TYNDP – Regional Group Baltic Sea

Market Model Results

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entsoe
Reliable Sustainable Connected

Scenarios

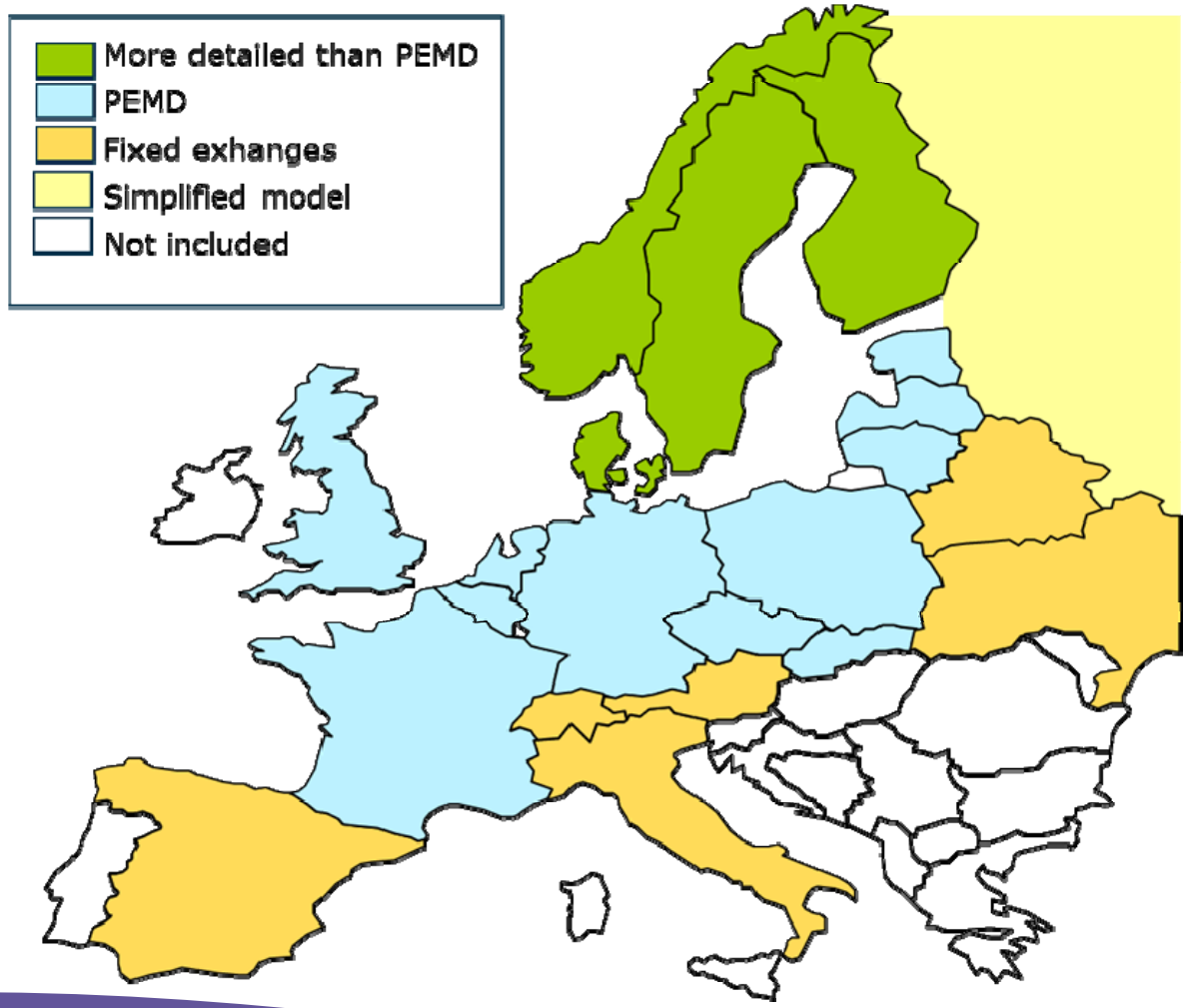
Base scenarios

- EU2020
  - Based on respective country's National Renewable Energy Action Plan
  - EU 20-20-20 targets fulfilled
  - High CO2-price
- B2020
  - Based on respective TSO's best estimate
  - Less renewable energy and higher consumption than in EU2020
  - Low CO2-price

Sensitivity Case

- Nuclear shutdown in Germany and Switzerland

Areas modeled



Modelling

EMPS model v. 8.4 (Samköringsmodellen)

- Windpower: Hourly windseries except for Norway
- Hydro power: 36 years of historical inflow series for Nordic countries, for other countries 1 year. Water values calculated separately for each case.
- Resolution: 10 periods per week
- Flexible demand in Nordic countries
- No start-up cost used for thermal power plants
- Germany and Poland modelled in one area each

Method – ”Portfolio concept”

Scenario EU2020 and B2020

with transmission system as in 2015 (but without further investments)

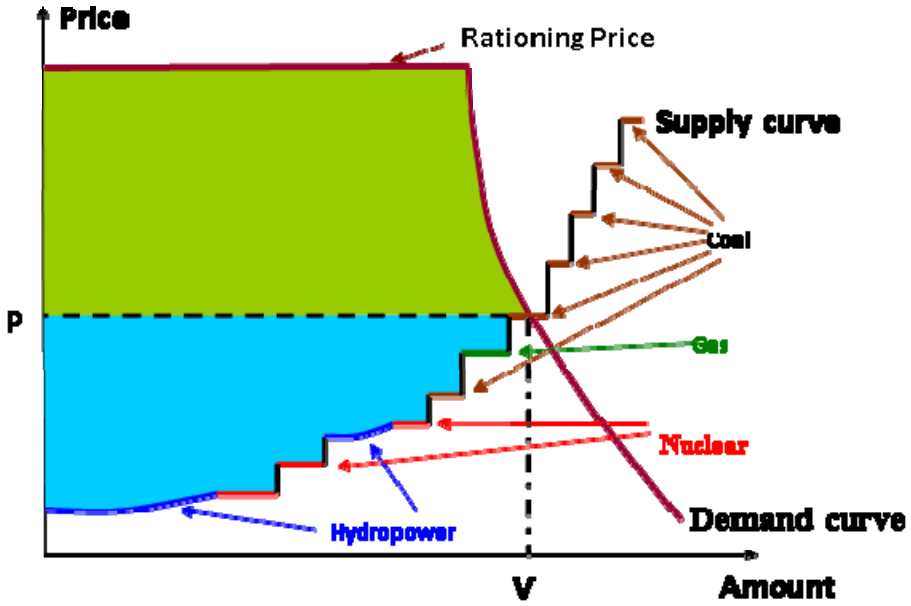
Scenario EU2020 and B2020

with transmission system as in 2015 + <u>expected projects</u>

Comparison with/without the <u>portfolio</u> - consisting of all projects with expected to go into operation 2015-2020

