STRATEGO WP2

Enhanced National Heating and Cooling Strategies

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INTRODUCTION TO STRATEGO

Keywords

- Heating and Cooling
- Planning (National H&C Plans and SEAPs)
- Thermal mapping (EU atlas and at local level)
- Transfer of knowledge
- Change on the ground / Identification of projects

➢ **<u>Objective</u>: bridge the gap between EU policy, national objectives and effective actions taken at regional and local levels**

Facts & Figures

- 73% of the EU population live in cities
- No energy transition w/o sustainable cities/regions
- Thermal energy accounts for nearly half of the final energy consumption in Europe today
- No sustainable cities/regions w/o sustainable thermal energy

Supporting policy / studies

- Energy Efficiency Directive
  - National Heating and Cooling Plans (art. 14)
- Covenant of Mayors
  - Sustainable Energy Action Plans
- Heat Roadmap Europe studies
  - With a holistic approach, more efficient solutions can be implemented

Principles

- Ambitious heating and cooling project is needed
- It must be technology neutral
- Link between NHCPs (EU – national level) and SEAPs (local level) is needed
- Sustainable solutions already exist but ambitious transfer of knowledge is missing

➢ **STRATEGO** is responding to these needs

Mapping thermal needs and sources

- Development of a European Thermal Atlas
  - Thermal needs
  - Thermal sources
    - Renewable energy
    - Excess heat from industry
- Development of local thermal maps

Developing sound NHCPs

- December 2015 – Deadline for MS to submit assessments of potential for efficiency in heating and cooling
- Quantify the energy efficiency potential for heating and cooling in 5 EU countries (Croatia, Czech Republic, Italy, Romania, and the UK)
- Communicate the results and foster the replicability

Define priority areas for intervention

- Support local authorities in taking action
  - **Priority areas** for intervention will be identified
  - At least **2 concrete projects** will be proposed in each of the 23 cities/regions
  - **Business models** for each of the projects will be developed
- Identified projects should be in line with NHCPs

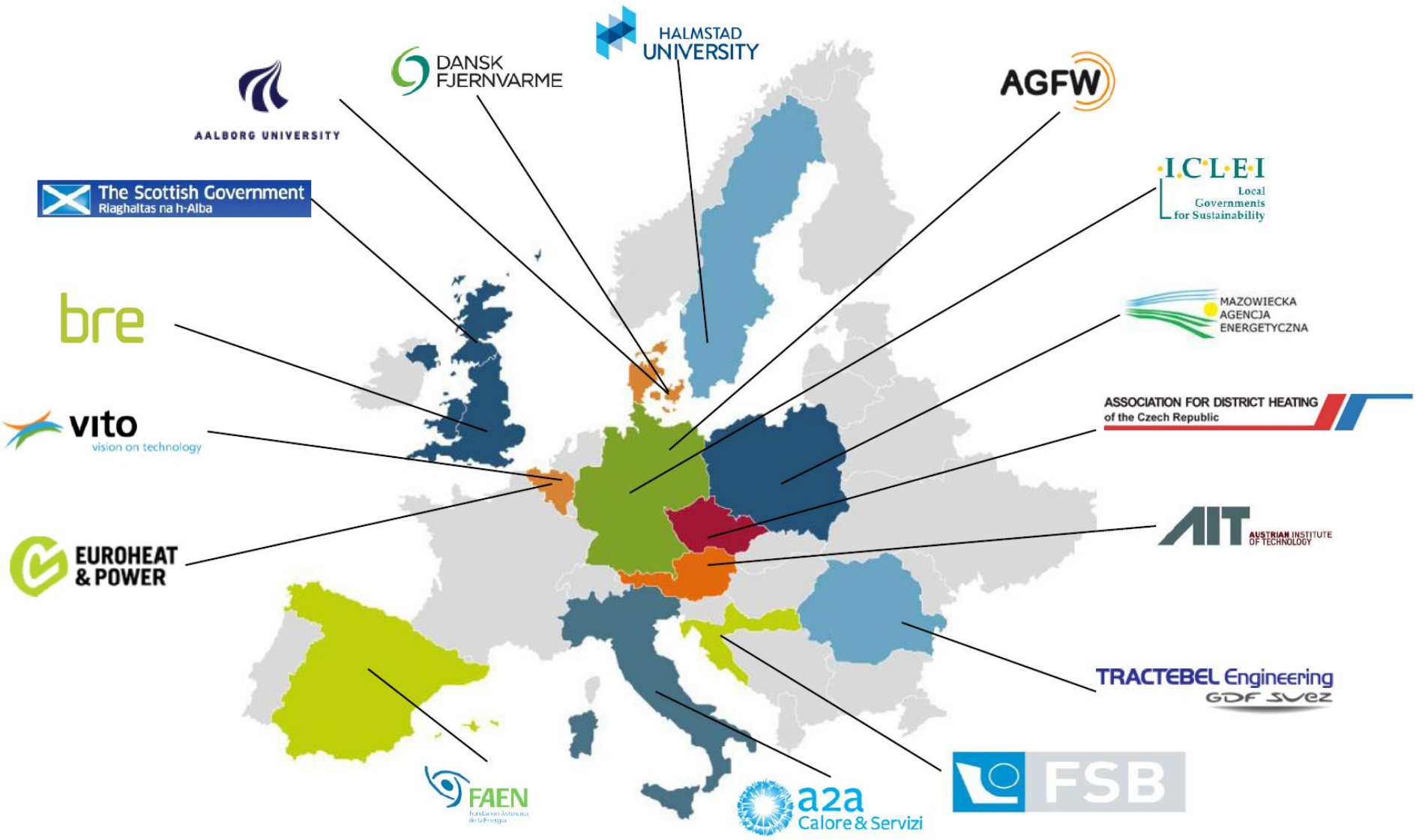
Transfer of know-how

- Coaching sessions
  - Between learning cities and experienced cities
  - Between local authorities and national authorities
- Replicability of the proposed solutions

STRATEGO in figures

- 23 cities/regions involved
- 5 deep assessments of national energy efficiency potential (CZ, HR, IT, RO and UK)
- 16 partners from 12 EU countries
  - AT, BE, CZ, DE, DK, ES, HR, IT, PL, RO, SE, UK
- 32 months project
  - From April 2014 until November 2016
- One Pan-European thermal atlas

Partners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ASSOCIATION FOR DISTRICT HEATING of the Czech Republic
EUROHEAT & POWER
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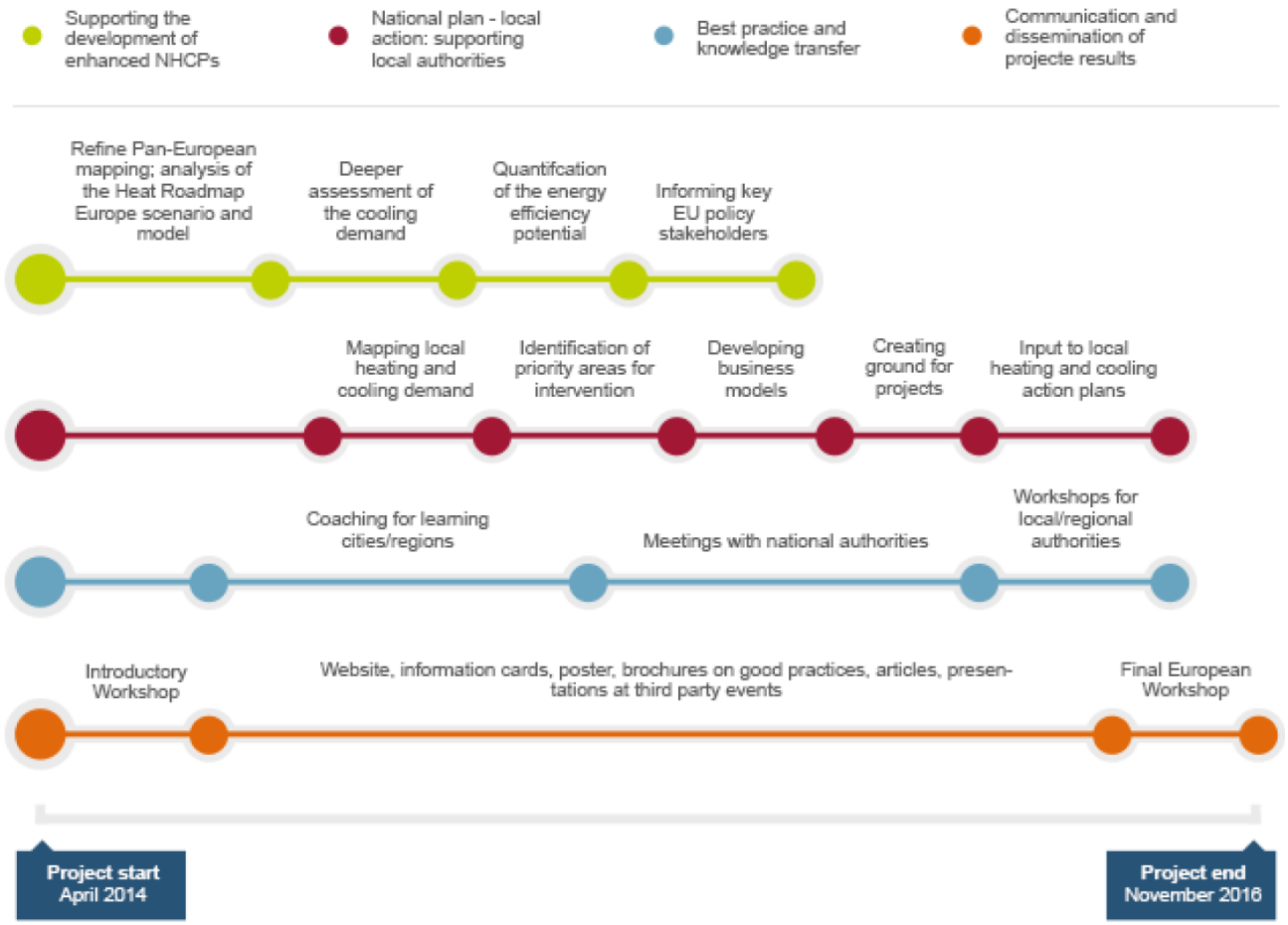
STRATEGO Activities



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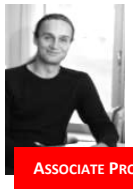

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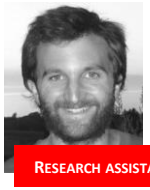

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What do we do…?

www.SmartEnergySystem.eu

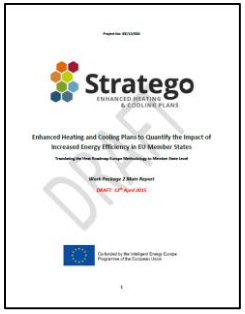
Energy Planning:

- Theories, Methodologies, Tools, Analyses, Case studies and Proposals

Three Key Approaches:

- Energy System Analysis
  - (Modelling & Mapping)
- Feasibility Studies
- Public Regulation

Heat Roadmap Europe 2050 www.heatroadmap.eu



INTRODUCTION TO STRATEGO WP2

Translating the Heat Roadmap Europe Methodology to Member State Level

www.heatroadmap.eu

Heat Roadmap Europe 2050

www.heatroadmap.eu

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Neven Duić

Co-funded by the Intelligent Energy Europe Programme of the European Union

- Three HRE Studies to Date:
  - 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): what is the balance between heat savings and heat supply for 5 member states?

Heat Roadmap Europe Creates New

- Data
- Tools
- Methodologies
- Results

Particularly for heating and cooling

Our Purpose in STRATEGO WP2

- Quantify the impact of energy efficiency at national level in the heating and cooling sectors:
  - Czech Republic, Croatia, Italy, Romania, and the United Kingdom
  - What heating and cooling technologies do we need?
  - How much of each technology and how do these technologies fit with the rest of the energy system?
  - **Quantify** what the impact will be

Aim in SRATEGO WP2

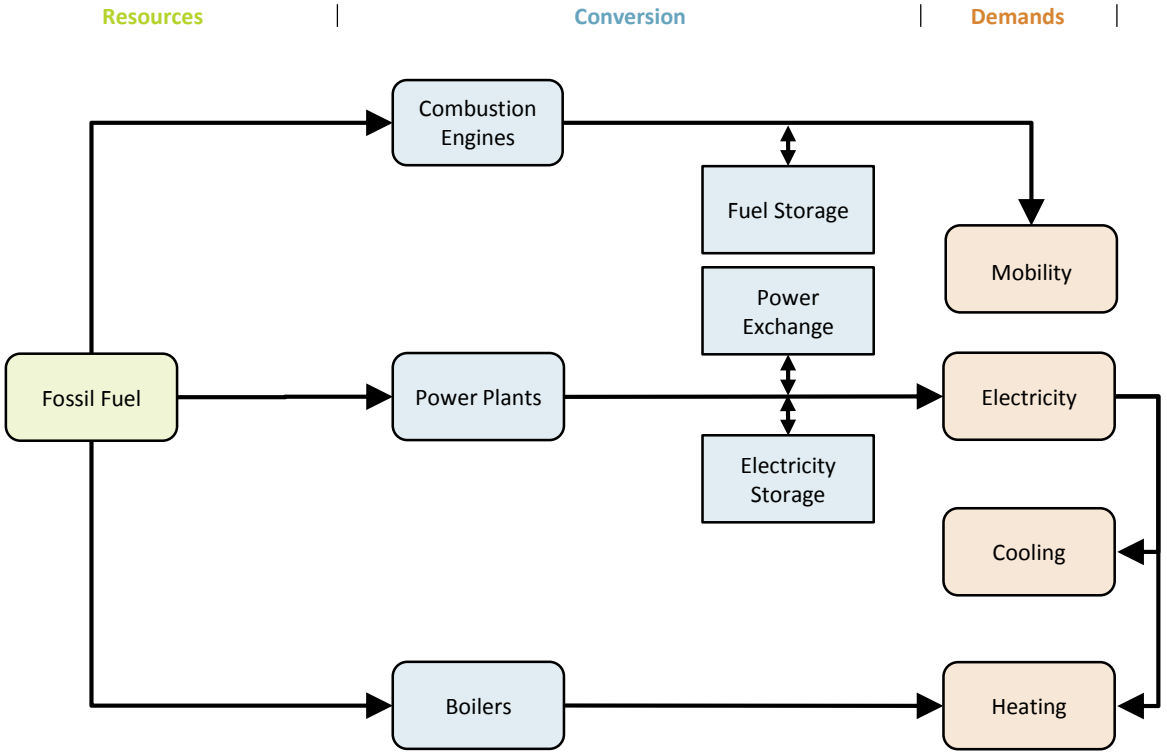
The overall aim in STRATEGO WP2 is to develop low-carbon heating and cooling strategies, which are called Heat Roadmaps, and subsequently to quantify the impact of implementing them at a national level for five EU Member States, which are Czech Republic, Croatia, Italy, Romania, and the United Kingdom.

METHODOLOGY PRINCIPLES

1. Energy is a System, Not a Sector
2. The Heat Sector is a System, inside the Energy System

1. Energy is a System, Not a Sector

Today's Energy System



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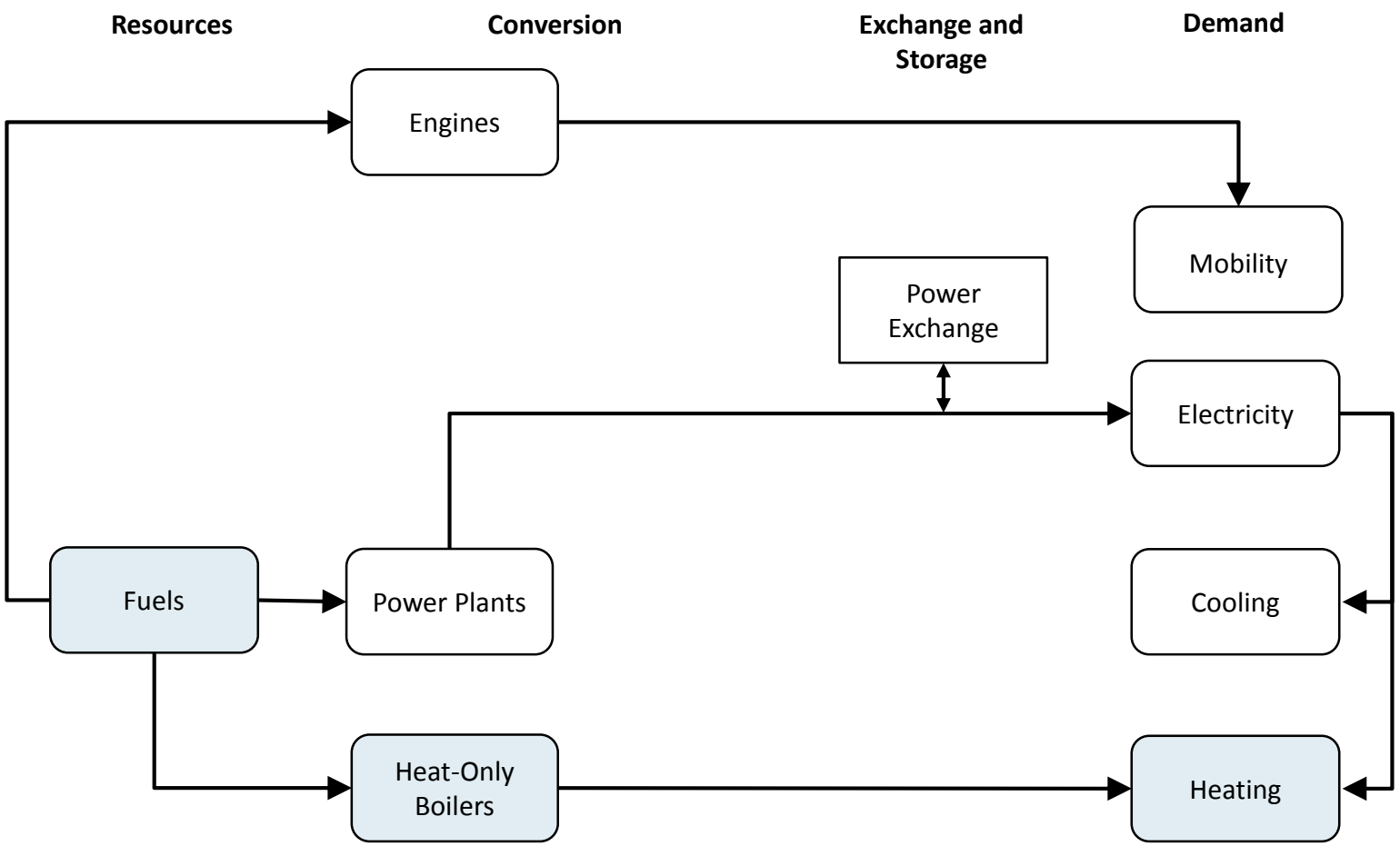
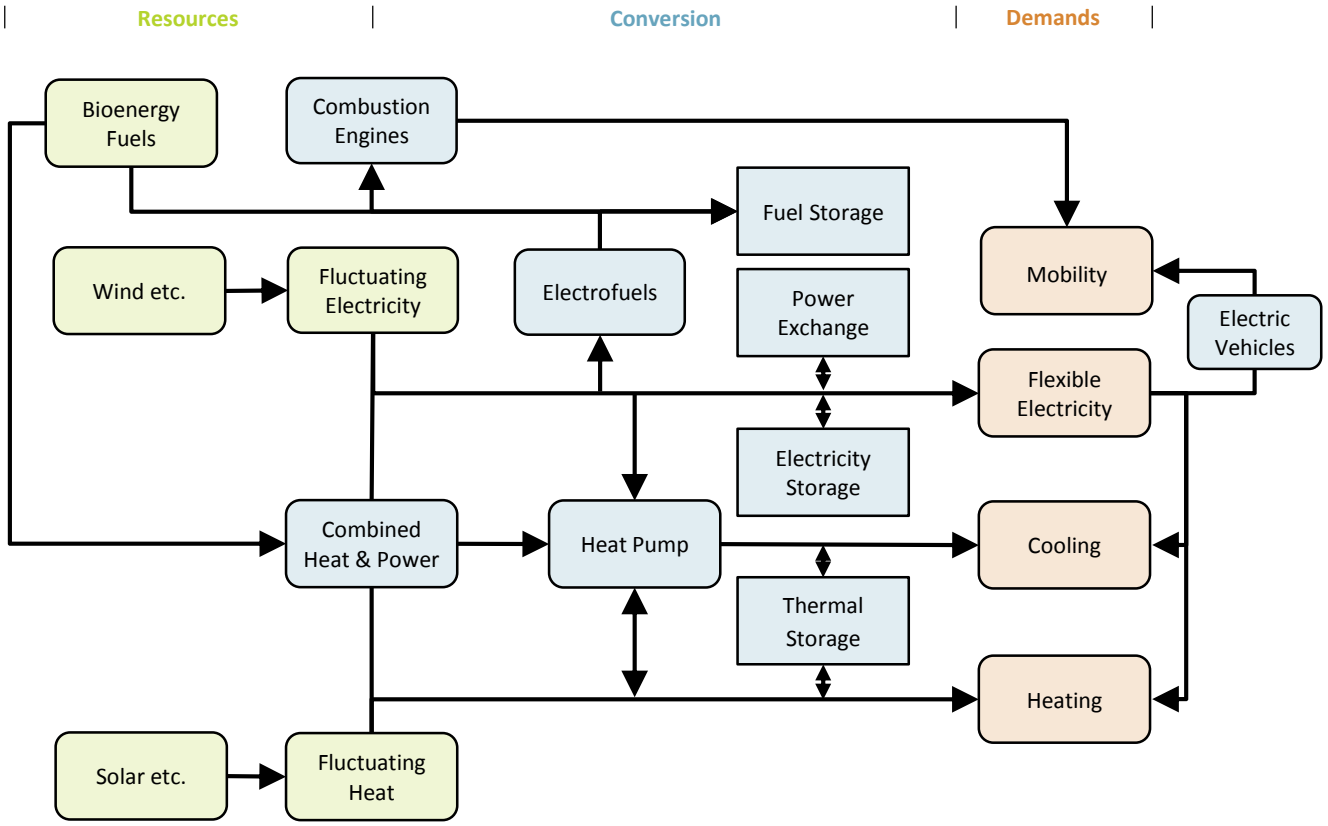
Today's Heat Sector

