates.



An asset is risk free if we know the expected returns on it with certainty (i.e., the actual return is always equal to the expected return). For this this to occur, there can be no default risk (e.g. government bond, namely the ones that can control the printing of currency) and there can be no reinvestment risk. There are very few assets that fulfill these two requirements, namely the second, where the bond would imply a zero coupon bond. In practical terms, we have to compromise with second best choices as a proxy.

Key variables on WACC calculation: the R_f

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Methodologies for the R_f variable in Portugal

Variable	Electricity Regulatory Period 2018-2020	Natural Gas Regulatory Period 2020 a 2023	Electricity Regulatory Period 2022 a 2025
Risk free rate(R_f)	5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands	5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands	5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands

Risk free rate(R_f)	**0.06%**

Key variables on WACC calculation: the RP_d

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Variable	Impact on	Comment
Debt risk premium (RP_d)	r_d	In this methodology it has an impact only on r_d.

Methodologies for the RP_d variable in Portugal

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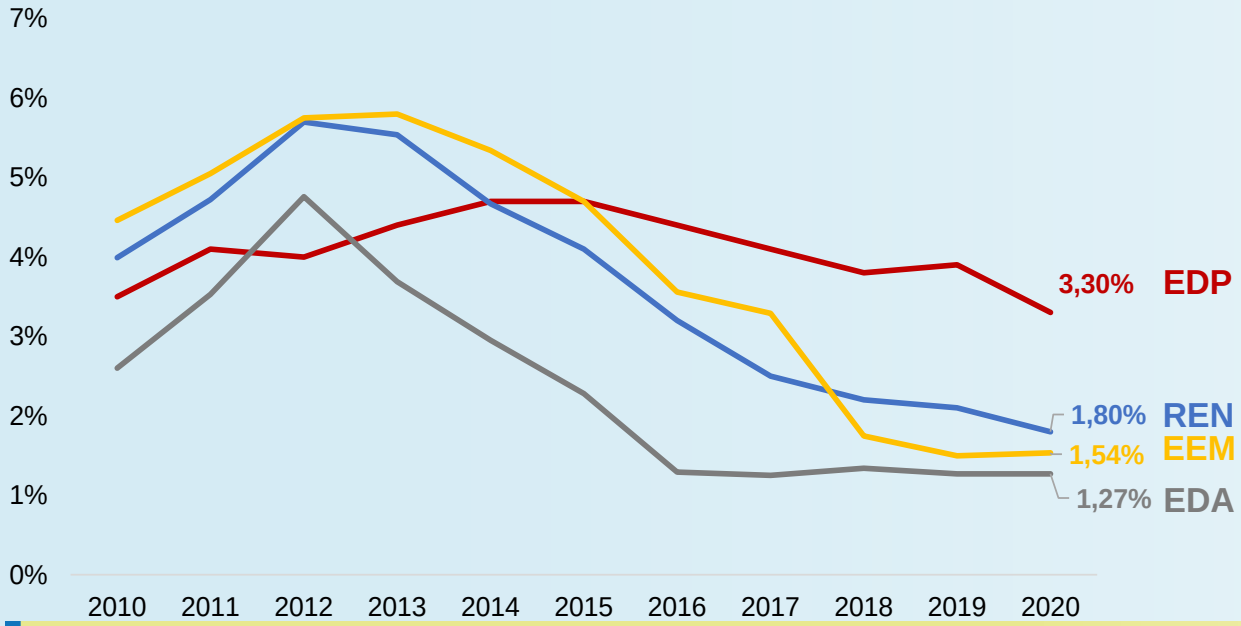
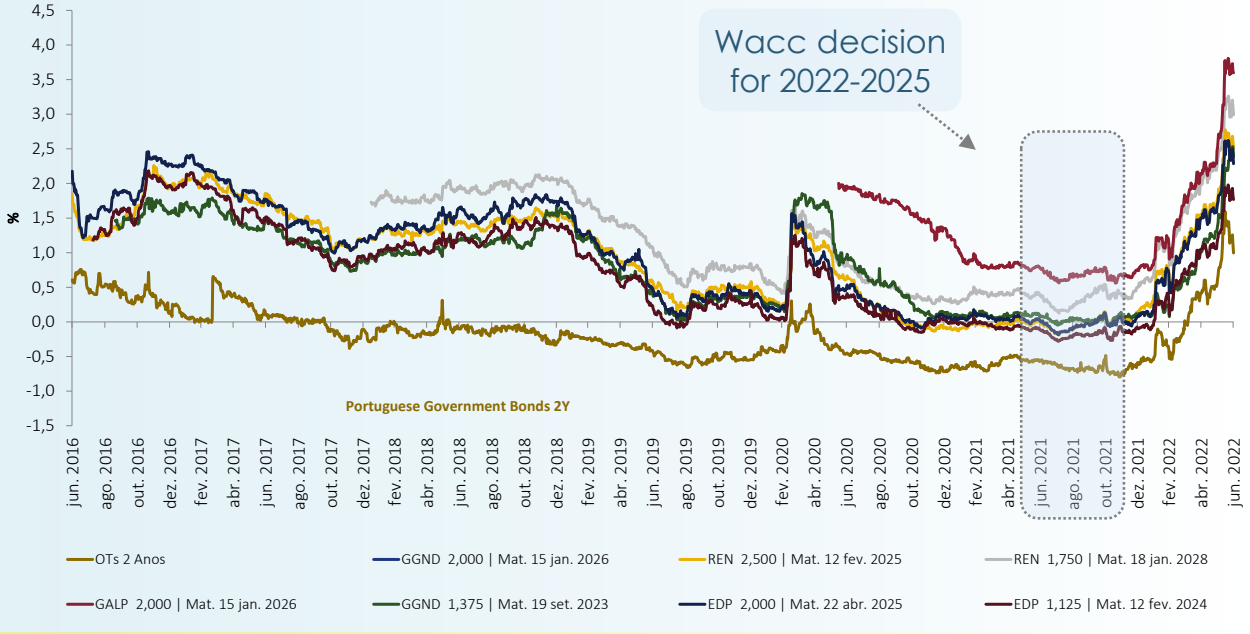
Variable	Electricity Regulatory Period 2018-2020	Natural Gas Regulatory Period 2020 a 2023	Electricity Regulatory Period 2022 a 2025
Debt risk premium (RP_d)	Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings	Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings	Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings





