2050
Heat Roadmap Europe
A low-carbon heating and cooling strategy

Heat Roadmap Europe – Implications for the European energy transition

Berlin, January 24, 2019

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Where do we start from?

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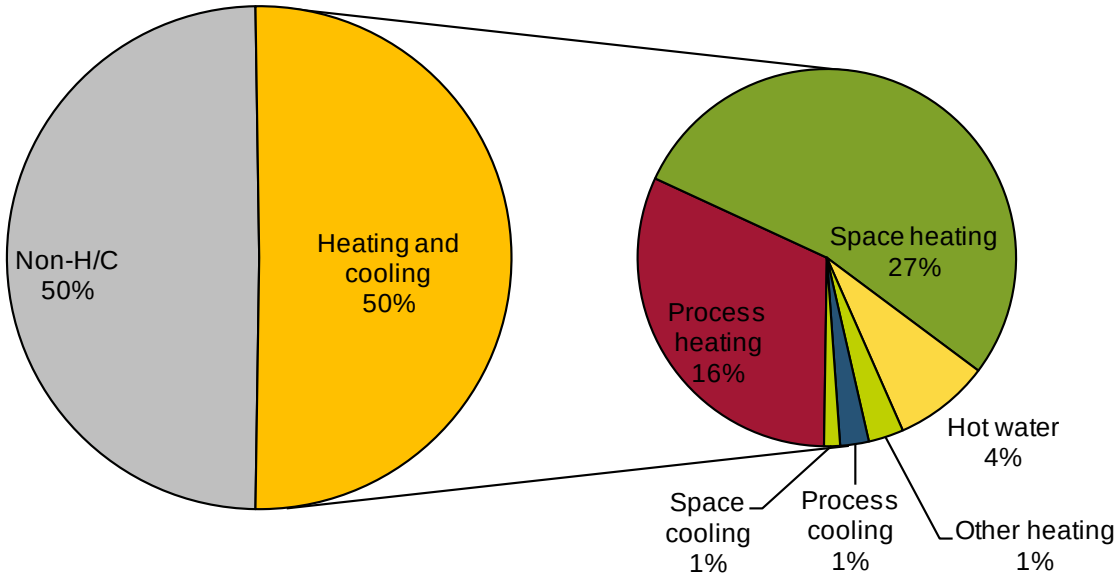
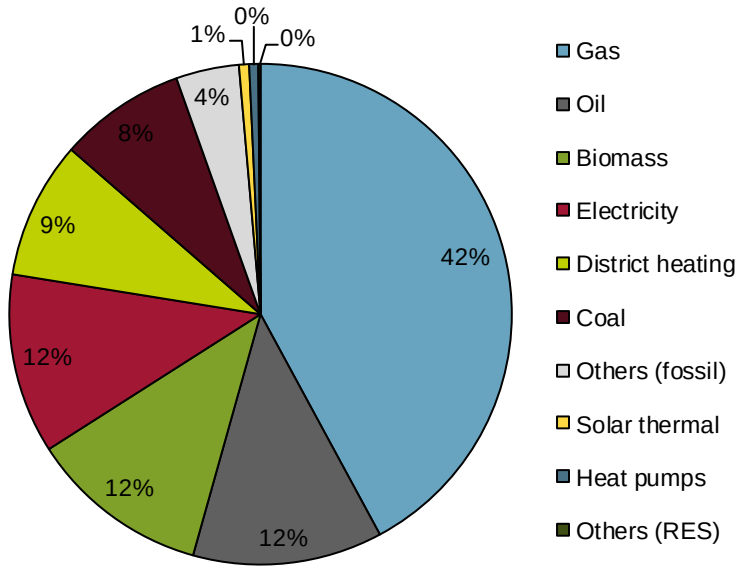
Heating & cooling is very important and fossil based

Heating and cooling demand in 2015 in the EU28 by end-use compared to total final energy demand



2015 EU final energy demand by energy carrier



High relevance: H&C about 50% of FED!

2015 shares:

Fossil: 66%, RES: 13%, El+DH: 21%

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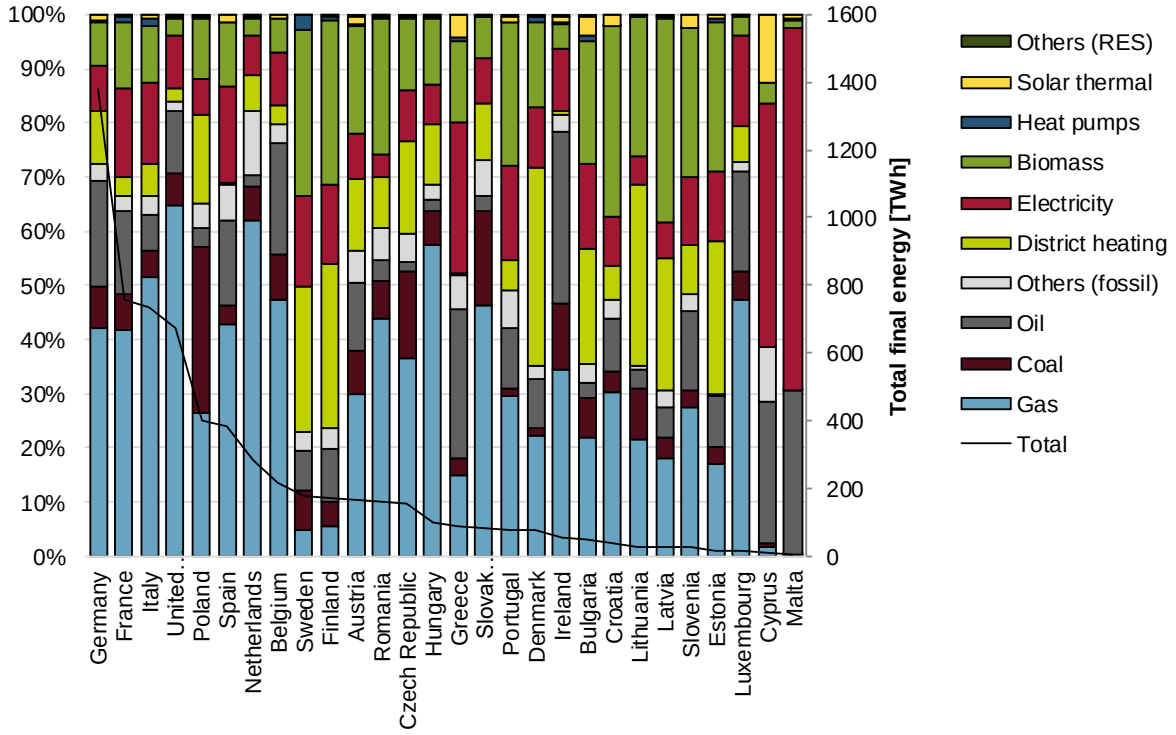
EU H&C is very diverse and local

2015 EU final energy demand by energy carrier and country



Diversity in main influencing factors

- **Heat supply mix** varies by country
- **Grid infrastructure** varies
- **Excess heat and RES resources** are local
- **Building typology** is local and country specific
- **Climate conditions** are regional and country specific
- **Political context** is country specific
- …

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What is Heat Roadmap Europe?

