Dialog zur Klimaökonomie

IfW KIEL INSTITUTE FOR THE WORLD ECONOMY

Dialogue on the Economics of Climate Change

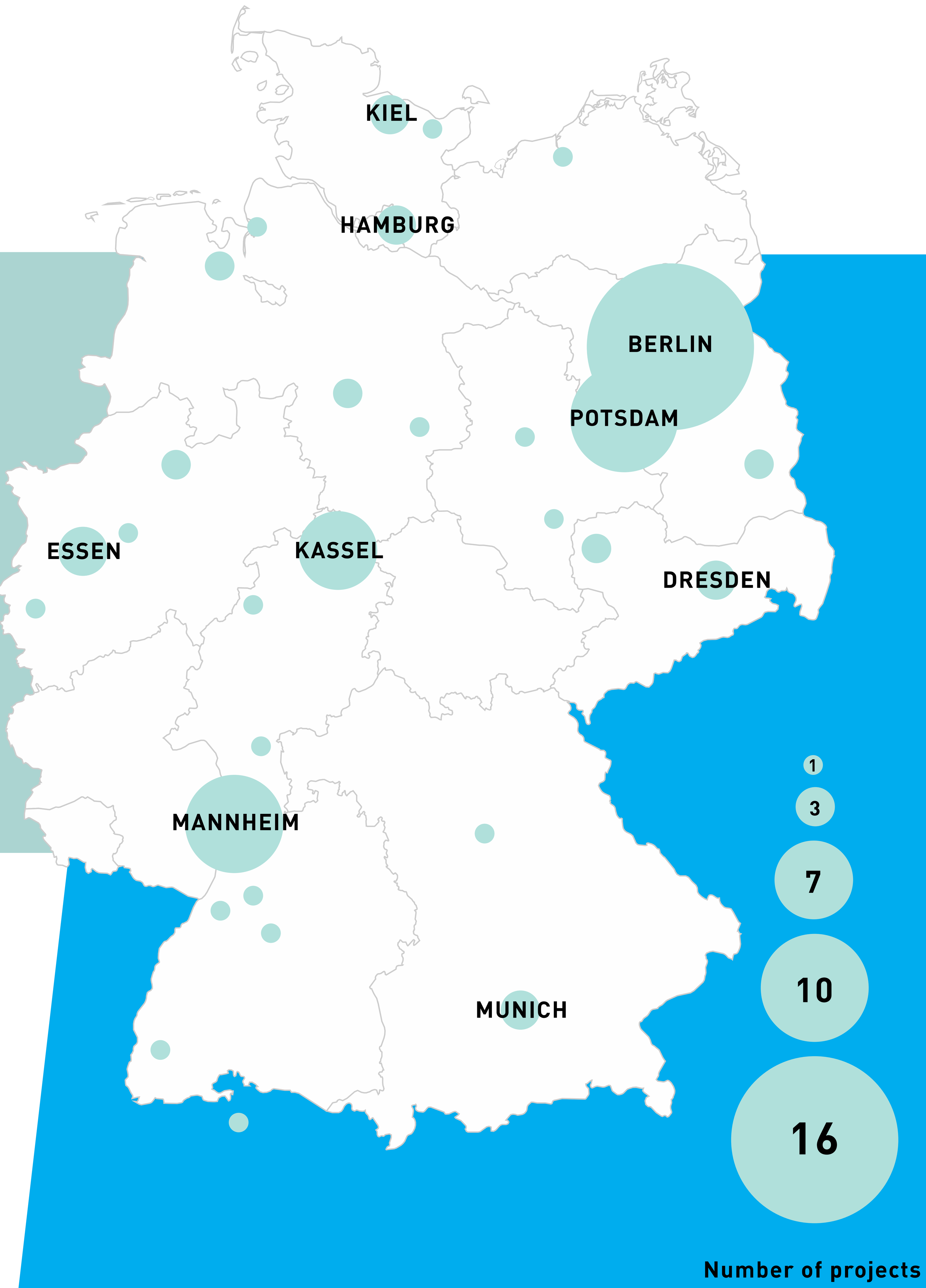
Prof. Gernot Klepper Ph.D. // Dr. Christine Merk // Dr. Andrea Franke
Kiel Institute for the World Economy (IfW)

Background

- The Dialogue on the Economics of Climate Change is the accompanying process to the BMBF funding measure **Economics of Climate Change II**
- The Dialogue is coordinated by the Kiel Institute for the World Economy (IfW)

The funding measure´s 29 consortia with 87 projects are organized in four main themes and a cross-cutting theme:

1. Climate protection & transformation
2. Climate protection: Instruments and policies after COP21
3. Dealing with climate risks
4. International climate policy
5. *Cross-cutting theme:*
   Financial markets, financial sector and climate finance



Goals

- Facilitate a dialogue between scientists and non-academic stakeholders
- Promote integrated, solution-oriented research
- Enable knowledge transfer among scientists and with practitioners
- Support the education of early career researchers
- Strengthen internationalization

Activities

- Organization of events that will enable the exchange between researchers and stakeholders from government, business and civil society on current topics in climate policy (e.g. Climate Fora)
- Contribution to well established formats (e.g. EAERE pre-Conference, side-events at COPs)
- Thematic workshops and workshops for early career researchers

The activities are steered by the Executive Board – representing the themes – & the Advisory Board – representing societal stakeholders.

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Contact: Gernot Klepper, Christine Merk & Andrea Franke // **klimaforum@ifw-kiel.de**

BeSmart

UNIKASSEL VERSITÄT

Smart-metering and dynamic electricity tariffing: energy consumption choices, regulatory policies and welfare effects [BeSmart]

Ipek Eraydin, Gerrit Gräper, Elke D. Groh, Victor v. Loessl, Leo Florian Reuter, Prof. Dr. Georg v. Wangenheim, Prof. Dr. Heike Wetzel and Prof. Dr. Andreas Ziegler (University of Kassel), Dr. Christian Gambardella and Dr. Michael Pahle (Potsdam Institute for Climate Impact Research)

Background

How to optimize adoption of dynamic electricity pricing in low-carbon electricity markets with mis-optimizing consumers?

- Integration of variable renewable electricity supply needs responsive demand
- Dynamic retail pricing can induce demand response to rapidly changing supply conditions
- Energy consumers often prone to biased decision-making
- Behavioral biases such as inattention, loss aversion or status-quo dependence
- Complexity of retail contracts and privacy concerns
- Hence, potentially non-optimal adoption of dynamic retail pricing schemes

Research Design

WP 1: Model of biased electricity retail contract choices
- Incorporate inattention and status-quo bias in a discrete electricity tariff choice model
- Derive rules for measures to correct non-optimal tariff choices
- Derive statistics for estimating empirical welfare effects of corrective measures in WP 4

WP 2: Legal remedies
- Modeling rational agents with finite information capacity
- Impact of legal instruments on consumer tariff choice
- Identification of consumer-sided acceptance barriers for dynamic electricity tariffs

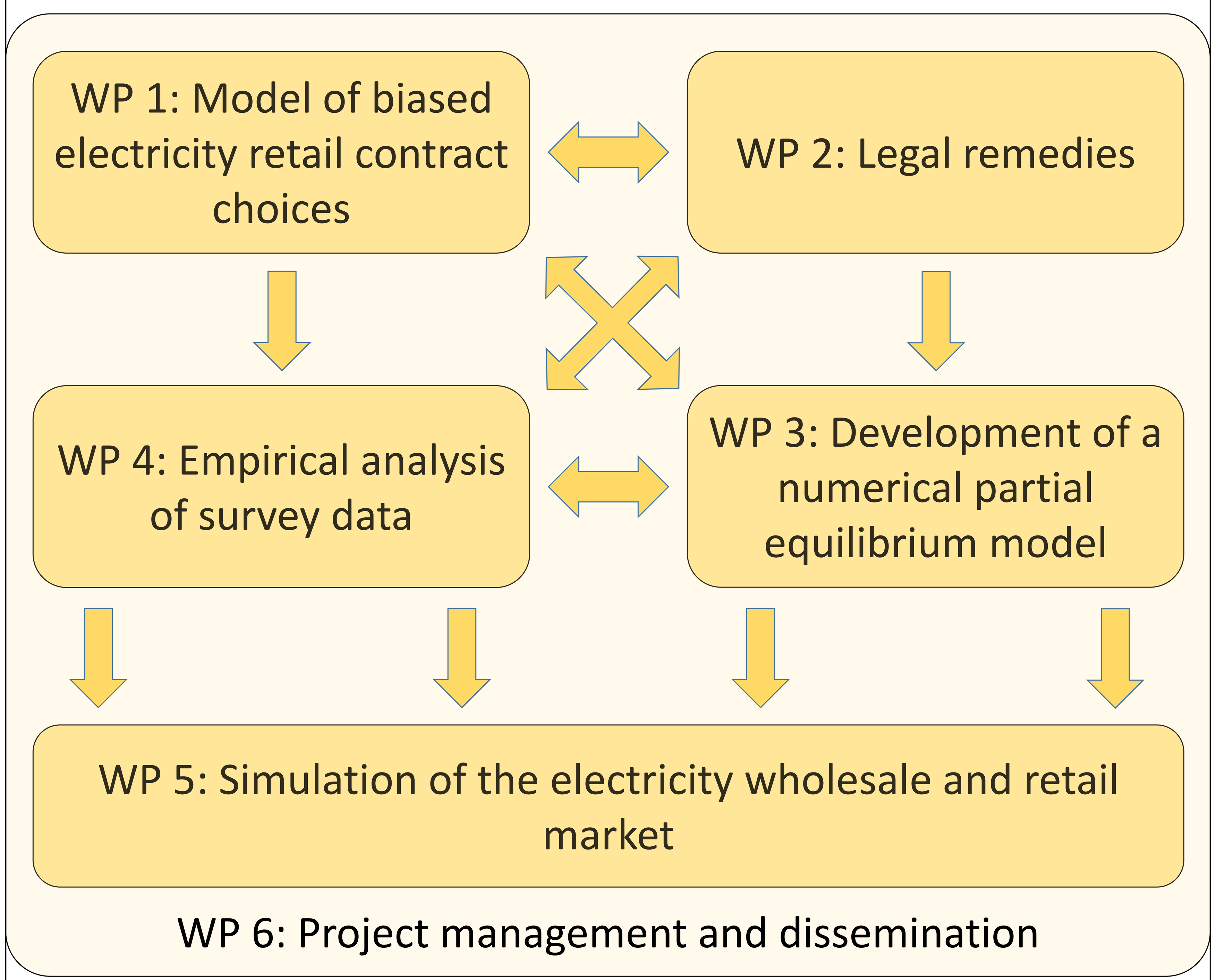
WP 3: Development of a numerical partial equilibrium model
- Computational electricity market model including biased retail tariff choices by heterogeneous consumers based on WP 1
- Welfare effects of non-optimal tariff choices
- Welfare effects of targeted and non-targeted policies to optimize dynamic pricing adoption

WP 4: Empirical analysis of survey data
- Representative household survey and a firm survey
- Stated choice experiment and econometric analysis
- Insights on preferences for dynamic electricity tariffs
- Derive Input for the numerical model in WP 3 and the simulations in WP 5

WP 5: Simulation of the electricity wholesale and retail market
- Calibration to tariff choice parameters estimated in WP 4
- Quantitative welfare analyses of correcting biased tariff choices
- Applying existing renewable generation and electrification scenarios for achieving 2050 carbon emission mitigation targets

WP 6: Project management and dissemination
- Administrative coordination and homepage design
- Workshops, information exchange with the advisory board, and active participation in the research support process
- Scientific publications, project reports, and policy briefs

Project Structure



Expected outcome and relevance

Expected outcome
- Development and empirical analysis of mechanisms for optimizing dynamic electricity pricing uptake
- Practical guidance for regulators and retail firms on dynamic electricity pricing roll-out in decarbonizing power markets

Relevance for climate policy
- Support grid integration of renewables
- Reduce peak load and thereby necessity for grid extension
- Enable sector coupling – especially regarding E-Mobility
- Reduce residential electricity costs – increase approval rate for the energy transition

Dialog zur Klimaökonomie

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CliDiTrans

Borderstep Institut für Innovation und Nachhaltigkeit
Wissen das bewegt.

ZEW

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Climate Protection Potentials of Digital Transformation

Micro- and Macroeconomic Evidence on the Role of Demand Effects and Relocations of Production in the Use of ICT (CliDiTrans)

Dr. Jens Clausen, Stefanie Schramm, Dr. Thomas Niebel, Janna Axenbeck

Starting Point

Information and communication technologies are constantly enabling new applications such as cloud computing, teleconferencing, big data analysis or the intelligent networking and automation of production processes (Industry 4.0). Consumption, work and production processes, even industrial structures, are being changed by digitization. Some studies predict that global CO2 emissions will be reduced by 20 percent through ICT until 2030. However, the analyzes do not consider two essential aspects of increasing digitization:

1. Digitization triggers changes in demand: New products and services are emerging or existing solutions are becoming qualitatively better and at the same time cheaper
2. The use of ICT solutions is associated with national and international shifts in production processes

Example

The IT sector promoted teleconferencing a lot: „Video is synonymous with environmental protection" - Cisco advertised in 2011. The Global e-Sustainability Initiative wrote in 2009: "… estimates have suggested that tele- and videoconferencing could replace between 5 and 20 percent of global business travel." Today, nearly all companies use telephone-conferences and about half make use of video- or web-conferencing. Nevertheless, real travel activity increased sharply.

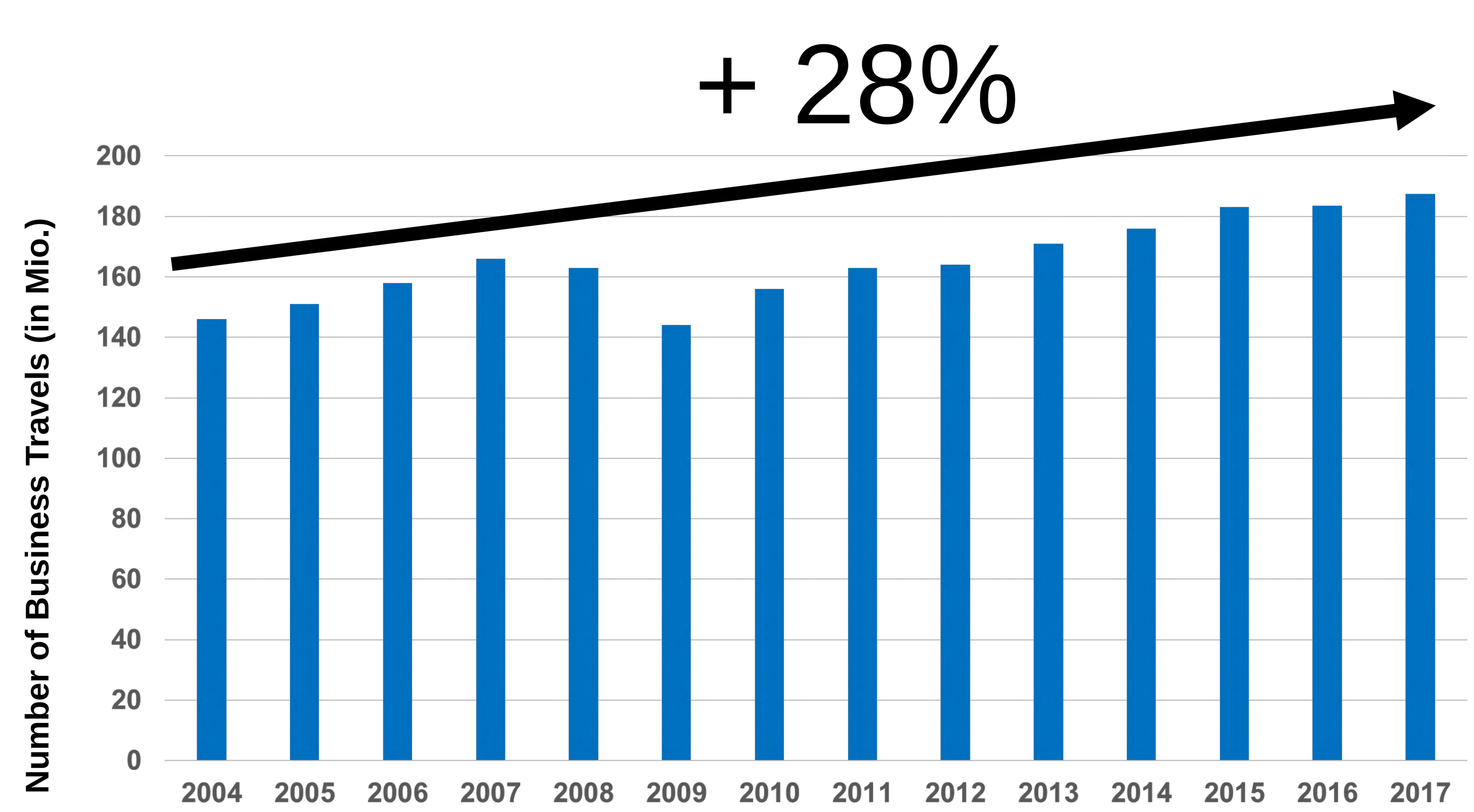

Figure 1: Development of Business Travels in Germany

Project Task

The project focuses on the question of whether digitization, with its effects on changes in behavior and production processes, leads to a reduction or to an increase in global CO_2 emissions. In CliDiTrans, climate protection effects of digitization are analyzed on the basis of case studies as well as micro- and macroeconomic considerations.

The analyses will shed a new, possibly more critical light on the contribution of digitization to climate protection. The results will be discussed with relevant stakeholders from politics, public authorities, business, science and civil society and presented in four policy papers, primarily aimed at actors in the political arena. In addition, the project results will be presented at international conferences and the publication in peer-reviewed journals will be sought.

Dialog zur Klimaökonomie

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Brandenburg University of Technology Cottbus - Senftenberg

TECHNISCHE UNIVERSITÄT DRESDEN

INSTITUTE FOR ECOLOGICAL ECONOMY RESEARCH

IWH Halle Institute for Economic Research Member of the Leibniz Association

Mobilising Endogenous Potentials for Structural Change - Decarbonisation in a Lignite Mining Region (DecarbLau)

Prof. Dr. Berger, Wolfram[1]; Dr. Brachert, Matthias[4]; Großmann, Doreen[1]; Heinbach, Katharina[3]; Prof. Dr. Hirschl, Bernd[1,3]; Jaw, Cheng-Wen[1]; Dr. Leuner, Bruna[1]; Dr. Markwardt, Gunther[2]; Prof. Dr. Müsgens, Felix[1]; Nagel, Marius[1]; Prof. Dr. Schnellenbach, Jan[1]; Schwarzer, Amelie[2] ;Scholz, Daniel[1]; Dr. Titze, Mirko[4]; Prof. Dr. Zundel, Stefan (project coordinator)[1]

[1]Brandenburg University of Technology Cottbus-Senftenberg (BTU), Cottbus and Senftenberg, Germany
[2]Technische Universität Dresden (TU Dresden), Dresden, Germany
[3]Intitute for Ecological Economy Research (IÖW), Berlin, Germany
[4]Halle Institute for Economic Research (IWH), Halle, Germany

Introduction

- The project region Lusatia is a structurally weak region.
- Its growth rate, employment level and per capita productivity are below average in comparison with other German regions.
- The Commission Growth, Structural Change and Employment recommends a gradual phasing-out of coal by 2038.
- This phasing-out of coal affects a region that has already had to cope with a massive structural break after the German Reunification.
- Between 15,000 and 20,000 jobs are directly and indirectly affected by the phasing-out.
- Therefore, a proactive structural policy is necessary, to prevent the loss of economic potential and to increase the acceptance of the phasing-out of lignite-fired power generation.
- A successful ecological and economic management of the transformation process in Lusatia can serve as a model for other regions and sectors.

Conveyor bridge and floating buildings on the former opencast mine on Lake Geierswald

Sub Projects & Working Steps

SP 1 • **Scenarios:** Identification of different development paths in the lignite sector (employment effects).

SP 2 • **Development potentials:** Analysis of the regional economic potentials within and beyond the energy industryas a basis for *smart specialisation.*

SP 3 • **Governance:** Identification of a governance structure that can effectively support the regional innovation system of Lusatia.

SP 4 • **Strategies, instruments:** Determining the best way that state-support can promote the activation of economic potentials.

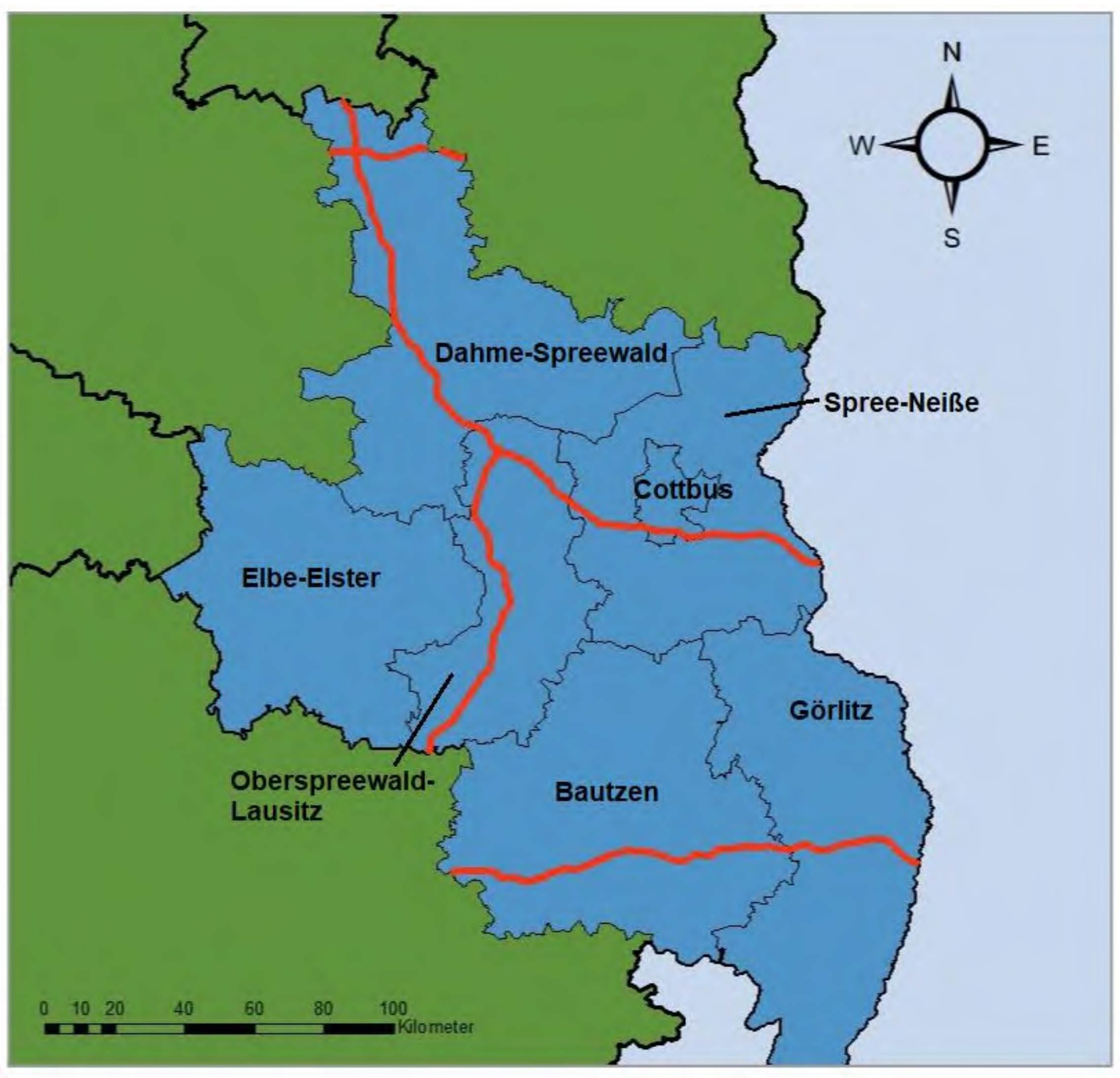
SP 5 • **Demography and finance:** Determining the financial scope of the local municipalities.

SP 6: Actors' perspectives: Mirror and corrective for the other sub-projects by providing the actors' perspectives and experiences through case studies.

Goal Definition

1. Model-based estimation w.r.t. possible job effects of different development paths of the coal phasing-out.
2. Identification of endogenous development potentials within and outside the energy industry *(smart specialisation).*
3. Evaluation of institutional arrangements to activate and develop these potentials and, where appropriate, proposals for reform.
4. Analysis and design of instruments and support programmes for structural development in Lusatia.
5. Analysis of municipal performance, with particular reference to regional public finance and demographic development, with a view to maintaining the quality of life in the region.
6. Strengthening stakeholder participation in regional structural development.

Project Region: Lusatia



Population: 1,165,246

Biggest cities:
- Cottbus
- Görlitz
- Bautzen
- Hoyerswerda

GDP per capita:
27,049€ (GER: 38,180€)

Unemployment rate:
7.4% (GER: 5.22%)

Monthly disposable income:
1,548€ (GER: 1,787€)

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Decarbonization of the building heat sector (DeGeb)

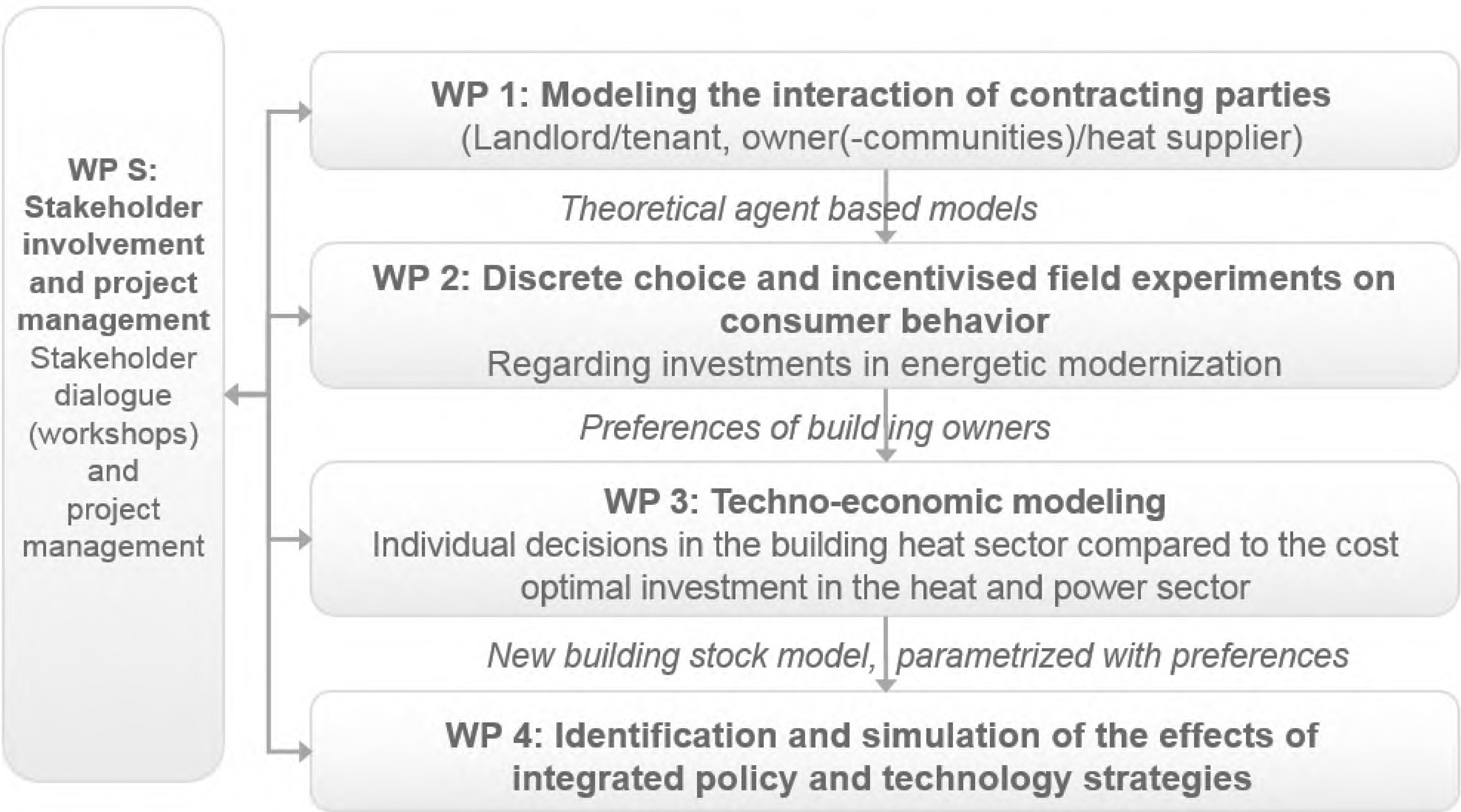
Matthias Deutsch, Senior Associate at Agora Energiewende
Alexandra Langenheld, Senior Associate at Agora Energiewende
Georg Thomaßen, Analyst at Agora Energiewende

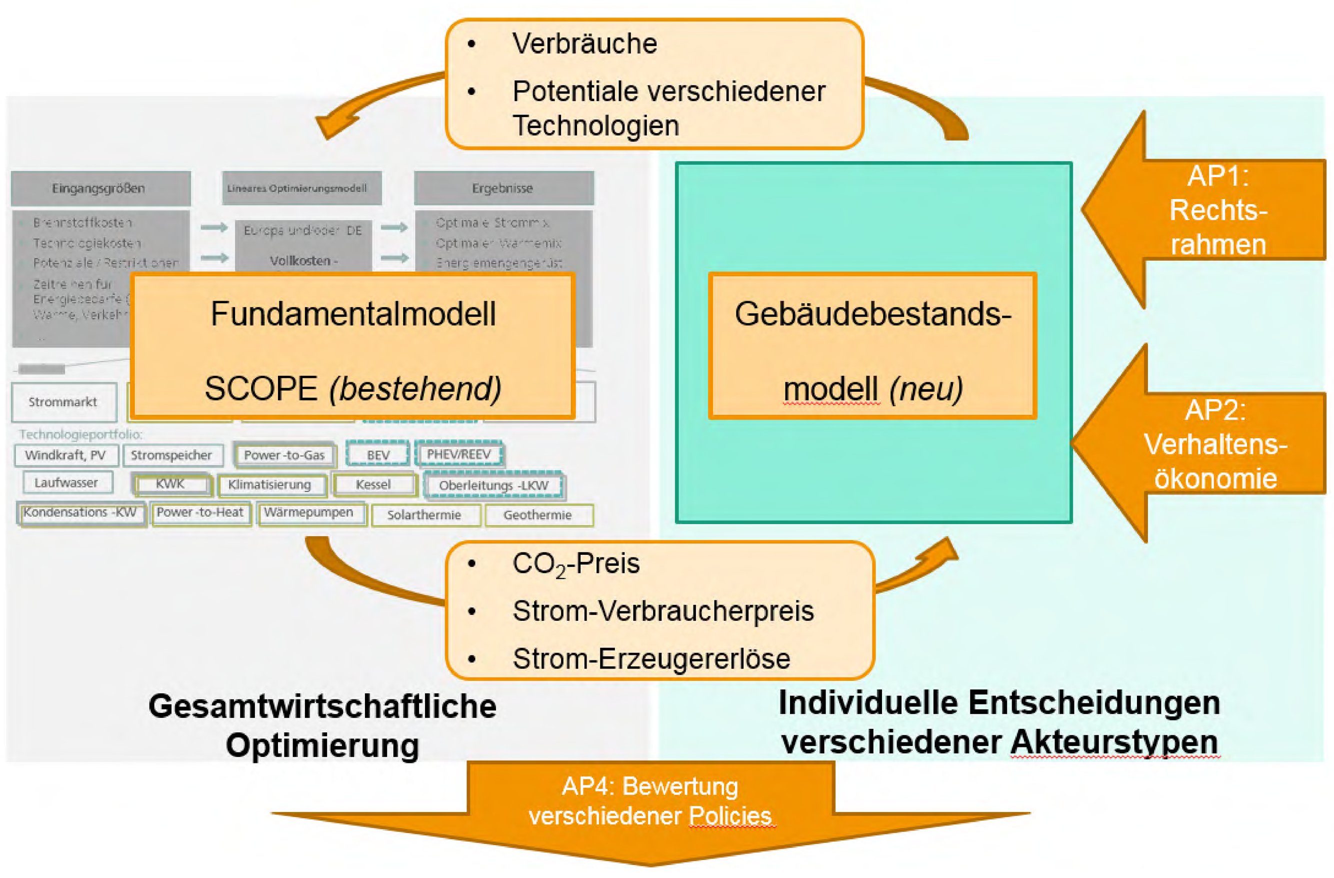
Research objective

Heating of residential and non-residential buildings is a major source of CO2 emissions in Germany. Buildings and heat systems are a long-living asset with the risk of path dependencies, which makes decarbonization in this sector a challenge. The effectiveness of options, such as energy efficiency and renewable energy, depends on the extent to which they are actually chosen by property owners. That is, it relies on incentives structures and the underlying regulatory framework, including both public and private law. Private law provides incentives to decarbonize (or not) by regulating the relationships between a variety of economic agents, such as landlords and tenants, residents and suppliers of heating appliances or district heating, and communities of joint heating-system owners.