$Cost\ of\ Debt\ (r_d = R_f + RP_d)$

3.31% = 0.06% + 3.25%

Key variables on WACC calculation: the β_E

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Variable	Impact on	Comment
Asset Beta (β_A) => Equity Beta (β_E)	r_e	Impact only on r_e.

$$\beta_A = \frac{\beta_E}{\left[1 + (1-t)\frac{G}{(1-G)}\right]}$$

$$\beta_E = \beta_A \left[1 + (1-t)\frac{G}{(1-G)}\right]$$

$$\beta_A = \sum_i w_i \beta_{Ai}$$

Methodologies for the β_E variable in Portugal

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Variable	Electricity Regulatory Period 2018-2020	Natural Gas Regulatory Period 2020 a 2023	Electricity Regulatory Period 2022 a 2025
Asset Beta (β_A) and Equity Beta (β_E)	Benchmark for similar companies, stock market analysis (integrated company). Adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$). Risk analysis based on bottom-up approach for activities integrated in companies quoted on stock market	Benchmark for similar companies, stock market analysis (integrated company). Adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$). Risk analysis based on bottom-up approach for activities integrated in companies quoted on stock market	Benchmark for similar companies, stock market analysis (integrated company). Adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$). Risk analysis based on bottom-up approach for activities integrated in companies quoted on stock market and on asset betas for electricity transmission and distribution operators of CEER countries included in the annual CEER Regulatory Frameworks Report.

The motivation for adjusting beta estimates is that, on average, the empirical evidence suggests, for most companies, that the beta coefficients of stocks seem to move toward the average beta, which is 1, over time. Given that beta has a tendency to evolve toward 1, a forecast of the future beta coefficient should adjust the sample estimate in that direction. This may be explained by the fact that firms get more diversified in their product mix and client base as they get larger. As it grows a firm often diversifies, first expanding to similar products and later to more diverse operations.

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Methodologies for the β_E variable in Portugal

Asset Beta - CEER Regulatory Frameworks Report		2021
Average	ORT	0,40
	ORD	0,40
Minimum	ORT	0,32
	ORD	0,19
Maximum	ORT	0,51
	ORD	0,54
Median	ORT	0,40
	ORD	0,40
Percentile 75	ORT	0,42
	ORD	0,42

