ENERGY REGULATORS
REGIONAL ASSOCIATION

Efficiency Analysis in tariff regulation

Ardian Berisha
ERRA Secretariat

ERRA Natural Gas Committee Meeting
26 May 2022

Contents

General policy objectives

Capital expenditure review and assessment tools

Regulatory practice among ERRA members

Two more detailed case studies

Predictable regulation increases value for customers (1/3)

- OECD conducted a study on Fostering investment in infrastructure

- Lessons learned from country experiences in enhancing private sector participation and end-user affordability in infrastructure sectors were compiled

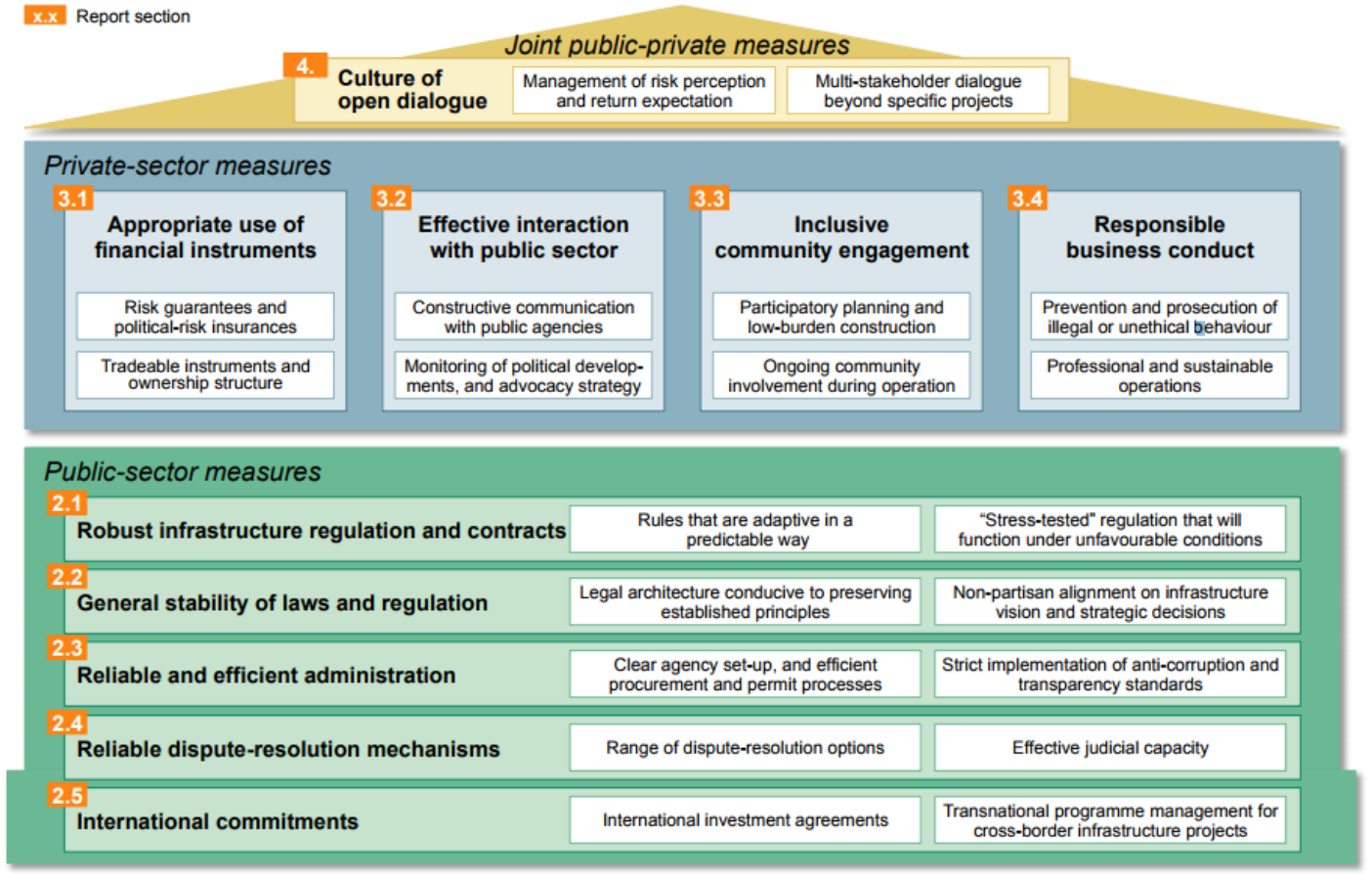
"Increasing private participation in infrastructure investment requires an investment regime that provides clarity and predictability for investors…" [1]

[1] OECD Fostering investment in infrastructure (January 2015)

Predictable regulation increases value for customers (2/3)

- WEF Study on Infrastructure Risk Mitigation

Risk Mitigation Framework[2]



[2] WEF Study on Mitigation of political and regulatory risks in Infrastructure project Risk Mitigation Framework (2015)

Predictable regulation increases value for customers (3/3)

- Facilitating infrastructure investment requires a **stable and predictable regulatory framework** which provides clarity to investors;
- Regulators should seek to **reduce discretionary practice** when assessing/reviewing the reasonableness of capex plans by having defined evaluation criteria
- Use of multiple measures and tools as indicators of inefficiency of companies, **consistent with previous regulatory precedents**
- **Specific Rule/regulation** dealing with capital expenditure review and assessment

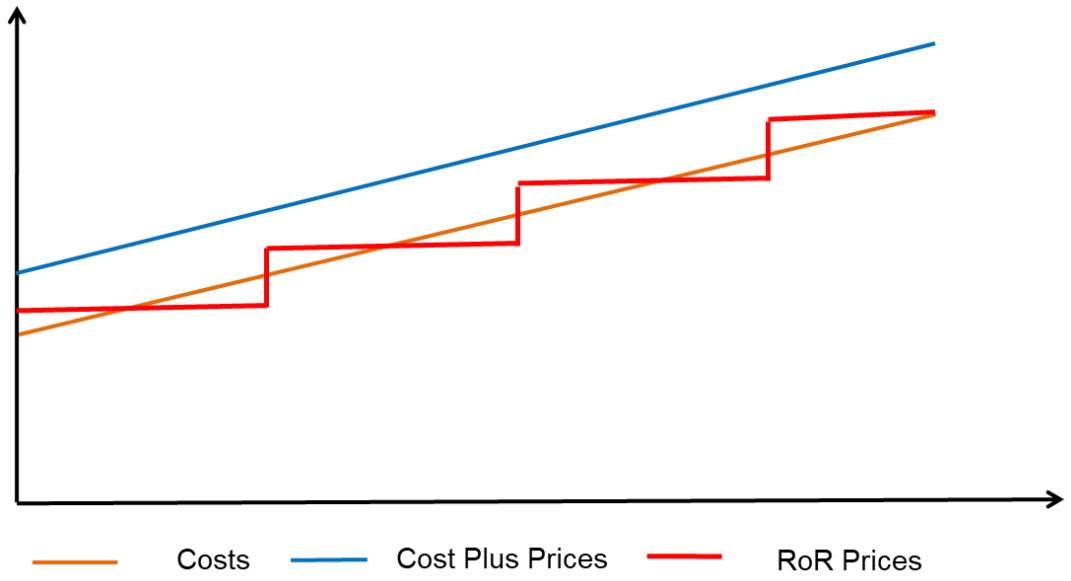
Cost plus and Rate of Return

Cost-plus

- Costs reset frequently, typically on an annual basis
- Regulator reviews utility expenses
- Regulator sets revenues to equal actual costs
- Pros:
  - Clear policy and revenue predictability for the company
  - Ensured cost coverage
- Cons:
  - No incentive to reduce costs

