Scenarios for the 2050 European Energy mix and large scale modelling of grid development and storage needs.

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Brief overview of EMPS modelling concept

- **Details for hydropower**
- **Market simulation (LP)**
  - Strategy calculation (SDP)
  - Water values
  - Solutions
- **Electricity market specification**
  - Market data
  - Calibration
- **Stochastic weather**
  - Realization
- **Strategy calculation (SDP)**
  - TWh
  - Eurocent/kWh
  - Weeks
- **Market data allocation**
- **Calibration**
- **Simulation results**
  - GWh
  - Weeks
**Investment algorithm** (for analysis of profitable increases in transmission capacities)
NORSTRAT objectives

- **Objectives**: To build knowledge about possible carbon neutral futures for an integrated Nordic power system in a time perspective up to 2050 based on quantitative scenario analysis of impacts on the electricity, the transport and partly the heating system combined with the necessary governance aspects to enable the transformation.
- **Partners**: SINTEF Energi, Stockholm Environment Institute (SEI), Technical University Denmark (DTU)
NORSTRAT scenarios

Volume of new RES in the Nordic region

**Purely RES**
200-250 TWh/y of new RES based production. Nuclear phased out. Connection to Europe mainly as today.

**Carbon Neutral Nordic**
100-150 TWh/y of new RES based production. Connection to Europe mainly as today.

**European Hub**
200-250 TWh/y of new RES. Up to 20 GW increased capacity in the Norwegian hydro power. Increased integration with Europe

**European Battery**
100-150 TWh/y of new RES. Up to 20 GW increased capacity in the Norwegian hydro power. Increased integration with Europe

Integration between the Nordic region and the rest of Europe
Production portfolio Europe

EU Energy Road Map Scenario 2050 (EU 27)

NORSTRAT
Europe minus Nordic region
### Purely RES 2050 (preliminary results)

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<th>Region</th>
<th>Region</th>
<th>TWh/year</th>
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<td>FIN-NORD</td>
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<td>TROMS</td>
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<td>SVER-SNO2</td>
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<tr>
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<tr>
<td>TOTAL</td>
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</tbody>
</table>

### Graphs

- **Bar Graph**:showing TWh/year for Denmark, Finland, Norway, and Sweden.
- **Pie Chart**: showing energy sources for each region.

**Legend**:
- Bio
- Nuclear
- Solar
- Wind
- Hydro

**Axes**:
- TWh/year
- MW

**Export vs. Import**:
- Blue bars represent export.
- Red bars represent import.

- **Denmark**: Export
- **Finland**: Import
- **Norway**: Export and Import
- **Sweden**: Export and Import
Purely RES 2050 Increases in transmission capacities (preliminary results)

Yellow line: max increase 2000 MW
Red line are 10 times a yellow line
Blue line: existing, no increase
Profitable investments in transmission grids
NORSTRAT scenarios (preliminary results)