Benefit Analysis

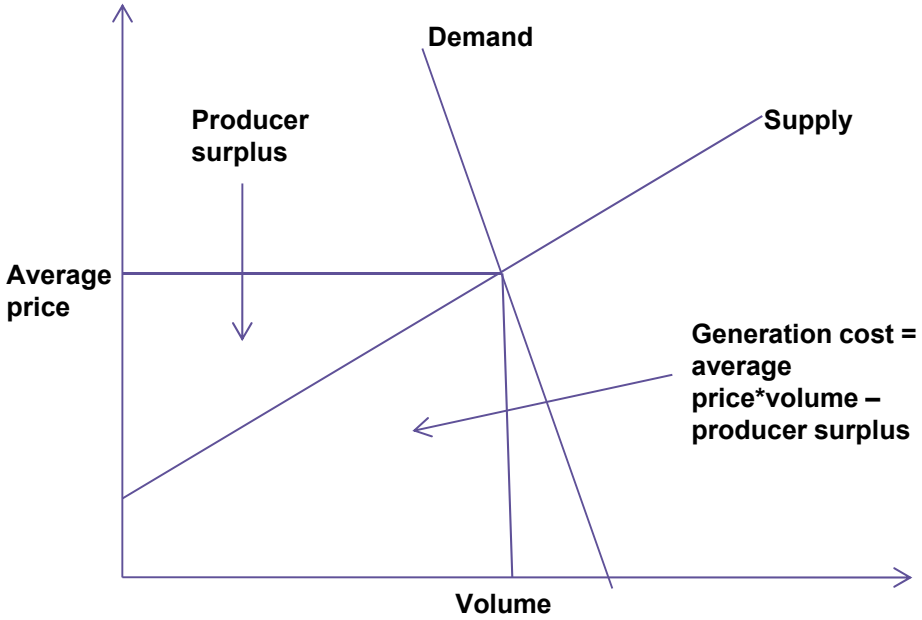
Electricity Market Benefit



Sum of:

- Producer surplus
- Consumer surplus
- Congestions rent

Savings in generation cost (ENTSO-E)



- Generation cost = average price * volume – producer surplus

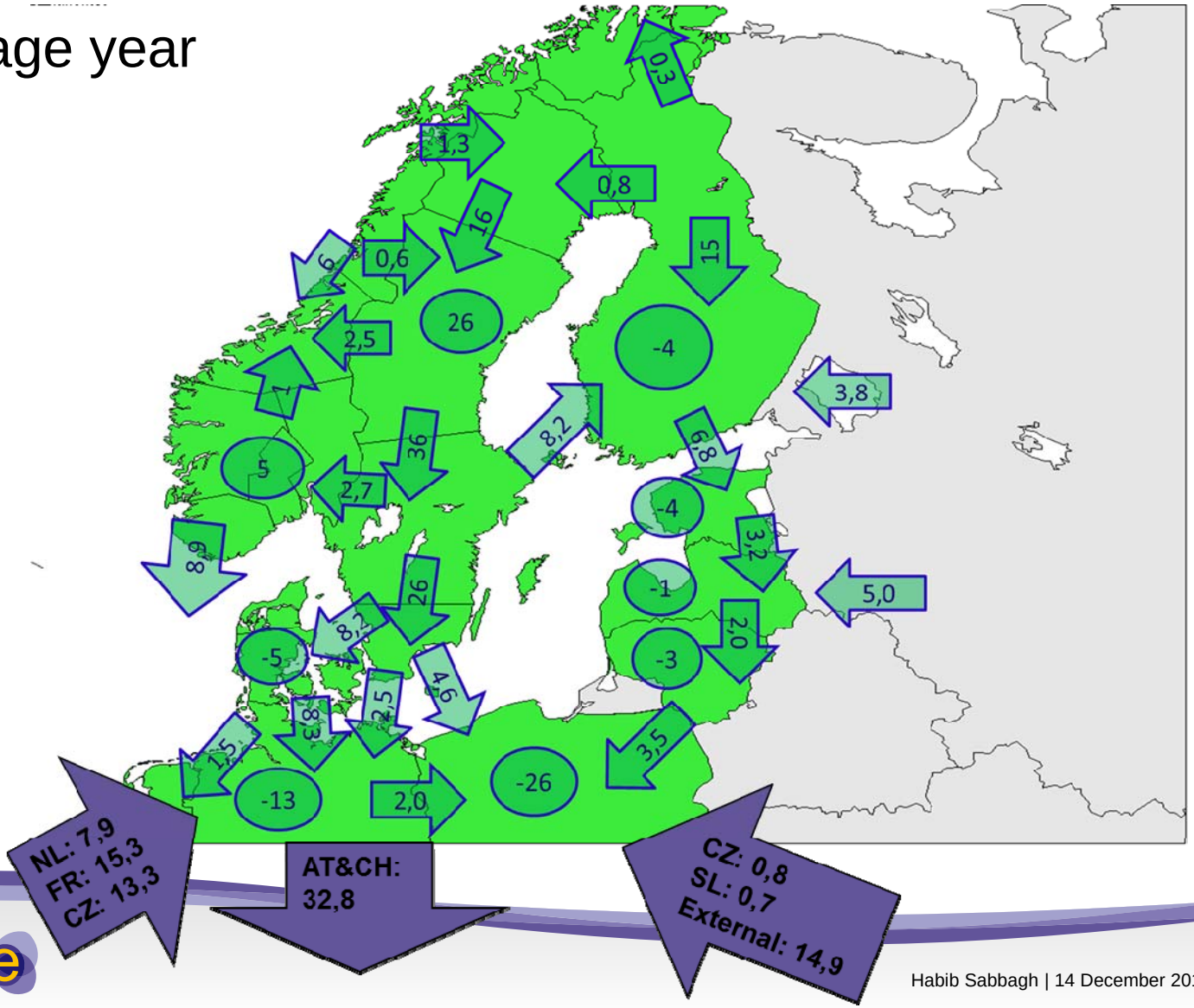
Results

- Balances & netflows
- Prices
- Benefits
  - Electricity Market Benefit
  - Savings in generation cost
- Changes in CO2 emissions
- Adequacy results

