



USAID
FROM THE AMERICAN PEOPLE



REKK REGIONAL CENTRE
FOR ENERGY
POLICY RESEARCH



National
Association of
Regulatory
Utility
Commissioners



Electricity Exchange Exercise

Péter Kaderják
Regional Centre for Energy Policy Research

NARUC/ERRA Training on Utility Regulation and Tariff
Development
November 5-8, 2007
Pristina, UNMIK/Kosovo

The Electricity Exchange

- We will try to simulate the operation of an electricity pool (centralized day-ahead market)
- You will play the role of generators/traders, bidding your energy into the market
- Demand side of the market is given by price-responsive demand functions
- We will be the system operators concerned with finding the market equilibrium

The supply side

- Each team gets one power plant
 - fixed production capacity [1000 MWh]
 - given fixed cost of operation [2000 \$]
 - given constant marginal cost of operation [40 \$/MWh]
- At most two capacity blocks can be offered at two distinct prices
 - the sum of energy in the two bids cannot exceed the total production capacity
- If either bid is accepted, fixed cost of operation must be paid
- Your objective is to maximize total profits!

Examples of bids ($C_{\max} = 1000\text{MWh}$)

	Quantity	Price
Block 1	400	45
Block 2	600	55

	Quantity	Price
Block 1	1000	72
Block 2		

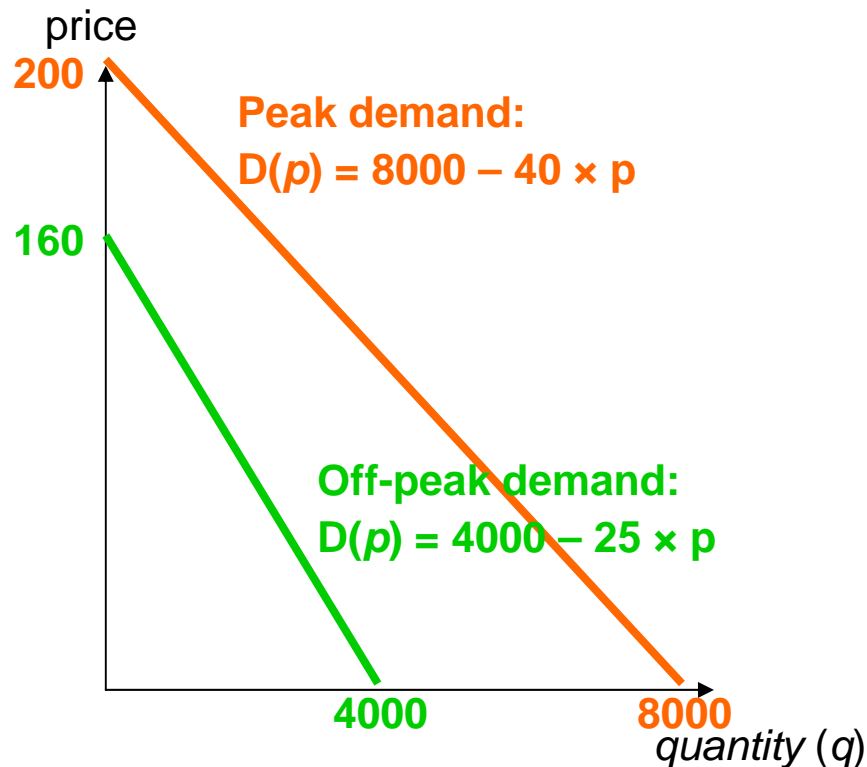
	Quantity	Price
Block 1	500	46
Block 2	600	23