Our research questions are: how do micro-incentives play out for the larger energy transformation of the building sector; what is the role of legal frameworks; how can decisions better be directed towards more sustainable building investment; and what can be learned from this for real-world policies and measures to become more effective?

The project's objective is to assess and compare the overall economic effects of alternative strategies for shaping the legal framework to decarbonize the building heat sector.





WP 1: Modelling the interaction of contracting parties (Lead: University of Kassel)

We start by developing theoretical microeconomic models of individual decisions within a legal framework. We consider legal change both in public law regulations and in contract law and its regulation, drawing on literature on markets with incomplete and asymmetric information as well as boundedly rational actors.

WP 2: Discrete choice and incentivized field experiments on consumer behavior (Lead: University of Kassel)

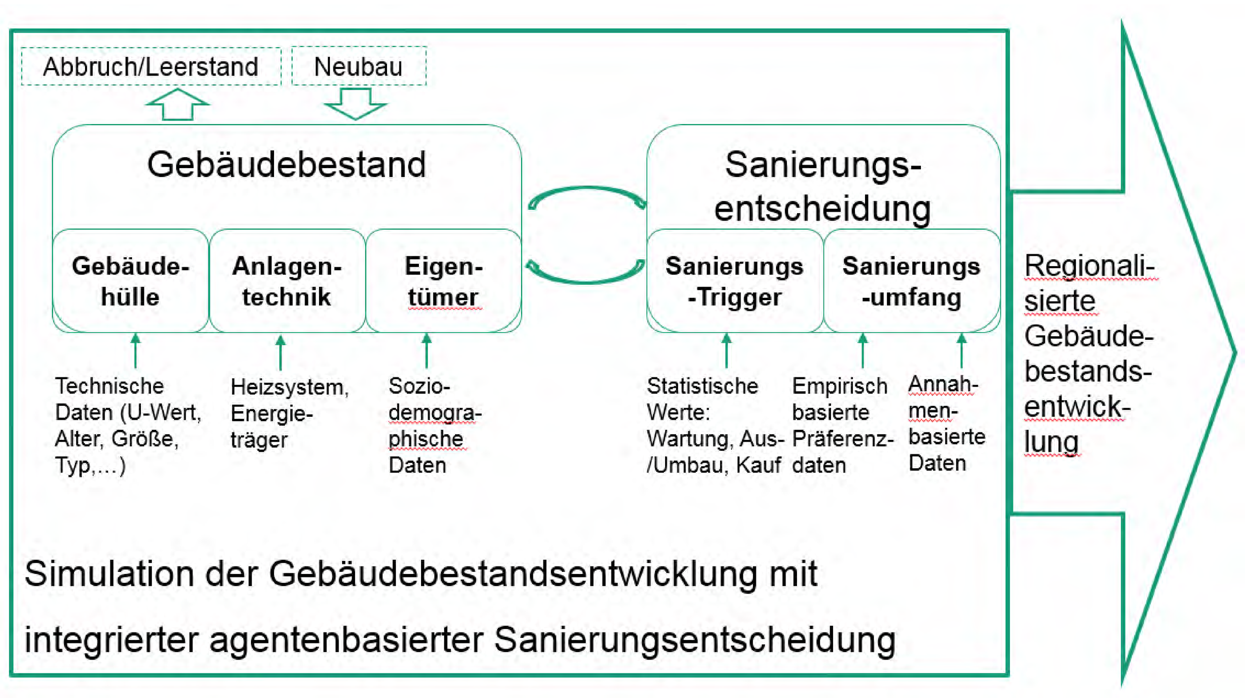
For calibrating the models, we implement a stated preference discrete choice experiment on hypothetical choices between several heating systems. To deepen the understanding of investment behavior, additional incentivized field experiments focusing on risk, time, and social preferences of the respondents are included. As a result, we obtain willingness-to-pay estimates and behavior-influencing factors.

WP 3: Techno-economic modeling of individual choices in the building heat sector (Lead: Fraunhofer IEE)

Those are fed into a new simulation model of the entire German heating building stock, including decentralized heat systems, heat networks, and actor groups to calculate the aggregate effect of agents' behavior.

WP 4: Identification and simulation of the effects of integrated policy and technology strategies (Lead: Agora Energiewende)

The outcomes are then compared with the results of an existing sector-integrated, large-scale optimization model of the entire German energy supply, and we reflect critically on the lessons to be learned from bottom-up and top-down modeling for real-world policy making and the promotion of building modernization.



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rwi Leibniz-Institut für Wirtschaftsforschung

Deep Transformation Scenarios for Informing the Climate Policy Discourse (**DIPOL**)

Elmar Kriegler[1], Dennis Tänzler[2], Colin Vance[3], Nico Bauer[1], Leon Merfort[1], Alexander Popp[1], Annekathrin Schoofs[3], Miodrag Stevanović[1], Jessica Strefler[1], Florian Wintermeyer[2], Emily Wright[2]

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Department of Environment & Resources

Relevance for Climate Policy

The **Paris Agreement** sets strong targets to prevent dangerous climate change and keep global mean temperature increase to well below 2°C. As explained by the IPCC Special Report on Global Warming of 1.5°C, “limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society”. Two milestones are particularly relevant for **Germany and Europe**:

- **the 2030 emissions reduction targets** determining the speed of replacement of fossil fuel-based energy consumption with renewable based energy
- **the mid-century transformation targets** towards the long-term goal of an emissions neutral economy.

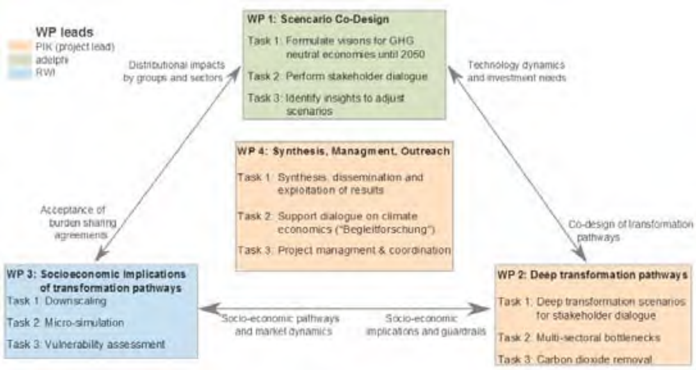

Figure 1 *Overview of the DIPOL project with Work Packages, tasks and interfaces.*

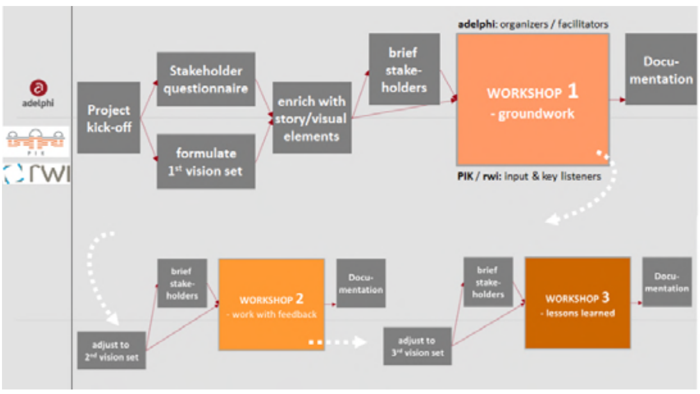

Figure 2 *Process of stakeholder dialogue reaching from groundwork (workshop 1) to work with feedback (workshop 2) and lessons learned (workshop 3).*

Aim

- Develop **climate change mitigation pathways** for Germany and Europe that are consistent with the climate targets.
- Bring together the scientific community with **key stakeholders** from policy making, business and civil society.
- **Co-develop** a set of **“pathway visions”** that incorporate stakeholder perspectives and are aligned with the Paris Agreement.

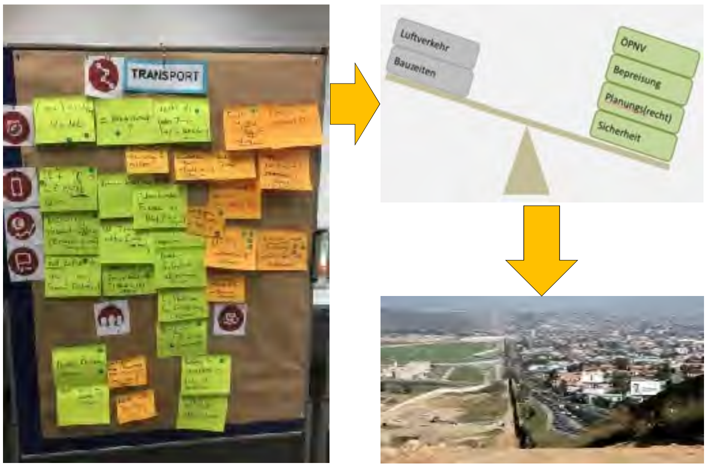

Figure 3 *Left: Picture from the 1st stakeholder workshop, Berlin, March 7, 2019. Right: Inputs from this workshop will feed into new transformation pathways.*

Results

- DIPOL will formulate concrete visions of **transformation pathways and their distributional impacts**, which are consistent with climate commitments and at the same time socially viable.
- **Support decision-making** processes and provide a direct contribution to various climate policy processes, including:
  - German Climate Action Plan 2050
  - EU Decarbonization Pathways Initiative (EDPI)
  - 2050 Pathways Platform of the United Nations Framework Convention on Climate Change (UNFCCC)
  - Sixth Assessment Report of the IPCC.

Duration: September 2018 – August 2021

Dialog zur Klimaökonomie

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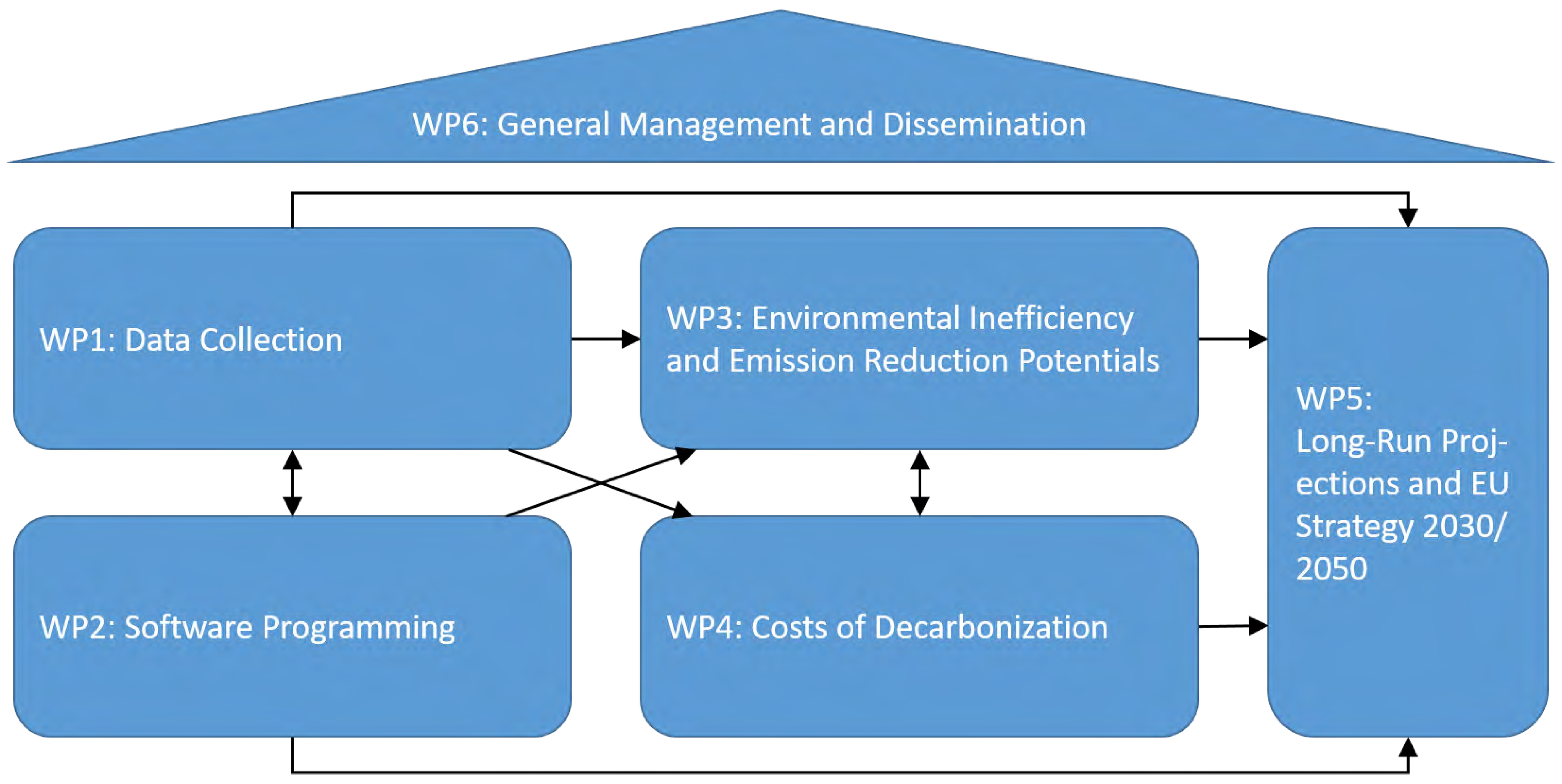
Macroeconomic Inefficiency and Emission Reduction Potentials: Accounting for Heterogeneous Industry Structures (*EcoEff*)

Prof. Dr. Jens Krüger – TU Darmstadt

Work Package 1 (Data Collection)

- Collection of data on inputs, outputs and pollutants
- Matching of industries from different sources using concordance tables
- Quality control by outlier removal and imputation of missing observations
- Harmonization of structure and organization of data
- Preparing the data for R and for the project homepage

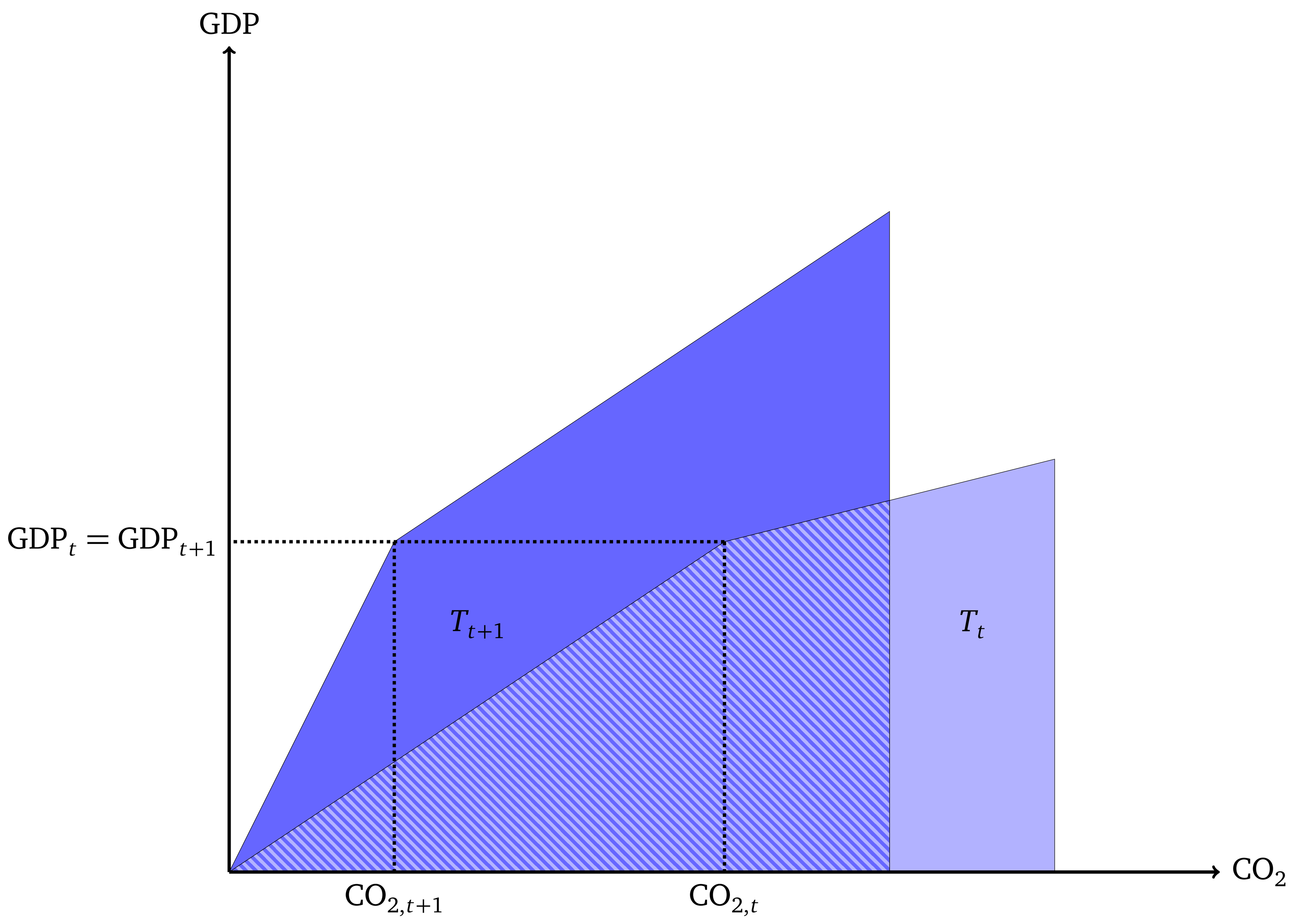


Work Package 2 (Software Programming)

- Programming of methods to estimate efficiency and reduction potentials using R
- Combining these methods with forecasting procedures for dynamic analyses
- Implementation of bootstrapping methods for statistical validation
- Preparation of the functions in R for download from the project homepage

Work Package 3 (Environmental Inefficiency and Emission Reduction Potentials)

- Estimation of environmental efficiency on industry- and country-level
- Quantification of reduction potentials for emissions
- Identification of short-, medium-, and long-run reduction potentials
- Estimation of confidence intervals (where possible)



Work Package 4 (Costs of Decarbonization)

- Quantification of abatement costs using shadow prices
- Comparison of cost differentials between efficient and inefficient industries
- Comparison of cost differentials between "clean" and "dirty" industries
- Quantification of the effects of decarbonization on distribution and competition

Work Package 5 (Long-Run Projections and EU Strategy 2030/2050)

- Estimation of dynamic changes in technical progress and inefficiency
- Scenario analysis of potential emission reductions until 2030/2050
- Comparison of projected reductions with the EU targets for 2030/2050
- Estimation of cost reductions due to technical progress
- Quantification of country- and industry-specific overall costs of decarbonization

$$\begin{aligned}
\max_{\delta,\boldsymbol{\alpha}_y,\boldsymbol{\alpha}_u,\boldsymbol{\lambda}} \quad & \delta \\
\text{s.t.} \quad & \boldsymbol{x}_i && \geq \boldsymbol{X\lambda} \\
& \boldsymbol{y}_i + \delta\boldsymbol{\alpha}_y \odot \boldsymbol{y}_i && \leq \boldsymbol{Y\lambda} \\
& \boldsymbol{u}_i - \delta\boldsymbol{\alpha}_u \odot \boldsymbol{u}_i && = \boldsymbol{U\lambda} \\
& \mathbf{1}'\boldsymbol{\alpha}_y + \mathbf{1}'\boldsymbol{\alpha}_u && = 1 \\
& \boldsymbol{\lambda}, \boldsymbol{\alpha}_y, \boldsymbol{\alpha}_u && \geq \mathbf{0}
\end{aligned}$$

Work Package 6 (General Management and Dissemination)

- Planning, designing and implementation of the project homepage
- Writing of project reports and scientific publications
- Preparation of policy briefs for stakeholders and other partners
- Participation in accompanying activities (like this here)

Dialog zur Klimaökonomie

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Future of Fossil Fuels

in the wake of greenhouse gas neutrality (FFF)

Hanna Brauers, Christan von Hirschhausen, Pao-Yu Oei (TU Berlin; CoalExit);
Wolf-Peter Schill, Alexander Zerrahn (DIW Berlin);
Sebastian Osorio, Michael Pahle (PIK)

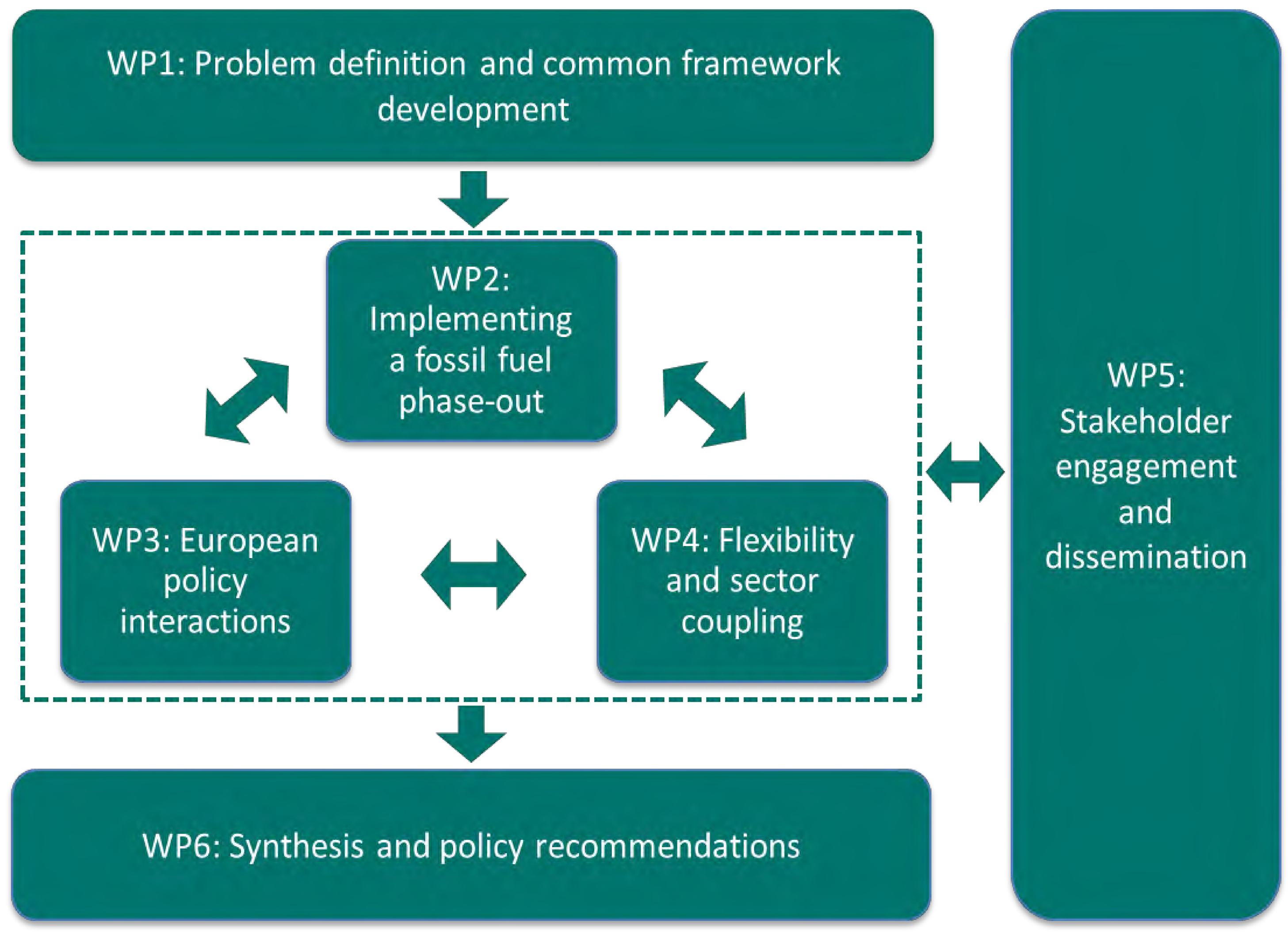
Project Duration: 2018 – 2021

ABSTRACT

In the project FFF, TU Berlin, PIK, and DIW Berlin investigate previously under-researched aspects of decarbonizing the German electricity sector in the European context. Specifically, FFF aims to derive an assessment of policy instruments for both the German and the European levels. In doing so, we consider a phase-out of all fossil fuels, in particular natural gas.

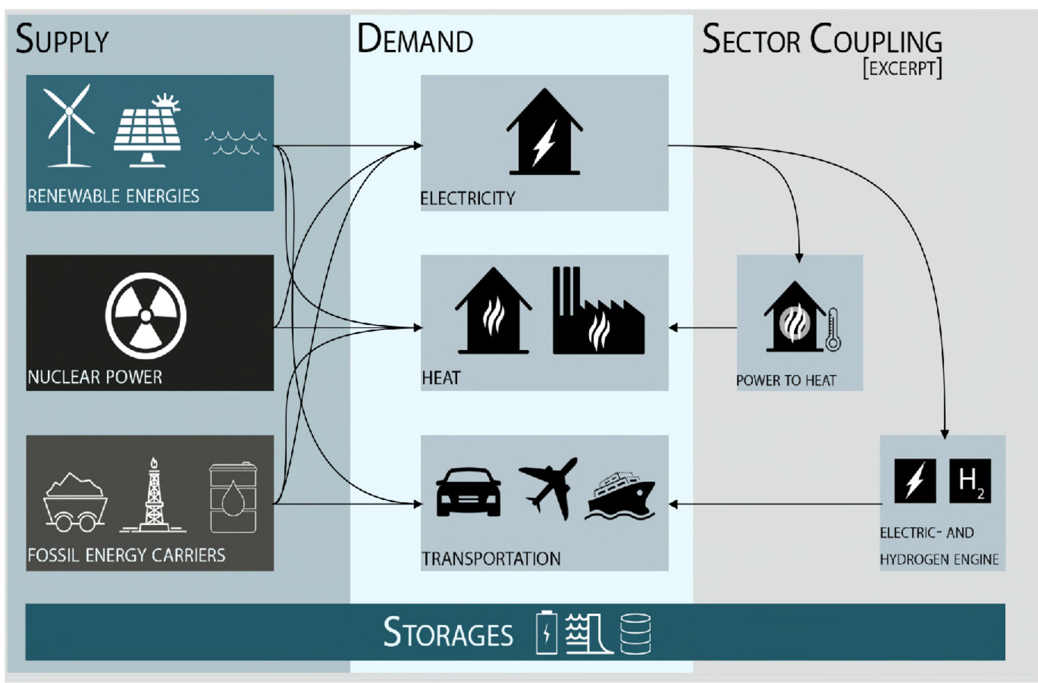
We focus on three aspects of the future of fossil fuels by, (1) identifying drivers and hurdles for implementing a European fossil fuel phase-out by 2050; (2) investigating how national phase-out pathways interact with European climate policies; and (3) analyzing interactions between a fossil fuel phase-out and power system flexibility requirements as well as the implications for sector coupling. Methodologically, the project builds on model-based analyses of the European power sector and case studies for Germany, the United Kingdom, Poland, and the Netherlands, which together account for more than half of coal and two thirds of gas demand in the EU.

