IEA SHC's new

SOLAR ACADEMY SHC
FOR HEATING & COOLING IN BUILDINGS & INDUSTRY

Why an academy?

To share our work and support R&D and implementation of solar heating and cooling projects worldwide.

How can you participate?

- **Webinars** held quarterly hosted by ISES

- **Videos** highlighting our work and other ST issues
    - Our 1st video package (11 videos) showcases presentations from Qatar's Green Expo held November 2016 in Doha. The speakers discuss our current projects and how IEA SHC is supporting solar thermal in the MENA region.

- **National Days** are country specific events held in conjunction with IEA SHC meetings for the exchange of information between national experts and IEA SHC experts.

- **Onsite Training** provided by IEA SHC experts at the request of IEA SHC member countries.

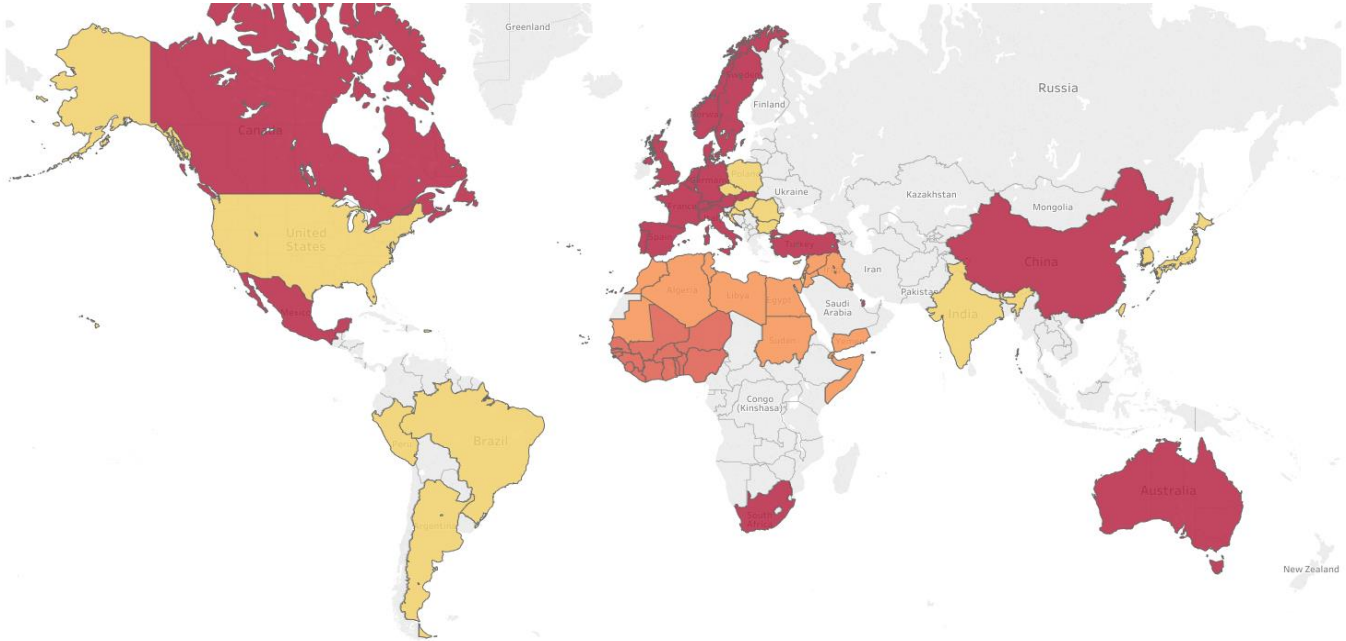
Where you can find more information

- Visit our website – www.iea-shc.org
- Follow us on social media

@IEASHC

IEA Solar Heating and Cooling Programme (group 4230381)

IEA SHC members and outreach



Red = Member countries Oranges = Sponsor members Yellow = Outreach countries

Background and Key objective

Solar Heat & Energy Economics in Urban Environments

- Help energy consultants, utilities and urban planners to better understand the role of solar thermal systems in energy supply systems of urban environments
- This includes the development of long term scenarios for energy supply systems integration fluctuating electric and heat sources and sinks

SCENARIO ANALYSIS ON FUTURE ROLE OF SOLAR HEAT

Sebastian Herkel (presenter)
Andreas Palzer
Brian V. Mathisen
Kenneth Hansen

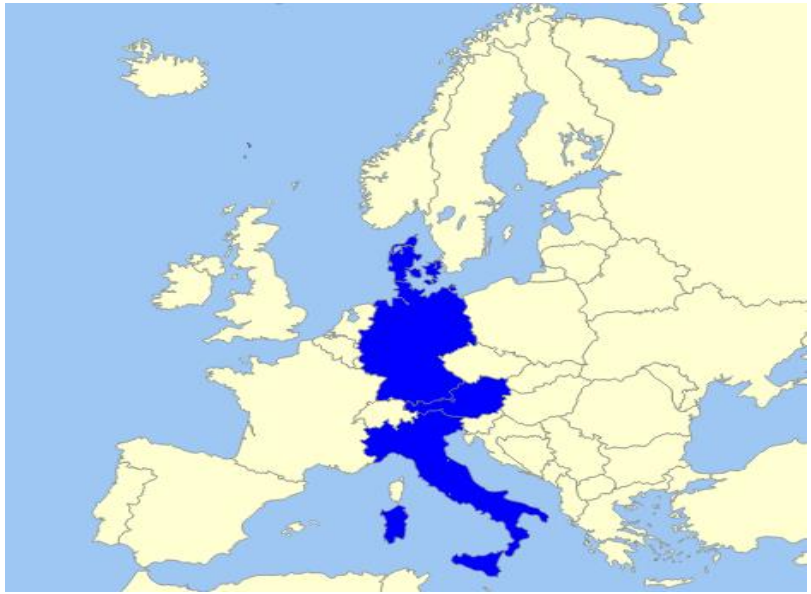
Fraunhofer ISE /
Aalborg University

SHC Academy Webinar,

14th December 2017

Content

- Scenarios for AT, DK, DE and IT
  - High-renewable scenario results
  - Solar thermal analysis
    - Marginal impact analysis
    - Solar potential analysis
    - Solar potential impact analysis
  - Sensitivity analysis
- Detailed Scenario DE
- Conclusions



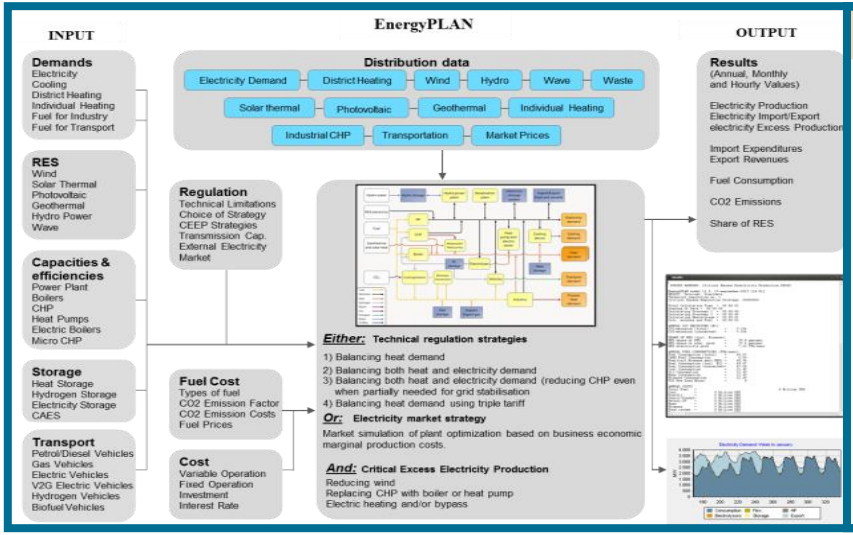
Scenario Analysis – How and Why

- What is a Scenario?
  - A Scenario is the calculation of techno-economical potentials, e.g. cost optimal systems under given boundaries – not a forecast of the future