	Quantity	Price
Block 1	1200	58
Block 2		

	Quantity	Price
Block 1	750	67
Block 2		

	Quantity	Price
Block 1		
Block 2		

The demand side

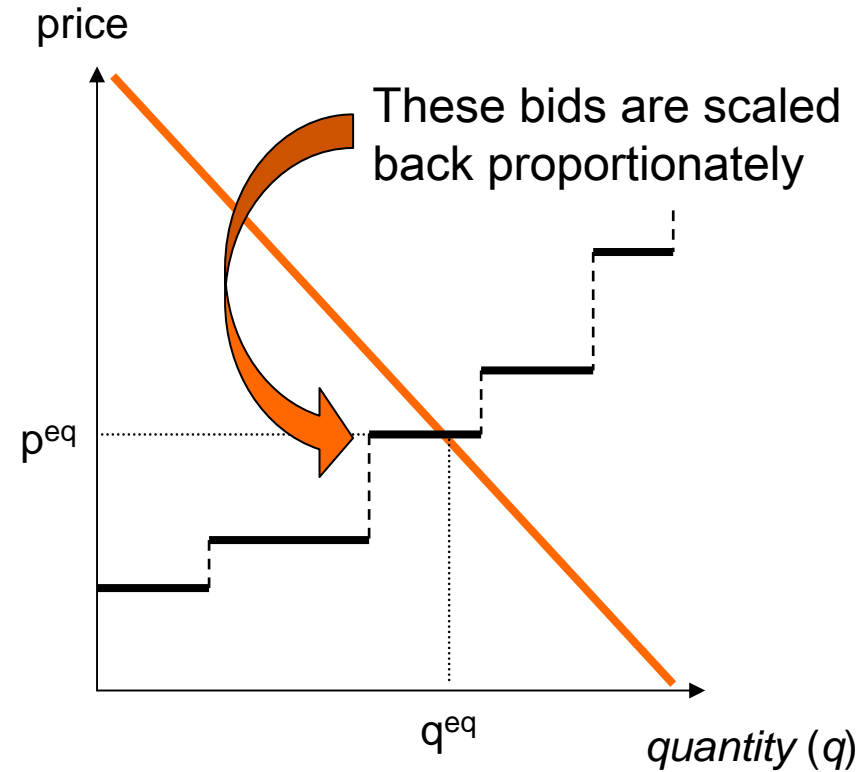
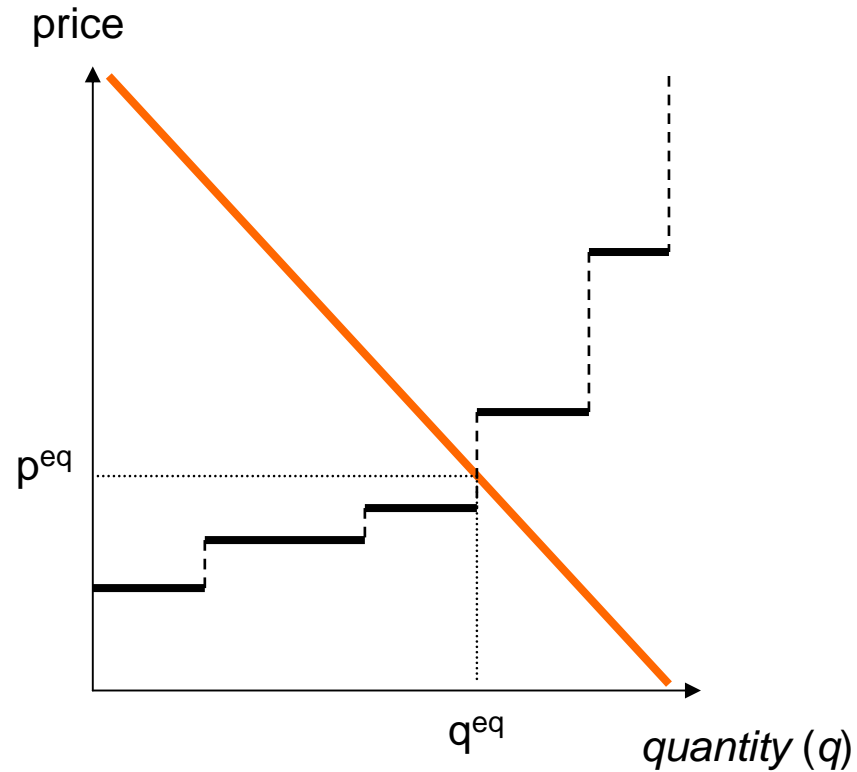


- Demand side is given by demand functions
- Peak and off-peak periods alternate
 - 4 peak, 2 off-peak per.
 - p, o, p, p, o, p
- Higher prices reduce demand in each period

