

# Welcome at Fraunhofer ISE

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Christoph Kost and Patrick Jürgens  
ETSAP Workshop  
Freiburg, 23rd May 2022  
[www.ise.fraunhofer.de](http://www.ise.fraunhofer.de)

# Fraunhofer Institute for Solar Energy Systems ISE

Performing research for the energy transition for over forty years

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## The Institute in Numbers

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### Institute Directors:

Prof. Dr. Hans-Martin Henning

Prof. Dr. Andreas Bett

Employees: ca. 1400

### Budget 2021:

Operation €104.4 million

Investment €12.3 million

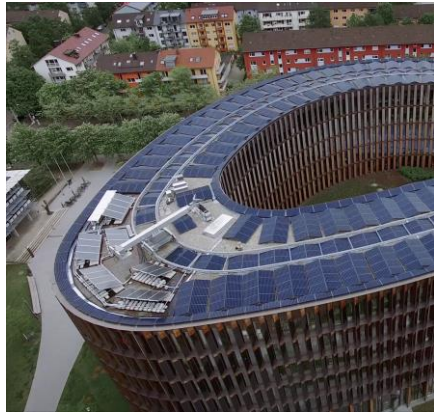
Total €116.7 million

Founded in 1981

# Our Business Areas



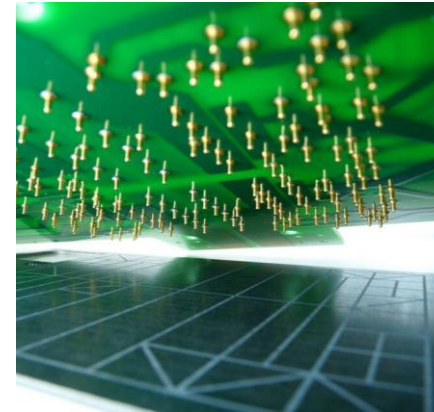
Photovoltaics



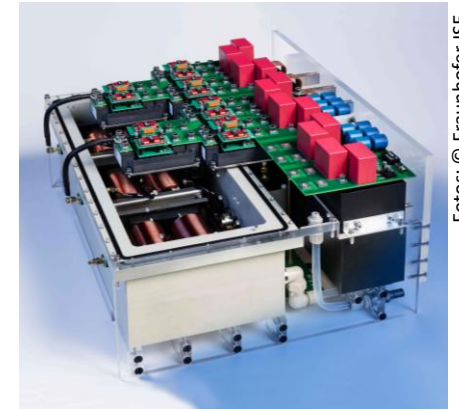
Energy Efficient Buildings



Solar Thermal Power  
Plants and Industrial  
Processes



Hydrogen Technologies  
and Electrical Energy  
Storage



Power Electronics, Grids  
and Smart Systems

Fotos: © Fraunhofer ISE

# Reserach Group Energy Systems and Energy Economics

Head of Group: Dr. Christoph Kost

Transformation and decarbonization analyses

Sector coupling issues

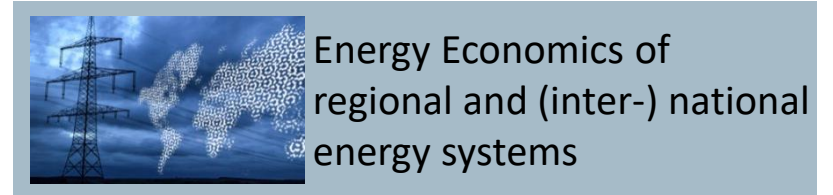
- Processes, buildings (e.g. WP), traffic (e.g. electromobility)
- Multiple technologies are optimized separately
- Detailed integration of sector coupling effects

Coupled expansion planning for infrastructure measures in GER/EU systems,

- storage, power plants (aggregation of data from EE)
- Gas grids, electricity grids, hydrogen