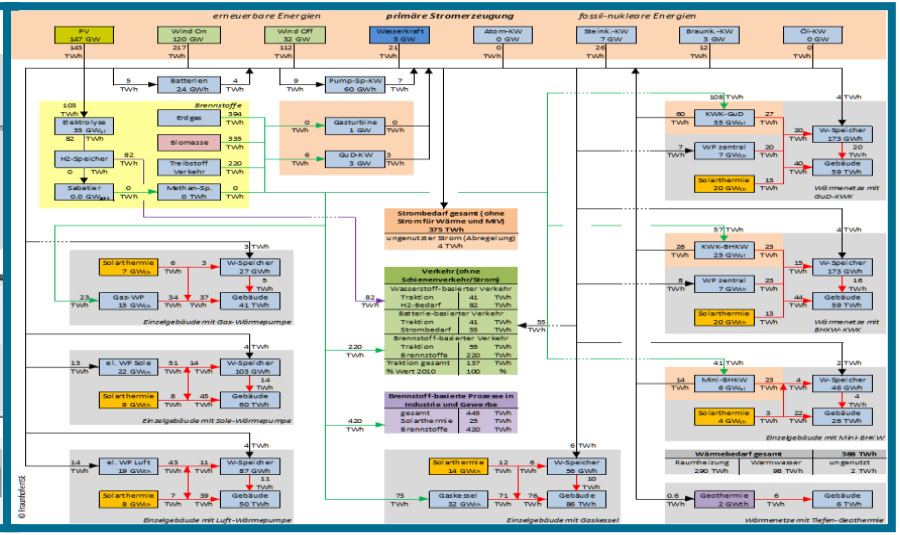
- Analyses of the role of solar thermal concepts in future energy systems including sensitivity analyses regarding cost developments, national and international system integration and the influence of climate change

Energy System Models

EnergyPlan
AAU



ReMod-D
ISE



Task 52
Solar Heat and Energy Economics in Urban Environments

SHC SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

SOLAR THERMAL ANALYSIS
AT, DE, DK, IT

Solar thermal concepts

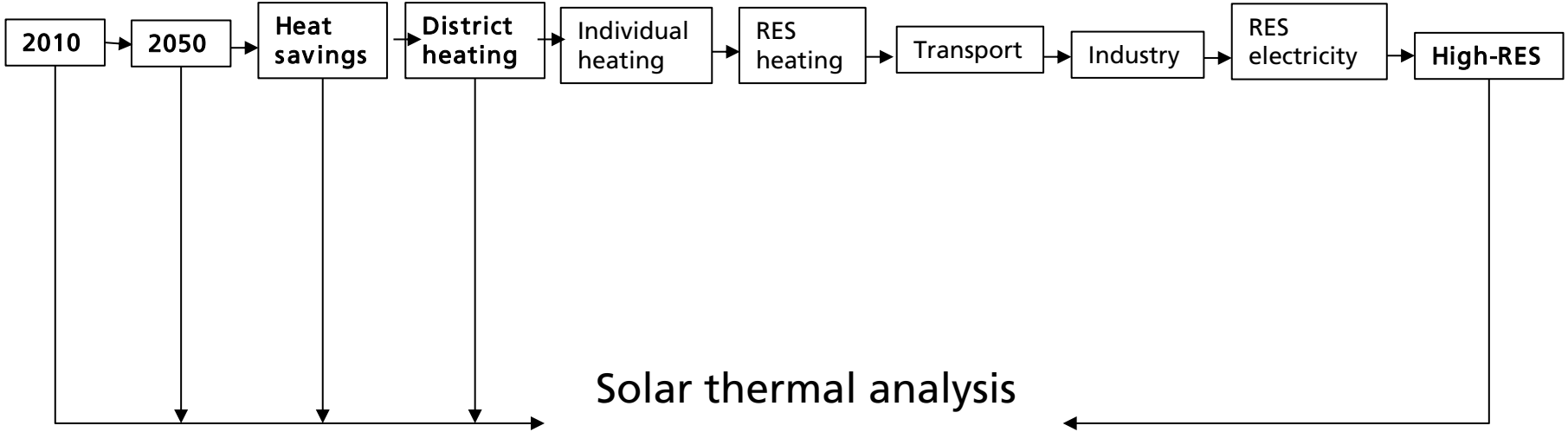
Solar thermal concepts for hot water and space heating:

- Single-Family houses (CS-SFH)
- Multi-Family houses (CS-MFH)
- Block heating – larger storage (BH-DE)
- Solar District Heating – diurnal storage (SDH-DK-Diurnal)
- Solar District Heating – seasonal storage (SDH-DK-Seasonal)

Scenarios

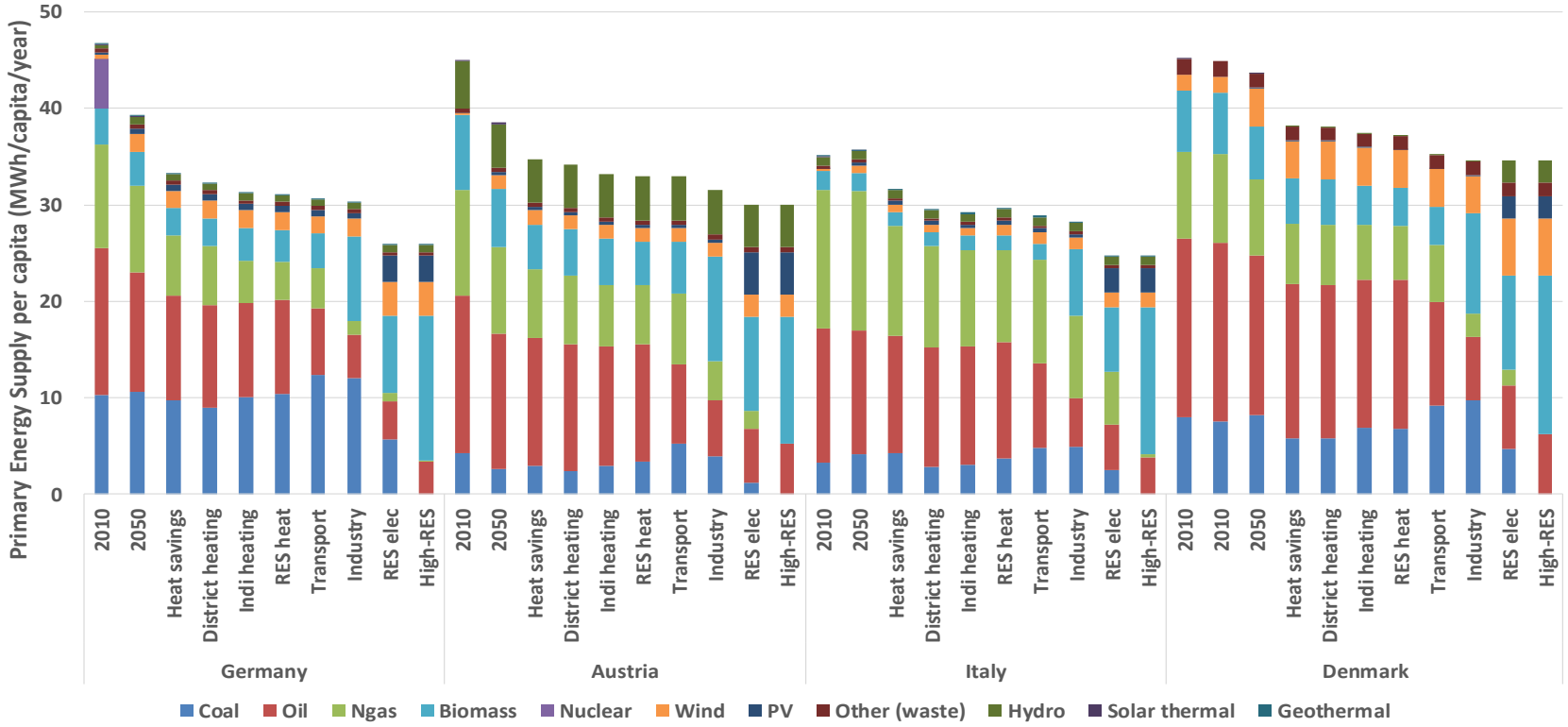
- Scenarios for each country towards a high-renewable energy system

