Heat Roadmap Europe
2050

Heat Roadmap Europe

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Heat Roadmap Europe 2050

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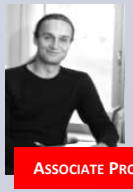

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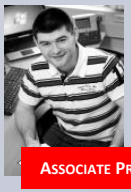

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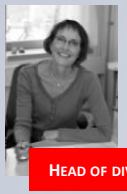

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What do we do…?

Energy Planning (Theories, Methodologies, Tools, Analyses, Case studies and Proposals)

- Energy System Analysis (incl. GIS)
- Feasibility Studies
- Public Regulation

Heat Roadmap Europe 2050 www.heatroadmap.eu

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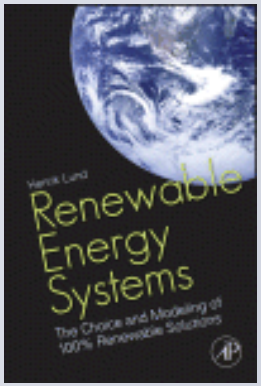
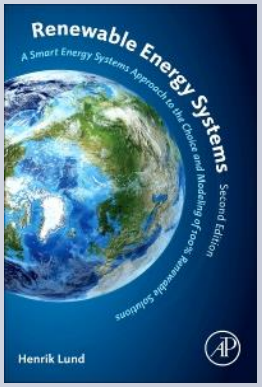
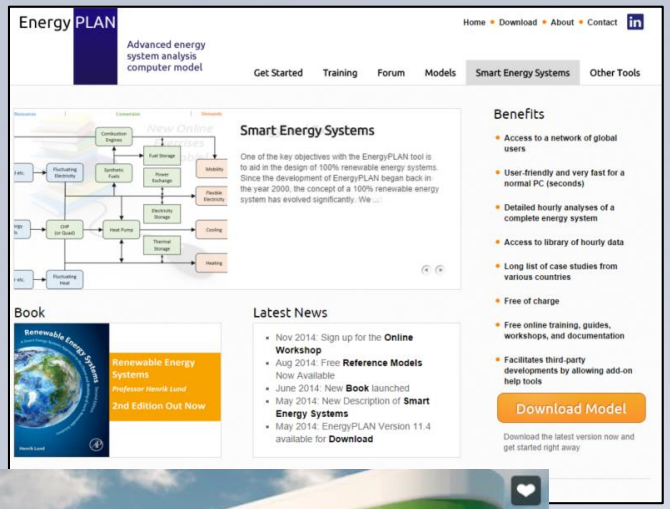
Smart Energy System

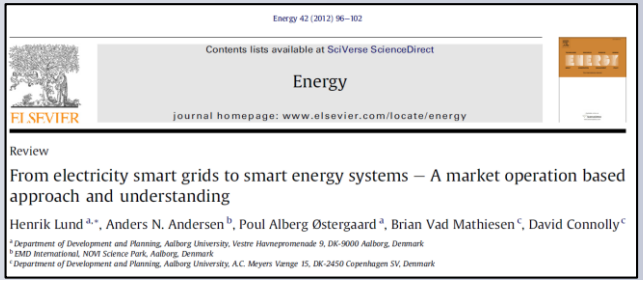
➥www.SmartEnergySystem.eu

➥www.EnergyPLAN.eu









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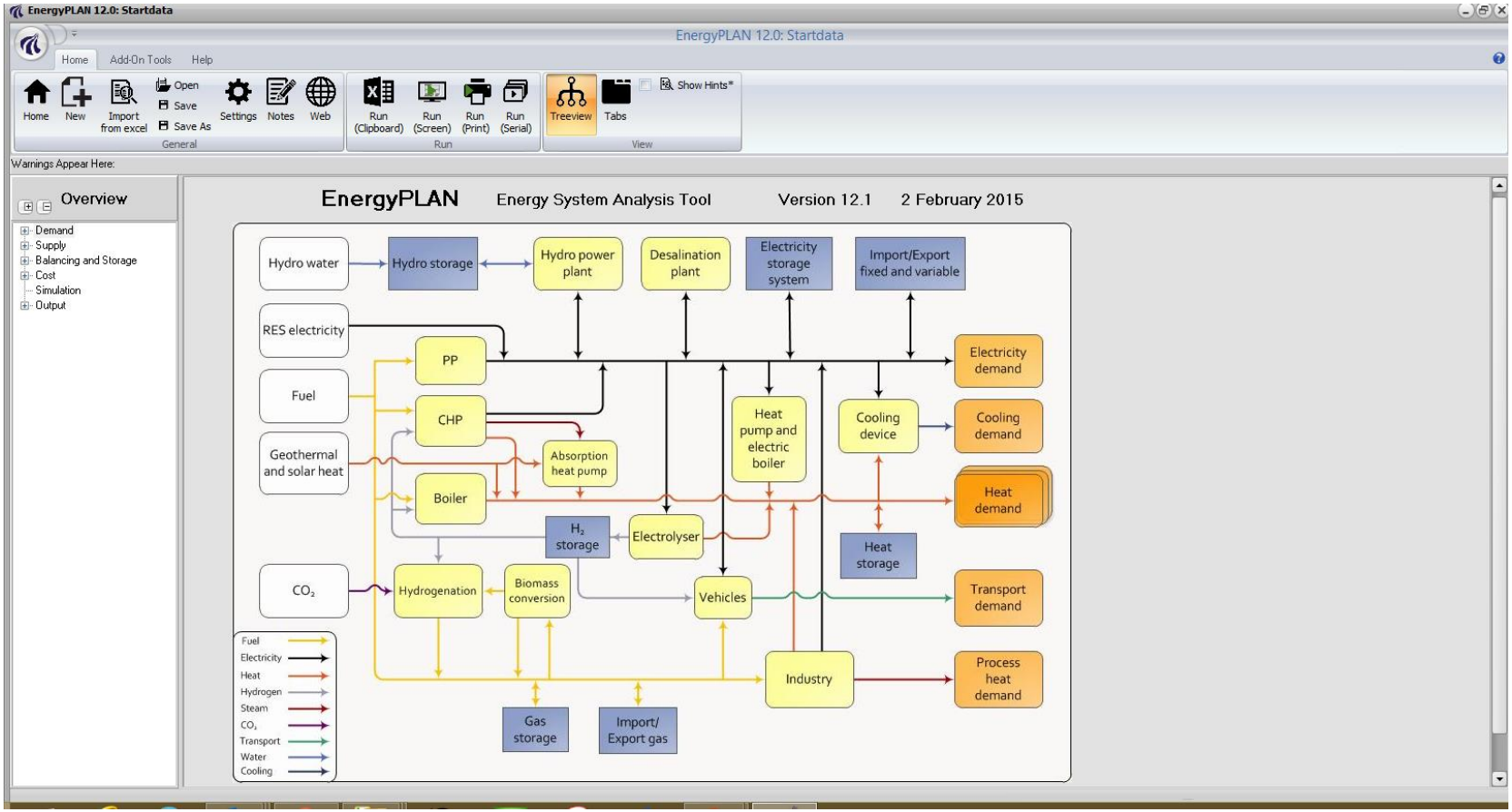
EnergyPLAN: Version 12 (www.EnergyPLAN.eu)

Hourly Modelling of Electricity, Heating, Cooling, Industry, and Transport



600 Registered Users since 1st Feb!
www.EnergyPLAN.eu: 2000 visitors/month

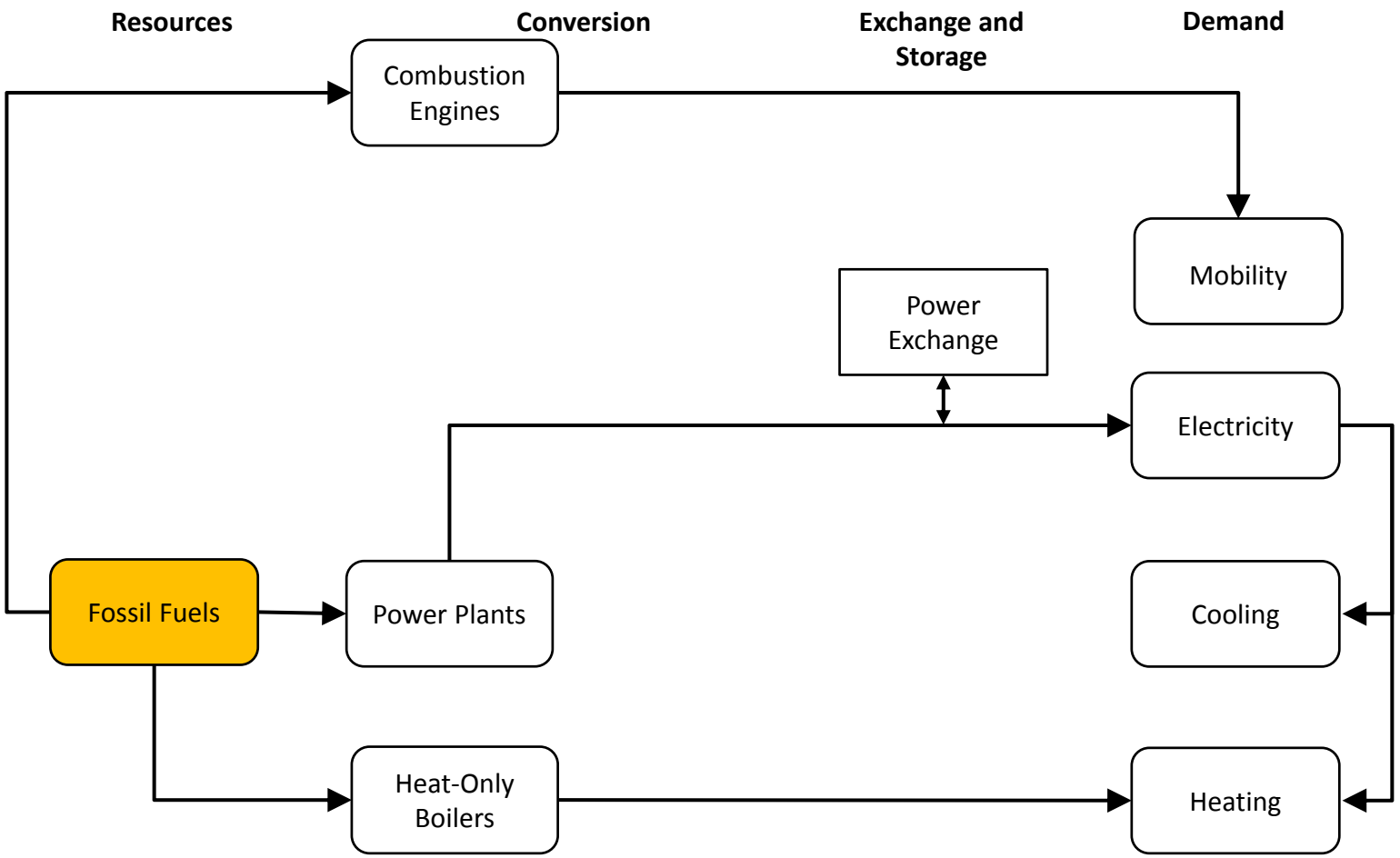
Switzerland

Members List

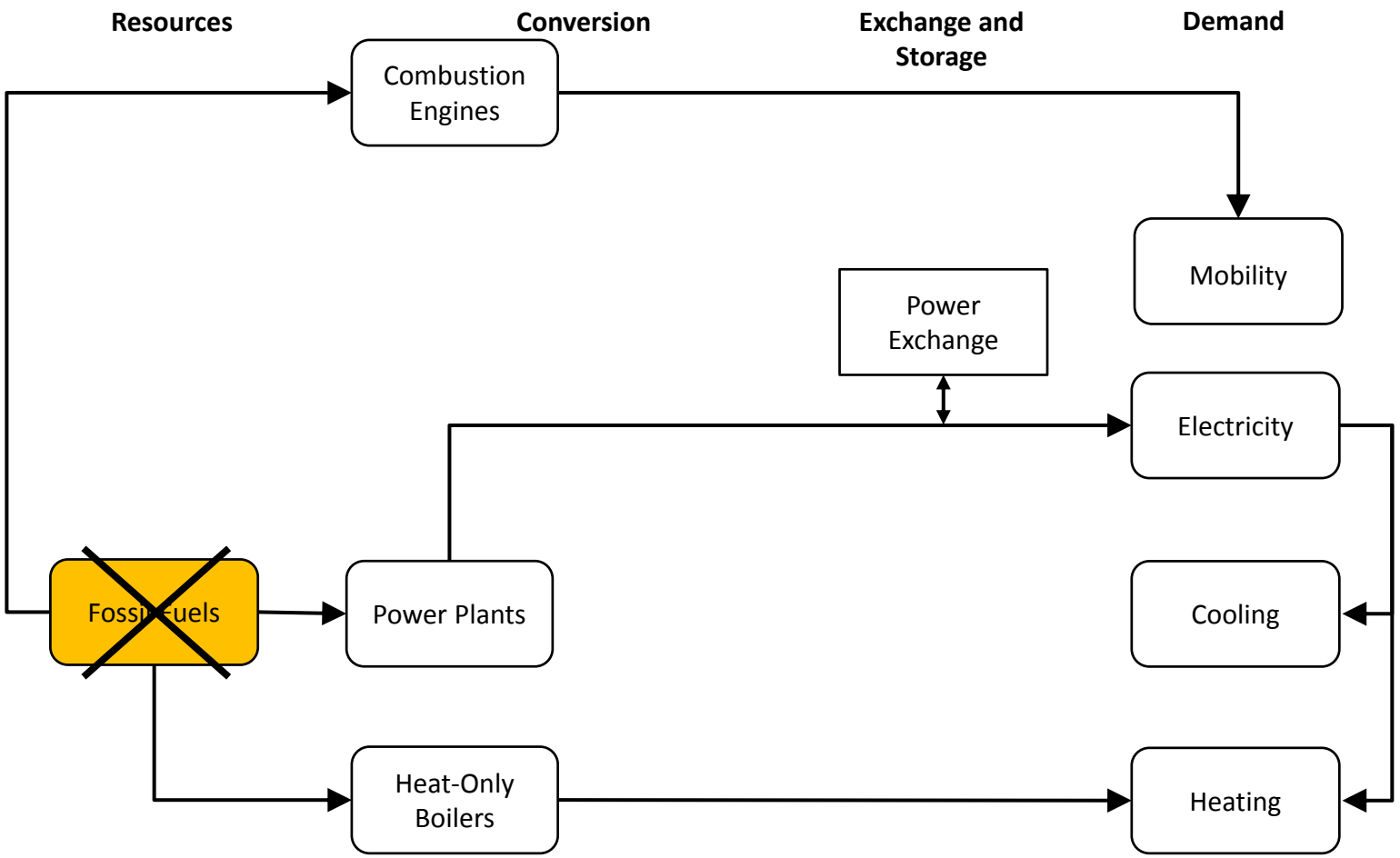
- Jimeno Fonseca
- Jerome Faessler
- Fanny Bondaz
- Loic Quiquerez

Department of Development and Planning, Aalborg University

What are we missing in the future?



