TOTEX REGULATION AND EFFICIENCY ANALYSIS

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OPTIMA ENERGY CONSULTING

Established in 2013

100% employee-owned

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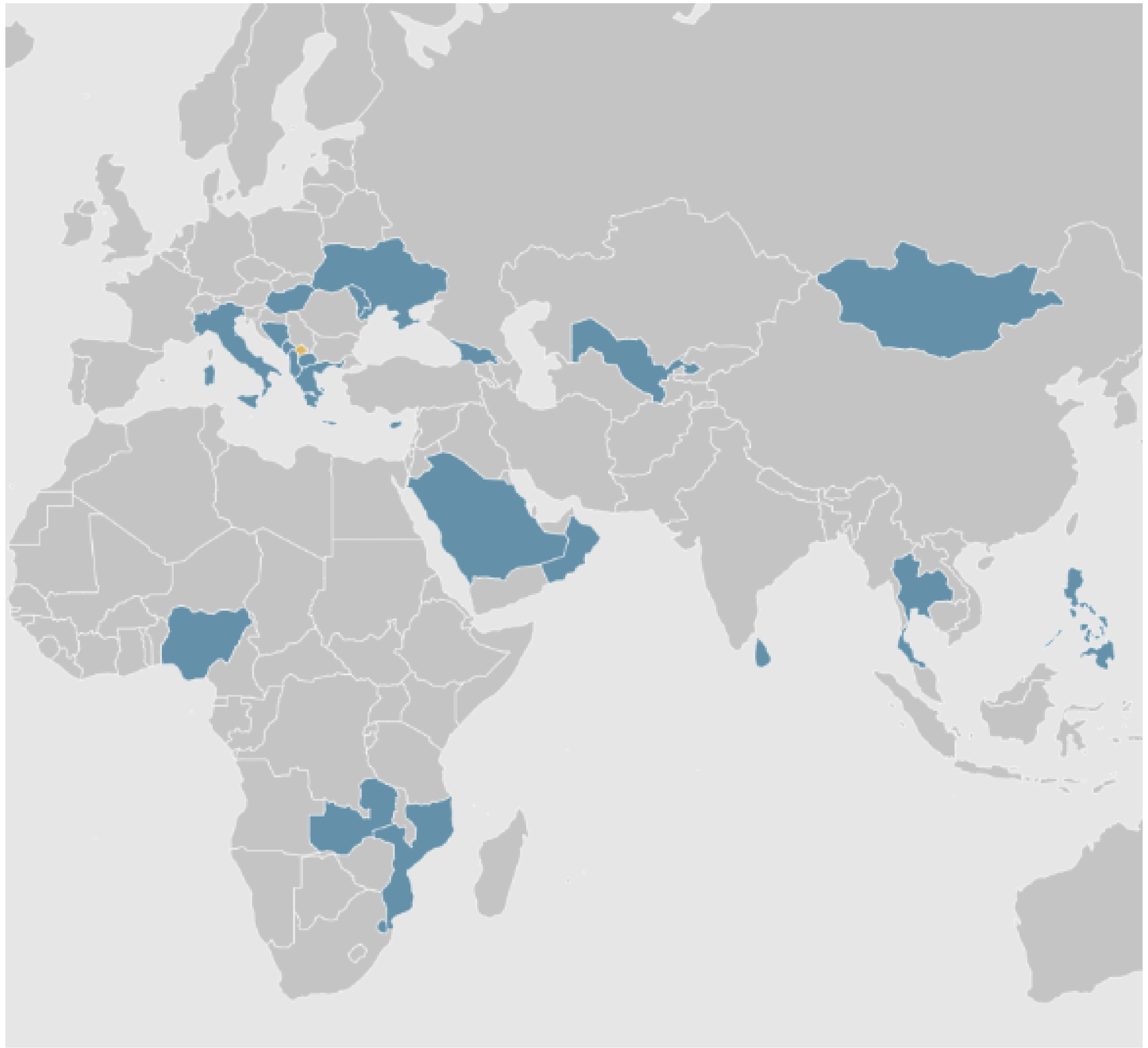
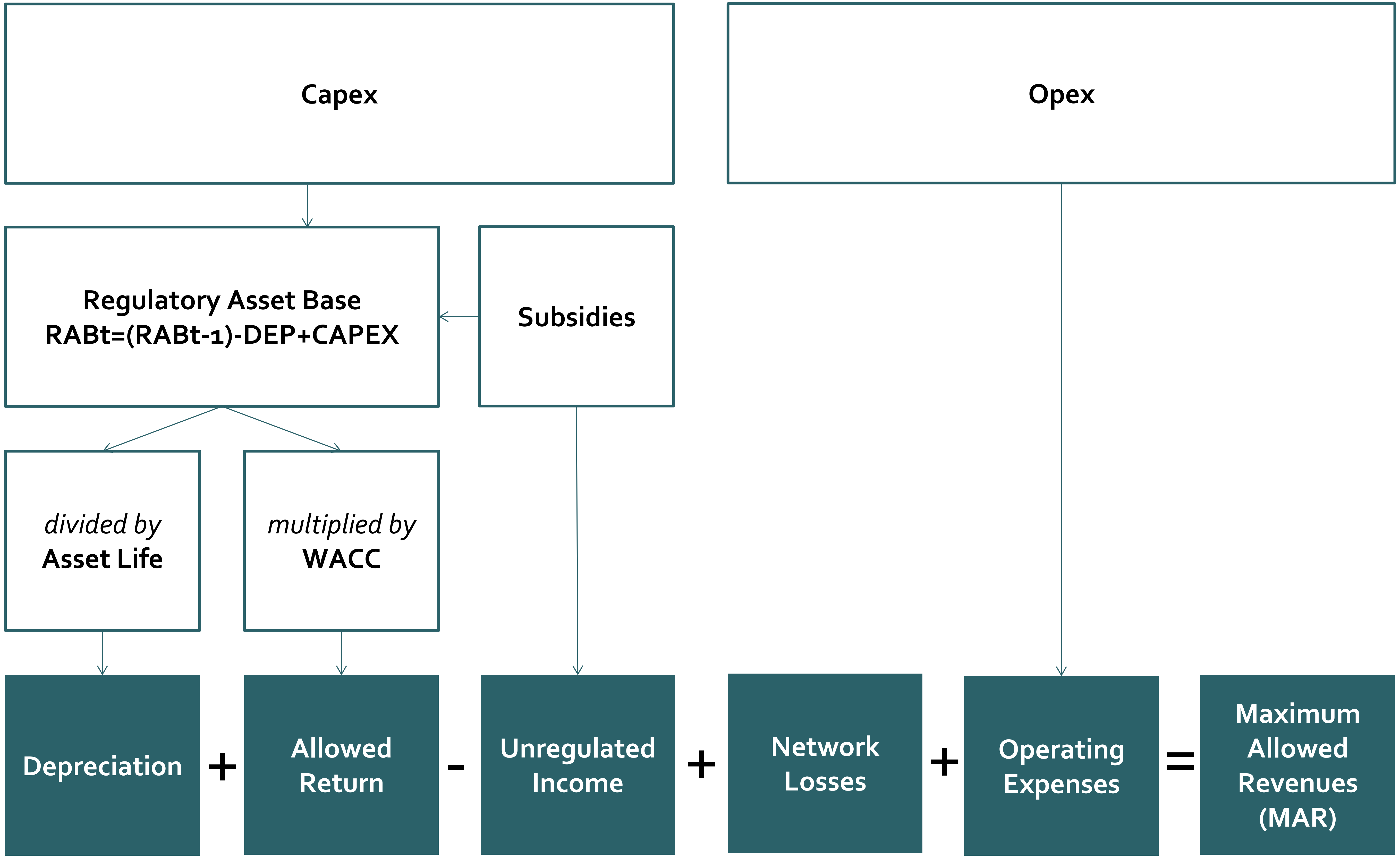
- Economic Regulation, Price Controls
- Renewable Energy Policy
- Legal and Policy Support
- Capital expenditure review and assessment
- District heating, energy efficiency and energy audits



