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Article

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A 100 percent renewable energy system in Europe is technically possible and economically rational

By Claudia Kemfert

ABSTRACT

- To achieve climate targets, efforts need to be made in Europe to improve energy efficiency and to expand renewable energies
- Conditions for investing in renewable energies in Europe must be improved, subsidies for fossil and nuclear energy reduced
- A 100 percent renewable energy system is technically possible and economically worthwhile

The participating states in the Paris Agreement have committed to reducing greenhouse gas emissions by up to 90 percent by 2050 in order to limit the increase in global warming to well below two degrees Celsius. Beyond individual member states' nationally defined climate change targets, the EU wants to push ahead in transforming the European energy system.¹ The "EU Clean Energy Package" sets the conditions and defines the goals of this transformation, with the objective of creating more competition for the most innovative technologies and the fastest implementation.² This should help the EU achieve market leadership in the field of climate-friendly technologies. In addition to energy efficiency, emission reduction, and research and innovation, the EU's objectives also include supply security, reduced import dependence, and a fully integrated internal energy market.

The EU has set a binding target of 20 percent final energy consumption from renewable sources by 2020. Seventeen percent of the target has already been reached, mainly thanks to the Scandinavian countries and some Eastern European countries (Figure). Eleven countries already meet the EU expansion targets for renewable energies, which require an increase in the use of renewables in electricity and thermal energy production as well as in the mobility sector. In 2017, 85 percent of all newly built electricity generation capacity came from renewable energies, above all wind energy. However, five countries are likely to miss the expansion targets completely, including Germany,³ France, England, Belgium, and the Netherlands.

This 20 percent target is only a first step. A 100 percent renewable energy system should be the end goal, as it is the only way to ensure supply security, that the climate protection goals can be met, and that fossil energy imports can be completely avoided. Modeling of electricity and energy systems shows that this is feasible, including both earlier

¹ Cf. Christian von Hirschhausen et al., "European Electricity Generation Post-2020: Renewable Energy Not To Be Underestimated," *DIW Economic Bulletin*, no. 9 (2013) (available online, accessed March 12, 2019). This applies to all other online sources in this report unless stated otherwise; as well as Jochen Diekmann, "Erneuerbare Energien in Europa: Ambitionierte Ziele jetzt konsequent verfolgen," *DIW Wochenbericht*, no. 45 (2009) (in German; available online).

² Cf. EU Commission, *Clean Energy for all Europeans* (available online).

³ Bundesregierung, *Klimaschutzplan 2050* (2016) (in German; available online).

work by the German Advisory Council on the Environment (*Sachverständigenrat für Umweltfragen, SRU*)⁴ as well as more recent, more detailed work.⁵ In terms of costs, renewable energies are much more affordable than conventional energies⁶ and model results show that transitioning to a 100 percent renewable energy system is economically rational.⁷ These studies also confirm this transition is not only currently technically feasible, but can also strengthen the economy and create innovations and technological advantages.⁸ Generating more energy via renewables reduces costs, especially for wind power and solar photovoltaics, and lower storage costs promote competitiveness. Were the EU to link the electricity, heating, and transport sectors (known as sector coupling) and to better integrate different regions on the continent by implementing uniform expansion targets and optimizing the EU internal market, costs would sink even further.

Positive investment conditions are important for transitioning to 100 percent renewable energy; this requires that the expansion is not capped or obstructed and that financing conditions are facilitated. In addition, all member states must consistently reduce subsidies for fossil energies and, above all, must not grant new subsidies for nuclear or fossil energies. Due to their often weather-dependent fluctuations and flexibilities, renewable energies must be well interlinked (a fine opportunity for utilizing intelligent technology); for this and for the use of storage, it is necessary to improve market conditions by removing existing barriers and enabling more flexibility. Only so will Europe be able to increase its economic and climate benefits through innovation and competitive advantage.

⁴ Sachverständigenrat für Umweltfragen, *100 Prozent erneuerbare Stromversorgung bis 2050: klimaverträglich, sicher, bezahlbar* (2010) (in German); Martin Faulstich et al. (2011), "Wege zur 100 Prozent erneuerbaren Stromversorgung," *Sondergutachten des Sachverständigenrates für Umweltfragen (SRU)*, Berlin (in German).

⁵ Michael Child et al., "Flexible electricity generation, grid exchange and storage for the transition to a 100 Prozent renewable energy system in Europe," *Renewable Energy* 139 (2019): 80–101 (available online).

⁶ Cf. von Hirschhausen, "European Electricity Generation Post-2020."

