INFRASTRUCTURE FOR RENEWABLE ENERGIES: A FACTOR OF LOCAL AND REGIONAL DEVELOPMENT
Abstract
This study draws a picture of the infrastructure development in the main renewable energy sectors (wind, solar, biomass, hydroelectric, geothermal) in European regions. It explains how projects developing regional infrastructure for renewable energy are financed in the current programming period of Structural Funding and it analyses the quality of these provisions. Finally, the study explores the existing and future measures for renewable energy infrastructure as well as electricity network plannings in Cohesion programmes and in the National renewable energy plans.
LIST OF ABBREVIATIONS

ADENE Portuguese Energy Agency
AIR Annual Implementation Report
AREAM Regional Agency for Energy and Environment of Madeira
BEMIP Baltic Energy Market Interconnection Plan
CAP Common Agricultural Policy
CBC Cross Border Countries
CCS Carbon Capture and Storage
CHP Combined Heat and Power
CO₂ Carbon dioxide
COP Corporate Operational Plan
DG Regio Directorate General for Regional Policy
EACI Executive Agency for Competitiveness and Innovation
EAFRD European Agricultural Fund for Rural Development
EBRD European Bank for Reconstruction and Development
EC European Commission
ECCC Edinburgh Climate Change Centre
EEM Electricidade da Madeira
EERP European Economic Recovery Plan
EIB European Investment Bank
ELENA European Local ENergy Assistance
ENNEREG Regions paving the way for a Sustainable Energy Europe
ENPI Kolarctic programme
EOWDC Aberdeen Offshore Wind Farm and European Offshore Deployment Centre
ERDF European Regional Development Fund
ESEP East of Scotland European Partnership
ESF European Social Fund
ETG Electricity Transmission Grid
EU European Union
EU ETS Emissions Trading Programme
EUR Euro
GBP Pound Sterling
GDP  Gross Domestic Product
GWh  Gigawatt hour
HIPP  Highlands and Islands Partnership Programme
IB/MA  Intermediate Bodies/Management Authorities
ICT  Information and Communication Technologies
IEE  Intelligent Energy Europe
IFI  International Financial Institutions
INTERREG  Community initiative aiming at stimulating interregional cooperation
ISLES  Irish-Scottish Links on Energy Study
JASPERS  Joint Assistance to Support Projects in European Regions
JEREMIE  Joint European Resources for Micro to Medium Enterprises
JESSICA  Joint European Support for Sustainable Investment in City Areas
KAI  Key Area of Intervention
km²  Square kilometer
kW  Kilowatt
LCRI  Low Carbon Research Institute Energy Programme
LEADER  Liaison Entre Actions de Développement de l'Économie Rurale
LRF  Farmers Federation
LUPS  Lowlands and Uplands Scotland
MAC  Transnational Cooperation Programme Madeira-Açores-Canarias
MW  Megawatt
MWh  Megawatt hours
NGO  Non-Governmental Organisation
NREAP  National Renewables Action Plan
NSRF  National Strategic Reference Framework
NUTS  Nomenclature of Units for Territorial Statistics
OP  Operational Programme
OR  Outermost Region
ÖROK  Austrian Conference on Spatial Planning
PA  Priority Axes
PPEC  Consumption Efficiency Promotion Plan
PPERAMM  Madeira’s Regional Energy Policy Plan
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<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tr>
<td>PPP</td>
<td>Purchasing Power Parity</td>
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<td>PRAI</td>
<td>Programme of Innovation Actions</td>
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<td>PRODESA</td>
<td>Operational Programme of the Autonomous Region of Azores</td>
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<td>R&amp;D</td>
<td>Research and Development</td>
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<td>RDI</td>
<td>Research, development and innovation</td>
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<td>RES</td>
<td>Renewable Energy Source</td>
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<td>REVA</td>
<td>Regionalverband</td>
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<td>RSFF</td>
<td>The Risk Sharing Finance Facility</td>
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<td>SEACAMS</td>
<td>Sustainable Expansion of the Applied Coastal and Marine Sectors</td>
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<td>SEGEC</td>
<td>Scottish European Green Energy Centre</td>
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<td>SME</td>
<td>Small and Medium-sized Enterprises</td>
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<td>SO(_2)</td>
<td>Sulfur dioxide</td>
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<td>SOP</td>
<td>Sectoral Operational Programme</td>
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<td>SOP-IEC</td>
<td>Sectoral Operational Programme – Increase of Economic Competitiveness</td>
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<td>SPD</td>
<td>Single Programming Document</td>
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<td>SRAM</td>
<td>Regional Secretariat of the Environment and Sea</td>
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<td>SSA</td>
<td>Strategic Search Area</td>
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<td>STRAT.AT</td>
<td>Nationaler Strategischer Rahmenplan Österreichs</td>
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<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities, Threats</td>
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<td>TAN</td>
<td>Technical Advice Note</td>
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<td>TEN-E</td>
<td>Trans-European Energy Network</td>
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<td>TSO</td>
<td>Technical Standards Organisations</td>
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<td>TWh</td>
<td>Terawatt hour</td>
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<td>TYNDP</td>
<td>Ten-Year Network Development Plan</td>
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<td>UK</td>
<td>United Kingdom</td>
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<td>USD</td>
<td>US Dollar</td>
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<td>WAG</td>
<td>Welsh Assembly Government</td>
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<td>WATERS</td>
<td>Wave and Tidal Energy: Research, Development and Demonstration Support Fund</td>
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<td>WEFO</td>
<td>Wales European Funding Office</td>
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EXECUTIVE SUMMARY

