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Generating spatially resolved energy carrier specific heat load profiles

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Background - XOS

Methodology

Results

Application





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The value of flexibility in the context of European electricity market coupling and extreme technological, regulatory and social developments



EnBW

50hertz



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Agora

Targets

- Development and application of **methods** to investigate the value of flexibility in the field of tension between Supply and Demand
- Scenarios taking disruptive developments in European energy markets – Analysis of the impacts for Germany
- Modelling of the regionalized energy system and power markets



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Key Data

- Duration: 01/2018 12/2020
- **Research Consortium:**
 - FfE e.V., FfE GmbH
 - Agora Energiewende, TUM (IFE, ENS), KIT ITAS
- 9 Project Partner
- www.ffe.de/en/xos















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The methodological approach contains three steps



Methodological approach to deduce energy carrier specific FEC for space heating and hot water on NUTS-3-level



Deduction of the heating structure: datasources, their level of detail and the type of processing

Country	Level of detail	Type of processing	Source
Austria	NUTS-3	Type 1	[6]
Belgium	NUTS-1	Type 1	[7]
Czech Republic	NUTS-3	Type 1	[8]
Denmark	NUTS-3	Type 1	[9]
France	LAU-1	Type 1	[10]
Hungary	NUTS-3	Type 1	[11]
Italy	NUTS-2	Type 1	[12]
Netherlands	NUTS-3	Type 1	[13]
Norway	NUTS-2	Type 2	[14]
Poland	NUTS-3	Type 1	[15]
Sweden	NUTS-3	Type 2	[16]
Switzerland	NUTS-3	Type 1	[17]
Slowakia	NUTS-0	Type 1	[18]
Slowenia	NUTS-3	Type 1	[19]
United Kingdom	LAU-1	Type 1	[20]

	Processina
 Preprocessing: Spatial resolution < N → distribution accord Data gaps (1) No data for a region → data is interpolated (2) EC known to be use missing → distributed uniform population. 	UTS-3 ing to population on and specific year d sed from the energy are hly according to the
 Types of datasets: Type 1: number of heat carrier → set equal to the sh 	ating systems by energy are of FEC.
• Type 2: FEC per EC w	ithout noting the

application. \rightarrow Share of energy carrier used for

other appliances than heating.

Example of raw data content: share of heating systems in Switzerland by energy carrier and NUTS-3-region, data from [17]



Clear differences in shares of heating systems among NUTS-3-regions can be identified





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Geographical and temporal variations persist in the processed data









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A scenario is defined which allows for the investigation of a radical shift

Motivation • One regulatory measure taken in Denmark in recent years was banning the installation of oilfired boilers and natural gas heating in new buildings from 1st of January 2013.

Scenario • Purpose: Illustrate the application of the derived model, hence it is simple and generic

• Substitution-Scenario:

- Oil fired heating systems are replaced by heat pumps (efficiency = 2,8)
- Gas fired heating systems are repleaced by direct electrical heating (efficiency = 1)
- Value Allows for the investigation of radical regulatory measurement on the electricity grid in energy system analysis

An index is created to investigate if spatial differences are going to be significant in this scenario

 $I_{enery\ carrier,\ NUTS-3} = \frac{Q_{enery\ carrier,\ NUTS-3}}{\{NUTS-3\ \in\ NUTS-0\ |\ \overline{Q}_{NUTS-3}\}} \qquad O: Consumption of heat supplies \\ \bullet \qquad Q: Average\ consumption of heat applications$



Differences in the heating structure can be seen. This will translate into spatial differences in electricity demand and peak load in the subsitution scenario

Spatial differences on a map are hard to spot, but it is possible...



E.g. a comparison of Northern Ireland with the UK still shows differences in the energy carrier index

Results yield an increase of up to more than 600 % in peak load and 400 % in electricity consumption of private households



Significant differences of change in peak load in countries with similar ratios of electricity consumption before and after substitution can be explained by different climate conditions







3,14 -> 350 %



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Conclusion and Outlook

Conclusion

- Metohodology and data are available for the calculation of spatially resolved heat load profiles
- The methodology allows for a differentiation in energy carriers and technologies
- The analyses of the scenario show strong spatial differences in the peak load of private households within a country
- This proves that a resolution at NUTS-3-level is necessary for energy system analysis, which consider the electrical transmission grid

+ Compare the change in electrical energy consumption not only to the consumption of private household.

Outlook

- + Refine the model with more country specific input data
- + Model the implications of renovation and demography
- + Do the same type of modelling for other sectors
- + ...ideas?



Thank you for your attention!



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Discussion Questions? Suggestions? Further Proceeding?

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