Key variables on WACC calculation: the RP_m

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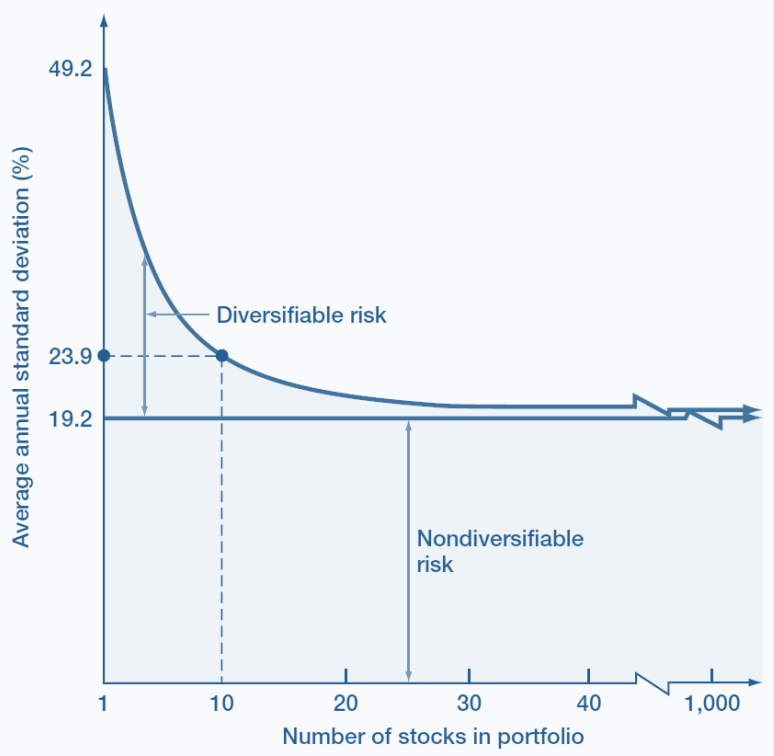
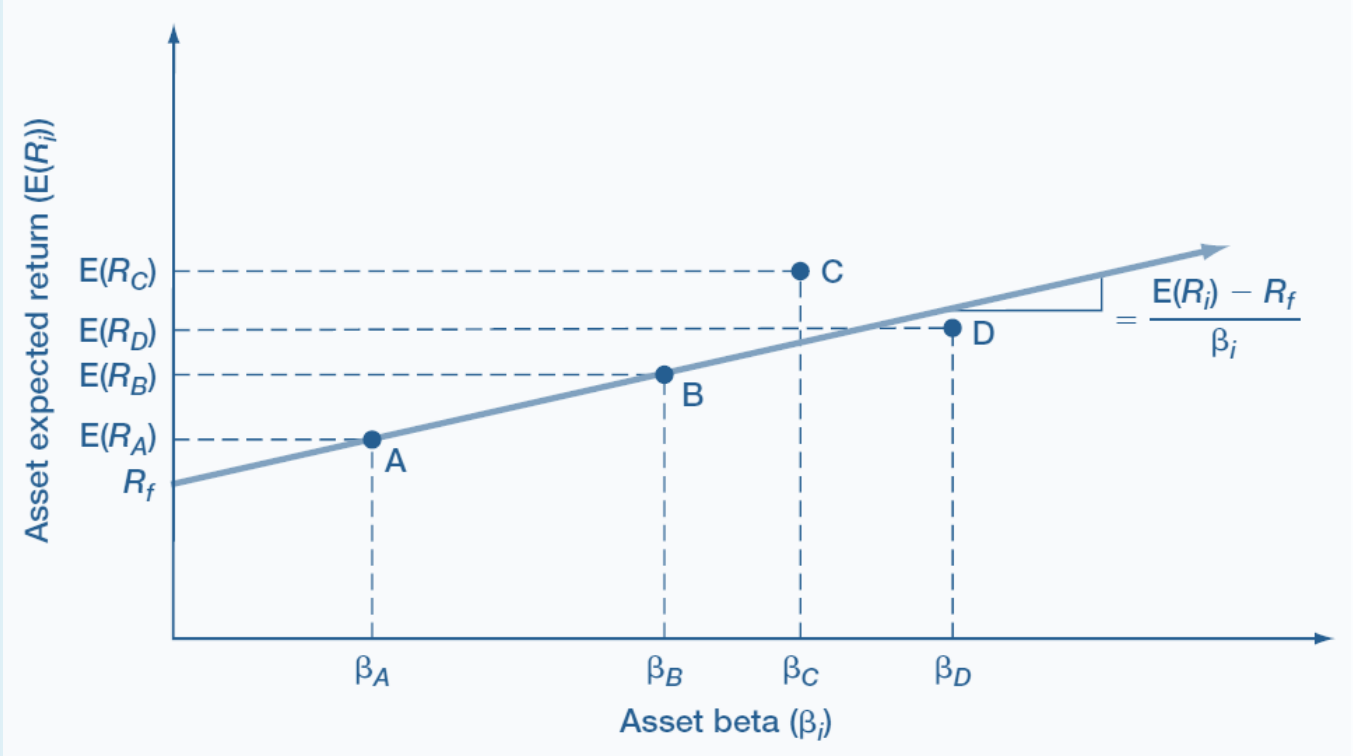
Variable	Impact on	Comment
Market risk premium (RP_m)	r_e	Impact only on r_e.





The fundamental relationship between beta and expected return is that all assets must have the same reward-to-risk ratio, $[E(R_i) - R_f]/\beta_i$. This means that they would all plot on the same straight line. Assets A and B are examples of this behavior. Asset C's expected return is too high; asset D's is too low.

Key variables on WACC calculation: the RP_m

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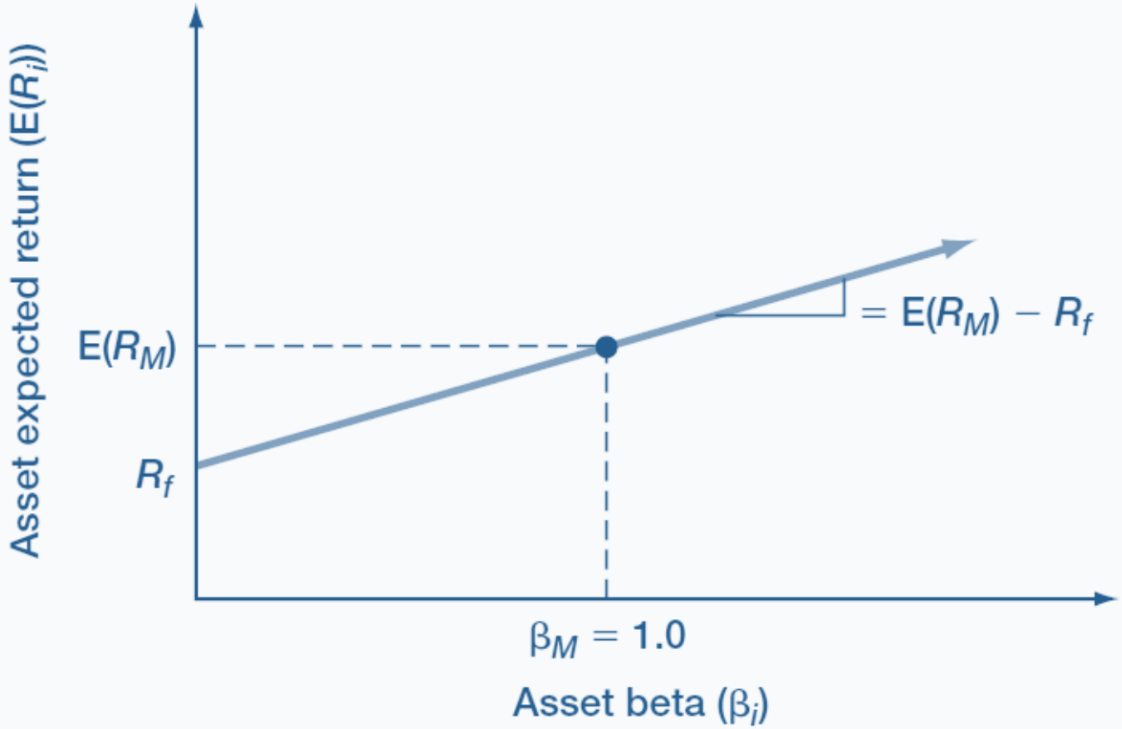
Variable	Impact on	Comment
Market risk premium (RP_m)	r_e	Impact only on r_e.



