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REGIONAL IMPACTS OF DIFFERENT ENERGY TRANSITION PATHS

MEASURING REGIONAL IMPACTS OF AN ENERGY SYSTEM TRANSFORMATION – A CONTRIBUTION TO SUSTAINABILITY ANALYSIS

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1. Introduction

Project and Research questions

- Project InNOSys

  - ⇨ Integrated sustainability assessment and optimization of energy systems (in Germany)
  - ⇨ Research project, funded by the Federal Ministry of Economic Affairs and Energy
  - ⇨ Lead by German Aerospace Center (DLR), until 2020
- Research questions in our work package
  - ⇨ How do the macroeconomic effects differ between the scenarios?
  - ⇨ **Who might benefit from energy transformations in a regional dimension?**
  - ⇨ **Which pathways is more or less sustainable (economic / social)?**

Regional impact – established findings

- Transition in power generation technologies – two different aspects
  - ⇨ Economic impacts during operation / power generation
    - Rural areas with RE-capacities vs. Agglomerations with carbon-based capacities
  - ⇨ Economic impacts by additional demand from investment
    - Local content and multipliers
- Even if national impacts in scenario analysis are low, there can large differences in regional impacts
- Regional economic structure (sectors and energy technologies) matters and influences
  - ⇨ Direct impact of changes in the energy mix in the energy sector
  - ⇨ The energy-related sectors have different shares in the regions
  - ⇨ Multiplicators of additional demand from investment are related to regional shares of sectors

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2. Method, models and scenarios

