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The renewable energy transition can reduce economic disparities in Europe

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The European Green Deal hinges on the decarbonisation of the energy system: More than 80% of total greenhouse gas emissions are caused by the energy system. The transformation from fossil energy to renewable energy brings deep structural changes for the economy. European regions will be affected differently – but more cohesion could be the result.

Europe's ambitious pursuit of climate neutrality hinges on the energy transition. By 2030, the goal is to elevate the share of renewable energy in the overall energy supply to a minimum of 42.5%, with a trajectory aiming for 100% by 2050, as outlined in the RePowerEU initiative (European Commission 2022) and the European Green Deal (European Commission, 2019, 2020). The imperative is clear: a substantial reduction in fossil-based energy coupled with a substantial expansion of renewable energy production.

This seismic shift towards renewable energy not only necessitates an overhaul of the energy system but also heralds a transformative era for the European economy. Established economic sectors, such as petroleum engineering, face inevitable threats, while the renewable energy industry, such as wind

turbine manufacturing, holds the promise of additional value creation and job opportunities. Moreover, the ripple effects extend across the entire economy, given that energy underpins virtually every economic activity. Consequently, the renewable energy transition stands poised to reshape the European economy fundamentally.

All this brings new economic opportunities and challenges for regional economies in Europe. The extent of impact on regions depends intricately on individual energy systems and economic structures. Regardless, the energy transition is set to redefine the current landscape of economic prosperity in Europe, introducing imbalances and disparities on the journey to carbon neutrality (European Commission 2022; Bertelsmann Stiftung 2022; Többen et al. 2023; Sasse and Trutnevyte 2023).

In our new study, "Energizing EU Cohesion" (Bertelsmann Stiftung 2023), we delve into these economic dynamics through a forecast exercise, offering robust empirical evidence. The study meticulously calculates the effects on value added and employment for European NUTS-2 regions, emphasizing territorial distribution. The findings, both surprising and impactful, underscore a notable trend: lagging rural regions show potential for catching up, while economically advanced, often urban, regions grapple with maintaining their existing levels of prosperity.

To counter negative effects on the EU's aim of harmonious economic development, European cohesion policy must extend its reach to encompass the challenges faced by regions currently not on policymakers' agenda, let alone radar. Supporting these regions in their efforts is not only important for European cohesion but also critical to guaranteeing support for the European Green Deal. Cohesion policy must therefore leverage synergies with energy policy and broaden its scope to make the renewable energy transition beneficial for all European regions.

European Green Deal and REPowerEU

The *Green Deal* is Europe's response to climate change and environmental degradation. By 2050, Europe wants to be the first continent with

- no net emissions of greenhouse gases by 2050
- economic growth decoupled from resource use
- no person and no place left behind

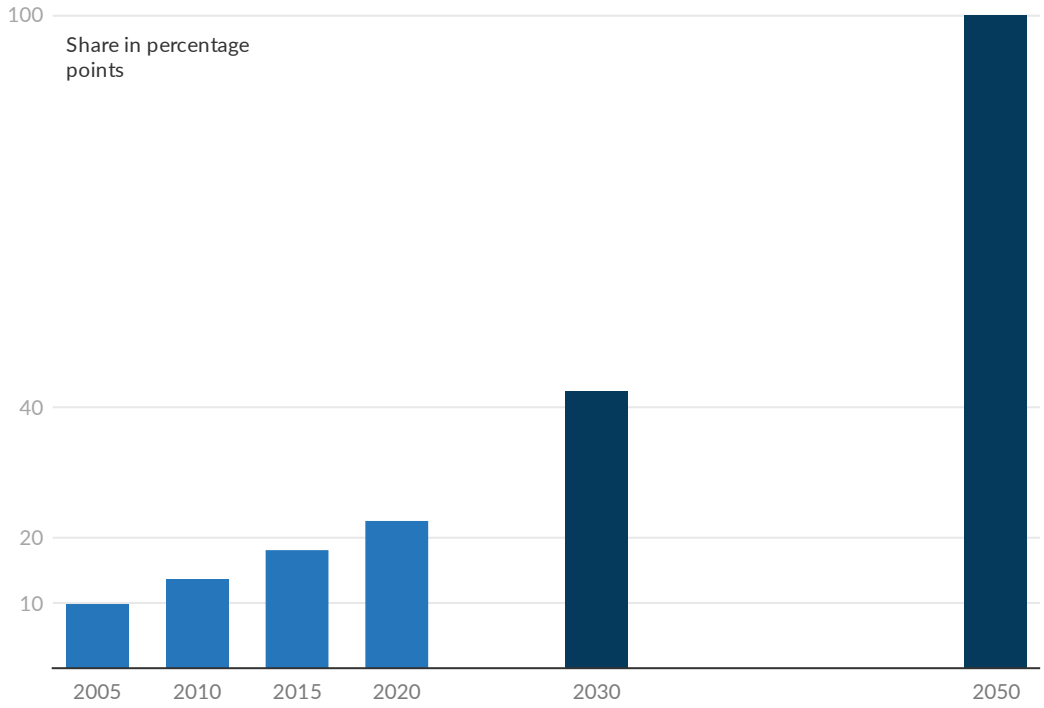
Several policy measures operationalize the Green Deal's goal. Most prominently, *Fit for 55* outlines focusses on reducing greenhouse gas emissions by at least 55% by 2030.

