

# Time-slice and regional structure - Experiences with NET- model

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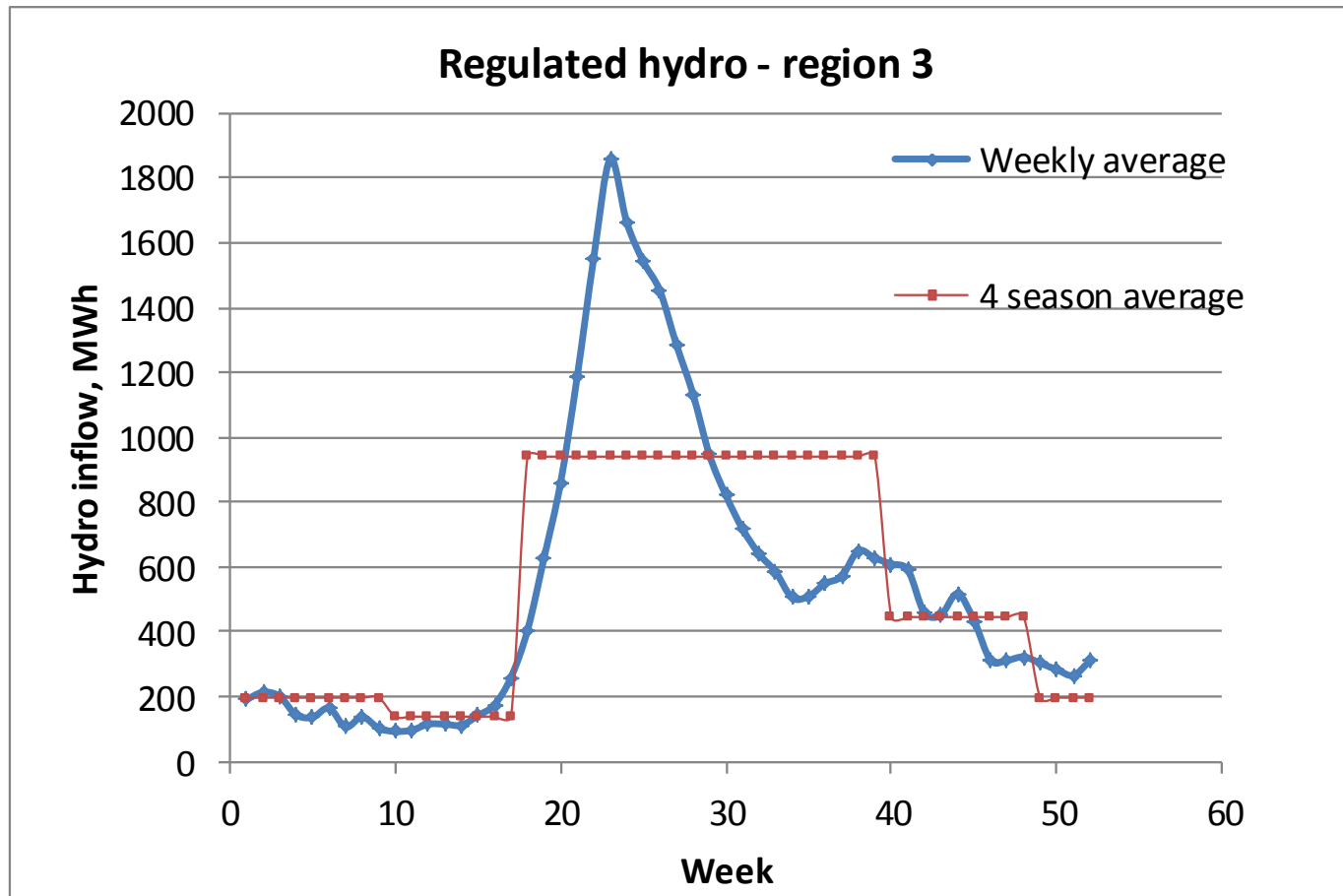
# Introduction

- Model results depend on the model structure
  - Time-slices & trade with external regions
  - Is bigger better?
- We have tested on a TIMES model of Norway
  - Two time-slice structures
  - Two regional structures
- What is optimal time-slice and regional structure?

