Towards an Energy Transition that Works
The importance of systems thinking

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1. Energy is a System, Not a Sector
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- Resources
  - Fuels
  - Power Plants
  - Heat-Only Boilers

- Conversion
  - Engines

- Exchange and Storage
  - Power Exchange
  - Electricity

- Demand
  - Mobility
  - Cooling
  - Heating

**Stratego**

Advanced energy system analysis computer model

Aalborg University

Denmark
2. The Heat Sector is a System, inside the Energy System
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- Resources
  - Wind etc.
  - Fluctuating Electricity
  - Fuels
  - Solar etc.

- Conversion
  - Engines & Motors
  - Fluctuating Heat
  - CHP (or Quad)

- Exchange and Storage
  - Electrofuels
  - Fuel Storage
  - Power Exchange
  - Electricity Storage
  - Thermal Storage

- Demand
  - Mobility (Vehicles)
  - Flexible Electricity
  - Cooling
  - Heating
Smart Energy System

- www.SmartEnergySystem.eu
- www.EnergyPLAN.eu
Heating & cooling is complicated!
So we have a mixed approach
1. It Combines Knowledge Across the Energy System (www.EnergyPLAN.eu)

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

- Over 1000 users across more than 100 countries
- Lot 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
2. With Knowledge Across the Heating and Cooling Sector

- Heat & Cooling Demand (HU)
- Renewable Energy Resources (PE)
- Mapping Surplus Heat (HU)
- Mapping Demands & RE (UF)
- Energy Efficiency Costs (Ecofys & AAU)
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
Quantify the impact of energy efficiency at national level in the heating and cooling sectors:

We create the following for the heating and cooling sector:

- Data
- Tools
- Methodologies
- Results
Three HRE Studies to Date:

- **Study 1 (2012):** will district heating play a role in the decarbonisation of the European energy system?
  - EU27

- **Study 2 (2013):** what is the balance between heat savings and heat supply at an EU level?
  - EU27

- **Study 3 (2015, STRATEGO WP2):** what is the balance between heat savings and heat supply for 5 member states?
  - Czech Republic, Croatia, Italy, Romania, and the United Kingdom
Unique Issues for Heating

1. Heat Savings
   - Reduce our demand for heat:
     - Space heating
     - Hot water

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

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

The Decision for Each Issue will Affect the Others
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
Main Results for WP2

All Five STRATEGIC Countries

Total Additional Energy Efficiency Investments Between 2010 & 2050 ~€1.1 Trillion

- Heat Savings ~€600 Billion
- District Heating ~€275 Billion
- Individual Heat Pumps ~€225 Billion

Annual Change for Heating, Cooling, & Electricity Sectors

- Energy -30%
- Carbon Dioxide -50%
- Costs -15%

Not Which One, But How Much of Each
Heat Savings are Essential

Heat Roadmap Europe 2 has:

“Heat savings equal to the most ambitious deep renovation space-heating scenario in the Eurima study from 2012”.

Savings are good for both DH & HPs because they have:
- Smaller peak loads and more baseload
- Improve plant performance i.e. CHP on DH will lose less electricity and individual HPs will have higher COPs

Furthermore, district heating can also:
- Access more resources: such as solar thermal, geothermal, heat pumps, and excess industrial heat
- Use cheaper pipes (i.e. plastic instead of steal)

While heat pumps can also:
- Use existing radiators
- Avoid large electricity demands in the winter
DISTRICT HEATING IS ESSENTIAL IN CITIES

A. Large heat density across Europe (i.e. lots of cities)
B. Large amounts of excess heat available in Europe (i.e. ‘free’ local fuel)
30-50% of Heat Currently Feasible for DH
B. Excess Heat for District Heating
B. Excess Heat from Power Plants Alone Exceeds Demand Today

European Union 2010

Energy Balance for the EU27 in 2010 (EJ)

- Primary Energy Supply
- Final Consumption
- End Use

- Non-specified
- Non-energy use
- Transport
- Electricity
- Heat for Industry
- Heat for Buildings
Key Methodological Conclusions

- Energy is a System, Not a Sector
- The Heat Sector is a System, inside the Energy System
- We need better data, tools, methodologies, and results to continue designing a cost-effective heating and cooling sector
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.
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
Specific Map & Summary Report Available for Each Country
Key Finding for the Cooling Sector

**Today’s Demand**
- Very Small (<15% of heat demand)
- So, Currently a Local Issue

**Future Demand**
- Could Grow a Lot (Up to 70% of heat demand)
- So, Potential National/EU Issue
Questions?

www.heatroadmap.eu
www.strategto-project.eu
www.SmartEnergySystem.eu

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Heat Roadmap Europe
2050