METU

Transmission Business

Transmission Business

Transmission Business

Transmission Activities

Basic Transmission Activities

Transmission business consists of activities;

- operation,
- control,
- maintenance,
- expansion and upgrade

of the transmission system

Kazan (Ankara) 154 kV Transformer Substation

What is Grid ?

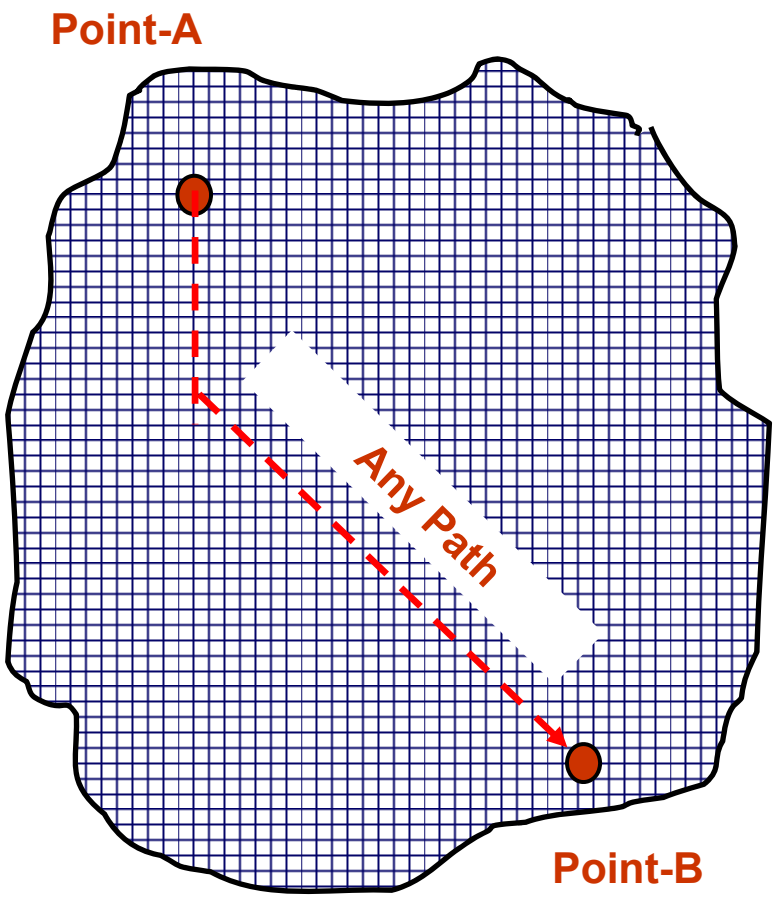
Definition

Grid (*): Network of squares on map, numbered for reference

(*) Oxford Dictionary of English

Grid:

A network structure, that permits to go everywhere, from everywhere through any path in the network



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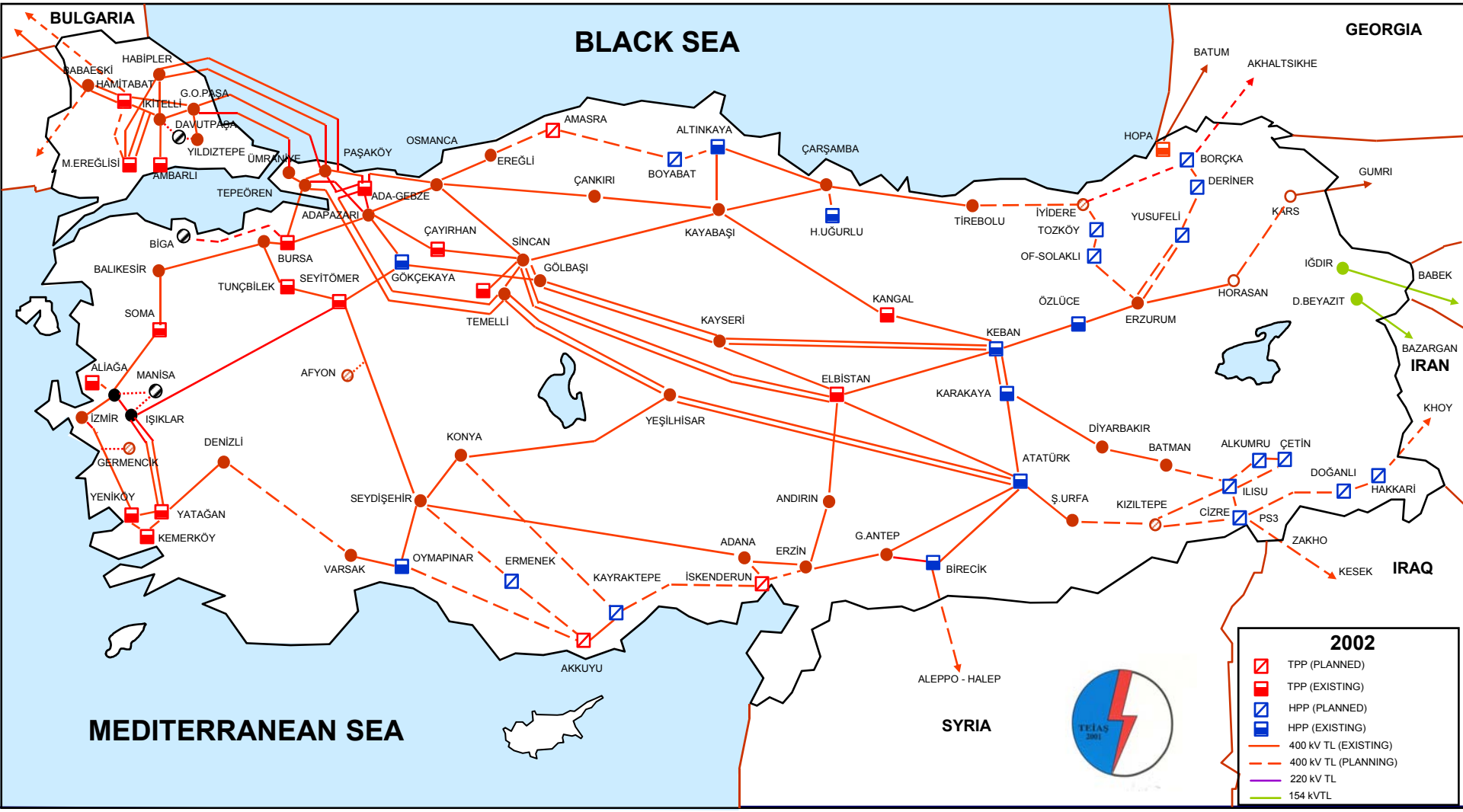
Turkish 400 kV Transmission System



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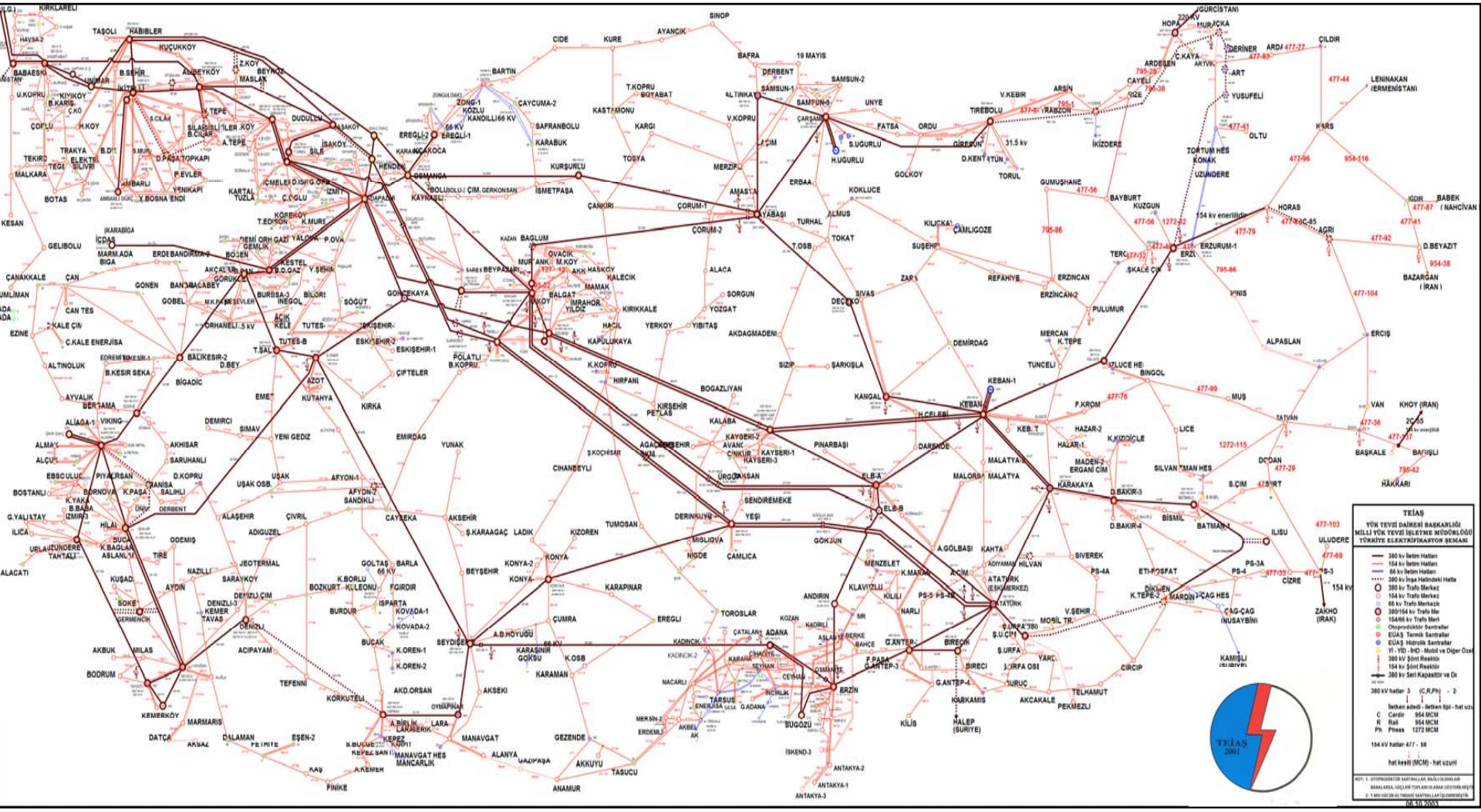
Turkish Transmission System



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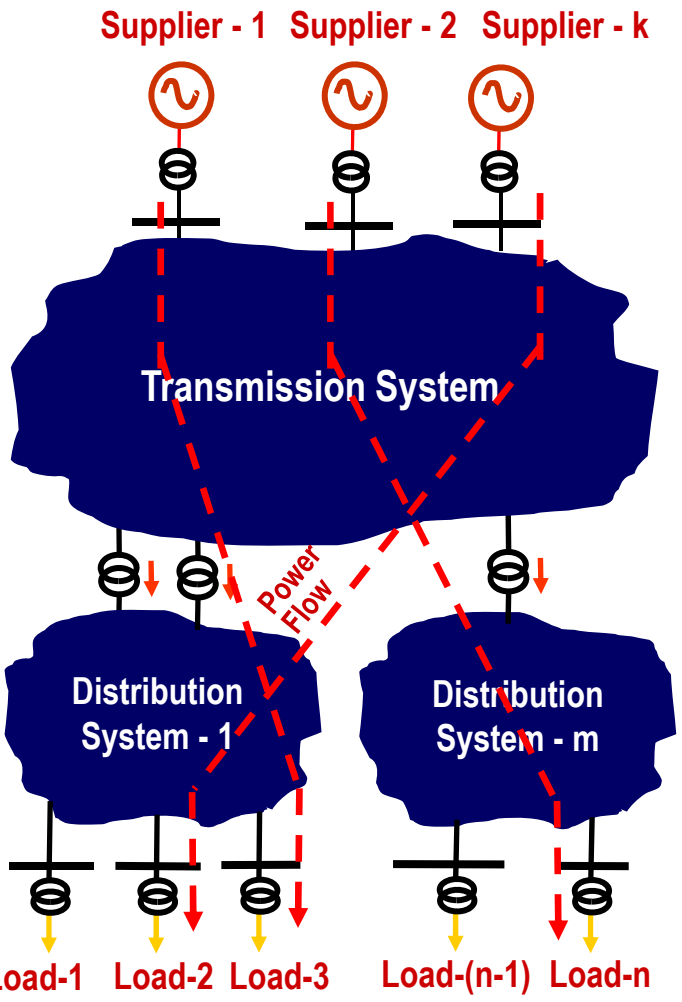
Why is Transmission System Called as Grid ?

Definition

A definiton for this course:
A network structure, that one can go everywhere, from everywhere through any path in the network

Similarly, in a transmission network, it is possible to transfer power everwhere, from everwhere, through any path

This type of power transfer from anywhere to anywhere in the transmission system is called "power wheeling", or simply "wheeling"



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Strength of a Transmission System

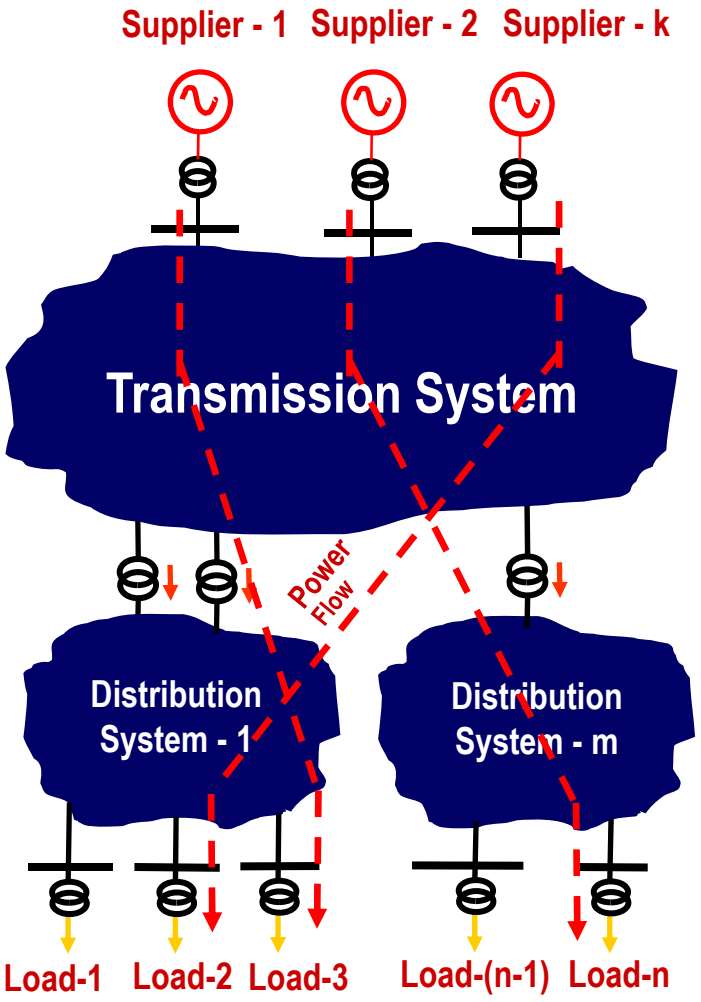
Definition

A transmission is system is called **"strong"** if it is possible to wheel any amount of power from anywhere in the system to anywhere

"A strong transmission system" is the one with a sufficient number of interconnections for wheeling from any point to any point

In a strong system, a customer has the right of choosing any supplier in the system without any technical restriction

Hence, in a market with a strong transmission system full - competition is possible



Strength of Transmission System

Strength of Transmission System

The strength of transmission system affects the competitiveness of the market

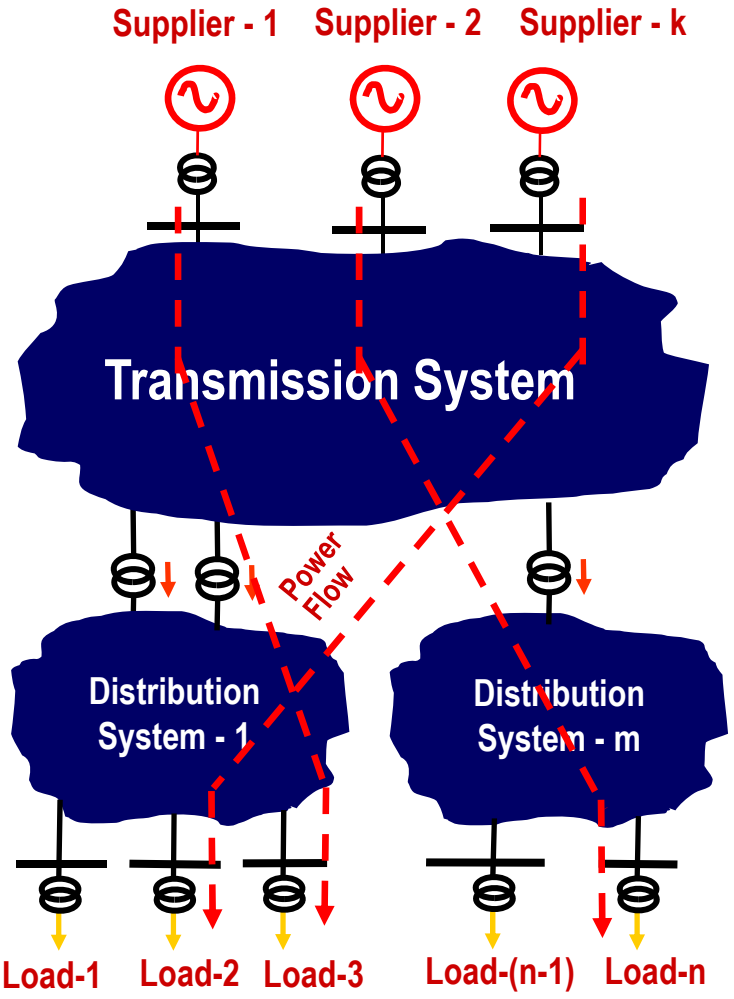
In other words, in order a customer (load) to be able to wheel power from any supplier, the transmission system must have a strong interconnection infrastructure

Congestion

Definition

Congestion is the situation of being unable to wheel power from a particular point to another in the system due to a restriction in the rating of a transmission system equipment

Congestion prevents customers from wheeling power from the suppliers they prefer



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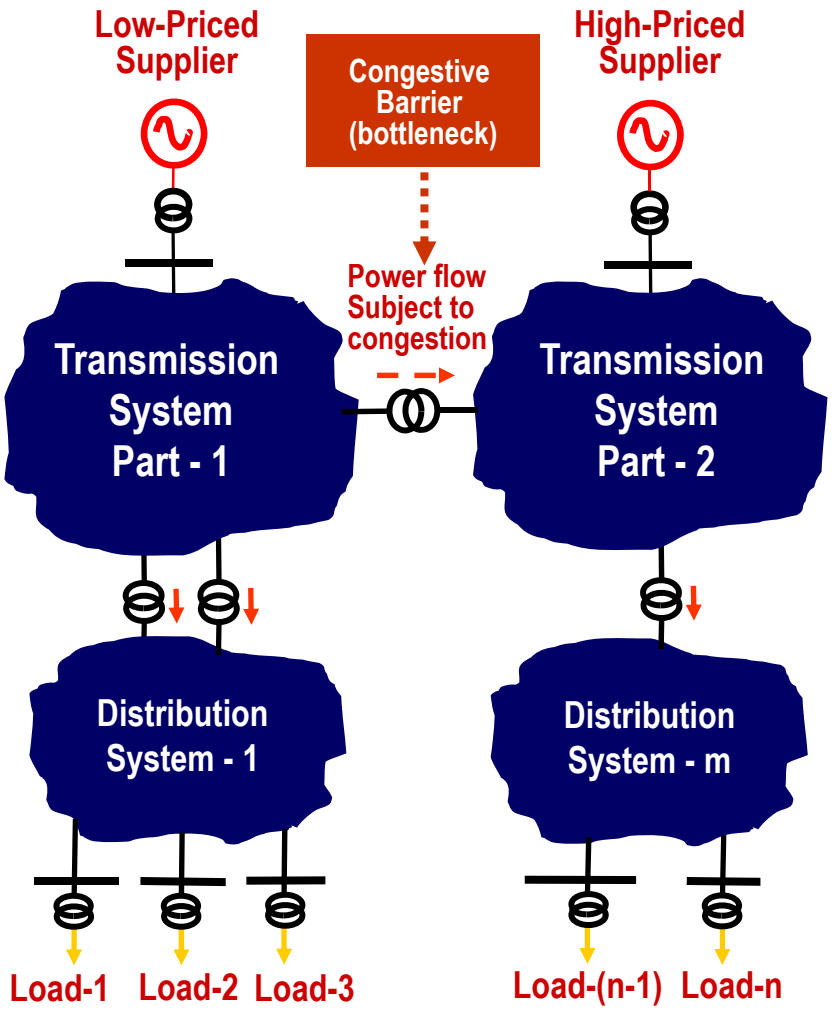
Congestive Barrier

Definition

Electrical commodities always flow from low-priced regions to high-priced regions

"Congestive barrier" or "bottleneck" is the part of system that creates "congestion" i.e. the transmission equipment(s) with restrictions in power transfer capacity

In a system with a congestive barrier, the power transfer (wheeled) is restricted by the limit determined by the rating of these equipment(s)



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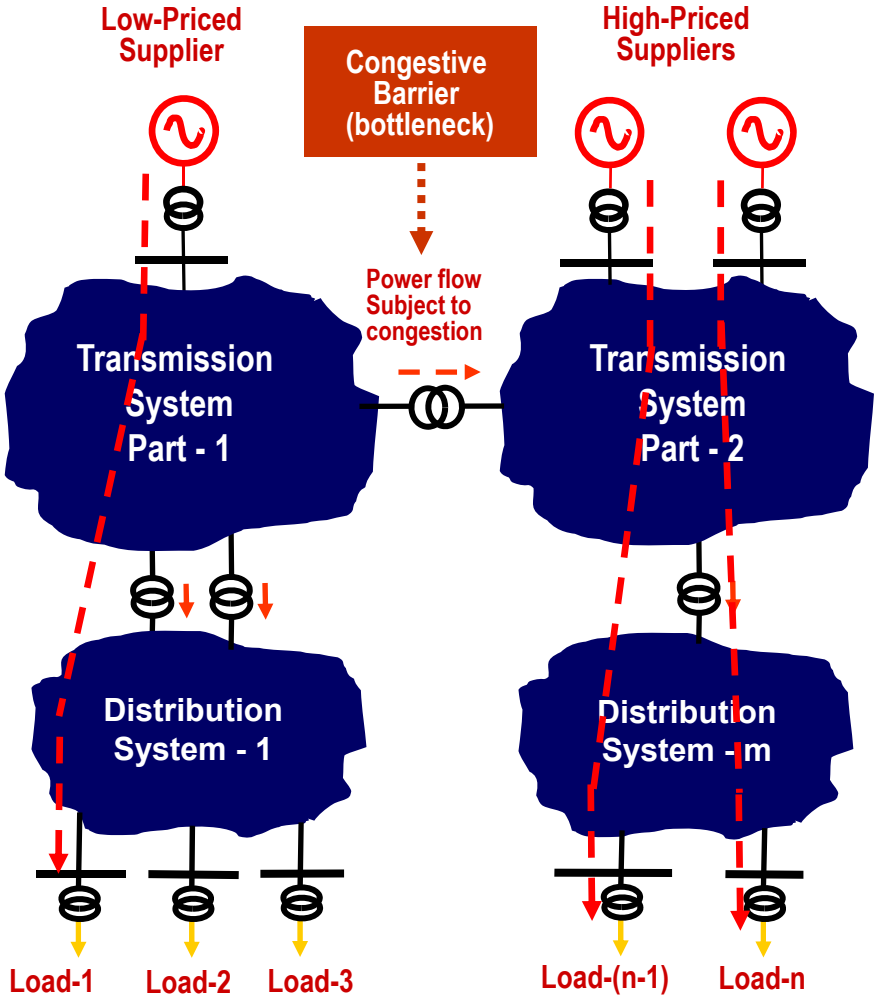
Congestive Barrier

Example

Transmission system in the figure on the RHS has a congestive barrier, preventing power wheeling from LHS of the system to the RHS

In this case, Loads 1, 2 and 3 will be able to purchase power from the cheap supplier, while the others will not.

In regions, where prices tends to drive up rapidly due to congestion, it may be necessary to regulate the wholesale prices



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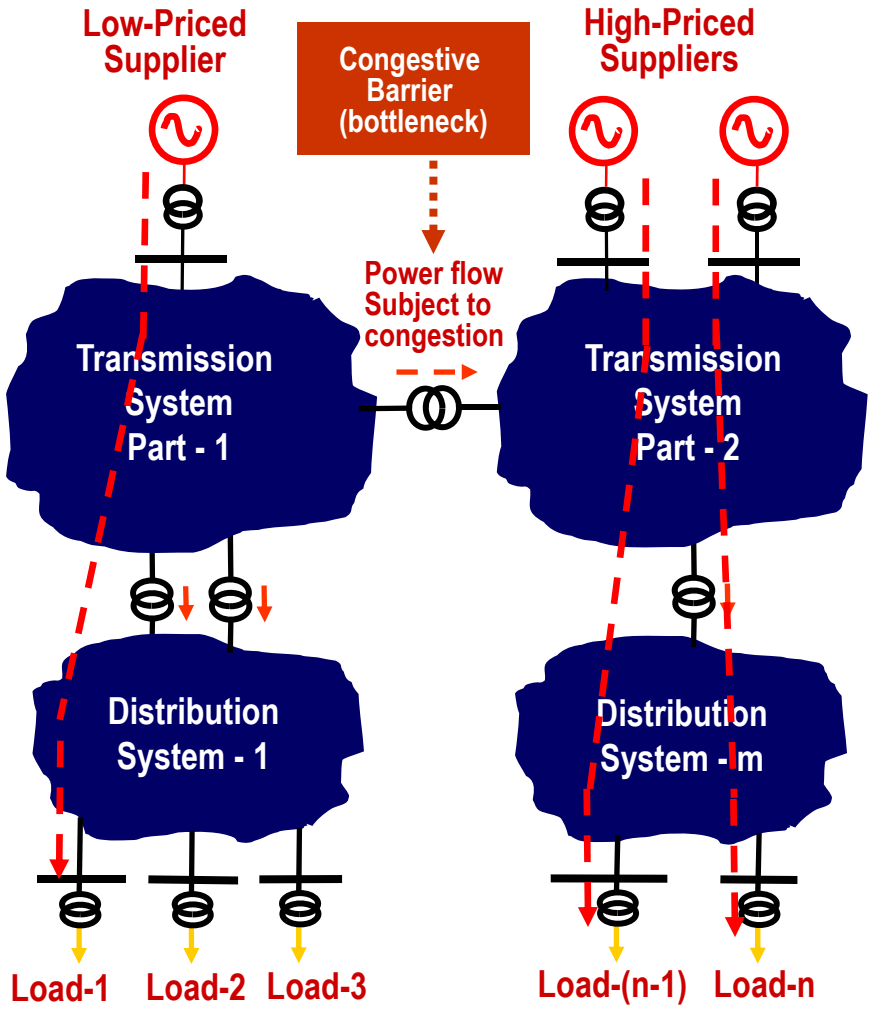
Congestive Barrier

Example

Hence, in a system with a congestive barrier, some customers may be forced to buy power from expensive suppliers, although there are some cheap suppliers in the system

Conclusions:

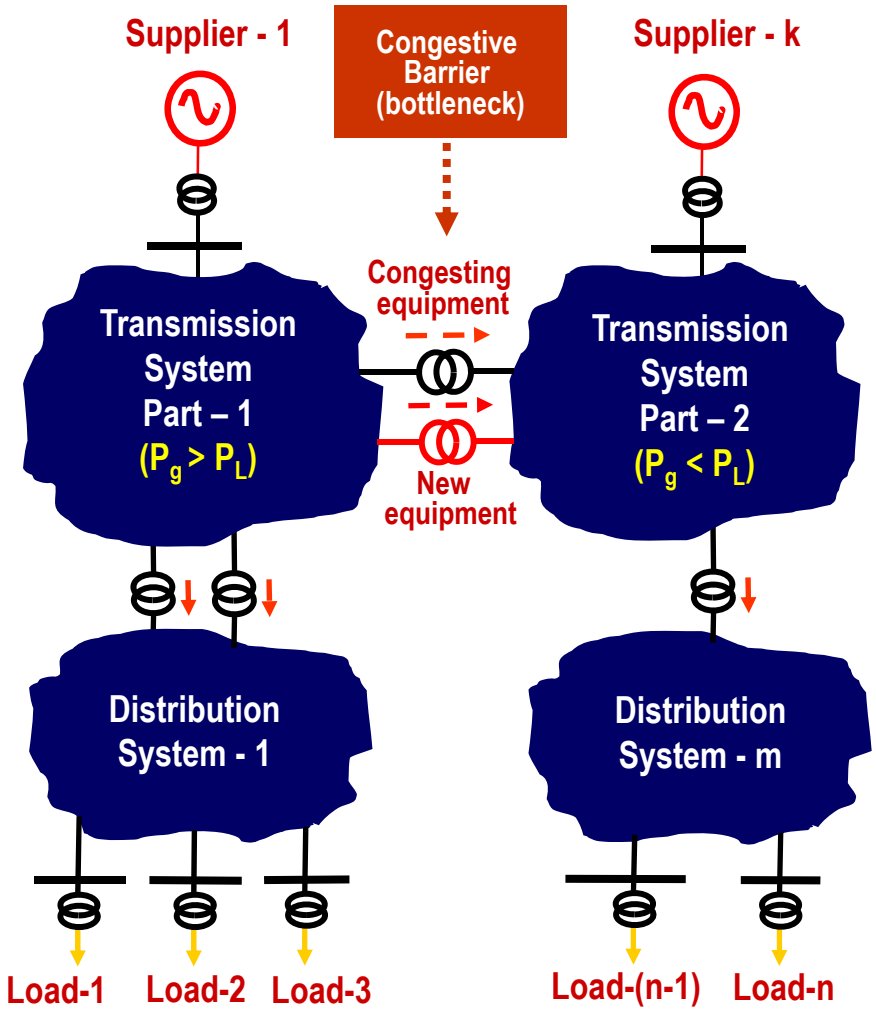
- ***Weak transmission capacity weakens competition, and results in local market power to plants installed in those regions, where generation is insufficient,***
- ***Strong transmission capacity improves competition and reduces market power***



Remedies for Congestion

Remedies for solving congestion may be classified into three main groups;

- Reinforcement of the transmission system infrastructure by making new investments in order to relieve the overloading in the congesting equipments,
- Employment of an incentive and/or penalty program in those regions in the system, where congestion is observed by encouraging and/or discouraging plant investments,
- Employment of both of the above remedies in a weighted combination determined by the regulator



Congestion Management - Solutions

Possible Solutions

- **First Come First Serve**: **If capacity limit is reached, no more requests are accepted.**
  - This approach seems to be against the Article 8(2) of the Directive, that states: ***"… the use of interconnectors shall be determined on the basis of criteria which must be objective, published and applied in a non-discriminatory manner which ensures the proper functioning of the internal market in electricity."***
- **Pro Rata Rationing: All requested transactions are carried out, but each transaction quantity is cut by the same percentage.**
- **Merit Ordering: Based on giving up confidentiality, the cheapest transactions are prioritized.**
  - This approach seems to be against the Article 8(2) of the Directive.
- **Renewable Priority: Transactions from a renewable electricity source are given priority.**

Cross-Bosphorus 380 kV Line

Congestion Management - Solutions

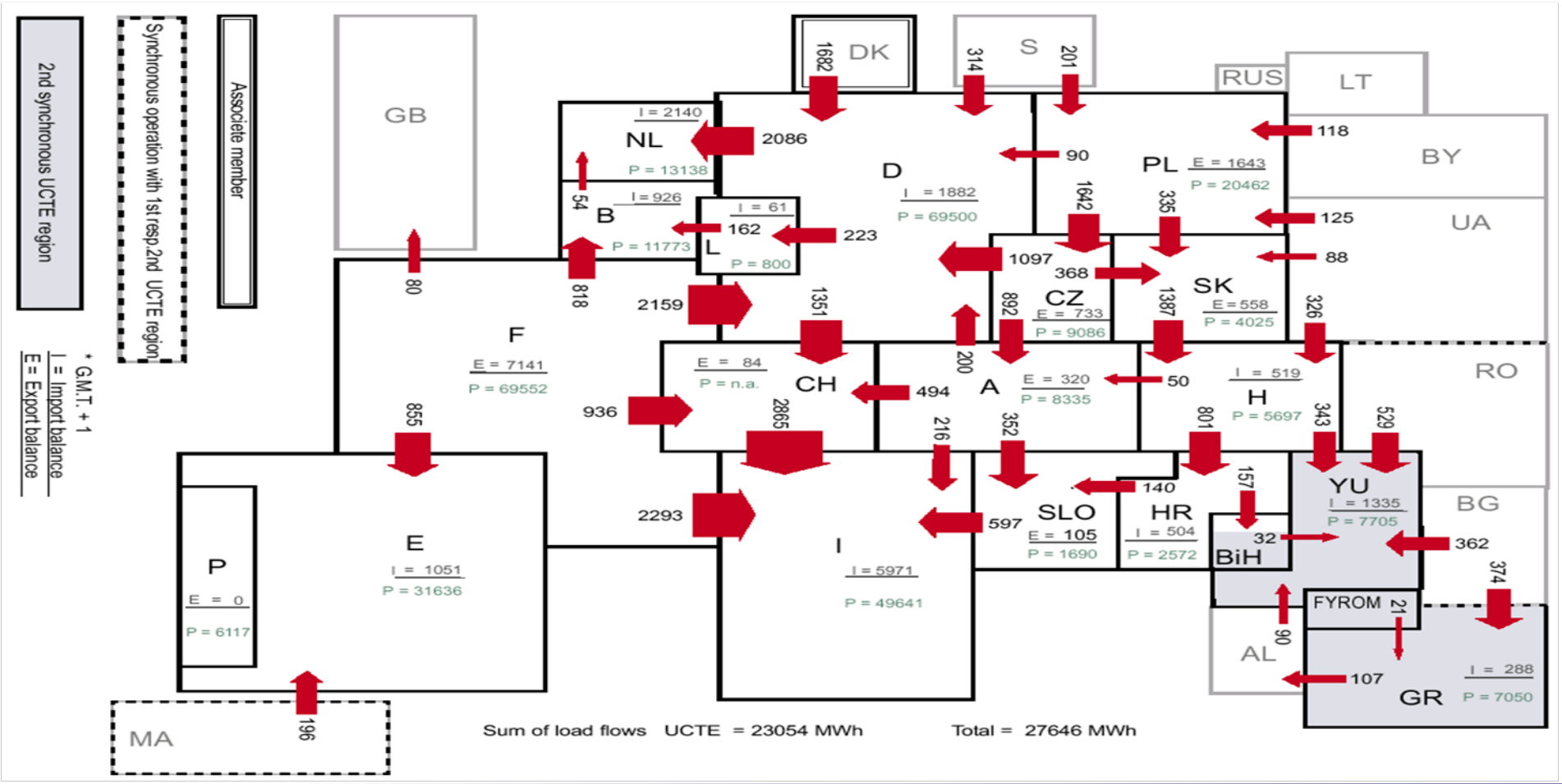
Possible Solutions

- **Explicit Bidding or Auctioning: Auctions for the scarce capacity.**
  - It is working for several interconnections (DK-D, NL-D-B, F-GB). ***They are based on the coincidence of physical and contractual paths (transaction based), which reduce the liquidity*** of the market, that is, they don't comply with the Florence Guidelines.
- **Implicit Auctioning: Coordinates one spot market with energy bids.**
- **Market Splitting: Implicit auctioning method, coordinating several Spot markets.**
  - It would satisfy the FLORENCE GUIDELINES which express a preference for non-transaction based methods. ***Too difficult to implement in the short term.***
- **Market Splitting with Coordinate Auction: It tries to conciliate bilateral contracts with the benefits of the implicit auctioning.**