This study explores the possibilities for renewable energy infrastructure development to reach the goals of the Europe 2020 Strategy, with an emphasis on the regional/local level. Both the investments of Cohesion Policy in this area to support the EU2020 goals and the effect of these investments on regions’ socio-economic development are taken into account.

By assessing case studies from five regions producing renewable energy in the European Union (EU), this study makes the case for integrated production of green energies through creation of power grids, energy storage facilities, smart energy infrastructure in households and enterprises and co-generation plants for heat and power. Attention is given to expanding transnational energy exchange, with particular attention to cross-border joint ventures between neighbouring countries and a greater trans-European energy infrastructure.

In line with the Regional Policy as a key component of the EU 2020 Strategy, this study explores the variety of options to increase support for extension of existing networks and creation of new infrastructure to maximize the potential of renewable energies.

Furthermore, it assesses how projects developing regional infrastructure for renewable energy are being financed in the current programming period of Structural Funding and in which quantity and quality.

At present, EU energy markets are facing pressure from political actions, e.g. the cut-off of the natural gas flow from Russia, fluctuations in fossil fuel prices and severe weather phenomenon causing damage to existing structures and stressing the energy supply during periods of extreme hot and cold. Due to the Fukushima Nuclear Power Plant disaster in Japan, European nations have also reconsidered their nuclear energy programmes, with Germany having shut down its seven oldest reactors.

The financial hardships caused by the economic crisis since 2008 have contributed to a drop in energy consumption, and a reluctance to invest in clean energy technologies. One positive effect was to inadvertently reduce CO₂ emissions due to reduced consumption, however this situation is fragile, and could lead to a shift back towards coal and gas fired plants. To prevent this backslide, now is the right time to make the case for investment in renewable energy infrastructures rather than fossil fuels, despite the heftier start up costs. The EU’s increasing dependency on imported fossil fuels and lack of sufficient energy storage facilities leaves it vulnerable to crises and regional competitiveness, as the disparity between regions of the EU is particularly pronounced in the most exposed areas.

Three key issues have been identified in terms of future energy markets:

**Insufficient investments in new energy capacities**, leaving aging infrastructure capable of an inadequate supply for the EU’s energy needs;

**Fossil energy supply shortfall** (and security), as much of the worlds’ sources and reserves are located outside of the EU, transportation, political and financial issues could all present a barrier to fossil fuel availability;

**Peak energy demand** (and security) becomes a problem during periods of increasingly extreme weather, which causes greater stress on energy provision.

**Current EU energy policy** considers the central goals to be security of supply, competitiveness and sustainability. To achieve these goals it is following a policy of deregulation in order to encourage competitiveness leading to low prices for the consumer, and to unite fragmented regional markets into a pan-European energy supply to ensure security. By striving for an overall reduction in fossil fuel consumption, a two-fold benefit is both a decrease in CO₂ emissions and reliance on external providers of fossil fuels, thereby supporting both the sustainability and security of supply objectives.
This energy will be replaced by renewable sources such as wind power, biofuels and solar energy, which can be harnessed on EU soil and through offshore plants.

Moreover, the so-called “20-20-20 targets” to be fulfilled by 2020 include a 20% reduction in greenhouse gas emissions compared to 1990, renewable energy sources (RES) providing 20% of all energy consumed in the EU, and 20% lower energy usage than in a comparable scenario where no measures were taken towards sustainability.