Energy PLAN
Advanced energy system analysis computer model

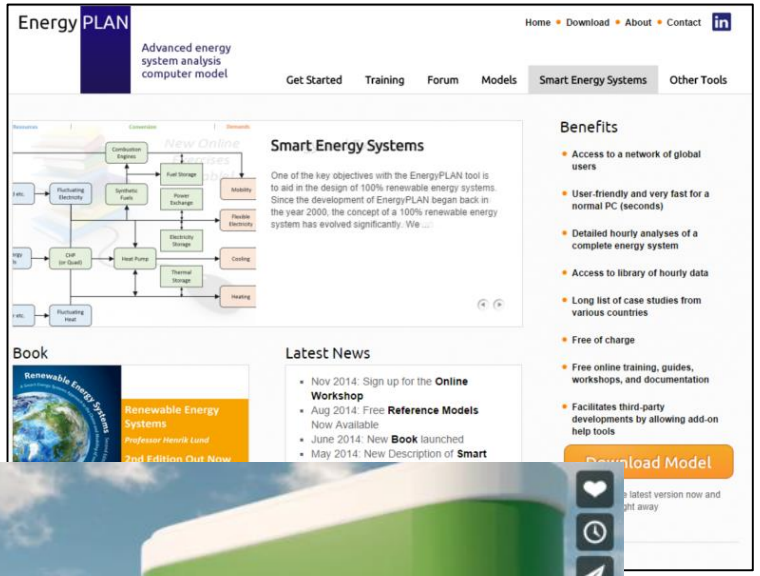


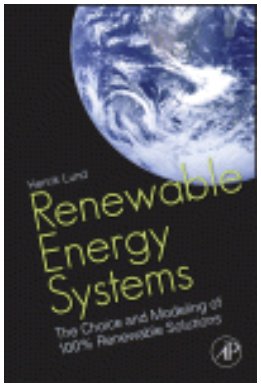
Smart Energy System

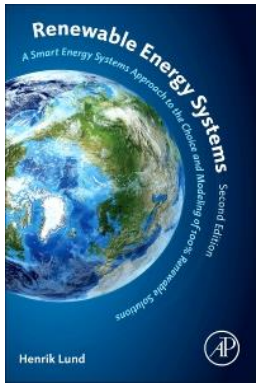


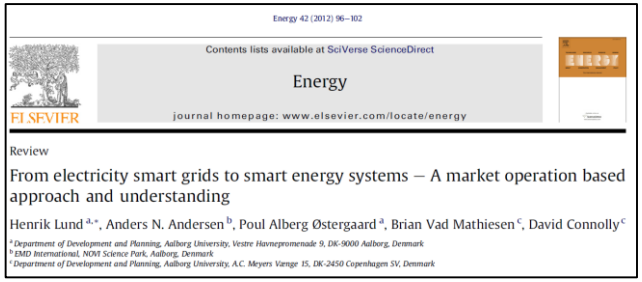
Smart Energy System

- www.SmartEnergySystem.eu
- www.EnergyPLAN.eu



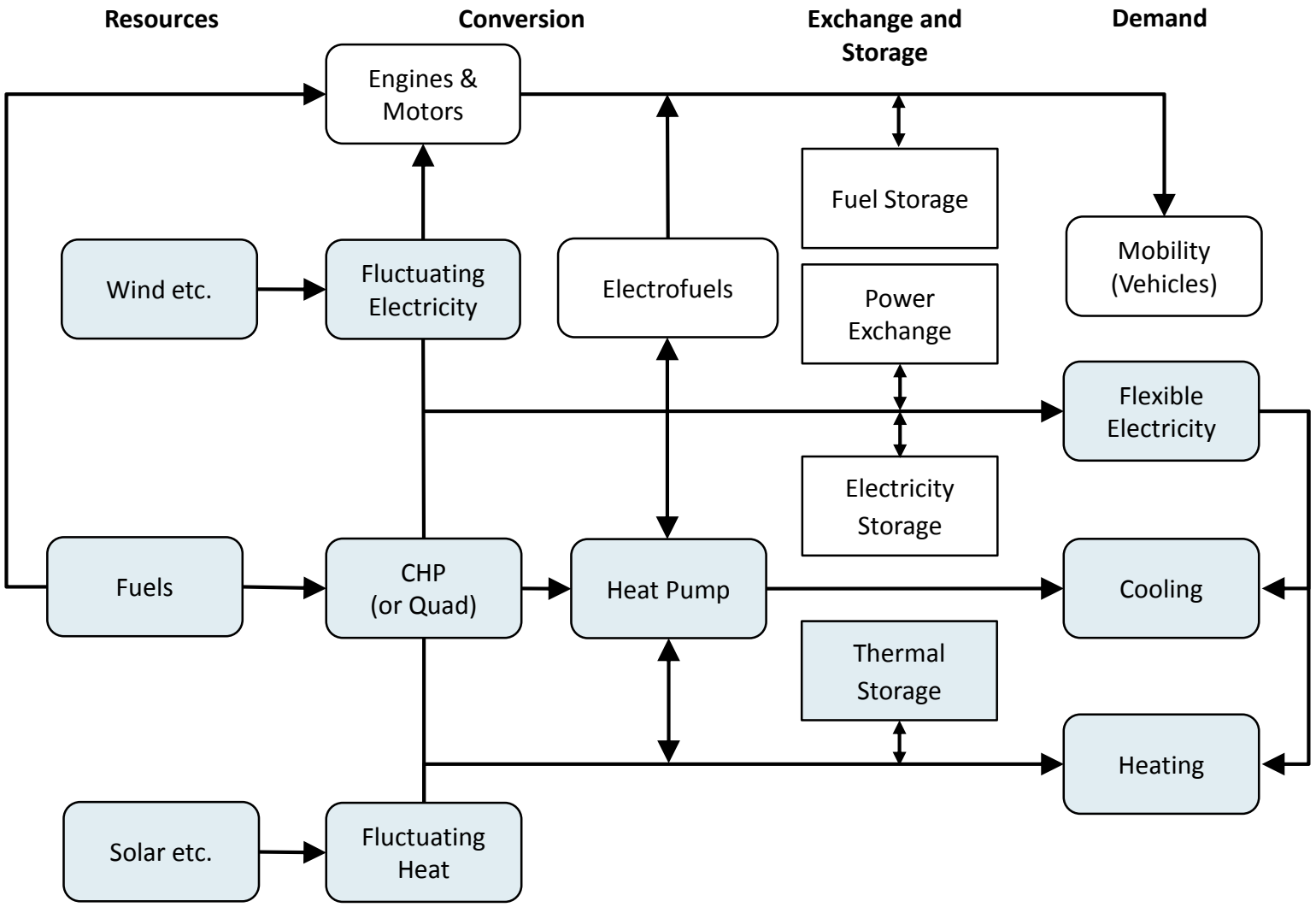






2. The Heat Sector is a System, inside the Energy System

The New Heat Sector



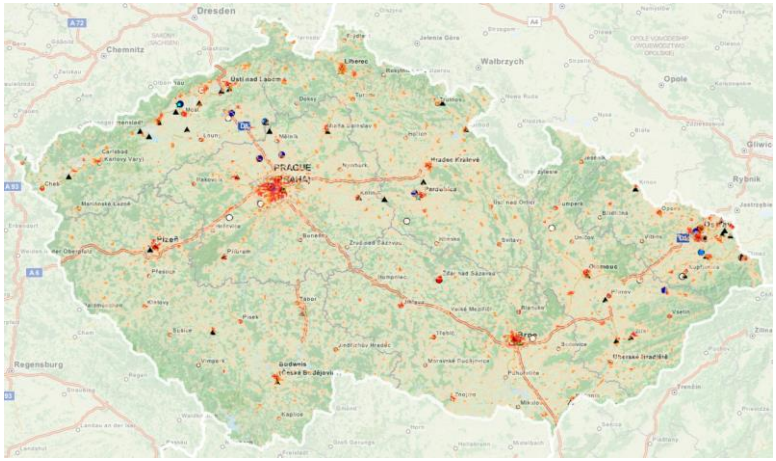
METHODOLOGY

How do we analyse a system within a system?

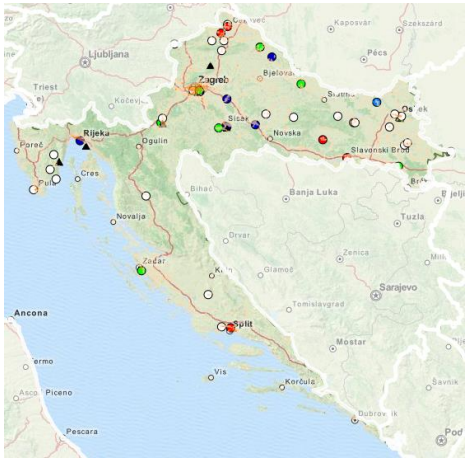
STRATEGO Methodology

Nine Background Reports

1. Creating National Energy Models for 2010 and 2050
2. Creating Hourly Profiles to Model both Demand and Supply
3. Quantifying the Cost of Heat Savings in EU Member States
4. Quantifying the Heating and Cooling Demand in Europe
5. Mapping the Heating and Cooling Demand in Europe
6. Quantifying the Potential for District Heating and Cooling in EU Member States
7. Quantifying the Excess Heat Available for District Heating in Europe
8. Estimating the Renewable Energy Resources Available in EU Member States
9. Mapping the Renewable Heat Resources in Europe



Czech Republic



Croatia

Heat Demand Classes

1 km2 densities of calculated heat demand.

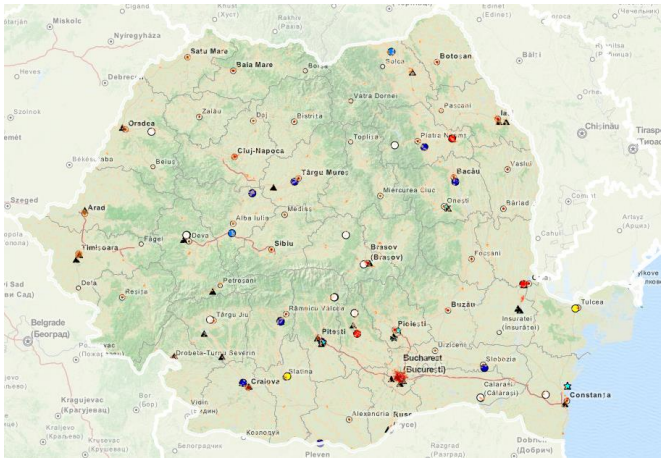
- < 30 TJ/km2
- 30 - 100 TJ/km2
- 100 - 300 TJ/km2
- > 300 TJ/km2

Excess heat facilities

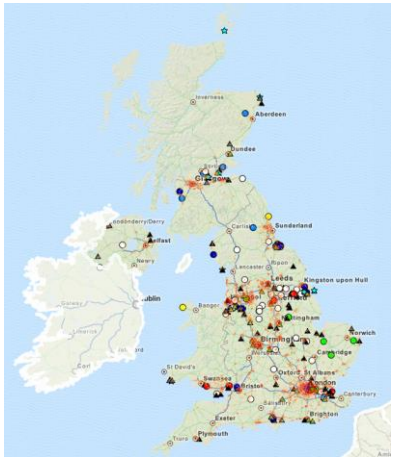
Annual excess heat volumes stated refers to maximal potential, not necessarily reflecting practically recoverable volumes.

- Chemical and petrochemical
- Food and beverage
- Iron and steel
- Non-ferrous metals
- Non-metallic minerals
- Paper, pulp and printing
- Fuel supply and refineries
- Thermal Power Generation - Waste-to-Energy
- Thermal Power Generation - Autoproducer
- Thermal Power Generation - Main activity

Italy

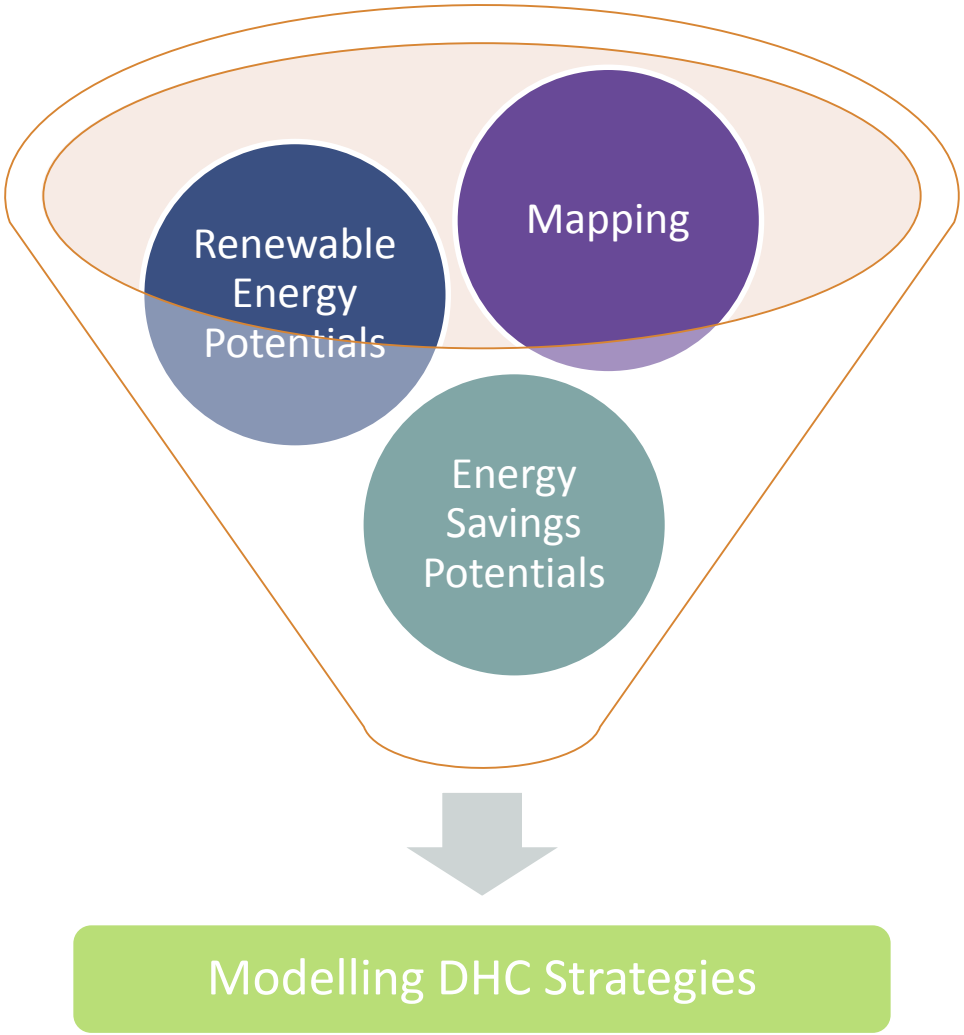


Romania



United Kingdom

Combine Inputs in Modelling



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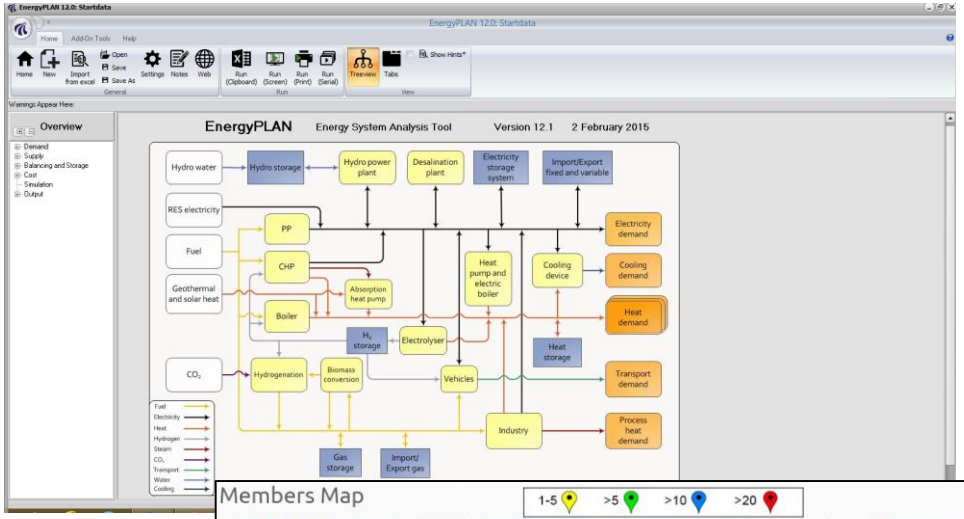
EnergyPLAN: Version 12

www.EnergyPLAN.eu

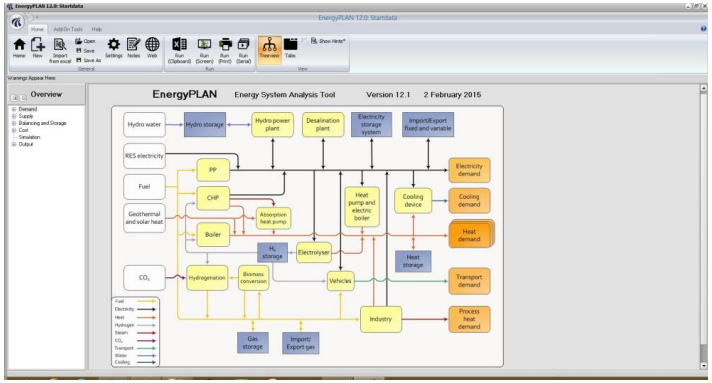
Energy PLAN
Advanced energy system analysis computer model