Rate-of-return regulation

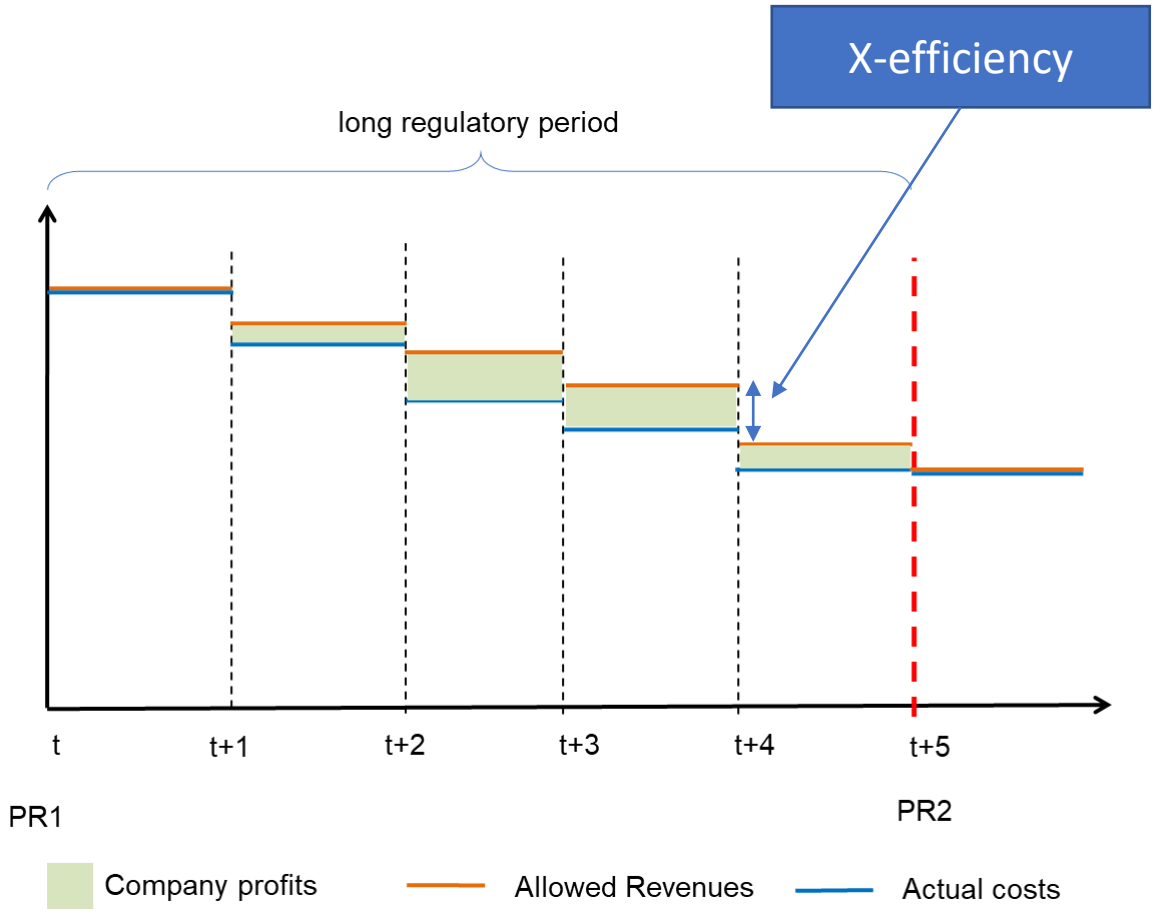
- Regulator reviews utility assets to determined their usefulness and prudency
- Regulator determines rate of return the utility should be allowed to earn on the capital invested
- Pros:
  - Clear policy and revenue predictability for the company
  - Ensured cost coverage
- Cons:
  - No incentive to reduce costs



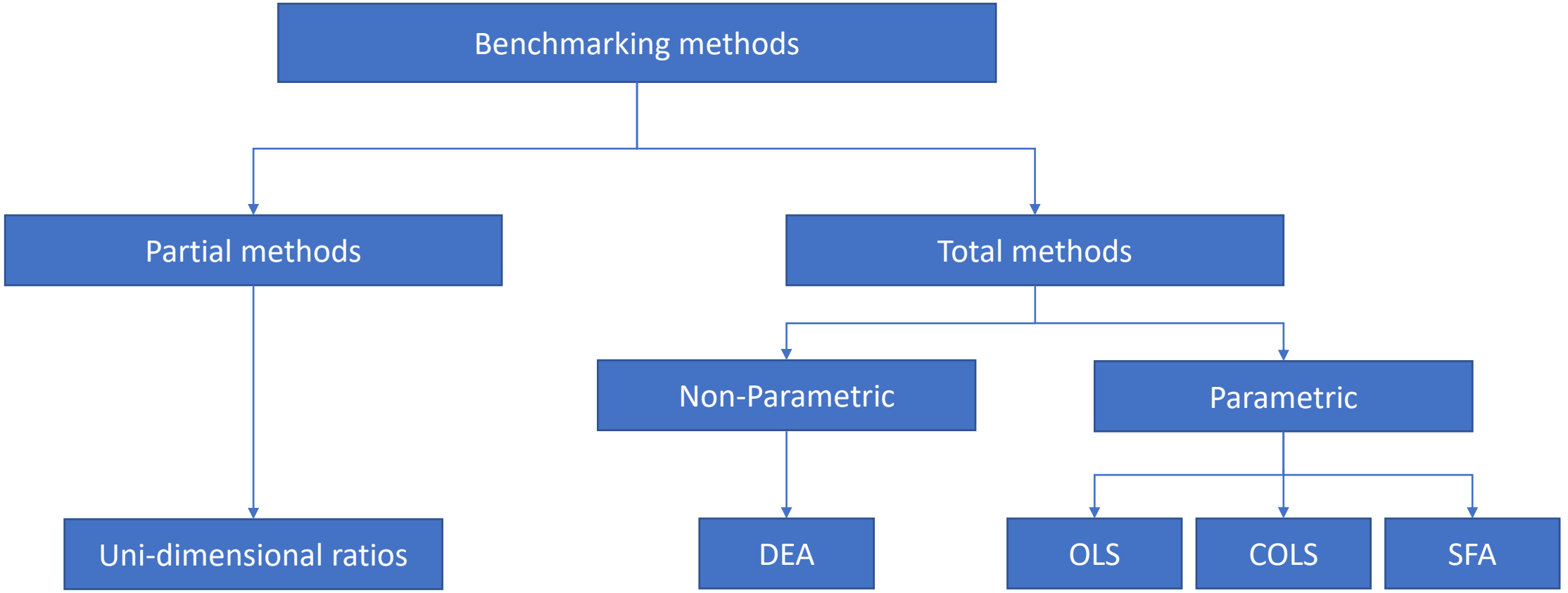
Cap regulation

Cap regulation

- Regulator sets a maximum level of revenues that a company is allowed to collect over a "regulatory period"
- X-efficiency imputed already in allowed revenues
- Companies allowed to make profits if actual costs for providing regulated service below approved revenues
- Pros:
  - Higher incentives for efficiency gains
  - Reduces asymmetry of information
- Cons:
  - Requires more monitoring for quality of supply/service