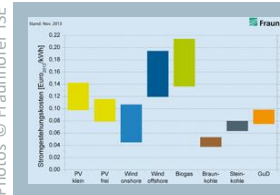
Market integration and system

- optimization of local/decentralized energy systems, properties and districts



Energy Economics of regional and (inter-) national energy systems

Photos © Fraunhofer ISE



Techno-Economic Assessment of Energy Technologies



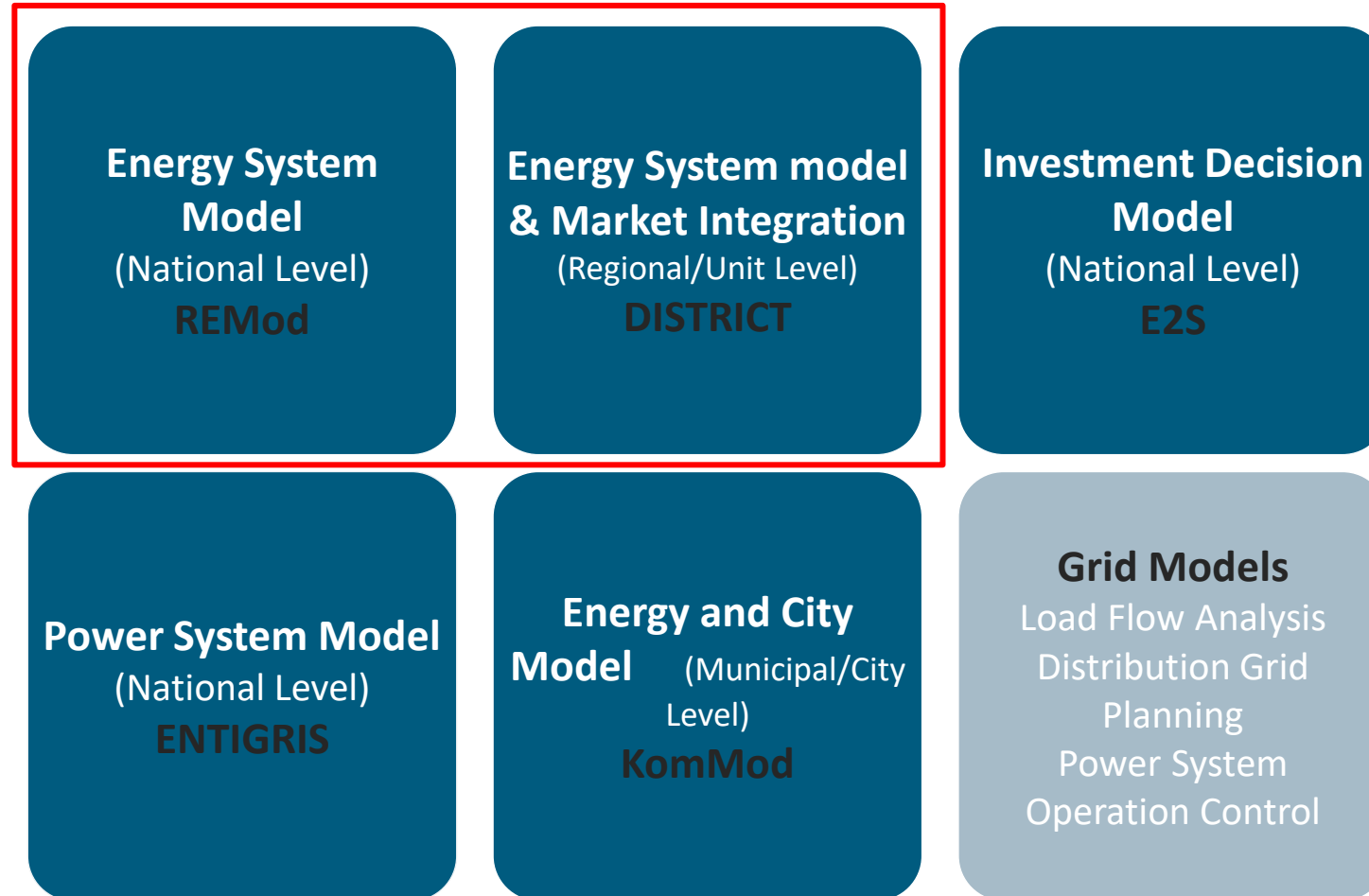
Market Analysis and Business Models



Planning and Operating Strategies of Power Plants

# Model based Energy System Analysis by Fraunhofer ISE

## Models for our services



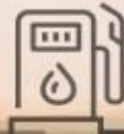
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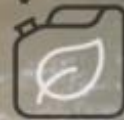
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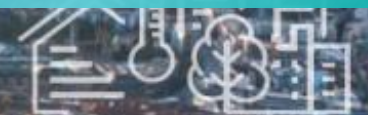
12%



ANNUAL  
GROWTH



23%



# Regionalization of the integrated sector coupled energy system model REMod

Patrick Jürgens  
ETSAP Workshop  
Freiburg, 23rd May 2022  
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# Regionalization of the integrated sector coupled energy system model REMod

## Agenda

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1. Sector coupling in the model REMod
2. Optimization Results
3. Regionalization: Energy Exchange Function
4. Outlook: REMod-EU