⁷ Wolf-Peter Schill et al., "Die Energiewende wird nicht an Stromspeichern scheitern," *DIW aktuell* 11 (2018) (in German; available online).

⁸ Karlo Hainsch et al., "Emission Pathways Towards a Low-Carbon Energy System for Europe: A Model-Based Analysis of Decarbonization Scenarios," *DIW Discussion Paper 1745* (available online) as well as Thorsten Burandt, Konstantin Löffler, Karlo Hainsch (2018), "GENeSYS-MOD v2.0—Enhancing the Global Energy System Model: Model Improvements, Framework Changes, and European Data Set," *DIW Data Documentation 94* (available online).

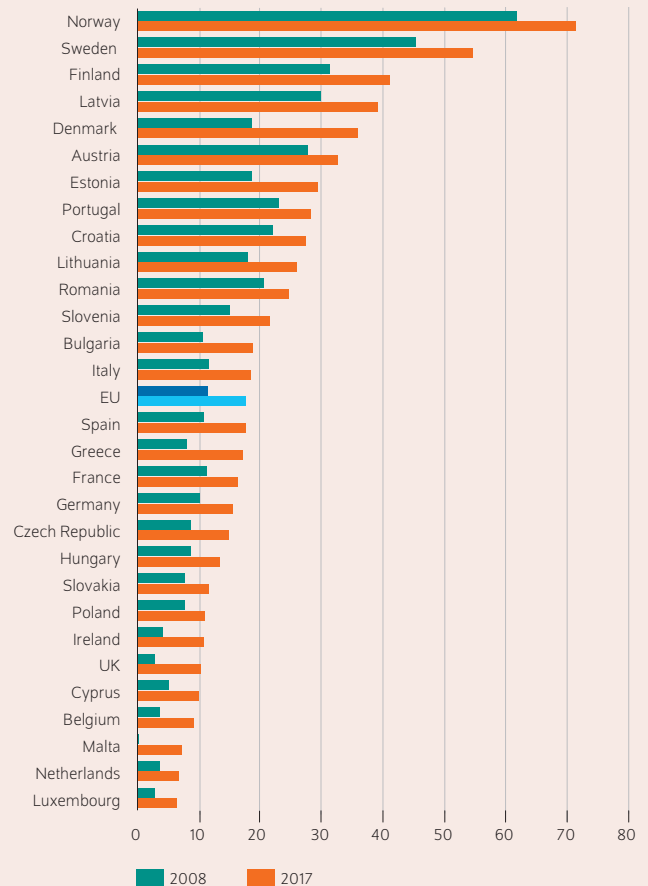
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JEL: Q13, Q42, O1

Keywords: Energy Transition, 100 % Renewable Energy, Climate policy, Europe

Figure

Share of renewable energies in the EU countries and Norway
In percent



Source: Eurostat.

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Northern European countries are far ahead of the rest of Europe in terms of renewable energy.

European framework conditions for a more climate-friendly industry

By Karsten Neuhoff, Jörn Richstein, and Vera Zipperer

ABSTRACT

- Basic materials industries such as steel and cement manufacturing generate around 25 percent of worldwide carbon emissions
- The European Union Emissions Trading Scheme (EU-ETS) could play an important role in reinforcing innovation and investment in climate-friendly technologies
- Generous exemptions under the EU-ETS rule for globally traded basic materials weaken the effect
- A climate deposit in the form of a charge for using basic materials is one possible solution to restore the incentives. The proceeds could be redistributed among all citizens

On the way to climate-friendly, low-emission industrial production, the basic materials industry has the greatest need for emission reductions. The production of steel, cement, and other basic materials generates around 25 percent of worldwide carbon emissions.¹ The European Commission's sector-specific roadmaps² and other studies³ have shown that 80 to 95 percent of those emissions could be reduced. However, this will not be achievable by simply improving the efficiency of the existing production processes. Instead, it will take measures such as conversion to climate-friendly production processes of basic materials, increased efficiency of material usage, switching to alternative materials, and improvements in recycling.⁴ A strong and clear regulatory framework is necessary for manufacturers and users of basic materials to convert to these climate-friendly options. For the following three reasons, the EU-ETS can take up an important steering function in this process.

First, the European market is large enough to be relevant for globally active companies. Second, nowadays, the European Union has more credibility in many areas when it comes to effective climate protection laws than individual member states, as shown by the Ecodesign Directive⁵ or the European Renewable Energy Directive. This is important for long-term corporate decisions on innovation and investment. The credible announcement that carbon-intensive options have no longer-term perspective further enhances companies' dedication to climate-friendly approaches. Third, uniform regulations prevent competitive distortion within the EU.

