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Renewables Pull

Opportunities and Risks for Coal Regions



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Renewables Pull – Opportunities and Risks

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IKI JET and its JET-CR Platform aim to support and accelerate just energy transitions away from coal to renewable energies and other sustainable economic activities in Colombia, Chile, South Africa, Indonesia, Vietnam, Thailand, and Mongolia.

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1.0 Introduction

Historically, energy-intensive industries have mainly settled in regions with the availability of large amounts of cheap energy. In the past, this was mainly hydropower or fossil fuels. Prominent examples are Pittsburgh in the USA, Sheffield and Manchester in England, or the Ruhr area in Germany, all of which have attracted steel and other heavy industries due to their proximity to large coal mining regions. (South Korea is one of the few interesting examples of a country with a globally competitive heavy industry, with neither significant domestic coal or mineral resources).

In the future, renewable energy—mainly solar and wind—is expected to provide the largest share of the global energy supply. So, the question is: Will energy-intensive industries in the future move to places where renewable energy can be provided at the lowest cost? Many factors influence private companies' investment decisions. But for energy-intensive industries, the availability of cheap energy is certainly a key factor - which we call “renewables pull” (see below).

Renewables Pull: Expert Insights on Advancing a Just Energy Transition

This Policy Brief was written in the context of and informed by an expert exchange entitled "Renewables Pull for a Just Energy Transition", which took place as an online session in February 2025. The expert exchange was organised by the Wuppertal Institute as part of the research project "Innovation Regions for a Just Energy Transition". The project is led by GIZ and co-funded by the International Climate Initiative of the German Federal Ministry of Economics and Technology (BMWK) and the European Union. The expert exchange brought together five global experts from scientific institutes and international organisations to discuss the potential future relevance of the renewables pull effect and its impact on different countries. More details on the expert exchange, including the speakers and their key messages, can be found here: [Renewables Pull for a Just Energy Transition](#).

For coal regions, this process of potential relocation of certain industries can be both an additional challenge in the energy transition but also an opportunity:

- For those coal regions which today are home to energy-intensive industries like steel, cement or chemical industries - they face the risk that in addition to coal mine closures

and all the economic challenges related to this, additionally heavy industries may leave the region.

- On the other hand, many coal regions are located in areas with high wind and solar potential. They may become green energy hubs. Either for domestic electricity production or even to keep or attract new climate-neutral energy-intensive industries.

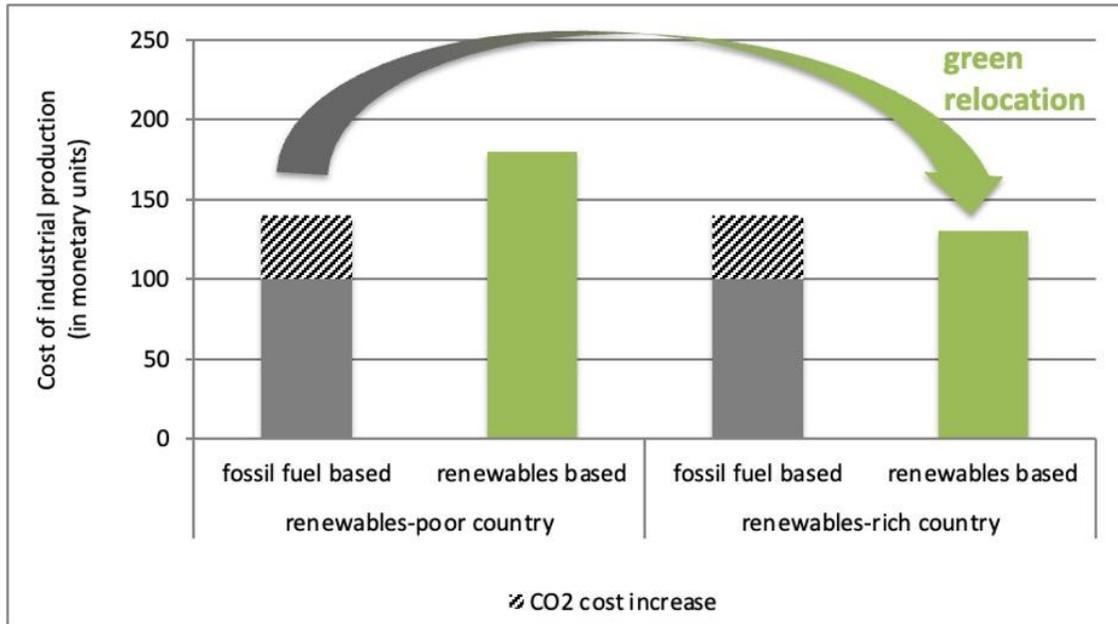
Both opportunities and risks not only depend on the specific conditions of any particular region, but also on national and regional energy, industry, and climate policy decisions as well as on global trends and investment decisions. Against this background, this short policy paper aims to provide a first orientation of what is at stake and how a coal region can realistically assess its opportunities in the global race for the best production sites of a new green industry.

