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Comments from Öko-Insitut on the ENTSOs TYNDP 2020 Draft Scenarios

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Planning the European electricity and gas infrastructure needs a greater scenario diversity, including a 100% RES scenario and efficient direct electrification resulting in faster GHG reductions using less unproven technologies (such as CCS).

On 12 November, ENTSO-E and ENTSOG published their joint draft scenarios of the TYNDP 2020 and made them available for public consultation. Based on the feedback, the scenarios will be finalised by March 2020. The scenario set consists of the three scenarios National Trends, Distributed Energy and Global Ambition. National Trends is based on the current goals and plans of individual European countries. The Distributed Energy and Global Ambition scenarios were developed with the aim of meeting the Paris climate targets. Distributed energy is a scenario with a more decentralized approach and global ambition with a more centralized approach.

Summary of commentary

This commentary focuses on the two 1.5°C scenarios, as there is still a fundamental need to revise these in order to achieve the Paris climate targets. Both scenarios rely heavily on an energy supply based on gas and the use of carbon capture technologies (CCS). On the other hand, a rather low level of electrification and a low level of expansion of wind and solar plants is considered.

A fast reduction of GHG-emissions based on a rapid expansion of wind and solar power combined with a phase out of fossil fuels is essential to comply with the Paris agreement.

To ensure that the planning of the electricity and gas infrastructure is based on an appropriate scenario diversity, the following points should be considered in at least one scenario:

- A faster emission reduction would diminish the dependency on CCS and the associated uncertainty regarding feasibility and costs. This way the climate goals can be achieved with a higher probability and costs and risks are not passed on to future generations.
- A faster wind and solar power expansion, as a proven emission reduction strategy.
- No predetermination of gas demand in an early stage of the scenario building process. Overall, the procedure at this central point is insufficiently documented.
- Exclusively using RES-E capacities for Power to Gas plants leads to high losses of renewable electricity.
- The assumptions for the bioenergy potential must be considered together with the assumptions for LULUCF and must not be overestimated.

1. An ambitious emission reduction for an ambitious scenario?

- It is not clear how the yearly emission targets were set.
- A faster emission reduction would diminish the dependency on CCS and the associated uncertainty regarding feasibility and costs.

The two ambitious scenarios show, with a linear reduction between 2025 and 2050. the same development in emission reductions (see Figure 1-1). A comparison of emissions in the electricity sector shows that in 2030 even all three scenarios are at the same level. In order to maintain an ambitious GHG budget, it is essential to reduce emissions at an early stage. As these early efforts can also unfold their effect in all subsequent years. Since this is not implemented in the TYNDP scenarios, the set overall budget is exceeded before 2035. All subsequent emissions must be later removed from the atmosphere. For this reason, after achieving climate neutrality in 2050, approximately 15 Gt will have to be offset by negative emissions until the year 2100. The decision for a linear emission reduction and the resulting need to withdraw emissions from the atmosphere is seen critically for the following reasons:

- Carbon Capture and Storage or Usage (CCS/CCU) technologies are not yet tested on a large scale. There are also unanswered questions regarding their implementation costs or the acceptance of final disposal.
- These uncertainties lead to a shift of responsibility and costs from the generation that draws up these plans to following generations.
- It doesn't reveal itself why the emission reduction was defined as a linear path. This approach puts the Paris-compatibility of the scenarios at risk, as it is unclear whether the required carbon capture technologies will be available.
- At least one scenario should consider a faster emission reduction to reduce the dependency on CCS.