TEIAS Golbasi Transformer Repair Shop

Cross-Border Flows in EU

Cross-Border Power Flows



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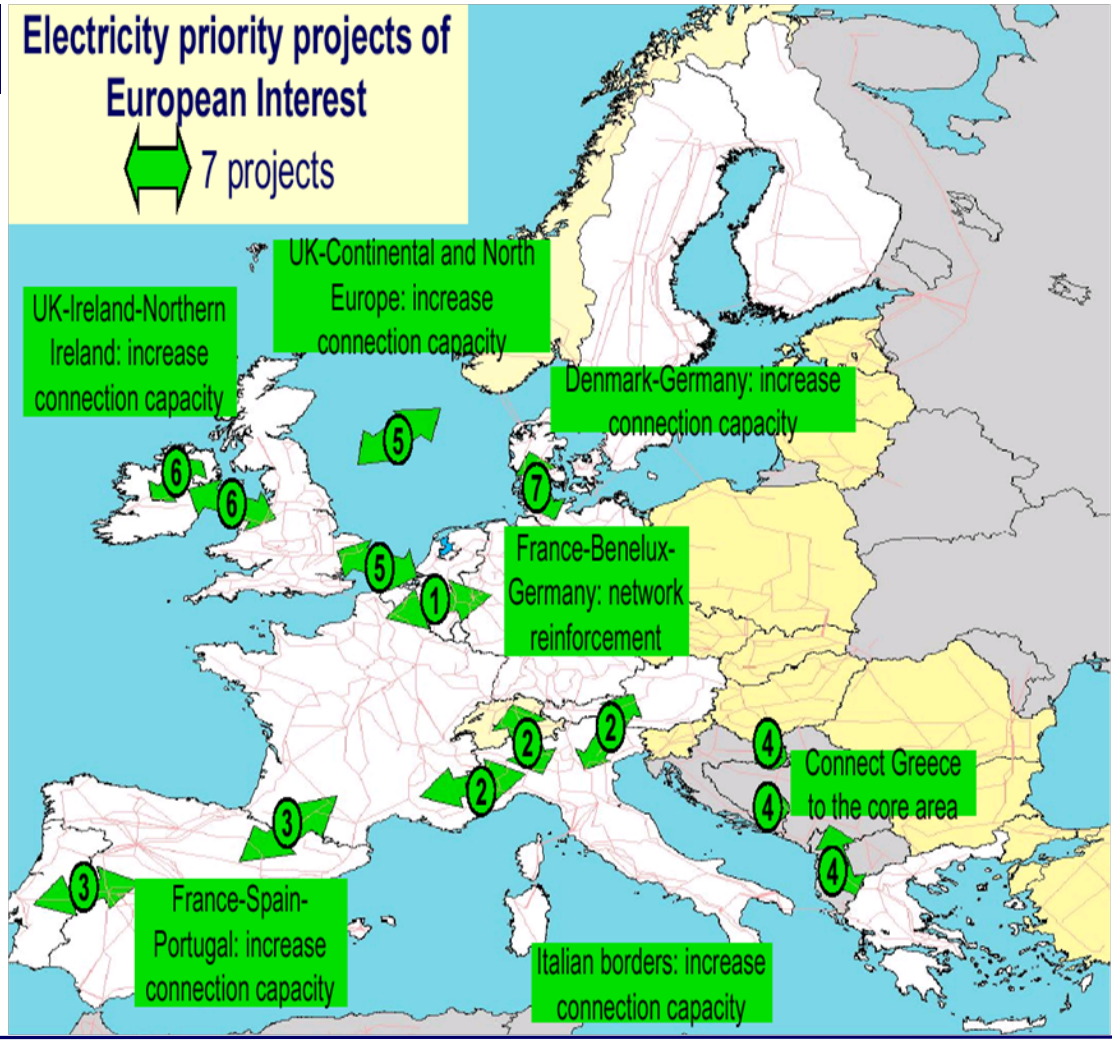
New Electricity Priority Projects in EU

Major Bottlenecks in EU System



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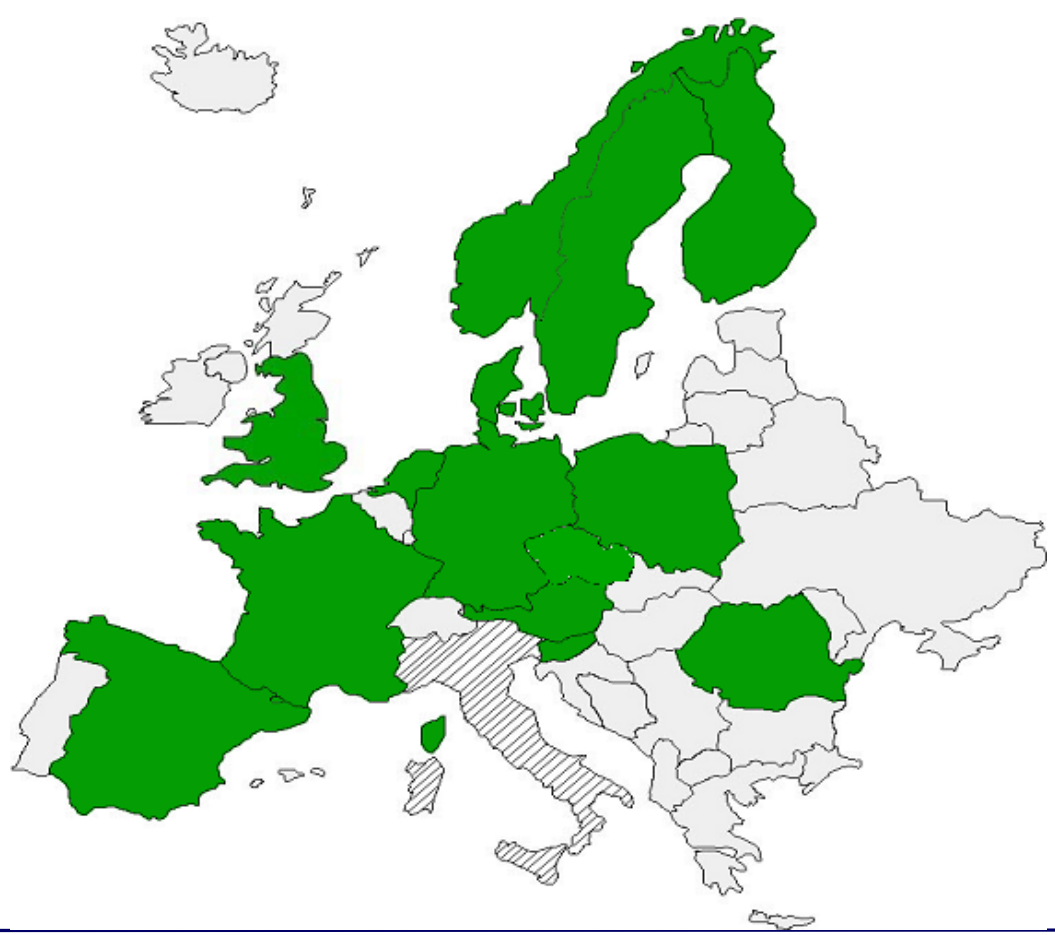
Presently Operating Electricity Markets in EU

TSO		
NORD POOL	Nord Pool (Norway)	1993
	(Sweden)	1996
	(Finland)	1998
	(Denmark)	2000
OMEL	Omel (Spain)	1998
apx	APX (The Netherlands)	1999
EEX	EEX Francoforte (Germany)	2000
LPX	LPX Lipsia (Germany)	2000
PPE	PPE Varsavia (Poland)	2000
NETA	NETA (England and Wales) 2001	2001
	Opcom (Romania)	2001
Powernext	Powernext (France)	2001
	Borzen (Slovenia)	2002
EXAA	Exaa (Austria)	2002
OTE	OTE (Czech Republic)	2002

European Interconnections



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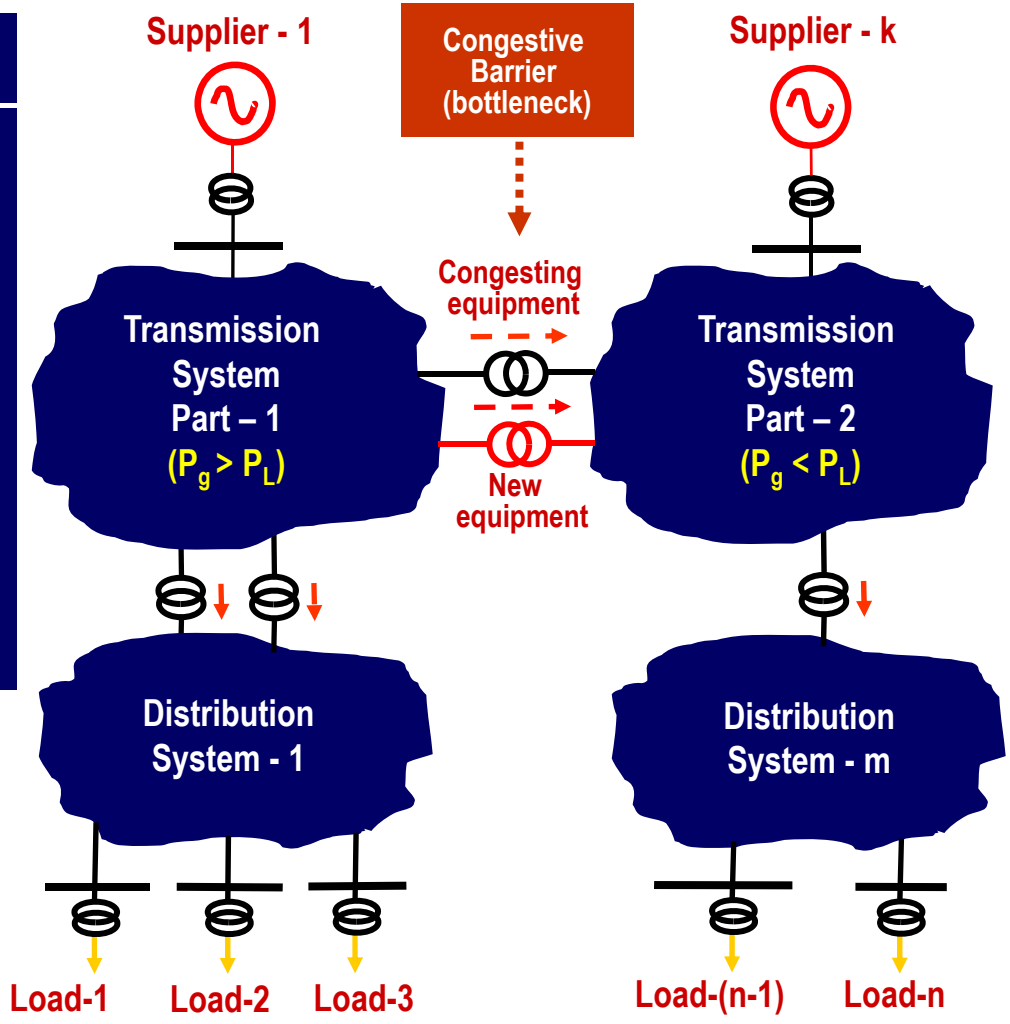
Remedy: Making Investment to Transmission Infrastructure

The most obvious remedy for congestion is to make investment for transmission infrastructure in order to strengthen and enlargen the transmission system capacity, so that the overloading on the (congesting) infrastructure is shared and relieved



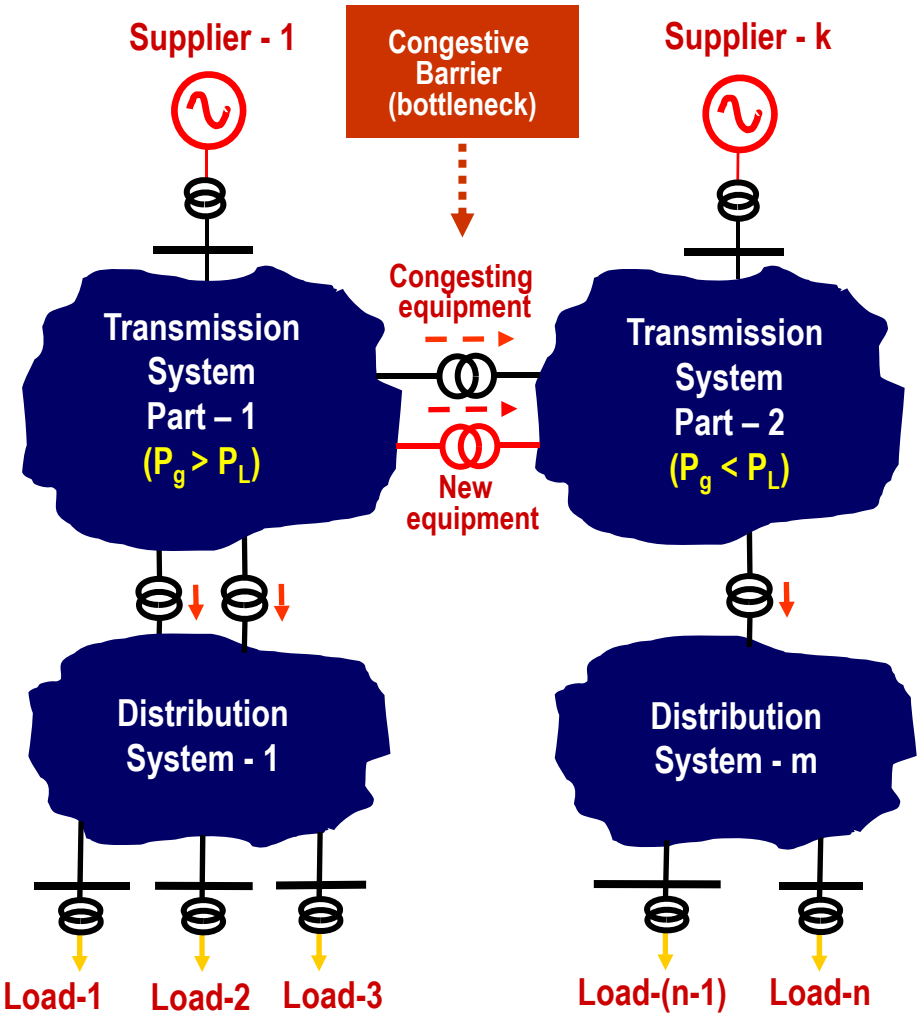
Transmission Business

Principle for Investment in Transmission Infrastucture

Principles for investment in transmission infrastructure may be classified in two groups;

- **Principles outlined by market designers in the direction of a designing a transmission system with a more competitive power, suitable for system operators,**
- **Principles outlined by regulators for-profit transcos(*) whose incentives govern their choice of transmission upgrades**

(*) Transmission companies with profit objectives



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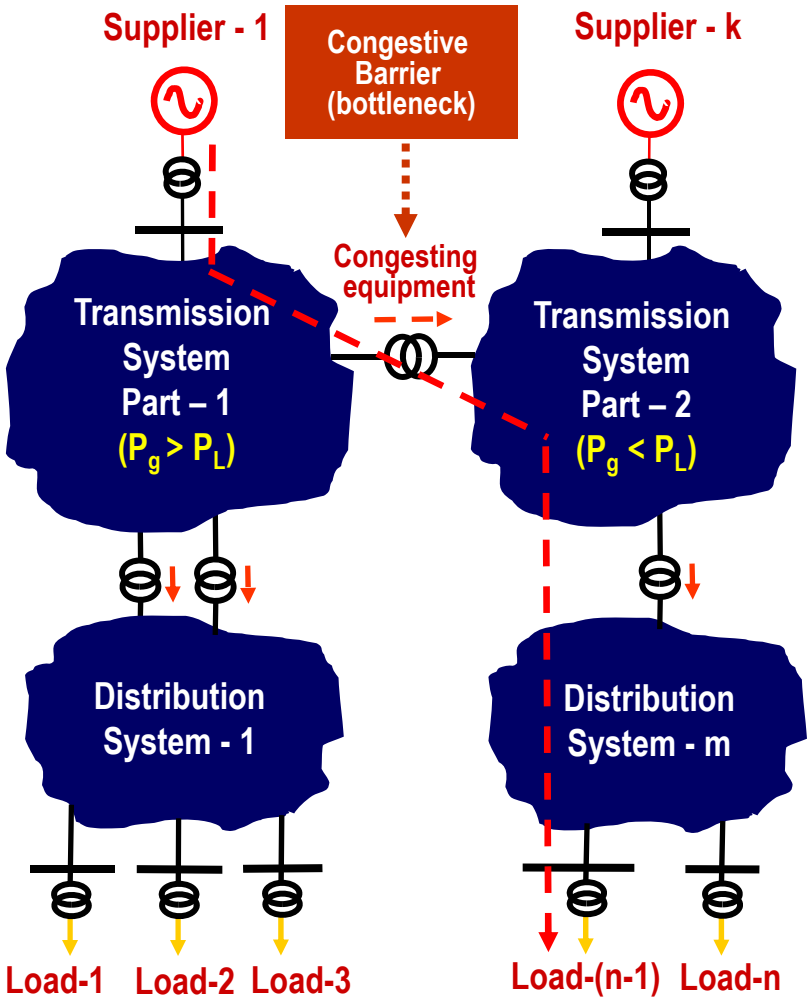
Remedy: Employing a Penalty or Incentive Program

Penalties and Incentives

Penalty and incentive programs for solving the congestion problem are employed in four alternative ways;

1) Directly through fees for power wheeling service. A **"Transmission Fee"** is determined by the regulator and this fee is paid by all power wheeling parties for each kWh transferred



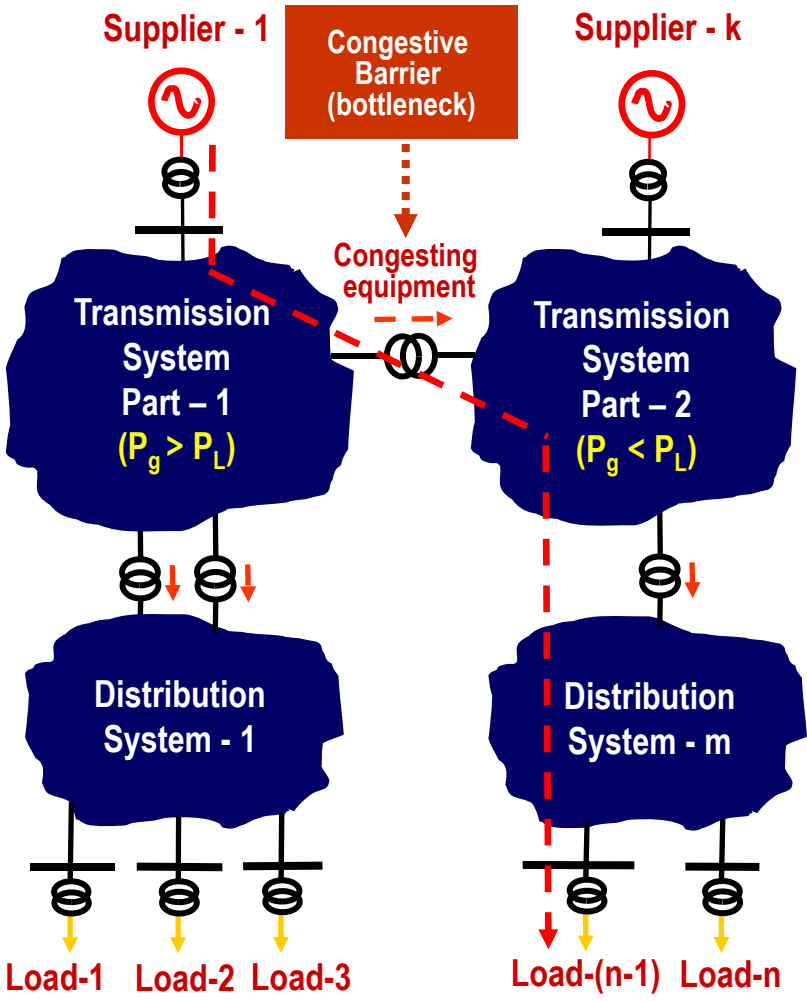
Remedy: Employing a Penalty or Incentive Program

Penalties and Incentives (Continued)

Penalty and incentive programs for solving the congestion problem are employed in four alternative ways;

2) **by imposing penalties, paid by those parties who wheel power through the congested part.**

In this example, Supplier-1 and Load (n-1) will make an additional payment for the extra investment to be made to resolve the congestion problem in the region



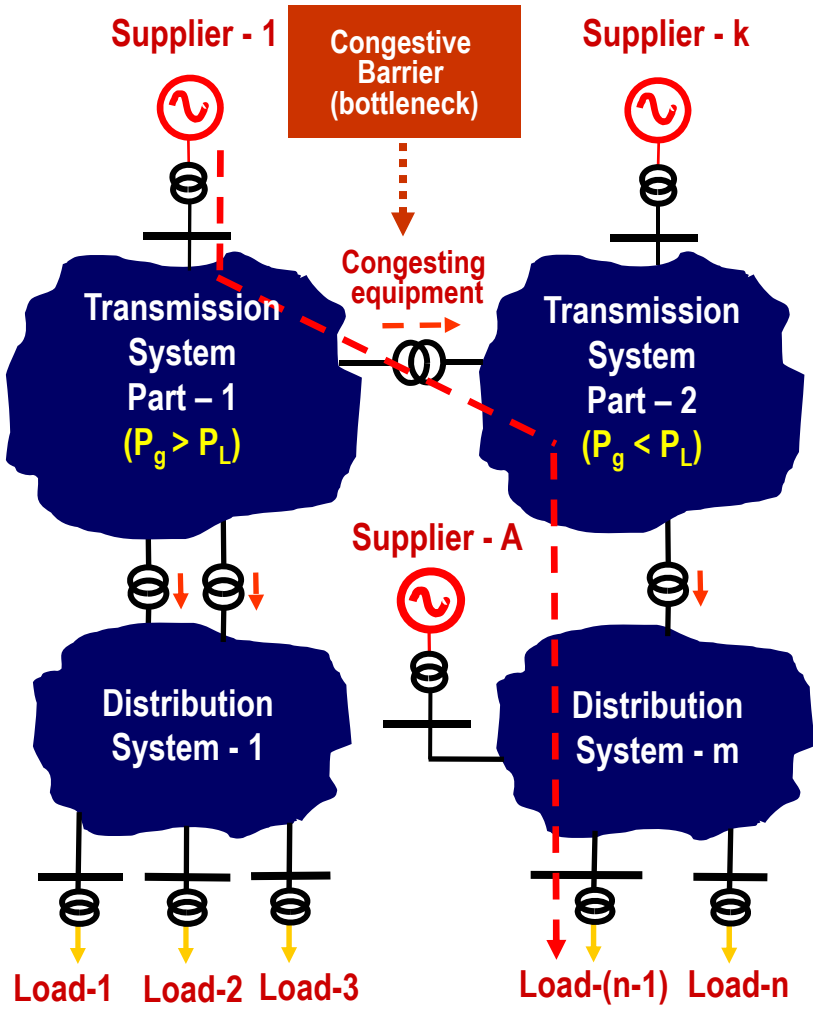
Remedy: Employing a Penalty or Incentive Program

Penalties and Incentives (Continued)

Penalty and incentive pograms for solving the congestion problem are employed in four alternative ways;

3. by employing incentives to those investors who make investment for generating plants in regions with congestion, where power loading exceeds generation.

In the present example, investor of the plant; "Supplier – A" in Part - 2, will earn an extra payment, i.e. an incentive term (reduction in taxes), since the investment helps to relieve the congestion



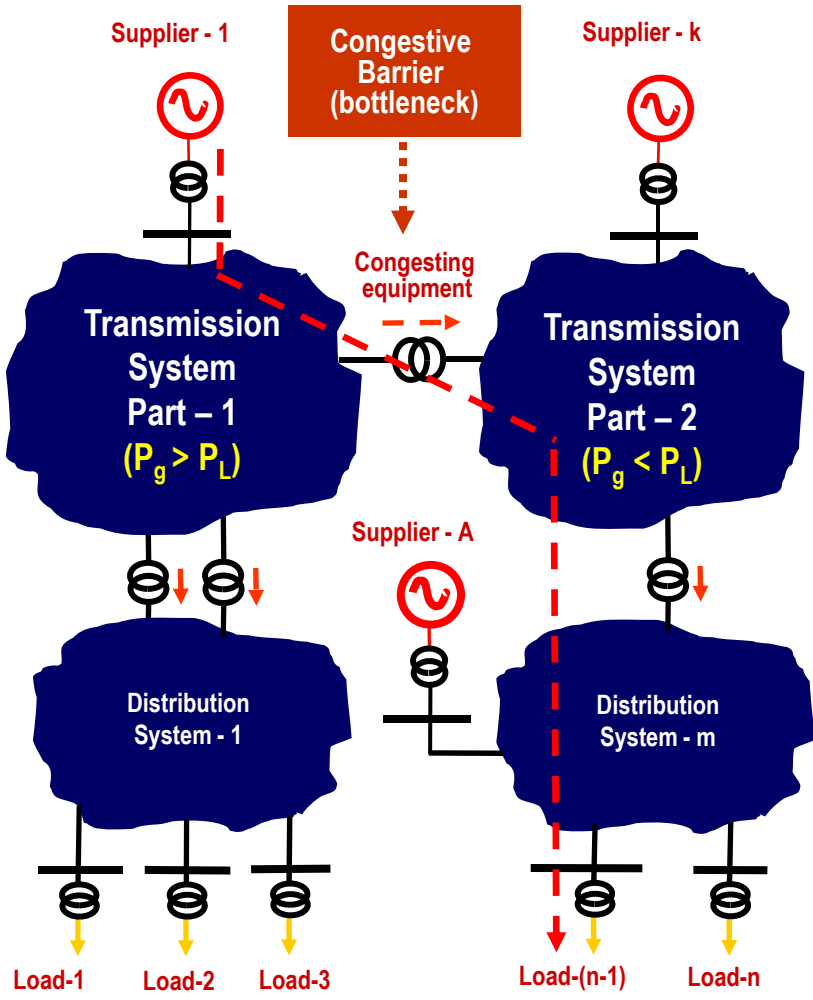
Remedy: "Must-run" Plants

Penalties and Incentives (Continued)

Penalty and incentive programs for solving the congestion problem are employed in four alternative ways;

4. by employing incentives, i.e. high regulated prices to existing generating plants in regions with congestion, where power loading exceeds generation.

In the present example, the "Must-run" Plant; "Supplier – A" in Part - 2, will run at a regulated (high) price and earn extra payment, i.e. an incentive term, since it helps to relieve the congestion



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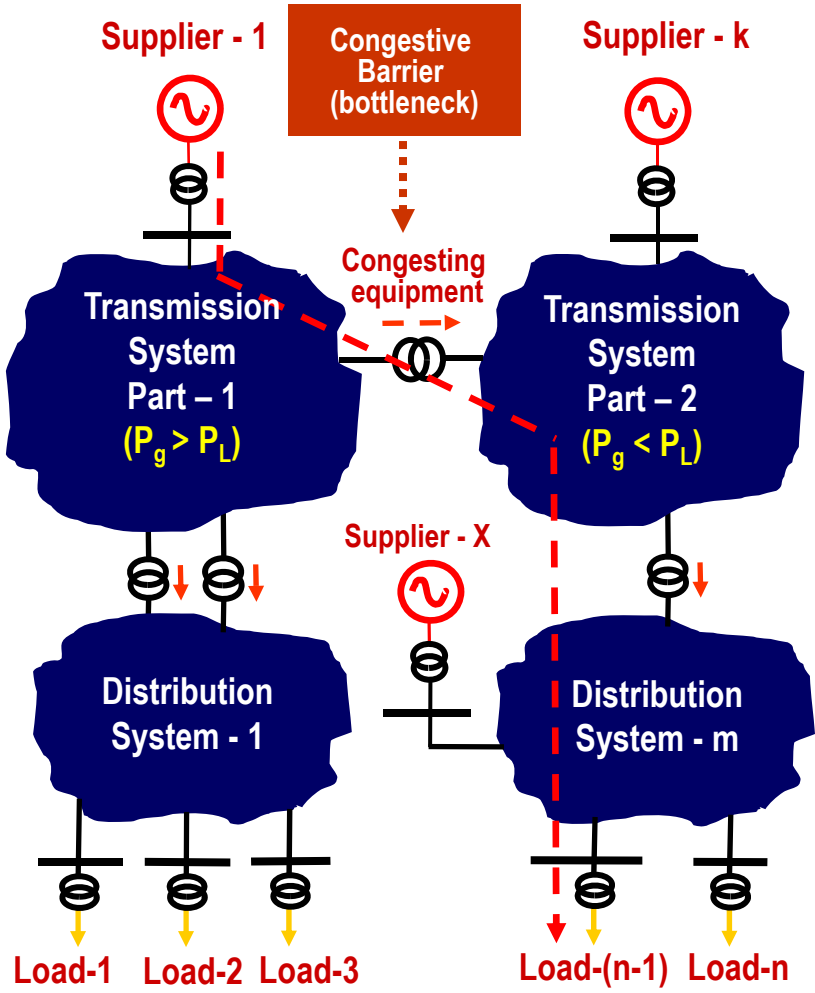
How does Congestion Affect Investors ?

Congestion affects investors in two different aspects;

- **Investers who plan to make investment in a generating plant in a region with congestion, where power generation is excessive, but loading is small (Part-1) will delay or even will cancel their investments**
- **Investers who plan to make investment in a generating plant in a region with congestion, where power generation is small, but loading is large (Part-2) will realize or even will increase the amount of their investments**



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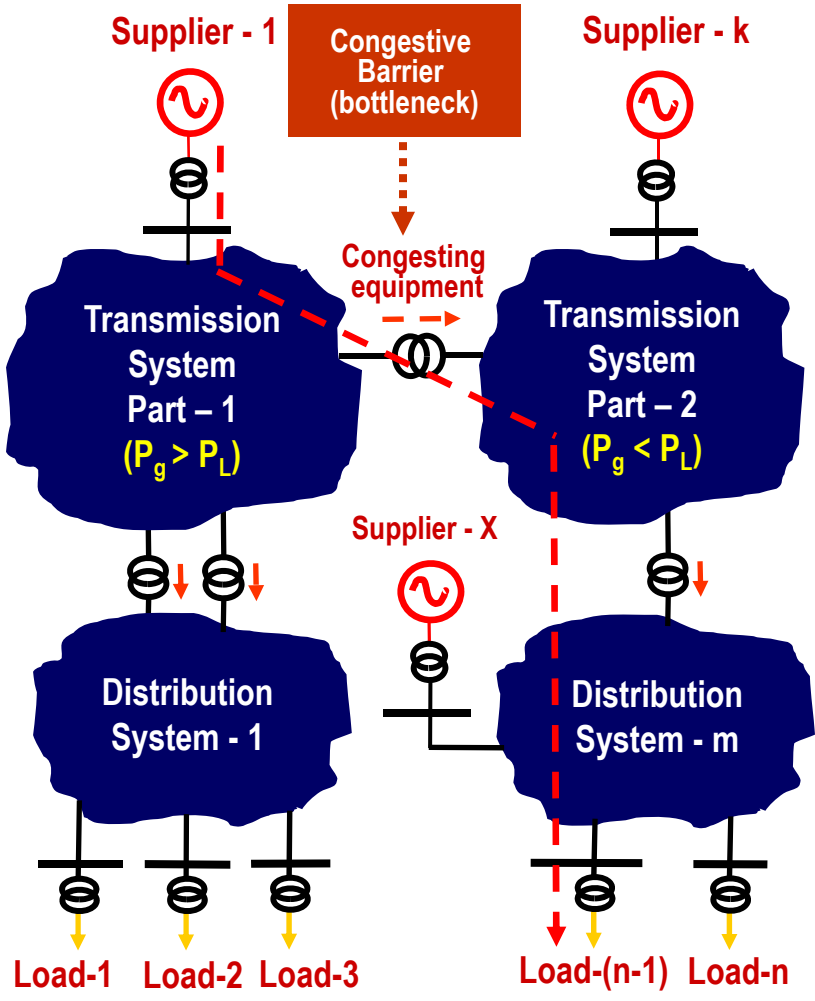
Role of the Regulator for Solving Congestion

Role of the Regulator

Main role of the Regulator is to adjust the terms in the above fees, i.e;

- **Transmission fee,**
- **Penalties for those parties who make generation plant investment in congested parts, where power generation is excessive,**
- **Incentives to those parties who make generation plant investment in congested parts where power loading is excessive**

in such a way that congesting is relieved or even removed by realizing extra investments



Rule for Making Investment for Congestion

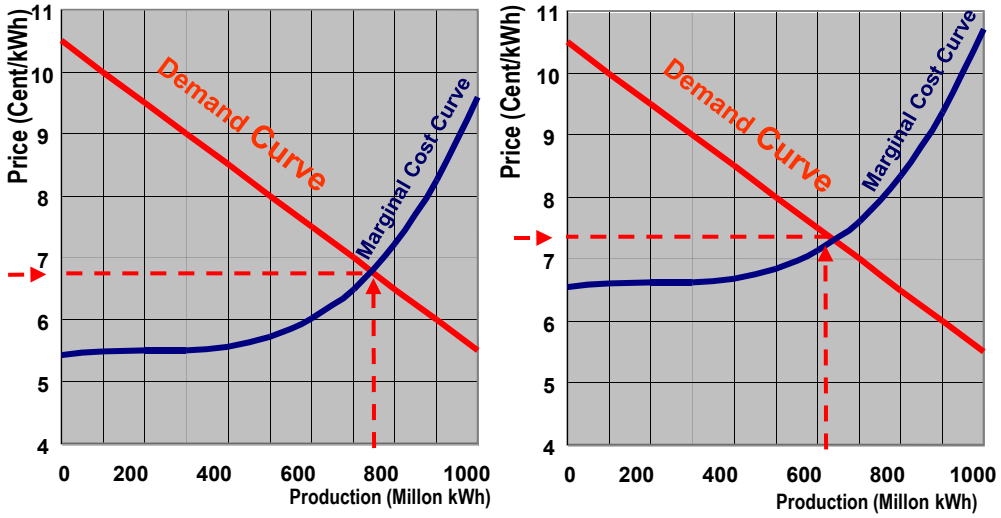
Investment for Congestion Problem

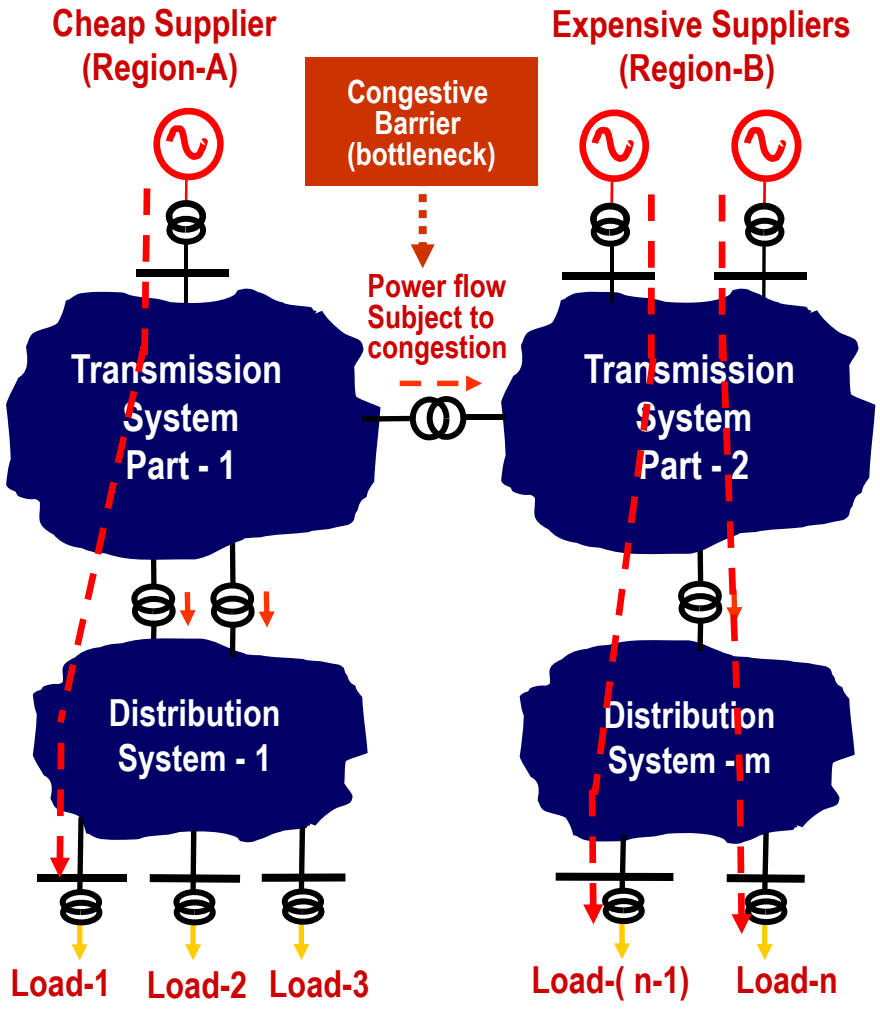
The investment becomes feasible, when the marginal cost of transaction;

$$MC_{Transaction} = MC_B - MC_A$$

exceeds the investment to be made to overcome the congestion problem

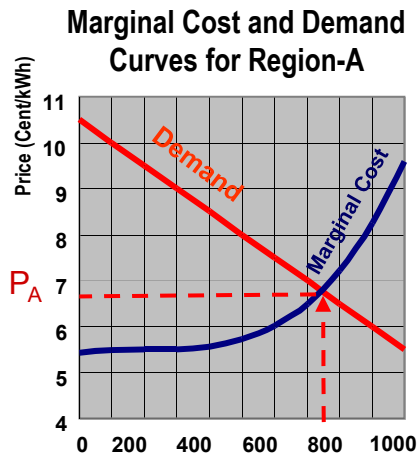
Marginal Cost and Demand Curves for Region-A and Region-2