Base scenarios

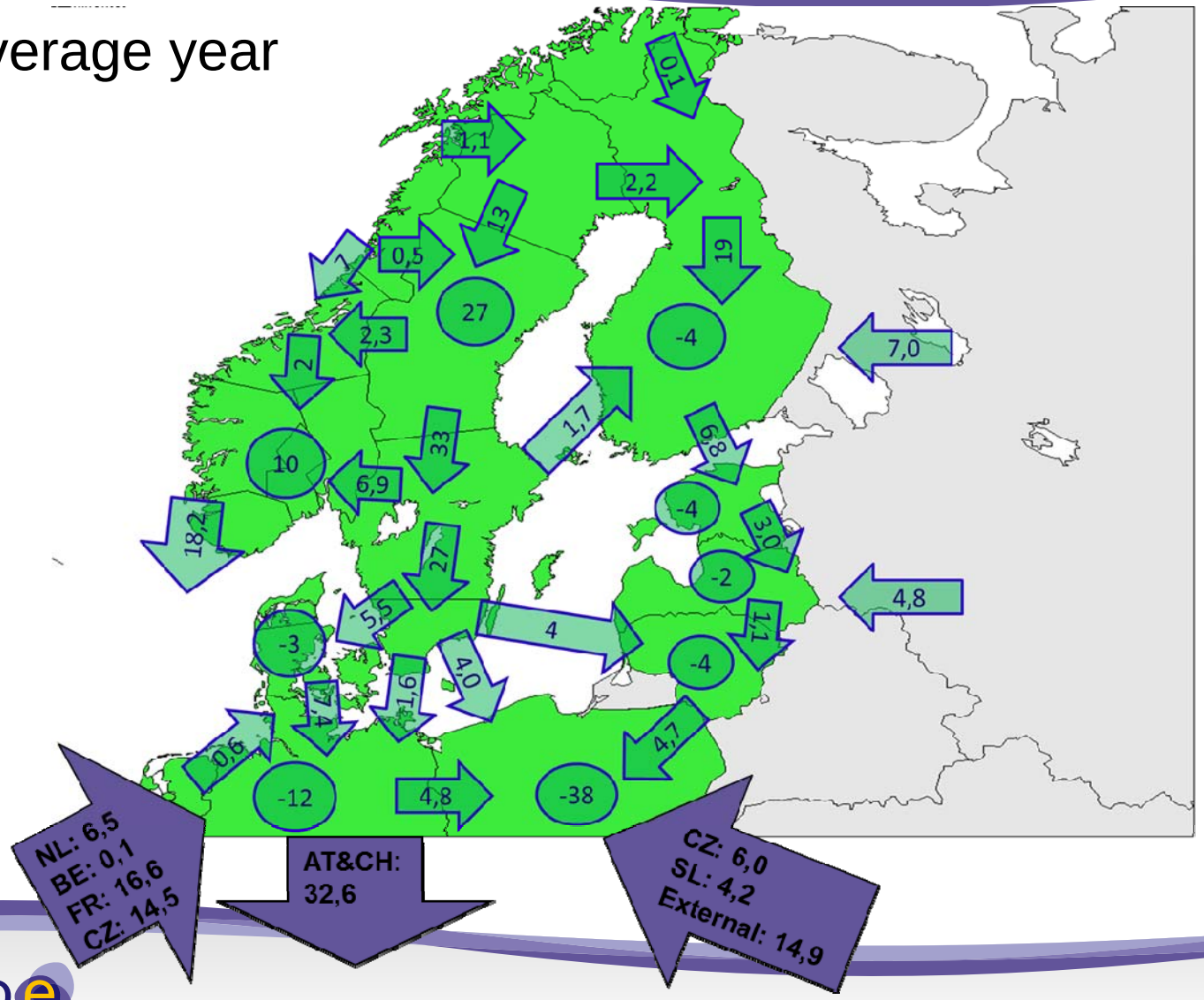
EU2020 with 2015 grid – Balances and netflows (TWh/a)

Average year



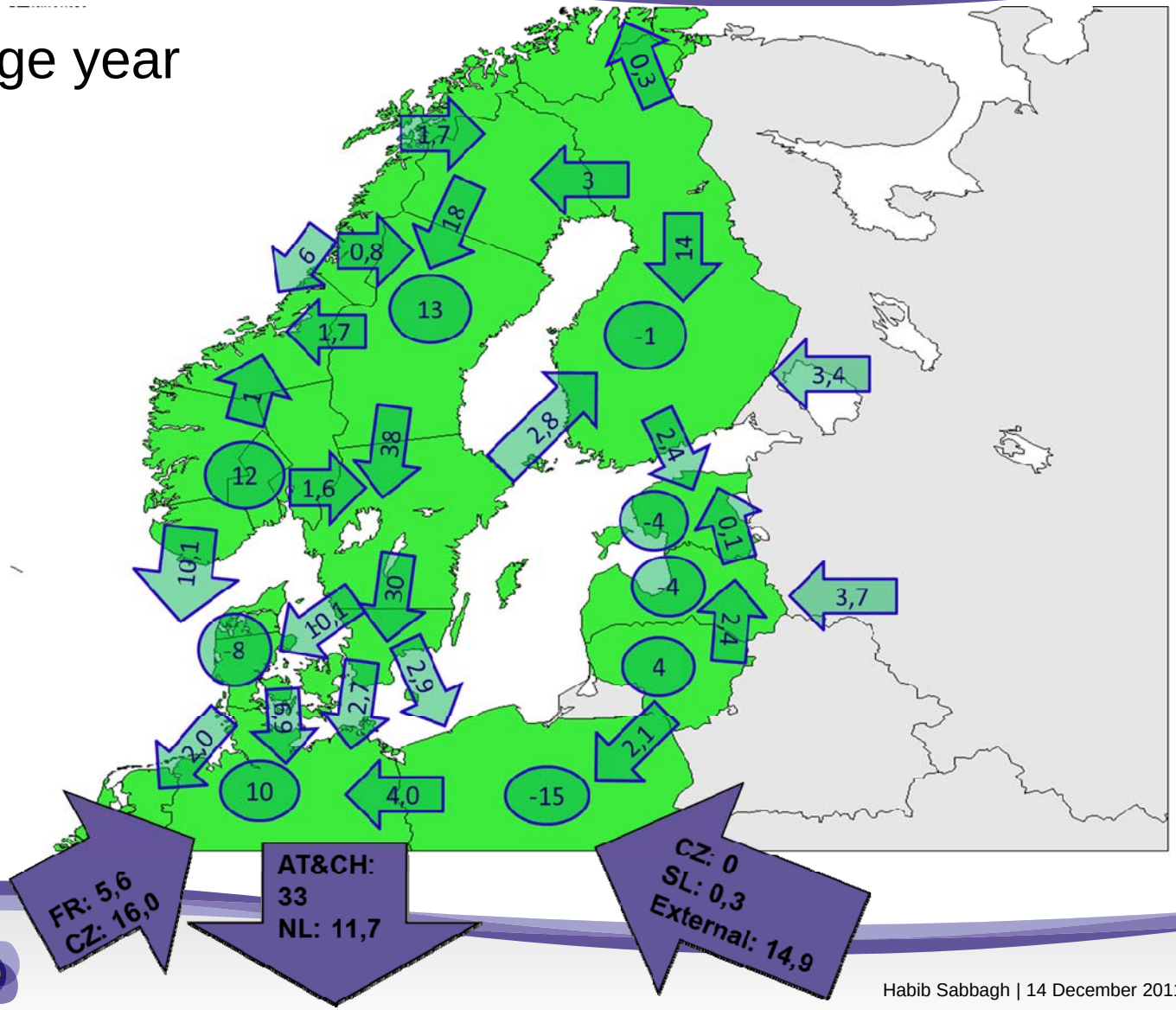
EU2020 with 2020 grid – Balances and netflows (TWh/a)