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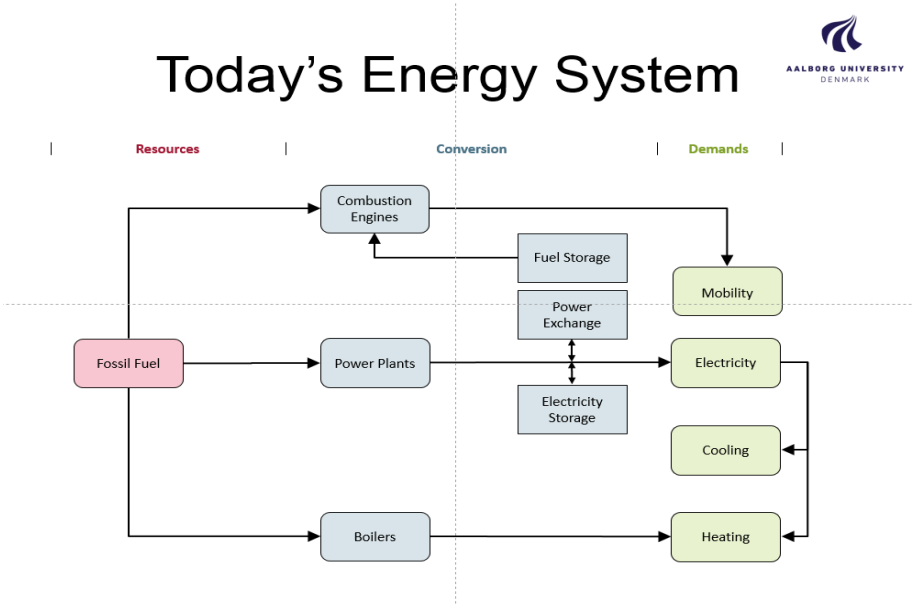
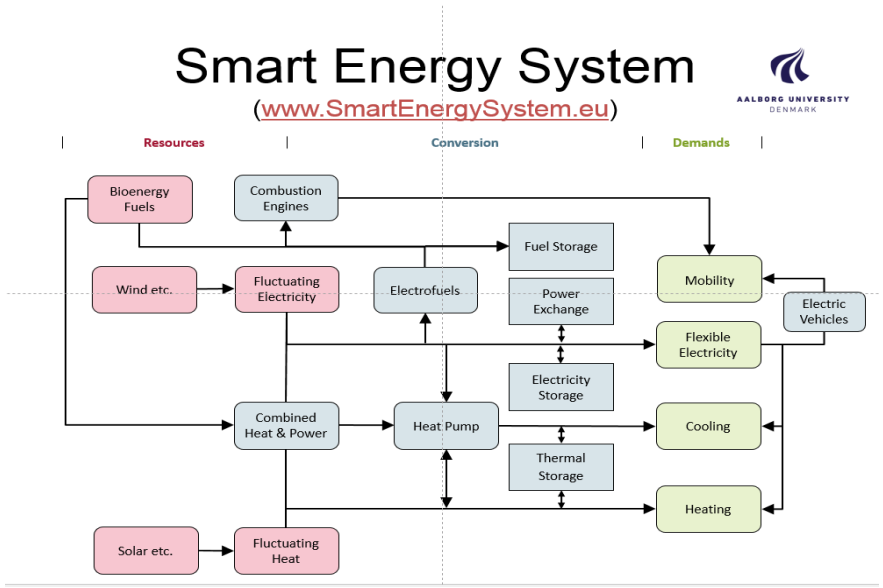
HRE 1, 2, 3, 4

- Study 1 (2012): will district heating play a role in the decarbonisation of the European energy system?
- Study 2 (2013): what is the balance between heat savings and heat supply at an EU level?
- Study 3 (2015, STRATEGO WP2): low-carbon heating and cooling strategies for 5 member states
- Study 4 (2016-2019): integrated low-carbon heating and cooling strategies for 14 member states

Our Purpose in HRE4

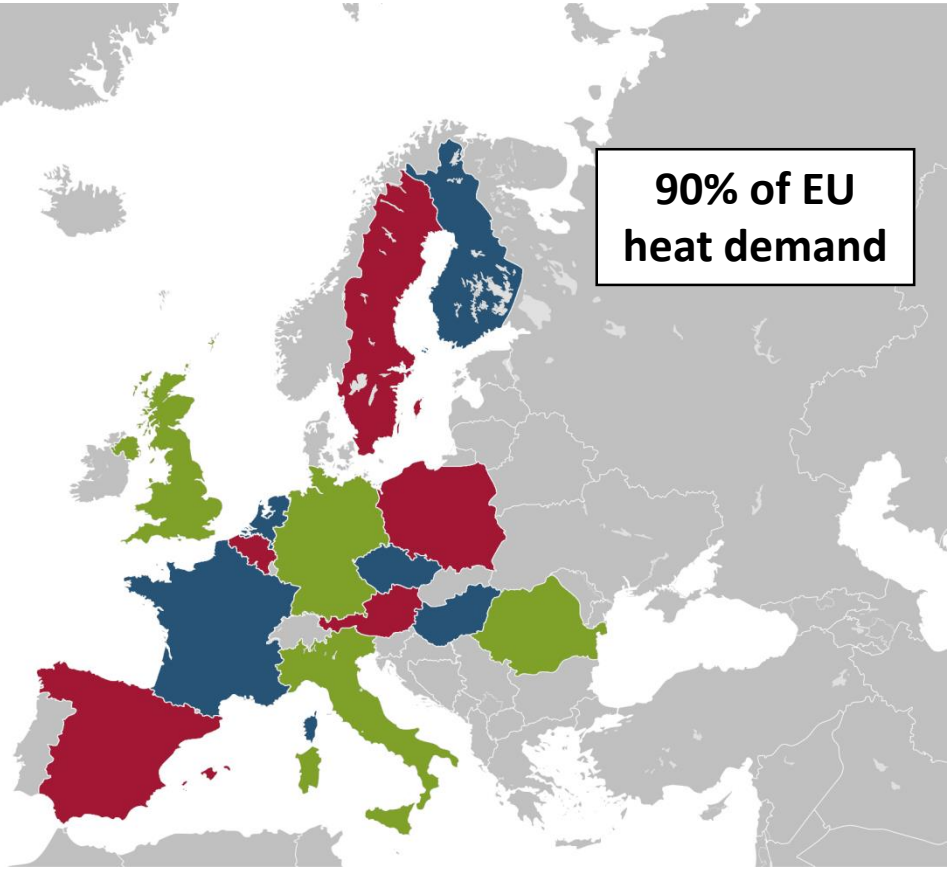
- Creating scientific **evidence** to support long-term energy strategies at local, national, and EU level and empower the transition to a low-carbon energy system
- By **quantifying** the impact of various alternatives for addressing the heating and cooling sectors