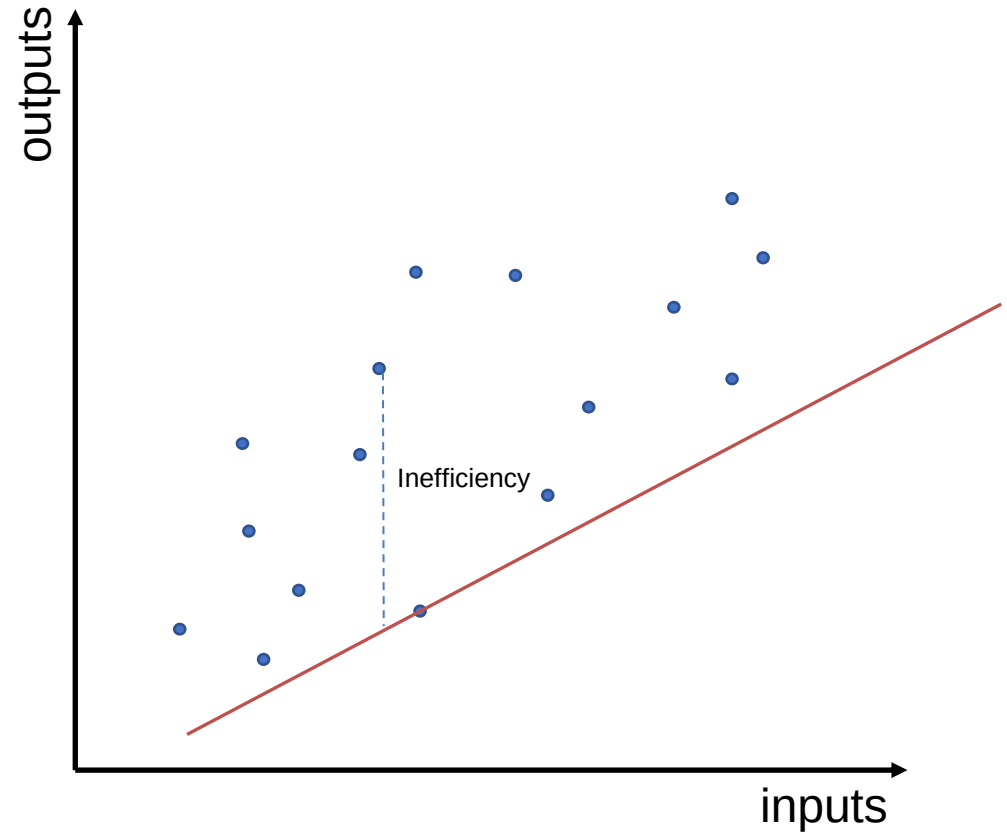
Benchmarking methods



Uni-dimensional ratios (1/2)

Uni-dimensional ratios

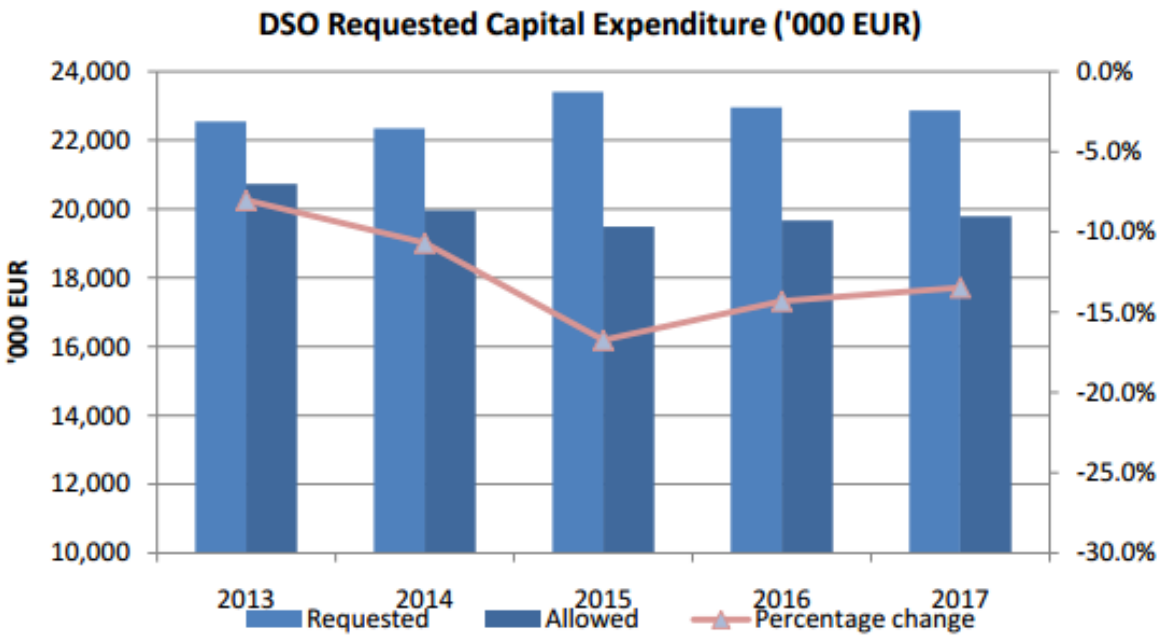
- Use of trend or ratio analysis on a businesses inputs or outputs to make simple comparisons about productivity and efficiency (identify some immediate outliers for instance)
- Carried out by calculating different measures of financial, operational or quality of service performance of different businesses
- 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

