Future Disparities: Asymmetric Climate Change Investments and Their Implications

Insights from the LOCALISED project

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Policy Brief
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Key Messages:

- Mitigating climate change and adapting to inevitable climate changes will place significant different burdens on European regions and cities in terms of necessary investments.
- To provide regions with a planning tool, the ***LOCALISED*** project has developed a method to downscale national decarbonisation plans to the local level.
- Preliminary results show that mitigation efforts and their associated costs will be spatially very unevenly distributed.
- Regions with a diversified portfolio of economic activities will be able to use more decarbonisation paths to the future than cities and regions with a focus on one or a few strong economic sectors.
- The results show that it will be very challenging for a significant share of regions to achieve full decarbonisation without external support.
- ***LOCALISED*** helps with this aspect by providing detailed, stakeholder-specific maps for all European Member States on a county or city (NUTS-3) level for the first time and estimating projected investment needs in individual regions.

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The LOCALISED project

The Horizon 2020 Project ***LOCALISED*** attempts to disaggregate national decarbonisation plans, consistent with Europe's net-zero target, to a regional level across Europe, and quantify the changes that must happen in each region and to assess which regions/cities may be affected. Previously, this was possible only with great effort and detail for individual regions, such as the disaggregation for Valencia [1].

To achieve the ***LOCALISED*** targets, the project uses a mixture of disaggregated national plans, regional statistics, and a newly developed model approach. For this purpose, ***LOCALISED*** utilises a large measure database to calculate an optimal regional response to reach its national decarbonisation pathway. As a secondary goal, the project seeks to estimate the measures necessary to adapt to climate change effects on a local level, based on impacts of climate change.

The results are embedded into end-user products and services for local and regional administration and their citizens, as well as policy and business decision-makers, supporting the establishment of Sustainable Energy and Climate Action Plans (SECAPs) and the monitoring of related Sustainable Development Goals (SDGs).

