## Note:

When the heating system in a building is replaced or modified, the building must be considered as a whole. The change may affect other parameters or features of the building.

- *Adjust the heating system*
  - After renovations, the heating system requires inspection and adjustments to fit with the new conditions.
- *Review the building's ventilation*
  - Changes made to the heating system can alter the ventilation, e.g. removal of a chimney may cause moist in the basement and attic.
- *Review the buildings electrical effect*
  - The current in the main fuses may be reduced as the electrical effect used by different heating systems may vary.

## About DREEAM

DREEAM (Demonstration of an integrated Renovation approach for Energy Efficiency At the Multi building scale) aims to show that renovating at a larger scale opens the opportunity for better integration of renewable energy and is generally more cost-effective. The project demonstrates a multi-building and single owner renovation approach that can achieve a 75% reduction of total energy demand.

The DREEAM approach is implemented on pilot sites in the UK, Germany and Italy. These demonstration sites are to validate the DREEAM method in different climate, cultural and institutional configurations.

dreeam
scaling energy renovation

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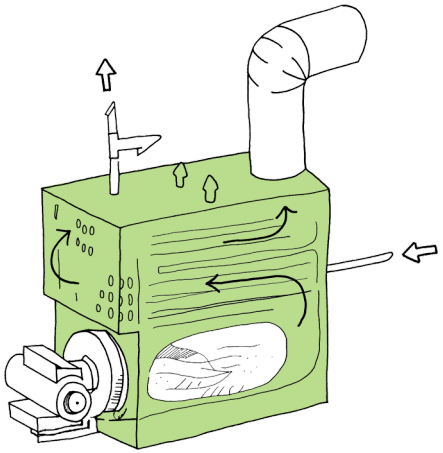
# HEATING SYSTEMS



## Temperature control and energy

Half of the energy consumed by the countries of the European Union is used to heat and cool buildings. In 2016, only 16 % of heating and cooling were produced by renewable energy sources. To fulfil the EU's climate and energy goals, the heating and cooling sector must considerably improve and shift to renewable energy sources (EU, 2016).

The energy consumption can be reduced through renovation processes, where the airtightness of the building fabric is improved, and intelligent thermostats and/or upgrade heating and cooling systems are installed. The change to renewable energy sources and local energy production can significantly decrease the need for fossil fuels.

## Different kinds of heating systems

The heating system is one of several installations in buildings. Below, some of the most common heating systems are listed. Either one can assist in the reduction of carbon footprint. The reduction depends on the type of fuel that is replaced e.g. the saving is larger for electrical heating compared to natural gas.

### *District heating*

District heating facilities distribute the heat using subcentres and is most common in larger communities and cities. The source of energy in district heating is often renewable.

### *Heat pump*

Heat pumps employ energy in the surroundings e.g. from the ground, air or water. Excess energy from ventilation and water may also be used. An electrical supply is needed to power the pump.

### *Electrical heating*

Electric boilers generate heat from an internal immersion heater, electrical radiators, floor heating or batteries in supply air channels.

### *Bio boilers and water-jacketed stoves*

The combination of bio boilers or water-jacket stoves with solar thermal energy is eminent in the heating of accumulator tanks and/or boilers. This combination reduces fuel use and maintenance during the summer. In contrast to other stoves, this method allows for storage of energy that could be used as either heat and/or hot water.

### *Solar thermal energy*

Solar thermal energy may be combined with a bio boiler or a water-jacketed stove. The bio boiler or water-jacketed stove will produce enough energy to make up for the decreased energy production from the solar panels in the winter.

STATE OF THE ART

## Micro Combined Heat and Power TRL 5-7

Combined heat and power (CHP) systems, also known as cogeneration, recovers the heat generated in the electricity production to be used in the heating of buildings. Micro CHPs in homes have a small fuel cell or heat engine that are commonly fuelled by natural gas. A generator in the device provides electric power, while the excess heat is used for heating, ventilation and air conditioning of the building.

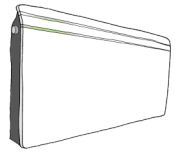
Depending on the used technology, the CHPs can be based on the reciprocating engine (TRL 7), Stirling engine (TRL 6) or fuel cells (TRL 5). The Micro CHPs takes advantage of wasted energy (heat) to provide an energy-efficiency of 95 %.