Figure 1-1: GHG emissions compared to 1990 level

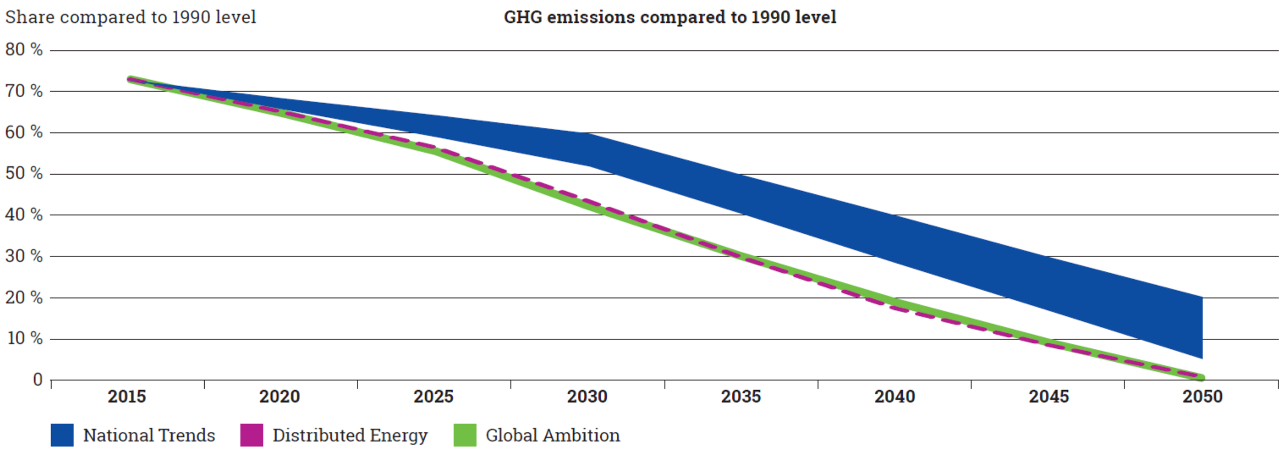


Figure 2: GHG emissions in ENTSOs' Scenarios

Source: (ENTSO-E; ENTSOG 2019)

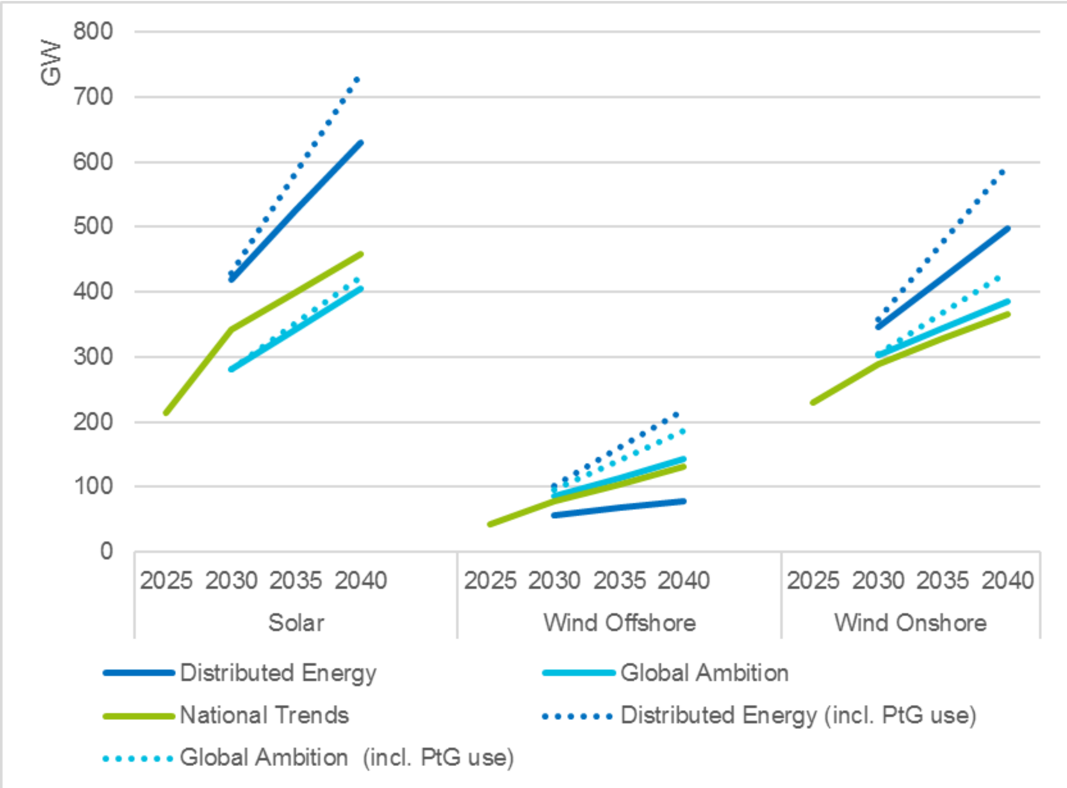
2. Ambitious deployment of Wind and PV is needed

Key messages:

- A scenario based on fast wind and solar expansion should be considered.
- One way of achieving this would be a higher CO_2 price resulting from a significantly faster reduction of the emission targets.