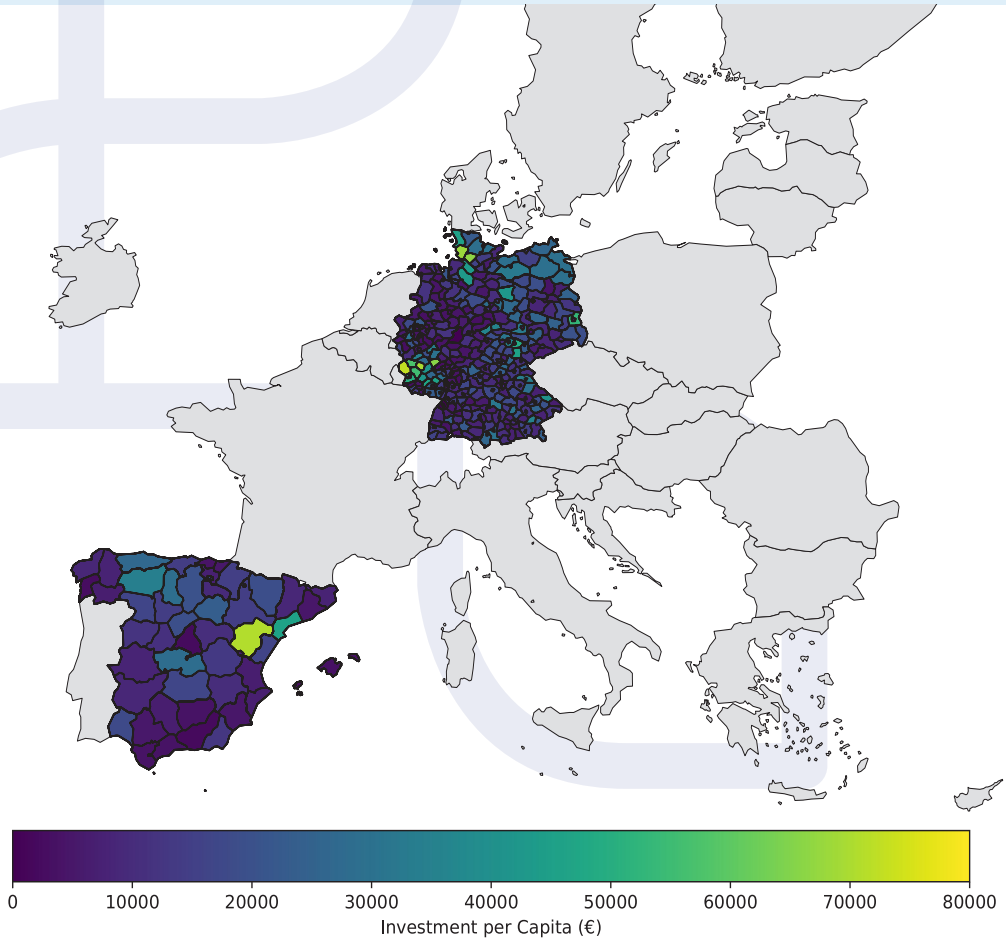

Figure 1: Investment per person for all NUTS-3 entities of Germany and Spain (own source).

Background

The decarbonisation of European economies is necessary to effectively combat climate change, and the adaptation to the inevitable impacts of climate change and the mitigation of emissions will be one of the greatest challenges for European policy in this century. The acceleration of global warming and the consequences of increasingly frequent extreme events make it clear that the effects will be very unevenly distributed both socially and geographically. One reason for this is that the economic and geographical diversity of the regions requires very different adaptation and mitigation measures. For example, regions with a more touristic nature have to implement different emission reduction measures than cities and regions with a more industrial character. Geographical factors also play an important role, as economic zones in valley regions, for example, can be more risk-prone to extreme rainfall than flatlands. This means that the costs for mitigation and adaptation options may vary greatly from region to region in the future. Such spatial and economic diversities also have the potential to exacerbate inequalities in European societies. For example, underrepresented groups can be disproportionately affected by climate change. Rising energy costs tend to have a greater impact on citizens who already suffer from, or are at risk of energy poverty, while climate change-related employment developments in regions with high tourism concentrations tend to have a strong impact on the service sector. Conversely, residents of prosperous regions may not experience such severe consequences in their everyday lives.

The Costs of Decarbonisation

When publishing the results of a new model, it is always useful to compare the results to previous studies. In [2] McKinsey estimated the total CAPEX from 2021 to 2050 for European decarbonisation to be 28 trillion €, although only 5 trillion € of that are estimated to be additional clean energy investments. This would result in an average cost per citizen to the economy of approximately 63.000 € for the total CAPEX and 11.000 € per person for the additional clean energy investments over that time period, respectively. These numbers do not include any OPEX, but still provide a useful frame of reference for the results for this policy brief, since our results are in the same range. It should be noted that in ***LOCALISED***, costs include both CAPEX and OPEX and are always calculated in $€_{2020}$.
If, for whatever reason a large part of the 63.000 € must be borne directly by citizens, e.g. in the course of the energetic renovation of apartments or houses, this could threaten the economic well-being of parts of the population. For this reason, ***LOCALISED*** tries to quantify which regions in Europe will be more or less affected by these financial burdens in the future and which stakeholders are most affected.

Method

LOCALISED works to quantify the transformation costs for each city/region by downscaling national decarbonisation pathways and then using the ***LOCALISED*** model to calculate a set of measures for each region that enables the region to follow the regional pathway. The creation of the regional pathways is done through a four-stage approach for each European county or city (NUTS-3 region) (*cf. Fig. 2*).

Figure 2: Process for creating regional pathways for every single region in the EU (own source).

