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# RATE OF RETURN REGULATION AND KEY ISSUES IN APPLYING INCENTIVE PRICE REGULATION

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**NARUC/ERRA Workshop on Public Utility Regulation  
In Market Economies**

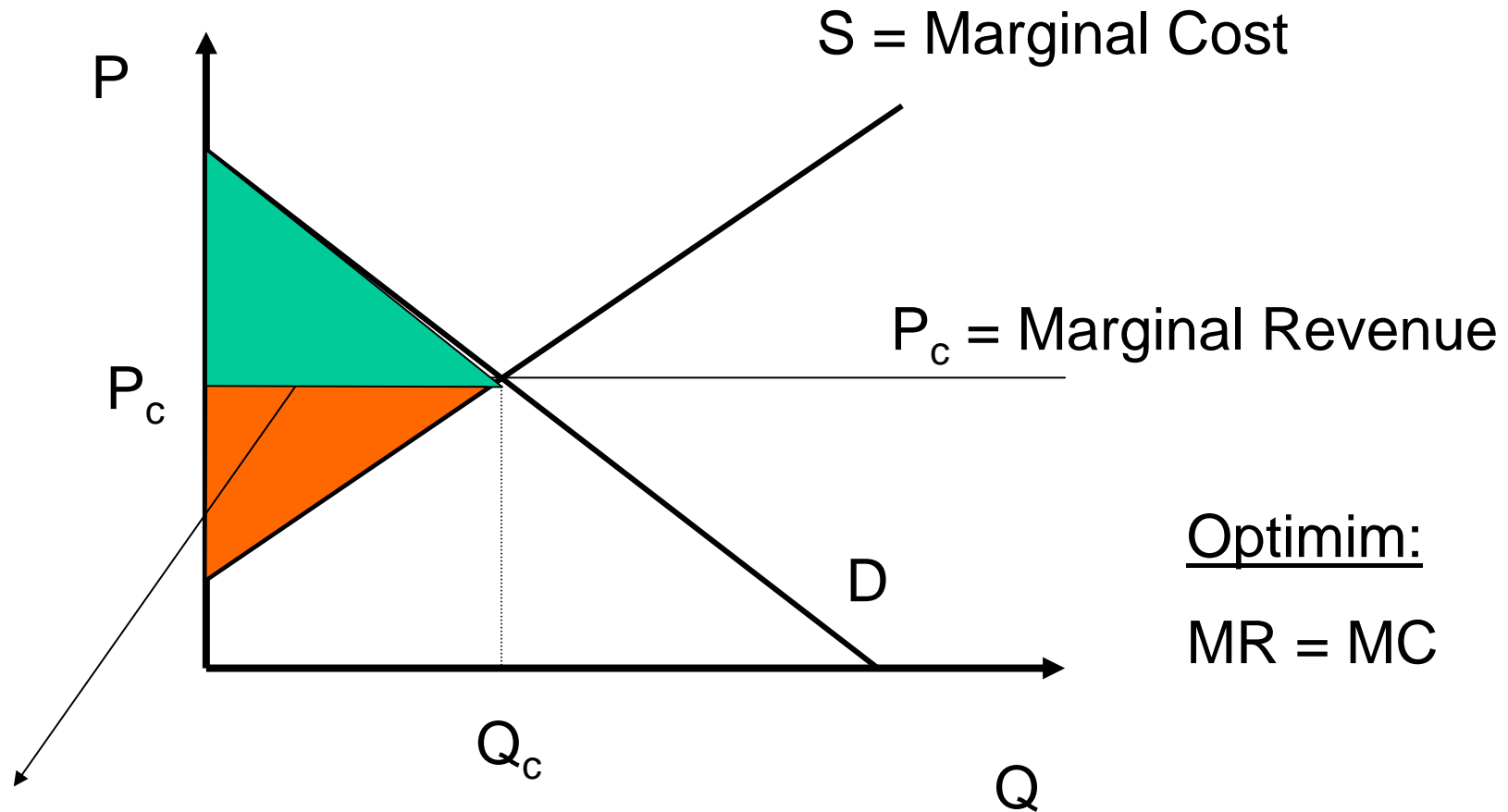
April 14-16, 2008

Pristina, Kosovo



- Price regulation „classic”
- Rate of return regulation
- Incentive price regulatory schemes
- Appendix

# STARTING POINT: EFFICIENT MARKETS



Optimum:

$$MR = MC$$

Social welfare = consumer surplus + producer surplus

# BEST PRICE REGULATOR IN AN EFFICIENT MARKET ECONOMY

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## EFFICIENT MARKET

- Number of players is large
- Easy entry to and exit from the market (*contestable market*)
- Fully informed market participants
- Most of the players are private (seeking for maximum profits)

## DISTORTION

- One or few players (monopoly, oligopoly)
- Legal entry / exit barriers
- Imperfectly informed players
- Players do not have to pay for the full social cost of their activities (subsidies, externalities)
- Most of the players are publicly owned (seeking for maximising growth and influence)

# DISTORTED PRICES – REGULATORY TASKS

## PRICE DISTORTIONS

- Above-efficient market prices
  - Monopoly pricing
  - Few players exercising their market power
- Below-efficient market prices
  - Subsidised industries
- Non-internalised external costs (free pollution)

## GETTING THE PRICES RIGHT (MIMIC THE MARKET)

- Monopoly price regulation
- Market price caps (?)
- (Merger control and antitrust)
  
- Removing direct and indirect price subsidies
  
- Renewables pricing
- (Creation of emission rights / green certificates markets)
- (Environmental taxation)

The regulator should set *regulated rates* or tariffs for the regulated companies so that the regulated rates allow the companies to earn a revenue that covers the “*justified costs*” of their operation, that is the costs that are *necessary* and *unavoidable* to provide the regulated service at a *predefined level of quality*