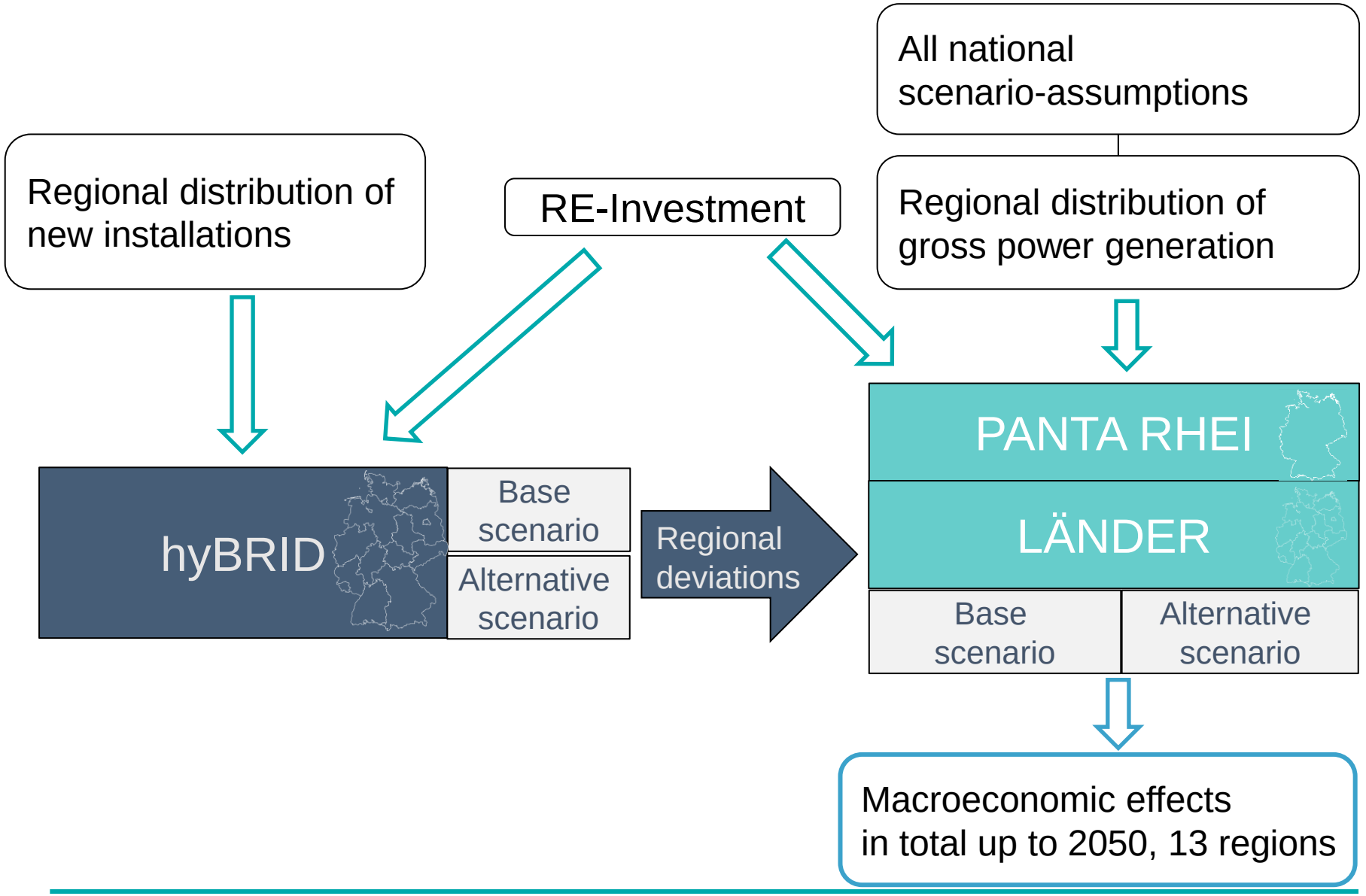
Modular structure of modelling

- Spatio-structural impacts of RE-investment
  - ⇨ RIOT-Simulation
    - RE-technology manufacturers and their location
    - Regional power generation capacities
    - Investment in 9 technologies and demand vector (63 products)
  - ⇨ Allocation of direct and indirect effects of investment
  - ⇨ Status-quo-reports since 2010 [Ulrich / Lehr 2018]
- Structural impact and dynamics of transition
  - ⇨ Integrated regional macro-economic model
  - ⇨ 37 sectors, structural changes in long term projection
  - ⇨ Top-down in a detailed macroeconomic framework (→ Macroeconomic IO-Model PANTA RHEI)
  - ⇨ Previous study [Ulrich / Lehr / Lutz 2018]

hyBRID

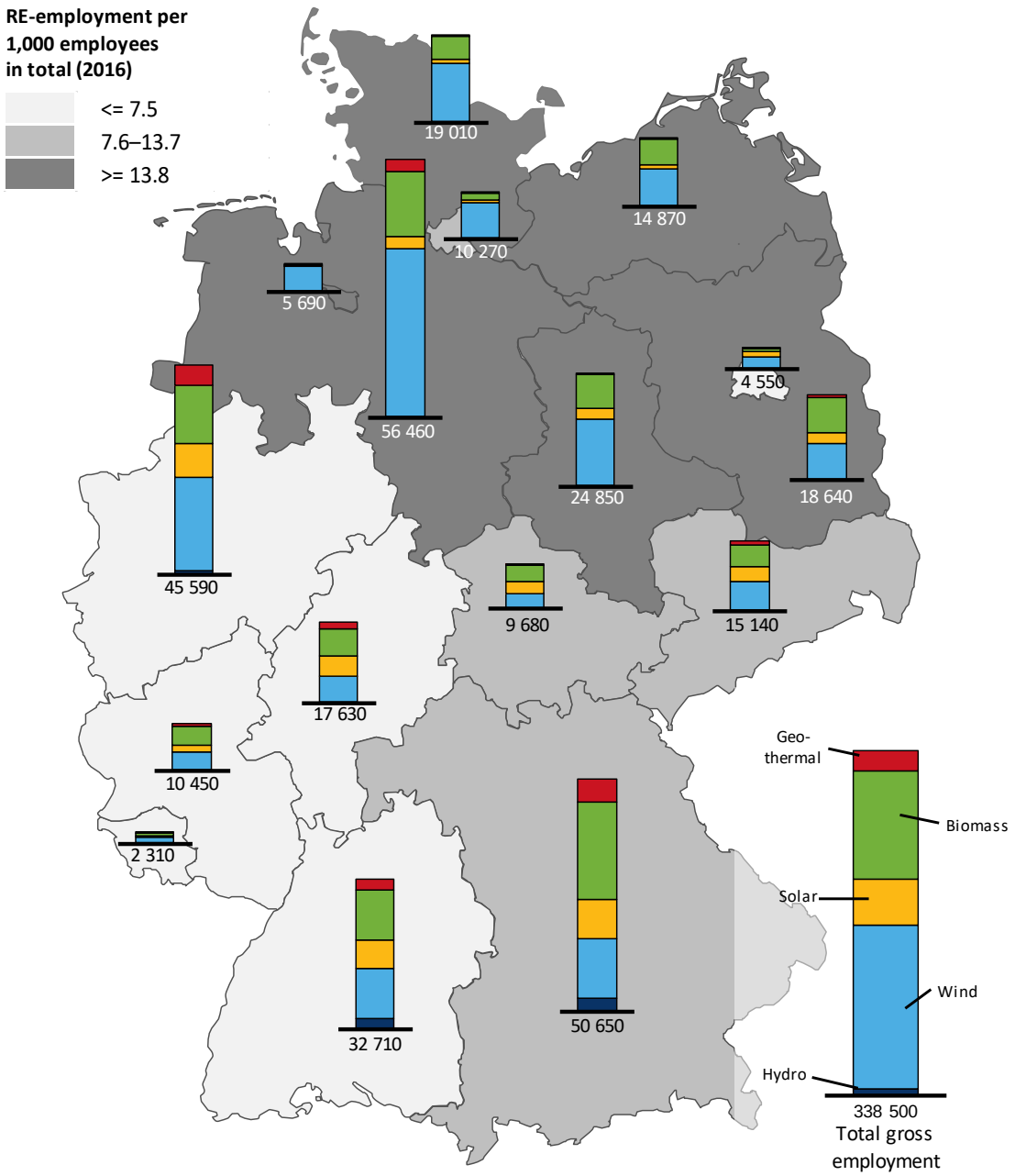
PANTA RHEI – LANDER

Modular structure of modelling



RE-jobs (2016)

- Results from hyBRID
- In eastern Germany every 80th job is related to RE-expansion, in the western part every 130th
- Contribution to more evenly distributed income? More sustainable?