Not Only Fuel, but also Energy Storage!



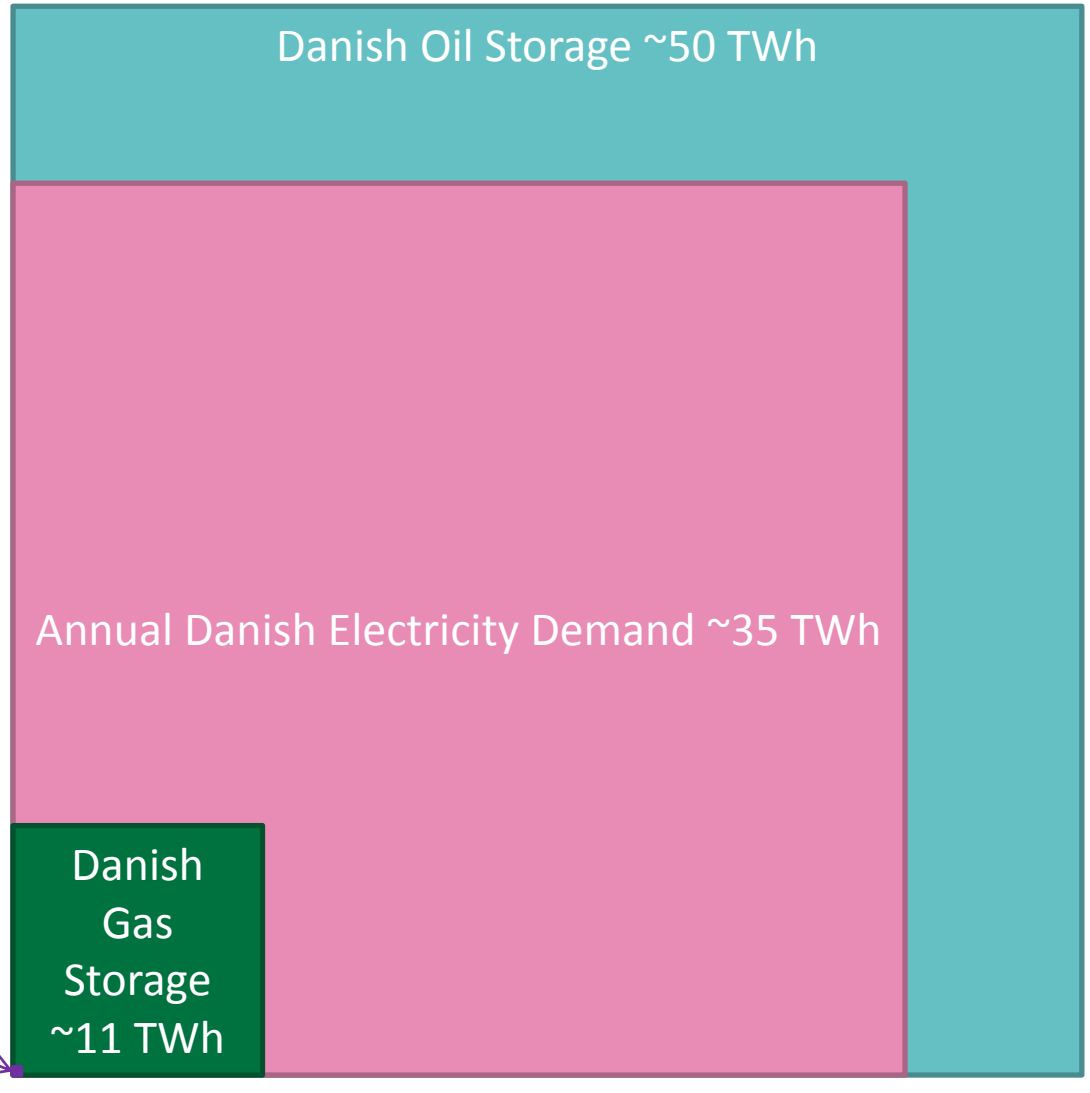
Scale of Energy Storage in Denmark

Electricity = €170/kWh

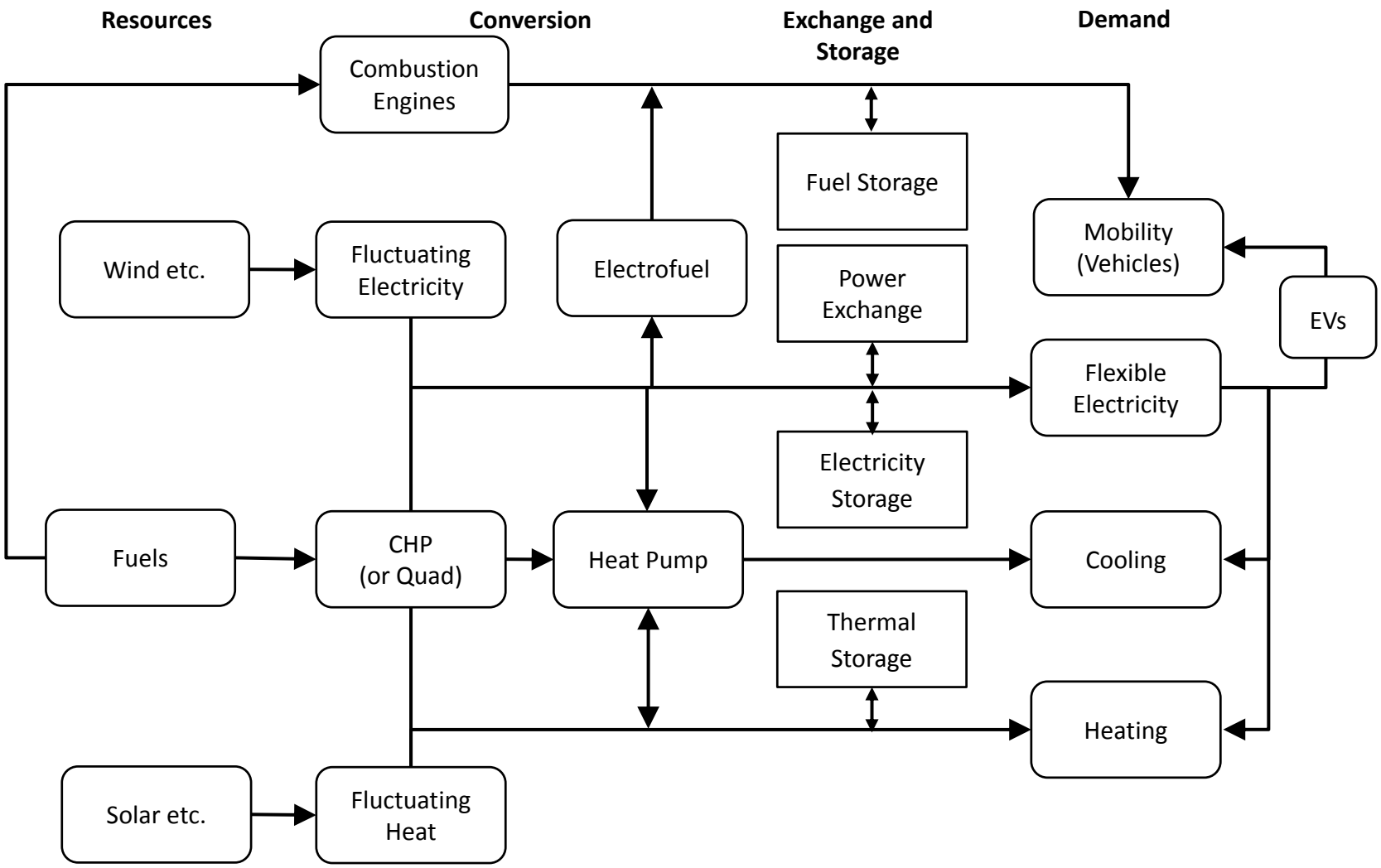
Thermal = €0.5-3/kWh

Gas = €0.05/kWh

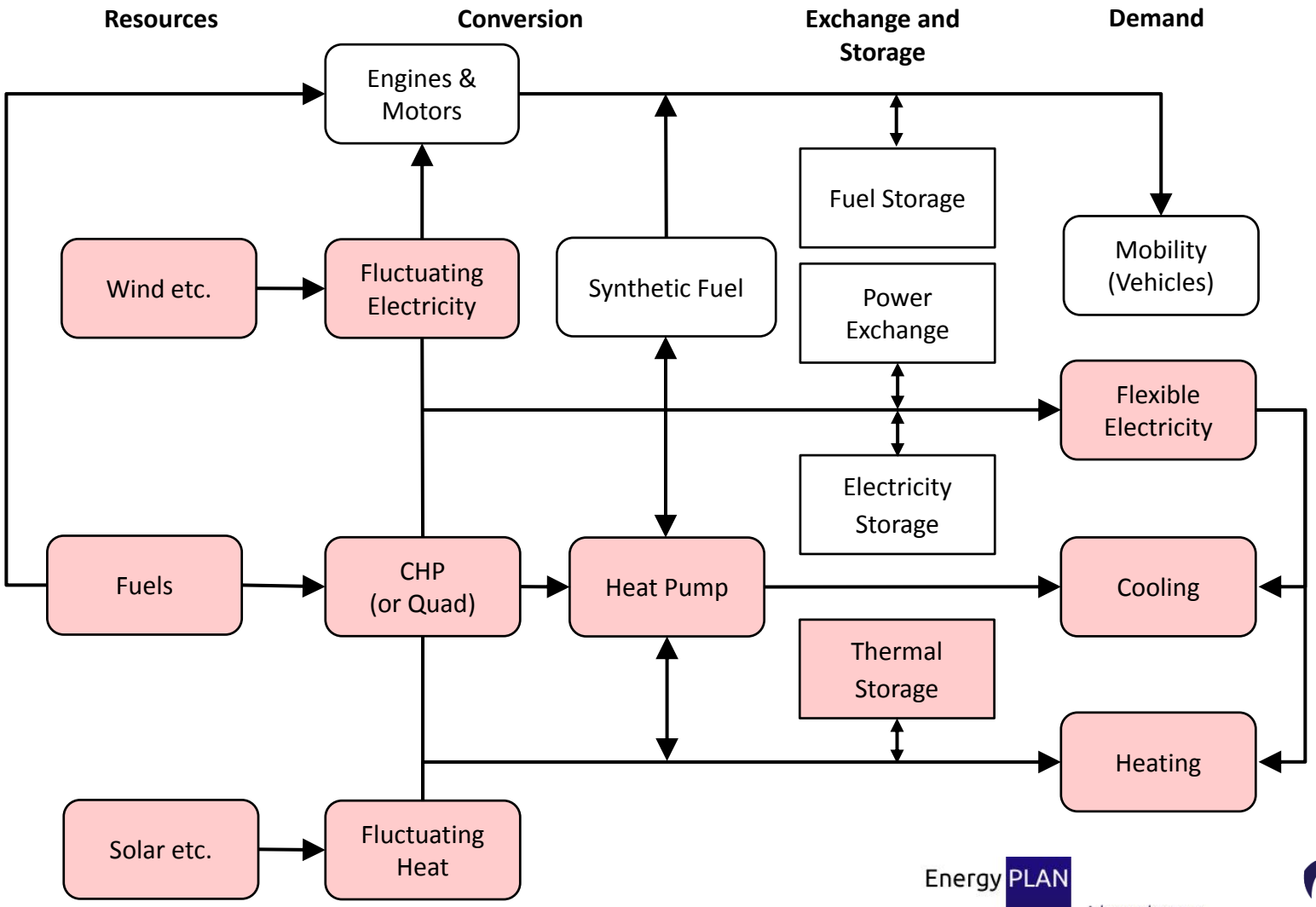
Oil = €0.02/kWh



Smart Energy System (80% Wind/Solar)



The New Heat Sector



Energy PLAN
Advanced energy system analysis computer model

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STUDY FOR THE EU27

by

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Daniel Trier

for

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Heat Roadmap Europe

- Two Reports & One Ongoing:
  - Study 1 (2012): is DHC beneficial in a business-as-usual scenario
  - Study 2 (2013): is DHC beneficial in a low-heat demand scenario (a complete heat strategy)
  - Study 3 (2014, IEE/13/650/SI2.675851): heating and cooling strategies for 5 member states

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ENHANCED HEATING & COOLING PLANS

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3 Options for the Heat Sector

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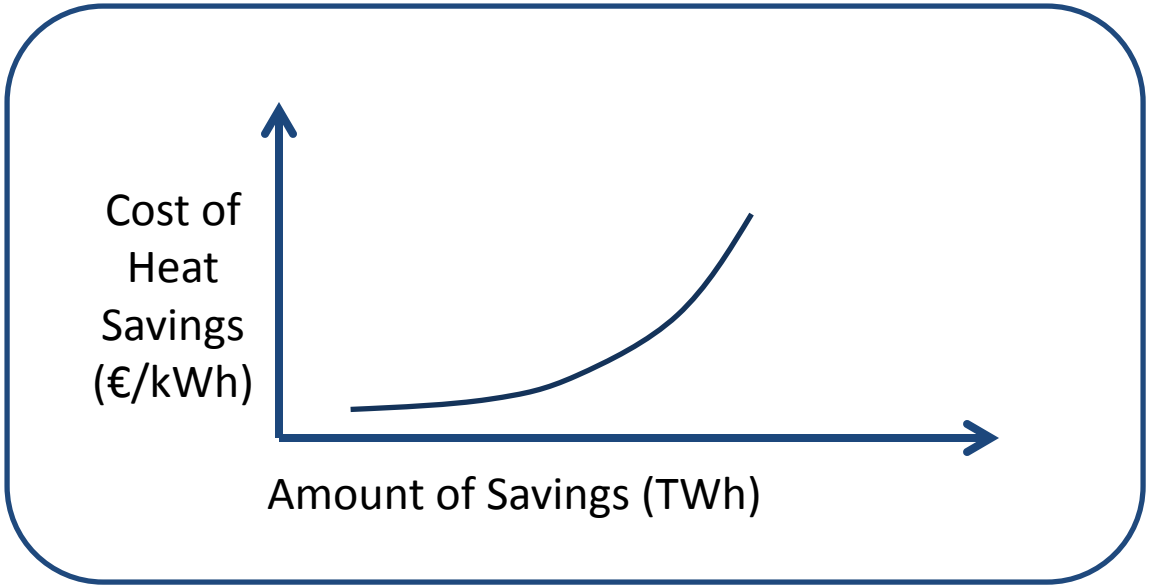
3 Options for the Heat Sector

1. Savings (Everywhere)

- Reduce our demand for heat:
  - Space heating
  - Hot water

How much Heat should we Save?