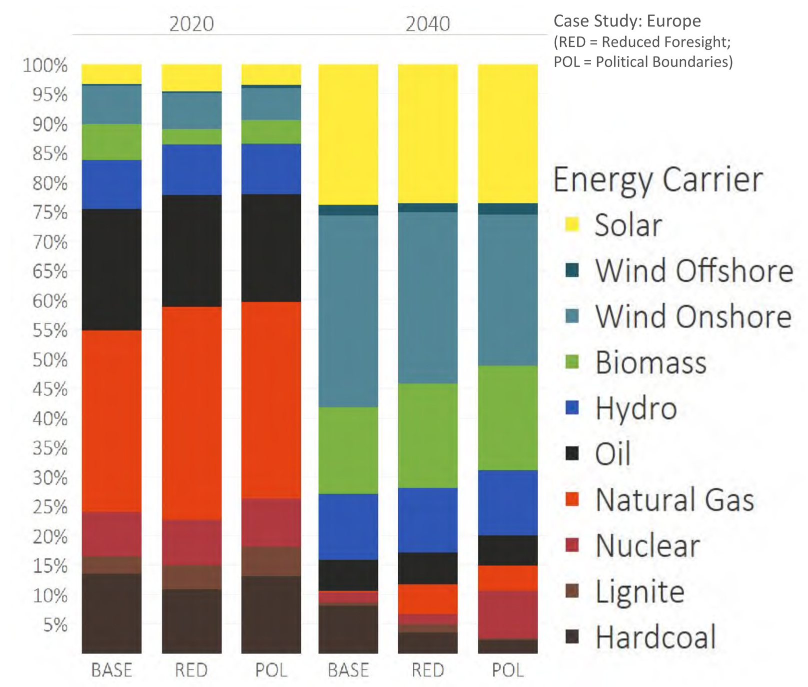
The innovative approach combines advanced methodology (numerical modeling, economic theory, econometrics, and political economy) with "hands-on" questions of current political decision making, considering relevant stakeholders in the German and the European context. Our contribution is application- and policy-oriented; we focus on the concrete challenge of disestablishing industries that produce and consume fossil fuels. Our products – scientific publications, regular stakeholder engagement formats, policy papers, and concrete policy advice – will stimulate the scientific and public debate on how to phase-out fossil fuels while minimizing negative side-effects and societal costs.

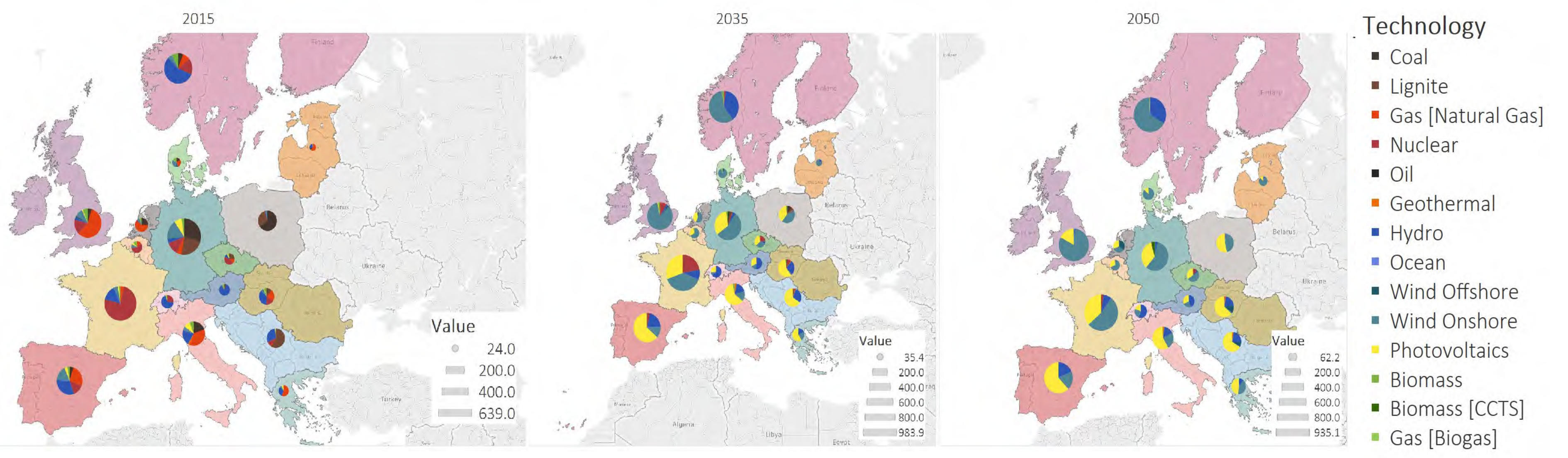


WP2: TECHNO-ECONOMIC ASSESSMENT OF A EUROPEAN FOSSIL FUEL PHASE-OUT

The Global Energy System Model (GENeSYS-MOD) – an application of the Open Source Energy Systems Model (OSeMOSYS)

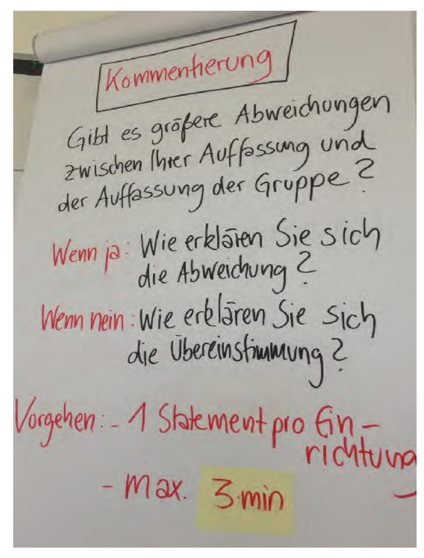


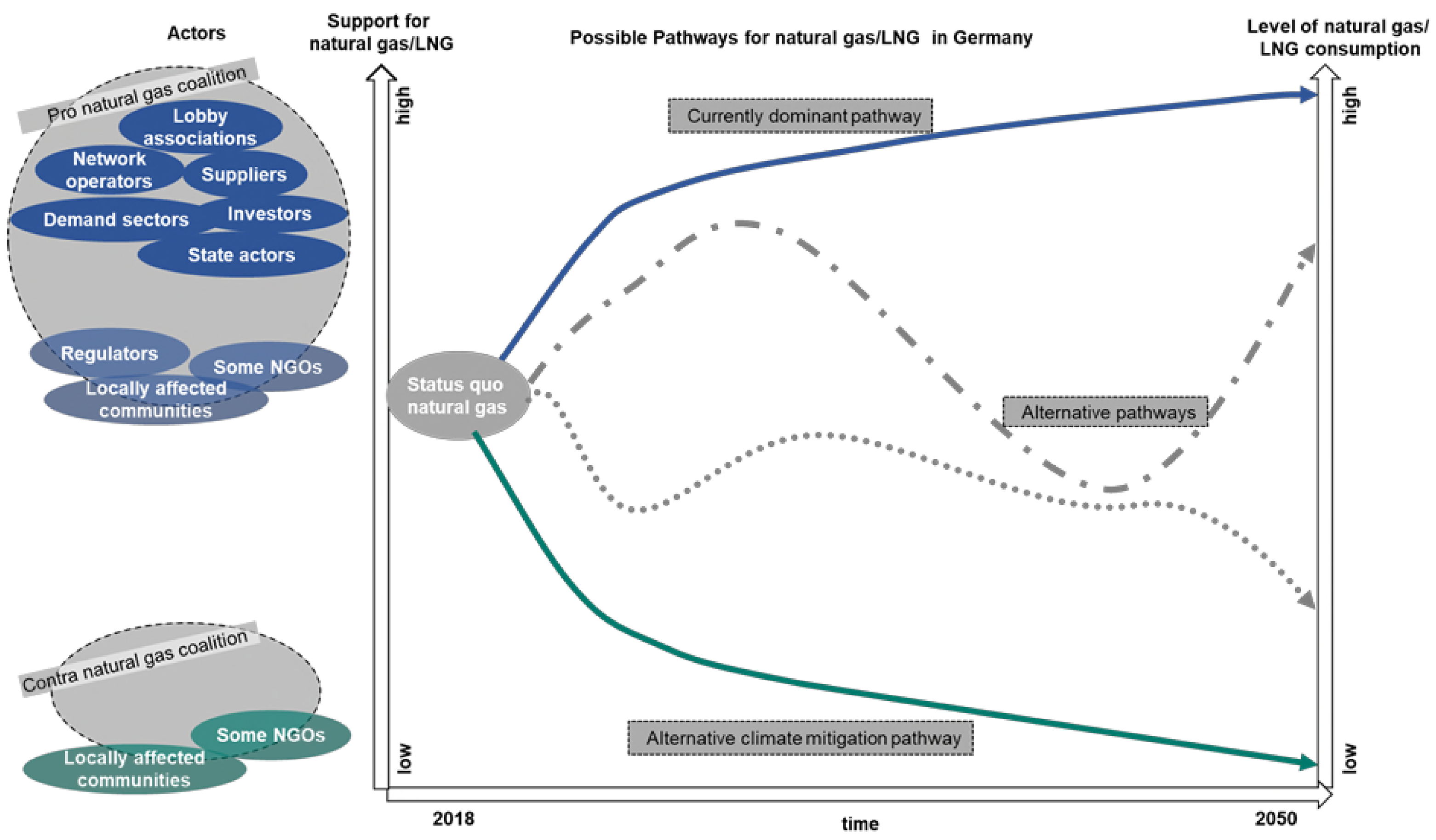




WP2: SOCIO-POLITICAL ASPECTS

Stakeholder discussions on possible pathways for (liquefied) natural gas and related actors

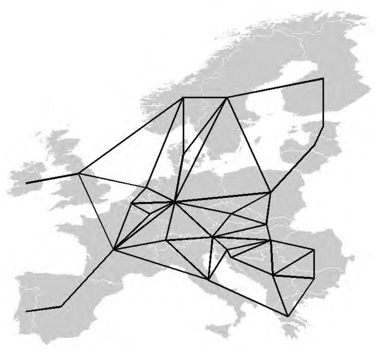




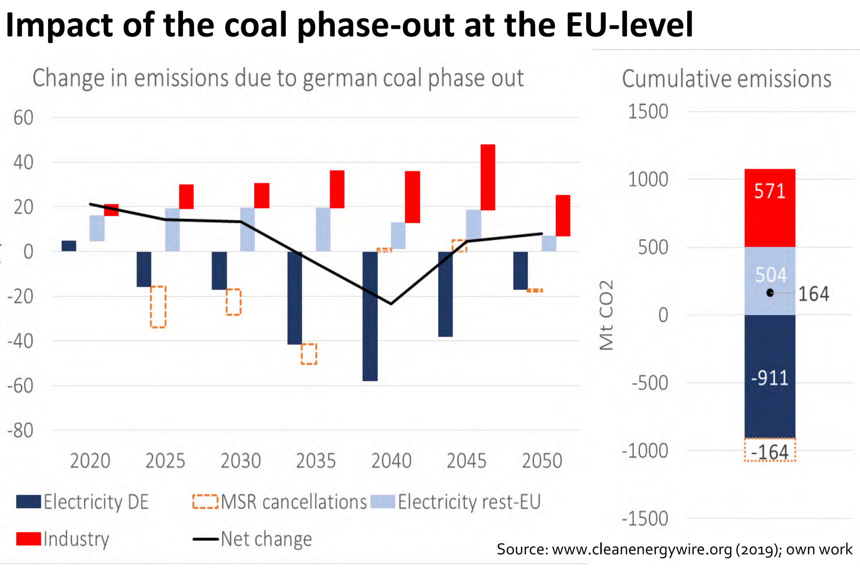
WP3: EUROPEAN POLICY INTERACTIONS

The Long-term Investment Model for the Electricity sector in Europe (LIMES-EU)

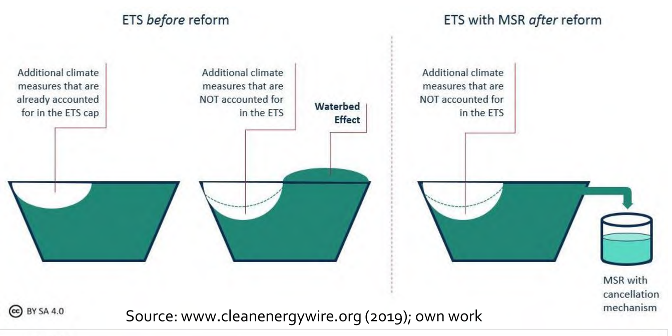
- Geographical scope: Europe (29 model regions)
  - EU (w/o MT and CY) + CH + NO + aggregated Balkan
- Detailed representation of electricity system
  - 33 generation and storage technologies
- EU ETS energy-intensive industry modelled through a marginal abatement cost curve
- Policy focus: EU ETS and MSR

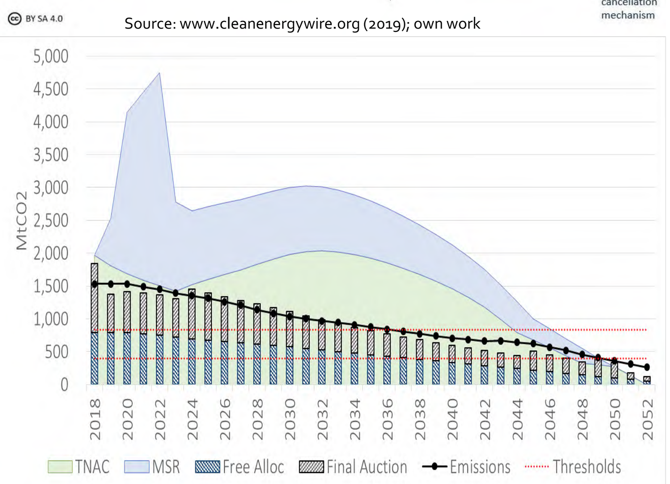


Impact of the coal phase-out at the EU-level



Impact of the market stability reserve?





Further research

- ➢ How do policies at the national- and EU-level interact in the presence of strong sector coupling?
- ➢ Will the MSR remove the waterbed effect?
- ➢ What policies could help mitigating the waterbed effect?

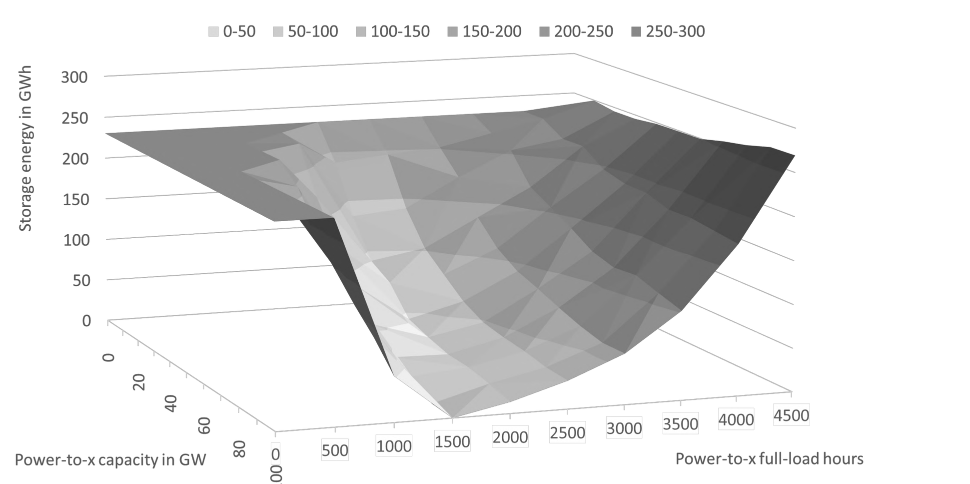
WP4: SECTOR COUPLING AND FLEXIBILITY REQUIREMENTS

Open-source power sector model DIETER

- Detailed analysis of German power sector in European context
- Long-term investment and dispatch model
- Representation of various options for flexibility and sector coupling
  - Electrical storage
  - Flexible demand
  - Sector coupling: heat, mobility, hydrogen

We build on own previous work on variable renewables and sector coupling

- Generic analysis of a power system with high shares of renewables (and some remaining fossil fuels)
- Stylized power-to-x technology
- If power-to-x is sufficiently flexible in time, it can substantially reduce required electrical storage capacities



Source: Zerrahn et al. (2018), https://doi.org/10.1016/j.euroecorev.2018.07.004

Further research

- ➢ How does a cost-efficient power system look like when fossil fuels are phased out?
- ➢ Focus on interactions of sector coupling technologies and storage: electric vehicles, power-to-gas
- ➢ Socio-economic aspects: econometric analyses

An additional aim of this project is to improve the coordination and research exchange between various (inter-)national research projects examining the expected phase-out pathways of fossil fuels as well as the corresponding social transitions. Please contact us if you are interested to engage in this endeavor.

This research is funded by the BMBF grant "economics of climate change".
Contact: Dr. Pao-Yu Oei: pyo@wip.tu-berlin.de | June 2019
Project Website: http://www.diw.de/fff

Investment Funds for low-carbon Infrastructure and their Implication for Climate Policy (IF)

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*Potsdam Institute for Climate Impact Research (PIK) – *Public Economics and Climate Finance*, #University of Kassel – *Empirical Economic Research*, §University of Kassel – *Corporate Finance*

Private sector finance will have a key role for the transition to a climate-neutral economy. It can provide finance for innovative, low or zero emissions alternatives in energy generation or energy efficient infrastructure, while managing the associated financial risks. But its success will depend on the available financial instruments. The IF project explores existing and novel instruments, their attractiveness for different groups of investor, and their potential within national climate policy.

Institutional investors are of particular interest, as they arguably favor the risk-return profile of infrastructure projects but have as of yet largely ignored green infrastructure. Small institutional as well as retail investors currently have very limited access to low-emission infrastructure investment.

Geographically, the project addresses EU Europe, with a focus on 5 representative countries in citizen surveys.

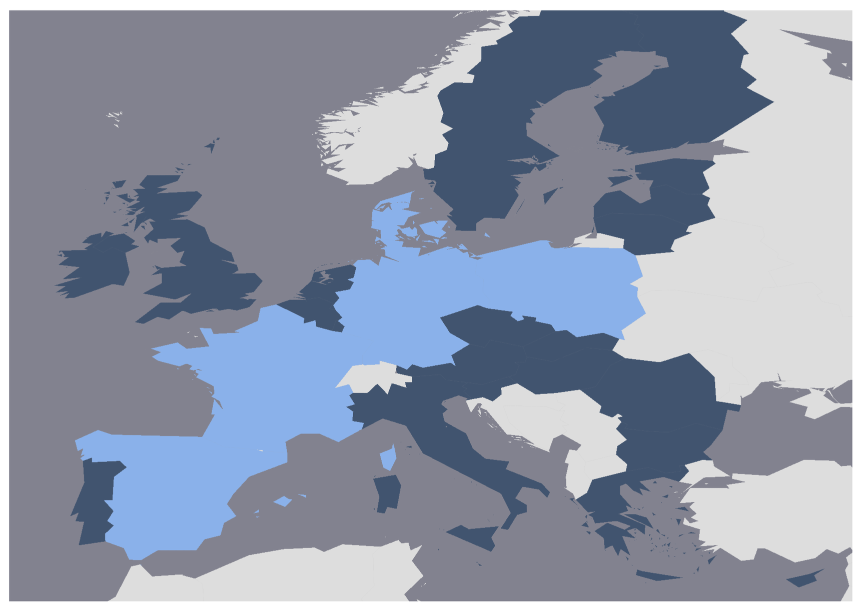

Fig. 1: Geographic focus of the project

What are the barriers to low-carbon infrastructure finance?

We want to identify which investment barriers are addressed by existing financial instruments and hypothetical novel instruments as well as how these investment instruments change the risk-return profiles of low-carbon infrastructure.

- We transfer lessons from the success factors of green bonds to public infrastructure funds
- We use energy and utility companies as a proxy for portfolios of low-carbon infrastructure investments

	Equity	Debt
Energy	- Infrastructure funds on stocks (13) - Participation rights (5) - Closed-end funds (2)	- Green Bond (3) - Crowdfunding (12) - Debenture (3)
Buildings	- Infrastructure funds on stocks (2)	- Green Bond (1) - Crowdfunding (3)

Fig. 2: Classification of low-carbon investment products (ongoing research)

Methods:

- **Building a database** of low carbon infrastructure investment products to identify their special characteristics and barriers
- **Econometric analysis** of the financial performance of green bonds and the influence of corporate social performance on corporate bond yields
- **Multifactor modeling** to understand the contribution of risk to low carbon infrastructure investments (i.e. utility companies)

Which investment products appeal to which investors?

To reveal the **relevance of barriers** and particularly determinants of the **preferences of retail and institutional investors** for different (hypothetical) **investment products** (e.g. green bonds, citizen funds) for low-carbon infrastructure investments, we use:

- **Large-scale online surveys** among retail and institutional investors in **five European countries** (Germany, Denmark, France, Poland, and Spain)
- **Incentivized choice experiments** on investment decisions
- State-of-the-art **discrete choice models** to analyze preferences for investment products and to characterize investor groups (e.g. with respect to risk aversion, time preferences, return expectations, etc.)

Portfolio		
RE	EE	Fund
		ETF
10%	20%	70%

Fig. 3: Exemplary choice set (portfolio)

Expected outcomes:

- Country-specific recommendations to **design investment instruments** that are best suited to mobilize private investors
- Contribution to **behavioral finance** in general by helping to understand the role of sustainability in investment decisions
- Insights on **investor decision making** in the context of renewable energies and energy efficiency measures

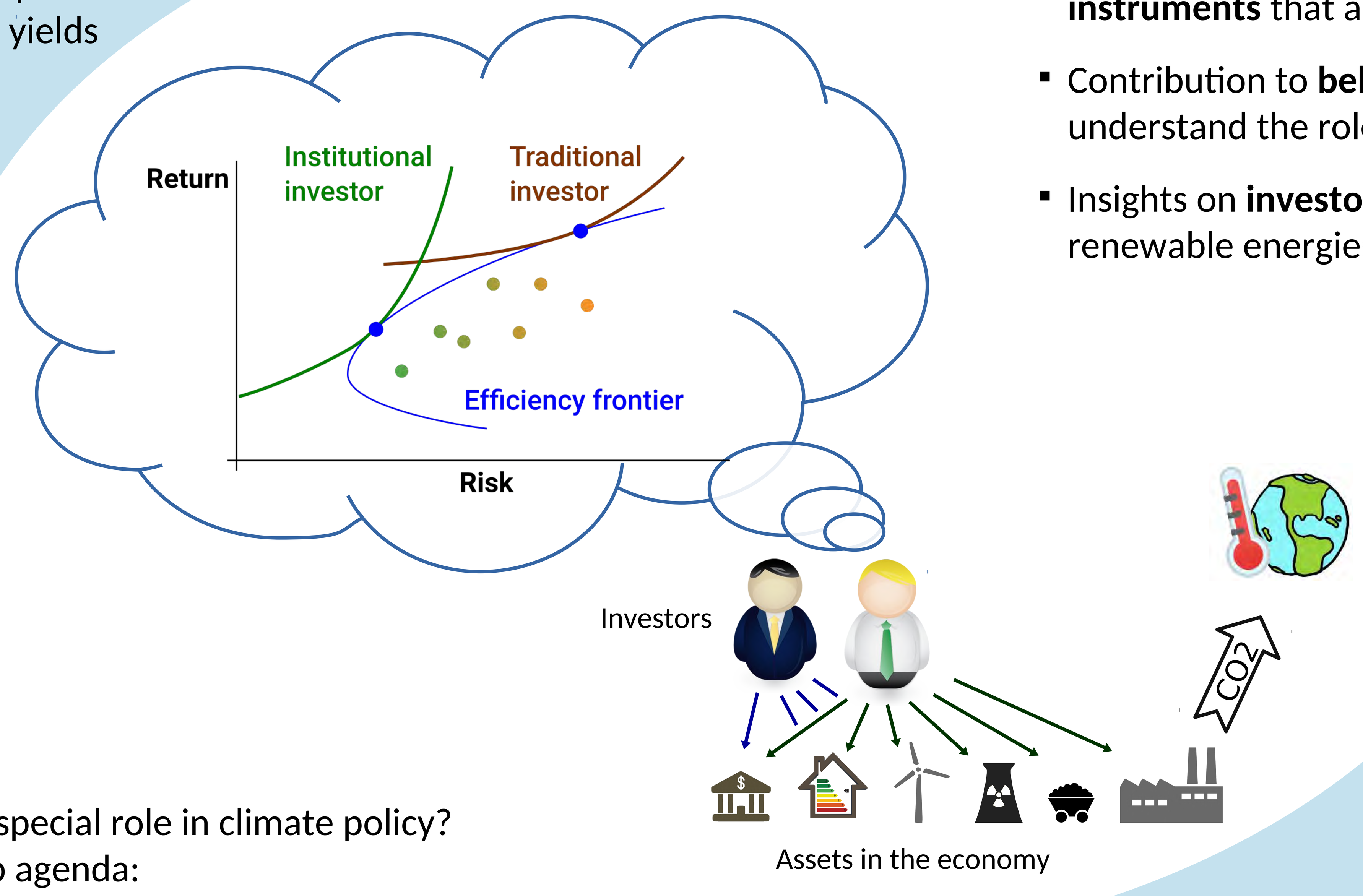

Fig. 4: Project overview: Portfolio optimization guides financing decisions. Our goal is to improve understanding of risk-return profiles of green and brown projects, investor decision making and their real implications, including climate change.

What are the implications for the global decarbonization process?

Do portfolio optimizing investors have a special role in climate policy? The question is addressed in a three-step agenda:

- Develop **risk profiles** for typical low-carbon infrastructure projects from market data and/or cash-flow-modeling
- Use modeling to explore how low-carbon infrastructure fits into optimal **investment portfolios** of institutional investors (CAPM) and retail investors (Behavioral Portfolio Theory)
- Integrate low-carbon infrastructure and portfolio optimizing investors in a general equilibrium **climate economy model** to estimate the contribution to climate policy and explore the effect of financing instruments.

In particular, we expect new insights on the «perfect match» of long-term investors and infrastructure assets, mathematical modeling of specific investor groups, and integrating financial decision making into the assessment of climate policy.

Expected outcomes

By better understanding what inhibits or facilitates important investor groups to invest in low-carbon infrastructure we can create a lever for policy makers to reduce the infrastructure investment gap.

An improved comprehension of investment instruments and barriers, and decision making by institutional and retail investors prepares the ground to propose new or improved **financial instruments and financial policies** to enhance low-carbon infrastructure finance.

Beyond proposing new designs for financial instruments, the project's modeling exercises will show their role and interplay with the implementation of **climate policy**.

