

Chapter 5: The Constrained Auction and Lumpiness

Introduction

- The Unconstrained Auction attempts to find the best solution from the point of view of Net Social Welfare. Recall that the last offer scheduled is the Price Setting Offer.
- If the Price Setting Offer is inflexible and partially scheduled, it will not be cleared. Without this offer it may be possible to improve Net Social Welfare by accepting other, more expensive, offer steps that are flexible or are smaller inflexible offer steps:
 - Locational Capacity Constraints may clear more capacity, such that the final amount of awarded capacity has gone beyond the level with the optimum Net Social Welfare.
 - But if Locational Capacity Constraints do not apply, or have little effect, then higher cost offers could still be cleared before reaching the optimum Net Social Welfare.
- This “Lumpiness” problem arises from the Inflexible offers. The Constrained Auction attempts to find a mix of offers that can improve Net Social Welfare.
- The focus is on concepts, not the actual solution methods or finer points (like tie-breaking).
- In this section we assume all uncleared offers are available to be cleared without worrying about the special rules on the treatment of New Capacity in the Constrained Auction.

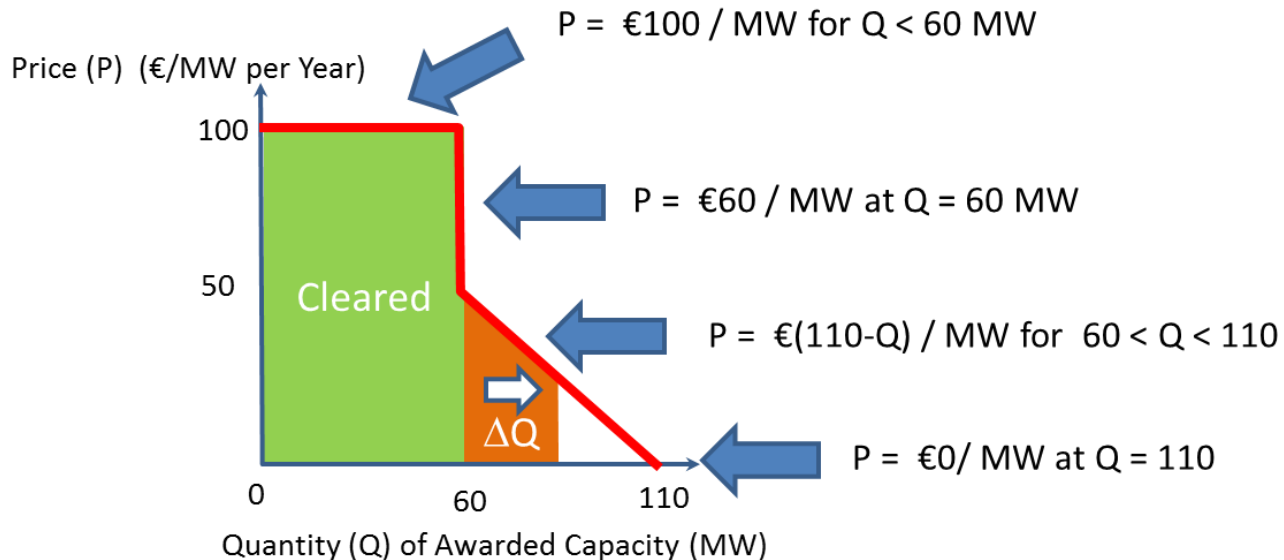
The Case with No Locational Capacity Constraints

	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 Quantities (MW)	10	15	10	10	15					
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