Scenarios

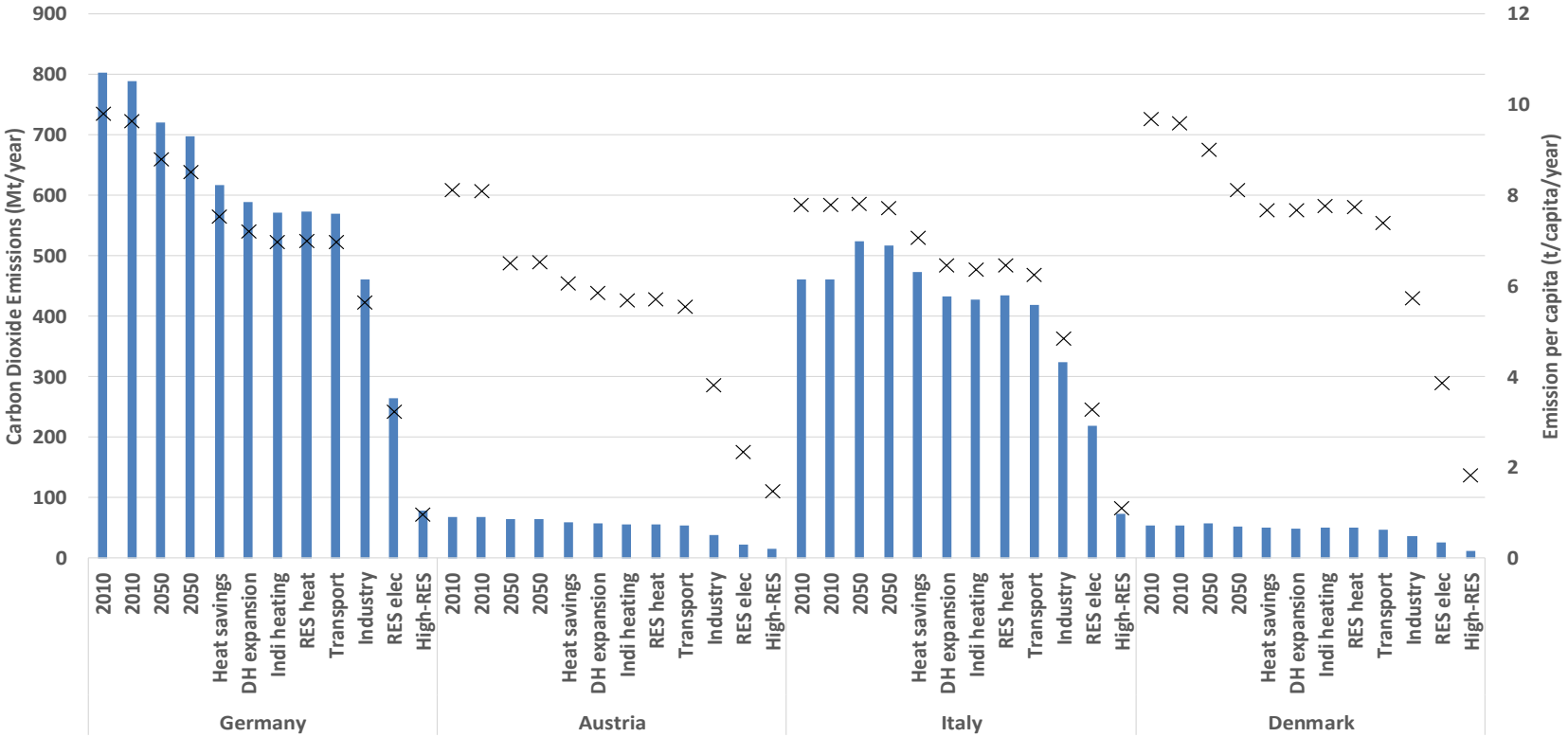

2010
2050
Heat savings
District heating
Individual heating
RES heating
Transport
Industry
RES electricity
High-RES
Solar thermal analysis
of the 5 solar concepts

RESULTS FOR THE SCENARIOS TOWARDS HIGH-RENEWABLE ENERGY SCENARIO

Primary energy supply



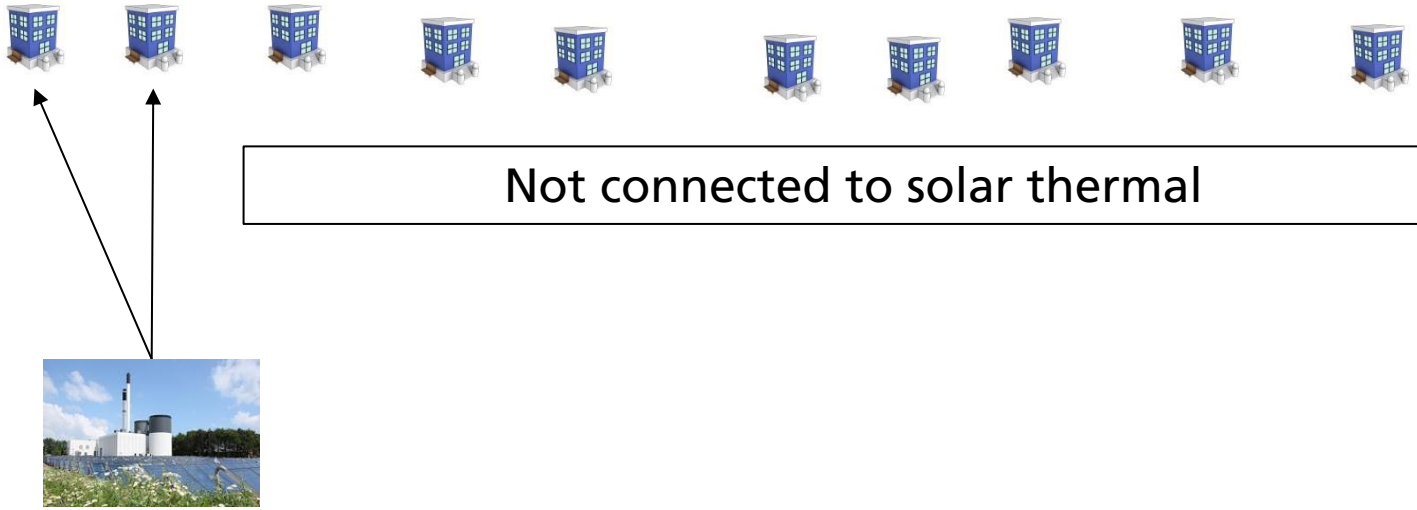
CO_2


Carbon Dioxide Emissions (Mt/year)
Emission per capita (t/capita/year)
900
800
700
600
500
400
300
200
100
0
12
10
8
6
4
2
0
2010
2010
2050
2050
Heat savings
DH expansion
Indi heating
RES heat
Transport
Industry
RES elec
High-RES
Germany
Austria
Italy
Denmark

Solar thermal analysis methods

1. Marginal impact of solar thermal
   - Installing 1 TWh of each concept and identifying the impact
2. Solar thermal potentials
   - The maximum solar thermal potential
     - 20% solar penetration
     - 50% solar penetration
   - Threshold to define maximum:
     - 5% of the solar thermal production can be wasted (reduced efficiency)
     - 5% imbalance in the district heating networks
3. Impacts of installing solar thermal potentials