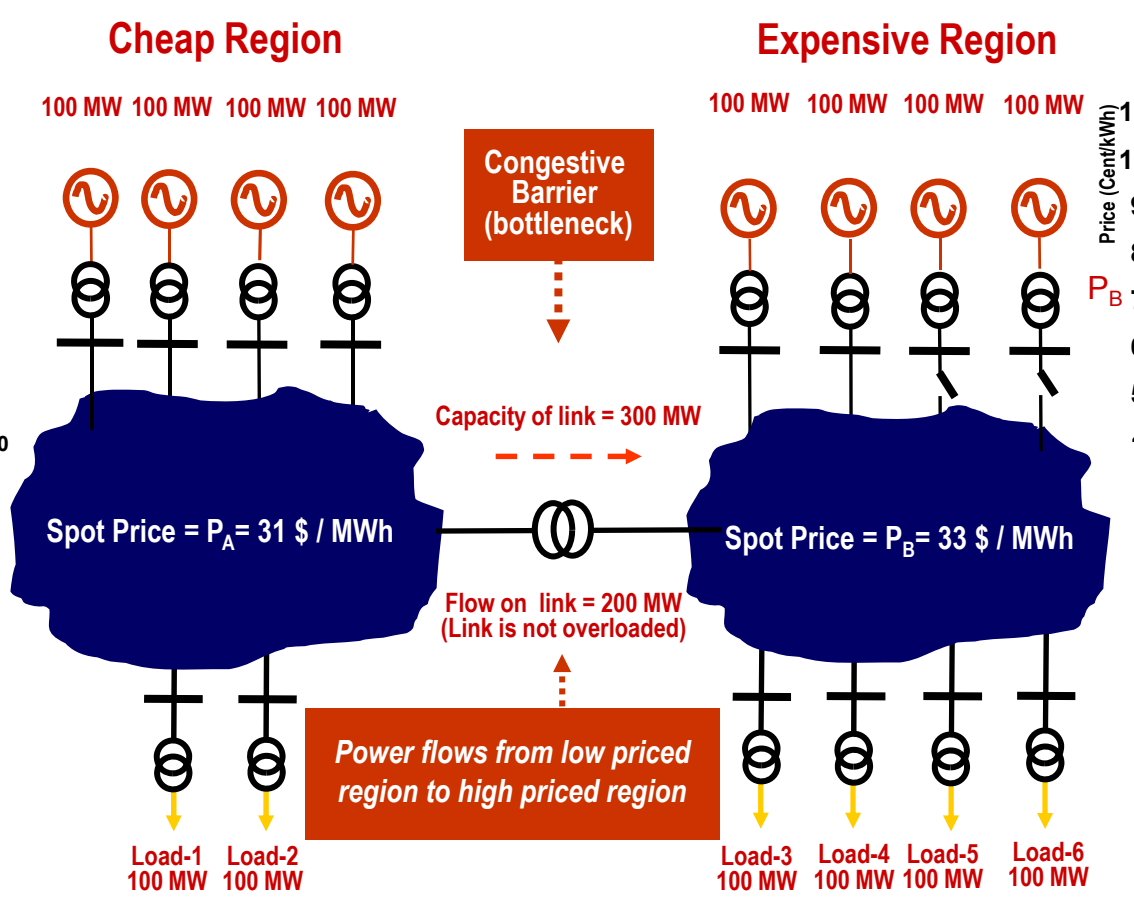


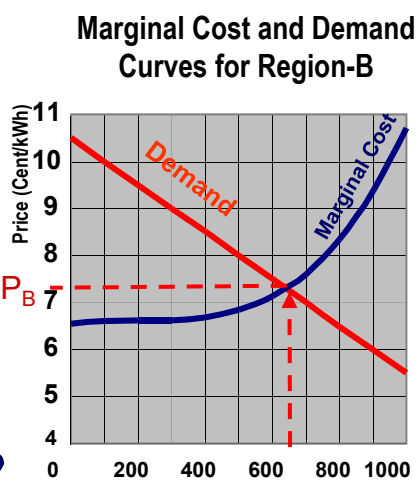


Rule for Making Investment for Congestion

Example: Two Regions with Different Spot Prices (No Congestion)

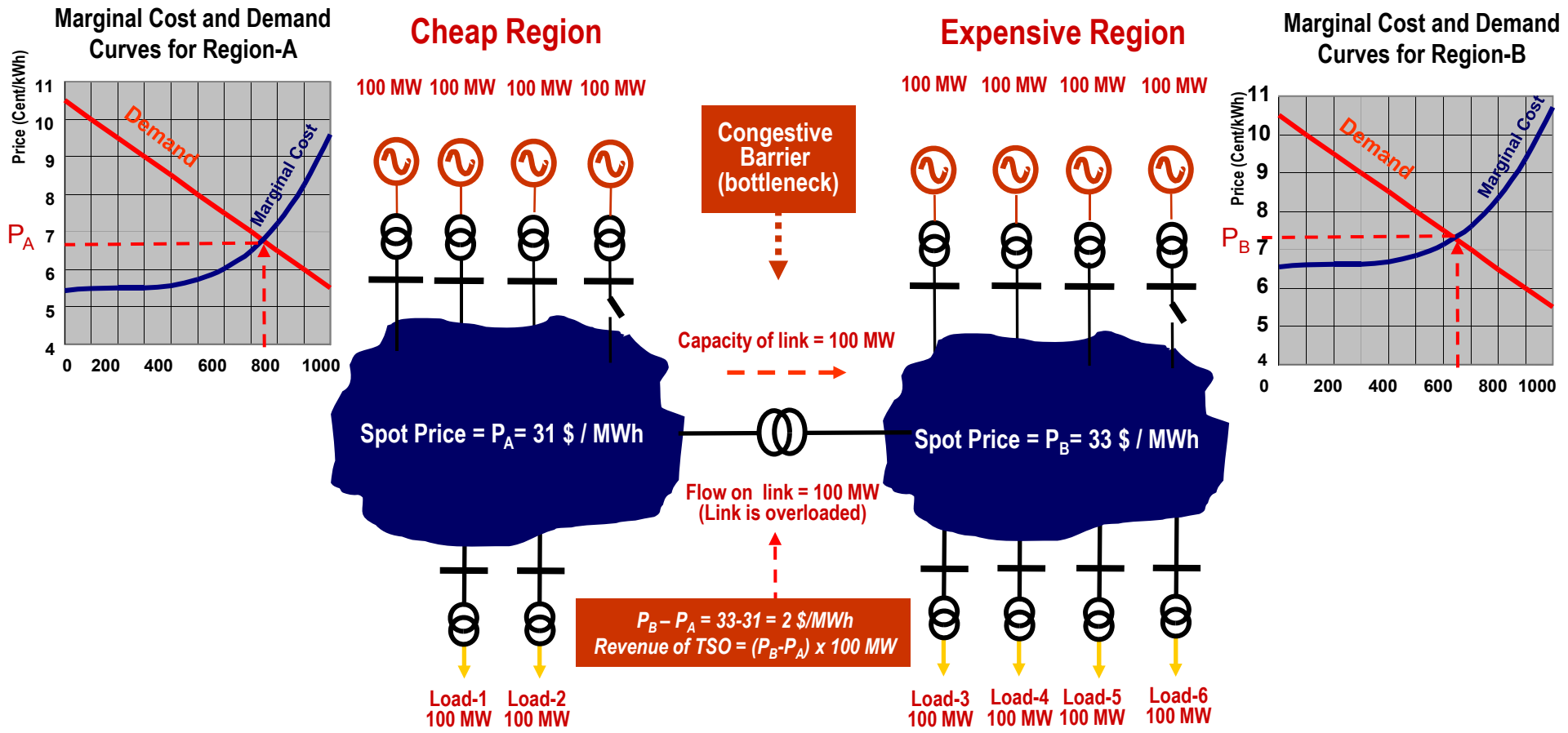






Rule for Making Investment for Congestion

Example: Two Regions with Different Spot Prices (Congestion)

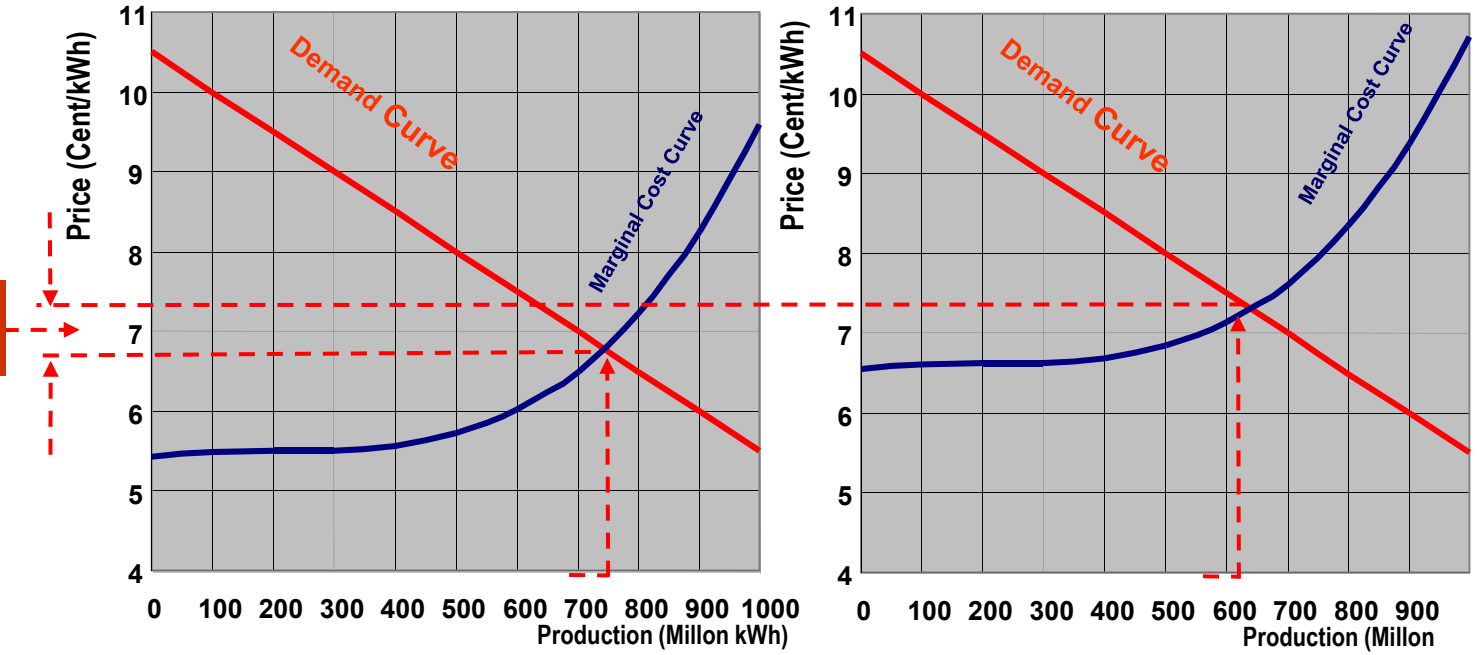


Transmission Business

Rule for Making Investment for Congestion

Investment for Congestion problem

Difference in spot prices:
$P_B - P_A$



The investment becomes feasible, when the marginal cost of transaction exceeds the investment to be made to overcome the congestion problem

$P_{Transaction} * Energy_{transfer} > Cost_{investment}$

$P_{Transaction} = P_B - P_A$

where, $Energy_{transfer} = Power_{transfer} * \Delta t$

Δt = pay-back period of investment

Principles for Congestion Pricing

Principles for Congestion Pricing

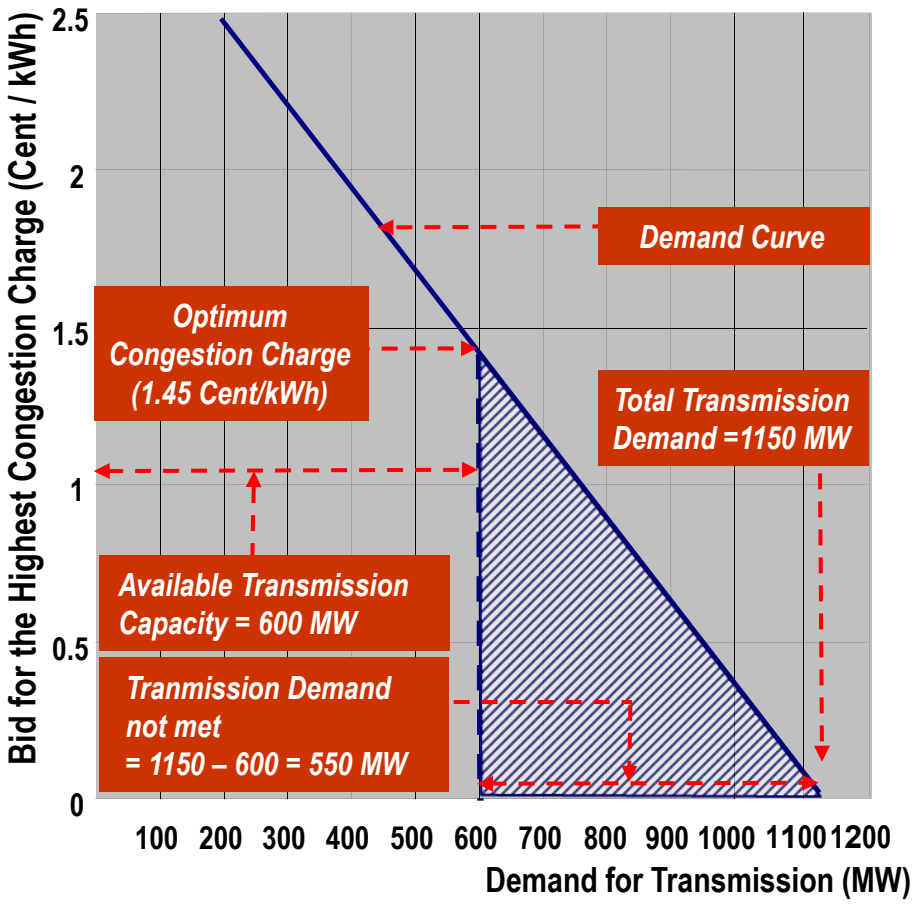
Although the contribution of congestion charge to overall cost in an efficiently run system is quite low, these charges in a badly designed system can make the system operation unmanageable.

- No congestion charge must be imposed on an underloaded line
- If the congestion price is set correctly, the demand for the use of the line will exactly be equal to the line capacity.

Who value the line most, get to use it

Congestion charges must always be regulated by the Regulator

Since total demand (1150 MW) is greater than available capacity (600 MW) , auction is necessary.



Transmission Business

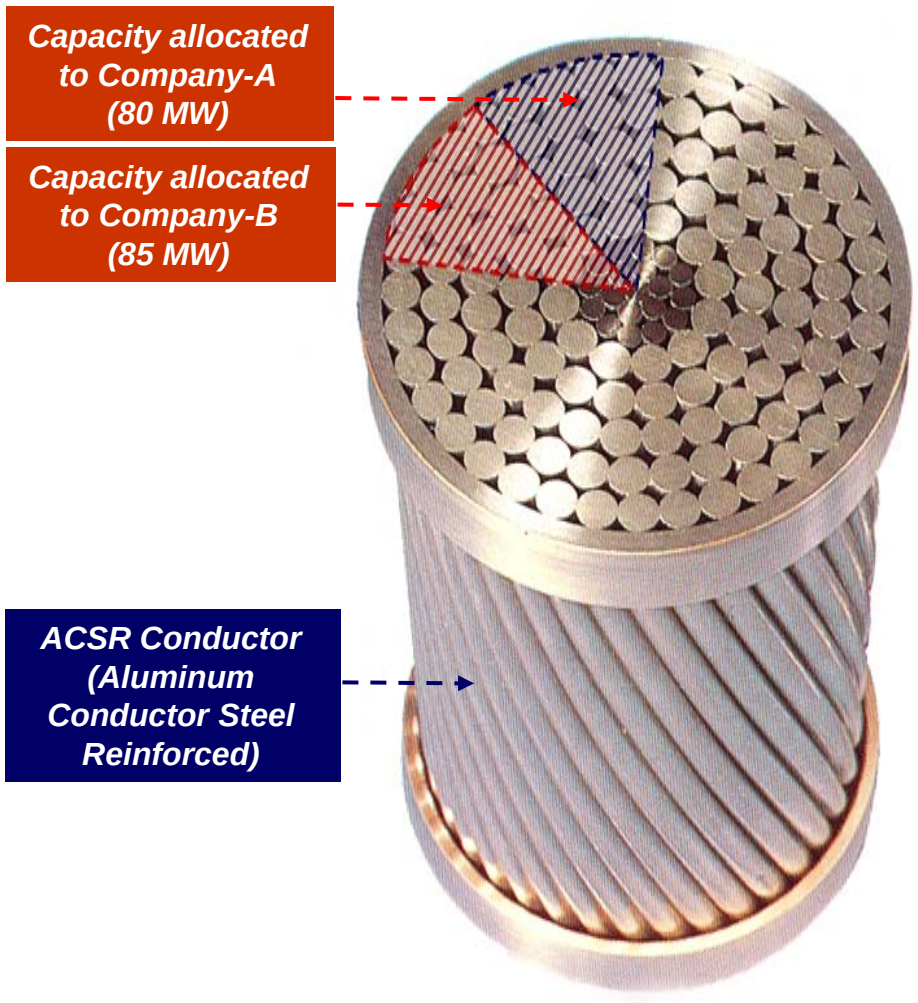
Secondary (Retail) Market for Transmission Capacity

Secondary Transmission Market

If it works efficiently as a competitive market should, the market will induce a secondary (retail) market for transmission capacity

The main (wholesale) company who has bought the transmission capacity, will split the capacity in terms of "Capacity factor (c)" and then market these portions to third parties by auction or agreement

In case of emergency, TEIAS should have the right of always buying back the capacity at the initial price that has been sold



Secondary (Retail) Market for Transmission Capacity

Capacity Factor (c)

Capacity Factor (c) is a measure of the percentage of capacity service allocated for an energy service

Capacity Factor is the same as defined earlier

$$c = (P / P_r) \times (t / T) \quad \text{(unitless)}$$

where, *α is the capacity factor,*
P is the capacity (power) allocated to customer,
P_r is the total rated power of the equipment,
t is the total duration of allocation (hours),
T is the overall duration of the availability of equipment (hours)

Example

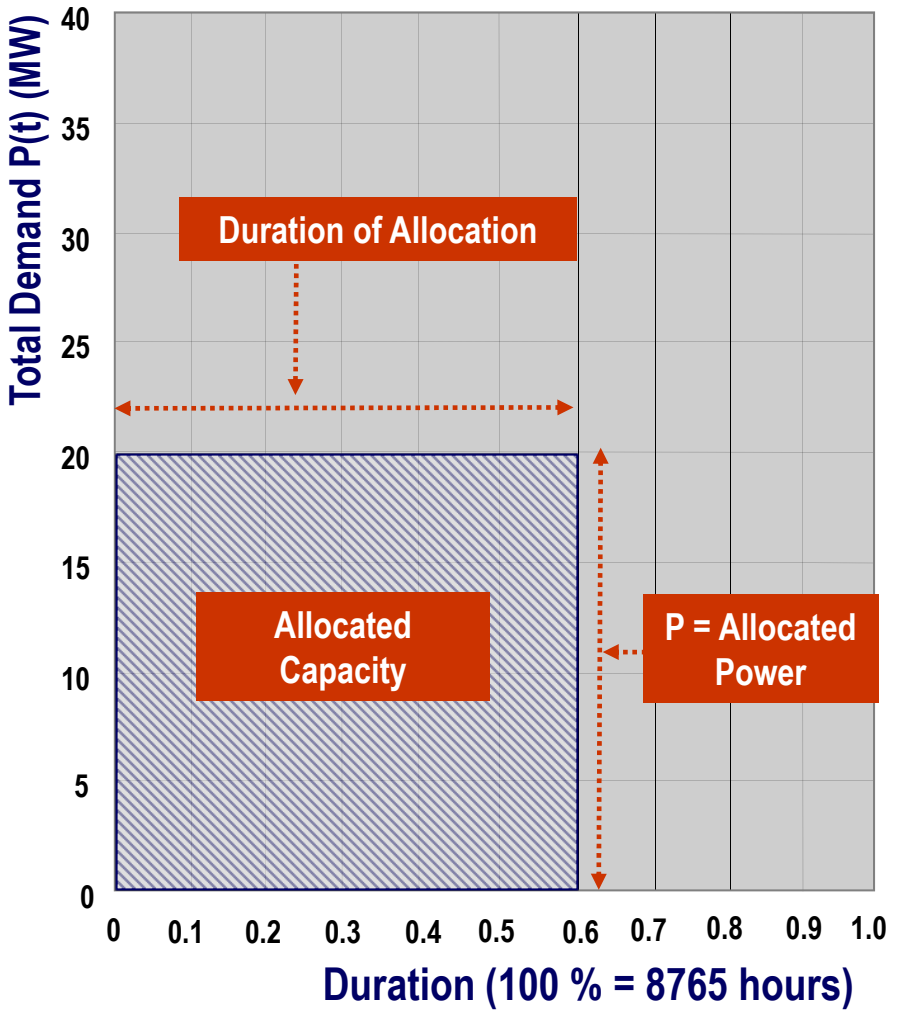
Question

Find the Capacity Factor of the order shown on the RHS

Answer

$c = (P / P_r) \times (t / T)$ *(unitless)*

$c = (20 / 40) \times (0.60 / 1.0) = 30.0\ \%$

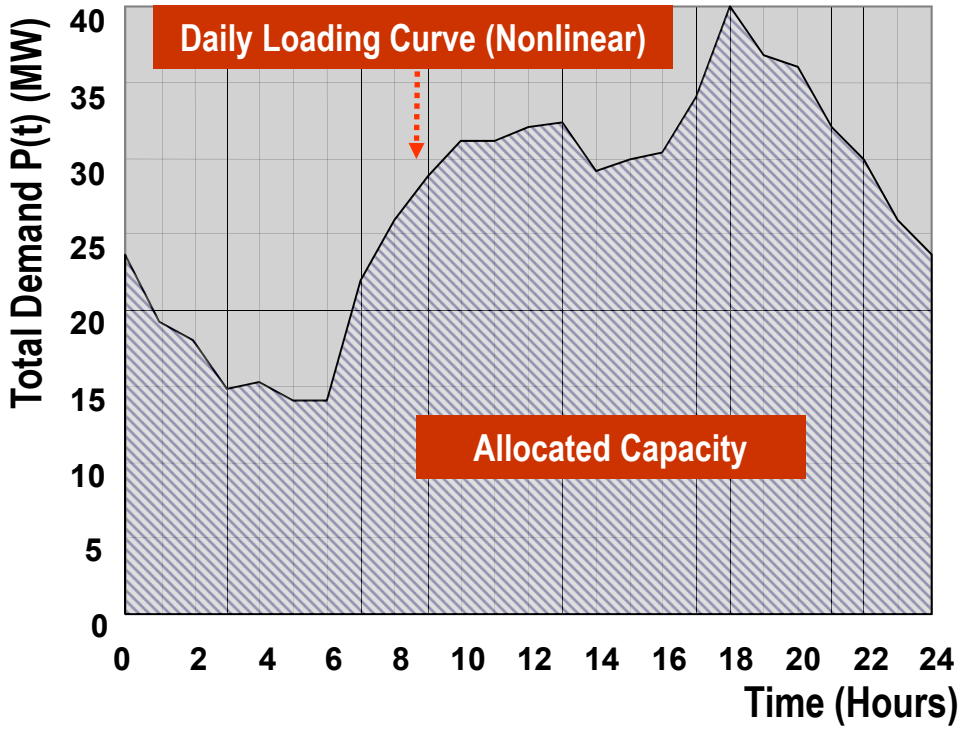


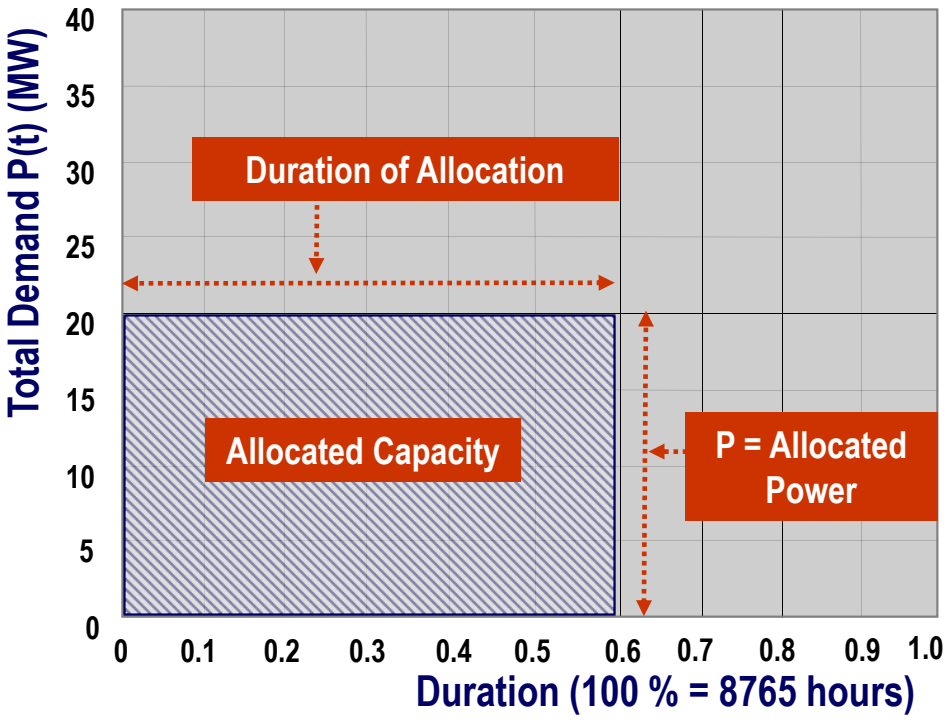
A Note

Please note that the approach which calculates the Capacity Factor by using the integral of the Laoding Curve is more general

c = Area under the Curve / Overall Area
= ∫ P(t) dt / Overall Area

$$c = (P / P_r) \times (t / T)$$





Congestion Rent

Principles for Spending Congestion Rent

The revenue collected by congestion management is called **"Congestion Rent"**

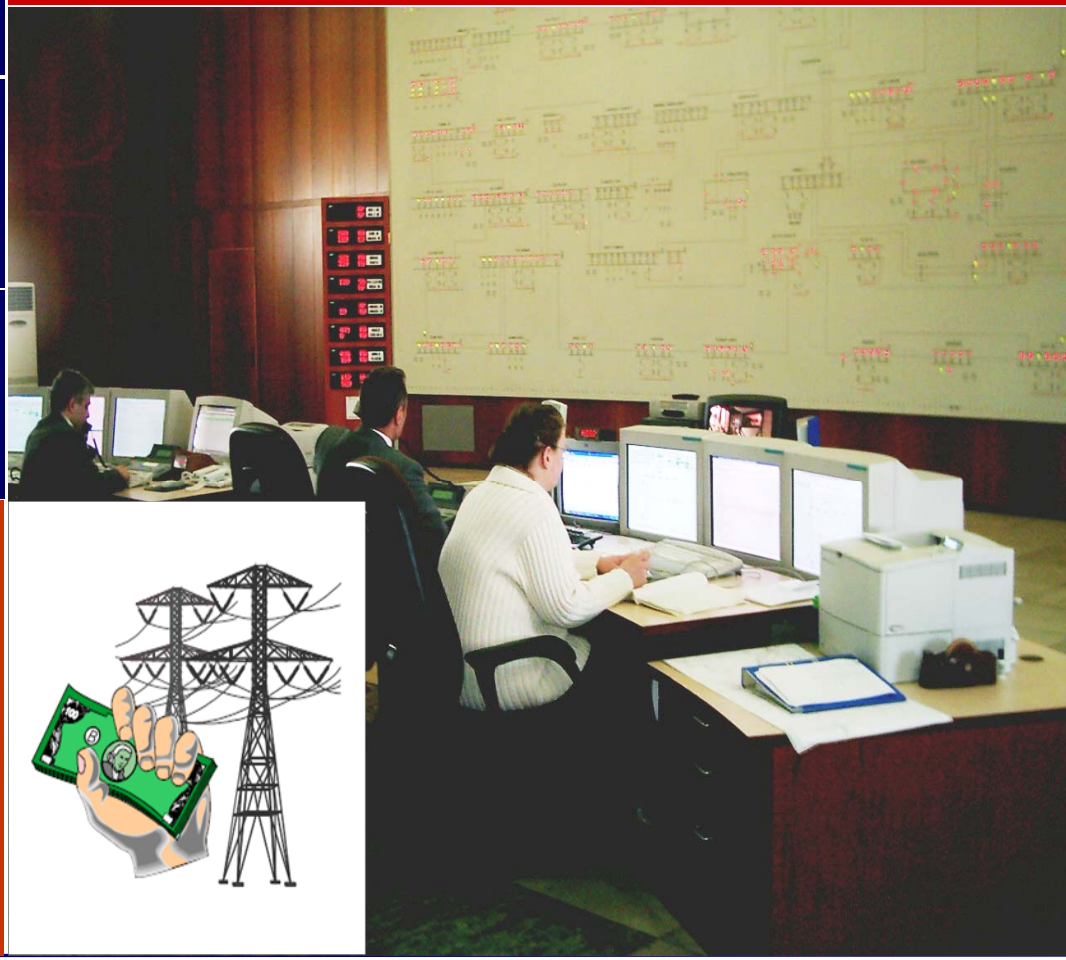
In Nodal Pricing Method, the system operator collects the congestion rent.

Congestion rent is NOT a profit.

TSO must;

- *sell transmission rights,*
- *create transmission rights,*
- *use the collected revenue to invest present and future transmission infrastucture*

TEIAS Golbasi System Control Center



Transmission Business

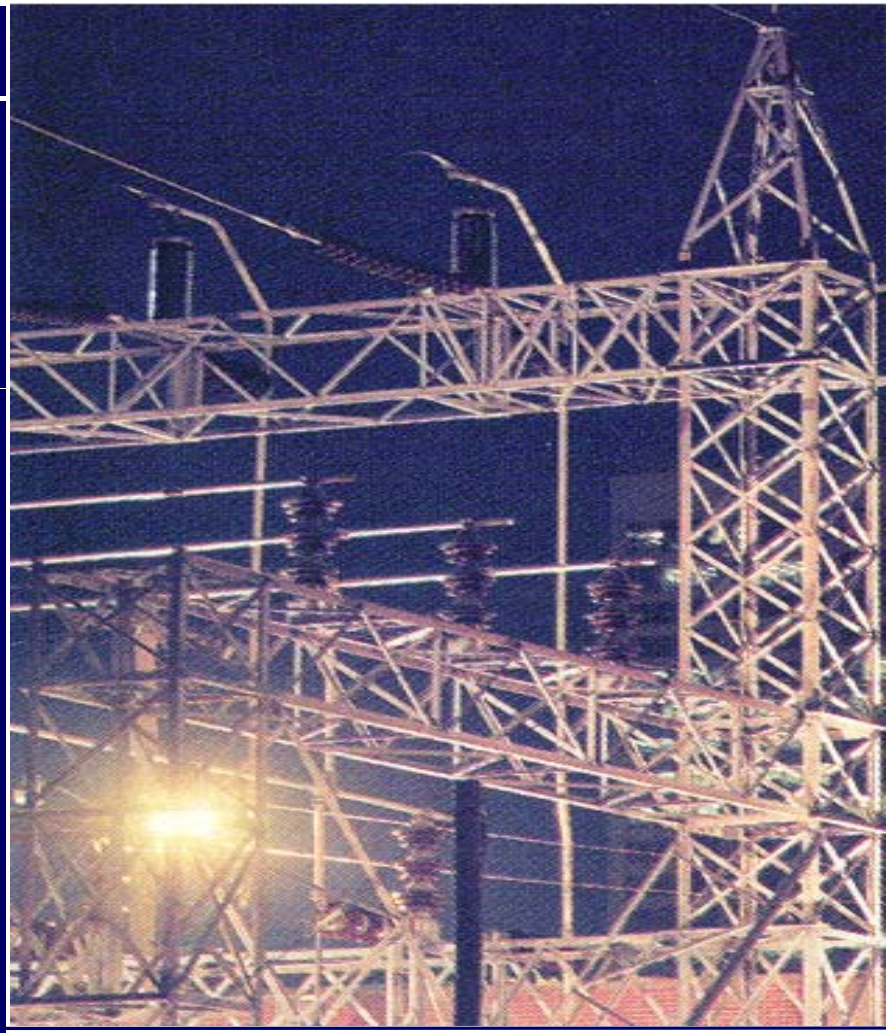
Regulation of Transmisssion Activities

Need for Regulation

Transmission business is a natural monopoly, providing a single unique infrastructure over which electricity can be delivered

Hence, a price-regulated mechanism must be established to ensure that;

- Transmission users pay a fair price,
- It is run as efficiently, reliably and fairly as possible,
- The right amount of investment is realized,
- Some transmission users are not favored at the expense of others



Rules for Transmission Activities

Basic Rules

Basic rules for transmission system activities are as follows;

- **Conditions for accessing in both the short and long run, including the rules for maintenance,**
- **The rules for pricing the transmission services,**
- **The rules for long-term expansion and upgrading of the system,**
- **The arrangements for the ownership and control of transmission system**

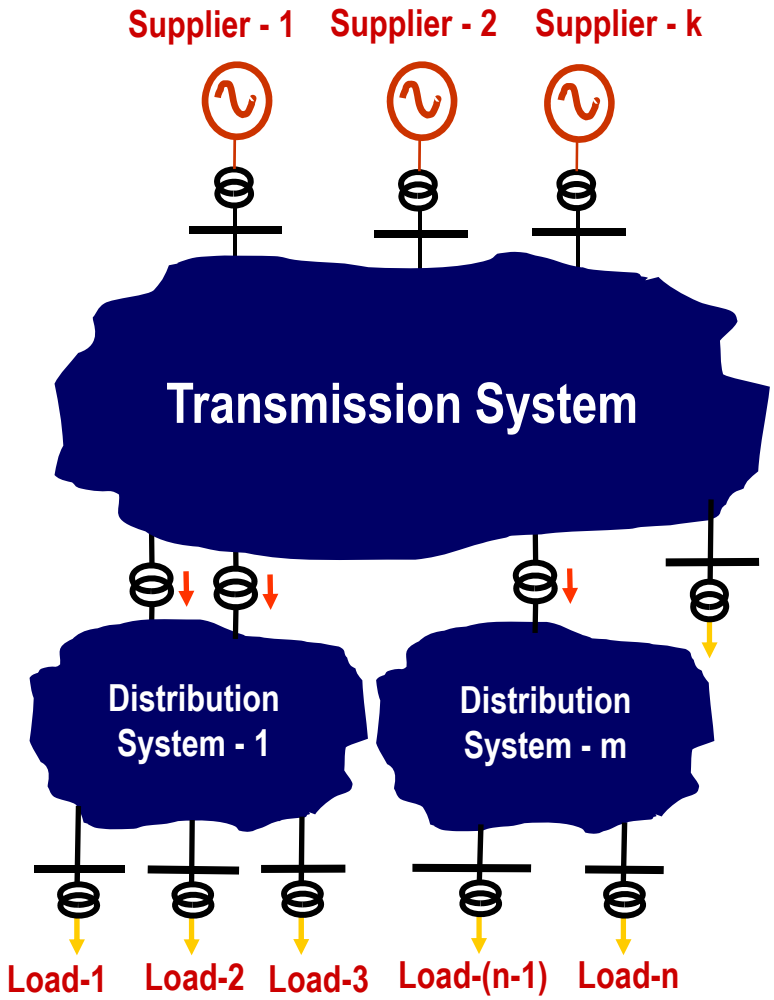
Transmission Business

Long-Term Access

Conditions

Transmission system users need;

- assurance for their access to system services in the long-term,
- arrangements which provide connections linking them by the transmission system owner and the system operator,
- clear conditions under which they shall be connected and maintain access to the transmission system



Transmission Business

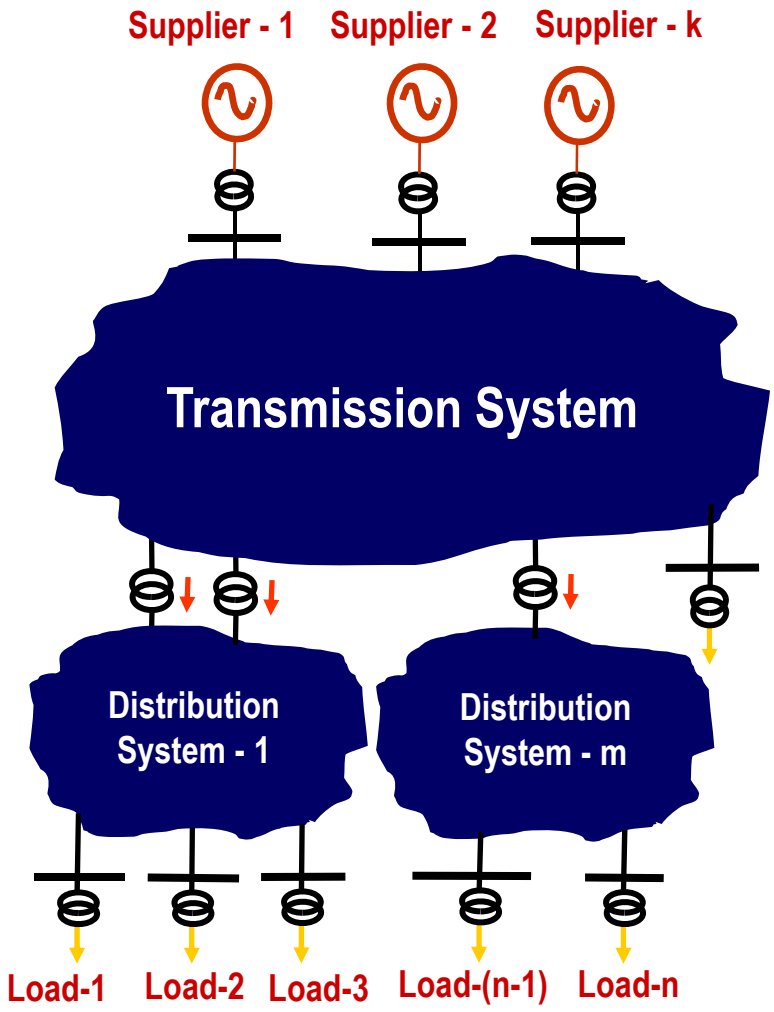
Grid Code

Grid Code

Grid Code is the basic regulation describing transmission connection and service arrangements, activities, services authorities and responsibilities among the system operator and users

Grid Code includes;

- Transmission service and connection arrangements, which ensure that connections are properly provided, maintained and modified efficiently and fairly to all parties connected,
- Transmission service agreements, which regulate the terms and charges for transmission services