In the capital asset pricing model (CAPM):
$E(R_i) = R_f + \beta_i \times [E(R_M) - R_f] = R_f + \beta_i \times RP_m$, where $RP_m = [E(R_M) - R_f]$ and $E(R_M)$ is the expected return on a diversified market portfolio, which has a beta of 1. The slope of the security market line is equal to the market risk premium, that is, the reward for bearing an average amount of systematic risk (nondiversifiable risk).

Methodologies for the RP_m variable in Portugal

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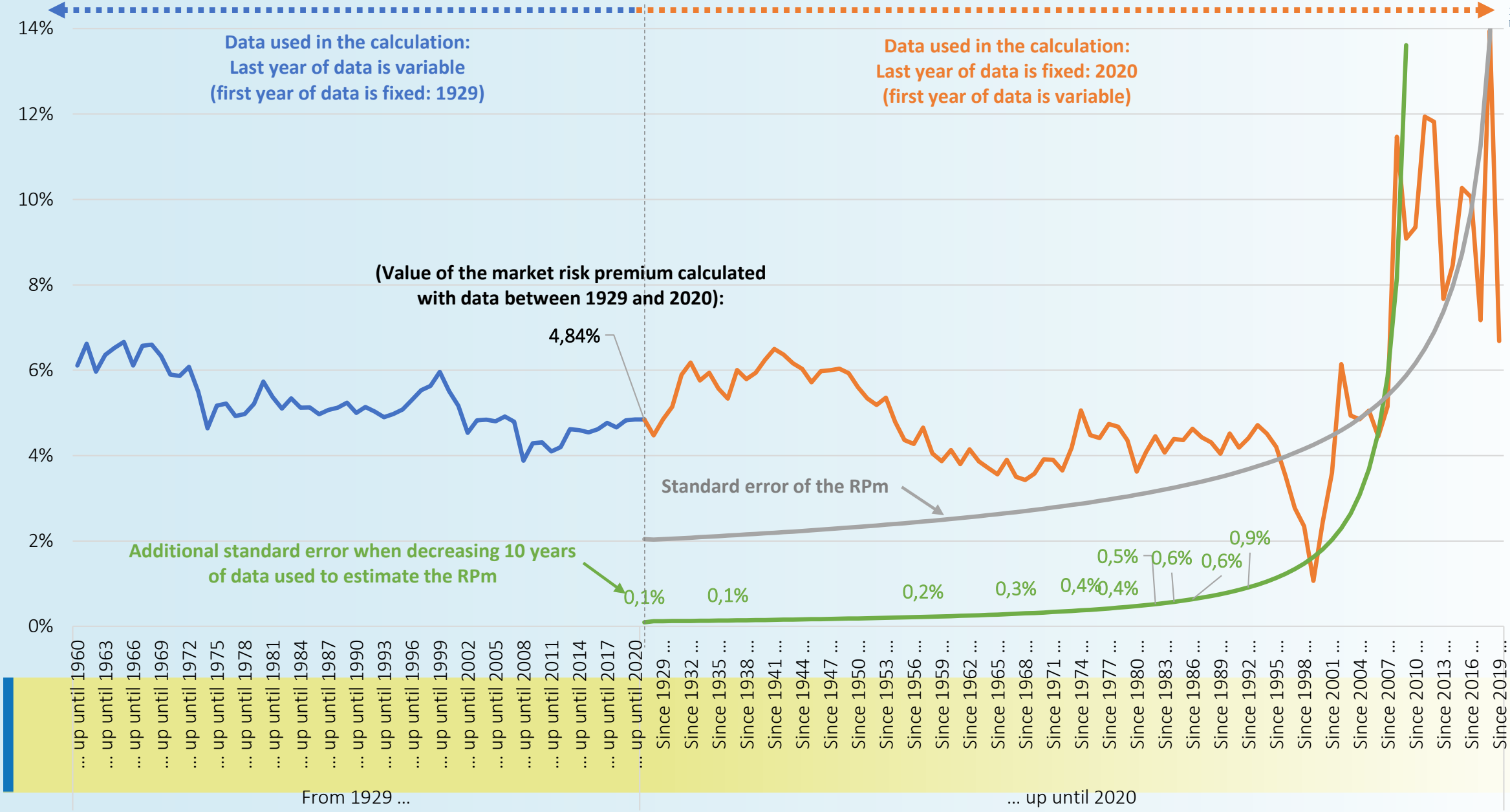
Variable	Electricity Regulatory Period 2018-2020	Natural Gas Regulatory Period 2020 a 2023	Electricity Regulatory Period 2022 a 2025
Market risk premium (RP_m) Note: includes country risk premium	International market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report	International market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report	International market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report

Market risk premium CEER Regulatory Frameworks Report		2013	2016	2021
Average	ORT	4,70%	4,73%	5,05%
	ORD	4,73%	4,69%	5,15%
Minimum	ORT	3,00%	3,50%	2,73%
	ORD	3,50%	3,50%	2,73%
Maximum	ORT	5,90%	5,50%	7,23%
	ORD	5,90%	5,50%	7,23%
Median	ORT	4,88%	5,00%	5,00%
	ORD	4,80%	5,00%	5,00%