## Air Source Heat Pumps TRL 7*

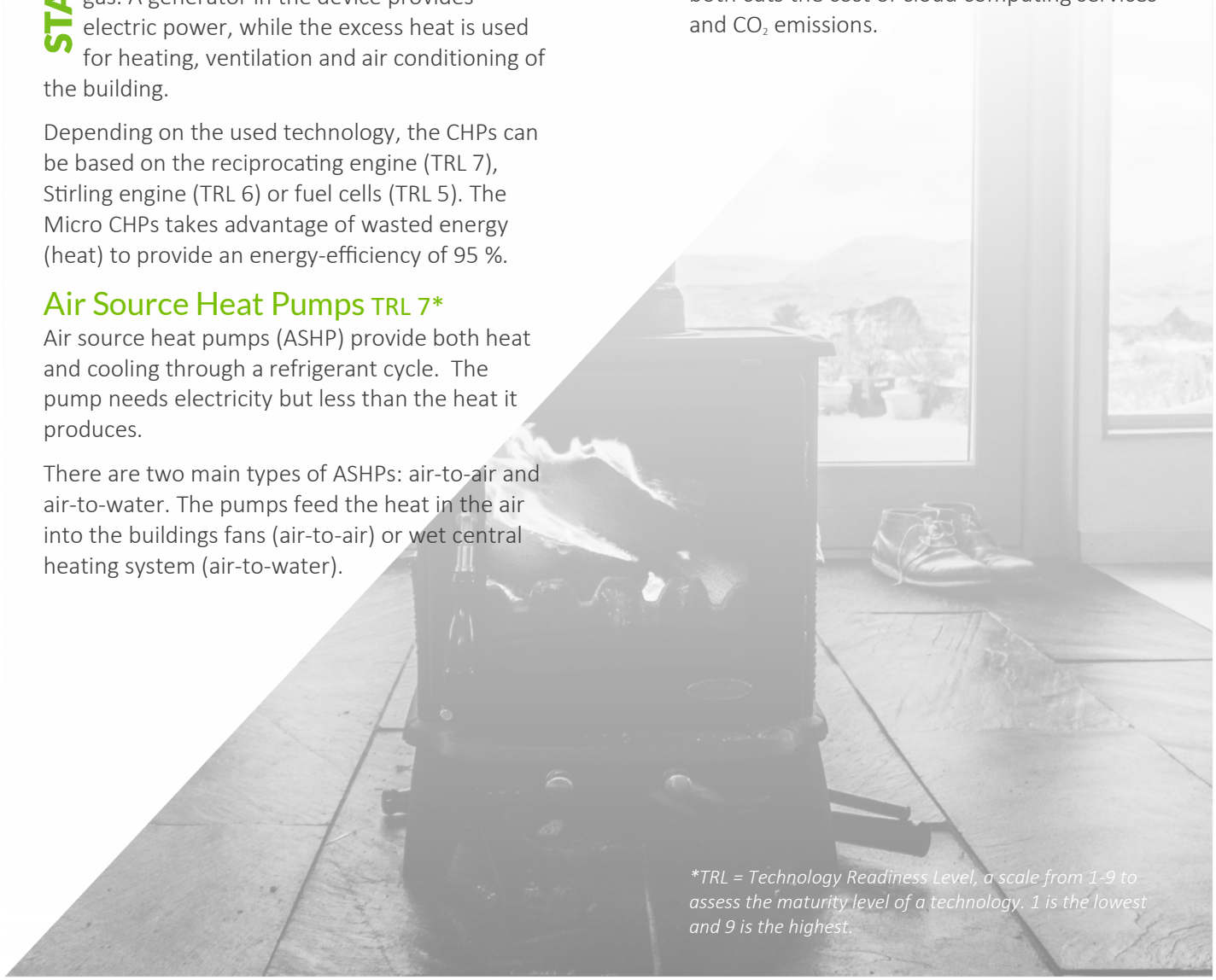
Air source heat pumps (ASHP) provide both heat and cooling through a refrigerant cycle. The pump needs electricity but less than the heat it produces.

There are two main types of ASHPs: air-to-air and air-to-water. The pumps feed the heat in the air into the buildings fans (air-to-air) or wet central heating system (air-to-water).

## Server-based Heating TRL 6



The excess heat from computer servers can be used to heat buildings. If the servers are placed in residential buildings, otherwise wasted heat can be employed as free heating and the need for cooling of data centres be reduced. This will both cuts the cost of cloud computing services and $CO_2$ emissions.



**TRL = Technology Readiness Level, a scale from 1-9 to assess the maturity level of a technology. 1 is the lowest and 9 is the highest.*