Transmission Business

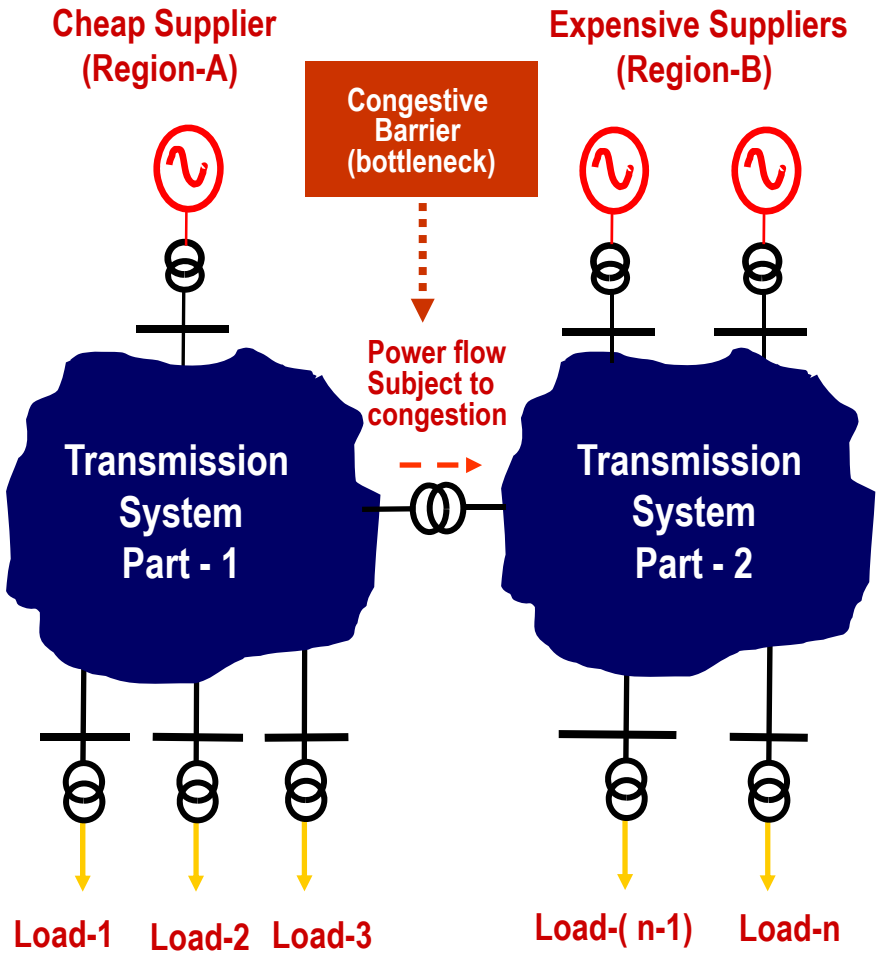
Scarcity of Transmission Capacity

Definition

"Transmission Right" will be more valuable when it is scarce, i.e. when the line is subject to congestion

Then the owner, i.e. TSO will have incentives to build when and where the transmission line is needed

Alternative to build a transmission line is to pay for the cost of congestion



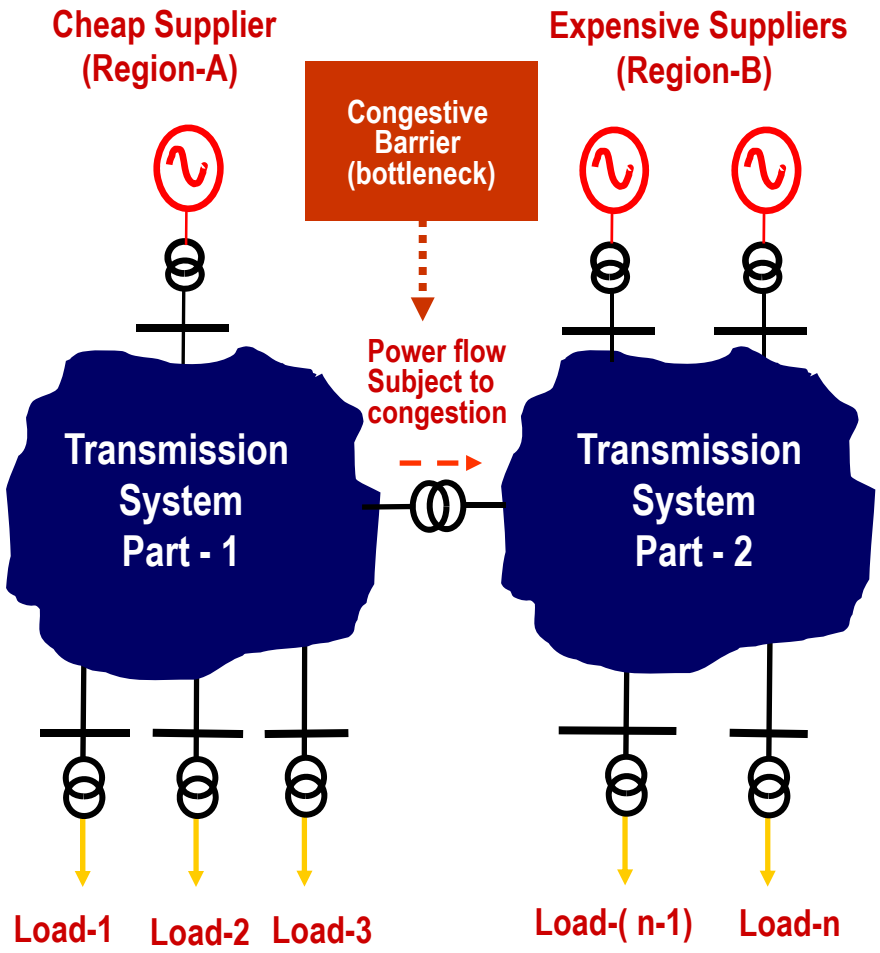
Transmission Business

Trading of Transmission Rights

Definition

"Transmission Right" is the right of using a transmission facility, i.e. a line and / or transformer, granted by an auction and / or contract for commercial purposes within a certain period of time

Transmission Right is a commercial commodity



Transmission Business

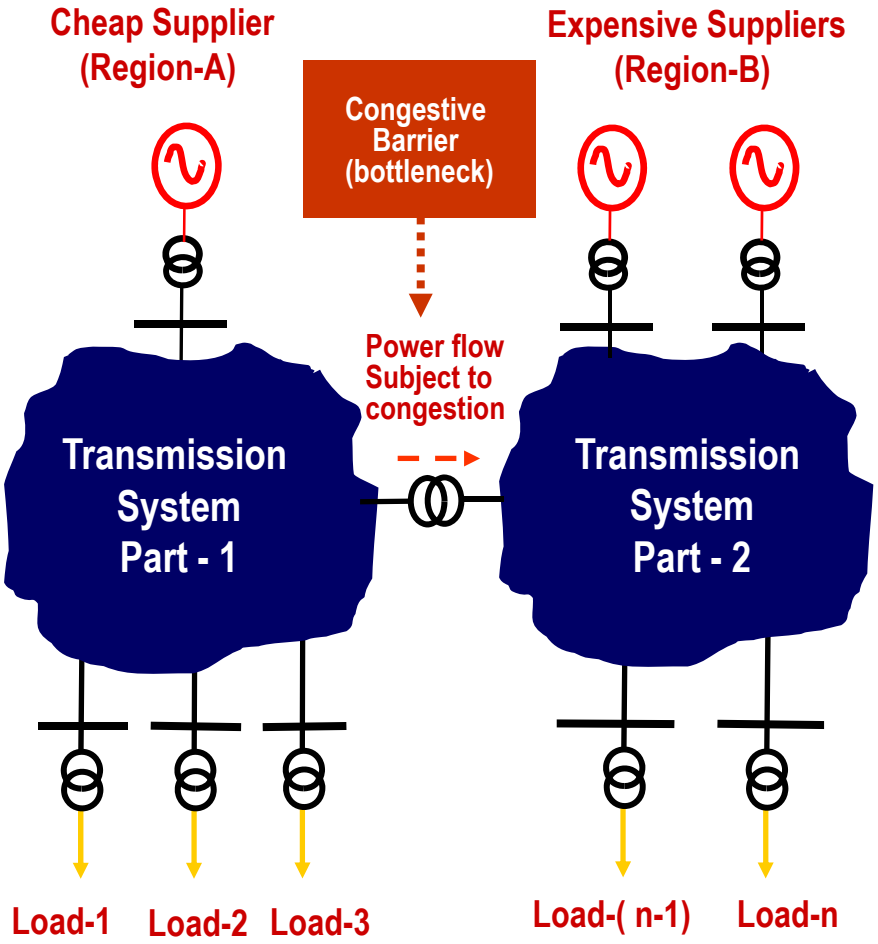
Trading of Transmission Rights

Definition

If we give the "transmission right", to a TSO who is responsible for expanding the transmission system, then the TSO will have sufficient incentives to expand the system if these rights are commercially valuable

Transmission right is commercialy valuable, since market participants will pay for each MWh power transaction through the line

Payment for Transmission Right is regulated by the Regulator



Transmission Business

Transmission Right Market

Question

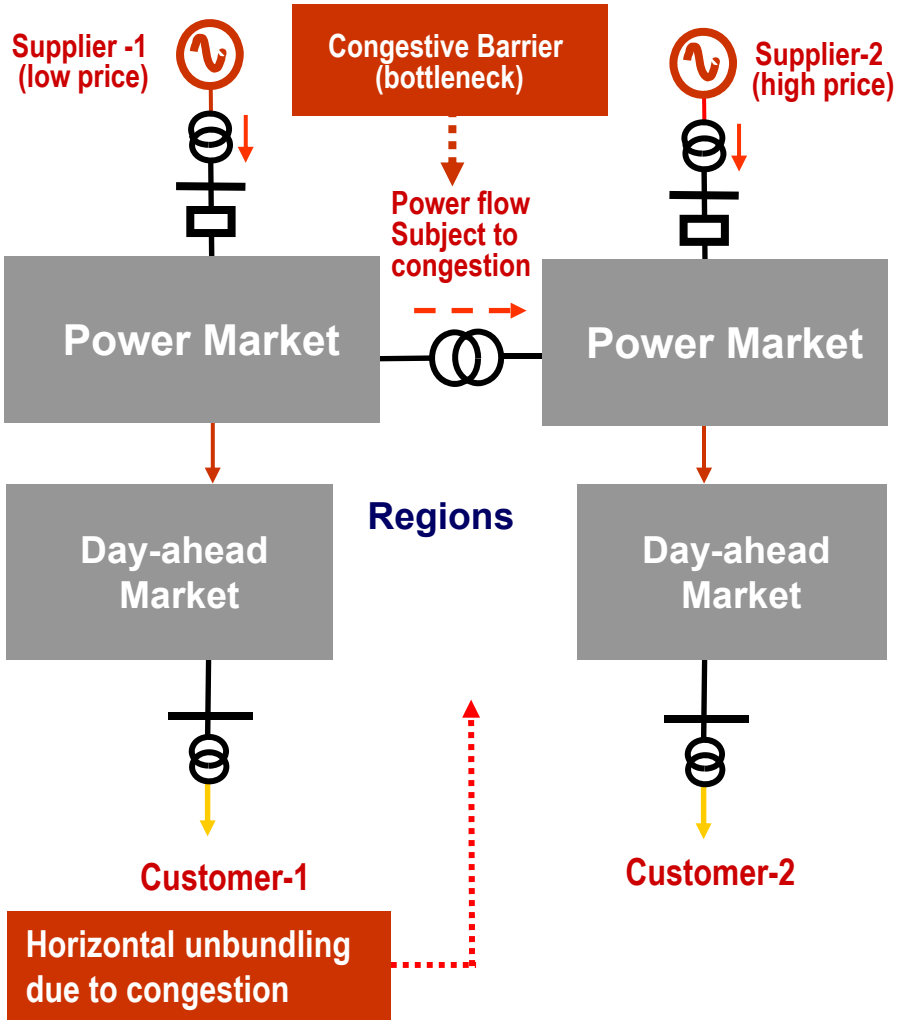
Can the transmission right of a transmission equipment be traded in a market ?

Answer: Yes

Suppose that power market is supplied by two suppliers which are effectively unbundled due to a congestion in the transmission system

Then, Load-2, will not be able to meet its demand from the cheap supplier-1

Hence, Load-2 will agree to pay a transmission charge for the equipment confronting congestion

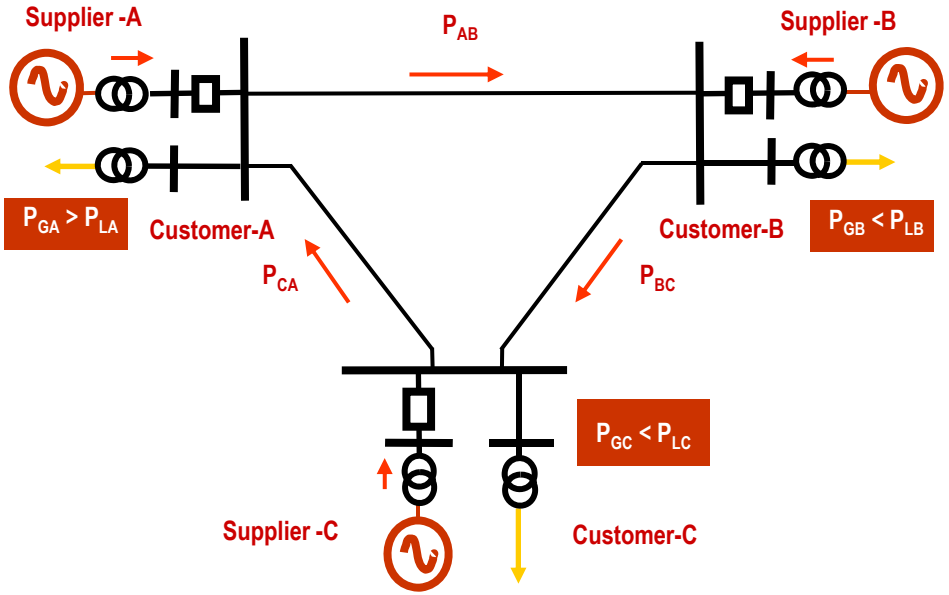


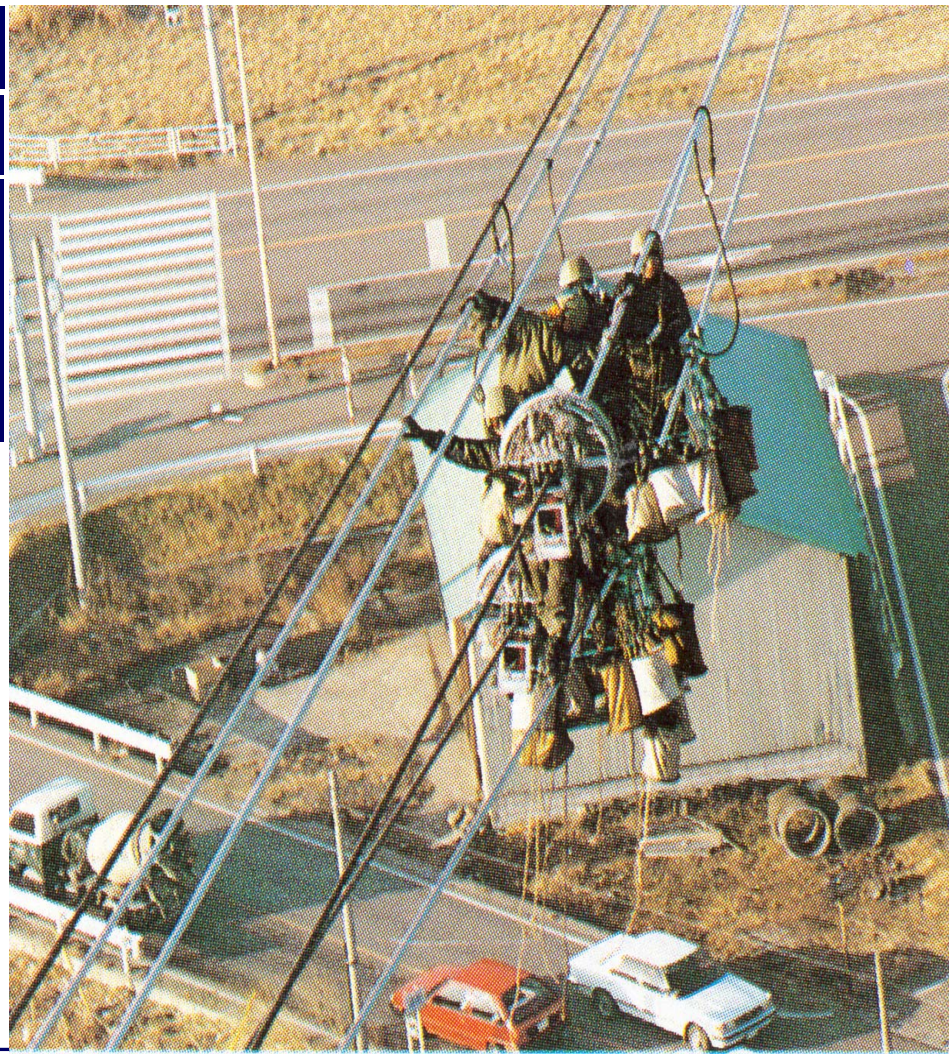
Kirchoff's Transmission Right (Voltage) Law

Basic Rule of Power System Operation

Consider the following three bus system

Power always flows from a region with generation exceeding consumption, to another region with generation less than consumption





Transmission Business

Kirchoff's Transmission Right (Voltage) Law

Consider the three bus system shown on the RHS

Transmission right prices from Bus A to B, Bus B to C, Bus C to A are charged separately

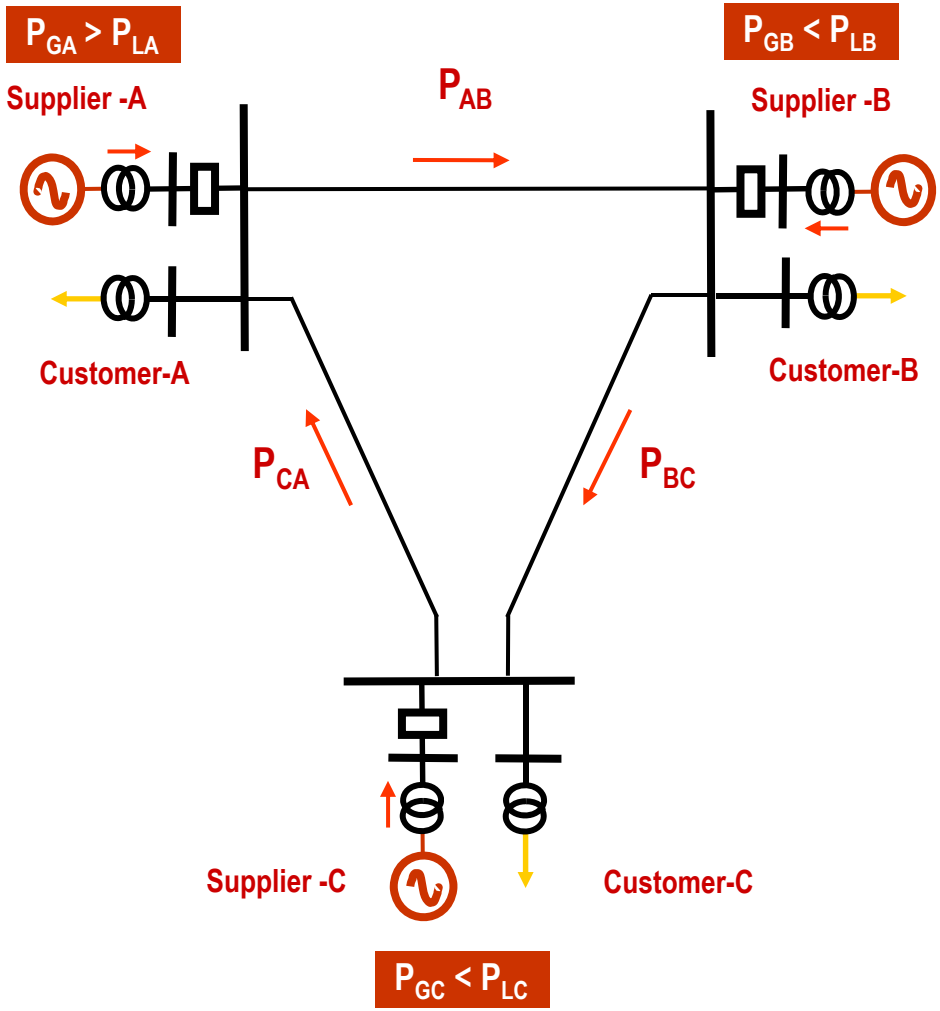
Then,

$$C_{PAB} + C_{PBC} + C_{PCA} = 0$$

or

$$\Sigma C_{km} = 0$$

where, C_{PAB} , C_{PBC} , C_{PCA} are transmission charges for power transfers from Bus A to B, Bus B to C, Bus C to A, respectively



Transmission Business

Kirchoff's Transmission Right (Voltage) Law

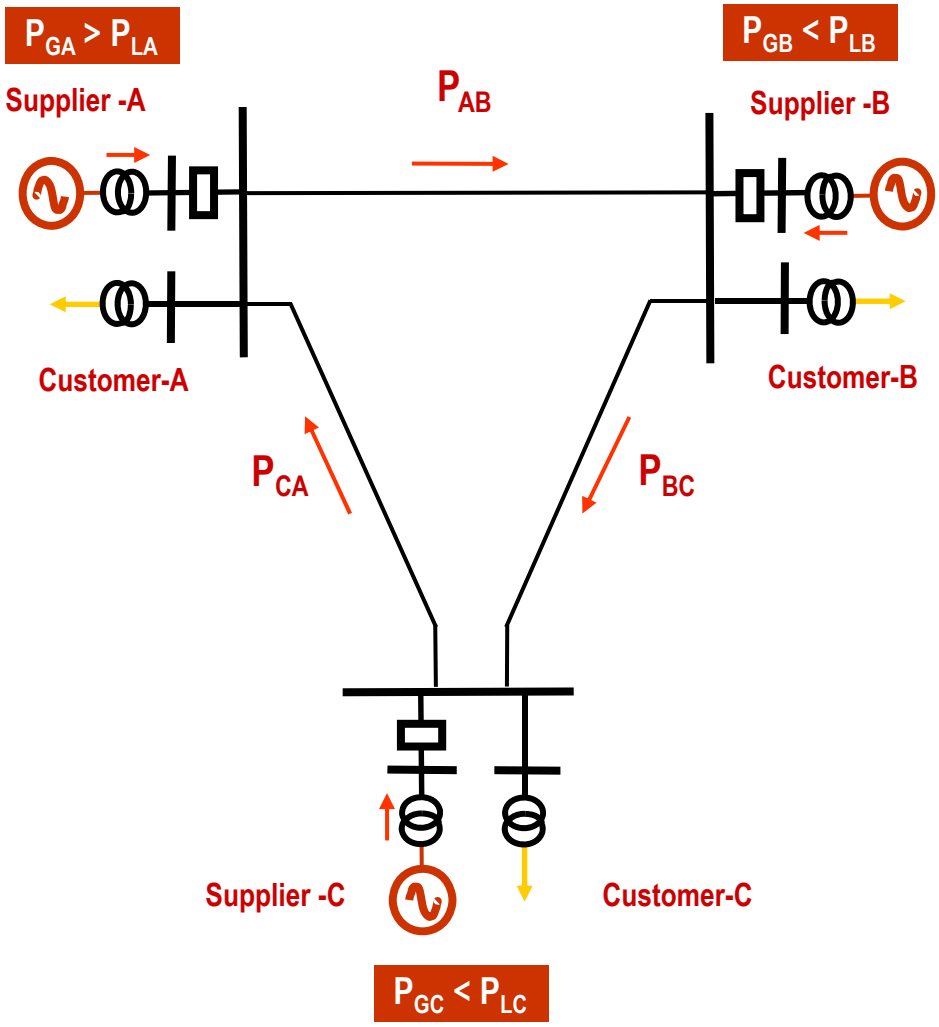
$$\Sigma C_{km} = 0$$

The above equation, known as Kirchoff's Transmission Right Law (KTRL)

KTRL states that Transmission System Operator (TSO) should earn nothing from transmission system congestion pricing

In principle, TSO should return the earnings obtained from a power transfer activity to another so that net sum is zero

In practice however, TSO sets prices zero for power transfer activities, which need to be paid



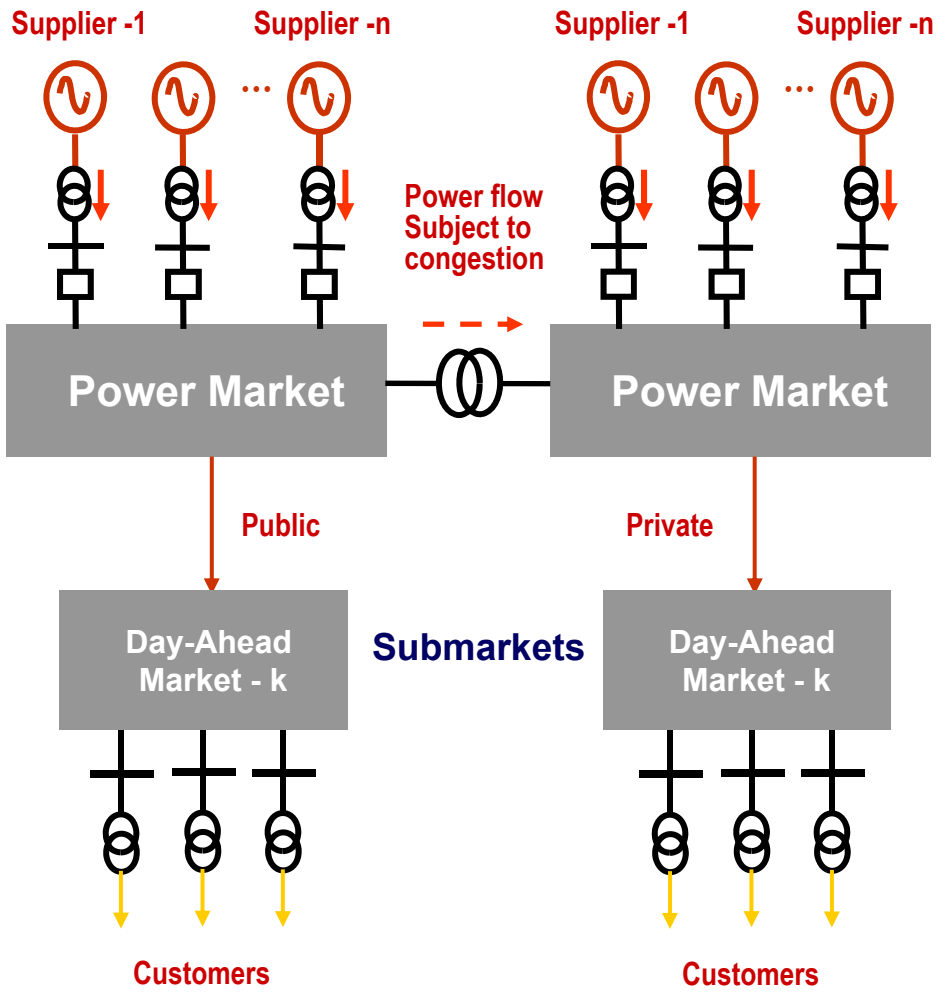
Transmission Business

Energy Market vs Transmission Right Market

Which is more appropriate ?

The answer to this question is rather ideological, and the same as the question;
"should public have a role in market ?"

Market architectures with system operators operating **"energy market"** are of more public governed nature, while those with the system operators operating only **"transmission right market"** are more liberal



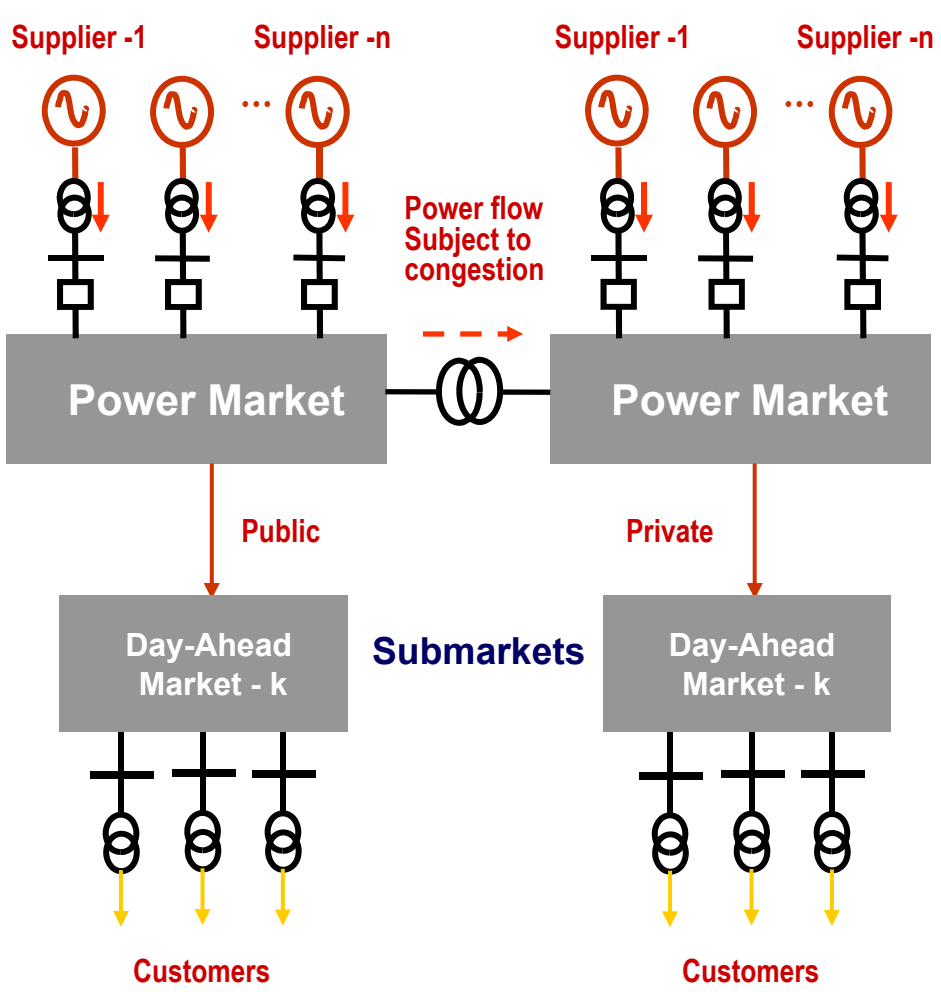
Transmission Business

Energy Market vs Transmission Right Market

Which is more appropriate ?

A system operator, i.e. the public owned organization operating the "energy market";

- performs direct commodity trading, i.e. it purchases and sell electrical commodities,
- Bids and offers to regulate the prices,
- is an integral part of the market, i.e. it is a market participant



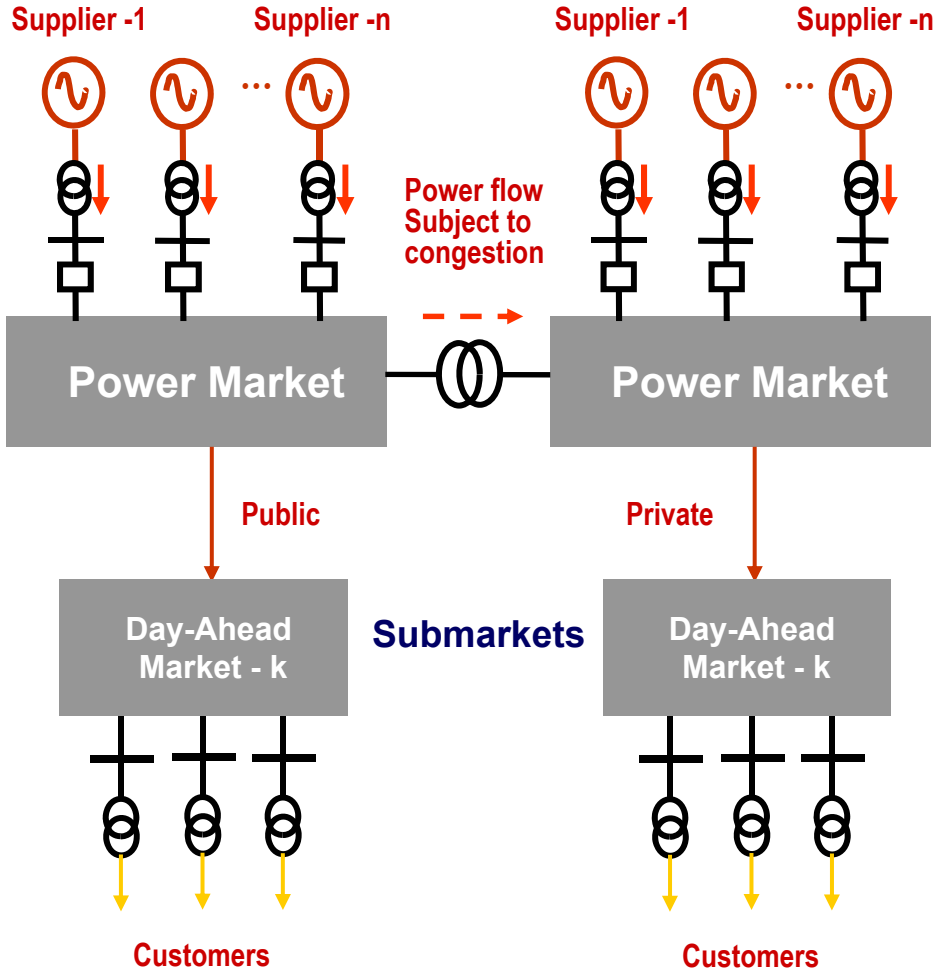
Transmission Business

Energy Market vs Transmission Right Market

Which is more appropriate ?

A system operator, i.e. the public owned organization operating only the **"transmission right market"** on the other hand;

- does not intervene prices and agreements between supply and demand,
- provides only an infrastructural service to market participants to realize committments in their agreements

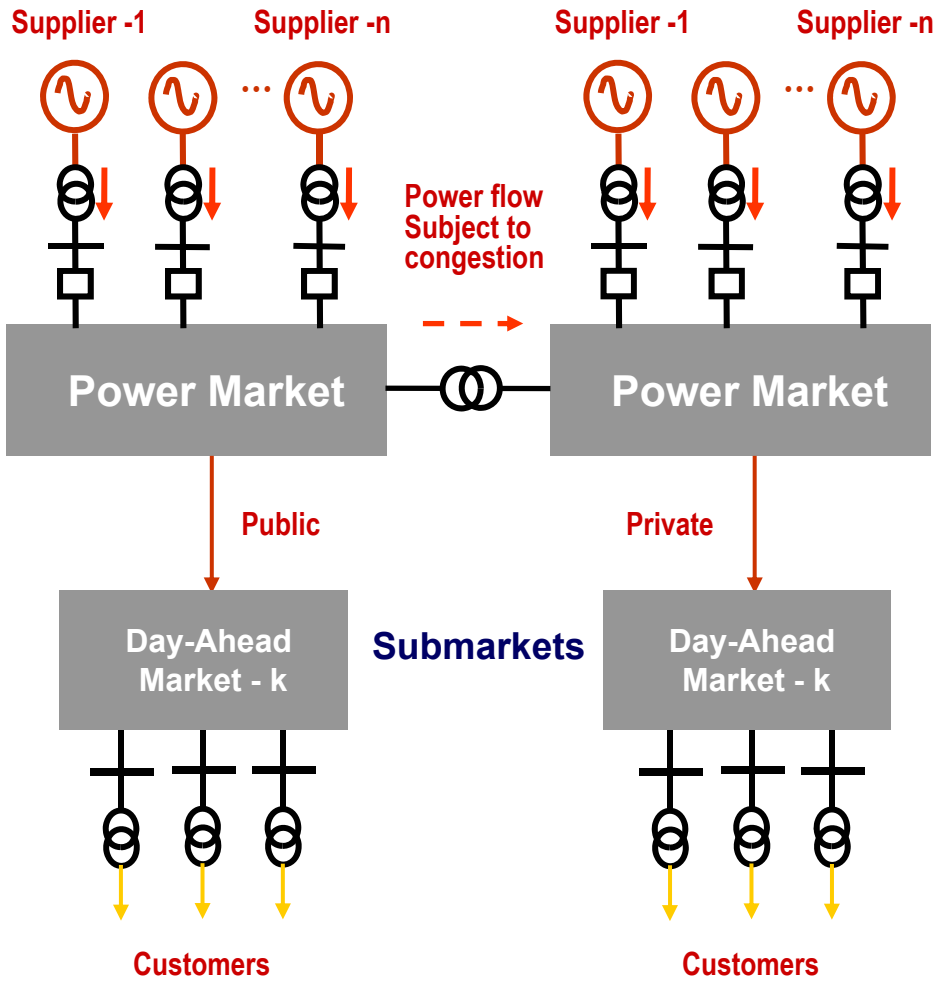


Transmission Business

Examples to Energy and Transmission Right Markets

Classical "Pool Architecture" is a perfect example for markets, where system operator, i.e. the public owned organization is an integral part of the market, i.e. it purchases and sell power, in other words, it is a market participant

Classical "Pool Architecture" has lost its popularity in Europe and World since it is more open to fraud



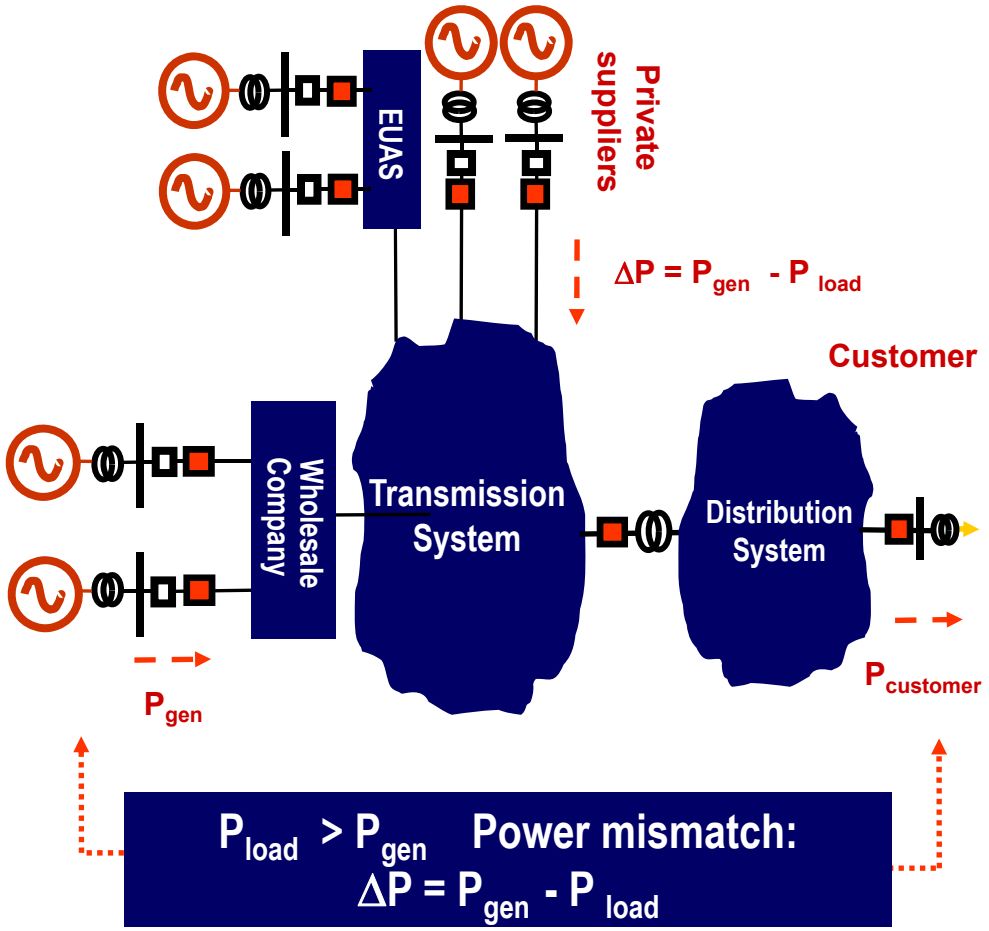
Transmission Business

Should Balancing Market be an Energy Market or a Transmission Right Market ?

