ALTERNATIVE CONGESTION MANAGEMENT – EFFECTIVE ZONAL (EZ) PRICING

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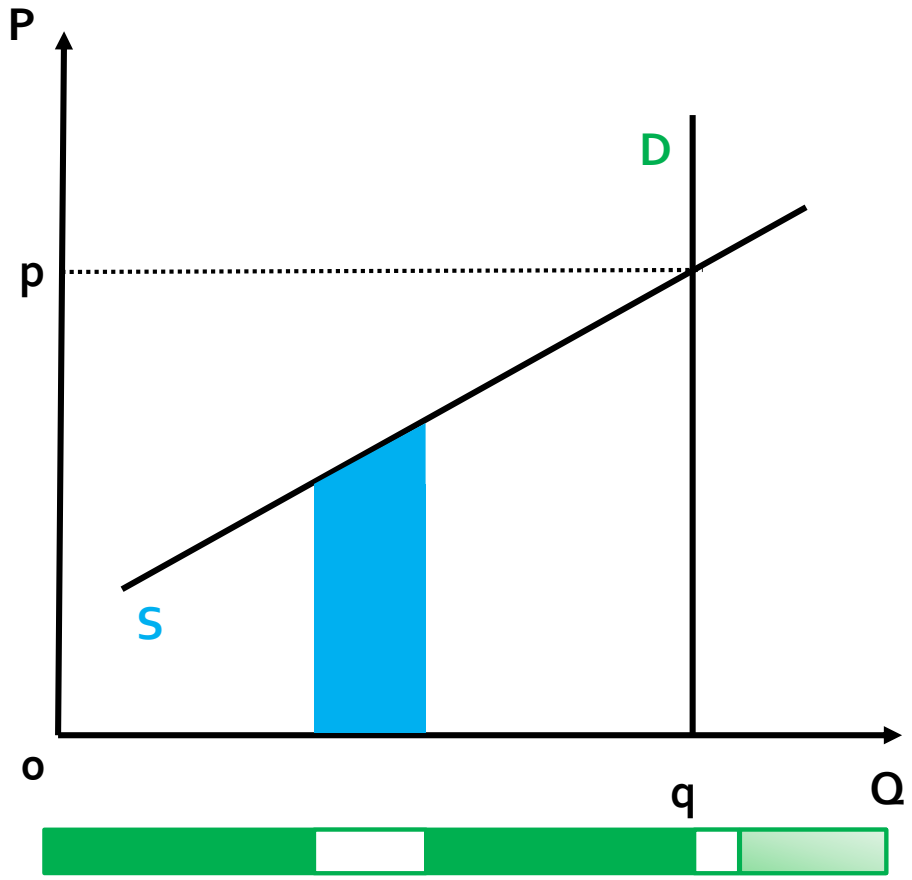
ZONAL PRICING

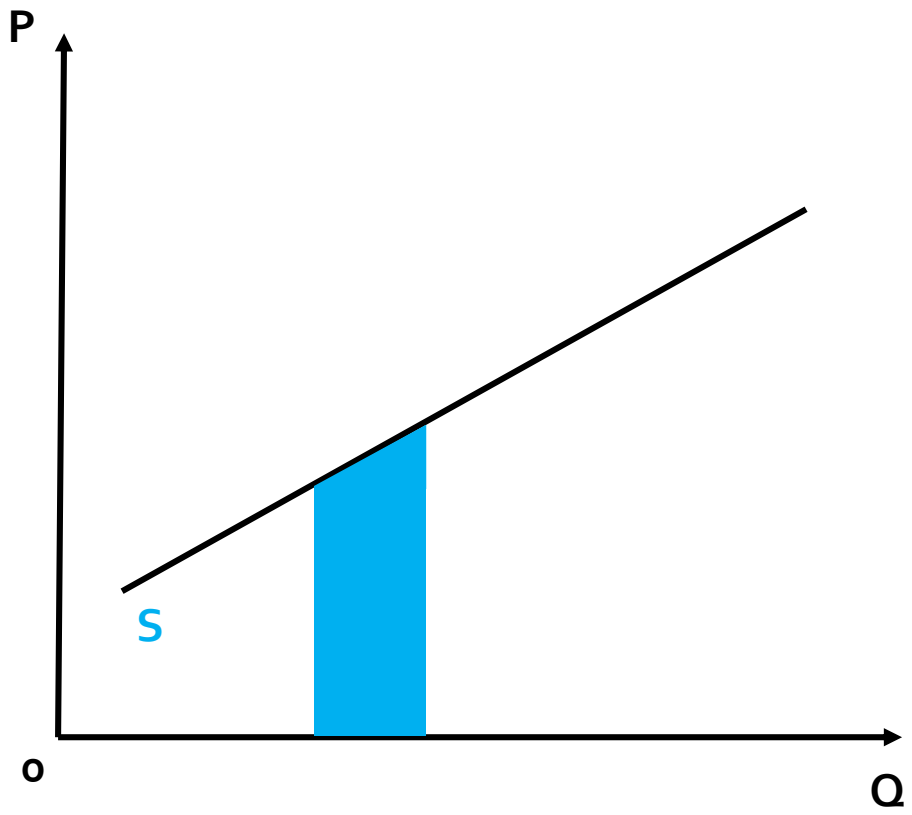
Zonal Pricing



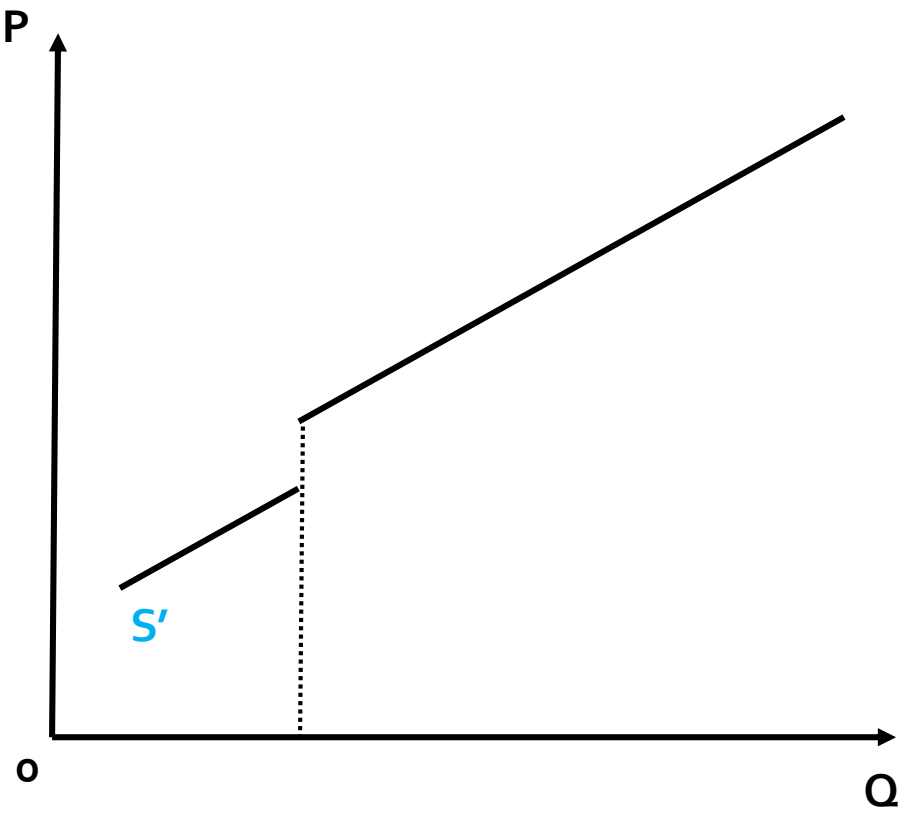
- Inelastic demand, **q** and supply curve form a spot market with zonal price **p**.
- Part of the production is not feasible but participated in the pricing calculation
- After redispatch, some of the demand **q** is matched with the supply (production) on the right side of demand curve.

