



# ProEcoPolyNet Technology Profile

## Low temperature heating systems

### Description

Low exergy (or LowEx) systems are defined as heating or cooling systems that allow the use of low valued energy as the energy source. In practice, this means systems that provide heating or cooling energy at a temperature close to room temperature. Low temperature heating systems in residential buildings are mainly floor heating but can also be wall- or roof heating. This technology profile description focuses on low temperature heating systems in general and a little bit more focused on a common type of floor heating system, also suitable for retrofits, floor heating with coils in the surface layer.

### Benefits

Research shows that people living in houses with low temperature heating systems are very satisfied with ambient indoor air quality. In particular, thermal comfort levels are considered to be higher than in houses with a traditional heating system. Residents also experienced a reduction in draughts and dust, and reported fresher air in houses with low temperature heating systems.

By using low temperature heating systems the room temperature can be decreased by a few degrees, while keeping the same sense of comfort and warmth. Low temperature heating systems do not usually require radiators, which can be unsightly and hard to clean. This offers the additional advantages of increased living space and more flexibility in terms of interior design. Safety can also be improved during the heating season due to absence of hot radiator surfaces.

Low temperature heating systems can be regarded as sustainable because of their flexibility regarding the energy source. These systems are not bound to any one energy source and fuel switching does not entail excessive cost. Low temperature systems can utilise a variety of sources of heat including district heat, biofuel, solar energy, gas, oil or electricity, and so the user is not constrained by choices made in the planning phase.

Low exergy heating and cooling systems allow an efficient use of low valued energy, which is delivered by sustainable energy sources (e.g. by using heat pumps, solar collectors, either separate or linked to waste heat, energy storage etc.).

Future buildings should be planned to use or to be suited to use sustainable energy sources for heating and cooling. One characteristic of these energy sources is that only a relatively moderate temperature level can be reached, if reasonably efficient systems

are desired. The development of low temperature heating is a necessary prerequisite for the usage of alternative energy sources. The basis for the needed energy supply is to provide occupants with a comfortable, clean and healthy environment.

### Cost

Low temperature heat distribution systems have an operating life of at least 30-40 years during which time the user benefits from the economic advantages offered by flexibility of fuel choice. The life cycle costs of a low temperature heating system are about the same as of a traditional system. Although the initial investment might be slightly higher, the system offers increased flexibility in terms of fuel choice and increased energy efficiency. For example the efficiency of solar heating and heat pumps is considerably higher in a low temperature heating system than in a traditional one.

### Technical characteristics - coils in surface layer

Coils are embedded in a thin supporting layer beneath the floorboard. Conductive foils or metal sheets are applied to distribute the heat evenly over the surface. A layer of rigid insulation under the floor board conducts the heat to the surface and makes fast and effective regulation and control possible. This system has a short response time.

Surface oriented surface layers can be applied to floors or ceilings. There are mainly three types available on the market:

- 1) Solid masonry elements with factory made grooves in the surface, which will form a pattern where the water coils can be mounted before the plastering is applied on the surface. This type is mostly used for walls.
- 2) Sheet metal profiles that are applied on frame structure and act as heat distributors and load bearing elements for the surface layer.
- 3) Pre-cut blocks of rigid insulation with grooves for the coil and a conductive metallic foil covering the surface and the inside of the grooves.

The coils can be replaced, if desired e.g. in connection with the retrofit of the floor covering, or if the floor / ceiling covering can be dismantled in a non-destructive manner. The system is also

suitable for retrofitting, because it can be mounted on an existing floor construction, it will add only 12 mm to the floor height.

### Risks - coils in surface layer

The placement of the coils near the surface makes the coils vulnerable to mechanical impact. The largest risk is connected to the application of mechanical fasteners such as screws or nails in the surface especially during the operation of the building. Some simple methods have been developed to identify the pipe position in the surface but ignorant inhabitants would still be a risk. A damage to the coil will not necessarily lead to serious consequences since a small leakage would make the pressure drop in the system.