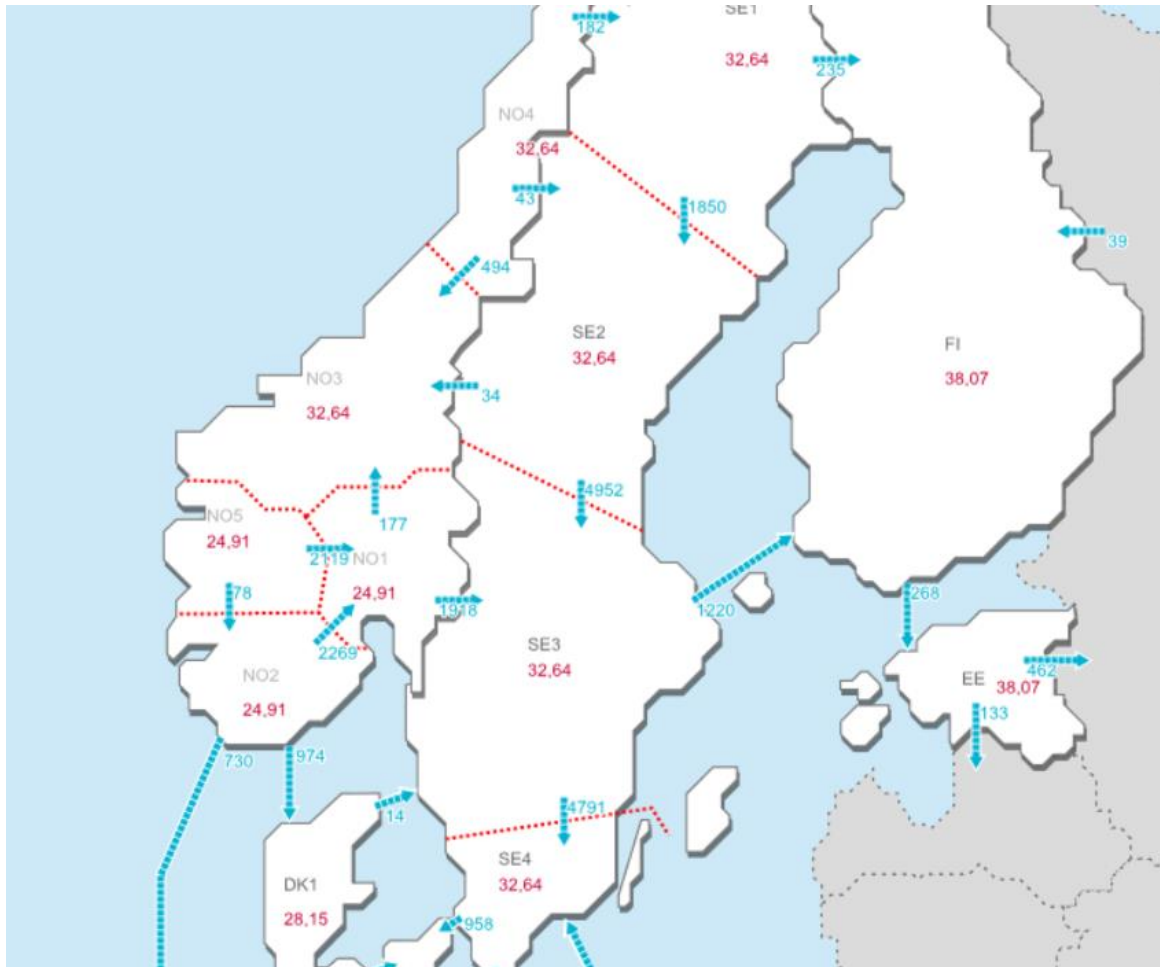
# Energy in Norway

- Electricity production by hydro power
- Electric intensive industry
- Electric heating
- Electricity market is highly interconnected to its neighbour countries