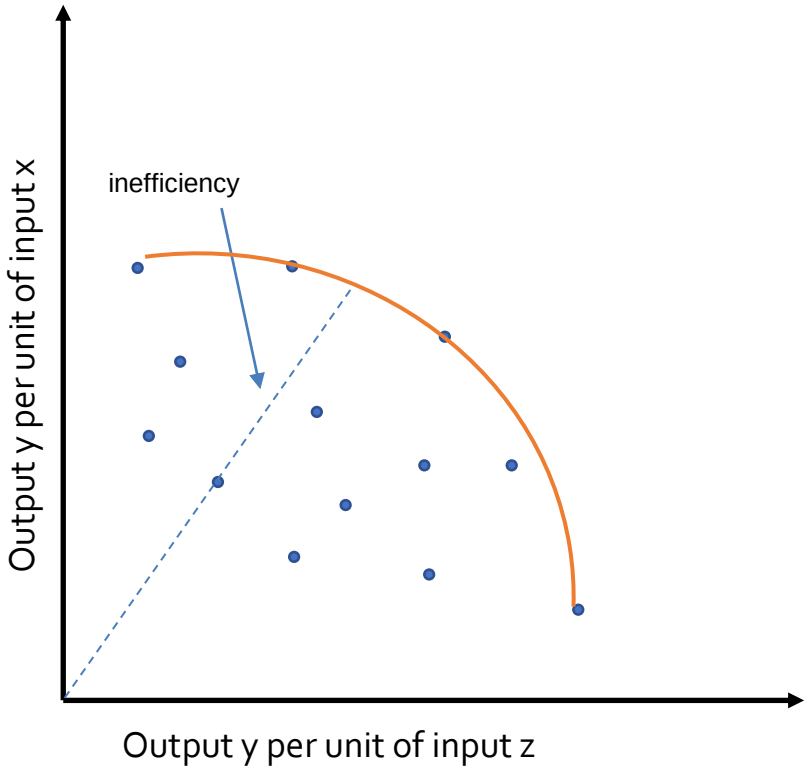
- Pros:
  - Simple, easy to calculate, accessible data requirement
- Cons:
  - Can give misleading information about utility performance (for instance a labor productivity measure can overstate results if company is deepening capex
- Widely used among the industry, regulators and practitioners
- CER (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 0.4 kV OH line per km



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)

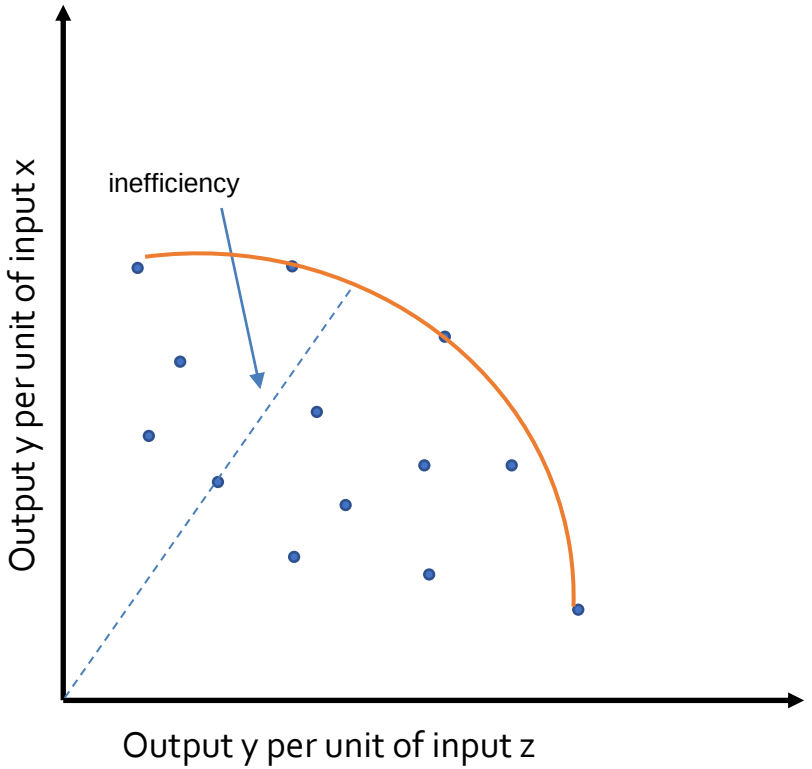


Data Envelopment Analysis (DEA) (2/2)

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)



