Electricity Market

Social-Welfare optimization

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https://github.com/nareshram256/electricity-market_exampe/tree/master for code

Social Welfare optimization for market clearing

The optimization is majorly aims at minimizing the total generation cost for Area_1 and Area_2, and therefore maximizing the welfare

$$\text{Max} \sum_i \lambda_i^D y_i^D - \sum_j \lambda_j^G y_j^G$$

$$\text{S.T} \sum_i y_i^{D,k} - \sum_j y_j^{G,K} = (\text{transmission line limits})_k$$

$$0 \le y_i^D \le P_i^D$$

$$0 \le y_j^G \le P_j^G$$

Lagrangian multiplier associated with these constraints are dual variables.

Market clearing prices (MCP) are those dual variables!

here λ^D represents demand side offer price

here y^D represents demand

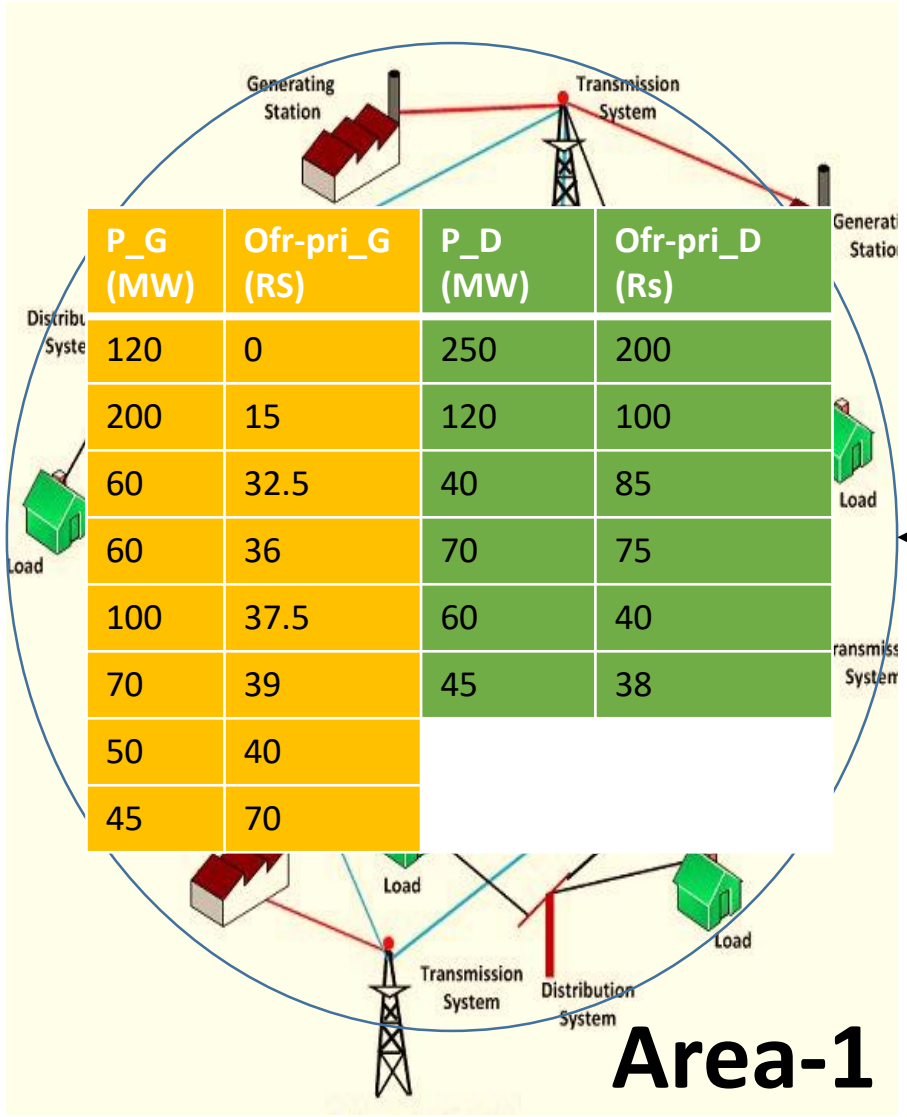
here λ^G represents Generator side offer price

here y^G represents Generation

Its Linear Programming, used cvxpt (python-C pkg) for solving the objective function