2.0 What is the renewables pull effect?

The renewables pull effect refers to the hypothesis that countries or regions with abundant renewable energy sources and relatively low (marginal) costs of producing electricity or hydrogen from renewable energy sources will become increasingly attractive locations for energy-intensive industries. When this renewables pull effect leads to companies investing in industrial production facilities in locations with relatively high renewable energy costs, the term "green relocation" is used.

An important trigger for the renewables pulls effect can be tightened climate policy in the form of an increase in CO₂ prices. The following figure shows the renewables pull effect and green relocation in a simplified two-country model. In this model, the cost of fossil fuels is assumed to be the same in both countries. In the initial situation, industrial production based on fossil fuels is assumed to be cheaper in both countries than the same production based on renewable energy sources. In such a situation, the introduction or increase of a CO₂ price can provide an incentive to relocate industrial production from the country with relatively poor renewable energy conditions to the country with relatively good renewable energy conditions. This can be the case if the increase in the cost of CO₂ causes the cost of industrial production based on fossil fuels to exceed the cost of production based on renewable energy sources in the country with good renewable energy conditions.

Figure 1. Schematic representation of the renewables pull effect due to rising costs of fossil fuel use



Source: Author's diagram.

Several researchers (e.g. Samadi et al. 2023, Verpoort et al. 2024) have pointed out that the renewables pull effect is likely to become more relevant in the coming years and decades, as CO₂ prices are expected to increase in countries around the world and the costs of renewable energy technologies are expected to continue to fall. The renewables pull effect is expected to be particularly relevant for goods that are energy-intensive and relatively easy to transport over long distances. Examples of such commodities are ammonia (see e.g. Egerer et al. 2023, Xiang et al. 2025) and direct reduced iron used for steel production (see e.g. Bilici et al. 2024, Devlin et al. 2023).

3.0 Assessing opportunities and risks

For decision-makers in coal regions, it is important to assess the opportunities and risks related to the potential renewables pull effect as soon as possible and then develop a tailored strategy for the future economic development of the specific regions. Such an economic transformation strategy depends on the specific regional characteristics and cannot be generalised. The following checklist, however, can help in the development of a region-specific strategy.

3.1 Assess the renewable energy potential

A critical first step for coal regions is to assess their renewable energy potential relative to other world regions in terms of volume and cost. Starting points can be existing data on solar and wind potential by world region:

- Global Solar Atlas (<https://globalsolaratlas.info/map>)
- Global Wind Atlas (<https://globalwindatlas.info/en/>)

For more detailed information about a region's renewable energy potential, specific assessments in the form of studies considering local weather data, the availability of land, and other factors may become necessary.

Depending on the results of this assessment of a region's renewable energy potentials, coal regions may choose one of the following strategies

- Regions with internationally competitive renewable electricity costs and sufficient production potential can aim to attract green energy-intensive industries that rely on cheap, abundant renewable electricity (or on green hydrogen produced from this electricity).
- Regions that do not have internationally competitive renewable electricity costs but have lower costs than neighbouring regions, may become producers and exporters of green electricity or green hydrogen.
- If regions have neither internationally nor regionally competitive green electricity generation costs, they may have to face the hard truth that in the long term, their energy-intensive industries may not be competitive - unless other factors are dominant (e.g. existing infrastructure and skills, availability of finance or access to other natural resources - see sections below). They should seriously consider diversifying their economy away from energy-intensive sectors, including toward the service sector.