## Objective:

Annual Revenue Requirement (ARR) = Total Cost

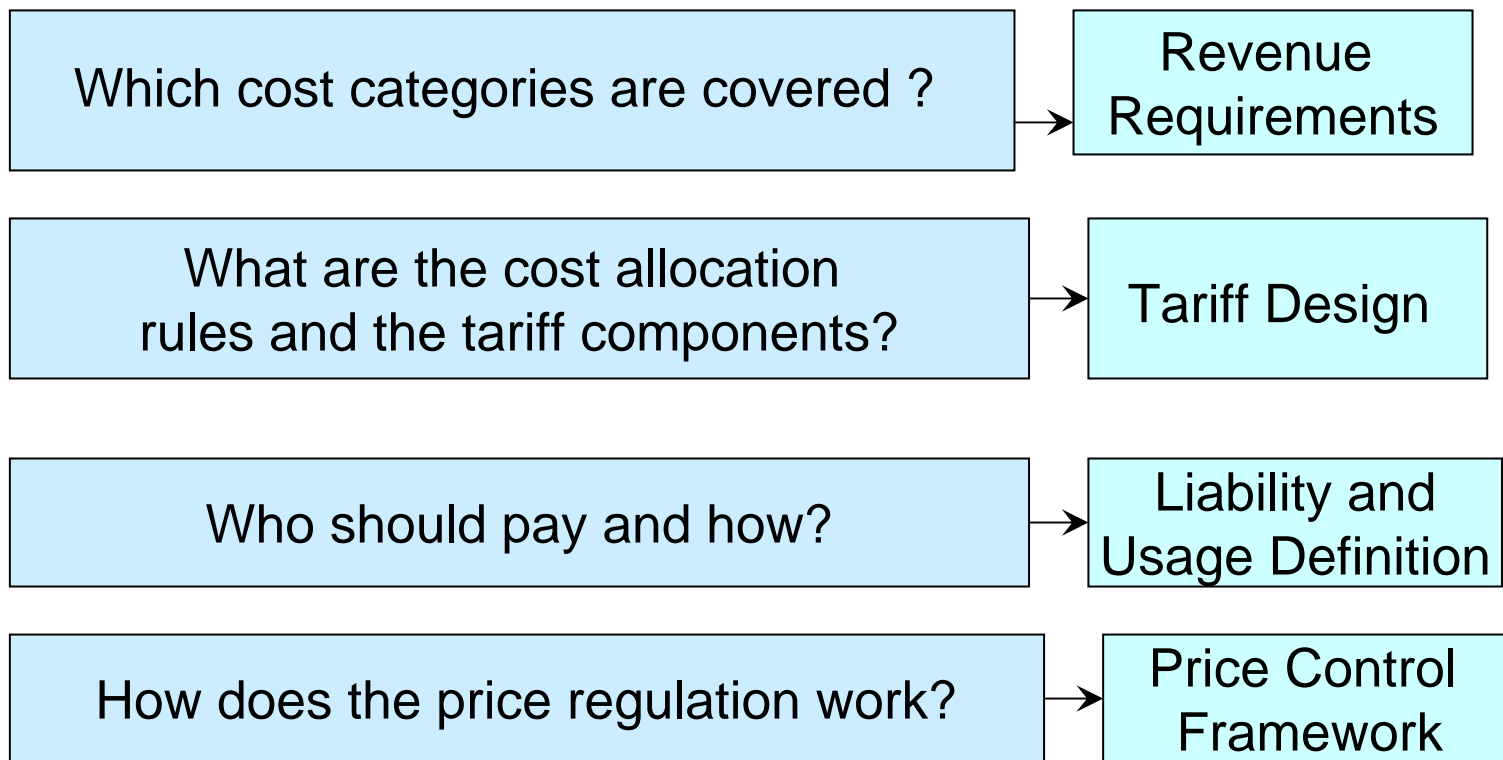
Price\*electricity sold = FC + VC (justified)

Price = (FC + VC) / electricity sold  
(\$/kWh)

Primary task is to understand costs

# MAJOR STEPS IN PRICE REGULATION „CLASSIC”

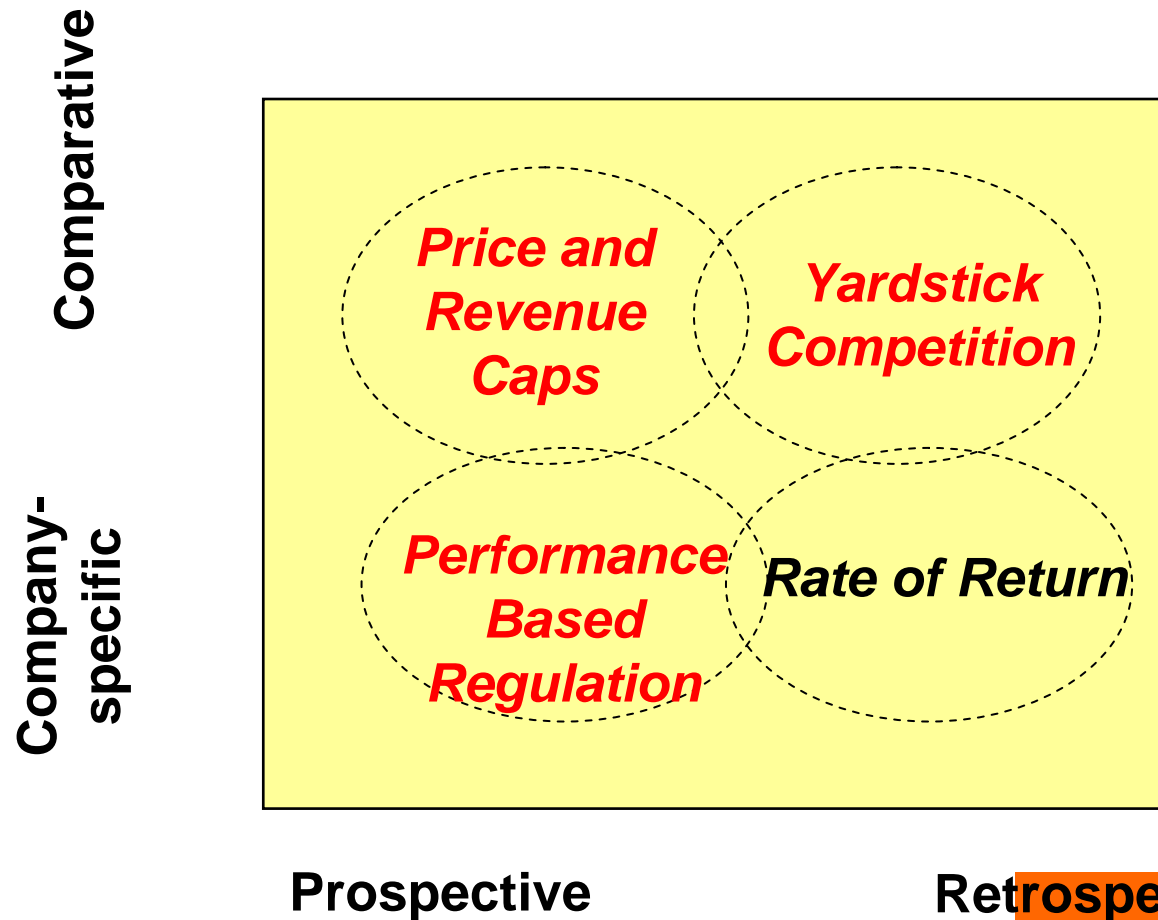
Pricing and price control process includes 4 major questions: (1) establishment of revenue requirements; (2) tariff design; (3) definition of payment liability and (4) design of price control framework