# Sector coupling in the model REMod

## Modeling approach and scope

### Geographical scope

- Germany as one node

### Conversion and consumption sectors

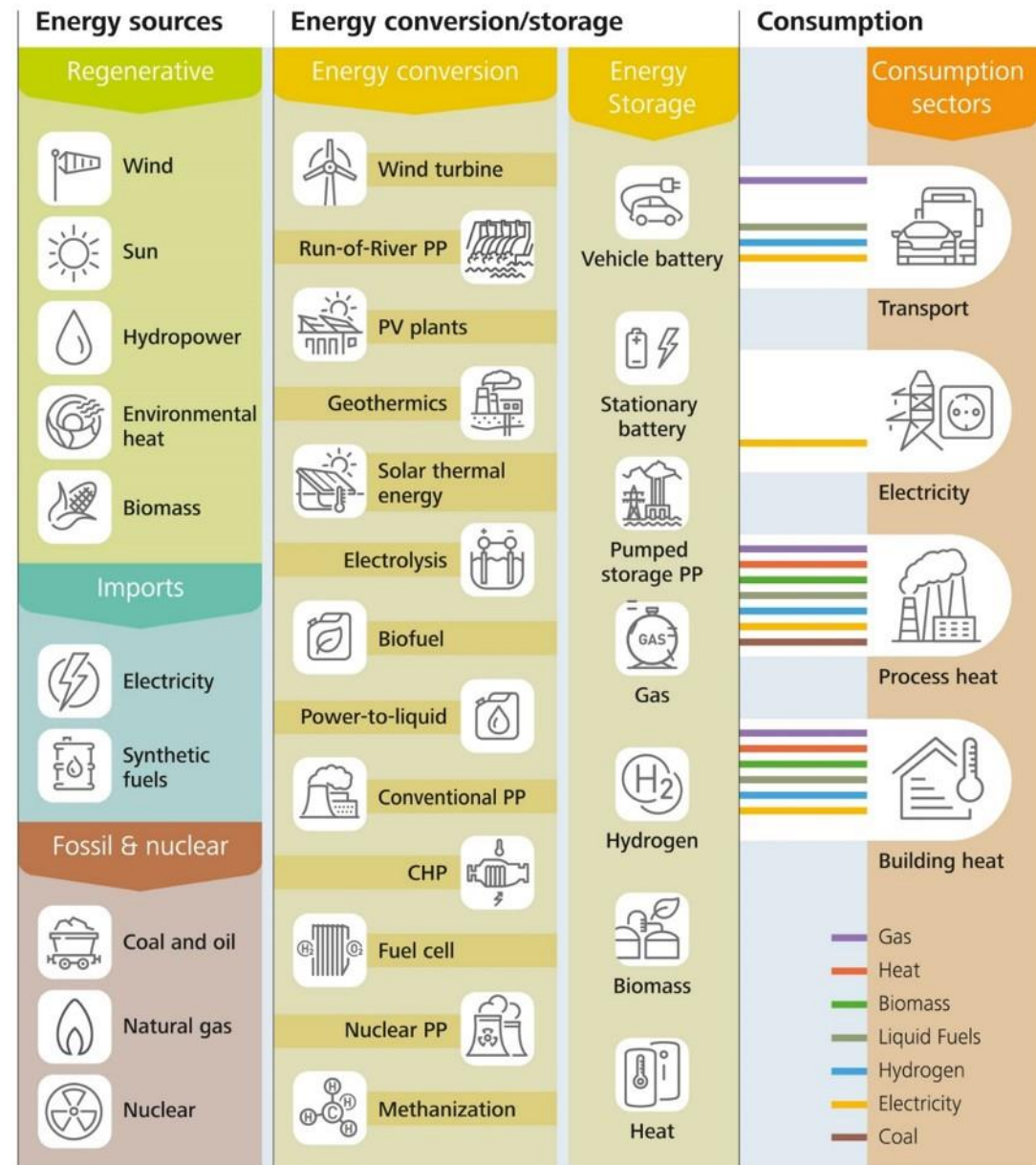
- Inclusion of all consumption sectors
- Multiple technologies are optimized separately
- Detailed integration of sector coupling effects

### Optimization

- Minimization of transformation costs
- Non-linear „Black box“ optimization of realistic simulation