EZ PRICING

Concept of EZ Pricing – Effective Supply

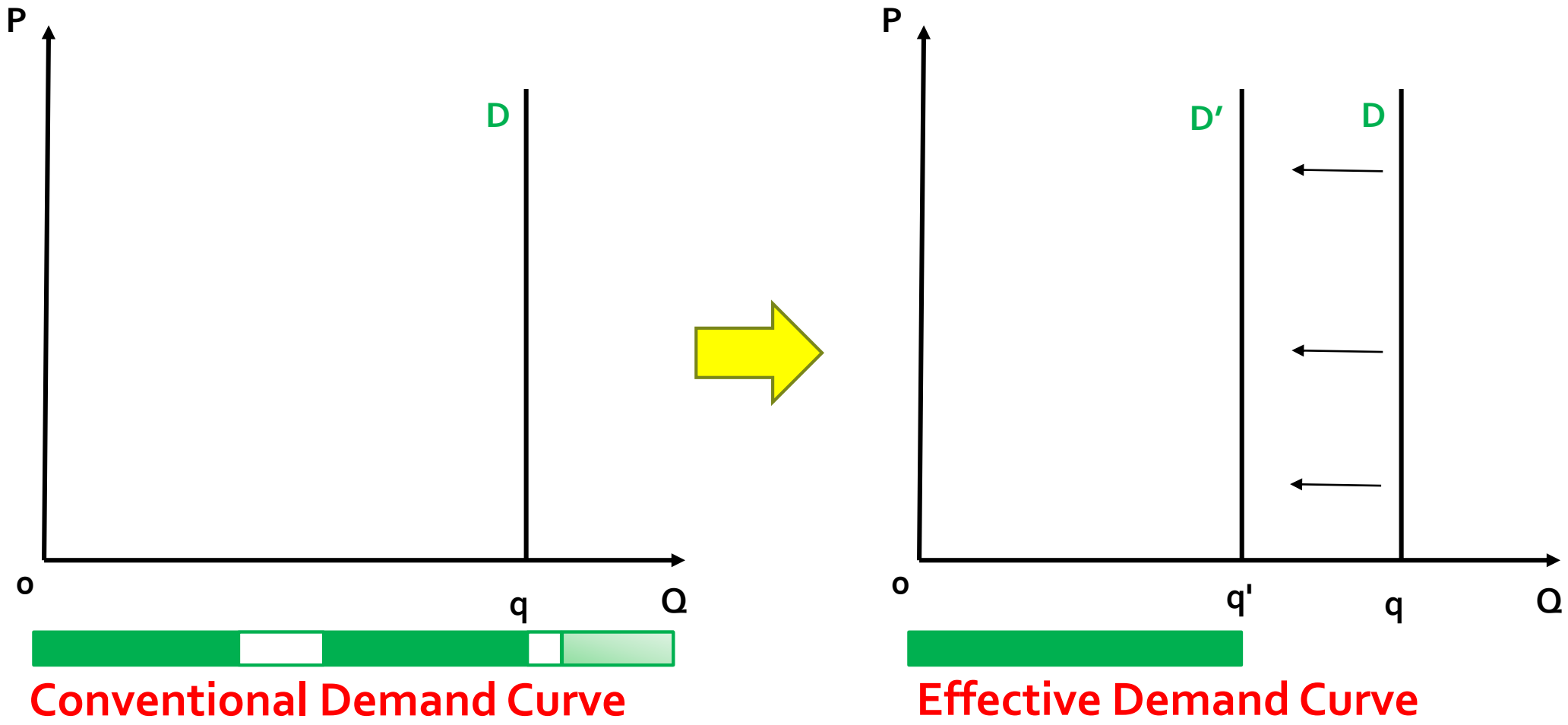


Conventional Supply Curve

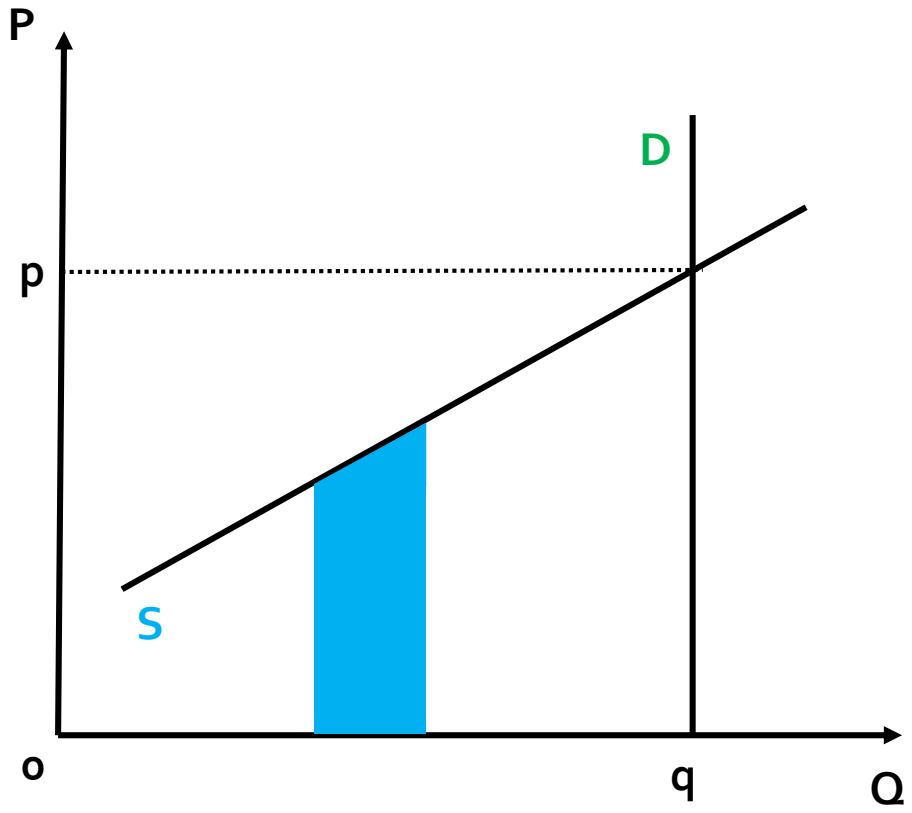


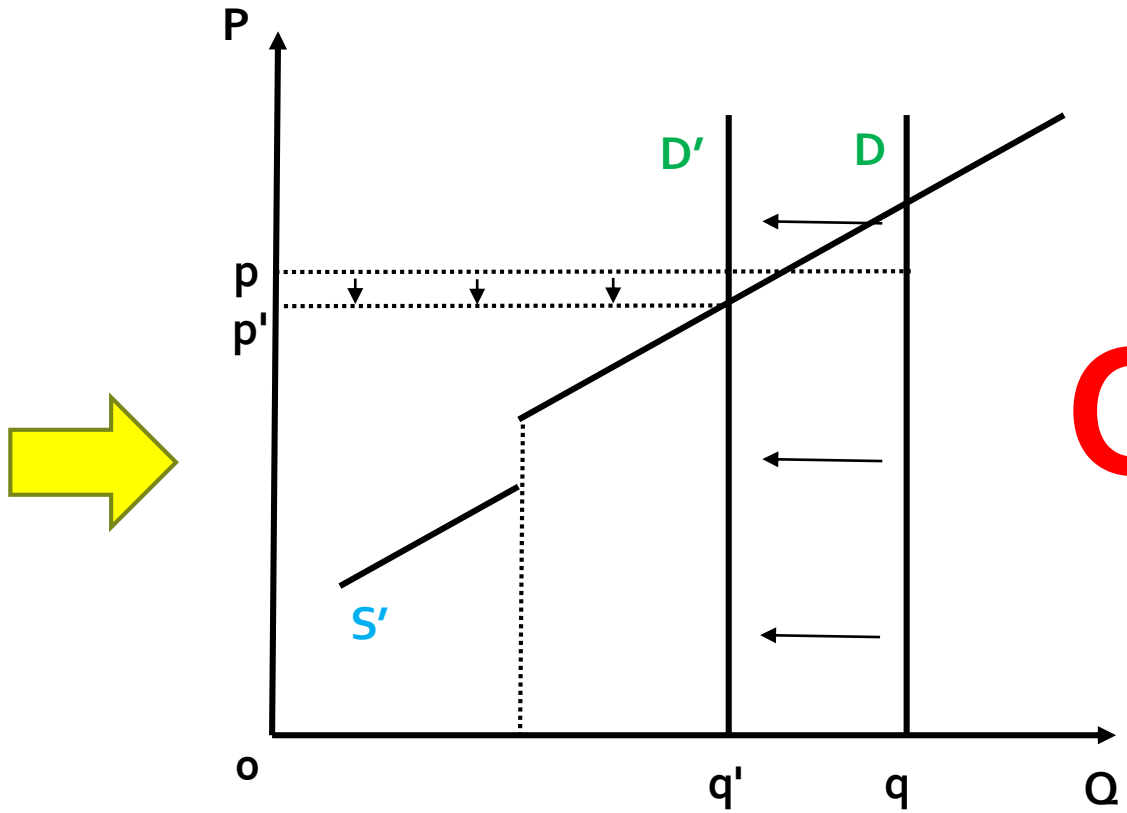
Effective Supply Curve

Concept of EZ Pricing – Effective Demand



EZ Pricing – Effective Zonal pricing



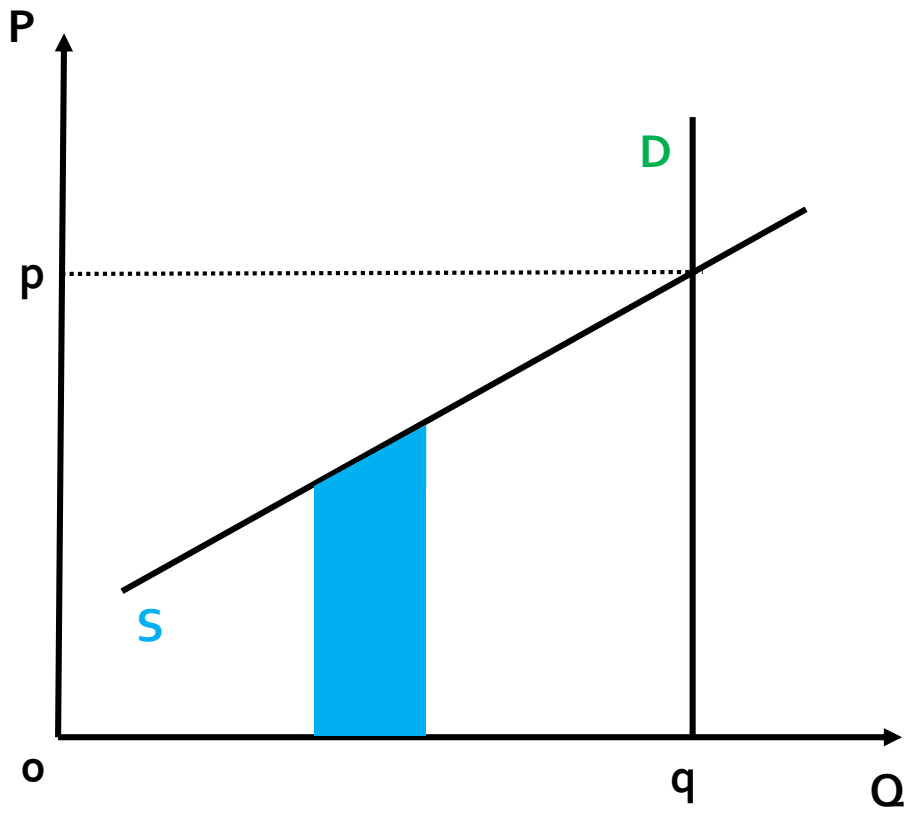


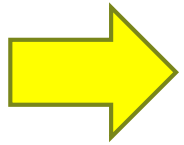
OR

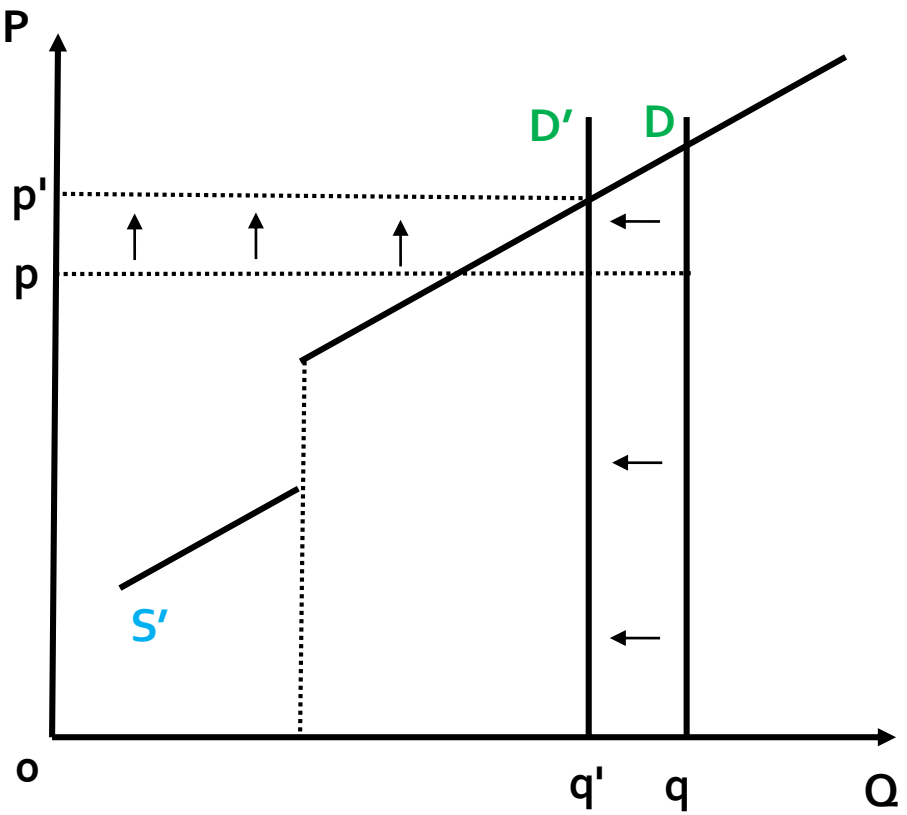
Zonal Pricing

EZ Pricing