- Multiple products / consumer groups with different costs to serve them
- Problems with one part uniform tariffs (MC or AC pricing)
- Two part tariffs related to fixed and variable cost elements ( $A*\$/MW + b*\$/MWh$ )
- Frequently used policy is *Fully Distributed Cost* (or: *FDC*) pricing: variable element and an arbitrary distribution of fixed costs across consumer groups

# PRICE REGULATION REGIMES

- **COST PLUS SCHEMES – ALLOCATIVE EFFICIENCY**
- **INCENTIVE SCHEMES – PRODUCTIVE EFFICIENCY**



- Price regulation „classic”
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# RATE OF RETURN FORMULA

$$P_t = (RB \cdot WACC + Opex + d + T) / Q_t$$

- **RB- rate base.** The amount of **capital or assets** the utility dedicates for providing its regulated service
- **WACC- allowed rate of return.** The **cost** the utility incurs **to finance** its rate base. Include both debt and equity.
- **Opex- operating expenses.** **Costs such as supplies, labor, other items** for resale consumed in a short period of time (less than 1 year)
- **d- annual depreciation expense**
- **T- taxes**

# DETERMINANTS OF REGULATED TARIFFS - 1

<i>Determinant</i>	<i>Options</i>	<i>Comments</i>
<b>Asset Valuation</b>	Historic Cost Replacement Cost Recoverable Cost	Approaches based on Replacement and Recoverable Cost support efficient network investments
<b>Return on Assets</b>	Administrative Approach Capital Asset Pricing Model (CAPM)	CAPM supports the establishment of a market-based rate of return
<b>Operation and Maintenance Cost</b>	Actual Cost Benchmarking	Benchmarking supports productive efficiency improvement
<b>Depreciation</b>	Standard approach (straight line) Economic Depreciation	'Competition depreciation' reflects the assets' market value but is difficult to implement
<b>Investment</b>	Actual Values Projected Values Partial Backward Looking	Generally, claw-back strategies are against the logic of incentive regulation

# DETERMINANTS OF REGULATED TARIFFS - 2

<i>Determinant</i>	<i>Options</i>	<i>Comments</i>
Inflation Indicator	<ul style="list-style-type: none"> <li>• General Inflation Index (CPI or RPI)</li> <li>• Individual industry- or company-specific indexes</li> </ul>	CPI or RPI is easy to determine and does not directly correlate with actual cost
X Factor	<ul style="list-style-type: none"> <li>• Same X Factor for all networks</li> <li>• <b>Benchmarking</b> and different X factors</li> </ul>	Different X factors impose different requirements for efficiency increases to network service providers and consider any efficiency differences at the outset
Regulatory Lag	<ul style="list-style-type: none"> <li>• <b>Annual review</b></li> <li>• Longer lag (3-5 years)</li> </ul>	Longer regulatory lag supports efficiency improvement incentives
Network Losses	<ul style="list-style-type: none"> <li>• Actual losses</li> <li>• Incentive schemes</li> </ul>	Incentive schemes are better but their design could be open to question
Benefit Sharing	<p>No Sharing</p> <p>Sharing within regulatory period/Sliding Scale or Correction Factor</p> <p>Sharing at the end of the regulatory period</p>	Benefit sharing transfers cost reductions to customers but might reduce efficiency incentives if fully anticipated by regulated firms

# WHERE IS THE DATA?

## COMPLICATIONS

- Public financial reports (balance, income statement) are not sufficiently detailed
  - Cost analysis
  - Information on investment (change of fixed assets)
- Accounting unbundling requirements
- Need to understand company accounting policies and rules
  - Depreciation, common costs
  - Accounting for affiliate and non-regulated transactions
- Use of Adopted Regulatory Chart of Accounts

# THE FALLACIES OF COST-PLUS REGULATION

- Motivation for over-investment (increased rate base) – ‘golden plating’
- No motivation to increase productive efficiency
- Continuous pressure for price increase (rare example of price decreases)
- No real pressure for selection
- Major source of fallacy: information asymmetry at the regulator’s side:
  - no up-to-date operating cost information,
  - no data on future business plans (investments, cost-reduction etc.),
  - obscure picture on consumer demand characteristics.

## EXAMPLE – COST-PLUS CONTRACT

- I. Poor, badly-paid (civil servant) regulator goes abroad...
- B) and gets a fixed, reduced per diem (daily salary); all direct costs are refunded ex post.

Result?

our regulator takes taxi  
eats in a restaurant  
stays at an expensive hotel, so  
he retains less money, but taxpayers pay more for this  
journey.