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



- Over 1000 Registered Users across more than 100 countries
- Lots of free training provided:
  - Exercises with solutions
  - FAQs
  - Forum
  - Quarterly online workshops
  - User Manual
- Can be used to model any national energy system
- Freeware software

Our Philosophy



Consequences for a Variety of Alternatives

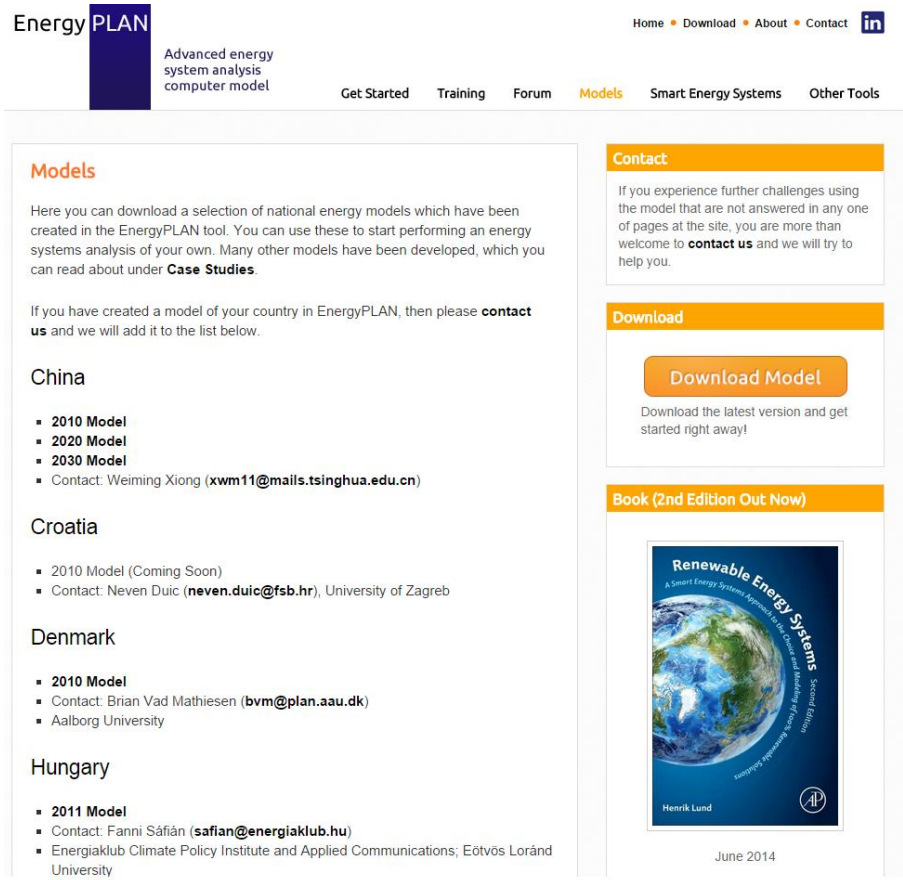
- Where will we **end up**, rather than where should we start: 2050 Analysis
- The future will require **radical technological change**: EnergyPLAN
- **All sectors** of the energy system will need to ne connected: EnergyPLAN
- Account for the **intermittency** of renewables such as wind: Hourly Analysis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

Existing EnergyPLAN Models

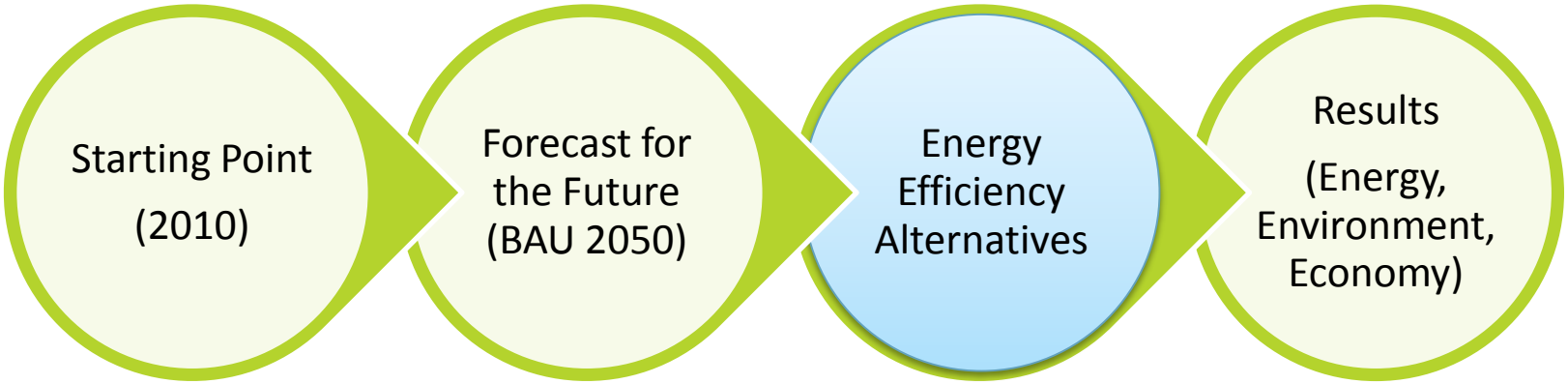
Existing Models

- Croatia
- China
- Czech Republic
- Denmark
- Hungary
- Ireland
- Italy
- Latvia
- Macedonia
- Mexico
- New Zealand
- Norway
- Romania
- Sweden
- United Kingdom

www.EnergyPLAN.eu/models



Modelling Steps



- Extra Heat Savings
- Extra District Heating
- Different Individual Heating Options

Modelling Steps for Each Country in STRATEGO (i.e. Alternatives in STRATEGO)

Step	Technologies
0a. 2010	2010 historical model (Calibration)
0b. BAU 2050	2050 business-as-usual scenario based on the latest European Commission forecasts
1: Heat savings	ADD: Heat savings
2: Heat networks	COMPARE: Gas and water (i.e. district heating) networks
3: Individual heating	COMPARE: Oil boilers, Biomass boilers, heat pumps, electric heating
4: Renewable Heat	ADD: Geothermal, waste incineration, excess industrial heat, large-scale solar thermal
5: Renewable Electricity	ADD: Large heat pumps, electric boilers
6. Heat Roadmap	OPTIMISE: Synergies in the new efficient heat sector
7. Cooling	COMPARE: Individual and District Cooling for the services sector in urban areas

What Should We Measure?

- Energy (Primary Energy Supply)
- Environment (Carbon Emissions)
- Economy (Total Annual Energy System Costs)

RESULTS

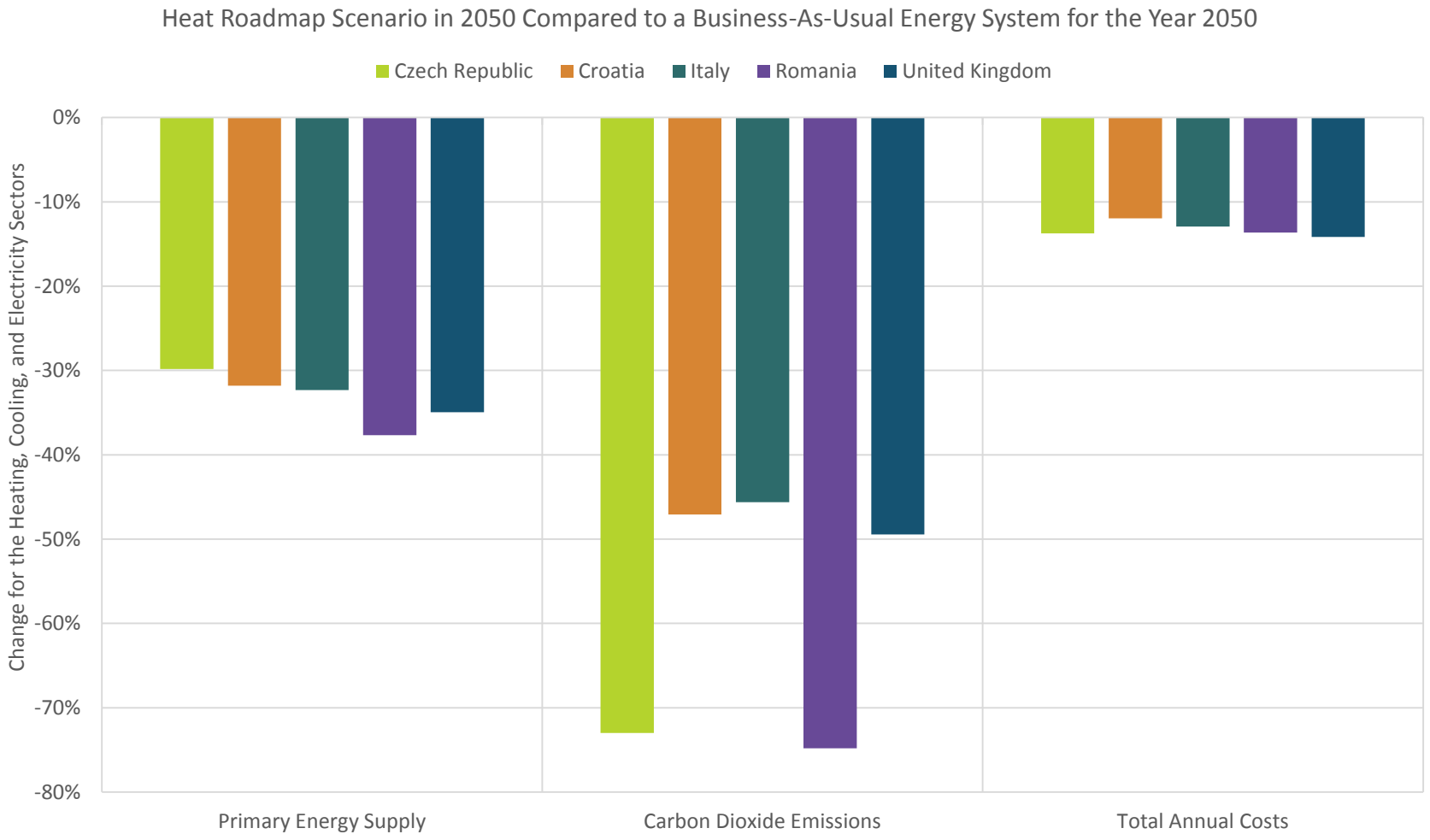
Stratego

Final Levels of Each Energy Efficiency Measure in the Low-Carbon Heating and Cooling Strategies

Heat Roadmaps	Heat Savings	District Heating	Individual Heating Technology	District Heat Supply from Renewable Heat & Excess Heat*
	Reduction as a Percentage of the BAU 2050 Heat Demand	% of Total Heat Demand after Heat Savings (vs. % today)	Primary Technology	% of District Heat Production
Czech Republic	40%	40% (25%)	Heat pumps are recommended as the primary technology with small shares for biomass boilers, and solar thermal. The exact mix of each technology is not optimised.	65%
Croatia	40%	40% (15%)		45%
Italy	30%	60% (<5%)		40%
Romania	50%	40% (20%)		50%
United Kingdom	40%	70% (<5%)		45%

*Doesn't include excess heat from thermal power plants or thermal boilers.

Change in HR Scenarios



Changes for Heating, Cooling, and Electricity

Heating, Cooling and Electricity Sectors Only	Energy		Environment		Economy	
Heat Roadmap vs. BAU 2050	Change in Primary Energy Supply		Change in Carbon Dioxide		Change in Energy System Costs (excludes vehicle costs)	
Unit	TWh/year	%	Mt/year	%	Billion €/year	%
Czech Republic	-109	-30%	-35	-73%	-3	-14%
Croatia	-18	-32%	-5	-47%	-1	-12%
Italy	-380	-32%	-101	-46%	-13	-13%
Romania	-118	-38%	-36	-75%	-3	-14%
United Kingdom	-444	-35%	-109	-49%	-15	-14%
All Five Countries	**-1069**	**-34%**	**-286**	**-52%**	**-35**	**-14%**

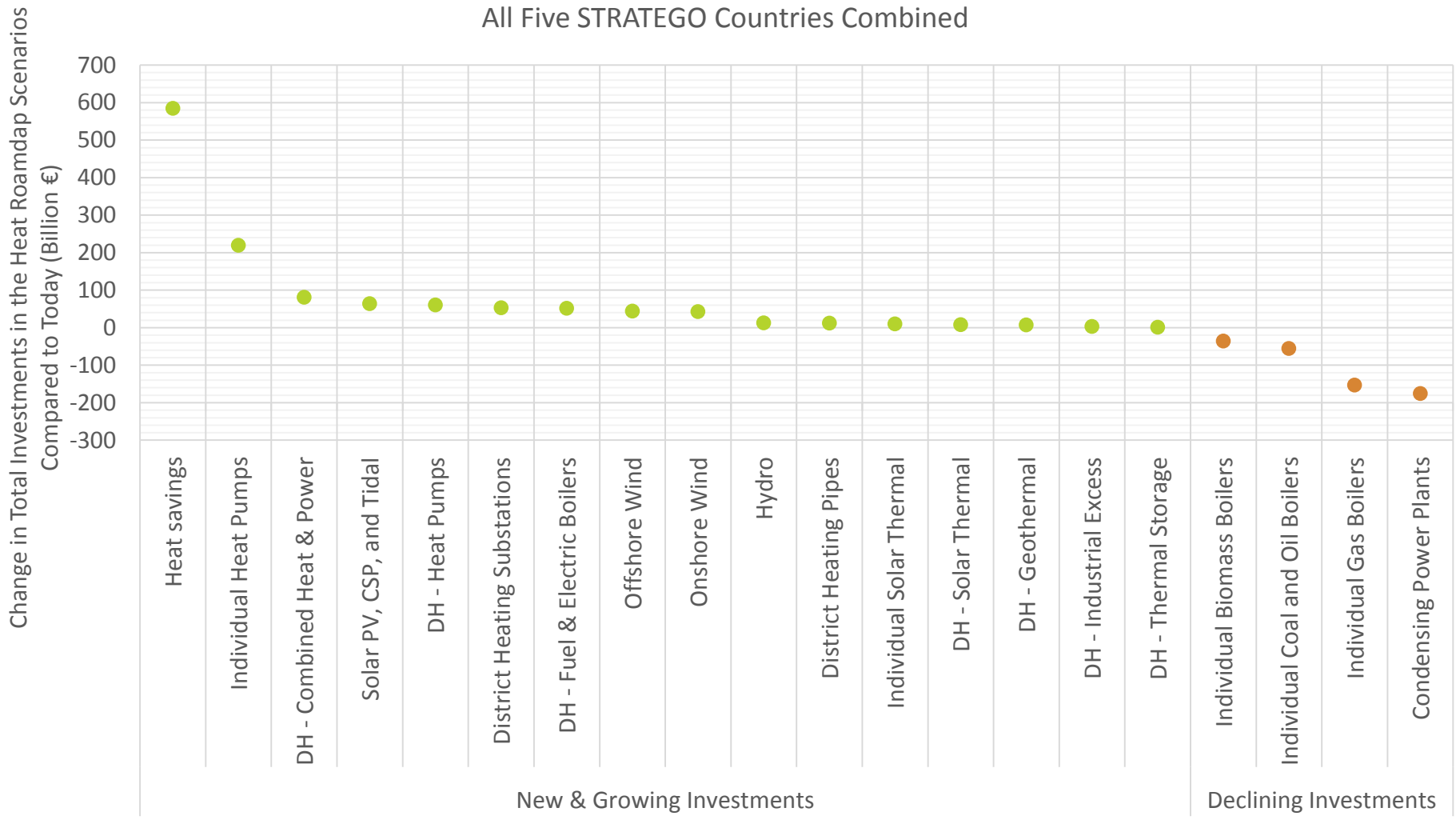
Contextualising the Changes

In total, the energy demand is reduced by ~1000 TWh/year if the Heat Roadmap scenarios are implemented in all five STRATEGO countries, which is the same as all of the energy required today in the Czech Republic, Croatia, and Romania combined.

Similarly, the combined reductions in carbon dioxide emissions of almost 300 Mt/year is more than all of the carbon dioxide emissions emitted from the Czech Republic, Croatia, and Romania today (which is ~225 Mt/year).