EZ Pricing – Effective Zonal pricing





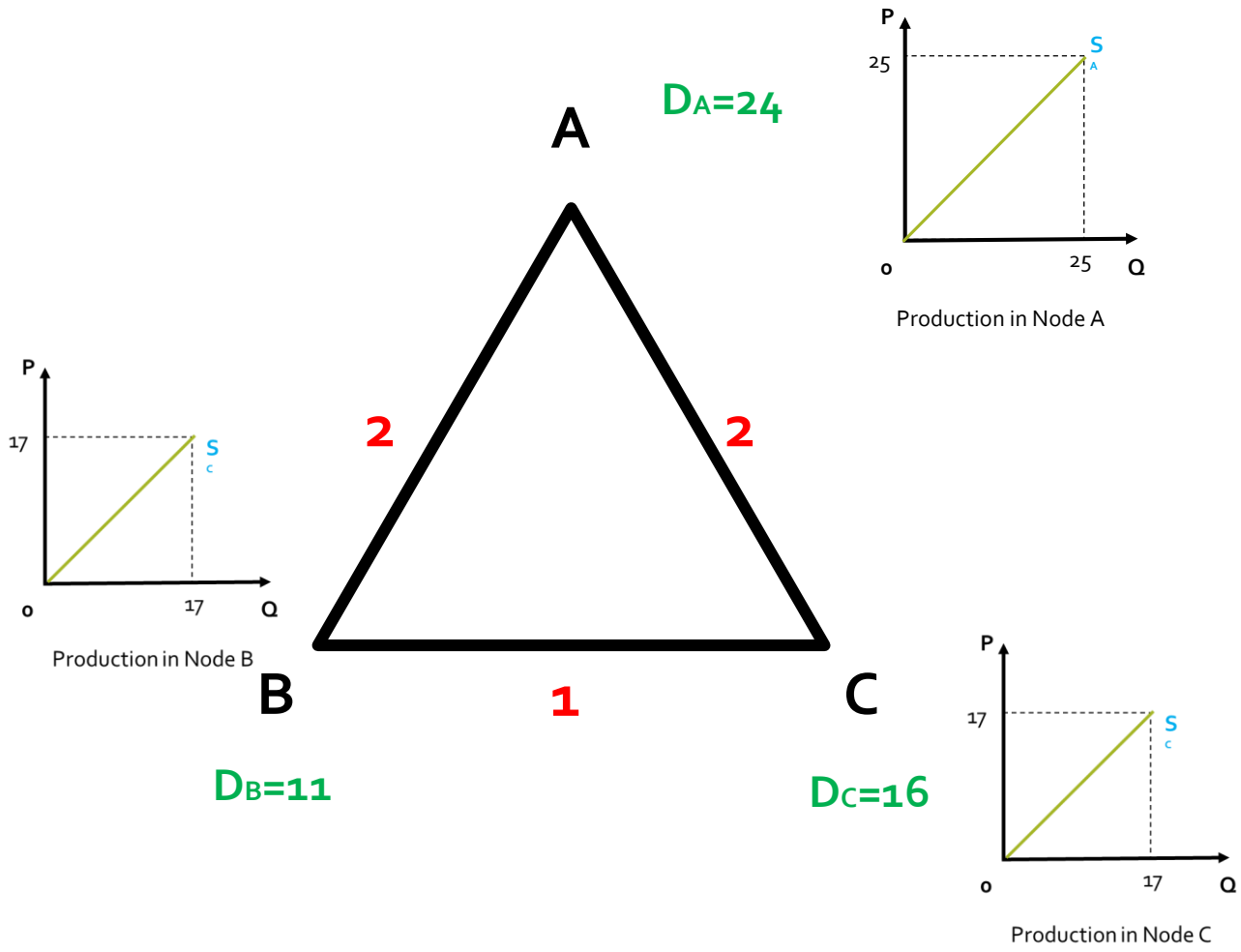


Zonal Pricing

EZ Pricing

EXAMPLE

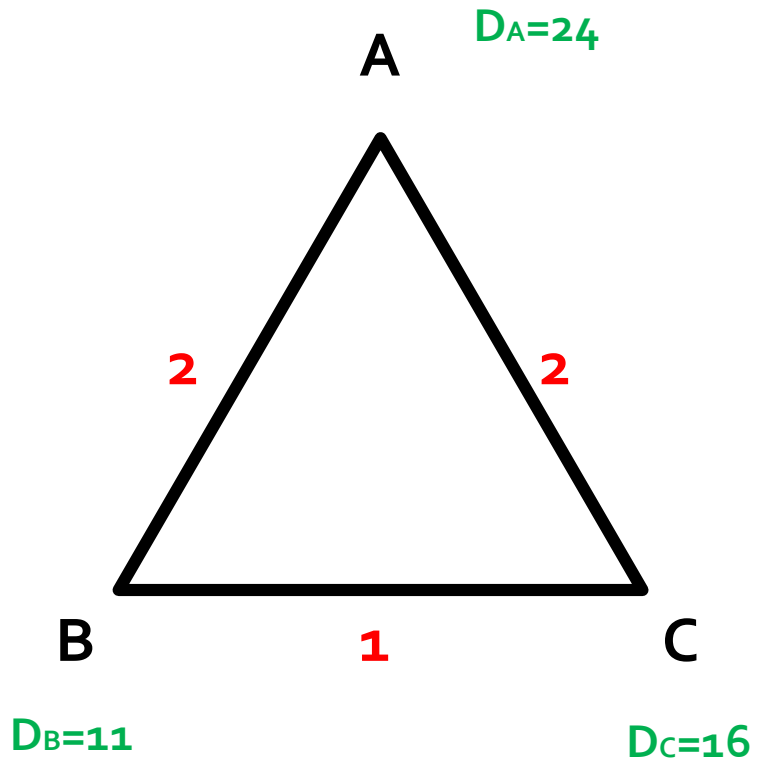
Example – Network



Node	MC	Max Supply	Demand
A	0-25	25	24
B	0-17	17	11
C	0-17	17	16
Total		59	51

The production in each node is increasing marginal cost of production. The more produced, the higher the marginal cost. The capacity of node A is 25, node B is 17 and node C is 17. The total possible production of the network is 59.