Renewable energy implementation and energy efficiency measures are currently in the hands of each of the Member States, as there is no EU-wide blanketing legislation. Member States are given specific targets, however the European Commission suggests EU-level policies to help speed along progress and ensure integrated markets. It has proposed various remedies to achieve an energy-efficient Europe, chief among them improving efficiency in the largely untapped building and transport industries, such as requirements for wider usage of Ecodesign and an infrastructure for electric vehicles.

The European Commission considers the current energy infrastructure as inadequate to connect and service the whole of Europe and recognizes the challenges to improving it both from the private sector and national governments, so it proposes to introduce top-down directives from the EU-level to sufficiently modernize and interconnect national energy grids with the eventual goal of a single European market. As the output of many Renewable Energy Sources (RES) fluctuates depending on weather patterns, a well-connected infrastructure could prevent future crises by shoring up supply that can be easily transported throughout the European Energy Grid. Additional measures such as ‘smart meters’ to transparently show the consumer their energy consumption could be in place in 80% of EU households by 2020.

Regional Policy plays an important role in this context. However, while renewable energies receive comparatively greater support from the European Regional Development Fund (ERDF) than conventional electricity, in relation to the overall budget and EU contribution the total share of support for renewable energy infrastructure only accounts for 4% of the complete ERDF EU contribution budgeted for 2007 – 2013. Greater funding for countries in Southern and Eastern Europe territorially reflects the role of Cohesion Policy for infrastructure investments, with Central and Northern European countries receiving the least amount of support for renewable energy infrastructure. Overall, the amount of ERDF funding in this field is rather low, especially in support of energy grid investments.

The two major EU co-funded direct policy sources of funding for support and promotion of energy efficiency and renewable energy are the Intelligent Energy Europe (IEE) programme and the Rural Development Fund (EAFRD). The IEE plan finances individual projects based on a call for proposals, and the EAFRD primarily supports biomass energy related to agricultural production. However, both sources only contribute negligible sums in the greater picture. Additional funding can be accessed through a variety of programmes such as Joint Assistance to Support Projects in European Regions (JASPERs), Joint European Resources for Micro to Medium Enterprises (JEREMIE), Joint European Support for Sustainable Investment in City Areas (JESSICA) and sources such as the European Investment Bank (EIB).
CASE STUDIES

Nine regions were selected as case studies and were analysed based on the existing and future measures for renewable energy infrastructure and their benefits for the social, economic and territorial development. Each case study elaborates on the following topics:

- Compatibility, complementarities and efficiency of EU Regional Funds supporting this infrastructure,
- Responsibility of the various actors involved in setting up the infrastructure and handling the support (multi-level governance),
- Economic, social and territorial development impacts of the investments.

Two locations in Austria were chosen as they have implemented a variety of successful actions for renewable energy use. Güssing in Burgenland and Vöckla-Agar in Upper Austria represent different economic, geographical and historical regions of the country and have had differing levels of success in renewable energy use. Güssing is a best practice example, transforming a previously poor peripheral region with bleak prospects into a model of sustainability with its entire energy production coming from renewable sources. Its energy production is a mixture of local biomass, solar energy and photovoltaic, and today 27 decentralized power plants in the Güssing district generate enough excess energy to make a profit to reinvest in funding RES.

By contrast, Vöckla-Agar is located in a wealthy industrial region of Austria in close proximity to large economic centres. Its strategy involves a Technology Centre which promotes innovative entrepreneurial activities in sustainability and the dissemination of ideas for energy efficiency, but it has not yet reached its own efficiency targets to become a model region. As in Güssing, the aim here is not only to make the energy system sustainable, but also to support the local economy, to keep as much value added in the region as possible, secure existing and create new jobs and protect the livelihoods of farmers. The strategy in Vöckla-Ager is to work across sectors and safeguard diversity.

Madeira and Azores in Portugal face special challenges as isolated archipelagos, with different population distribution and economic situations. As they are greatly distanced from substantial population centres, access is restricted to internal energy markets and must incur high costs of fossil fuel transit or produce energy themselves. Madeira employs hydroelectric, wind, waste incineration and photovoltaic energy, the development of which was largely co-funded by ERDF. Its Socorridos power plant has the capability to store energy during off-peak periods, thus improving the islands’ energy efficiency. Azores has large unexploited potential for renewable energy, particularly geothermal due to its fault-line location. Currently, two geothermal plants provide 40% of its energy, and wind and hydroelectric power are also sourced on the islands. In the 2000-2007 period, Azores was one of the most energy efficient regions of the EU. In both areas several initiatives are taking place to explore and expand the use of RES and to develop new forms of energy production (e.g. wave, tidal, hydrogen). These islands received more support from EU funding initiatives than the other case studies in question, which have played in significant role in the development of renewable energy generation capacities.