3.2 Other available resources: water, biomass and minerals

Coal regions looking for new economic opportunities in the future should also take into consideration the resources - beyond renewables - that are available in their respective regions or in close proximity. The availability of local resources plays a crucial role in determining which energy-intensive industries (if any) are best suited for making new investments in a coal region transitioning to a green economy. How resource availability can shape industrial strategies is explained in the following using three products that are expected to play an important role in global trade in a climate-neutral future world: green iron, green ammonia, and green methanol.

- For green ammonia production, **water availability** is a critical factor, as water is essential for green hydrogen production through electrolysis. Regions with not only exceptional renewable energy conditions but also abundant water resources are better positioned to support green ammonia projects than regions affected by water scarcity.
- In contrast, green methanol production requires not only green hydrogen but also **biogenic carbon**, which can be scarce in areas with high renewable energy potential. Specifically, solar-rich regions are often arid regions with little biomass potential. In contrast, biomass-rich regions in the tropics do not have the best solar potential (in a global comparison). This may explain why, when looking at project announcements, the renewables pull effect appears to be more pronounced for green ammonia than for green methanol, where the availability of biogenic carbon becomes a limiting factor.
- For green iron production, regions that have **iron ore** reserves or are near such reserves have a unique advantage. Coal regions with exceptional renewable energy potential and iron ore reserves have the opportunity to become future hubs for green iron production, particularly through hydrogen-based direct reduction processes. Similarly, other key **minerals** can become attractive factors for green industries, like nickel for battery production.

3.3 Assess potentials of existing infrastructure and knowledge base

Another key factor is existing industrial infrastructure and expertise. This includes not only physical infrastructure, such as railways, ports, power grid access and manufacturing facilities, but also intangible assets like know-how among the workforce, established links between companies, and special knowledge within companies of industrial processes and technologies. For regions aiming to export green industrial products, such as green iron, ammonia, or methanol, existing rail and port infrastructure is a critical advantage. Coal regions with well-developed transport networks can leverage this infrastructure to integrate into global supply chains. This existing infrastructure can form the backbone of future business models in green energy-intensive industries. Equally important are the industries already operating in coal regions today, particularly those connected to coal mining. Even if a particular coal region does not have internationally competitive green electricity costs, these industries possess valuable expertise in technology, processes, and market dynamics. Especially in combination with strong available infrastructure, these companies can potentially remain viable by collaborating with other regions or global "sweet spots" to import energy-intensive intermediate products, such as green iron, ammonia, and methanol, and focus on downstream processing. This approach may allow coal regions to maintain their industrial base and economic relevance, even in the absence of abundant renewable energy resources.

3.4 Secure finance

Renewable energy and green industries are capital-intensive, making access to finance a critical factor. Coal regions with cheap and abundant renewable energy potential may face difficulties of turning their geographic assets into a competitive advantage if high interest rates make renewable electricity production too expensive. Coal regions therefore need to explore public and private financing options, including grants, loans, and public-private partnerships. International climate finance and green investment funds can also bridge funding gaps. However, finance constraints often are beyond what regional decision-makers can influence. National or international support schemes are often needed. In the process of a regional industrial strategy development, a realistic assessment of finance options is therefore key.

In addition, an international approach to financing is essential, ensuring that coal regions in the Global South with strong renewable energy potential are not overlooked in the global race for green investments.

4.0 Early strategy development of key importance

To harvest the opportunities and mitigate the risks of the renewables pull effect, coal regions must assess their unique situation early on and come up with a tailor-made regional economic strategy. The transition process is extremely long-term, as the timelines of key factors span decades rather than years.

- Lifetimes of key technologies in the energy-intensive industries are very long. E.g. the average lifetime of a blast furnace for iron production is around 50 years, that of steam crackers or cement kilns is even longer. Wrong decisions can lead to lock-in effects and stranded assets.
- Equally, transport infrastructure (rail, roads, ports) often requires massive capital investments and remains in use for many decades.
- Also, skill development is a long-term process. While retraining workers may be done within a few years, setting up broad-scale education (vocational and university) and creating a strong regional knowledge base suited for future green industries is not possible overnight.