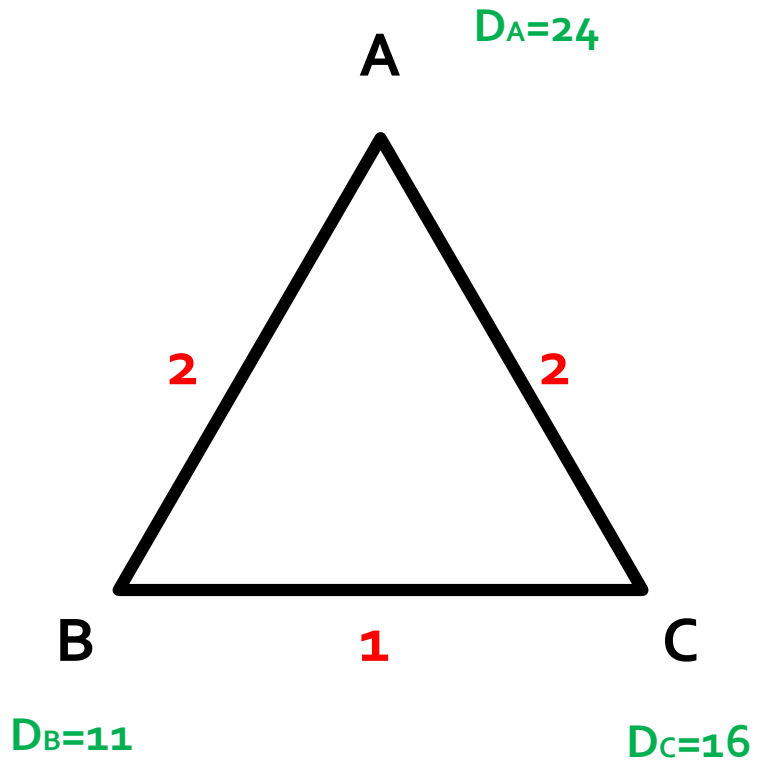
Solution – Nodal Pricing



Node	Node Price €	Node Supply
A	20	20
B	14	14
C	17	17

Efficient dispatch is node A produce 20 unit, node B produce 14 unit and node C produce 17 unit

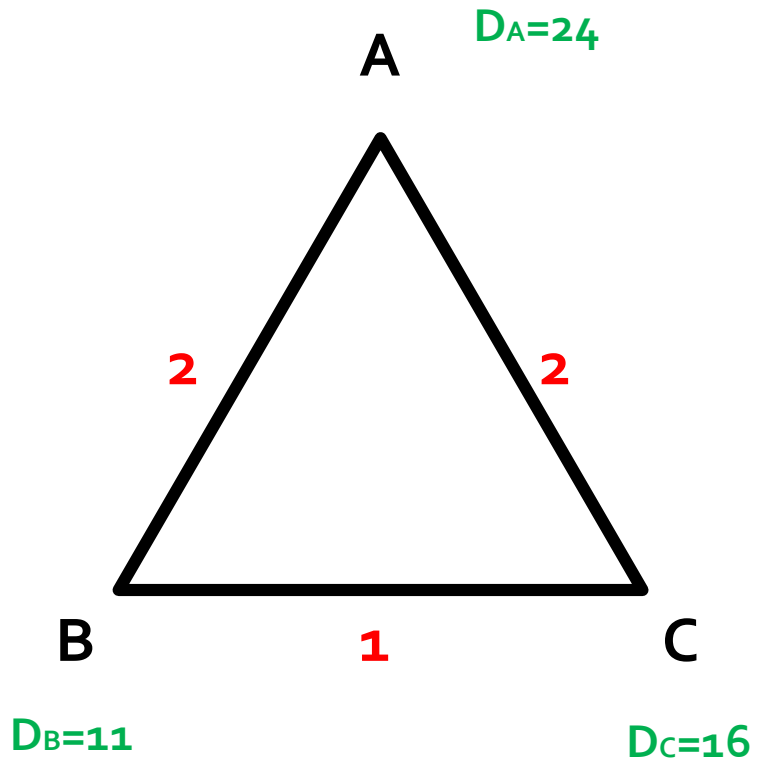
Solution – Zonal Pricing (cost-based redispatch)



Zonal Price: 17

	Node	MC	Supply	Demand
Market Clearing	A	17	17	17+3=20
	B	17	17	17-3=14
	C	17	17	17
Redispatch	A	(17+20)/2	3	3
	B	(14+17)/2	-3	-3
	C	n/a	n/a	n/a

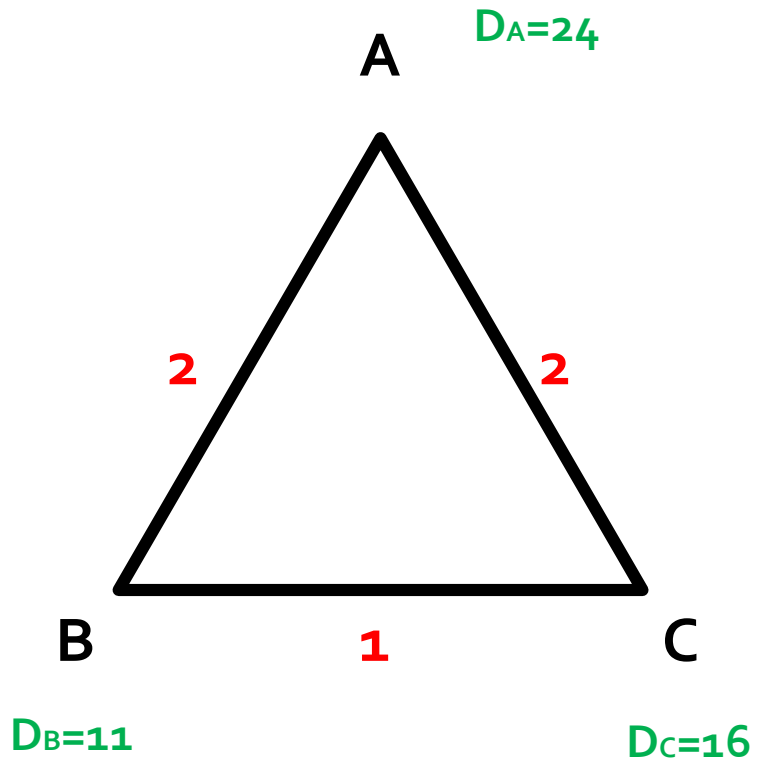
Solution – Zonal Pricing (market-based redispatch)



Zonal Price: 17

	Node	MC	Supply	Demand
Market Clearing	A	17	17	17+3=20
	B	17	17	17-3=14
	C	17	17	17
Redispatch	A	20	3	3
	B	14	-3	-3
	C	n/a	n/a	n/a

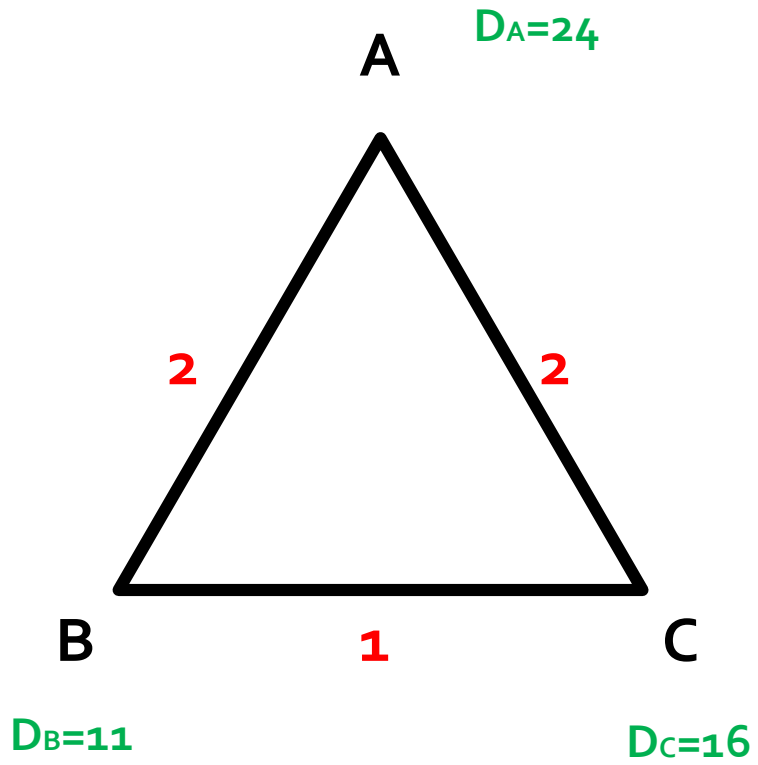
Solution – Zonal Pricing (bid-based redispatch)



Zonal Price: 20

	Node	MC	Supply	Demand
Market Clearing	A	20	17	17+3=20
	B	20	17	17-3=14
	C	20	17	17
Redispatch	A	20	3	3
	B	14	-3	-3
	C	n/a	n/a	n/a