### Market situation

The application of LowEx systems is far more common in new buildings than in existing buildings. For example in The Netherlands and in Norway it is more or less common practise to install low temperature heating or high temperature cooling systems in new residential buildings. For existing residential buildings it is more of an unknown concept but the trend is, however, positive. In Japan and Canada, hardly any cases with low exergy systems installed in existing residential buildings can be found.

The arguments for the use of LowEx systems need to be communicated more clearly for all the target groups in most countries in order to reach a wider application of these systems. The positive associations need to be supported by good examples gained from the use of LowEx systems. When the additional benefits are reliably presented, people will most probably be willing to accept extra investment costs. Thermal comfort is seen as an important aspect, but in some countries end users are ready to accept incomplete comfort.

End users are usually not familiar with low temperature systems, except in Germany where they are quite well known. Manufacturers and suppliers, on the other hand, are usually familiar with LT systems. Variation in the other groups is considerable among the countries and even inside the countries. The architects have been defined as a group to which more information about low temperature systems needs to be given to. This is the group, which has a great influence in implementing the systems into the market.

In general, LowEx systems seem to bring very positive associations, like energy efficiency, comfort, soft heating or safety. There were a few comments about suspected comfort problems, but

these were exceptional. Some doubts about the functionality and ease-of-use of the systems were expressed. Sometimes the systems are regarded as new and exceptional systems, and therefore something to be careful with. There are groups, which will rather stick to the traditional systems. In many cases Low Temperature Heating was associated with floor heating.

### Obstacles for market penetration

There is a lot of variation in attitudes towards extra investment costs. In Finland, France and Germany extra costs are less accepted than in Sweden, Netherlands or Norway. In Canada people are mostly willing to pay for the extra benefits offered by the LowEx systems. Extra costs are sometimes accepted also in Japan, when the additional benefits are clearly communicated. Also in other countries good arguments are needed to change the negative attitudes towards extra investments. In some countries LowEx systems are considered as luxury systems. Using life-cycle costs instead of investment costs when comparing different alternatives, would be a solution to this problem.

In most countries thermal comfort is seen as a very important target for building design by all interviewed groups. Incomplete comfort is, however, tolerated by end users in many countries. It seems that they do not know that they could demand good thermal comfort in their houses. Also, architects often ignore thermal comfort as a target. Controllability is often considered more important than thermal comfort.

### Conclusions

The classical exergy analysis enables to pinpoint the location, to understand the cause, and to establish the true magnitude of waste and loss. Exergy analysis is therefore an important tool for the design of thermal systems since it provides the designer with additional information on where and why the losses occur. The designer can then proceed forward and work on how to improve the thermal system. Application of exergy analysis into buildings has not been common before the implementation of the project IEA ECBCS Annex 37. Tools for exergy analysis of buildings were developed during the working time of the project. More information about the analyses from the design guidebook developed in the project: <http://www.lowex.net/english/inside/guidebook.html>

There are currently many LowEx technologies available. Low temperature systems successfully combine both traditional and innovative new approaches to heating. Usually the heat is transferred into the room through air or liquid

circulation systems and the same system can often be used for both heating and cooling.

Thorough planning and expert implementation are prerequisites for an appropriate and functional system. System flexibility will be dependent on the choice of appliances and overall system design, which can be difficult and expensive to change after installation.

A wide application of LowEx heating and cooling systems in buildings will create a building stock, which will be able to adapt to use of sustainable energy sources, when desired. Without this ability, the transfer towards an energy-wise sustainable world will be delayed for decades.

Design Guidebook. Online: <http://www.lowex.net/english/inside/guidebook.html>

More information: "Towards sustainable architecture" report: <http://www.lowex.net/downloads/TSA.PDF>

### Contact and further information

IEA ECBCS Annex37: Low temperature heating systems for heating and cooling of buildings -

Date of release of this Best Practice Sheet: March 2007

ProEcoPolyNet is a **Network** for the **Promotion** of RTD results in the field of **Eco**-building technologies, small **Poly**generation and renewable heating and cooling technologies for buildings. The Consortium consists of the following partners.



The ProEcoPolyNet project is supported by



The sole responsibility for the content of this sheets lies with the authors. It does not necessary reflect the opinion of the European Community. The European Commission is not responsible for any use that may be made of the information contained therein.