HRE4 Countries: 14 Largest EU Countries by Heat Demand = 90% of EU Heat

1. Germany
2. France
3. United Kingdom
4. Italy
5. Poland
6. Spain
7. Netherlands
8. Sweden
9. Belgium
10. Czech Republic
11. Romania
12. Austria
13. Finland
14. Hungary



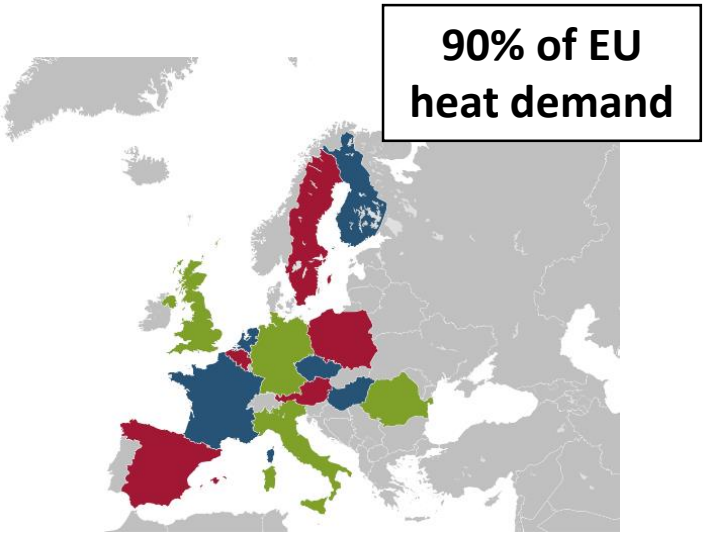
Making an Impact at Member State Level

Technical Outputs

- Profiling (incl. industry and cooling)
- Maps
- Models
- Technology Data
- Low-Carbon Heating & Cooling Strategies

Communication

- Website, Videos
- Newsletters,Twitter
- Workshops
- Reports and Scientific Papers



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Who are we in HRE?

Method and results

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Our ambition and approach

Ambition

- Decarbonise in line with Paris Agreement
- Consider local nature of heating and cooling
- Consider the wider energy system
- Technically possible, socio-economically feasible

4 Models combined

Energy PLAN

The JRC-EU-TIMES model

FORECAST
FORecasting Energy Consumption Analysis and Simulation Tool

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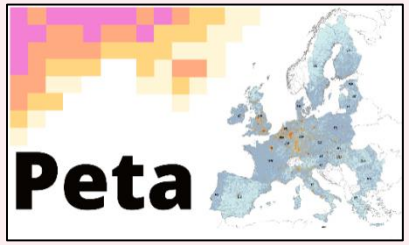
Combining the strengths of models

Heating & Cooling
(Creating Data)

Location of Heating & Cooling (WP2)



Profile of H&C and baseline to 2050
(WP3/4)

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Energy System
(Creating Scenarios)

Energy System Transition (WP5/6)

The JRC-EU-TIMES model

Energy System Operation in 2050 (WP5/6)

Energy PLAN
Advanced energy system analysis computer model

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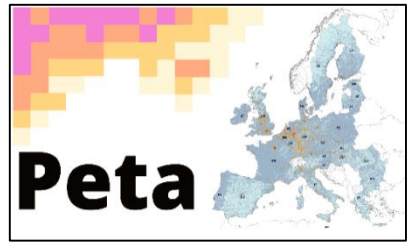
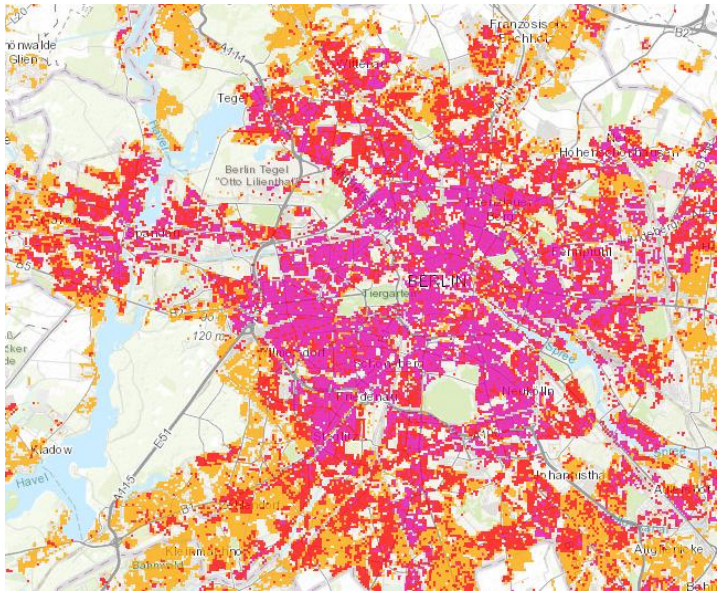
Step 1 - GIS: 3 steps to calculate economically feasible DH expansion

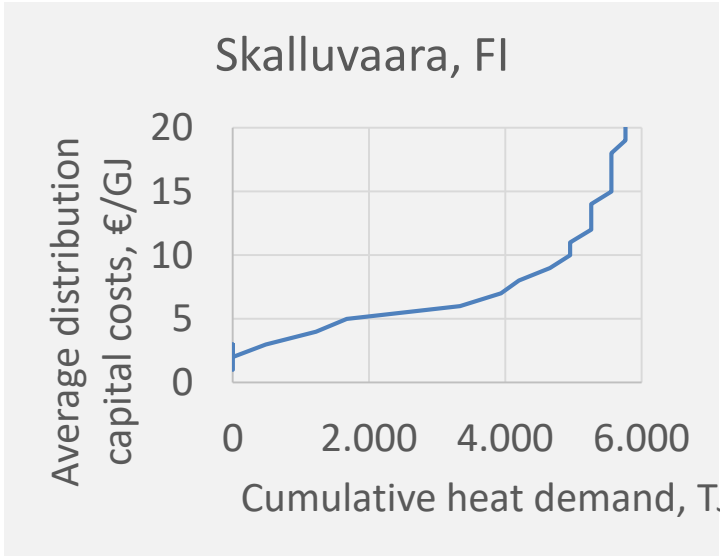


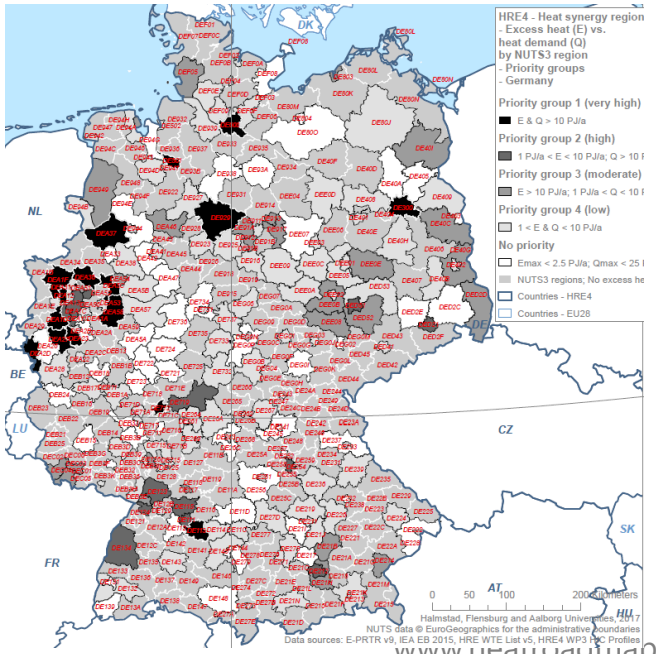
Calculate **hectare level heat demand** using linear regression model taking into account population, land-use, built-up area and soil sealing