First, a detailed inventory of the present is carried out using public statistics, land use data, OpenStreetMap, and other data sources. As a second step, values that are only available on an aggregated level, such as countrywide statistics, are disaggregated down to NUTS-3. This is necessary because not all required data is available for the NUTS-3 level. For example, population and economic data are generally available, but other variables such as land use or local infrastructure are only freely available for selected regions. As a third step, missing values are imputed using machine learning methods to create a complete data set for all regions in all countries. As a fourth step, national Long-Term Strategies, as submitted to the European Commission by each country, are replicated via the EUCalc (Horizon 2020 project #730459) decarbonisation model, with the aim of creating comparable datasets for each European member country. These pathways are subsequently disaggregated to the NUTS-3 level to provide target projections for critical indicators, such as emission reductions per sector, the local steel industry, or the local agriculture industry. The goal is to generate accurate emission targets for all regions, so that only regions with appropriate indicator values, such as those with steel production plants, are assigned the correct corresponding measures, such as switching steel plants to hydrogen for reducing CO_2 emissions from steel production. Additionally, the database is enriched with climate data and climate change impact estimates from the county or city (NUTS-3 region) for every single region as foundation for calculation adaptation measures, which will be discussed in more detail in a future policy brief.

Based on this data, coherent recommendations for measures to achieve the specified goals are developed for each region. For this purpose, a large database (catalogue of response actions) is used, containing more than 800 individual measures, such as “build renewable energy plants”, “renovate buildings”, “increase electric cars”, or “increase public transportation”. The database has been published already as [3]. Each measure is quantified in terms of its regional impact, requirements, costs and emission result, and are additionally adjusted for purchasing power [4], where applicable. Measures are analysed and filtered based on local criteria to reflect regional limits. In many cases, multiple measures are available to achieve a single goal, such as decarbonising the energy supply by increasing renewable energy supply versus reducing the overall energy demand through building renovations. In such cases, the ***LOCALISED*** model calculates the optimal set of measures for a region using algorithmic and genetic optimization methods.

For this policy brief, Germany and Spain were selected as examples to compare more northern and more southern regions in the EU. Additionally, this provided a case study on the impacts that purchasing power differences between the countries may have (*cf. Fig. 3*).