Key variables on WACC calculation: the RP_m



Methodologies for the key WACC variables in Portugal

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Variable	Electricity Regulatory Period 2018-2020	Natural Gas Regulatory Period 2020 a 2023	Electricity Regulatory Period 2022 a 2025
Gearing (G)	Theoretical optimal value based on analysis on regulated companies' capital structure	Theoretical optimal value based on analysis on regulated companies' capital structure	Theoretical optimal value based on analysis on regulated companies' capital structure the and the regulatory gearing ratio applied by other European regulators
Risk free rate(R_f)	5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands	5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands	5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands
Debt risk premium (RP_d)	Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings	Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings	Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings
Asset Beta (β_A) and Equity Beta (β_E)	Benchmark for similar companies, stock market analysis (integrated company). Adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$). Risk analysis based on bottom-up approach for activities integrated in companies quoted on stock market	Benchmark for similar companies, stock market analysis (integrated company). Adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$). Risk analysis based on bottom-up approach for activities integrated in companies quoted on stock market	Benchmark for similar companies, stock market analysis (integrated company). Adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$). Risk analysis based on bottom-up approach for activities integrated in companies quoted on stock market and on asset betas for electricity transmission and distribution operators of CEER countries included in the annual CEER Regulatory Frameworks Report.
Market risk premium (RP_m) Note: includes country risk premium	International market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report	International market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report	International market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report

Methodology and values for key variables on WACC

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Variable	Electricity Regulatory Period 2022 a 2025
Marginal tax rate (T)	**31.5%** National level of flat corporate income tax 21% + Local surtax 1,5% + State surtax 9% on profit exceeding 35 million EUR
Risk free rate(R_f)	**0.06%** 5 year average of historical returns on Government 10Y maturity bonds, of the Euro Zone countries with AAA rating: Germany and Netherlands
Gearing (G)	Theoretical optimal value of **50%** based on analysis on regulated companies' capital structure the and the regulatory gearing ratio applied by other European regulators
Debt risk premium (RP_d)	**3.25%** Based on companies' average cost of debt analysis and Benchmark Spreads for Utilities with similar ratings
Market risk premium (RP_m)	Value between 3.95% and 5.10%, based in international market analysis (spread between average historical returns on S&P 500 and 10Y US bond) and benchmarking based on CEER report
Asset Beta (β_A) and Equity Beta (β_E)	β_E EDP = 1.08; β_A EDP = 0.58; β_A DSO = **0.41** β_E REN = 0.67; β_A REN = 0.31; β_A TSO = **0.37** Bottom-up Betas, adjusted β_E calculated from raw betas ($\beta_E = \beta_E^{Adj} = \beta_E^{Raw} \times \frac{2}{3} + 1/3$)
$Cost\ of\ Debt\ (r_d = R_f + RP_d)$	**3.31%** = 0.06% + 3.25%

Pre-tax nominal WACC calculation for DSO and TSO in Portugal

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		DSO		TSO	
		Minimum	Maximum	Minimum	Maximum
Risk free rate	A	0,06%	0,06%	0,06%	0,06%
Debt risk premium	B	3,25%	3,25%	3,25%	3,25%
Cost of debt before taxes	C=A+B	3,31%	3,31%	3,31%	3,31%
Cost of debt after taxes	D=Cx(1-J)	2,27%	2,27%	2,27%	2,27%
Gearing (D/[E+D])	E	50,00%	50,00%	50,00%	50,00%
Market risk premium for a mature market	F'	3,95%	5,10%	3,95%	5,10%
Country risk premium	F''	1,41%	1,41%	1,41%	1,41%
Total Market Risk Premium	F = F' + F''	5,37%	6,51%	5,37%	6,51%
Equity Beta	G	0,68	0,70	0,56	0,68
Cost of equity after taxes	H=A+(FxG)	3,70%	4,65%	3,05%	4,48%
Cost of equity before taxes	I=H/(1-J)	5,40%	6,79%	4,46%	6,54%
Taxa rate	J	31,50%	31,50%	31,50%	31,50%
Pre-tax nominal WACC	K=(CxE)+(Ix[1-E])	4,36%	5,05%	3,88%	4,92%
Pre-tax nominal WACC for RP 2022-2025		4,70%		4,40%	

