



Five science-based tips for the EU's green transition





LOCOMOTION helps policymakers and civil society to identify the most effective routes to a sustainable, climate-neutral society.

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Locomotion policy briefing

Tip 1: No space for error

Challenge

One overlooked challenge associated with renewable energy is that its infrastructure is space hungry. Owing to the relatively low penetration of this technology, this has not proven problematic to date. However, as we move towards an energy system that relies heavily on renewable sources, this will become a major concern.

This challenge is less prevalent when it comes to wind power because the space occupied by wind turbines is vertical, they are often installed in relatively remote windy locations, and they can be fairly well combined with other land uses. For solar power, the challenges are significantly higher. Our [research indicates](#) that, in a scenario where 80% of electricity is extracted from the sun by 2050, solar installations would require as much as 5% of the total land mass of Japan and South Korea, and 2.8% of the European Union's total territory.

To give you an idea of the scale of this, an estimated [4% of EU land](#) is currently covered with manmade surfaces, such as cities, towns, villages and the roads and other infrastructure required to sustain them.

Managed incorrectly, this massive demand for land can lead to direct and indirect environmental repercussions. Potential direct impacts include the conversion of arable land and the fragmentation of ecosystems. Indirect effects include the relocation of activities displaced by solar installations to other areas,

such as forests and other biodiversity-rich areas.

Solution

The benefits of transitioning to solar power and other forms of renewable energy are enormous. To ensure that this transition proceeds sustainably requires us to tackle and mitigate the negative effects associated with these land requirements.

This can be achieved by placing solar energy infrastructure in places where it does not compete for land with agriculture, nature or human rights. This can be done by integrating installations into existing urban spaces or locating them on marginal land with negligible productive or natural value.

When placing solar installation on productive land is unavoidable, they should be integrated into the agricultural system instead of the current common practice of clearing the land.

Policy recommendations

- Conduct broad environmental impact assessments for individual solar installations and for national and European plans to roll out solar energy
- Put in place good monitoring and policy implementation tools to avoid the land use challenges associated with solar energy and other forms of "environmental problem shifting", [recommends the European Environment Agency \(EEA\)](#).





Tip 2: More renewables, less energy

Challenge

To help keep global warming below 1.5°C, the Intergovernmental Panel on Climate Change (IPCC) estimates that [70-85% of the world's electricity supply](#) will need to come from renewable sources by 2050. Likewise, the European Green deal aims to extract the bulk of the EU's electricity from renewable sources and to electrify much of its transport systems by the same deadline.

While these goals are noble, they present enormous challenges. We modelled what a large-scale switchover to renewables would entail and what ramifications it would have in a scenario of green growth, i.e. where the economy continues to expand but using renewable energy instead of fossil fuels.

Owing to the relatively low energy density of renewable sources and the initial large investments in infrastructure required, we estimated that the [Energy Return on Investment \(EROI\) would fall to precipitously low levels](#). EROI is the ratio of useable energy generated compared with the energy required to extract it. In our current fossil fuel-based society, the EROI is about 12:1. In a scenario of green growth, extracting 75% of our energy from renewable sources would cause the EROI to drop to around 9:1 in 2050 and to below 6:1 by 2060. The near 100% required by the IPCC's high-end forecast would lead the EROI to fall further, to around 4:1 by 2050, about 3:1 by 2055 and around 5:1 by 2060.

Such low EROIs would require a significant overcapacity of energy production of around 35% to deliver the required net energy. This would in turn boost demand for the minerals needed to construct this renewable energy infrastructure. The mining of these minerals can cause

enormous environmental damage but also social impacts for the affected communities, in the form of toxic pollution, destruction of nature and loss of biodiversity. Moreover, we estimate that a large-scale transition could lead to shortages of certain raw materials – such as tellurium, indium, tin, silver and gallium – and strain the supplies of others, including lithium, manganese, lead and copper.