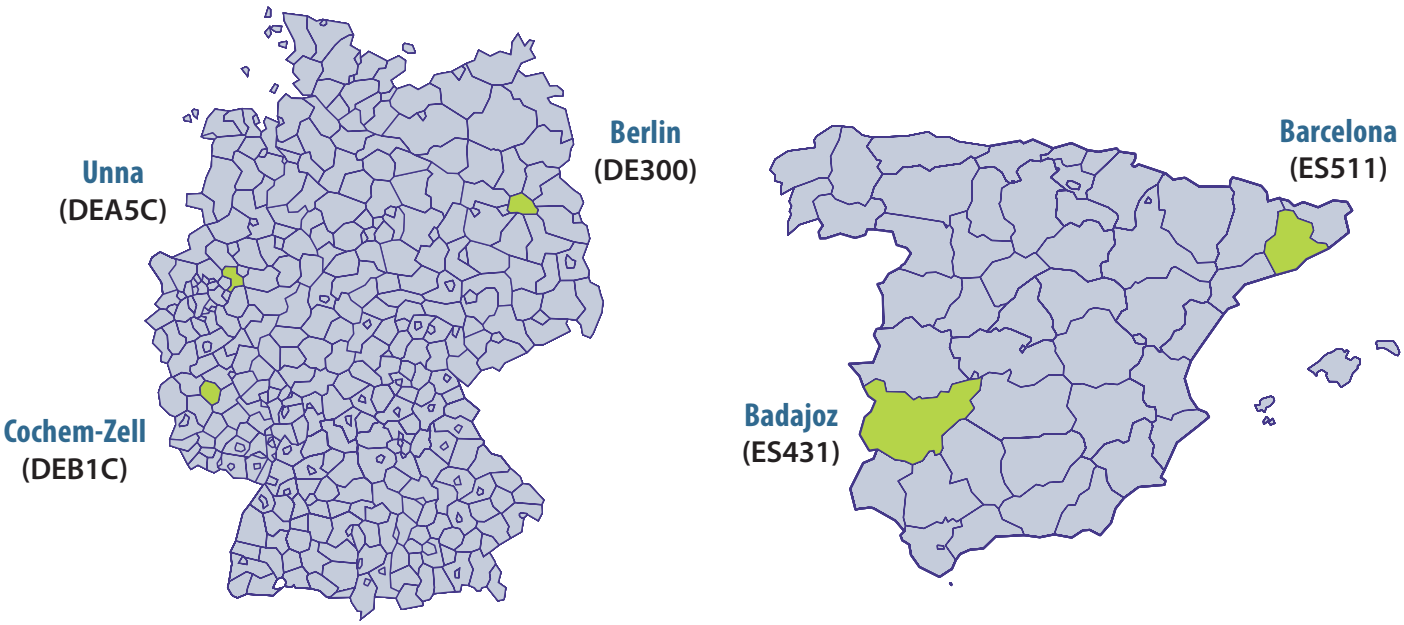

Figure 3: Focal regions analysed in detail in this policy brief (own source).

Results

Figure 3 shows the results of the ***LOCALISED*** model for every single region in both Spain and Germany. They indicate that the total costs (CAPEX and OPEX in $€_{2020}$) in the regions per person lies largely within the range reported in the aforementioned McKinsey study [2].

While the majority of regions exhibit costs within a reasonable range, equivalent to approximately 100% of their annual 2020 GDP over the next 25 years, or about 4% of the yearly GDP, a notable portion of regions are projected to face significantly higher expenses, potentially several times that amount.

Germany in general exhibits higher costs across its regions than Spain does, due primarily to differences in purchasing power and regional typologies. For example it's more expensive to decarbonize a heavily industrialised region than an agricultural one. However, selected regions are able to invert their investment burden by exporting excess renewable energy production because they are actually front-runners in the energy transition, ultimately resulting in a net profit of up to 25,000 $€_{2020}$ per person over 25 years in the most extreme case and demonstrating that consequences of the climate transition may not be negative in all cases.