Main Results for WP2

Total Investments vs. Today



Status of Some Key Technologies in the Heat Roadmap Compared to the Ref 2010 Scenario

Key Messages: Heating

- Heat savings should begin today and be strongly supported to the point where their total heat demand is reduced to 60-90 kWh/m2
  - In existing buildings while they are undergoing other refurbishments and in new buildings,
- Share of district heating can be expanded significantly in all countries
  - Urban Areas
- Electric heat pumps are the most sustainable option for individual heating
  - Rural Areas
- In all the countries there are large amounts of renewable and excess heat available, but there is a limited supply of renewable electricity, while there is likely to be a shortfall of biomass if the aim is to decarbonise the entire energy system.
- The results are extremely sensitive to cost assumptions, but the conclusions are very robust

Key Recommendations for the Heat Sector

Everywhere

- Heat Savings
- Balance Savings vs. Supply
- 30-50% Total Reduction

Urban Areas

- District Heating Networks
- High Heat Density Areas
- Supply 40-70% of the Heat Demand

Rural Areas

- Primarily Electric Heat Pumps
- Smaller Shares of Solar Thermal & Biomass Boilers
- Remaining 30-60% of the Heat Demand

DETAILED DISCUSSION ABOUT THE KEY DECISIONS FOR HEATING

3 options for the Heat Sector

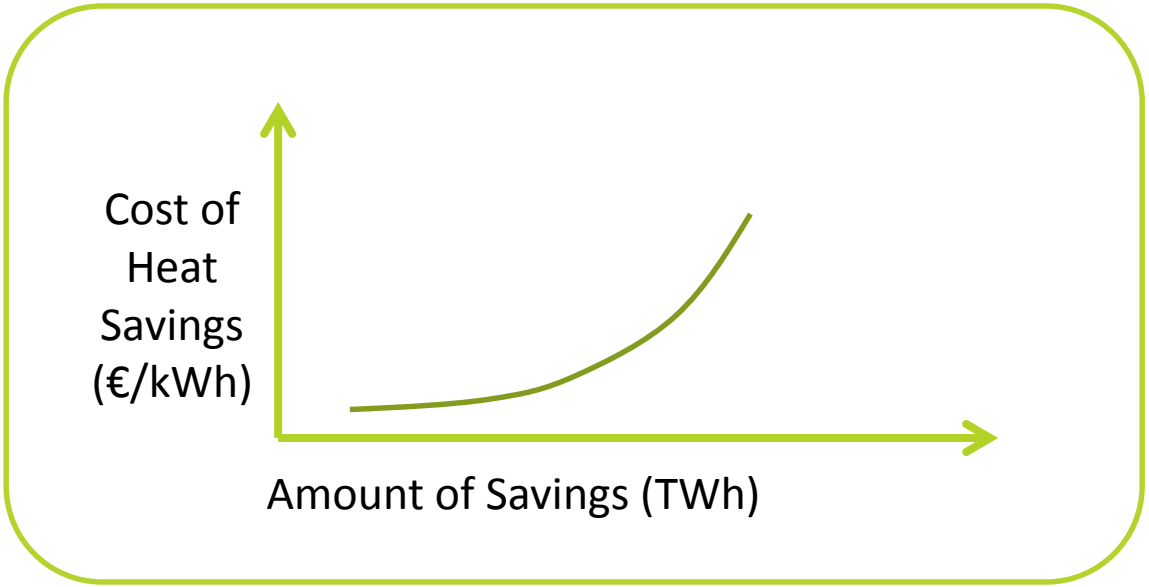
3 options for the Heat Sector

1. Savings

- 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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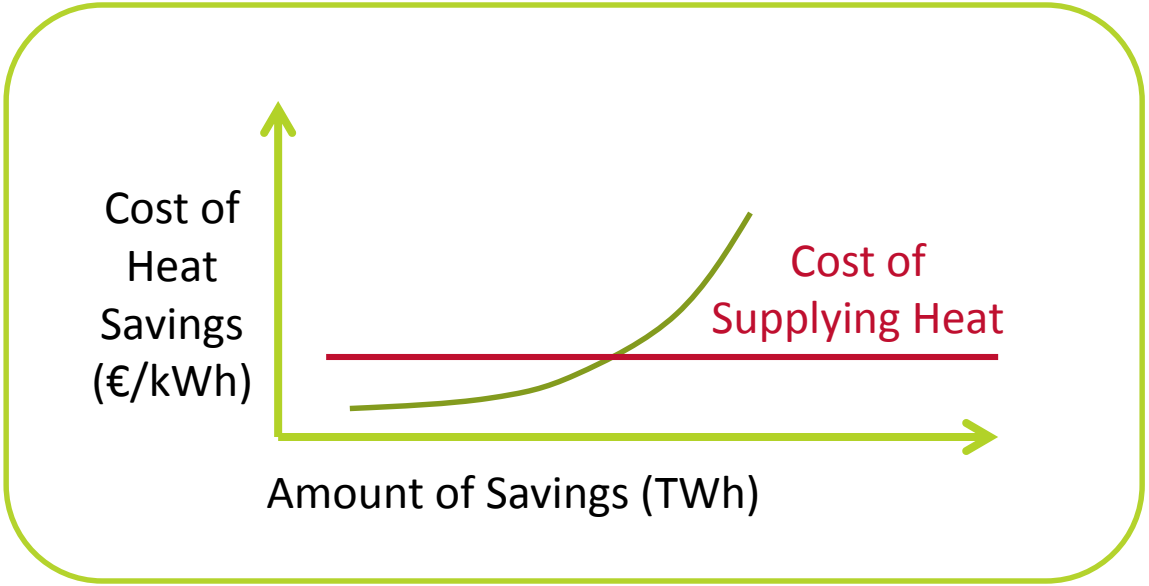

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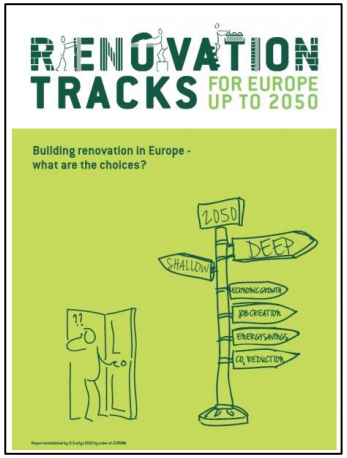
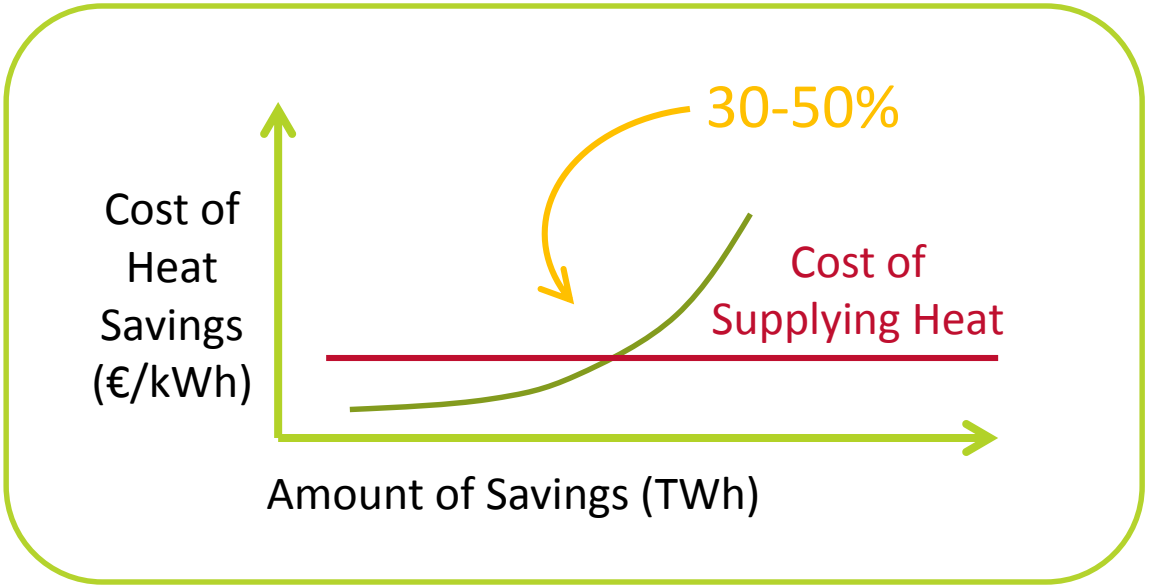




Same Recommendation, but Different Numbers Reported

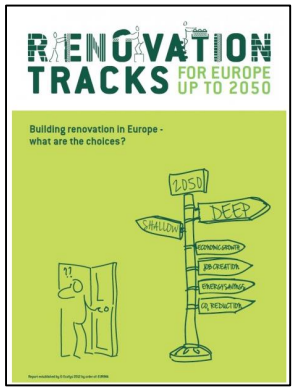
Eurima Deep Renovation says:
"Final Energy ~75%"

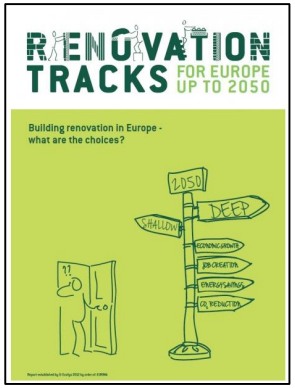
- Energy Going into the Heating Unit

Eurima and Heat Roadmap Europe says
"Heat Demand Reduction up 50%"

- Heat Coming Out of the Heating Unit

10 Units of Fuel → Hypothetical Boiler with an Efficiency of 90% → 9 Units of Heat





Stratego

3 options for the Heat Sector

1. Savings

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

2. Urban Areas

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

3. Rural Areas

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

30-50%
Marginal

Stratego

3 options for the Heat Sector

1. Savings

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

2. Urban Areas

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

3. Rural Areas

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

30-50%
Marginal

Gas or
District Heating?


OR
FACT
MYTH?

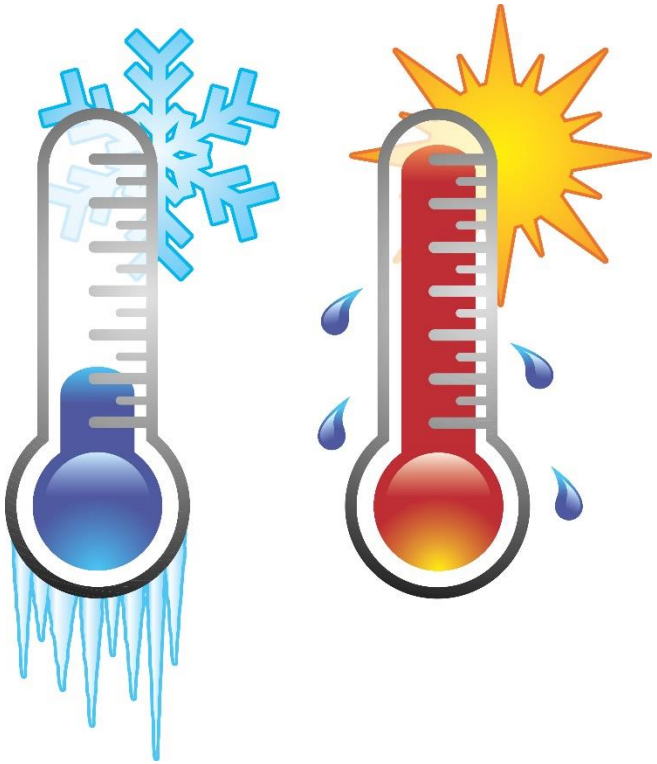
1. Northern Europe needs heating and southern Europe needs cooling

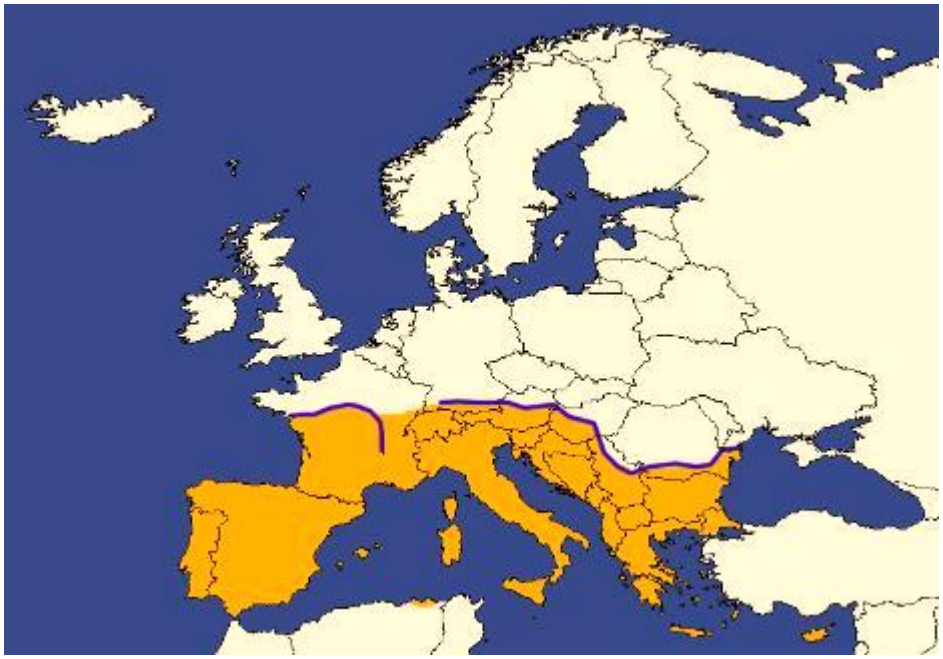
2. District Heating is a Local Solution for a Local Problem

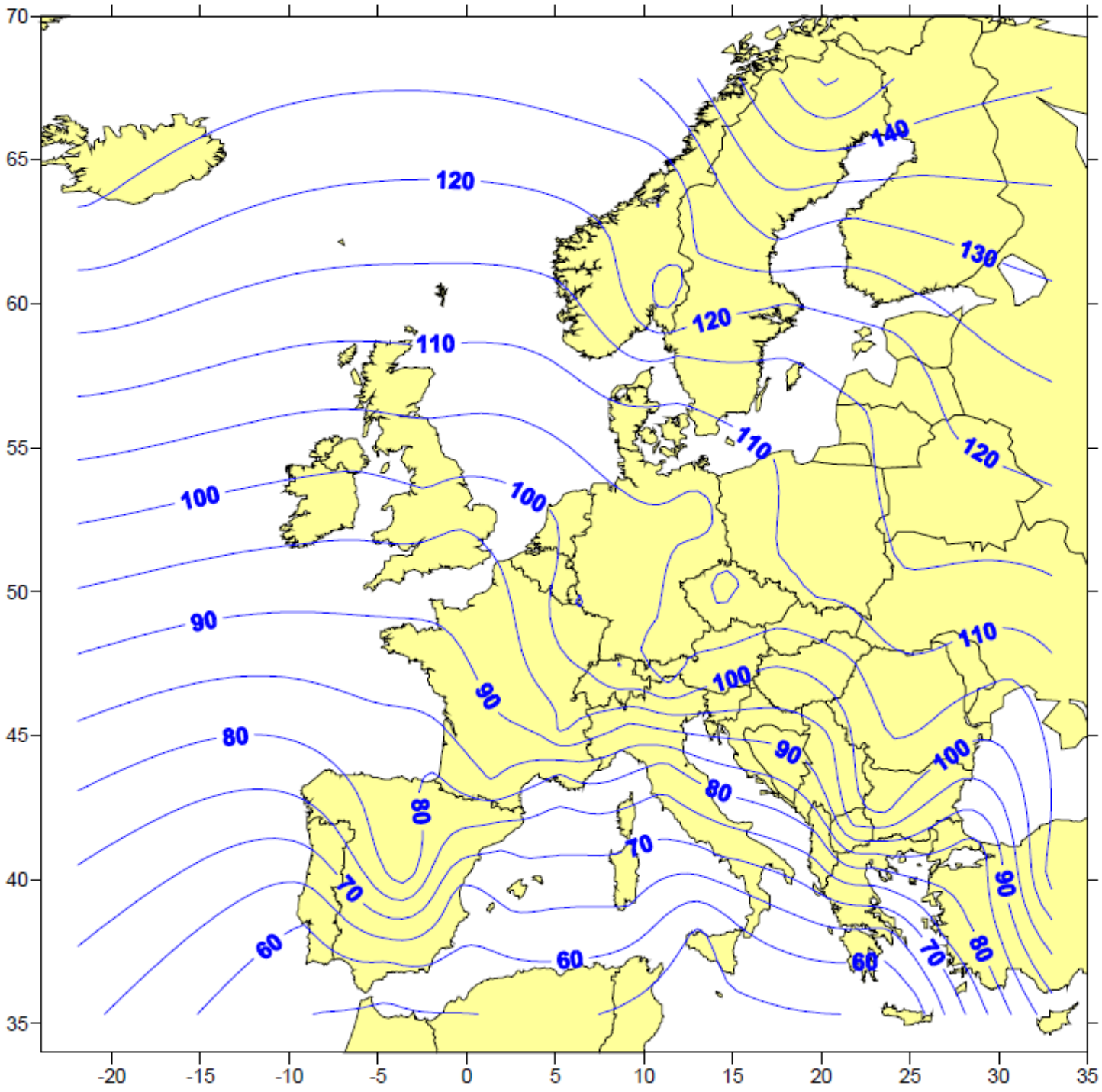
3. District Heating is Expensive

4. Heat savings will remove the need for heat supply

1. Northern Europe needs heating and southern Europe needs cooling

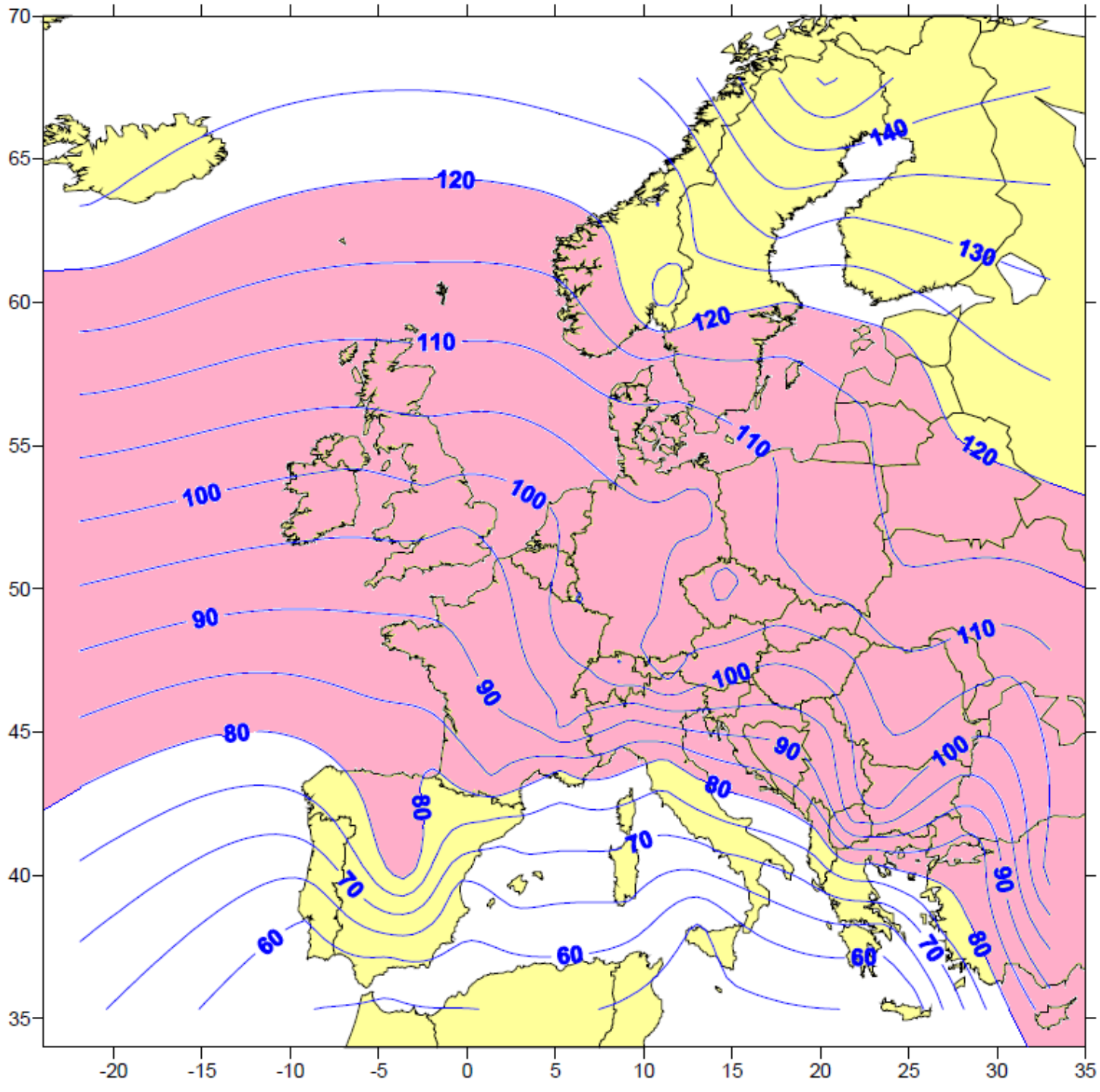






European Heating Index

(Source: ecoheatcool)