## EXAMPLE – FIXED PRICE CONTRACT

- I. Poor, badly-paid (civil servant) regulator goes abroad...
- A) and gets a fixed per diem, all costs inclusive; no ex-post accounting is required (savings can be retained by him/her) .

Result?

our regulator uses public transport  
eats sandwiches  
stays at an inexpensive hotel and  
keeps the rest of the daily allowance.

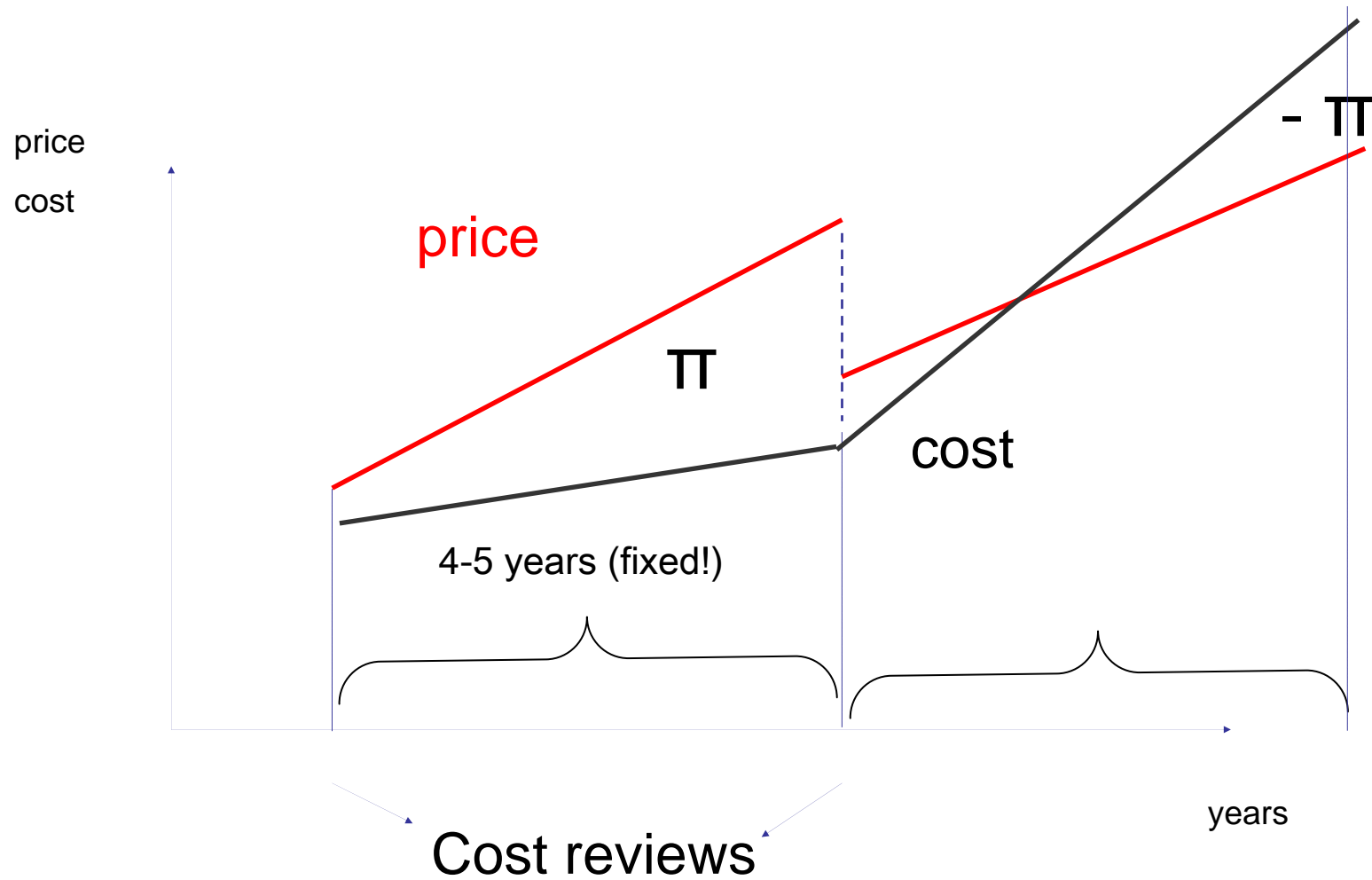
1. Fixed price contracts provide sufficient incentives to reduce operating costs and increase productive efficiency
  - high-powered incentive scheme
2. Fixed price contracts might result in „too high” profits and distributive concerns may arise
  - might hurt allocative efficiency and fair welfare distribution
3. Cost-plus contract provides no incentive to improve productive efficiency
  - low-powered incentive scheme
4. The profit provided by the cost plus contract will not be „too high”
  - does not hurt allocative efficiency

- Price regulation „classic”
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# INCENTIVE PRICE REGULATION: FEATURE 1

*Rewarding (penalizing) regulated firms for better-than-expected (worse-than-expected) (economic) performance.*