# Hydro power



# Transmission capacity



# TIMES-Norway - Overview

- Model horizon 2010 – 2050
- Regional structure 5 Nord Pool regions
- Demand sub-sectors 75-78
- 260 time-slices
  - EMPS
  - 52 weeks
    - Day 1 Mon-Fri: 07:00-11:00
    - Day 2 Mon-Fri: 11:00-17:00
    - Day 3 Mon-Fri: 17:00-23:00
    - Night Mon: 00.00 – 07:00 & Tue-Fri: 23:00-07:00
    - Weekend Fri 23:00 – Sunday 24:00

# Experiment 1= Time-slice structure

- Two time slices options in TIMES-NORWAY
  - HIGH - 260 time slices
    - 52 weeks; Day 1, Day2, Day 3, Night & Weekend
    - EMPS
  - LOW - 48 time slices
    - 4 seasons, 12 daily periods
    - Chronological
- Other model assumptions are identical
- Different exogenous electricity certificates price
  - CERT = 0 – 180 kNOK/GWh (C0, C60, C100, C140, C180)

# Experiment 1- Computational time

## Computer

### System

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Rating:	System rating is not available
Processor:	Intel(R) Xeon(R) CPU E5-2650 0 @ 2.00GHz 2.00 GHz (2 processors)
Installed memory (RAM):	32.0 GB
System type:	64-bit Operating System