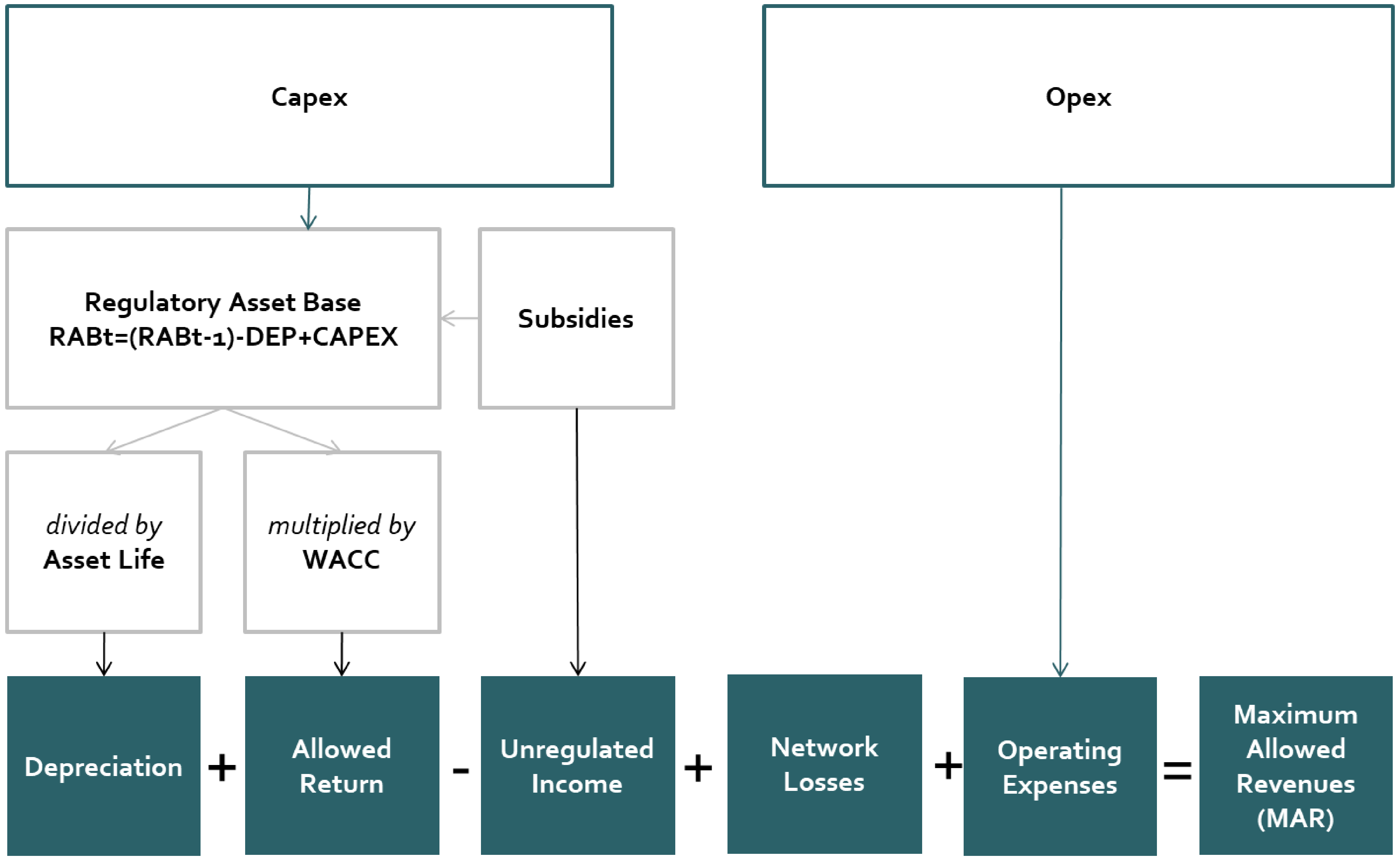
CLASSICAL MODEL – BUILDING BLOCKS



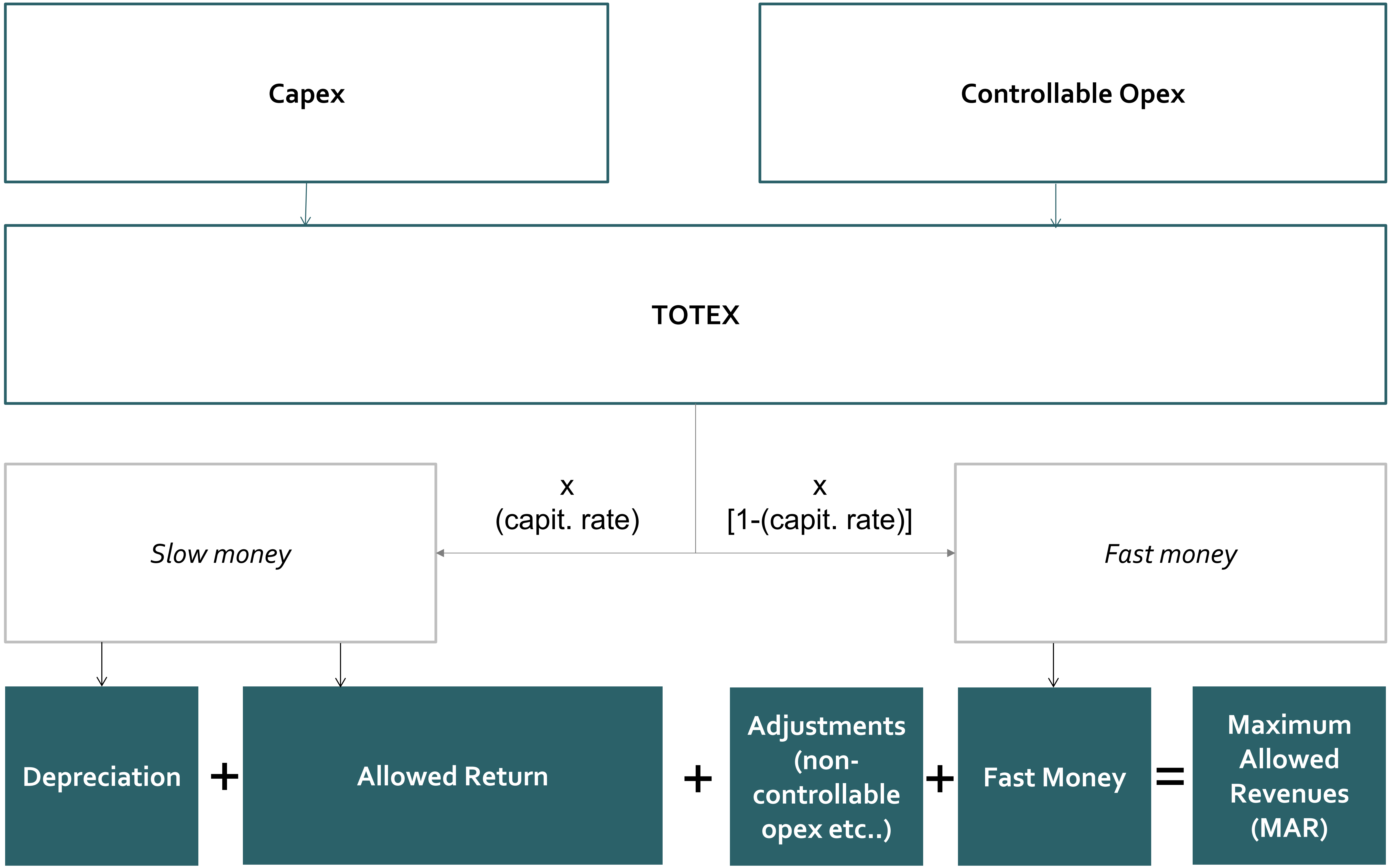
CHALLENGES WITH THE BUILDING-BLOCK MODEL

Capex-bias

- **Profit incentive** - Allowed return increased by increasing spending in capex
- **Efficiency incentive** – X-factors typically applied on Opex, which is more scrutinized than Capex – efficiency gains can be improved by increasing capex even if customers are worse off overall
- **Regulatory review incentive** - Regulators tend to be more accepting of capex increases vs. opex as these are seen as contributing to technical requirements/security of supply
- **Operational incentive** – utilities would rather invest on long-term capex that they own rather than engage in short-term opex contracts which require admin to monitor and implement
- **QOS incentive** - Quality of service indicators (SAIDI/SAIFI/ENS) affecting Allowed Revenues encourage capex investment



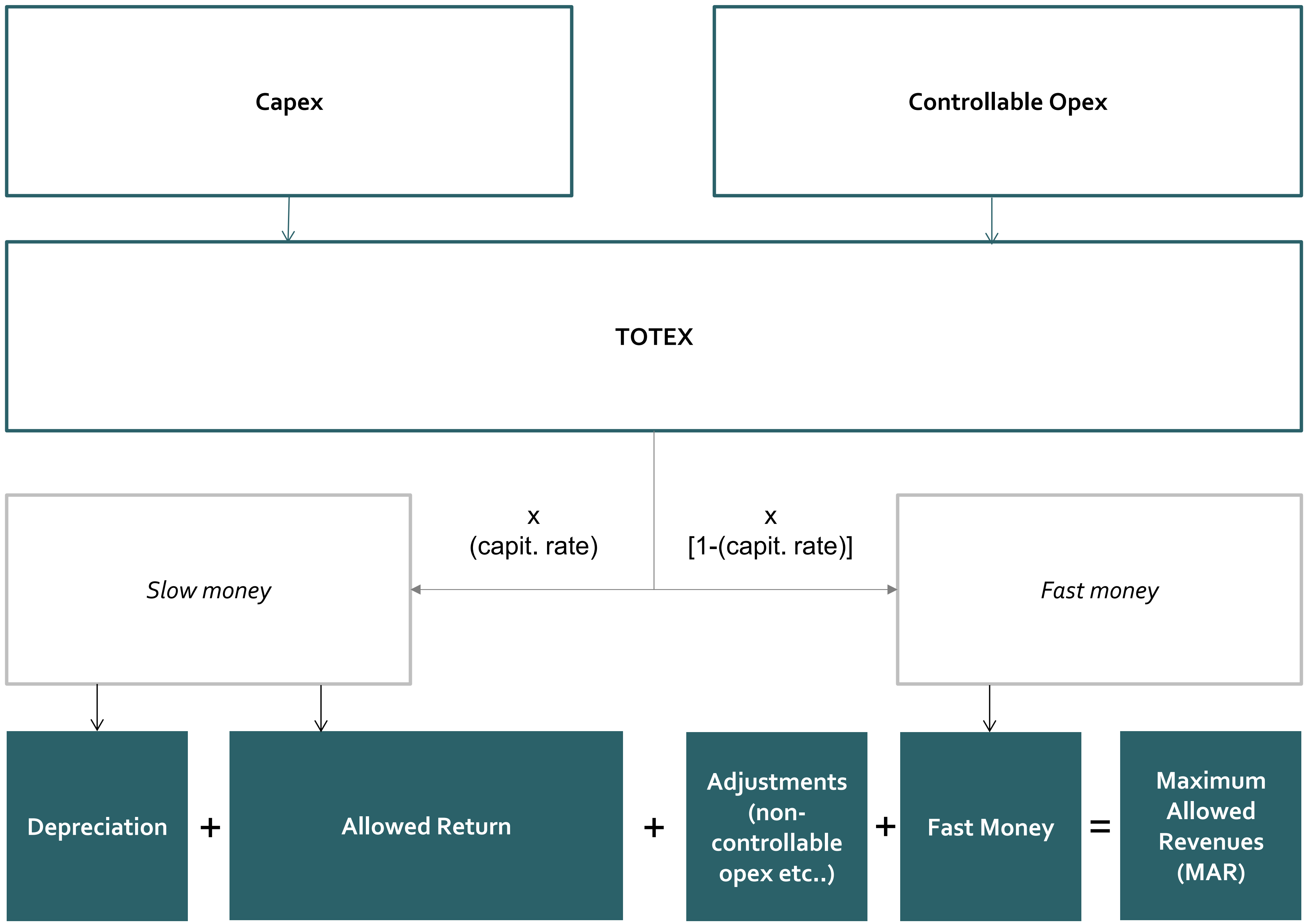
ALTERNATIVE MODEL – TOTEX



KEY FEATURES OF THE TOTEX MODEL

TOTEX model

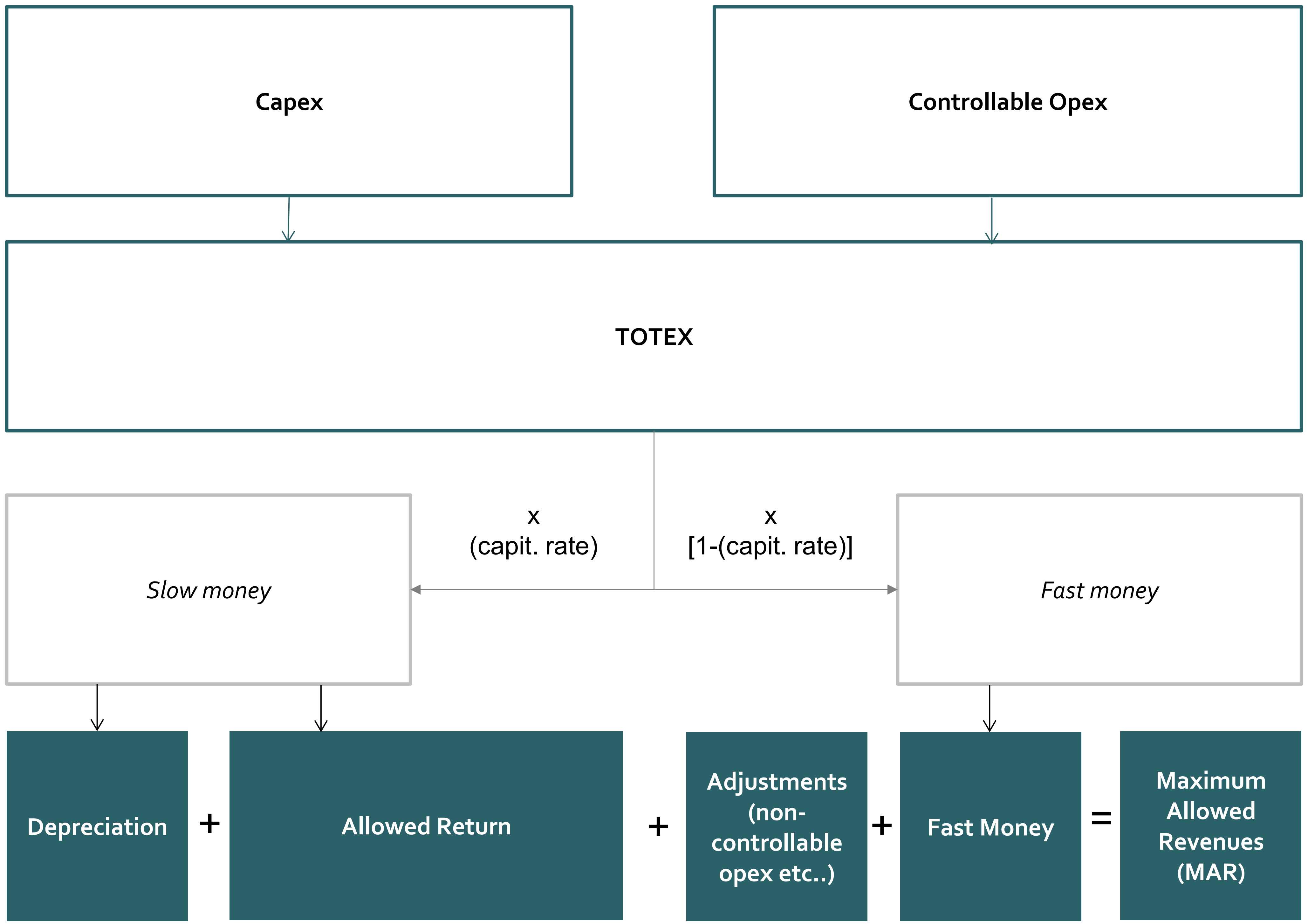
- Capital and operational expenses are lumped into a total expenditure box (Totex)
- A capitalization rate is set to determine
  - Slow money – money that is recovered over a period of time, in a similar manner as capex would; and
  - Fast money – money that would be recovered within a year of the regulatory period to cover operational expenses
- Addresses capex bias incentive