Calculate **DH supply costs** by combining demands, costs and connectivity

Calculate **DH synergy regions** by connecting prospective DH systems with potential sources like renewables and excess heat







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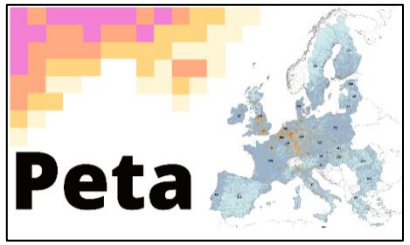
GIS analysis: Key messages



- District heating can cost-effectively provide at least half of the heating demand in 2050 in the 14 HRE countries, expanded from about 12% today.

Investment initiative needed to quadruple thermal grids in European cities

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Step 2 - Profiles: Detailed picture of H&C energy demand in 2015

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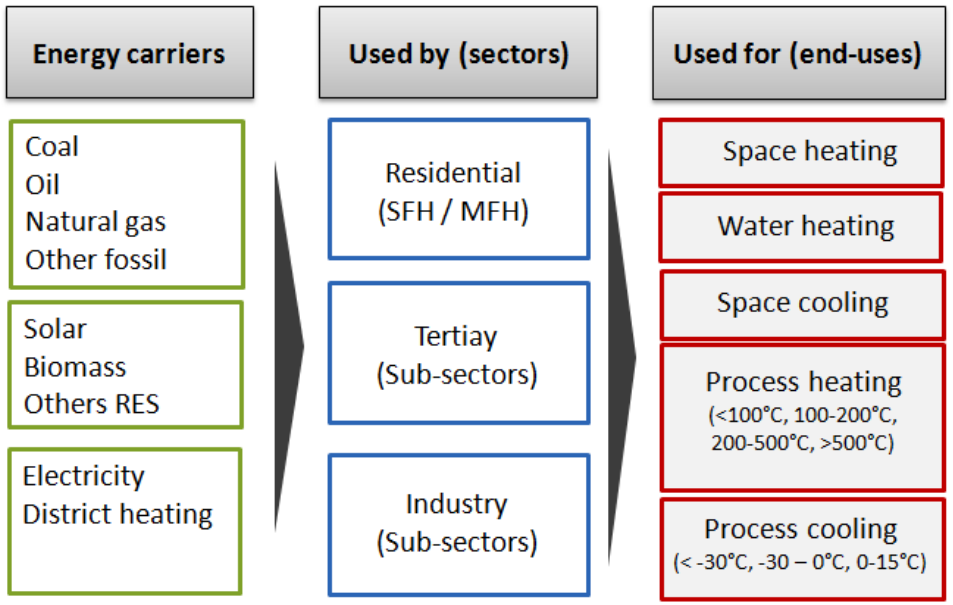
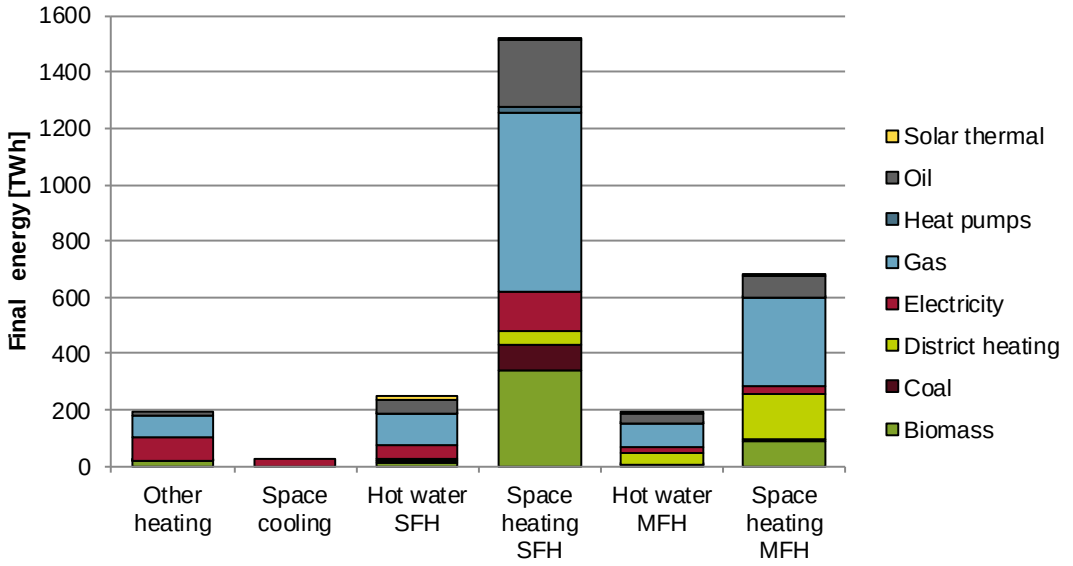
Use **bottom-up model FORECAST** to break down final energy demand by end-use, country, sector and temperature level



Example result: Final energy demand in residential H&C demand EU28



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Profiles: Key messages

FORECAST
FORecasting Energy Consumption Analysis and Simulation Tool

- H&C is very important with ~50% of EU28 final energy demand and still mainly based on fossil fuels (>65%)
- Results allow a deep dive into heat and cold demand in each country

H&C should make up a core component of any long-term strategies for sustainable energy system transitions.

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Step 3 - 2050 demand baseline and energy saving cost curves