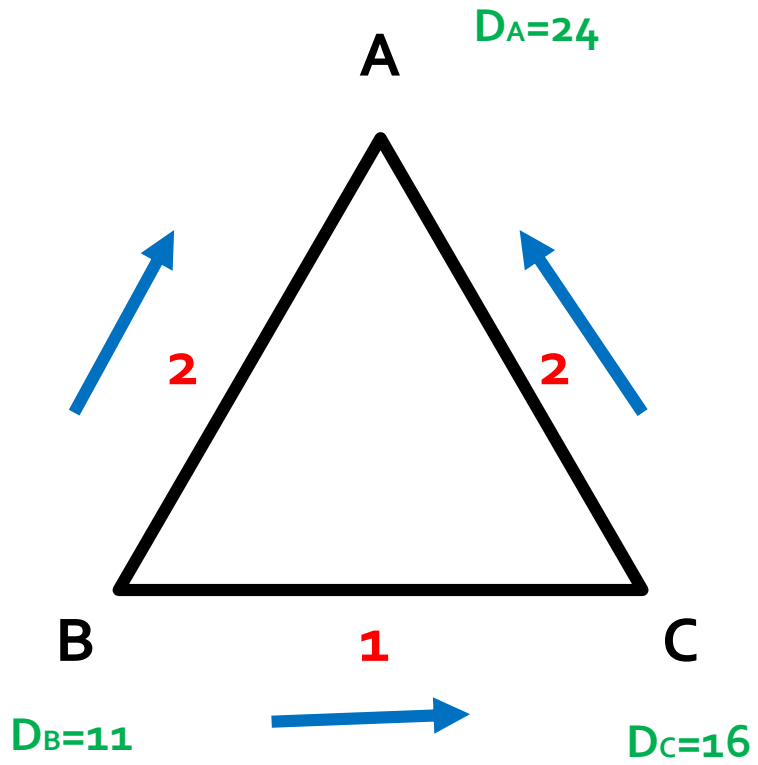
EZ Pricing (1. calculate nodal price and dispatch)



Node	Node Price €	Node Supply	Demand
A	20	20	24
B	14	14	12
C	17	17	16

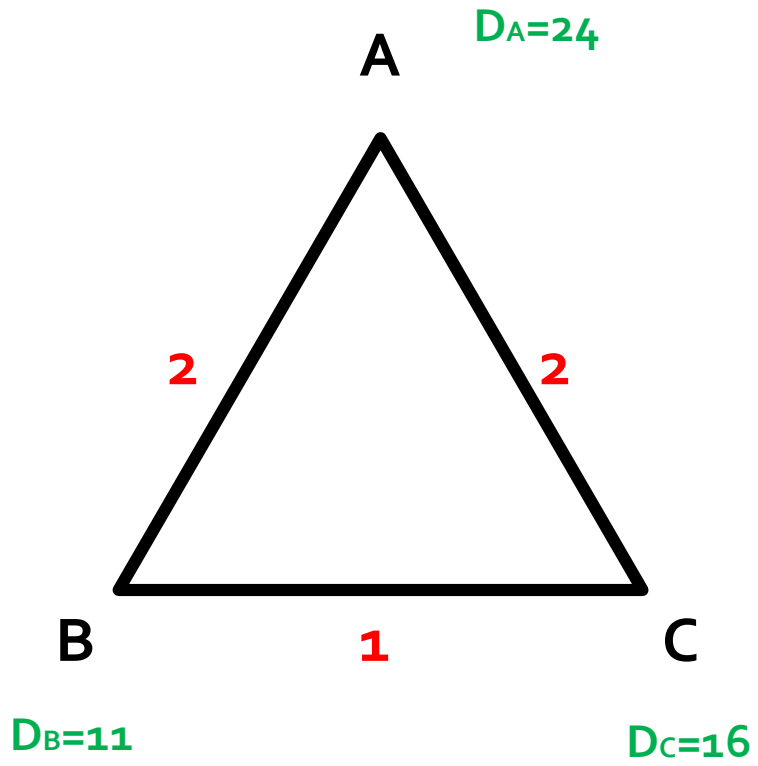
To obtain efficient dispatch, electricity flow, production in each node and nodal price

EZ Pricing (2. determine ICN and ECN)



Node	All lines are inflow and congested	All lines are outflow and congested	Characteristic
A	Yes	No	Import Constrained Node (ICN)
B	No	Yes	Export Constrained Node (ECN)
C	No	No	Transition Node

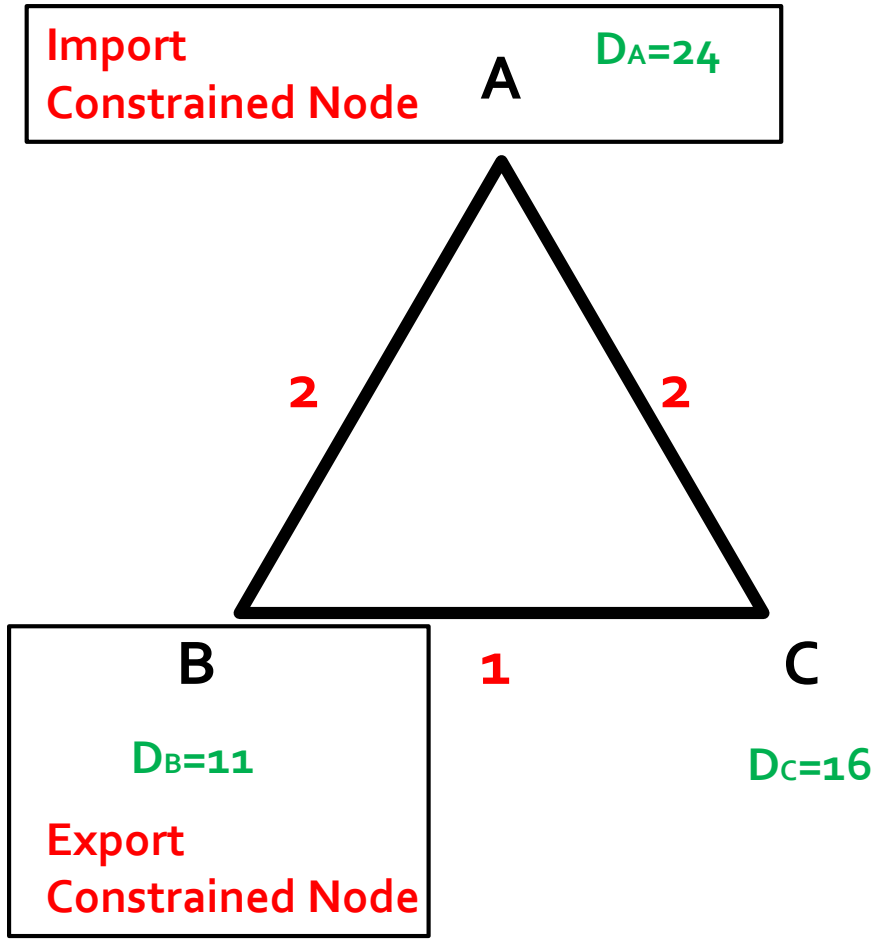
EZ Pricing (3 obtain effective supply and effective demand)



Node	MC	Max Supply	Demand
A	0-25	25	24
B	0-17	17	11
C	0-17	17	16

Set node A (ICN) has no production and demand is the total capacity of connected line.

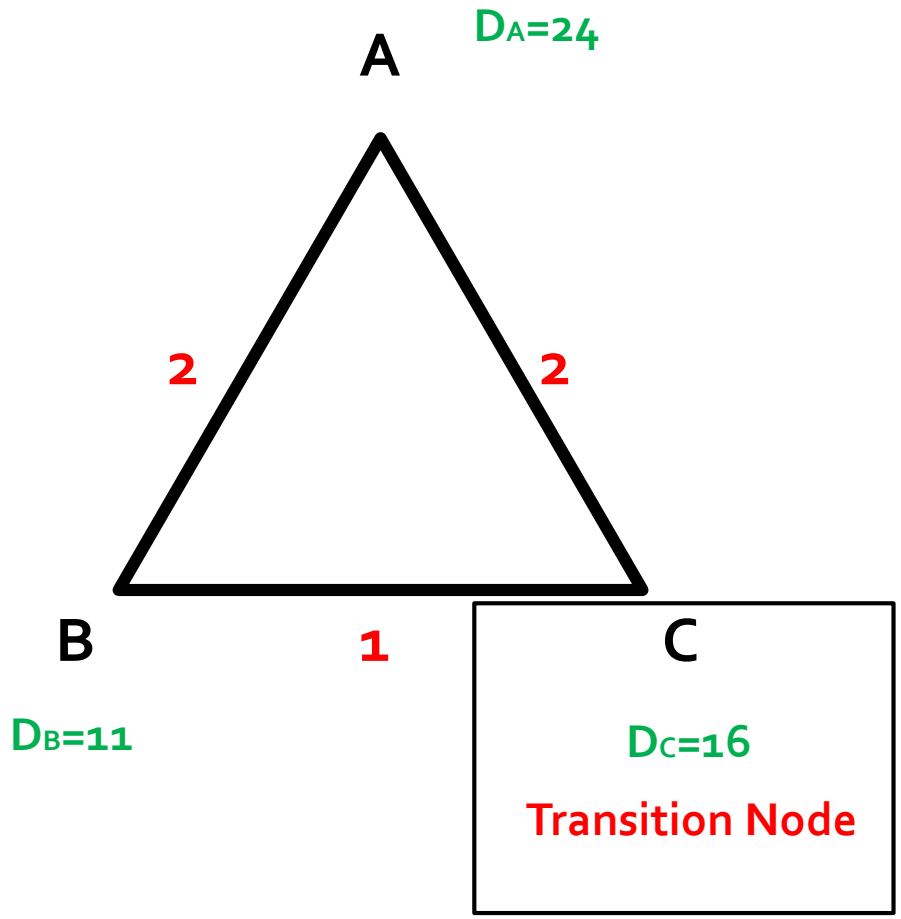
EZ Pricing (3 obtain effective supply and effective demand)



Node	MC	Effective Supply	Effective Demand
A	0	0	2+2=4
B	14	2+1=3	0
C	0-17	17	16

Set node A (ICN) has no production and demand is the total capacity of connected line.
Set node B (ECN) has no demand, nodal price remain the same but the supply capacity is the total capacity of connected line.