KEY FEATURES OF THE TOTEX MODEL

Setting the capitalization rate

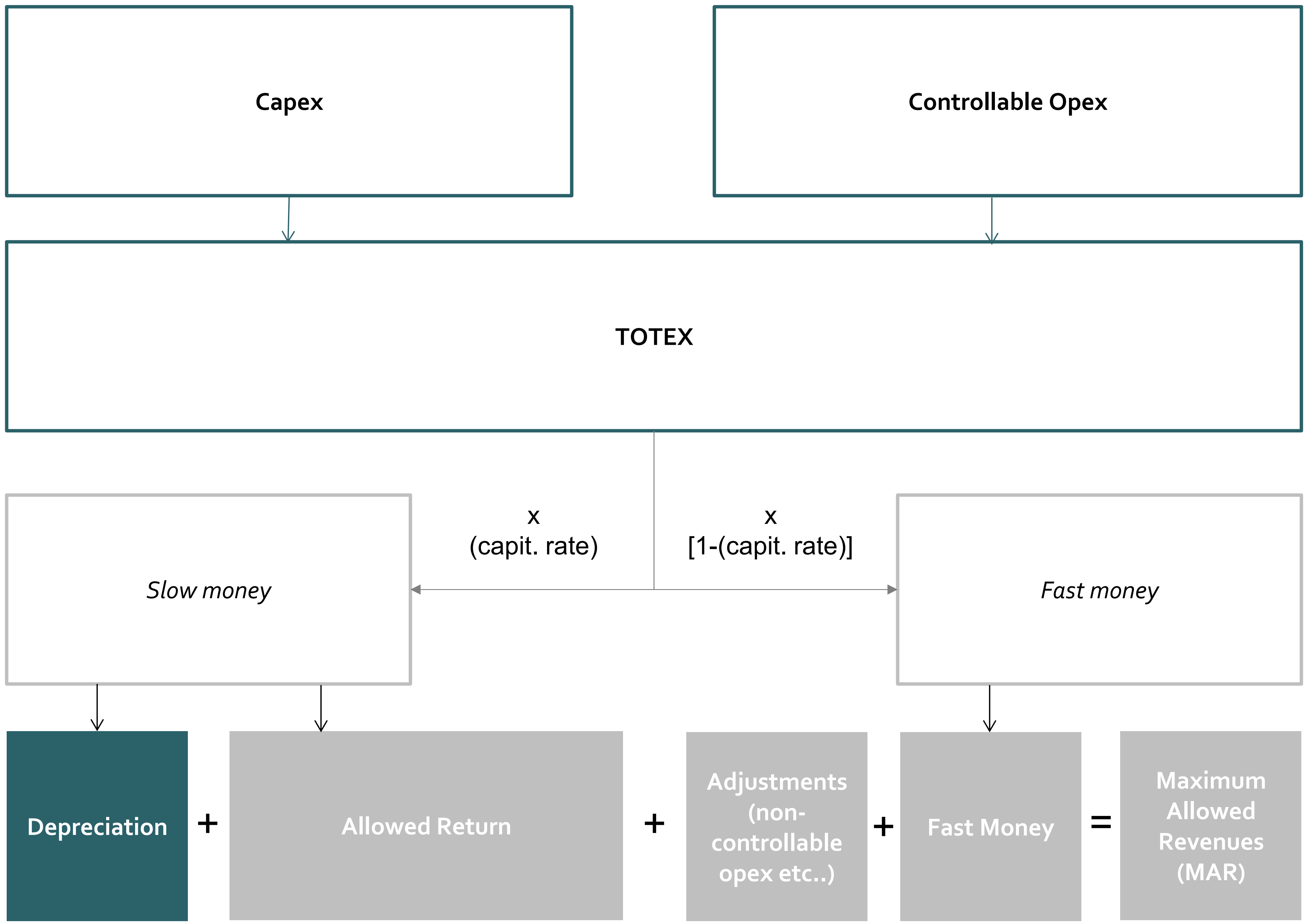
- Capitalization rates affect proportion of the costs added to the ‘slow money’ with the remainder recovered in the year it is incurred
- Important impact on financeability
- Set based on regulatory assessment of an efficient structure
- Case study UK: Ofgem (RIIO-1)
  - Regulators Average rates estimated by companies over 8 years
  - Levels used in previous determinations
  - Financial solvency of the utilities
  - Ofgem precedents: 74% - 90%



ALLOWED REVENUE COMPONENTS: DEPCT

Depreciation

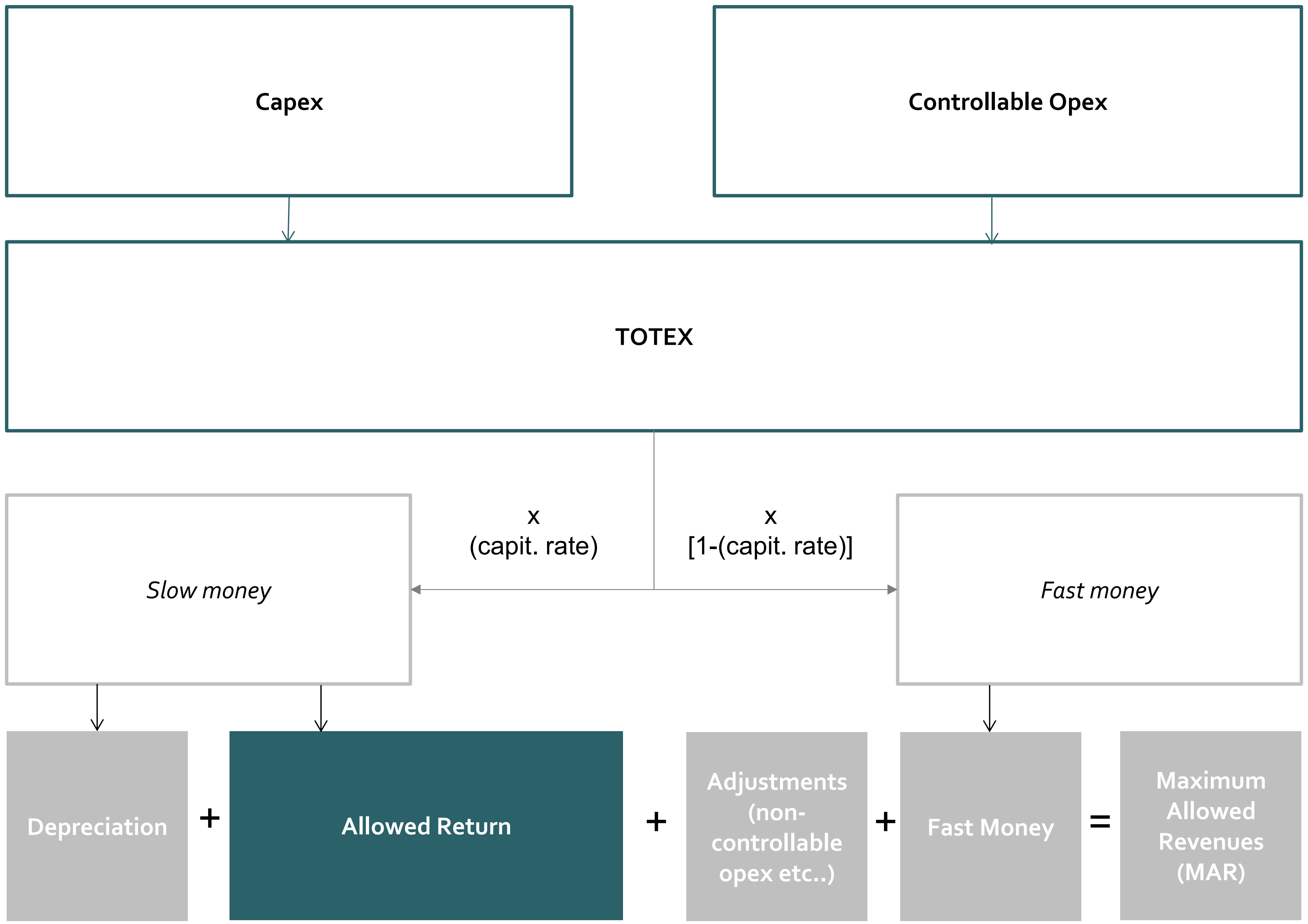
- Ratio of previously existing RAB + capex additions to the weighted average asset life
- Straight line depreciation by default
- Front-loaded depreciation as an exemption to enhance liquidity and enable loan financing for tenures shorter than asset life (technical life)



ALLOWED REVENUE COMPONENTS: ALLOWED RETURN

Allowed Return

- Product of average value of non-depreciated Slow Money x WACC
- Assets assumed to be added middle of the year (half return + depreciation allowed in any given year)
- Calculated similarly to the building-block approach for the 'slow money' portion of TOTEX



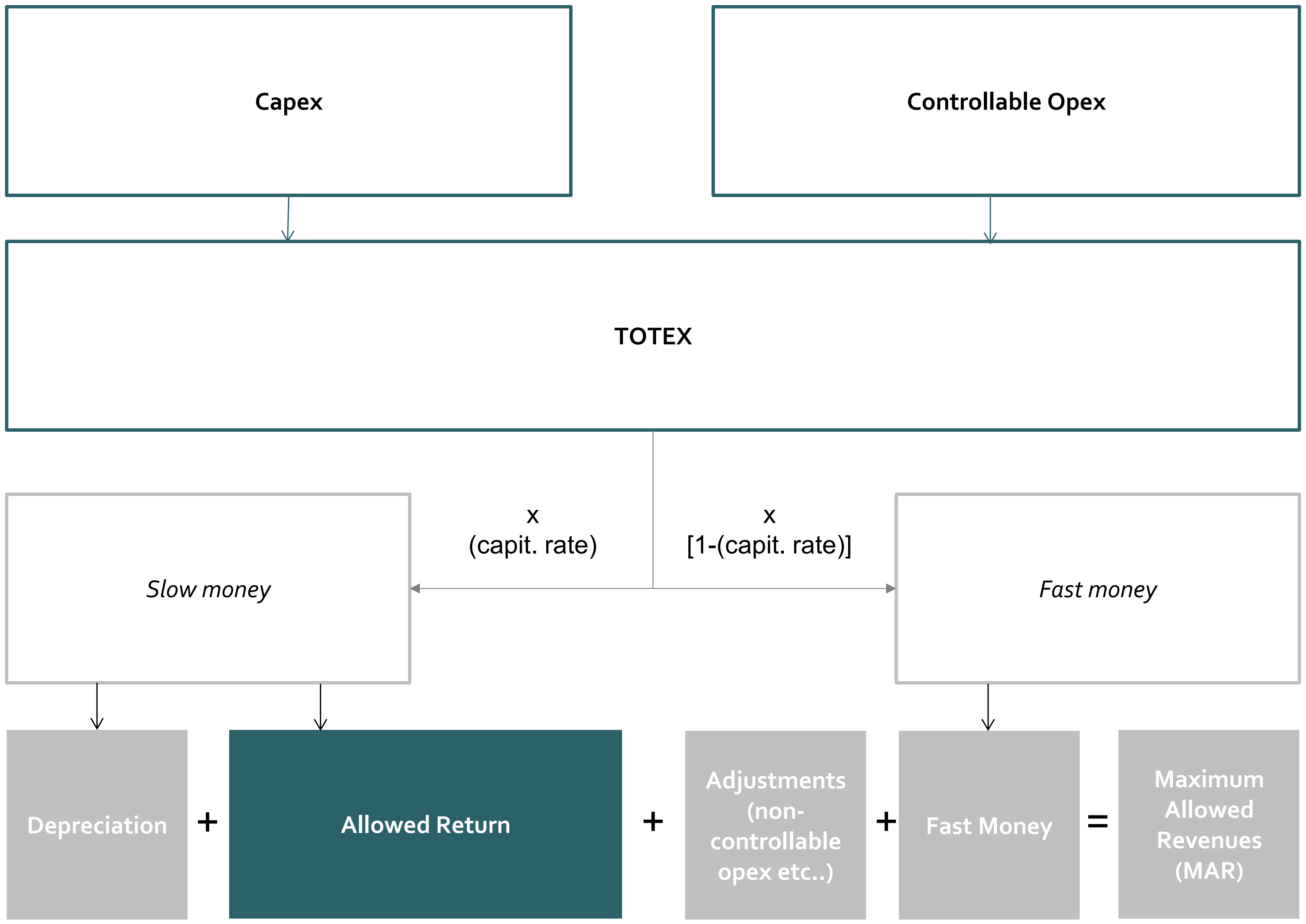
ALLOWED REVENUE COMPONENTS: ALLOWED RETURN

Weighted Average Cost of Capital

- WACC represents the percentage return that debt and equity holders require for the risk they assume by investing in regulated infrastructure
- WACC = g x r_d + (1-g) x r_e
- Return on equity estimated according to CAPM:

  Re=(rf+B*ERP)/(1-t)

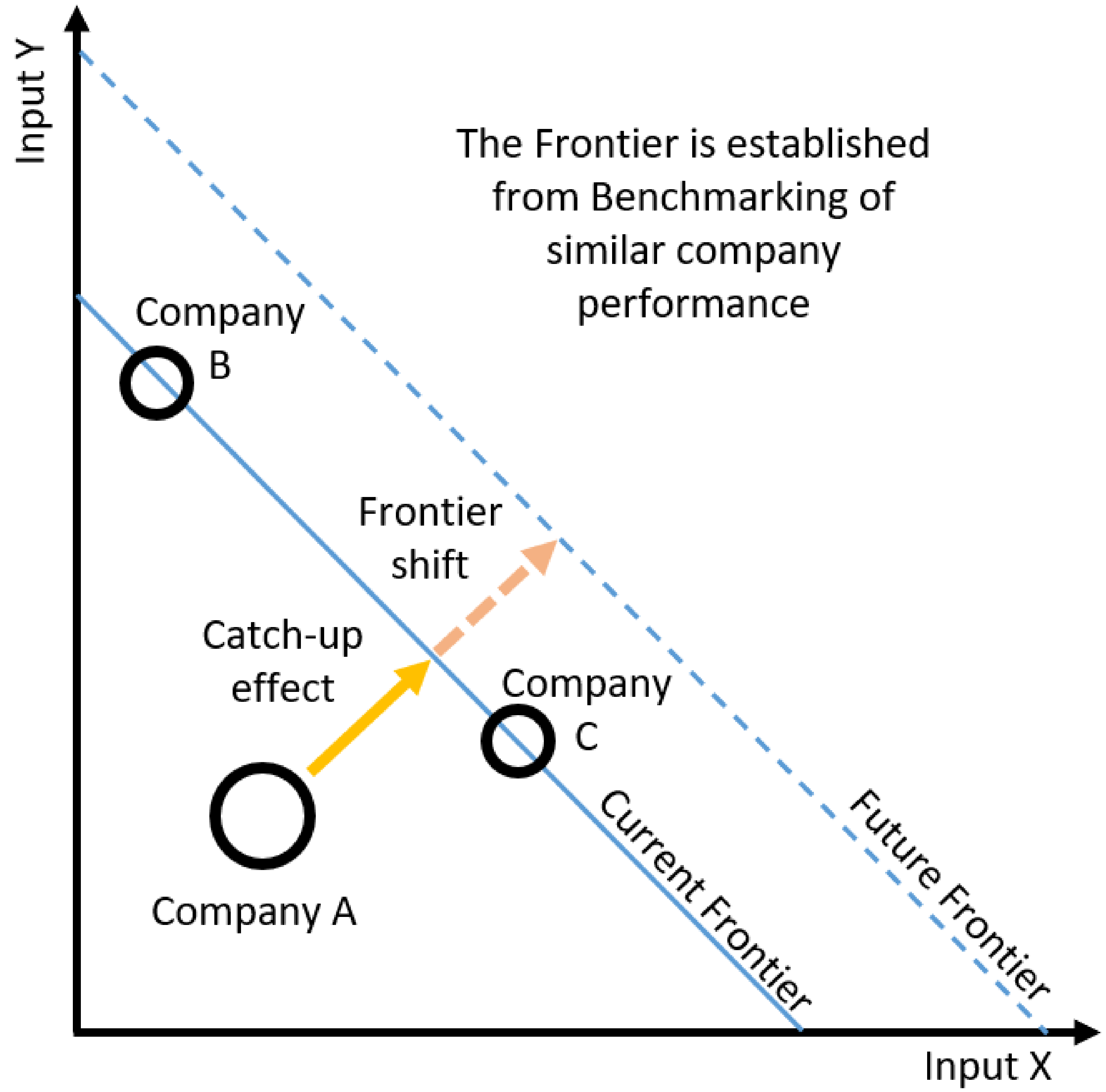
- Case studies:
- BnetzA: Sets Rd based on actual debt rates
- Ofgem: Updates Rf rates annually for WACC setting



EFFICIENCY ANALYSIS

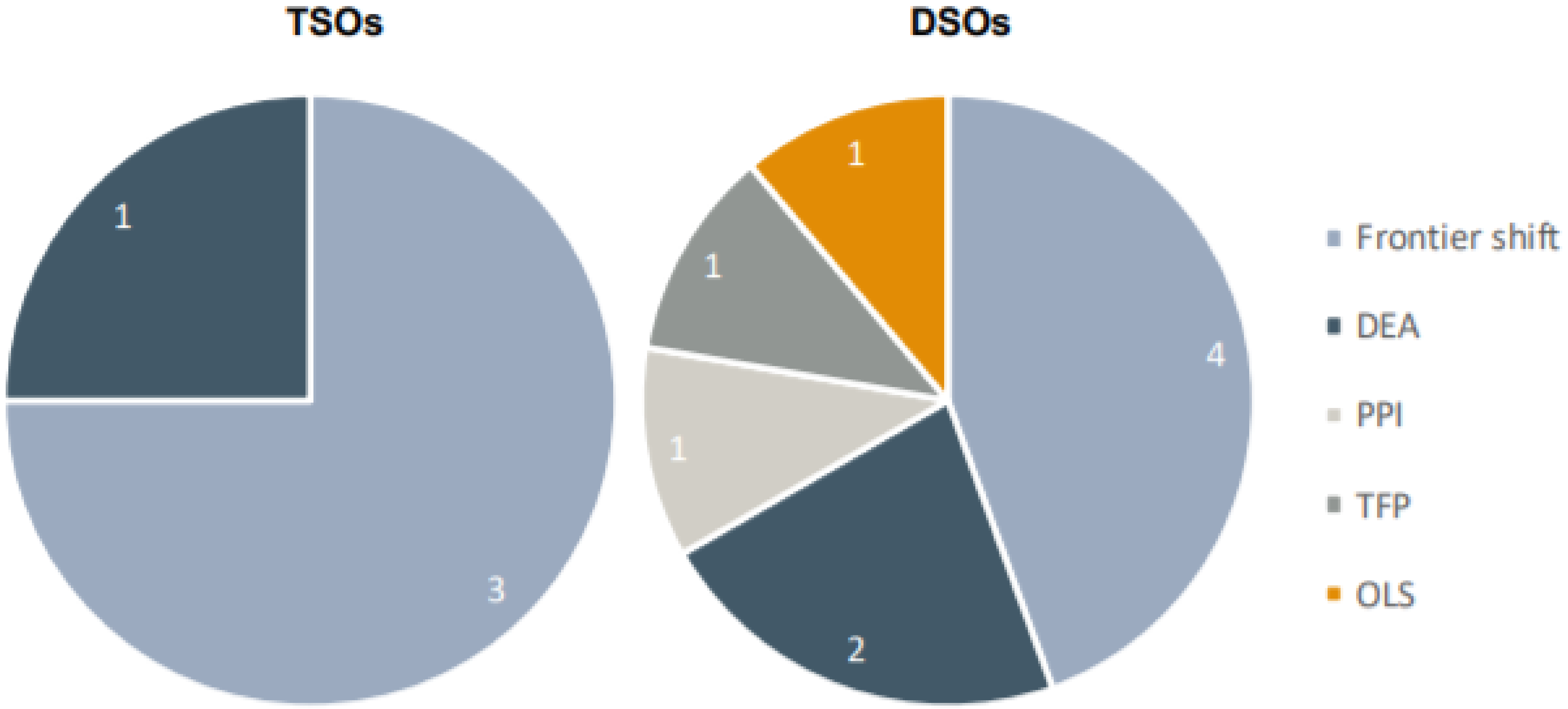
Price/revenue cap – opex

- X-efficiency factor set based on top-down or bottom-up approaches
- Top-down, efficiency set based on:
  - Inefficiency of an individual utility relative to comparable sample; and
  - Frontier-shift effect
    - Estimated by Ofgem under RIIO-2 to be 1.5%

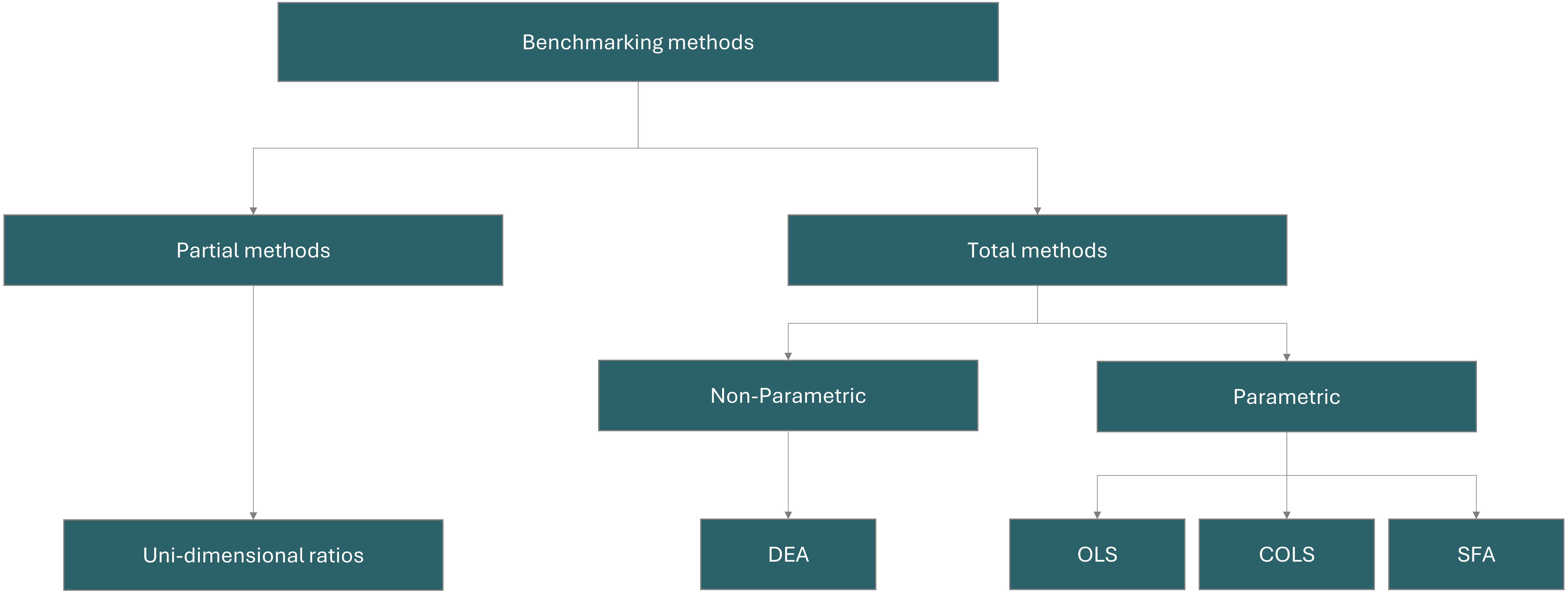


ERRA TSO&DSO STUDY RESULTS (2/2)