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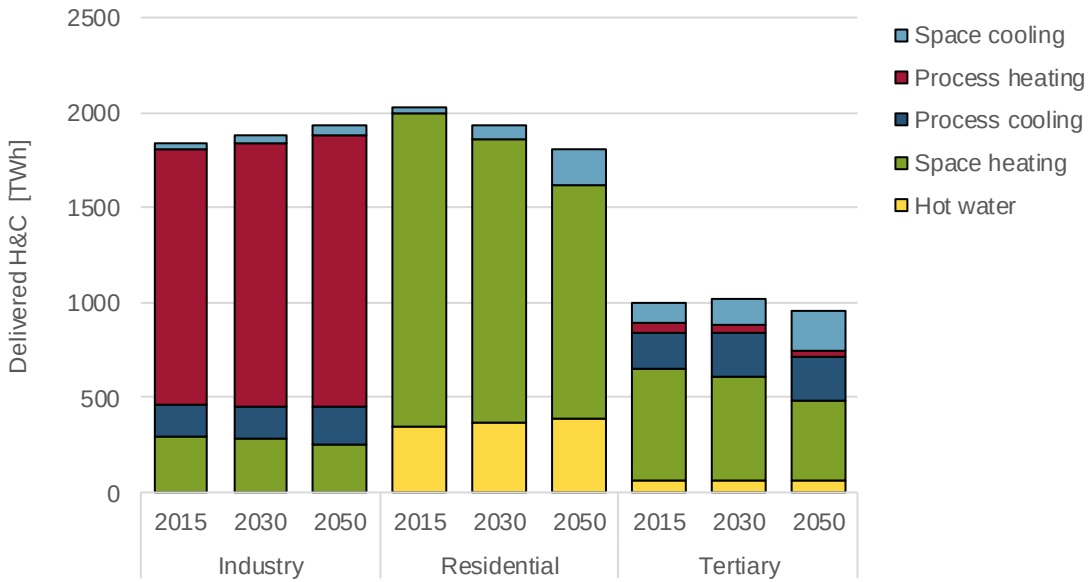
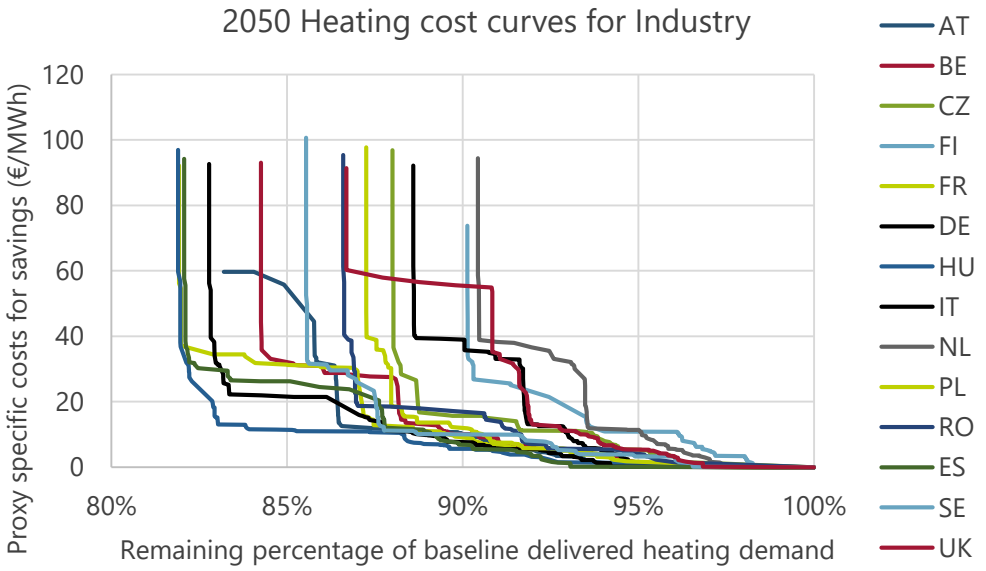
FORecasting Energy Consumption Analysis and Simulation Tool

Use bottom-up model FORECAST to generate a **baseline development towards 2050**

Develop energy saving cost curves to calculate balance between heat savings and heat supply





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Cost Curves: Key messages

FORECAST
FORecasting Energy Consumption Analysis and Simulation Tool

- Energy efficiency reduces costs for the transition
- An investment of €3,600 billion can potentially lower buildings' heat demand by about 1000 TWh by 2050 - nearly 40% of today's heat demand in buildings.
- This allows a reduction of total delivered heat demand by about one third compared to 2015.

More frequent refurbishment (1.5-2%/a) and and deeper renovations are needed

Deeper thermal renovation of buildings that anyway undergo a renovation is the most important missed opportunity

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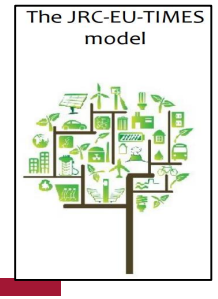
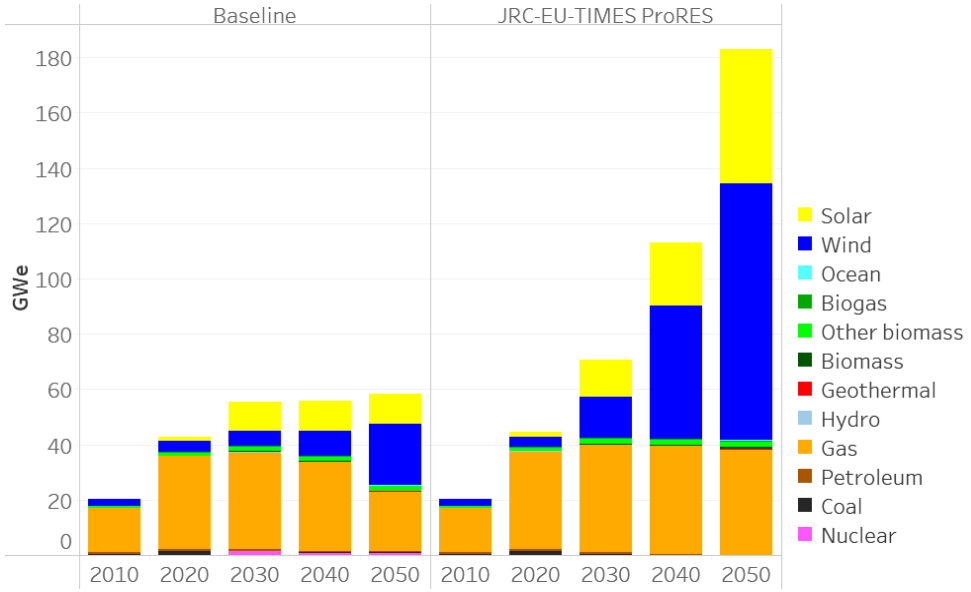
Step 4 - The transition towards 2050 for the entire energy system



Use JRC TIMES model to calculate a **cost-optimal transition** towards a 2050 low-carbon energy system

- JRC TIMES calculates the transition from today to 2050
- JRC TIMES model used to capture entire energy system also including non-H&C sectors like transport
- Calculation of least cost path

Example: **Future deployment of RES** in NL sees drastic increase in wind and solar capacities



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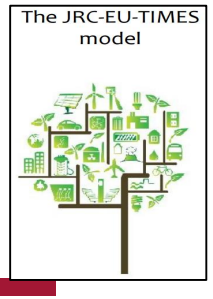
The energy system transition: Key messages



- **Biomass and hydro** used up to their technical, sustainable potential. The other renewable resources are used up to the economic optimum.
- **Electricity** plays important role in transport, buildings and industry decarbonisation
- By 2050, energy **import dependency** can reduce from 55% to below 20%.