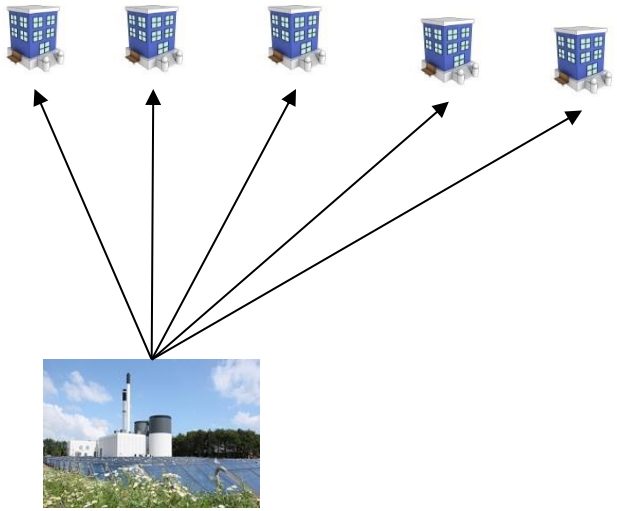
Solar penetration is crucial



20% solar penetration

Solar penetration = share of buildings connected to the solar systems

Solar penetration is crucial

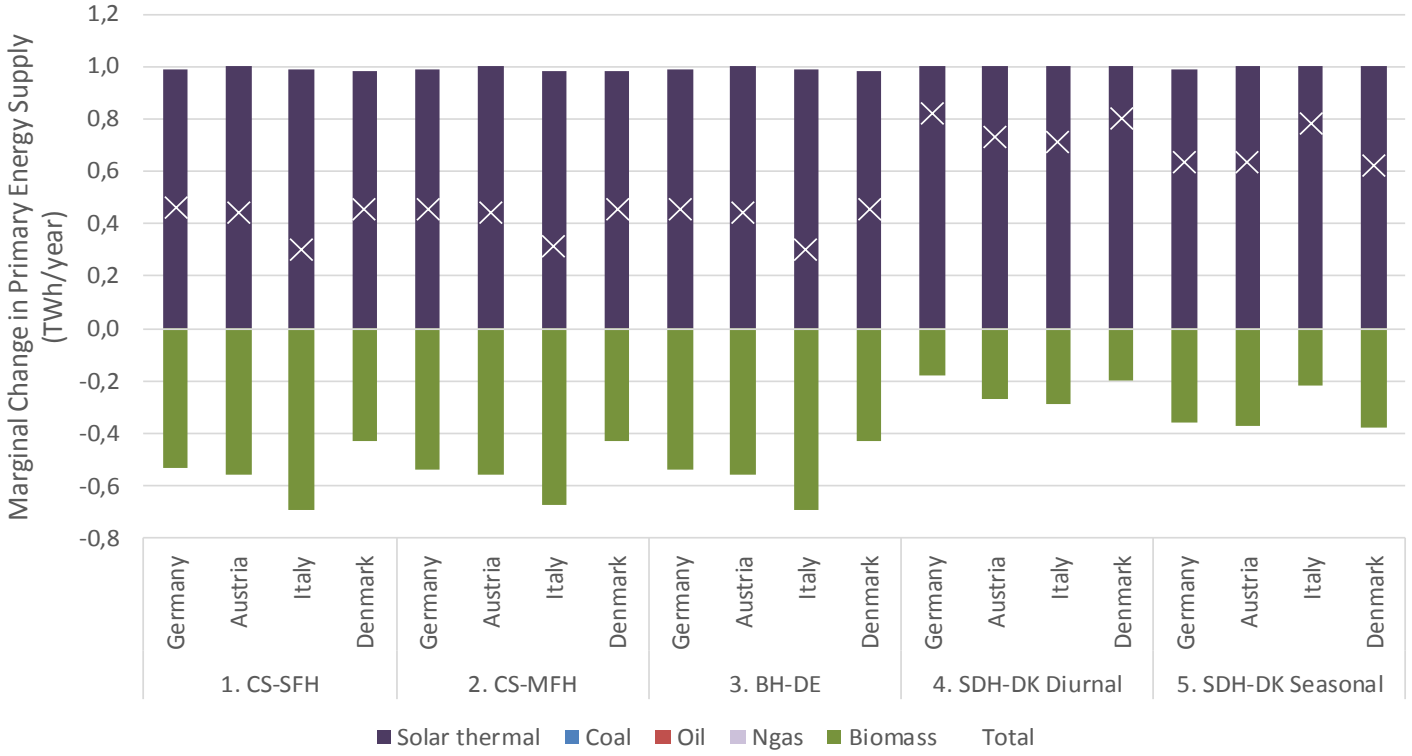


Not connected to solar thermal

50% solar penetration

→ More buildings that can utilize the summer production

Marginal impacts – Primary energy high-RES



Biomass reductions:

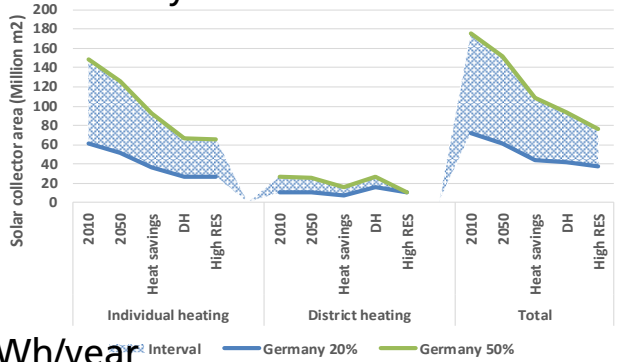
Individual: 0.5-0.7 TWh

DH: 0.2-0.4 TWh

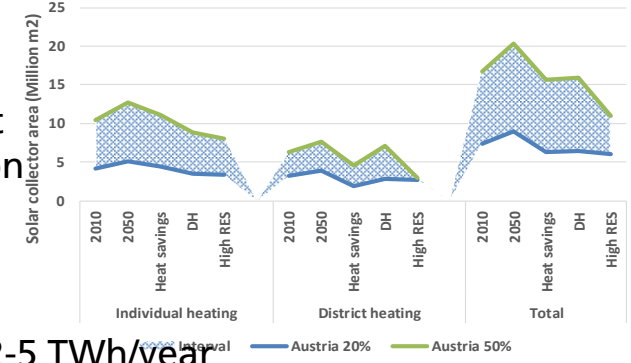
Replaces large and small heat pumps → higher excess electricity → worse flexibility

Potential Solar Thermal- share of heat, heat and m²

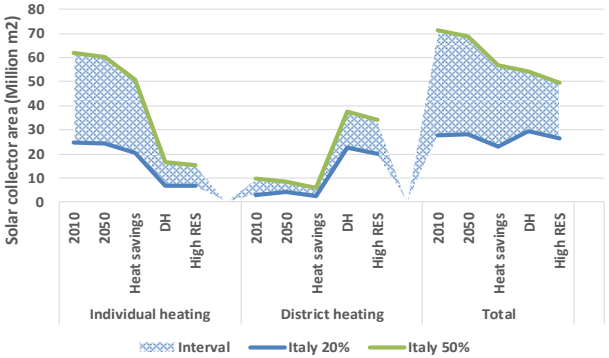
Germany: 15-60 TWh/year
3-11% of total heat production



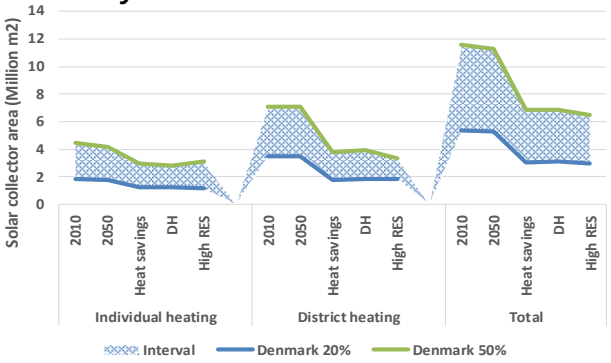
Austria: 2-7 TWh/year
4-12% of total heat production



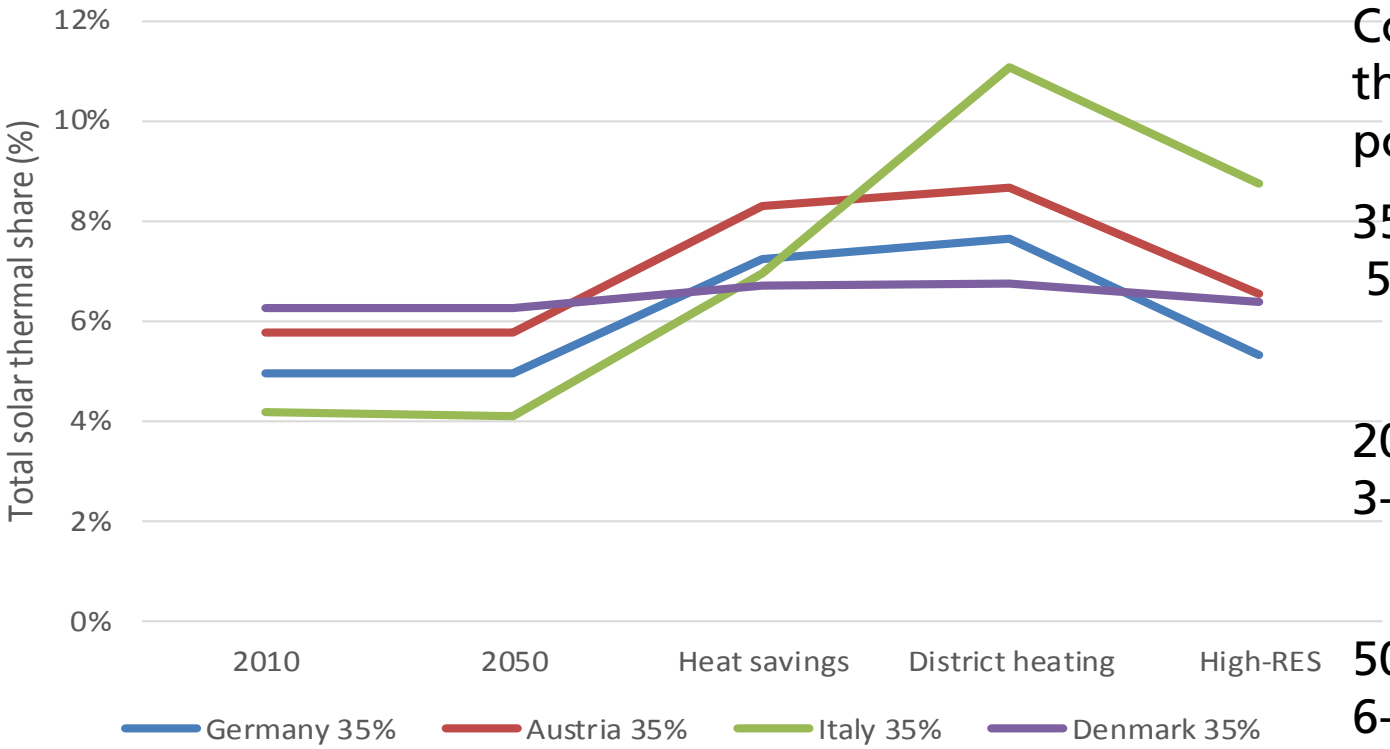
Italy: 8-24 TWh/year
2-10% of total heat production