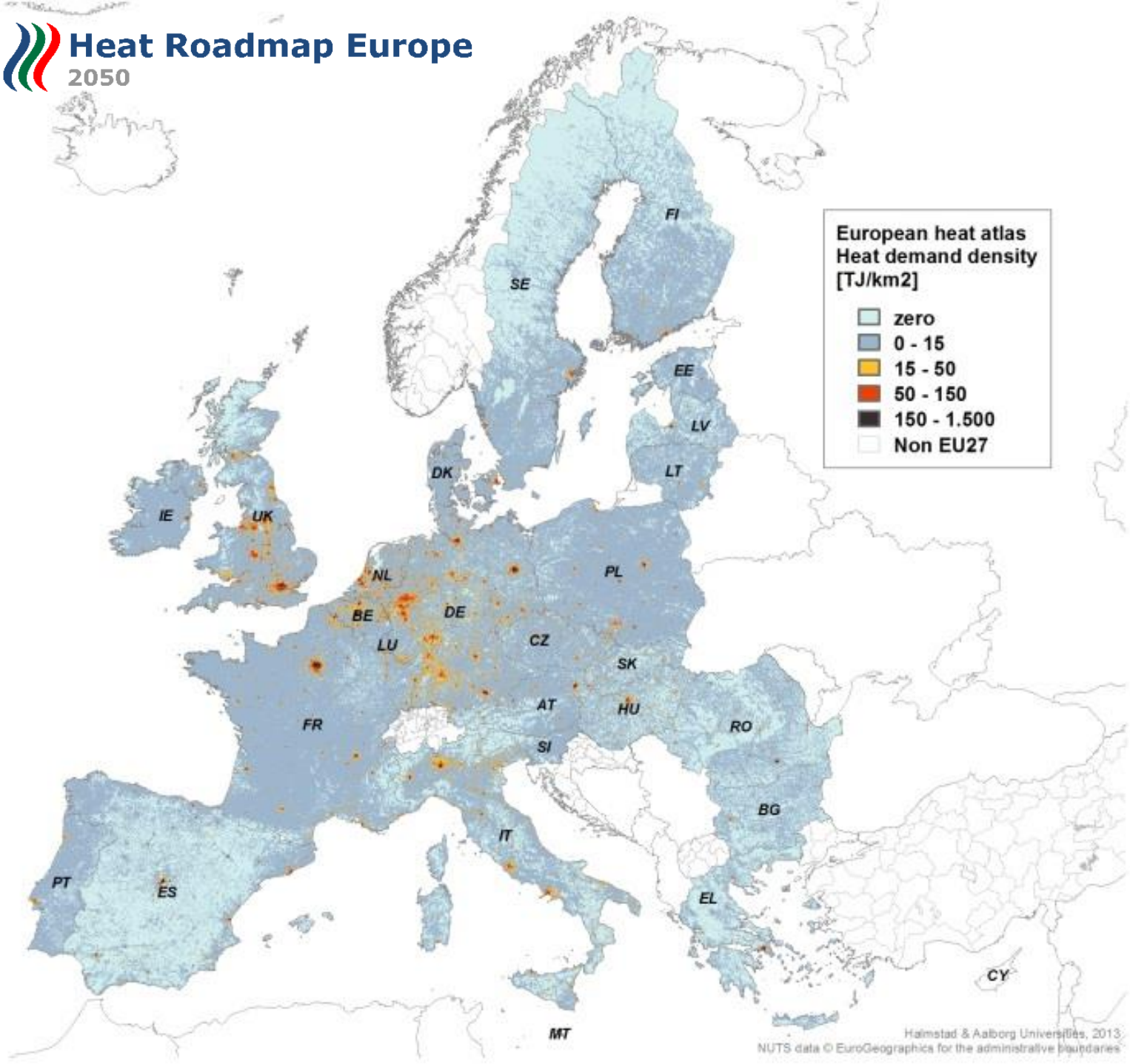


European Heating Index

(Source: ecoheatcool)

+/- 20%

Heat Roadmap Europe
2050

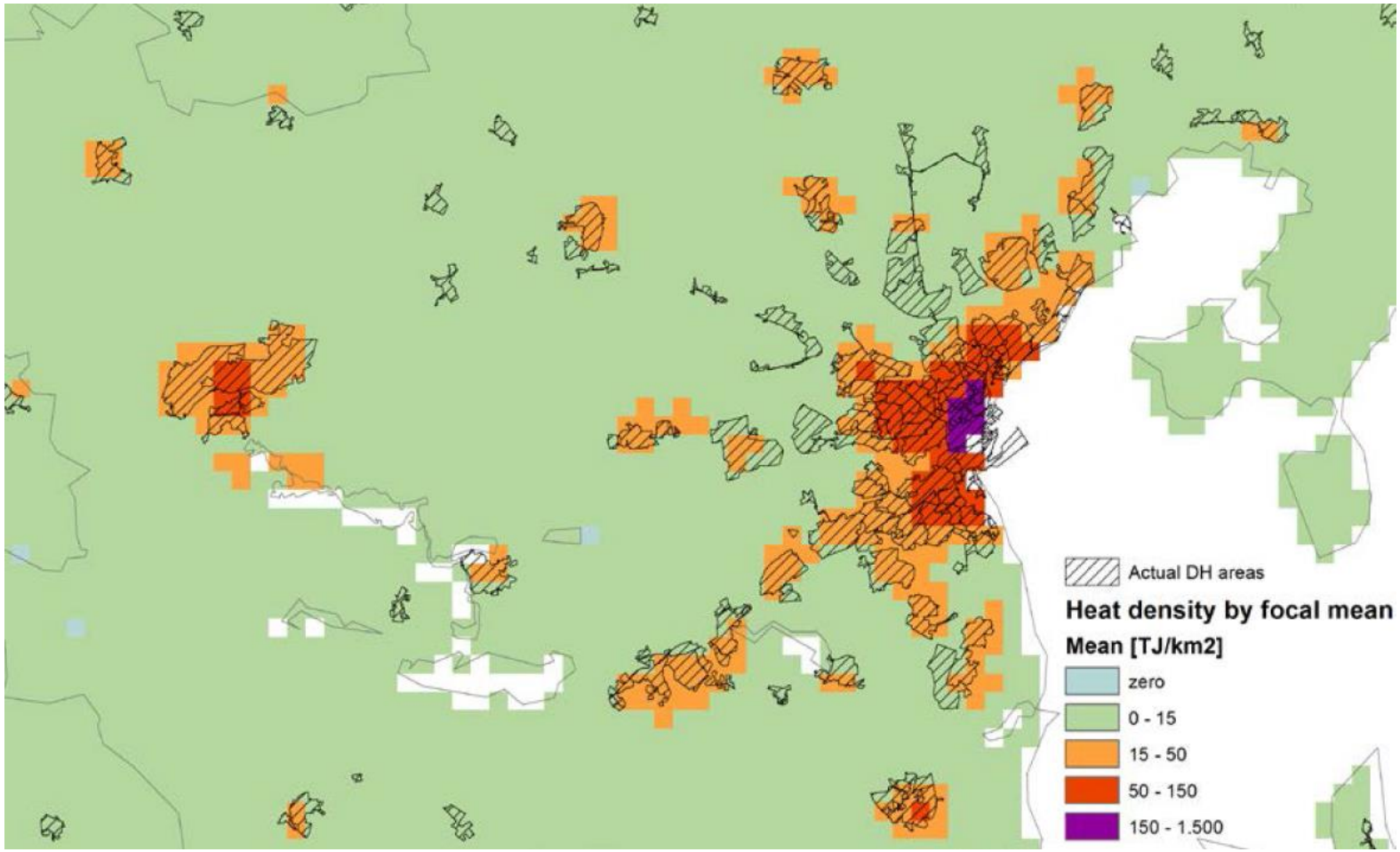


EU Heat Atlas

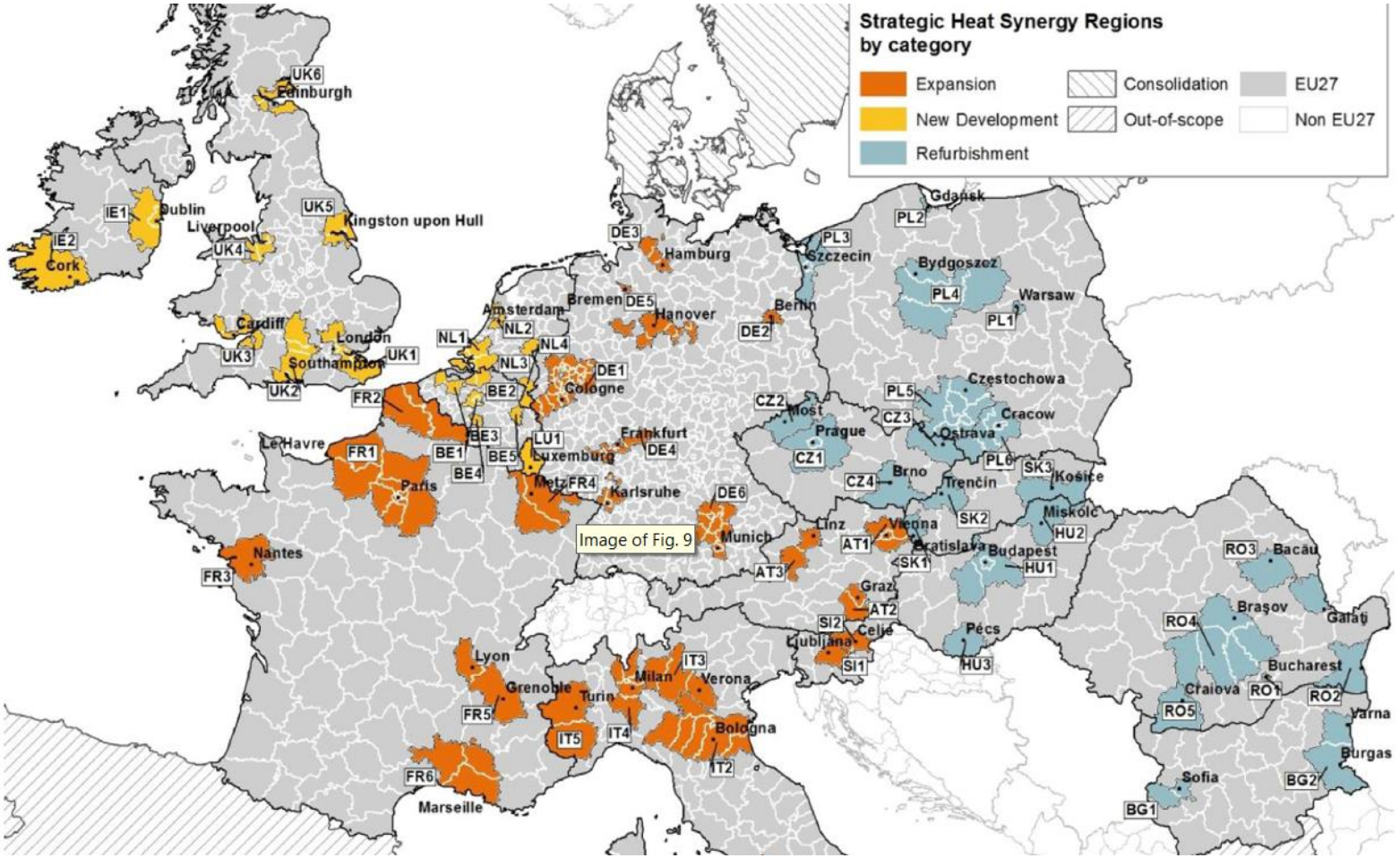
30-50% of Heat Currently Feasible for DH

Stratego

HRE Heat Atlas at a Local Level



HRE Mapping:


Strategic Heat Synergy Regions
by category
Expansion
Consolidation
EU27
New Development
Out-of-scope
Non EU27
Refurbishment
Image of Fig. 9
UK6
Edinburgh
IE1
Dublin
Liverpool
UK5
Kingston upon Hull
IE2
Cork
UK4
Cardiff
London
UK3
Southampton
UK1
UK2
FR2
NL1
NL2
NL4
NL3
DE1
Cologne
BE2
BE3
LU1
Luxemburg
BE1
BE5
BE4
FR1
Le Havre
Paris
Metz
FR4
Karlsruhe
DE4
DE6
Frankfurt
Amsterdam
Bremen
DE5
Hanover
DE3
Hamburg
DE2
Berlin
PL3
Szczecin
Gdańsk
PL2
Bydgoszcz
PL4
Warsaw
PL1
Częstochowa
PL5
Cracow
CZ2
Most
Prague
CZ3
Ostrava
CZ1
PL6
SK3
Košice
CZ4
Brno
Trenčín
Miskolc
SK2
HU2
Linz
Vienna
AT1
Bratislava
Budapest
SK1
HU1
Munich
AT3
Graz
AT2
SI2
Celje
Ljubljana
SI1
Pécs
HU3
RO3
Bacău
Brașov
Galați
RO4
Bucharest
Craiova
RO1
RO2
RO5
Varna
Burgas
Sofia
BG2
BG1
Nantes
FR3
Lyon
Grenoble
Turin
Milan
IT3
Verona
FR5
IT5
IT4
Bologna
IT2
FR6
Marseille

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*

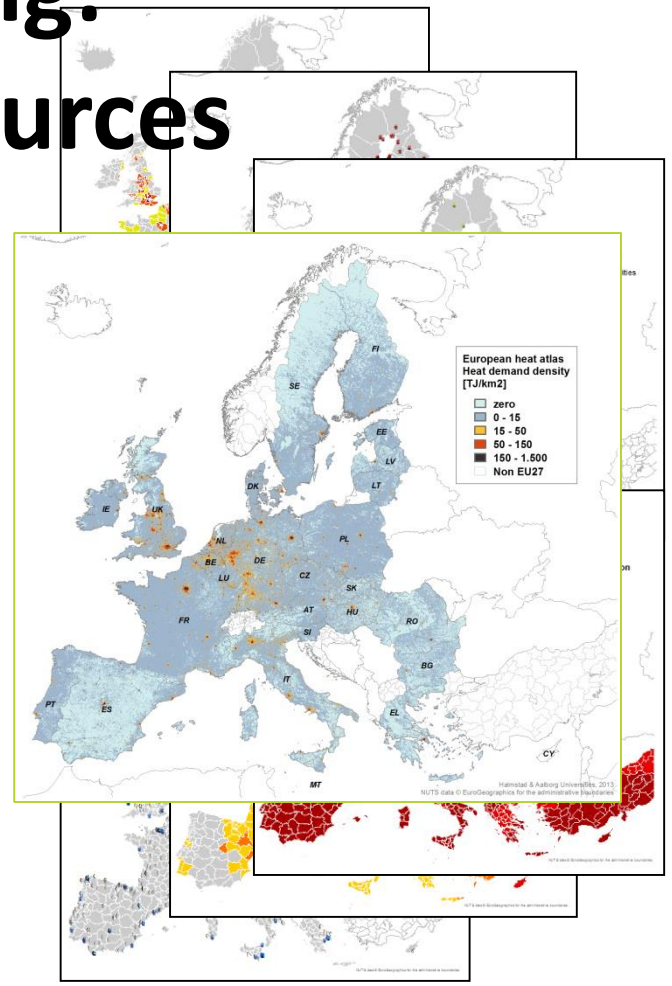
Table 7
NUTS3 regions (N3R) in EU27 Member States (MS), all in study (left), all with excess heat ratio (right) by population (P), heat demand (HD), primary energy supply (PES), and excess heat (EH). Excess heat specified by sectors: Thermal power (TP), Waste-to-Energy (WTE), and Industrial (Ind). Energy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