# THE SCHEME OF PRICE CAP REGULATION



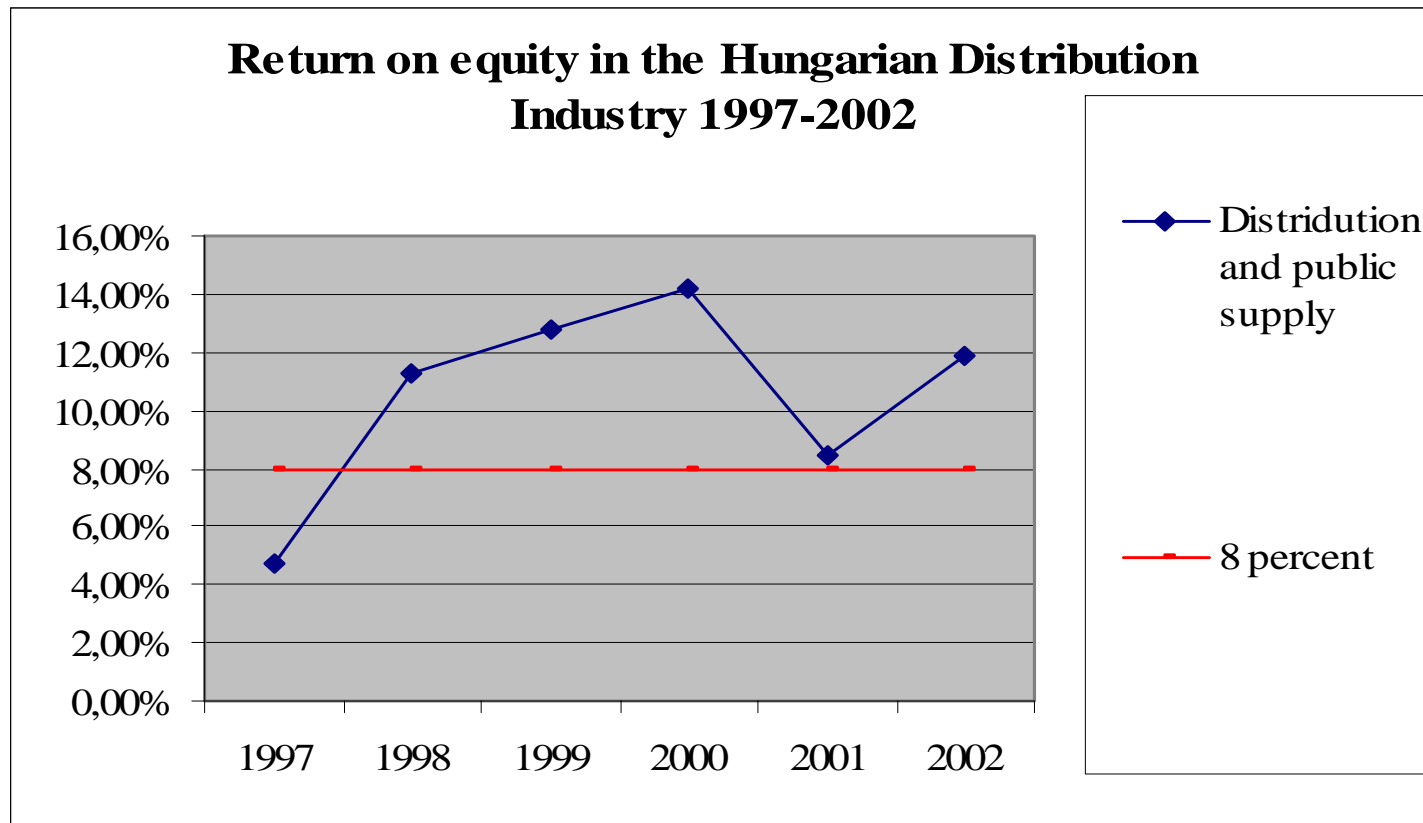
# PRICE CAP REGULATION: SINGLE PRODUCT

- Pre-defined regulatory period (4-5 years) and pricing rule:

$$p_t = p_{t-1} * (1 + \text{CPI} - X)$$

- CPI: consumer price index (other price index is possible)
  - X: efficiency improvement requirement
- 
- Transparency
  - Credibility is needed
  - Sharing of benefits from efficiency improvement among industry and consumers
  - Trade-off between incentive property and flexibility
    - E.g. what to do in times of sharply decreasing oil prices?

# PRICE CAP: REGULATED *versus* ACTUAL RATE OF RETURN



Problem: to explain when actual return is >> proposed regulated return

# IMPROVED PROFIT SHARING (SLIDING SCALE REGULATION )

- A system that shares the difference between proposed and actual return among producers and consumers:

$$s_a = s_t + h(s^* - s_t)$$

- $s_a$  : rate of return built into the regulated price
- $s^*$  : proposed (regulated) rate of return
- $s_t$  : actual rate of return produced by the company before rate adjustment by the regulator
- The value of  $h$  falls between 0 and 1
- *Consider the case when  $h = 0$*
- *Consider the case when  $h = 1$*

# PRICE CAP REGULATION: MULTIPRODUCT CASE

- Multi-product monopoly, but exact cost structure is unknown to the regulator
- Demand information available to the regulator may also be limited
- Under these conditions, it seems reasonable to delegate *some* pricing decisions to the firm itself
- However, pricing behaviour still needs to be controlled to restrict market power abuse
- These controls typically come in the form of constraints on weighted average price levels

# PRICE CAP REGULATION: MULTIPRODUCT CASE

- N regulated product markets
- Prices:  $P_n$  [ $n = 1, \dots, N$ ]
- Weights in the scheme:  $w_n$  (one for each product)
- The cap is a value:  $P^*$
- Price cap constraint:

$$w_1 \times P_1 + w_2 \times P_2 + \dots + w_N \times P_N \leq P^*$$

- What effect does the choice of weights have on the „goodness” of the cap scheme?

# PRICE CAPS: EXAMPLE WITH FIXED WEIGHTS

- Suppose it is known „historically” by the regulator, that prices  $P_1^*$ , ...,  $P_N^*$  yield demand levels  $Q_1^*$ , ...,  $Q_N^*$  and acceptably low profits for the monopoly
- Let us weight the prices in the cap scheme by the (historically known) demand quantities:  $w_n = Q_n^*$
- Let us set the cap equal to the historic revenue ( $R^*$ ) of the firm:
  - $P^* = P_1^* \times Q_1^* + \dots + P_N^* \times Q_N^* \equiv R^*$
- Thus, the monopolist can choose any prices it likes as long as the following holds:

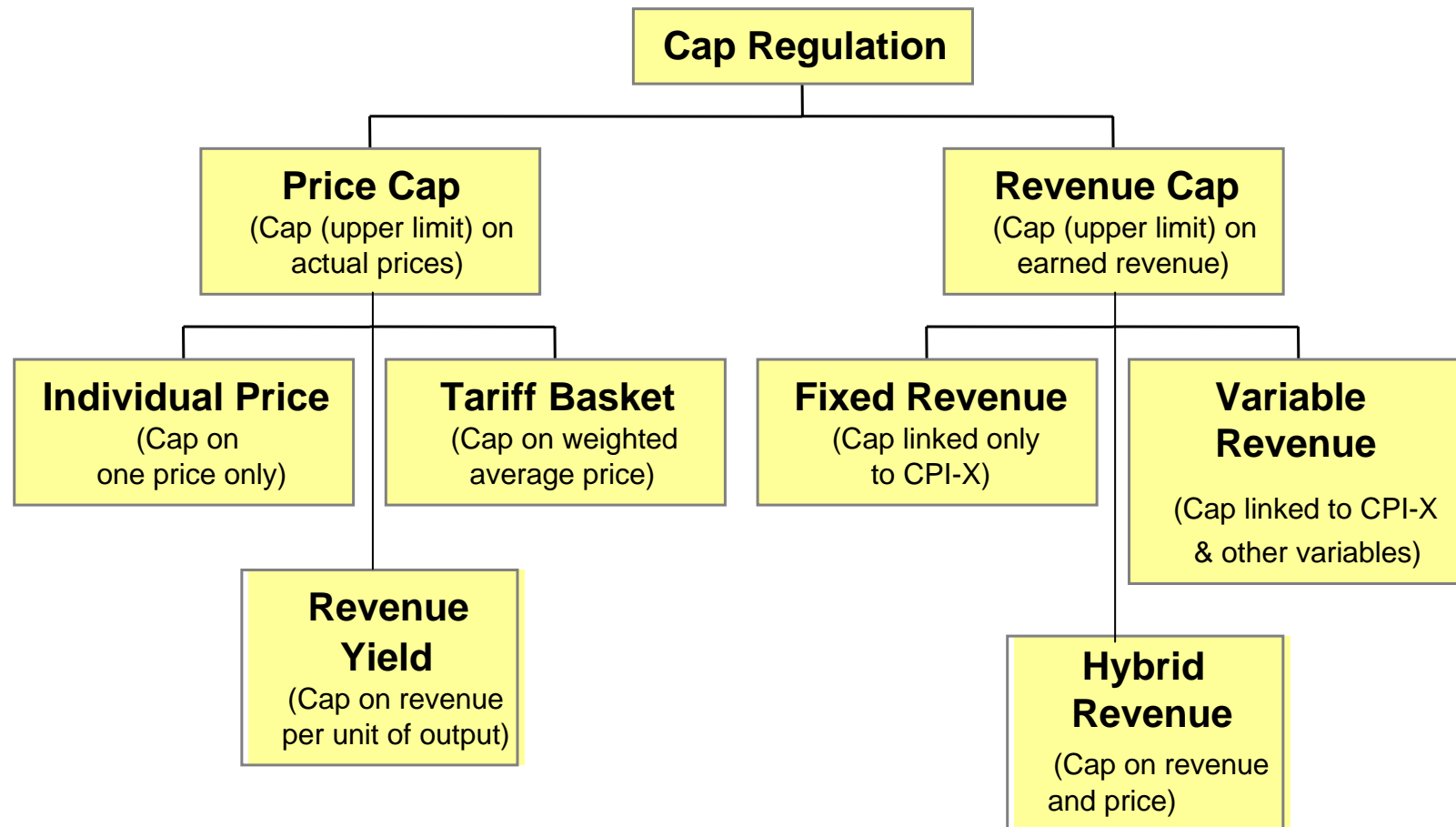
$$P_1 \times Q_1^* + \dots + P_N \times Q_N^* \leq R^*$$

- Consequences:
  - under the new set of prices, consumers (on aggregate) will still be able to maintain their old consumption level by spending an equal amount of (or less) money as before
  - as a result, they will be at least as well-off, and most likely better-off than historically
  - the firm can also increase its profits without harming the customers (on aggregate)
  - the regulator needs little information about either demand or cost conditions
- On the other hand:
  - some consumer classes may lose from the price cap scheme, while others will benefit from it