- We should implement heat savings until the price of sustainable supply is less than the marginal price of additional savings



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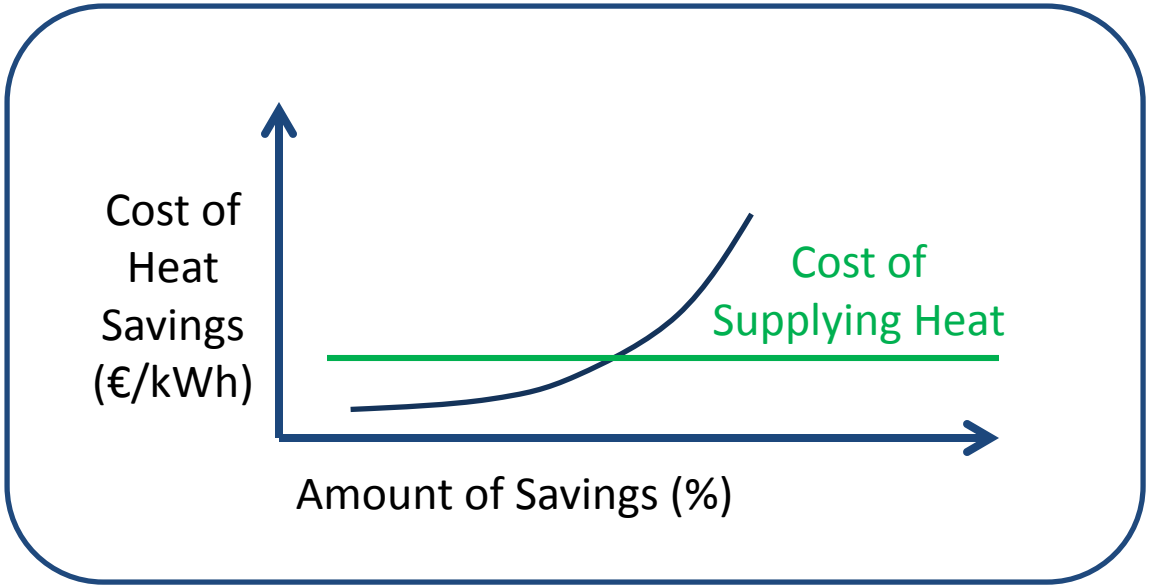

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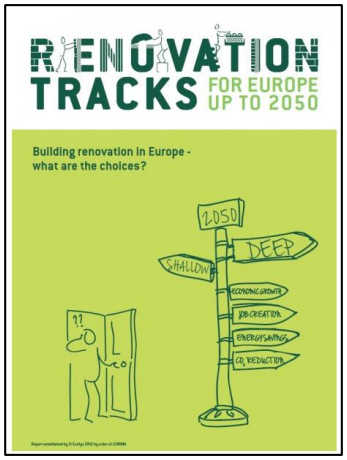

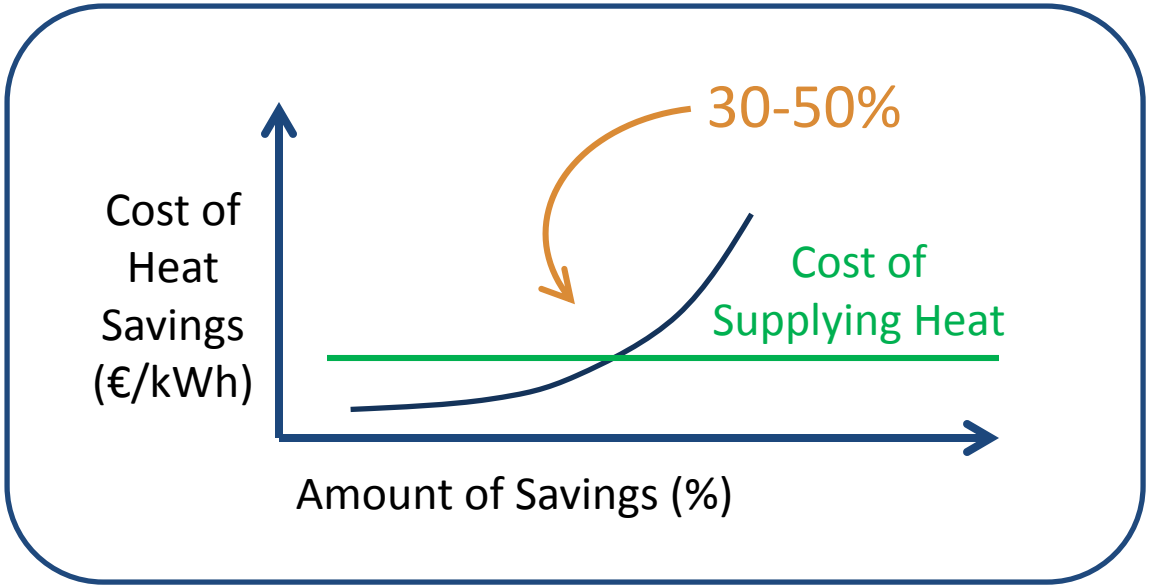

Heat Roadmap Europe 2050

3 Options for the Heat Sector

1. Savings (Everywhere)

- Reduce our demand for heat:
  - Space heating
  - Hot water

2. Individual Units (Everywhere)

- Use a heating unit in each building:
  - Boilers:
    - Oil
    - Biomass
  - Heat Pumps
  - Electric Heating

2. Individual Heating Options

Heating Unit	Sustainable Resources	Efficient	Cost	Cost Sensitivity
Electric Heating	☺	☹	😐	☹
Heat Pumps	☺	☺	😐	😐
Oil Boilers	☹	😐	☹	☹
Biomass Boilers	☹	☹	☺	☹

Heat Roadmap Europe 2050

3 Options for the Heat Sector

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  - Electric Heating

3. Networks (Urban Areas)

- Share a heating network:
  - Gas Grid
  - Water (i.e. district heating)

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2050

3 options for the Heat Sector

1. Savings

- Reduce our demand for heat:
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3. Networks

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30-50%	~50%	~50%
Marginal	Heat Pumps	District Heating

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OR
FACT
MYTH?

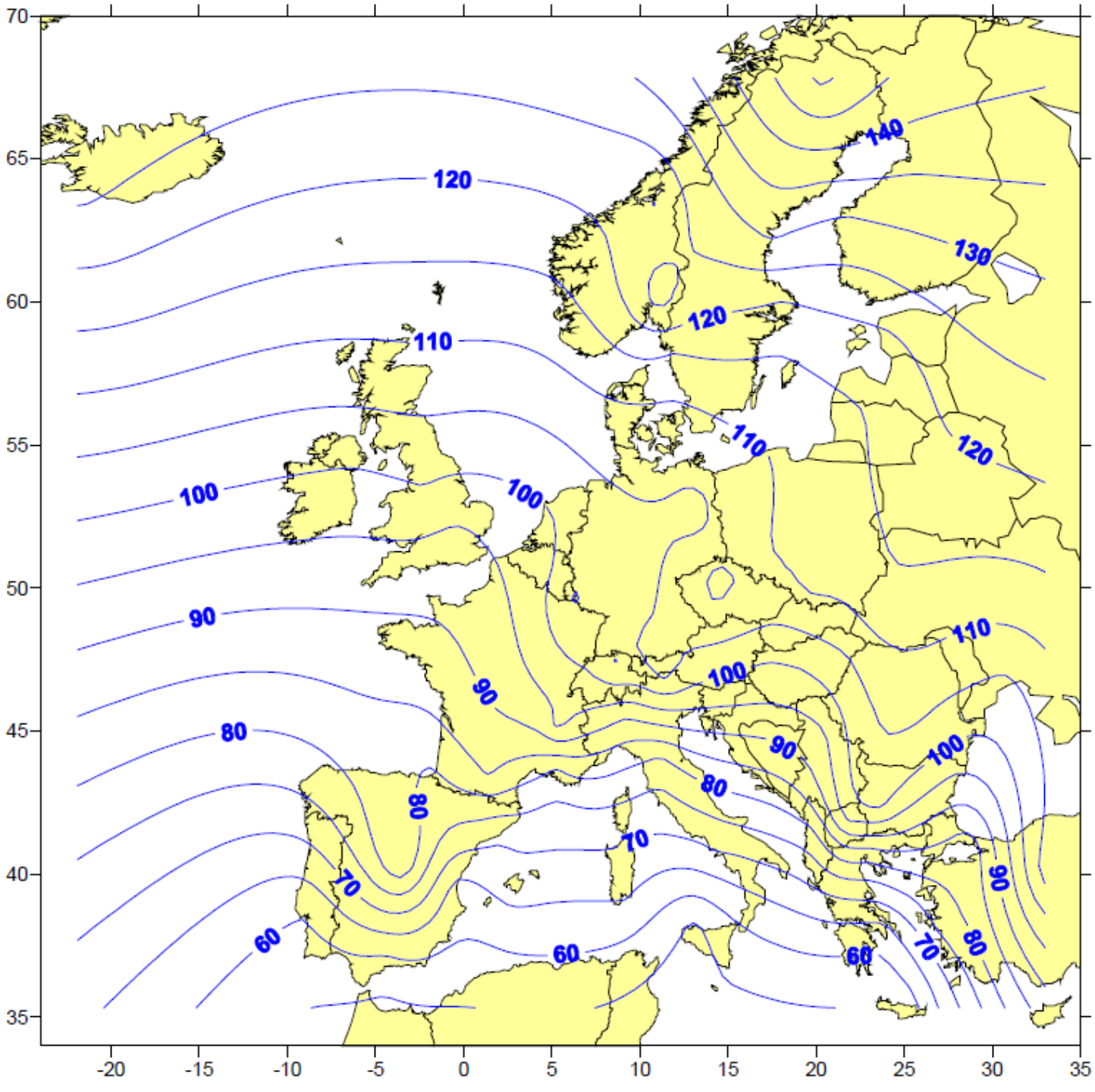
1. District Heating is only for Cold Parts of Europe

2. District Heating is a Local Solution for a Local Problem

3. District Heating is Expensive

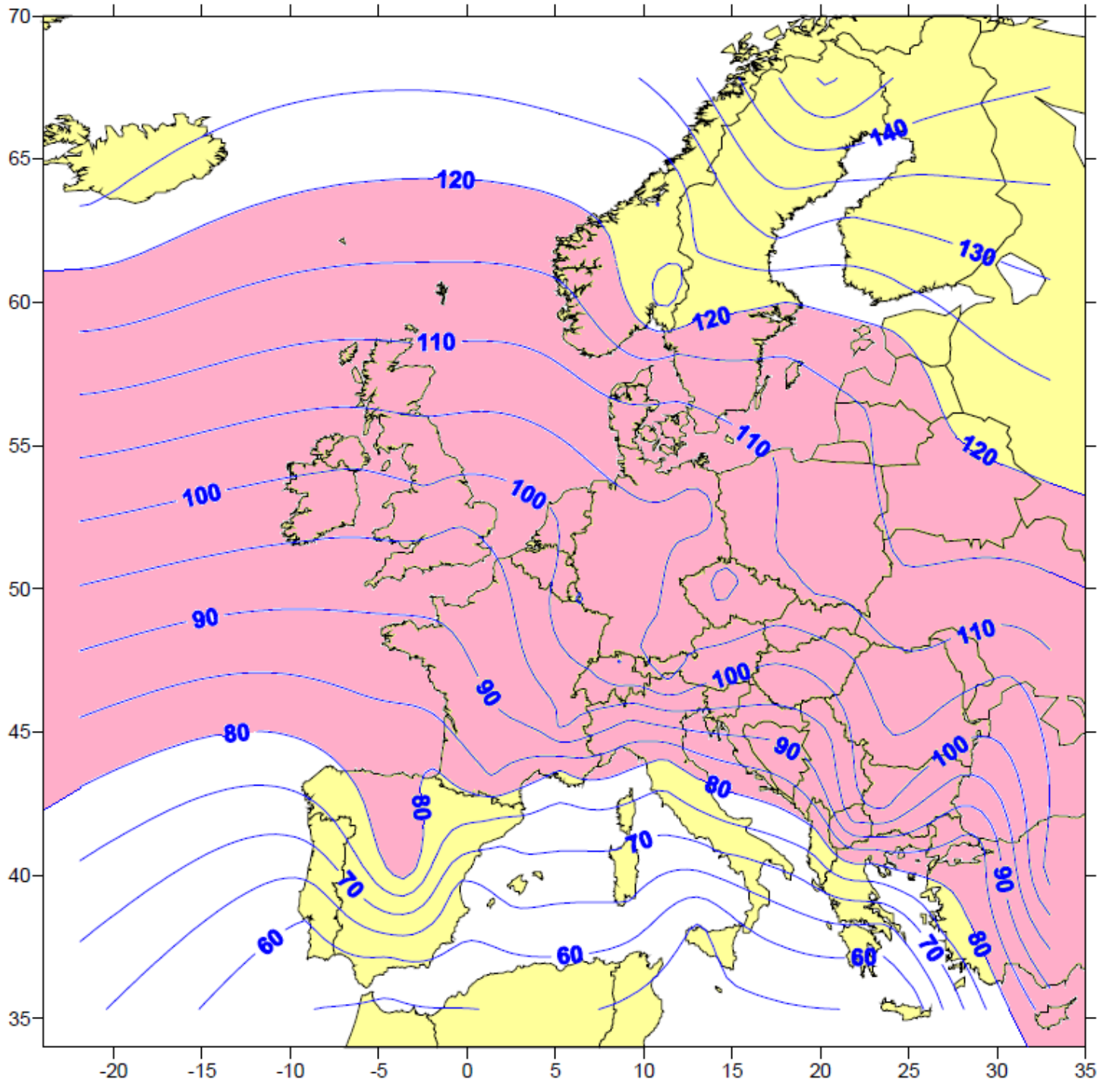
… and How can I investigate these for my country?