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

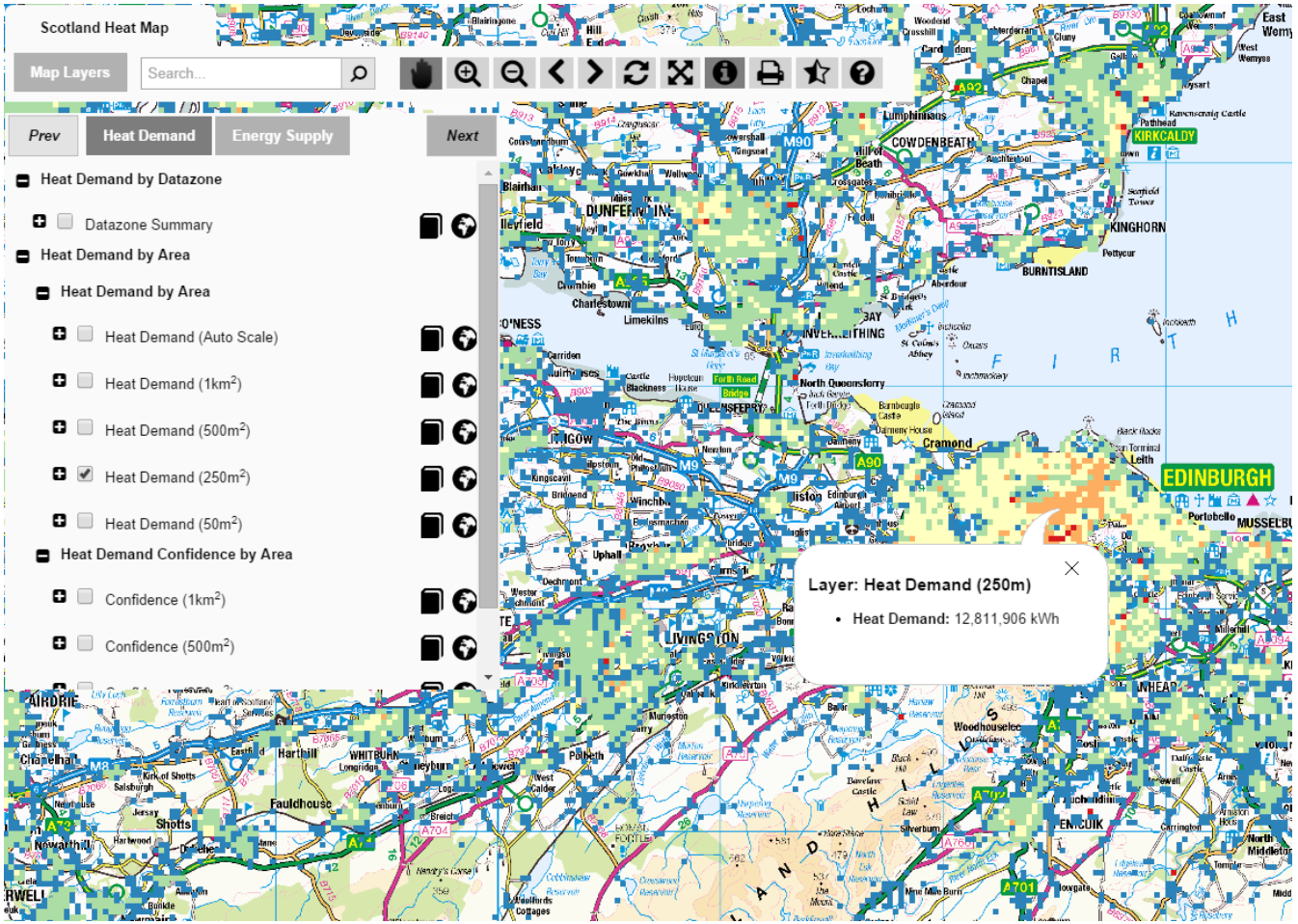
GIS Mapping:
Many Heat Sources

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



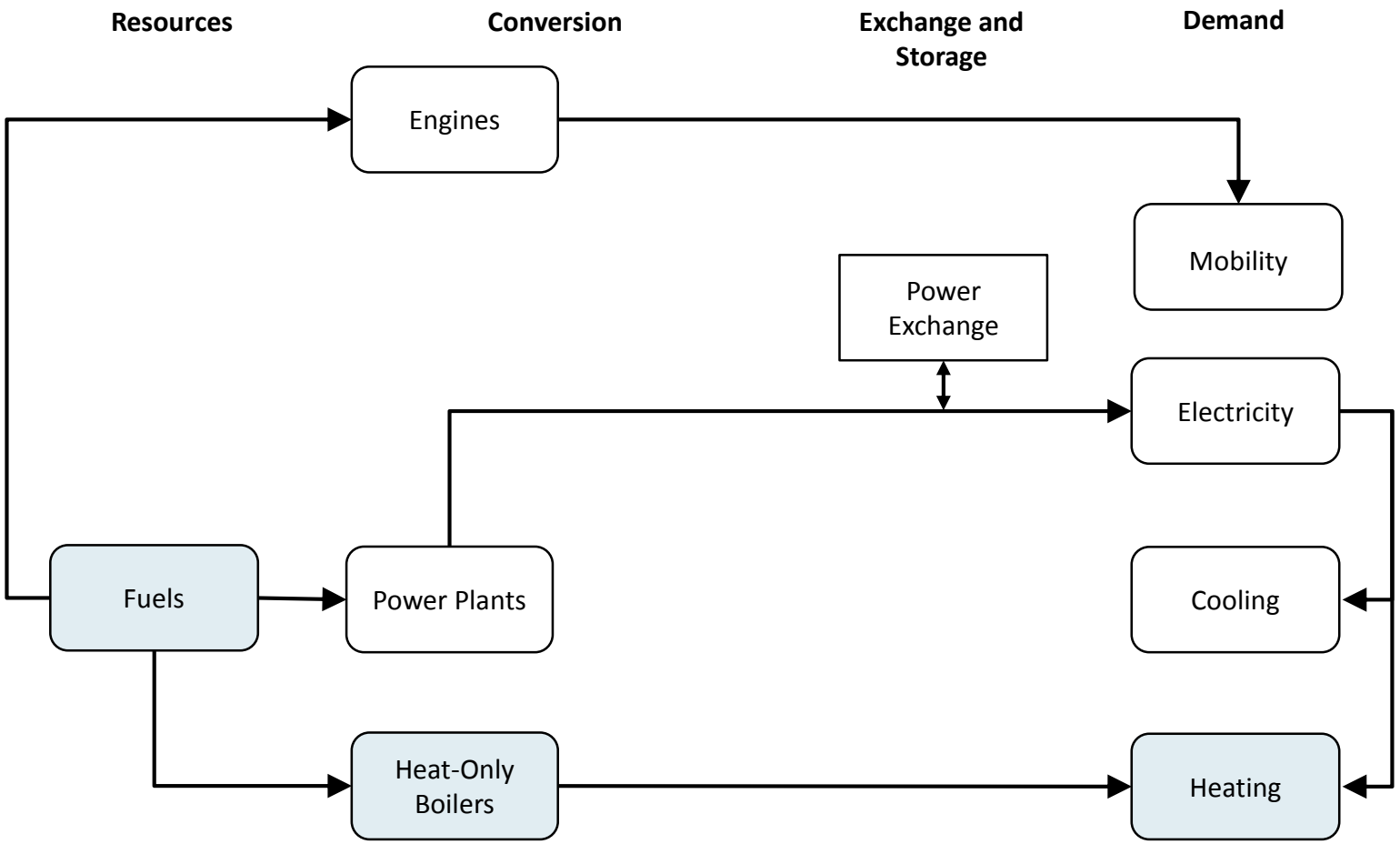
Stratego

Interactive Online Maps



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

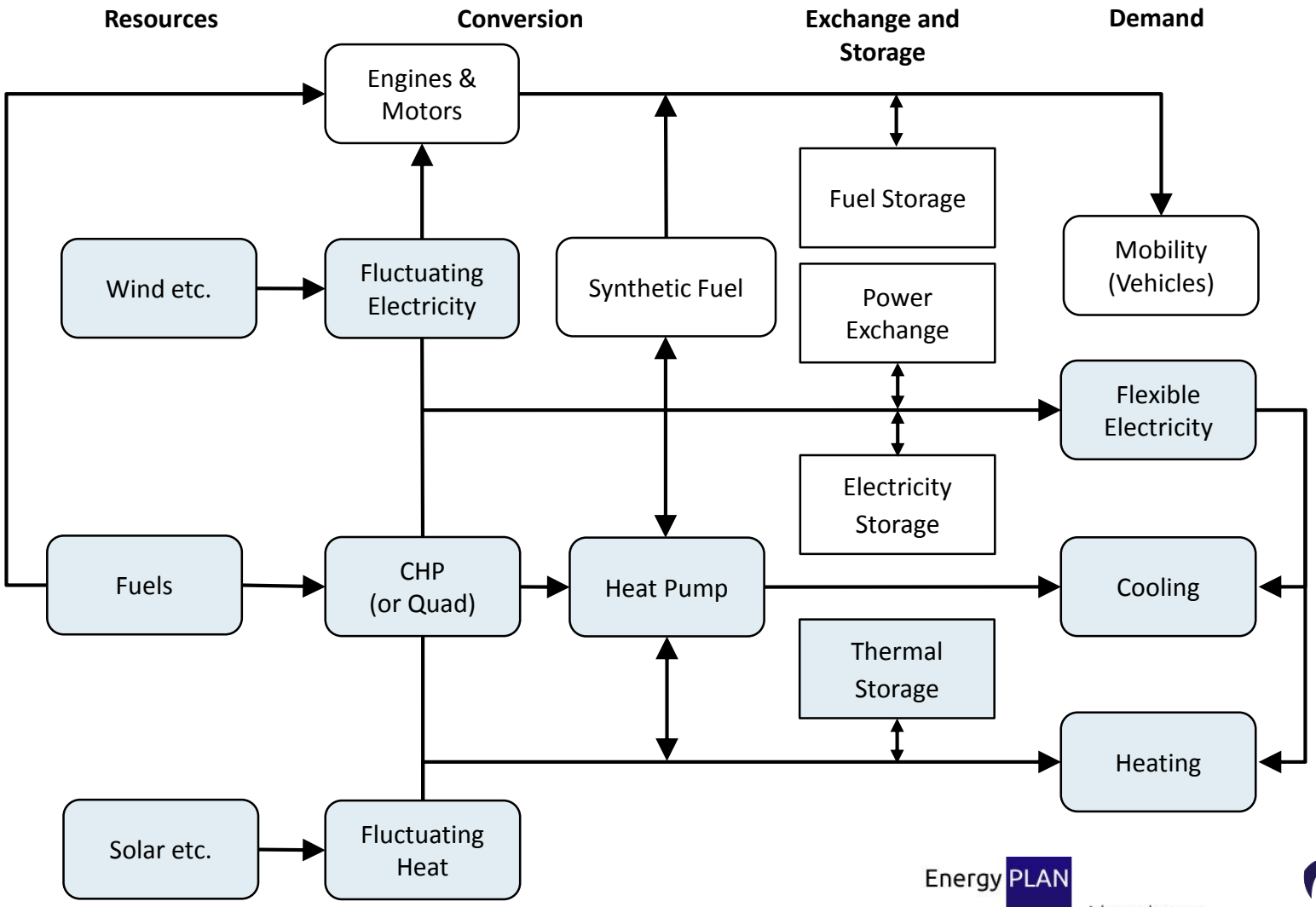
Today's Heat Sector



Energy PLAN
Advanced energy system analysis computer model

AALBORG UNIVERSITY
DENMARK

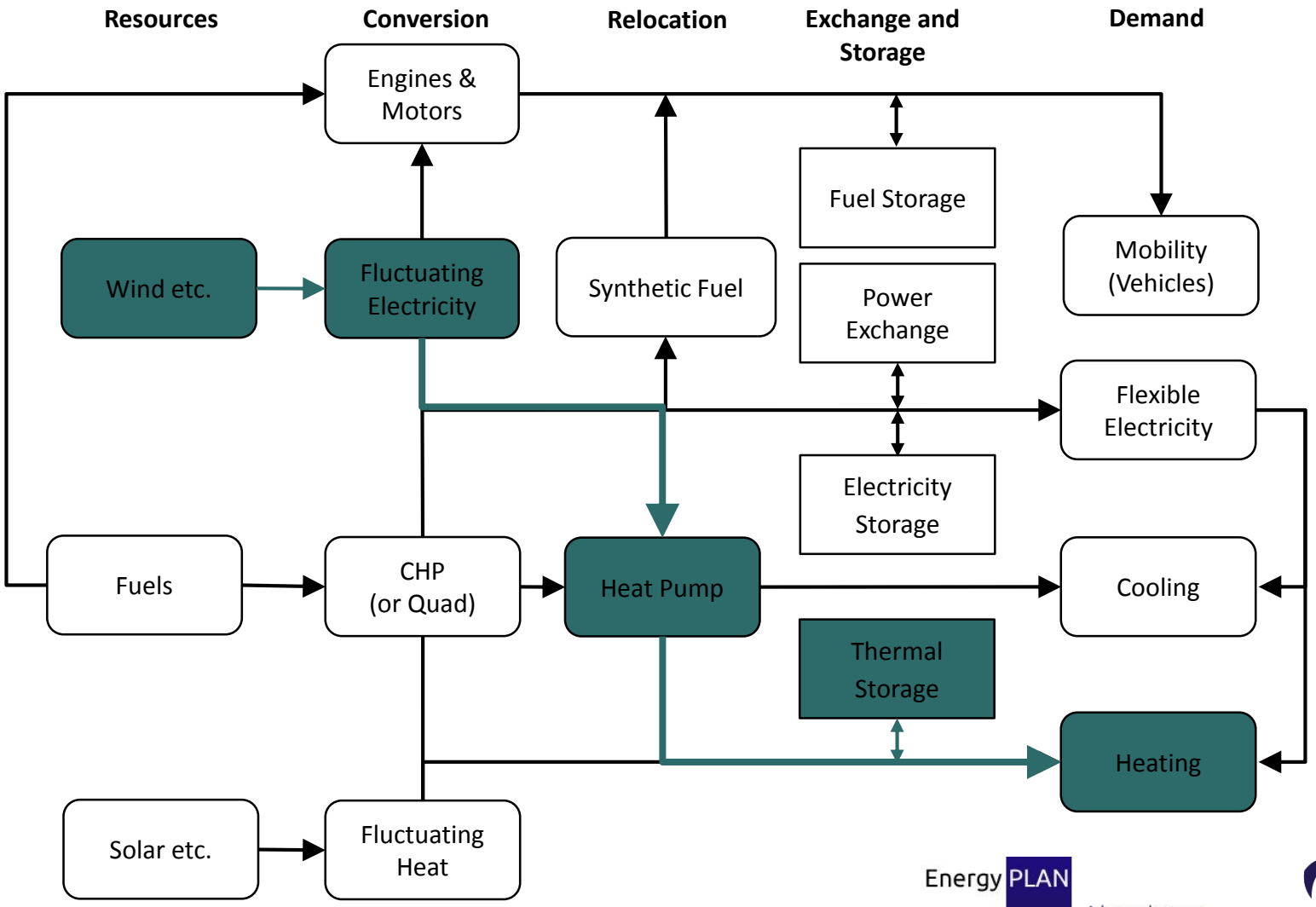
The New Heat Sector



Energy PLAN
Advanced energy system analysis computer model

AALBORG UNIVERSITY
DENMARK

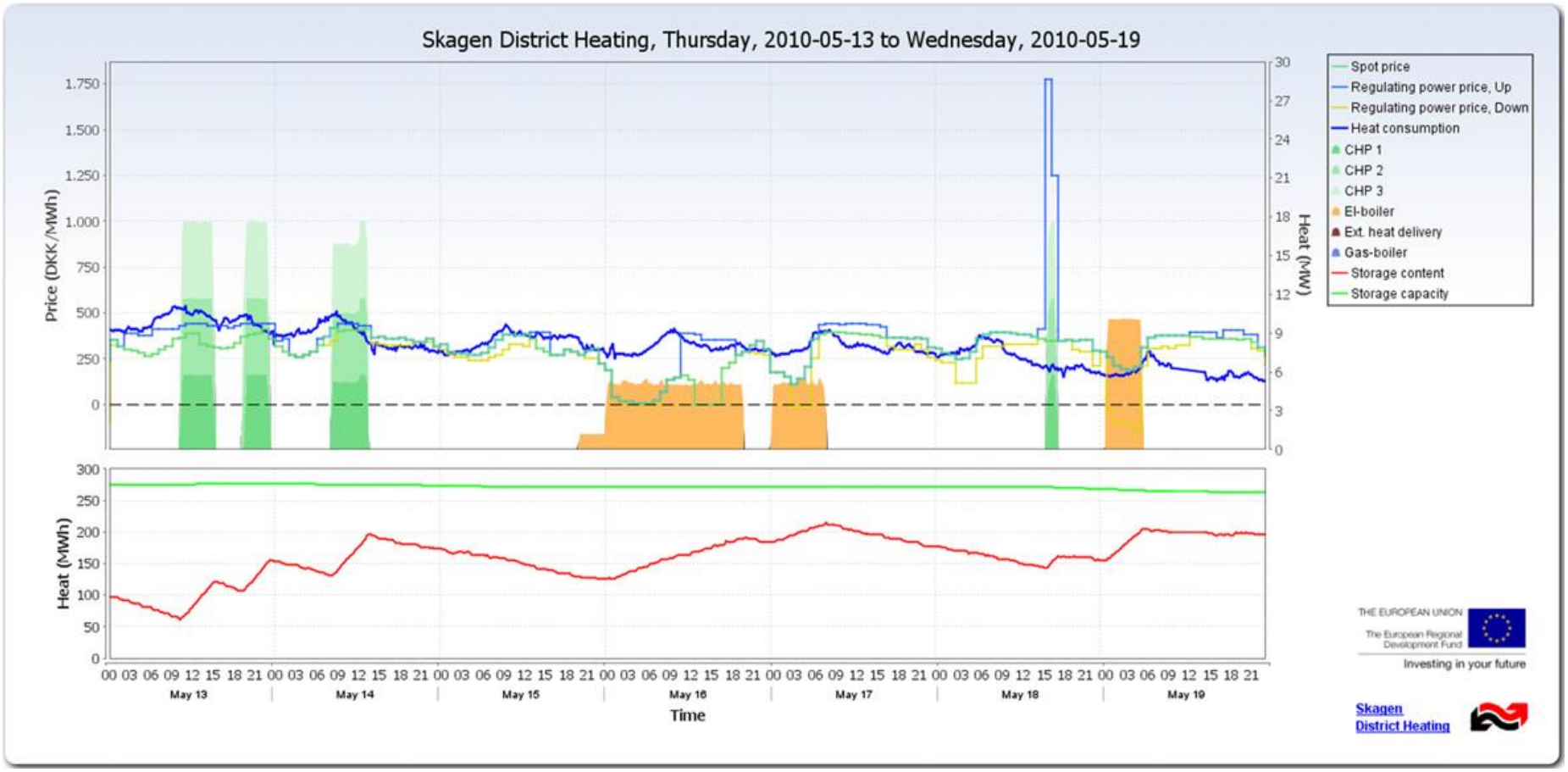
Integrating 40% Wind Power with District Heating



Energy PLAN
Advanced energy system analysis computer model

AALBORG UNIVERSITY
DENMARK

Denmark


Skagen District Heating, Thursday, 2010-05-13 to Wednesday, 2010-05-19
Price (DKK/MWh)
Heat (MW)
Heat (MWh)
Time
May 13
May 14
May 15
May 16
May 17
May 18
May 19
Spot price
Regulating power price, Up
Regulating power price, Down
Heat consumption
CHP 1
CHP 2
CHP 3
El-boiler
Ext. heat delivery
Gas-boiler
Storage content
Storage capacity
THE EUROPEAN UNION
The European Regional Development Fund
Investing in your future
Skagen District Heating

Sustainable: Flexible, so more Solar (Marstal: >50% solar in heat supply)

Storage Costs

- Electricity = €170/kWh

- Thermal = €0.5-3/kWh

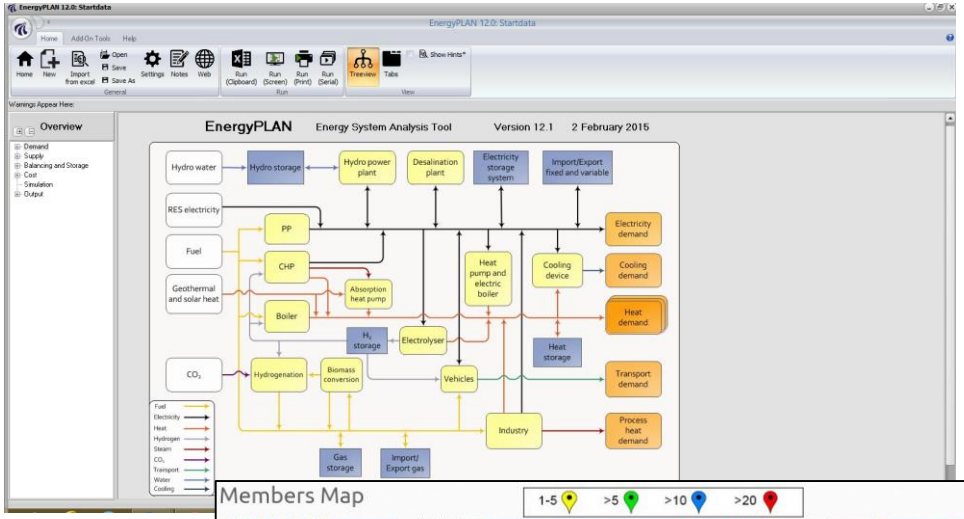
AALBORG UNIVERSITY
DENMARK

EnergyPLAN: Version 12

www.EnergyPLAN.eu

Energy PLAN
Advanced energy system analysis computer model

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



- Over 1000 Registered Users across more than 100 countries
- Lots of free training provided:
  - Exercises with solutions
  - FAQs
  - Forum
  - Quarterly online workshops
  - User Manual
- Can be used to model any national energy system
- Freeware software

