EMPS market curves

Exploring the "Black box" with market curves

User meeting in Production planning, May 10th 2017

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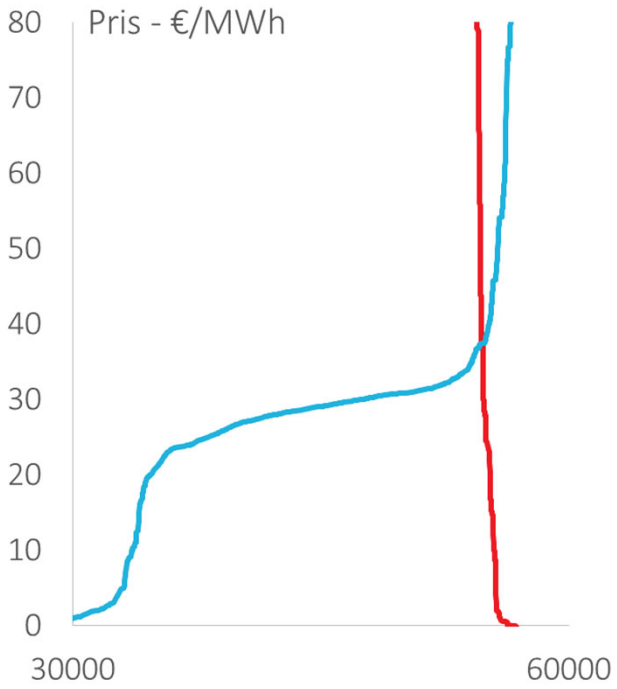
We lack short term price variation



System price curve, March 20th 2017 hour 8-9 from Nord Pool

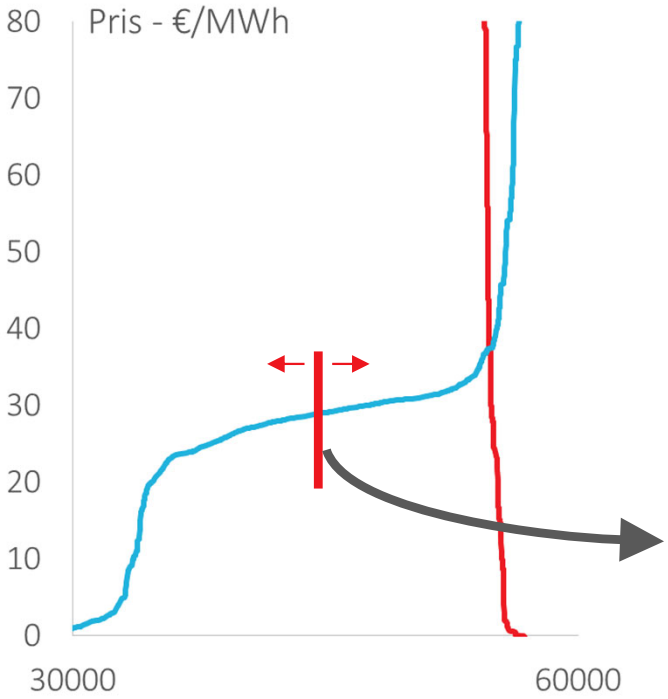
- The world is changing
  - Volatile renewables
  - More exchange with Europe
  - Larger Nordic power deficit
- The models need to keep up
  - Hourly time resolution
  - New models
  - Better data
- But still we haven't got the price right

We've tried to improve the data

- CHP flexibility
- Start and stop cost
- Reserves
- Efficiency curves
- Remove power plants
- Increase load variation

Unfortunately, none increase price variation considerably

Why doesn't price variation increase?



