Industry must prepare now for a new world of green electricity

October 28 2021

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Industry must speed up investment in new technologies that allow manufacture of materials using renewable electricity if net zero emissions targets are to be met, research led by the University of Leeds warns.

The study cautions that national strategies for replacing fossil fuels with renewables need an integrated approach to energy use and material production—or risk industry being unable to use electricity produced from renewable sources.

Ensuring that no electricity is produced from fossil fuels by 2050 is essential for achieving net zero. However, its effect will be limited if industry cannot use this electricity. Steel manufacturing alone accounts for a tenth of all carbon dioxide (CO_2) emissions in industrialized countries but latest estimates suggest new technologies to manufacture steel using electricity will not become fully operational until at least 2040.

The next leading metal, aluminum, which provides significant weight and energy savings compared to steel when used in transport systems, is produced using electricity, and its manufacture currently accounts for 3% of all CO_2 emissions. Yet since 2000 two thirds of world production of aluminum has switched from countries such as the UK—which used nuclear power—to China and Persian Gulf countries, which mainly generate electricity from fossil fuels.

The lead author of the study, Dr. Alan Grainger, from the University of Leeds School of Geography, said: "Delays in replacing existing steel and aluminum manufacturing capacity represent a crucial 'lock in' constraint on achieving net zero.

"Humanity's overwhelming dependence on steel, which accounts for 94% of all metal production, and the size of new aluminum manufacturing capacity in China and the Persian Gulf, are a huge blockage that cannot be ignored. The UK Net Zero Strategy, published last week, recognizes this problem, but lacks detail on how to tackle it."

Governments should strengthen international carbon reporting standards

for energy- intensive industries, the paper says, so that total levels of CO_2 production during the manufacture and lifetime of materials can be measured more transparently in assessing progress towards national net zero targets. The carbon price also needs to rise to make it economically viable to introduce new manufacturing technologies with low CO_2 emissions.

Cutting CO_2 emissions is only half of the challenge. Dr. Grainger said: "To achieve net zero we need to remove as much as CO_2 as we put into the atmosphere. It's like those old greengrocers' scales—with carbon emissions on the one side and carbon removals on the other. We can take emissions out of the atmosphere by planting new forests and deploying carbon capture and storage technology."

Achieving net zero by 2050 would have been entirely feasible, Dr. Grainger said, if governments had followed a step-by-step afforestation plan set out by the Intergovernmental Panel on Climate Change in a 1990 study to which he contributed. As well as soaking up CO_2 from the atmosphere, forests provide wood products that can substitute for metals and petroleum-based plastics.

Instead, since then the rate of afforestation has declined, while CO_2 emissions have doubled. The slow rate of forest expansion is canceled out by continuing tropical deforestation, which is a major source of CO_2 emissions.

Therefore, while Dr. Grainger and his co-author, Professor George Smith, a former Professor of Materials at Oxford University, urge a new afforestation drive, this should be accompanied by stronger efforts under the UN Framework Convention on Climate Change to control tropical deforestation.

The delay in global forest expansion and the time needed to introduce

new manufacturing technologies with low CO_2 emissions, mean there will be much greater reliance on carbon capture and storage technology. This will be even more important in the UK, whose forests currently remove only 4% of national CO_2 emissions. The UK Net Zero Strategy acknowledges this, but only plans a modest initial expansion in carbon capture and storage capacity.

This peer-reviewed study is published in the journal *Current Opinion in Environmental Sustainability*, Volume 49 pages 164-189.

More information: The role of low carbon and high carbon materials in carbon neutrality science and carbon economics, *Current Opinion in Environmental Sustainability*, Volume 49 pages 164-189.

Provided by University of Leeds