

#### **REGIONAL IMPACTS**

#### 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
- Research project, funded by the Federal Ministry of Economic Affairs and Energy
- 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 carbonbased capacities
  - ⇒ Economic impacts by additional demand from investment
    - Local content and multipliers
- (Regional) economic structure (sectors and energy technologies) matters and influences
  - ⇒ Likelihood of direct impact of changes in the energy mix
  - ⇒ Impacts of additional investment
  - ⇒ Multiplicators of additional demand from investment



#### 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
    (→ PANTA RHEI)
  - ⇒ Previous study Ulrich / Lehr / Lutz (2018)

PANTA

# Modular structure of modelling



# RE-jobs (2016)

Results from hyBRID



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# Outline of two scenarios

- Scenario 1
  - ⇒ Energy transition "baseline"
  - ⇒ 80%-Reduction of GHG-Emissions
  - ⇔ Text
  - ⇒ Federal ministry of economic affairs and energy
- Scenario 6
  - Climate Protection Scenarios
    2050
  - ⇒ 95%-Reduction of GHG-Emissions
  - ⇒ 80%-Share of RE in power generation
  - ⇒ Federal Ministry for the Environment

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# **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



#### Regional allocation of investment



Investment



### 3. Results

## Results

► Total, national



# Regional total impacts - jobs

#### Relative difference, in %







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regions

6 7

8

1 2

3 4 5

9 10 11 12 13

1 2 3 4 5 6 7 8 9

Ljubljana, August 2019

regions

10 11 12 13

# Modular structure of modelling

![](_page_13_Figure_1.jpeg)

## Results from the macroeconomic model

#### Relative difference, in %

![](_page_14_Figure_2.jpeg)

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9 10 11 12 13

2050

6 7 8

regions

0,06 - 0,35

0,35 - 1,30

0,00 - 0,06

## Redistributed with hyBRID

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![](_page_15_Figure_2.jpeg)

![](_page_15_Figure_3.jpeg)

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### 4. Conclusions

## Conclusions

- There are many different pathways to a low-carbon energy system and comparative analysis shows different economic effects
- Different regional structures in power generation in this context – lead to major regional shifts in the energy supply sector and different regional economic effects
  - ⇒ slow process with rather stable effect distributions
- Regional distribution of investment and its structure lead to regionally-differentiated effects on the regional economy
  - ⇒ unevenly distributed effects
  - ⇒ only for a few region it is the major effect component
- Regions in eastern Germany profit most from a more ambitious transformation in the power generating sector

# Potential further research

- Integrated regional Input-Output-Assessment?
- ► More regional rural-urban context
- Changes in regional manufacturing / market shares

**CONTACT PERSON** 

#### Thank you for your attention.

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