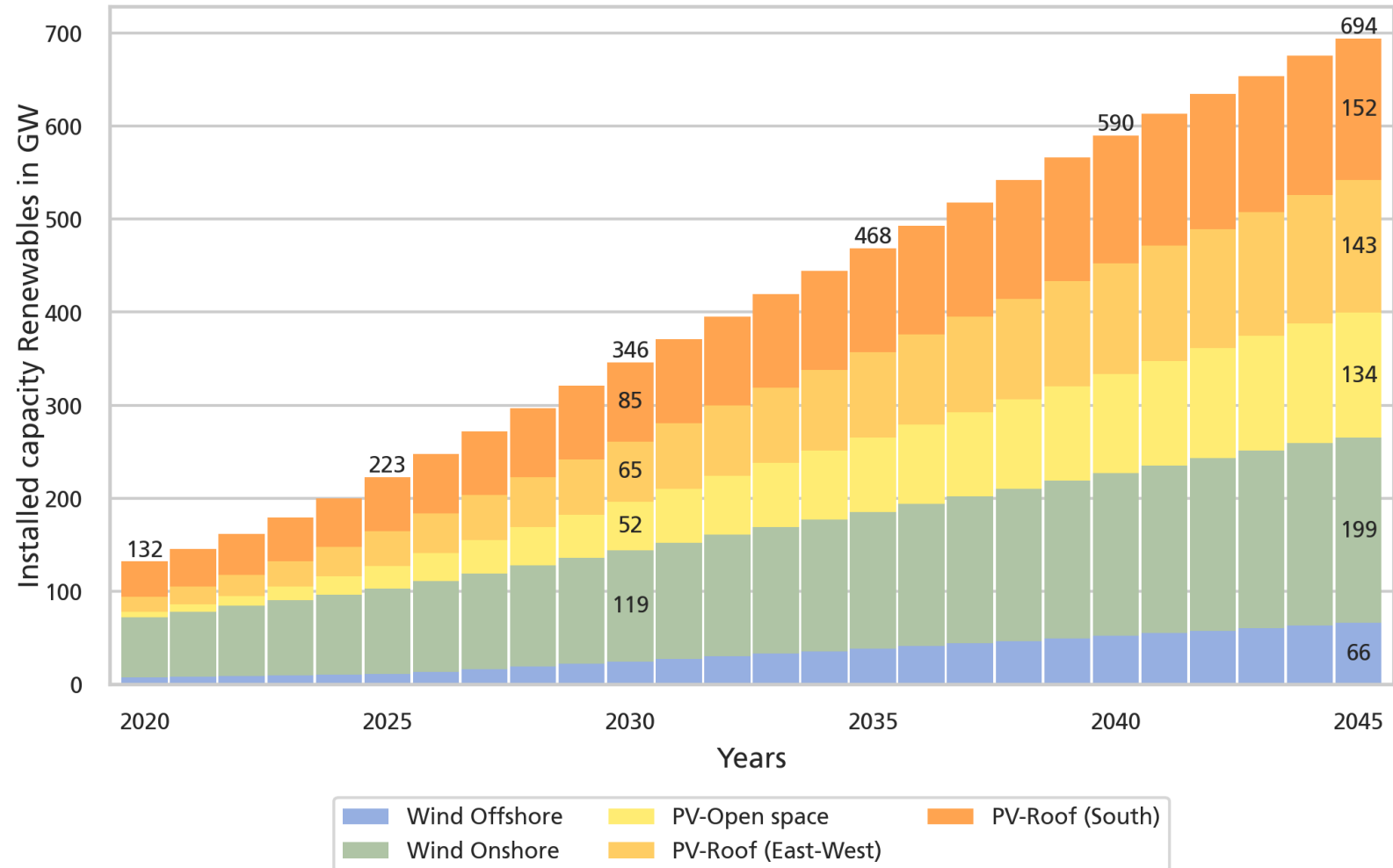
### Time resolution

- Simulation on hourly basis
- Including historic timeseries (demand, weather) of five years
- Optimization of transformation on yearly basis