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NOSTA CLIMATE

WWU MÜNSTER

ZEW

Fraunhofer ISI

The relevance of non-state actors for individual climate protection activities and climate policy (NostaClimate)

Ipek Eraydın, Elke D. Groh, Amantia Simixhiu, Prof. Dr. Andreas Ziegler (University of Kassel); Carina Fugger, Dr. Carlo Gallier, Prof. Dr. Martin Kesternich, Dr. Christiane Reif (ZEW – Leibniz Centre for European Economic Research); Dr. Heike Brugger, Dr. Elisabeth Dütschke, Dr. Vicki Duscha, Prof. Dr. Joachim Schleich (Fraunhofer Institute for Systems and Innovation Research ISI), Prof. Dr. Andreas Lange, Dr. Claudia Schwirplies (University of Hamburg); Marvin Gleue, Prof. Dr. Andreas Löschel (University of Münster)

Overview

Goal

Analysis of the role of non-state actors for the reduction of greenhouse gas emissions through own activities and especially through

- their influence on attitudes and climate protection activities of individual actors and
- their monitoring of activities of state and other non-state actors

Methods

Use of a mix of complementary methods that include theoretical, empirical, and experimental approaches

Structure

WP0: Project coordination

WP1: Theoretical analysis of relations between state, non-state, and individual actors

WP2: Empirical analysis of relations between non-state and state actors

WP3: Empirical analysis of relations between non-state and individual actors

WP4: Laboratory experiments on relations between non-state and individual actors

WP5: Field experiments on relations between non-state and individual actors
WP5a: Municipalities WP5b: Employers

WP6: Consolidation of theoretical, empirical, and experimental results

WP7: Exchange with stakeholders and dissemination of results

Relevance

Development of strategies and recommendations

- for non-state actors, especially with respect to the influence on individual climate protection activities and
- for policymakers, for example, to strengthen the position of non-state actors in the monitoring of activities of other actors

Work program

WP0: Project coordination

WP1: Theoretical analysis of relations between state, non-state, and individual actors

- Modeling of mechanisms used by non-state actors to influence individual environmental behavior
- Public choice approaches to model the role of non-state actors
- Basis for hypotheses in the empirical and experimental analyses

WP2: Empirical analysis of relations between non-state and state actors

- Analysis of motivations and strategies for climate protection activities by municipalities and their monitoring of state activities
- Interviews with representatives of climate-active municipalities

WP3: Empirical analysis of relations between non-state and individual actors

- Analysis of the effect of social norms and leading by example on individual attitudes and climate protection activities
- Representative survey of citizens in Germany

WP4: Laboratory experiments on relations between non-state and individual actors

- Analysis of individual preferences for the formation and design of non-governmental but formalized institutions in the context of climate protection
- Laboratory experiments at the University of Mannheim

WP5: Field experiments on relations between non-state and individual actors

WP5a: Municipalities

- Analysis of the effect of religious and municipal norm-shaping on individual climate protection activities
- Field experiment at the German Evangelical Church Assembly and online field experiments with citizens from Heidelberg, Mannheim, Hamburg, and Münster

WP5b: Employers

- Analysis of the effect of employers' activities and norms at the workplace on climate protection activities of employees
- Field experiments with employees of the University of Hamburg, University of Kassel, and Grenoble Ecole de Management

WP6: Consolidation of theoretical, empirical, and experimental results

- Consolidation of the results from WP1 to WP5

WP7: Exchange with stakeholders and dissemination of results

Dialog zur Klimaökonomie

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The Political Economy of a Global Coal Phase-out (PEGASOS)

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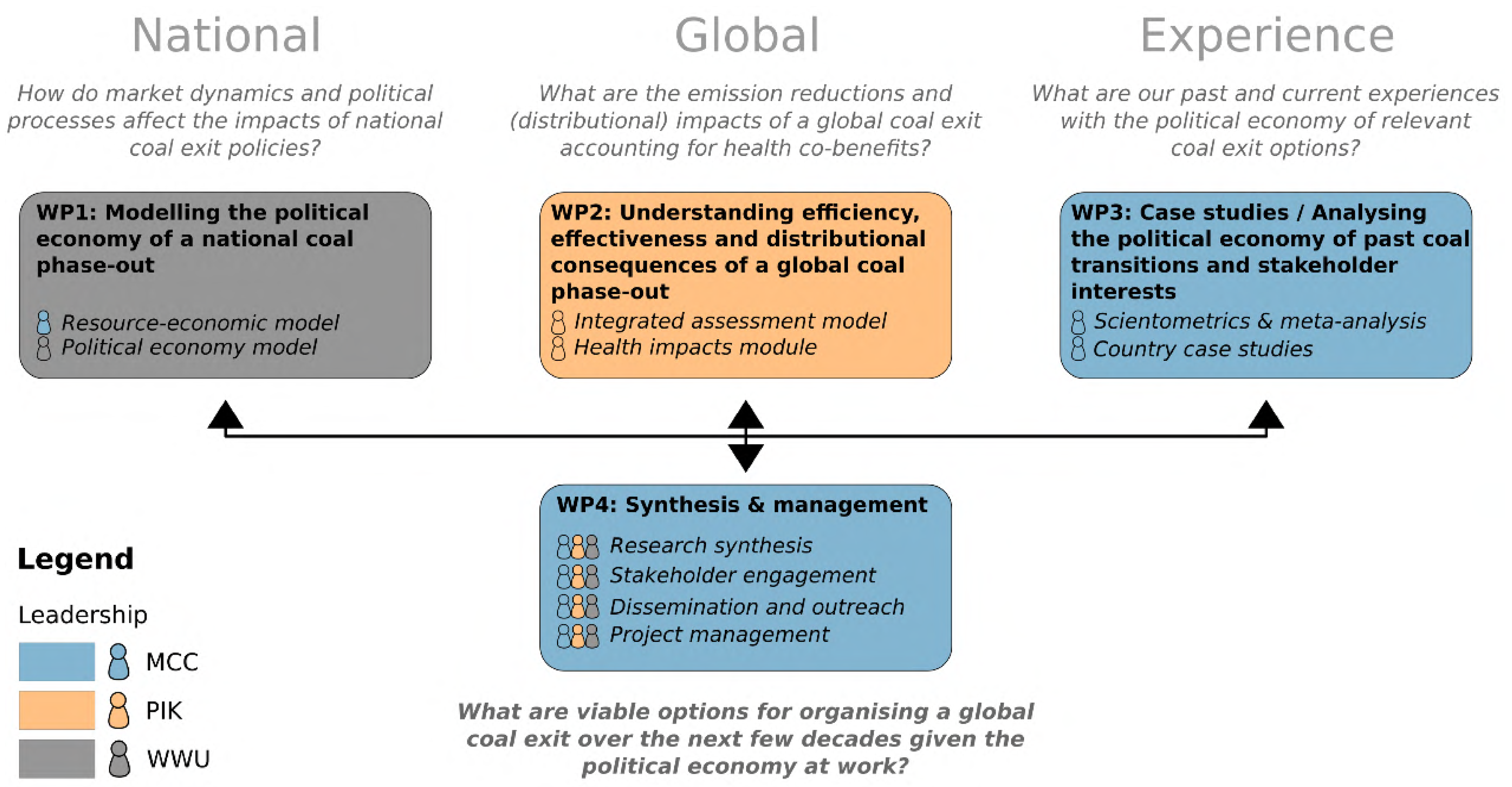
Dr. J. C. Steckel (MCC), Dr. N. Bauer (PIK), S. Bi (PIK), M. Huseynova (WWU), Prof. A. Löschel (WWU), Dr. J. P. Lingens (WWU)

INTRODUCTION AND OBJECTIVES

A timely phase-out of carbon-intensive coal-using activities is essential for meeting the international climate goals of the Paris Agreement. This project will assess policy options for a global coal phase-out which are economically efficient and – of utmost importance - politically viable. This requires a deep understanding of the distributional consequences of these policies and the political economy at work. The research program will be carried out in a comprehensive and multidisciplinary framework that analyses climate, public health and competitiveness objectives simultaneously.

The **main objectives** of the project are:

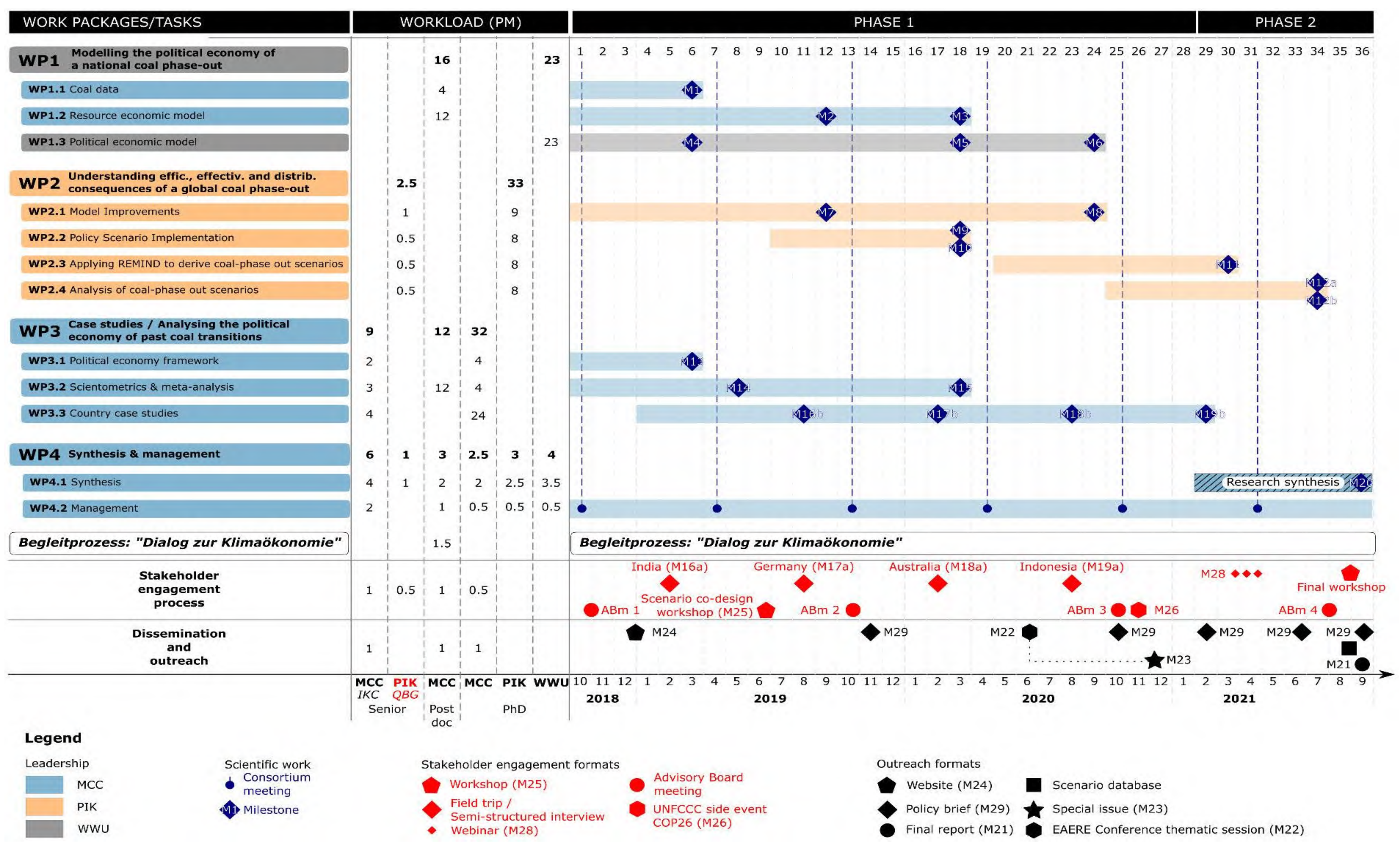
- Advance scientific knowledge of the economics of coal phase-outs
- Make this knowledge accessible to science, politics, and society
- Engagement of multiple stakeholders (Federal Ministry of Economics and Energy (BMWi), Federal Association of Energy and Water Management (BDEW), Agora Energiewende, Deutscher Gewerkschaftsbund, Klima Allianz Deutschland, GERMANWATCH) for critical reflection and communication of the results
- Publication in international, peer-reviewed scientific journals



WP 1: MODELLING THE POLITICAL ECONOMY OF A NATIONAL COAL PHASE-OUT

How do market dynamics and political processes affect the options and impacts of national coal exit policies? This WP aims to understand the political economy of a national coal phase-out and the hurdles that impede it. We will construct a detailed database of coal mines that considers political economy factors. We will also develop a political economy model and a resource economic model. The resource economic model will help to (i) understand the role of coal exit policies on committed carbon and (ii) estimate the direct job losses from coal exit policies. The political economy model conceptualises frictions caused by strategic behaviour of institutional actors.

GANTT CHART



WP 2: UNDERSTANDING EFFICIENCY, EFFECTIVENESS, AND DISTRIBUTIONAL CONSEQUENCES OF A GLOBAL COAL PHASE-OUT

In this WP we will use the global multiregion model of the integrated energy-economic-climate system (REMIND) to quantify the efficiency, effectiveness and distributional consequences as well as positive health effects from reduced air pollution resulting from various coal phase-out policies. The model REMIND will be improved to that end regarding the coal sector.

WP 3: CASE STUDIES / ANALYSING THE POLITICAL ECONOMY OF PAST COAL TRANSITIONS AND STAKEHOLDER INTERESTS

This WP will focus on mapping and aggregating existing coal phase-out experiences and importing crucial knowledge from key stakeholders outside the public domain. The analysis will be undertaken in four case study countries (Germany, Australia, India, Indonesia) that we consider archetypical. An analytical framework will be developed and used to gain a detailed understanding of the political economy of coal exits. This framework will guide both meta-analytical research on coal exit discussions from publicly available, documented knowledge domains as well as case study research targeting undocumented knowledge from key actors. This work package will provide the analytical framework for political economy consideration in the entire project.

WP 4: SYNTHESIS AND MANAGEMENT

Synthesis is at the core of this project. The outcomes of the WPs will be jointly analysed, facilitated by the common scenario design features in WP1 and WP2, the overarching conceptual framework in WP3, and the specific selection of the case study countries in WP3 that allows treating them as archetypes for broader groups of countries. The unique contribution of this project is to provide a holistic map of knowledge regarding the efficiency, effectiveness and distributional impacts of alternative policy packages towards global and national coal-phase outs. In this part, we will explore the use of formal evidence synthesis methods to analyse the various strands of qualitative and quantitative evidence. Linking climate change mitigation scenarios and insights from political economy studies is fundamental to advancing our understanding of viable policy pathways to global and national coal exits.

Pegasos
The political economy of a global coal phase-out

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Economics of Climate Change – Transformation of the energy system towards sustainability focussing on community-based activities (REsCO)

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[1] Forschungszentrum Jülich - Institute of Energy and Climate Research - Systems Analysis and Technology Evaluation (IEK-STE)

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Duration: 01.12.2018-30.11.2021 - Infos: www.resco-fona.de

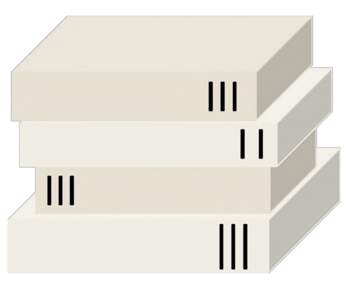
Motivation and Research Questions

In Germany, a lot of effort has been undertaken in the past to transform its energy system into a sustainable one. However, it is becoming more and more obvious that Germany will miss the GHG emission reduction targets set for the "Energiewende". In particular, in the sector "private households" progress is slower than hoped for. Our research questions are:

- To what extent or how can private households be motivated to participate in community-based activities?
- To what extent or how can existing economic explanatory approaches of behaviour patterns be developed further by integrating psychological aspects?
- Regarding transformation processes of the energy system and related economic as well as ecological impacts: What is the relevance of joint activities by private households from the point of view of the economy as a whole?

WPO: „Individuals“ and „households“ from an interdisciplinary perspective

- Reconsideration and expansion of economic definitions of individuals, households, and other relevant terms from a psychological perspective
- Overview of potential factors influencing the behaviour of private households with regard to energy usage

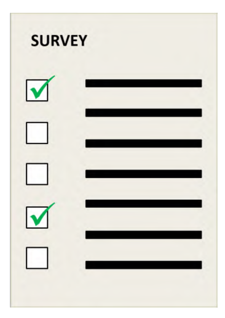


Methods:
- Literature review

Expected Results:
- Interdisciplinary report/paper with a critical reflection on definitions of relevant terms
- Overview of factors influencing household behaviour in the energy system

WP1: Identification and assessment of influencing factors

- Identification of factors at the household level, or at the level of individuals of central importance for active participation in activities making local energy systems more sustainable
- Focus on influences emerging from the social context

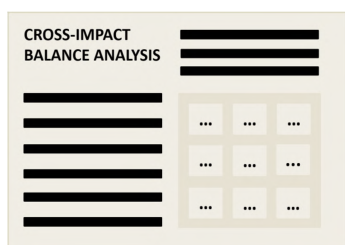


Methods:
- Quantitative surveys
- Discrete choice experiments

Expected Results:
- Insights into possible ways to encourage active participation in the energy system's transformation
- Insights into the role of social context

WP2: Systems perspective – Households in interaction

- Identification of behaviour constellations that result from the interaction of heterogeneous households and their socio-economic environment
- Consideration of households as elements of a dynamic system that interact with each other or with other factors

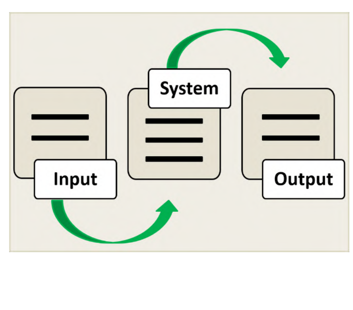


Methods:
- Cross-impact balance analysis

Expected Results:
- Identification of consistent factor constellations including sets of households-specific behaviour patterns and contextual factors

WP3: Specification and assessment of transformation paths

- Creation of possible transformation paths in conjunction with assumptions about how relevant framework conditions will likely evolve in the future
- Impact assessment of transformation paths on the overall economy and the energy economy
- Evaluation of the social context's significance and its influence on people's behaviour from a macroeconomic perspective



Methods:
- Application of an electricity market model
- Application of an input-output model

Expected Results:
- Information on macroeconomic effects
- Assessment of the relevance of changes on the local level for the overall economy

WP4: Policy recommendations and discussion

- Communication of project's findings
- Policy recommendations
- Advocacy of concrete actions based on results and close cooperation with the Practitioners Advisory Council

Methods:
- Compilation of results of WP1 – WP3

Expected Results:
- Publication(s) containing the project's results

Dialog zur Klimaökonomie

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Mitigation Policies in a Globalized and Developing World: The Role of Structural Change and Distributional Effects (ROCHADE)

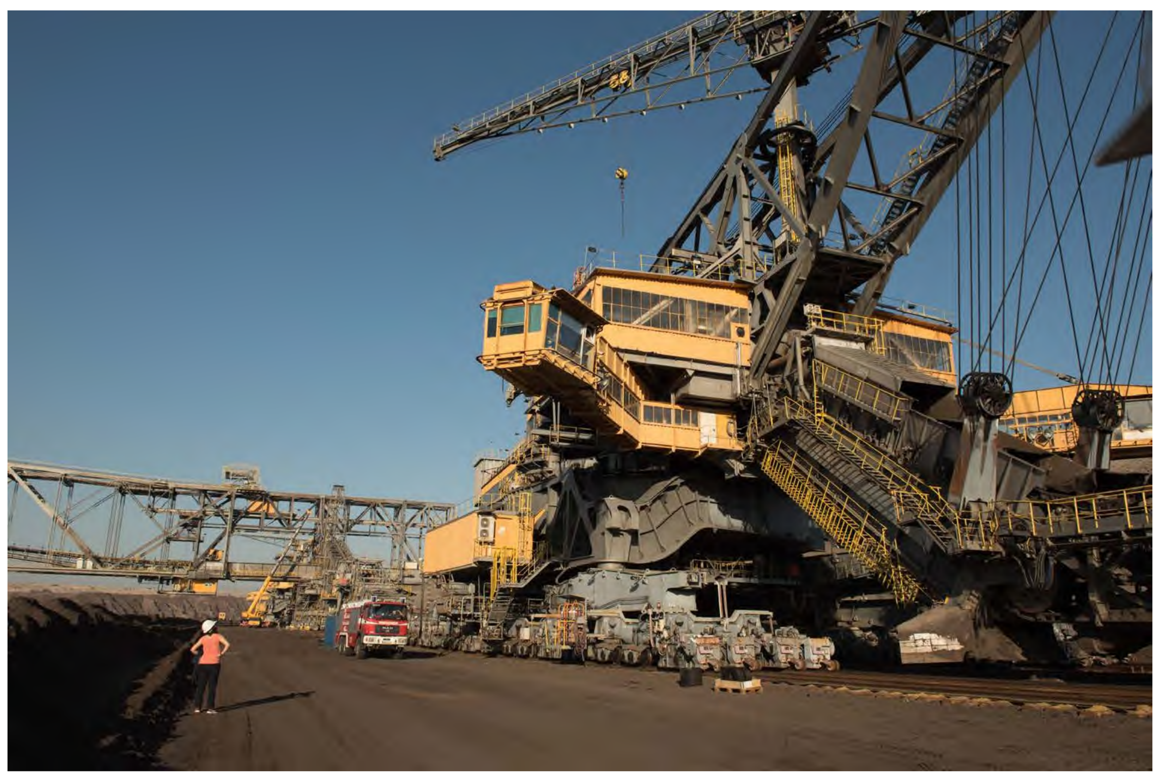
Marian Leimbach (PIK), Matthias Kalkuhl und Jan Steckel (MCC), Michael Hübler (LUH), Gabriel Felbermayr (IfW Kiel)

Structural Change: is the reallocation of economic activity across broad sectors of the economy - agriculture, manufacturing and services – that accompanies the process of economic growth

Subject and Objective

Ambitious climate policy may

- prevent the expansion/rise of industrial activities that are necessary for long-term growth and development
- have a disproportional negative impact on poor households by an increase in relative prices of carbon-intensive goods and services.



Focusing on development and distributional impacts of climate policies, this project will study

- the particular role of structural change, and its interaction with climate change and climate change mitigation
- how the level of climate change, and hence the challenges of mitigation, depends on how fast developing countries industrialize and advanced economies transform towards service-based economies.

The project aims

- to quantify distributional effects of climate policies by taking structural change explicitly into account
- explore policies to overcome potential distributional trade-offs.

Relevance for Climate Policies

Findings of this project will inform decision-makers about distributional implications of climate policies and about complementary measures (e.g. cash transfer schemes, public investments) to reduce adverse effects for low income groups. Uncovering the interaction between structural change and greenhouse gas emissions provides a better understanding of how transitions to low-carbon service economies can be accelerated.

Research Design/Methods

- Conceptual and empirical (multi-sector growth model)
- Econometrically (poverty, emissions and industrialization, drivers of structural change, income distribution)
- Numerical (climate policy analysis, REMIND, NQTT models)

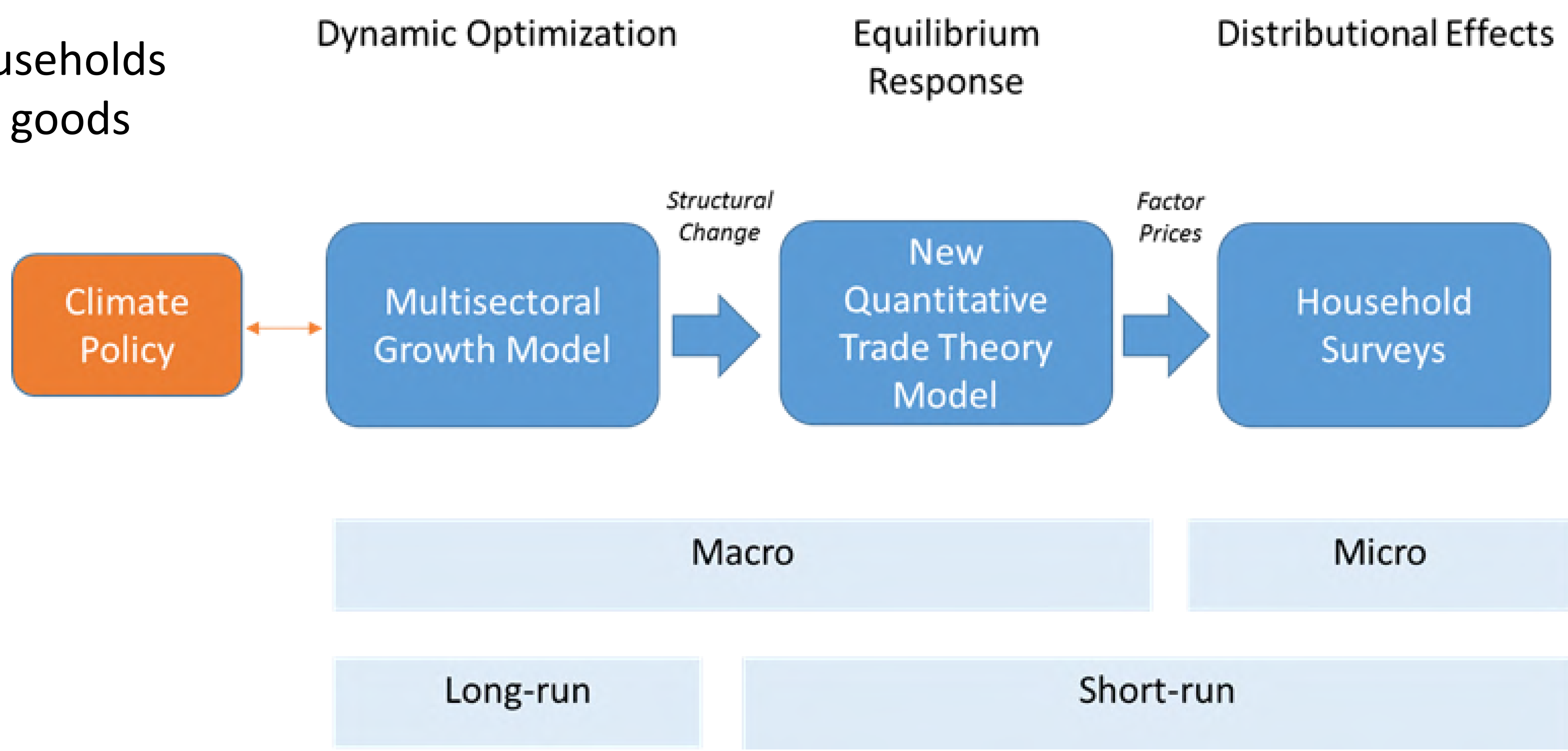


Fig.: Representation of Model Coupling

Working Program

1. Interaction of Structural Change, Development and Carbonization

- Structural Change and Poverty (case study India)
- Historical Drivers of Structural Change
- Sensitivity of Global Emissions to Structural Change

2. Interaction of Structural Change and Climate Impacts

- Trade as a Determinant of Climate Induced Structural Change
- Cross-Country Differences in the Effects of Climate-Induced Structural Change

3. Interaction of Structural Change and Climate Policy

- Effectiveness of Climate Policy under Scenarios of Structural Change
- Global Transformation Pathways

4. Distributional Impacts of Climate Policies

- Distributional Effects (i) between Countries, (ii) on National/Sectoral Level, (iii) on Household Level
- Coupled Model Analysis
- Policies to avoid adverse Distributional Effects

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Kontakt: Marian Leimbach
Potsdam Institut for Climate Impact Research

Assisting Households to adapt to Climate Change (ADAPT)

Kati Krähnert, Svenja Fluhrer & Aleksandra Wojewska

Potsdam Institute for Climate Impact Research (PIK)

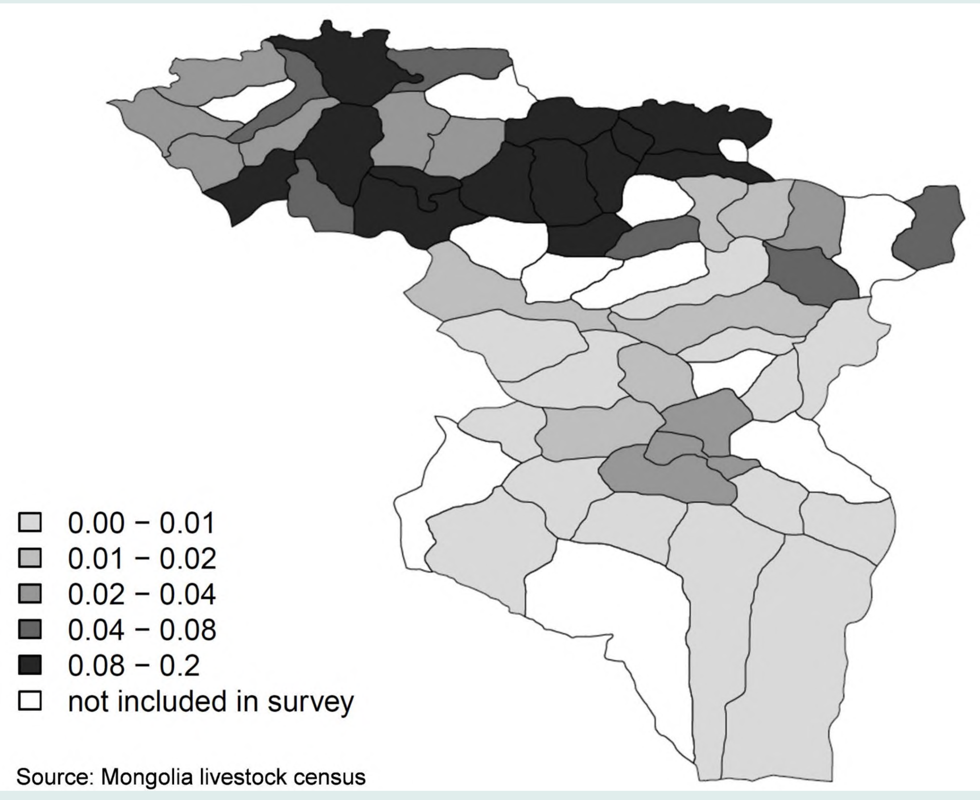
Motivation

Due to climate change, extreme weather events, such as heat waves, droughts, and floods, are expected to become more frequent and intense (Seneviratne et al. 2012). The impact of climate change will be particularly damaging for rural households in developing countries, where much of the population depends on natural resources and where governments often lack the financial and technical means to manage increasing climate risk (Hallegatte et al. 2016; World Bank 2010). There is an urgent need for policy interventions that can help households to adapt and reduce their vulnerability to future events.

Extreme weather events in Mongolia

Catastrophic weather events occur in Mongolia in form of harsh winters (called *dzud* in Mongolian) triggered by extremely cold temperatures and excessive snowfall. As a consequence of these extreme weather events, mass numbers of animals die, thus threatening the livelihood of rural populations that depend on herding. In Mongolia, winter disasters are considered to be a major cause of poverty and distress migration to urban centers (Goodland et al. 2009; Sternberg 2010). The extreme winter 2015/16 in some regions of the country is the focus of the project.

Figure 1: Livestock mortality in 2016 in survey area, per district



Two adaptation interventions

The first adaptation intervention is an index-based weather insurance that provides indemnity payments to insured households in the aftermath of an extreme weather event whenever an index measured at a more aggregated geographical level has exceeded or fallen short of a predefined threshold. The second adaptation intervention is the provision of two types of meteorological data to households: daily weather forecasts sent to households via text messaging and medium-term projections of extreme weather events.