Country	TSO	DSO
Albania	0%*	0%*
Austria		0%*
Kosovo	1.5%	1.5%
Moldova	1%	1%
Oman	2%	2%
Pakistan		0% - 5.8%**
Slovakia	3.5%	3.5%
Turkey		0% - 2.34%**



BENCHMARKING METHODS



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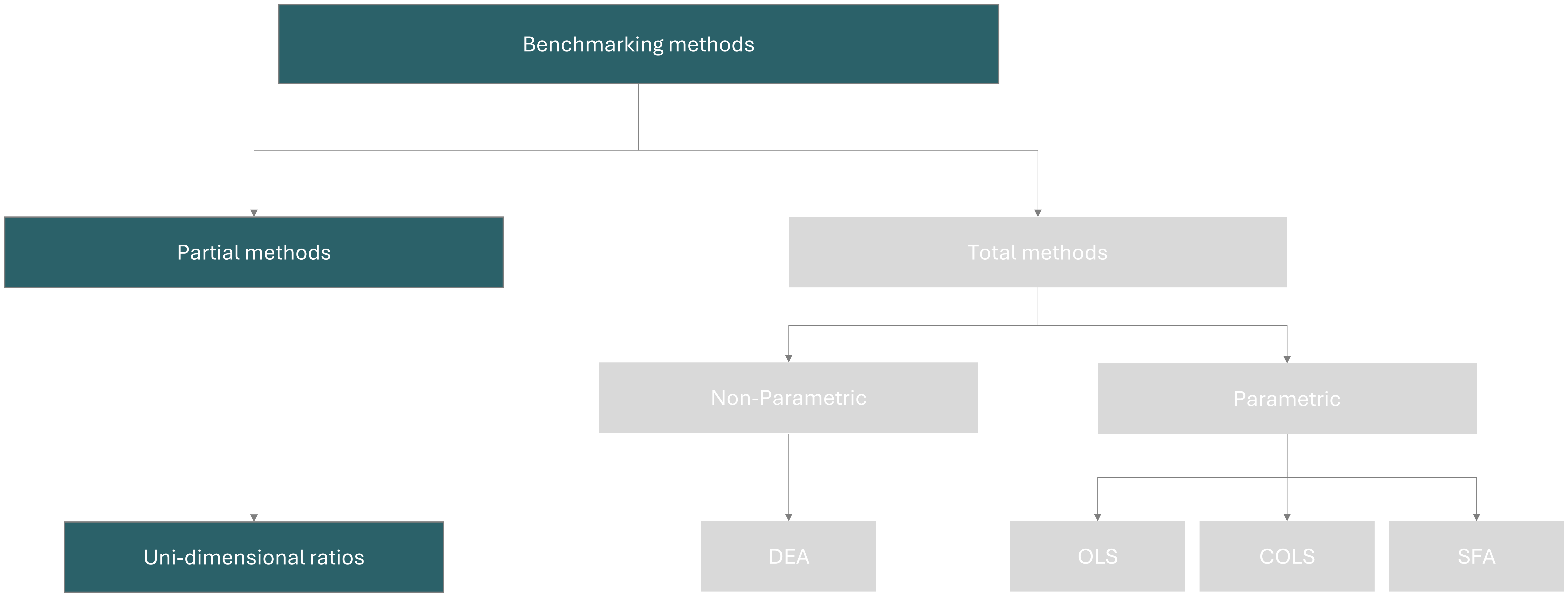
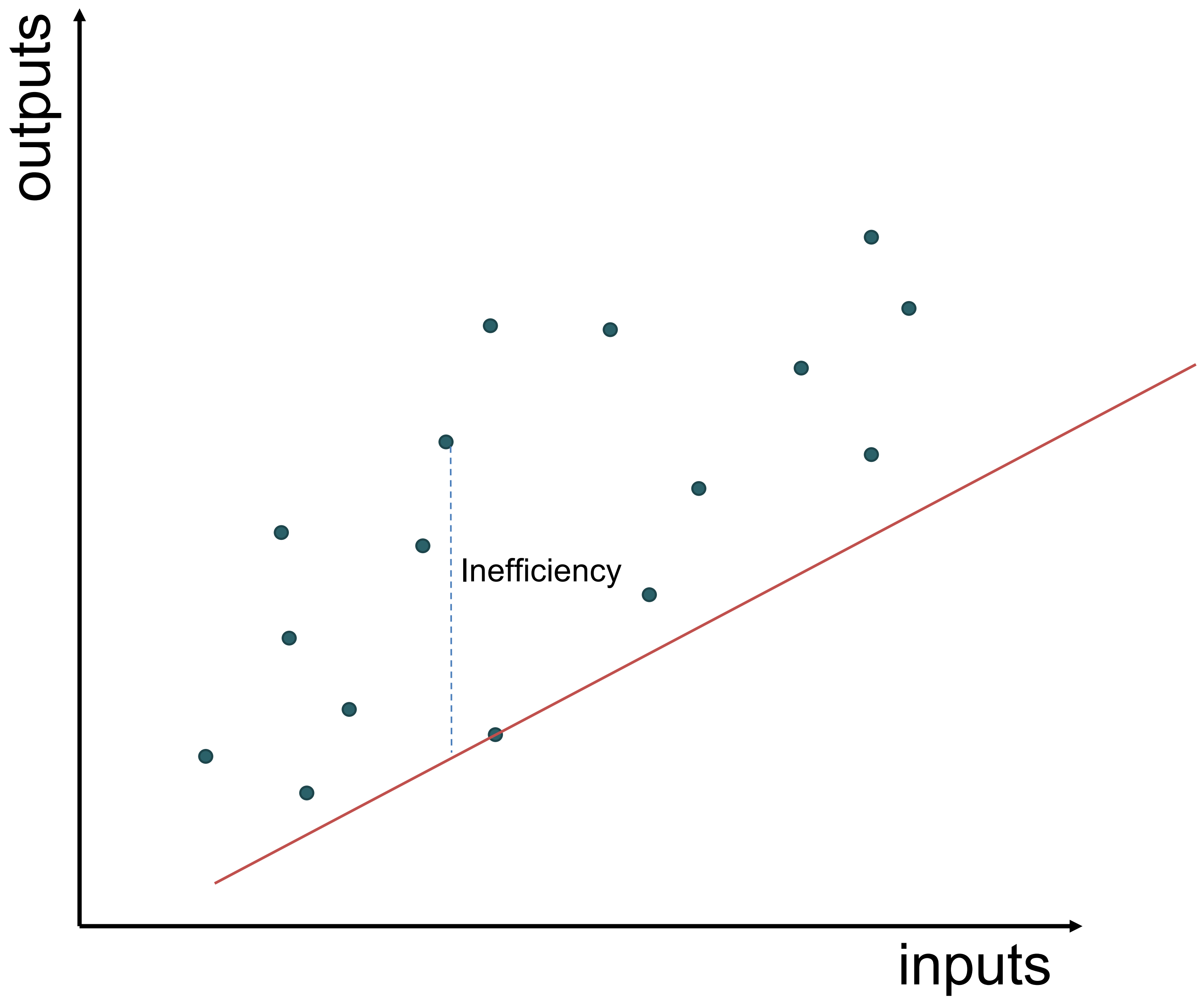


UNI-DIMENSIONAL RATIOS (1/2)

Uni-dimensional ratios

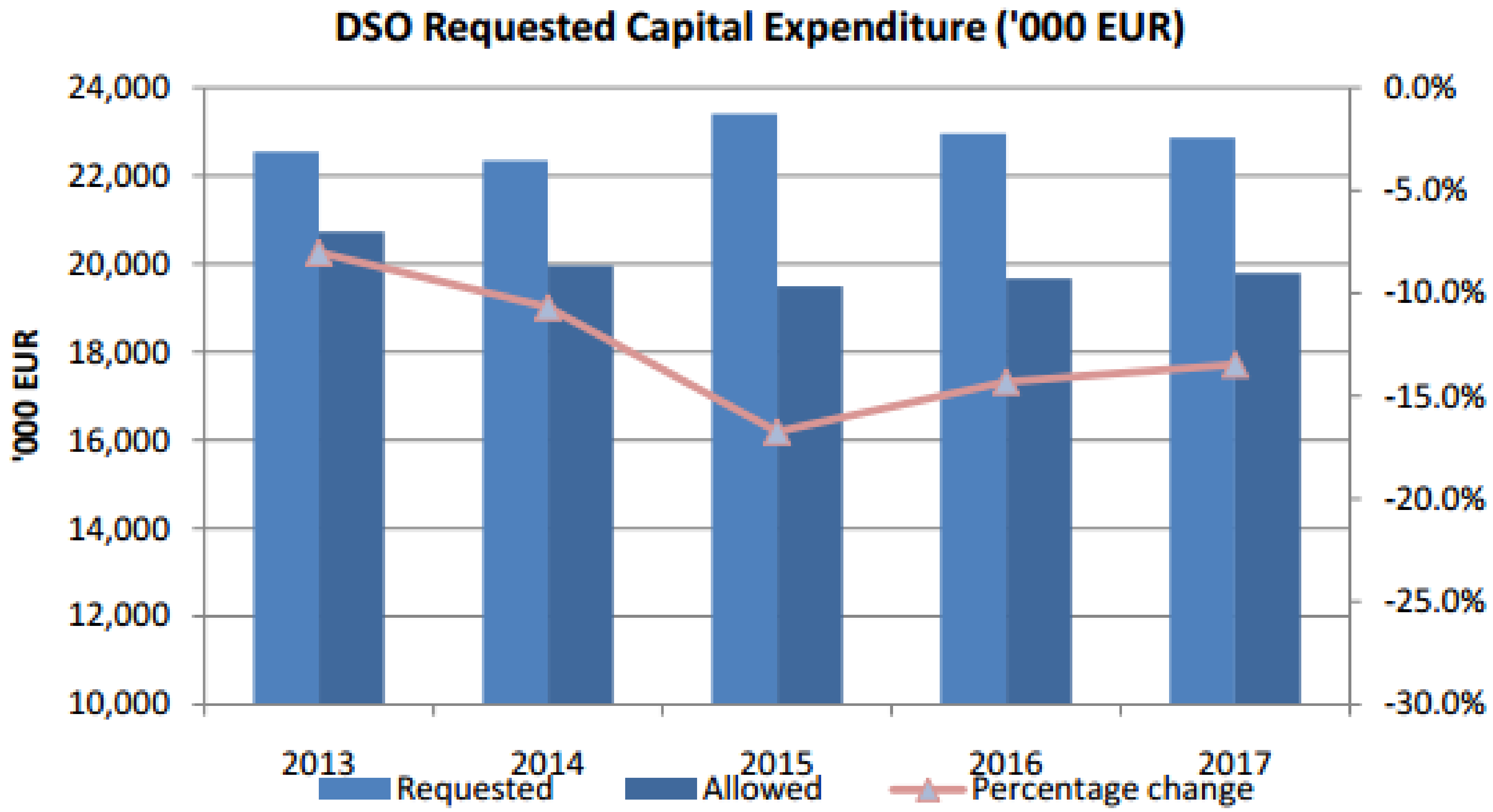
- Use of trend or ratio analysis on a businesses inputs or outputs to make simple comparisons about productivity and efficiency (identify some immediate outliers for instance)
- Carried out by calculating different measures of financial, operational or quality of service performance of different businesses
- Examples can include: Opex per km vs customer density, opex per customer vs. customer density, opex vs. distributed energy, opex vs. number of users
- Applied on Cross Sectional, Time Series or Panel data