Average year



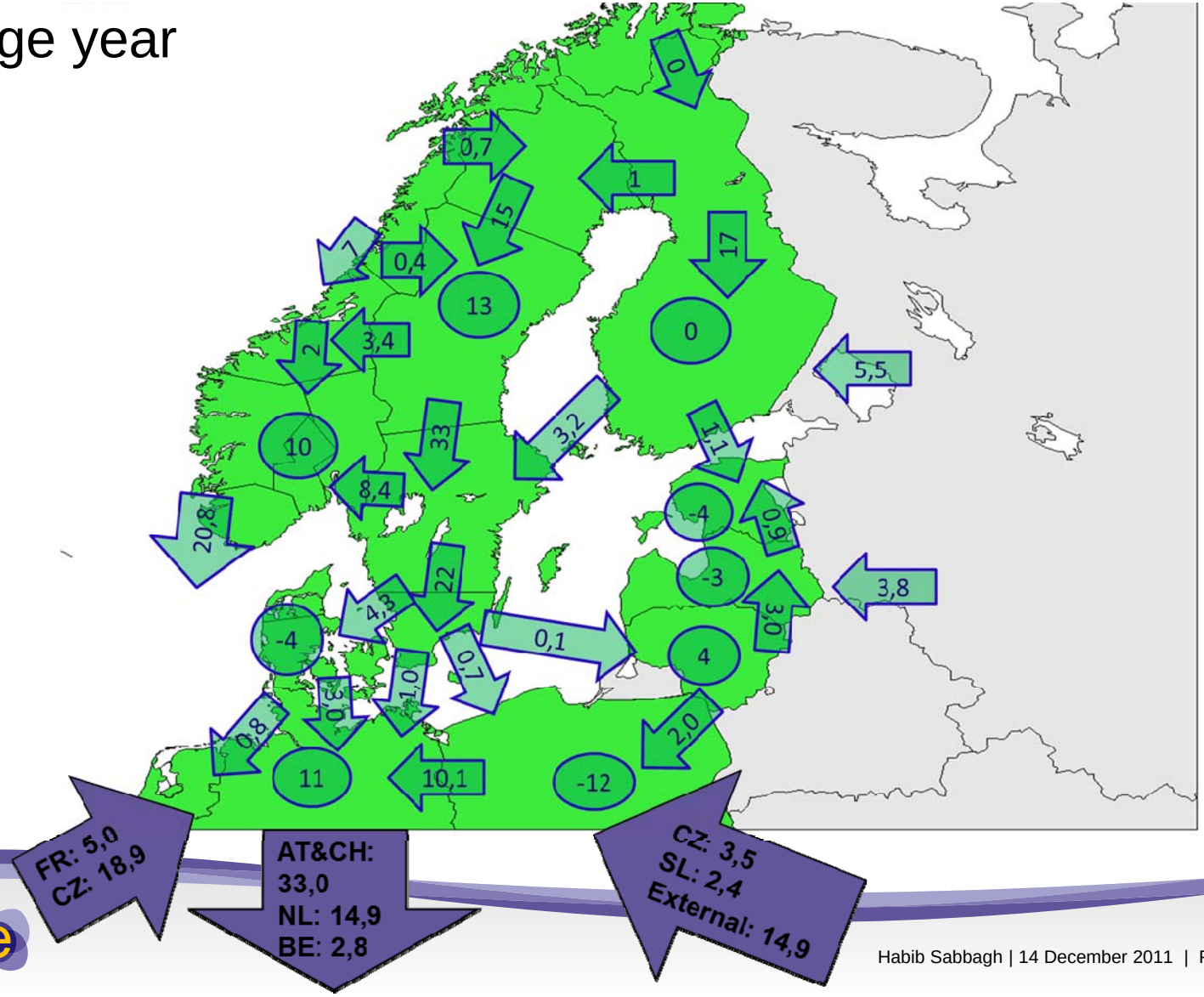
B2020 with 2015 grid– Balances and netflows (TWh/a)

Average year

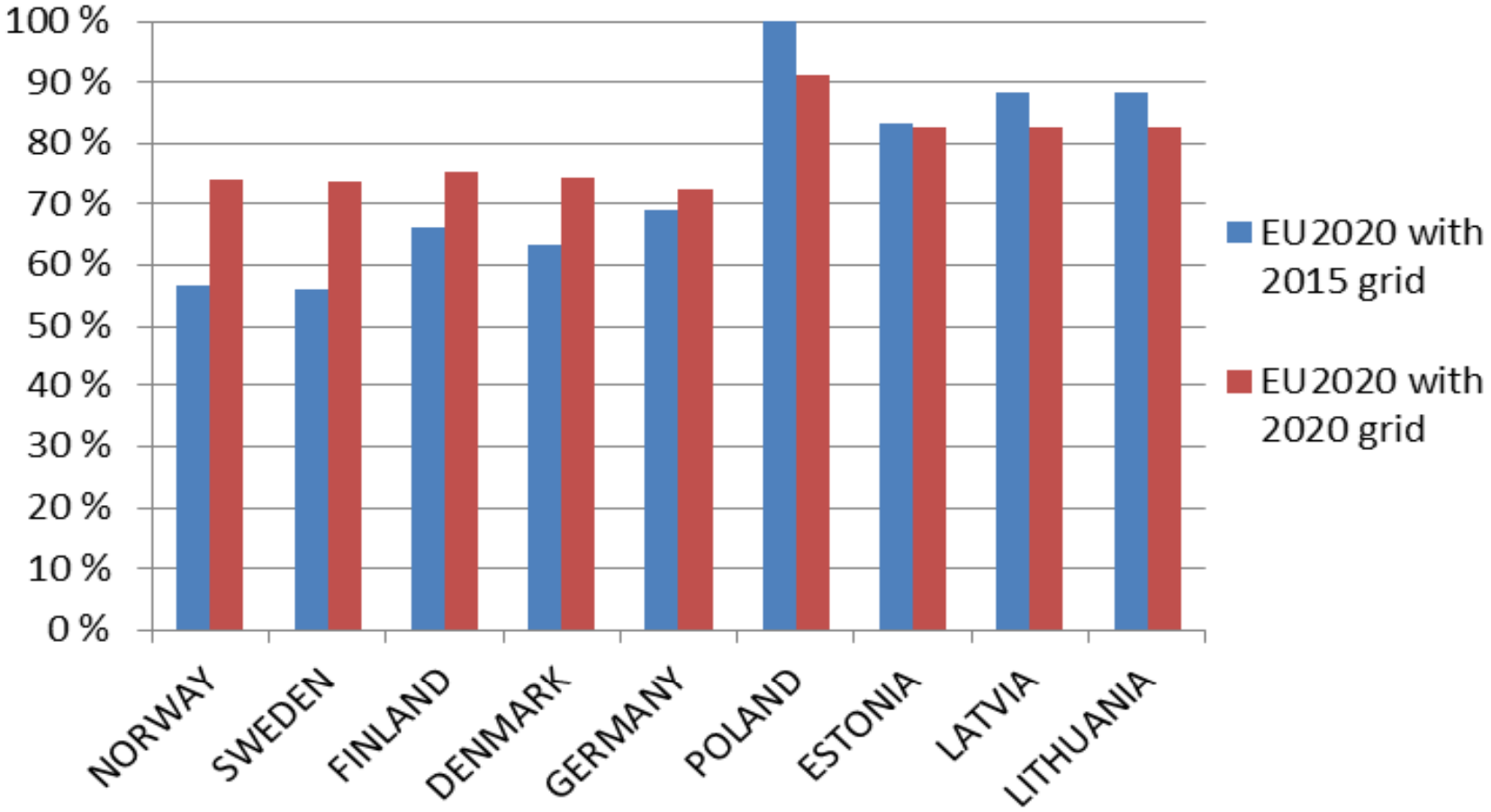


B2020 with 2020 grid – Balances and netflows (TWh/a)