3. District Heating is Expensive

Stratego

3 options for the Heat Sector

1. Savings

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

2. Urban Areas

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

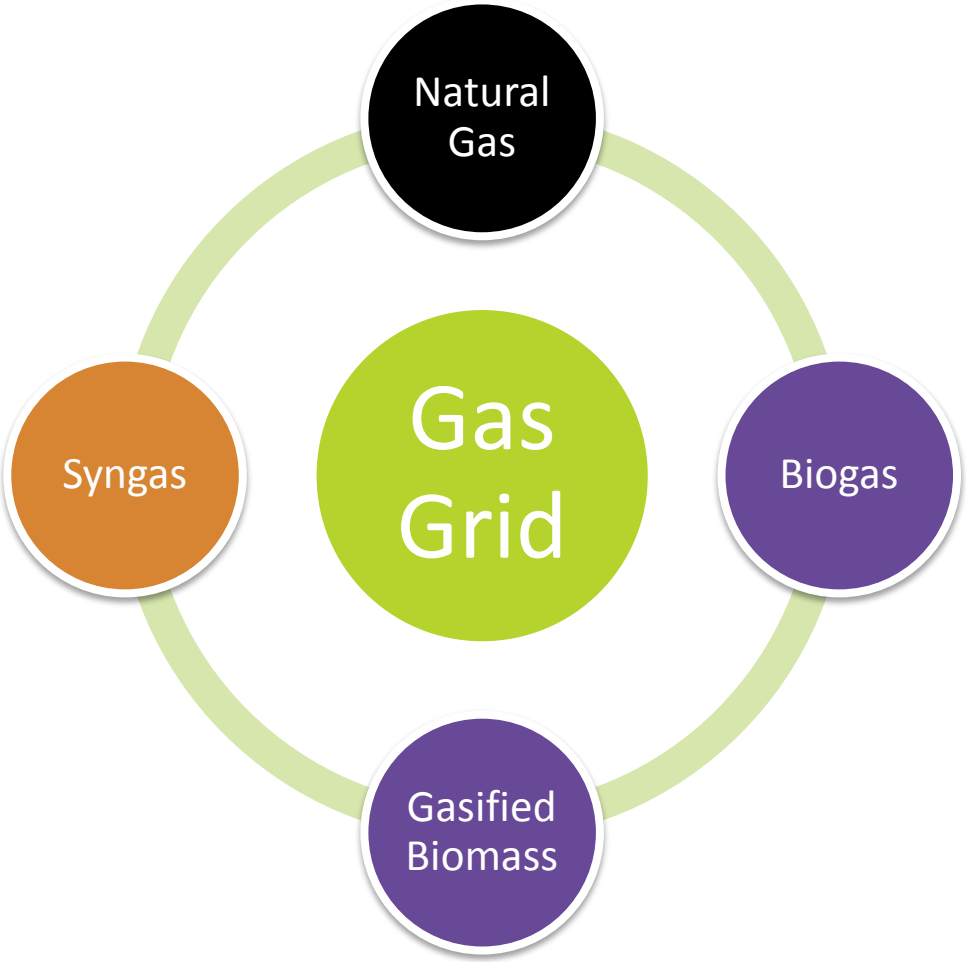
3. Rural Areas

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

30-50%
Marginal

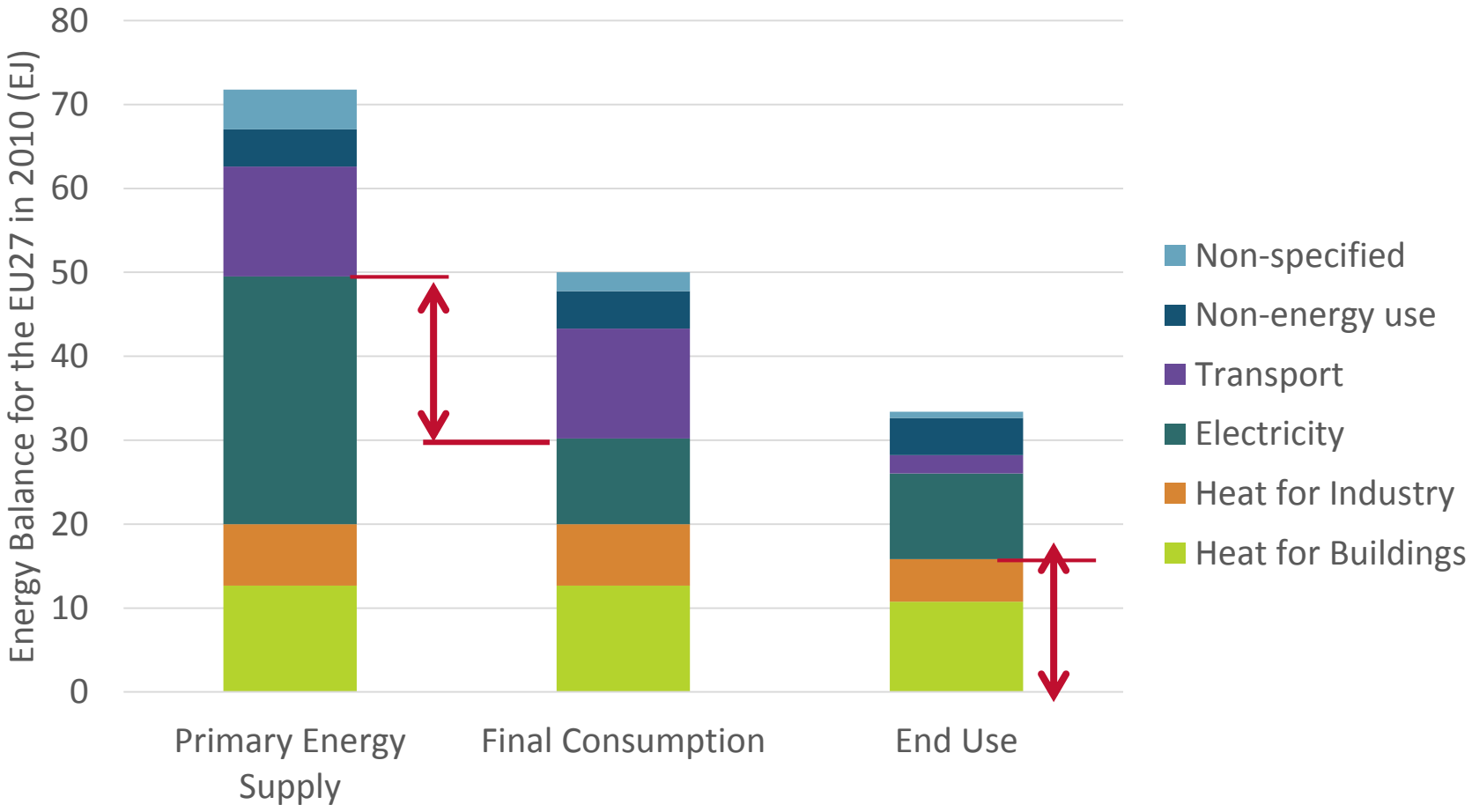
Gas or
District Heating?

Gas Grid
High quality energy for a low quality demand



District Heating
Low quality energy for a low quality demand

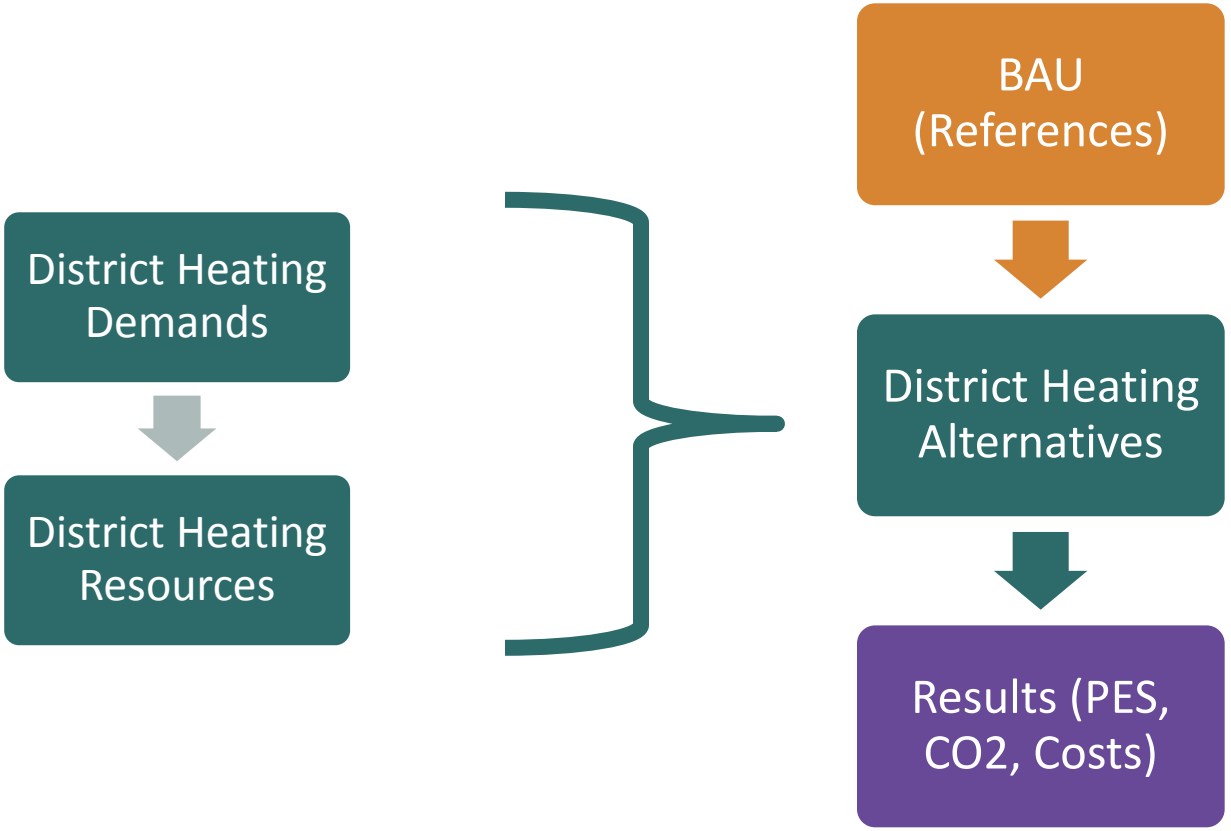
The Current Situation



District Heating Analysis

GIS Mapping
(could be another technology, resource, etc)

Energy System Modelling (EnergyPLAN)



HRE2: Key Conclusion

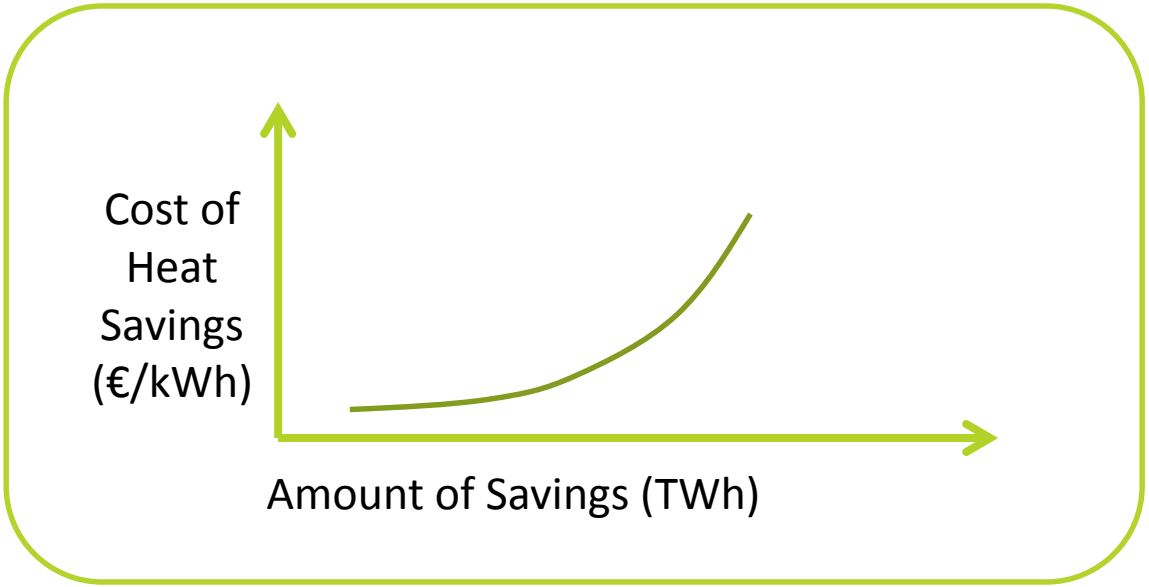
- A combination of:
  - 50% District Heating (*Cities*)
  - 50% Heat Pumps (*Rural Areas*)
  - 35% Energy Savings (*Everywhere*)

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

4. Heat savings will remove the need for heat supply

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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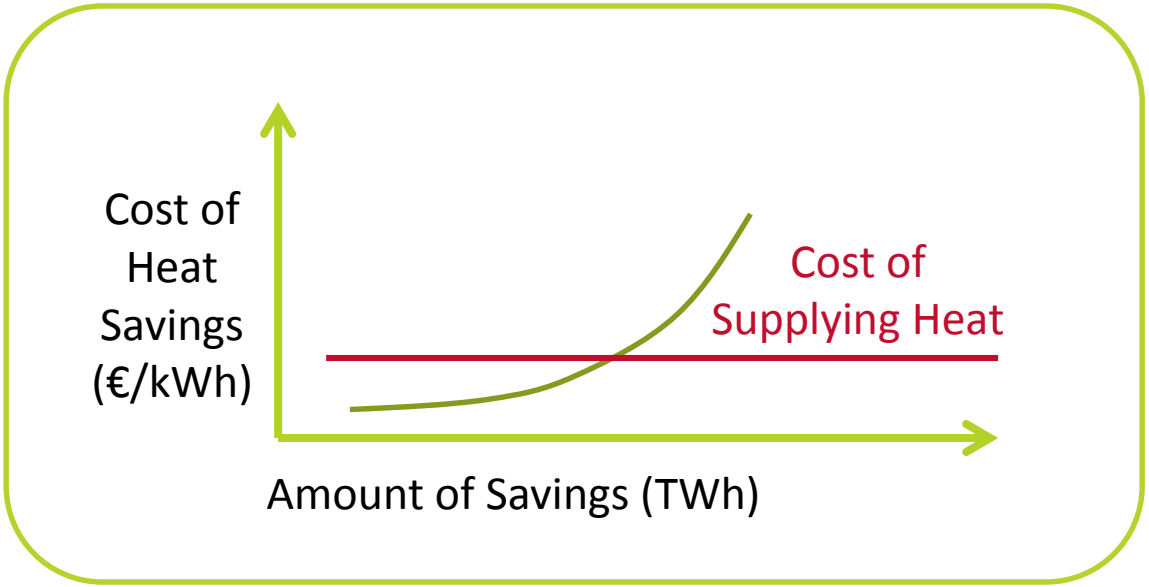

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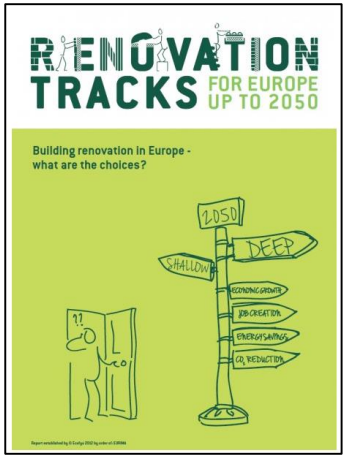
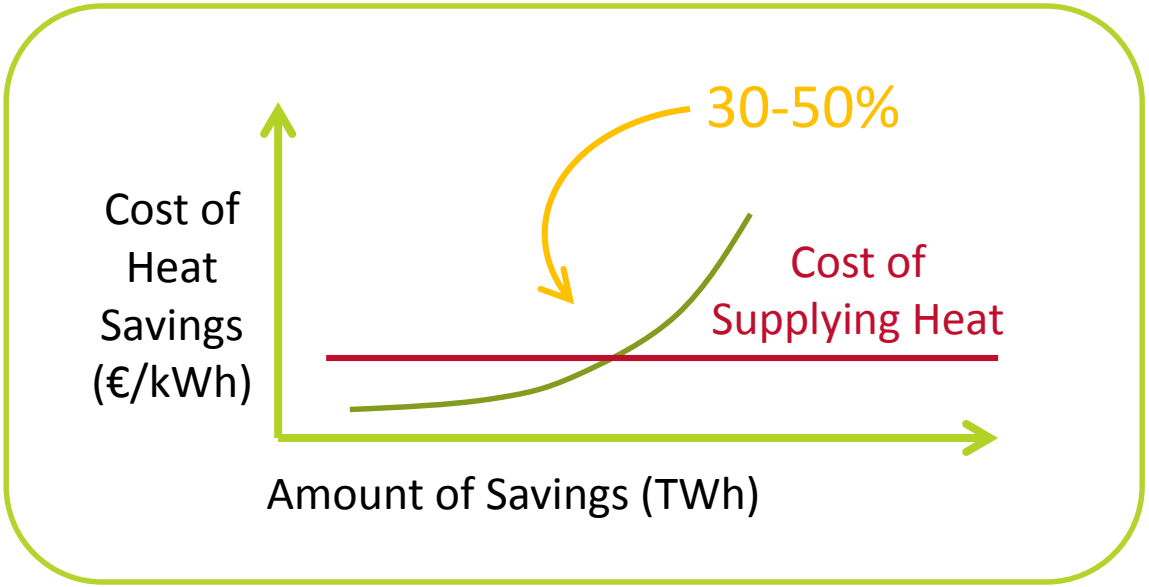
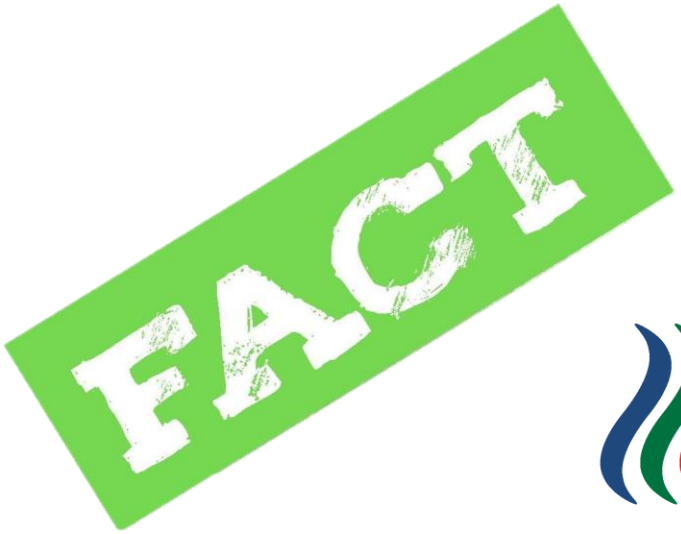




4DH
4th Generation District Heating Technologies and Systems

4th generation district heating provides lower and more flexible distribution temperatures, enabling the utilization of renewable energy sources such as geothermal and solar while meeting the requirements of low-energy buildings and energy conservation measures in the existing building stock.



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

4. Heat savings will not remove the need for heat supply

Stratego

3 options for the Heat Sector

1. Savings	2. Urban Areas	3. Rural Areas
➥ Reduce our demand for heat: ➥ Space heating ➥ Hot water	➥ Share a heating network: ➥ Gas Grid ➥ Water (i.e. district heating)	➥ Use a heating unit in each building: ➥ Oil ➥ Biomass ➥ Heat Pumps ➥ Electric Heating
30-50% Marginal	~50% District Heating	Which one?