1. District Heating is for only for Cold Parts of Europe



European Heating Index

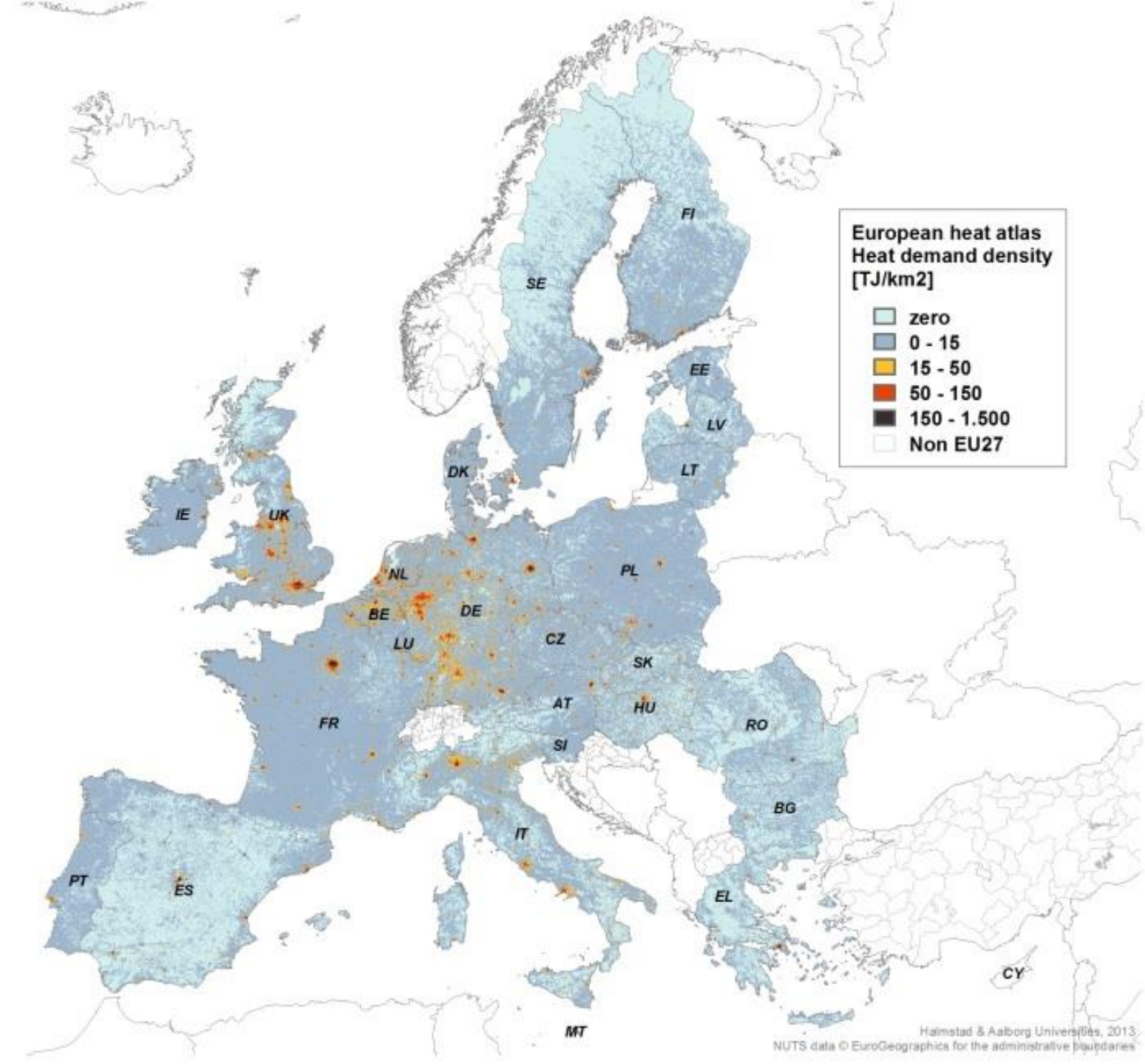
(Source: ecoheatcool)



European Heating Index

(Source: ecoheatcool)

+/- 20%



EU Heat Atlas

30-50% of Heat Currently Feasible for DH

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EU Cooling Atlas

Spring 2015

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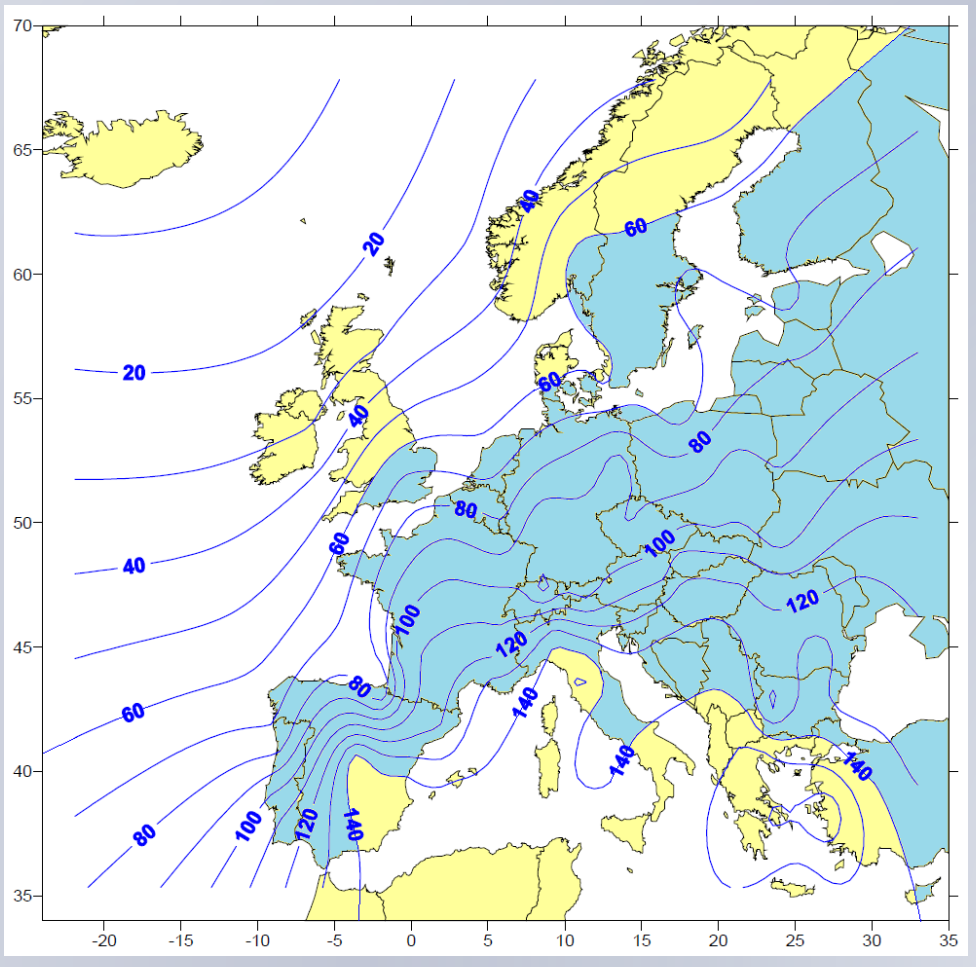
EU Cooling Demand



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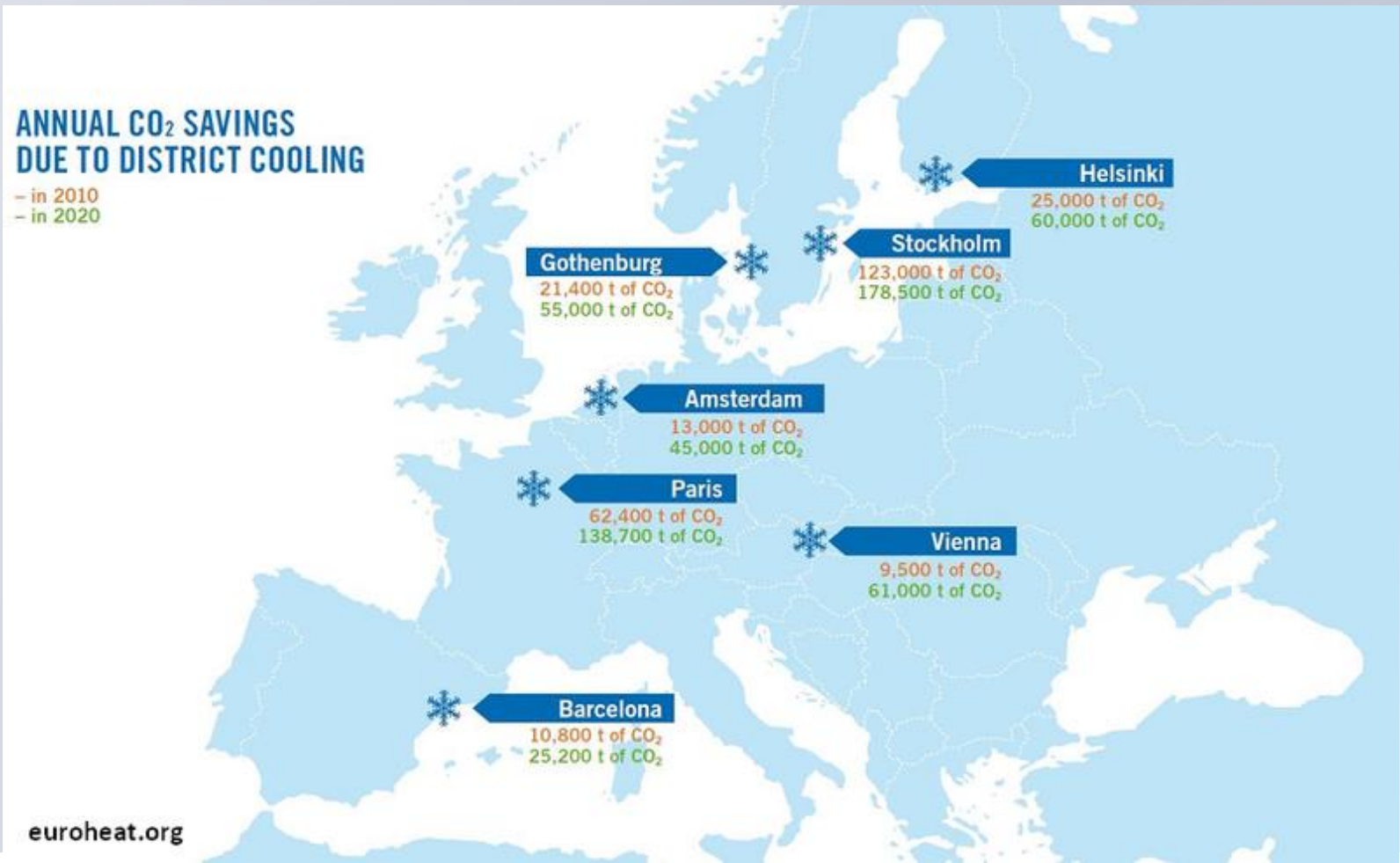
District Cooling in Europe



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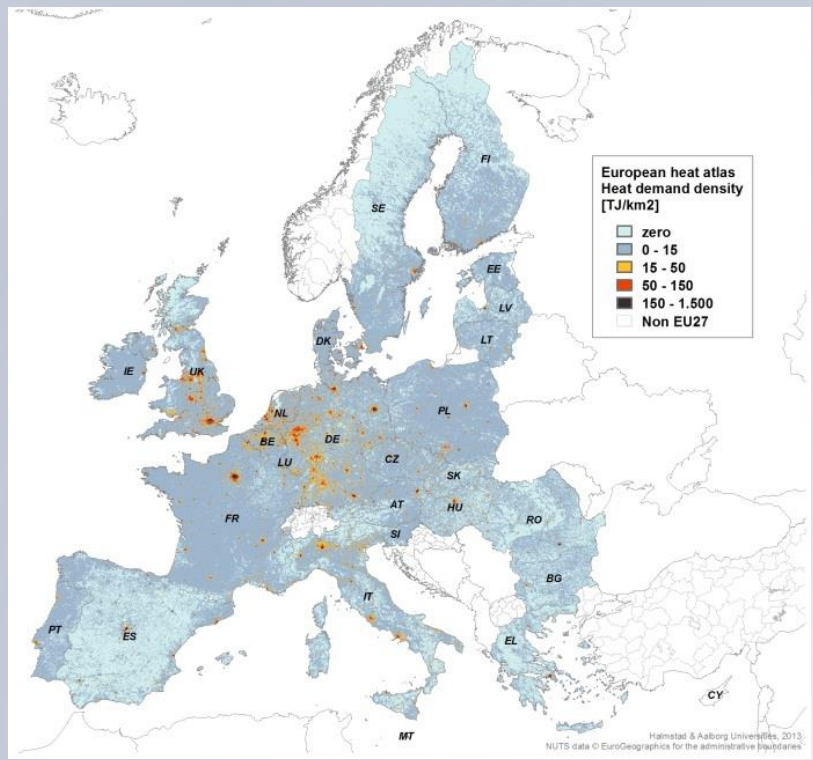
Applying this Methodology at MS Level

Mapping

- Data can be extracted at MS level
  - Heat Demands
  - Cooling Demands (after STRATEGO)
  - Renewable Heat Potentials
- Some potentials already extracted in HRE:
  - Heat Demand
  - Power plant surplus heat
  - Industrial surplus heat
  - Waste incineration
- STRATEGO:
  - Static data already provided online: www.heatroadmap.eu
  - Interactive maps being developed. Delivery date: Spring 2015