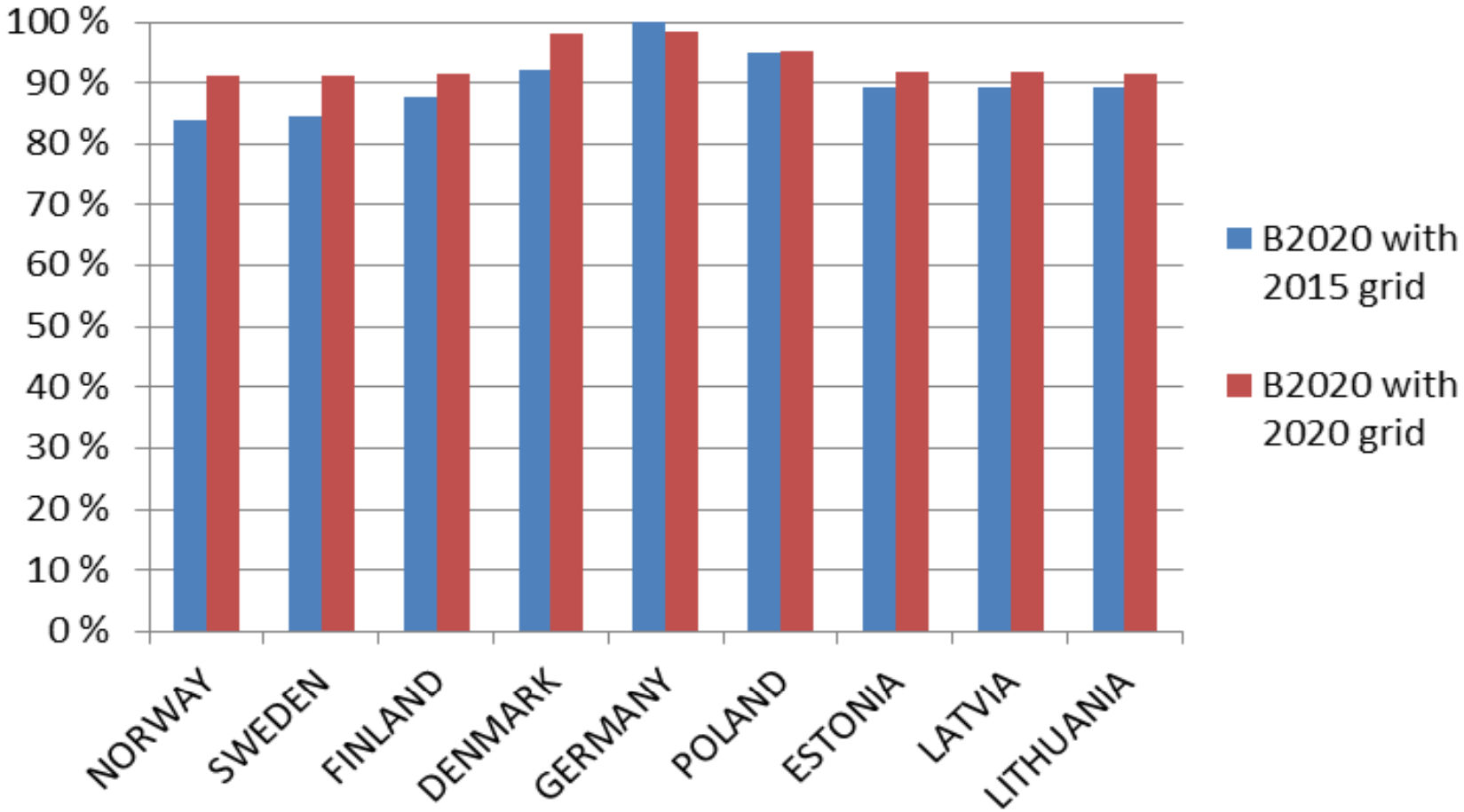
Average year



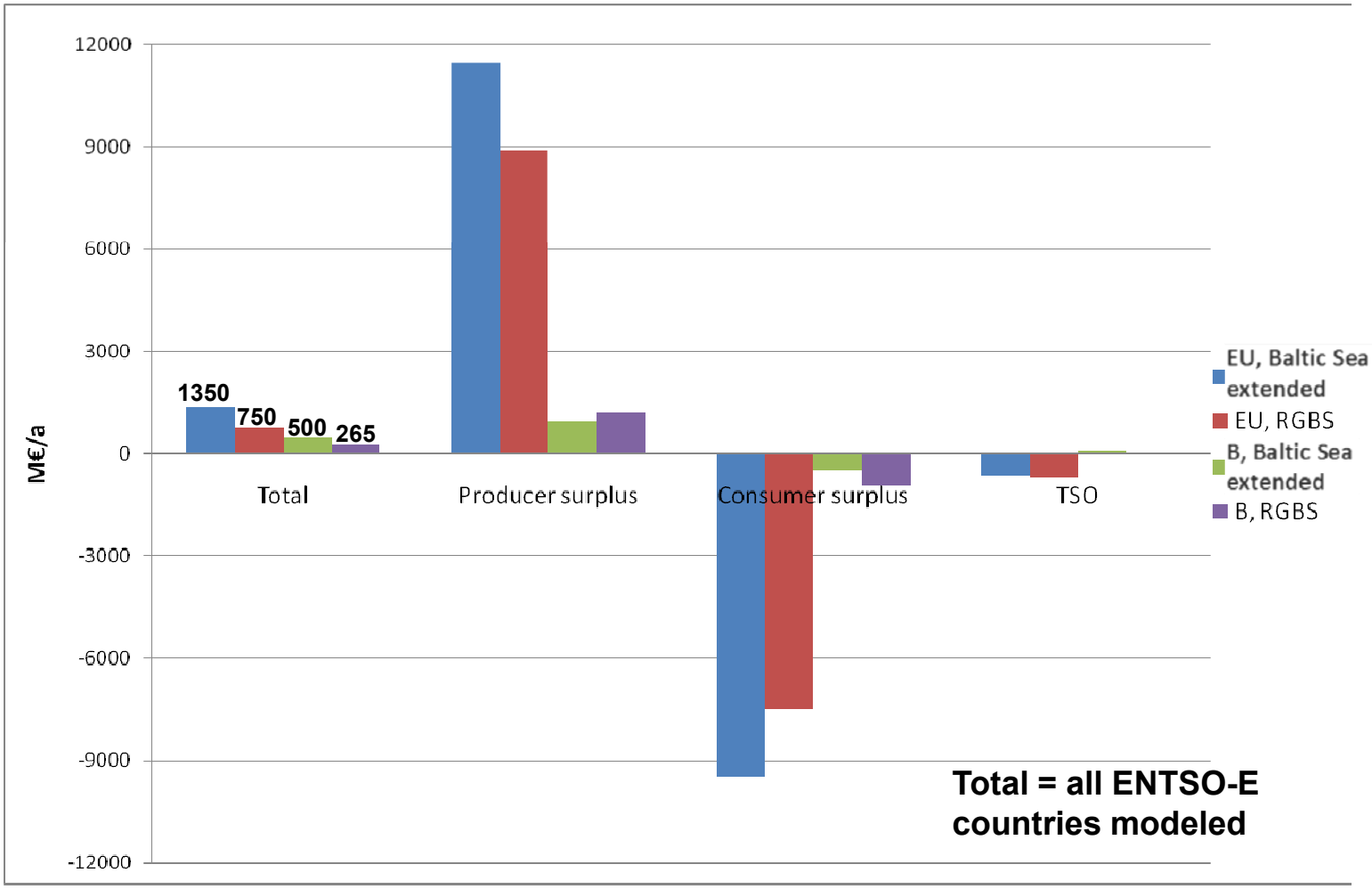
Prices in scenario EU2020



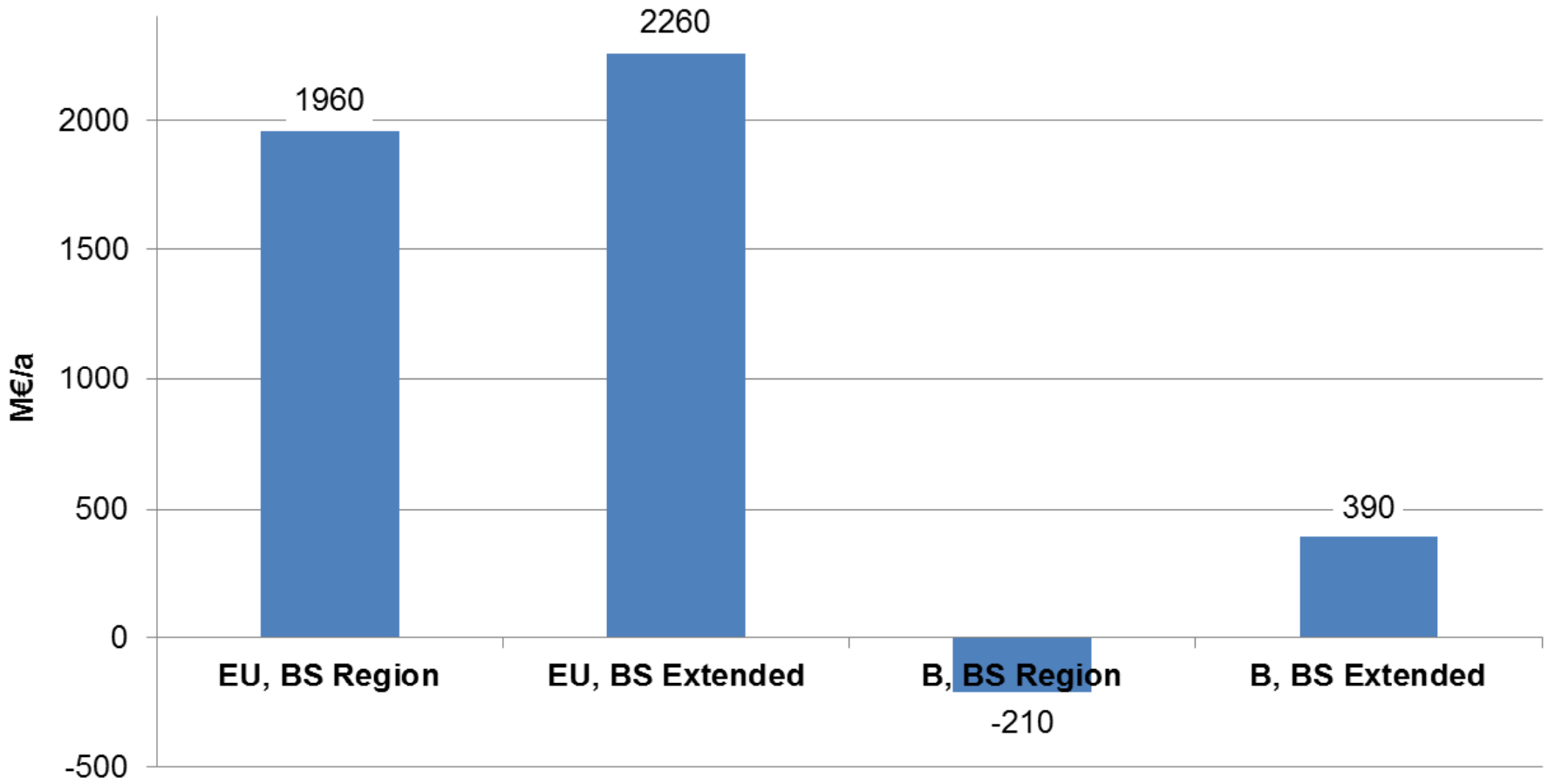