Answer

The answer is not so obvious;
In balancing market architectures, where the system operator, operating the "energy market", a public owned organization takes over the responsibility of regulating the real-time (spot) prices in the Balancing Market

Example:
Turkish Case: TETAS took over the responsibility of performing trading and regulating the real-time (spot) prices in the Balancing Market



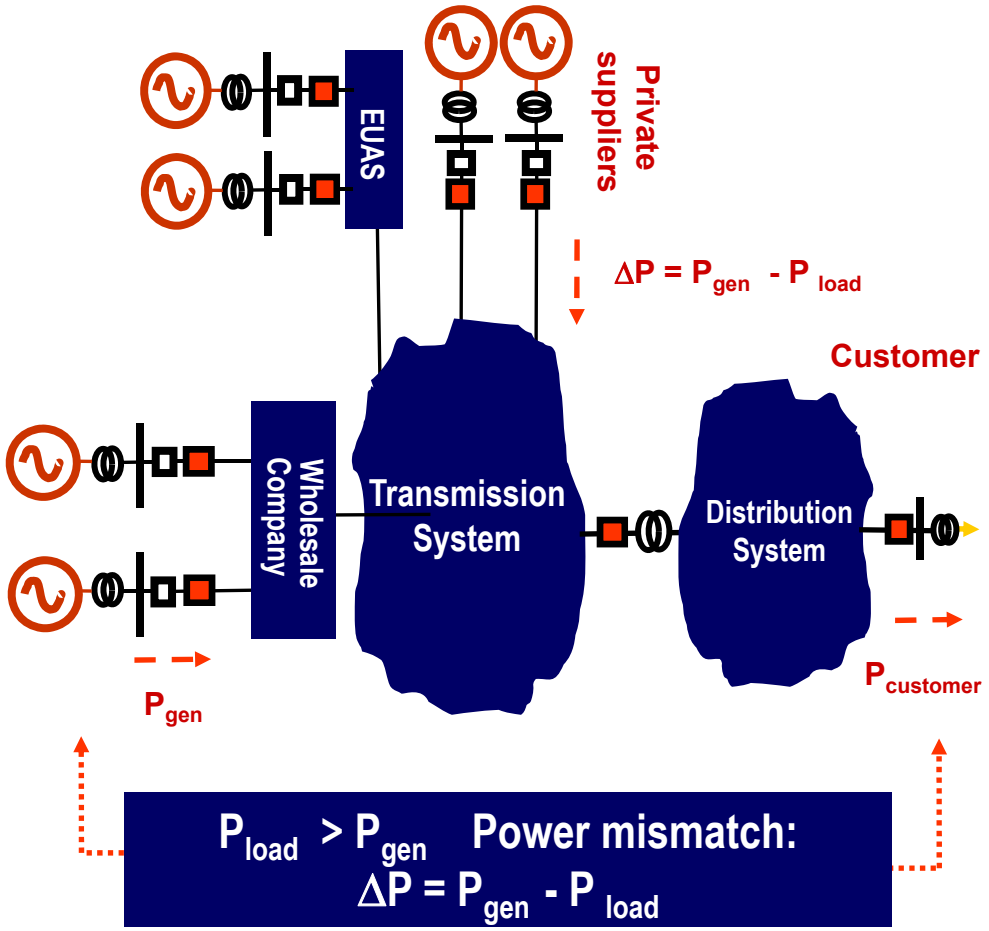
Transmission Business

Should Balancing Market be an Energy Market or a Transmission Right Market ?

Answer

In balancing market architectures, where the system operator, operating the only "Transmission Right Market", on the other hand, the public owned organization provides only an infrastructural service in order the market participants to realize committments in their agreements in Balancing Market

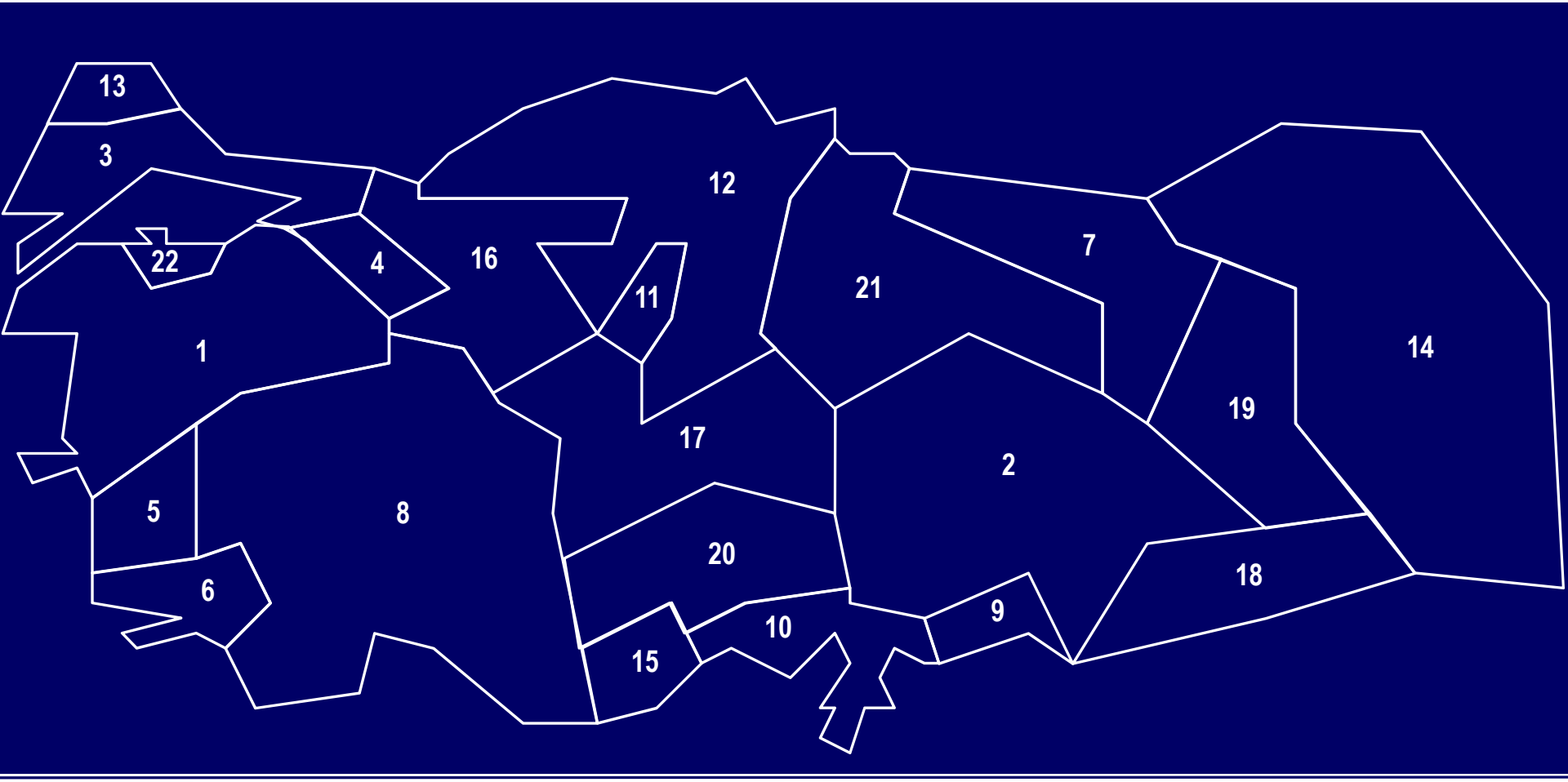
Example:
Turkish Case: Commercial rights of TETAS will expire at the end of five-year preparatory period, and market participants will take over the duty



Comparison of Transmission Right Pricing Methods

How does TSO try to realize the above objectives ?

Regions of TEIAS



Transmission Business

Comparison of Transmission Right Pricing Methods

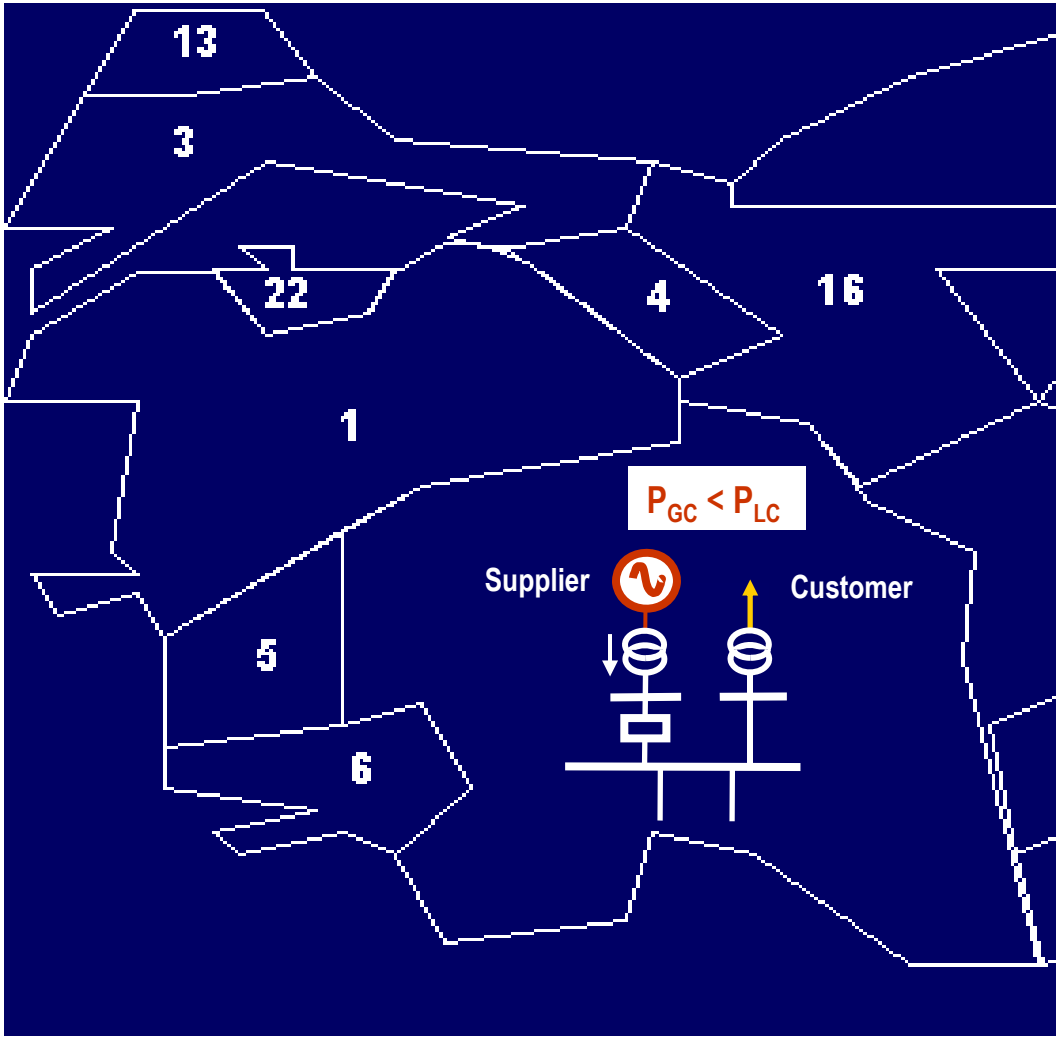
How does TSO realize the above objectives ?

By imposing penalty and incentives;

TSO will impose penalty terms upon the tariffs of those;

- **customers in the congested regions, where consumption exceeds generation,**
- **generators in the congested regions, where generation exceeds consumption**

Similarly, incentive terms will be imposed upon the tariffs for the opposite cases



Comparison of Transmission Right Pricing Methods

BÖLGESEL BAZDA İLETİM TARİFESİ				
BÖLGE	ÜRETİM (*)		TÜKETİM (*)	
	Sistem Kullanım Tarifesi YTL/MW-Yıl	Sistem İşletim Tarifesi YTL/MW-Yıl	Sistem Kullanım Tarifesi YTL/MW-Yıl	Sistem İşletim Tarifesi YTL/MW-Yıl
1	16.664,70	253,69	5.885,75	253,69
2	10.574,67	253,69	13.465,22	253,69
3	7.440,87	253,69	15.340,48	253,69
4	1.605,33	253,69	20.079,36	253,69
5	11.538,90	253,69	8.827,40	253,69
6	19.603,06	253,69	1.865,29	253,69
7	76,44	253,69	26.730,69	253,69
8	1.899,69	253,69	17.726,62	253,69
9	5.300,70	253,69	15.402,55	253,69
10	76,44	253,69	18.555,31	253,69
11	5.026,67	253,69	12.642,94	253,69
12	6.958,01	253,69	19.538,03	253,69
13	10.751,91	253,69	14.263,47	253,69
14	76,44	253,69	39.070,65	253,69
15	76,44	253,69	27.613,38	253,69
16	10.699,88	253,69	14.461,70	253,69
17	9.551,52	253,69	13.677,77	253,69
18	76,44	253,69	27.009,85	253,69
19	76,44	253,69	17.094,53	253,69
20	76,44	253,69	23.225,82	253,69
21	6.549,67	253,69	16.271,24	253,69
22	6.731,07	253,69	10.705,48	253,69
23 (**)	11.611,03	253,69	5.805,51	253,69
(*) Tarifelere İletim Ek Ücreti dahil Edilmiştir.				
(**) Üretim Kısmındaki Fiyatlar İthalata, Tüketim Kısmındaki Fiyatlar ise, ihracata Uygulanacak Tarifelerdir.				

Transmission Business

Comparison of Transmission Right Pricing Methods

Nodal Pricing

Nodal (Fixed Transmission Right) Pricing (TEIAS example) is applicable when;

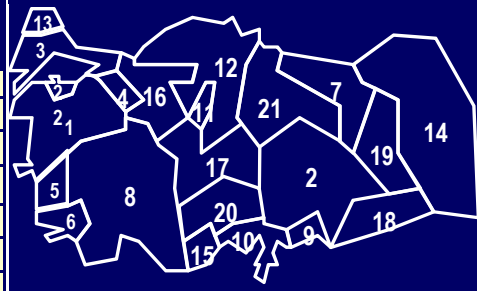
- the system is not yet fully or partially confronted with congestion, but it seems that in terms of the growing demand in the near future (within few ten months), it will,
- an immediate remedy is not yet needed, but a financial resource needs to be collected, in order to resolve the near problem

Fixed transmission tariff must be revised at least annually, in order to adapt the prices to the changing situation

TEIAS Example

Region	Generation		Consumption	
	System		System	
	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year
1	15.528.272.243	242.915.990	5.966.717.617	242.915.990
2	9.853.543.117	242.915.990	13.650.463.890	242.915.990
3	6.933.453.832	242.915.990	15.551.519.107	242.915.990
4	1.495.854.121	242.915.990	20.355.601.741	242.915.990
5	10.752.021.133	242.915.990	8.948.836.654	242.915.990
6	18.266.255.008	242.915.990	1.890.952.558	242.915.990
7	0	242.915.990	27.098.431.744	242.915.990
8	1.770.145.948	242.915.990	17.970.490.740	242.915.990
9	4.939.224.084	242.915.990	15.614.449.332	242.915.990
10	0	242.915.990	18.810.583.312	242.915.990
11	4.683.880.841	242.915.990	12.816.867.747	242.915.990
12	6.483.518.193	242.915.990	19.806.815.886	242.915.990
13	10.018.695.687	242.915.990	14.459.698.087	242.915.990
14	0	242.915.990	39.608.158.226	242.915.990
15	0	242.915.990	27.993.260.912	242.915.990
16	9.970.211.380	242.915.990	14.660.658.387	242.915.990
17	8.900.162.740	242.915.990	13.865.934.580	242.915.990
18	0	242.915.990	27.381.429.786	242.915.990
19	0	242.915.990	17.329.701.373	242.915.990
20	0	242.915.990	23.545.348.568	242.915.990
21	6.103.025.755	242.915.990	16.495.085.538	242.915.990
22	6.272.052.534	242.915.990	10.852.753.584	242.915.990

Regions in TEIAS Transmission System



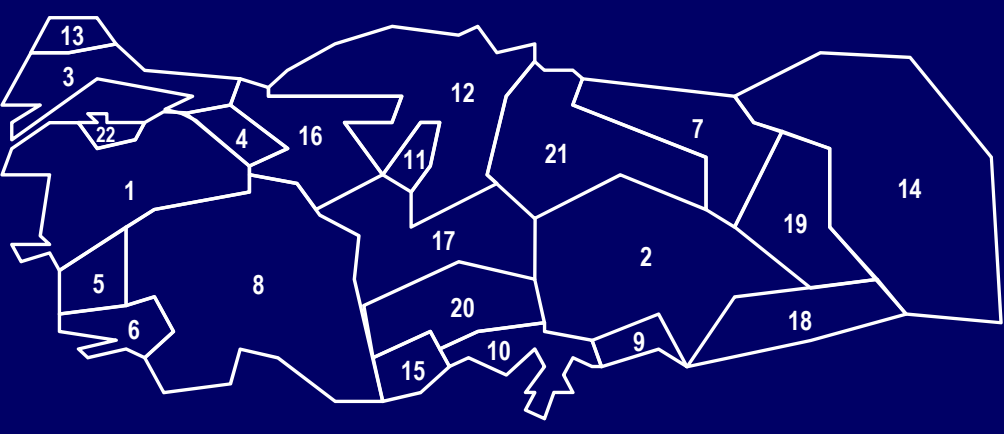
To find the overhead on electricity prices in Cent / kWh, divide these figures by 1000 kW / MW, then divide by 8765 Hours / year, multiply by 1 400 000 USD / TL, then multiply by 100 Cent / USD

System Usage Fee: Fee for using the capacity of transmission system infrastructure,
System Operation Fee: Fee for using system operation services, such as BSC task, etc.

Transmission Business

Comparison of Transmission Right Pricing Methods

Nodal Pricing



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System Usage Fee: *Fee for using the capacity of transmission system infrastructure,*

System Operation Fee: *Fee for using system operation services, such as BSC task, etc.*

Region	Generation System		Consumption System	
	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year
1	15.528.272.243	242.915.990	5.966.717.617	242.915.990
2	9.853.543.117	242.915.990	13.650.463.890	242.915.990
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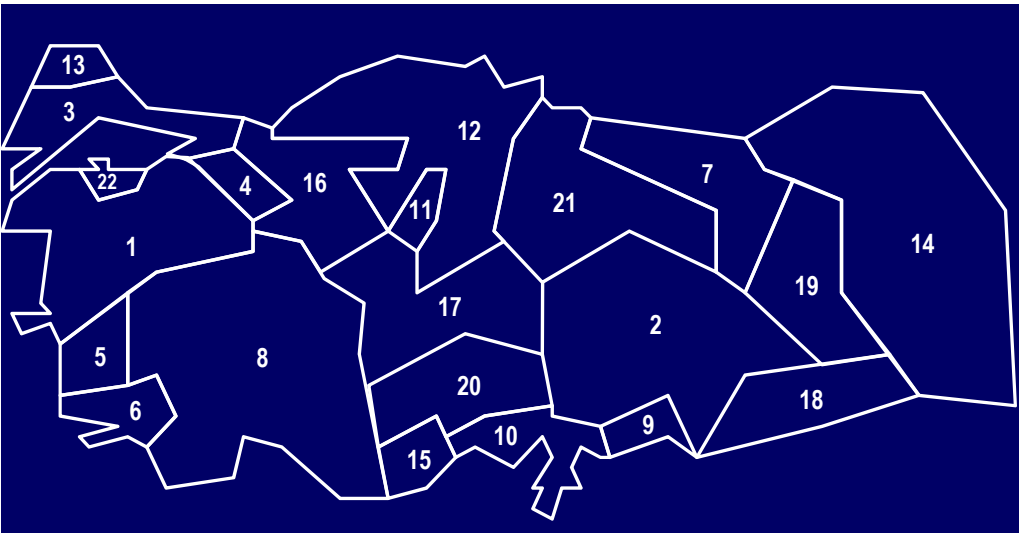
Transmission Business

Comparison of Transmission Right Pricing Methods

Nodal Pricing



Please note that in regions, where generation is deficient, system usage fee set to is zero in order to encourage investors for generating plant investments and set to a large (almost double) value for customers in order to discourage

Region	Generation		Consumption	
	System		System	
	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year
6	18.266.255.008	242.915.990	1.890.952.558	242.915.990
7	0	242.915.990	27.098.431.744	242.915.990
8	1.770.145.948	242.915.990	17.970.490.740	242.915.990
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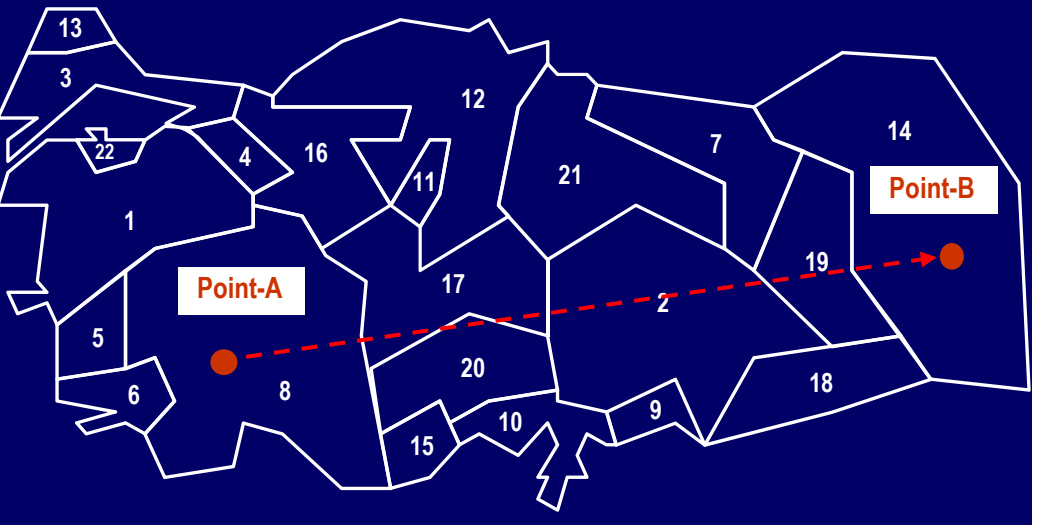
Transmission Business

Comparison of Transmission Right Pricing Methods

Nodal Pricing



Total overhead on price = 0.34036 Cent / kWh

Transmission System Invesments

Investments made in the transmission system is financed by the Transmission Fee given in the table in the previous page

Example:

Transmission Fee for power transfer from Region 8 to Region 14 comes out to be;

For Generation in Region 8:

System Usage = 0.0144 Cent / kWh
System Operation = 0.00198 Cent / kWh

For Consumption in Region 14:

System Usage = 0.3220 Cent / kWh
System Operation = 0.00198 Cent / kWh

Comparison of Transmission Right Pricing Methods

Variable Transmission Pricing

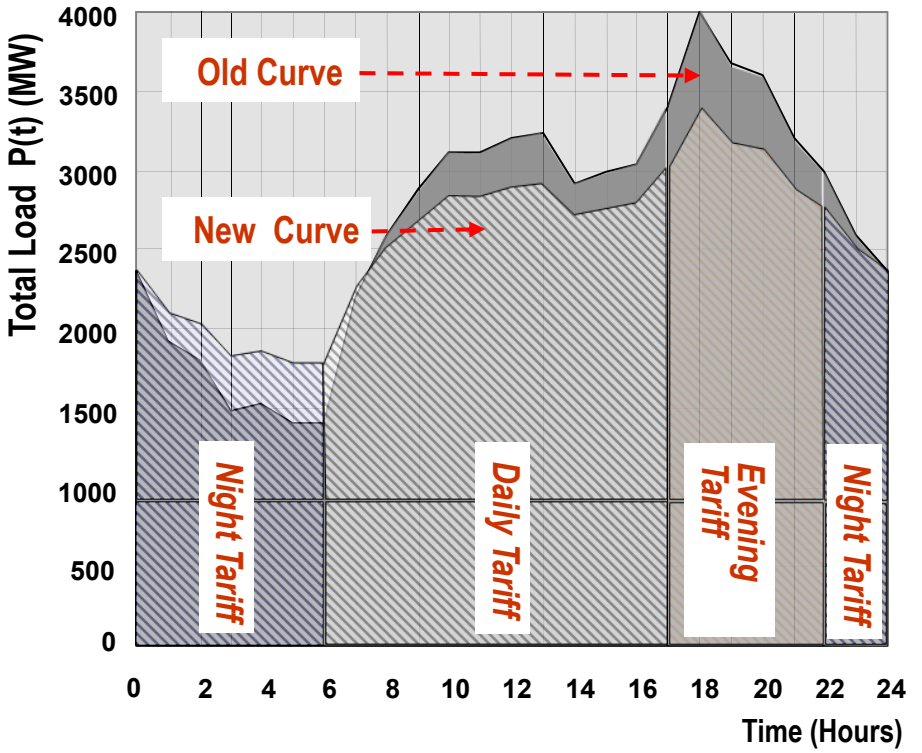
Variable transmission right pricing method is applicable when;

- the system is not yet confronted with full or partial congestion, it is in the verge of congestion,
- Hence, an immediate remedy is not needed, but congestion must be retarded by employing a time-varying transmission tariff in order to discourage the demands causing congestion

Variable transmission tariff must be revised at least annually, in order to adapt the prices to the changing situation

Variable Transmission Tariff

Evening (17:00-22:00) (Cent/kWh)	Night (22:00-06:00) (Cent/kWh)	Daily (06:00-17:00) (Cent/kWh)
0.520	0.244	0.340



Comparison of Transmission Right Pricing Methods

Auction for Transmission Rights

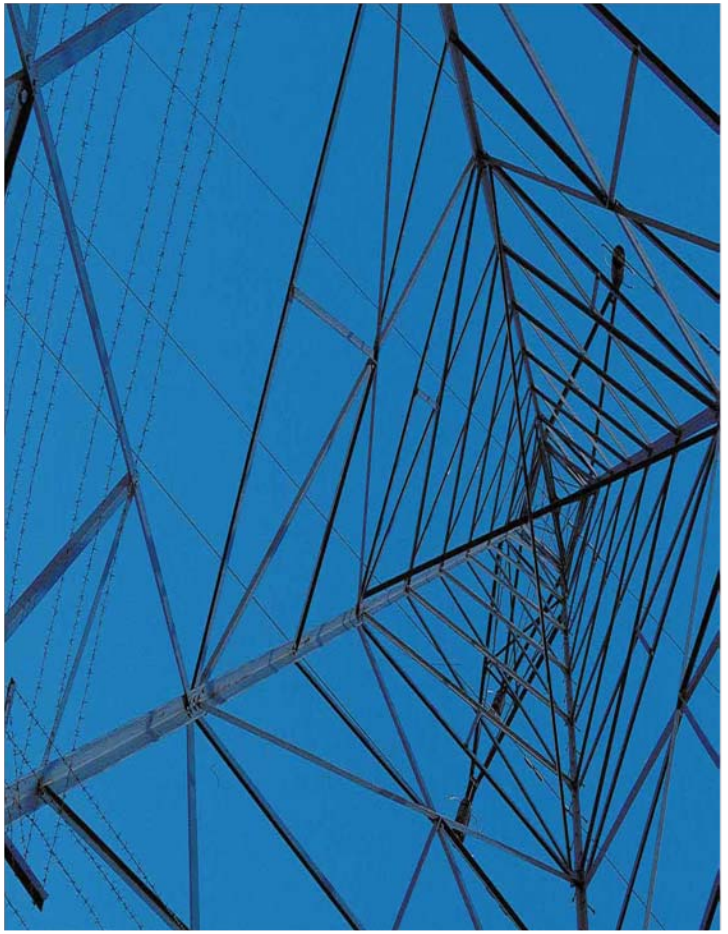
Auction for transmission right is applicable when;

- the system is confronted with full or partial congestion,
- hence an immediate solution is needed, and there is no immediate solution, except auction

Transmission right is granted to party, who offers the highest transmission price for that period

Revenue obtained from the auction;

- must not be regardes as a profit,
- but must be invested back for resolving the congestion problem

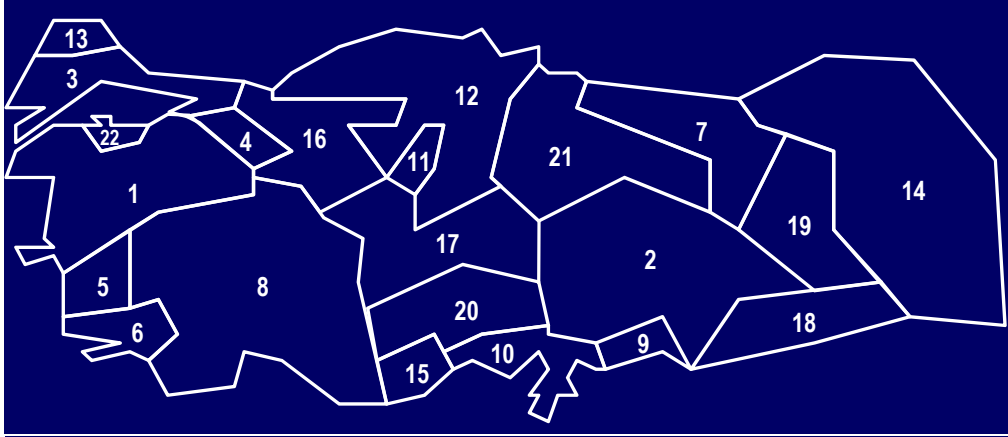


Transmission Business

Transmission Fee

Region	Generation System		Consumption System	
	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year
1	15.528.272.243	242.915.990	5.966.717.617	242.915.990
2	9.853.543.117	242.915.990	13.650.463.890	242.915.990
3	6.933.453.832	242.915.990	15.551.519.107	242.915.990
4	1.495.854.121	242.915.990	20.355.601.741	242.915.990
5	10.752.021.133	242.915.990	8.948.836.654	242.915.990
6	18.266.255.008	242.915.990	1.890.952.558	242.915.990
7	0	242.915.990	27.098.431.744	242.915.990
8	1.770.145.948	242.915.990	17.970.490.740	242.915.990
9	4.939.224.084	242.915.990	15.614.449.332	242.915.990
10	0	242.915.990	18.810.583.312	242.915.990
11	4.683.880.841	242.915.990	12.816.867.747	242.915.990
12	6.483.518.193	242.915.990	19.806.815.886	242.915.990
13	10.018.695.687	242.915.990	14.459.698.087	242.915.990
14	0	242.915.990	39.608.158.226	242.915.990
15	0	242.915.990	27.993.260.912	242.915.990
16	9.970.211.380	242.915.990	14.660.658.387	242.915.990
17	8.900.162.740	242.915.990	13.865.934.580	242.915.990
18	0	242.915.990	27.381.429.786	242.915.990
19	0	242.915.990	17.329.701.373	242.915.990
20	0	242.915.990	23.545.348.568	242.915.990
21	6.103.025.755	242.915.990	16.495.085.538	242.915.990
22	6.272.052.534	242.915.990	10.852.753.584	242.915.990

Regions in TEIAS Transmission System



To find the overhead on electricity prices in Cent / kWh, divide the figures in the table by 1000 kW / MW, then divide by 8765 Hours / year, multiply by 1 400 000 USD / TL, then multiply by 100 Cent / USD

System Usage Fee: *Fee for using the capacity of transmission system infrastructure,*

System Operation Fee: *Fee for using system operation services, such as BSC task, etc.*

Transmission Business

Transmission Fee

Region	Generation System		Consumption System	
	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year
6	18.266.255.008	242.915.990	1.890.952.558	242.915.990
7	0	242.915.990	27.098.431.744	242.915.990
8	1.770.145.948	242.915.990	17.970.490.740	242.915.990
9	4.939.224.084	242.915.990	15.614.449.332	242.915.990
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13	10.018.695.687	242.915.990	14.459.698.087	242.915.990
14	0	242.915.990	39.608.158.226	242.915.990
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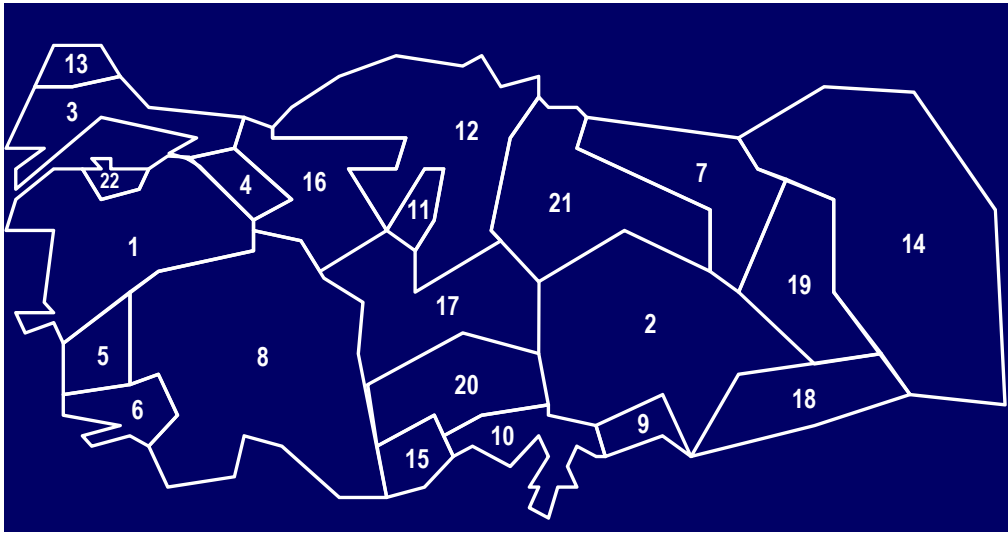
Regions in TEIAS Transmission System



Please note that in regions, where generation is deficient, system usage fee set to is zero in order to promote investors for generating plant investments and set to a large (almost double) value for consumers in order to discourage

Transmission Business

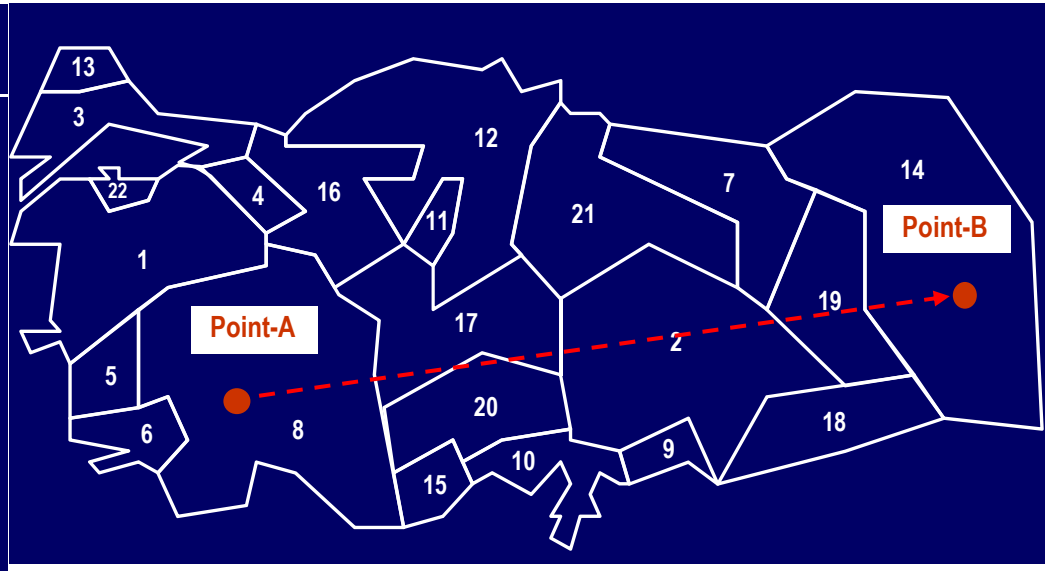
The Effect of Transmission Fee on Price

Transmission System Invesments

Investments made in the transmission system is financed by the transmission fee given in the table in the previous page

Example:

Transmission fee for power transfer from Region 8 to Region 14 comes out to be;



For Generation in Region 8:

System Usage = 0.0144 Cent / kWh
System Operation = 0.00198 Cent / kWh

For Consumption in Region 14:

System Usage = 0.3220 Cent / kWh
System Operation = 0.00198 Cent / kWh

Total overhead on tariff = 0.34036 Cent / kWh

Transmission Business

Transmission Right Pricing

Methods

Transmission right market may employ;

- **Fixed transmission right pricing (TEIAS example),**
- **Variable pricing with respect to hourly, daily, seasonal and annual loading conditions,**
- **auction**

TEIAS Example

Region	Generation		Consumption	
	System		System	
	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year	Usage Fee TL/MW-Year	Operation Fee TL/MW-Year
1	43	242.915.990	5.966.717.617	242.915.990
2	9.853.543.117	242.915.990	13.650.463.890	242.915.990
3	6.933.453.832	242.915.990	15.551.519.107	242.915.990
4	1.495.854.121	242.915.990	20.355.601.741	242.915.990
5	10.752.021.133	242.915.990	8.948.836.654	242.915.990
6	18.266.255.008	242.915.990	1.890.952.558	242.915.990
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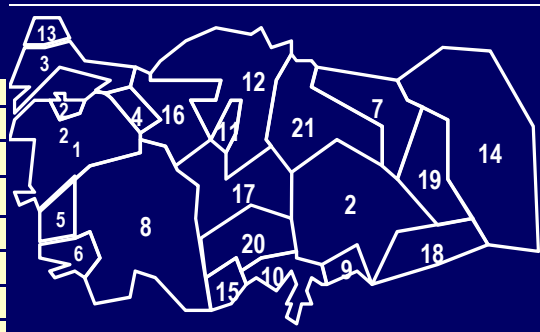
Regions in TEIAS Transmission System



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System Usage Fee: Fee for using the capacity of transmission system infrastructure,

System Operation Fee: Fee for using system operation services, such as BSC task, etc.