If we start here, then we won't see results until all problems are solved

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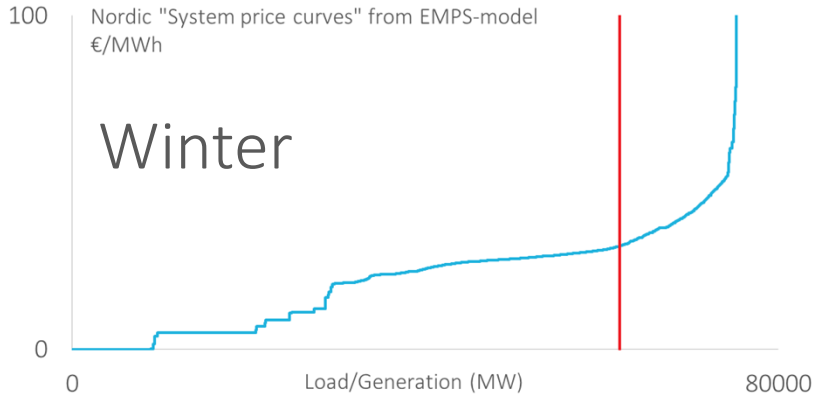
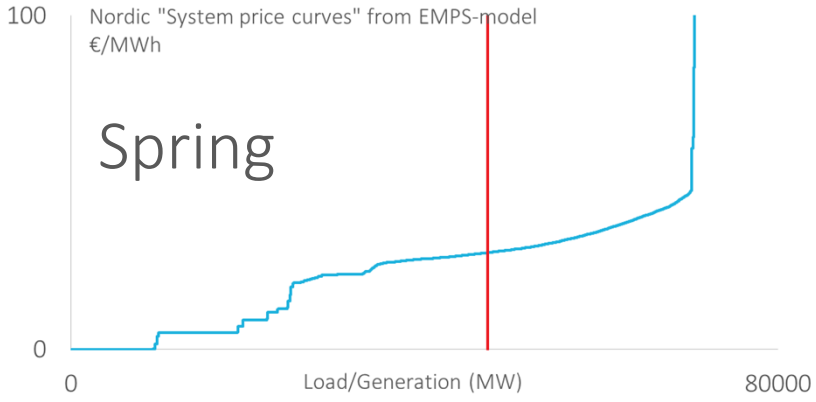
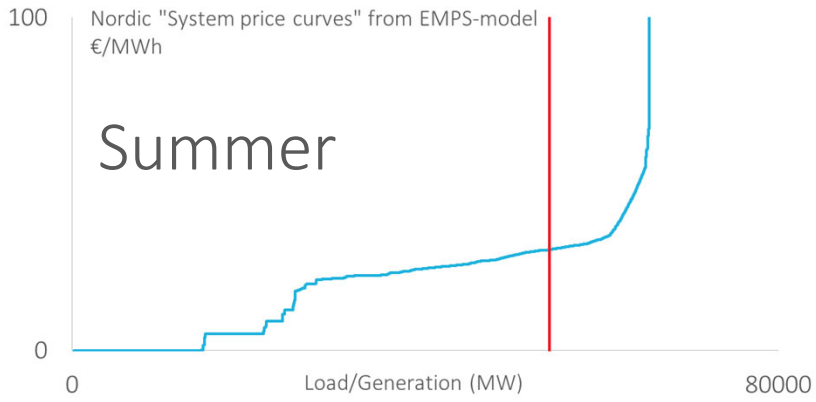
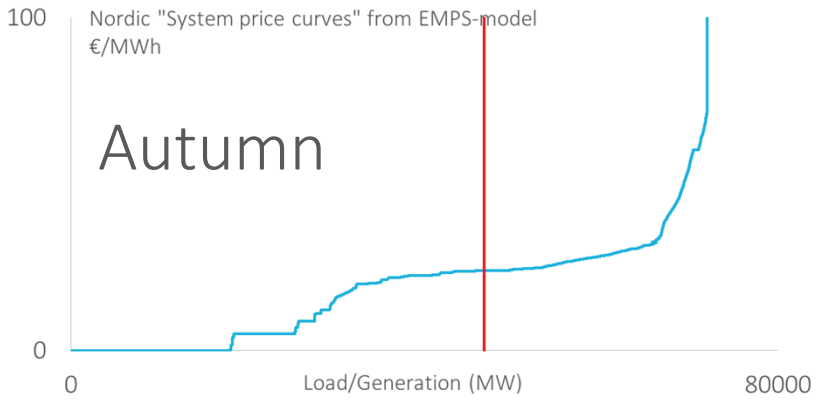
SINTEF has given us a helpful tool

- We can look at the market curves directly
- Important tool for understanding the model
- Instead of observing change in price and production, we can see change in market
- A change that doesn't affect realized prices can still be a step in the right direction