Heat Demand at MS Level



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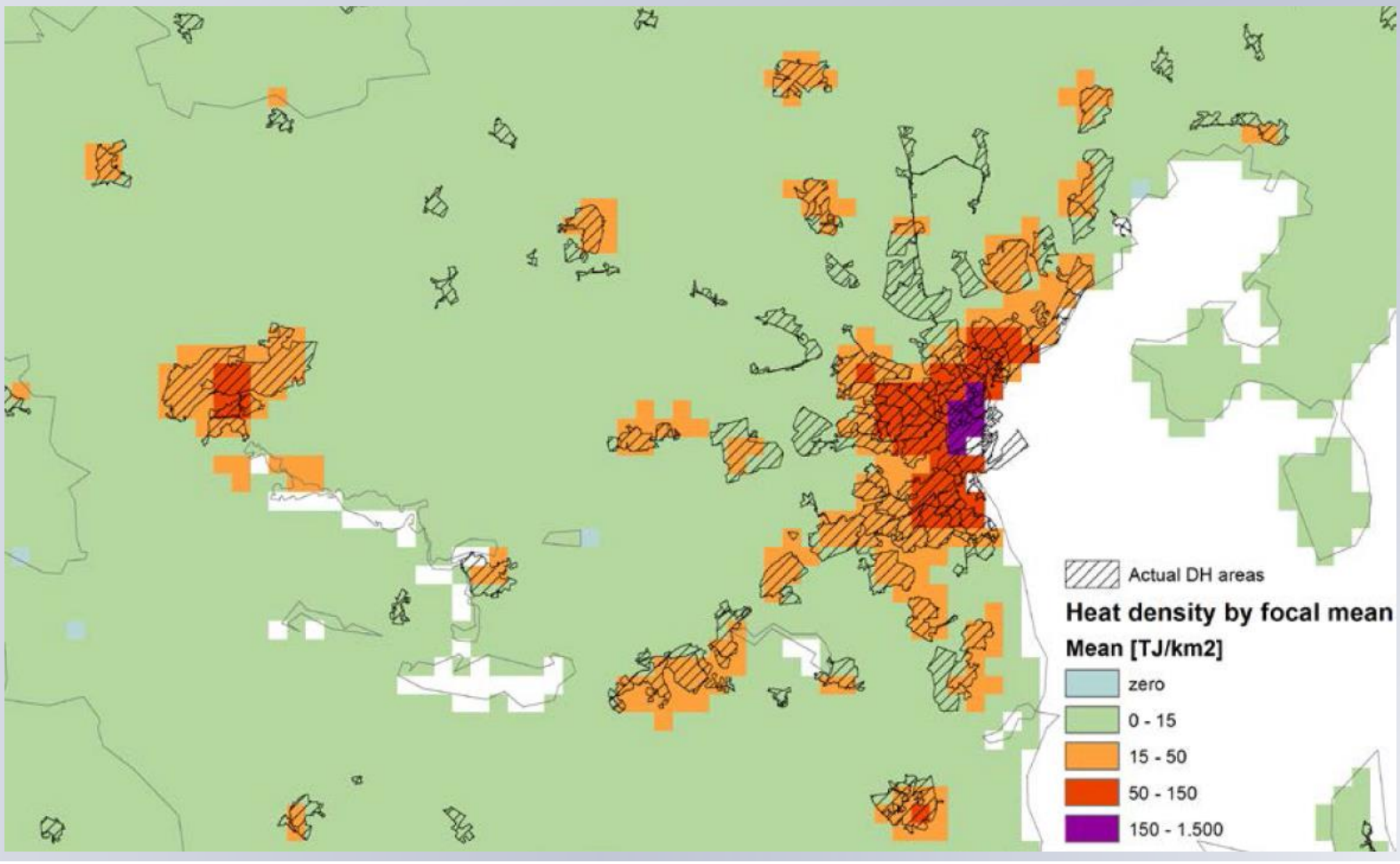
HRE Heat Atlas at a Local Level



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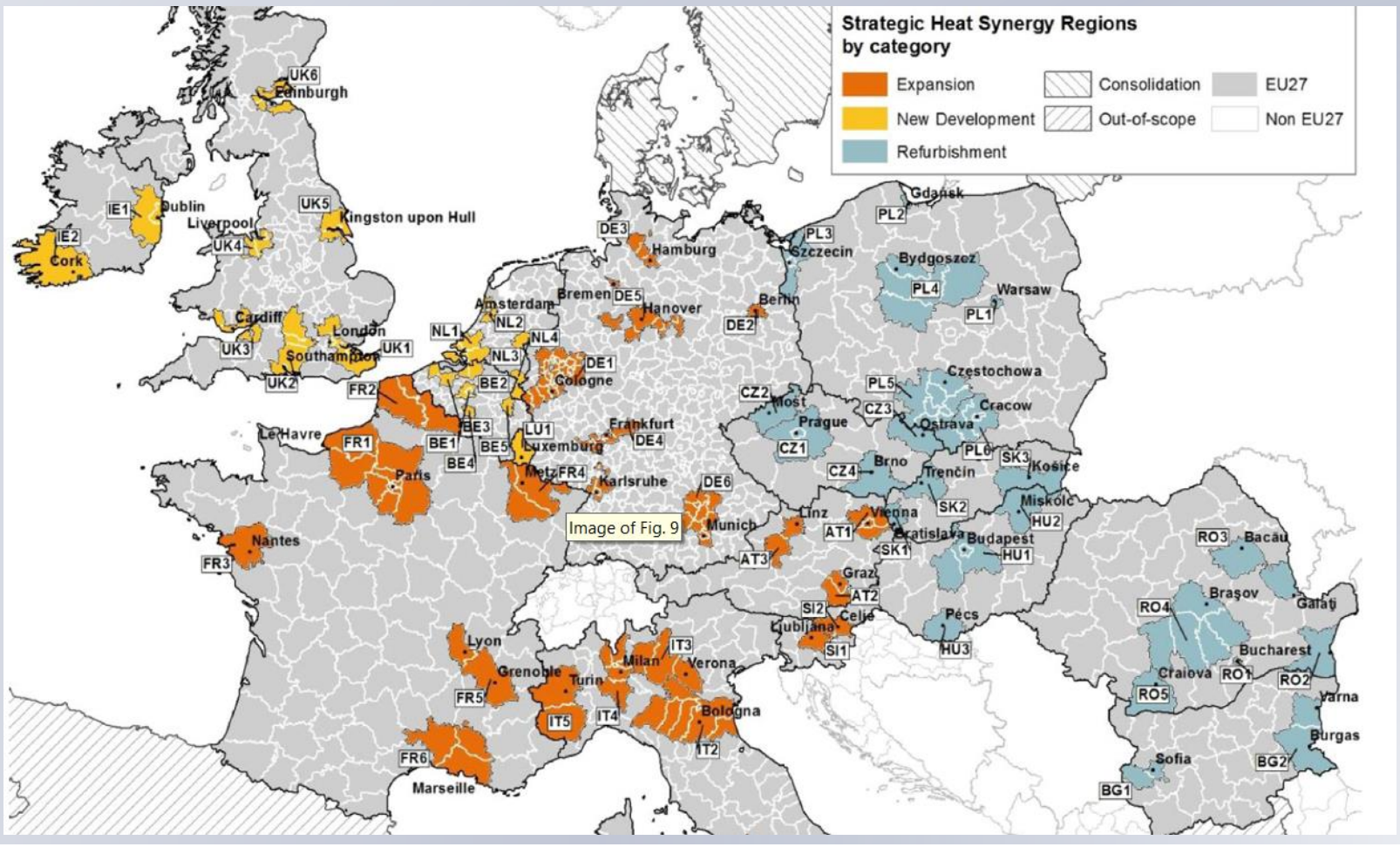
HRE Mapping:
Best Places to Start District Heating in the EU



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Surplus Heat in Different MS

Table 7
NUTS3 regions (N3R) in EU27 Member States (MS), all in study (left), all with excess heat ratio (right) by population (P), heat demand (HD), primary energy supply (PES), and excess heat (EH). Excess heat specified by sectors: Thermal power (TP), Waste-to-Energy (WTE), and Industrial (Ind). Energy volumes in PJ/a. Population in millions.

MS	EU27			EU27 with excess heat ratio value > 0							
	N3R	P	HD	N3R	P	HD	PES	EH	*TP*	*WTE*	*Ind*
AT	35	8.4	261	20	6.4	200	456	167	*63*	*21*	*84*
BE	44	10.8	353	32	9.5	311	805	313	*157*	*17*	*138*
BG	28	7.6	71	18	5.7	54	382	180	*161*	*0*	*19*
LT	10	3.3	66	4	2.0	41	100	42	*21*	*0*	*21*
LU	1	0.5	22	1	0.5	22	35	13	*8*	*1*	*4*
LV	6	2.2	64	2	1.0	28	13	4	*2*	*0*	*2*
MT	2	0.4	2	1	0.4	2	25	13	*13*	*0*	*0*
NL	40	16.6	549	27	13.1	433	1348	583	*366*	*46*	*171*
PL	66	38.2	835	56	33.1	724	2171	975	*809*	*0*	*165*
PT	28	10.1	92	16	8.1	72	373	147	*76*	*10*	*61*
RO	42	21.5	294	28	16.0	217	613	252	*177*	*0*	*75*
SE	21	9.3	302	21	9.3	302	594	217	*82*	*30*	*106*
SI	12	2.0	46	6	1.3	30	81	37	*34*	*0*	*3*
SK	8	5.4	120	7	4.9	108	258	90	*41*	*1*	*48*
UK	139	61.9	1450	82	40.3	944	3229	1477	*1140*	*40*	*297*
Total	**1281**	**496.6**	**11,724**	**834**	**402.4**	**9453**	**26,123**	**11,274**	*7842*	*508*	*2924*
Share (%)	**100**	**100**	**100**	**65**	**81**	**81**	**100**	**100**	*70*	*4*	*26*

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NUTS3 regions (N3R) in EU27 Member States (MS), all in study (left), all with excess heat ratio (right) by population (P), heat demand (HD), primary energy supply (PES), and excess heat (EH). Excess heat specified by sectors: Thermal power (TP), Waste-to-Energy (WTE), and Industrial (Ind). Energy volumes in PJ/a. Population in millions.

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AT	35	8.4	261	20	6.4	200	456	167	*63*	*21*	*84*

Please cite this article as: Persson, U., et al., Heat Roadmap Europe: Identifying strategic heat synergy regions. Energy Policy (2014), http://dx.doi.org/10.1016/j.enpol.2014.07.015

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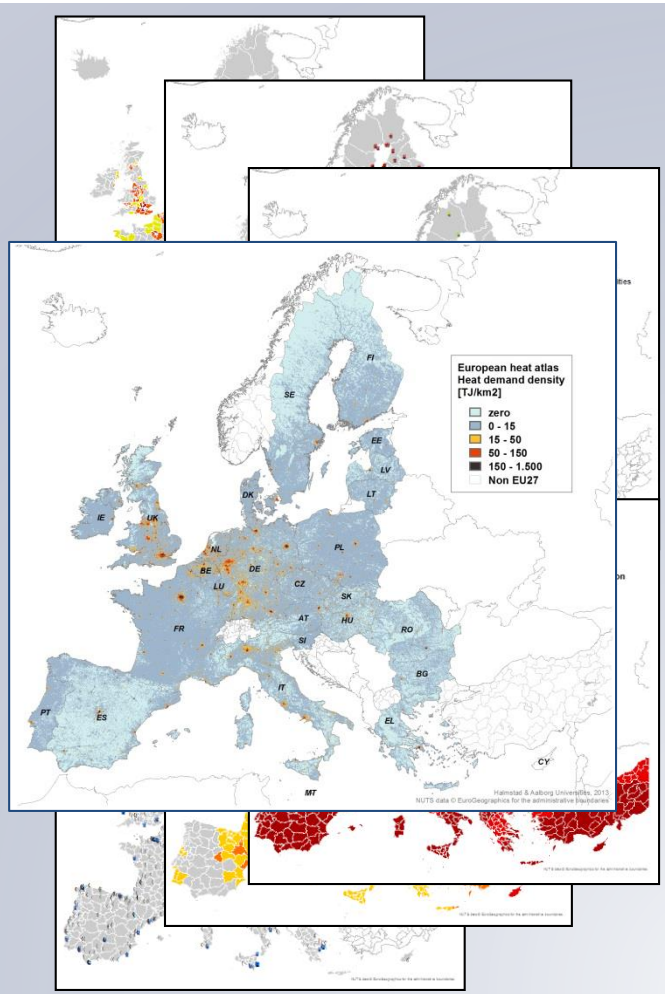
Heat Roadmap Europe 2050

GIS Mapping: Many Heat Sources

- Heating and Cooling Demands
- Power and Heat Generation
- Waste Incineration
- Industrial waste heat potential
- Geothermal heat
- Solar Thermal
- Bioenergy Potential