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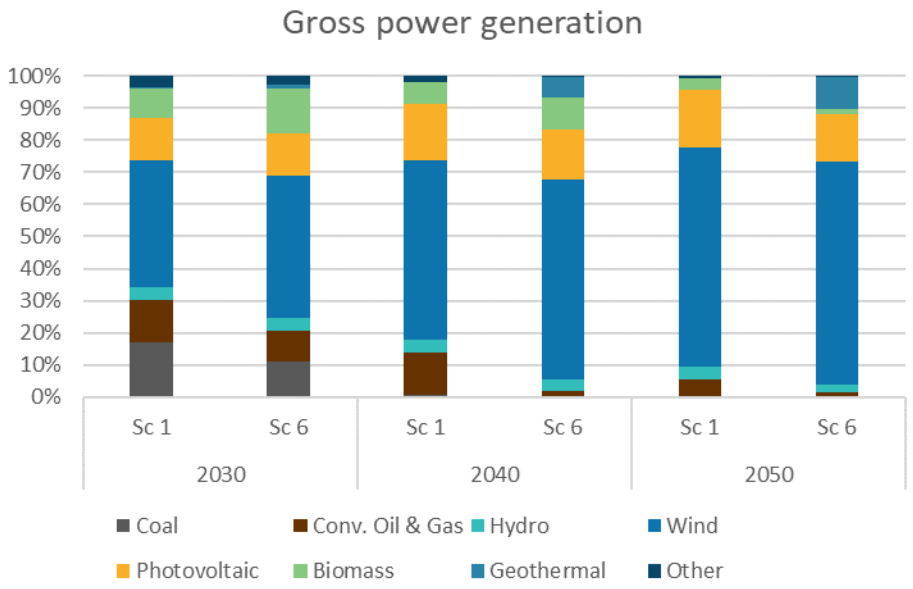
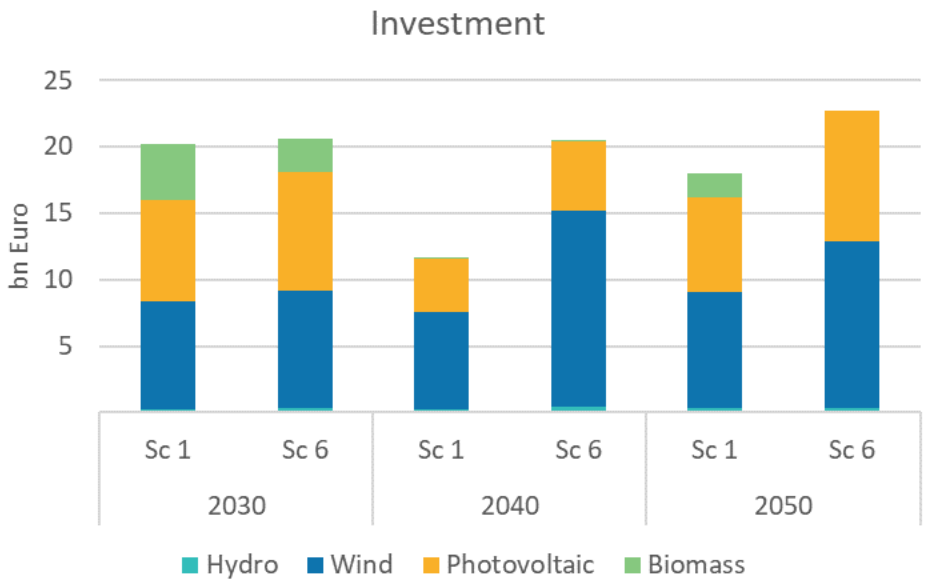
Outline of two scenarios

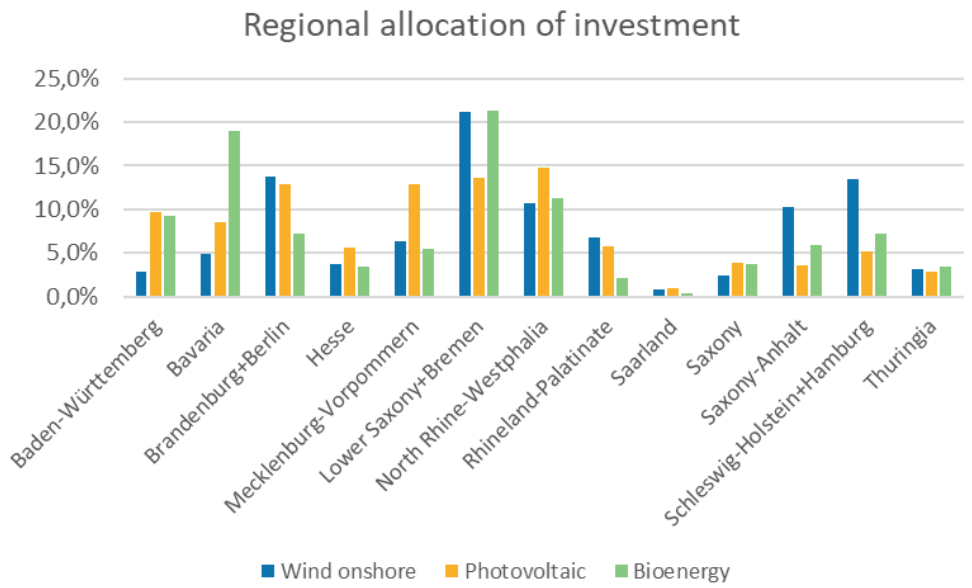
- Scenario 1
  - ⇨ Energy transition “baseline”
  - ⇨ 80%-Share of RE in power generation **2040**
  - ⇨ 80%-Reduction of GHG-Emissions
  - ⇨ Federal Ministry of Economic Affairs and Energy
- Scenario 6
  - ⇨ Climate Protection Scenarios 2050
  - ⇨ 80%-Share of RE in power generation **2032**
  - ⇨ 95%-Reduction of GHG-Emissions
  - ⇨ Federal Ministry for the Environment