Solution

Continuing to exploit fossil fuels over the coming decades is not an option, both for environmental, supply reasons and social reasons. This means that the switch to renewables is an urgent necessity. However, the low EROI of renewables under green growth threatens our economies with system collapse, not to mention the potentially devastating environmental impact of mineral extraction.

This implies that though renewables are the solution, green growth is not. In order to transition to renewables and safeguard our future sustainability, the world will need to abandon its commitment to growth and focus on sufficiency coupled with social justice.

Policy recommendations

- Reduce the demand for raw minerals by improving recycling rates and enhancing end-of-life material recovery
- Conduct environmental impact assessments for minerals required for renewable infrastructure
- Promote circular economy principles in the renewable energy sector
- Policies to boost energy and resource efficiency
- Reduce overall energy demand by encouraging sufficiency.

Tip 3: Navigating the future of electric vehicles

Challenge

Transportation releases a quarter of the EU's greenhouse gas emissions. In order to meet its climate neutrality targets, the European Green Deal aims to slash transport-related emissions by a massive [90% by 2050](#).

A major pillar of the EU's strategy is to transition to so-called clean vehicles. The European Commission estimates that there will be 13 million zero- and low-emission vehicles on Europe's roads by 2025 alone.

However, simply replacing current vehicles with electric ones is unsustainable, especially when scaled up globally, according to our research. Our [simulation shows](#) that the scenario with a high concentration of electric vehicles ('EV-high'), which bets on wide-scale electrification but does not change our current mobility patterns, only manages to reduce by 15% the greenhouse gas emissions from transport by 2050, a far cry from the 90% target.

A second, more ambitious scenario is 'E-bike'. These models a radical change in mobility where cars are largely removed in favour of electric motorcycles (60%), electric bicycles (20%) and non-motorised modes (8%), with only 12% of private vehicles being electric four-wheelers. This results in a reduction in emissions of 30% by 2050.

Another problem, like with renewables above, is mineral resources. Manufacturing batteries for all these electric vehicles would run down reserves of copper, lithium, nickel and manganese in existing mines.

Solution

In order to achieve an 80% reduction in global transport emissions requires a scenario which involves, in addition to the measures outlined in 'E-bike', a drastic reduction in demand for transport (especially air transport), combined with a reduction in world economic activity of 23% lower than present.

This requires not only much less flying but also that tomorrow's society are propelled mainly by bicycles and trams, not cars, and that haulage and long-distance travel should be mostly done on the railways.

Policy recommendations

- Introduce an EU-wide ban of short-haul flights
- Impose a kerosene tax on flying
- Policies to promote widespread teleworking even after the pandemic
- Making inner-city areas car-free zones
- Investing heavily in public transport and car-sharing





Tip 4: Avoiding the inequalities of green growth

Challenge

Despite its focus on environmental sustainability and tackling the climate and biodiversity crises, the European Green Deal is centred around economic growth. “The European Green Deal is our new growth strategy – for a growth that gives back more than it takes away,” European Commission President Ursula von der Leyen said at the launch of the strategy.

Green growth relates to energy policies and incentives for innovations that foster labour productivity and energy efficiency. Advocates of green growth say that it will not only tackle the climate crisis but that it will also create jobs and lead to fair and equitable income distributions. However, on its own, it appears that green growth accentuates inequalities. This was the startling finding of [one of our studies](#).

The green growth scenario, which combines the shift to renewable energy with market incentives for innovation and energy efficiency, found that reduced emissions were accompanied by an increase in unemployment and inequality. Moreover, the environmental performance of green growth only occurred in a situation where it failed to boost GDP growth. If it were to increase economic growth, this would lead to higher emissions.

Solution

Our simulation explored two alternative scenarios to green growth. The first integrated policies aimed at promoting social equity, such as a job guarantee programme and a reduction of five hours to the working week. This scenario not only reduced emissions significantly, it also improved income distribution and employment levels.

