A common vision for renewable heating and cooling

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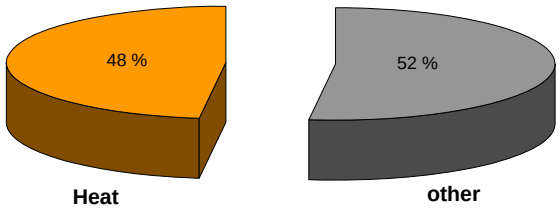
Heat is a substantial part of all energy needs!

In 2007, a share of 48 % of the final energy consumption in EU 27 was in the form of heat.

Heat accounted for:

- 86 % of the final energy consumption in households,
- 76 % in commerce, services and agriculture, and
- 55 % in industry.



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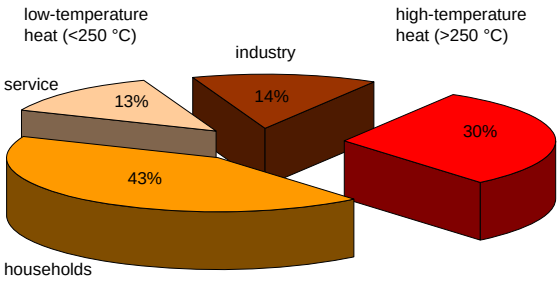
Some particularities of heat as a form of energy:

- The heat source must be near the heat demand
- The temperature of supply must meet the required temperature
- Heat users quite often have a specific demand profile

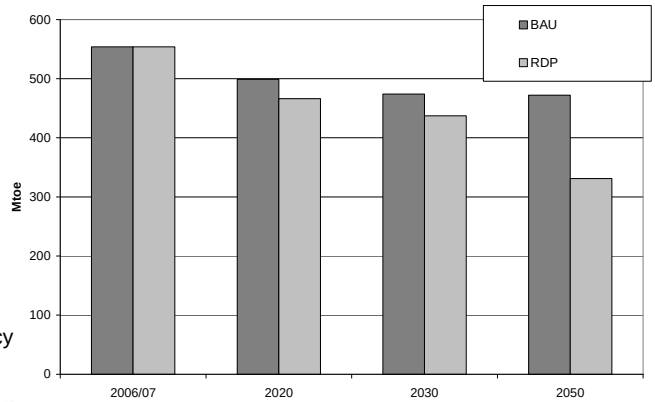
Quantification of the different uses of heat in EU 27

(in 2006, after data from Weiss & Biermayr, 2009)



Forecast of heat demand

Despite growing economy and increasing request for comfort, heat demand is expected to decrease due to efficiency gains.



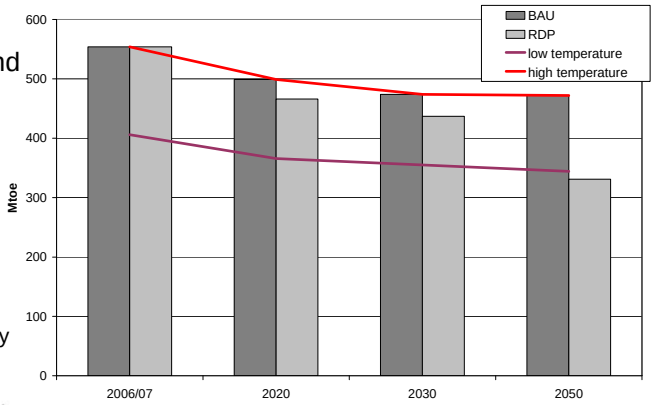
BAU:
Business as usual

RDP:
Full R&D and Policy driven

Forecast of heat demand

Despite growing economy and increasing request for comfort, heat demand is expected to decrease due to efficiency gains.

Distinction between low and high (>250 °C) temperature heat (in BAU)



BAU:
Business as usual

RDP:
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Renewable Energy for Heating and Cooling

The Directive 2009/28/EC on the promotion of the use of energy from renewable sources states in art. 2:

The following definitions also apply:

a) 'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

Of the renewable energy sources listed, only a selection is suitable to provide heating and cooling directly:

- solar thermal
- biomass
- geothermal
- aerothermal/hydrothermal (only with the use of heat pumps)

Solar Thermal

Principle:
Solar radiation is collected and the resulting heat conveyed to a heat transfer medium

Current key areas of applications:

- Domestic hot water preparation for single and multiple family houses
- Space heating of single and multiple family houses
- Hot water preparation in the hotel and service sector
- In some European countries also solar assisted district heating systems
- The number of solar thermal systems for cooling and air conditioning and industrial process heat increased considerably

