NEPP
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NEPP Synthesis results *(preliminary results to be further refined)*

Results

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The development of European electricity supply under climate-policy constraints

This study is a recent scenario update, including the decided German nuclear phase-out by 2023, of the outlook of the European electricity supply towards 2050. The scenario used here, "Market", is distinguished by a continued European growth in electricity demand, a common European CO_2-reduction target of 85 percent by 2050 and a commercial break-through for CCS by 2020.

It is shown that CCS and renewable electricity generation will dominate the electricity generation in most European regions beyond 2030. Especially in the case of renewables this is noteworthy, since the scenario assumes no dedicated renewable policies beyond 2020. However, regional differences are quite significant and relate mainly to differences in availability of renewables and CO_2-disposal costs. Gas power is a key technology for new investments while awaiting the commercialization of CCS. If such a commercialization proves to fail, the need for gas and renewable is likely to become considerably larger than estimated in the present "Market" scenario. This would also call for additional end-use efficiency measures.

Finally, the prospects for nuclear power is highly uncertain in Europe, especially in the wake of the Fukushima accident in Japan. In this study, only Germany is assumed to carry out a complete phase-out of nuclear power. This means that, given the assumptions of the present "Market" scenario, part of that capacity is replaced by new investments in nuclear power elsewhere in Europe.

Massive increase in renewables

The expansion of wind power is very rapid especially in Western and Southern Europe. Beyond 2020 the expansion is halted due to the introduction of CCS. The amount supplied by electricity generated from biomass (including peat and refuse) is initially smaller than wind power in Western and Southern Europe but reaches the same magnitude towards the end of the period. On the other hand, in Eastern Europe biomass-fired electricity supplies the lion share of all renewable electricity. The amount is of the same size as in Western Europe despite the fact that the Eastern European electricity market is less than a third in size of the market in Western Europe around 2030.

Regional differences

The distribution of the different means of producing electricity varies substantially across the four regions (and across countries within a given region). Northern Europe, as defined here, will have the largest share of renewable energy sources in the future, while fossil fuels are expected to continue to play a vital role in the other regions, especially in Southern and Eastern Europe.

In **Western Europe** (Figure 2, top), CCS plays an important role beyond 2025. The share of renewables is around 25% by 2030. Conventional coal power declines steadily but persists, even towards the end of the period. Nuclear power may grow in nuclear states outside Germany if profitable (this is also reflected in the model results).

In **Northern Europe** (Figure 2, bottom), renewable electricity generation, is the main option for significantly reducing CO_2 emissions. Since it is assumed that the contribution from new hydro power schemes will be marginal, most new investments in renewables will be in wind power and biomass power. In addition, nuclear power plays an important role, and a sixth nuclear unit in Finland, to be brought online in 2020, is in-

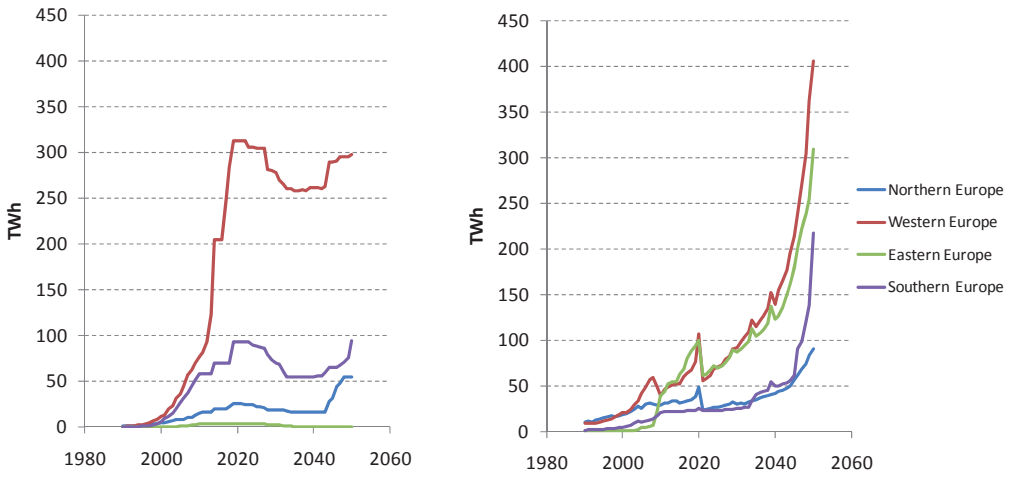

Figure 1: Electricity generation from wind power (left) and biomass (right)

cluded in the calculations. At the same time, the Swedish capacity for nuclear power is slowly being phased out. CCS yields only a relatively small share as opposed to the other regions.

In many **Eastern European** countries (Figure 3, top), the short- and mid-term needs for new investments are substantial, since many power plants are aged. Therefore, significant changes in power supply are imminent in this region. Contrary to the other regions, it is assumed that the growth in electricity demand in Eastern European countries is quite significant. Finally, the amount of biomass-based power (CHP, co-firing, and some condensing power plants) forms a substantial share towards the end of the period, and this is significantly larger in relative terms than in any other region. This is explained by the assumptions made regarding abundant (and relatively cheap) biomass resources.

