Fact sheet #6/6: Contributions of resource efficiency towards 100% renewables

This fact sheet shows the potentials of resource efficiency to contribute to the global transformation towards renewable energy regarding reduced energy demand in the industry sector.

Using larger system dynamics simulation models (see fact sheet #1), we quantitatively analysed different scenarios of the global transition towards renewable energies (wind onshore/offshore, photovoltaics (PV), power-to-liquid/gas (P2L/G), biomass/hydro) and their dependency on raw materials availability as well as on the need for energy from all sectors including that associated with the use of raw materials. We also considered the substitution (based on P2L/G) of material use of fossil resources for the chemical industry.

The scenarios are running until 2100 to capture continued raw materials needs for repowering, but assuming no changes in energy demand between 2050 and 2100. We use data from the International World Energy Outlook (WEO) 2015[1] with its most sophisticated projection of moderate demand for energy in the future. In addition, we included the assumptions of the GreenEe Scenario[2] of the German Environment Agency's RESCUE study regarding further reduced energy demand.

For this fact sheet scenario 2 (figure 1, S2) assumes 15% less demand (sufficiency) by the year 2050, compared to a business-as-usual scenario (S1), and GreenEe's mix of renewables and its level of electrification of the sectors (transportation, industry, housing).

- Scenario 5 (figure 1, S3) assumes resource efficiency approaches based on the WEO 2015's material efficiency scenario (MES).
- Scenario 6 (figure 1, S6) adds another 15% of sufficiency to scenario 5, i.e. 30% less demand than S1.
- Scenario 7b (figure 1, S7b) assumes less electrification and more use of synthetic fuels instead.
- Scenario 8 (figure 1, S8) uses biotic resources for the substitution of parts of steel and concrete with an end-of-life energetic use. The potential for biotic resources is derived from a global LULUCF model from this project (see fact sheet #5).
- Scenario 9 (figure 1, S9) assumes twice the capacity for photovoltaics (see fact sheet #2).

Figure 1 shows the need for onshore wind power installations in North America as a proxy for global renewables since its proportion remains the same in all scenarios (only scenario 9 assumes more PV and less wind energy, see fact sheet#2) according to the future demand for energy. With raw material use accounting for more than 45% of total global GHG emissions (during extraction, processing, transportation, usage, recycling, disposal)[3] resource efficiency appears to be a relevant lever to support climate protection. Along these lines, our modelling results show that compared to a scenario with already foreseeable (according to WEO) resource efficiency efforts (scenario 2), the most sophisticated resource efficiency at the limit of what is currently technically feasible (based on a 'Material Efficiency Scenario (MES)' taken from the WEO 2015) would help reducing the need for renewable energy capacities by just about 2% (figure 1, scenario 5).