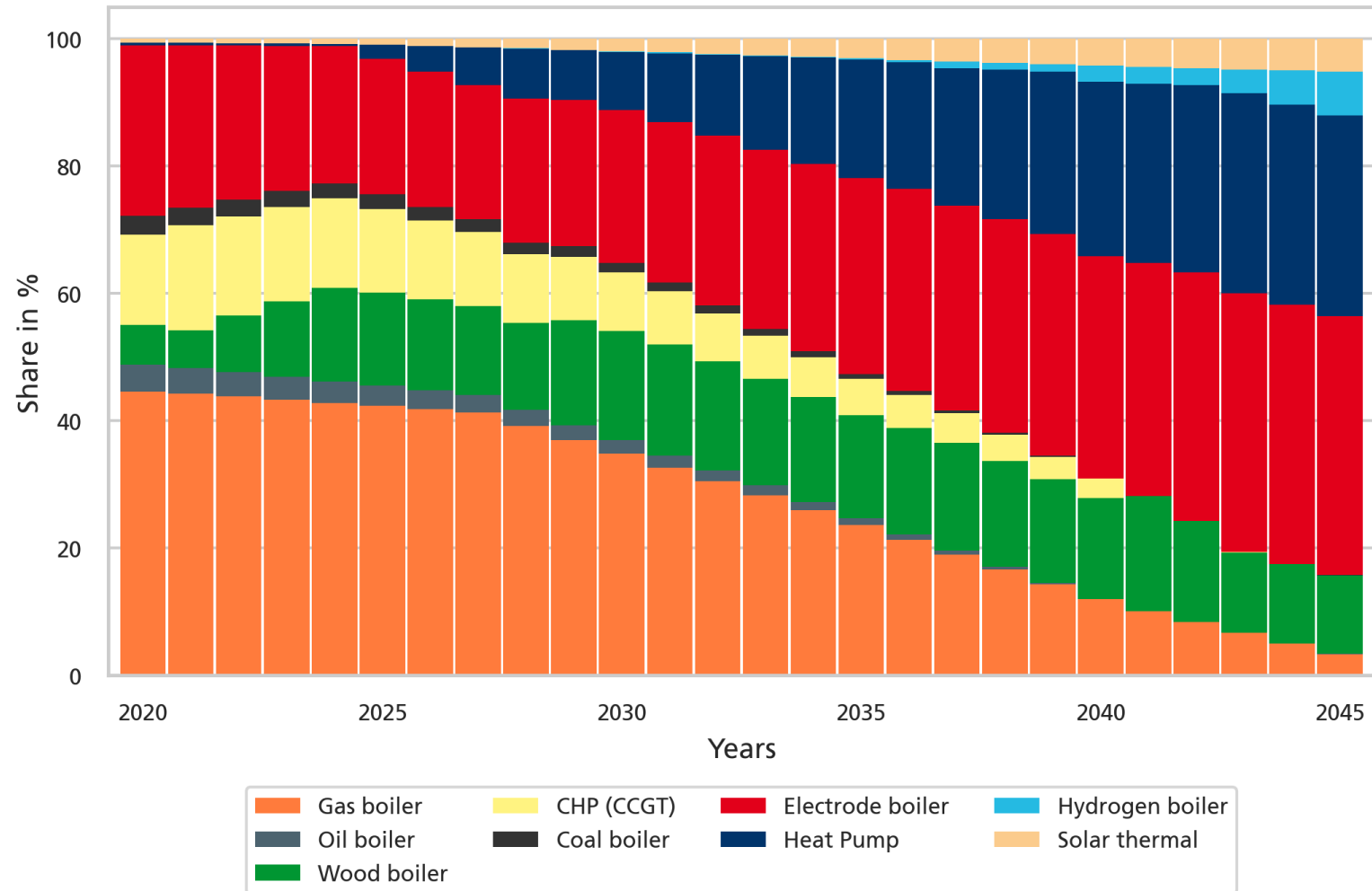
# Optimization Results

## Transformation path of technologies – renewable energy sources



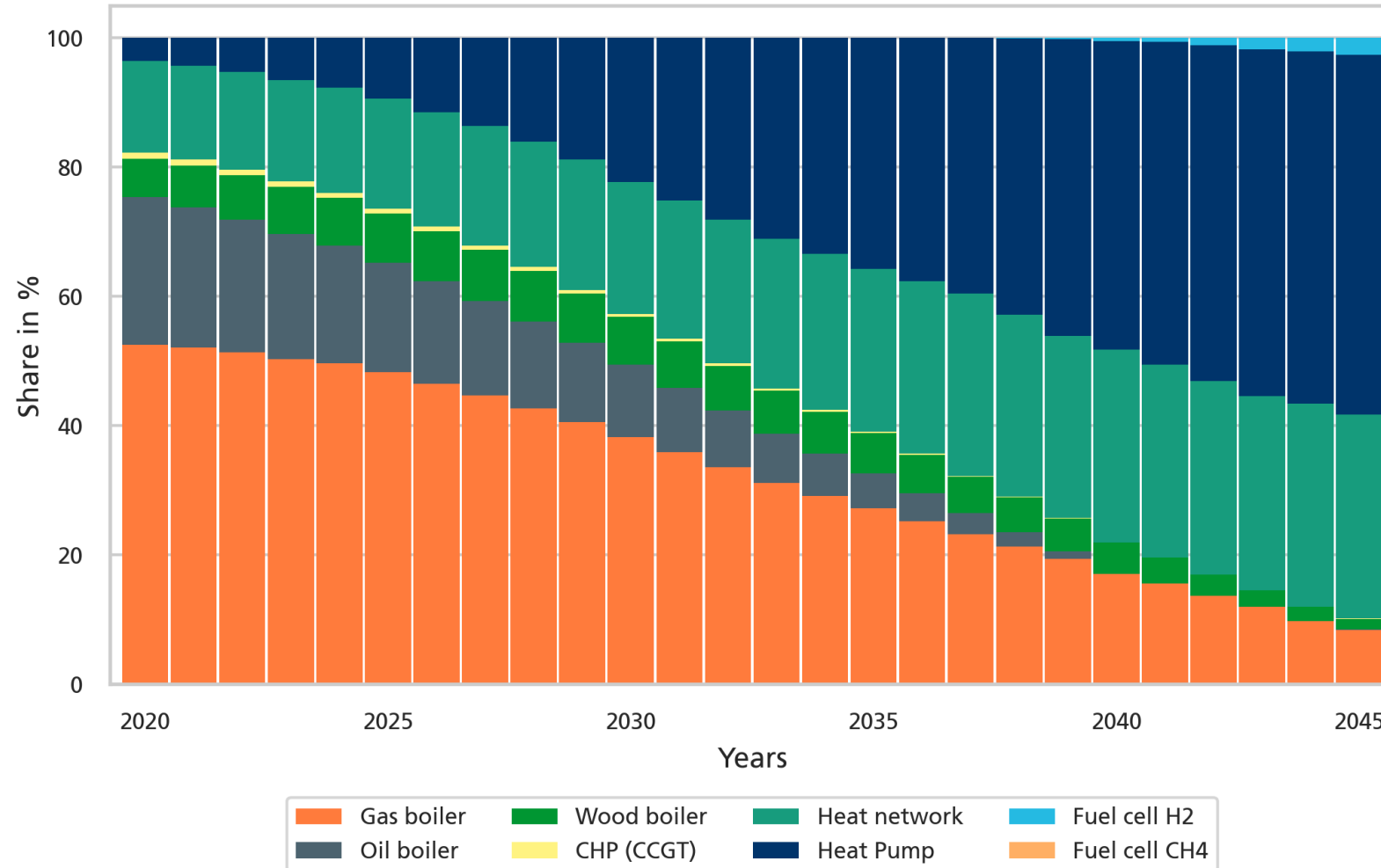
# Optimization Results

## Transformation path of technologies – industry sector