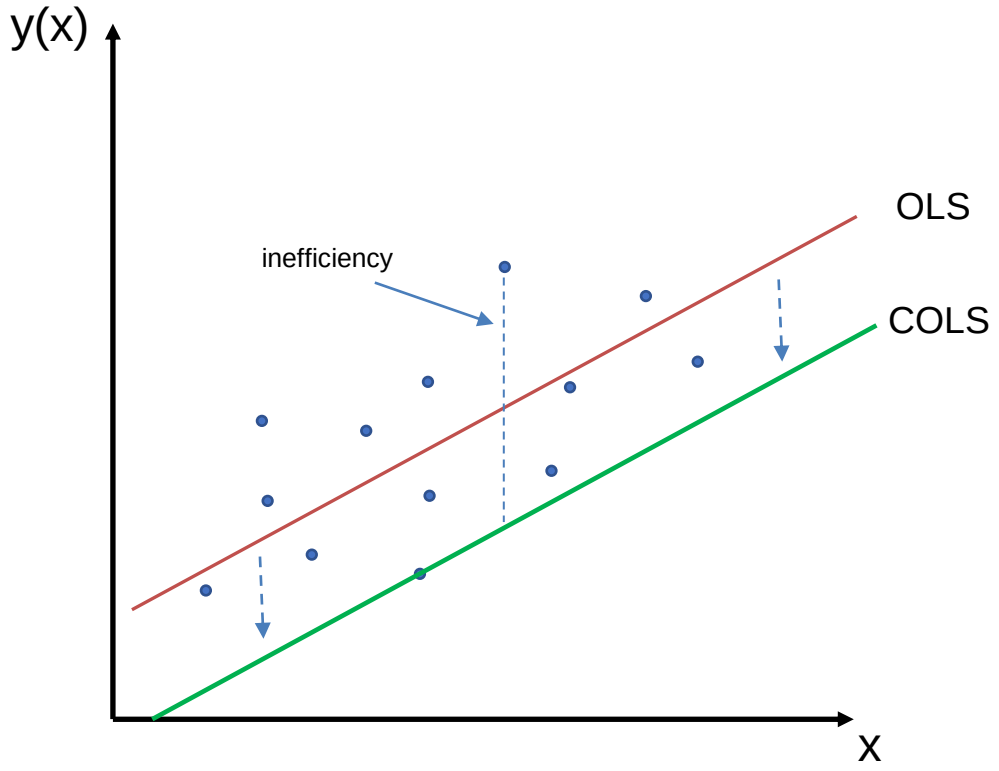
Parametric techniques: OLS, COLS

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

$$Yi=\beta o+ \beta_1 X_i+ \mu_i$$

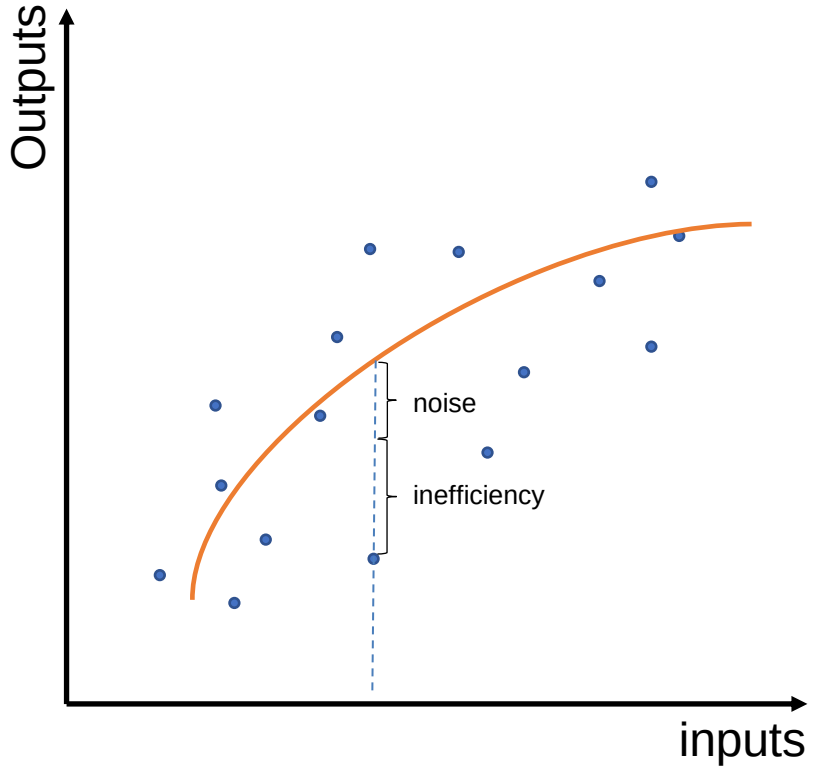
- Relies on a set of statistical assumptions about the data which do not always hold (assumes the relationship is linear in the parameters, homoscedasticity etc.)



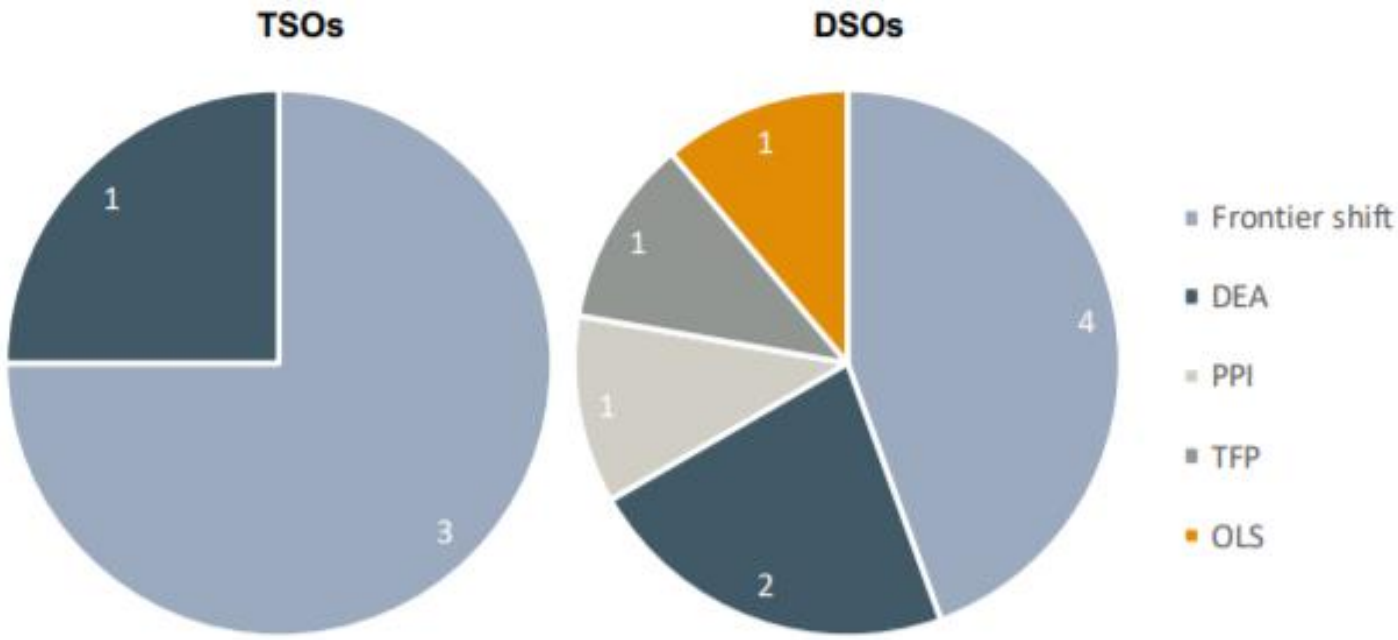
Parametric techniques: SFA

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



ERRA TSO&DSO Study results (1/3)



Capex integration in RAB

- Main challenge for regulators: The appropriate level of capex to be recovered from regulated tariffs
  - Asymmetry of information (regulated entity is better informed about the level of capex and the associated cost)
  - Incentive to inflate costs (so as to gain on the difference between the approved and actual cost)
  - Incentive to increase total investments (also referred to as "gilding" – occurs when there are differences between allowed and actual cost of capital - WACC)

Capex financial and economic tests

Cost-Benefit Analysis

Comparison of the Costs and the Benefits of the Investment

Investment decision if Benefits>Costs

Distinguish between Financial CBA and Economic CBA

Benefit-Cost Ratio (BCR)

Net Present Value (NPV)

Discount the future cash flows of a project to account for the time-value of money

$$\mathrm{NPV}(i,N)=\sum_{t=0}^{N}\frac{R_t}{(1+i)^t}$$

Simple and familiar technique to practitioners;

Does not determine when a positive NPV is achieved

Must make decisions about appropriate discount rate

Internal Rate of Return (IRR)

Internal rate of return finds a discount rate (r) at which the project NPV equals 0.

$$\mathrm{NPV}=\sum_{n=0}^{N}\frac{C_n}{(1+r)^n}=0$$

Very useful technique and widely accepted because it shows borrowing costs up to which a project can have a positive NPV.

A project can have multiple IRRs or no IRR (if negatives at any point in cash-flow stream)

Payback period (PBP)

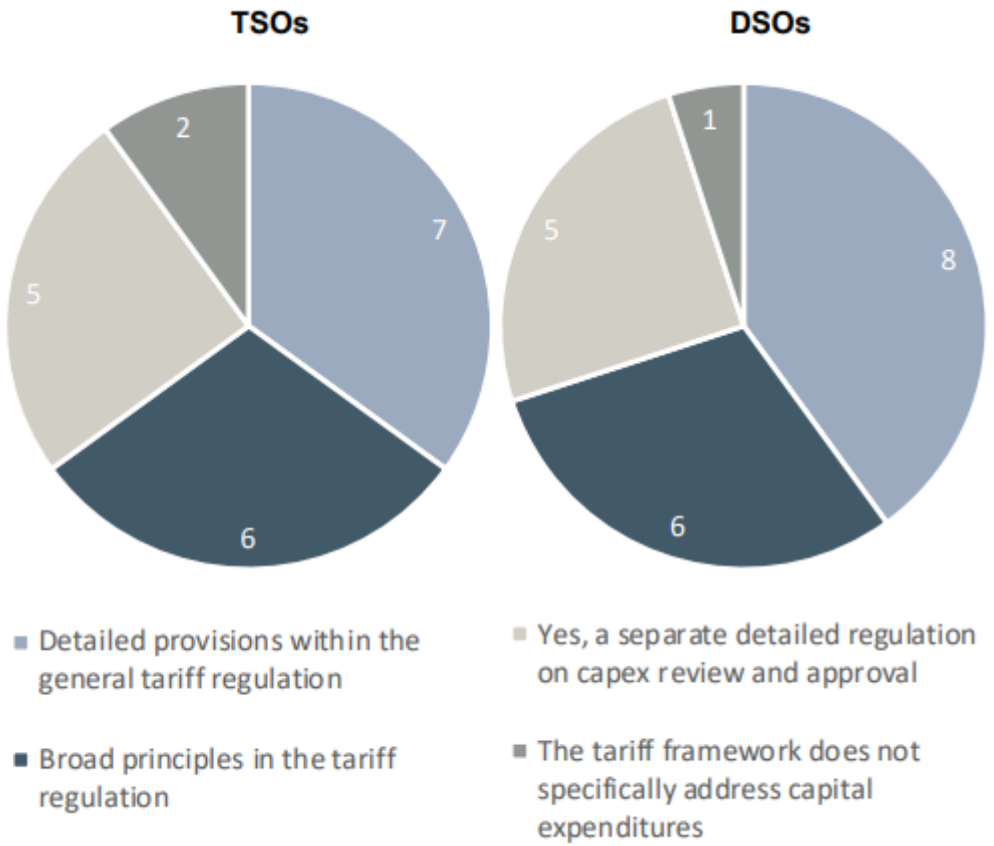
Determines the length of time it takes for an investment to be returned (to pay back initial capex)