REPowerEU is a plan to reduce the dependency of Russian fossil fuel set up shortly after the start of the Russian invasion in Ukraine. It steps up the ambition of the Green Deal in the energy transition with a doubling of renewable energy supply from 22.1% in 2020 to at least 42.5% – preferably 45% – in 2030.

Where we stand with energy

Since 2005, Europe has made significant strides in transitioning to renewable energy, with the share of renewables in the energy mix more than doubling from 10% to 22.1% in 2020 (see Figure 1). Despite this progress, achieving climate-neutrality by 2050 requires a substantial increase to nearly 100%,

Figure 1: Renewable energy consumption more than doubled between 2005 and 2020 – but a further doubling by 2030 and quadrupling by 2050 is necessary



translating to a more than quadrupling of the current share. The interim target set by RePowerEU aims for a renewable energy contribution of at least 42.5%, preferably 45%, by 2030, representing a doubling compared to 2020. This underscores the urgent need for a rapid acceleration in renewable energy production.

Existing policy plans and initiatives fall short. Without further action, carbon neutrality by 2050 is at risk, with greenhouse gas emissions projected to reduce only by 60% (European Commission 2019, 2021; IPCC 2023). The EU Reference Scenario's sophisticated model-based results highlight key challenges, indicating that the renewable energy share in space heating may only increase to 40%, in the transport sector to 57%, and in the power sector to 75% instead of the desired 100% (European Commission 2021).

Closing the gap between current political ambitions and the necessary actions is imperative. Achieving the targets requires substantial additional annual investments, estimated at about € 260 billion (European Commission 2019, 2020). While this poses a significant cost, the longer-term benefits of the energy transition are projected to outweigh the damages caused by climate change (Gillingham 2019; Flaute et al. 2022). Aligning political ambition of the Green Deal and RePowerEU with actionable measures is not only essential for meeting climate goals but is also economically prudent in the face of the long-term consequences of climate change.

How to transform the energy sector

The transformation of the energy sector revolves around four pivotal levers, each already in motion but requiring full activation:

Phasing out Fossil Fuels: A critical shift involves eliminating all fossil fuel-based energy in electricity generation, space heating, and

private transportation. This necessitates reduced usage of coal, refined petroleum, and gas, consequently impacting activities related to exploration, refining, and distribution of fossil-based products.

Expanding Renewable Energy Production: While progress has been made, a substantial push is needed to achieve full decarbonization through increased use of renewables, reduced demand, and enhanced energy efficiency (European Commission 2019; IPCC 2023). The expansion in renewable energy production propels economic activities in the production, distribution, installation, and maintenance of wind turbines, solar panels, hydro-power technology, and similar assets.

Investment in Renewable Technology, Storage, and Transmission: Addressing the geographic disparity between fossil and renewable sources requires new infrastructure, connecting regions with abundant, cost-effective energy to high-demand centres (IEA 2023).