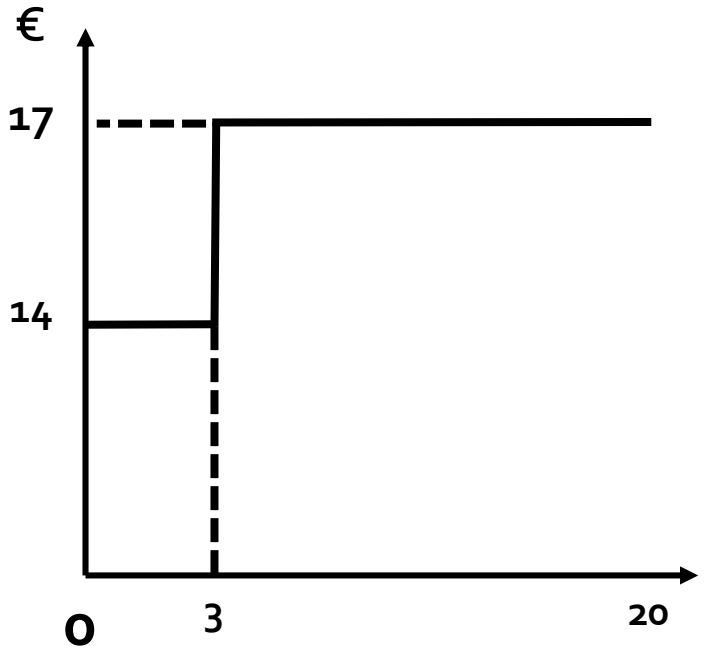
EZ Pricing (3 obtain effective supply and effective demand)



Node	MC	Effective Supply	Effective Demand
A	0	0	4
B	14	3	0
C	17	17	16

Set the nodal price and supply quantity of node C (transition node) according to the nodal pricing (first step) .

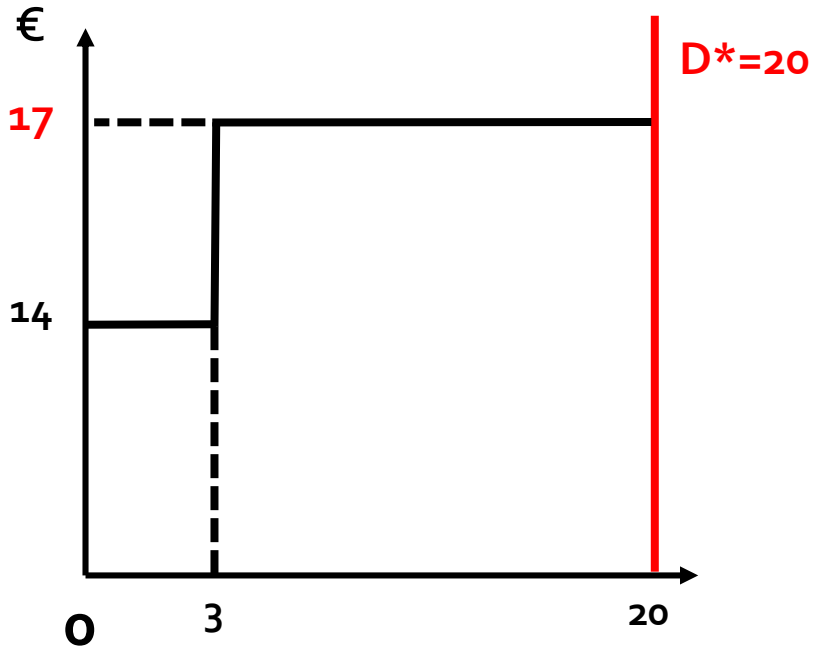
EZ Pricing (3 obtain effective supply and effective demand)



Node	MC	Effective Supply	Effective Demand
A	0	0	4
B	14	3	0
C	17	17	16
Total		20	20

The effective supply curve of the network is shown as left. The effective inelastic demand of the network is **20**.

EZ Pricing (4. determine EZ price)

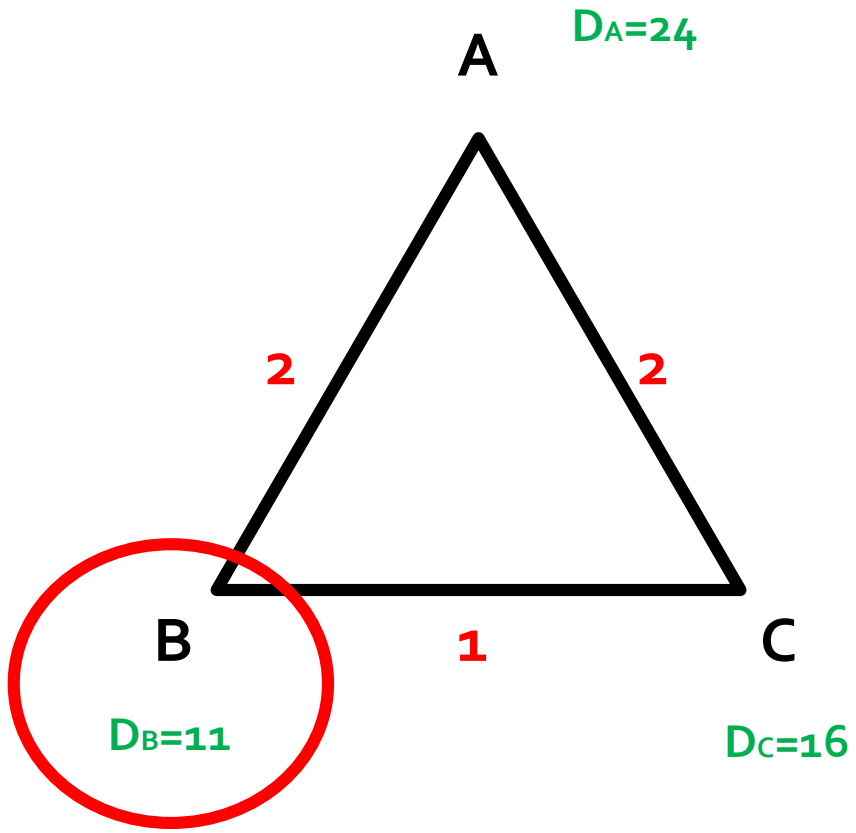


EZ Price: 17

Node	Node Price €	Effective Supply	Effective Demand
A	0	0	4
B	14	3	0
C	17	17	16
		Effective Demand (D*)	20

The determined EZ price from the left graph is €17

EZ Pricing (5. dispatch and payment)

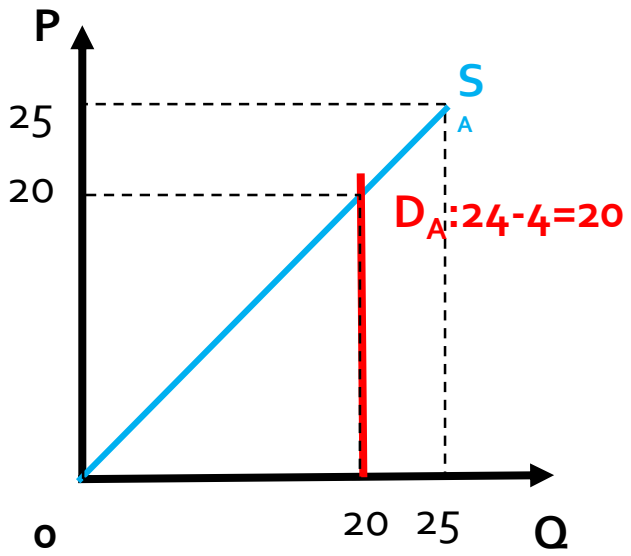


	Node	Node Price €	Node Supply	Cleared Demand
Market Clearing	A	n/a	n/a	4
	B	17	3	0
	C	17	17	16
Redispatch	A			
	B	17	14-3= 11	11
	C	n/a	n/a	n/a

The production in node B (ECN) is limited to 14, that was computed in the nodal pricing (first step). Therefore the chosen 14 unit are paid 17 for each unit produced and the redispatch quantity is 14-3=11.