There are many examples of regions that are actively tackling their economic transition process. It is better to start developing a future strategy „while you are ahead “, meaning while the old

industry is still economically viable, and generating income that the region can use to invest in the future. As soon as the decline has started, it becomes increasingly difficult to find the funds and resources necessary to actively sharpen the transition process. Two inspiring examples of early strategy development to diversify the economies of coal regions are:

- East Kalimantan in Indonesia, where in 2024 a regional stakeholder consultation forum was set up to advise the regional government on its economic diversification strategy (International Institute for Sustainable Development, 2024).
- The Rhenish Lignite Mining Region in Germany—As a neighbour to the Ruhr area, Germany’s largest hard coal mining region, local decision-makers were aware of how difficult a decline in the coal industry could become economically. So, they set up a regional economic diversification agency well before the decline in coal use started. One of the key tasks of this agency today is to support the local energy-intensive industries in their efforts to decarbonise and stay competitive globally (Directorate-General for Energy, 2020).

From these and many other examples, it becomes clear that it is not only up to industry to make the right investment choices, but various stakeholders in a region need to get together and align their activities. Regional governments often play a key role in facilitating this process and shaping the conditions (i.e. infrastructure and education) to enable a sound economic development in coal regions.¹

¹ For more on how regional decision makers can strategically support the transition process in coal regions see: <https://www.coaltransitions-toolbox.org/>

5.0 Conclusions

The renewables pull effect poses both risks and opportunities for coal regions around the world. Depending on the specific circumstances and preconditions of a coal region, either the risks or the opportunities of this effect may be more pronounced. We suggest that coal regions proactively explore whether they have the potential to attract green industrial production in the future.

Coal regions with exceptional renewable energy conditions are best positioned to benefit from the renewables pull effect, especially when they also have additional resources such as sufficient fresh water, biomass or mineral deposits. Furthermore, if these regions already are industrial regions today, this is an additional advantage, as this means that know-how and skilled labour is available locally and that transport and energy infrastructure is in place that can typically also be used - at least to some extent - for the green industrial production of the future. Coal regions with such favourable conditions should explore which type of green industrial production is most promising for their specific circumstances.

However, not all coal regions around the world have internationally competitive renewable energy production costs. Some coal regions without such competitive costs may still be able to benefit from the transformation of the energy system if they have above-average renewable energy conditions relative to nearby regions. In this case they may become green electricity or perhaps even green hydrogen exporters to industrial hubs and cities with high energy demand in their country.

Other coal regions may not have sufficiently good renewable energy potentials to be able to export green electricity or green hydrogen in the future. If these regions currently have strong energy-intensive industries, they should be aware that it will likely be difficult to hold on to these industries in the future, as sooner or later there will be growing pressure to reduce and eventually eliminate industrial CO₂ emissions. These regions need to assess early on whether it may be possible to maintain future competitiveness of at least some of these industries by importing energy-intensive intermediate goods from other regions of the world while maintaining the (less energy-intensive) downstream production steps. Regions with future energy cost disadvantages should intensively look for economic opportunities beyond energy production and energy-intensive industrial production and consider a broad approach in diversifying their respective economies.

For all coal regions, proactive planning and strategic decision-making will be key to turning the opportunities into tangible outcomes and dealing with the risks associated with the renewables pull effect, ensuring a just and sustainable energy transition for coal-dependent communities. Many actions have very long lead times - investments into energy intensive industry technologies, development of local infrastructure (like rail, road and ports), and educating the

young generation to build the skills for a green economy - thus acting early and planning with a long-term time horizon is key. Obviously, preparing for such long-term developments has to be done under high uncertainties. So, thinking of alternative options and likely scenarios - and not only in one fixed roadmap - is needed. Furthermore, addressing the complexity of renewable energy potential, finance options, available resources and existing industry and infrastructure as well as other very specific local framework conditions, calls for an approach which brings in the expertise and views of many experts and stakeholders and helps to align decision making even beyond the timeline of usual legislative periods.

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