RE-investment and regional allocation

- Investment
  - ⇨ More investment in Sc. 6, especially in 2040
  - ⇨ Differences highest for wind energy, hardly any differences for PV
  - ⇨ Model-based estimation by DLR
- Regional distribution
  - ⇨ Distribution along natural potentials (DLR)
  - ⇨ 13 greater regions





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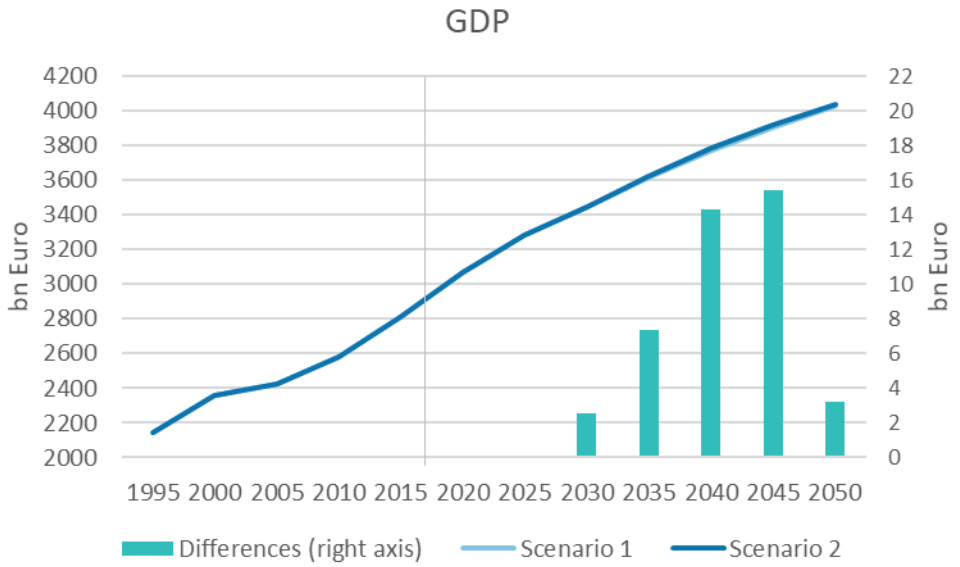
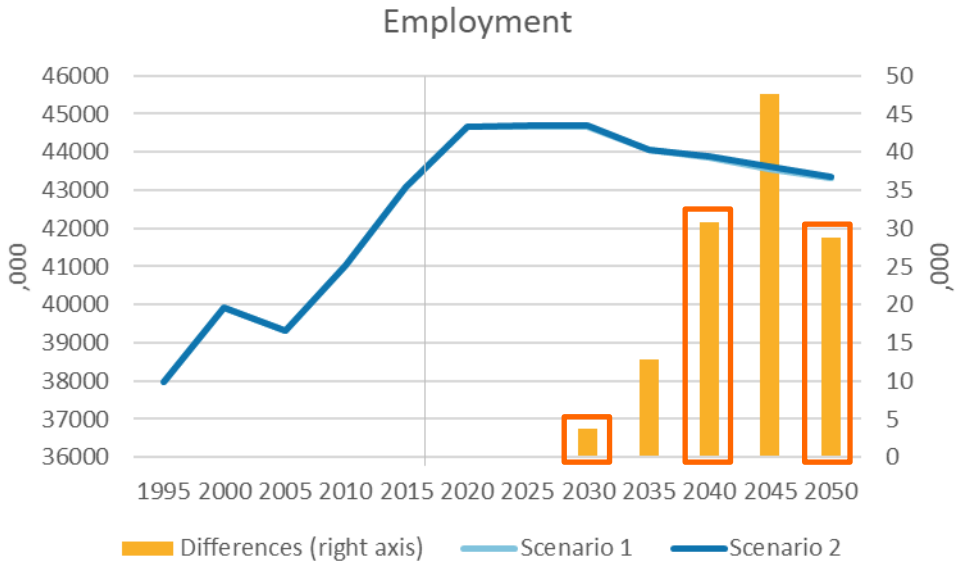
3. Results