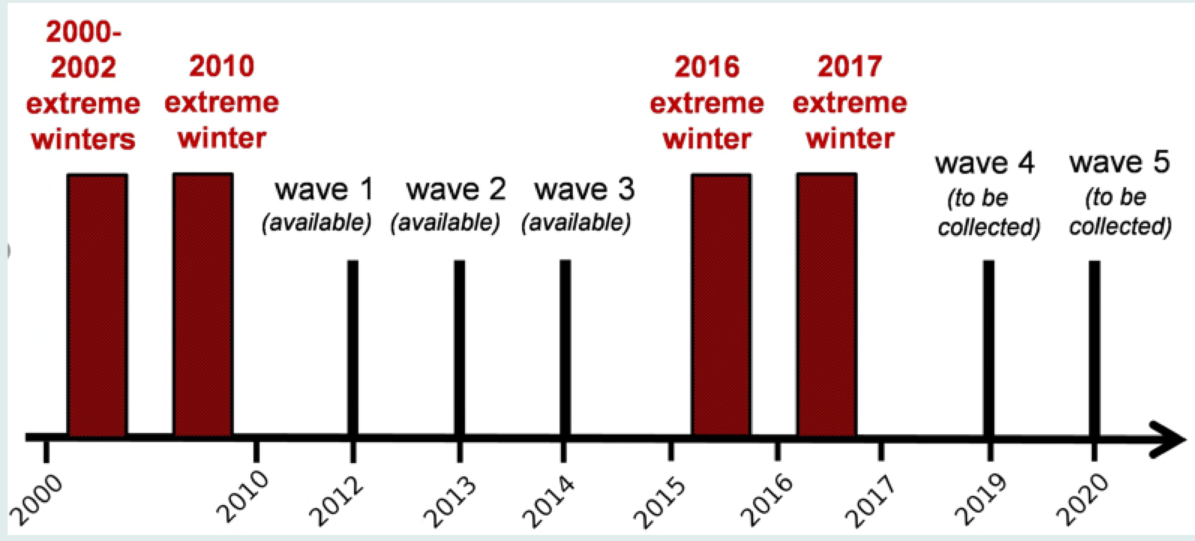
Data and methods

The project will draw on novel household panel data consisting of five panel waves – the *Coping with Shocks in Mongolia Household Panel Survey*. At our disposal, we have three panel waves collected in 2012, 2013, and 2014, just before the extreme winters of 2015/16 and 2016/17. The project will collect two additional panel waves from the same households in 2019 and 2020, after the extreme events. The availability of household panel data spanning the time period before and after extreme weather events is a unique feature.

In addition, two Randomized Control Trials (RCTs) are planned: A random sub-sample of households included in the *Coping with Shocks in Mongolia Household Panel Survey* will receive access to short-team weather forecasts and medium-term predictions on the occurrence of extreme events.

Micro-econometric methods will be used to analyze the data.

Figure 2: Timeline of extreme weather effects and data collection



Research questions

- Impact evaluation of index insurance (quasi-experimental methods): Does index insurance help households recover faster from losses caused by an extreme weather event?
- What are the determinants of purchasing index insurance?
- Impact evaluation of access to daily weather forecasts (RCT): Do weather forecast information help households avoid losses?
- Impact evaluation of access to medium-term projections of extreme events (RCT): Do projections influence households' use of adaptation strategies?
- How effective are informal adaptation strategies?
- What are the long-term consequences of extreme winters on socio-economic outcomes? E.g., child anthropometrics, health, education, poverty, migration

Relevance for Climate Policies

The research contributes new evidence on the effectiveness of adaptation interventions in developing countries, thus addressing issues raised in articles 7 and 8 of the Paris climate agreement. The evidence will help make accurate cost-benefit analyses and furthermore enrich the evidence base that guides policy stakeholders in the question whether these adaptation interventions should be scaled up or introduced in other countries.

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Climate Impact Chains in a Globalized World: a Challenge for Germany (CLIC)

Authors: Kaiser, Theresa (adelphi); Osberghaus, Daniel (ZEW); Levermann, Anders and Willner, Sven (both PIK)

Background and Relevance

In a globalized world, extreme weather events and the consequences of climate change do not only have local impacts: Via trade links, they can also have an effect over a large geographical distance. It is assumed that these indirect effects of climate change are at least as relevant for Germany as the direct consequences of climate change within the country. However, due to the complexity of supply chains and flows of goods, these risks are difficult to capture. Thus, the knowledge about those risks is important in order to adapt in time.

Project Objectives

The objectives of this project are to **develop methods** for the economic evaluation of the effects of cross-border consequences of weather extremes and climate change on economic activities. We then apply these methods to **describe impacts on the German economy** in more detail and **develop recommendations** to reduce existing risks and seize possible opportunities.

1 Developing impact chains

Goal: Identification of most relevant transboundary climate impacts (via trade) for Germany

Activities:

- Identification of sectors which might suffer or benefit particularly from climate change due to changes in international trade routes or demand and supply abroad
- Development of detailed impact chains for these sectors

2 Econometric analysis of disaster and climate impacts on trade flows

Goals:

- Identify and quantify the effects of weather and climatic events on sectoral trade flows to and from Germany in the last 40 years
- Derive estimates of economic benefits of adaptation measures
- Inform the Acclimate modelling framework in WP 3

Methods:

Data on natural hazards and weather variations, e.g. ifoGAME

Regressions, e.g. PPML

Interactions with resilience data, e.g. ND-GAIN

INTERNATIONAL MONETARY FUND

Bilateral trade data, e.g. IMF DOTS

Output:

- Literature review on related empirical studies (already accepted at “Economics of Disasters and Climate Change”)
- Description of Dataset
- Report on Estimations

CLIC

Developing recommendations on adaptation

Development of recommendations on how to reduce risks from transboundary climate impacts and how to seize opportunities. Target groups: policy-makers, professionals in development cooperation as well as decision-makers in relevant companies and industry associations in Germany

5 Case Studies

Goal: Testing and illustrating findings from WP 1-3 by collecting and analysing evidence on experiences of individual companies with adaptation measures

Methods: Interviews, analysis of scientific literature and company publications, analysis of trade databases

Output: Case studies illustrating how extreme weather events outside of Germany affect German companies and showing company responses

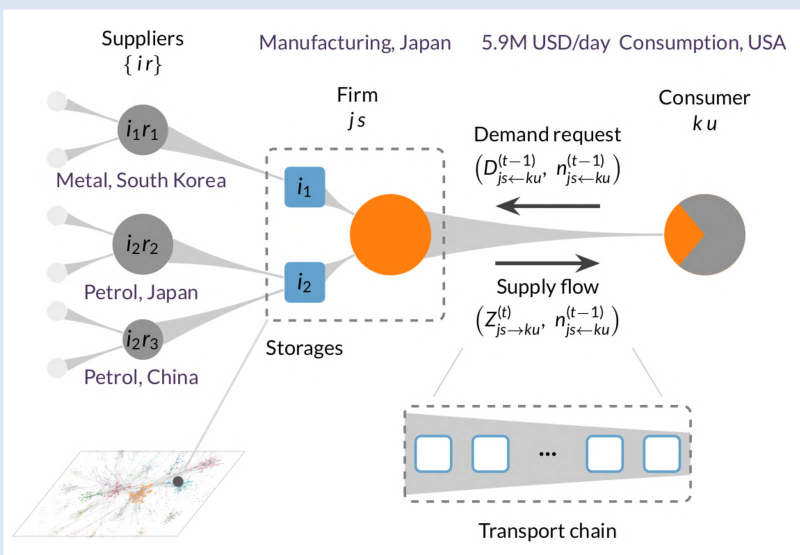
3 Numerical modelling of impact chains

Goals:

- Assess the short-term response of unforeseen climatic extreme events whilst taking the complex trade and supply chain network into account
- Develop structural adaptation strategies to cope with adverse effects in the network for an ensemble of possible climatic and economic scenarios

Methods: Using trade network data in an agent-based model that resolves production shocks on a daily time scale using local optimization as a micro-foundation rationale

Outputs: Examination of total production losses and price changes due to extreme events; adaptation strategies



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Dialog zur Klimaökonomie

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Project Website:
https://clic-climate.de/

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“Implications of Climate Change and Climate-induced Disasters for Individuals, Firms and the Insurance Sector” (CLIMATE_AFFECT)

Prof. Dr. M. Berlemann (HSU), Dr. S. Bumann (HSU), M. Eurich (HSU), E. Haustein (HSU), Dr. C. Hott (HSU), Dr. R. Lehmann (ifo), J. Regner (HSU), X. Tran (HSU)

Project Background and Objectives

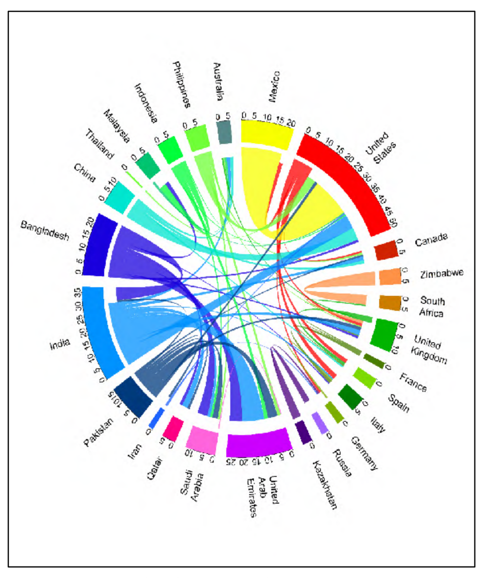
- The ongoing process of **global warming** can have severe consequences: increase of the frequency and/or severity of **natural catastrophes** and **extreme weather events.**
- A necessary precondition for the implementation of **climate policy** is to convince voters of the necessity and usefulness of climate policies.
- The **first goal** of the project is to study the knowledge and attitudes of individuals and firms related to climate change.
- The **second goal** is to assess the reaction of individuals and firms to climate change and extreme weather events; the focus of this analysis is on migration decisions and firm behavior.
- The **third goal** is to analyse how insurances can contribute to mitigating the effects of climate change and extreme weather events.

Individuals

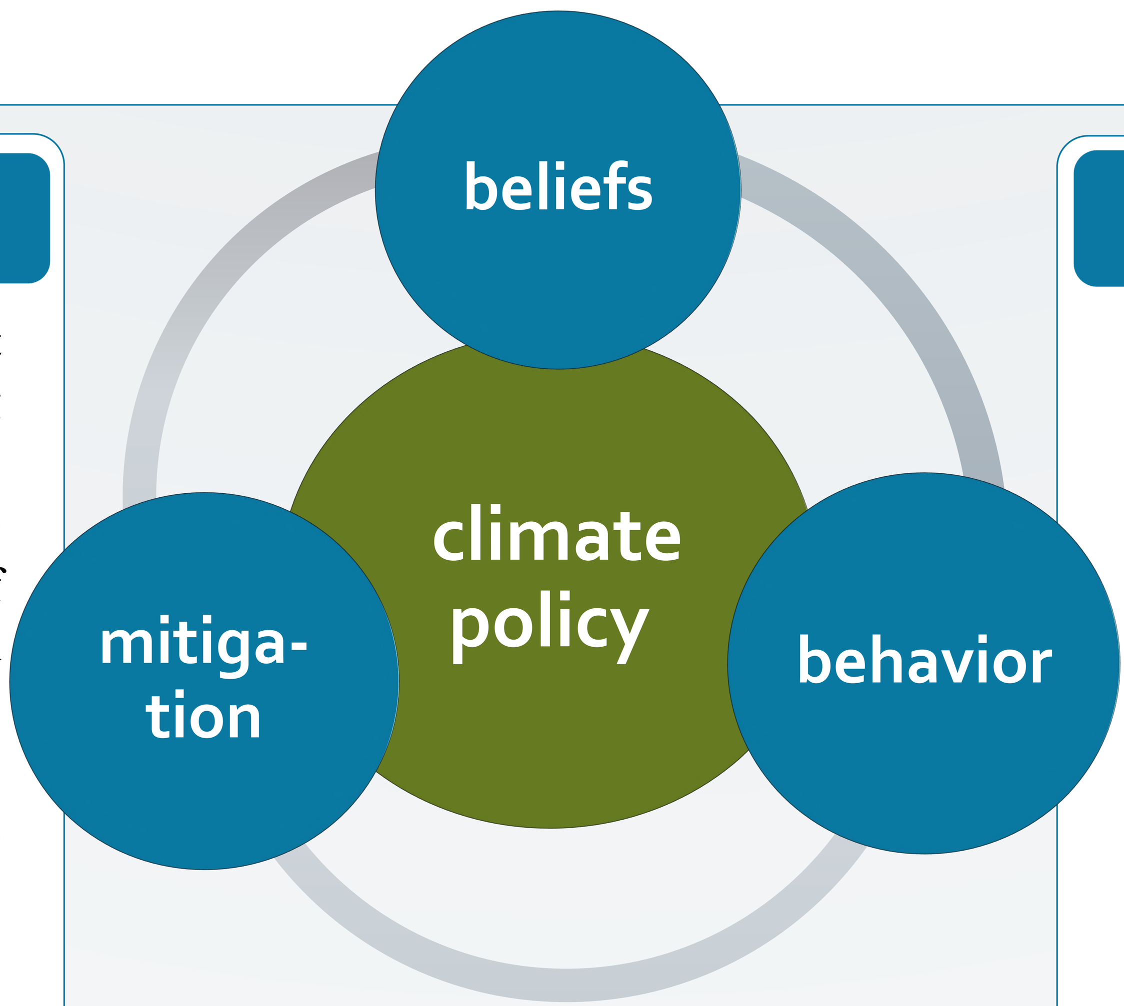
- **Beliefs:** Assessment of individuals‘ **knowledge and attitudes** related to climate change based on data from the Gallup Worldwide Poll
- **Empirical identification** of factors influencing beliefs and attitudes towards climate change
- Analysis of the effects of climate change and natural disaster risk on self-reported measures of **life satisfaction** based on the Gallup U.S. Daily Poll

- **Behavior:** Focus on **migration** as an adaption strategy for climate change
- No clear consensus on the effects of climate change on internal and international **migration flows**
- Use of newly available international **bilateral migration** datasets, such as Abel (2018)
- Construction and usage of a worldwide gridded **population distribution** dataset based on census data and satellite night light imagery

5-year migrant flows 2005-2010

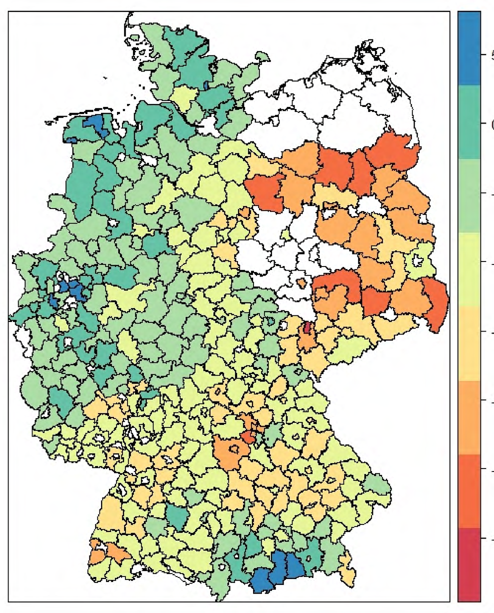


Source: Abel (2018)



Insurance Sector

Impact of severe weather events on German agriculture
Deviations from average winter-wheat yields following drought of 2003



Source: Statistisches Bundesamt

- **Climate risks** especially affect agriculture and developing economies
- **Insurance** can create a peace of mind, avoid insolvency of farmers, protect people from falling into poverty
- Climate risks are **often uninsured** or insurance has to be heavily subsidized (e.g., agriculture in the US)
- **Goals:** (1) assess reasons for the low insurance penetration; (2) evaluate potential solutions to deal with climate risks

Firms

- Analysis based on **ifo business survey data**
- Influence of actual extreme weather events on **business conditions** of firms (repeated survey, use of weather and climate databases)
- **Self-evaluation** of firms with respect to influence of extreme weather events and natural disasters on business conditions
- Study of **firms‘ preparedness** to deal with different sorts of extreme weather events
- Analysis for firms from different **sectors and regions**

Policy Implications

- The project results will help **political decision makers** to evaluate the actual degree of **information of voters** on climate change and the support for climate policies in an **international comparison**.
- The results will show which **factors** drive attitudes towards climate change and help identifying ways to increase **climate sensitivity**.
- The project will shed light on likely **economic consequences** of climate change for individuals (migration, life satisfaction) as well as for firms (profitability, losses) and will, thus, be helpful for **policymakers**, individual **economic agents** as well as **firms**.
- The project will analyze various policies to deal with **increasing risks** resulting from natural catastrophes.

Methods

- Modern methods of **panel data** econometrics
- Use of **micro-survey data** (Gallup polls, ifo business surveys) and combination with climate and weather datasets
- Use of **macro-data** for international migration flows and Axco **insurance dataset** in combination with climate and disaster datasets
- Use of **satellite night light imagery** and **geo-referenced data**
- **Theoretical and empirical analysis** of the insurance sector in the context of climate change and natural disasters, such as analyzing driving factors of **insurance demand in developing economies** and assessing the value of **weather index insurance** for farmers in Germany (e.g., high uninsured losses following droughts of 2003 (*see Figure*) and 2018)

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Economics of climate adaptation for biodiversity conservation (Ecoclimb)

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1. Introduction and motivation

Climate change is a major threat for biodiversity. For many species, existing habitats will be lost partially or completely, but the habitat suitability in previously unsuitable regions (new climate space) may increase.
Ecologists have developed two types of climate adaptation strategies:

- supporting migration towards new climate space with appropriate land use measures and
- improving habitat quality in existing habitats to create climate refugia.

Economic research on climate adaptation has until now largely ignored the threat to biodiversity. In Ecoclimb, we will develop models to investigate how to protect species under climate change.

2.1. Case study area

The models will be developed for selected case study regions in Schleswig-Holstein and Niedersachsen, Germany. In cooperation with our stakeholders in these areas the case study regions were chosen depending on:

- the characteristics of the land
- data availability.

→ case study regions take into account in how far the land satisfies a species' habitat requirements and how this will change in the future due to climate change.

2.2. Species considered in the analysis

Pseudochorthippus montanus

- rare grasshopper
- lives mainly on wet grasslands (Fig. 1)
- very immobile species

Figure 1: *P. montanus* habitat: low-lying, wet grasslands

Large marsh grasshopper (*Stethophyma grossum*)

- large grasshopper (Fig. 2)
- lives on wet grasslands
- moderately mobile

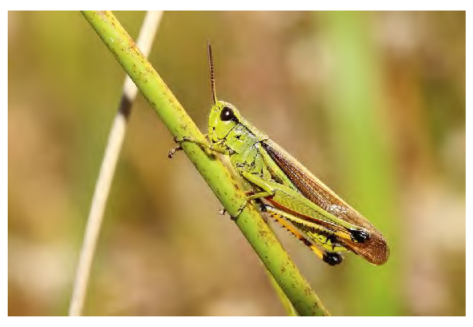

Figure 2: *S. grossum* is a large grasshopper; source: Daniel Konn-Vetterlein

Marsh fritillary (*Euphydryas aurinia*)

- endangered butterfly (Fig. 3)
- inhabits wet and dry grasslands
- migrates along hedgerows (Fig. 4)

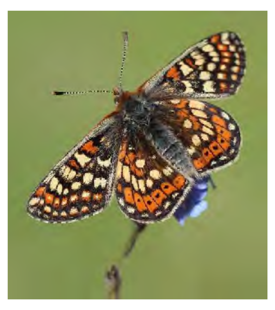

Figure 3: *E. aurinia*; source: Stiftung Naturschutz Schleswig Holstein

Figure 4: hedgerows as possible migration routes

Black-tailed godwit (*Limosa limosa*)

- migratory bird (Fig. 5)
- breeds on large open grasslands with flooded areas (Fig. 6)

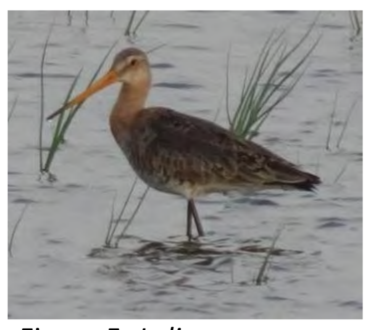

Figure 5: *L. limosa*; source: Stiftung Naturschutz Schleswig Holstein

Figure 6: open grassland with a high groundwater table are ideal *L. limosa* habitat

3. Sub-projects

3.1. Climate simulation

This subproject provides climatological input data for the ecological models, the ecological-economic models and the agri-economic cost assessment. For this purpose, results of an ensemble of high resolution regional climate simulations (Euro-CORDEX runs extended by the ReKliEs-De project) are used. The projection results represent the potential spread of future climate change in the case study regions and are adapted to the needs of the project partners. Appropriate climate indices relevant to characterize the habitat conditions for the grassland species are determined and calculated to investigate how these conditions will change under the influence of different climate change scenarios.

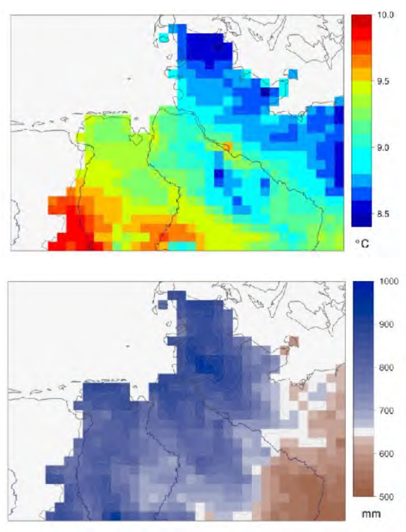

Figure 7: present-day climate in Northern Germany

3.2. Design of policy instruments under climate change

This subproject identifies and analyses possible design options of policy instruments that are relevant for the conservation of biodiversity under climate change. We will consider three important policy instruments of biodiversity conservation:

- incentive payments for nature conservation measures,
- offsets and
- land purchase for conservation.

The analysis will be conducted on a qualitative and conceptual level. The results from this subproject will be an input for the development of the ecological-economic model.

3.3. Ecological model

In the present subproject demographic (stage-based) models and dispersal models are developed for the four study species and the species' population dynamics are simulated for the next 60 years. Changing climatic conditions and land use measures are dynamically integrated into the models. The models are used to analyse the long-term survival probability of the study species under different climate and land use scenarios. They thus support the development of suitable conservation strategies for these species.

3.4. Economic model and agri-economic cost assessment

This subproject will assess the costs of conservation measures. This includes the opportunity costs of measures implemented via the three types of policy instruments. In order to estimate the costs over a 60 year-period we consider possible socio-economic scenarios that may influence conservation costs in the future. The cost data including the modifications based on the scenarios will feed into the ecological-economic models.

3.5. Ecological-economic modelling

The ecological-economic model will combine the output from the ecological models and the agri-economic cost assessment. As a first step, the costs and ecological benefits of the policy instruments are simulated. In a second step the results are optimized. For the optimization, we consider two options: (1) maximize species survival under climate change for given budgets (2) minimize budget that allows for species survival under climate change.

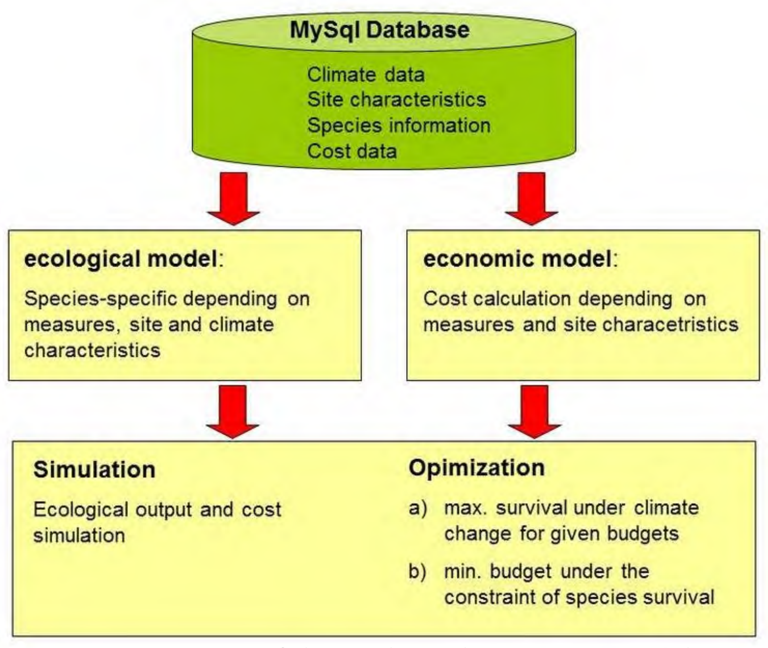

Figure 8: overview of the ecological-economic model

3.6. Risk and uncertainty

The predicted effects of the analysed strategies and instruments for biodiversity conservation are subject to considerable uncertainty. In the present work package these uncertainties are assessed through sensitivity analyses. Based on the results, the conservation strategies and instruments will be assessed with regard to their robustness, i.e. their ability to achieve high levels of effectiveness and cost-effectiveness even under uncertainty.

4. Relevance of the project for climate policies

Policy makers need to consider the effectiveness and cost-effectiveness of climate policies. Ecoclimb is relevant for evaluating climate policies targeting species conservation as:

- We examine the effectiveness of different policy options considering selected species
- We develop an evaluation framework to assess policies for species protection under climate change
- We develop an ecological-economic model taking into account both the effectiveness and cost-effectiveness of different climate policies

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Dialog zur Klimaökonomie

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GoCoase

CAU Christian-Albrechts-Universität zu Kiel · Technische Universität Berlin · Ludwig-Franzius-Institut für Wasserbau, Ästuar- und Küsteningenieurwesen · EUCC-D

Governing climate change adaptation at the Baltic Sea Coast (GoCoase)

BACKGROUND: The **rising sea level** and the increasing frequency of extreme weather events raise the likelihood of **storm-generated floods** that are the most common and widespread of all natural hazards. This increasingly exposes human populations, critical infrastructure and other assets to these hazards.

RELEVANCE: By providing integrated science-based information on coastal adaptation options the project will **support informed decision-making** at the regional and local level. At the national level, it will make a valuable contribution to the **German Adaptation Strategy (DAS)**, in particular in the focus area 'Water Resources, Water Management, Coastal and Marine Protection'.

Picture: S. Maack

AIM: The overall aim of the project is to develop and evaluate **adaptation scenarios to climate change impacts** at the regional level **on the German Baltic Sea Coast**.

METHOD: Quantitative (population survey and choice experiments) and qualitative methods (interviews and workshops) will be applied.

PERSPECTIVE: An **inter- and transdisciplinary approach** is used, involving societal stakeholders (including the industry, science and NGOs) and political decision-makers. The project brings together the disciplines coastal engineering, environmental and institutional economics and natural sciences.

Joint evaluation of coastal adaptation strategies

Evaluation of adaptation pathways

Coastal protection strategies: The work package aims to evaluate potential coastal adaptation strategies from a coastal engineering perspective, including:

- Identification of coastal sections with protection need and assessment of vulnerabilities
- Evaluation of adaptation potentials and pathways

Cost-Benefit-Analysis: The work package addresses the economic effects of the protection measures with a focus on affected non-market goods and services, including:

- Assessment of the preferences of the German population for different coastal protection strategies based on discrete choice experiments
- Comprehensive Cost-Benefit-Analysis and distributional analysis of protection measures

Institutions and governance

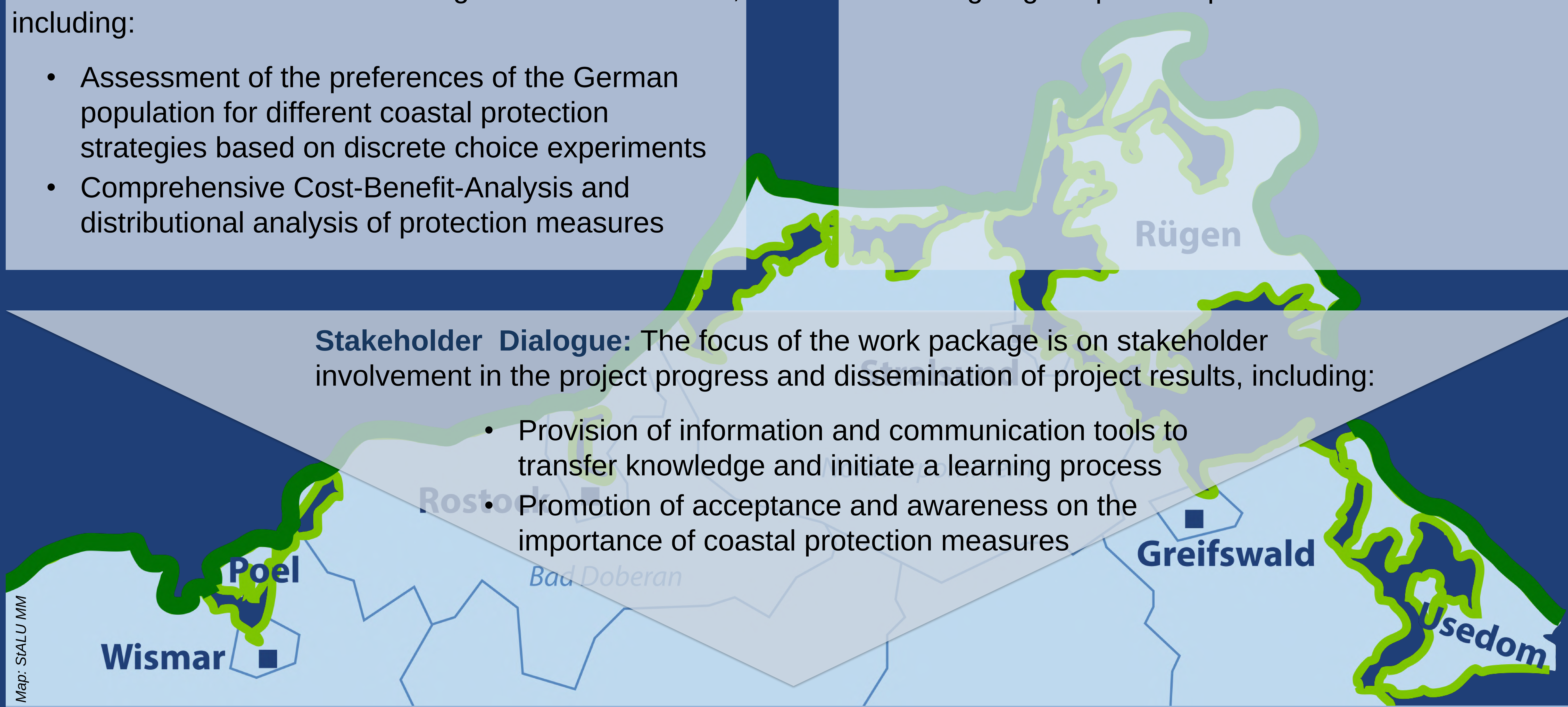
Institutional set-ups and governance structures: The work package's purpose is to analyse the formal and informal institutions, processes of decision-making and involved actors in coastal protection, focusing on:

- Role of institutions and different stakeholders concerning different adaptation strategies in administrative and societal decision-making processes
- Use and integration of (economic) knowledge for designing adaptation options

Generating knowledge

Stakeholder Dialogue: The focus of the work package is on stakeholder involvement in the project progress and dissemination of project results, including:

- Provision of information and communication tools to transfer knowledge and initiate a learning process
- Promotion of acceptance and awareness on the importance of coastal protection measures



Map: StALU MM

Public events and communication of results

Knowledge utilisation

Project website: www.eucc-d.de/gocoase.html

Dialog zur Klimaökonomie

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RUINS

Risk, Uncertainty and Insurance under Climate Change. Coastal Land Management on the German North Sea.