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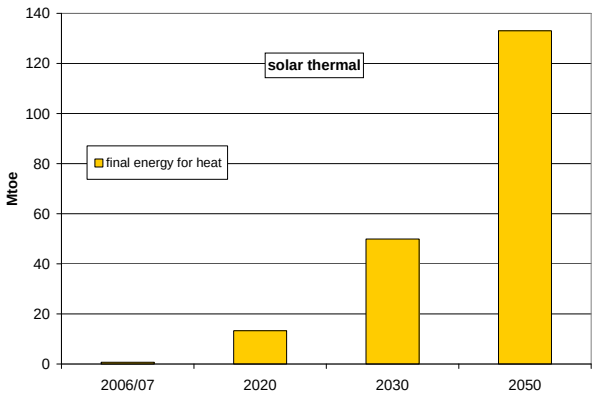
Solar Thermal

The contribution of solar thermal energy to the EU 20% Renewable Energy target by 2020 could be 6.3 %

In 2050, the total final energy for heating could reach 133 Mtoe



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Solar Thermal

Research needs:

- Solar collectors
  - Improvement of cost and performance of low temperature collectors
  - Process heat collectors with working temperatures up to 250°C
- Compact thermal storages with high energy density
- Thermally driven cooling and refrigeration
- Multi-functional building elements like fully integrated façade and roof collectors
- System designs for industrial applications

Biomass for Heat

Heating is the core function of energetic biomass use (78 % in 2007).

Biomass for heat currently covers more than half of the total renewable energy contribution in Europe.

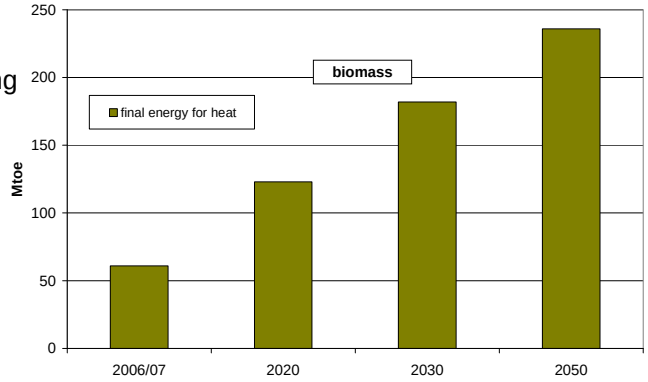
Current key areas of applications:

- Technology for providing bioheat to households, commerce and industry is available but has to compete against well established systems based on fossil fuels.
- Bioenergy can provide both
  - low temperature heat and vapour and
  - high temperature heat for industrial processes.

Biomass for Heat

The platform expects the biomass use to more than double till 2020 and to reach around 370 Mtoe of primary energy in 2050 (for all energy sectors).

The total final energy for heating could go up to 236 Mtoe



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Biomass for Heat

Research needs:

- Development of cost-efficient, high quality fuels from agricultural biomass, forestry, waste and algae – e.g. via torrefaction
- Development of agro-to-energy chains and mobilisation of forest residues
- Increase efficiency and reduce particle emissions of stoves and boilers
- Development of efficient small scale CHP plants and ability to run on multiple fuels
- Training of plumbers/installers of new biomass and combined RES systems

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Geothermal for Heat

Principle:
Geothermal energy is the energy stored in form of heat beneath the earth's surface.

Geothermal heating and cooling is currently provided from:

- The relatively stable groundwater and ground temperatures at shallow depths (mostly including heat pumps in the systems).
- Heat from ground and groundwater at higher depths and temperature varying between 25/30°C and about 150°C.

Current key areas of applications:

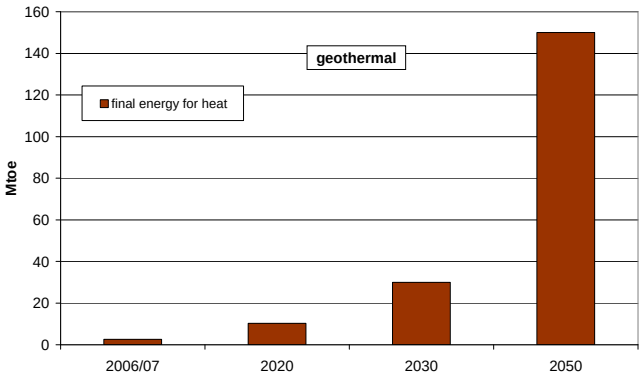
district heating, heating (and cooling) of individual buildings including both small and large schemes (offices, shops, residential houses, schools, green-houses, bathing etc.).

Geothermal for Heat

Direct use of geothermal heat is subject to the availability of resources; EGS is promising to open up all remaining area for direct heat use.

Geothermal heat pumps can be used virtually everywhere.