# INCENTIVE PRICE REGULATION: FEATURE 2

*Giving regulated firms partial freedom in setting tariffs*

# CAP-BASED REGULATION: AN OVERVIEW



## Pros

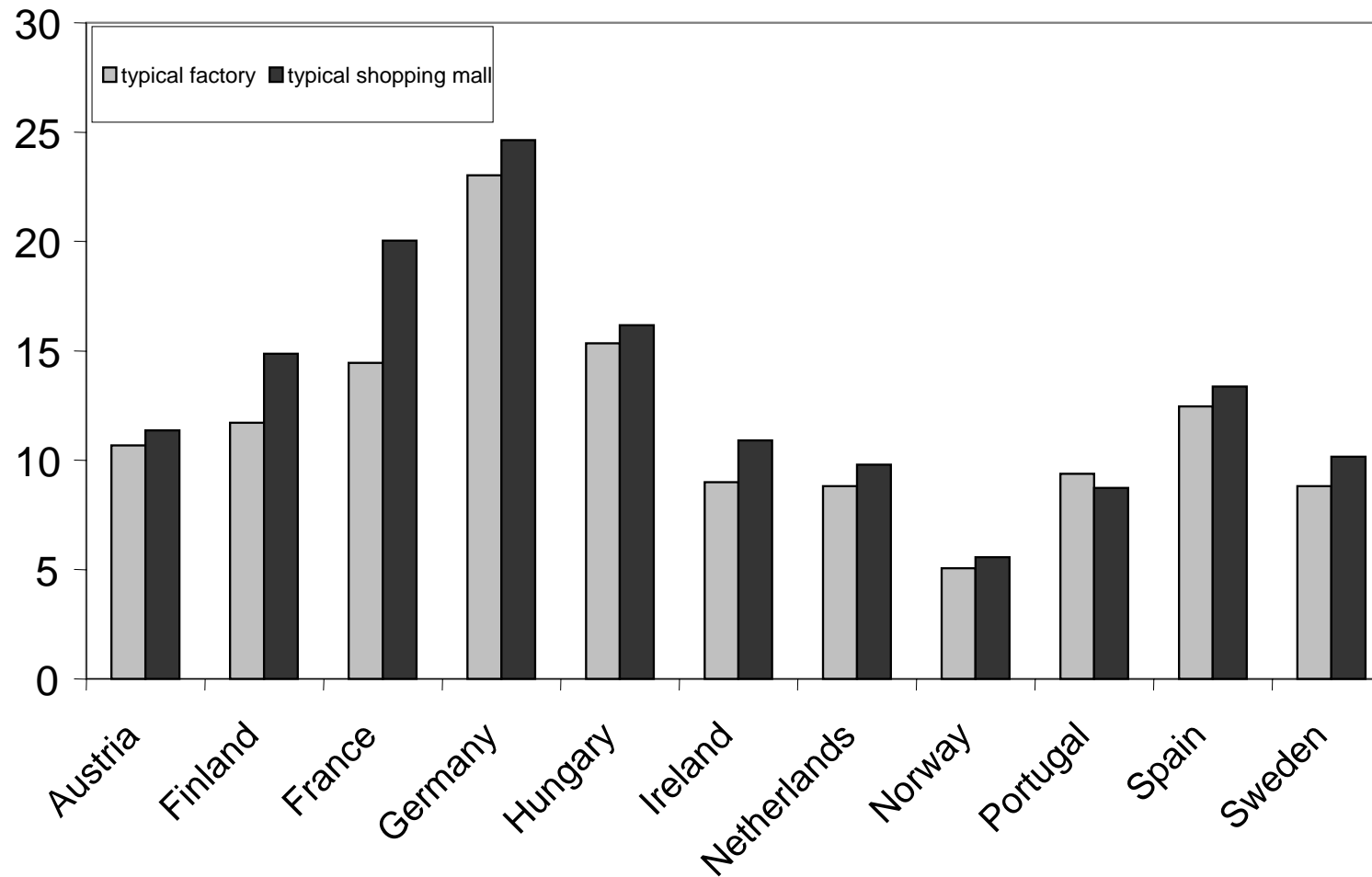
- Simple, clear incentives
- Balance between company and consumer interests under incomplete information
- Moderate resource and info needs for the regulator
- Extremely useful when company auditing systems are not well developed

## Cons

- Starting price – cost review
- How to define X?
- Choice of inflation index
- Provides for inflation inertia in times of high inflation
- Political problems when real return deviates from regulated return
- Unfair profit sharing within the regulatory period
- Incentive for degrading service quality:  $CPI-X+Q$

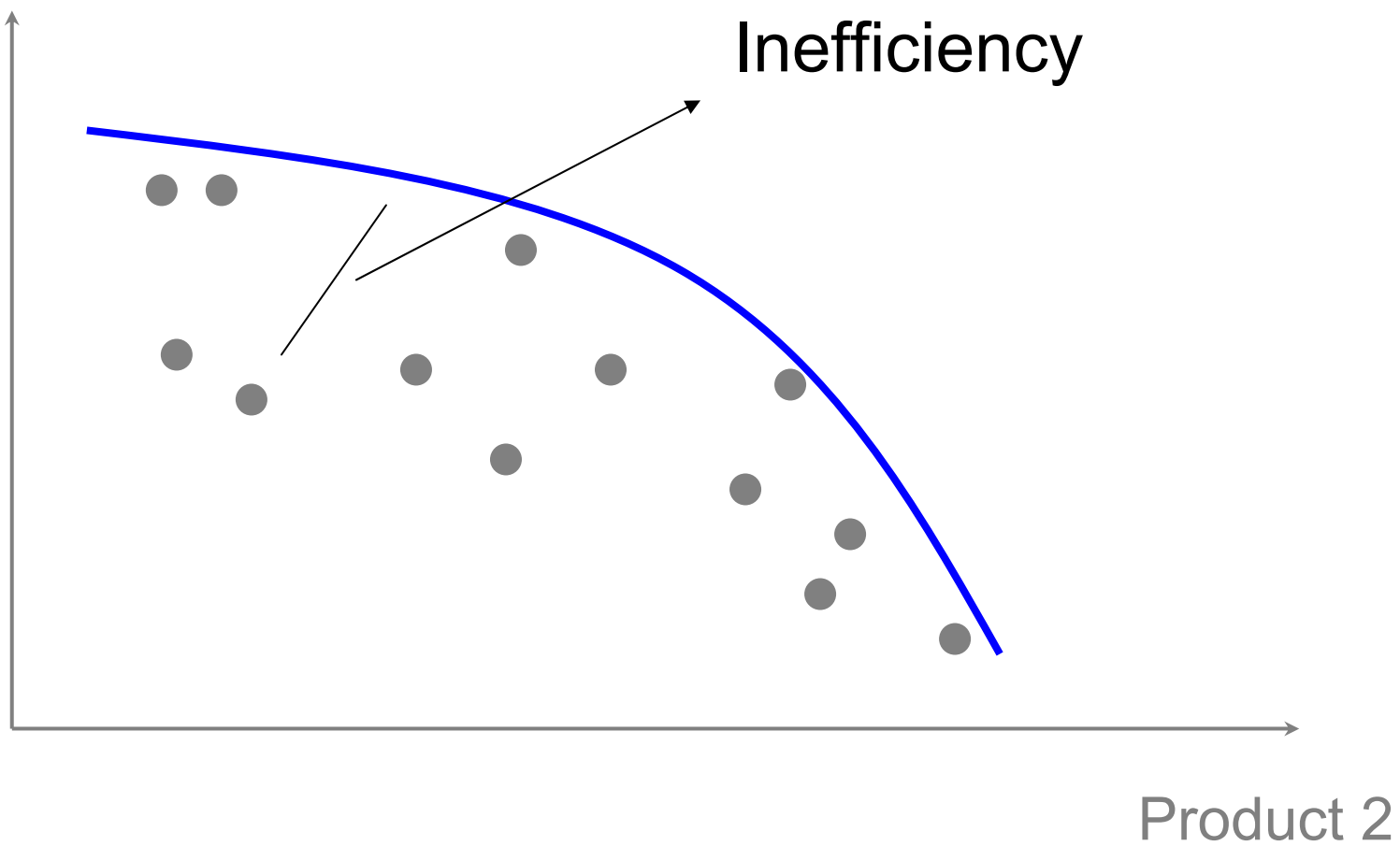
- Historic costs *versus* benchmarking
- Simple, single variable benchmarks (labour cost per kWh output, revenue / km line, etc.)
- Strong regulatory tool when a company wishes to hide performance results
- Has to be employed by much care – only for simple comparisons
- Legal background is to be taken into account – Dte example