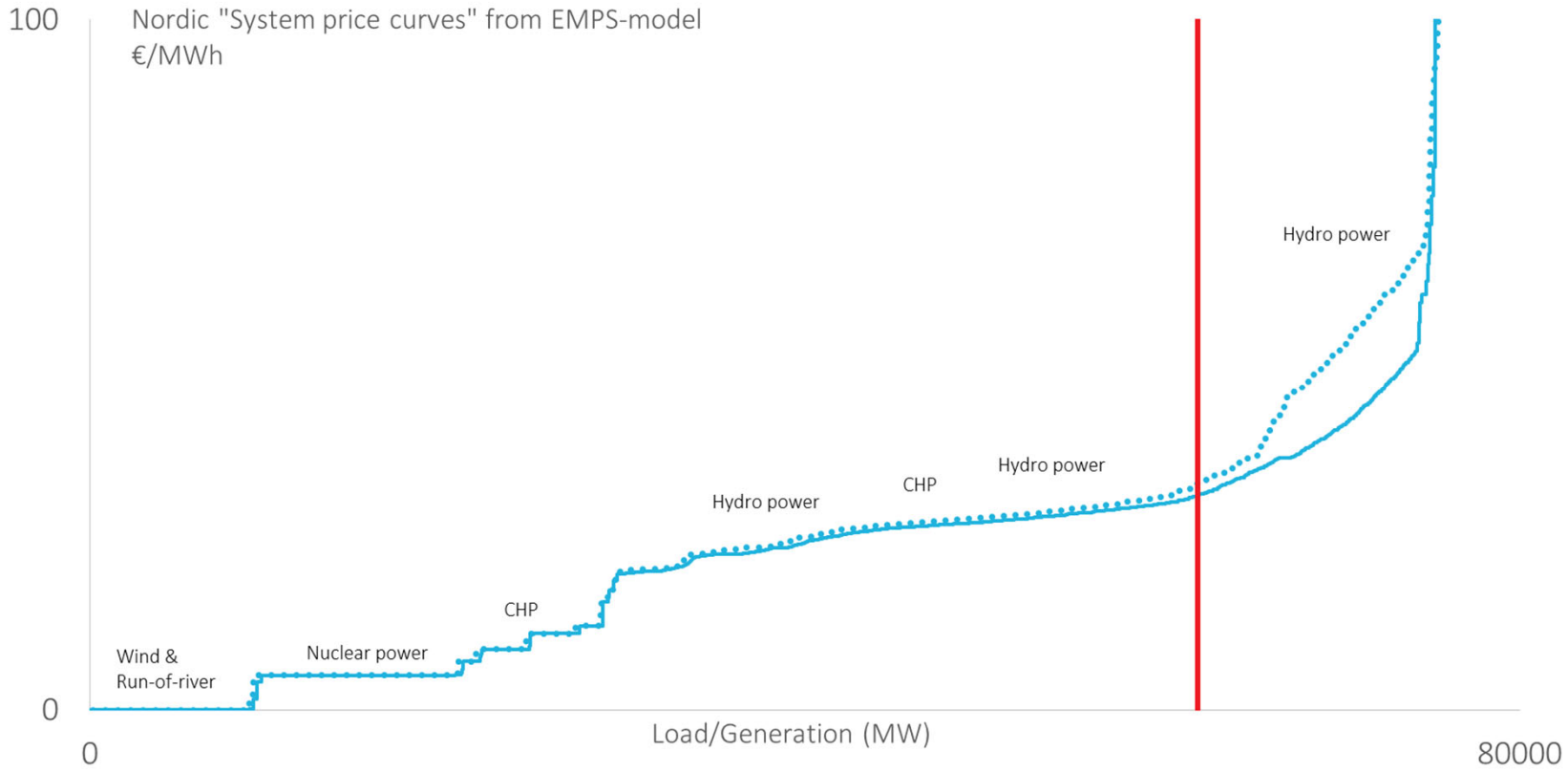

100
Nordic "System price curves" from EMPS-model
€/MWh
Winter
0
0
Load/Generation (MW)
80000


100
Nordic "System price curves" from EMPS-model
€/MWh
Spring
0
0
Load/Generation (MW)
80000


100
Nordic "System price curves" from EMPS-model
€/MWh
Summer
0
0
Load/Generation (MW)
80000


100
Nordic "System price curves" from EMPS-model
€/MWh
Autumn
0
0
Load/Generation (MW)
80000

Result with new efficiency curves



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How can we use this insight?

- Identify weaknesses in our data and model
- Find factors that mimic real operation better
- E.g. understand how does the system respond to
  - Implementation of efficiency curves
  - Procurement of reserves
  - Start and stop costs
  - Calibration

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Our status and plans

- So far only done small scale tests
- Will use to cast new light on backtesting
- Improve data and model where it counts most
- Evaluate our models – SOVN & MAD vs. EMPS

How the function works

SDInput.dat

```
Område, prisavsnitt, tilsigsår, uke
1,3,1,4
1,3,1,18
1,3,1,29
1,3,1,37
2,3,1,4
2,3,1,18
2,3,1,29
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3,3,1,4
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3,3,1,37
4,3,1,4
4,3,1,18
4,3,1,29
4,3,1,37
5,3,1,4
```

SDRes.sdv

```
Supply and demand information
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    1;    3;    1;    4;S Price ;      0.000000;       0.000000;       0.000000;       0.010000;
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    1;    3;    1;    4;D Price ;    900.000000;     900.000000;      37.500000;      37.500000;
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    2;    3;    1;    4;D Price ;    900.000000;     900.000000;      37.500000;      37.500000;
IVERK;IPENM;YEAR;WEEK;TYPE;                ;UReg Hydro          ;Exchange           ;Pa. Kjop DELLAST
    3;    3;    1;    4;S Volume;      0.000000;       0.002832;       0.110040;       0.111940;
    3;    3;    1;    4;S Price ;      0.000000;       0.000000;       3.105356;       6.023868;
IVERK;IPENM;YEAR;WEEK;TYPE;                ;Firm demand         ;FLOMKRAFT          ;
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    3;    3;    1;    4;D Price ;    900.000000;     900.000000;       0.002000;
IVERK;IPENM;YEAR;WEEK;TYPE;                ;UReg Hydro          ;Reg Hydro          ;Reg Hydro
    4;    3;    1;    4;S Volume;      0.000000;       0.108677;       0.509383;       0.910089;
    4;    3;    1;    4;S Price ;      0.000000;       0.000000;       2.710862;       2.725618;
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    4;    3;    1;    4;D Price ;    900.000000;     900.000000;      37.500000;      37.500000;
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IVERK;IPENM;YEAR;WEEK;TYPE;                ;UReg Hydro          ;Wind               ;Exchange
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```

Input
Specify which areas, years, weeks and price segments to analyze

Run simulation

Output
Aggregated bid volumes and prices are given as output from the simulation