Risk, Uncertainty and Insurance under Climate Change. Coastal Land Management on the German North Sea (RUINS)

Stefan Baumgärtner[1], Christian Mittelstaedt[1], Elisa Schroettke[1], Conrad Jackisch[2], Anett Schibalski[2] & Boris Schröder-Esselbach[2]

1) University of Freiburg | Professorship of Environmental Economics and Resource Management
2) Technische Universität Braunschweig | Department for Landscape Ecology & Environmental Systems Analysis

The project

We study both **risk and Knightian uncertainty of climate change impacts and adaptation options** for the case of coastal land management on the German North Sea, where people benefit from a suite of ecosystem services which are subject to climate change and to alternative land management options.
In this case, both risk and uncertainty are relevant for decision-making about local adaptations to climate change. We **combine economics with landscape ecology** through modelling, and we **include local stakeholders** in the process of analysis and conclusion.

Aims

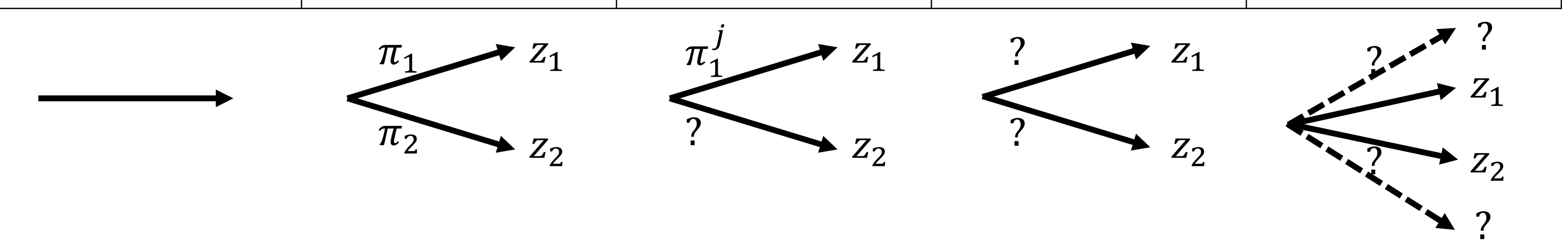
(1) To develop **concepts for the economic valuation** of adaptation options and concepts of (natural or financial) insurance under Knightian uncertainty.

(2) To develop a procedure to **assess and communicate combined risk-and-uncertainty** throughout the full chain of analysis and implementation – from basic science all the way to practical solution.

(3) To identify – in exchange with stakeholders – which potential land management option is their **preferred way of addressing the risks and uncertainties** of (adapting to) climate change. This includes identifying stakeholders' risk-and-uncertainty preferences as well as potential synergies, conflicts and trade-offs between ecosystem services and between stakeholder groups.

Concept of risk and uncertainty

	certainty	risk	ambiguity	uncertainty	ignorance
potential states of the world z_i	one single	several, known	several, known	several, known	unknown
probabilities π_i	100 %	objectively given	not objectively given, partially known	not objectively given	--



Ecological-economic modelling

Land Management Options
Water Management Options
↓
Ecosystem Services
↓
Economic Valuation

Expected results and exploitation of results

For **stakeholders and policy-makers in the case-study region**:
(1) Economic valuation of the land management options currently discussed in the case study region
(2) Bringing results to the stakeholders, through workshops in the region and a policy brief for decision-makers

For the **scientific community**:
(3) A better scientific understanding of how to model, evaluate and academically communicate the various risks and uncertainties of potential adaptation options to climate change
(4) Contribution to the biannual international *Summer School on Sustainability Economics*
(5) Producing a framework for uncertainty analysis in model chains, including visualization options

For the **business sector and the economy at large**:
(6) Develop follow-up research-and-development projects on the basis of this project and its expected results

Dialog zur Klimaökonomie

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Short- and Long-Term Impacts of Climate Extremes

Identifying key impact channels and effective strategies for long-term economic development under climate change

POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

ifo INSTITUTE Leibniz Institute for Economic Research at the University of Munich

CLIMATE ANALYTICS

@climpacts

Short- and Long-Term Impacts of Climate Extremes (SLICE)

Climate Analytics: Sarah D'haen, Anne Zimmer **ifo Institute:** Karen Pittel, Markus Zimmer

PIK: Katja Frieler, Tobias Geiger, Christian Otto, Franziska Piontek, Inga Sauer, Anne Scheibe

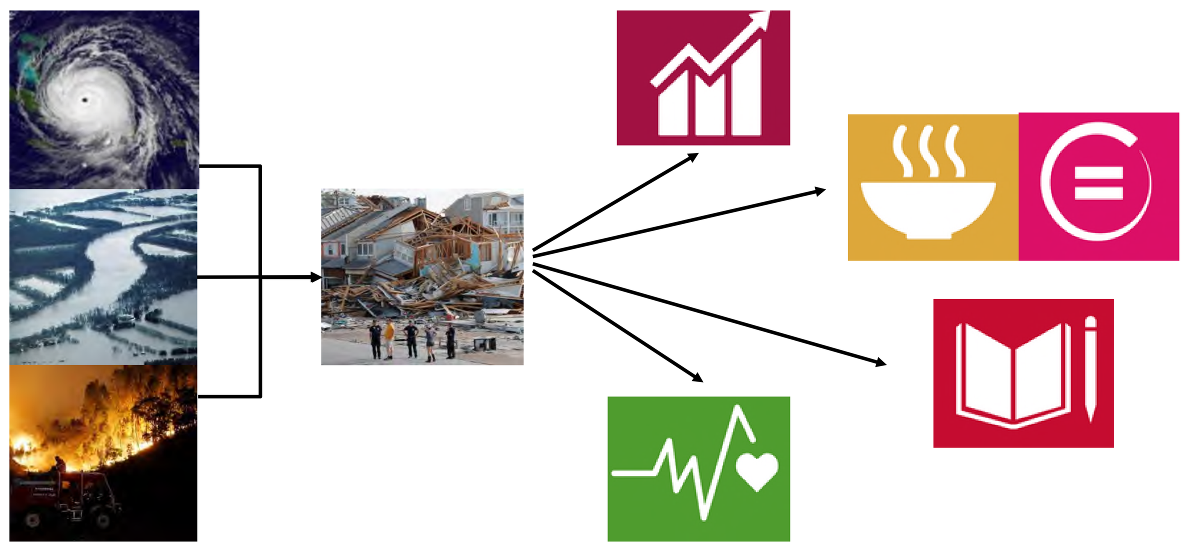
www.climate-impact-economics.org

Aims

- Combine empirical methods with dynamic scenario analysis to assess short- and long-term impacts of climate extremes on socioeconomic development pathways
- Combine household level and macroeconomic analyses to gain profound process-based understanding of main impact channels and their relative importance
- Understand differences in resilience of low-income and industrialized countries to climate extremes
- Account for inequality dimension of climate impacts

The Impact Chain: From Bio-physical Hazards Over Direct Losses to Long-term Impacts on Socioeconomic Development

Climate extremes | Direct damages | Long-term implication for socioeconomic development



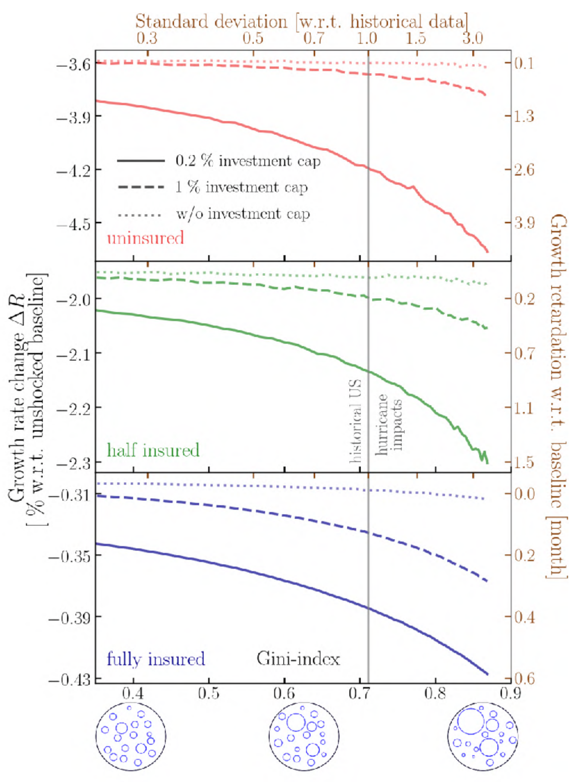
Objectives

- Quantify losses induced by climate extremes consistently across the principal hazard categories (tropical cyclones, fluvial floods, wildfires, droughts, heatwaves, etc.) today (about +1°C above preindustrial global mean temperature) and at higher levels of global warming
- Account for inequality dimension of impacts by developing income specific metrics
- Single out hot-spot countries were high climate risks meet vulnerable populations
- Assess viability and limits of coping strategies

WP6 – Persistence of impacts
Development Pathways Under Climate Extremes

- Constrain empirically
- Assess relative importance of different impact channels
- Resolve nonlinear loss-amplification due to incomplete recovery
  - → Debt distress
- Assess inequality dimension of impacts::

1. Low-income vs. industrialized countries
2. Well-being instead of asses losses



[Otto, Kuhla et al., in prep.]

Stakeholder Interaction & Outreach
Climate Policy Relevance of SLICE

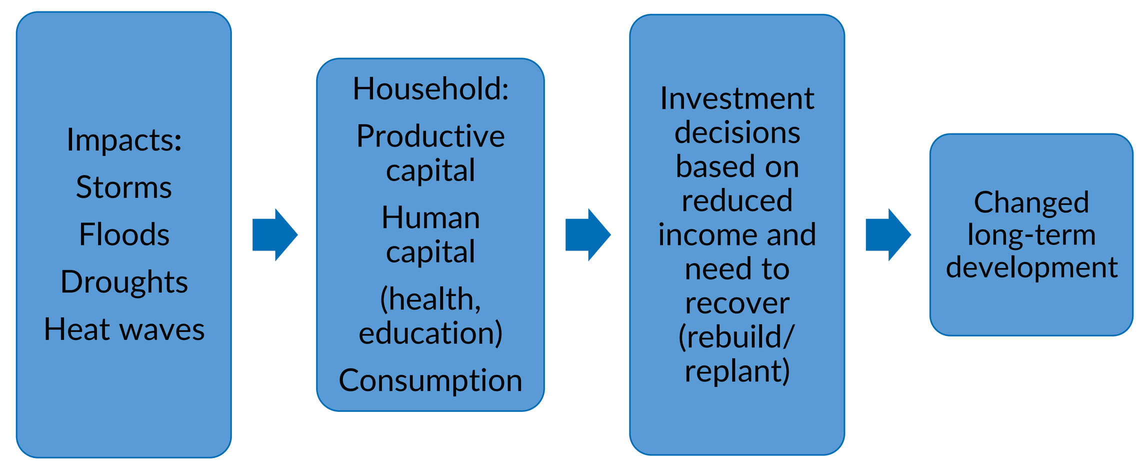
- Continuously collaborate with different groups stakeholders from local and international institutions and the private sector by
  - → Identifying hot-spot countries
  - → Jointly developing critical decision support tools (models, databases)
  - → Singling out main impact channels and assesse viability and limits of coping strategies
- Inform international climate negotiations by providing reliable estimates of the losses averted by limiting global warming to well below 2°C with respect to higher levels of warming

Kick-off Stakeholder Workshop at IFAD, Rome

Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung | giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH | GFDRR | IFAD

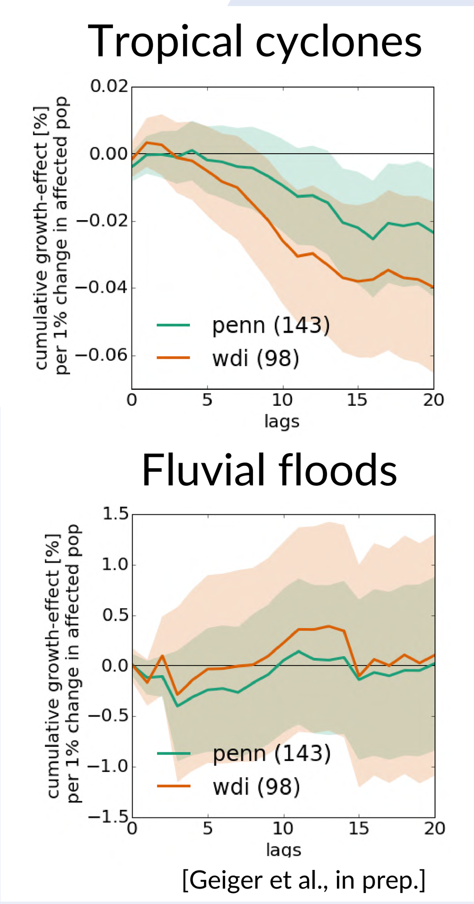
WP4 – Distributional effects
Dynamic Household Level Modelling

- Understand long-term dynamic effects of extreme events on households and relation to macroeconomic growth effects
- Link to research efforts on Sustainable development goals, distributional effects, and poverty traps
- Explore different socioeconomic scenarios and role of coping strategies



WP5 – Indirect losses
Quantification of Long-term Losses

- Use empirical methods to gain process-based understanding on main impact channels of climate extremes on socioeconomic development pathways
- Assess persistences of disaster impacts consistently across categories
- Assess viability of disaster insurance schemes



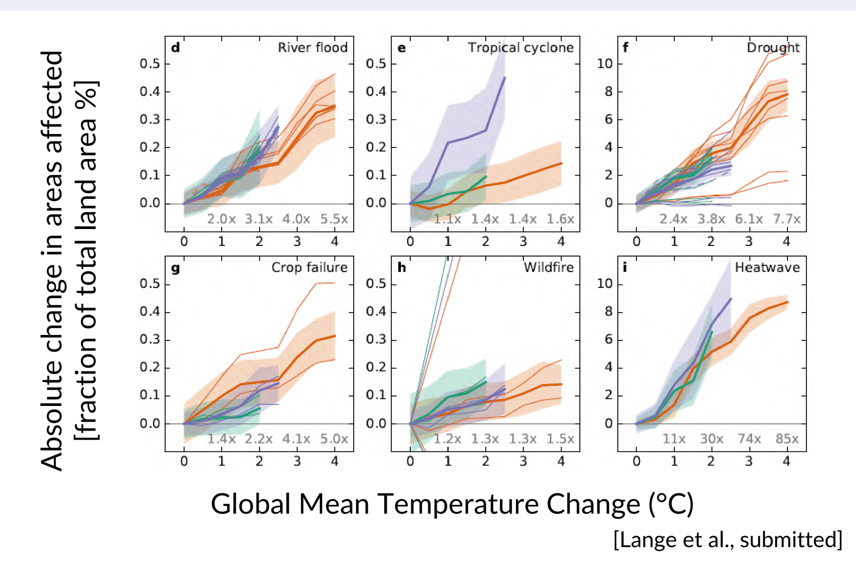
[Geiger et al., in prep.]

WP3 – Empirical analyses
Long-term Impacts on Households

- Empirical impact assessment of climate-related disasters at the household level
- Focus on extreme events such as floods, droughts, cold/heat waves, cyclones
- Focus on low-income countries
- Analysis of impacts that affect development prospects and socio-economic wellbeing in the long-run: e.g. impacts on education/schooling and health
- Identify relevant policy strategies for climate resilient development

WP1 – Key hazard risk indicators
ISIMIP as Bio-physical Impact Basis

- Develop global gridded hazard risk indicators for river floods, tropical cyclones, wildfires, extreme heat, droughts, and crop failures
- Provide historical and future simulations of hazard indicators for different future climate change and socioeconomic development scenarios

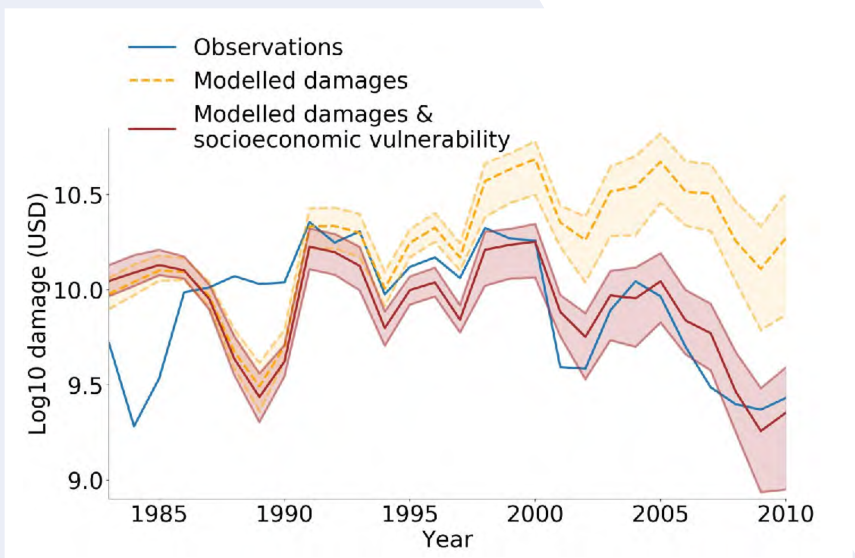


[Lange et al., submitted]

ISIMIP

WP2 – Direct damage
The Loss & Adaptation Model Climada

- Quantitative estimates of direct damages of climate extremes today and at different warming levels and socioeconomic scenarios
- Appraisal of different coping strategies



[Geiger, Reese et al., in prep.]

Dialog zur Klimaökonomie

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Dr. Bernhard Zwergel
Tobias Bauckloh

WWF Deutschland
Matthias Kopp

Affiliated partner: Radboud University (Nijmegen, Netherlands)
Prof. Dr. Daniel Reimsbach

Climate Reporting as Instrument for CO_2 Reduction (CRed)

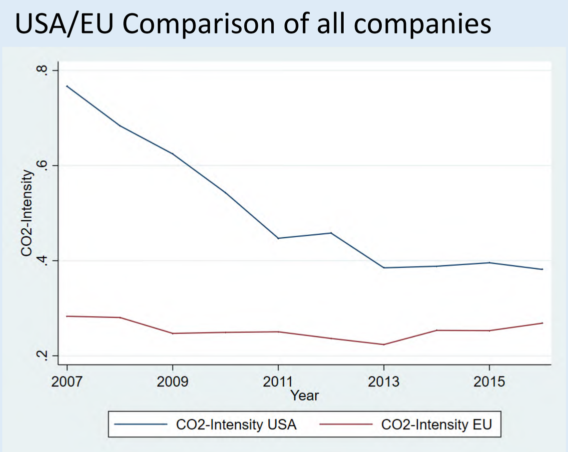
The current situation and call for research:
A wide range of voluntary and mandatory carbon reporting initiatives put pressure on companies to report their efforts, aims, and performance regarding CO_2 emissions. However, it is unclear whether those climate disclosure schemes have the potential to foster CO_2 reduction. The project analyses the contribution of climate reporting to CO_2 reductions and will provide recommendations to improve climate reporting and help implementing a carbon neutral economy.

Status quo of climate change reporting (WP1)

Work package 1 illuminates the status quo of climate reporting. We analyse whether and how mandatory and voluntary climate reporting is associated with changes in corporate CO_2 emissions and with changes in investor reactions to disclosed climate data.
In an archival panel data analysis, the different times of introduction of mandatory disclosure of CO_2 emission in the USA and Europe are used to form control groups.

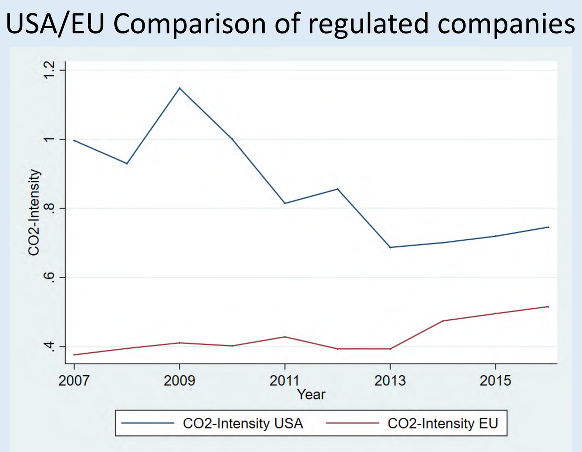
Preliminary results:

USA/EU Comparison of all companies



Since the introduction of the EPA Greenhouse Gas Reporting Program in the USA in 2010, scope 1 CO_2 emissions have been steadily declining, approximating EU levels.

USA/EU Comparison of regulated companies



Emission intensive industries that are regulated in the USA as well as the EU (through the European Emission Trading Scheme) reveal a similar trend of somewhat steady levels in the EU and a decline in the USA.

The preliminary results indicate that mandatory disclosure of CO_2 emissions motivates firms to improve their CO_2 performance.

Corporate climate data in the investment process (WP2)

In work package 2, the research takes the investor's perspective on climate change reporting. It is unclear, whether and potentially how investors use climate data in their evaluation and investment decision process.

These questions are addressed first in an explorative qualitative study with investors, analysts, and company representatives using semi-structured in-depth interviews. In a second step, the results are verified in a large scale survey.

The analysis helps to better understand the relevance of climate data in the investment decision-making process with the goal to present recommendations on how to improve the use of this data.

Climate change reporting and management decision making (WP3)

In work package 3, the project analyses the influence of different designs of climate reporting on managerial decision-making and thus also takes the corporate perspective on climate reporting. In a series of laboratory experiments, managers make climate change-related decisions in a realistic market setting.

The results will allow recommendations on which design(s) of climate change reporting are best suited to encourage managers to make emission-reducing investments and thus meet the overall goal of reducing corporate CO_2 emissions and the carbon footprint.

Processing and dissemination of results, project management (WP4, ongoing)

Apart from the project management and the scientific writing, in work package 4 we will compile practice-oriented publications (management summaries, policy briefs and articles for the relevant target groups), which will be opened to a broader audience. For the exchange and intensive discussion of the project results, there will be a series of stakeholder workshops, which will function as a link between the pillars of practice-oriented and academic dissemination. Results of all three working packages will be summarized in "policy briefs" providing recommendations for decision makers in politics and society.

Dialog zur Klimaökonomie

For further information please contact us!

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MCC Mercator Research Institute on Global Commons and Climate Change

GIGA German Institute of Global and Area Studies
Leibniz-Institut für Globale und Regionale Studien

rwi

De-Carbonizing Economic Development in Sub-Saharan Africa (DECADE)

MCC: Dr. Jan Steckel, Dr. Sinem Ayhan, Dr. Michael Jakob, Ira Dorband
GIGA: Apl. Prof. Dr. Jann Lay, Dr. Sebastian Renner, Hannes Greve
RWI: Prof. Dr. Jörg Peters, Julian Rose

The project aims at investigating carbonization dynamics and climate policy options in Sub-Saharan Africa (SSA). In particular, feasible short term entry points for SSA countries to embark on low-carbon development paths and prevent lock-ins in long-lived infrastructure will be analysed. Central aspects of this analysis are policy impacts on the household and firm level as well as political economy considerations.

CARBONIZATION PATTERNS

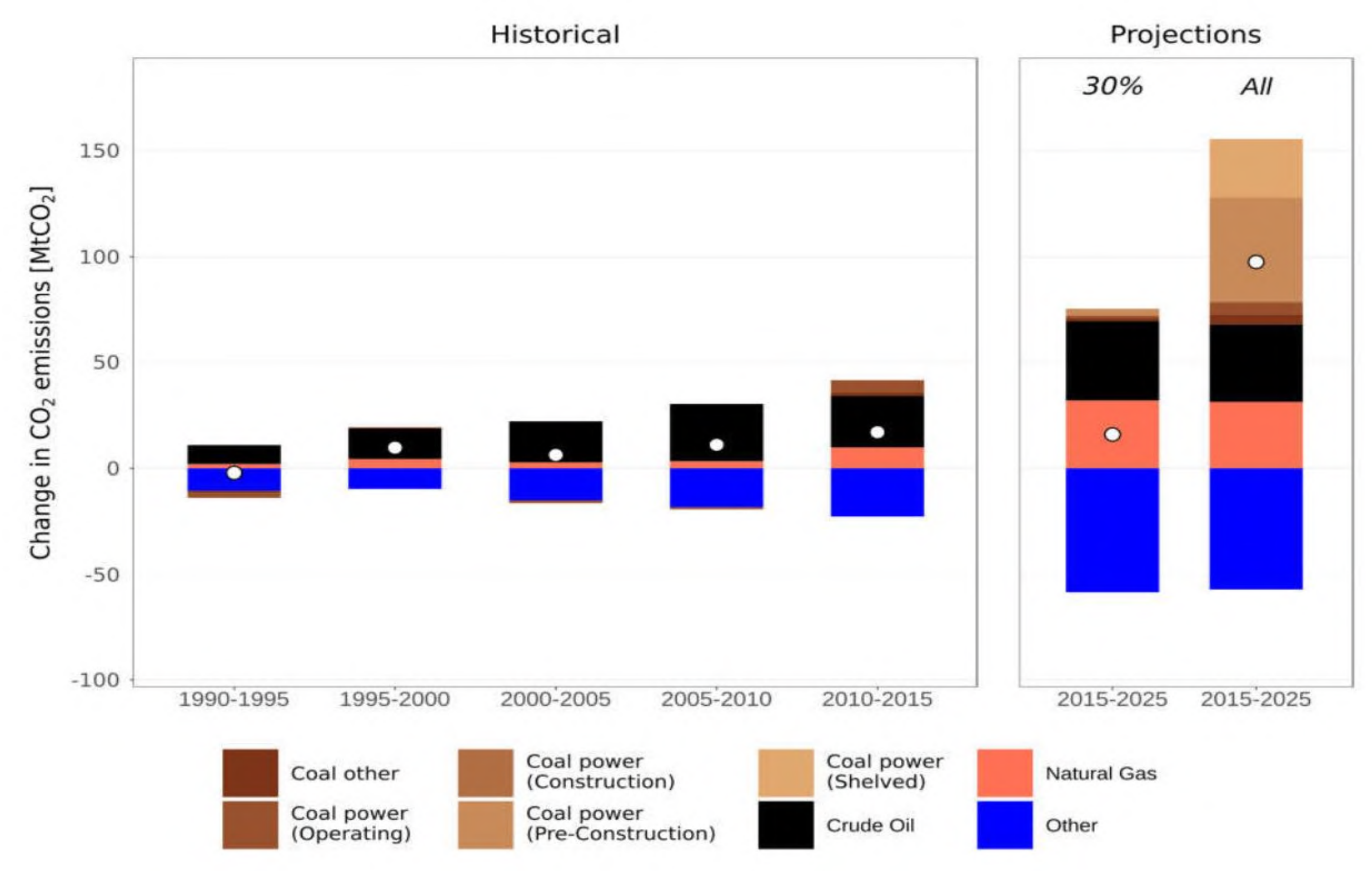

Fig. 1: Carbonization patterns 1990-2015 (left) and projections (right). (Source: Steckel et al. (under review))

- As of now, SSA exhibits relatively low levels of carbon emissions. However, *strong growth* in recent years (particularly in the transportation sector)
- *Coal* could become main source of power generation
- Which emission dynamics can be observed in the *agricultural and forestry sector*?
- Which role does *charcoal* play?