In Figure 2-1 the installed wind and solar capacities for EU28 are shown. It should be noted that in the Paris scenarios, wind and solar systems are foreseen, whose electricity is used exclusively for Power-to-Gas (PtG) applications (dotted lines). This is approach is discussed in chapter 4.

Figure 2-1: Installed wind and solar capacities for EU28



Source: Own illustration based on (ENTSO-E; ENTSOG 2019)

The installed grid-connected solar capacities are much lower than in the TYNDP 2018 (-110 GW Distributed Generation and -180 GW Global Climate Ambition). If the plants used for PtG production are also included the Distributed Scenarios reach roughly the same level. It would have been expected that the additional efforts to achieve a 1.5° scenario would result in additional solar capacity and not in an equal level or even capacity reduction.

Compared to the last TYNDP, the wind capacities increase significantly, but in comparison to other scenarios the wind generation for the year 2040 is in the lower third (see Figure 2-2). The grid-connected wind capacities of the Global Ambition scenario are roughly at the level of national trends; a significant increase in capacity would have been expected for a 1.5° scenario. In line with the storyline, the grid-connected offshore capacities of the Distributed Energy Scenario are significantly lower. But if the plants for PtG use are considered, the offshore capacities are almost three times higher and even exceed the capacities of the Global Ambition scenario.

Figure 2-2: Projected Electricity Demand and Wind/Solar Generation for EU28

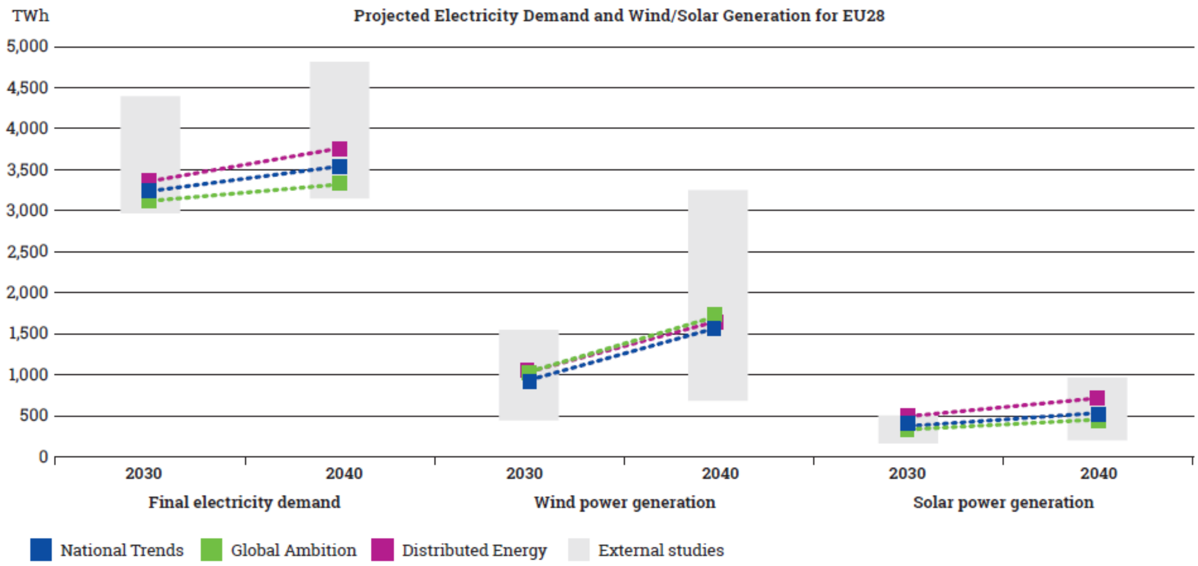


Figure 34: Benchmarking of projected electricity demand and wind/solar generation for EU28

Source: (ENTSO-E; ENTSOG 2019)

Since in the TYNDP modelling wind and solar plants are built mainly by market-driven investment decisions, the level of the CO_2 price is an important factor for their development. The CO_2 price is set model endogenous to reach the yearly carbon target. Depending on the scenario, they are between 27 and 53 €/t in 2030. In TYNDP 2018 the maximum CO2 price in 2030 was 84€/t, without aiming for a 1.5° scenario. In the scenarios of the EU long-term strategic vision, achieving climate neutrality, CO2 prices rise to a value of 350 EUR/t. That means that more ambitious yearly CO2 targets would result in higher CO2 prices and these in a stronger growth of wind and solar plants.