Prices in scenario B2020



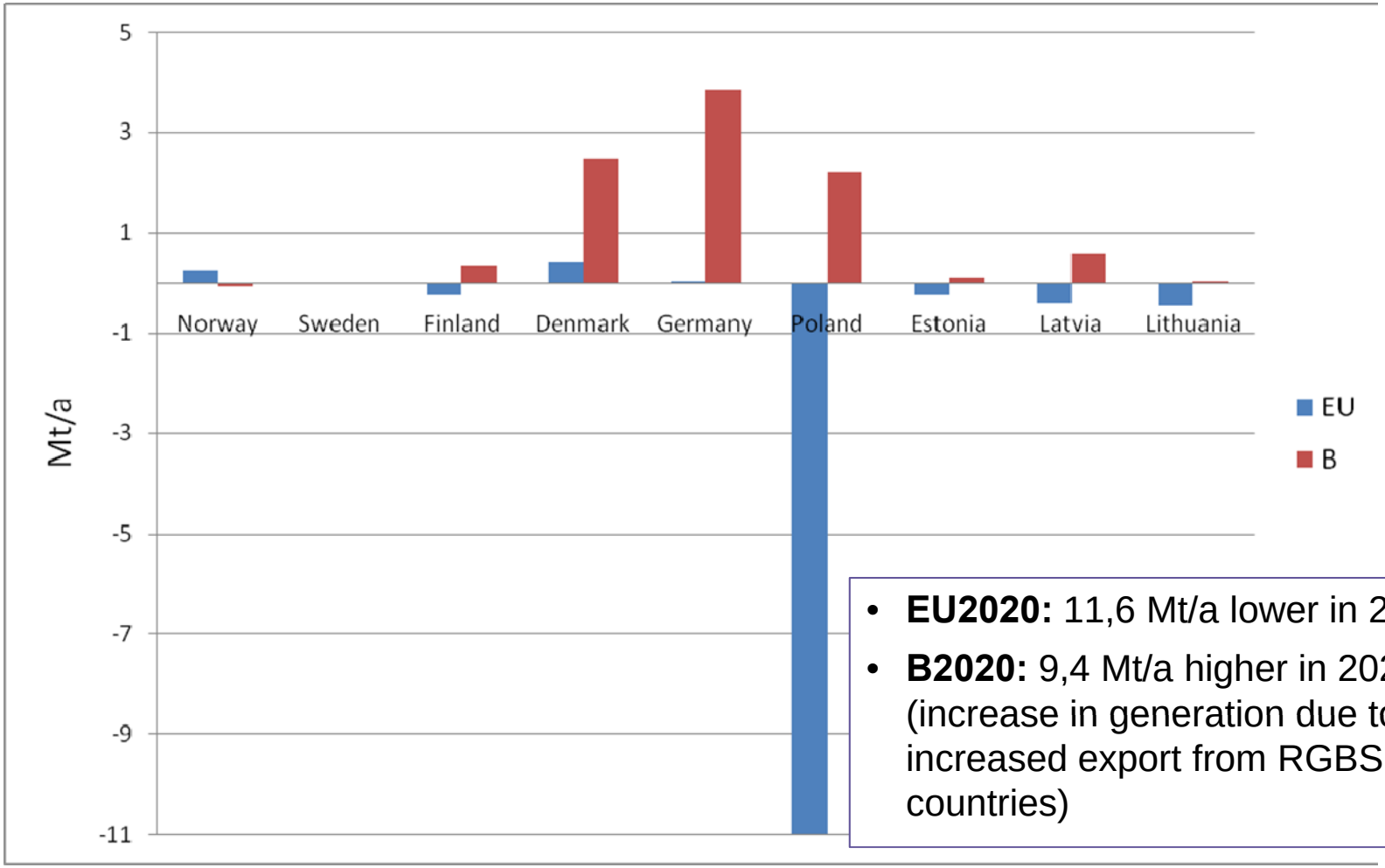
Electricity Market Benefit



Savings in Generation Cost



Change in CO2 emissions