Distinguish between:

- simple payback – period of time it takes for future net positive cash-flows to recover initial investment;
- Dynamic payback – period of time it takes for uture discounted net cash flows to recover initial investment

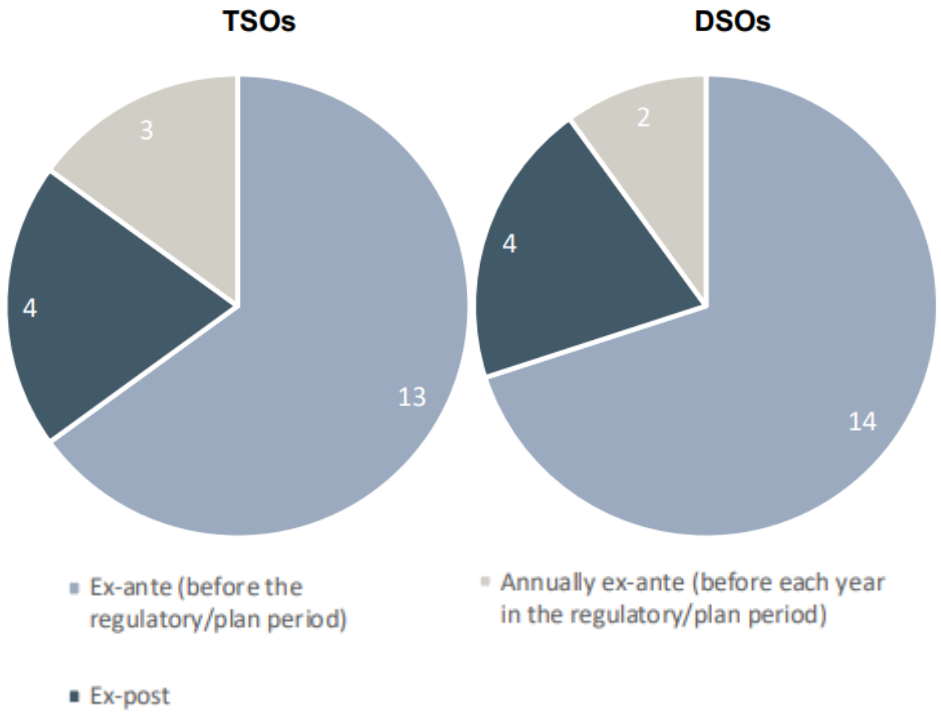
Specific rules/regulations on Capex review

Figure 36 Rules on capex



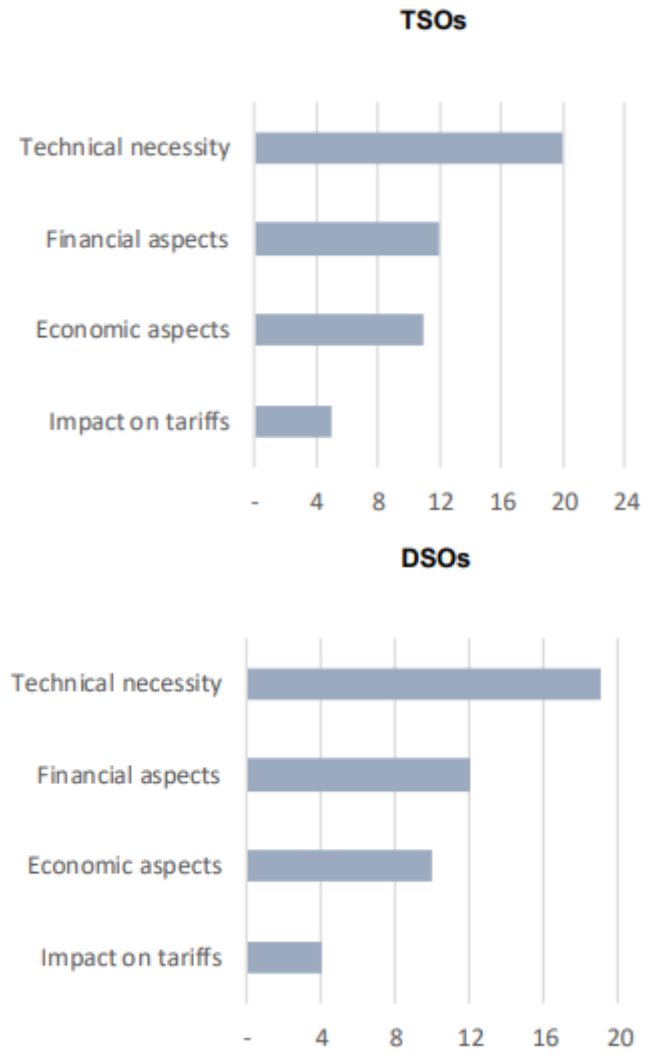
	AL	AT	AZ	BG	CZ	EE	GE	HU	LT	LV	MD	MK	NG	OM	PE	PK	PL	SK	TR	XK[†]
TSO																				
Detailed provisions in tariff methoc		✓				✓	✓	✓	✓	✓		✓								
Broad principles in tariff method			✓	✓	✓								✓			✓			✓	
Separate regulation	✓										✓			✓	✓					✓
Framework does not address capex method																	✓	✓		
DSO																				
Detailed provisions in tariff method		✓				✓	✓	✓	✓	✓		✓					✓			
Broad principles in tariff method			✓	✓	✓								✓		✓	✓				
Separate regulation	✓										✓			✓					✓	✓
Framework does not address capex method																		✓		