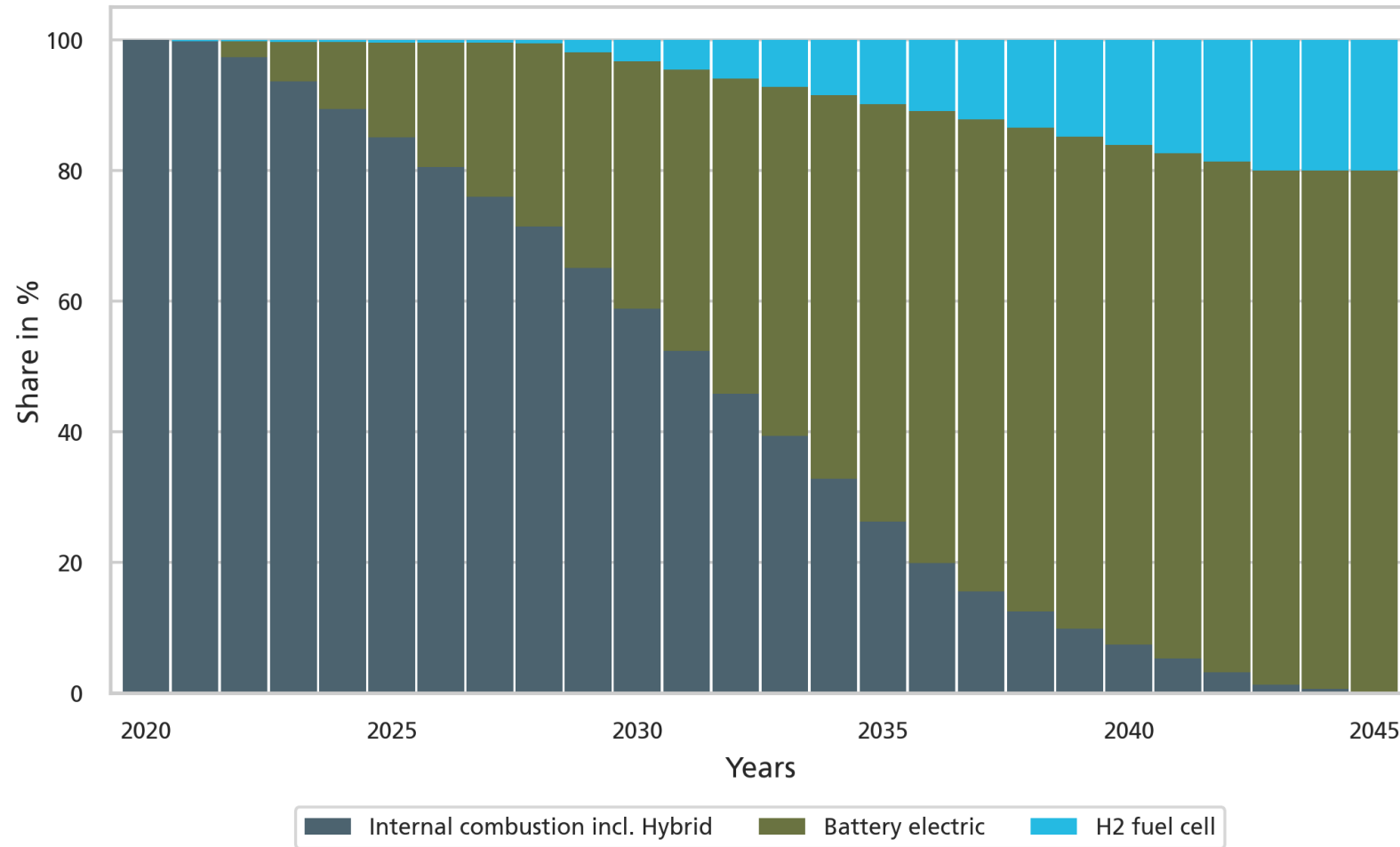
# Optimization Results

## Transformation path of technologies – buildings sector



# Optimization Results

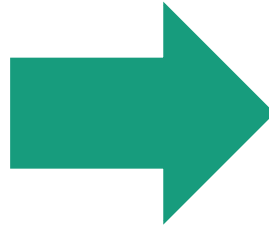
## Transformation path of technologies – transportation sector