[1] *https://www.european-calculator.eu/model/*

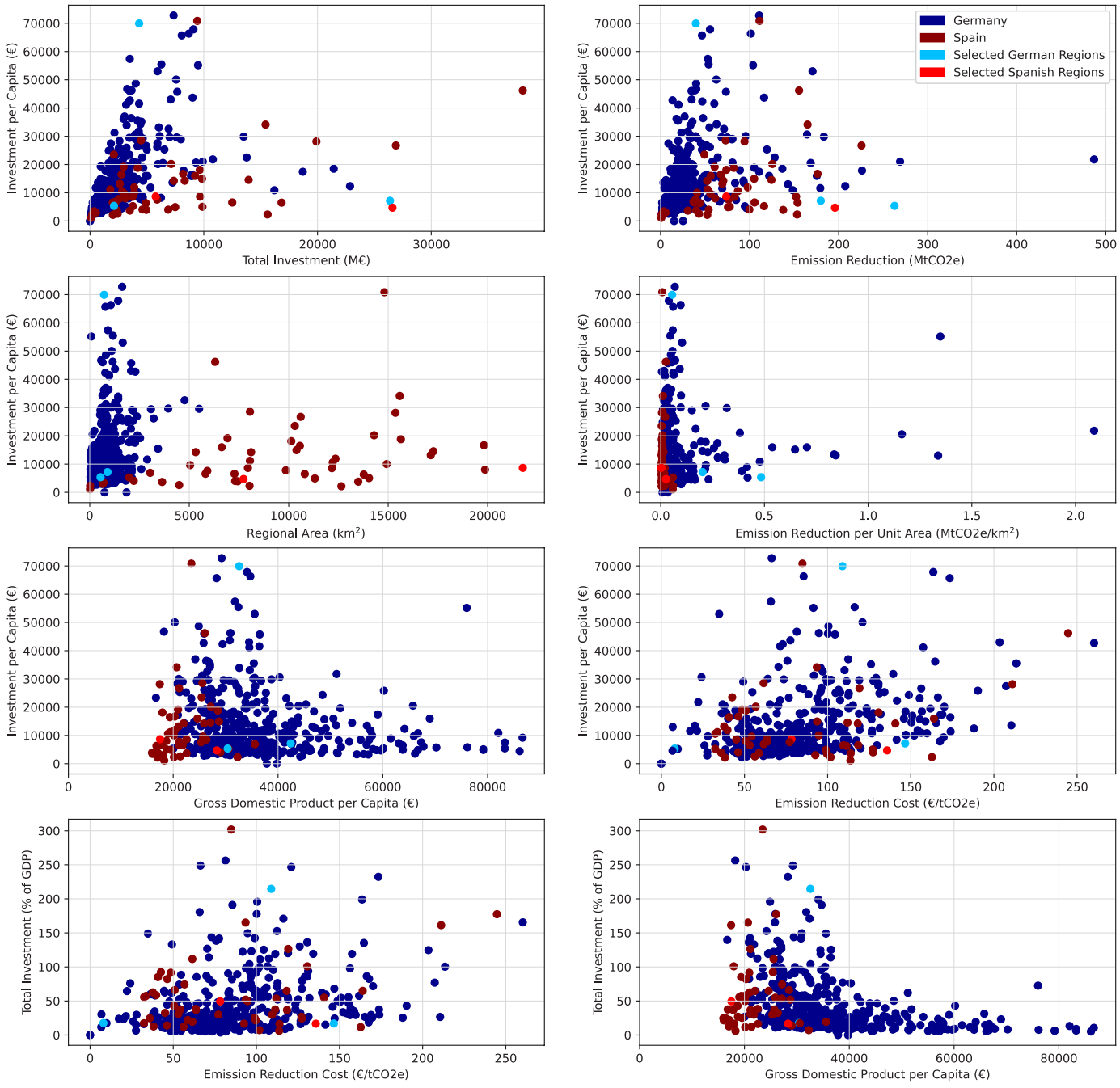

Figure 4: Total costs per person (CAPEX + OPEX in €$_{2020}$) over various indicators for all NUTS-3 entities of Spain and Germany, with the selected regions shown in Figure 2 highlighted (own source).

Policy Conclusions

With the early-stage project results we can draw the following key conclusions:

- Investments necessary to achieve net-zero emissions on a regional scale will be asymmetrically distributed across regions and regional actors. The ***LOCALISED*** approach makes it possible to quantify in advance who is likely to experience the most unfavourable conditions. This makes it possible to intervene at an early stage if necessary.
- Costs will be strongly affected by region type, economic diversification, and decarbonisation speed.
- Some regions will be existentially threatened due to high costs and will need financial support to avoid social disruption. Appropriate funding for regions at risk is needed.
- Rather than creating a large redistributive infrastructure that could create major disincentives in a future market, the stark differences show that it will be possible to target support to truly disproportionately affected regional entities and interest groups, thereby strengthening the European economy as a whole.

Outlook

The results give an early impression of the upcoming results of the project ***LOCALISED***. More detailed analysis of other European Member States, stakeholders and regional typologies is planned in our upcoming mitigation and adaptation studies. Additionally, the ***LOCALISED*** model serves as the backend for a web tool currently in development that will enable city administrations and other regional stakeholders to easily access the results and plans for their region and modify them to better suit their own plans. And while the web tool will primarily be targeted at city administrators, it will be open and free to use for everyone.

References:

[1] *Muñoz I, Hernández P, Pérez-Iribarren E, García-Gusano D, Arrizabalaga E. How can cities effectively contribute towards decarbonisation targets? A downscaling method to assess the alignment of local energy plans with national strategies. Energy Strategy Reviews 2023;49:101137. https://doi.org/10.1016/j.esr.2023.101137.*

[2] *Europe's path to decarbonization | McKinsey n.d. https://www.mckinsey.com/capabilities/sustainability/our-insights/how-the-european-union-could-achieve-net-zero-emissions-at-net-zero-cost (accessed June 12, 2024).*

[3] *Martínez Görbig G, Flacke J, Keller M, Pflugradt N, Sliuzas R, Reckien D. Fitting consistent knowledge into the planning process: An integrated database on adaptation and mitigation measures in Europe. Data in Brief 2024:110580. https://doi.org/10.1016/j.dib.2024.110580.*

[4] *Database Purchasing Power - Eurostat n.d. https://ec.europa.eu/eurostat/web/purchasing-power-parities/database (accessed June 12, 2024).*

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