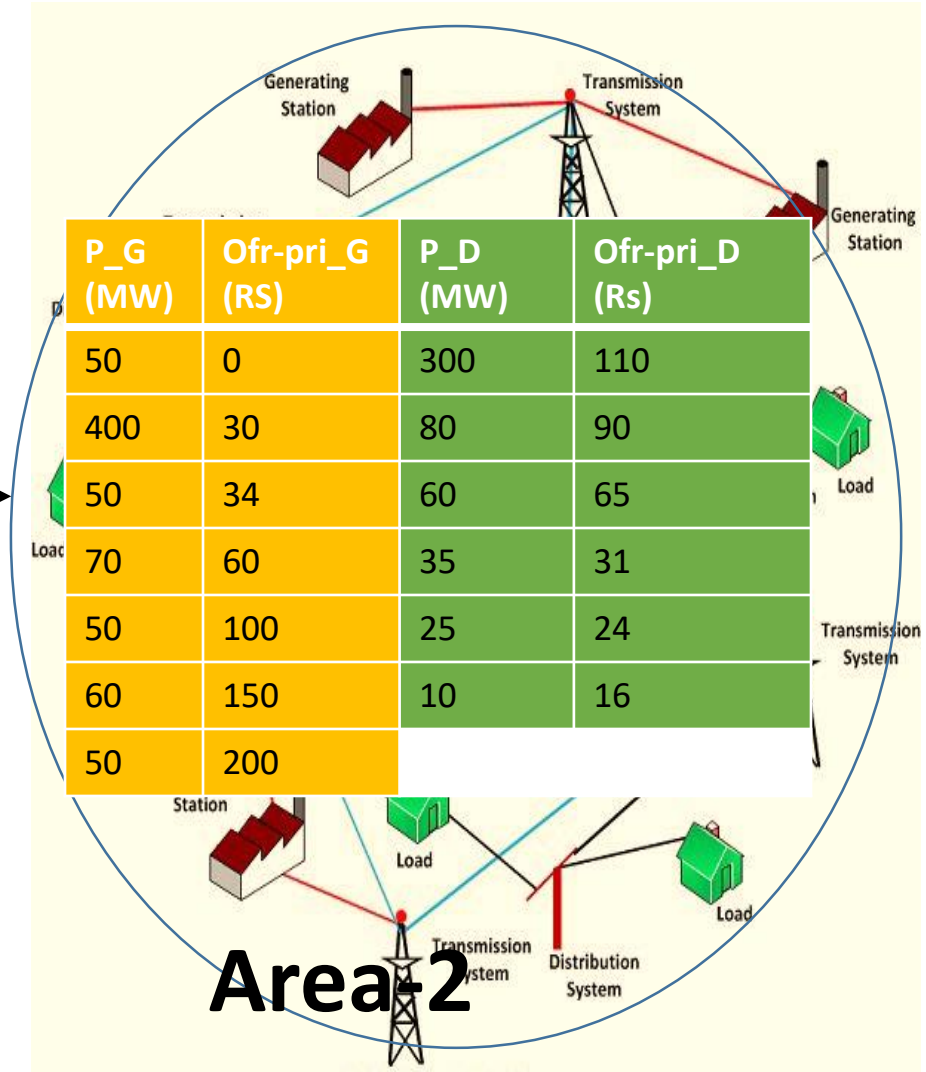
Two area market example

-double-sided auction- without any constraints

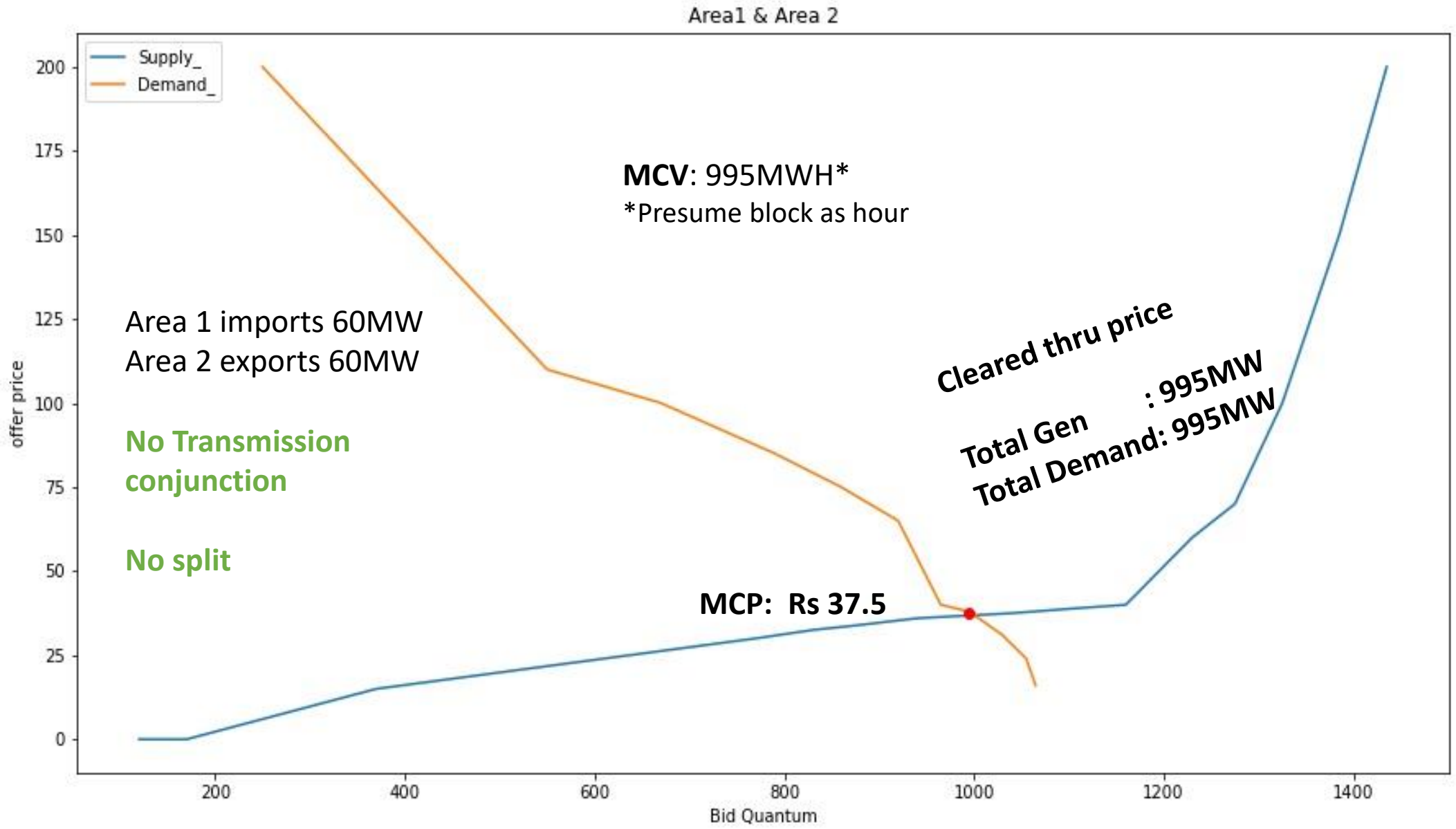


P_G (MW)	Ofr-pri_G (RS)	P_D (MW)	Ofr-pri_D (Rs)
120	0	250	200
200	15	120	100
60	32.5	40	85
60	36	70	75
100	37.5	60	40
70	39	45	38
50	40		
45	70		