Ex-ante vs. Ex-post approval



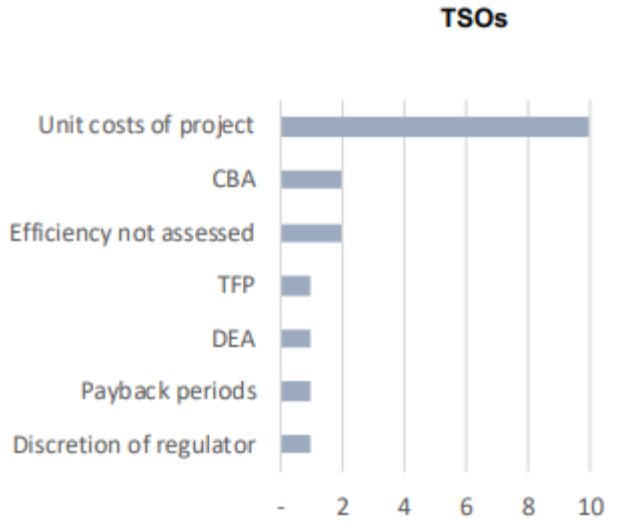
	AL	AT	AZ	BG	CZ	EE	GE	HU	LT	LV	MD	MK	NG	OM	PE	PK	PL	SK	TR	XK†
TSO																				
Ex-ante (before the regulatory / plan period)	✓		✓	✓		✓	✓					✓	✓	✓	✓	✓	✓		✓	✓
Ex-post		✓			✓			✓										✓		
Annually *ex-ante*									✓	✓	✓									
DSO																				
Ex-ante (before the regulatory / plan period)	✓		✓	✓		✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓
Ex-post		✓			✓			✓										✓		
Annually *ex-ante*									✓		✓									

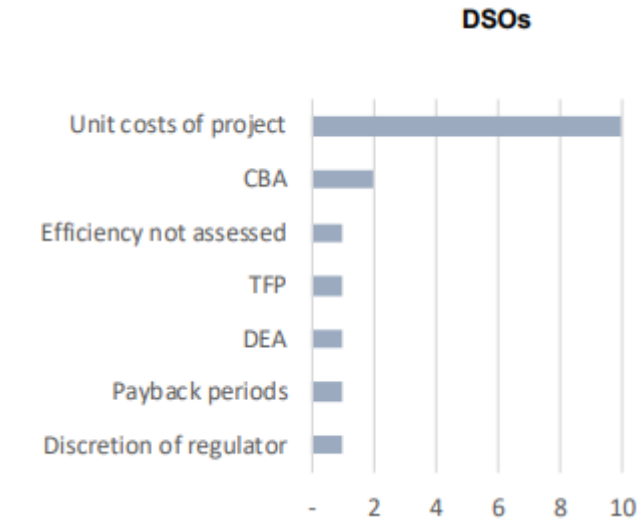
The basis to approve a capital expenditure project



	AL	AT	AZ	BG	CZ	EE	GE	HU	LT	LV	MD	MK	NG	OM	PE	PK	PL	SK	TR	XK†
TSO																				
Technical necessity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Financial aspects	✓	✓	✓	✓			✓					✓	✓	✓		✓	✓		✓	✓
Economic aspects	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓			✓				
Impact on tariffs							✓						✓			✓			✓	✓
DSO																				
Technical necessity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	✓	✓	✓
Financial aspects	✓	✓	✓	✓			✓					✓	✓	✓	?	✓	✓		✓	✓
Economic aspects	✓	✓				✓	✓		✓	✓	✓	✓	✓		?	✓				
Impact on tariffs							✓								?	✓			✓	✓

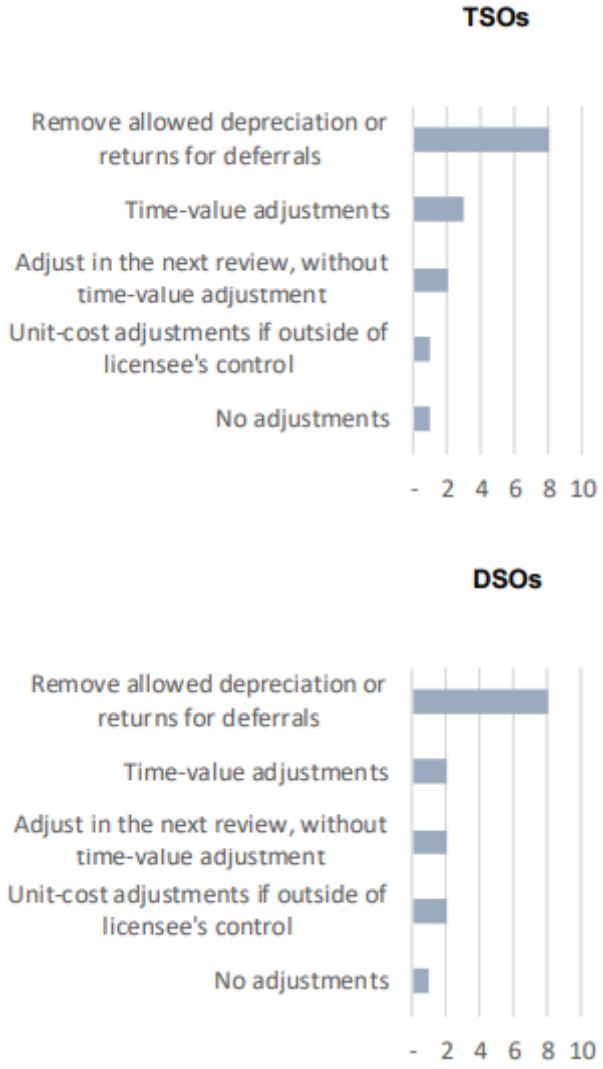
Method applied in ex-ante approval





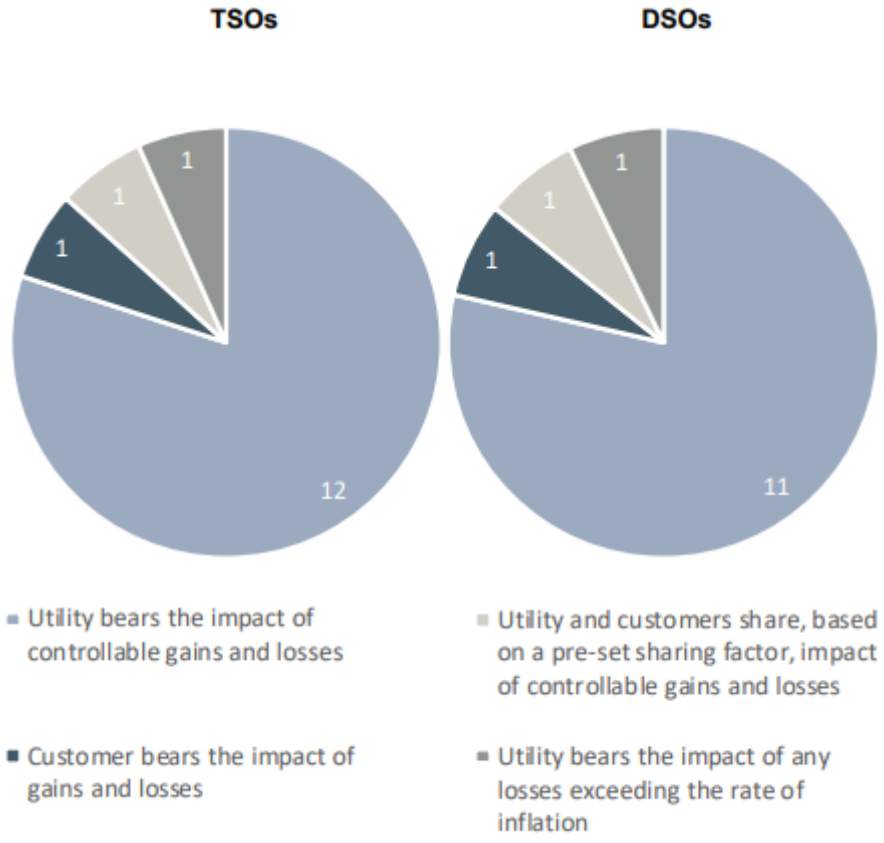
	AL	AT	AZ	BG	CZ	EE	GE	HU	LT	LV	MD	MK	NG	OM	PE	PK	PL	SK	TR	XK†
TSO																				
Capex determined *ex-ante*?	✓	x	✓	✓	x	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓
Unit cost of project	✓		✓			✓	✓				✓	✓	✓	✓	✓		?			✓
CBA																✓	?			✓
Efficiency not assessed									✓								?		✓	
TFP				✓													?			
Payback periods																✓	?			
Discretion of regulator										✓							?			
DEA				✓													?			