Energy Price Changes: The shift to renewable energy systems will influence electricity prices, offset in part by lower costs for carbon emissions. The net impact on prices hinges on the cost reduction of renewable energy technologies, transmission, storage, and EU carbon pricing policy. These changes ripple through the entire economy.

The spatial distribution of a renewable energy-centric system contrasts with the current fossil-dominated one. Consequently, structural economic changes will be spatially dispersed, and the positive effects of renewable energy expansion in one region may spill over to neighbours, fostering economic interdependence. Conversely, negative spillover effects may occur when economic activity loss in one region impacts others.

This transition is anticipated to stimulate employment across the renewable energy value chain, from manufacturing to installation, operation, and maintenance. However, jobs in the carbon-intensive energy sector will decline, particularly affecting regions heavily reliant on the coal industry (Alves Dias et al. 2018; European Commission 2022).

How regional starting points differ

It is a well-known fact that regional economic disparities are stark in Europe. Western and Northern European regions boasting the highest GDP per capita, while Central-Eastern and Southern regions lag behind (see Figure 2). All over Europe, urban and metropolitan areas outshine their rural counterparts in prosperity.

Meeting the targets outlined in the European Green Deal necessitates decarbonization across all regions by 2050. Some regions face a more extended journey to climate neutrality than others (see Figure 3). High carbon intensity is prevalent in numerous Central and Eastern European regions, as well as parts of Southern Europe. Regions in Czechia, Poland, and Greece exhibit the highest carbon intensity, requiring comprehensive changes in their energy systems. Conversely, many regions in France, Italy, Germany, and Scandinavia already demonstrate low carbon intensity. Notably, less developed regions, constituting 17% of the EU's GDP, contribute disproportionately to fossil-based emissions, accounting for 27%. Yet, these regions face challenges in funding the transition to renewable energy from their own resources.

The potential for transitioning to renewables, considering factors like available space, sunlight hours, wind volumes, and water supply, varies across regions (see Figure 4). Regions in the core of Europe face lower potential, whereas many peripheral regions display high potential. Notably, onshore wind potential (with 45% of total potential the most important renewable energy source) reaches its peak in Germany, France, and Sweden, while offshore wind potential is highest along the North and Baltic Sea coastlines. Regions in Spain, France, Italy, and Greece exhibit strong potential for solar panels, with some German, Polish, and Romanian regions also very suitable. Mountainous areas in Sweden, Austria, and France show substantial hydropower potential. In general, urban areas exhibit significant potential in rooftop solar panels, while rural regions offer numerous suitable locations.

Taken together, lagging regions exhibit high carbon intensity implying substantial challenges for transforming their economies. At the same time, they face higher potential than their more developed counterparts. It is therefore unclear whether the chances of fresh economic opportunities balance out the challenges of decarbonisation in regions.

How the renewable energy transition reshapes EU cohesion

Our study employs an innovative MRIO model framework to quantify the far-reaching effects of a comprehensive energy transition aligned with the European Green Deal. This framework takes into account region-specific economic structures, inter-regional value chains, and anticipated developments in the energy sector.

Figure 2: GDP per capita in European regions (2019, in purchasing power standards)