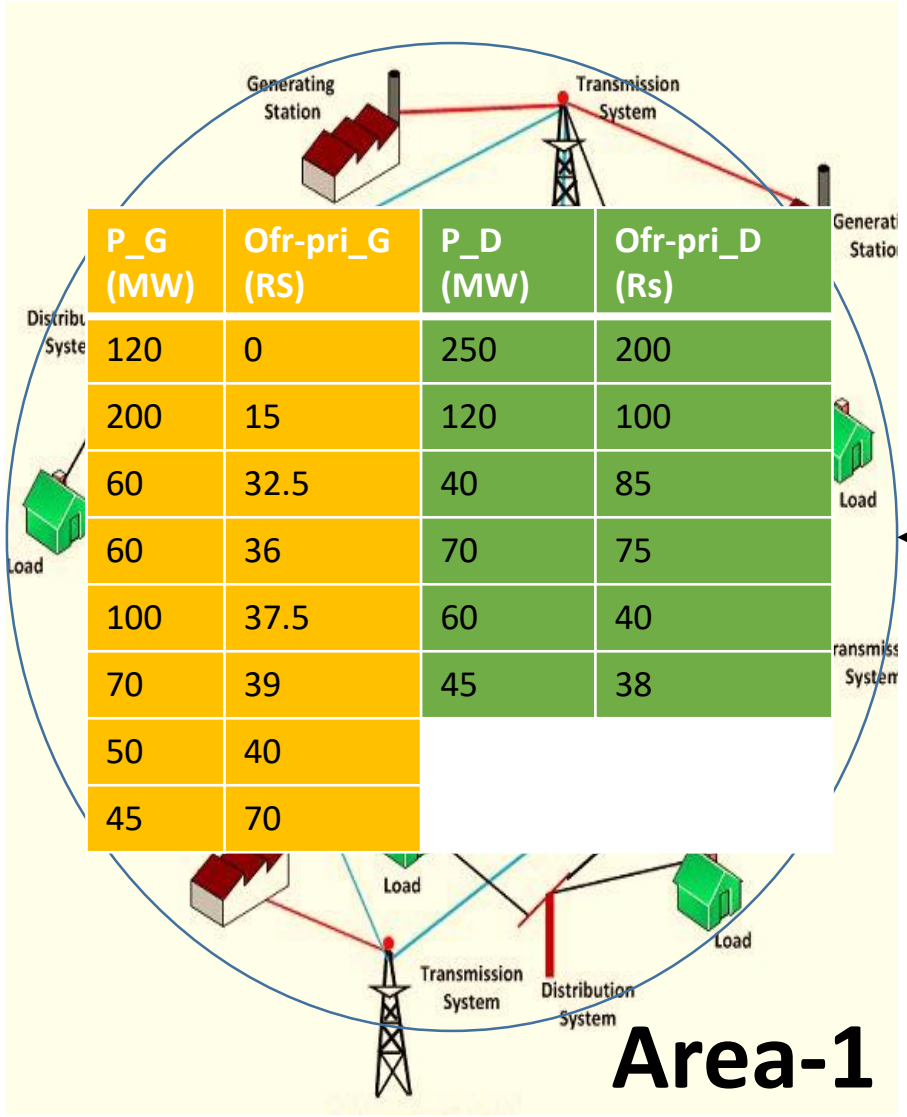
Transmission capacity
(no restriction)



P_G (MW)	Ofr-pri_G (RS)	P_D (MW)	Ofr-pri_D (Rs)
50	0	300	110
400	30	80	90
50	34	60	65
70	60	35	31
50	100	25	24
60	150	10	16
50	200		