Interface      ANSWER

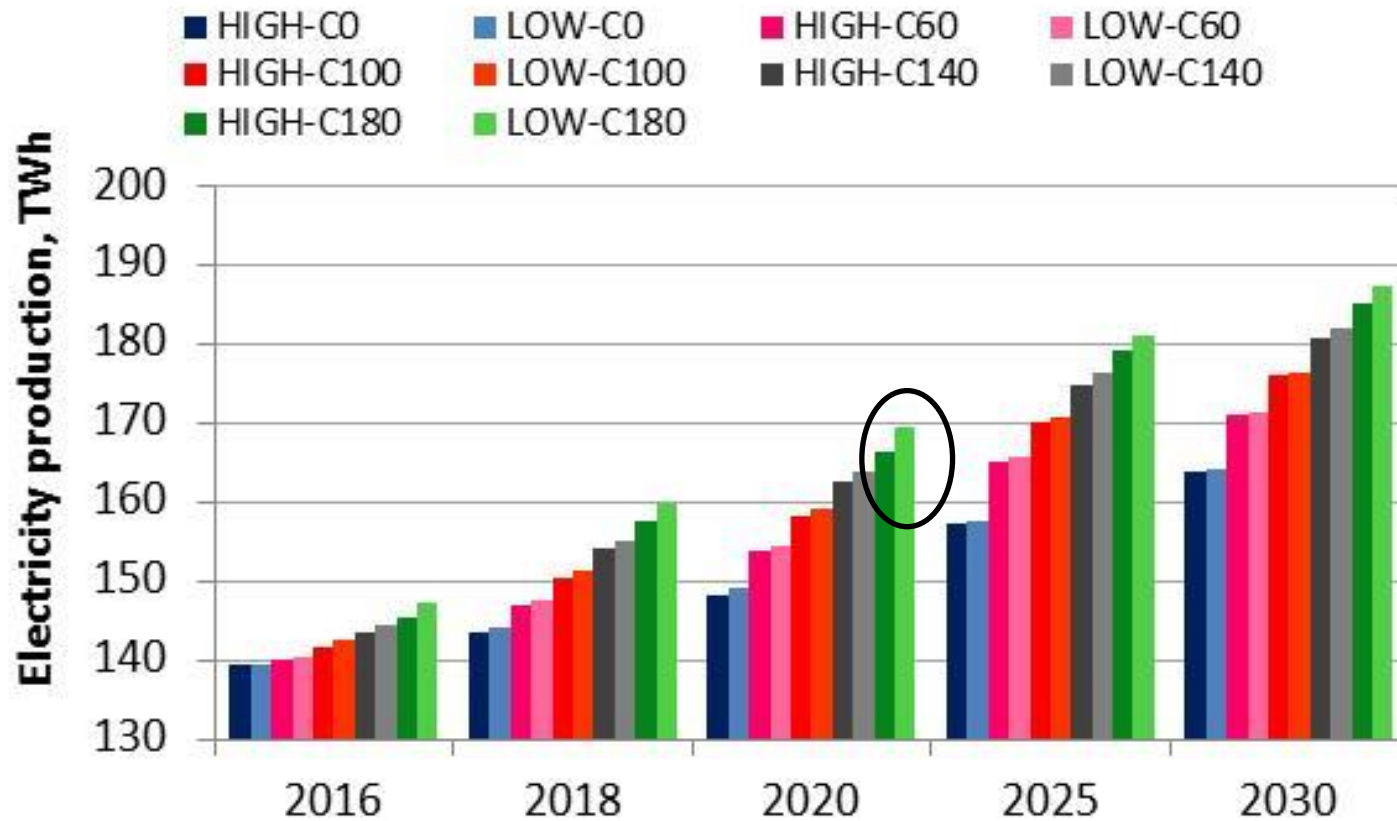
Solver          XPRESS

Computational time C0

- HIGH          4 hours, 30 min, 56 sek
- LOW          10 min, 31 sek