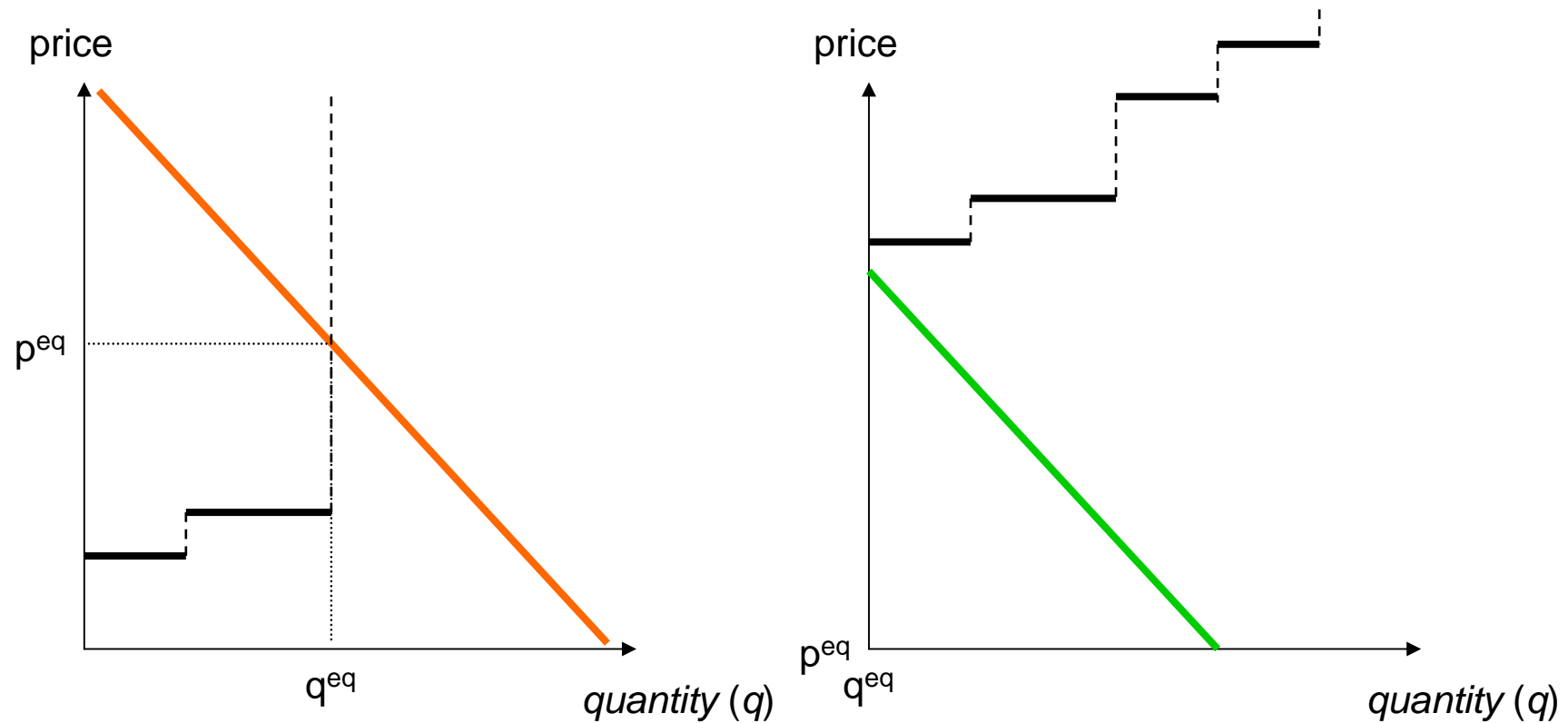
Market equilibrium

- We will put the bids in increasing (merit) order
 - supply function
- Determine the price at which demand equals (or does not exceed) supply
 - equilibrium price
 - if supply is greater than demand at the equilibrium price, all supply bids submitted at that price will be scaled back proportionately
- Every bid accepted is paid the equilibrium price
- Bids not accepted are not paid anything