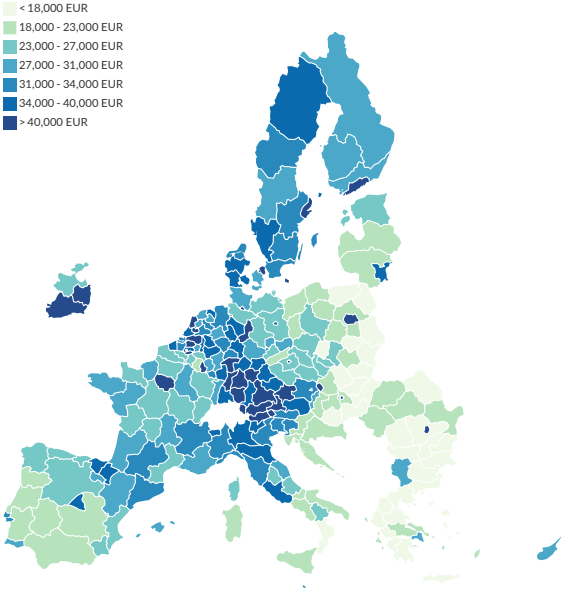


Figure 3: Economically strongest regions in Europe with lowest CO2 emissions

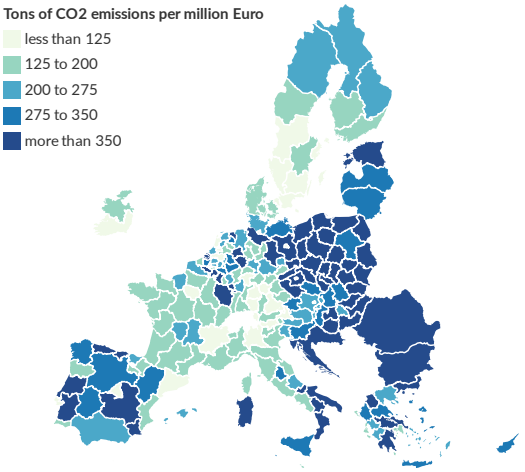
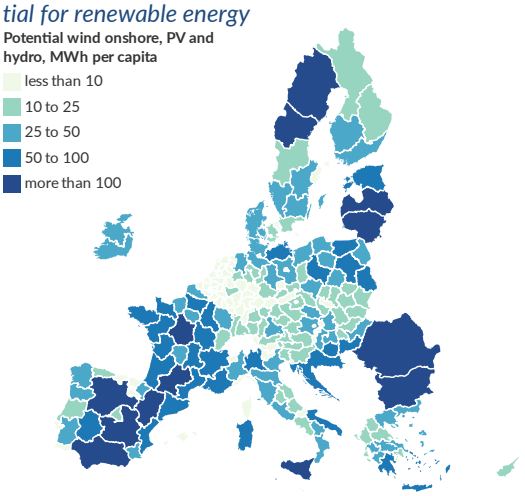


Figure 4: Economically lagging regions with highest potential for renewable energy



MRIO model framework

The MRIO (Multi-Regional Input-Output) model framework represents an innovative methodology designed to quantify the potential effects on value added and employment across EU regions arising from the renewable energy transition. This framework meticulously maps value chains within and between European regions, extending to interactions with non-EU countries.

For instance, it allows us to dissect the intricate connections between regions, such as how output from the electronic sector in Noord-Holland (NL) — like microchips — serves as intermediate products (input) for the chemicals sector in Rheinhessen-Pfalz (DE), perhaps for a digitized chemicals production plant. If the renewable energy transition triggers reduced demand in the chemical sector, our framework captures the subsequent changes in both regions, including indirect effects.

Additionally, it factors in shifts in energy costs and consumer responses, providing a comprehensive understanding of the cumulative changes in value added and employment across EU regions induced by the energy transition. This approach ensures a nuanced analysis of the intricate web of economic interdependencies affected by the transition to renewable energy.

We find for economic activities directly impacted by the energy transition (mining, electricity, gas, and the manufacture of coke and refined petroleum products) a 35% reduction in value added in the decarbonization scenario by 2050. In contrast, renewable energy-related industries, such as solar and wind technologies, display increases between 16 and 40% in value added and employment intensities.

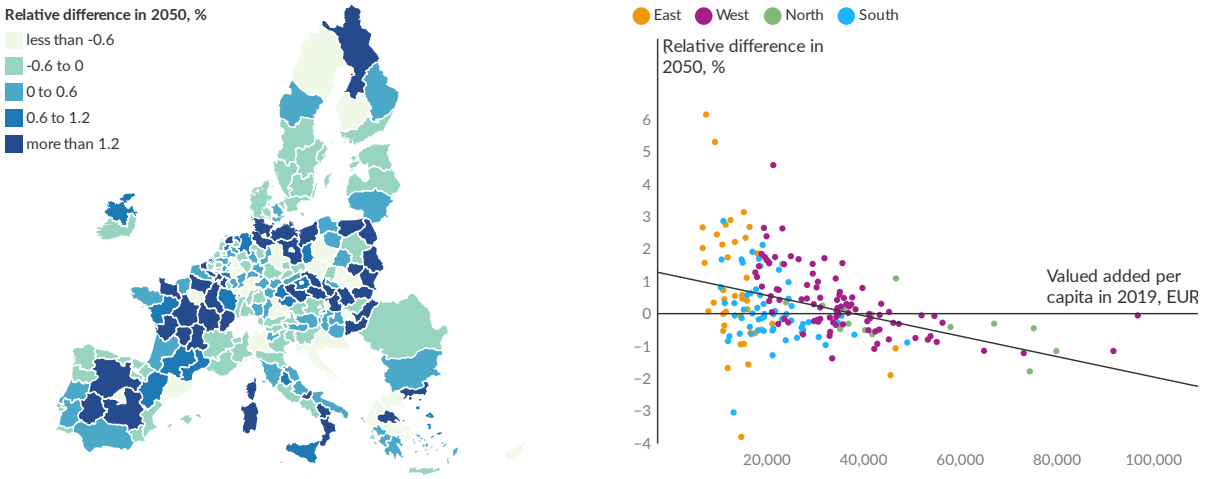
Industries indirectly affected by the energy transition, particularly high-tech manufacturing and knowledge-intensive service sectors, see substantial benefits across regions. Interestingly, the gains for these industries are bigger in rural regions.