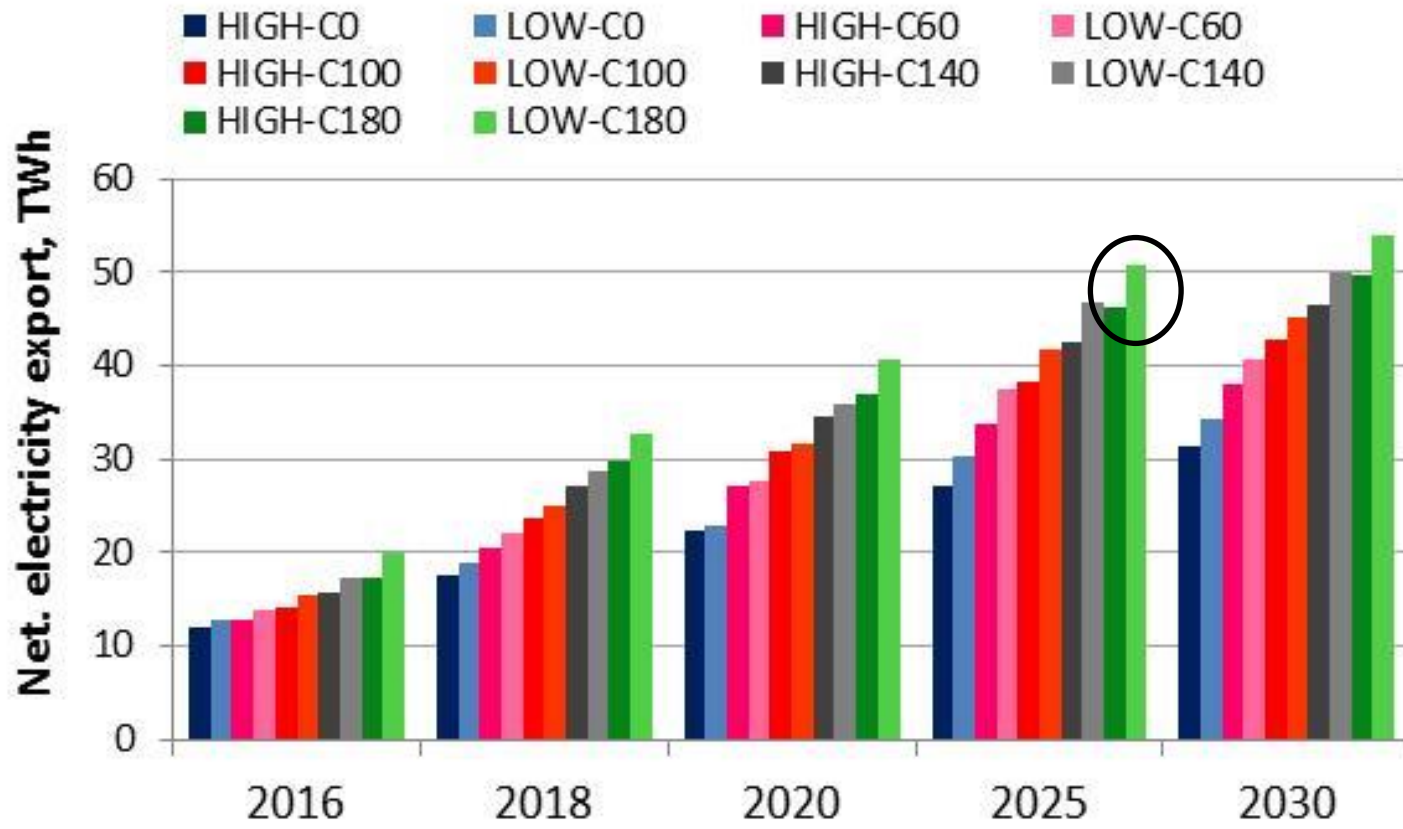


# Experiment 1- Electricity production



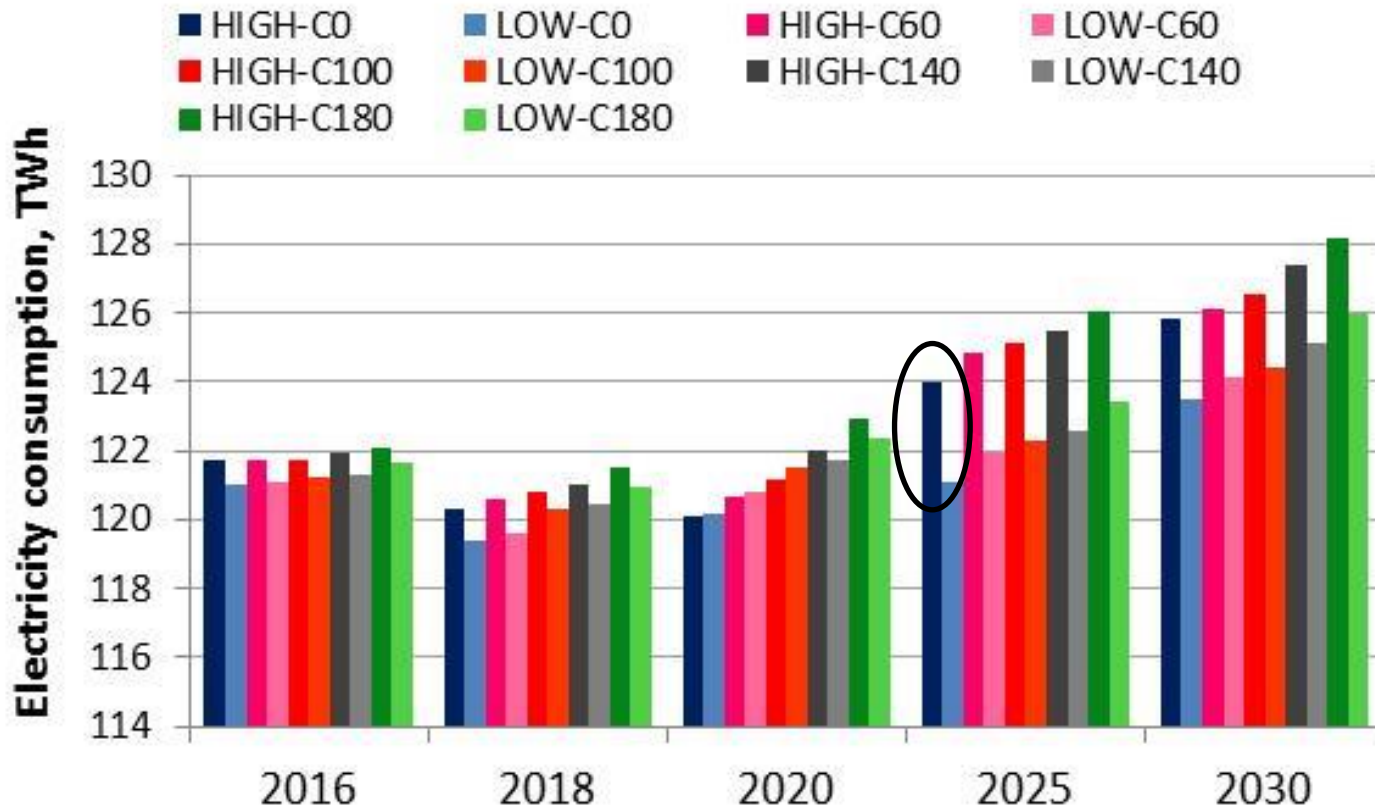
→ Largest deviation 3.2 TWh (C180)