Fast and ambitious deployment of wind and solar energy is fundamental

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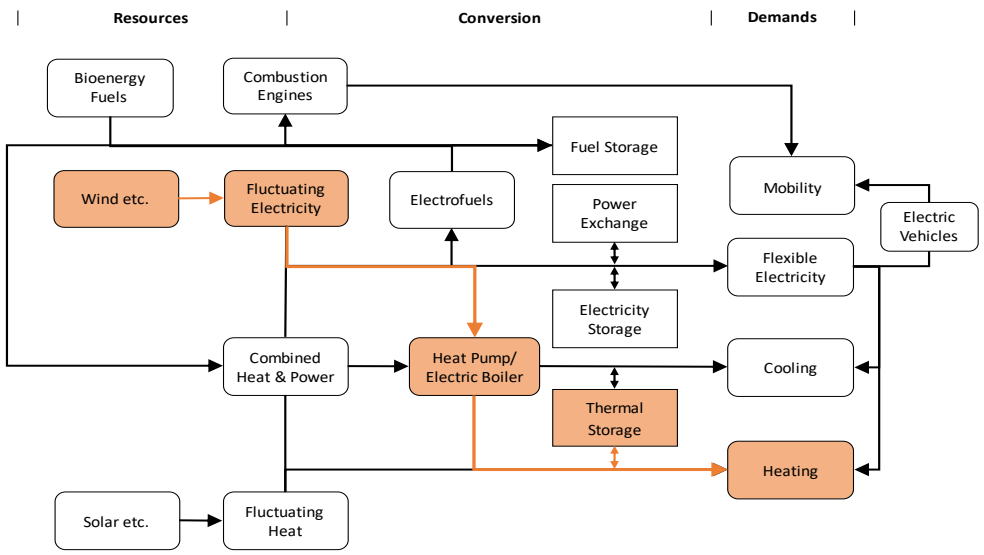
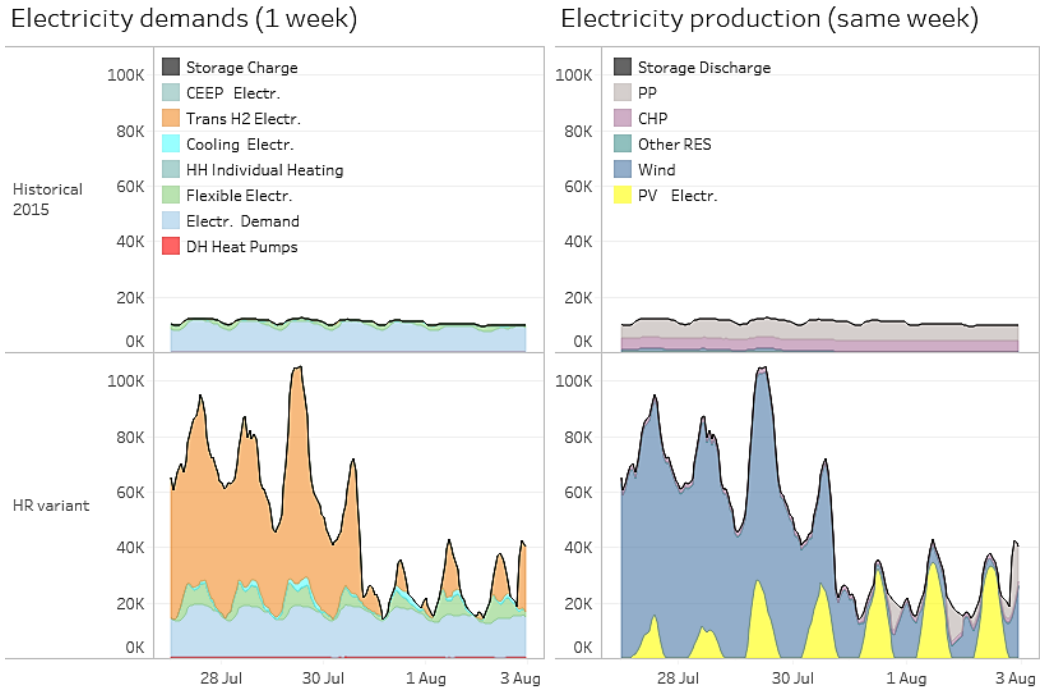
Step 5 - 2050 energy system with hourly resolution

Use model Energy Plan to calculate detailed **2050 energy system with hourly resolution**



Example result: **Hourly demand and supply** for one week in summer in the Netherlands in 2050



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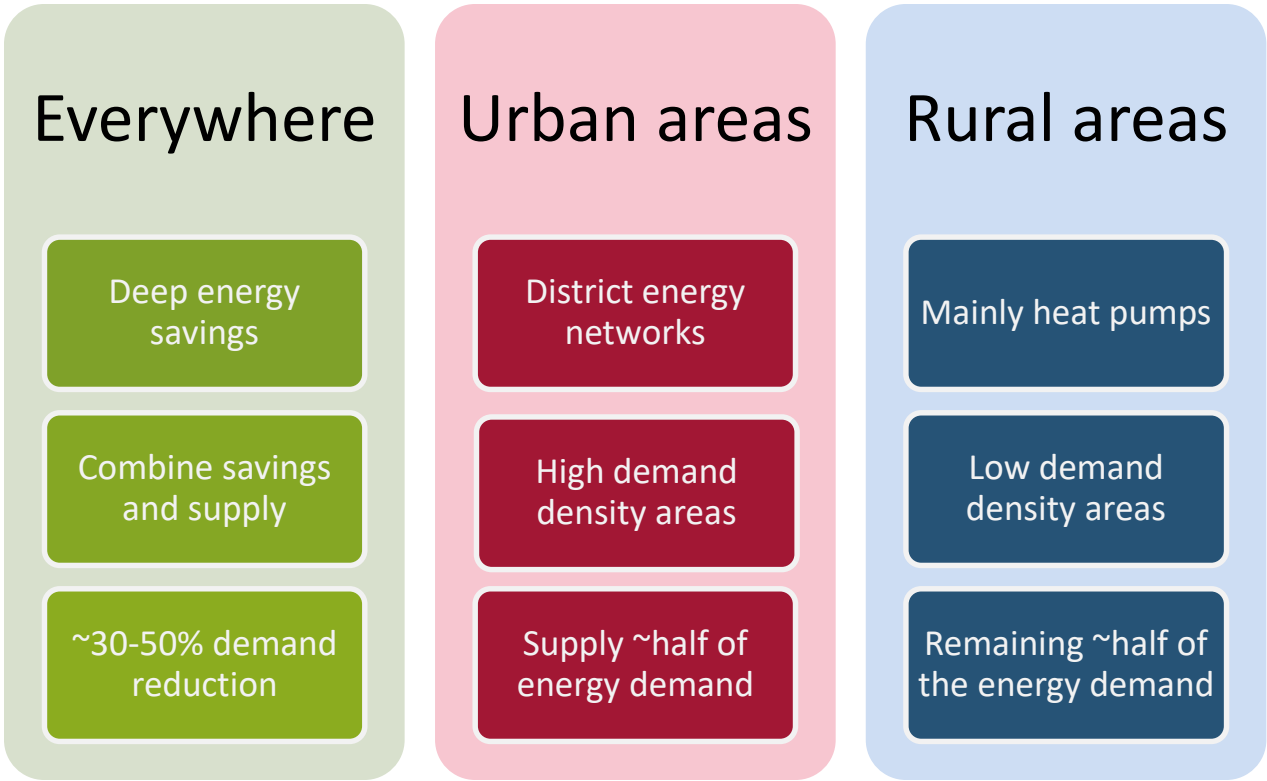
Heat Roadmaps for transitions

- Decarbonise in line with Paris Agreement
- Technically possible, socio-economically feasible
- Consider local nature of heating and cooling
- Consider the wider energy system



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Thank you!