EZ Pricing (5. dispatch and payment)

Redispatch in node **A**

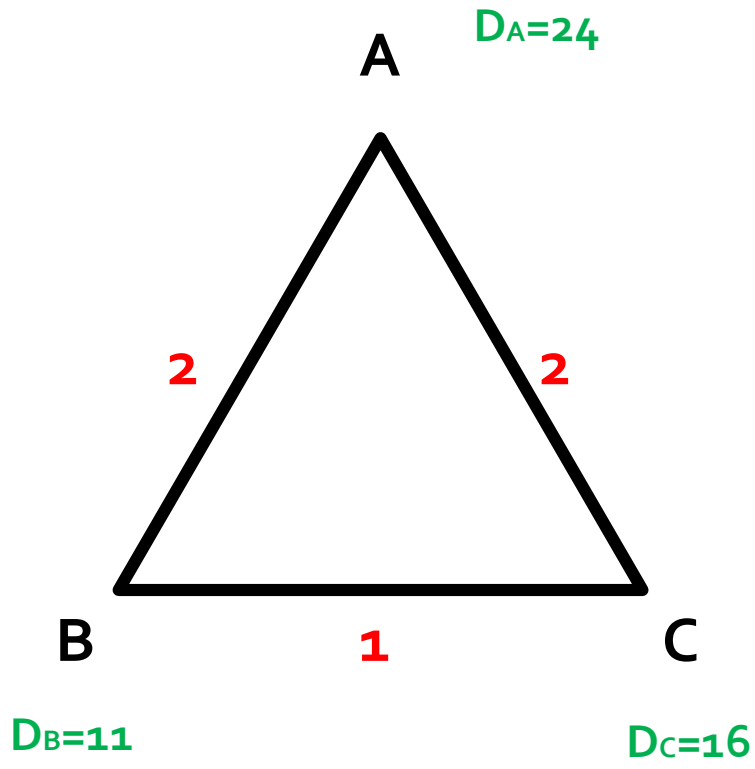


Nodal-market-based Redispatch

	Node	Node Price €	Node Supply	Cleared Demand
Market Clearing	A	n/a	n/a	4
	B	17	3	0
	C	17	17	16
Redispatch	A	20	20	20
	B	17	11	11
	C	n/a	n/a	n/a

Remaining demand in node A (ICN) are cleared by **nodal-market-based redispatch**.

Solution – EZ Pricing



EZ Price: 17

	Node	Node Price €	Node Supply	Cleared Demand
Market Clearing	A	n/a	n/a	4
	B	17	3	0
	C	17	17	16
Redispatch	A	20	20	20
	B	17	11	11
	C	n/a	n/a	n/a

Summarizing

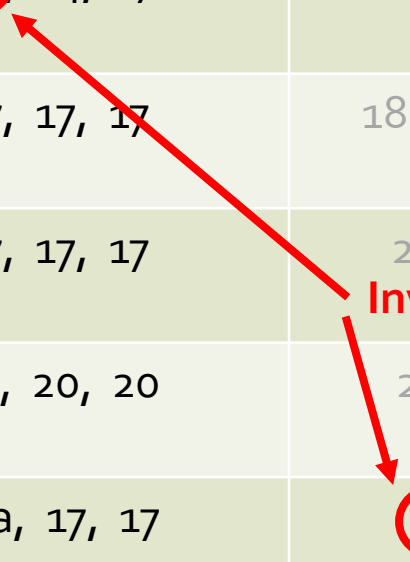
Congestion Management technique	Market Clearing Price	Average Redispatch Price
Nodal Pricing	20, 14, 17	n/a, n/a, n/a
Zonal Pricing (cost-based redispatch)	17, 17, 17	18.5, (15.5), n/a
Zonal Pricing (market-based redispatch)	17, 17, 17	20, (14), n/a
Zonal Pricing (bid-based redispatch)	20, 20, 20	20, (14), n/a
EZ Pricing	n/a, 17, 17	20, 17, n/a

Comparison

Comparison	Nodal Pricing	Zonal Pricing	EZ Pricing
Efficient dispatch	Yes	Yes	Yes
Effective Investment signal	Yes	No	Yes
Fairness (produce and receive payment)	Yes	No	Yes
Competitiveness	Low	High	Medium
Computation	Medium	Easy	Complicated

Comparison – Effective Investment signal

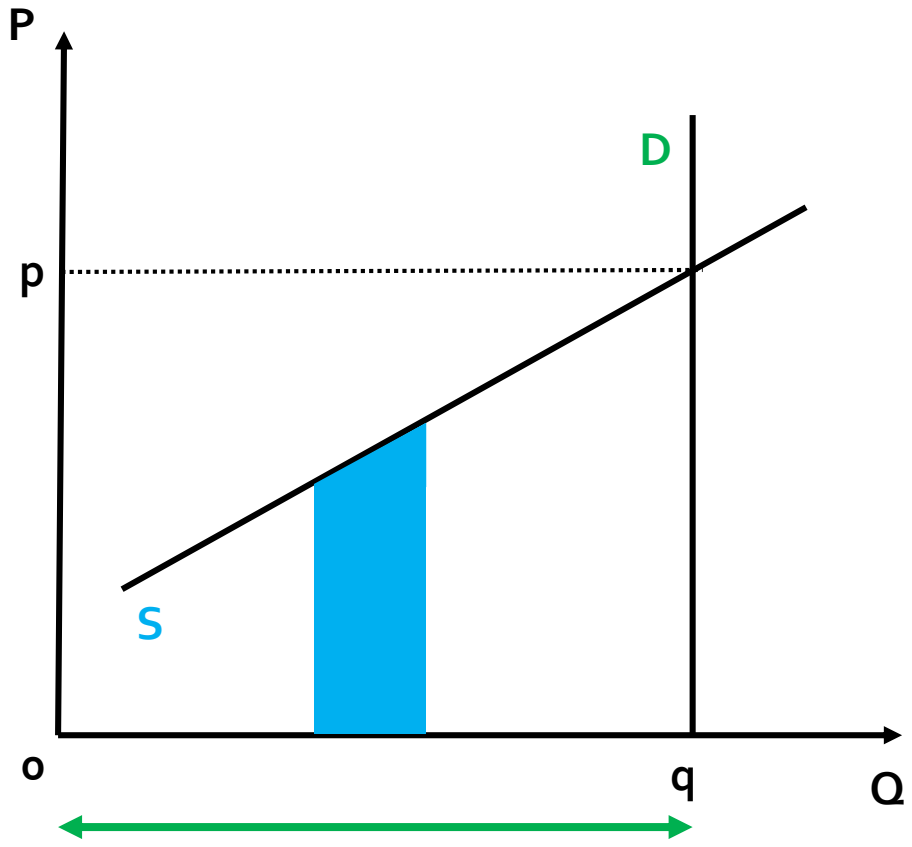
Congestion Management technique	Market Clearing Price	Average Redispatch Price
Nodal Pricing	20, 14, 17	n/a, n/a, n/a
Zonal Pricing (cost-based redispatch)	17, 17, 17	18.5, (15.5), n/a
Zonal Pricing (market-based redispatch)	17, 17, 17	20, (14), n/a
Zonal Pricing (bid-based redispatch)	20, 20, 20	20, (14), n/a
EZ Pricing	n/a, 17, 17	20, 17, n/a