Experience with the EU-ETS since its implementation in 2005 has shown that basic materials manufacturers only pass through part of the price of carbon certificates along

¹ Own calculations based on the International Energy Agency's Energy Technology Perspectives (2017) (available online, accessed on April 8, 2019; this applies to all other online sources in this report unless stated otherwise).

² European Commission, A roadmap for moving to a competitive low carbon economy in 2050 (2011) (available online).

³ Boston Consulting Group and Prognos, Climate Paths for Germany (2018) (available online); and Deutsche Energieagentur (Dena), Integrated Energy Transition study (2018) (available online).

⁴ Climate Strategies, Filling Gaps in the Policy Package to Decarbonise Production and Use of Materials (2018) (available online).

⁵ European Parliament and Council of the European Union, "Council Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (recast)," *Official Journal of the European Union* L 153/1 (2010) (available online).

the value chain, since they are facing competition from the global market. Due to fear that basic materials manufacturers will shift their production to foreign locations because of additional environmental costs in Europe (carbon leakage risk) these manufacturers receive free emission allowances. This leads to a further reduction in the pass through rate of carbon prices along the value chain.⁶ Without prices being passed through, however, there is little to no incentive for the basic materials producers to use less carbon-intensive production processes or to replace them with alternatives that are more environmentally friendly. At the same time, end customers are not contributing to additional costs, undermining the economic perspective for large-scale use of climate-friendly production processes and thus incentives for innovation.

To tackle this problem, the EU-ETS should be supplemented by a climate deposit⁷ on the use of carbon-intensive basic materials. This refers to a charge paid by the consumers of industrial products, based on the benchmark level of carbon intensity of the basic materials contained in the products.

A combination of two reforms would make it possible to implement a charge like this. First, the allocation of free emission certificates to industrial companies should be tied to the company's current production volume instead of the historical volume. This would mean that companies would only have to purchase emission certificates for emissions exceeding the emission benchmark level. Companies that emit less than the benchmark would benefit from the option to sell their excess certificates.

Second, the climate deposit would be charged for the use of basic materials. The deposit would be equivalent to the value of the certificates per ton of basic materials that are allocated for free as part of the EU-ETS. For example, if two certificates (at 30 euros each) were allocated per ton of steel (efficiency benchmark), and one ton of steel is processed to make one car, the climate deposit for the car would be 60 euros. Unlike under today's EU-ETS regulation, the deposit would be added to the price of the end product, providing an incentive for the downstream industry to use carbon-intensive basic materials more efficiently or replace them with climate-friendly alternatives. As is the case with other consumption charges, the climate deposit would be applied to imported basic materials and products, while exports would be excluded. This prevents competitive distortions and carbon leakage. Designing the deposit as a consumption charge would also ensure compliance with World Trade Organization rules and reduce administrative complexity.

Part of the proceeds could finance climate protection measures, while most of them could be used to reimburse all citizens on a simple per capita basis—hence the name climate “deposit.” The climate deposit would have a progressive component, since poorer households that use fewer basic materials on average would pay less climate deposit than wealthier households but would receive the same amount of reimbursement.

Supplementing the EU-ETS with a climate deposit would restore the intended steering effect towards more climate-friendly investments along the entire value chain. At the same time, the scheme would provide robust long-term protection against carbon leakage. This mechanism can and should be taken up as part of the EU Emissions Trading Directive to strengthen the environmental effectiveness.⁸

⁸ Roland Ismer and Manuel Haußner, "Inclusion of Consumption into the EU ETS: The Legal Basis under European Union Law," *Review of European, Comparative & International Environmental Law*, 25 (2016): 69–80.

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⁶ One-time free allocation of certificates would not negatively affect the carbon price transfer. The effect arises since 1) the future allocation of certificates is tied to the current production level and 2) new plants also receive free certificates, making investment more attractive, boosting supply in the market, and causing it to fall based on the equilibrium price.

⁷ Karsten Neuhoff et al., "Inclusion of Consumption of carbon intensive materials in emissions trading—An option for carbon pricing post-2020", Report of project convened by Research Network Climate Strategies, available with technical reports (available online).