# MEDIUM VOLTAGE DISTRIBUTION TARIFFS, EURO/MWH



# STOCHASTIC FRONTIER ANALYSIS

Product 1



Product 2

- Productive and allocative efficiency
- Fixed-price (high powered) and cost-plus (low powered) contracts
- Price cap regulation
- Revenue cap regulation
- Sliding scale regulation
- Simple benchmarking
- Yardstick competition

- Price regulation „classic”
- Rate of return regulation
- Incentive price regulatory schemes
- Appendix: generation price regulation in FYRM

# EXAMPLE 1 – REGULATED MAXIMUM REVENUE

$$MAR_t = PUB_t * [FIX_{t-1} * (1 + CPI_t) * (1 - X) + RA_t] + VAR_t + FUEL_t$$

where:

- $MAR_t$**  - regulated maximum revenue in the year  $t$  of the regulated period;
- $PUB_t$**  - the proportion of the total planned generating capacity designed for tariff consumers and total installed generating capacity;
- $FIX_{t-1}$**  - revenue to cover fixed costs in the year  $t-1$ ;
- $CPI_t$**  - consumer price index;
- $X$**  - efficiency factor;
- $RA_t$**  - return on regulated assets in the year  $t$ ;
- $VAR_t$**  - revenue to cover variable costs in the year  $t$ ;
- $FUEL_t$**  - revenue to cover fuel costs in the year  $t$ ;  
(for hydro plants  $FUEL_t = 0$ ).

## EXAMPLE 2 – NORMALISED FIXED COSTS

### 1.7. *Normalised costs*

The operating and maintenance costs, according to this methodology, are costs for the operation and maintenance of the regulated activity of the company, in accordance to the technical standards that are applied in the Republic of Macedonia, and represent normalised costs necessary to conduct the regulated activity.

The level of normalised costs is formed according to the following benchmarks:

- 1 cost for materials, energy, spare parts and inventory, based on the norms of purchase and the average prices on the market in the period of the procurement;
- 2 cost for current maintenance, repair and maintenance services up to 25% of the annual depreciation rate level;
- 3 gross salaries per employee up to the average gross salaries per employee in the economy in the Republic of Macedonia in the current year, increased up to 30%, representing qualification structure and complexity of the regulated activity;
- 4 management salaries and management bonuses, in normalised amounts, according to the increase of efficiency and the decisions of the governing bodies of the company;
- 5 other services, up to the level of a three years average participation in the costs for materials, energy, spare parts and inventory (item no.1);
- 6 other and extraordinary (excessive) costs, up to 10% of the costs in items 1; 2; 3 and 5.
- 7 The depreciation of the regulated assets is calculated according to minimum rates regulated by law
- 8 Taxes, contributions and other fees are allowed according to the law.

# RETURN ON REGULATED ASSETS (FIXED COST) - RAB

$$RA = RAB * WACC$$

where:

- RA** - return on regulated assets;
- RAB** - average value of the assets that are used in the regulated activity (regulated assets) ;
- WACC** - weighted average cost of capital.

$$RAB = \frac{RAB_{start} + RAB_{end}}{2}$$

- RAB** - average value of the assets that are used for the regulated activity (regulated assets);
- RAB<sub>start</sub>** - regulated assets value at the beginning of the year;
- RAB<sub>end</sub>** - regulated assets value at the end of the year.

# RETURN ON REGULATED ASSETS (FIXED COST) -RAB

$$RAB_{end} = RAB_{start} + NI - Grant - D - RAB_{out}$$

where:

**$RAB_{end}$**  - regulated assets value at the end of the year;

**$RAB_{start}$**  - regulated assets value at the beginning of the year;

**$NI$**  - new investments;

**$Grant$**  - grants;

# RETURN ON REGULATED ASSETS (FIXED COST) - WACC

$$WACC = \frac{E * K_e}{E + Debt} + \frac{Debt * K_d * (1 - T_p)}{E + Debt}$$

where:

**WACC** - weighted average cost of capital;

**E** - equity;

**K<sub>e</sub>** - cost of equity;

**Debt** - debt;

**K<sub>d</sub>** - cost of debt;

**T<sub>p</sub>** - profit tax.

# ACCOUNTING FOR FUEL COSTS

$$FUEL_t = [ 0.9 * ACT_t + 0.1 * ACT_{t-1} * ( 1 + GAS_t ) * ( 1 - X_f ) ] * G_t$$

where:

<b><math>FUEL_t</math></b>	- revenue to cover fuel costs in the year $t$ ;	[MKD]
<b><math>ACT_t</math></b>	- planned average fuel costs by generated energy unit in the year $t$ ;	[MKD]]
<b><math>ACT_{t-1}</math></b>	- realised average fuel costs by generated energy unit in the year $t-1$ ;	[MKD]]
<b><math>X_f</math></b>	- efficiency factor of fuel;	[0÷1]
<b><math>G_t</math></b>	- planned electricity generation for tariff consumers in the year $t$ ;	[kWh]
<b><math>COAL_t</math></b>	- lignite price index	
<b><math>OIL_t</math></b>	- oil price index;	
<b><math>GAS_t</math></b>	- gas price index;	