National results

- Two integrated scenarios: only power generation in this analysis
- Total, national
  - ⇨ GDP in Scenario 6 (more ambitious) is slightly higher
  - ⇨ Differences are below +0.5 percent and highest in 2040
  - ⇨ Differences employment:
    +0.01 % 2030
    +0.07 % 2040
    +0.07 % 2050





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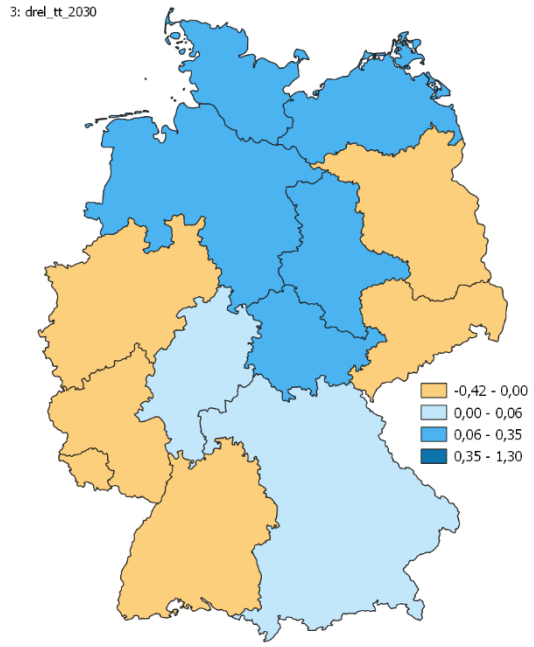
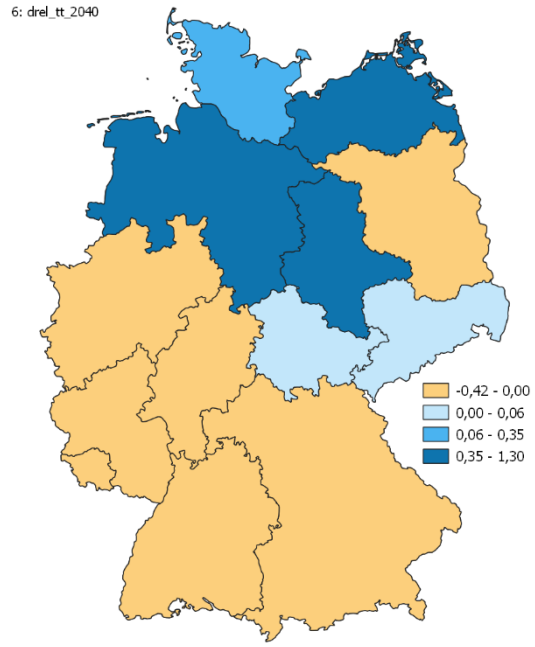
Regional total impacts – jobs