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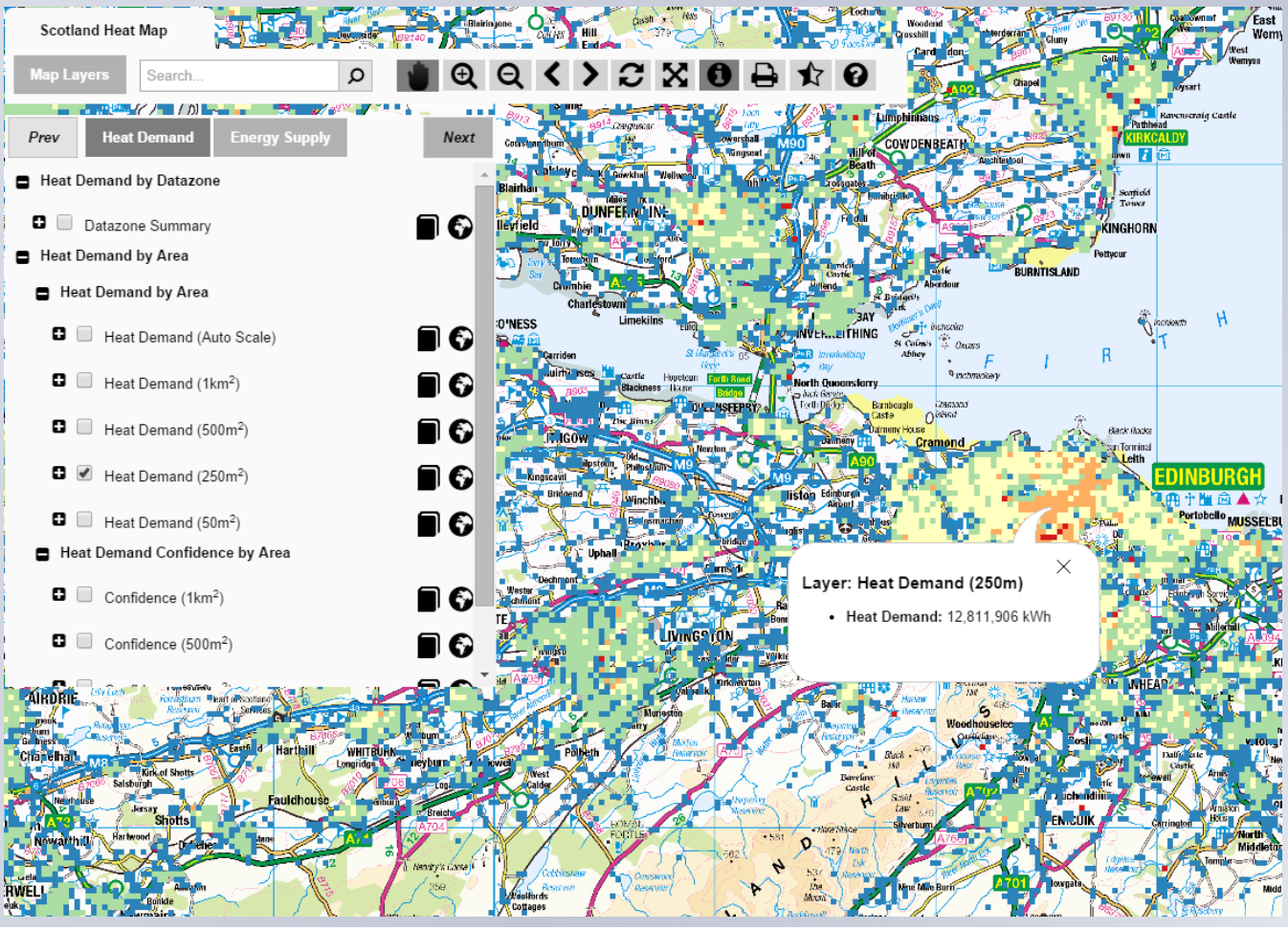
Interactive Online Maps



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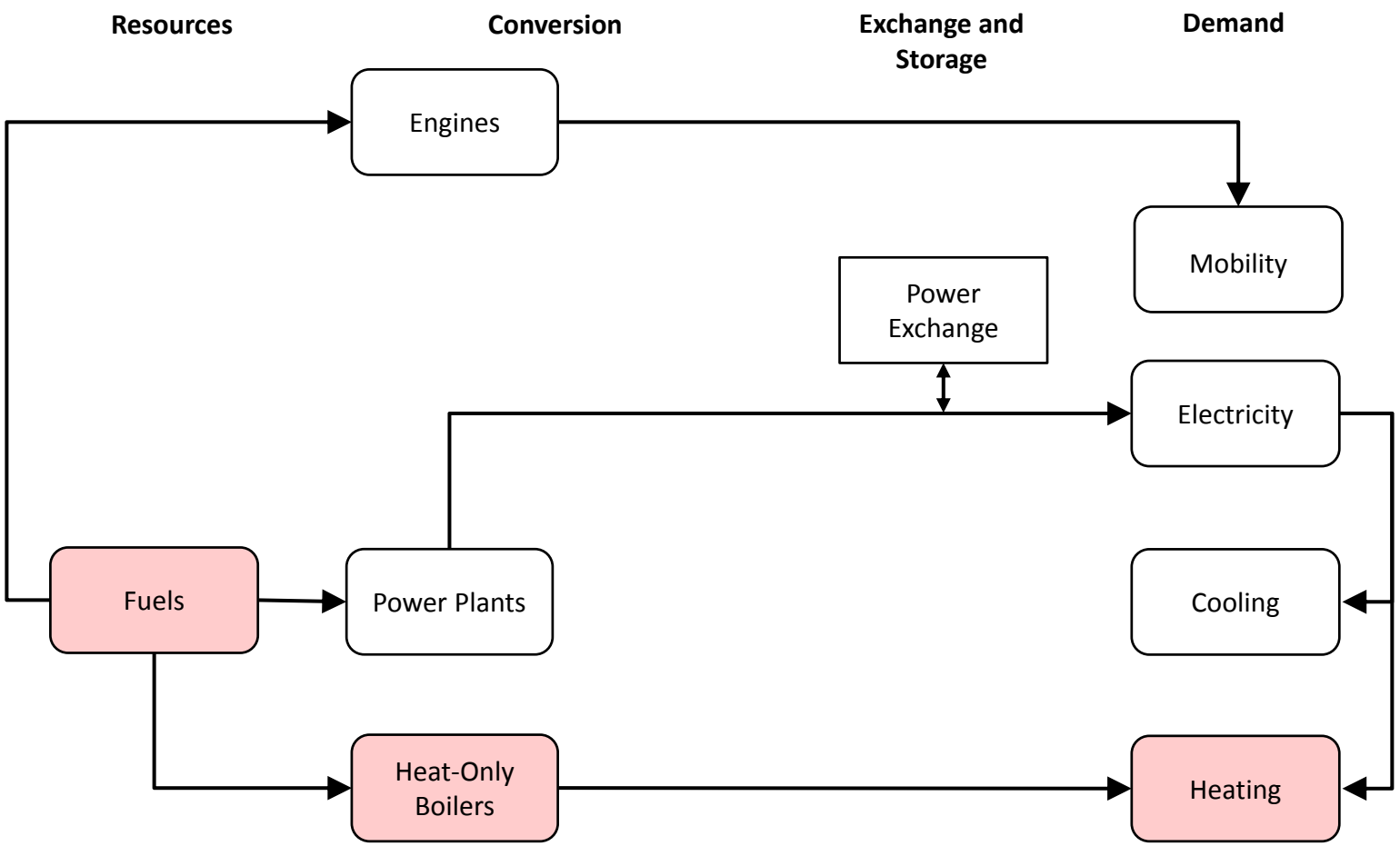
2. District Heating is a Local Solution for a Local Problem

Today's Heat Sector



Energy PLAN
Advanced energy system analysis computer model

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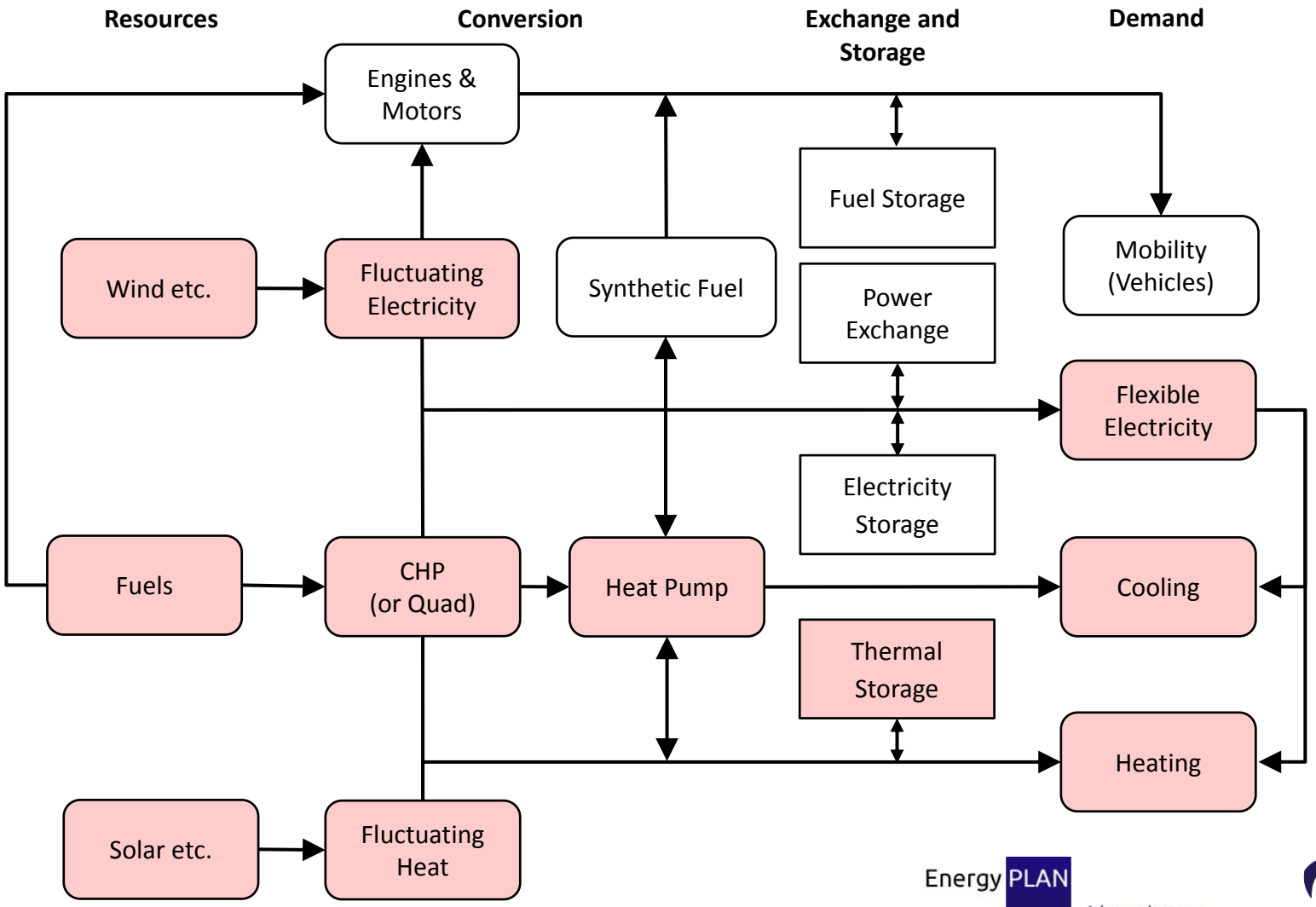
The New Heat Sector



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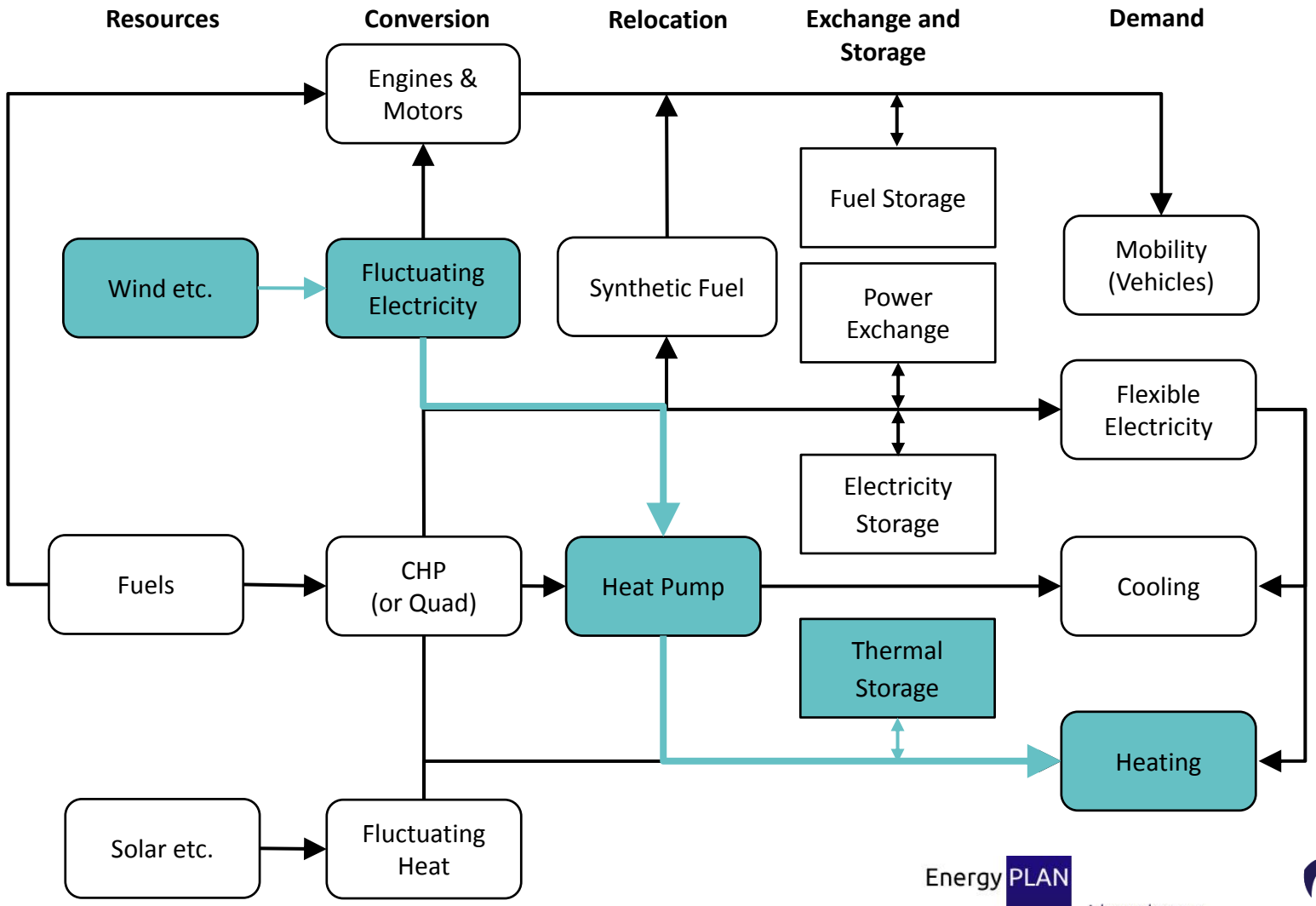
Integrating 40% Wind Power with District Heating