# Experiment 1 – Electricity net export



→ Largest deviation 4.5 TWh (C180)

# Experiment 1 – Elc. consumption



→ Largest deviation 2.9 TWh (C0)

# Experiment 2 = Regional structure

- Significant of electricity export in Exp. 1. Realistic?
- Assumption trading prices
  - Independent traded quantities
  - Deterministic

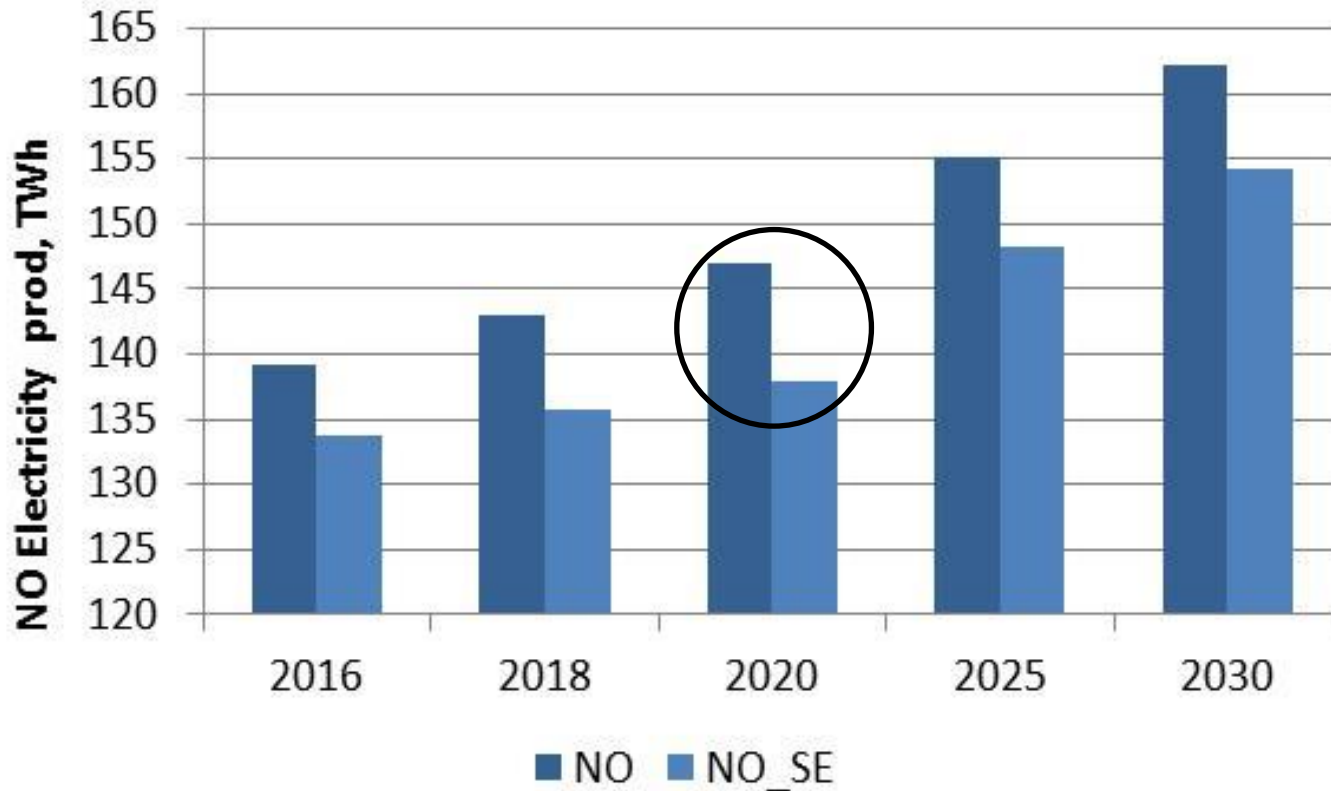
## Model improvement

- Endogenise trading prices/ include more regions
- Elasticity on exogenous electricity prices
- Stochastic prices