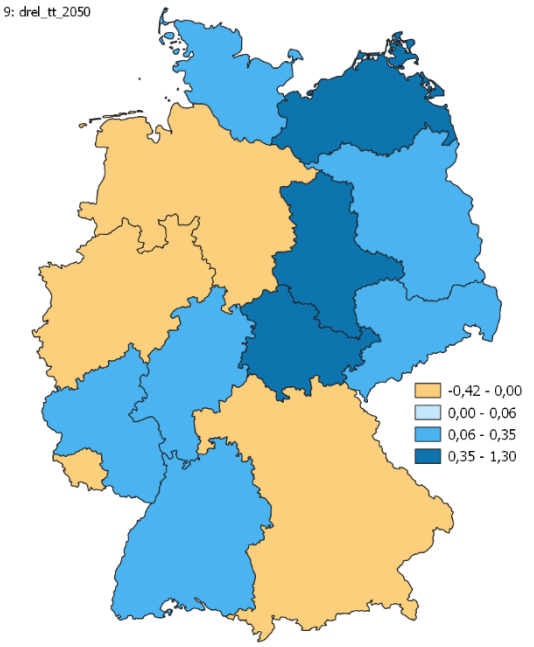
Relative difference, in %



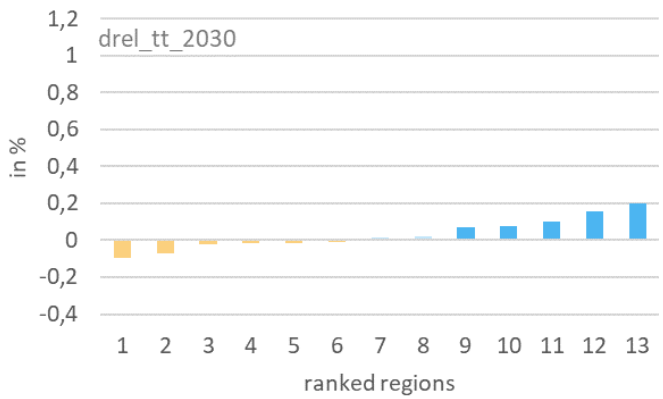
2030

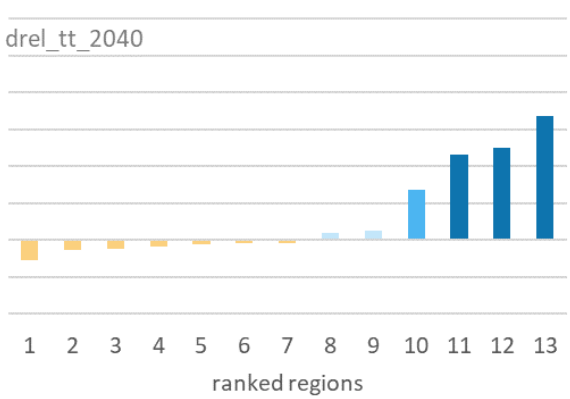


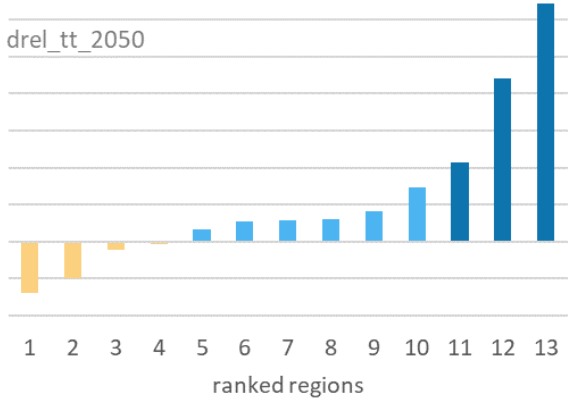
2040



2050





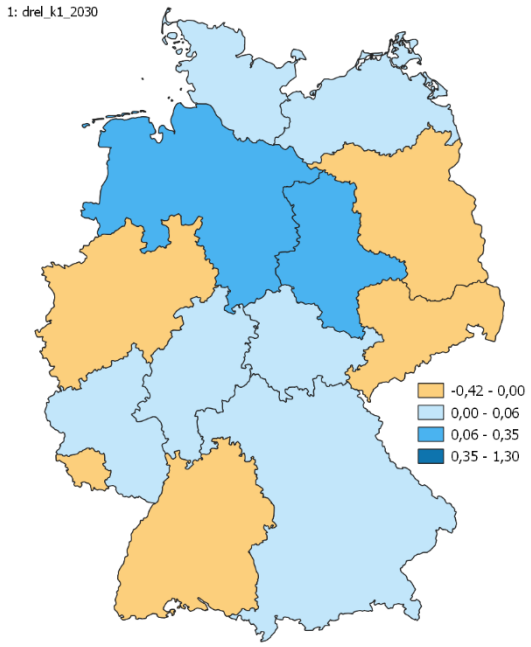


Two effect components – two models

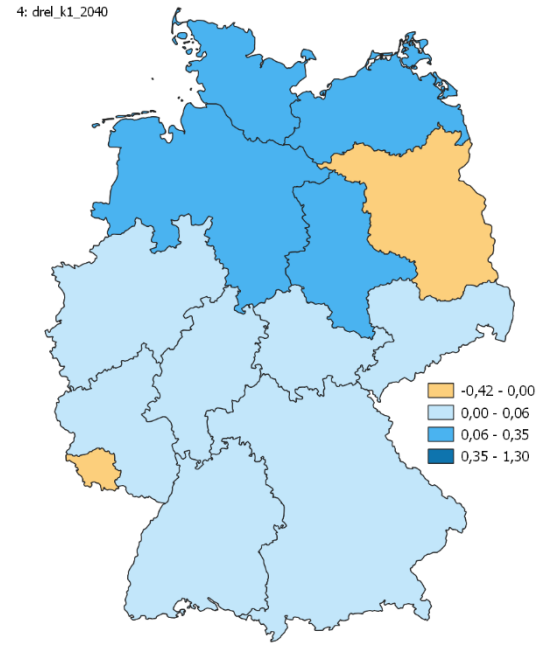
Basic assumptions and main drivers	Total national investment in 9 technologies, Shift in power generation	
	Overall change of economic structure (regional and national)	Only investment and regional capacities
Regional assumption investment	Regional distribution equivalent to sectoral demand triggered by RE-investment	Regional distribution given by regional assumptions (sensitivities possible)
Decisive cause-effect relationships	-Regional importance of energy sector a.o. -Regional power generation mix	-Location of facility manufacturers -Input goods and related sector and fit to regional economic structure
Model	PANTA RHEI – LÄNDER	hyBRID
Principle of regional estimation	Top-down	Regional balancing