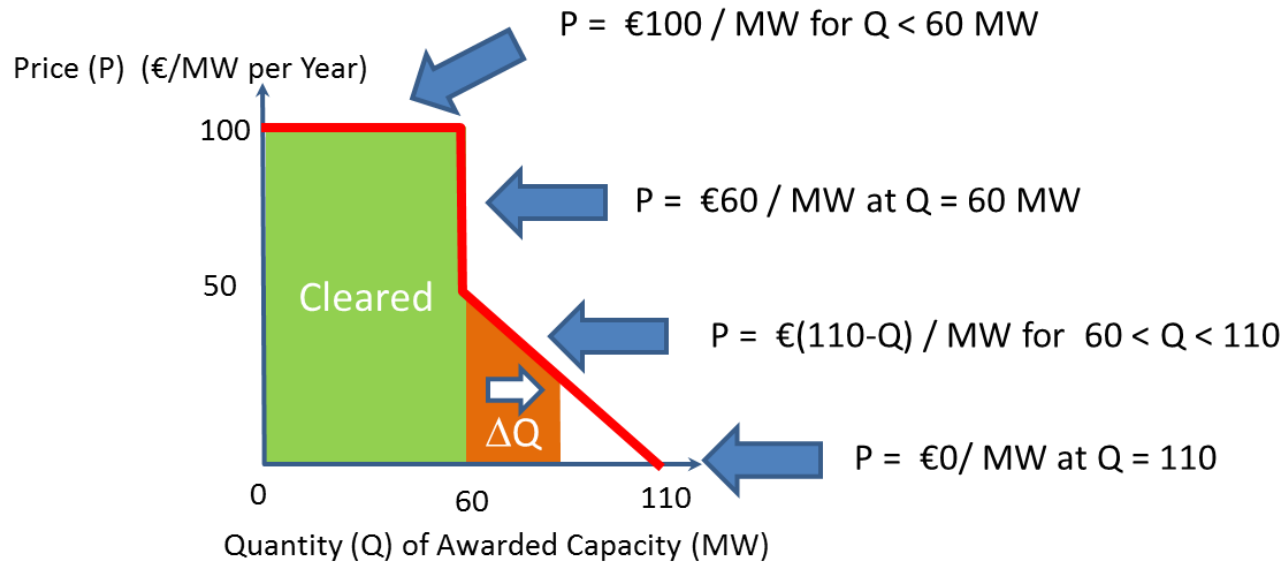
- If there were no locational constraints we still have to consider “lumpiness”.
- Lumpiness reflects the fact that unconstrained auction scheduled Unit D but being inflexible and only partly scheduled it was not accepted.
- Given we have excluded Unit D, are there additional Units we could schedule that give a better Net Social Welfare than the current solution?
- The starting solution has 60 MW cleared from units A, B, C, E and F.

How Do We Measure Improved Net Social Welfare? – (1/2)



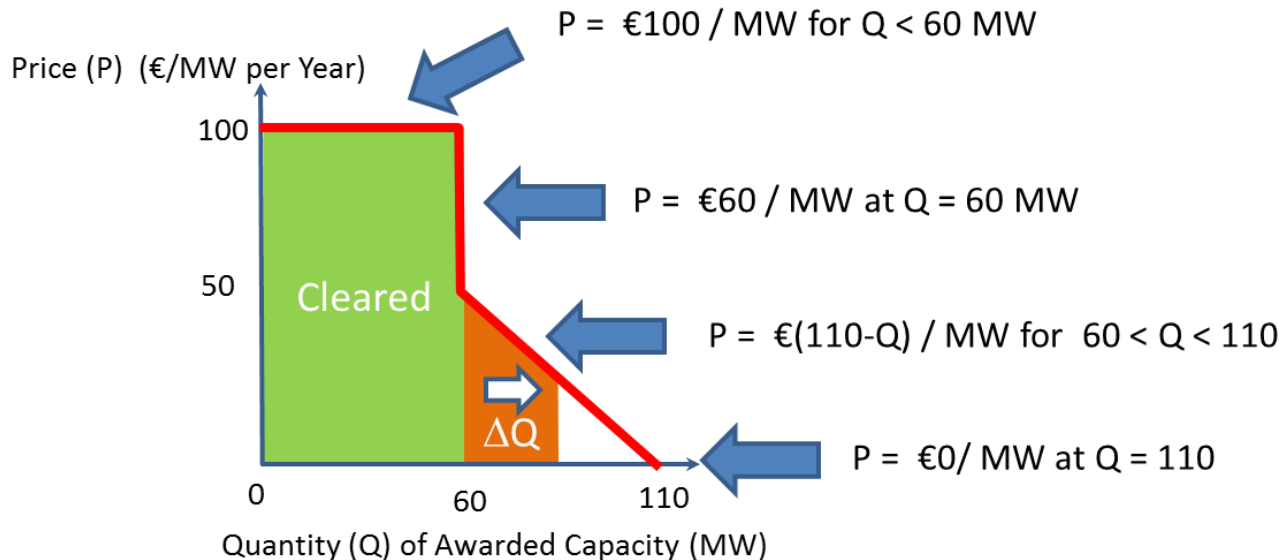
- Consider this version of the demand curve. In order to determine if we can improve Net Social Welfare (NSW) by clearing additional Capacity Auction Offers, we first need to use the demand curve to define an equation to calculate increased benefit. We can then use this equation to test what combination of additional offers, if any, would increase net benefit if cleared.
- The Price P at point ($Q=60\text{MW}$) of the demand curve = €50.
- Any additional quantity cleared, ΔQ , will be on the segment where price changes based on the formula $P = €(110-Q) / \text{MW}$. The quantity Q beyond 60 is given by $Q = 60 + \Delta Q$, putting this into the formula for change in price we have $P = 50 - \Delta Q$.