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Heat Roadmap Europe: www.heatroadmap.eu

Pan-European Thermal Atlas: www.heatroadmap.eu/maps

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Backup

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HRE Methodology

Data and mapping

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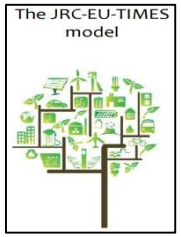
Building Demand Savings Potential

Costs of Making Savings

District Heating Potential

District Heating Resources



Energy PLAN

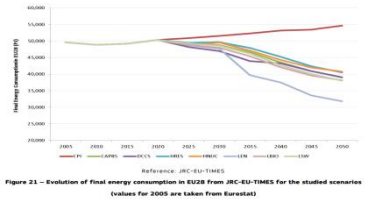
Energy System Potential

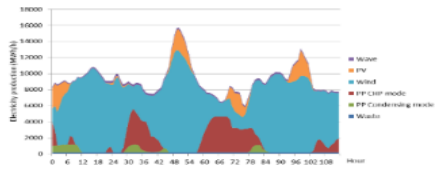
Energy System Resources

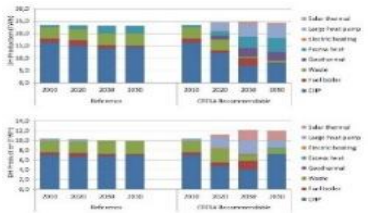
BAU (References)

Heat Roadmap Europe Alternatives

Results (PES, CO2, Costs)