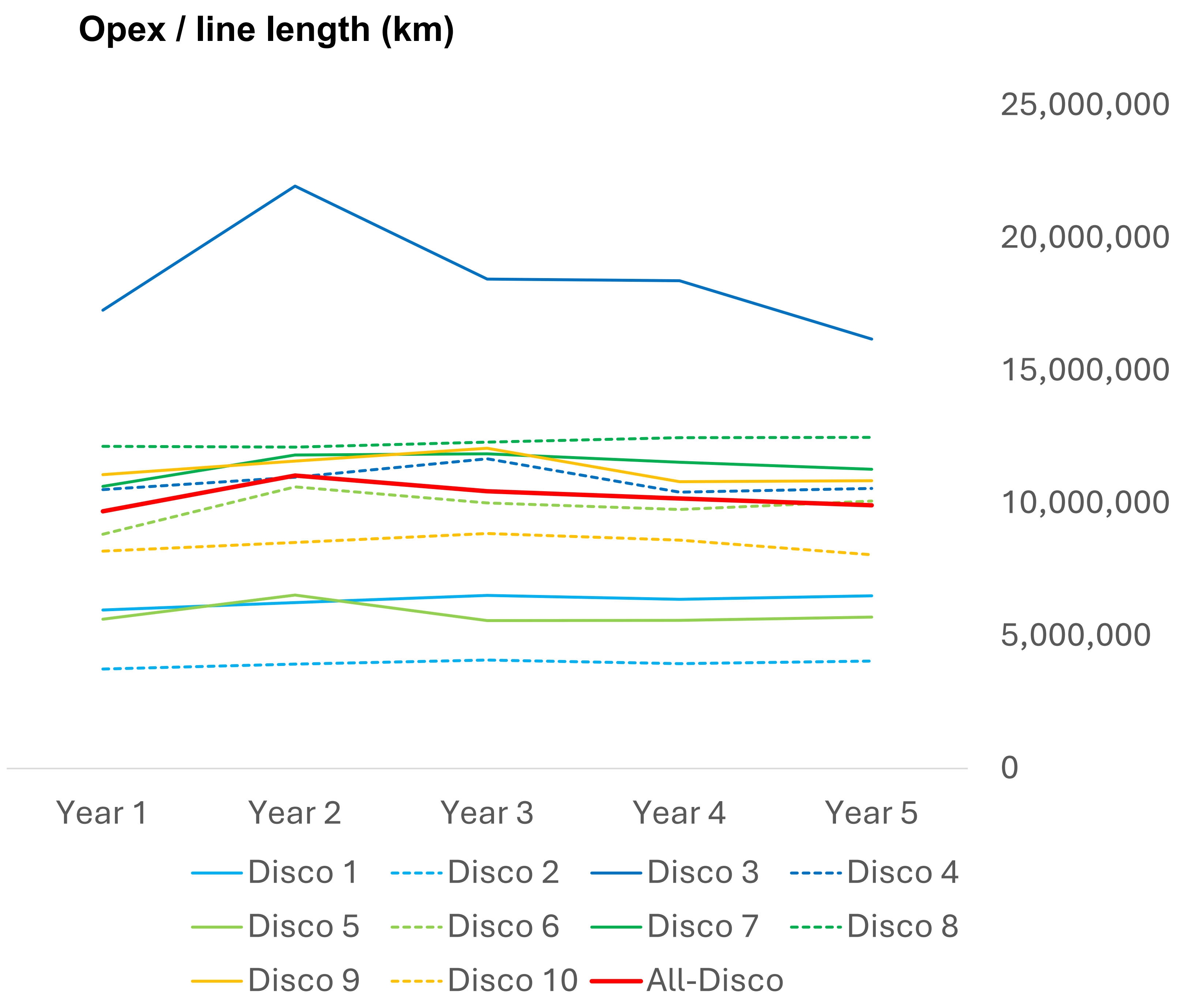
UNI-DIMENSIONAL RATIOS (2/2)

Uni-dimensional ratios

- Pros:
  - Simple, easy to calculate, accessible data requirement
- Cons:
  - Can give misleading information about utility performance (for instance a labor productivity measure can overstate results if company is deepening capex
- Widely used among the industry, regulators and practitioners
- CER (Ireland)
  - Tree-cutting costs per network kilometer and tree coverage per km
  - Fault costs per network km
- ERO (Kosovo)
  - Employee numbers per network length (km) (2012)
  - Cost of 110 kV OH line per km



COMPARABLE DATA IS KEY (1/2)



Frontier shift
Change in most effiicent Disco

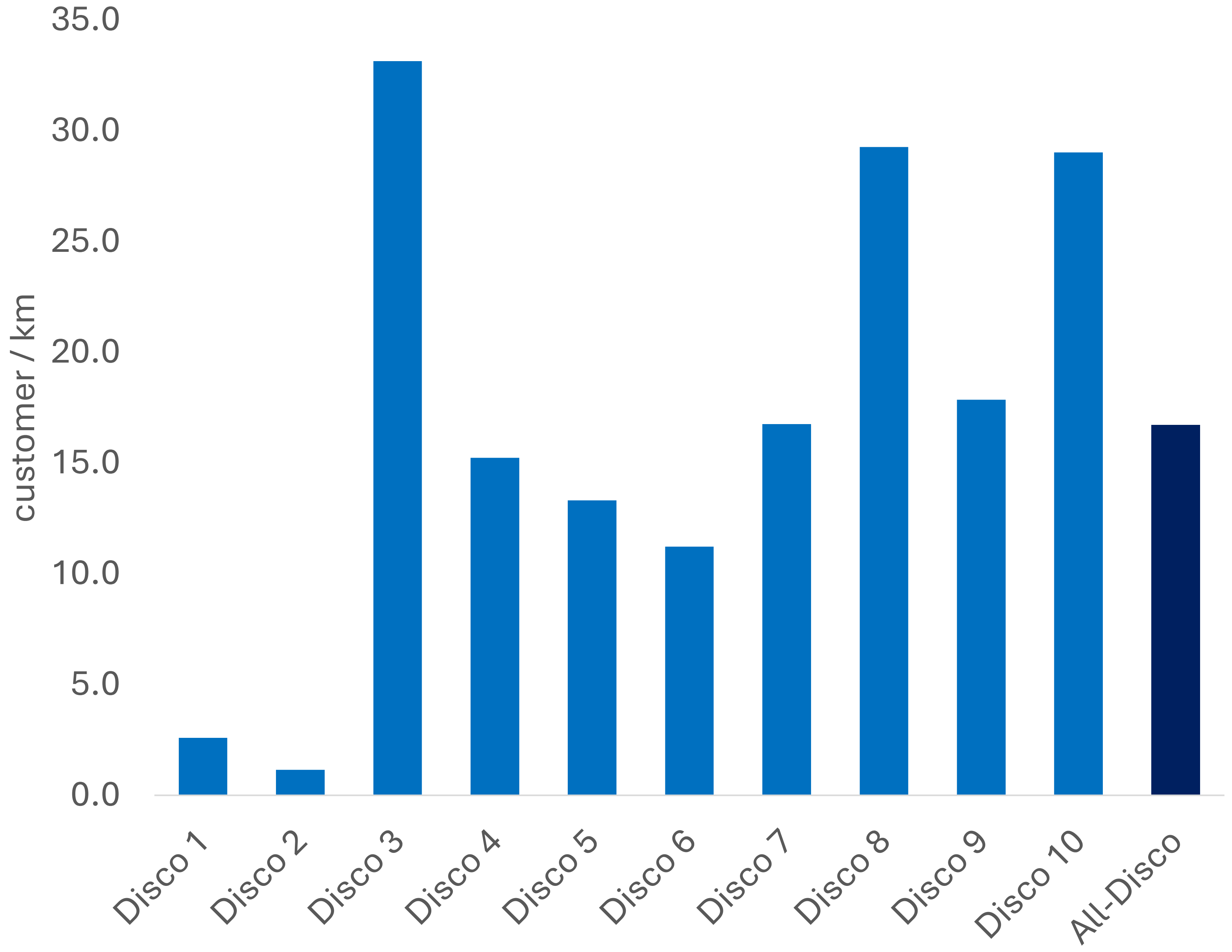
Applied to all Discos	1.9%pa	

Catch-up
Gap from most efficient Discco * Share of inefficiency removed

Share of inefficiency removed	50.0%	
	<u>Relative efficiency</u>	<u>Catch-up efficiency</u>
Disco 1	62.2%	-18.9%
Disco 2	100.0%	0.0%
Disco 3	25.0%	-37.5%
Disco 4	38.4%	-30.8%
Disco 5	70.9%	-14.5%
Disco 6	40.2%	-29.9%
Disco 7	35.9%	-32.0%
Disco 8	32.4%	-33.8%
Disco 9	37.3%	-31.3%
Disco 10	50.3%	-24.9%

COMPARABLE DATA IS KEY (2/2)

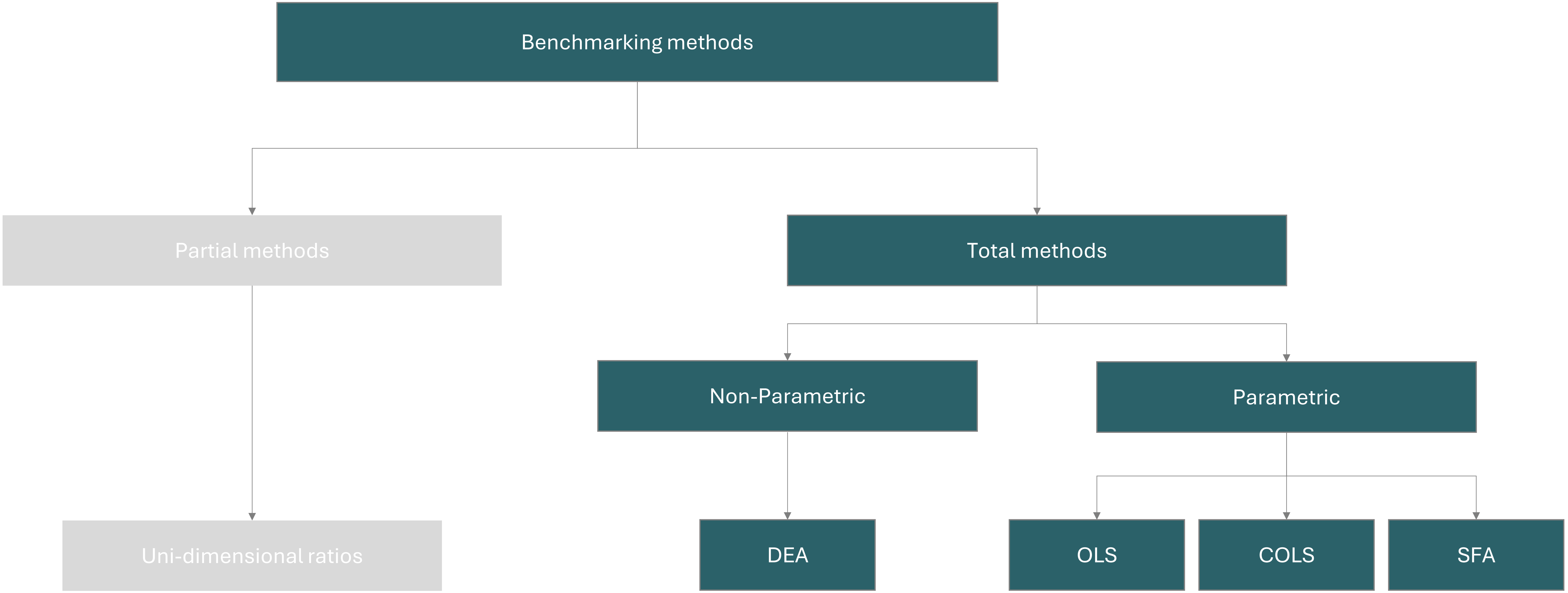
Customers / km



Number of customer per km of network

Disco 1	customer / km	2.6
Disco 2	customer / km	1.2
Disco 3	customer / km	33.2
Disco 4	customer / km	15.2
Disco 5	customer / km	13.3
Disco 6	customer / km	11.2
Disco 7	customer / km	16.8
Disco 8	customer / km	29.3
Disco 9	customer / km	17.9
Disco 10	customer / km	29.0
All-Disco	customer / km	16.7