POLICY IMPACTS

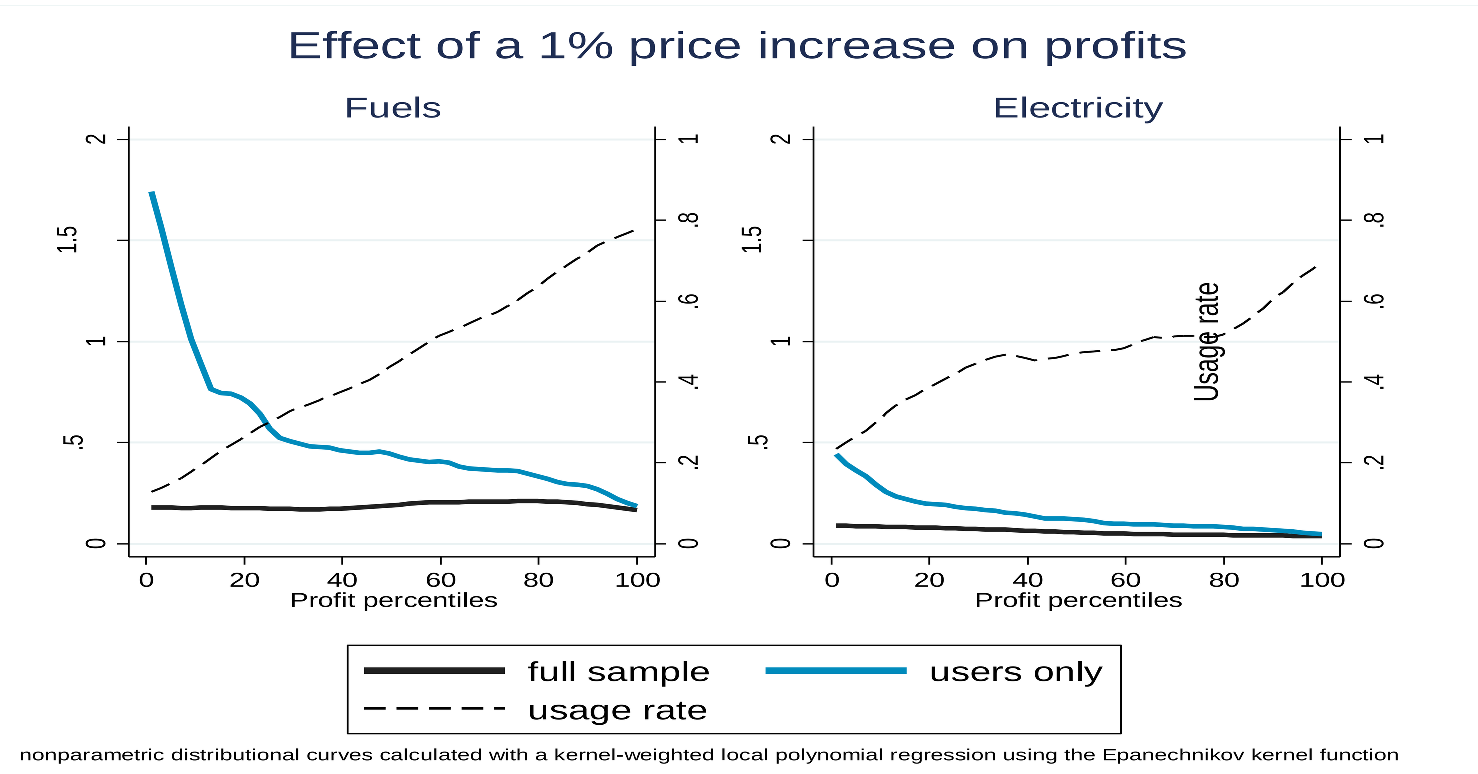

Fig. 2: Effect of energy price increases on profits of Mexican microenterprises (Source: own calculations using ENAMIN 2012 data)

- Climate policy can affect the *income distribution* and *competiveness* of firms
- What are potential effects of climate protection measures on *households* as well as *firms?*
- *Ex-post*: Effects of energy subsidy reforms?
- How can revenue generated by environmental taxes be *redistributed* to ensure vertical and horizontal equity?

POLITICAL ECONOMY

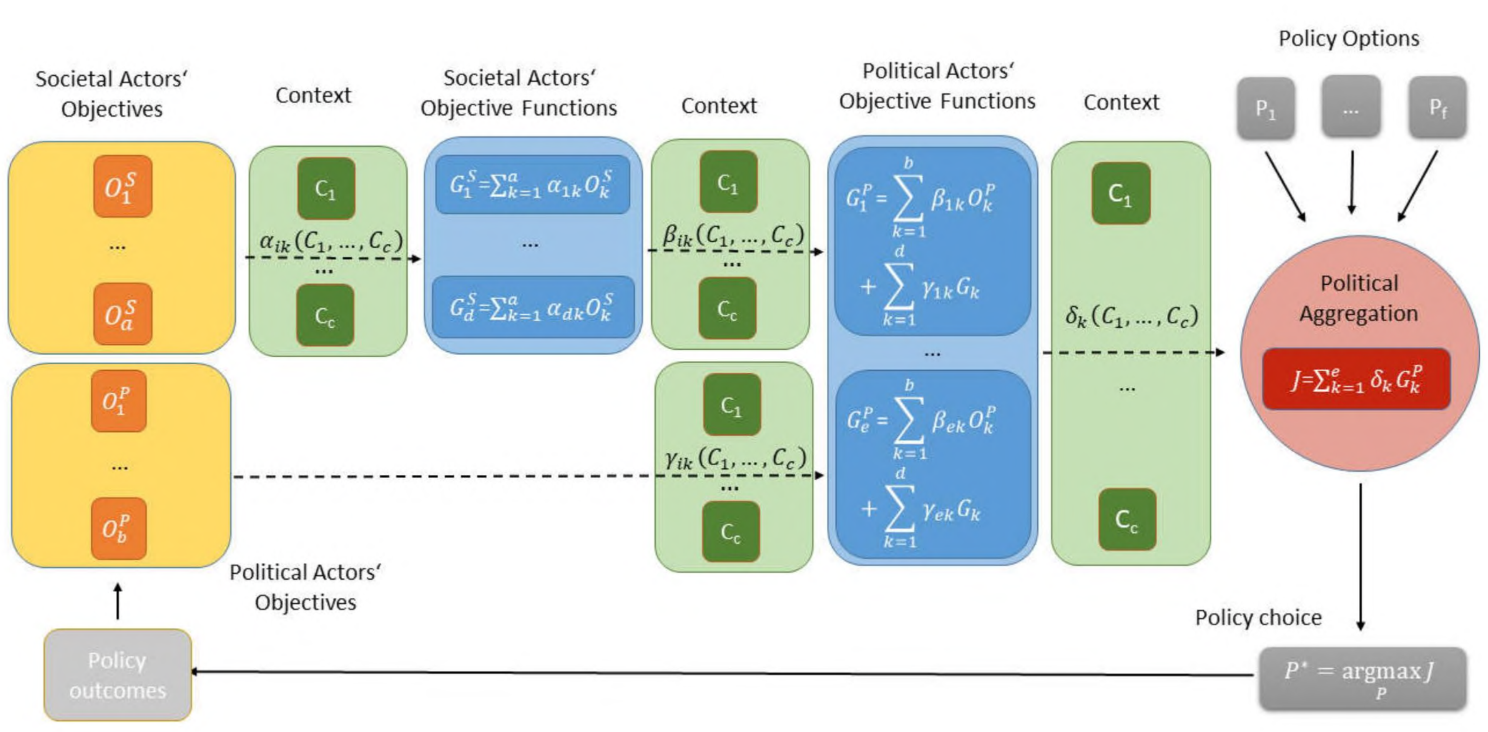

Fig. 3: Energy and climate policy are determined by actors, their interests and influence on the political process.
(Sources: Jakob et al. (under review))

- Many SSA countries rely on fossil fuels, except widespread availability of renewable energy sources
- Not only due to economic, but also *political* reasons
- Country case studies (Nigeria, Senegal, Tanzania) with consistent methodological approach

STAKEHOLDER AND POLITICS

- Policy Briefs with central results for stakeholders
- Expert interviews with national and international actors
- Workshop with African scholars and decision-makers

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Dialog zur Klimaökonomie

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ZEW

Universität Potsdam

rwi Leibniz-Institut für Wirtschaftsforschung

EVALUATING GERMANY'S CLIMATE MITIGATION AND ADAPTATION PRACTICE (EVAL-MAP II)

Gerhard Kussel

RWI – Leibniz Institute for Economic Research, Essen

Objectives

The substantial implications of climate policy measures make their sound scientific evaluation imperative.

The Eval-MAP 2 project contributes to this by:

- Creating the necessary but non-existent database, extending the publicly accessible household panel data set established in the first project Eval-MAP by two additional survey waves
- Evaluating Germany's mitigation practice
- Evaluating Germany's adaptation practice

Data – Green SOEP

Comprehensive household panel data on climate change and energy use. The data captures households':

- Knowledge and perceptions of climate change
- Preferences for energy technologies and sources
- Energy consumption
- Adaptation efforts
- Socio-economic characteristics

The data is provided for scientific use by the Research Data Center Ruhr (FDZ Ruhr): en.rwi-essen.de/forschung-und-beratung/fdz-ruhr

Data description (German):
Kussel, G. and T. Larysch (2017), Sozial-Ökologiches Panel: Datenbeschreibung der Haushaltsbefragung. *RWI Materialien 110*. Essen: RWI.

Project Team

RWI – Leibniz Institute for Economic Research (consortium leader):
Prof. Dr. Manuel Frondel (project management)
Dr. Gerhard Kussel (project management)

ZEW, Centre for European Economic Research:
Dr. Daniel Osberghaus

University of Potsdam, Project group "Geography and natural risks research":
Prof. Dr. Annegret H. Thieken
Dr. Philip Bubeck

IÖR, Leibniz Institute of Ecological Urban and Regional Development
Dr. Martin Achtnicht

Dialog zur Klimaökonomie

Mitigation

The trade-off between climate protection efforts and the resulting cost burden critically affects the public acceptance of climate policy.

Against this background we analyze households':

- Willingness-to-pay for different energy mixes
- Responsiveness to price signals
- Preferences for fair burden sharing (industry exceptions)
- Sensibility for energy conservation nudges (labeling)

Selected results from Eval-MAP:

- Andor, M. A., M. Frondel and S. Sommer (2018), Equity and the Willingness to Pay for Green Electricity in Germany. *Nature Energy* 3 (10): 876-881.
- Frondel, M. and G. Kussel (2019), Switching on Electricity Demand Response: Evidence for German Households. *Energy Journal* (forthcoming)
- Frondel, M., G. Kussel and S. Sommer (2019), Heterogeneity in the Price Response of Residential Electricity Demand: A Dynamic Approach for Germany. *Resource and Energy Economics* (forthcoming)

Adaptation

Irrespective of the world's mitigation efforts, the earth's climate is likely to change substantially. The degree to which these changes are harmful to households depends on their ability to adapt.

We analyze households' adaptation to:

- Extreme weather events
- Flood risk
- High indoor temperatures

Selected results from Eval-MAP:

- Kahsay, G. A., and D. Osberghaus (2018). Storm Damage and Risk Preferences: Panel Evidence from Germany. *Environmental and Resource Economics*, 71, 301–318.
- Kussel, G. (2018), Adaptation to Climate Variability: Evidence from German Households. *Ecological Economics 143*: 1-9.
- Osberghaus, D. (2015), The determinants of private flood mitigation measures in Germany - Evidence from a nationwide survey. *Ecological Economics*, 110, 36-50.
- Osberghaus, D. (2017). The effect of flood experience on household mitigation – Evidence from longitudinal and insurance data. *Global Environmental Change*, 43, 126–136.

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TAPPING THE DOUBLE DIVIDEND:
HOUSEHOLD ENERGY IN DEVELOPING COUNTRIES, CLIMATE CHANGE MITIGATION AND ADAPTATION (TapD²)

Marc Jeuland[a], Luciane Lenz[b], Samba Mbaye[c], Ousmane Ndiaye[c], Jörg Peters[b], Maximiliane Sievert[b], Faraz Usmani[a,d]
[a] Duke University, [b] RWI, [c] Université Gaston Berger, [d] Cornell University

Background

- Three billion people worldwide cook with charcoal and firewood using inefficient stoves, resulting in
  - Greenhouse gas emissions
  - Forest degradation and deforestation
  - Household air pollution causing over four million deaths annually (WHO, 2014).
- Climate and health policies heavily promote improved/ clean cookstoves (ICS, see EnDev, UN-CCA, UN-SE4ALL, WHO).
- Challenges: weak supply chains and unknown cost-benefits of different cooking technologies.

Figure 1: Indoor Air Pollution and fuelwood consumption from cooking

Project 1: Can matching of urban supply and rural demand increase rural ICS penetration?

Study Design

- Randomized Controlled Trial (RCT) to overcome market failures in the supply of ICS:
  - information asymmetries
  - credit market imperfections.
- Intervention among traders to incentivize ICS sales in rural areas:
  - Rural demand information (assessed via Second Price Vickrey auctions)
  - End-user and producer contacts
  - Marketing materials
  - Transport subsidy.
- Monthly monitoring of ICS sales and prices among producers and traders.

Estimation and main outcomes

- Difference-in-Differences estimation of intervention's effects on:
  - Traders: ICS sales, marketing activities and market outreach.
  - ICS supply chain: Production, prices, arbitrage, and crowding-out effects.

Figure 2: Study samples

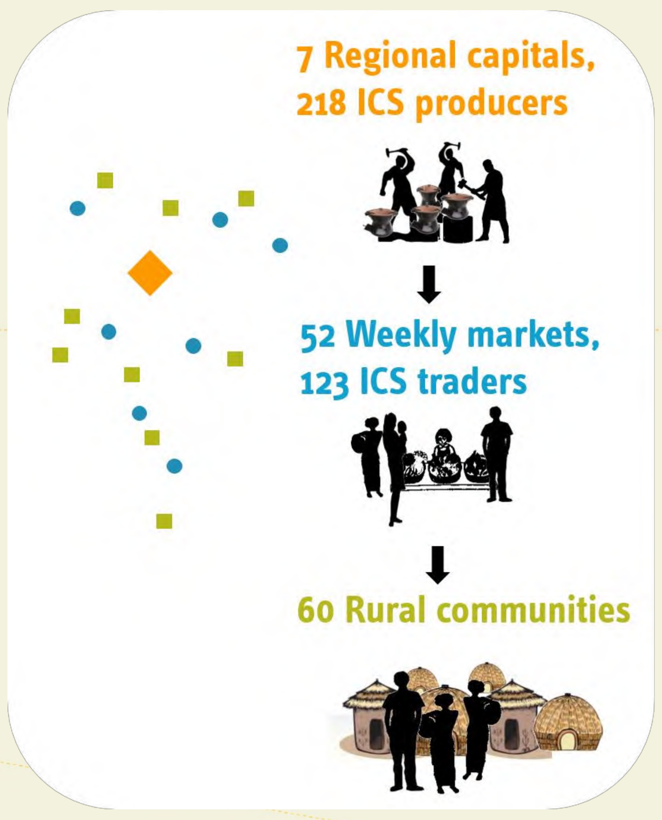
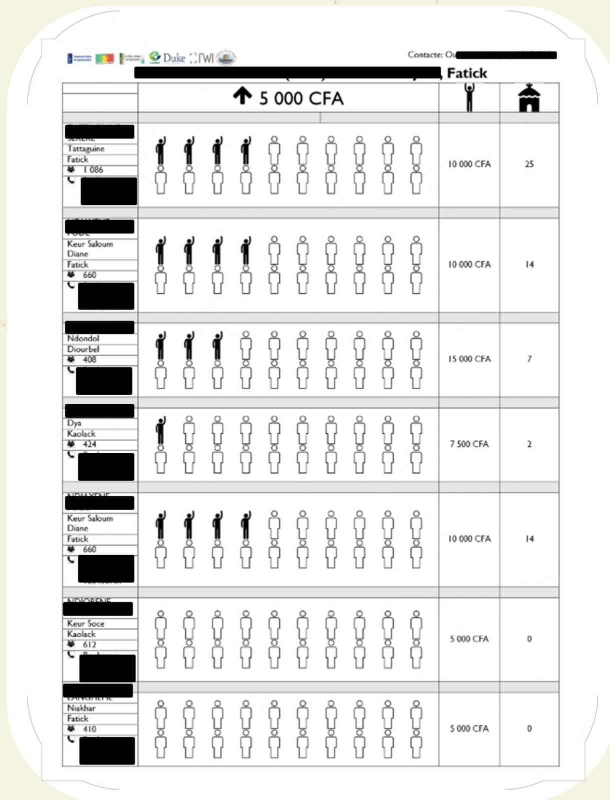


Figure 3: Rural demand information



Project 2: How do effects of simple ICS compare to those of advanced ICS?

Study Design

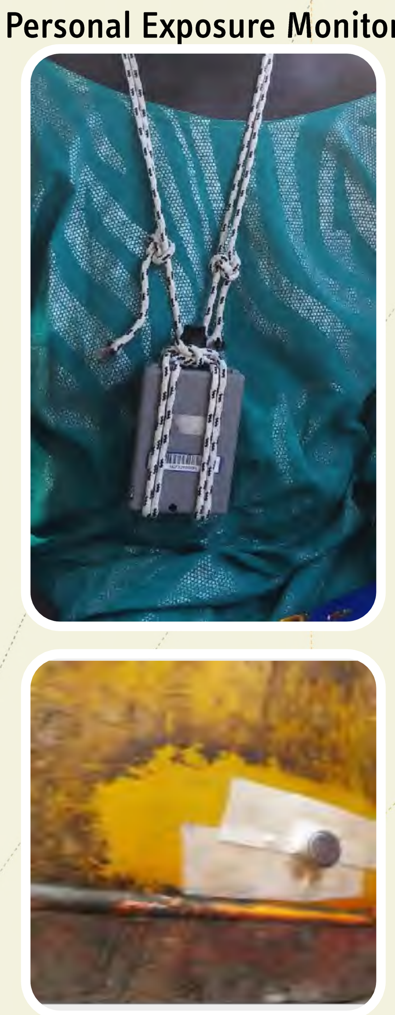
- Randomized Controlled Trial (RCT) among 535 rural households in 15 communities.
- Intervention randomizes simple ICS, advanced ICS, and placebo treatment among households.
- Three household surveys elicit pre-treatment situation, and post-treatment situation in rainy and in dry seasons.

Estimation and main outcomes

- Difference in Differences estimation of effects of ICS ownership on objective and subjective outcomes.
- Objectively measured:
  - Primary cook's health
  - Kitchen PM2.5 pollution and primary cooks' exposure to PM2.5
  - Stove use
  - Fuel consumption
- Subjectively measured
  - Household members' health
  - Fuel collection time
  - Primary Cooks' Time Use

Figure 4: Baseline, simple and advanced ICS

Figure 5: Stove Use Monitor, Personal Exposure Monitor



Dialog zur Klimaökonomie

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EVALUATING POLICY INSTRUMENTS FOR THE TRANSFORMATION TO A LOW CARBON ECONOMY

// CAUSAL EVIDENCE FROM ADMINISTRATIVE MICRODATA (TRACE)

UWE BLIEN AND MARKUS JANSER (INSTITUTE FOR EMPLOYMENT RESEARCH) | ANDREAS GERSTER AND ULRICH WAGNER (UNIVERSITY OF MANNHEIM) | ROBERT GERMESHAUSEN, KATHRINE VON GRAEVENITZ AND ELISA ROTTNER (ZEW)

Objective

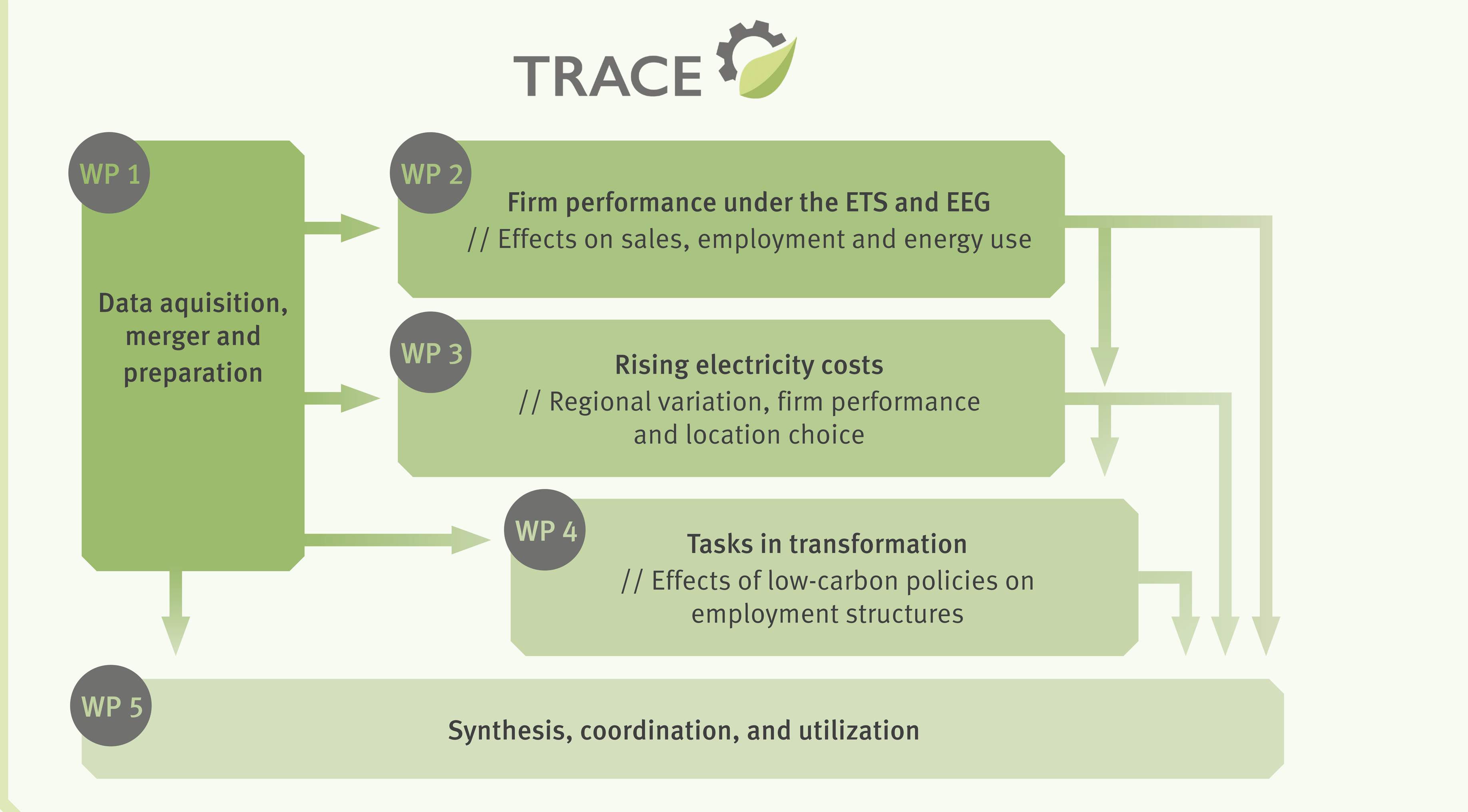
The main objective of TRACE is to subject existing climate policy measures to scientific ex-post evaluation of the highest standard for the case of Germany focusing on the manufacturing sector.

The evaluation focuses on

» Effectiveness towards achieving policy goals
» Costs and unintended consequences
» Regional and sectoral disparities in impacts on the labor market

Throughout the project, special emphasis will be put on identifying the channels through which these effects occur in order to better understand how the regulated firms respond to the policy measures. The project brings together labor and environmental economists and sociologists and utilizes the most advanced administrative micro data sets available.

Scientific approach (Work packages 1-4)



WP 2 Firm performance under the ETS and the EEG

Objective
Quantify the causal effect of the European Union Emissions Trading Scheme (EU ETS) and of exemptions from the Renewable Energy Surcharge on sales, energy use, employment, wages and plant exit.

Method
Quasi-experimental approaches and panel econometrics

Relevance
Understanding how changes in input prices for primary fuels and electricity affect the performance of manufacturing is crucial to gauge the cost of ambitious climate policies in terms of job losses, output reductions, and firm relocations.

WP 3 Rising electricity costs

Objective
To quantify the impact of rising electricity prices on plant performance and emissions, on plant location choice or exit from the market, and on workers' wages.

Method
Quasi-experimental approaches and panel econometrics

Relevance
Understanding the effects of rising electricity costs allows for an assessment of the distribution of the burden regionally as well as the incidence of electricity costs. This information facilitates the (improved) design of future and current policy instruments.

WP 4 Tasks in transformation

Objective
To create an index of the carbon-relevance of occupations and to quantify the impact of climate policy on occupation structures.

Method
Text-mining, machine learning for creation of the index, Quasi-experimental approaches for econometric analysis

Relevance
The analysis of tasks addresses the intensive margin of job content and the climate-policy relevance of existing occupations. It sheds light on whether employment growth is stronger/weaker in occupations identified as having a low/high climate policy relevance.

Knowledge transfer and utilization (WP5)

TO THE SCIENTIFIC COMMUNITY
» Seminars and conferences
» Working papers (ex: ZEW discussion papers)
» Publications in peer-review journals

TO THE POLICY COMMUNITY
» ZEW lunch debates in Brussels
» Side events at UNFCCC Conferences of the Parties

TO THE GENERAL PUBLIC
» Advisory boards
» Workshops
» Website

PROJECT WEBSITE
https://kooperationen.zew.de/trace/home.html

Dialog zur Klimaökonomie

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Organization and Steering Committee:

Carbon Pricing after Paris (CarPri)

Malte Winkler[1], Sonja Peterson[1], Christoph Böhringer[2], Jan Schneider[2,3]

[1]Kiel Institute for the World Economy (IfW); [2]Carl von Ossietzky University, Oldenburg; [3]ETH Zürich

Based at Stanford University, the **Energy Modelling Forum (EMF)** improves the use of energy and environmental policy models by harnessing collective capabilities of **multiple models**. **Dissemination** of results is a key aspect of EMF.

Within the EMF framework, **EMF36 (CarPri)** focusses on the implementation of the emission targets (NDCs) of the **Paris Agreement** and the role of extended **carbon pricing**.

23 modelling groups from 17 countries (incl. USA, China, India…) have joined EMF36.

Core Scenarios

- Analyzed by all groups
- Harmonized emission / GDP baseline
- NDC scenario
- 2°C scenario

➢ Achieve detailed picture of implications

➢ Derive policy conclusions

Additional In-Depth Analysis

Set of topics from which each group analyses one in detail:

1. International climate policies (climate coalitions, revenue recycling, overlapping policies
2. Country perspectives (Germany, Canada, China…)
3. Modelling issues (coupling different models, model mechanisms…)

CarPri will deliver valuable highly **insights** into core aspects (tools, coalitions, implications…) regarding NDCs **implementation**. Using numerous models with **different foci** will provide a sound and detailed analysis.

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Contact: malte.winkler@ifw-kiel.de; +49 431 8814-401

CLIMATE POLICY COMPLIANCE

THE ECONOMICS OF INTERNATIONAL CLIMATE POLICY COMPLIANCE

// MONITORING, REPORTING, VERIFICATION & ENFORCEMENT (COMPLIANCE)

PROF. DR. ASTRID DANNENBERG AND MARCEL LUMKOWSKY (UNIVERSITY OF KASSEL) | PROF. TIMO GOESCHL, PHD (HEIDELBERG UNIVERSITY) | PROF. ULRICH J. WAGNER, PHD (UNIVERSITY OF MANNHEIM) | VERA HUWE, CLAIRE GAVARD, PHD AND DR. WOLFGANG HABLA (ZEW)

Overarching goal

» Create knowledge about systematic and country-specific factors that influence compliance with monitoring, reporting, verification and enforcement mechanisms (MRV&E) in international climate policy

» Particular emphasis on countries highly committed to fulfill their obligations under the Paris Agreement given commitment heterogeneity among countries

WP 1 Positive Analysis of Compliance

Idea: Investigation of compliance within existing monitoring and enforcement provisions of international environmental agreements (IEA) at firm and state level

Method: Theoretical and empirical analysis, surveys

Relevance: Insights on the effectiveness of different monitoring and enforcement mechanisms in IEAs

WP 2 Normative Analysis of Compliance

Idea: Analysis of possible MRV&E regimes (e.g. costly monitoring as well as soft compliance mechanisms) taking regime cost and actor asymmetries into account

Method: Theoretical, empirical and experimental analysis

Relevance: Robust insights on the structure of an effective and efficient MRV&E regime, especially with regards to the Transparency Mechanism of the Paris Agreement

WP 3 Strategic Analysis of Compliance

Idea:
» Analysis of the implications of heterogeneity in transparence and compliance orientations for behavior, social welfare and governance
» Examination of institutional linking between climate and trade policy as a mean for inducing compliance, also taking the associated risks into account

Method: Theoretical and experimental analyses

Relevance: Recommendations on how countries strongly committed to transparency and compliance can further their goals in the presence of less ambitious countries

WP 4 Communication and dissemination of the results

TO THE SCIENTIFIC COMMUNITY	TO THE POLICY COMMUNITY	TO ALL
» Seminars and conferences » Working papers (ex: ZEW discussion papers) » Publications in peer-review journals	» ZEW lunch debates in Brussels » Side events at UNFCCC Conferences of the Parties	» Workshops » Project website » Advisory board*

*Advisory Board: Prof. S. Barrett, Columbia University | Prof. A. Dechezleprêtre, OECD & London School of Economics | Prof. J. Shimshack, University of Virginia | Prof. J. Stranlund, University of Massachusetts | J. Burck, Germanwatch | Prof. C. Ji, Rocky Mountain Institute | Dr. B. Huckestein, BASF

SIDE EVENT AT THE EU-PAVILLION IN KATOWICE

Setting the Paris Agreement in motion: key requirements for the implementing guidelines

PROJECT WEBSITE
https://kooperationen.zew.de/compliance/home.html

Dialog zur Klimaökonomie

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ZEW – Leibniz Centre for European Economic Research

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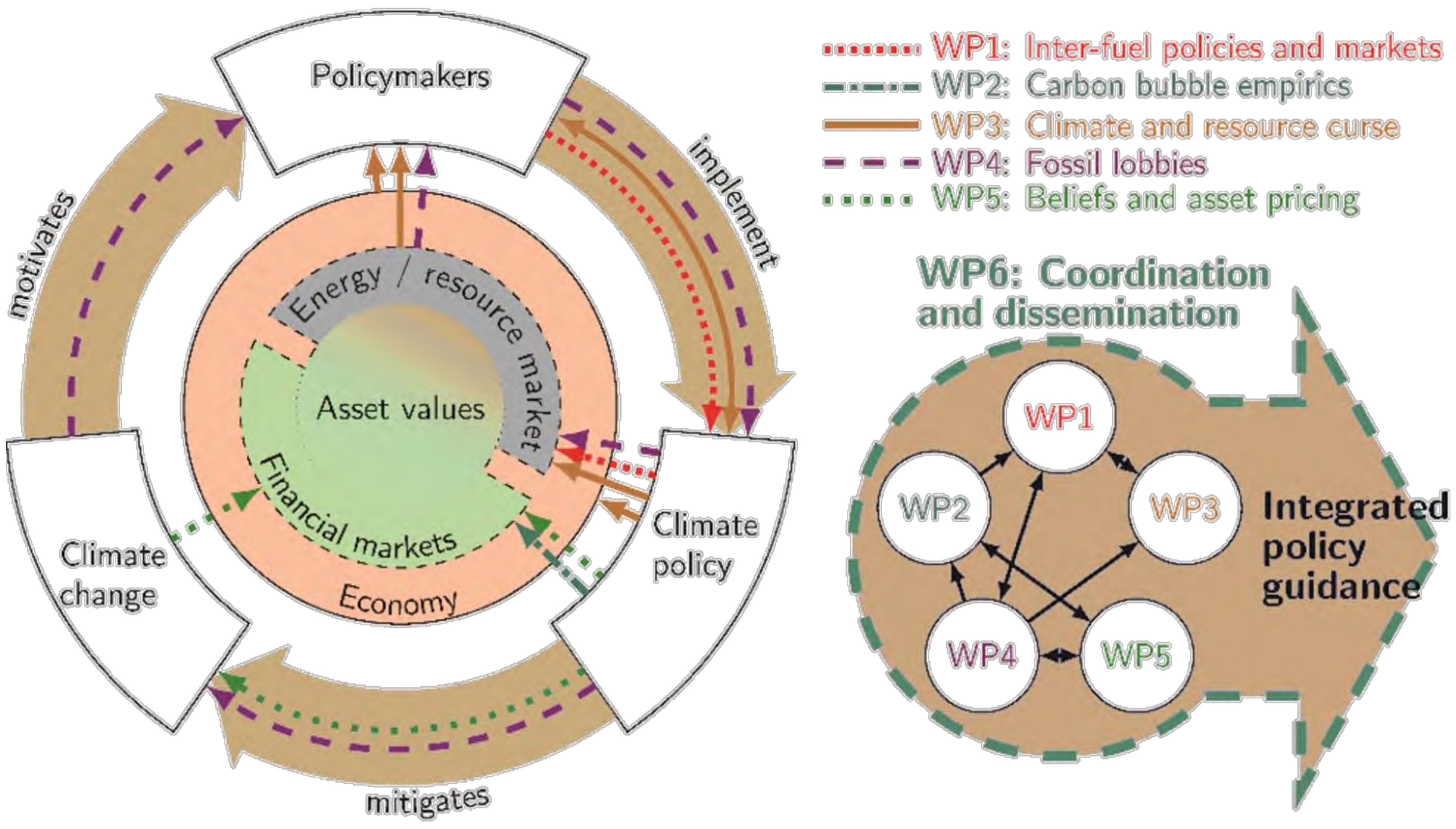
Fossil Resource Markets and Climate Policy:

Stranded Assets, Expectations and the Political Economy of Climate Change (FoReSee)

Dawud Ansari (DIW), Klaus Eisenack (HU), Achim Hagen (HU)
Franziska Holz (DIW), Karen Pittel (ifo), Alex Schmitt (ifo)

THE PROJECT AT A GLANCE



Stranded assets: work packages focus on different parts of the mechanism…

…and support each other via research linkages

FoReSee studies…

- the interplay between climate policies and participants in financial & fossil fuel markets
- how policies can overcome the inertia of the energy system without excessive costs
- redistribution of rents in sectors and countries vulnerable to asset stranding
- private actors' responses to current and expected (uncertain) climate policies
- policy designs to correct inefficient market-side responses

Combined excellence in methods	Econometrics
	Game theory
	Numerical modelling
	Political economy
	Stakeholder dialogue

PROJECT THEMES

Inter-fuel policies and markets (WP1)
FoReSee analyses different climate policies that affect the distribution of rents between fuels and countries. Using game-theory and numerical modelling, we test and design novel policies that have been recently proposed by experts. Special emphasis is given to the inter-fuel effects of proposed supply-side policies and different arrangements of property rights.