Transmission Business

Transmission Charges

Definition

Transmission charges are payments made by market participants for transmission services

Components of Transmission Charges

Transmission charging scheme is generally comprised of the following three components;

- **Transmission system usage charge,**
- **Transmission system connection charge,**
- **Transmission system access charge**

Transmission services are supplied (offered) by the system operator (regulated) and demand sides of these services (market) is competitive

Cross-Bosphorus Line

Transmission Business

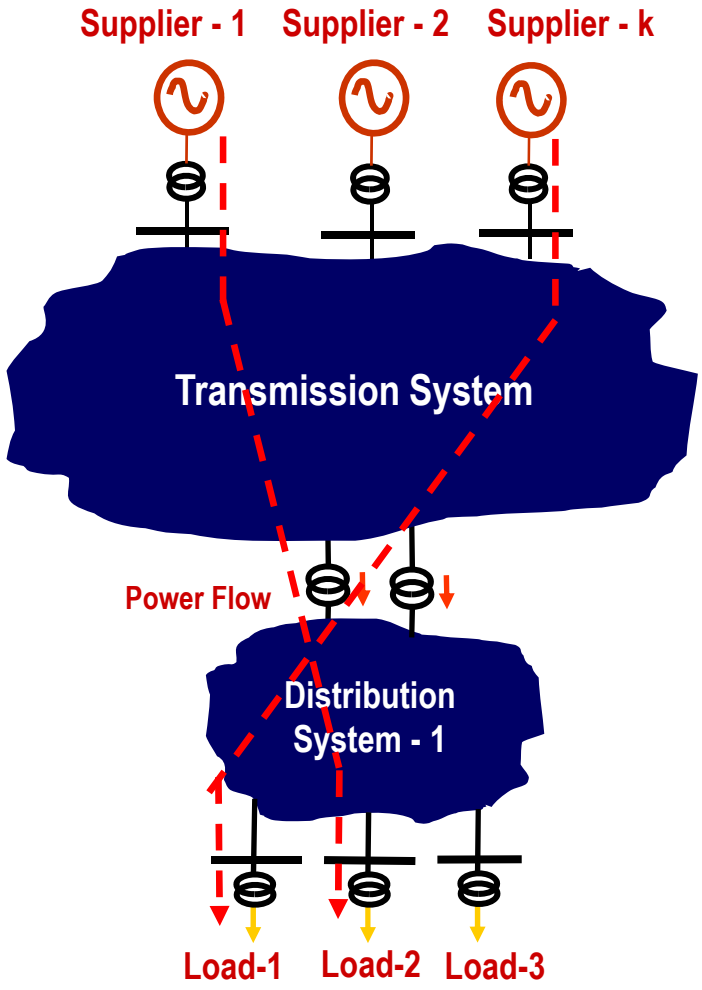
Transmission System Usage Charge

Definition

Each MWh wheeled through the system results in some some increase in system losses or overloading on the congested system element

Transmission system usage charge is a fee collected for these losses and overloadings from users on the basis of each MWh wheeled through the system

An efficient pricing system will charge the short-term marginal cost of transmission service

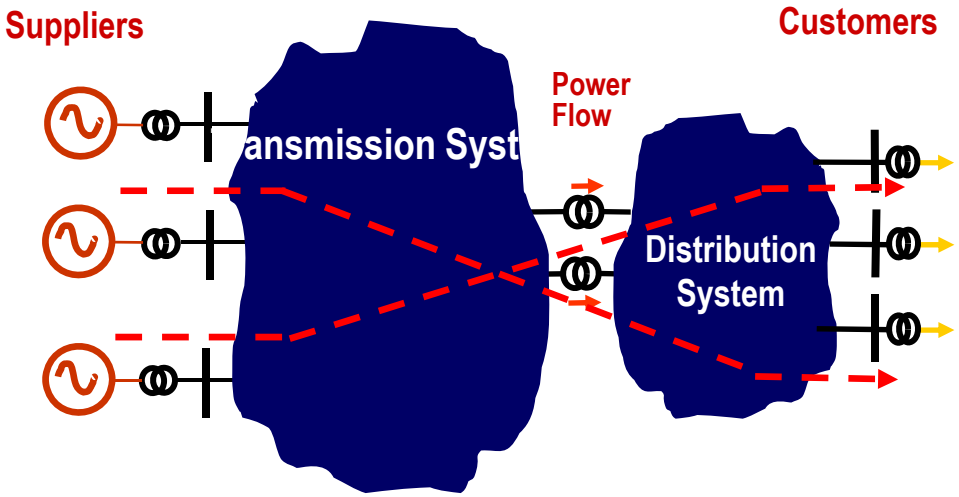


Transmission System Usage Charge

Components of Transmission System Usage Charge

Transmission system usage charge consists of the following two components;

- **Charge for the increase in transmission system losses,**
- **Charge for congestion**



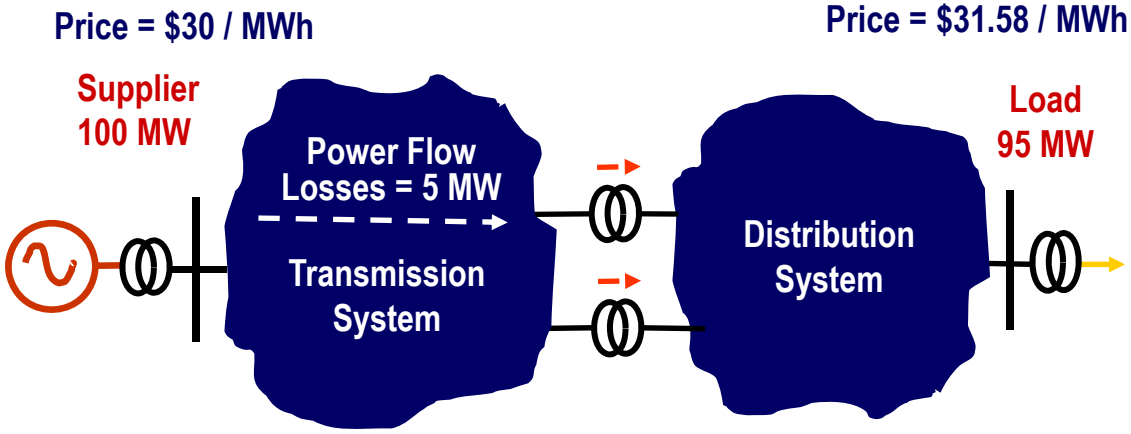
Charge for Transmission System Losses

Calculation of charge for system losses

Assuming that transmission system has 5 % loss;

$P_{supplied}$ = 100 MW,
$P_{received}$ = 95 MW

100 MW * $ 30 / MWh = 3000 $,
95 MW * $ 31.58 / MWh = 3000 $
Hence, Transmission Charge = 1.58 $ / MWh



Congestion Charge

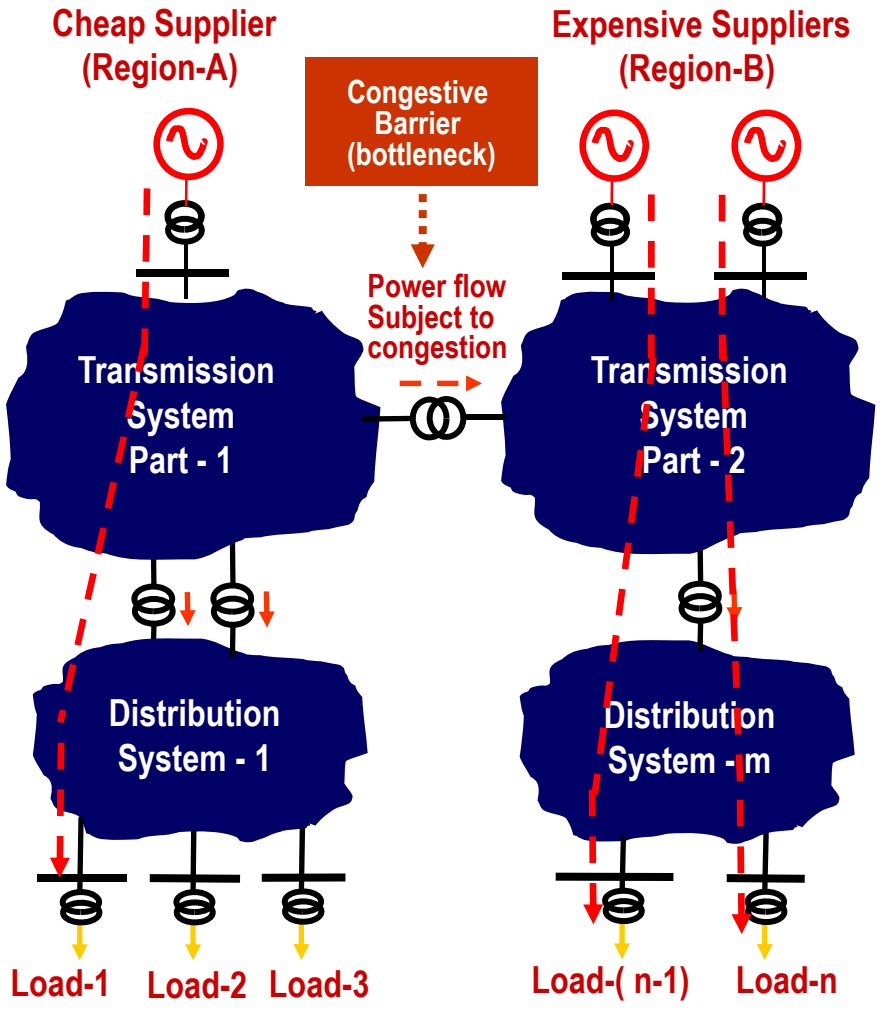
Solution to Congestion Problem

Supplier in Region-B must produce an extra MW to serve the load in Region-B and supplier in Region-A must generate a negative power, i.e. it must reduce down its output by one MW

Marginal cost of transaction may then be written as;

$$MC_{Transaction} = MC_B - MC_A$$

where, MC_B is the marginal cost of production of plant in Region – B, MC_A is the marginal cost of production plant in Region – A,



Transmission Business

Transmission System Connection Charge

Definition

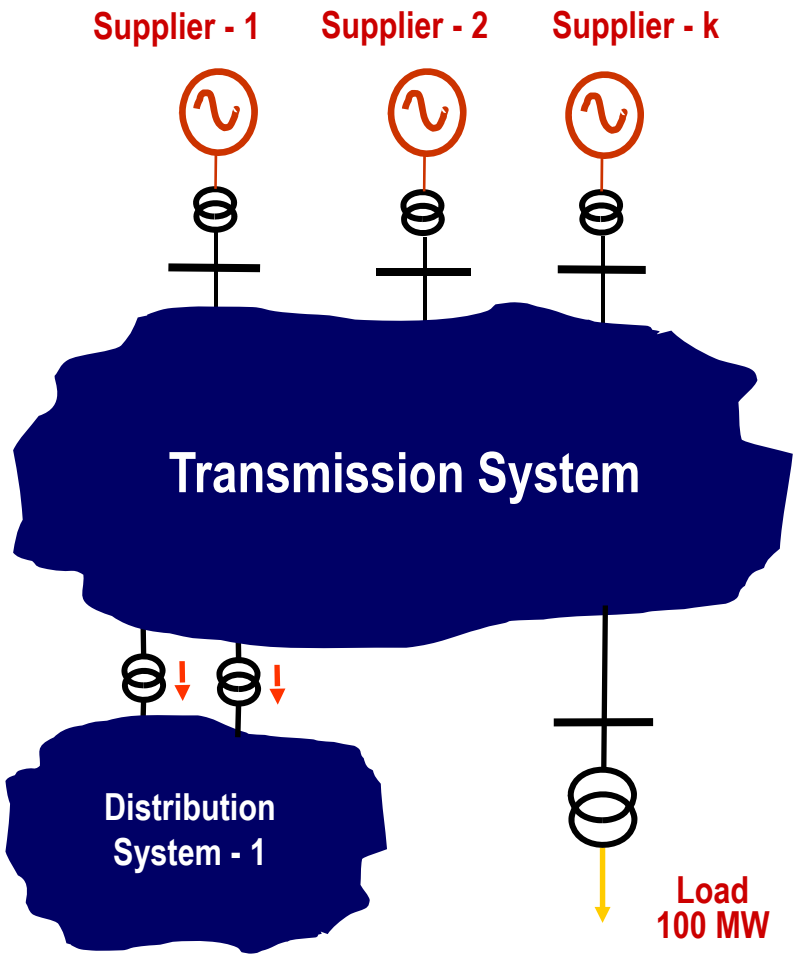
Transmission system connection charge is the fee collected from all parties who connect a generating plant and / or load (or distribution system) to the transmission system

Transmission system usage charge alone is usually not sufficient for recovering the heavy long-run investment costs of the transmission system

Hence, regulated transmission

- **connection,**
- **access**

charges are needed to recover rest



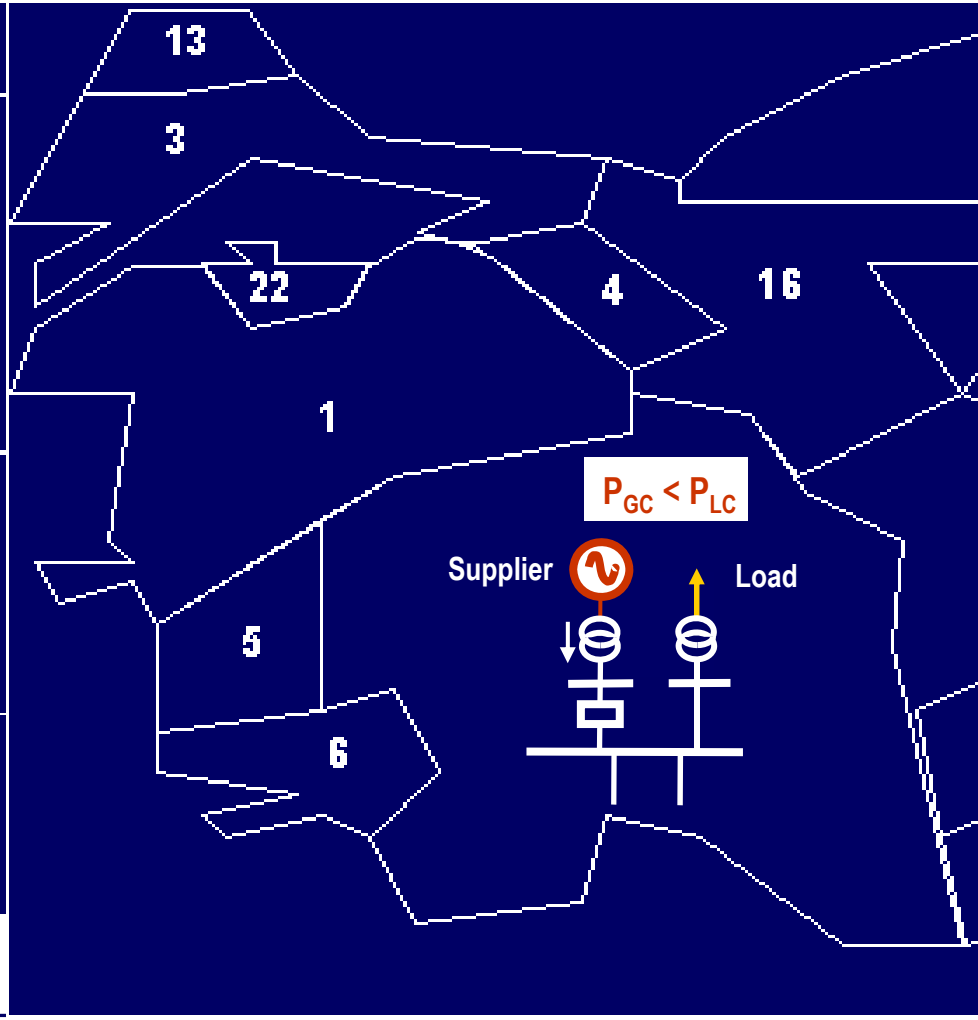
Transmission Business

Transmission System Connection Charge

Transmission system connection charge recover directly attributable long-run costs such as the cost of connecting a generator to the transmission system

Transmission system connection charge is dependent on the location of connection with respect to supply-demand balance in that location

Hence, connecting a generator to the system at a certain point may be quite different from that at another point



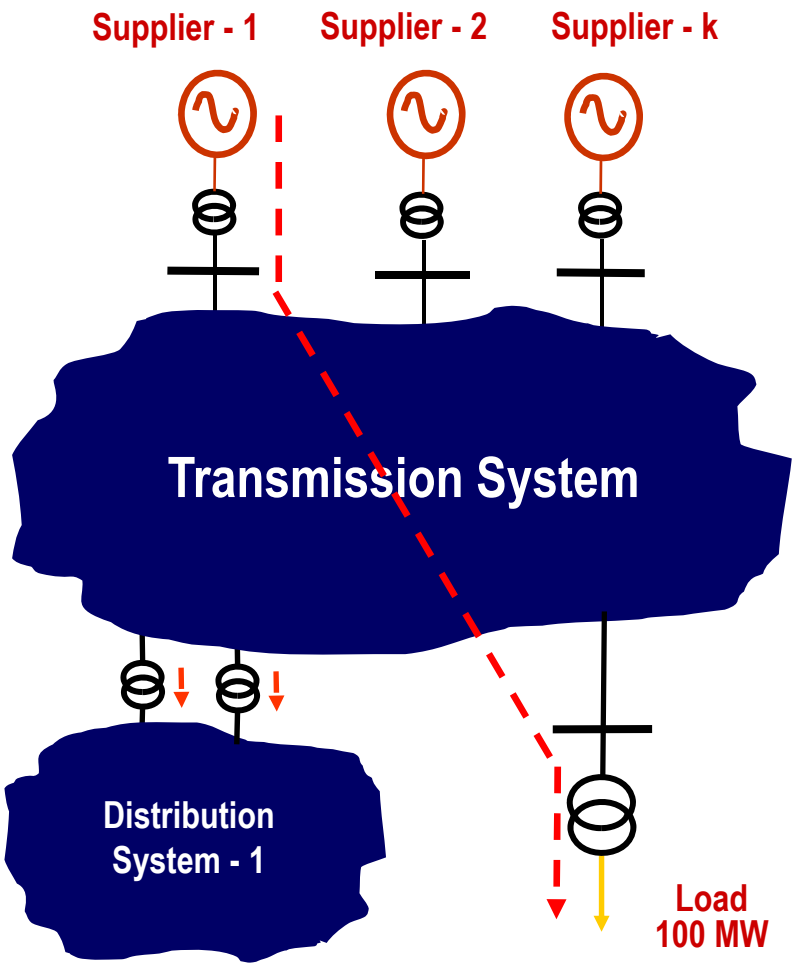
Transmission Business

Transmission System Access Charge

Definition

Transmission system access charge is the fee collected fairly on each MWh wheeled through the system from those parties who has made an agreement on that wheeling

Normally, transmission system access charge is assumed to be the most effectual instrument to recover the approved costs (by the Regulator) that are not recovered by the system usage and system connection charges

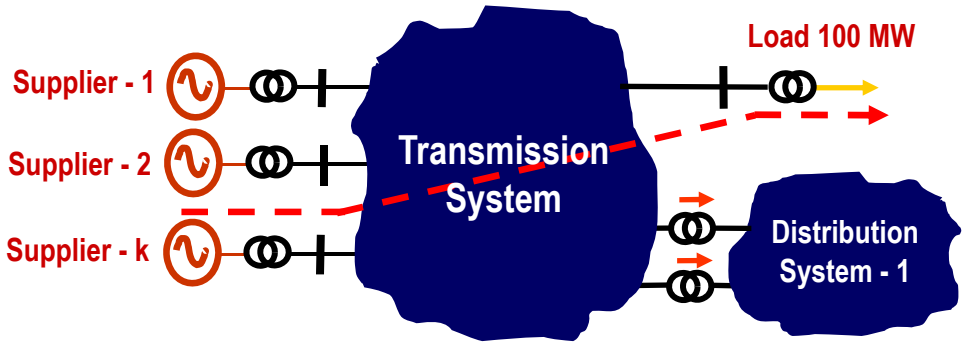


Transmission System Access Charge

Definition

Like transmission system usage and connection charges, the basis by which the transmission access charge is implemented is controversial and there is no perfect answer

The rules for implementing transmission system access charge should be simple and stable over the long-term

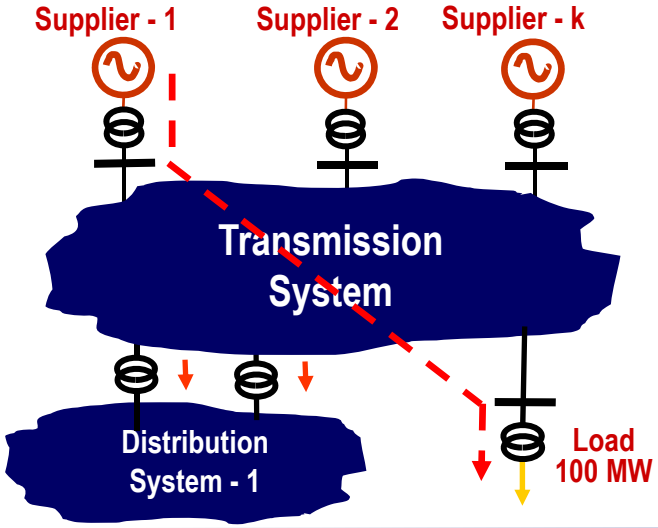


Transmission System Access Charge

Definition

Transmission access charges should be applied by compromising the two challenging objectives;

- Achieving fairness and long-term efficiency,
- While at the same time, not distorting the short-term efficiency

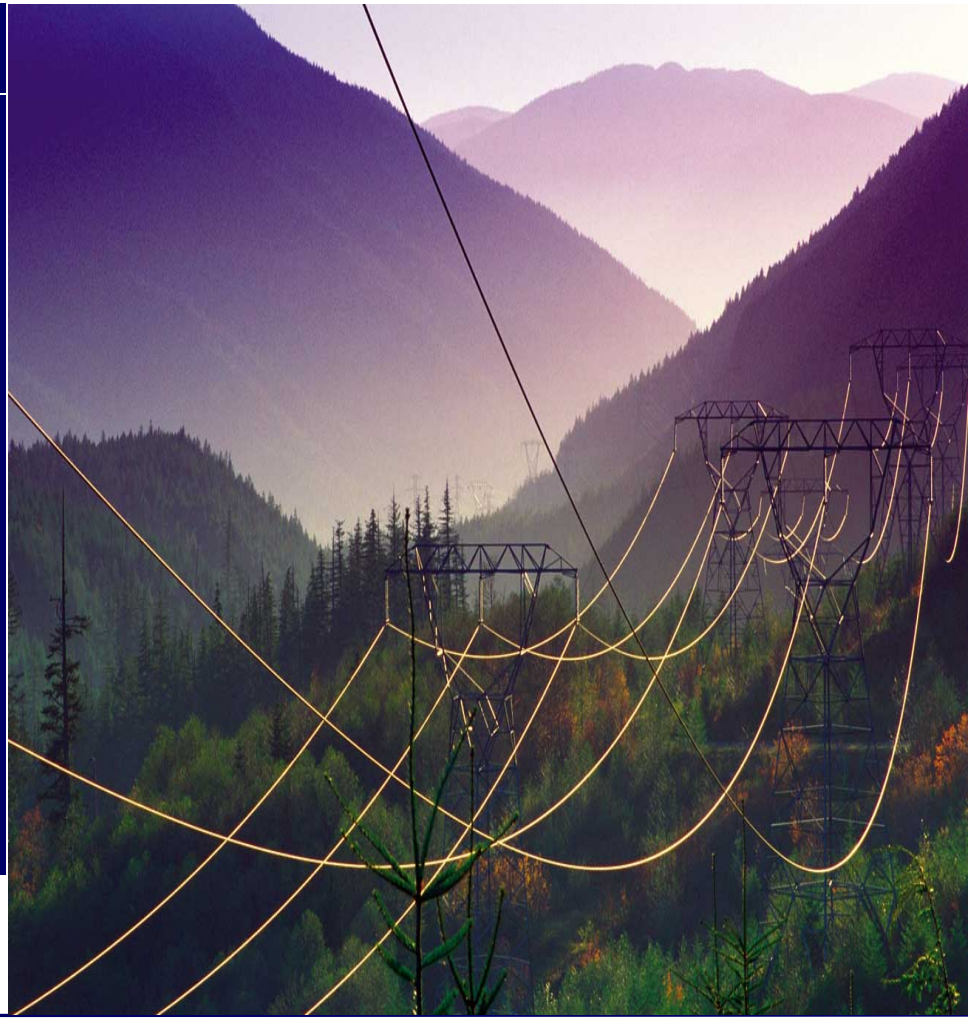


500 kV Submarine Cable

Transmission System Access Charge

Approaches

- End user customers are always the ultimate and the only source of revenue,
- Hence, it is quite simple to charge them,
- But, there is no perfect way to determine what locational system element if any, to incorporate the charge,
- A common and simple solution, is to have a single system wide rate, called "Postage Stamp Rate"

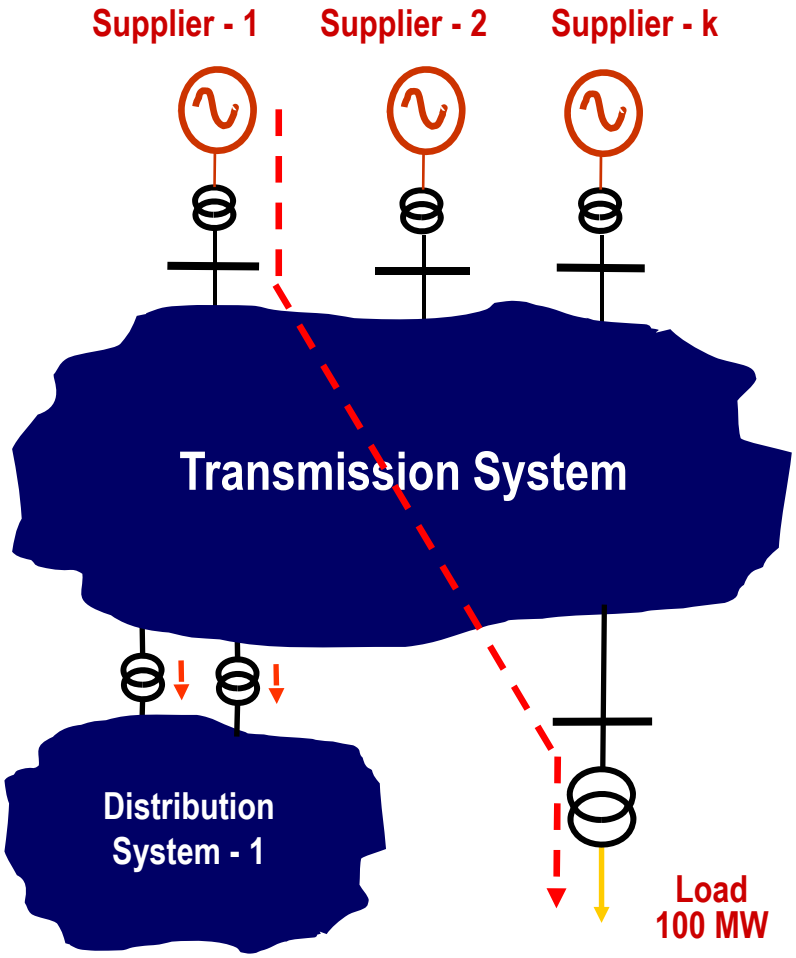


Transmission System Expansion

Importance of Transmission Expansion

Another important issue that market participants are most concerned is the transmission system expansion plans

Transmission system expansion plans can dramatically influence in either direction, the flexibility of the market participants in accessing the market and/or the price at which the electricity will be sold or bought

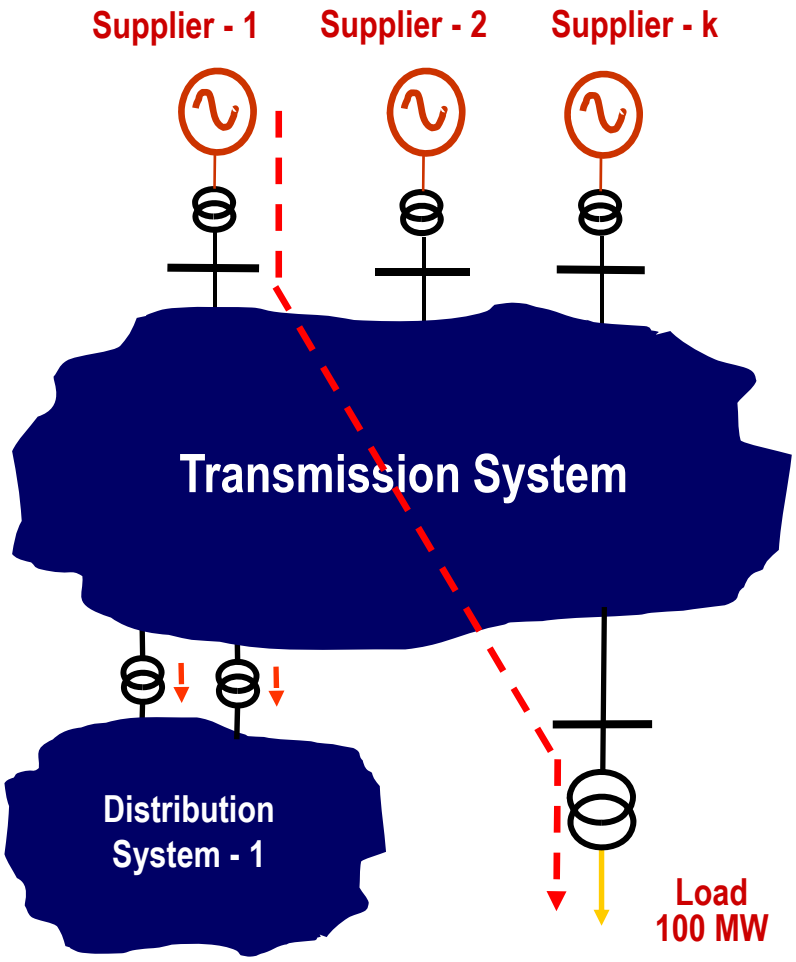


Transmission System Expansion

Major Concerns of Market Participants

Market participants need to know;

- That someone is in charge of expanding the transmission system,
- The principles to be followed for expansion,
- that they will not be discriminated against, in terms of the fairness in payments and the objectives of service expected from the expansion,
- The parties who propose the new lines,
- The parties who will mostly pay for the expansion



A Basic Rule for Transmission System Expansion

A Basic Rule for Investment

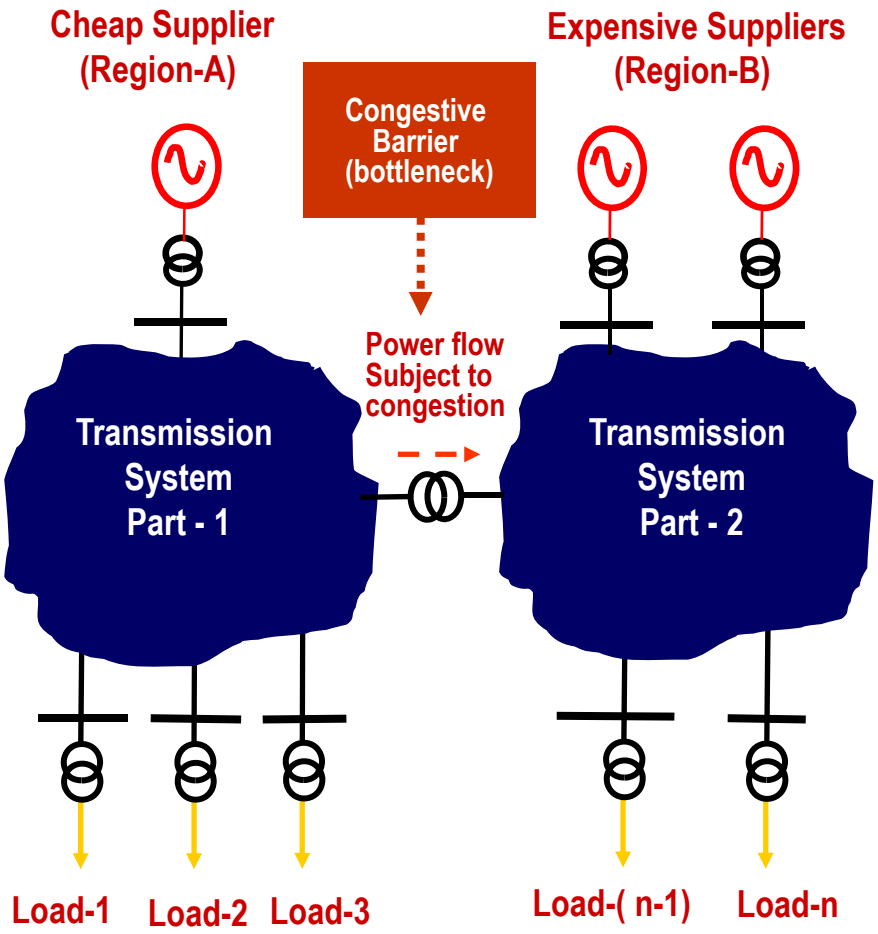
Build a new line or transformer between points A and B, if the difference between marginal costs of generating at point A and B exceeds the investment cost of the line

$$MC_{Transaction} * Energy_{transfer} > Cost_{investment}$$

$$MC_{Transaction} = MC_B - MC_A$$

where, $Energy_{transfer} = Power_{transfer} * \Delta t$

Δt = pay-back period of investment



Basic Principles of TSO

Basic Principles of TSO

Basic Principle of Transmission System Operator (TSO)

TSO always aims to improve;

- bus voltages,
- system stability

by reducing power flow in the lines

Hence, TSO always aims to reduce power flows by;

- balancing supply and demand at each region, i.e. making them equal,
- installing Customers and generators as near as possible to each other, so that this balance is maintained

Basic Principles of TSO

Basic Principles of TSO

How does TSO try to realize the above objectives ?

By imposing;

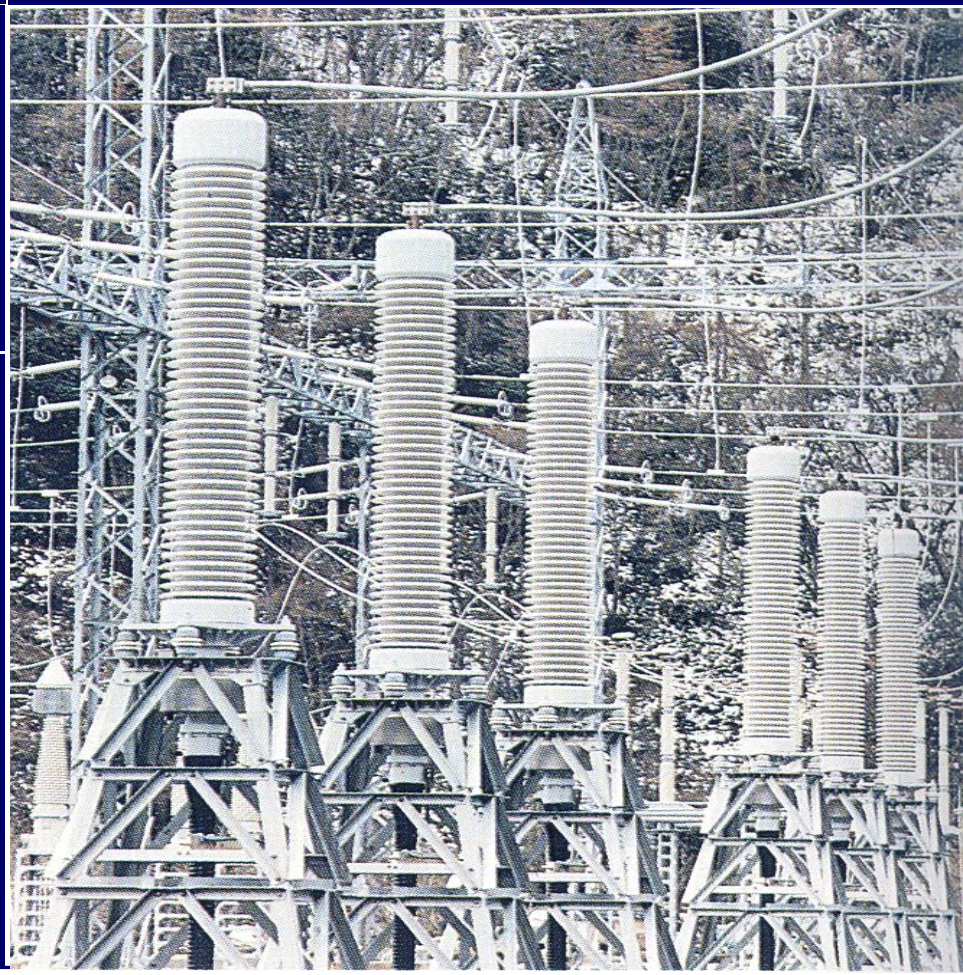
- extra penalty terms,
- incentives upon the tariffs

Penalty Terms;

Penalty terms are imposed upon the tariffs of;

- the customers in the congested regions, where consumption exceeds generation,
- the generators in the congested regions, where generation exceeds consumption

Basic Principle TSO



Basic Principles of TSO

Basic Principles of TSO

How does TSO try to realize the above objectives ?