Differences between allowed and actual commissioning



	AL	AT	AZ	BG	CZ	EE	GE	HU	LT	LV	MD	MK	NG	OM	PE	PK	PL	SK	TR	XK†
TSO																				
Capex determined *ex-ante*?	✓	x	✓	✓	x	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓
Remove allowed depreciation or returns for deferrals	✓		?	✓					?	?	✓		✓	?		✓	✓		✓	✓
Time-value adjustments			?				✓		?	?				?	✓				✓	
Adjust in the next review, without time-value adjustment			?						?	?		✓		?			✓			
Unit-cost adjustments if outside of licensee's control			?	✓					?	?				?						
No adjustments			?			✓			?	?				?						

Differences between allowed and actual unit cost



DSO																				
Capex determined *ex-ante*?	✓	x	✓	✓	x	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓
Utility bears impact			✓	✓		✓			✓	✓		✓	✓	?	?	✓	✓		✓	✓
Customer bears impact							✓							?	?					
Utility and customers share impact	✓													?	?					
Utility bears losses above inflation											✓			?	?					

Case Study: Lithuania (1/2)

No.	Investment type / purpose	Financial justification			Economical justification		
		FNPV	FIRR	Fin. capability	Net benefits	Impact to the price cap	Other aspects (social, SoS)
1.	Investments depicted in the national energy strategy (approved by Parliament) or national development plan (approved by Government) which purpose is SoS, renewal/reconstruction, connection to the RES and DH)	Not assessed	Not assessed	Positive	Positive for electricity and gas (except for renewal/reconstruction and connection to RES) Not assessed for DH	Provided for informational purposes	Described social and SoS benefits
2.	Electricity and gas investments to smart-meters, PCIs	Calculated FNPV and included into net benefit	Calculated FIRR and included into net benefit	Positive	Positive	Provided for informational purposes	Described social benefits

Case Study: Lithuania (2/2)

No.	Investment type / purpose	Financial justification			Economical justification		
		FNPV	FIRR	Company's financial capability assessment	Net benefits	Impact to the price cap	Other aspects (social, SoS)
3.	Investments for system development to the new areas, connection to the grid (except for DH)	FNPV ≥0*	FIRR≥ WACC*	Positive	Positive	Can't increase the price cap (except for connection to the electricity grid)	
4.	Investments for existing infrastructure energy effciency / modernisation	FNPV ≥0*	FIRR ≥ WACC*	Positive	Positive	Can't increase the price cap	Described social and SoS benefits
5.	Investments of regulated independant heat producers which do not ensure heat generation reserve.					Can't increase the price cap for DH consumers.	

Case Study: Philippines (1/2)

Valuation handbook published by ERC

- ERC Philippines applies performance-based regulation for Distribution Utilities
- Capex submissions must adhere to the 'valuation handbook' which provides technical and financial criteria for the submission of capex projects
- Capex projects are updated and submitted in line with the 'handbook'
- Access updated draft: https://bit.ly/38MM35R

Case Study: Philippines (2/2)

- **Information to be provided by DUs**
  - independent expert review of technical submission;
  - auditor's report etc.
  - Asset register, including data on each individual asset procured and included in the asset register
- **Optimization information**
  - Technical compliance criteria which inform planning by the DUs
- **Unit cost information**
  - For each asset category a unit cost is provided by the handbook, alongside a depreciated asset life

STANDARD REPLACEMENT COSTS FOR OVERHEAD LINES: POLES

Asset Class	Unit	Notes	Standard Value (PhP '000)	Standard Life (Years)
Wooden Poles				
7.5 M or 8.0 M (25 FT)	No.	a	10.1	20
9.0 M or 9.5 M (30 FT)	No.	a	12.8	20
10.5 M or 11M (35 FT)	No.	a	17.0	20
12.0 M (40 FT)	No.	a	25.7	20
13.5 M (45 FT)	No.	a	36.3	20
15.0 M (50 FT)	No.	a	50.3	20
16.5 M (55 FT)	No.	a	65.0	20
18.0 M (60 FT)	No.	a	87.0	20
19.5 M (65 FT)	No.	a	108.9	20
21.0 M (70 FT)	No.	a	122.5	20
22.5 M or 23.0 M (75 FT)	No.	a	136.0	20
Concrete Poles				
7.5 M or 8.0 M (25 FT)	No.	a	13.8	30
9.0 M (30 FT)	No.	a	16.8	30
9.5 M (32 FT)	No.	a	20.5	30
10.5 M or 11M (35 FT)	No.	a	24.2	30
12.0 M (40 FT)	No.	a	27.3	30
13.5 M (45 FT)	No.	a	33.2	30
15.0 M (50 FT)	No.	a	40.3	30
16.5 M (55 FT)	No.	a	42.5	30
18.0 M (60 FT)	No.	a	56.3	30
20.0 M (65 FT)	No.	a	99.5	30
21.5 M (70 FT)	No.	a	145.8	30
23.0 M (75 FT)	No.	a	167.9	30
24.5 M (80 FT)	No.	a	214.4	30
27.5M, (90 FT)	No.	a	248.9	30
Steel Poles				
7.5 M or 8.0 M (25 FT)	No.	a	15.0	40
9.0 M or 9.5 M (30 FT)	No.	a	20.3	40
10.5 M or 11M (35 FT)	No.	a	27.4	40
12.0 M (40 FT)	No.	a	37.6	40
13.5 M (45 FT)	No.	a	45.3	40
13.5 M or 15.0 M (50 FT)	No.	a	58.0	40
16.5 M (55 FT)	No.	a	105.2	40
18.0 M (60 FT)	No.	a	148.6	40
20.0 M (65 FT)	No.	a	169.4	40
21.0 M (70 FT)	No.	a	202.2	40

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THANK YOU
FOR YOUR ATTENTION!

Ardian Berisha
ardian.Berisha@erranet.org