Europe must work together to alleviate migratory pressure from Africa

By Lukas Menkhoff and Tobias Stöhr

ABSTRACT

- Improved living conditions in Africa would lessen migratory pressure on Europe
- The scope of Germany's "Marshall Plan with Africa" is too narrow; progress can only be made if Europe works together
- A financial system that reaches as many people as possible could be one key to future development in Africa

Migratory pressure on Europe from Africa will not diminish in the future, but rather continue to rise. Africa's population is growing rapidly (by around 32 million people per year), often lives in politically and economically unstable conditions, and is significantly less prosperous than the population in Europe. As a result, it is likely that the number of individuals considering migrating to Europe will increase rather than decrease. Consequently, Europe has a threefold interest in stable economic development in Africa: to limit migration in the medium term, to combat often staggering poverty, and to benefit more from economic exchanges with a growing neighboring continent.

The difficulty of achieving these objectives has been recognized and various development-oriented policy packages have been proposed, such as the German Federal Ministry for Economic Cooperation and Development's "Marshall Plan with Africa" and the G20 countries' "Compact with Africa."¹ What is to be expected of these proposals, and to what extent can they promote economic development and actually slow migration?

The G20 Compact aims at promoting private investment and is thus restricted to only one important aspect of development. In contrast, the German "Marshall Plan" is broader in scope, encompassing three main objectives: employment, stability, and the rule of law. It also recommends measures for achieving these objectives which can be implemented in Germany, in Africa, and at the international level. If the program could be broadly implemented, it would create fantastic medium- and long-term conditions for development. However, this is not expected.

Currently, there are around 1.3 billion Africans living in 55 countries on a continent three times the size of Europe. By 2050, the population will double. In total, German (bilateral) development cooperation with Africa amounts to around three billion euros per year,² significantly less than the volume of economic assistance provided by the original

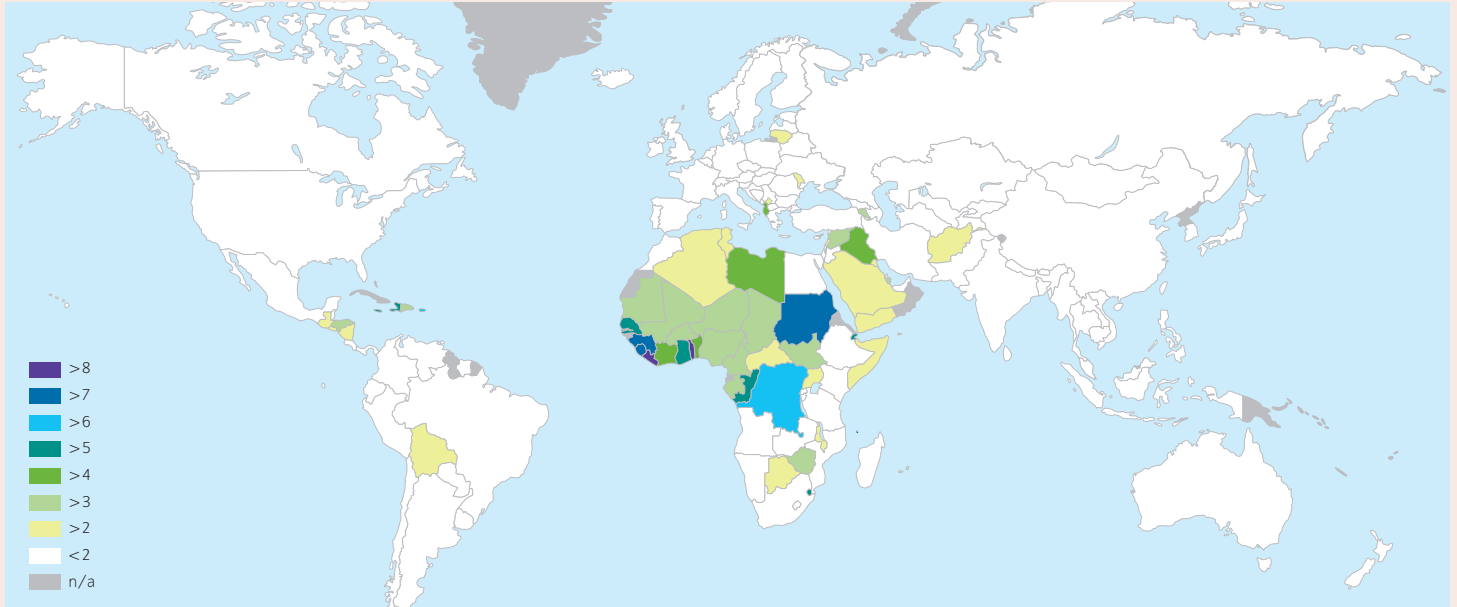
¹ Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, *Afrika und Europa—Neue Partnerschaft für Entwicklung, Frieden und Zukunft; Eckpunkte für einen Marshallplan mit Afrika* (2017) (in German). Information on Compact with Africa available at www.compactwithafrica.org.