For regional economies as a whole, we find that lagging regions will catch up in economic prosperity and employment (see Figure 5). By 2050, the energy transition alone boosts value added by up to 6.2% and employment by up to 4.9%. In contrast, we find for more developed regions reductions in value added of up to -3.8% and in employment by up to -2.1%.

The results underscore that regions with higher initial economic performance are more likely to be negatively affected, while rural regions experience the strongest positive effects. Rural regions can not only compensate the negative effects caused by phasing out fossil energy, but also gain in exploiting their rich renewable energy potential. In contrast, urban regions with limited potential for renewables are more likely to experience adverse effects.

Overall, 109 out of 213 (51%) assessed regions exhibit show better economic prosperity. The average change in all regions in value added per capita is 10 EUR and in employment 0.3%. This brings greater convergence across regions with a reduction in territorial inequality of about 1% – a remarkable outcome in the pursuit of a sustainable and cohesive future. However, this has the flaw that some more developed regions may have to deal with reduced economic prosperity.

Figure 5: Lagging regions to catch up in economic prosperity in the renewable energy transition



Implications for Cohesion Policy

The shift from fossil energy to renewable sources as required by the European Green Deal marks a pivotal and seismic economic transformation. Navigating this evolution is paramount for European policymakers, demanding a meticulous approach to prevent any detriment to European cohesion and ensuring no part of the continent is left behind.

Empowering Less Developed Regions: For less developed regions, many of them rural ones, the expansion of renewable energies serves as a potent catalyst for economic advancement. Realizing their full potential necessitates facilitating knowledge exchange, providing technical support, and crucially, tangible investments. By capitalizing on synergies between renewable energy policies and strategic cohesion fund utilization, investments can be scaled up, fostering simultaneous progress in both energy and cohesion policies. The essence of cohesion policy lies in channelling funds into regions with the greatest needs, while concurrently ensuring that value added remains in these regions. Concepts like Energy Communities can significantly contribute to this objective, benefiting local stakeholders.

Proactive Management for Urban Regions: More developed urban regions are confronted with unforeseen challenges requiring proactive management. The risk of compromising economic prosperity poses a potential threat to their support for the renewable energy transition. Preserving their current level of prosperity is not only crucial for overall upward convergence but also for sustaining backing for the renewable energy transition. In this context, an expanded scope of cohesion policy, coupled with suitable policy instruments, emerges as a pivotal player. While these regions possess adequate funds, the lack of technical potential for renewable energy production necessitates collaborative initiatives. Partnerships between less developed rural regions with high technical potential and energy-hungry urban regions can result in win-win scenarios for all stakeholders. Initiatives like Interreg's under-utilized Renewable Energy Partnerships showcase urban regions benefiting from fossil-fuel-free energy, and rural regions gaining much-needed investment certainty.

Cohesion Policy as a Key Player: Cohesion policy assumes a central role in the renewable energy transition. While the success of

the European Green Deal hinges on decarbonization, securing citizens' support for the accompanying economic upheaval is equally dependent on fulfilling the core objective of European cohesion. Failure to align these parallel objectives poses a risk to the ultimate goal: forging a fairer and greener Europe.

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