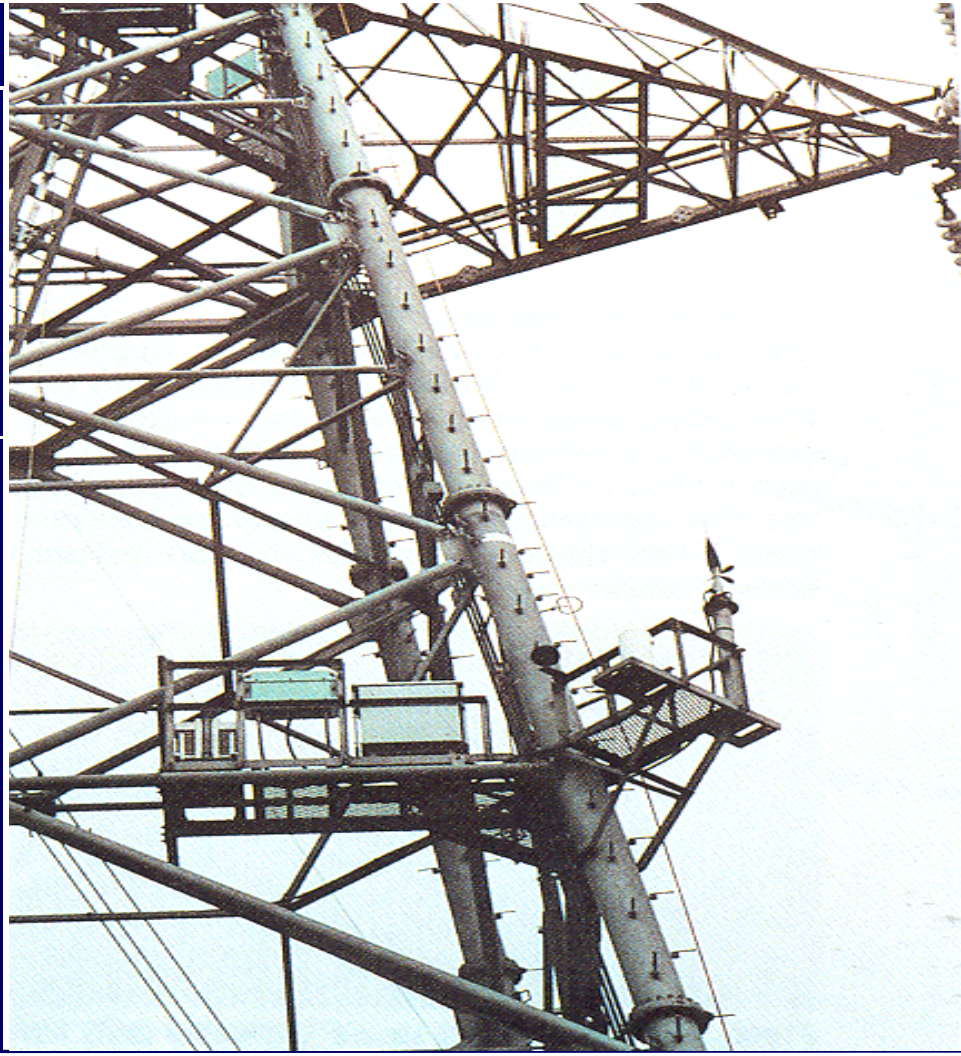
By imposing;

- extra penalty terms,
- incentives upon the tariffs

Incentive Terms;

At least in principle, TSO should impose incentives upon the tariffs of;

- the customers in the congested regions, where generation exceeds consumption,
- the generators in the congested regions, where generation is less than consumption



Transmission Business

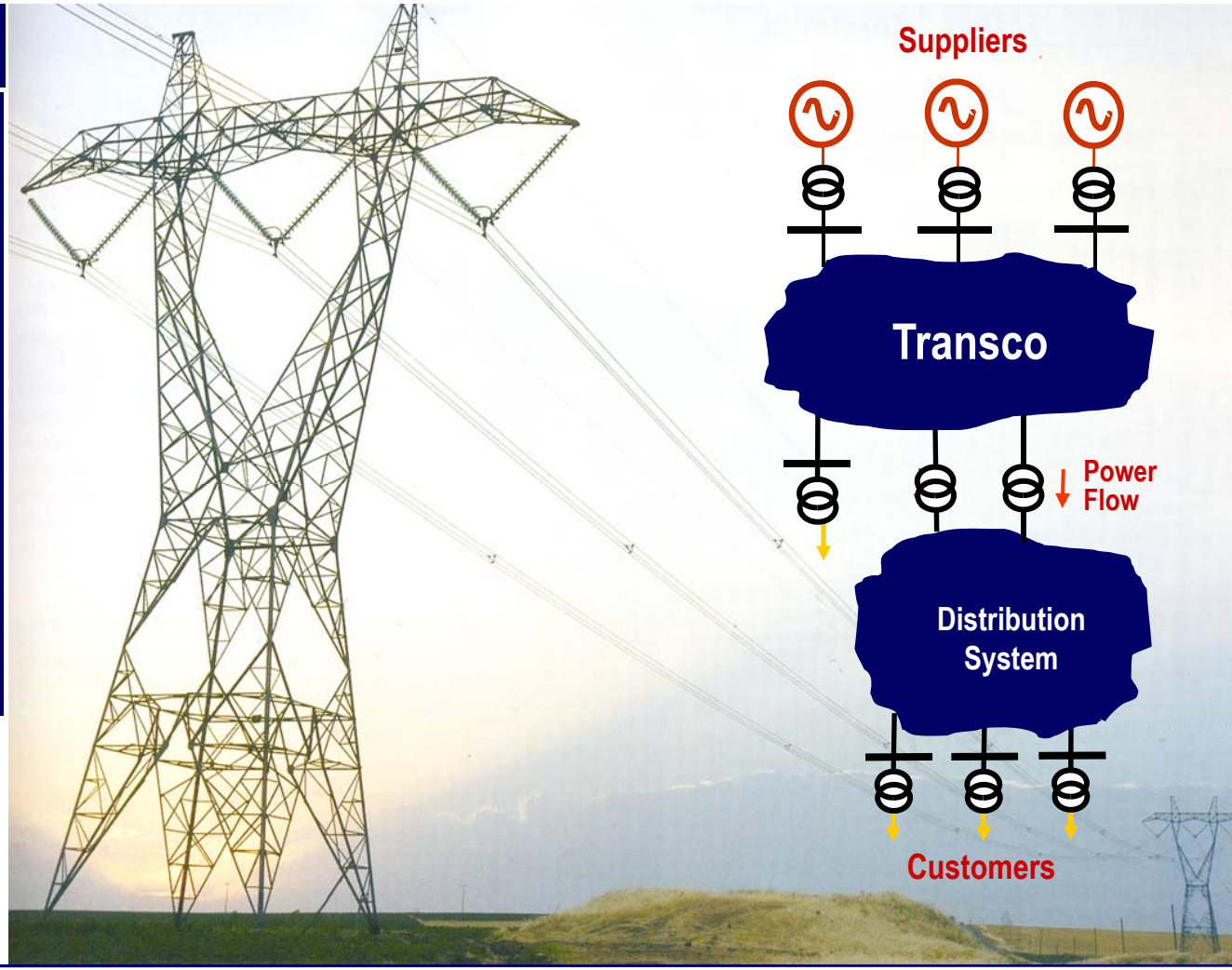
For-Profit Company: Transco

Transco Model

Transco is a profit-making Transmission System Operator (TSO) company which;

- owns,
- plans,
- maintains,
- expands,
- operates

transmission system assets



Transmission Business

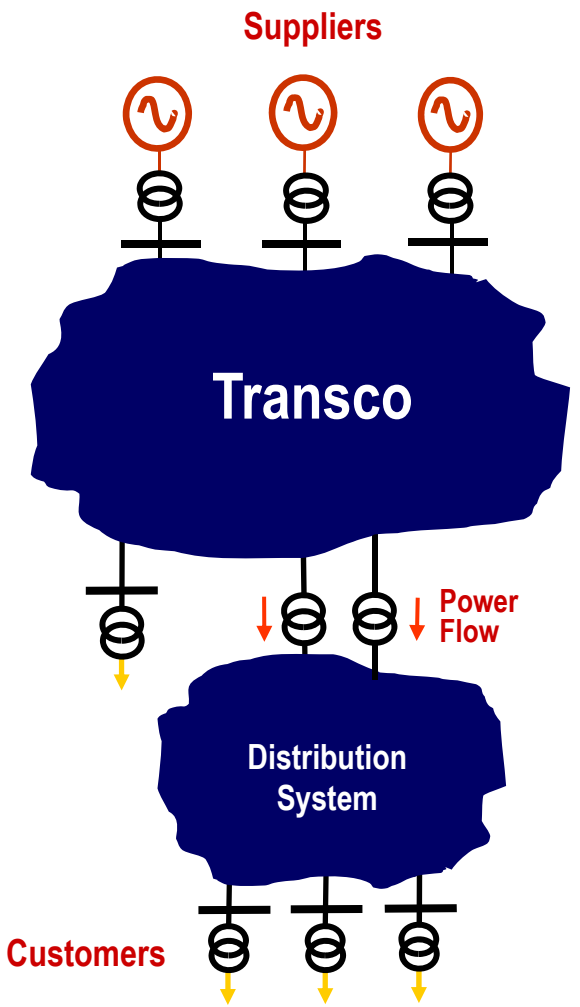
For-Profit Company: Transco

Transco Model

Transco;

- is profit making company,
- independent of all market participants, responsible for carrying out the above functions,
- has a strong motive to maximize its rent by witholding the transmission services, particularly during congestion

- ***which is unfair, and inefficient way of system operation,***
- ***Hence, it must be fully regulated***



Transmission Business

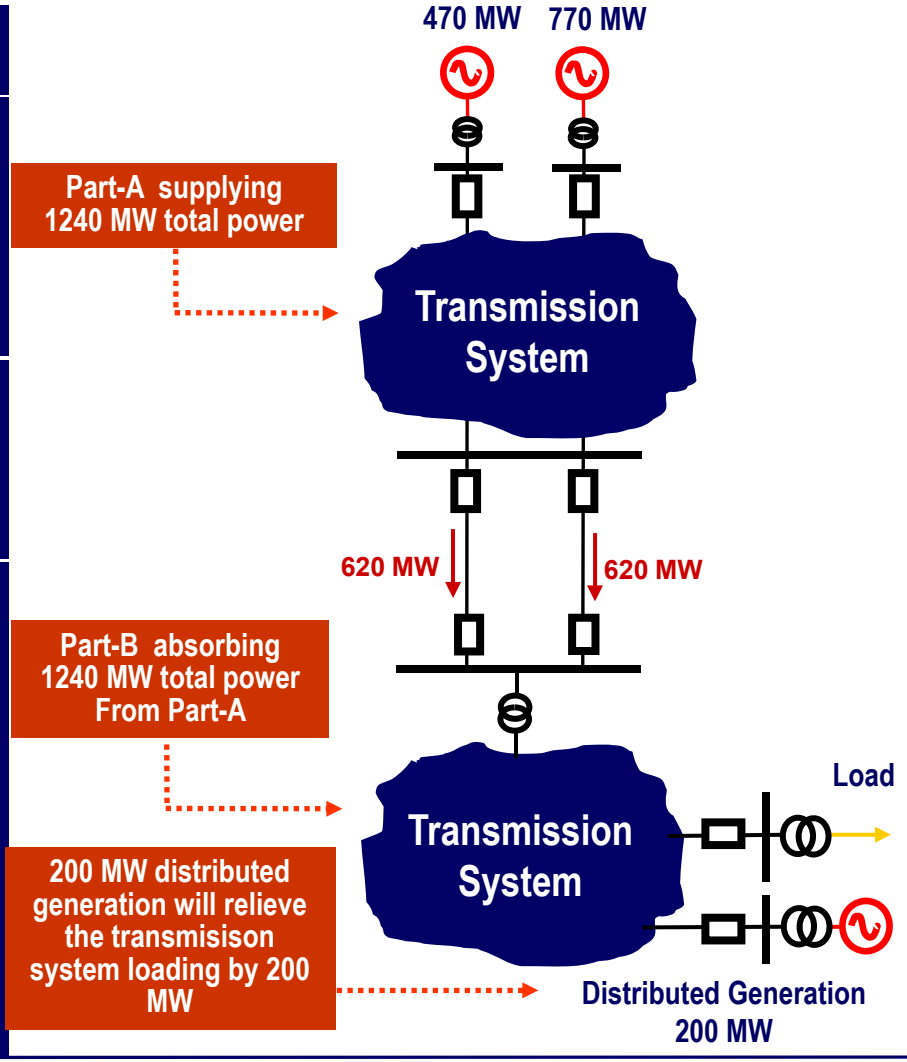
Can Distributed Generation Compete with Transco ?

The Effect of Distributed Generation

Distributed generators meet the local demand and hence reduce the need for and the loading on the transmission system

In that respect, distributed generation may seem to be competiting with the transmission company: Transco

Although this is partially true, relying heavily upon distributed generation may result in weakening of the transmission system, which may further result in weakening of competiton as the system will effectively be split into several submarkets each with different regional prices



Transmission Business

Unbundling of Transco Services

Ownership and System Operation Service

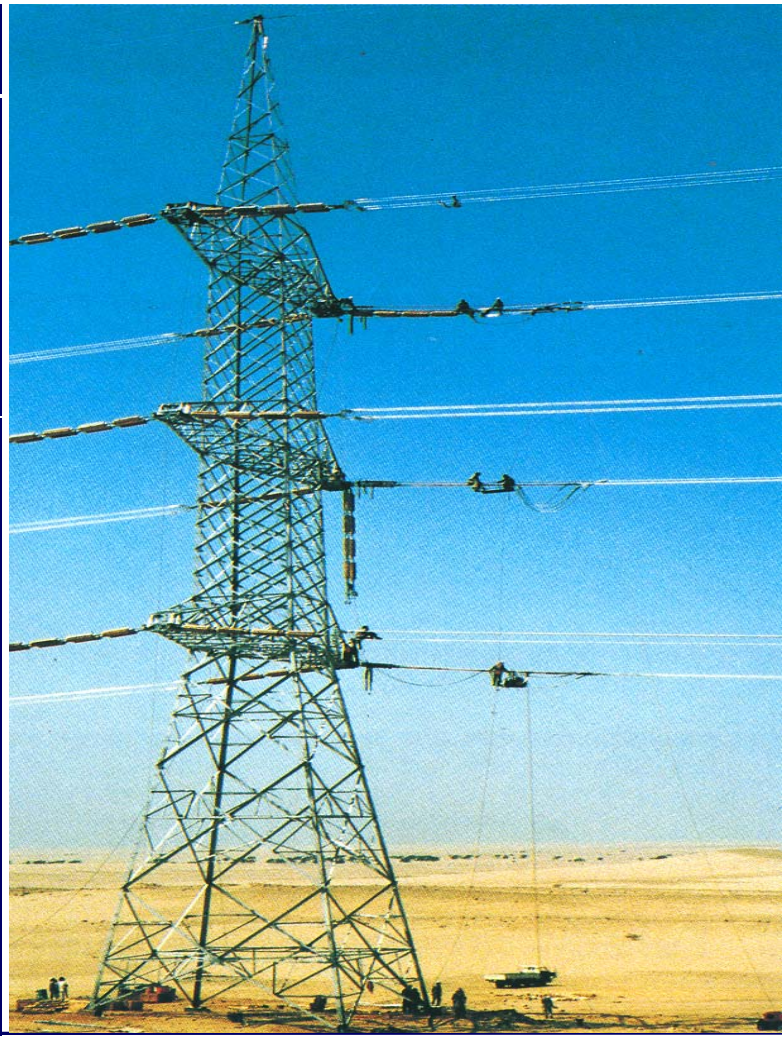
One of the most difficult restructuring issues regarding transmission concerns the unbundling of;

- System operator service, and
- Transmission system ownership

Transco Services may be unbundled into two independent companies;

- ISO,
- Gridco

The former is responsible for carrying out the system operation service, and
the latter is responsible for ownership, planning, maintaining and expanding the system assets



Transmission Business

ISO: Operation, Gridco: Maintenance Services

ISO and Gridco Model

- **ISO** is an independent **non-profit making** system operator company,
- **Gridco** is another independent company which owns, plans, maintains and expands the transmission system assets

The main reason for this unbundling is to prevent TSO from earning excessive rent by witholding the transmission services, during system operation, particularly during congestion, which is unfair, and inefficient

Hence, system operation service must be left to an independent non-profit company called ISO,that will have no motive to earn rent by congestion management,
Hence, it cannot keep that rent as profit

Basic Principles of ISO

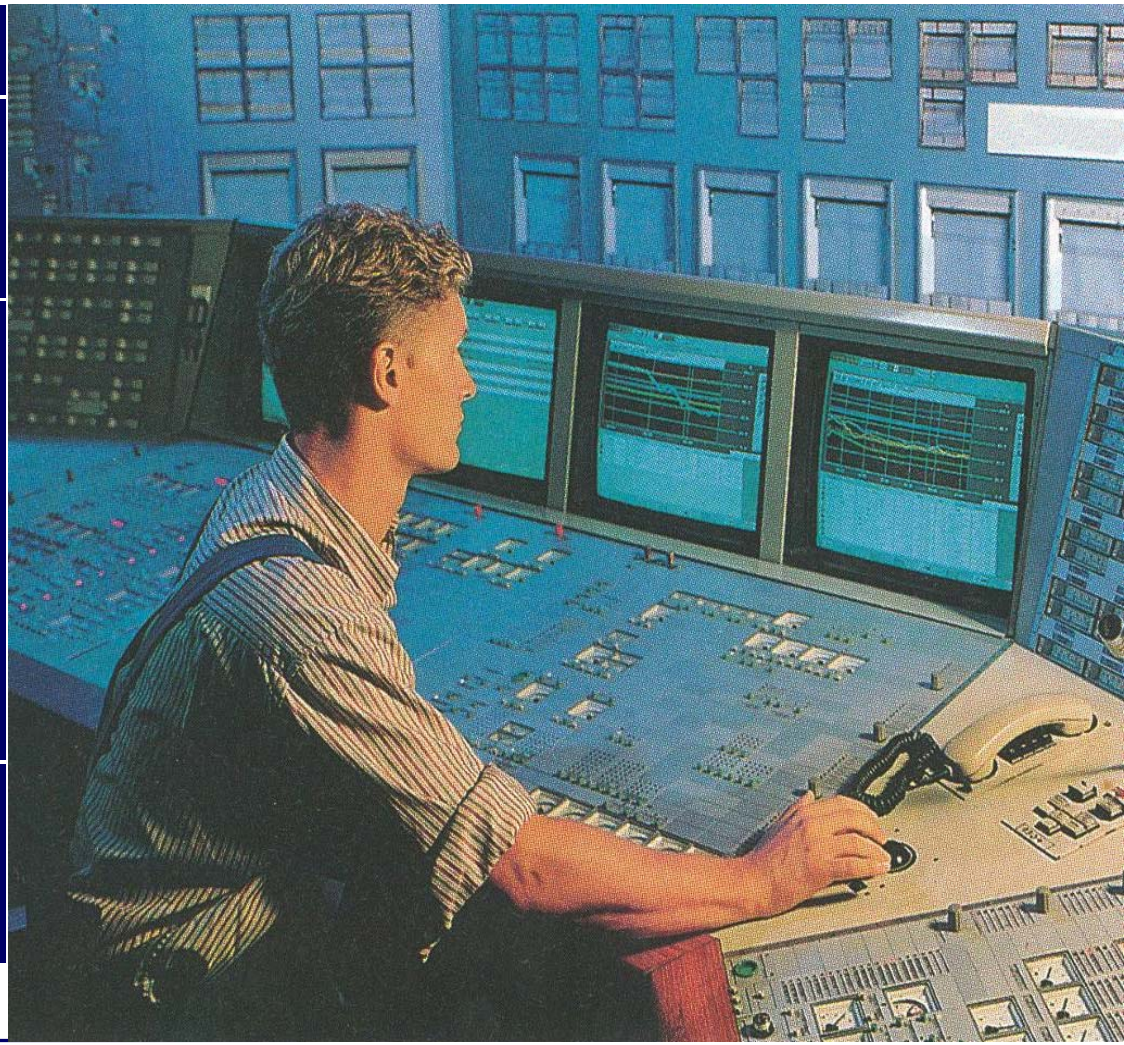
ISO

ISO is a regulated, independent and **non-profit making** company model

Its main functions are;

- to advise Gridco about transmission expansion and future maintenance needs,
- to operate the system and carry out balancing, control and settlement tasks

The only asset of **ISO** is the control room, computer, control and communication equipment



Basic Motive of ISO

Basic Motive of ISO

Being non-profit companies, ISOs have no motive and incentive to earn monopoly rents, hence they have weakened motive to act efficiently

Basic motivation of ISO is public scrunity, which is enhanced by the critisism of market participants, who have a lot to lose from inefficincies in system operation

Since it does not pay for, ISO always demands Gridco to install new lines. Transco or Gridco on the other hand, do not have the same interest.

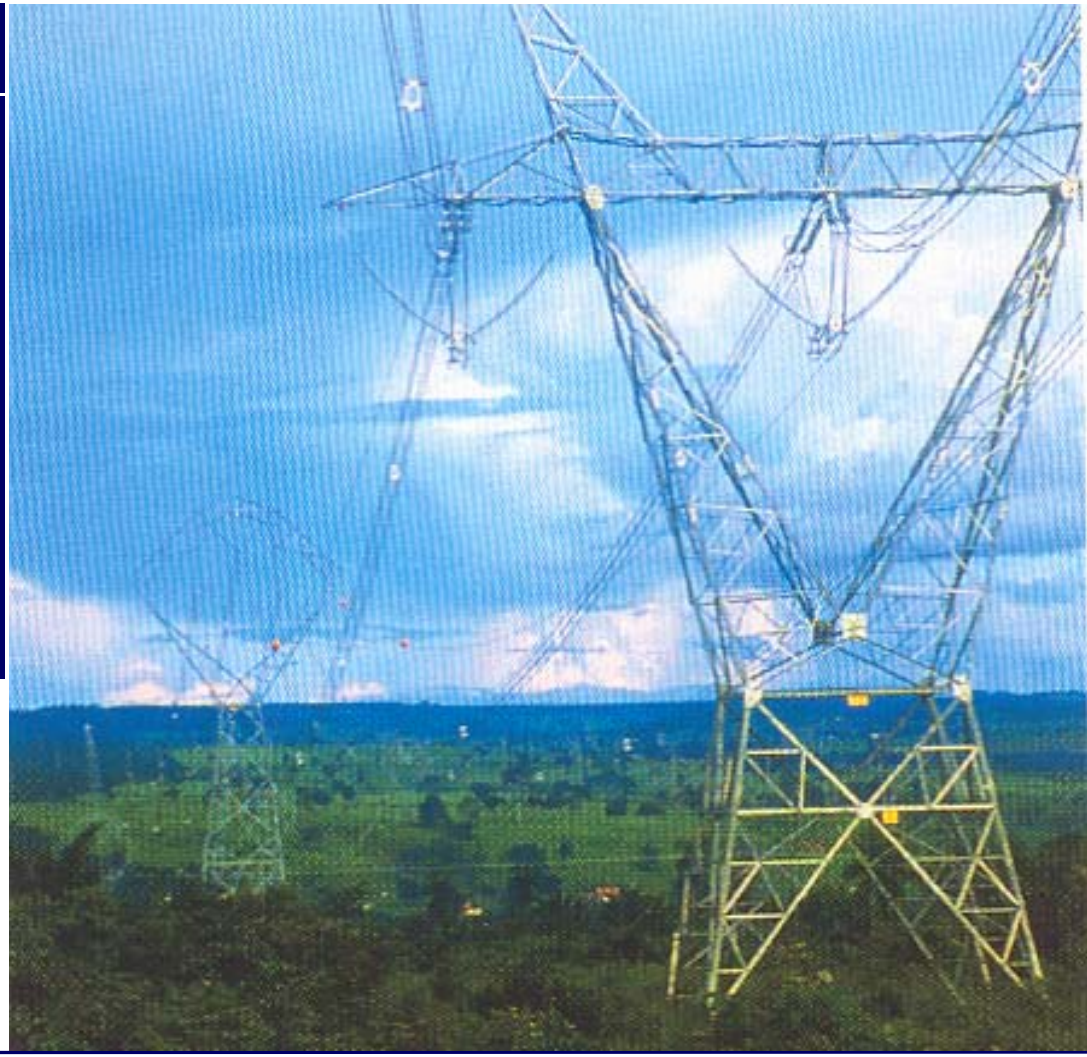
NGC (UK) Control Center

Transmission Business

Ownership and Control

Gridco

Gridco is a regulated, independent and profit making company.
It does nothing but; to own, plan, maintain and expand the transmission system assets through charges levied on market participants



2003 YILI
ELEKTRİK İLETİM TARİFESİ
VE
BÖLGESEL FİYATLANDIRMA
MODELİ

Transmission Business

Elektrik Piyasası Kanununun 03.03.2001 tarihli Resmi Gazetede yayımlanmasını takiben, 05.02.2001 tarih ve 2001/2026 sayılı Bakanlar Kurulu Kararı ile **TEAŞ** üçe bölünerek;

EÜAŞ
TEİAŞ
TETAŞ

şeklinde yeniden yapılandırılmış olup,

TEİAŞ;
enterkonnekte sistemin işletilmesi, şebekenin gerekli yatırımların yapılarak genişletilmesi ve iyileştirilmesi ile görevlendirilmiştir.

Transmission Business

Elektrik Piyasası Tarifeler Yönetmeliği'nin
8. Maddesi gereğince;
TEİAŞ
faaliyetlerini yürütmek üzere
iletim sistemini kullananlardan

Sistem Kullanım Fiyatı
ve
Sistem İşletim Fiyatı

adı altında ücret alacaktır.

İletim Sistemi Kullanım Fiyatı;
İletim Sistemi Gelirinin Düzenlenmesi Hakkında Tebliğ

İletim Sistemi İşletim Fiyatı;
İletim Sistemi İşletim Gelirinin Düzenlenmesi Hakkında Tebliğ

hükümleri esas alınarak hesaplanır.

Ayrıca, TEİAŞ iletim sitemine bağlantı yapmak isteyen yeni kullanıcılardan da bağlantı maliyetlerini karşılayacak şekilde İletim ve Dağıtım Bağlantı Bedellerinin Belirlenmesi Hakkında Tebliğ gereğince;

Bağlantı Bedeli

tahsil edecektir.

Transmission Business

Kanunda belirtilen hazırlık döneminin 2002 yılı Eylül ayında sona ermesini müteakip, **Elektrik Piyasası Lisans Yönetmeliği** uyarınca TEİAŞ; 02.12.2002 tarih ve 2410 sayılı yazısı ile iletim lisansı almak ve 2003 yılı iletim tarifelerinin onaylanması için Kurumumuza başvurmuştur.

Bu başvurusu ile TEİAŞ;

- ✓ İletim Sistemi Sistem Kullanım ve Sistem İşletim Fiyatları Metodolojisi Bildirimini,
- ✓ Bağlantı Bedelleri Metodolojisi Bildirimini,
- ✓ İletim Sistemi Sistem Kullanım Fiyat Bildirimini,
- ✓ İletim Sistemi Sistem İşletim Fiyat Bildirimini ve
- ✓ Trafo Merkezi Bazında İletim Sistem Kullanım Tarife Bölgelerini

onaylanmak üzere sunmuştur.

TEİAŞ KAR/ZARAR TABLOSU	2001 3 Aylık Gerçekleşme	2002 Geçici	2003 Program
İletilen Net Enerji, GWh	26.000,3	103.330,0	109.950,0
İletim Hizmeti Ortalama Satış Fiyatı (Brüt)	2.652,6	6.378,6	-
İletim Hizmeti Satış Hasılatı (Brüt)	68.966.997,2	659.095.973,8	-
İletim Ek Ücreti	0,0	3.279.084,4	-
İletim Hizmeti Ortalama Satış Fiyatı (Net)	2.652,6	6.346,8	6.197,4
İLETİM HİZMETİ SATIŞ HASILATI (Net)	**68.966.997,2**	**655.816.889,4**	**681.399.000,0**
İŞLETME GİDERLERİ			
Malzeme	1.307.843,9	7.385.439,8	9.202.258,0
İşçi ve Personel Masrafları	28.961.491,4	133.868.512,1	155.885.000,0
Diğer Çeşitli Masraflar	8.562.831,8	59.274.317,2	71.433.495,0
Amortismanlar	37.629.786,3	250.433.301,0	281.696.000,0
Vergiler	91.741,1	873.392,1	1.088.247,0
	76.553.694,5	**451.834.962,2**	**519.305.000,0**
NET İŞLETME GELİRİ	**-7.586.697,3**	**203.981.927,2**	**162.094.000,0**
FAALİYET DIŞI GELİR VE KARLAR			
Faiz Gelirleri	1.090.205,5	496.348,8	618.450,6
İştiraklerimiz Temettü Gelirleri	0,0	0,0	0,0
Bağlı Ortaklıklarımız Temettü Gelirleri	0,0	0,0	0,0
Karşılıklardan Kullanılmayan Kısım	191.157,4	75.971,5	94.660,5
Geçmiş Yıllara Ait Gelir ve Karlar	17.497,9	267.190,0	332.918,7
Faaliyetlerle İlgili Olan Diğer Gelirler	46.925.434,8	82.500.000,0	5.667.247,7
Diğer Olağan Dışı Gelir ve Karlar	3.093.095,9	7.722.088,7	9.621.722,5
	51.317.391,5	**91.061.599,0**	**16.335.000,0**
FAALİYET DIŞI GİDER VE ZARARLAR			
Komisyon Giderleri	830,3	7.416,4	9.240,8
Faiz Giderleri	28.264.372,5	50.808.138,9	34.920.000,0
Çalışmayan Kısım Giderleri	0,0	0,0	0,0
Karşılık Giderleri	1.824.190,3	3.945.148,0	4.915.654,4
Önceki Dönem Gider ve Zarar	0,0	29.021.565,0	36.193.100,1
Diğer Olağan Dışı Gider ve Zararlar	1.361.066,0	15.252,6	19.004,7
Kur Farkı	1.043.822,6	211.246.005,3	101.914.000,0
	32.494.281,7	**295.043.526,2**	**177.971.000,0**
DÖNEM ZARAR VE KARI	**11.236.412,5**	**0,0**	**458.000,0**

TEİAŞ 2003 Genel Yatırım ve Finansman Programı Kararnamesi

Transmission Business

TEİAŞ tarafından yürütülecek olan faaliyetler; şebeke ve sistem işletim faaliyetlerine ait giderler dikkate alınarak Elektrik Piyasası Tarifeler Yönetmeliğinde yer aldığı üzere ayrıştırılmış olup, Hazine Müsteşarlığı tarafından belirlenmiş ve tarafımızca da makul bulunan

681,4 Trilyon TL
Satış Hasılatının

667,7 Trilyon TL
İletim Sistemi Sistem Kullanım Fiyatları

13,7 Trilyon TL
İletim Sistemi Sistem İşletim Fiyatları

vasıtasıyla sağlanacağı öngörülmektedir.

İLETİM SİSTEMİ SİSTEM KULLANIM VE İLETİM SİSTEMİ SİSTEM İŞLETİM FİYATLARI METODOLOJİSİ

Sistem kullanım fiyatları olarak tüm kullanıcılardan tahsil edilmesi hedeflenen 667,7 Trilyon TL'nın; iletim sistemini kullananlar arasında nasıl dağıtılacağı, TEİAŞ tarafından hazırlanarak lisans başvurusu sırasında Kurumumuza sunulmuş olan İletim Sistemi Sistem Kullanım ve Sistem İşletim Fiyatları Metodolojisi Bildiriminde detayları ile açıklanmıştır.

Bu metodoloji; Yatırım Maliyetine Dayalı Fiyatlandırma Nakil Modeli adı verilen matematiksel bir modele dayanmaktadır.

Transmission Business

Bölgesel Fiyatların hesaplanmasında kullanılan Yatırım Maliyetine Dayalı Fiyatlandırma Nakil Modeli ile;

- Marjinal yatırım maliyetini yansıtan fiyatların belirlenmesi,
- 2003 yılı yaz ve kış puant durumunda MWkm cinsinden iletim sistemi kullanım miktarının dikkate alınması,
- Enerji iletim hatlarının yatırım maliyetleri dikkate alınarak eş değer hale getirilmesi ve en kısa güzergahların tercih edilerek enerji naklinin sağlanması,
- 667 adet düğüm noktasında, 1 MW ilave üretim ve tüketimin o düğüm noktasındaki marjinal yatırım maliyetinin yansıtılması (MWkm),

hedeflenmiştir.

Transmission Business

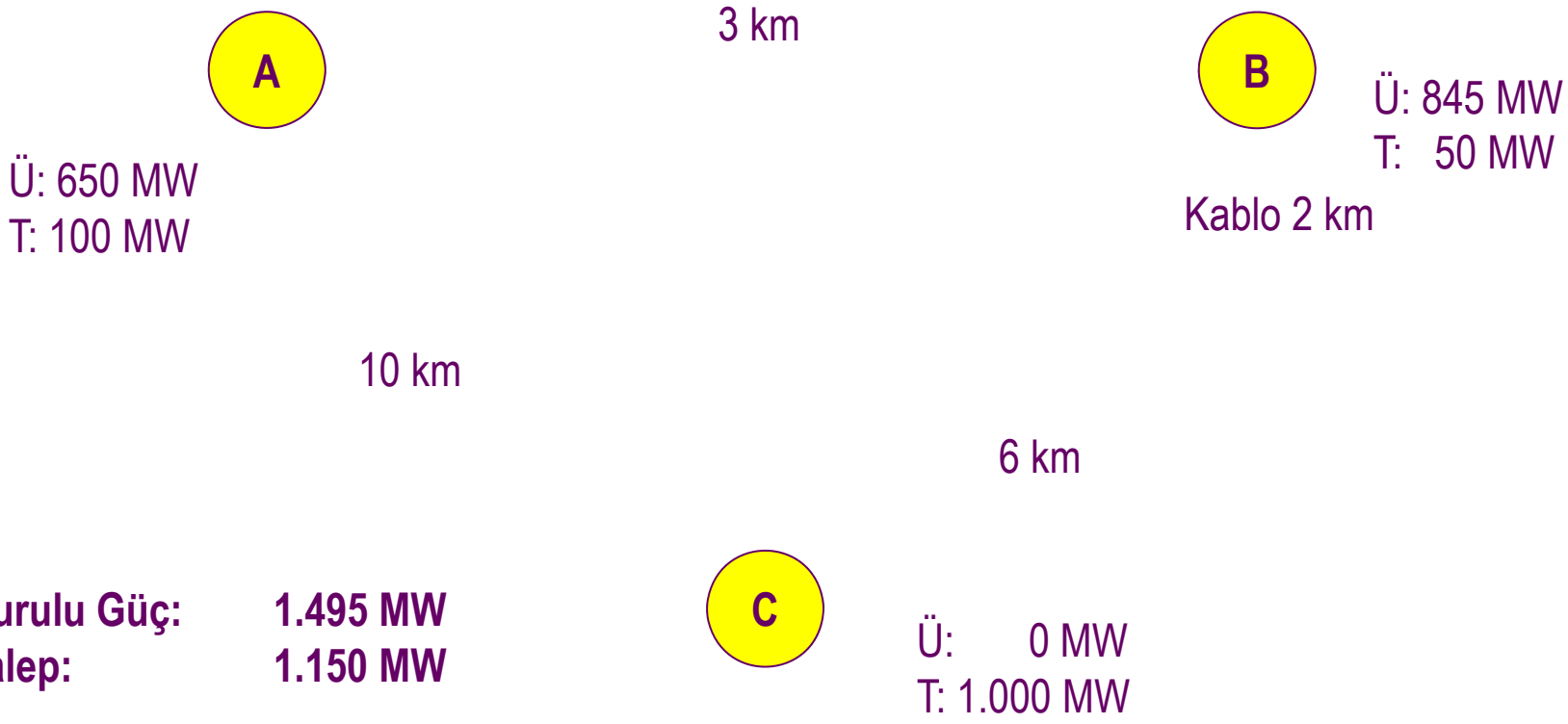
Yatırım Maliyetine Dayalı
Fiyatlandırma Modeli;

- Marjinal yatırım maliyetini yansıtan fiyatları belirlemeyi hedefleyen ve
- Elektriksel değil Matematiksel yaklaşımla çalışan

bir modeldir.