The empirics of carbon bubbles (WP2)
We investigate which types of infor-mation shape investors' expectations of asset stranding, what the relevant sig-nals from policymakers are, and how companies react to climate policy risk and uncertainty. Mispricing of stranded asset risk might lead to costly conse-quences for the whole economy, which is why an understanding of financial market behaviour is crucial.

Climate and the resource curse (WP3)
FoReSee investigates fossil-resource rich economies, that are often dependent on their natural endowments. We analyse the effect that climate policy has on them, their internal dynamics, and the role of institutions. In close collaboration with stakeholders, we supply new insight into resource management, economic diver-sification, and the role of alternative forms of governance.

Fossil lobbies and feasible policy (WP4)
Effective climate policies need to be politically sustainable and credible to be feasible. FoReSee investigates strategic competition for political influence be-tween different interest groups in the fossil energy sector, under the threat of asset stranding. We aim at evaluating the previous behaviour of lobbies and the design of novel policies that take the viability of future regulation into account.

Beliefs and asset pricing (WP5)
We assess how uncertainty over future climate change and climate policy inter-acts with asset prices and technological investments. Poor information process-ing, market incompleteness and policy uncertainty result in inefficient resource allocations, raising the cost of climate policy and inhibiting the shift to a green economy. By constructing a new version of the DICE model that features stochas-ticity, we design policies to address these long-run risks and to minimise the cost of uncertainty to society. This can prevent inefficient asset stranding.

OUTREACH AND ORGANISATION

- Project publications: working papers, peer-reviewed academic journal articles, policy briefs
- Presentations at international conferences and integrative project workshops
- Education of junior researchers
- Active engagement with the national and international community of the economics of climate change
- Integration of stakeholders' incentives, strategies, and modelling input
- Transdisciplinary workshops and bilateral consultations
- A diverse high-level advisory board

Project duration: October 2018 – September 2021
Project lead: Prof. Dr. Karen Pittel (ifo Center for Energy, Climate and Resources)
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June 2019

INFAIRCOM

HTWK Leipzig University of Applied Sciences | Hochschule Bochum Bochum University of Applied Sciences | Leibniz Institute of Ecological Urban and Regional Development | ZEW

INCENTIVES, FAIRNESS AND COMPLIANCE IN INTERNATIONAL ENVIRONMENTAL AGREEMENTS (INFAIRCOM)

CLAIRE GAVARD, PHD, DR. CARLO GALLIER, PROF. DR. MARTIN KESTERNICH, MARIUS ALT AND PROF. ACHIM WAMBACH, PHD (ZEW) | PROF. DR. CORNELIA MANGER-NESTLER, PROF. DR. BODO STURM AND DR. ULRIKE WILL (HTWK LEIPZIG) | PROF. DR. CARLA VOGT (HS BOCHUM) | DR. MARTIN ACHTNICHT AND DONIA MAHABADI, M.SC. (IOER DRESDEN)

Objective

» InFairCom analyses pending issues for a successful implementation of the Paris Agreement. The analyses focuses on the conditions for the dynamic review process of joint mitigation efforts and financial transfers to implement, monitor, and foster nationally determined contributions to converge towards the long-term climate objectives.

» The project combines several distinct but complementary methodological approaches including qualified judicial assessments, meta-analyses of existing international environmental agreements, theoretical economic models linked with experimental and empirical applications.

SIDE EVENT AT UN CLIMATE CHANGE CONFERENCE (COP 24) IN KATOWICE
// Pledges and compliance in international cooperation

WP 1 – Field evidence for successful cooperation in past international environmental agreements

Objective: Identify and analyze determinants for successful cooperation in international environmental agreements by addressing equity and fairness issues.

Method: Legal perspective on the equity and fairness issues in the Paris Agreement accompanied with systematic review of the academic literature on past international environmental agreements as well as an empirical analysis of the role of of financial transfers in international climate action.

WP 2 – Theoretical analysis of transfer schemes to stabilize outcomes in coalition games

Objective: Identify features of successful transfer schemes for stabilizing heterogeneous climate coalitions and investigate effects of the identified transfer schemes on stable climate coalitions.

Method: Empirical estimation of inequality aversion for collective preferences, numerical simulations of a multi-country coalition formation model.

WP 3 – Laboratory evidence of compliance in international environmental agreements

Objective: Test procedural aspects contained in the Paris Agreement, in particular dynamic review and contribution schemes, to derive insights and establish an agreement architecture that provides incentives for compliance and increasing efforts.

Method: The analysis is based on well-established economic experiments, which are strategically extended to map core characteristics and challenges in international environmental agreements.

WP 4 – Survey among Delegates on processes in the Paris Agreement

Objective: Study preferences of delegates in international climate negotiations associated with the Paris Agreement to identify possible differences and similarities in governments' collective preferences.

Method: Discrete Choice Experiment on financial transfers, fairness in burden sharing, and leadership in climate change mitigation conducted online among UNFCCC delegates. Econometric analysis of influential factors on countries' decisions to comply with the Paris Agreement, and how parties trade off their national self-interests to implement the Paris Agreement.

WP 5 – Communication and dissemination:

TO THE GENERAL PUBLIC
- » Advisory board
- » Workshops
- » Project website

TO THE SCIENTIFIC COMMUNITY
- » Seminars and conferences
- » Working papers
- » Publications in peer-review journals

TO THE POLICY COMMUNITY
- » Side events at UNFCCC Conferences on the Parties
- » ZEW lunch debates in Brussels

PROJECT WEBSITE
https://kooperationen.zew.de/infaircom/home.html

Dialog zur Klimaökonomie

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ZEW – Leibniz Centre for European Economic Research

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Sustainable Climate Finance and its Impact (SUFI)

Frankfurt School of Finance & Management
Prof. Dr. Oliver Schenker
Prof. Dr. Ulf Moslener
Menglu Zhuang, MSc.

Philipps-Universität Marburg
Prof. Dr. Björn Vollan
Prof. Dr. Andreas Landmann (Georg-August Universität Göttingen)
Marco Nilgen, MSc.

Objective: Fully Understanding the Climate Finance Project Cycle

Work Package 1: Policy Decisions to Transfer Resources → Investment in Projects and Programs

Work Package 3

Work Package 2: Implementation of Projects and Programs → Impact

Work Package 4

Work Package 1 – Understanding Climate Finance and Investment Support Measures

WP-Lead: Frankfurt School of Finance and Management

Objective 1: Identification of barriers and market failures that affect investment in climate finance projects and shape investment support policy instruments.
Objective 2: Development of a theoretical framework in order to examine the potential of these policy instruments in overcoming said barriers and market imperfections.
Objective 3: Drawing of empirical conclusions on the effectiveness of instruments embedded in specific investment environments.

Output: Detailed reports on the current state of knowledge, the composition of the theoretical model used to assess the consequences of environmental policies for capital costs, as well as a report on model calibration, the data used and the model's key parameters. All of these reports will be published on the project website and distributed to interested stakeholders and researchers.

Work Package 3 – Learning from an Integrated Perspective

WP-Lead: Frankfurt School of Finance and Management

Thematically positioned at the interface between project finance and implementation, the goal of this WP is to synthesize findings and results from both WP1 and WP2. Connecting project finance and investment support measures with the impact of these projects on the ground, enables an integrated assessment of climate finance. WP3 will bring together the results of individual studies, connect the dots between finance and effectiveness, and develop a comprehensive unifying analytical framework.

Output: Synthesizing report; Policy briefs on investment support policies, the impact of climate finance projects on socioeconomic development and the impact of climate finance and investment

Work Package 4 – Dissemination and Project Management

WP-Lead: Frankfurt School of Finance and Management

Work Package 2 – Evaluating the Impact of Climate Finance Projects

WP-Lead: Philipps-Universität Marburg

Objective 1: Implementation of a household survey to evaluate the socioeconomic impact of solar home system (SHS) installations in rural Sindh, Pakistan.
Objective 2: Examining preferences for different attributes of SHSs among the rural population (via discrete choice experiments).
Objective 3: Implementation of an economic field experiment to closely investigate cooperation problems among and within rural communities. The experiments will be framed to mimic the decision to cooperatively invest in a solar mini-grid system – the next step on the electrification ladder.
Objective 4: Establishing a long-term collaboration with our Pakistani project partner (NRSP – National Rural Support Programme) to potentially implement a randomized controlled trial (RCT) on solar installations.

Output: At least two academic papers (impact evaluation, experiments) and a cooperation basis for a future RCT in Pakistan.

Photos taken by Andreas Landmann and Marco Nilgen during WP2's scoping trip to Pakistan in March 2019.

Implications and Relevance for Climate Policy

1.) An improved understanding about capital market inefficiencies, as well as barriers in national and international legal systems, energy policy and system governance, ensure solid recommendations on optimal investment support instruments for climate finance projects. These are especially relevant for investments in reneweable energies, as they are characterized by high upfront but low operating costs. Thus, the profitability of such projects crucially depends on capital costs.

2.) A better understanding of the "additionality" of climate finance projects – What is their impact on rural socioeconomic development and how can we improve it? Do such projects lead developing countries on a more sustainable development path?

→ Our findings will contribute towards an evidence-based, and therefore enhanced and more efficient political decision-making with regards to investments in climate finance projects.

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Dialog zur Klimaökonomie

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Universität Augsburg University

verein für umweltmanagement und nachhaltigkeit in finanzinstituten e.V.

Carbon Risk Management (CARIMA)

'Carbon Risks' and 'Financed Emissions' of Financial Assets and Portfolios – Measurement, Management and Reporting based on Capital Market Data

Prof. Dr. Marco Wilkens, University of Augsburg | Prof. Dr. Dr. Bernd Wagner, VfU e.V. | Henrik Ohlsen, VfU e.V. | Dr. Sven Remer, VfU e.V.
Maximilian Görgen, VfU e.V. & University of Augsburg | Andrea Jacob, University of Augsburg | Martin Nerlinger, University of Augsburg

CARIMA

A. Master Dataset

4 Databases
785 ESG Variables
10 Capital Market Variables
~40,000 Firms

THOMSON REUTERS ~7,000 Firms
MSCI ~35,000 Firms
SUSTAINALYTICS ~10,000 Firms
CDP ~3,000 Firms

B. Scoring Concept

55 Carbon Risk Proxy Variables:
- 19 on Value Chain
- 26 on Adaptability
- 10 on Public Perception

GROUP INDICATORS

VALUE CHAIN	ADAPTABILITY	PUBLIC PERCEPTION
e.g. Carbon Footprint	e.g. Strategic Goals	e.g. Ratings

Brown-Green-Score *BGS*

C. Carbon Risk Factor *BMG*

624 „Brown" Firms
484 „Green" Firms

$$BMG_t = \text{Return „Brown" Firms}_t - \text{Return „Green" Firms}_t$$

D. Factor Model

$$er_{i,t} = \alpha_i + \beta_i^{mkt}\, er_{M,t} + \beta_i^{smb}\, SMB_t + \beta_i^{hml}\, HML_t + \beta_i^{wml}\, WML_t + \beta_i^{bmg}\, BMG_t + \varepsilon_{i,t}$$

Carbon Beta
as Measure of Carbon Risk

E. Applications

- Equity
- Bonds
- Loans
- Portfolios
- Equity and Bond Funds
- Geographic Breakdown
- Sectoral Breakdown
- Reporting
- Fundamental Analysis
- Stress Tests
- Factor Investing
- Best-in-class Approach
- Hedging
- Case Studies
- etc.

Quantification and management of carbon risk is a necessary condition to **prevent unnecessary welfare losses** from the transition process towards a Green Economy:

- **CARIMA** develops a capital market-based approach and provides a freely accessible Carbon Risk Factor *BMG* that allows anybody to quantify carbon risks of financial assets and portfolios without having access to climate change-relevant firm data
- **CARIMA** offers a manual that explains the methodological foundation and manifold practical applications exemplified by a number of Excel spreadsheets
- **CARIMA** enables further developments and integration of the concept in professional risk management systems

Dialog zur Klimaökonomie

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Financial market failures, investor behavior, and their implications for climate policy (FINFAIL)

Kai Lessmann, Hendrik Schuldt, Emilie Rosenlund Soysal, Ibrahim Tahri, Andrew McConnell

Financing the Transition to a Climate-Neutral Economy

- The ambition of the **Paris Agreement** to limit global warming to 2°C implies substantial upscaling of **investment** into low-carbon technologies and **divestment** from conventional carbon-intensive technologies (Fig. 1)
- Such unprecedented **reallocation of investment flows** requires a well-functioning finance sector able to provide efficiency and stability under the paradigm of **green economies**. Current Research and experiences from the latest financial crisis cast doubt on the capabilities of the global finance industry.
- What are the impacts of **capital market failures** and **imperfect investor behaviour** on the potential of **national climate policy**?

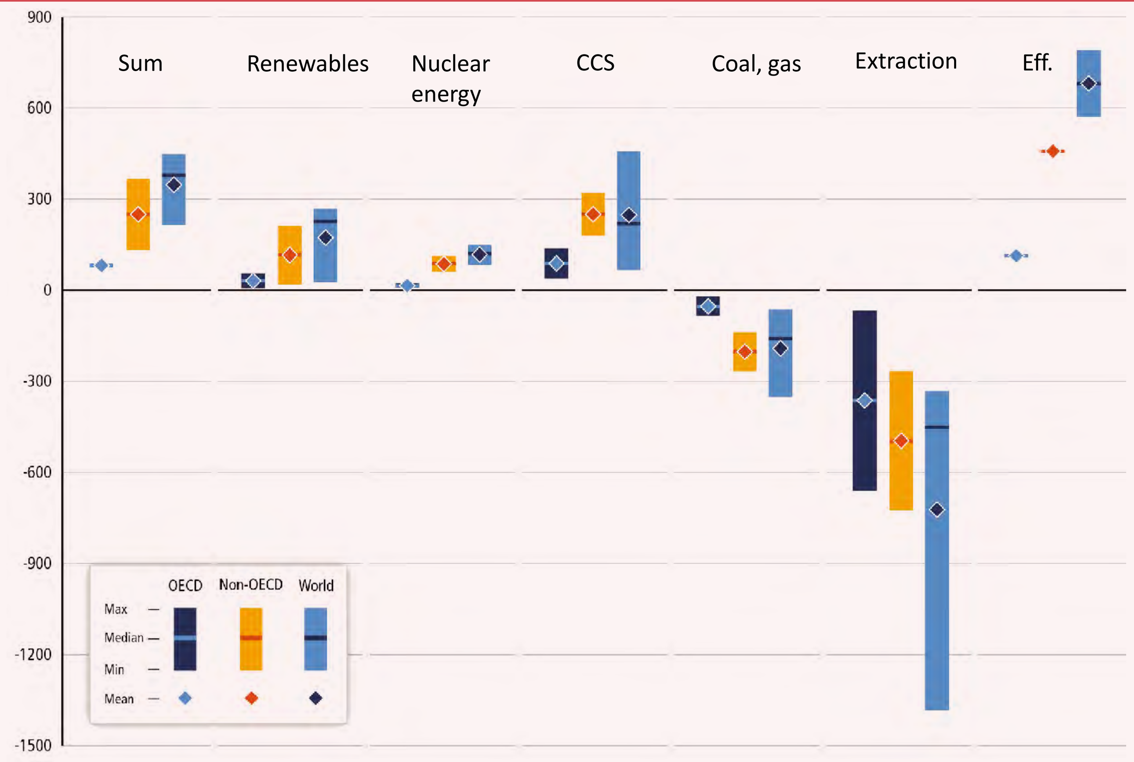


Fig. 1: Change of annual investment in mitigation scenarios (2030-2049) which stabilize concentrations within the range of 430-530 ppm CO_2eq by 2100 compared to average baseline investments in billion US Dollar. *Source: IPCC 2014, Ch. 16*

Research Questions and Approach

FINFAIL couples **financial and climate economy analysis and modelling** to investigate the implications of (imperfect) capital markets and investor behaviour for climate policy.

The project deepens the understanding of the financial sector as part of the economy, identifies possible obstacles for the implementation of climate policy and drafts **policy recommendations for financing the transition to a low-carbon economy.**

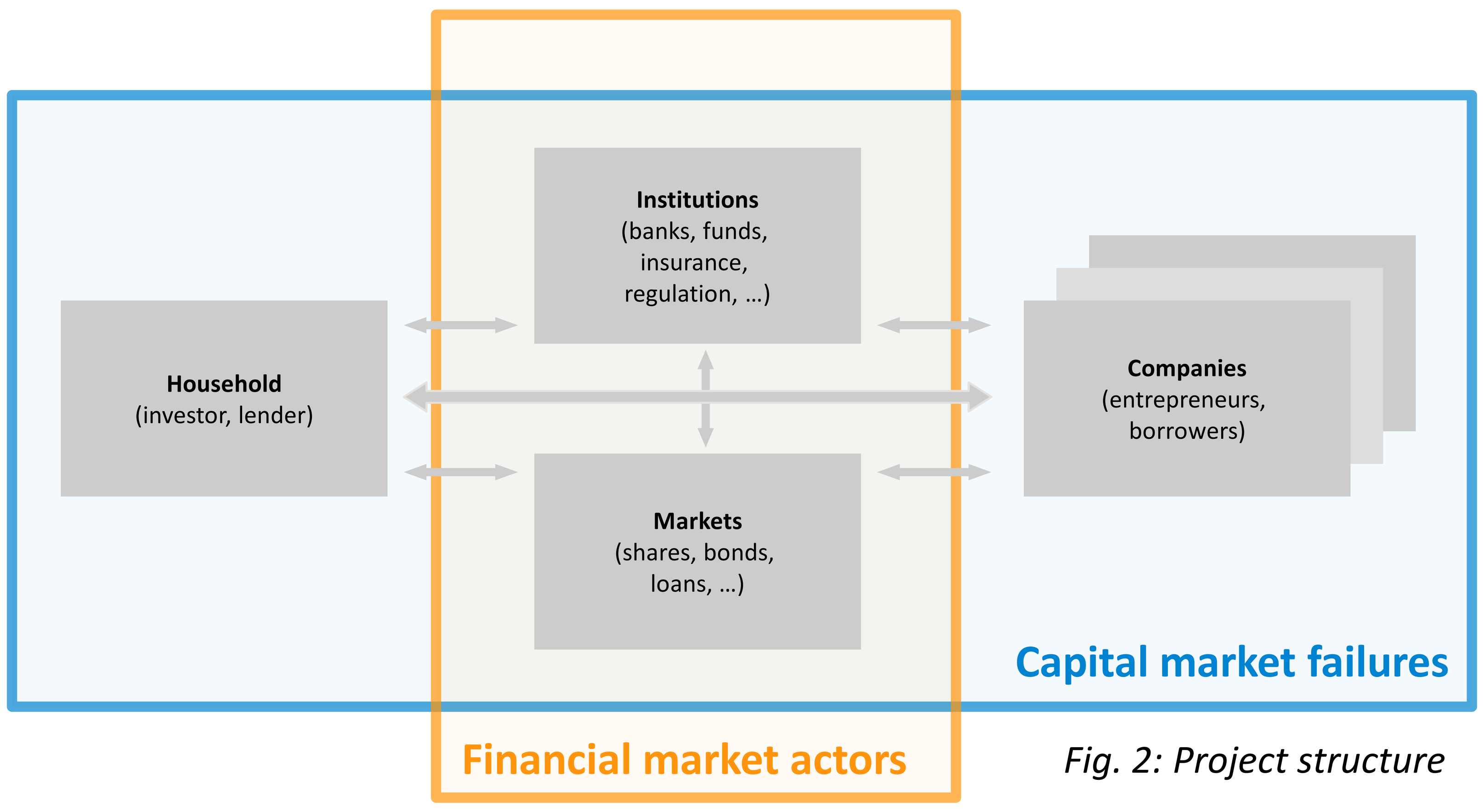


Fig. 2: Project structure

Macro-Perspective: Capital Market Failures

Agency problems and imperfect information produce financial frictions that inhibit the efficient allocation of investment funds. We enrich climate economy models with finance sectors subject to frictions to investigate:

- To what extent undermine financial frictions climate policy impacts?
- Are less developed financial sectors in low-income countries an additional obstacle?
- In light of capital market failures, what constitutes good climate and finance policy?

Methods: numerical modelling (general equilibrium, DSGE)

Micro-Perspective: Behavior of Financial Market Actors

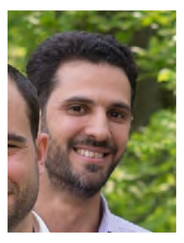
- Why have capital markets not (yet) responded to climate targets?
- What is the role of short termism of financial decisions?
- What particular roles play
  - Long-term oriented (institutional) investors?
  - State owned funds with substantial fossil investments?

Methods: *asset pricing* and portfolio models, informational constraints

Kai Lessmann
Group leader

Hendrik Schuldt
Macroeconomic modelling, *financial frictions*

Emilie Rosenlund Soysal
Macro- and microeconomic modelling



Ibrahim Tahri
Portfolio decision, investor behavior

Andrew McConnell
Student assistant

The Green Transition and Information Asymmetries

- Information Asymmetries between companies and banks generate higher financing costs for low-carbon technologies vis-à-vis fossil technologies
- This increases the costs associated with a transition to a low-carbon economy and delays the technology switching and hence emission mitigation

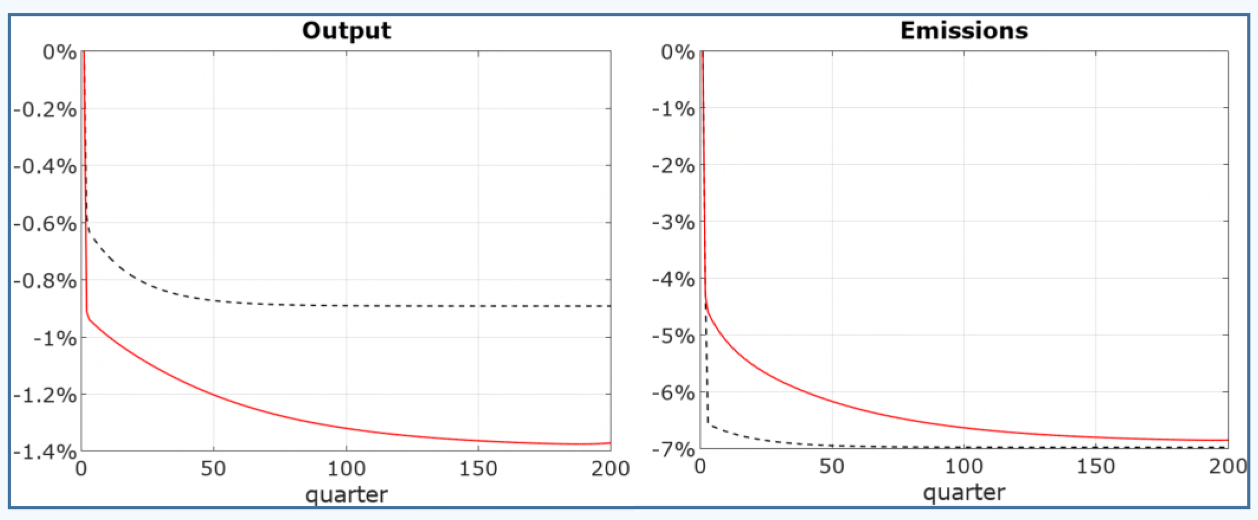


Fig. 3: Model simulation of the implementation of an emissions tax at t=0 where firms have to pay one percent of the numeraire for each unit of emission intensive resource used in production. The red line corresponds to an economy subject to financial frictions, the black line to a frictionless economy.

- With financial frictions present, the adverse effects of financial crisis can aggravate for low-carbon technologies compared to fossil technologies

Investors under «*carbon risk*»

- The Paris Agreement implies value depreciation and divestment of fossil assets (carbon risk)
- Share prices
  - (a) ...experience downward pressure proportional to the credibility of climate policy
  - (b) ...are backed via share repurchases
- In sum, share repurchases by oil companies offset the divestment volume reported by the divestment movement
- Companies can use share repurchases to maximize their market value when expecting a devaluation of shares

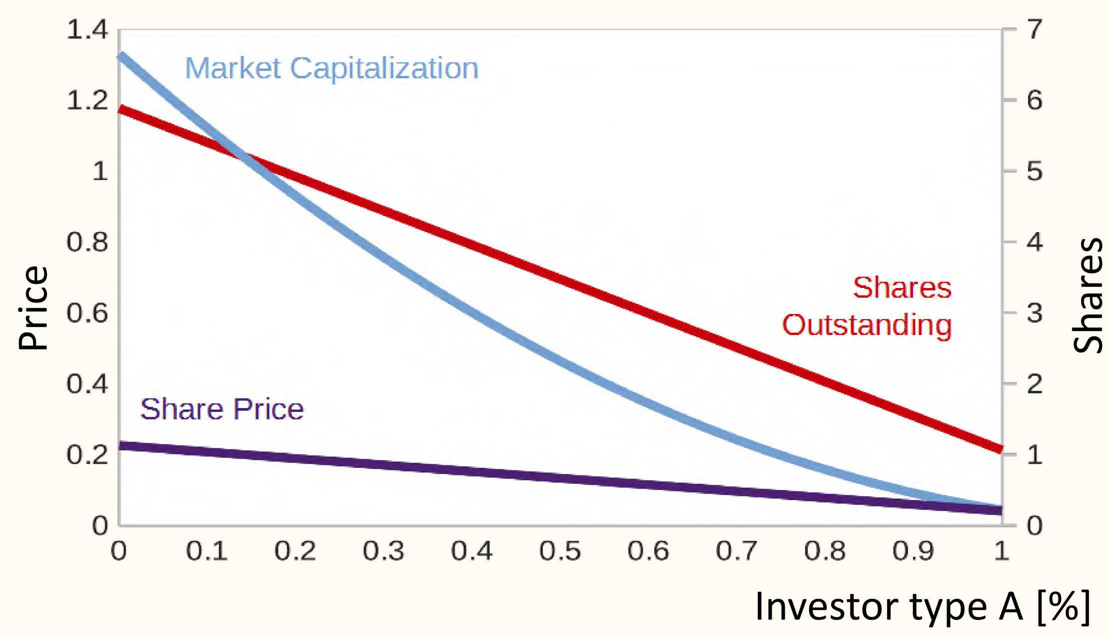


Fig. 4: Outstanding shares. A company's share price experiences downward pressure if investors switch from type B (high valuation of company) to type A (lower valuation). Under optimality, the company counteracts with share repurchases.

Dialog zur Klimaökonomie

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