Romania follows a centralized approach to Regional Policy, which is why no particular regions in the country were singled out as case studies. While the country is well covered with electricity grids, its aging infrastructure (30% of which was built in the 1960s) is causing significant losses along energy supply chains, spurred on by increasingly high demands from the burgeoning economy. However, the potential for Renewable Energy Sources development is high, mainly from solid biomass, hydropower, geothermal and wind energy, the latter in particular on the Black Sea coast and in the mountainous areas. The EU has set a target of
24% renewable energy production for Romania by 2020, but they have also identified large investment needs and operating costs as key barriers to the successful implementation of increased generation capacity. As a new Member State, Romania has little experience with EU funds, and is currently investing very little in renewables, however this may change in the near future.

**Sweden** points to **Upper-North Sweden** as a region that hosts good practice examples as well as unused potential. It is a sparsely populated area with favourable natural resources for hydroelectric power, wind and bio energy. The large amount of available land and lack of competing interests create excellent conditions for energy exploitation, and the region has already been producing hydroelectric power for over 100 years; such plants located throughout the country generate 50% of Sweden’s energy. Upper-North Sweden’s production of heating, biogas, wind energy, refined fuels and biomass could increase significantly, but it faces hurdles such as transmission in the national grid due to its remoteness and the lack of infrastructure developed enough to handle the large amounts of energy that could be produced. There is little unused potential in the current grid, so it would need to be greatly reinforced to expand production. Additionally, municipal governments pose a hindrance to strengthening the grid, as some municipalities do not recognize renewable energy as a growth industry, and even implement policies to discourage it. As the local authorities have quite a lot of sway in Sweden, establishing compensation systems or by highlighting good examples of how a municipality or a region can benefit from investments in infrastructure for renewable energy may be necessary to push forward progress in this field.

In the **UK, Scotland and Wales** serve as case studies, both with high potential in renewable energy production, but at different stages of infrastructure. The Irish-Scottish Links on Energy Study (ISLES) programme views two offshore locations in the UK as prime candidates for development of a massive offshore grid harnessing wind, tidal and wave energy; the Northern Concept in Scottish waters and the Southern Concept of the coast of Wales. As Scotland currently possesses up to a quarter of Europe’s offshore wind and tidal energy resources, the government has set ambitious renewable targets, hoping to capitalise on this vast resource and positioning the nation as a world leader in innovation, development and deployment of renewable energy. Many of the power stations are located in peripheral areas and are recipient of Structural Funds. As part of its “Energy Policy Statement, A Low Carbon Revolution”, Wales intends a twofold increase to the amount of current electricity generation to come from renewable sources by 2025, with 40% coming from marine, a third from wind and the rest from sustainable biomass power or smaller projects using wind, solar, hydro or indigenous biomass. However at present, Wales still lacks sufficient onshore grid capacity, and the issue of multi-level governance has posed a huge barrier to the uptake of renewable energy, given the delay in connecting wind projects to an onshore grid.

This study posed “cardinal questions” that were stipulated in the Terms of Reference, and the findings seek to answer the following:

- **Which regional infrastructure is necessary to boost the use of renewable energies?**

A mix of infrastructure on the regional level will be necessary to boost the use of renewable energy. The specific strengths of a region (e.g. wind power, biomass, geothermal, etc) must be detected and best utilized, a process that is well on its way as evidenced by the case study regions. To deal with the imbalance in renewable energies available throughout the EU, grid structures must be strengthened and integrated to create a pan-European energy market capable of delivering these energies to all regions. Smart grids, as envisioned by the European Commission energy policy blue print will be particularly relevant in the future.
• Which are the present main measures to promote renewable energies infrastructure in ERDF programmes and national renewable energy plans and are they complementary or do they overlap?

ERDF funding has proved minimal in investing in renewable energy infrastructure in the sense of this study; rather its support lies more in renewable energy production and energy efficiency measures. Due to overall weak support of renewable energy infrastructure, the ERDF programmes and National Renewable Energy Plans do not contradict each other.

• Why have Cohesion Policy investments in regional infrastructure for renewable energy been slow so far?

Findings have shown that renewable energy infrastructure is especially difficult to fund, as there are few incentives for private investors, and administrational logic in many Member States involves various levels and branches of government in energy policy, leading to enormous frictional losses of the funding strategies and resulting in unnecessarily high transaction costs for the beneficiary of the funds. Experience and know-how in EU fund management are an essential prerequisite to safeguarding consumption of funds, and the difficulties in delivering funds to the right beneficiaries is evidenced by the Romanian case study.