Denmark: 2-5 TWh/year
3-10% of total heat production



Solar thermal potential



Combined solar thermal share potential:

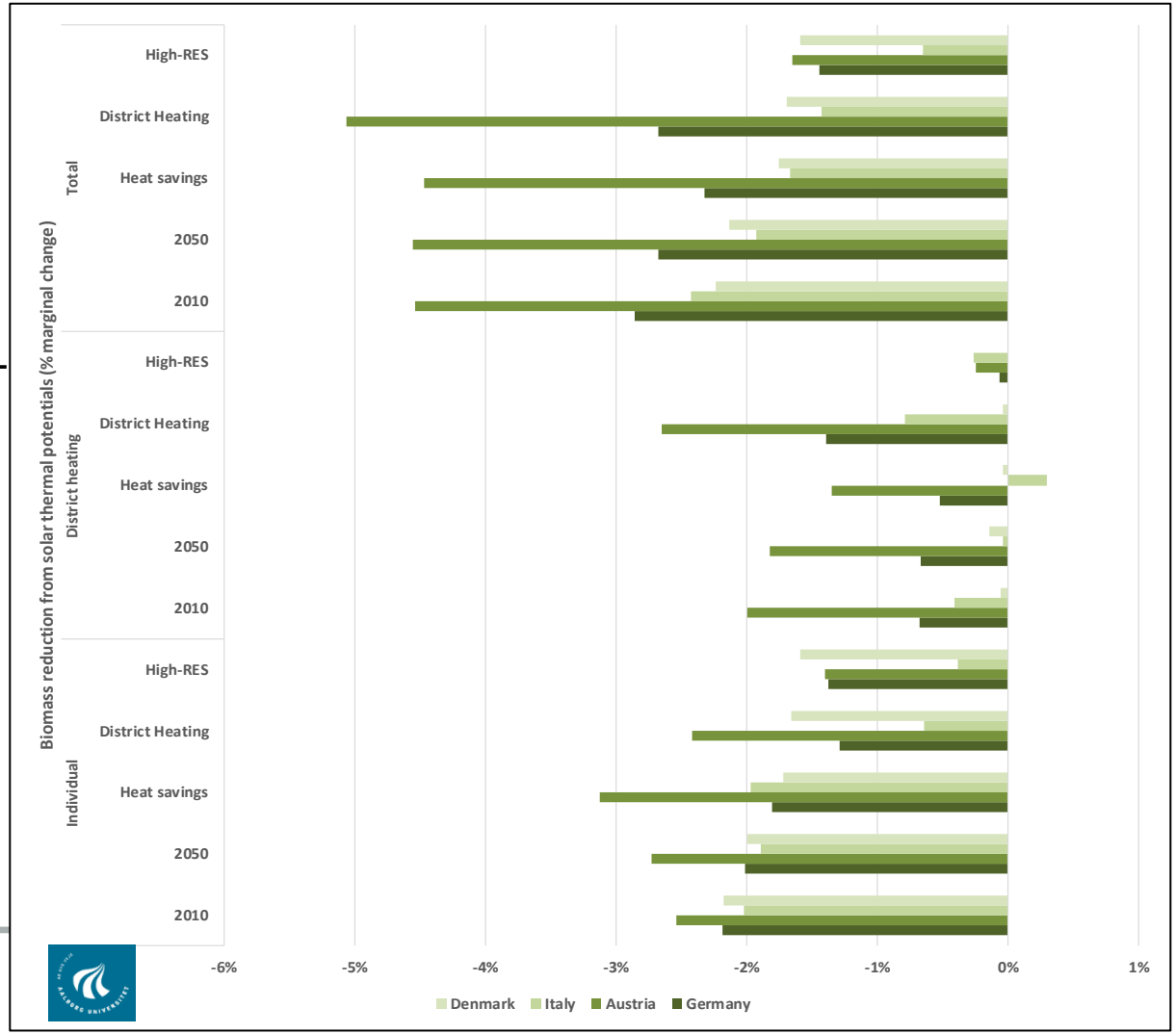
35% penetration: 5-8%

20% penetration: 3-6%

50% penetration: 6-12%

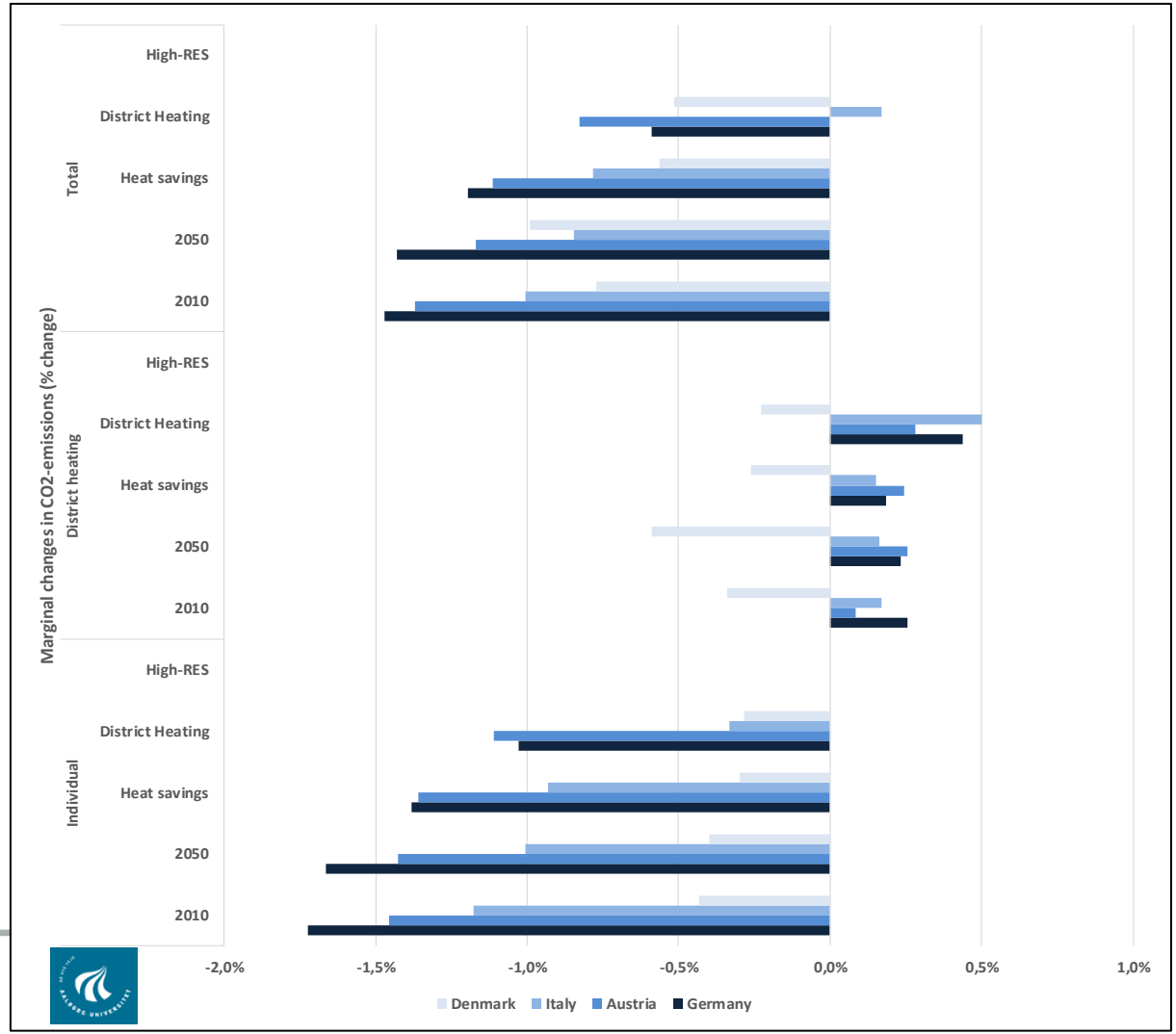
Biomass

- 2-4% overall reduction before high-RES
- 1-2% reduction in high-RES
- Lower reductions when moving towards high-RES



CO2

- 0.5-1.5% overall reduction before high-RES
- Lower reductions when moving towards high-RES