The second alternative scenario focused on economic contraction founded on the principles of sufficiency, efficiency and solidarity. It modelled a voluntary reduction in private consumption combined with a wealth tax on top of all the policies implemented in the social equity scenario. This alternative was the most effective at reducing greenhouse gas emissions while boosting employment and lowering inequalities.

Policy recommendations

- Expand and enlarge the EU's Just Transition Mechanism (JTM) to truly ensure that nobody is left behind by incorporating the gender and other dimensions of exclusion and marginalisation.
- Introduce innovative redistributive policies such as universal basic income, shorter working weeks, job sharing, job guarantee schemes.

Tip 5: Remove carbon removals

Challenge

The proposed European Climate Law seeks to reduce carbon emissions by 55% by 2030 compared with levels in 1990. While this is better than the original target of 40% and higher than the United States, it is still much less than the 65% scientists estimate is required to keep global warming to below 1.5°C.

The challenge is compounded by the controversial issue of carbon removal, which are counted towards so-called net emissions. Recently, the European Parliament and Council [agreed to limit](#) the removal of carbon through land use change and forestry to 225 million tonnes of CO₂ equivalents.

Nevertheless, carbon capture and storage (CCS) remains part of the European Commission 2030 [climate and energy policy framework](#). CCS relies on capturing CO₂ from ambient air or from streams of pollution directly as it is emitted and storing it underground.

CCS technologies are still in their infancy and are often expensive to upscale from experimental projects or unproven at larger scales. The exorbitant costs associated with the technology are not only because it is new but also because the energy required to capture and store the

emitted carbon is immense. This reduces the technology's energy return on investment (EROI). For example, in a conventional coal-fired power station, the EROI is a high 14.7. However, in an equivalent plant using carbon capture and storage, the EROI plummets to just 4.6, [according to our modelling](#).

Solution

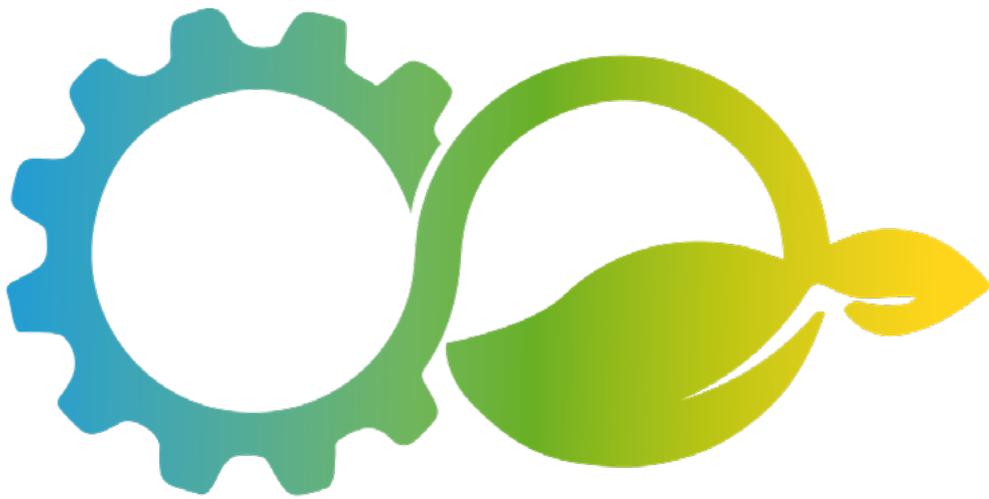
Carbon removal needs to be pursued as secondary and complementary to, not substitute for, emissions reductions. In addition, the limitations and uncertainties associated with carbon removal must be fully factored into our climate actions.

The absolute priority remains for all sectors of the economy to radically and rapidly reduce their emissions to as close as zero as possible.

Policy recommendations

- The EU's at least 55% target should be solely dedicated to emissions reductions.
- Carbon removals should be a separate goal and be over and above this bare minimum.
- Scrap net targets and replace them with absolute targets to ensure that we navigate a truly sustainable path.





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