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Renewable energy future possible and preferable

A future where electricity comes mostly from low-carbon sources is not just sustainable in a materials context, but would also significantly reduce air pollution globally according to a new study.

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The study, published in the *Proceedings of the National Academy of Sciences (PNAS)*, involved an international research team led by Edgar Hertwich and Thomas Gibon from the Norwegian University of Science and Technology.

The team conducted what they say is the first-ever global comprehensive life cycle assessment of the long-term, wide-scale implementation of electricity generation from renewable resources.

'This is the first study that has assembled and scaled up the assessment of individual technologies to the whole world and assessed technology implementation to 2050, taking the environmental impacts of production into account,' Hertwich said.

The researchers did the study because so little is known about the environmental costs of a widespread global shift to renewable energy technologies such as wind and solar power, and what the effect of this shift might have on material requirements.

'Would the shift to low-carbon energy systems increase or decrease other types of pollution?' the researchers asked.

An important aspect of the integrated hybrid life cycle assessment model was that 'it allowed the integration of electricity produced by these prospective technologies back into the economic model,' Gibon said.

The researchers looked at concentrating solar power, photovoltaics, wind power, hydropower, and gas- and coal-fired power plants with carbon capture and storage. They also assumed that the efficiency of the production of important raw

materials, such as aluminium, copper, nickel, iron and steel, for example, would improve over time.

Two different energy scenarios developed by the International Energy Agency (IEA) were used to assess how renewable energy would perform.

The first of these was the baseline scenario, in which global electricity production is assumed to increase by 134 per cent between 2007 and 2050, and where fossil fuels maintain their high share in the electricity generation mix, accounting for two-thirds of the total. Under this scenario, coal-based generation is 149 per cent higher in 2050 than in 2007, accounting for 44 per cent of all power generation.

The other was the 'blue map' scenario, which assumes that electricity demand in 2050 is 13 per cent lower than in the baseline scenario because of increased energy efficiency, and that the power sector emits less pollutants from fossil fuels by reducing their use and adopting carbon capture and storage technologies, along with an increase in the use of renewable energies.

Low-carbon technologies can demand much more use of raw materials per unit of power generation than conventional fossil fuel plants, the researchers noted. For example, photovoltaic systems need 11–40 times more copper than fossil fuel production, while wind power plants need 6–14 times more iron than fossil fuel production.

The researchers characterised these material demands as 'manageable but not negligible.' For example, the amount of copper needed to build out photovoltaic systems by 2050 represents just 2 years of current copper production.

The demand for iron and steel would increase by a mere 10 per cent, while the demand for aluminium will decrease. The change will also decrease air pollution and reduce fossil fuel extraction.

The human health benefits are clear, Hertwich said. 'Pursuing climate mitigation will limit the human health impacts from air pollution, while continuing with business as usual will increase it,' he said.

Source: Norwegian University of Science and Technology

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