In **Southern Europe** (Figure 3, bottom), the model results indicate that gas power is the most important player in the short-to-mid term. A considerable share of the facilities is already decided upon or planned. At the end of the period, CCS gains momentum and becomes the dominant contributor towards the end of the period. The relatively low penetration of nuclear power is mainly explained by its low share today. Even though, for example, Italy currently considers nuclear power as an option, it has not been included in the model.

The Market scenario

is one of several scenarios defined within the Pathways and NEPP research projects. The scenario is characterized by a somewhat higher electricity demand following the anticipated larger share of electricity in the total demand for energy services. As opposed to the nuclear phase out in Germany, the other European nuclear states may increase their nuclear capacity somewhat. Therefore, the European net decrease in nuclear generation is only around 30 TWh by 2025 even though Germany phases out its operational 150 TWh.

No national policy schemes are included. The EU renewable target set for 2020 is achieved jointly. Beyond that, no additional targets are assumed. CO_2 emissions are, also jointly, reduced by 30% by 2020 and by 85% by 2050.

Even though focus is set almost entirely on climate policy beyond 2020 (without any specific renewable targets) the expansion of renewable electricity is of considerate size. The Market scenario outlined here is but one scenario of several others that are currently under investigation in the NEPP project. A broader and more complete picture of the development of the electricity-generation system in Europe will, therefore, be reported in due time. Accordingly, we will also take a closer look at scenarios where the share of renewable electricity is further being boosted by ambitious renewable policies as a supplement to climate-policy targets.

Model framework

The model used in this study, the ELIN model, includes a very detailed description of the existing electricity-generating capacity of all 27 EU Member States and Norway. Furthermore, the model includes an extensive basket of new generating technologies to meet the future generation deficit due to ageing and phasing-out of existing capacity and increase in electricity demand. For reasons of simplicity concerning model result's presentation, the countries included in the model have been divided into four main European regions (see Figure).

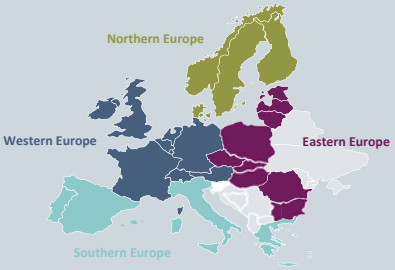

Figure: The four main regions of the EU (plus Norway and Switzerland) used in the present analysis

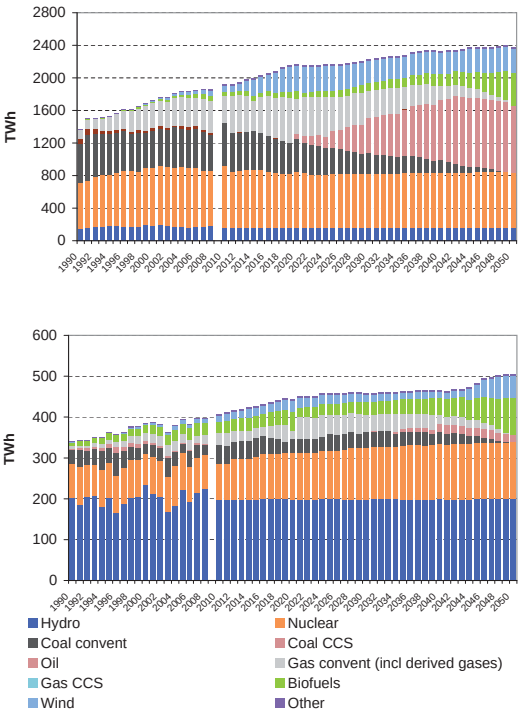

Figure 2: Western Europe (top) Northern Europe (bottom)

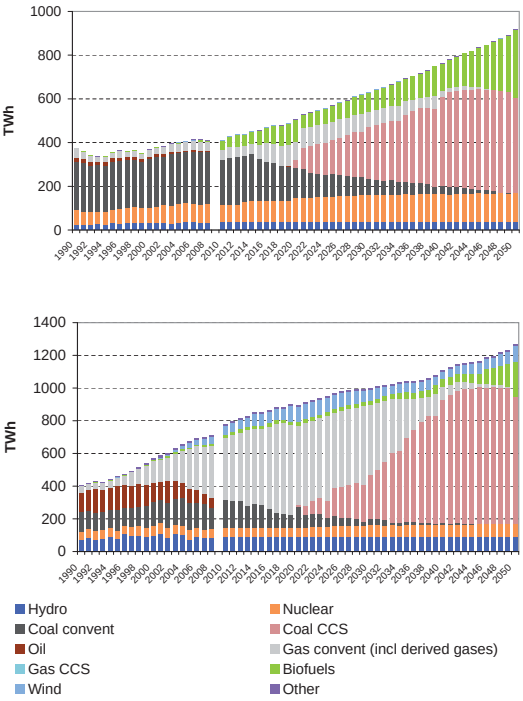

Figure 3: Eastern Europe (top), Southern Europe (bottom)

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