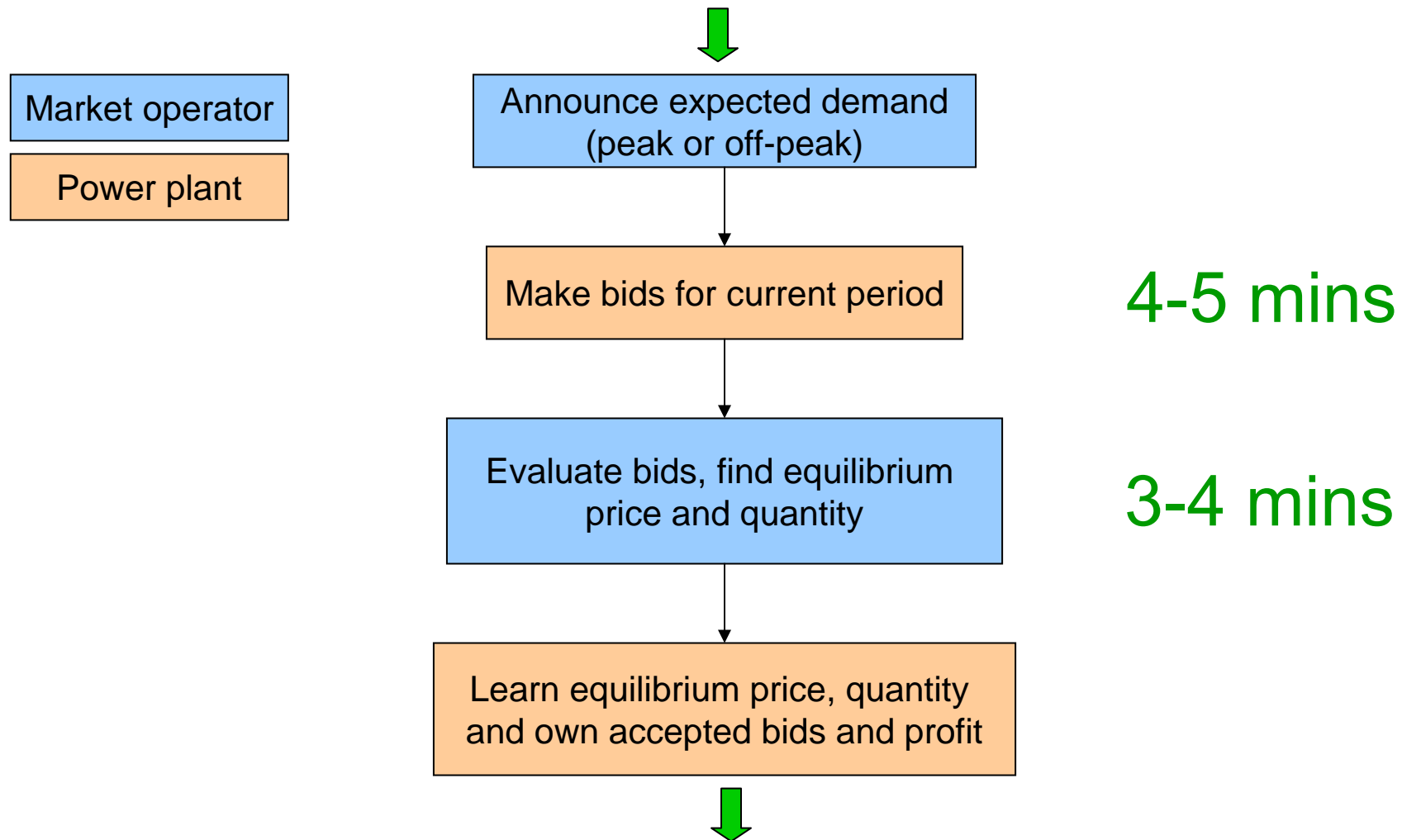
Examples of market equilibrium



Examples of market equilibrium



Course of one period



Course of the game

- One decision sheet per team (8 teams total)
- Teams do not observe each other's decisions
- Talks between teams not permitted for first 3 periods
- 5-10 minutes initial time for „market strategy” and questions
- 5 minutes per period for preparing bids
- 3-4 mins per period for market clearing
- After 6 rounds, total profit is calculated and winning team is announced
- Final discussion about market strategies

Let's play!

- Peak demand: $D(p) = 8000 - 40 \times p$
- Off-peak demand: $D(p) = 4000 - 25 \times p$
- All power plants are the same
 - FC = 2000 \$, MC = 40 \$/MWh, $C_{\max} = 1000$ MWh
- Fixed cost must be paid if (and only if) production is non-zero
- All accepted bids are paid the equilibrium price
- If supply exceeds demand at the equilibrium price, marginal bids are reduced proportionately
- Talking between teams is not permitted for the first three periods
- Your only objective is profit-maximization!