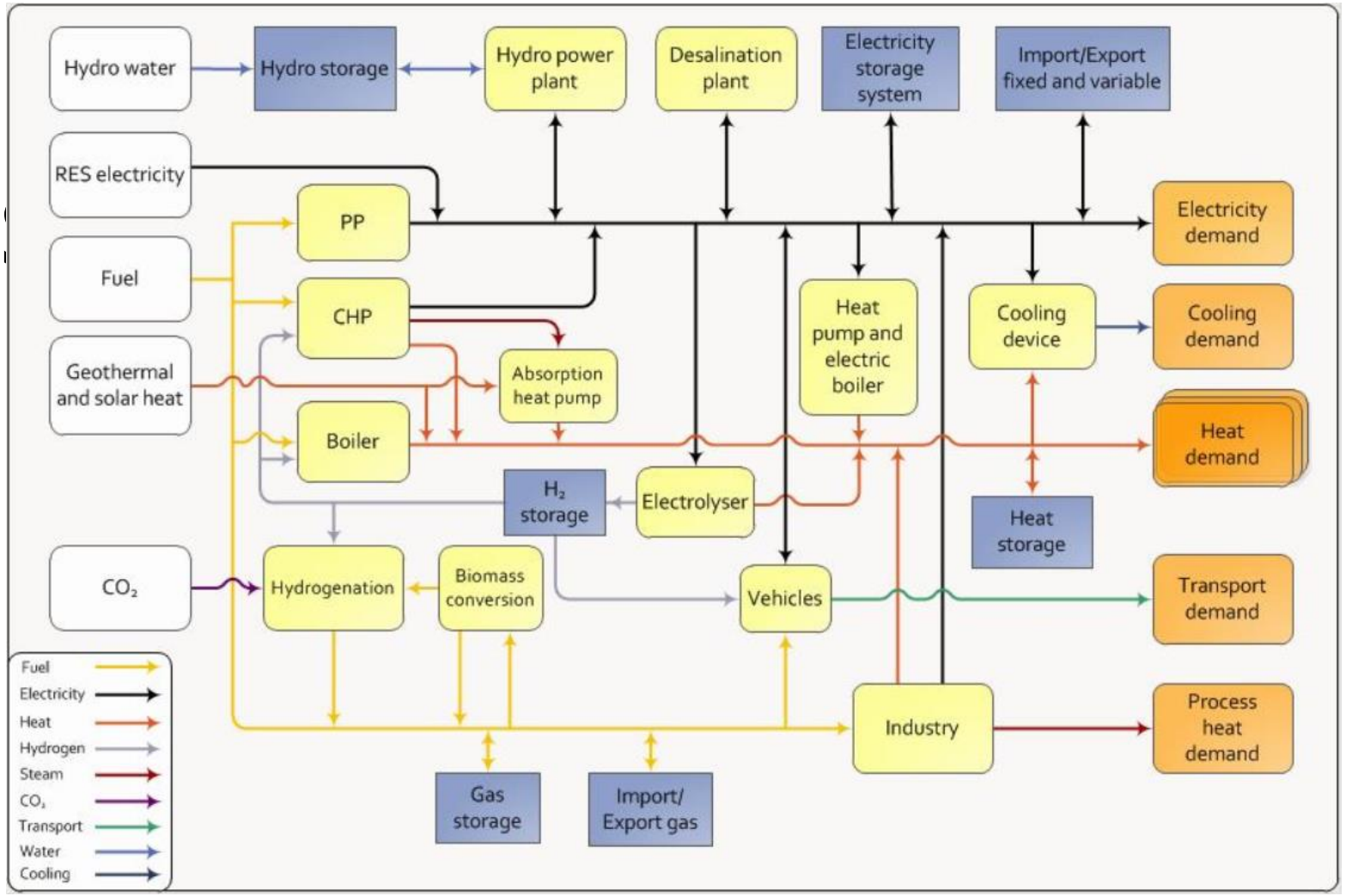






Energy

- Hourly resolution
- Sector integration
- Smart energy system approach



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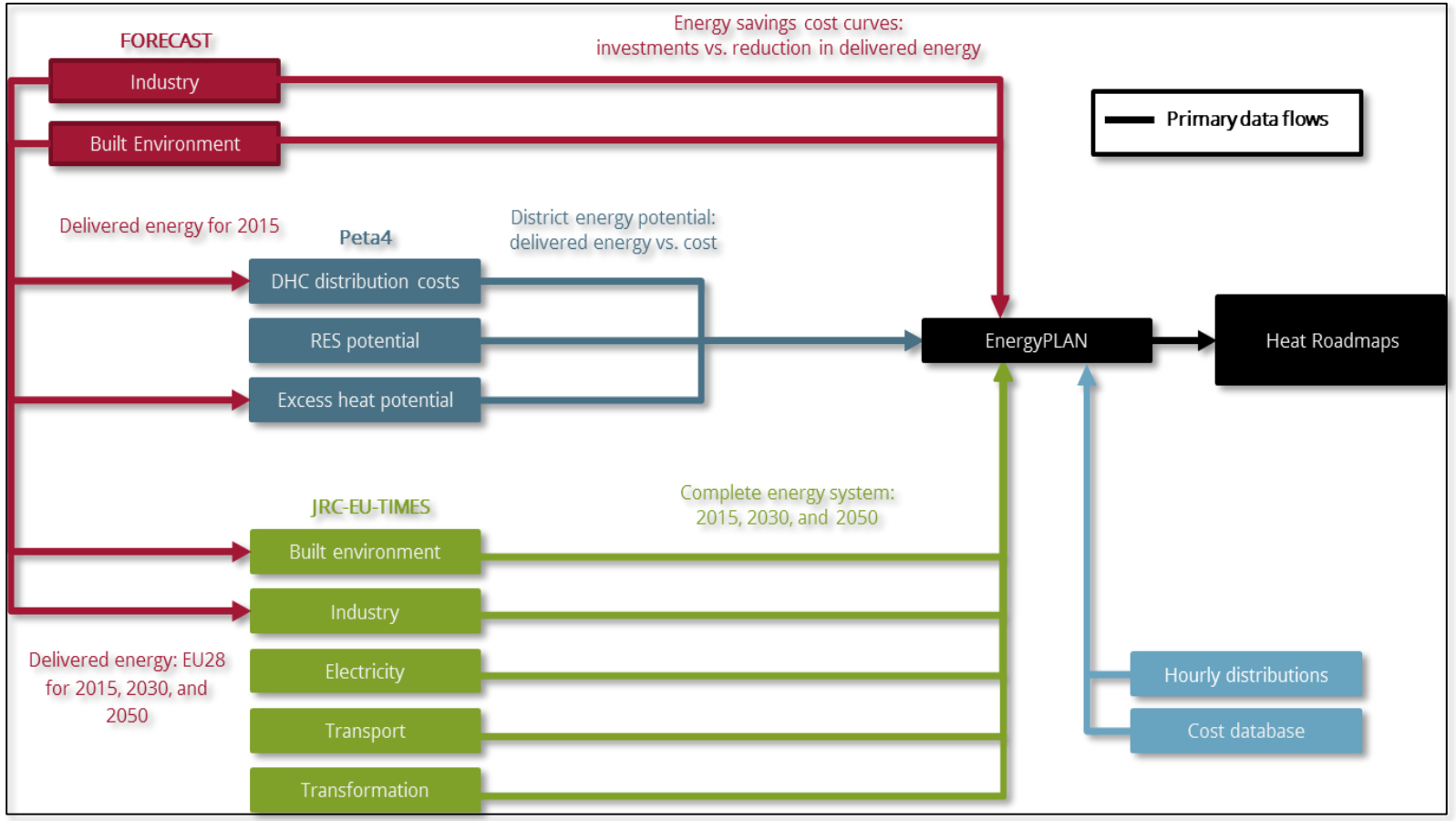
Data flows between models



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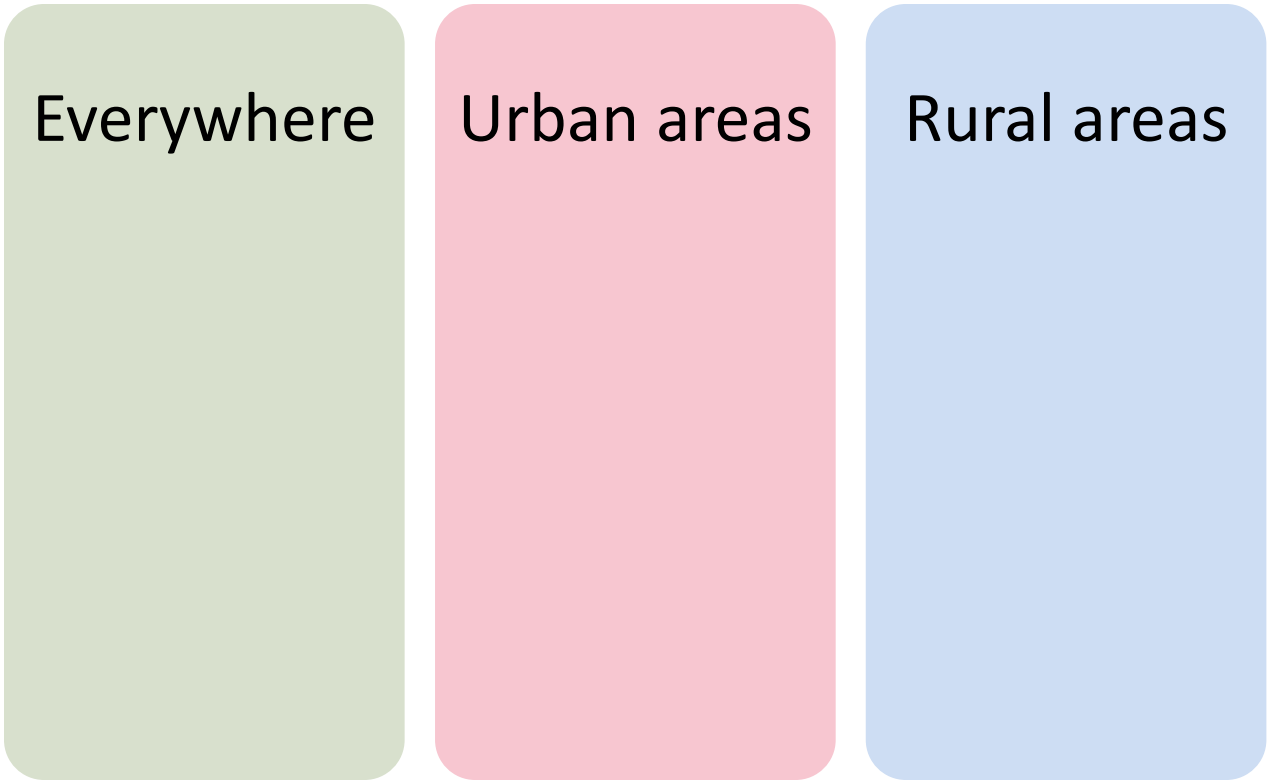
Main conclusions from profiles

- Very diverse composition of **energy carriers** for H&C supply across countries. Still:
  - **Fossil fuels** account for >65% in EU28 FED for H&C
  - **Gas** is the most dominant fuel in EU28 and in most countries
  - Of **RES**, only **biomass** is used substantially; solar thermal, geothermal and heat pumps are still marginal in almost every country
  - District heating strong in Nordic and central/eastern countries and marginal in others (UK, Ireland, Spain, Portugal, Italy)
- **Space heating and process heating** most relevant end-uses
- **Space heating**: SFH twice as important as MFHs as an EU28 average, but huge differences on national level
- **Process heating**: Process heat >200°C accounts for ~50% of industrial H&C FED, and represents a challenge when switching to RES
- **Cooling** accounts for ~2% of total FED for H&C and currently has low shares in most countries but the potential to grow strongly in future

The building blocks of the EU heating & cooling transition according the HRE

- Decarbonise in line with Paris Agreement
- Technically possible, socio-economically feasible
- Consider local nature of heating and cooling
- Consider the wider energy system



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