Additional questions:

- How would a stronger spatial distribution of renewables in Europe and the resulting reduced simultaneity affect their profitability and the likelihood of a "dunkelflaute"? (for further information see e.g. Grams et al. 2017)

3. Strong need to consider further decarbonisations strategies beyond blue or green gas as well as all GHG-Emissions of gases

Key messages:

- The use of domestic or imported gas in any form (Hydrogen, Methane, decarbonised gas based on CCS) should not already be predefined in the "Ambition Tool" and rather be in competition to other decarbonisation strategies such as electrification and further deployment of RES-E within Europe.
- It should be clearly stated how the electricity and gas demand is estimated by the ambition tool.
- Blue hydrogen is not a long-term decarbonisation strategy and should not play a major role in long-term scenarios.
- It seems likely that methane emissions from losses and leakages are not fully considered in the overall calculation of CO2-equivalents within the TYNDP.

Calculation of the gas and the electricity demand

The calculation of the gas and the electricity demand is part of the "Ambition Tool" and described in section 4.1 (step 1) and section 4.2 (step 2) of the *TYNDP 2020 Scenario Methodology Report*:

- The objective of step 1 is to estimate the fuel type specific demand and its CO_2-emissions for all sectors. The outcome of step 1 is the electricity, methane and hydrogen demand. Already in this step, the demand of electricity and gas is predefined by the considered technology mix of the target year (ENTSOG / ENTSO-E 2019, p. 32). Particularly for this part further documentation of the underlying assumptions is recommended.
- In step 2a the electricity demand is further specified into its primary energy demand (e.g. fossil fuels and renewables) and the corresponding CO_2-emissions.
- In step 2b the methane and hydrogen demand are further specified into different gas sources and the corresponding CO_2-emissions. The decarbonisation target can be reached *"[…] by the increasing share of renewable gases or the application of pre- or post-combustive CCS"* (ENTSOG / ENTSO-E 2019, p. 37).

As a result of this procedure,

- the electricity demand is relatively low compared to other studies (it is only in the lower half of the scenario range as can be seen in Figure 2-2 as well as for the amount of heat pumps as an indicator for the electrification of heat supply which is shown in figure of 11 of (ENTSO-E; ENTSOG 2019, p. 22)) and
- the gas demand is above the 1,5°C scenarios from the EC long term strategies and other ambitious scenarios (ENTSO-E; ENTSOG 2019, p. 42) and
- renewable gases and CCS are the main decarbonisation strategies.

It seems likely that there is no direct competition between additional electrification and additional wind and solar power on the one hand side and renewable gases and CCS and the other side. The final capacities of wind and solar power are calculated later on within the Power Sector Modelling part (see also section 2) and therefore after the decision on the kind of decarbonisation strategies.

It should be clearly stated how the electricity and gas demand is estimated by the ambition tool. At this point we would suggest differentiating fuel type specific demands for the two scenarios. This would make a broader range of scenarios possible, that would result in different infrastructure needs.

Blue hydrogen and CCS are not a long-term decarbonisation option

Blue hydrogen based on CCS and fossil natural gas cannot be a long-term option to decarbonise the European energy system because it is based on restricted resources (gas and storage for CO_2). Also, this option should not be a major decarbonisation strategy within the TYNDP as technology development, costs and acceptance are very uncertain. The focus should be on green gas (based on RES-E) for sectors that do not have the possibility to decarbonise any further by reducing demand or using RES-E directly.

Consideration of all greenhouse gas emissions from the energetic use of methane, especially from losses and leakages

Methane emissions occur during the production and processing of natural gas, biogas or synthetic gas, during gas transport and storage as well as during the final combustion process. Especially for gas fired engines, the combustion process is linked with relevant methane emissions of about 1% to 3% of methane input depending on technical specification of the engine and its maintenance (Prognos 2019, pp. 51–53).

For methane emissions a global warming potential of 28 (GWP_{100} defined as CO_2-equivalents related to CO_2) should be used according to the Fifth Assessment Report of the IPCC (IPCC 2013, p. 713). It is not clear, if this actual factor is used or the former factor with an GWP_{100} of 21 from the Kyoto Protocol.