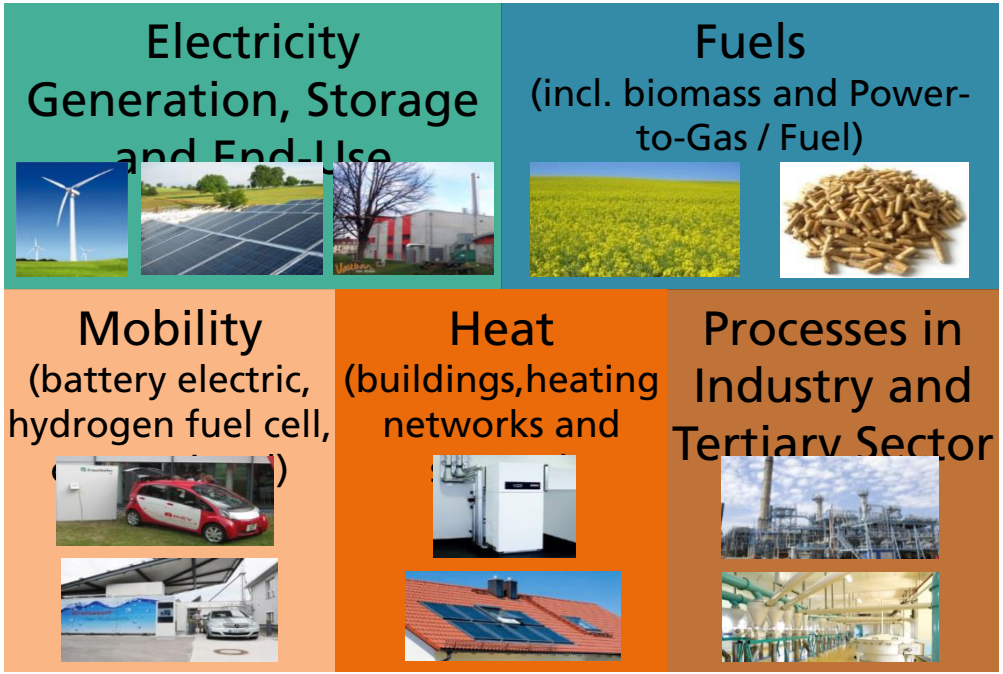
SCENARIOS FOR HEATING AND COOLING IN GERMANY BY 2050

Energy System Analysis

Renewable Energy Model for Germany (REMod-D)

Set up an energy system based predominantly on renewable energy.

- All energy end-use sectors included
- Focus on electricity / heat
- Goal: Develop a cost-optimized transformation strategy to reach goal of reducing carbon emissions by 80 % and beyond



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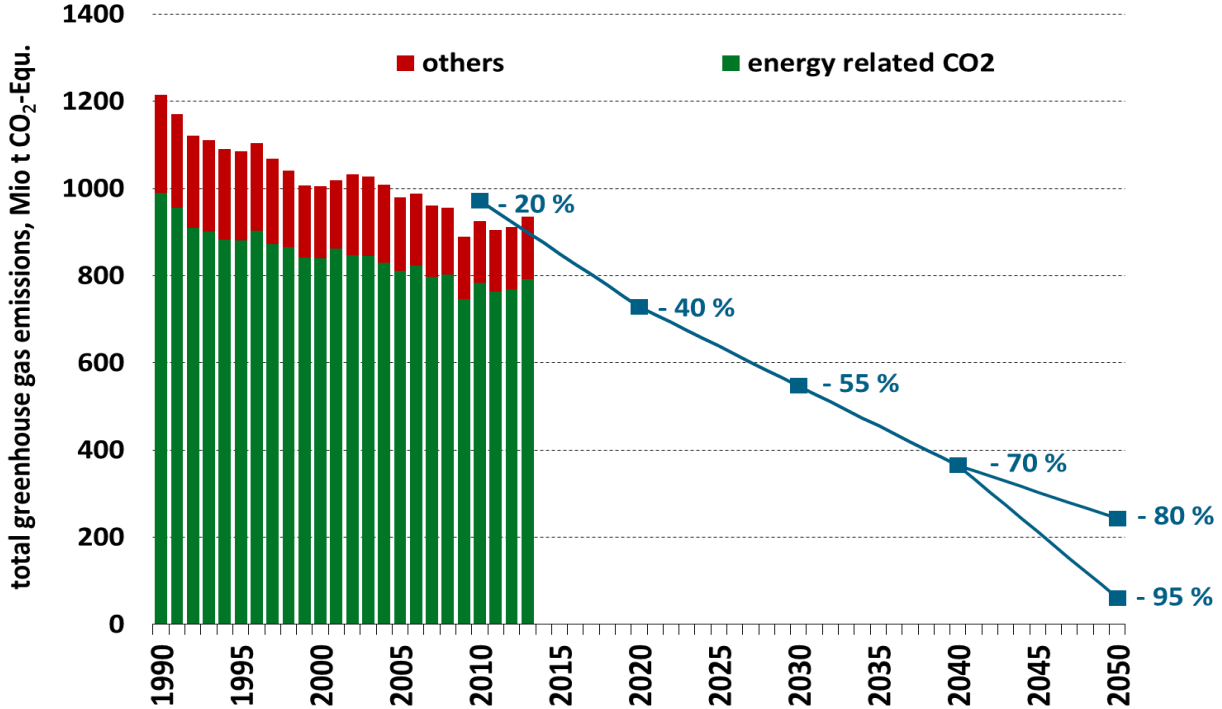
Development of German GHG emissions 1990 – 2013 & target values until 2050



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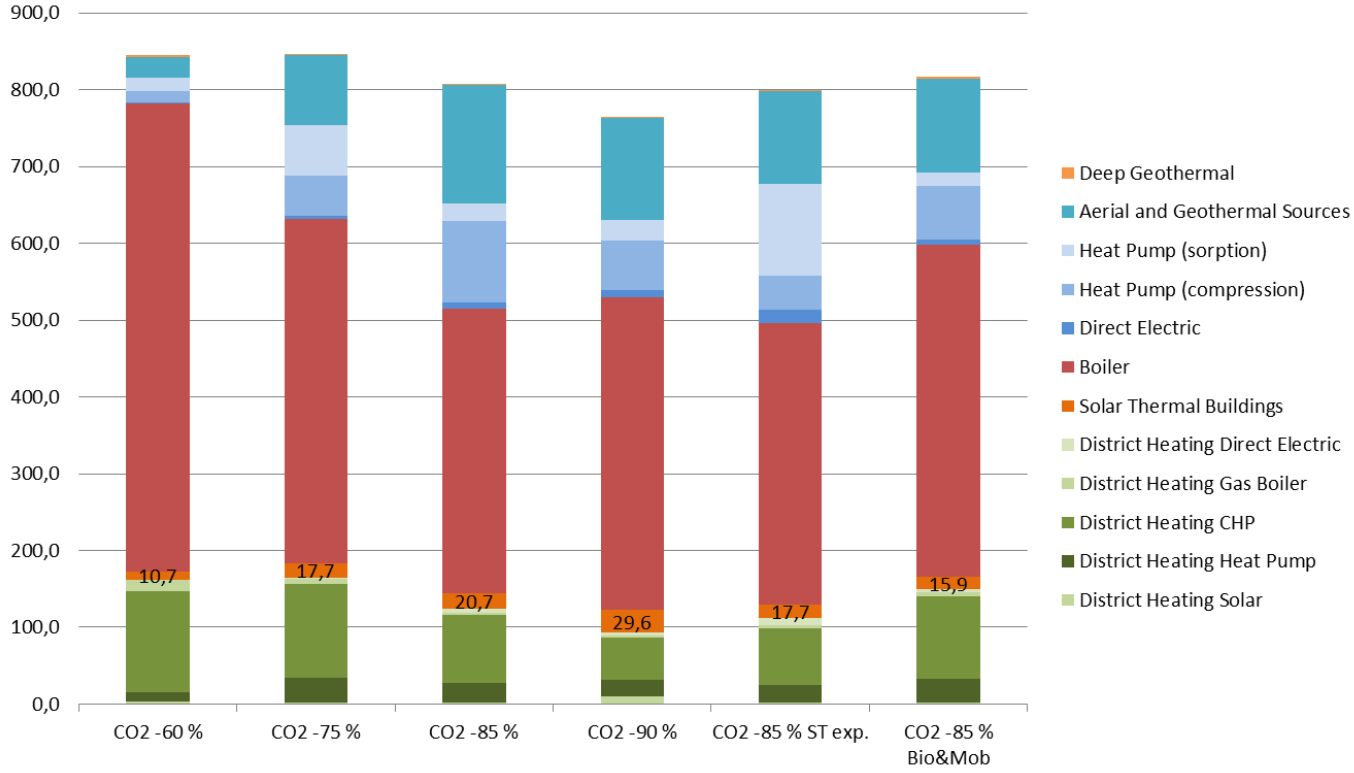
Results