# First energy system model for all sectors on state level

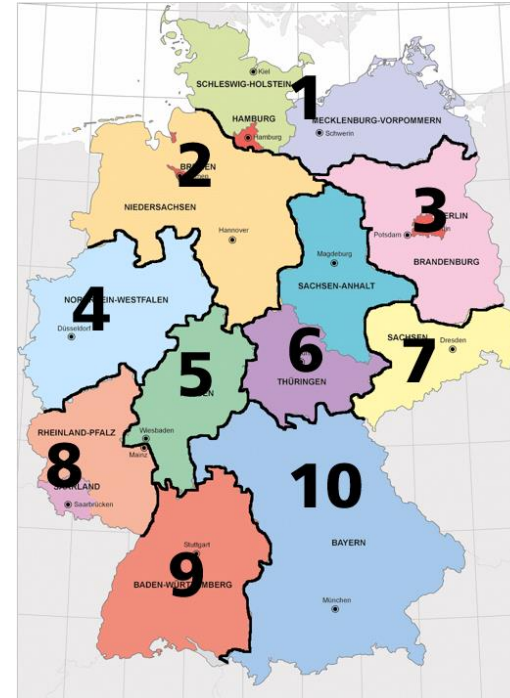
## Current Model

- Germany as one node
- Assumption: energy is available at any place

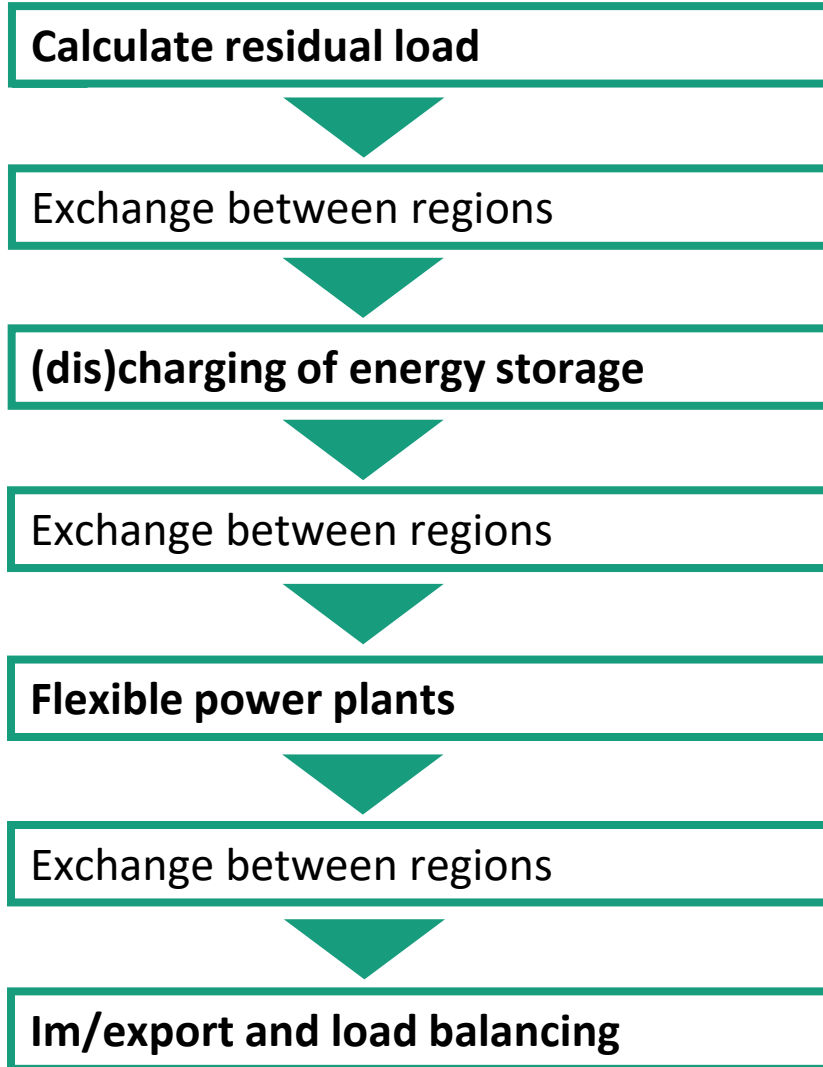


## Regionalized Model

- Multi-node: each region simulated separately
- Simulated energy-exchange between regions
- Optimization of electricity grid and gas network