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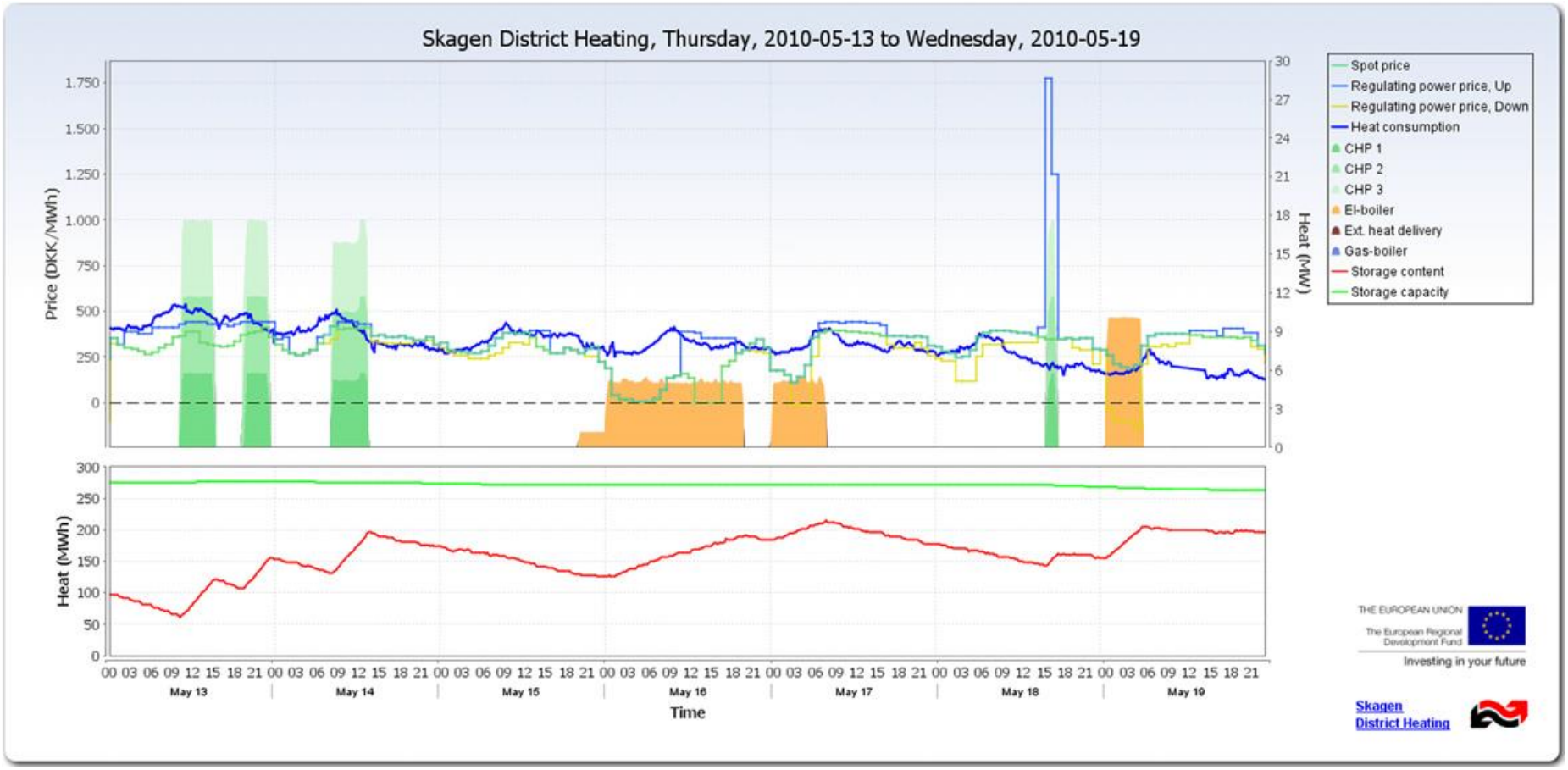
Denmark
50% Wind for December 2013



Heat Roadmap Europe 2050

(Marstal: >50% solar in heat supply)

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Storage Costs

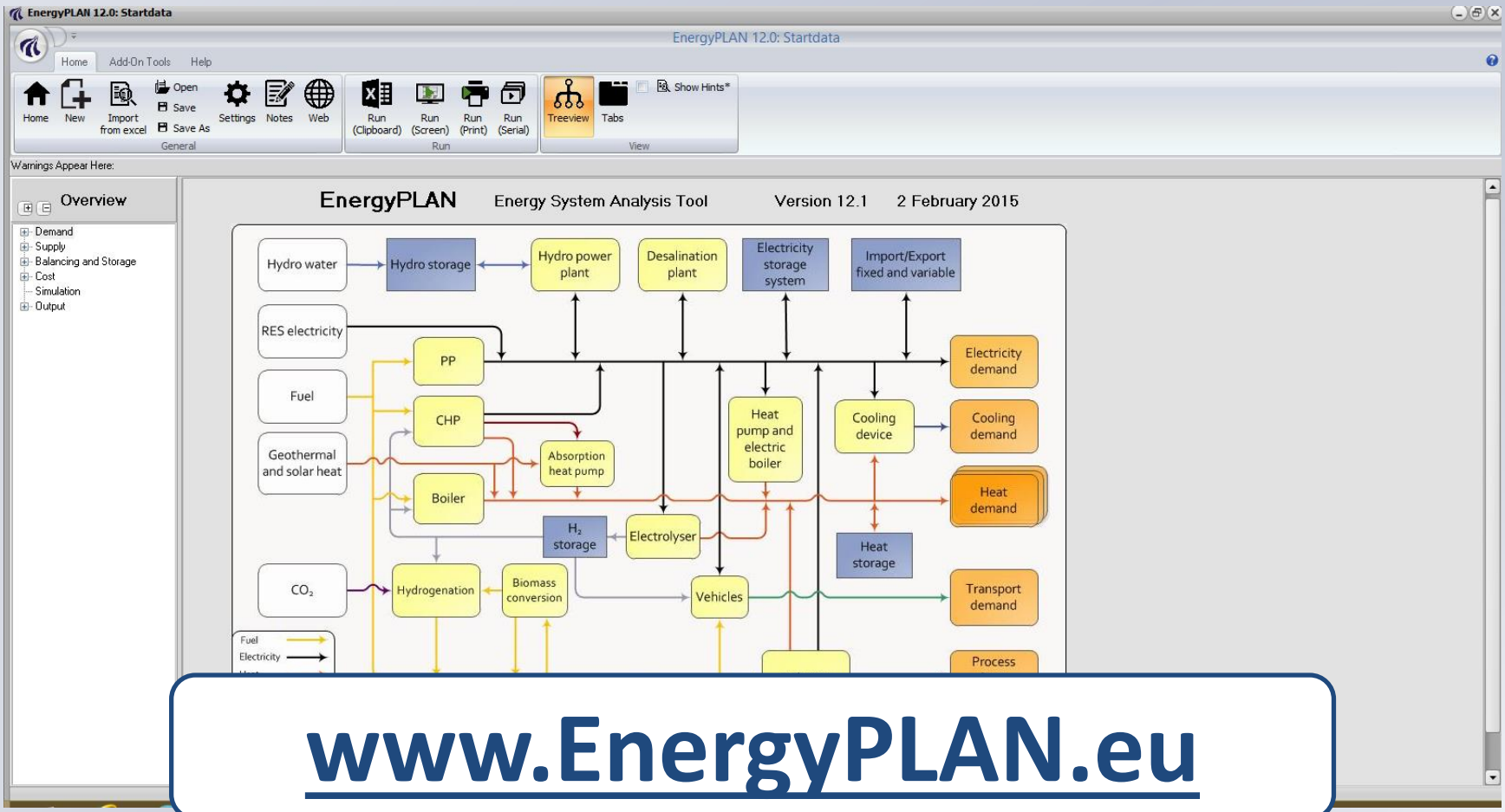
- Electricity = €170/kWh

- Thermal = €0.5-3/kWh

Heat Roadmap Europe 2050

EnergyPLAN

Hourly Model of the Complete Energy System



www.EnergyPLAN.eu

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3. District Heating is Expensive

Heat Roadmap Europe
2050

3 options for the Heat Sector

1. Savings

- Reduce our demand for heat:
  - Space heating
  - Hot water

2. Individual Units

- Use a heating unit in each building:
  - Oil
  - Biomass
  - Heat Pumps
  - Electric Heating

3. Networks

- Share a heating network:
  - Gas Grid
  - Water (i.e. district heating)

30-50%	~50%	~50%
Marginal	Heat Pumps	District Heating

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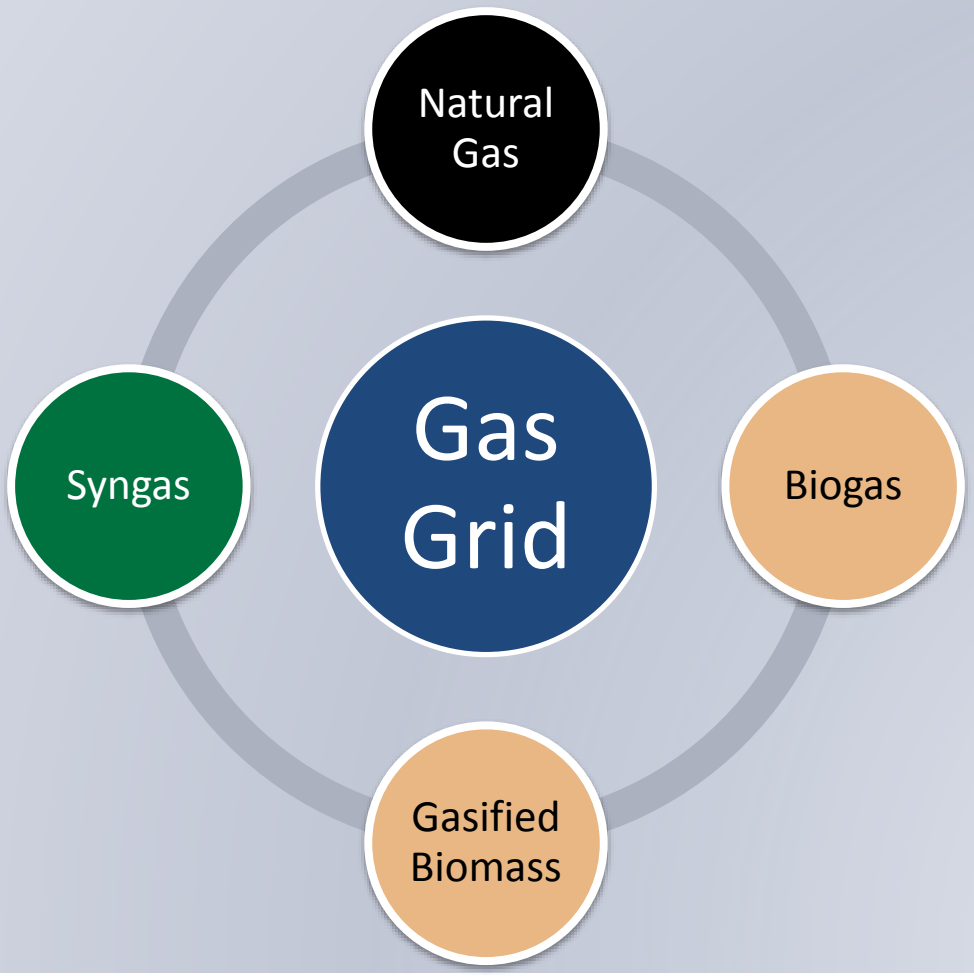
Gas Grid

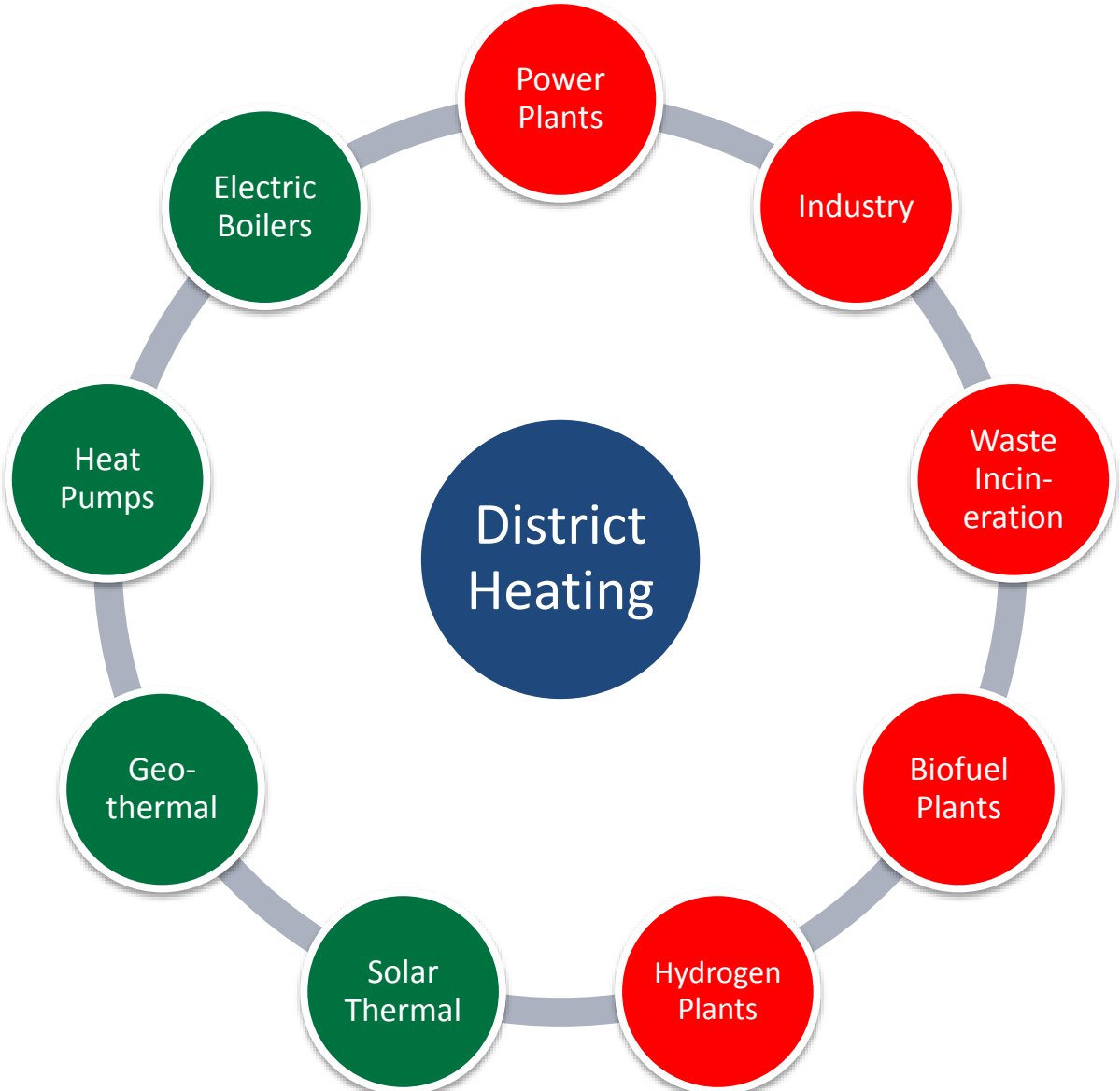
High quality energy for a low quality demand