• How could regional and national stakeholders be encouraged to invest more in infrastructure for renewable energies?

The chief obstacles to more support from ERDF are complex market conditions and regulatory frameworks, which are a main issue of EU energy market liberalisation attempts; however, they have not shown large-scale effects so far. The European Commission, Member State governments and regulators should intensify their efforts to remove these obstacles in order to accelerate the integration of the European Electricity Grid, improving the security of supply. Closer cooperation in the European Technical Standards Organisations (TSO) improves electricity flows’ fluidity, which in turn improves solidarity between countries during difficult periods. Regional/local investments should follow integrated plans decided on various levels of national and EU-wide policy, meaning that National Renewable Energy Plans will have to be more closely and effectively linked to national EU funding strategies.

• What are the differences between Member States in this context and what are the reasons for problems discovered?

The following differences have been identified: Overall governance mechanisms for managing Regional Policy and territorial development differ, with federal states showing higher frictional losses than centralized ones. Market power distribution in energy markets is affected by policy, e.g. economies with policy-controlled energy providers can prevent the development of alternative energy supply systems. National policy priorities can also pose impediment to renewable energy investment when funding precedence lies elsewhere.

• What is the relevance of multi-level governance, shared management and potential of public private partnerships for renewable energy investments?

To date, multi-level governance has posed more of an obstacle than a supporting factor. The extra layers of bureaucracy cause delays and barriers to renewable energy implementation.
• **What is the potential of cross-border cooperation and macro-regional strategies in renewable energy infrastructure?**

Cross-border transmission of energy is vital to ensuring security of supply. The geographic conditions in Europe offer many locations where two nations could both effectively tap a natural resource, thus transnational synergies can aid in energy production capacity. The analysis indicates that national interests still take precedence, however large-scale investments in the high voltage grid are a step in the right direction.

• **How could potential territorial, social and economic effects of renewable energy for the development of regions be projected?**

It is difficult to directly attribute socio-economic effects to most of the investments but positive effects on renewable energy infrastructure – employment, regional value added and CO2 emission reduction can be observed, as a decrease in spending on fossil fuels allows for increased public spending on socio-economic development structures and improvements in the energy infrastructure.

To meet the challenge facing massive industrial electricity storage, various solutions to improve the renewable energy supply have been proposed such as ‘smart grids’, which would require large investments. Transmission and distribution tariffs would have to be redesigned (and increased) in order to incentivize grid operators to invest as needed.

**VULNERABILITY**

In order to assess the future needs and emphasis of support it is necessary to analyse where the territorial need indicates such support. All regions of the EU were assessed for vulnerability indicators in new energy capacities and susceptibility to fossil fuel shortfall. Highly dependent on fossil fuels, Europe currently imports 53.1% of primary energy consumed. Vulnerability to fossil energy shortfall shows a clear distinction between Western Europe and Eastern Europe. Most regions in Western Europe – except in Ireland – are prepared for fossil energy supply shortfall while in Eastern Europe the vulnerability is above average, with Romania and the Baltic States being the most vulnerable. Gross Domestic Product (GDP) per capita is the driving factor for the vulnerability; high GDP stands for high adaptive capacity in Western Europe vs. low GDP in Eastern Europe and Ireland.

**CONCLUSION**

To use these findings to identify suitable regions in which to boost investment in renewable energy infrastructure, it is useful to compare the vulnerability maps with the European Commission’s blueprint for renewable energy. European regions differ in suitability for renewable energy production and especially in modes of renewable energy production which is why the balancing of supply and demand between regions and within regions will be necessary when paving the way towards the EU energy policy goals and to reducing the dependency on fossil fuels. Regional policy is an essential means to do so successfully as a more regionalized approach of renewable infrastructure support will be needed in the future.
These key factors must be met to further development of renewable energies:

**Increase of investments in regional strength of renewable energy production** – e.g. wind energy potential as well as solar energy in southern regions, and biomass energy heavily forested regions where the potential is still not fulfilled.

**The distinction between “high tech” renewable energy (electricity) and “low tech” renewable energy (heat)** will be necessary for a more effective and efficient use of these energy forms. It will be necessary to better distinguish which energy supply covers which energy demand.

**The establishment of smart grid solutions** in combination with high voltage TEN solutions will safeguard a better distribution of the relatively valuable energy from electricity. The market structure obstacles will have to be tackled in order to establish a smooth and efficient exchange on this level.

**The most vulnerable regions** with respect to energy supply shortfalls and dependency on fossil fuels should be targets for EU/national support in order to counteract these vulnerabilities in the long run.