² Cf. the OECD website (accessed March 4, 2019). This applies to all other online sources in this report unless stated otherwise).

Figure

Share of the adult population planning to emigrate in the next twelve months

In percent, most recent available year in each case (2015–2017)



Source: Gallup World Poll; authors' own calculations.

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Africa has the highest migratory pressure worldwide.

Marshall Plan.³ Based on the amount of aid alone, the claim that Germany could significantly advance Africa's economic development on its own is rather presumptuous.

Due to the limited nature of these funds, the German government will only work with countries that hold promise in terms of progress towards all three objectives. These relationships are known as "reform partnerships." Working exclusively with these countries is a good idea in the sense that the objectives can act as complements, i.e., reaching one goal can ease progress towards the others. For example, achieving stability and rule of law, for example, are important for fostering economic growth and employment. However, so far neither the committed personnel nor the finances are sufficient for this. Crisis states, such as failed states or countries on the brink of civil war, are neglected, although an increasing number of migrants could come to Europe in the future from precisely these countries. Since there are hardly any legal migration channels for these individuals, many who are not personally facing persecution will try their luck as refugees.

More could be done if the EU countries were to join forces. Although the EU's total expenditure is roughly on par with

that of China,⁴ so far there has been no binding, coordinated European development effort between the member states nor any initiative to work together to combat the root causes of emigration from Africa. Joint European cooperation is also complicated by the fact that EU countries have different political interests in Africa and very different attitudes towards different forms of migration, in particular legal labor migration and receiving asylum seekers.

What can development cooperation do to further develop African countries and limit emigration? In the short term, even doubling the current development aid would only marginally reduce the annual emigration rate.⁵ The aim must be to achieve medium and long-term effects by increasing economic growth and creating positive effects on living conditions downstream.

Individuals living in poor and unstable countries have the greatest interest in migrating, but many are too poor to afford to emigrate to Europe (Figure). While the poorest do migrate in larger numbers when they have unexpected disposable income, the likelihood of emigration decreases as soon as

³ At today's value, the "Marshall Plan" provided over 130 billion dollars in aid to 16 OECD countries over a four-year period.

⁴ Between 2010 and 2014, China spent the equivalent of a good ten billion euros annually, five billion of which was official development aid plus 5.6 billion euros in other financial services. Cf. Axel Dreher et al., "Aid, China, and Growth: Evidence from a New Global Development Finance Dataset." AidData Working Paper 46, 2017 (available online).

⁵ The annual emigration rate could be reduced by ten to 15 percent, cf. Mauro Lanati and Rainer Thiele, "The impact of foreign aid on migration revisited," *World Development* 111 (2018): 59–75.

their income is higher in the medium or long-term.⁶ That is why the three main objectives in the German “Marshall Plan” are so important: growth must be strengthened in addition to resilience and the social environment; strengthening these latter two factors increases the rule of law and lowers corruption.⁷

A part of these main objectives is the “inclusive financial system,” a building block of the German “Marshall Plan”. For example, modern mobile phone-based payment systems in Africa offer financial access to many more people than was previously possible with conventional branch offices. In many countries, financial literacy is also being promoted in order to make meaningful use of these new services. This encourages saving behavior, financial planning, and small businesses’ investments.⁸ However, there needs to be less

corruption and stable rule of law for these growth drivers to develop. For this reason alone, the EU should work together with states which are not repressive and autocratic.

Effectively fighting the flow of migration can mean focusing on medium and long-term effects rather than attempting to reduce irregular migration in the short term. The complex factors involved in slowing migration should also be clearly communicated to the European population. However, neither growth, financial inclusion, nor any other objective will be successfully implemented in Africa to a greater extent if the EU does not work together.

6 Samuel Bazzi, “Welt Heterogeneity and the Income Elasticity of Migration,” *American Economic Journal: Applied Economics* 9, no. 2 (2017): 219–255; Christian Dustmann and Anna Okatenko, “Out-migration, wealth constraints, and the quality of local amenities,” *Journal of Development Economics* 110 (2014): 52–63.

7 Esther Ademmer et al., *MEDAM Assessment Report on Asylum and Migration Policies. Flexible Solidarity: A comprehensive strategy for asylum and immigration in the EU* (2018) (available online).

8 Antonia Grohmann and Lukas Menkhoff, “Finanzbildung fördert finanzielle Inklusion in armen und reichen Ländern,” *DIW Wochenbericht* no. 41 (2017): 905–913 (in German; available online).

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