Area1 & Area 2
Supply_
Demand_
offer price
Bid Quantum
MCV: 995MWH*
*Presume block as hour
Area 1 imports 60MW
Area 2 exports 60MW
No Transmission conjunction
No split
Cleared thru price
Total Gen : 995MW
Total Demand: 995MW
MCP: Rs 37.5

Two area market with Transmission constraint



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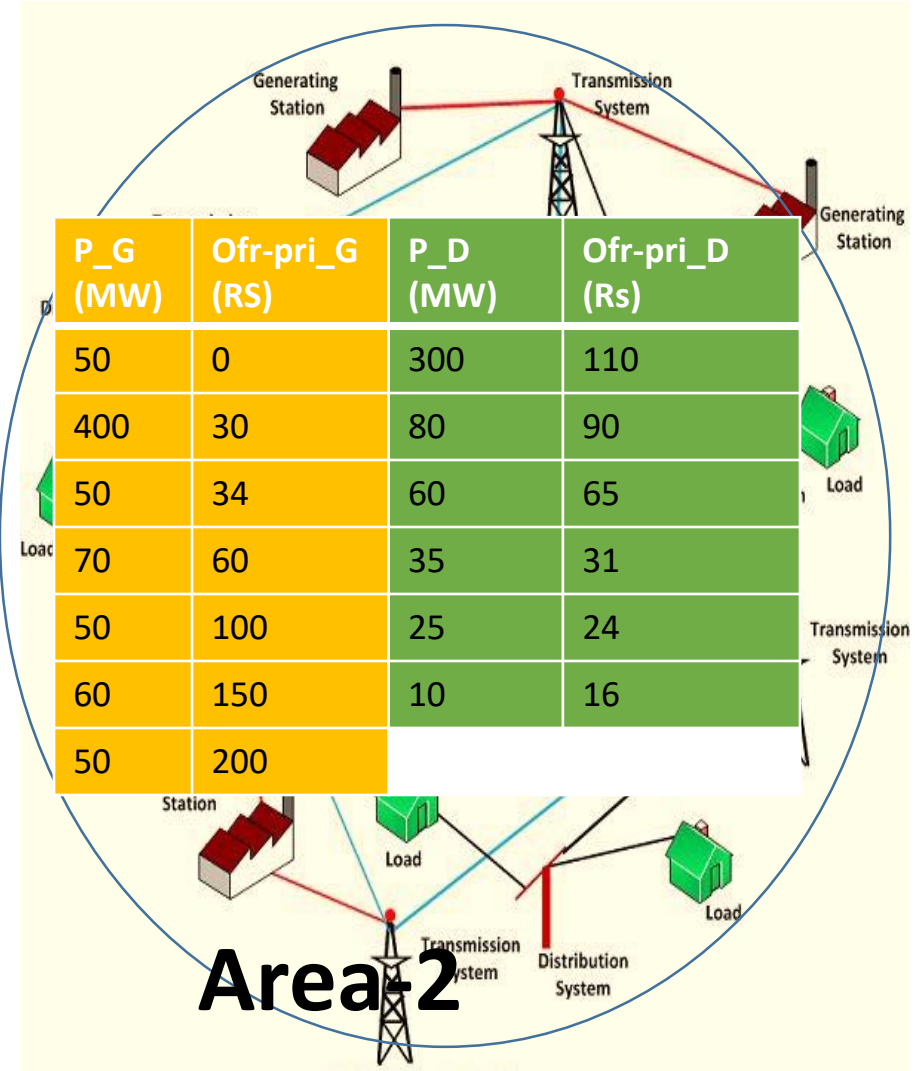
50	40		
45	70		