In the *TYNDP 2020 Scenario Methodology Report* the calculation of greenhouse gas emissions is described in section 4.2.3 (ENTSOG / ENTSO-E 2019, p. 37):

- “The CO_2 emissions in the energy sector are calculated multiplying the primary energy demand per fuel with the fuel-specific CO_2 emissions factor (in g/kWh).”
- “For non-CO_2 emissions and LULUCF, the Ambition Tool refers to country-specific values given by EC’s EU Reference Scenario 2016. On an EU28 level, the EC-study “Clean Planet for all” has been taken as a reference.”

Based on this wording, it seems likely that methane emissions losses and leakages as described above are not fully considered in the overall calculation of CO_2-equivalents.

Additional questions:

- It should be checked whether a higher consideration of flexibility in the electricity sector could reduce the need of gas back up.

4. How to implement Power to Gas in the modelling

Key messages:

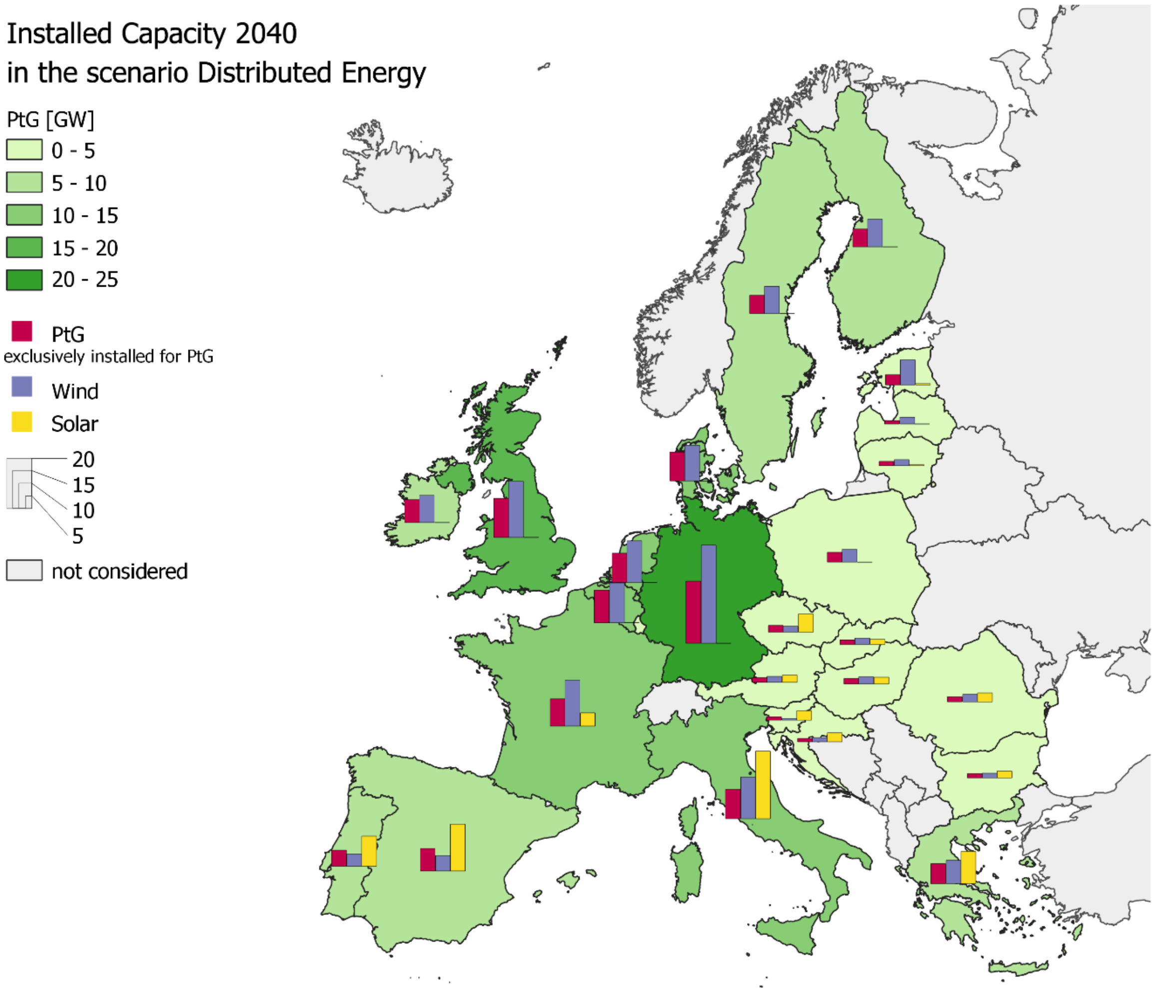
- Exclusive RES-E capacities for Power to Gas plants lead to high losses of renewable electricity
- In the communication of the scenarios, it must be clearly stated that the direct connection of RES-E is not a general proposal but was chosen due to modelling difficulties. The modelling approach urgently needs to be revised so that a market-integrated implementation is possible.
- The use of curtailed RES-E should be modelled in competition to other options of using this energy.