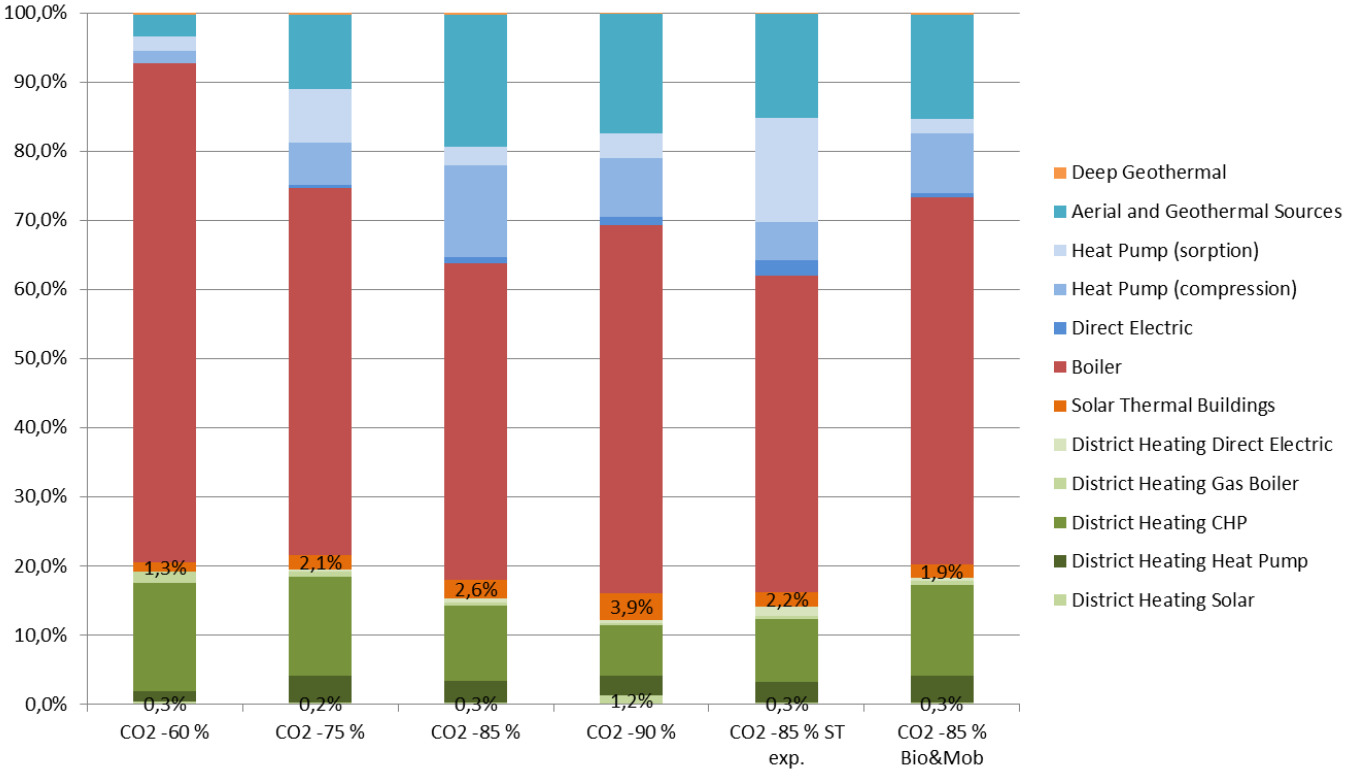
- Transformation 2013 until 2050

- 6 Scenarios
  - CO2 -60 %
  - CO2 -75 %
  - CO2 -85 %
  - CO2 -90 %
  - CO2 -85 % ST exp.
  - CO2 -85 % Bio&Mob (same boundary conditions as AAU)

2030, Heat


900,0
800,0
700,0
600,0
500,0
400,0
300,0
200,0
100,0
0,0
10,7
17,7
20,7
29,6
17,7
15,9
CO2 -60 %
CO2 -75 %
CO2 -85 %
CO2 -90 %
CO2 -85 % ST exp.
CO2 -85 % Bio&Mob
Deep Geothermal
Aerial and Geothermal Sources
Heat Pump (sorption)
Heat Pump (compression)
Direct Electric
Boiler
Solar Thermal Buildings
District Heating Direct Electric
District Heating Gas Boiler
District Heating CHP
District Heating Heat Pump
District Heating Solar

2030, Heat relative



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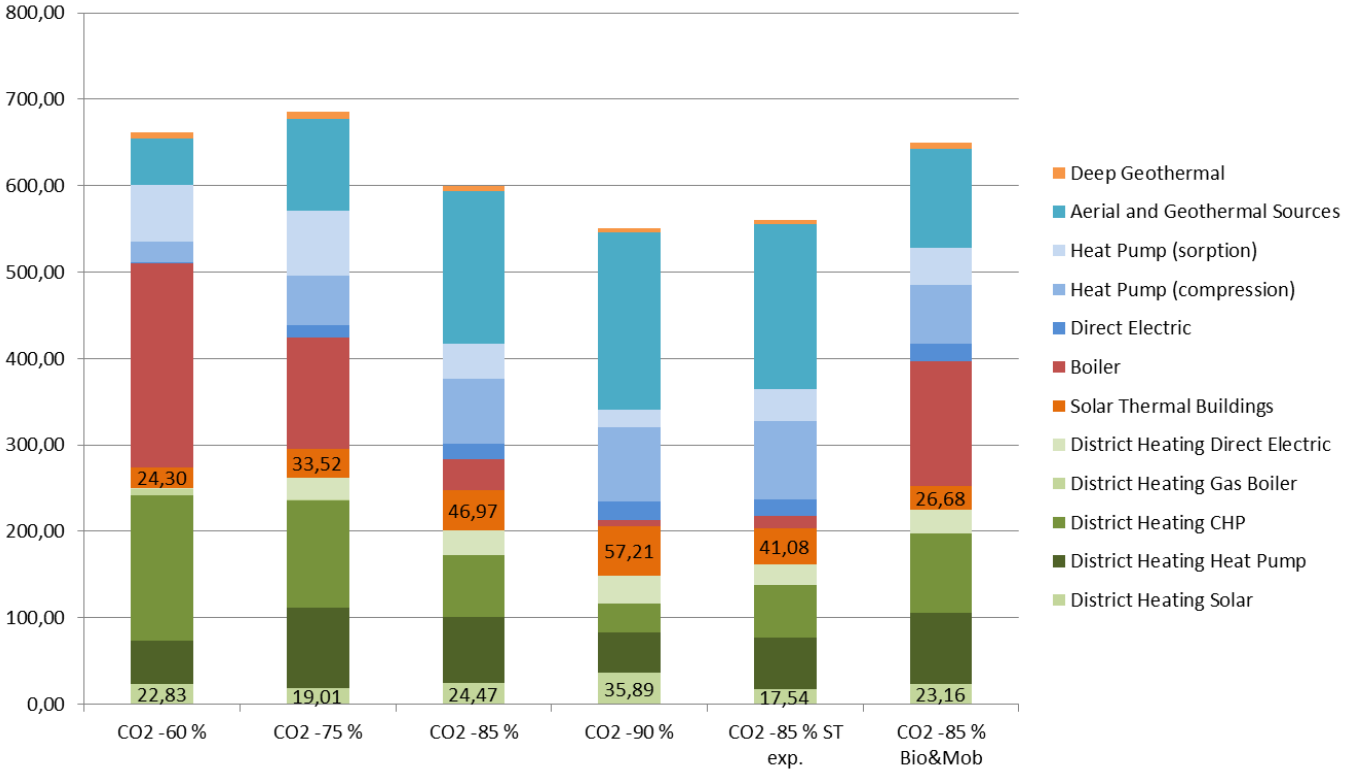
2050, Heat, TWh



