Chapter 4:
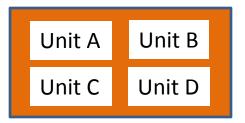# The Constrained Auction & Locational Capacity Constraints

Introduction

- We focus on the auction design to be used in the first Capacity Auctions.

- The Constrained Auction introduces Locational Capacity Constraints.

- Relative to the Unconstrained Auction solution, additional offers can be cleared to cover these constraints.

- The Constrained Auction explicitly recognises whether offers are Flexible or Inflexible.

- The focus is on concepts, not the actual solution methods or finer points (like tie-breaking).

Locational Capacity Constraints Revisited

Locational Capacity Constraint R1

Unit A	Unit B
Unit C	Unit D

Required Awarded Capacity = **40**
Cleared Capacity = **35**
Additional Capacity Required = 5

We have updated the constraint information based on the solution to the Unconstrained Auction from earlier.
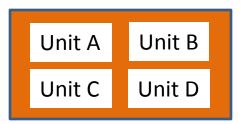
Locational Capacity Constraint R2

Unit E	Unit F
Unit G	

Required Awarded Capacity = **35**
Cleared Capacity = **25**
Additional Capacity Required = 10

Unit	A	B	C	D	E	F	G
Cleared Capacity	10	15	10		10	15	
Remaining Existing Capacity				25			
Remaining New Capacity			5		5	6	7
Locational Capacity Constraint	R1	R1	R1	R1	R2	R2	R2
Exemption for New Capacity			N		N/A	Y	Y

Solving for Locational Capacity Constraint R1

Locational Capacity Constraint R1

Unit A	Unit B
Unit C	Unit D

Required Awarded Capacity = **40**
Cleared Capacity = **35**
Additional Capacity Required = 5

To get 5 more MW we could take Unit C's new capacity of 5 MW at €99/MW year. Being inflexible we would take it all, costing €485/year, and in its offer it has a Capacity Duration of 10 years so would be paid that for 10 years.

Or we could take Unit D's existing capacity for 1 year, being an inflexible 25 MW at €40/MW year or €900/year. This is more per year than Unit C but has shorter term commitment.
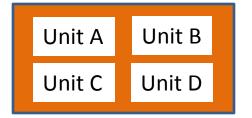
However - As Unit C is not exempt, its offer exceeds the Auction Clearing Price, and its Capacity Duration > 1 year it is not allowed to be cleared.

Unit	A	B	C	D			
Cleared Capacity	10	15	10				
Remaining Existing Capacity				25			
Remaining New Capacity			5				
Locational Capacity Constraint	R1	R1	R1	R1			
New Capacity Exemption			N				

Solution for Locational Capacity Constraint R1

Locational Capacity Constraint R1

Unit A	Unit B
Unit C	Unit D

Required Awarded Capacity = **40**
Cleared Capacity = **60**
Constraint Satisfied

Since Unit C's New Capacity cannot clear we can only take the inflexible 25 MW from Unit D.

The constraint is satisfied, though the inflexibility of Unit D requires more to be cleared than is necessary to satisfy the constraint.

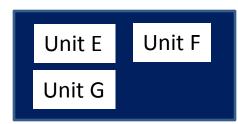| Unit	A	B	C	D			
Cleared Capacity	10	15	10	25			
Remaining Existing Capacity							
Remaining New Capacity			5 ✗				
Locational Capacity Constraint	R1	R1	R1	R1			
New Capacity Exemption			N				

Solving for Locational Capacity Constraint R2

Constraint R2 is not fully satisfied. Only 25 MW of Awarded Capacity has been cleared in that region. A further 10 MW must be procured from the region.

This can only be supplied by New Capacity supplied by some mix of units E, F or G.

Locational Capacity Constraint R2

Unit E	Unit F
Unit G	

Required Awarded Capacity = **35**
Cleared Capacity = **25**
Additional Capacity Required = 10

Unit	A	B	C	D	E	F	G
Cleared Capacity					10	15	
Remaining Existing Capacity							
Remaining New Capacity					*5*	*6*	*7*
Locational Capacity Constraint					R2	R2	R2
New Capacity Exemption						Y	Y

Solution for Local Capacity Constraint R2

Additional Capacity Required = 10

Options: New Capacity from E, F, G:

> E: Flexible, can take 0 to 5 MW at €80/MW per year. Can be cleared as 1 year duration.
> F: Inflexible, can take 0 or 6 MW at €65/MW per year. Long term award but exempt.
> G: Inflexible, can take 0 or 7 MW at €75/MW per year. Long term award but exempt.

F & G exemptions mean that E should be treated as lower cost and given priority in clearing. However, to supply 10 MW we must take one of F or G fully, with the flexible offer from E covering the remainder.

Feasible Combinations:

3 MW from E (Flexible), 7 MW from G (Inflexible).
Gives 10 MW for a cost of 3×80 + 7×75 = 240 + 525 = €765

Expensive

4 MW from E (Flexible), 6 MW from F (Inflexible).
Gives 10 MW for a cost of 4×80 + 6×65 = 320 + 390 = €710

Best

The Solution – With Locational Capacity Constraints

	A	B	E	C	F	D	F*	G*	E*	C*
Price (€/MW per Year)	€5	€10	€15	€25	€35	€40	€65	€75	€80	€99
Offer (MW)	10	15	10	10	15	25	6	7	5	5
Flexible?	Y	N	N	N	N	N	N	N	Y	N
Unconstrained Auction Cleared Quantities (MW)	10	15	10	10	15					
Final Cleared Quantity (MW)	10	15	10	10	15	25	6		4	
Settlement Price (€/MW per Year)	€40	€40	€40	€40	€40	€40	€65		€80	
Capacity Duration	1	1	1	1	1	1	10	10	1	10

E*, C*, F*, G* indicate offers from New Capacity. All other offers are from Existing Capacity

- All the offers cleared based on the unconstrained auction solutions are settled at the Auction Clearing Price of €40/MW per year set by the Price Setting Offer from Unit D. Unit D is cleared to cover the R1 constraint. It receives a pay-as-offer price, though being the Price Setting Offer this happens to equal the Auction Clearing Price.

- New Capacity from Units E and F is cleared to cover the R2 constraint and each receives a pay-as-offer price. Unit F is awarded capacity for 10 years, all other units are awarded for 1 year.

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