How Do We Measure Improved Net Social Welfare? – (2/2)



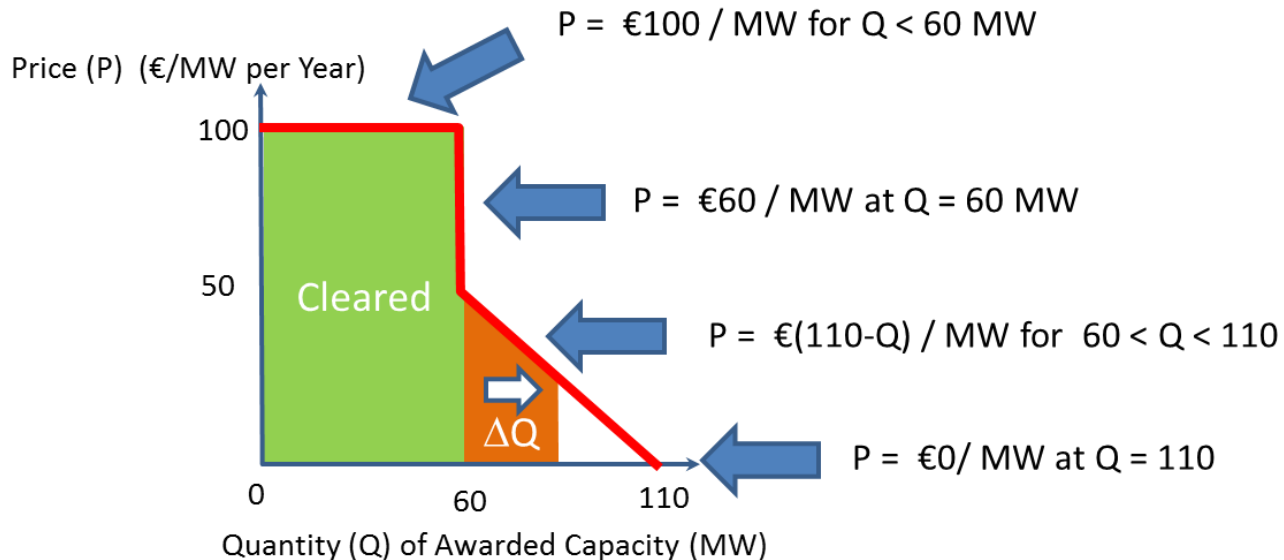
- The increased benefit is the area of the orange region, being its average height (considering changes in prices) times its width (considering changes in quantities). Taking our inputs from the previous points, this area is $0.5 \times [(P(Q=60) + P(Q=60 + \Delta Q))] \times \Delta Q = 0.5 \times [(50 + (50 - \Delta Q))] \times \Delta Q = (50 - 0.5 \Delta Q) \times \Delta Q$.