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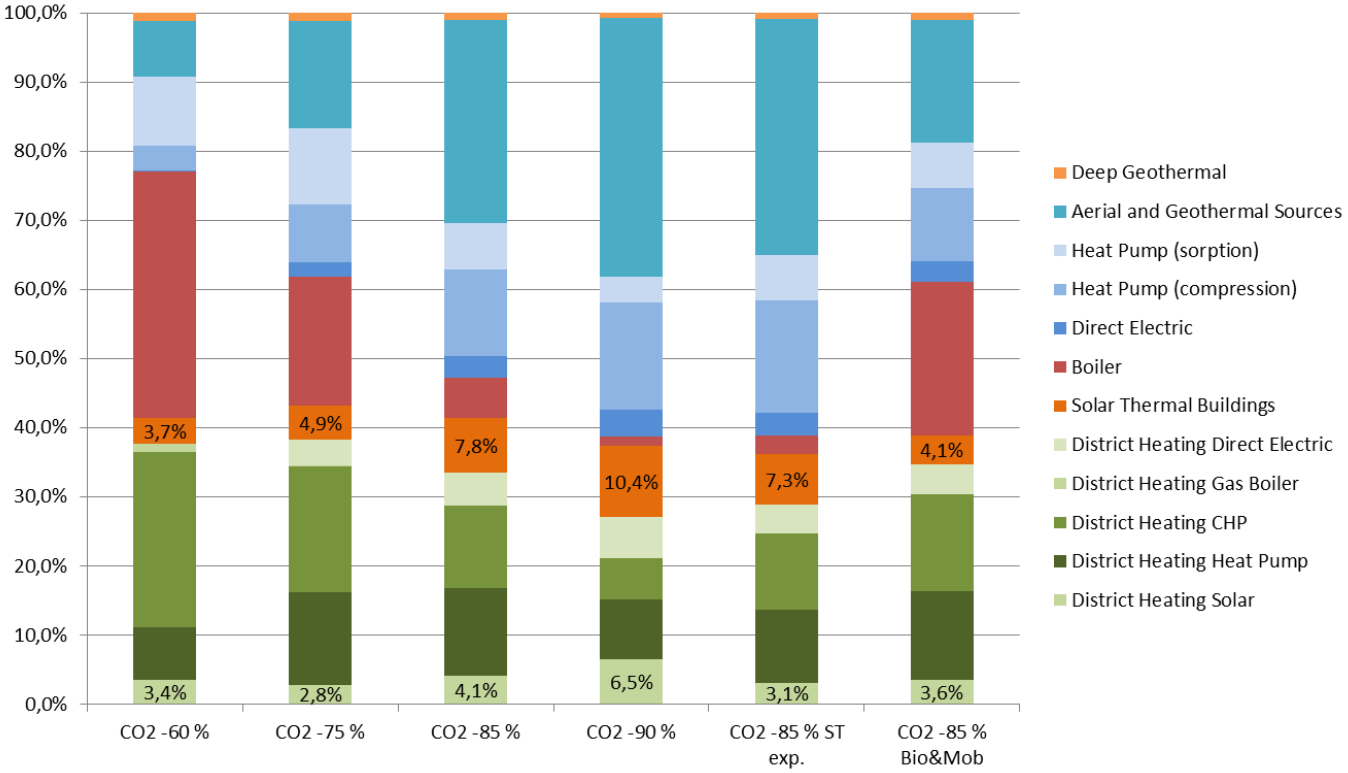
2050, Heat, relative



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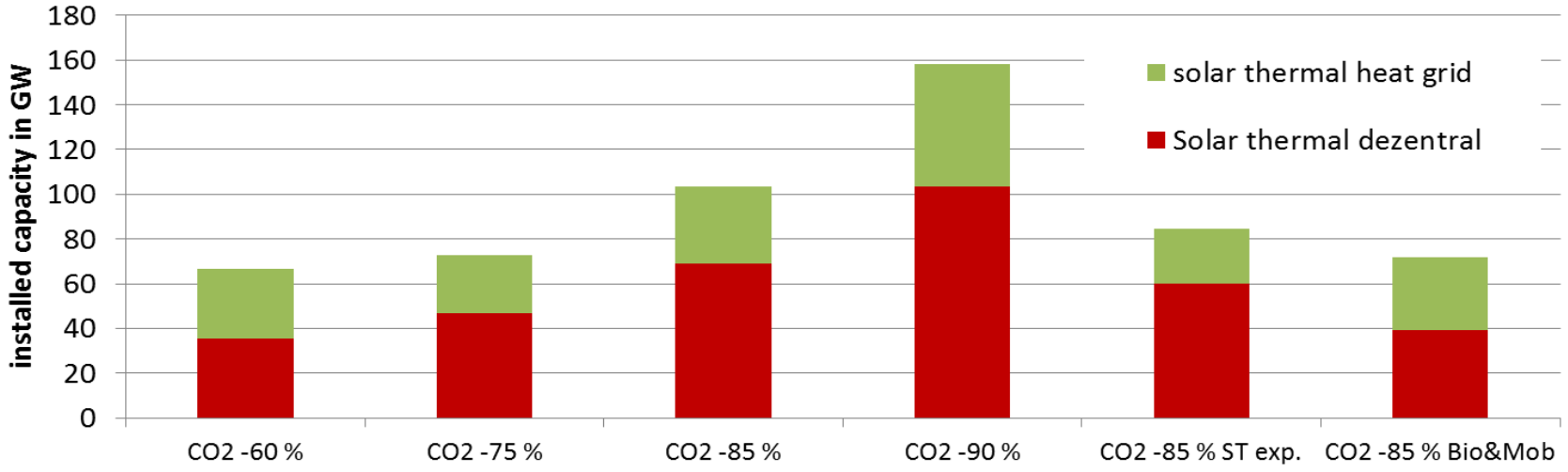
Installed Solar Thermal capacity



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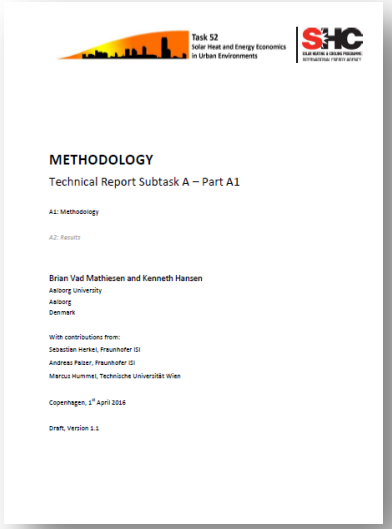
Conclusion

- Solar thermal will play a role in a future energy system
- The energy system design is crucial in terms of solar thermal feasibility: Hydrogen or Electricity as main carrier?
- The overall solar thermal potential across the countries is in the range of 3-12% of the total heat production.
- Solar thermal could ease the pressure on scarce renewable resources such as biomass
- Solar thermal will be competing with other renewable sources in a high-renewable energy system in saving CO2
- District heating: good potential but competition with waste heat

Reports available

- http://task52.iea-shc.org/


Task 52
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METHODOLOGY

Technical Report Subtask A – Part A1

A1: Methodology

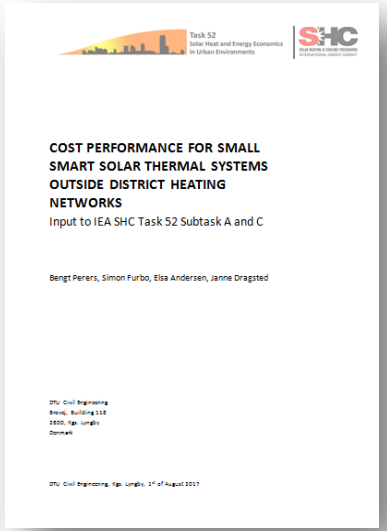
A2: Results

Brian Vad Mathiesen and Kenneth Hansen
Aalborg University
Aalborg
Denmark

With contributions from:
Sebastian Herkel, Fraunhofer ISI
Andreas Palzer, Fraunhofer ISI
Marcus Hummel, Technische Universität Wien

Copenhagen, 1st April 2016

Draft, Version 1.1


Task 52
Solar Heat and Energy Economics in Urban Environments

COST PERFORMANCE FOR SMALL SMART SOLAR THERMAL SYSTEMS OUTSIDE DISTRICT HEATING NETWORKS

Input to IEA SHC Task 52 Subtask A and C

Bengt Perers, Simon Furbo, Elsa Andersen, Janne Dragsted

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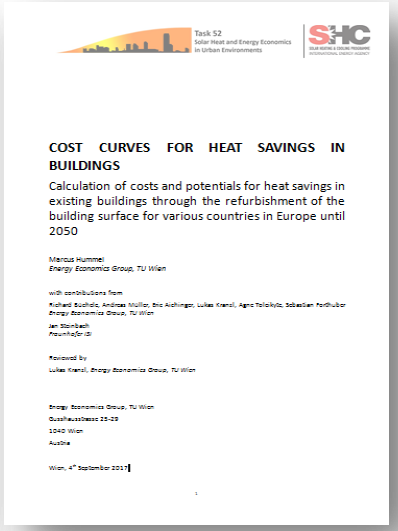
Brovej, Building 118
2800, Kgs. Lyngby
Denmark

DTU Civil Engineering, Kgs. Lyngby, 1st of August 2017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COST CURVES FOR HEAT SAVINGS IN BUILDINGS

Calculation of costs and potentials for heat savings in existing buildings through the refurbishment of the building surface for various countries in Europe until 2050

Marcus Hummel
Energy Economics Group, TU Wien

with contributions from
Richard Büchele, Andreas Müller, Eric Kiesling, Lukas Kranzl, Agnes Toleikyte, Sebastian Forthuber
Energy Economics Group, TU Wien
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Wien, 4th September 2017

Thank you for attention!

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des Deutschen Bundestages