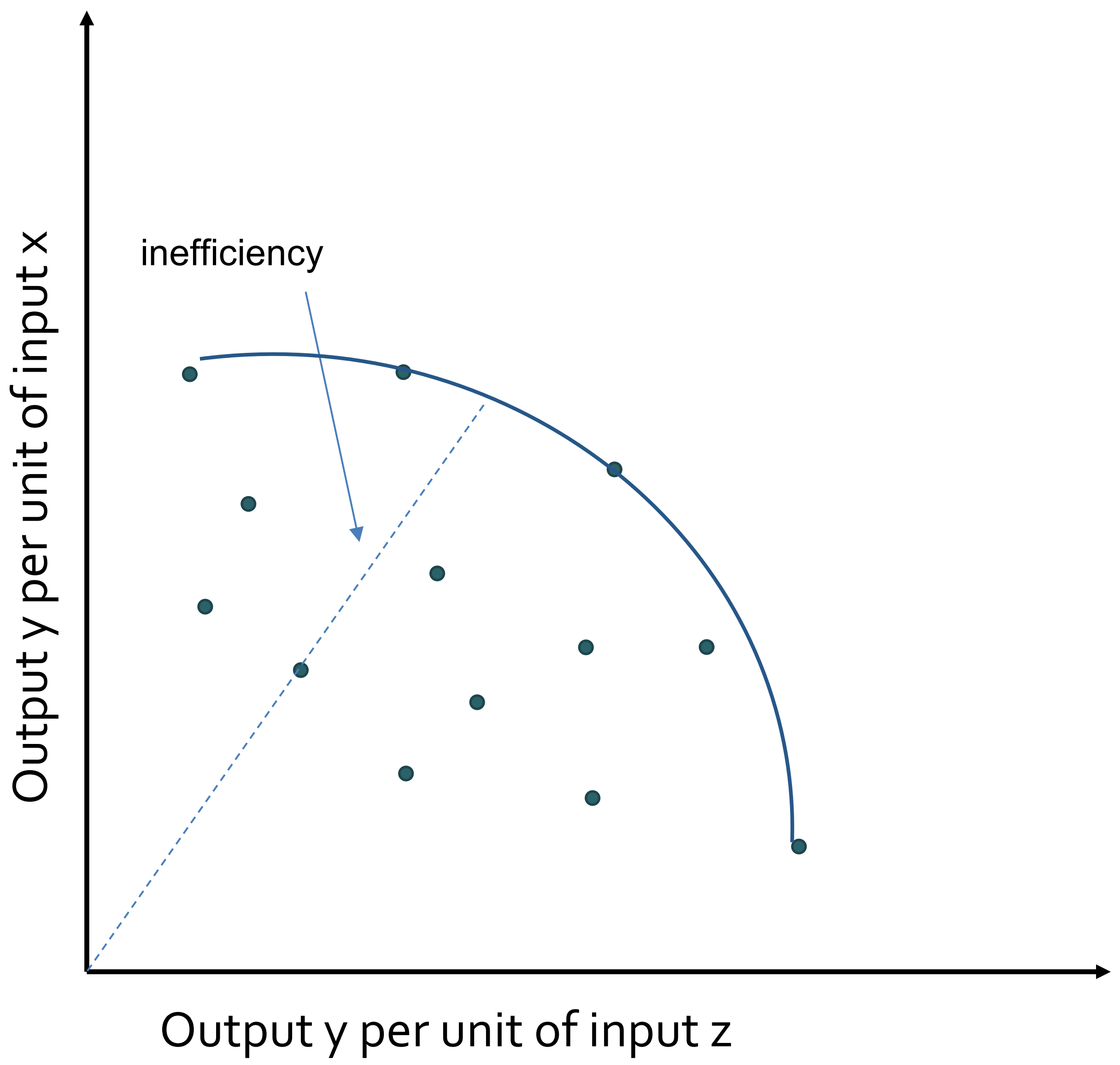
BENCHMARKING METHODS



DATA ENVELOPMENT ANALYSIS (DEA) (1/2)

Data Envelopment Analysis (DEA)

- DEA compares the efficiency of firms producing similar outputs using similar inputs
- (i.e. Observations from the input-output combinations from actual data give information about the set of possible input-output combinations that are available to the industry.)
- After constructing a feasible 'input-output' combination, a DEA score for a particular business is assigned based on the level according to which the set of input parameters can be reduced while keeping the same level of output (input-oriented model)

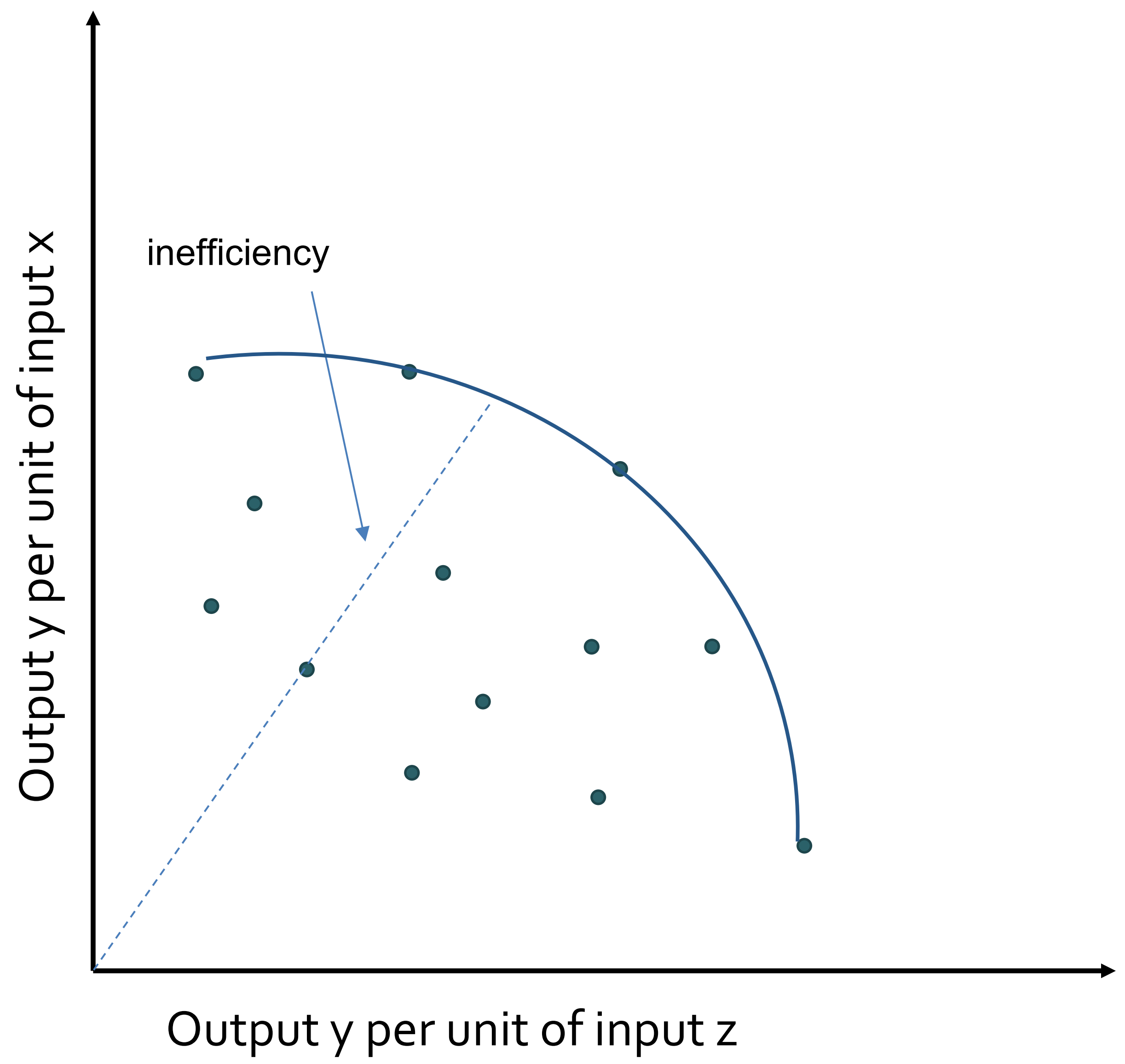


DATA ENVELOPMENT ANALYSIS (DEA) (2/2)

DEA example

		Firm 1	Firm 2	Firm 3
Outputs	Service A	110	55	22
	Service B	9.79	66	22
Input	Cost	110	165	66

- Assuming Constant Returns to Scale (CRS), it is possible to produce the output of firm 3 using 0.036 copies of firm 1 and 0.328 copies of Firm 2.
- This combination of firms could produce the same output as Firm 3 but with a lost cost of 58.1
- The efficiency score of Firm 3, therefore, is 0.88 (58.1/66.0)



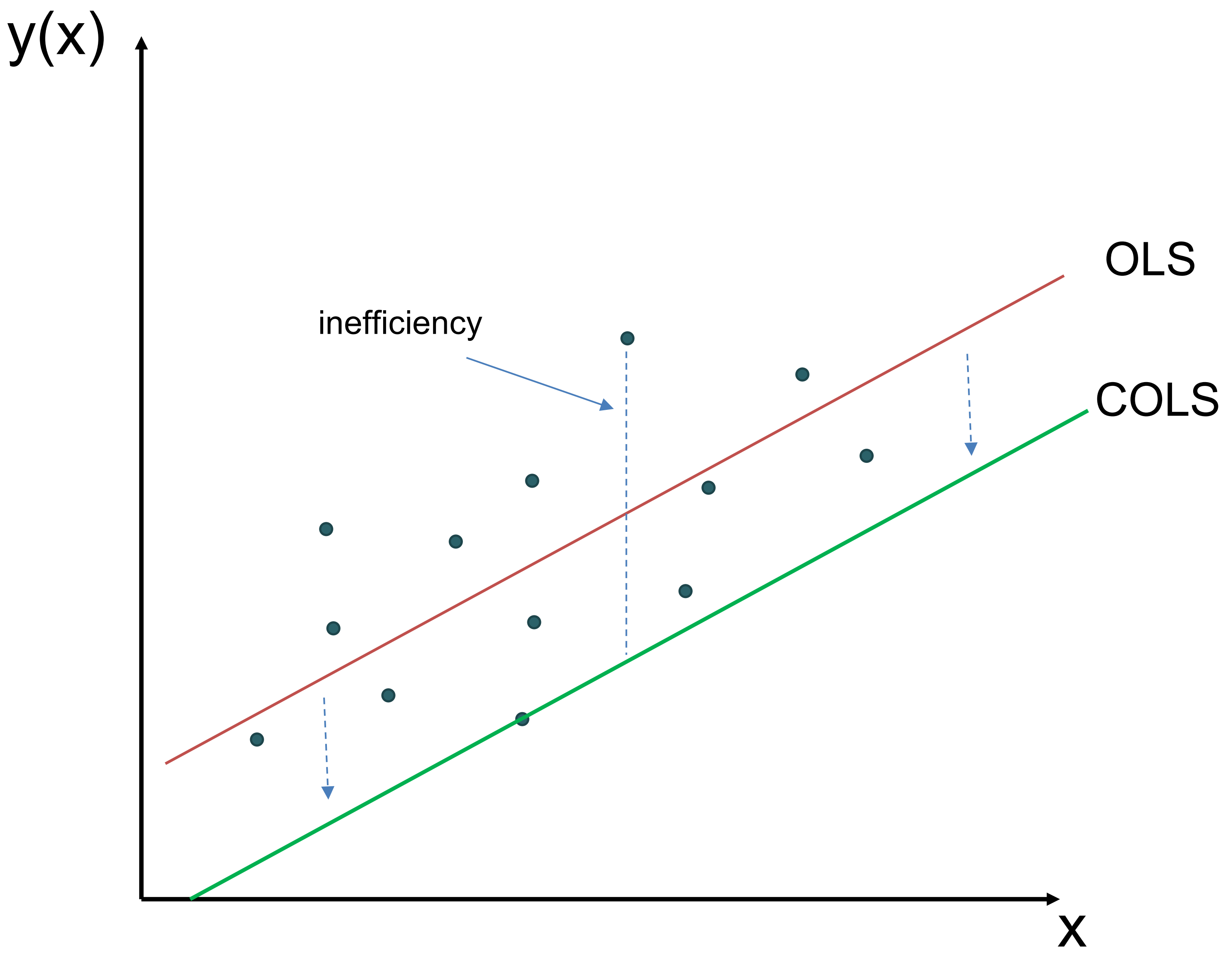
PARAMETRIC TECHNIQUES: OLS, COLS

OLS and COLS estimations

- Ordinary Least Squares (OLS) is an econometric technique applying a linear least squares method to estimate unknown parameters in a regression model
- Corrected Ordinary Least Squares (COLS) shifted downwards to the pass through the most efficient company of the sample

$$Y_i = \beta_o + \beta_1 X_i + \mu_i$$

- Relies on a set of statistical assumptions about the data which do not always hold (assumes the relationship is linear in the parameters, homoscedasticity etc.)