Metodoloji Bölüm:2

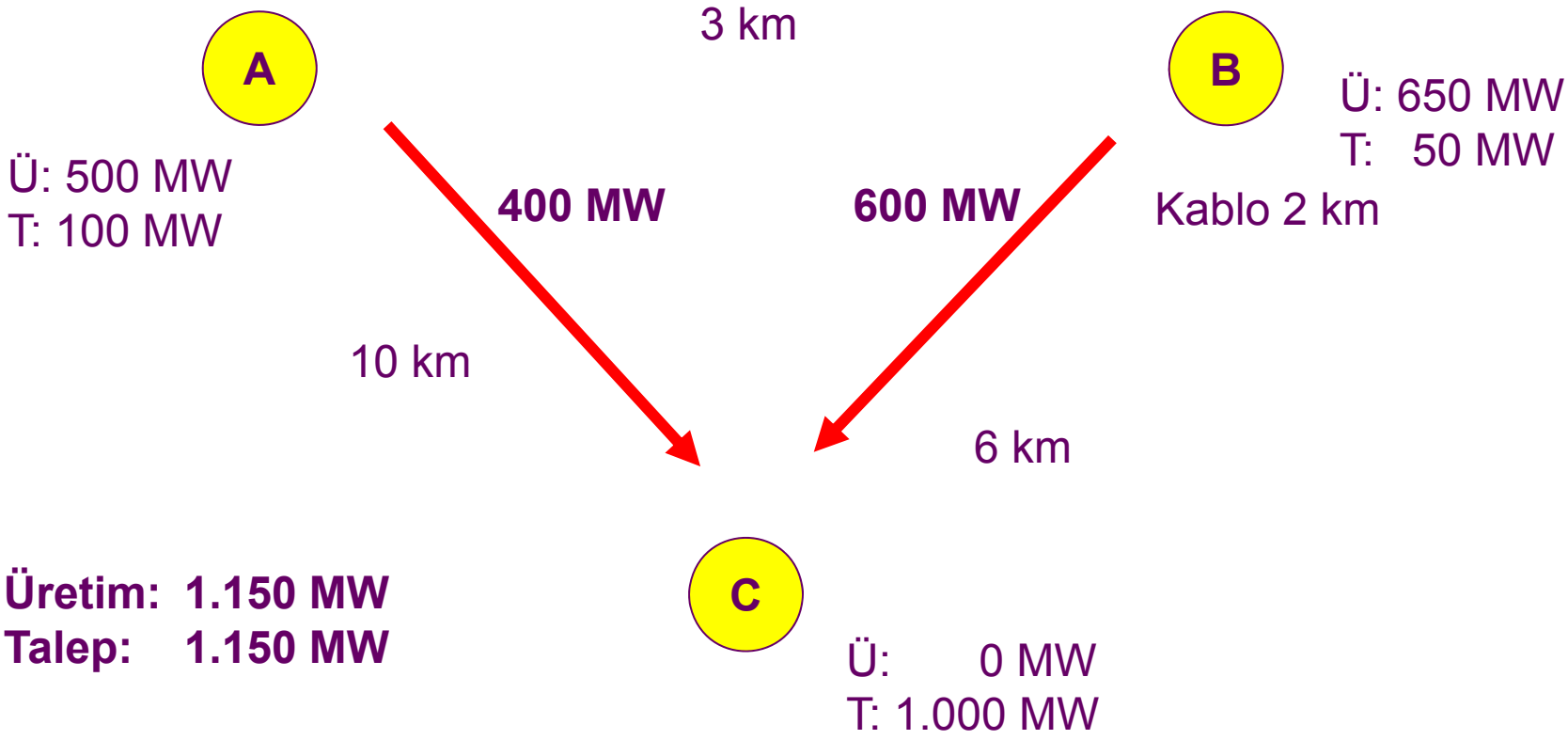
Nakil Modeli



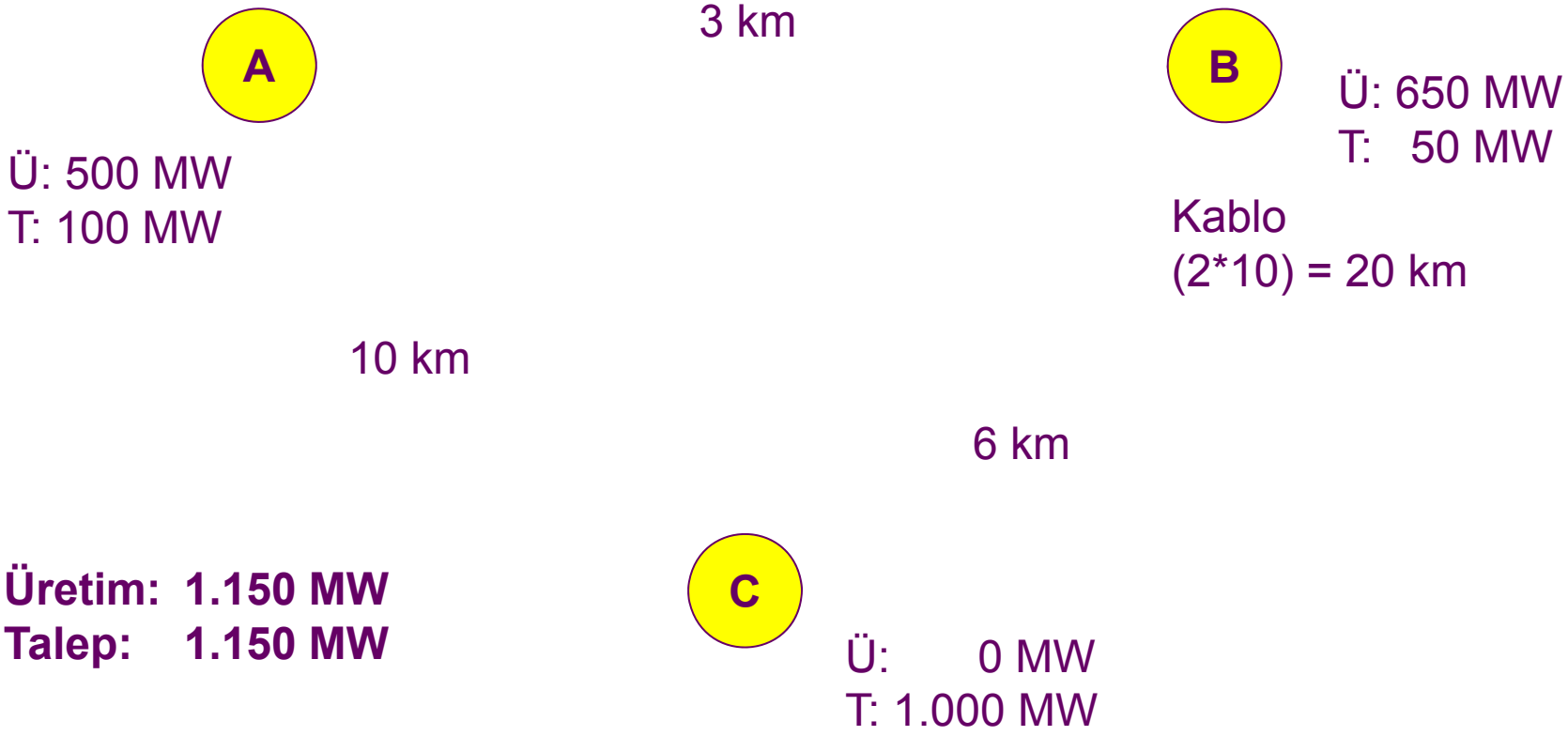
Kurulu Güç: **1.495 MW**
Talep: **1.150 MW**

Üç düğüm noktasına sahip bir iletim sistemi konfigürasyonunu göstermektedir.

Üretim-Tüketim Dengesi



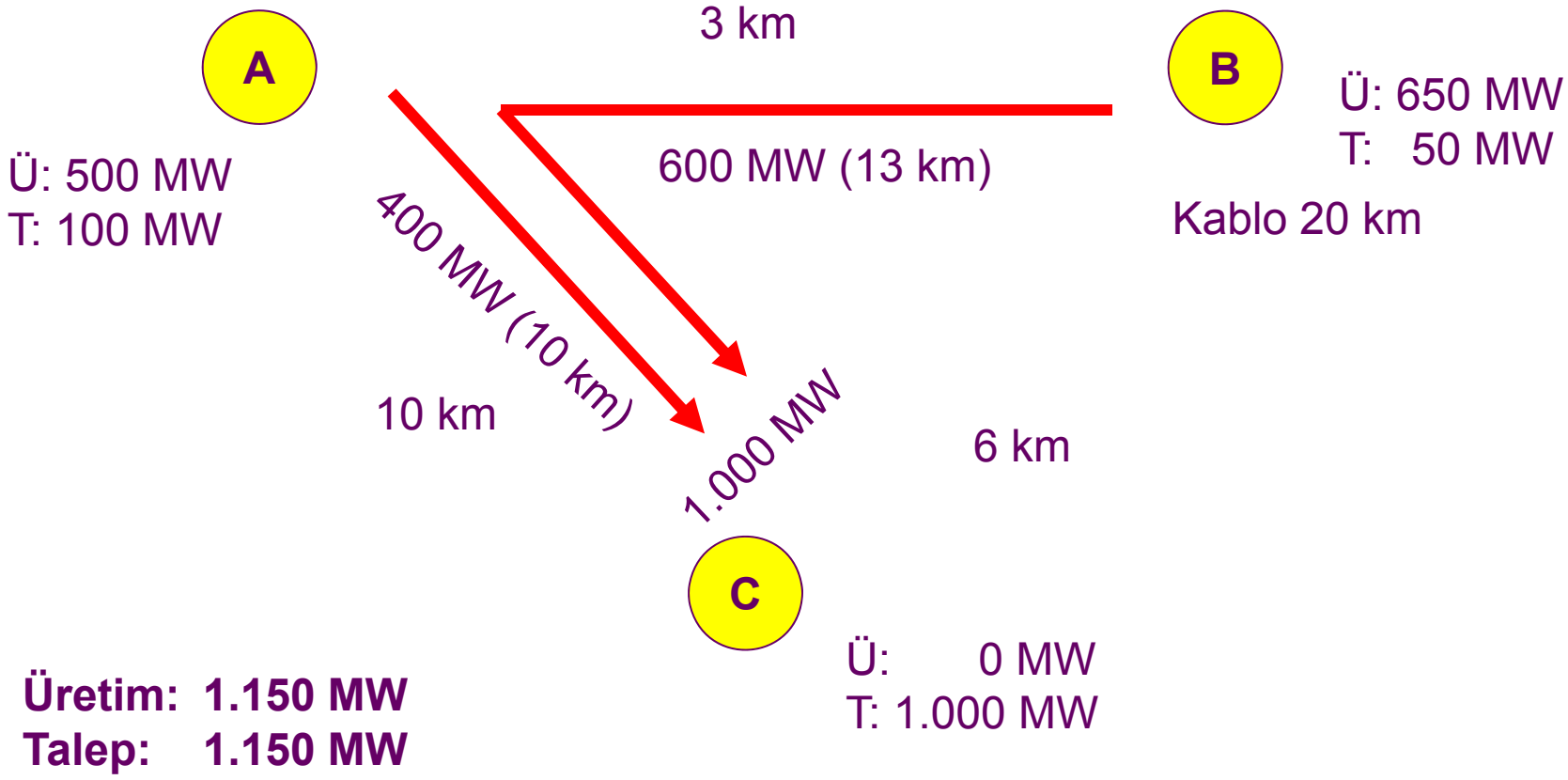
Hat Mesafesi–Yatırım Maliyeti



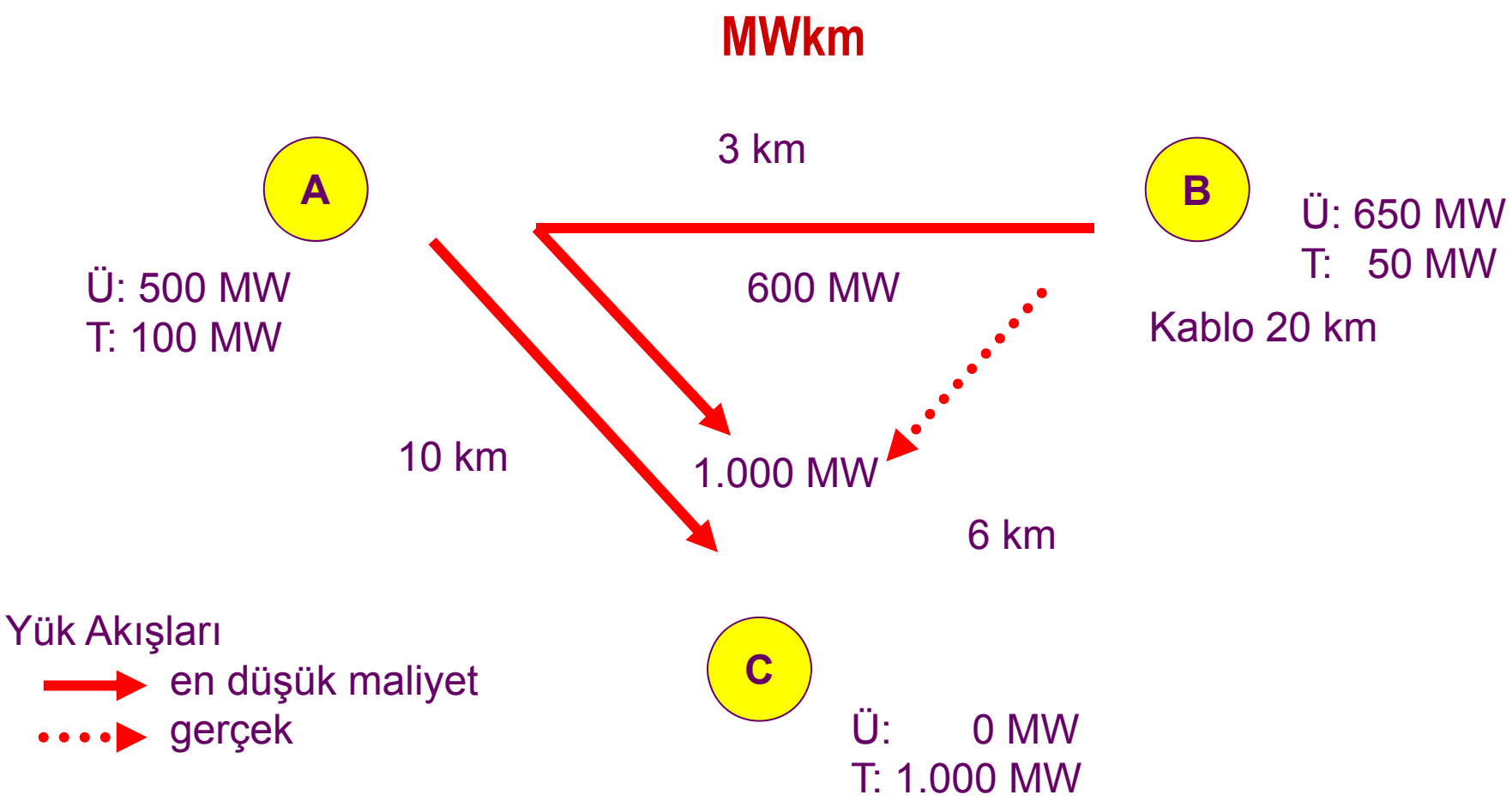
Yatırım nakil modelinin uygulanması için orijinal sistem konfigürasyonunun dönüşümünü göstermektedir.

Transmission Business

Hat Uzunluğu–Yatırım Maliyeti



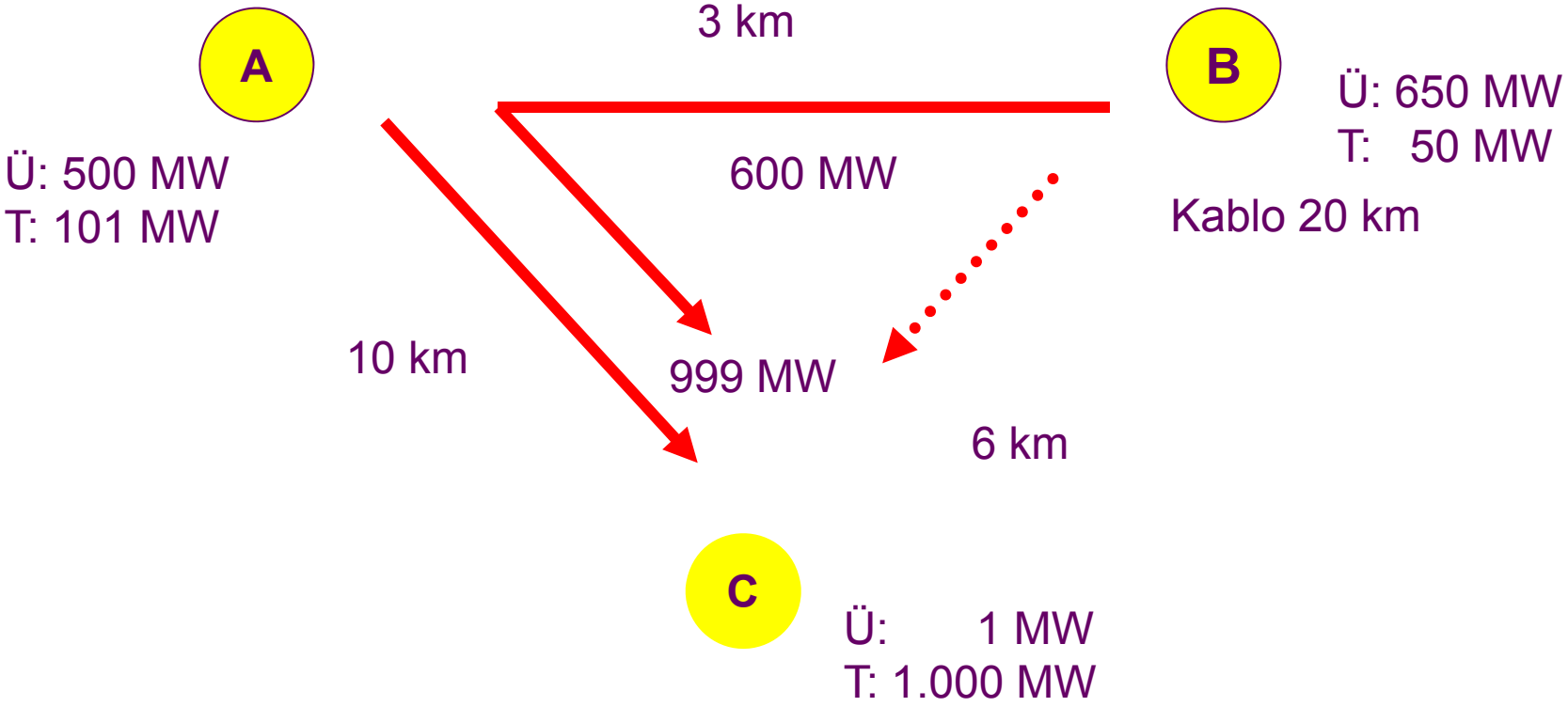
Transmission Business



En Düşük Maliyetli İletim:
3 km x 600 MW + 10 km x 1.000 MW = 11.800 MWkm

Transmission Business

İlave 1 MW Üretim (C)



En Düşük Maliyetli İletim:
3 km x 600 MW + 10 km x 999 MW = 11.790 MWkm

Maliyet Artışı:
11.790 – 11.800 = -10 MWkm/MW

Maliyet Artışları (MWkm/MW)

Düğüm Noktası	A	B	C
Üretim	0	9	-10
Tüketim	0	-9	10

Gelir Hesabı

Metodoloji Madde 3.19 – 3.25

	MODEL	AYARLANMIŞ FİYAT (5 TL ilave her MW için)
Düğüm Noktası A	G: 500 x 0 = 0 D: 100 x 0 = 0	G: 500 x 5 = 2.500 D: 100 x 5 = 500
Düğüm Noktası B	G: 845 x 9 = 7.605 D: 50 x (-9) = -450	G: 845 x 14 = 12.765 D: 50 x (-4) = -200
Düğüm Noktası C	G: 0 x (-10) = 0 D: 1.000 x 10 = 10.000	G: 0 x -5 = 0 D: 1.000 x 15 = 15.000
Toplam	= 17.605 - 450 = 17.155	= 30.765 – 200 = 30.565

Sistem Genişleme Sabiti (2003 YP)

Metodoloji Madde 3.2

1 MW gücü 1 km taşımak için gerekli iletim alt yapısı sermaye yatırımının değerini ifade eder.

		154 kV	154 kV Kablo	380 kV
Proje Sayısı	HAT	46	4	22
	TM	102		22
	TOPLAM	148	4	44
Yatırım (Milyar TL)	HAT	189.070	44.600	279.650
	TM	192.550		167.900
	TOPLAM	381.620	44.600	447.550
Yaratılan Kapasite (MWkm)		432.668	3.523	2.096.730
Milyon TL / MWkm		882	12.660	213
Milyon TL / MWkm-yıl		118	1.695	29

MODELİN GİRDİLERİ

- 667 adet Düğüm Noktası (Trafo Merkezi)
- 667,7 Trilyon TL Yıllık Gelir
- Gelir içindeki üretim ve tüketim payları %50-%50
- 3 Hat Tipi (154 kV, 380 kV, yer altı kablosu)

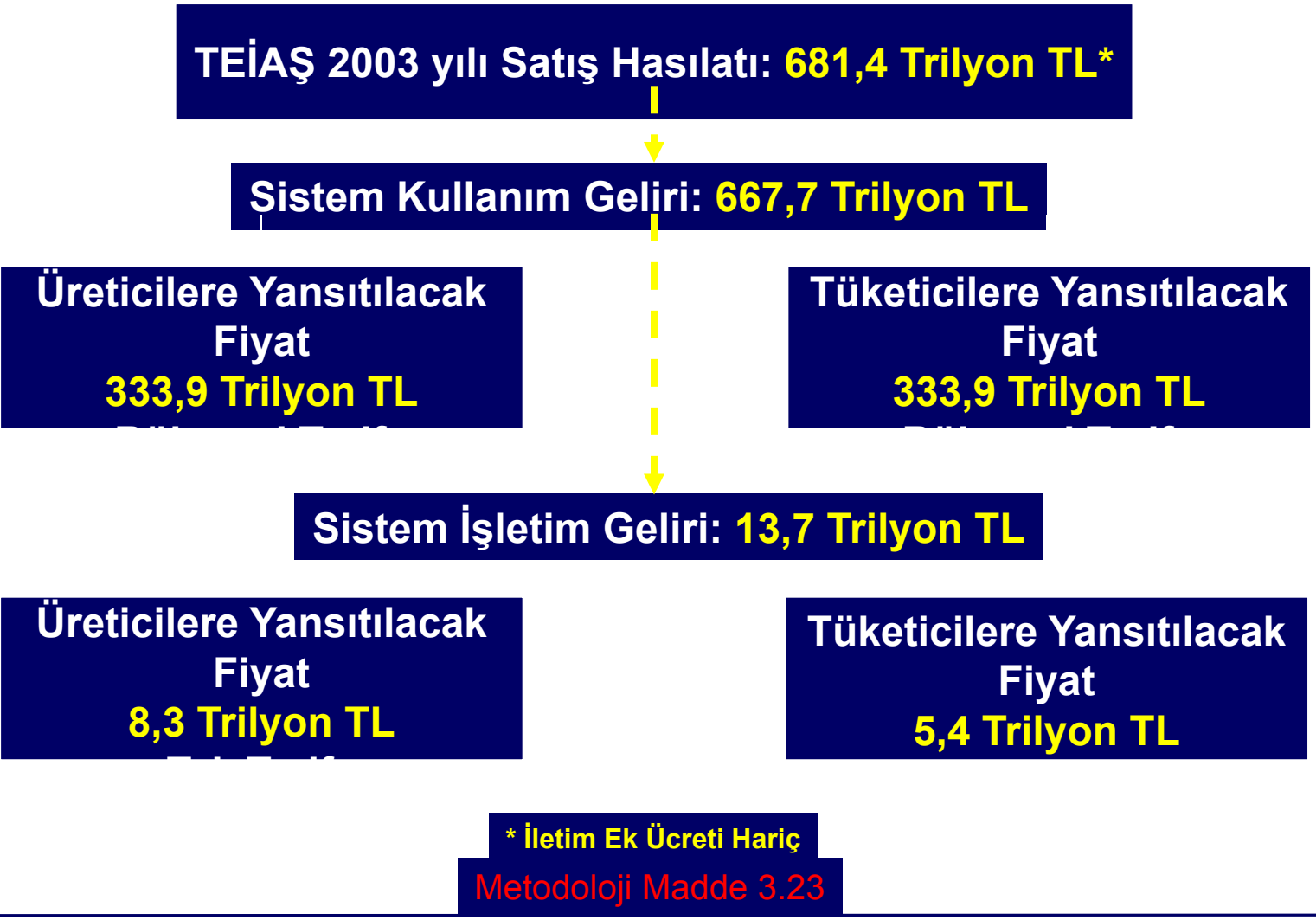
Metodoloji Madde 3.6 – 3.11

İLETİM SİSTEMİ SİSTEM İŞLETİM FİYATI

	ÜRETİM	TÜKETİM	TOPLAM
	MW	MW	MW
TOPLAM GÜÇ	**35.638,0**	**22.970,5**	**58.608,6**
ÇEAŞ (2-10-15-20. Bölgeler)	988,2	1.480,8	2.469,0
KEPEZ (8. Bölge)	127,6	311,7	439,3
TOPLAM (ÇEAŞ+KEPEZ HARİÇ)	**34.522,2**	**21.178,0**	**55.700,3**
İSKENDERUN (Yİ) (10. Bölge)	1.210,0	0,0	1.210,0
ANKARA (Yİ) (16. Bölge)	770,0	0,0	770,0
SİSTEM İŞLETİM NET TOPLAM GÜÇ	**32.542,2**	**21.178,0**	**53.720,3**

SİSTEM İŞLETİM GELİRİ, Bin TL	**13.700.000.000**
SİSTEM İŞLETİM FİYATI, Bin TL/MW-Yıl	**255.025**

Transmission Business



MODEL SONUÇLARININ DEĞERLENDİRİLMESİ

Trafo merkezleri bazında noktasal olarak hesaplanan marjinal yatırım maliyetlerinde,

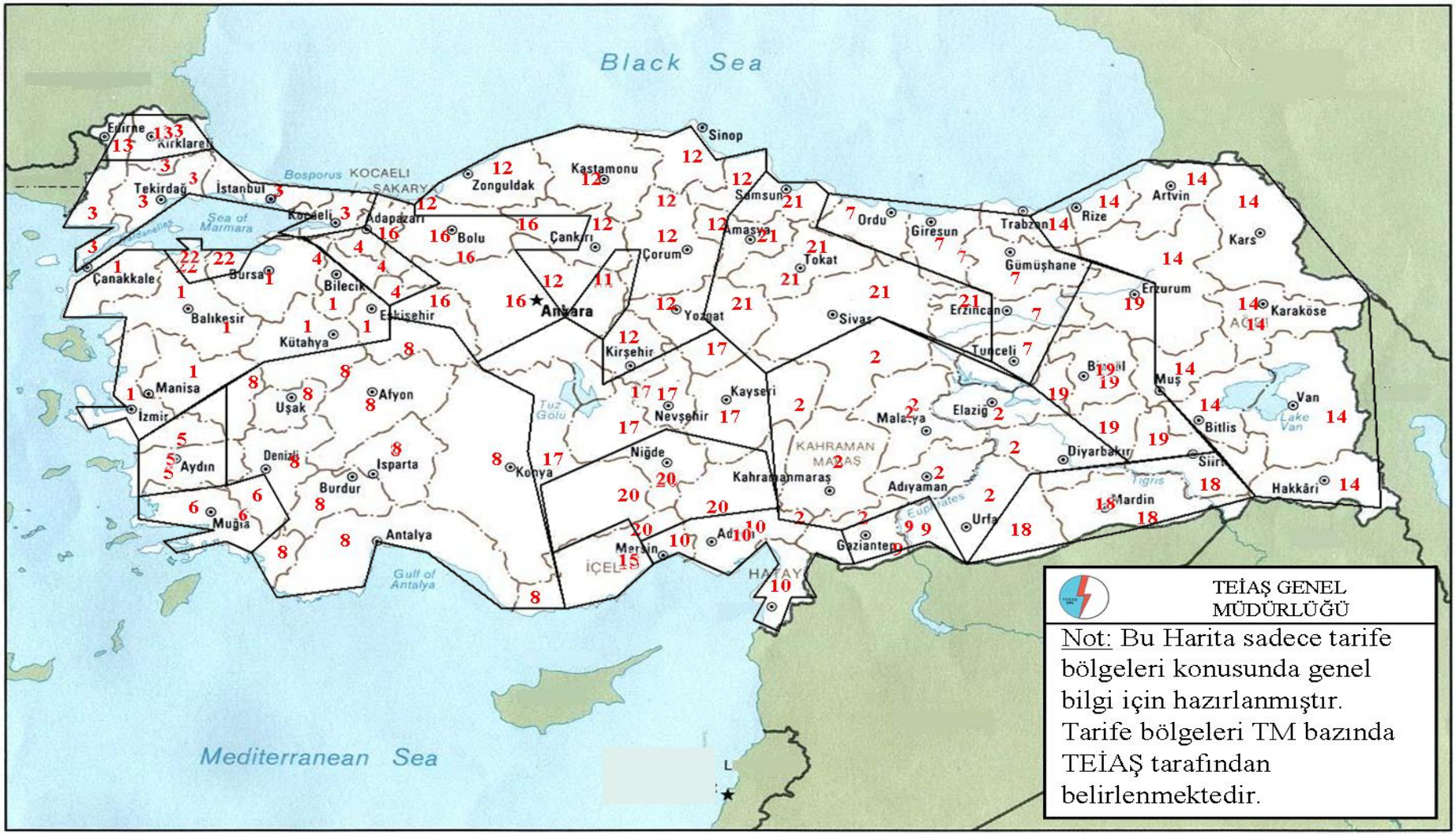
1) Aynı bölge içerisinde maksimum ve minimum sinyaller arasındaki fark %10'u aşmayacak şekilde

2) Her bir tarife bölgesinde enaz 1 adet (>10 MW) üretim tesisi yer alacak şekilde

22 adet Bölge için üretim ve tüketim bazında İletim Sistemi Sistem Kullanım Fiyatları belirlenmiştir.

Metodoloji Madde 3.18 – 3.19

Transmission Business



Transmission Business

	ÜRETİM		TÜKETİM	
Bölge	SİSTEM KULLANIM TARİFESİ Bin TL/MW-Yıl	SİSTEM İŞLETİM TARİFESİ Bin TL/MW-Yıl	SİSTEM KULLANIM TARİFESİ Bin TL/MW-Yıl	SİSTEM İŞLETİM TARİFESİ Bin TL/MW-Yıl
1	15.971.803	256.823	6.358.510	256.823
2	10.134.945	256.823	14.547.835	256.823
3	7.131.923	256.823	16.574.018	256.823
4	1.538.771	256.823	21.693.857	256.823
5	11.059.416	256.823	9.536.757	256.823
6	18.788.520	256.823	2.015.106	256.823
7	0	256.823	28.880.161	256.823
8	1.820.745	256.823	19.152.064	256.823
9	5.080.564	256.823	16.641.490	256.823
10	0	256.823	20.047.331	256.823
11	4.817.724	256.823	13.659.617	256.823
12	6.668.681	256.823	21.108.761	256.823
13	10.305.136	256.823	15.409.869	256.823
14	0	256.823	42.212.487	256.823
15	0	256.823	29.833.837	256.823
16	10.254.783	256.823	15.624.371	256.823
17	9.154.079	256.823	14.777.442	256.823
18	0	256.823	29.181.269	256.823
19	0	256.823	18.469.285	256.823
20	0	256.823	25.093.656	256.823
21	6.276.939	256.823	17.580.060	256.823
22	6.451.158	256.823	11.565.962	256.823

Fiyatlara iletim ek ücreti dahil edilmiştir.

TEİAŞ 2003 YILI ÜRETİM TARAFINDAN BEKLENEN GELİR

Bölge	TOPLAM GÜÇ MW	SİSTEM KULLANIM FİYATI Bin TL/MW-Yıl	SİSTEM İŞLETİM FİYATI Bin TL/MW-Yıl	İLETİM EK ÜCRETİ Bin TL/MW-Yıl	TARİFE Bin TL/MW-Yıl	TOPLAM GELİR Bin TL
1	6.827,6	15.860.000,0	255.024,8	113.600,4	**16.228.625,2**	110.802.561.535,2
2	7.800,9	10.064.000,0	255.024,8	72.742,4	**10.391.767,2**	81.065.136.840,1
3	4.506,6	7.082.000,0	255.024,8	51.721,2	**7.388.746,1**	33.298.123.009,5
4	176,1	1.528.000,0	255.024,8	12.569,2	**1.795.594,0**	316.204.103,2
5	52,5	10.982.000,0	255.024,8	79.213,7	**11.316.238,5**	594.102.521,8
6	1.842,5	18.657.000,0	255.024,8	133.317,4	**19.045.342,2**	35.091.043.071,0
7	112,0	0,0	255.024,8	1.797,8	**256.822,6**	28.764.131,1
8	1.108,8	1.808.000,0	255.024,8	14.543,0	**2.077.567,8**	2.303.652.900,6
9	861,0	5.045.000,0	255.024,8	37.361,7	**5.337.386,5**	4.595.489.816,8
10	1.693,0	0,0	255.024,8	1.797,8	**256.822,6**	124.045.315,4
11	435,6	4.784.000,0	255.024,8	35.521,8	**5.074.546,7**	2.210.472.528,4
12	573,4	6.622.000,0	255.024,8	48.478,5	**6.925.503,4**	3.971.083.629,2
13	1.850,0	10.233.000,0	255.024,8	73.933,7	**10.561.958,6**	19.539.623.319,1
14	261,1	0,0	255.024,8	1.797,8	**256.822,6**	67.056.380,7
15	2,5	0,0	255.024,8	1.797,8	**256.822,6**	642.056,5
16	3.940,3	10.183.000,0	255.024,8	73.581,2	**10.511.606,1**	38.589.066.955,4
17	128,9	9.090.000,0	255.024,8	65.876,3	**9.410.901,1**	1.213.065.158,1
18	192,3	0,0	255.024,8	1.797,8	**256.822,6**	49.386.985,8
19	327,5	0,0	255.024,8	1.797,8	**256.822,6**	84.109.401,2
20	190,4	0,0	255.024,8	1.797,8	**256.822,6**	48.904.159,3
21	1.614,3	6.233.000,0	255.024,8	45.736,3	**6.533.761,2**	10.547.450.655,4
22	24,9	6.406.000,0	255.024,8	46.955,9	**6.707.980,7**	167.028.719,6
	34.522,2					**344.707.013.193,6**

TEİAŞ 2003 YILI TÜKETİM TARAFINDAN BEKLENEN GELİR

Bölge	TOPLAM GÜÇ MW	SİSTEM KULLANIM FİYATI Bin TL/MW-Yıl	SİSTEM İŞLETİM FİYATI Bin TL/MW-Yıl	İLETİM EK ÜCRETİ Bin TL/MW-Yıl	TARİFE Bin TL/MW-Yıl	TOPLAM GELİR Bin TL
1	3.518,0	6.314.000,0	255.024,8	46.307,3	6.615.332,2	23.272.738.560,6
2	1.672,4	14.446.000,0	255.024,8	103.632,6	14.804.657,4	24.759.309.107,8
3	6.887,9	16.458.000,0	255.024,8	117.815,9	16.830.840,7	115.929.147.837,2
4	339,5	21.542.000,0	255.024,8	153.654,8	21.950.679,6	7.452.255.723,6
5	294,4	9.470.000,0	255.024,8	68.555,1	9.793.579,9	2.883.229.922,6
6	680,3	2.001.000,0	255.024,8	15.903,5	2.271.928,3	1.545.592.849,3
7	277,2	28.678.000,0	255.024,8	203.958,9	29.136.983,7	8.076.771.889,1
8	1.379,3	19.018.000,0	255.024,8	135.862,2	19.408.887,1	26.770.677.908,6
9	294,3	16.525.000,0	255.024,8	118.288,2	16.898.313,0	4.973.173.525,4
10	0,0	19.907.000,0	255.024,8	142.129,1	20.304.153,9	0,0
11	101,2	13.564.000,0	255.024,8	97.415,1	13.916.439,9	1.408.343.719,9
12	875,3	20.961.000,0	255.024,8	149.559,1	21.365.583,9	18.701.295.612,6
13	184,8	15.302.000,0	255.024,8	109.666,8	15.666.691,7	2.895.204.623,0
14	714,0	41.917.000,0	255.024,8	297.285,2	42.469.310,0	30.323.087.347,9
15	0,0	29.625.000,0	255.024,8	210.634,6	30.090.659,5	0,0
16	1.403,7	15.515.000,0	255.024,8	111.168,4	15.881.193,2	22.292.430.885,5
17	588,6	14.674.000,0	255.024,8	105.239,9	15.034.264,7	8.849.168.198,8
18	582,6	28.977.000,0	255.024,8	206.066,6	29.438.091,5	17.150.632.097,0
19	551,6	18.340.000,0	255.024,8	131.082,8	18.726.107,6	10.329.320.948,9
20	92,0	24.918.000,0	255.024,8	177.453,3	25.350.478,2	2.332.243.993,3
21	513,6	17.457.000,0	255.024,8	124.858,2	17.836.883,0	9.161.023.120,2
22	226,9	11.485.000,0	255.024,8	82.759,5	11.822.784,3	2.682.589.764,8
	21.177,6					341.788.237.636,3

TEİAŞ 2003 YILI GELİRLERİ

	ÜRETİM	TÜKETİM	TOPLAM	
	Trilyon TL	Trilyon TL	Trilyon TL	%
SİSTEM KULLANIM GELİRLERİ	334,0	334,0	668,0	97,3%
SİSTEM İŞLETİM GELİRLERİ	8,3	5,4	13,7	2,0%
İLETİM EK ÜCRETİ	2,4	2,4	4,8	0,7%
TOPLAM	**344,7**	**341,8**	**686,5**	100,0%
%	50,2%	49,8%	100,0%	