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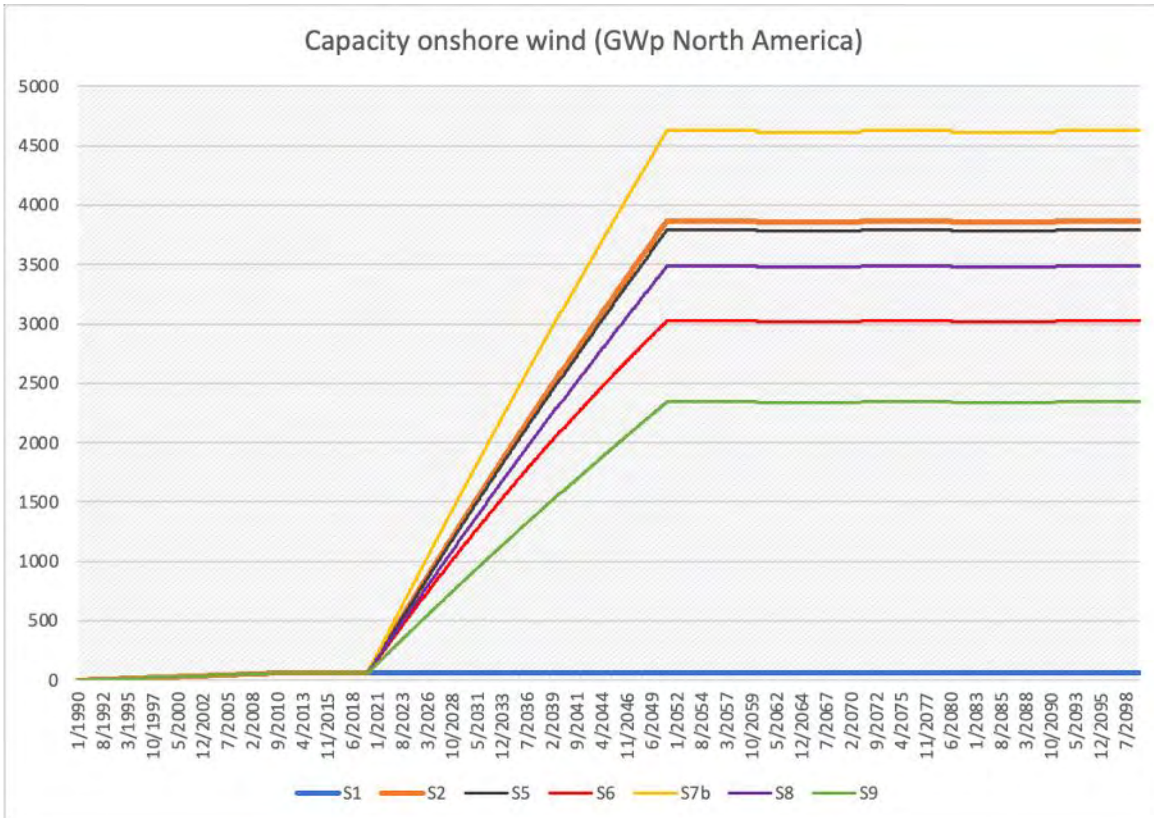
[1] https://www.iea.org/reports/world-energy-outlook-2015 by the International Energy Agency

[2] See https://www.umweltbundesamt.de/en/topics/climate-energy/climate-protection-energy-policy-in-germany/a-resource-efficient-greenhouse-gas-neutral-germany/rescue-scenarios-greenee1-greenee2.

[3] Ellen MacArthur Foundation (2019): Completing the Picture: How the Circular Economy Tackles Climate Change.; Accessed April 19, 2021

Fig. 1: Need for installations using North America's onshore wind capacities as a proxy



Source: Data from the ICARE Energy Model

These results show that resource efficiency is just one of many needed levers for climate protection. The reason is that as long as there is growth of the population and its material wealth with new infrastructures (the basic assumption behind the WEO data) a circular economy and efficiency measures like lightweight construction or waste reduction can only limit the need for new materials and the energy needed for mining and processing.

Therefore, as scenario 6 (figure 1, scenario 6) shows, sufficiency shows the biggest potentials to reduce the additional demand for energy infrastructure. This scenario also uses the full potential of the reinforcing feedback loop that less demand for energy causes less demand for renewables and their need for resources that cause the need for energy again.

Scenario 7b shows another aspect of (energy) efficiency assuming less direct use of electric energy and more conversion into P2L/G which requires more capacities for renewables and hence more raw materials.

To reduce the need for materials means to decrease the need for energy, to enhance the potentials for future generations, to mitigate price developments for the transformation towards renewables, and to thus reduce the environmental impacts associated with resource use. However, only an absolute reduction in material use seems to be truly sustainable in the long run.

Disclaimer: This paper was developed within the project „Erkennen und Bewerten der Wechselwirkungen von internationaler Klima- und Ressourcenschonungspolitik", FKZ 3718 31 101 0, for the German Environment Agency, coordinated by Dr. Martin Hirschnitz-Garbers from Ecologic Institute and modelling done by Kai Neumann from Consideo GmbH. The responsibility for the content of this publication lies with the authors and does not necessarily reflect the opinion or the policies of the German Environment Agency.