Results from the macroeconomic model

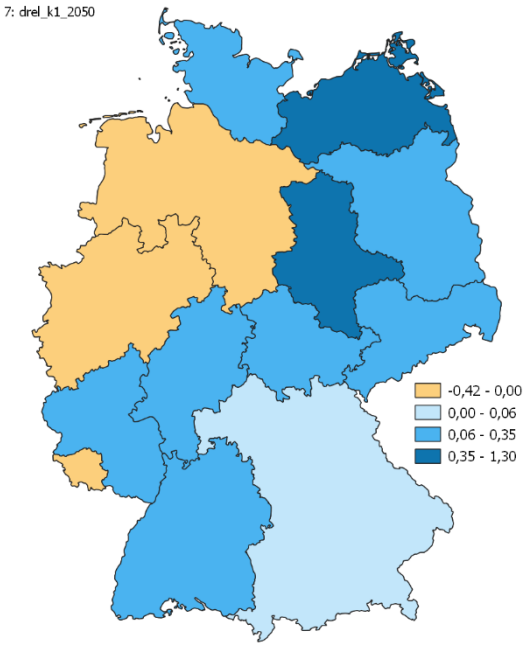
Relative difference, in %



2030



2040



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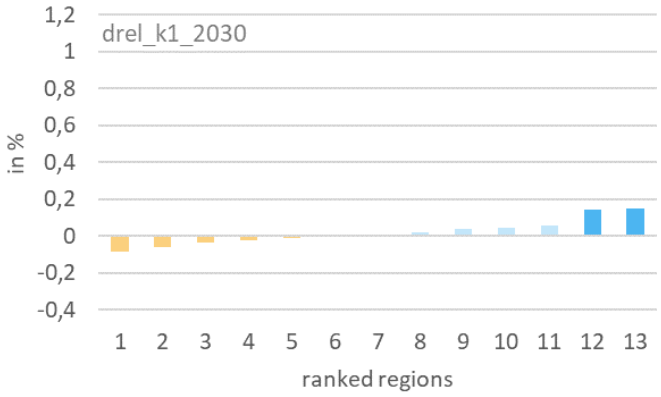
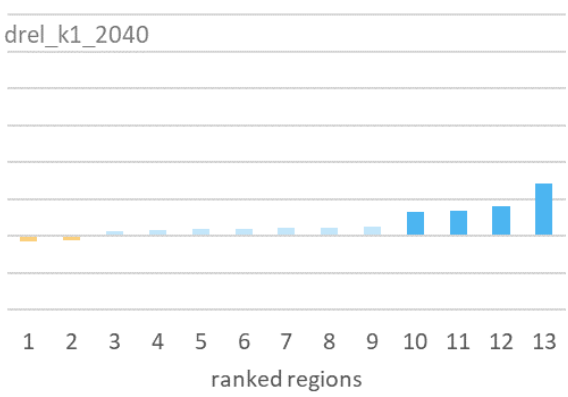
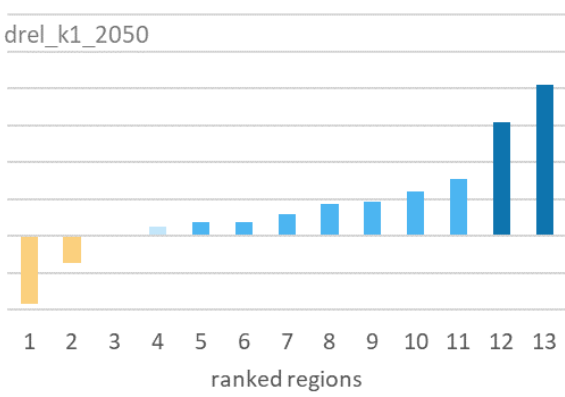
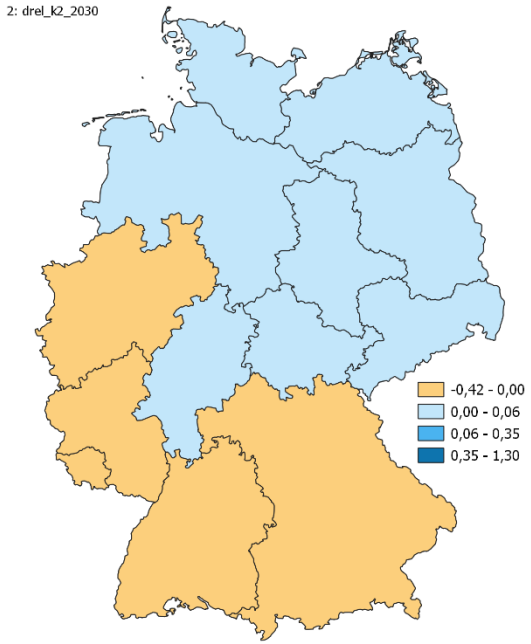






Redistribution of impact with hyBRID

Relative difference, in %



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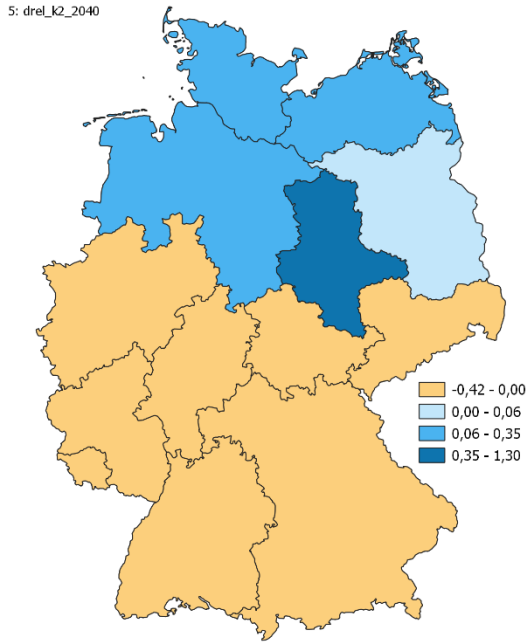