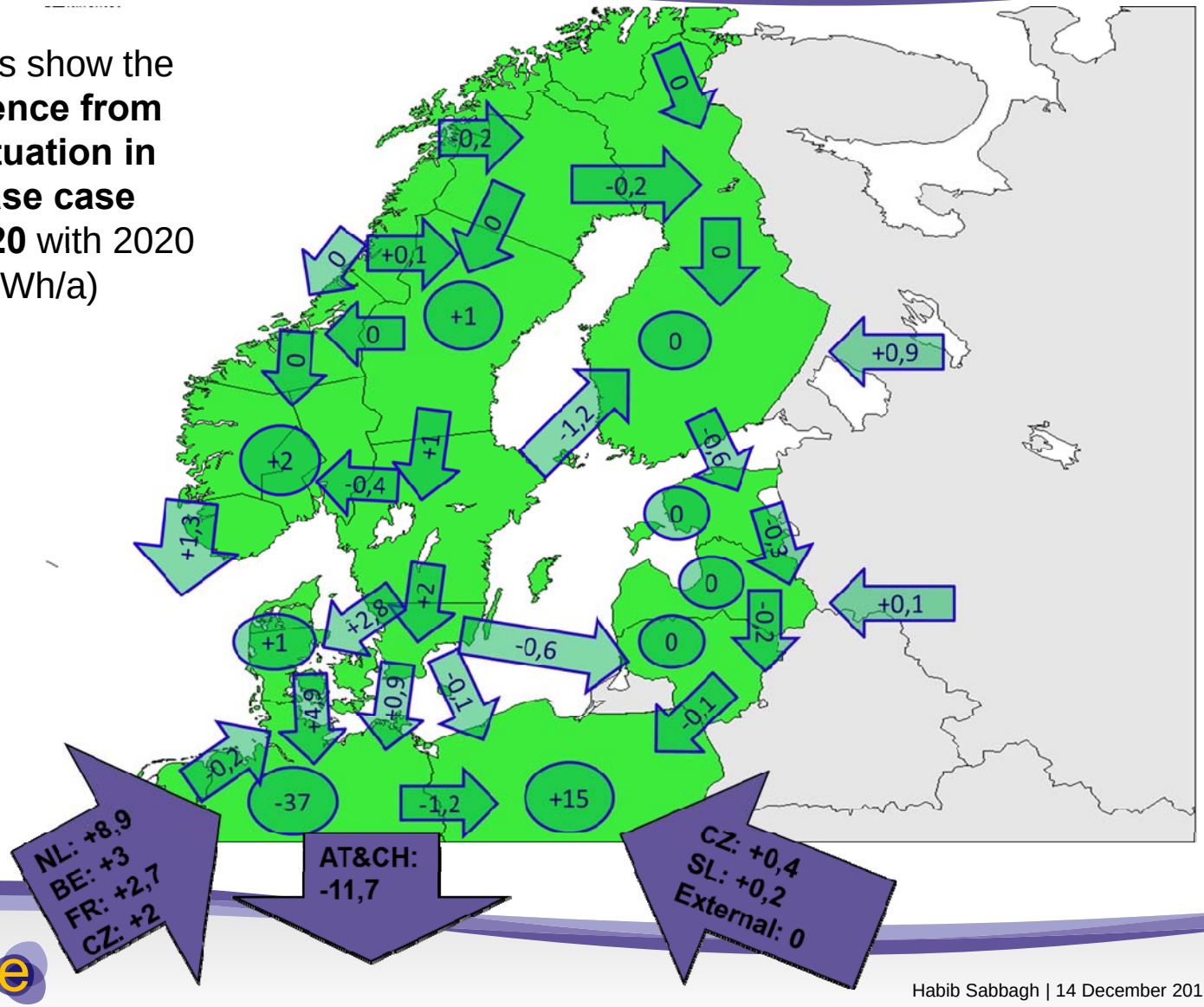


- **EU2020:** 11,6 Mt/a lower in 2020
- **B2020:** 9,4 Mt/a higher in 2020 (increase in generation due to increased export from RGBS countries)