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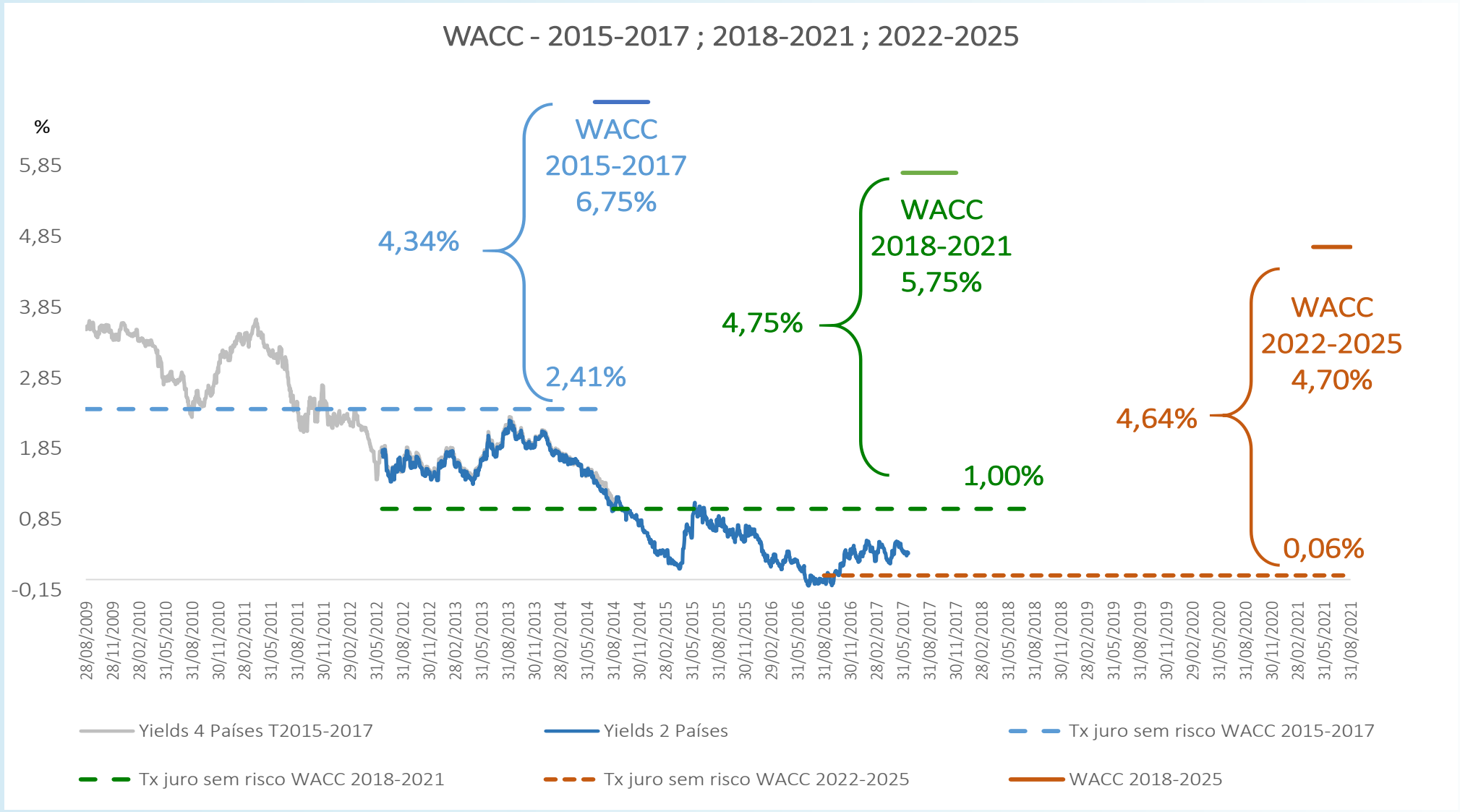

WACC DSO

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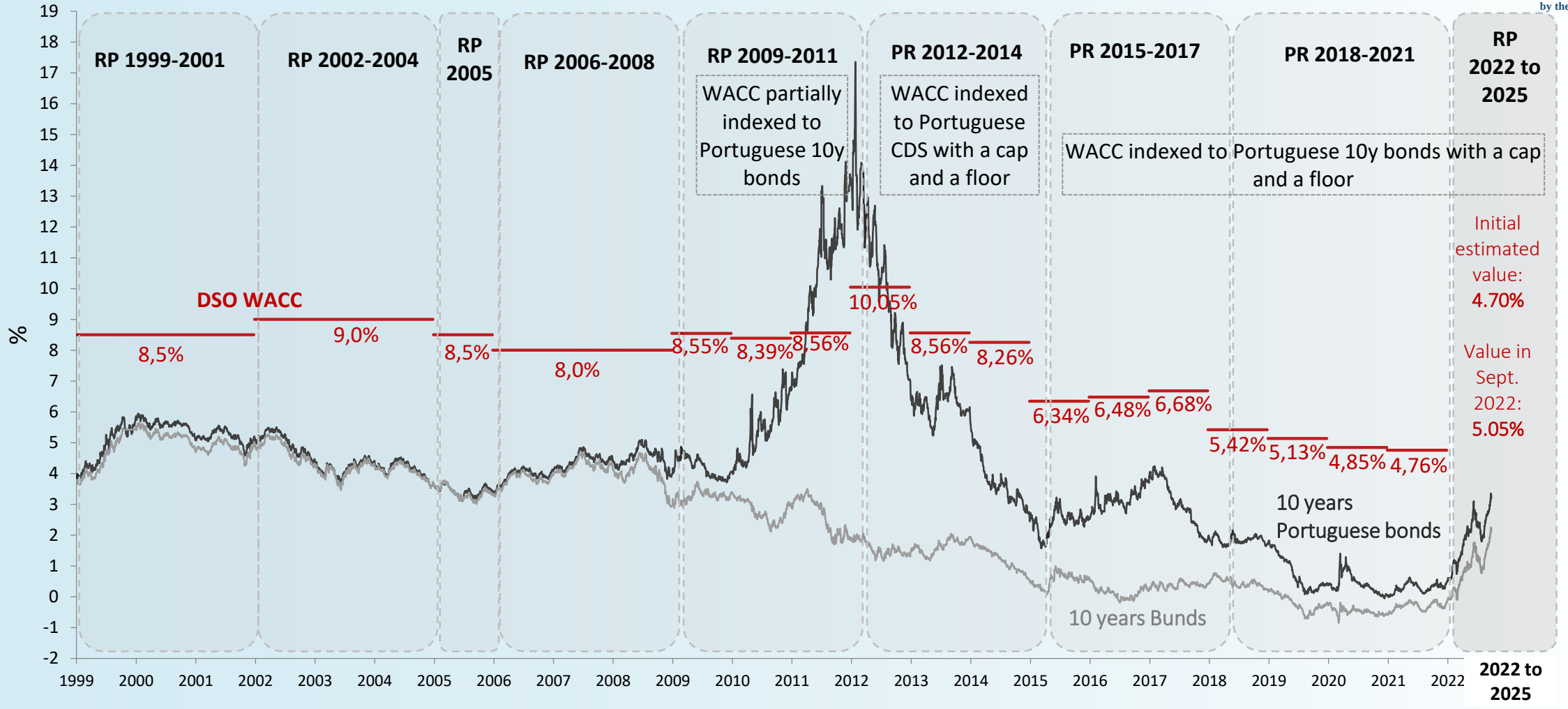