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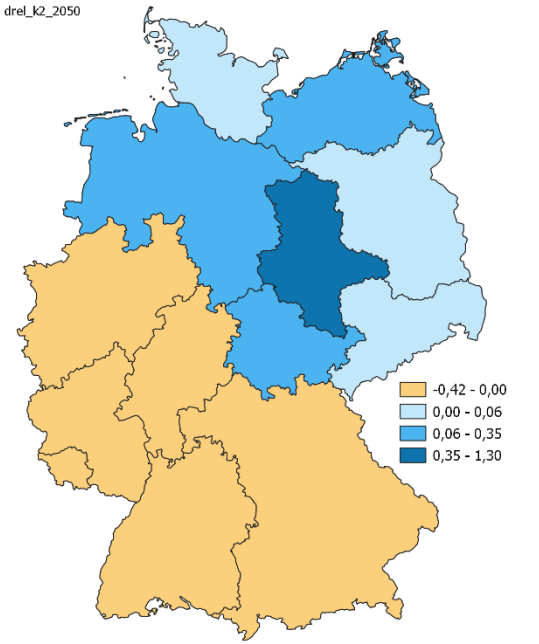

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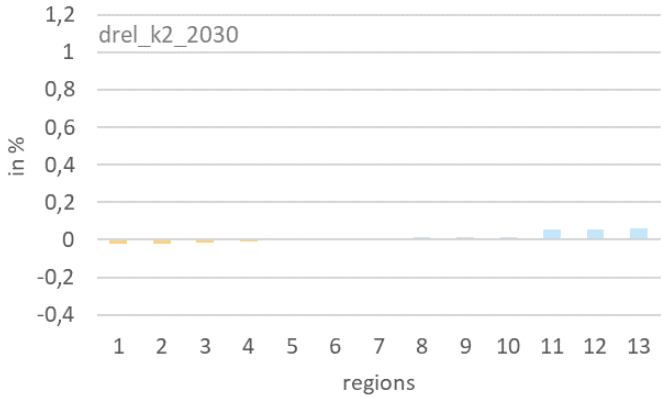

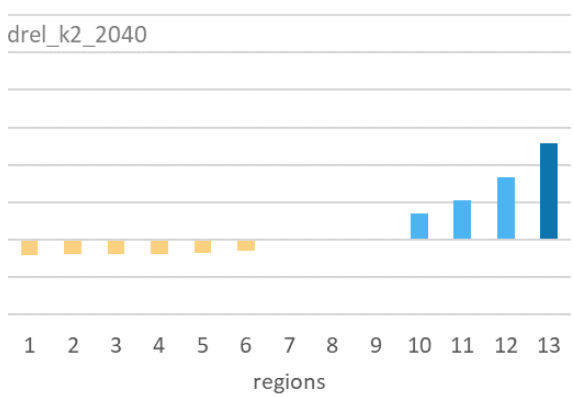

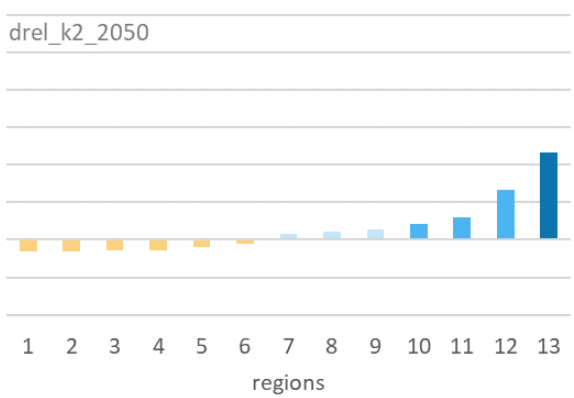

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4. Conclusions

Conclusions (so far)

- Pathways to a more sustainable energy supply can be very different
- Different climate protection scenarios: the differences at the macroeconomic level are rather small. As a result, questions of distribution become more important.
- The regional distribution of investments in Germany has a high influence on the overall effects
- Assumptions on the future regional distribution of investments are also characterized by a high degree of uncertainty.
- Policy-makers could also focus here on the structural impact of the investments in a regional context. Social sustainability can also be supported by guidelines on the regional distribution of investments (SDG 10 and 11).

Potential further research

- Changes in regional manufacturing / market shares
- Lignite Mining and the phase-out of coal
- Integrated regional Input-Output-Assessment?
- More regional – rural-urban context

Literature:

- Ulrich, P. & Lehr, U. (2018): Erneuerbar beschäftigt in den Bundesländern – Bericht zur aktualisierten Abschätzung der Bruttobeschäftigung 2016 in den Bundesländern. GWS Research Report 2018/2, Osnabrück.
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Thank you for your attention.

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