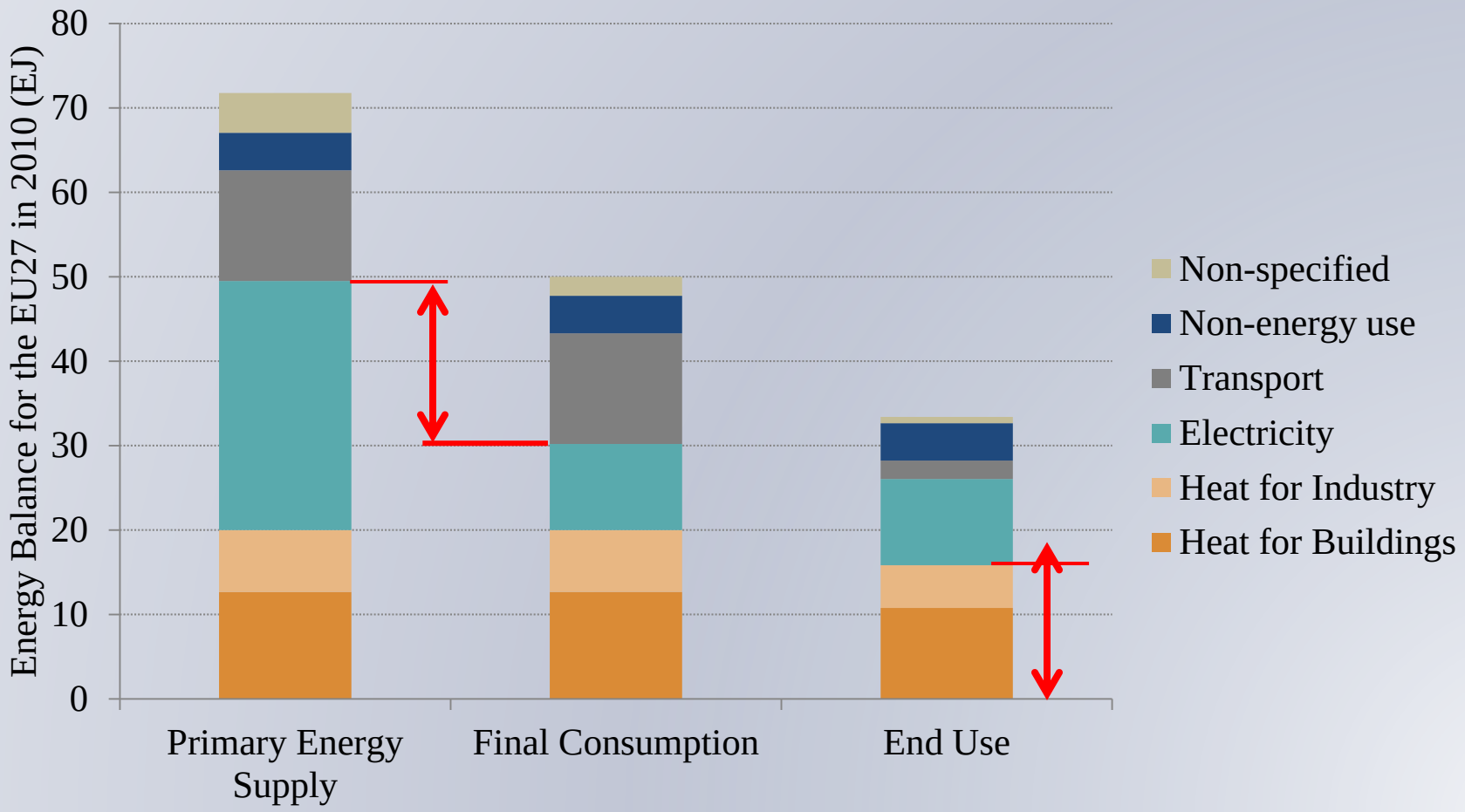
Heat Roadmap Europe 2050

District Heating

Low quality energy for a low quality demand

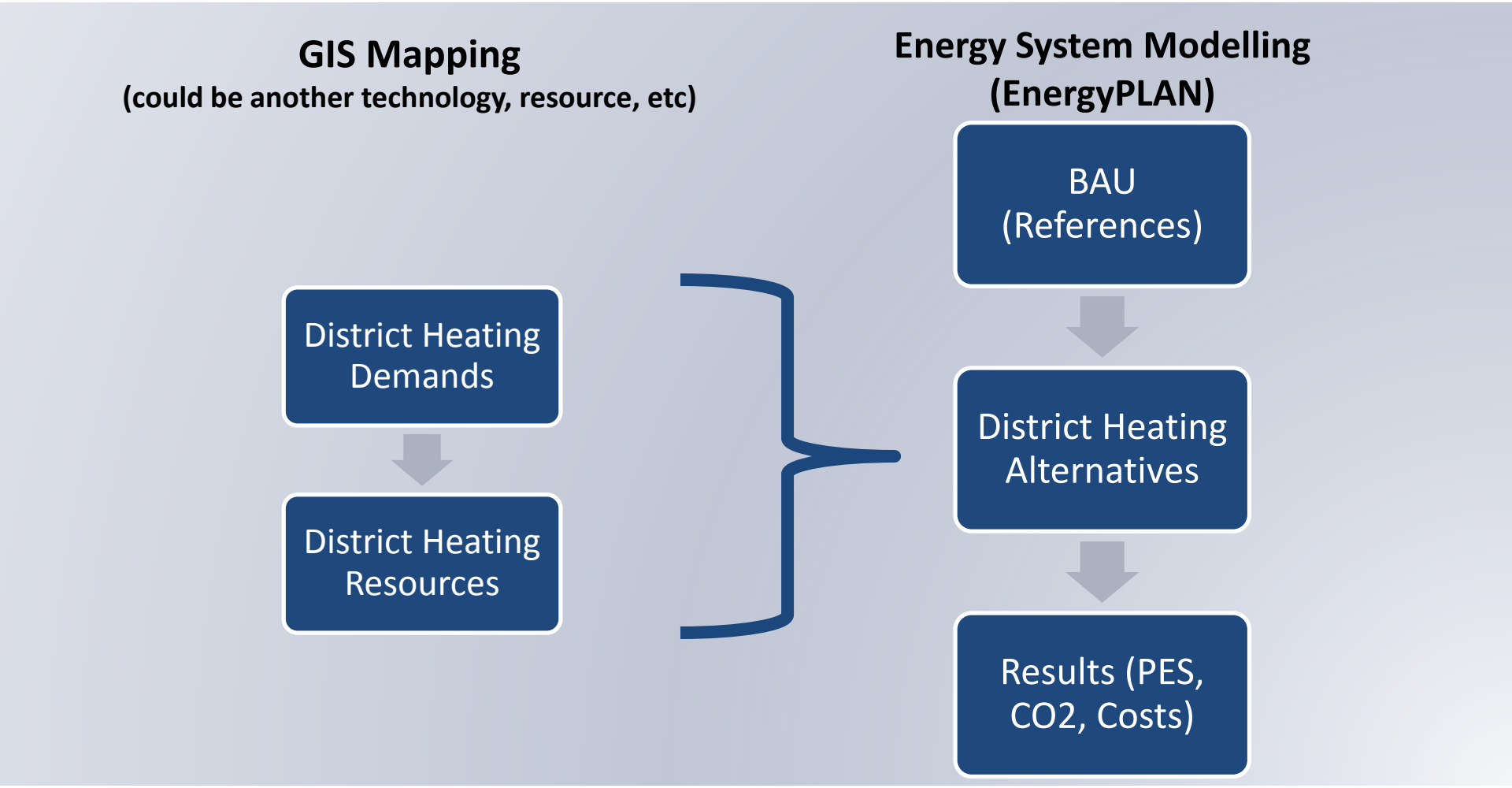


The Current Situation



Heat Roadmap Europe 2050

HRE Methodology



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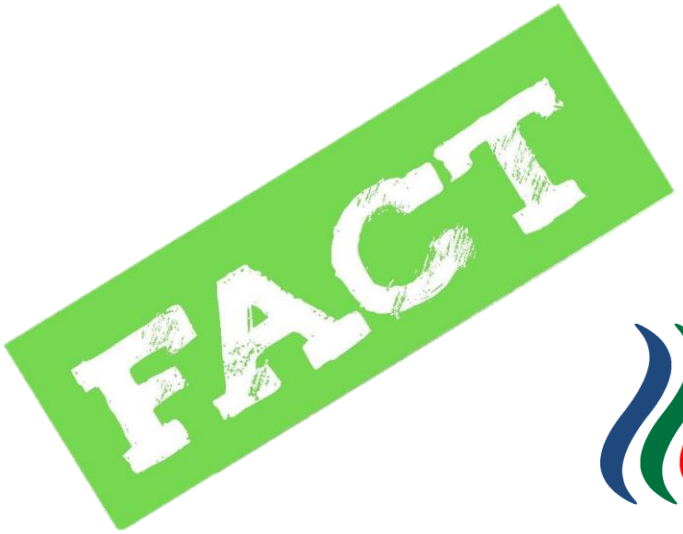
HRE2: Key Conclusion

- A combination of:
  - 50% District Heating (*Cities*)
  - 50% Heat Pumps (*Rural Areas*)
  - 35% Energy Savings (*Everywhere*)

Can enable the EU to reach its CO2 target in 2050 for €100 billion/year less than energy savings on their own.



Heat Roadmap Europe
2050

1. District Heating is not only for Cold Parts of Europe

2. District Heating is a Local Solution for an EU Problem

3. District Heating can reduce the cost of energy in the EU

The HRE methodology can be repeated at Member State Level… and will be in STRATEGO

Heat Roadmap Europe
2050

Moving from EU to Member State Level (STRATEGO)

http://www.stratego-project.eu/

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Applying this Methodology at MS Level

Modelling

- EnergyPLAN is available as a freeware: www.EnergyPLAN.eu
- Lot of training provided:
  - Exercises with solutions
  - FAQs
  - Forum
  - Quarterly online workshops
  - User Manual
- Can be used to model any national energy system

Developing MS Models

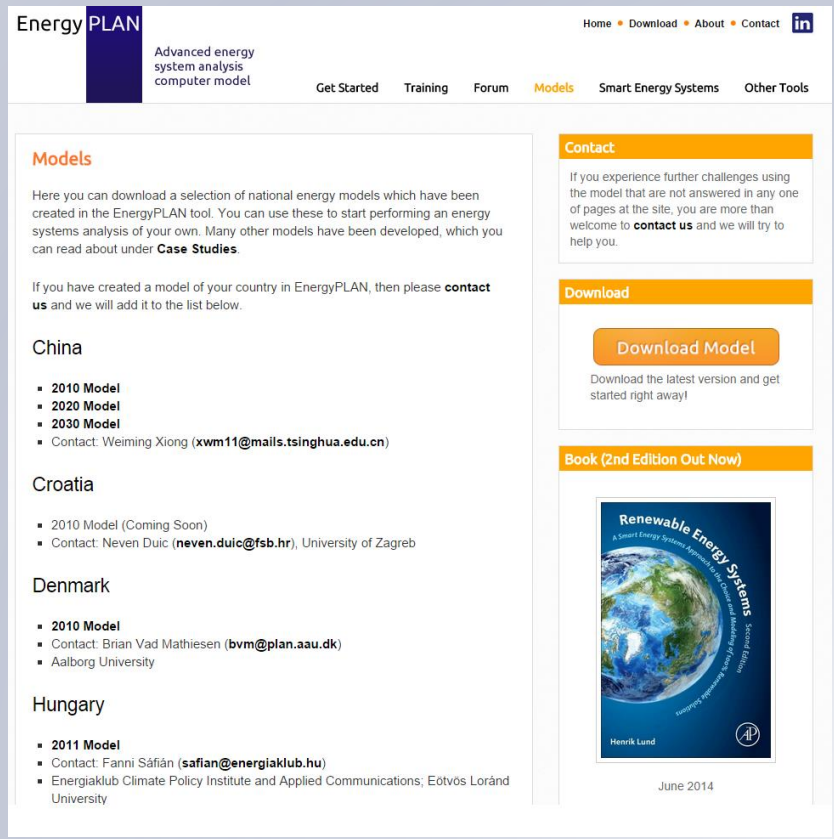
- STRATEGO:
  - Streamlining the process of developing MS 'reference' models
- Countries:
  - Croatia
  - Czech Republic
  - Italy
  - Romania
  - United Kingdom

Existing Reference Models

Existing Models

- China
- Denmark
- Hungary
- Ireland
- Latvia
- Macedonia
- Mexico
- New Zealand
- Norway
- Sweden
- United Kingdom

www.EnergyPLAN.eu/models



Our Philosophy

Consequences for a Variety of Alternatives

- Where will we **end up**, rather than where should we start:2030/2050 Analysis
- The future will require **radical technological change**: EnergyPLAN
- **All sectors** of the energy system will need to ne connected: EnergyPLAN
- Account for the **intermittency** of renewables such as wind: Hourly Analysis
- **Free from existing market regulations**: Socio-Economic Analysis

Conclusions: 100% Renewable Energy

- 100% Renewable Energy is Technically Possible
- 100% Renewable Energy will cost approximately the same price as a Fossil Fuel alternative
- New forms of Flexibility/Storage are essential
- The most economic way to create flexibility is by utilising the synergies between the electricity, heating, and transport sectors

Conclusions: Heat Sector

- **Savings:**
  - There is an economic balance between reducing heat and supplying heat
  - 30-50% heat savings is a good proxy for the economic limit of heat savings
- **Individual:** Heat pumps are the most suitable individual heating solution in a 100% renewable context
- **Networks/Urban:** District heating is the most suitable urban heating in a 100% renewable energy context

Thank you

- Want to find out more?
- david@plan.aau.dk
- www.heatroadmap.eu
- www.EnergyPLAN.eu