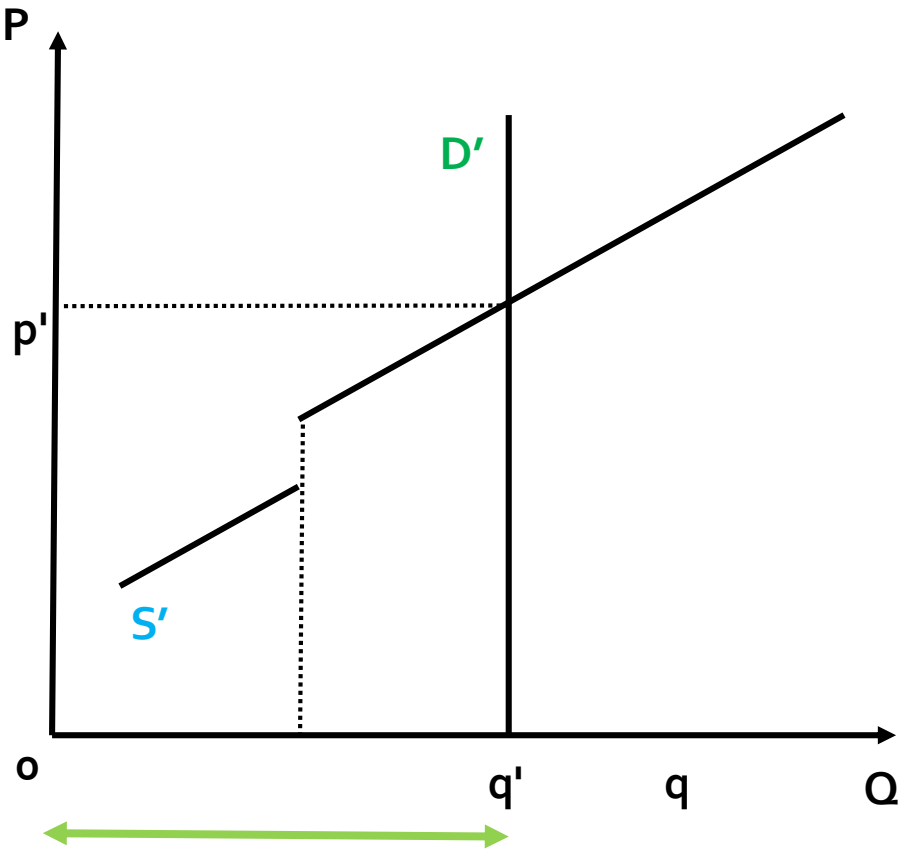


Comparison – Fairness

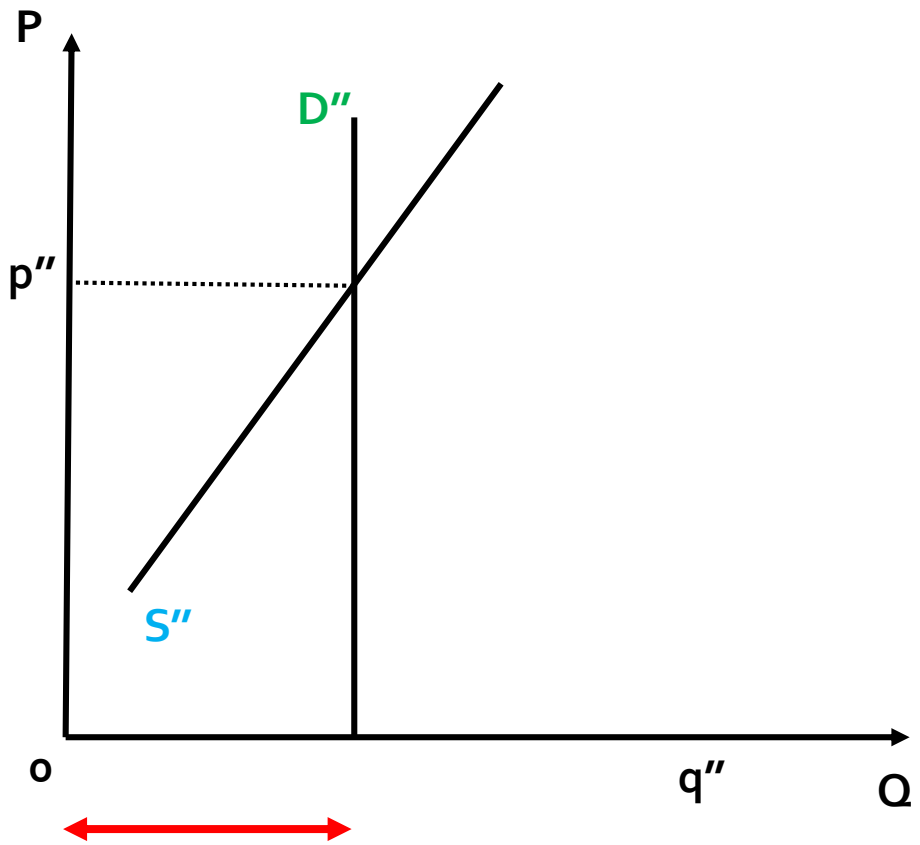
Congestion Management technique	Market Clearing Price	Average Redispatch Price
Nodal Pricing	20, 14, 17	n/a, n/a, n/a
Zonal Pricing (cost-based redispatch)	17, 17, 17	18.5, (15.5), n/a
Zonal Pricing (market-based redispatch)	Not producing, but receive profit!	20, (14), n/a
Zonal Pricing (bid-based redispatch)	20, 20, 20	20, (14), n/a
EZ Pricing	n/a, 17, 17	20, 17, n/a

Zonal Pricing vs EZ Pricing





Nodal Pricing



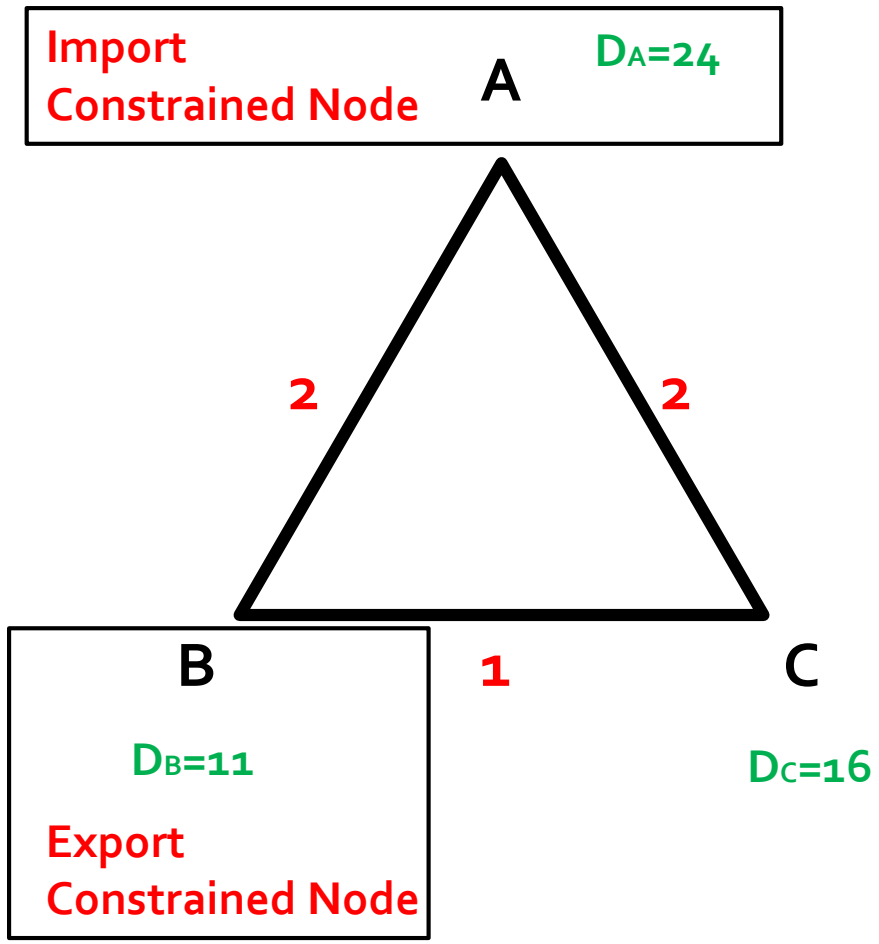
Competitiveness

Nodal Pricing

Zonal Pricing

EZ Pricing

Discussion



1. What happen if there is a sudden huge supply of renewable energy in node B (Export Constrained Node)? (3 more quantity supplied)
2. What happen if there is a demand spike in node A (Import Constrained Node)? (3 more quantity demanded)

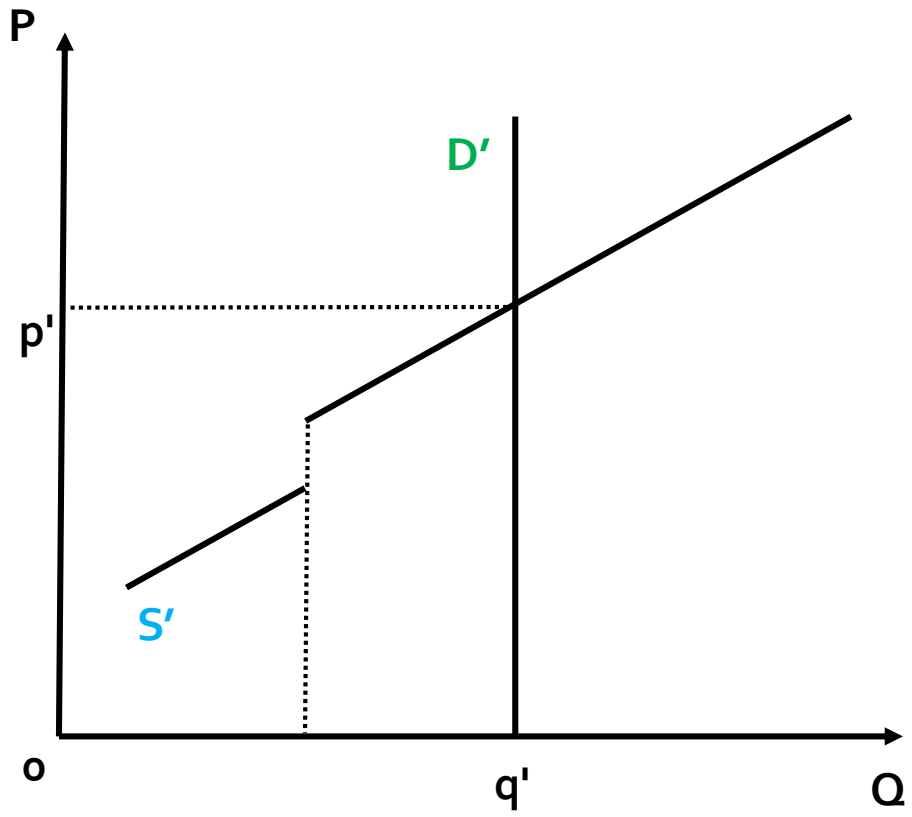
Solutions – Supply Shocks in ECN

Congestion Management technique	Market Clearing Price	Average Redispatch Price
Nodal Pricing	20, 11, 17	n/a, n/a, n/a
Zonal Pricing (cost-based redispatch)	16, 16, 16	18, (13.5), 16.5
Zonal Pricing (market-based redispatch)	16, 16, 16	20, (11), 20
Zonal Pricing (bid-based redispatch)	20, 20, 20	20, (11), n/a
EZ Pricing	n/a, 17, 17	20, 17, n/a

Solutions – Demand Shocks in ICN

Congestion Management technique	Market Clearing Price	Average Redispatch Price
Nodal Pricing	23, 14, 17	n/a, n/a, n/a
Zonal Pricing (cost-based redispatch)	20, 20, 20	21, (15.5), n/a
Zonal Pricing (market-based redispatch)	20, 20, 20	23, (14), n/a
Zonal Pricing (bid-based redispatch)	23, 23, 23	23, (14), n/a
EZ Pricing	n/a, 17, 17	23, 17, n/a

Conclusion of EZ Pricing



- Effective supply consist of feasible production
- Effective demand matched by the production on the left side
- The reduced demand are paid by the price from nodal **market-based** redispatch or EZ price (whichever is higher)
- Fair pricing technique that uniform price only involve active producers and feasible demand
- Stable price that has less spill over effect

THANK YOU

By: V Qian, Lim