Stratego

3. Individual Heating Options

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

Stratego

3. Individual Heating Options

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

Stratego

3 options for the Heat Sector

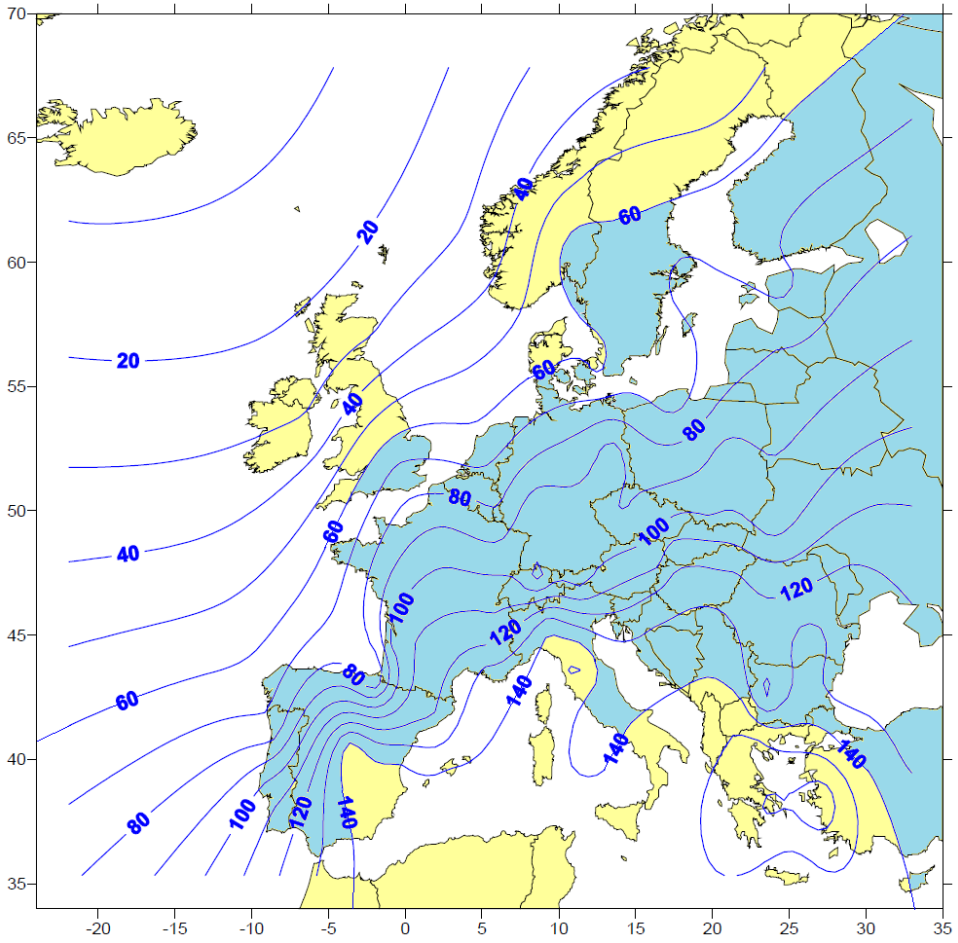
1. Savings	2. Urban Areas	3. Rural Areas
➥ Reduce our demand for heat: ➥ Space heating ➥ Hot water	➥ Share a heating network: ➥ Gas Grid ➥ Water (i.e. district heating)	➥ Use a heating unit in each building: ➥ Oil ➥ Biomass ➥ Heat Pumps ➥ Electric Heating
30-50% Marginal	~50% District Heating	~50% Heat Pumps

Conclusions: Heat Sector

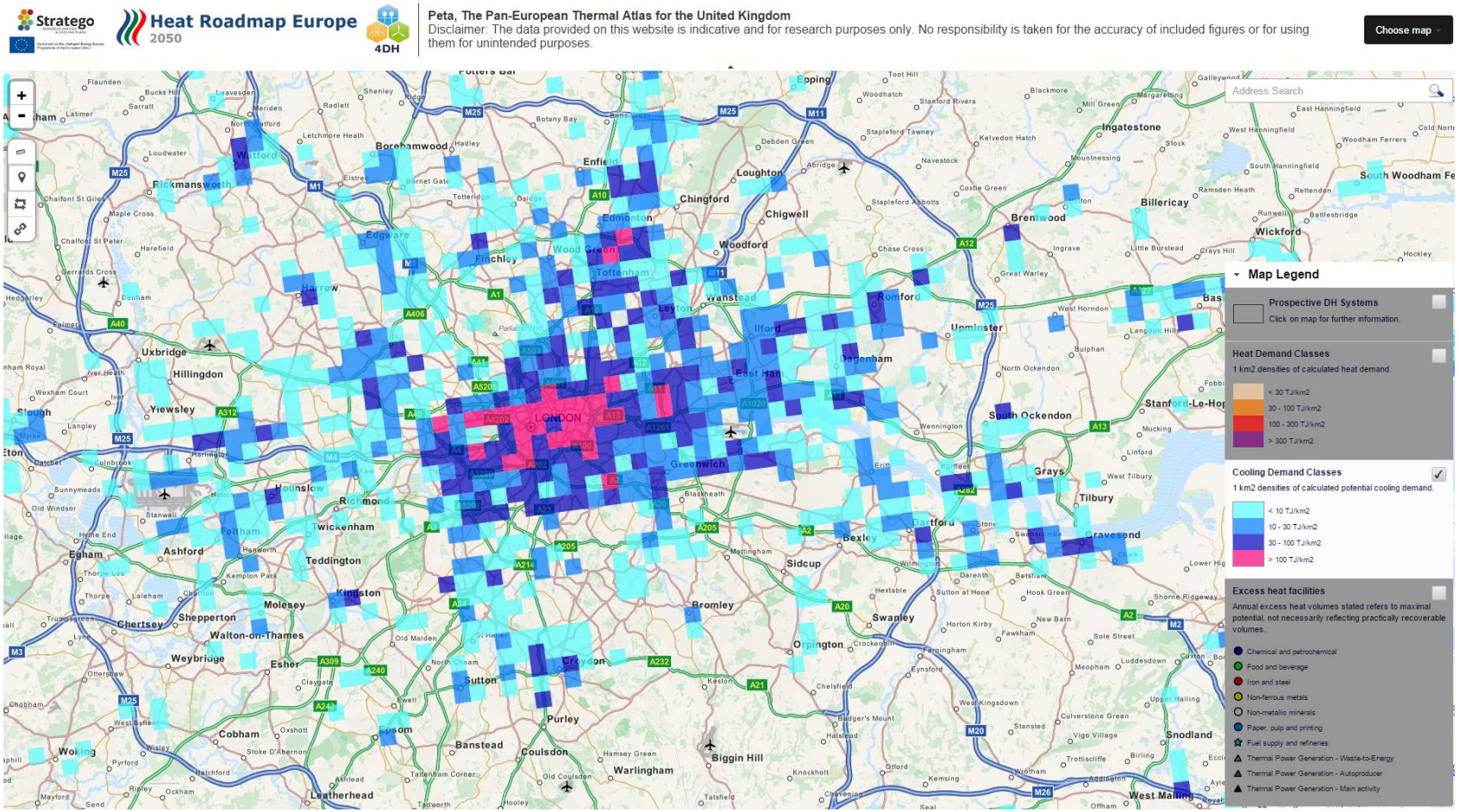
- **Savings:**
  - There is an economic balance between reducing heat and supplying heat
  - 30-50% heat savings is a good proxy for the economic limit of heat savings
- **Individual:** Heat pumps are the most suitable individual heating solution in a 100% renewable context
- **Networks/Urban:** District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

COOLING

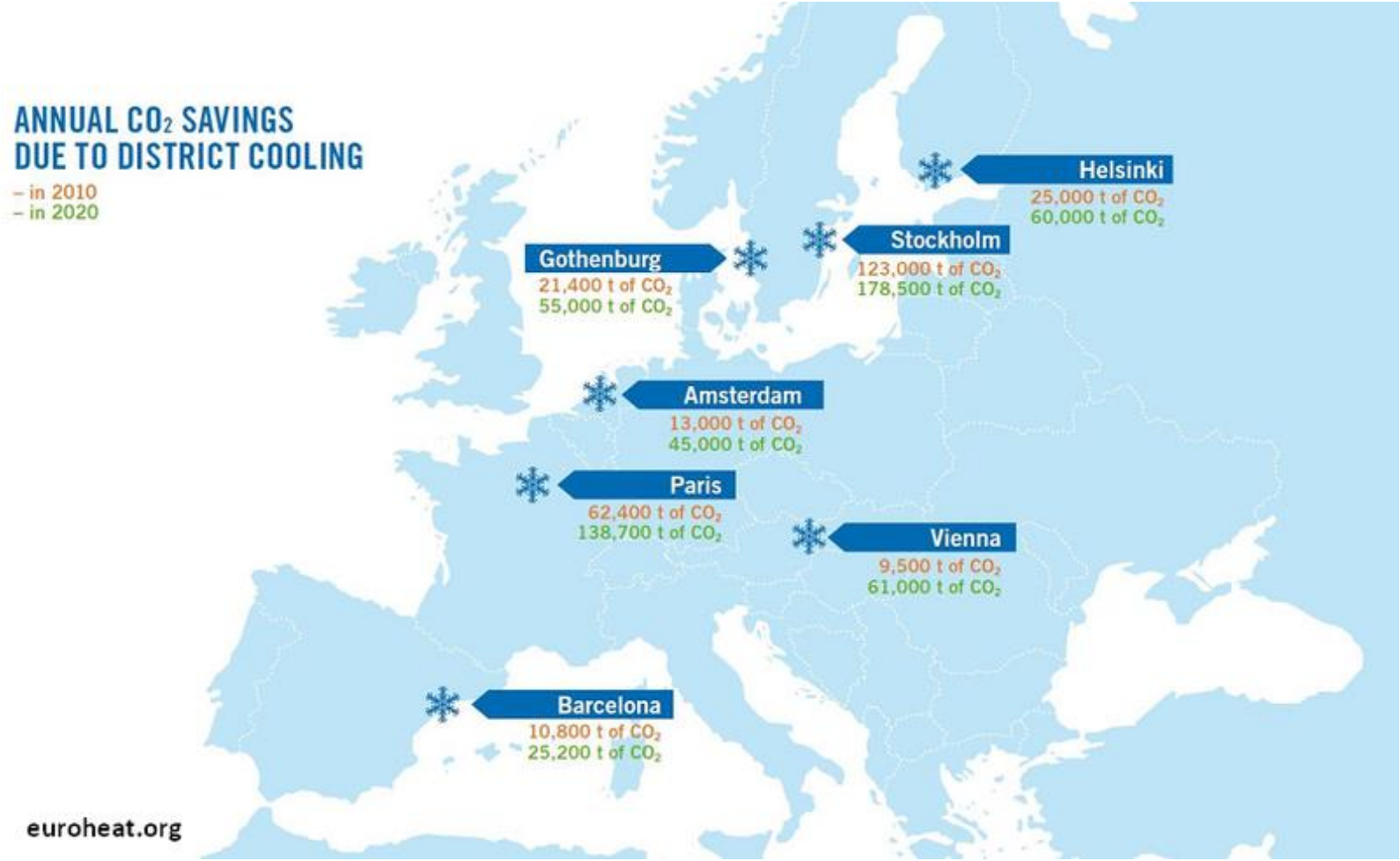
EU Cooling Demand



Sample Cooling Atlas from STRATEGO: London



District Cooling in Europe



Key Finding for the Cooling Sector

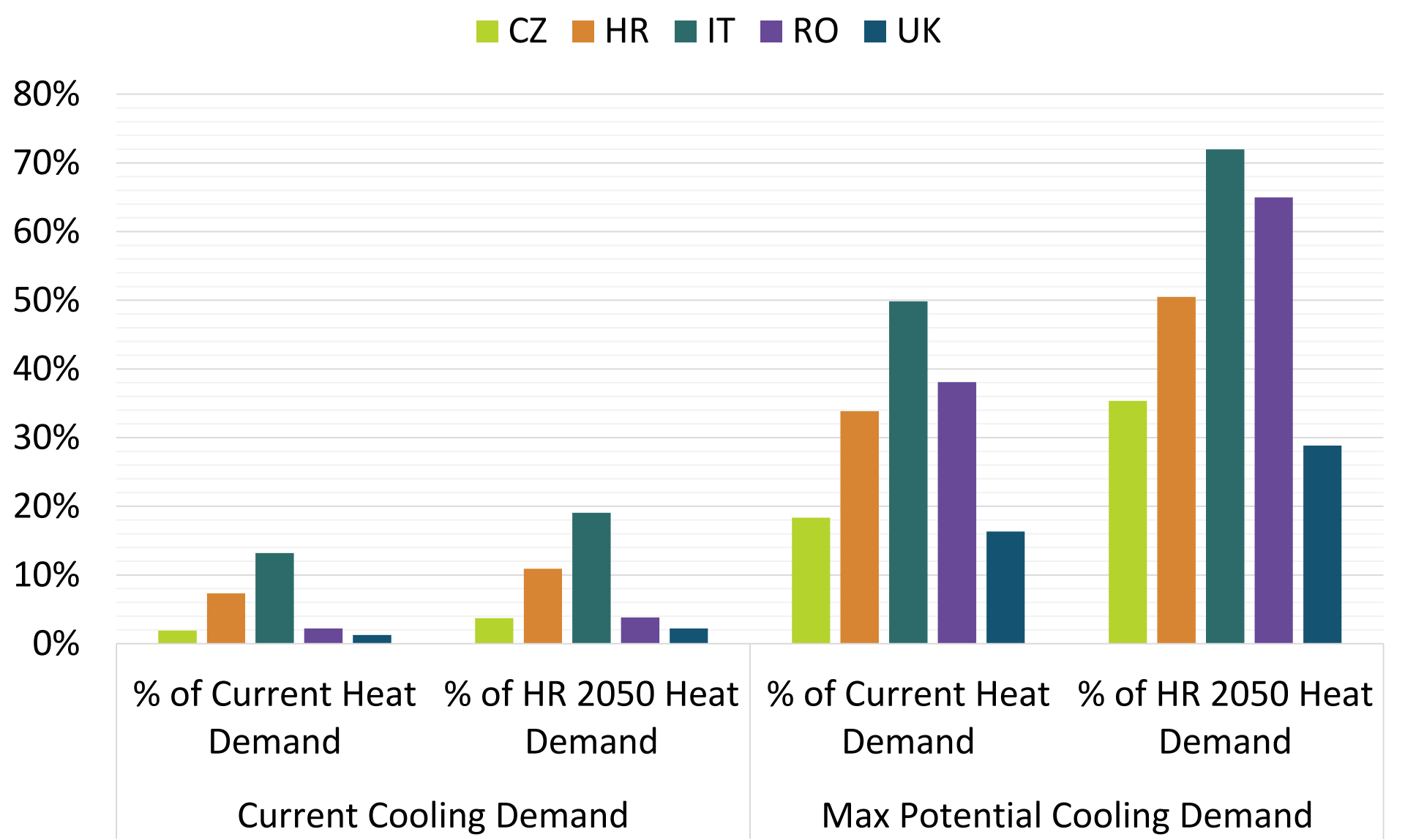
Today's Demand

- Very Small (~10% of heat demand with only CY, MA, & GR >30%)
- So, Currently a Local Issue

Future Demand

- Could Grow a Lot (Up to ~40% of heat demand with max of 140%)
- So, Potential National/EU Issue

Cooling Demand is Much Lower



Cooling: Key Messages

- Today, the cooling demand is too small to have a major influence at national level
- However, implementing district cooling is likely to have a positive impact at the local level
- If buildings meet their cooling needs in the future, then the cooling sector will start influencing the national energy system
- More research is required to identify an optimal level of district cooling: mapping and local modelling is most urgent in the short term

CONCLUSIONS AND RECOMMENDATIONS

STRATEGO WP2: Aim and Conclusion

- *AIM:*

The overall aim in STRATEGO WP2 is to develop low-carbon heating and cooling strategies, which are called Heat Roadmaps, and subsequently to quantify the impact of implementing them at a national level for five EU Member States, which are Czech Republic, Croatia, Italy, Romania, and the United Kingdom.

- *CONCLUSION:*

The overall conclusion is that a combination of energy efficiency measures, in the form of heat savings, district heating in the urban areas, and heat pumps in the rural areas, reduces the energy system costs, energy demand, and carbon dioxide emissions in all five STRATEGO countries for the year 2050 compared to a 'Business-As-Usual' projection.

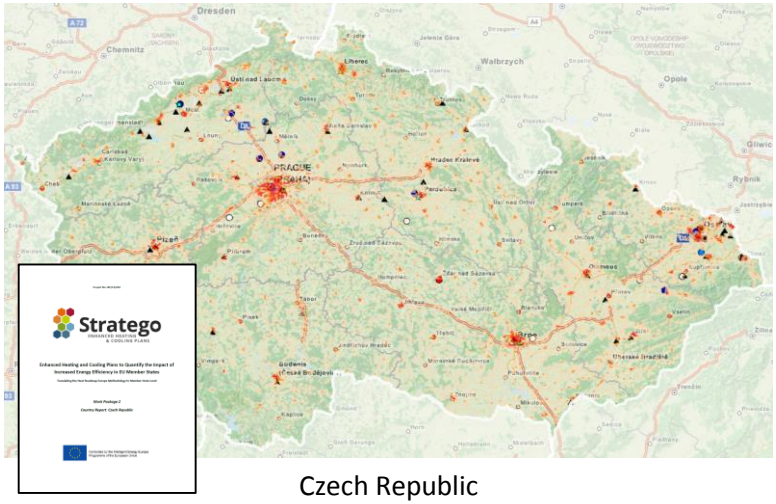
Recommendations

- 21 Recommendations in the Main Report, divided by:
  - Heat Savings
  - Heat Networks in Urban Areas
  - Individual Heating in Rural Areas
  - Cooling
  - Resources
  - Methodology and Tools

Avoiding the Grey Area

Option	Clear Message: We need to implement a lot of each one, not choose between them	Grey Area	Recommendation: The exact end point will become clearer over the next 30 years
Heat Savings	We need a 30-50% reduction in the total heat demand	Should it be 35%, 40%, 45%?	Start now by aiming for one target e.g. 40% reduction
District Heating	We need to go from ~10% to ~50% of the heat demand	Where do we go from a network to an individual solution?	Start now with the city centres or beside waste heat, progress outwards to rural areas
Heat Pumps	We need to go from <10% to ~50% of the heat demand	Same as district heating and, where is biomass more suitable	Start with any building that is far away from 1) easy access to biomass and 2) an urban area, progress towards the cities

Specific Map & Summary Report Available for Each Country



Czech Republic

Croatia

Heat Demand Classes

1 km2 densities of calculated heat demand.

- < 30 TJ/km2
- 30 - 100 TJ/km2
- 100 - 300 TJ/km2
- > 300 TJ/km2

Excess heat facilities

Annual excess heat volumes stated refers to maximal potential, not necessarily reflecting practically recoverable volumes.

- Chemical and petrochemical
- Food and beverage
- Iron and steel
- Non-ferrous metals
- Non-metallic minerals
- Paper, pulp and printing
- Fuel supply and refineries
- Thermal Power Generation - Waste-to-Energy
- Thermal Power Generation - Autoproducer
- Thermal Power Generation - Main activity

Italy

Romania

United Kingdom

Stratego

4DH
4th Generation District Heating Technologies and Systems

Questions?

How can we use this knowledge?

Visit our website for more information

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