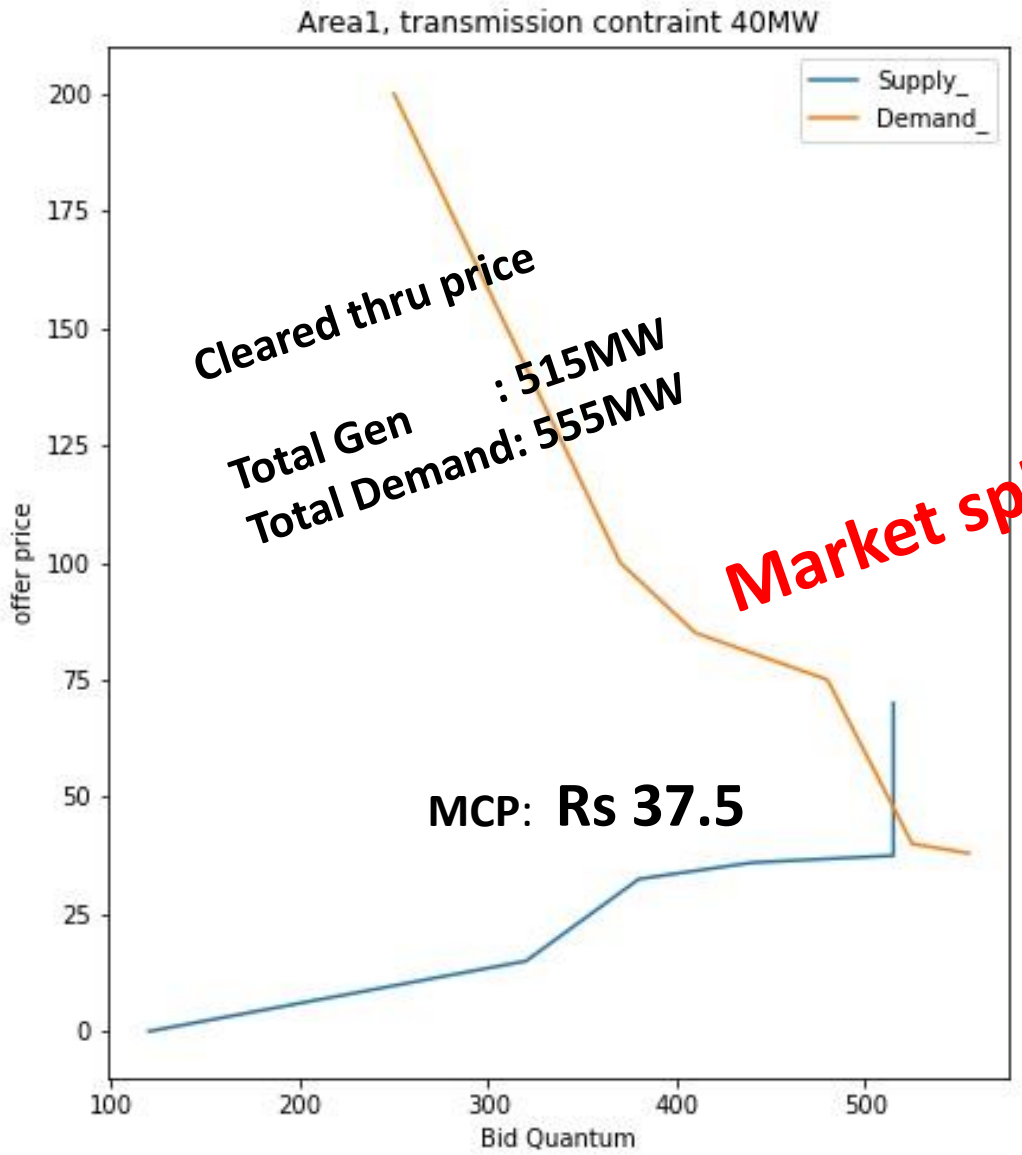
Transmission capacity (40MW)



P_G (MW)	Ofr-pri_G (RS)	P_D (MW)	Ofr-pri_D (Rs)
50	0	300	110
400	30	80	90
50	34	60	65
70	60	35	31
50	100	25	24
60	150	10	16
50	200		

Total MCV: 995MWH*(wont change)

*presume block hour



Market split-Area wise