Price cap TOTEX regulation

Price cap OPEX regulation + Cost-based (rate-of-return) regulation on CAPEX with innovation incentive

HV/MV: Same as 2009-2018; LV: TOTEX

TOTEX

WACC TSO

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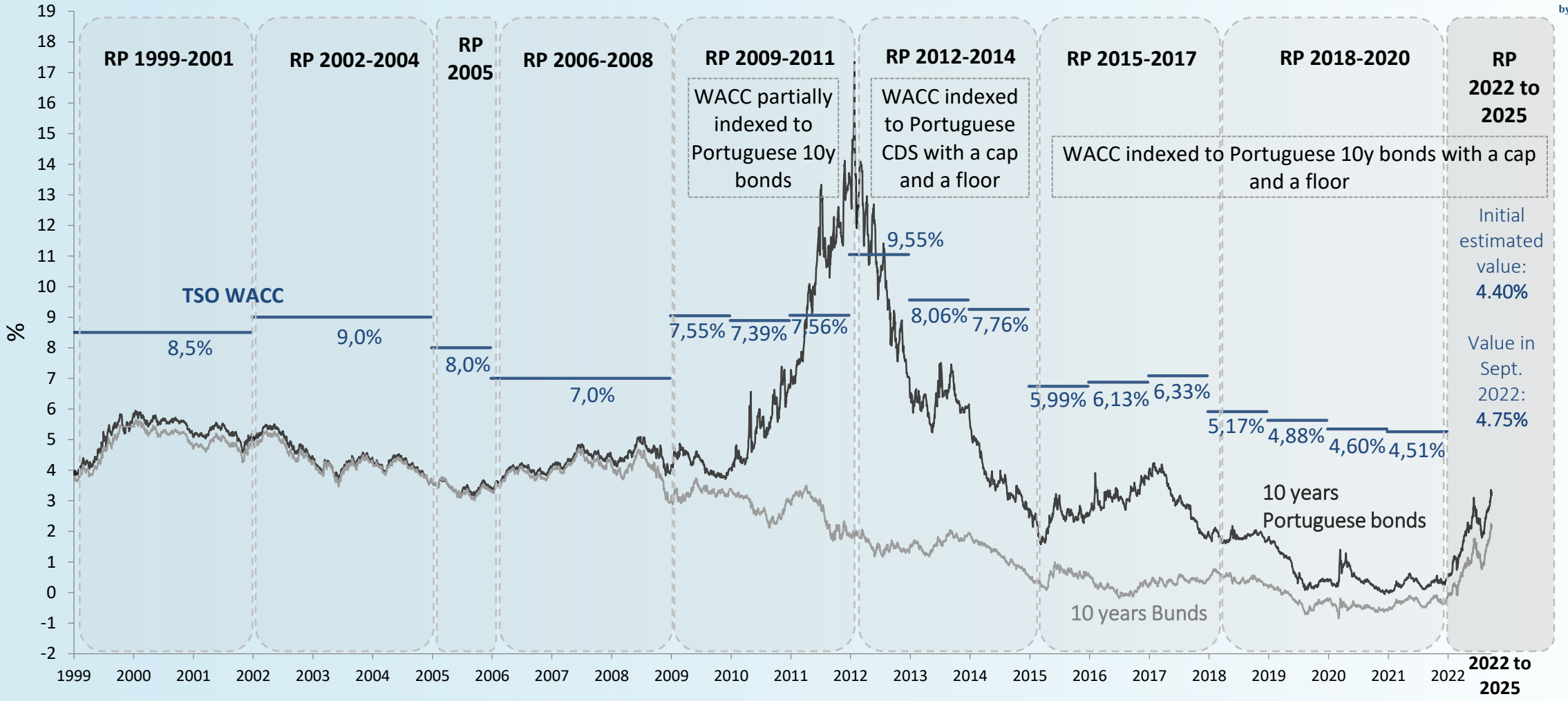

Cost-based (rate-of-return) regulation on OPEX and CAPEX

Price cap OPEX regulation + Mixed cost-based (rate-of-return) regulation on CAPEX with standard costs in new investments

TOTEX

Allowed revenues definition: Portuguese specificities - WACC indexation (both electricity and natural gas sectors)