Sensitivity case – Nuclear shutdown in Germany and Switzerland

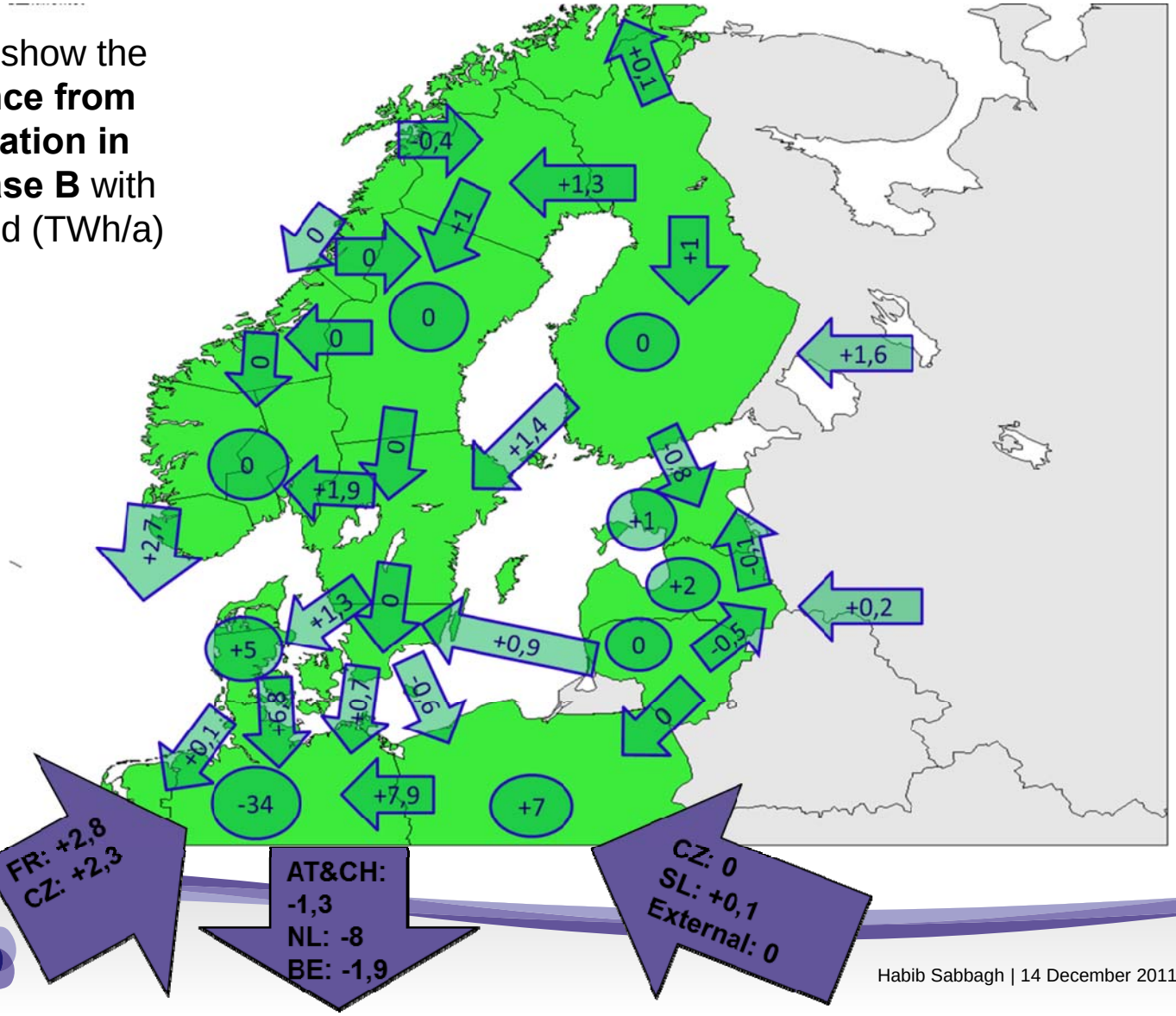
EU2020 with 2020 grid / Nuclear shutdown - Balances and netflows

Figures show the **difference from the situation in the base case EU2020** with 2020 grid (TWh/a)



B2020 with 2020 grid / Nuclear shutdown - Balances and netflows

Figures show the **difference from the situation in base case B** with 2020 grid (TWh/a)



Adequacy results

MAPS, Multiarea security Analysis for large scale electric Power Systems

The model is used to analyze the adequacy in power systems

Monte-Carlo simulation, Stochastic processes

Input

- NTC is used between areas
- Production capacity with Forced Outage Rate for every unit
- Load is modeled according to a load curve with 1080 h of top load for each area
- Connections to countries outside the region are modeled as generator nodes

Areas

- Norway: 1-7, Sweden: 8-11, Finland: 12-13, Denmark: 14-17, Estonia: 18, Latvia:19, Lithuania: 20.

Results

- Loss of Load Probability (LOLP) = probability that one consumer will be disconnected, more or less probability for that production do not meet the consumption.
  Accepted criteria is less than 0,1 %, that is less than 9 hours per area

MAPS, scenarios

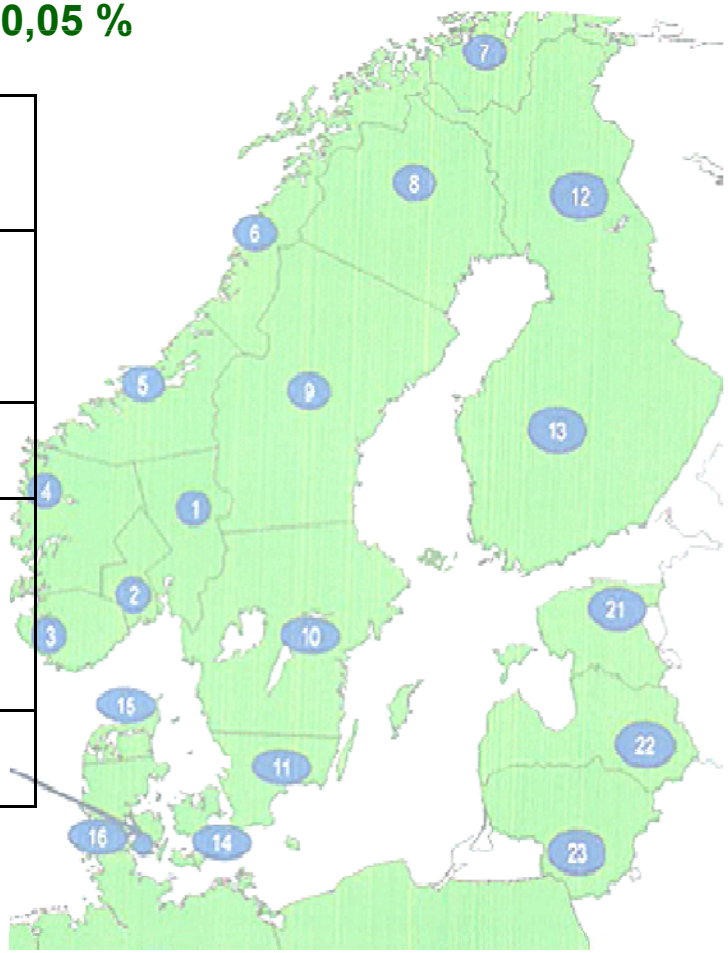
- **EU2020**
- **B2020**

Modified to match strained situations:

1. Severe load with no windpower and no import
2. Normal load with failure on nuclear reactors with BWR-technique (boiled water reactor), that is seven out of ten 10 Swedish reactors and two out of six Finish reactors, and half import.

Portfolio concept was used, that is results are presented for before and after the portfolio

MAPS, results - LOLP

Red > 0,1 % **Yellow 0,05 % - 0,1 %** **Green < 0,05 %**

	Servere load No wind No import	Normal load BWR failure Half import
EU2020 with 2015 grid ↓	<0.05% for all areas but area 7 (NorwayFinn) = 0,4%	Area 11 (SE4) > 0,1% Area 7, 10 and 13
EU2020 with 2020 grid	< 0.05% for all areas	< 0.05% for all areas
B2020 with 2015 grid ↓	0.05% for all areas but area 7 (NorwayFinn) = 0,4%	Area 10 (SE3), 11 (SE4) and 13 (Finland south) > 0,1% Area 7
B2020 with 2020 grid	< 0.05% for all areas	< 0,05% for all areas