What Increase in Quantity Maximises Net Social Welfare? – (1/2)



- So the orange area is given by the formula Increased Benefit = $(50 - 0.5 \Delta Q) \times \Delta Q$.
- If the cost of clearing an additional 1MW of a Capacity Auction Offer (ΔQ) is its offer price, OP , and a change in Net Social Welfare is given by the difference between the change in benefit and change in cost, the change in Net Social Welfare resulting from clearing ΔQ from that step is $\Delta \text{NSW} = (50 - 0.5 \Delta Q - OP) \times \Delta Q$.
- We want to increase ΔQ while ΔNSW is positive, or until $\Delta \text{NSW} = 0$.
- Taking $\Delta \text{NSW} = 0$ as the desired result, we can build it into the formula. Now $(50 - 0.5 \Delta Q - OP) \times \Delta Q = 0$ when either we make no change, $\Delta Q = 0$, or when $\Delta Q = 100 - 2OP$ which could be positive or negative. We only want a positive ΔQ so can only increase a quantity if OP , the offer price, is less than $€50 / \text{MW}$ per year.

What Increase in Quantity Maximises Net Social Welfare? – (2/2)



- Now $(50 - 0.5 DQ - OP) \times DQ = 0$ when either we make no change, $DQ = 0$, or when $DQ = 100 - 2OP$ which could be positive or negative. We only want a positive DQ so can only increase a quantity if OP , the offer price, is less than $€50 / \text{MW}$ per year.
- These rules allows us to determine what quantity of an individual offer step, given its price, can be accepted while having a net increase or net neutral change in Net Social Welfare. From this and considering additional rules on flexibility of offers (i.e. if the offer must be taken as a whole or can be partially taken) we can determine if any offer step additional to those from the unconstrained auction should be cleared.

Can any Offer Replace the Price Setting Offer?

	D	F*	G*	E*	C*
Price (€/MW per year)	€40	€65	€75	€80	€99
Offer (MW)	25	6	7	5	5
Flexible?	N	N	N	Y	N
Is Offer Price < €50	Y	N	N	N	N
$\Delta Q = 100 - 2OP$	20	-40	-60	-70	-98

- The last slide demonstrated that we could only justify clearing more from an offer with an offer price, OP, less than €50/MW per year.
- We see that only offer D, the Price Setting Offer, satisfies this condition.
- The optimal increase in D is 20 MW but this is not acceptable because the offer was inflexible. Taking all 25 MW gives $\Delta NSW = (50 - 0.5 \Delta Q - OP) \times \Delta Q = (50 - 0.5 \times 25 - 40) \times 25 = -62.5$. This is worse than taking nothing.
- The optimal change in net social welfare from the other uncleared steps require a negative cleared quantity, so they are not acceptable.
- No additional offers are cleared.

The Solution – No 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					
Settlement Price(€/MW per Year)	€40	€40	€40	€40	€40					
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										

- We cannot improve the solution by clearing any offers, including the Price Setting Offer so the Unconstrained Auction solution (excluding the Price Setting Offer) is the final solution.

A Case Where Lumpiness Does Change The Solution

	D	Z
Price (€/MW per year)	€40	€45
Offer (MW)	25	6
Flexible?	N	N
Is Offer Price < €50	Y	Y
$\Delta Q = 100 - 2OP$	20	10

- Here is an alternative example where a new offer Z would be cleared to resolve lumpiness.
- Unit D is as before and will not be selected.
- Unit Z is smaller than Unit D and only slightly more expensive. It is also inflexible like Unit D. Because the benefit declines less over a change in capacity of 6 MW, the optimal quantity to clear from Z is 10 MW, which is more than it has available. Hence 6 MW will be cleared. It will be awarded capacity at a price of €45/MW per year, its offer price.

Auction Results and New Capacity

- Final Capacity Auction Results for a participant are final and binding.
- When capacity is awarded in respect of New Capacity the Participant must post a Performance Security with the System Operators and must confirm acceptance of any updates to its Implementation Plans submitted in Qualification so as to reflect final Auction Results (e.g. what capacity was awarded).