Energy Markets

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Exercise Session 1: Day-Ahead electricity markets - Basics

The aim of this exercise session is to appraise and better understand the basic structure of electricity markets, and most particularly its day-ahead mechanism.

Problem 1: General description of a day-ahead market and the example of the Nord Pool

This Problem is based on the Nord Pool website, and more particularly its sets of webpages titled "The power market". The most recent status report for Nord Pool is available at: Nord Pool Annual Review 2020. Some hints and answers are also on the wikipedia page for the Nord Pool.

1.1 What is the common name of the day-ahead market in Nord Pool?

1.2 How many participants are they in the day-ahead market? And how many power producers in the whole area covered by the Nord Pool? Can you explain why all power producers do not trade through the Nord Pool, and how they then proceed?

1.3 What is the overall volume (on average) of energy generated over the Nordic and Baltic countries?

1.4 What was the average systems price in the Nordic area in 2020?

1.5 What was the overall amount of energy exchanged through the Nord Pool (Nordic and Baltic) day-ahead market in 2020? What about the UK?

1.6 What are the various types of power production technologies in the Nordic and Baltic countries? Rank them in terms of marginal production costs (in increasing order). What are the most important ones?

1.7 Who are the various participants in the day-ahead market? What is their role?

1.8 Who owns Nord Pool? (see webpage "About us")

1.9 What is the market time unit (i.e, few minutes, whole day, ...?), and what are the bidding areas?

1.10 What are the assumptions for the definition of bidding areas?

Problem 2: General description of a day-ahead market and the example of the Nord Pool

For this and some of the following Problems, we set up our own day-ahead electricity market, with characteristics similar to that of the Nord Pool and analysed in Problem 1.

The market has 5 players on the supply side. For a given time unit (say, between 2pm and 3pm the following day), the market operator has received a set of single-hourly supply offers (i.e., blocks of energy for a single market time unit) from these 5 participants. These offers are defined as:

2.1 What do we call the "supply curve" in the day-ahead market?

2.2 How is it defined based on a set of offers?

Supplier Name	Supplier id.	Quantity [MWh]	Price [€/MWh]
Flexigas	G_1	15	75
Nuke22	G_2	100	15
ShinyPower	G_3	32	0
RoskildeCHP	G_4	25	42
BlueWater	G_5	70	10

2.3 Draw (paper, or plot based on Matlab/R/Excel/etc.) the supply curve for this market time unit.

2.4 What is the total amount of energy offered through the market?

2.5 By the way... Can they be other types of offers than single-hourly offers?

Problem 3: Consideration and ordering of demand offers in a pool

We continue here based on the previous Problem and our day-ahead electricity market setup.

The market has 7 players on the demand side. For the same time unit as in Problem 2 (say, between 2pm and 3pm the following day) the market operator has received a set of single-hourly consumption offers defined as:

Demand Name	Demand id.	Quantity [MWh]	Price [€/MWh]
WeLovePower	D_1	35	65
CleanChange	D_2	23	78
JyskeEl	D_3	12	10
ElRetail	D_4	38	46
QualiWatt	D_5	43	63
IntelliWatt	D_6	16	32
El-Forbundet	D_7	57	50

3.1 What do we call the "demand curve" in the day-ahead market?

3.2 How is it defined based on a set of offers?

3.3 Draw (paper, or plot based on Matlab/R/Excel/etc.) the demand curve for this market time unit.

3.4 What is the total amount of energy asked for through the market? Compare it to the total amount of energy supply offers. Is there a problem there?

Problem 4: Equilibrium and market-clearing

We continue here based on Problems 2 and 3, and our day-ahead electricity market setup.

4.1 Have your supply and demand curve on the same drawing/plot.

4.2 Identify the "equilibrium point". What does it mean in the present case?

4.3 What is the equilibrium price and quantity?

4.4 Who will be effectively supplying power (and how much)? And, who will be effectively consuming (and how much)? Why does that make natural sense?

4.5 Calculate social welfare.