WHAT AN OLS ESTIMATION MIGHT LOOK LIKE

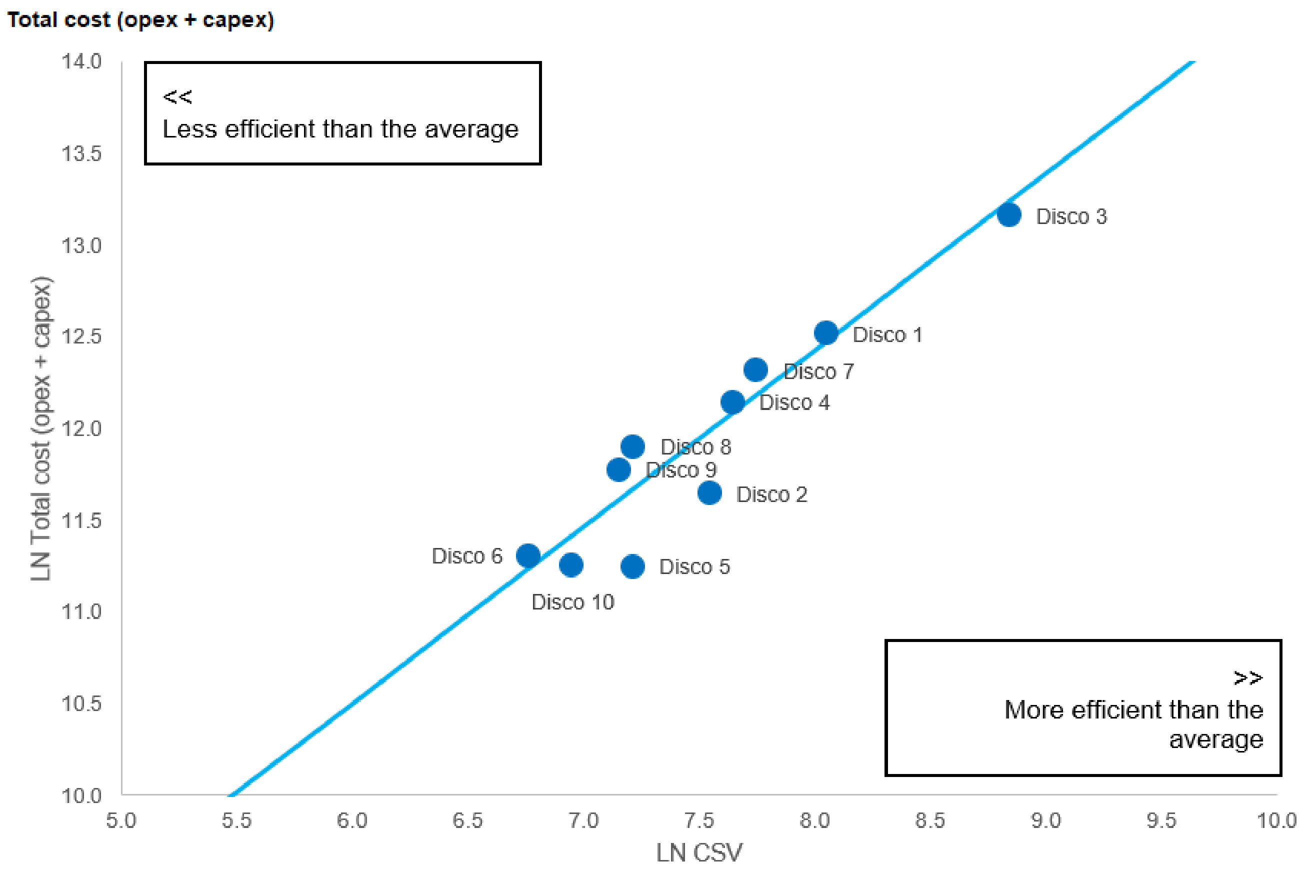
Step 1: Identify input cost and assign weights to desired outputs

Cost	USD million	Total cost (opex + capex)
Outputs		
		Example
Sales - Total	GWh	50.0%
Peak demand - Total	MW	25.0%
Customers - Total	Number	0.0%
Line length	circuit km	25.0%

Step 2: Run OLS diagnostics

1. Model specification;
2. Linearity of the parameters
3. Homoscedasticity
4. Normal distribution of the residuals
5. Multicollinearity

Step 3: Run OLS model



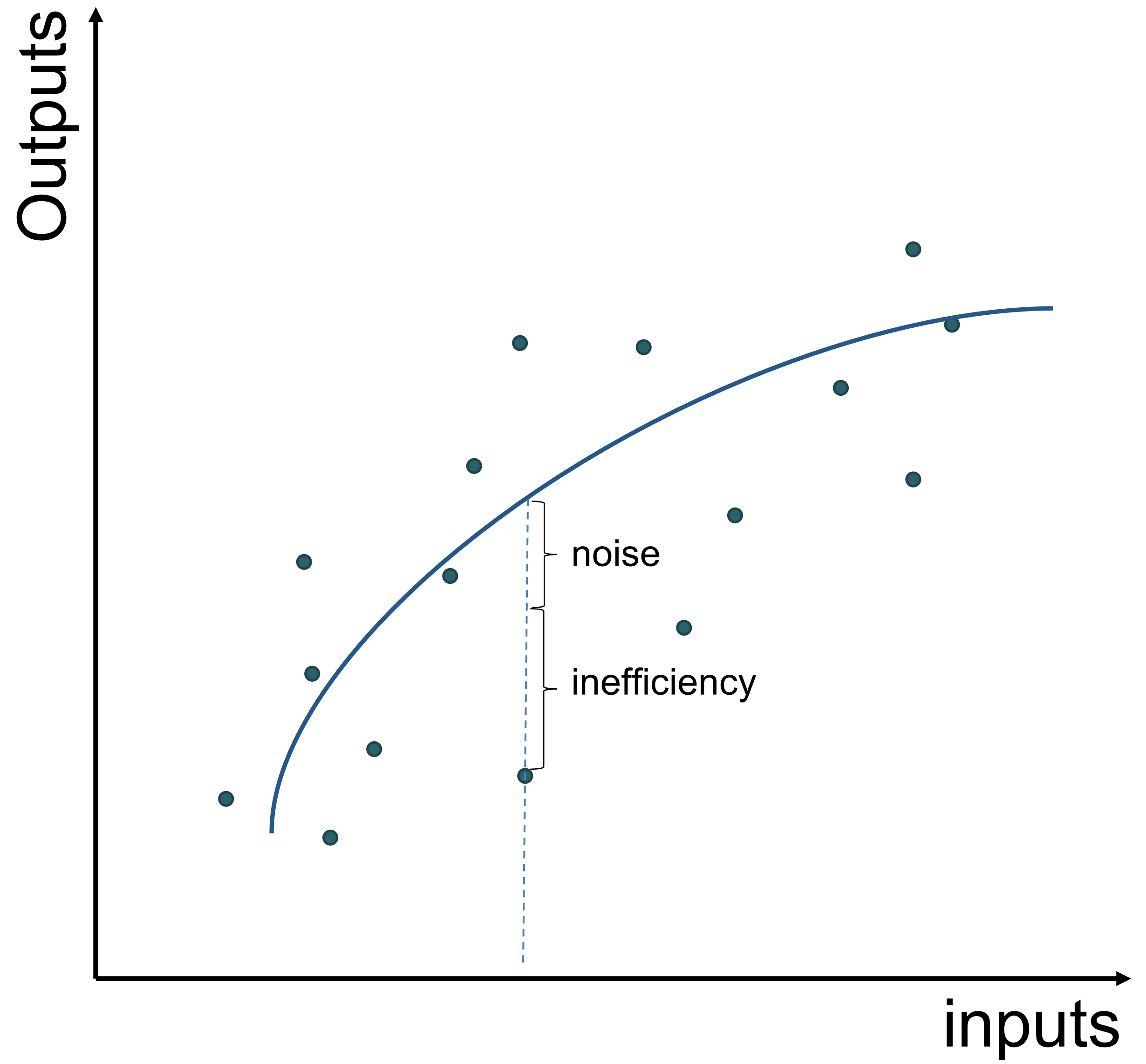
Step 4: Assign efficiency scores

		Year 5		Ranked 1 = most efficient in Year 5	
		Actual	**Fitted**		
1	Disco 1	12.5	12.5	1	Disco 5
2	Disco 2	11.6	12.0	2	Disco 2
3	Disco 3	13.2	13.2	3	Disco 10
4	Disco 4	12.1	12.1	4	Disco 3
5	Disco 5	11.2	11.7	5	Disco 1
6	Disco 6	11.3	11.2	6	Disco 4
7	Disco 7	12.3	12.2	7	Disco 6
8	Disco 8	11.9	11.7	8	Disco 7
9	Disco 9	11.8	11.6	9	Disco 9
10	Disco 10	11.2	11.4	10	Disco 8

PARAMETRIC TECHNIQUES: SFA

Stochastic Frontier Analysis

- SFA estimates a cost frontier from which the actual costs incurred by the businesses can be estimated (typically-using a Cobb-Douglas production function)
- Differs from OLS in two important ways:
    - It estimates a cost frontier representing the minimum costs, rather than the average costs;
    - Separates the presence of random statistical noise from actual inefficiency incurred by the firm
- Limited number of regulators using SFA, typically requires large number of comparators (data-intensive benchmarking tool)
- Sweden, Germany and Finland used SFA in combination with DEA



CLOSING REMARKS

- Totex came as a natural evolution of:
  - regulatory frameworks due to shifting priorities form promoting predictability and investments towards seeking efficiency gains
  - Regulatory frameworks encouraging efficiency and innovation, including non-wire solutions, to support the energy transition
- More efficient allocation of Opex and Capex options between the regulated companies
- Complexities in implementation relate to:
  - to the determination of capitalization rates
  - Synthetic RAB, a regulatory construct, not aligning with regulatory returns on asset values (book values) which can raise concerns about transparency, cost savings and acceptability of the Totex model
  - Cost-benchmarking can be an obstacle due to limited comparable data setting allowed costs based on Totex allowance
  - Concerns about risk perceptiveness of the framework

THANK YOU FOR YOUR ATTENTION!

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