# Experiment 2= Regional structure

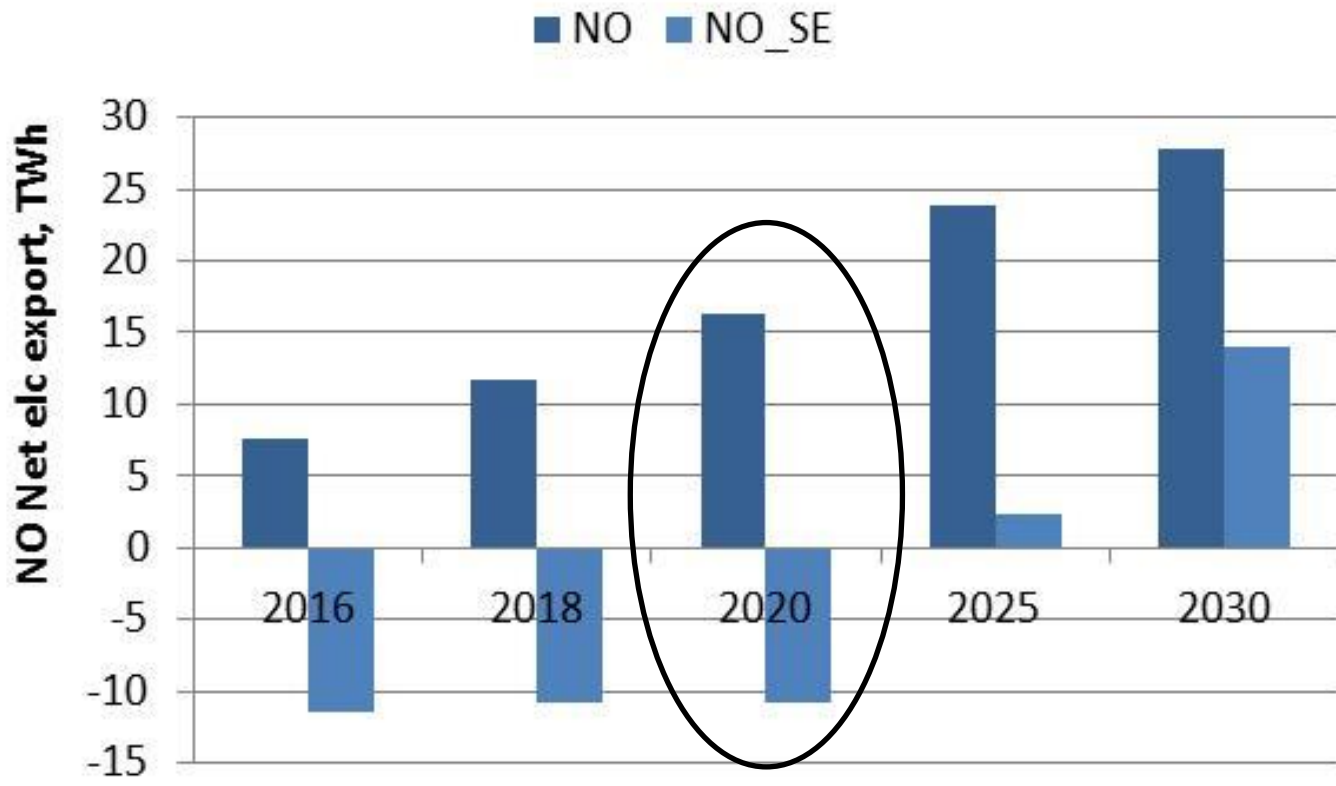
- Two regional options in a simplified TIMES-NORWAY
  - 48 time slices ; 4 seasons, 12 daily periods
- Model instances
  - NO                      N01-N05
  - NO\_SE                NO1-N05 & SE1-SE4
- Computational time
  - NO                      7 min 31 sek
  - NO\_SE                12 min 6 sek

# Experiment 2 – Electricity production



→ Largest deviation 9.0 TWh

# Experiment 2 – Net. electricity export



- Largest deviation 27 TWh

# Discussion

- How can we use model results when they clearly depend on model structure?
- Topics of interest
  - Elastic trading prices
  - Stochastic trading prices



**Thank you for the attention!**

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