By 2050, a value in excess of 150 Mtoe of heat production is deemed possible



Geothermal for Heat

Research needs:

- Combined Heat and Power: cogeneration with Enhanced Geothermal Systems and low temperature power plants
- Develop commercial deep geothermal projects for industrial use and agriculture applications, desalination and innovative applications
- Development of large integrated DHC systems in which geothermal energy is flexibly used in different forms, individually or in combination with other Renewable Energy Sources
- Heat pump performance improvement as discussed in the CCT panel also will help to increase shallow geothermal efficiency.
- Shallow geothermal underground systems testing devices and methods

Cross-cutting technologies

Cross-cutting issues allow to overcome some incompatibilities that exist between the different sources and the demand side.

Renewable Energy Sources	Examples of problems and CCT solutions	Heat demand in buildings and industry
Solar Thermal Biomass Heat Geothermal Heat (in addition: aerothermal, hydrothermal)	Time of peak RES yield is different from peak heat/ cold demand: **Heat or Cold Storage** Source requires large ca-pacity installation, demand is in smaller units (e.g. buildings): **District Heating and Cooling** Temperature levels of source and demand do not match: **Heat Pumps** Required capacity, temperature and reliability cannot be met with one RES alone: **Hybrid Systems**	Buildings: - Space heating (in colder season) - Space cooling (in warmer season) - DHW (all year) - Swimming pools etc. Industry: - continuous demand - batch processes with intermittent demand - seasonal processes (e.g. sugar refinery)

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Cross-cutting technologies

District Heating and Cooling (DHC)

- The large integration of renewables in district heating will require the development of truly multiple source systems that can draw on a variety of heat and cold sources at different places
- Highly efficient and cost effective heat and cold storage is important for achieving the best allocation of resources in this process.
- For District Cooling, research and deployment of pilot demonstration sites is a necessary step for approaching the large-scale implementation of innovative systems

Target: A smart energy exchange network, allowing for optimal resource allocation between multiple low carbon energy sources feeding into the system and various temperature demands of costumers.

Cross-cutting technologies

Thermal Energy Storage

Storage systems can be required for daily demand-supply matching and for seasonal demand-supply mismatch for thermal energy needs.

The goal is to make an effective use of all thermal energy harvested by renewable heat production technologies.

- For solar thermal energy this implies to increase the solar fraction of the solar collector from 50% to 100%.
- For biomass boilers and heat pumps, heat storage leads to longer running time (reduced emissions and higher efficiency)
- Integrating effective heat storage capabilities in district heating system both enhances system performance and increases the operational cost effectiveness.

Cross-cutting technologies

Renewable Energy hybrid systems and heat pumps

Hybrid systems, combining one or more energy sources into a single system for a building, offer the potential of overcoming limitations from individual technologies.

One major barrier that should be tackled is related to control and automation of systems. As an hybrid system is not the simple addition of two (or more) separate systems put together, specific research should be carried on the best way to control one single system that manages thermal efficiency in the most effective way.

The combination of heat pumps with all sources included in this technology platform, as well as with aerothermal and hydrothermal source, can greatly improve the share of renewables and the efficiency of their production in heating and cooling.

Non-technical issues

The market for renewable heating and cooling is of quite different nature than that for electricity; it is diffuse, with many diverse players, and the product can have a large range in ‘energy-quality’.

The non-technical issues can be classified as:

- Policy and Legislation
- Stimulation/financial support
- Standardisation
- Training
- Communication

Conclusion / Synopsis

With sufficient R&D to develop fully all the potential in the different technologies,

with cross-cutting technologies available to help overcome source-demand mis-match,

with the necessary non-technical measures in place,

the renewable heating and cooling contribution to the European energy market could add up to…

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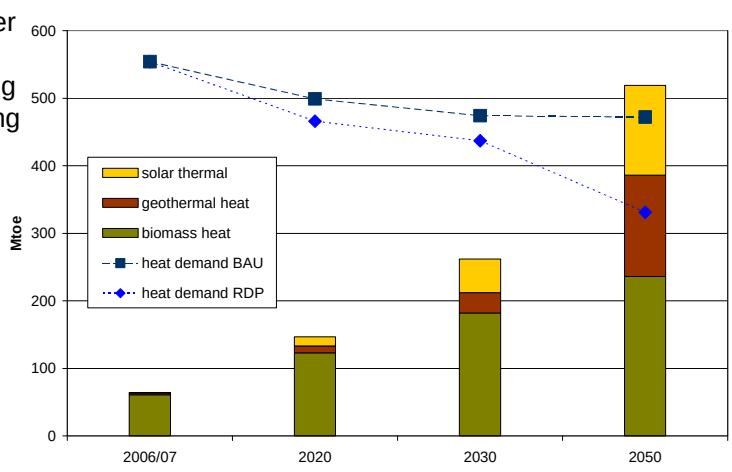
Conclusion / Synopsis

…well over 100 % of the heating and cooling demand!



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