Direct connection of RES-E with PtG-Plants

Direct connection to RES-E source is in line with RED II. However, it is questionable if segregating RES-E sources and PtG from the electricity grid is the way to go: This pathway does not use the effect of geographical balancing of variable RES-E feed-in and therefore might increase total amount of RES-E.

We question, why overall capacities for RES-E dedicated to PtG production exceed the capacity for P2G (see Figure 4-1). This assumption increases full load hours for P2G but also increases curtailment of RES-E generation. We question if this model can be economically feasible?

Figure 4-1: Installed Power-to-Gas and dedicated RES-E plants



Source: Own illustration based on (ENTSO-E; ENTSOG 2019)

Use of curtailed RES-E sources

Power to gas plants can also use curtailed RES-E in the TYNDP Modelling. However, what are the assumptions of other flexible electricity demands to strive for those curtailed amounts? Options like demand side management especially within the large industries as well as Power to heat and flexible demand for electric mobility should be considered in scenarios that attempt a highly efficient and low-cost energy system of the future. Using curtailed RES-E for power to gas would then be in strong competition with those other options.

5. A combined view on biomass and LULUCF is necessary

Key messages:

- As there is a direct dependency between the level of sinks and the potential bio-energy use, it is not acceptable to take these assumptions independently from each other from different literature sources.
- The assumptions for (sustainable) bioenergy use are significantly too high.

We see major inconsistencies in the construction of the TYNDP Scenarios regarding the potential of biomass and the expected sink from LULUCF. The assumptions taken by the authors ignore the close interlinkages between these two aspects. Biomass sourcing is associated with emissions in the land use sector. Therefore, scenarios that rely on biomass use for emission reduction in other sectors need to take implications for emissions and removals in the LULUCF sector into account.

The authors state that they expect LULUCF removals to amount 390 Mt CO2 per year until 2050. The figure is derived "from the European Commission's most ambitious 1.5Tech and 1.5Life scenarios (average) as published in the "A Clean Planet for all"- Study" (ENTSO-E; ENTSOG 2019, p. 12). This is in two ways problematic.

- It is not good practice to take averages of two scenarios. Averages of scenarios do not make much sense because they ignore that there are consistent storylines and developments behind the scenarios.
- The two scenarios are also quite different regarding their treatment of the land use sector. The 1,5LIFE scenario assumes the LULUCF sink amounts 464 Mt CO2 per year, in the 1,5TECH scenario the sink is considerably smaller (317 Mt CO2 per year, EC 2018, p. 198, Table 9). This is because the 1,5LIFE has more afforestation and less energy plantations. Consequently, also the biomass use is different: 205 mtoe (2384 TWh) in the 1,5LIFE and 250 mtoe (2908TWh) in the 1,5TECH scenario. While the TYNDP requires a much higher biomass use of approx. 4000 TWh in the Distributed Energy Scenario.

It is unclear how the authors relate LULUCF sink and biomass supply and how they take impacts of biomass use into account. As there is a direct dependency between the level of sinks and the potential biomass use, it is not acceptable to take these assumptions independently from each other from different literature sources.

The study "GHG-neutral EU2050 – a scenario of an EU with net-zero greenhouse gas emissions and its implications" assumed that biomass available for energy purposes needs to be limited to waste and residual materials in 2050 to be able to increase the sink. Further, cultivation of energy crops and the import of biomass from non-EU countries were excluded. Bioenergy production amounts 1062 TWh in 2050, which corresponds to roughly two thirds of the gross consumption in 2015 of 1584 TWh. This allows a sink in the LULUCF sector of about 500 Mt CO2 in 2050, to a large degree achieved by new forests that are established on unused cropland and grassland.

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