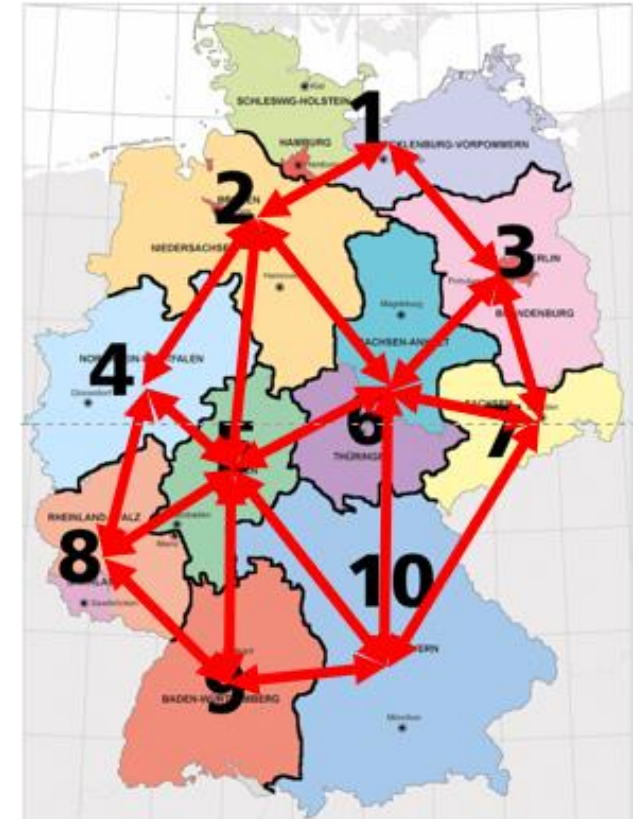


# Regionalization: Simulation with Energy Exchange Function



balance  
neighbouring region

balance  
neighbouring region



# Outlook: REMod-EU

## Modeling approach and scope

### Data

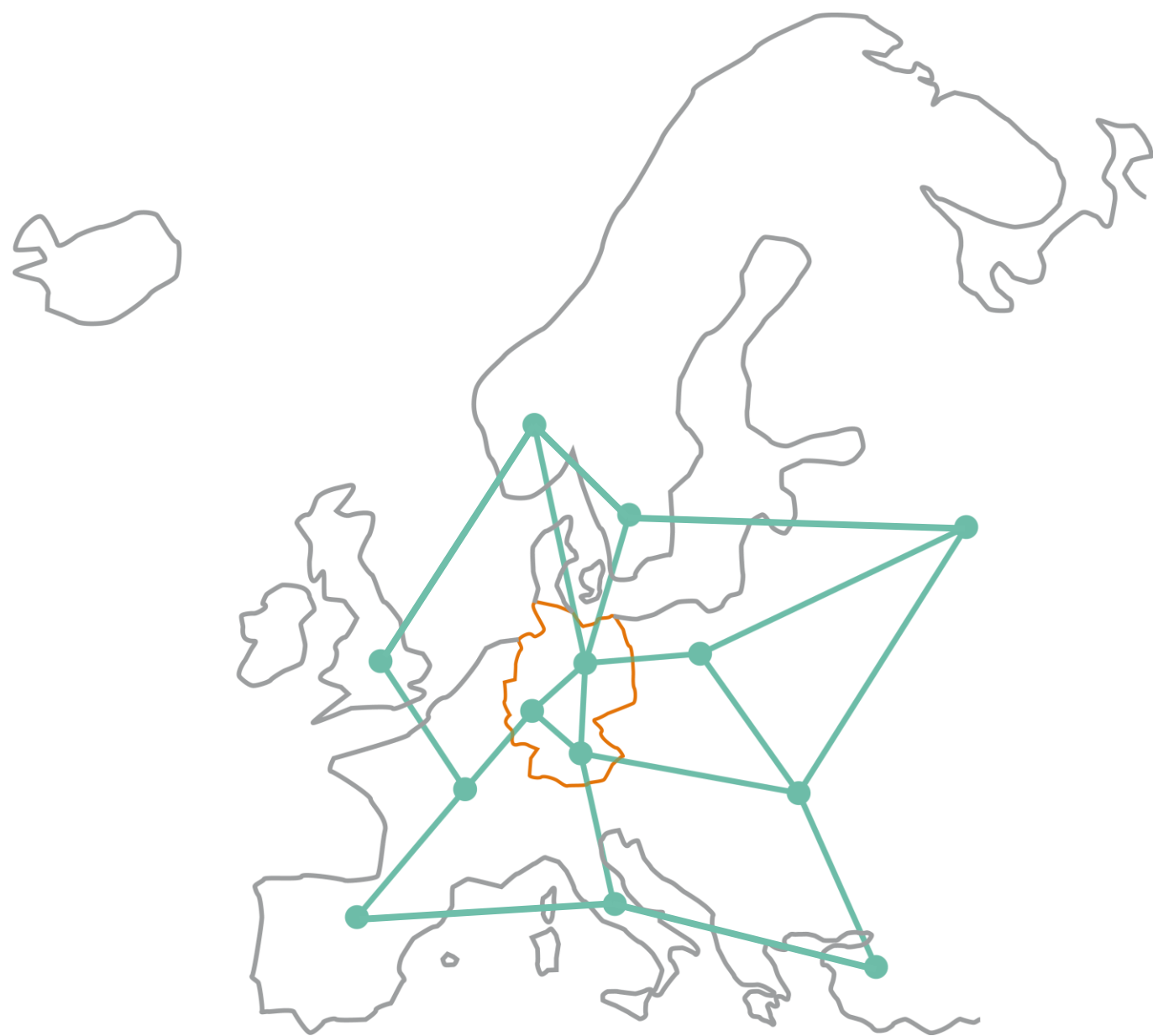
- Development of database
- Coupling to models: renewables.ninja, GlobalEnergyGIS.jl, ...
- Coupling of public Databases: Energy-Charts, Entso-E, Eurostat, ...

### Optimization and Calculation Effort

- Parallelization
- Adjust optimization algorithm
- Flexible reduction of optimization variables

### Scenario Analysis

- European Green Deal & Effort Sharing
- Network Expansion (Electricity, Gas, H2)
- Role of Technologies (e.g. Nuclear, Gas)



A photograph of a modern, curved, multi-story building with a grid of windows and a glass-enclosed staircase. The building is surrounded by green trees and a lawn. In the foreground, three white vertical banners on poles display the Fraunhofer logo and the text 'Fraunhofer ISE'.

# Thank You for Your Attention!

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