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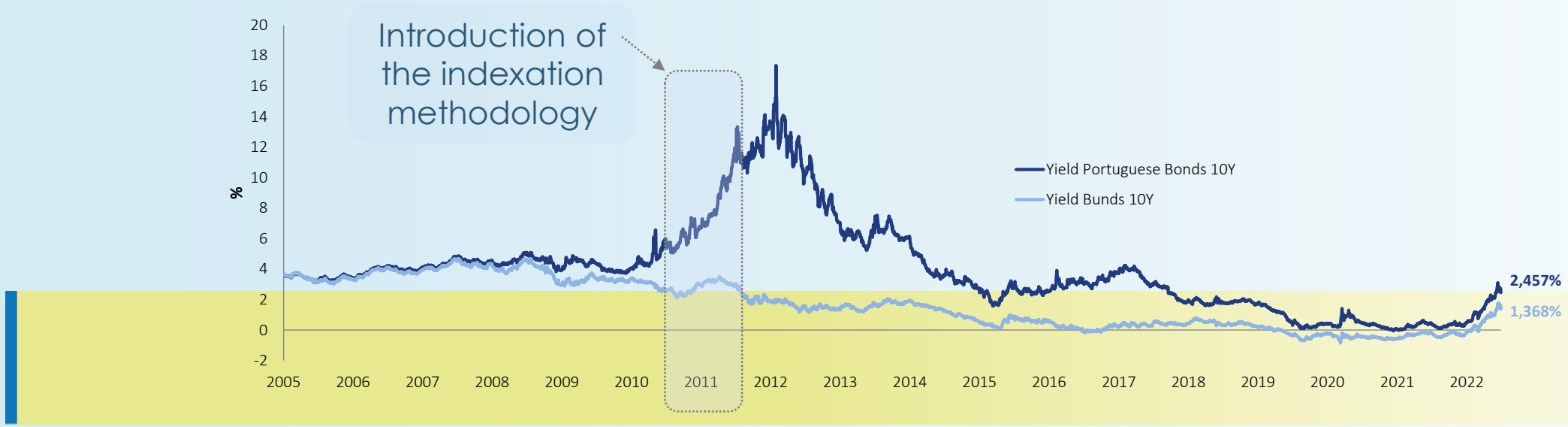
- Between May 2011 and June 2014, Portugal was under the framework of the Economic and Financial Assistance Program;
- Given the very high volatility and levels of Portuguese bond yields, an indexation methodology was established in 2012 (2013 for natural gas) in order to provide a balance between the economic signals provided by the high rates and the need for regulatory stability.



Allowed revenues definition: Portuguese specificities - WACC indexation (both electricity and natural gas sectors)

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- The indexation mechanism includes a set of parameters that are defined *ex-ante* and that are fixed for the regulatory period:

  A. An initial estimated WACC value for the first year of the regulatory period;
  B. Cap and floor values for the maximum and minimum values of the allowed rate of return (RoR);
  C. An initial estimated value for the indexation variable defined for the first year of the regulatory period. The indexation variable is, currently, the Portuguese 10 year bond yield;
  D. The ratio between the incremental variation of the RoR and the incremental variation of the index variable (the slope of the line in the indexation mechanism).

- The rate of return is updated ex-post each year in order to reflect the evolution of financial market conditions, through the index variation.

Allowed revenues definition: Portuguese specificities - WACC indexation (both electricity and natural gas sectors)

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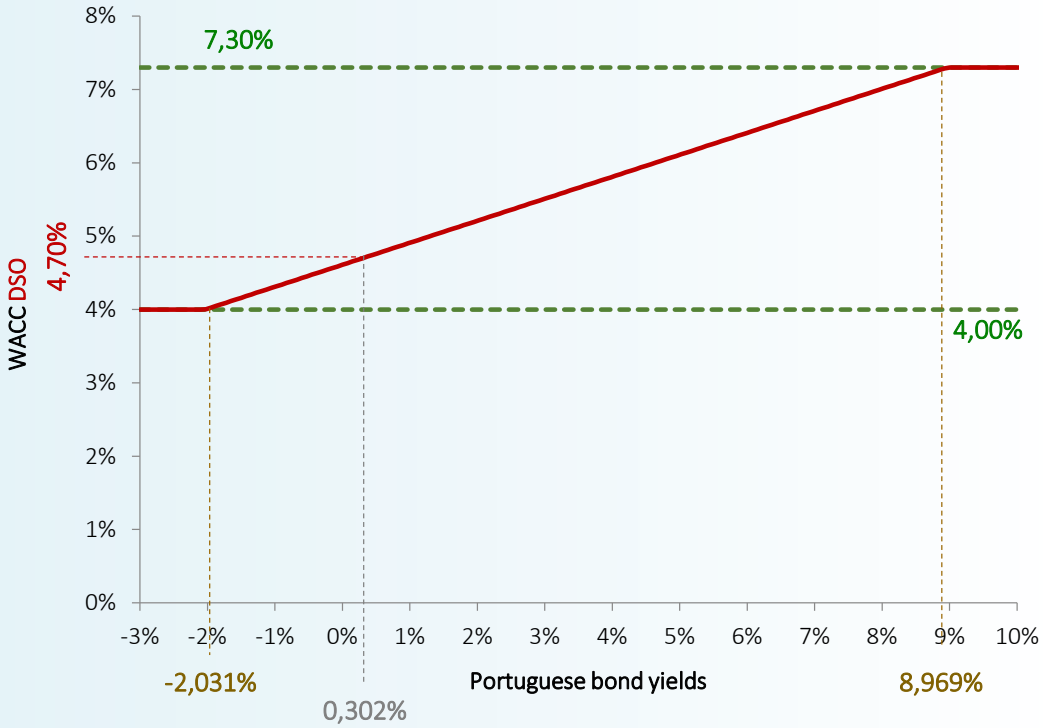
➢ How the indexation mechanism applies to the electricity distribution (example)

A. Initial estimated WACC value for the first year of the regulatory period: **4.70%** (bond yields= **0.302%**)

B. Cap value for the maximum value of the RoR: **7.30%** (where bond yields ≥ **8,969%: $Yield_H$**) and the floor value for the minimum value of the RoR: **4.00%** (where bond yields ≤ **-2,031%: $Yield_L$**)

C. Rule for the incremental variation of the RoR (the slope of the line), a 1pp change in the bond yields implies a **0.3**pp change in the RoR:

$$SLOPE = \frac{CAP - Floor}{Yield_H - Yield_L} = \frac{7.30 - 4.00}{8.969 - (-2.031)} = \frac{3.3}{11} = 0.3$$



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