



Module 6

# Heating and Cooling Services

Energy Efficiency for Construction



24  
partners

12  
countries

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To equip the learner with the relevant knowledge and skills required to understand the importance of energy efficient Space Heating and Cooling, and Domestic Hot Water.



# Heating and Cooling Services | Objectives

1. Outline why space heating and domestic hot water provision is typically one of the **highest sources of carbon emissions** from a dwelling.
2. Outline why all hot water storage **vessels, pipes and ducts** associated with the provision of heating and hot water should be **fully insulated**.
3. Understand the relationship between providing heating and cooling with **energy savings, operational costs** and levels of comfort of the occupiers
4. Identify heating generation strategies to **minimise heating demand** during winter.
5. Identify cooling (latent and sensible) generation strategies to **minimise cooling demand** during summer.
6. Understand passive cooling strategies to **avoid overheating** or reduce the cooling demand during summer.
7. Identify **emerging technologies** being adopted onsite for energy performance of buildings



Topic 1 – Space Heating and Cooling

Topic 2 – Water Heating

On the following slides you will  
see this icon:



Click and play to find out more



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# 1. Space Heating and Cooling



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# 'Thermal' = 80% of Energy Consumption in Homes!



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- **Over 80%** of the energy in a typical dwelling is for thermal purposes: heating, cooling and domestic hot water, DHW.
- **Risk of high carbon emissions** associated with thermal energy
- Exact usage of DHW in homes is unknown
- Hot water losses in the Energy Assessment Procedure depend on several key factors

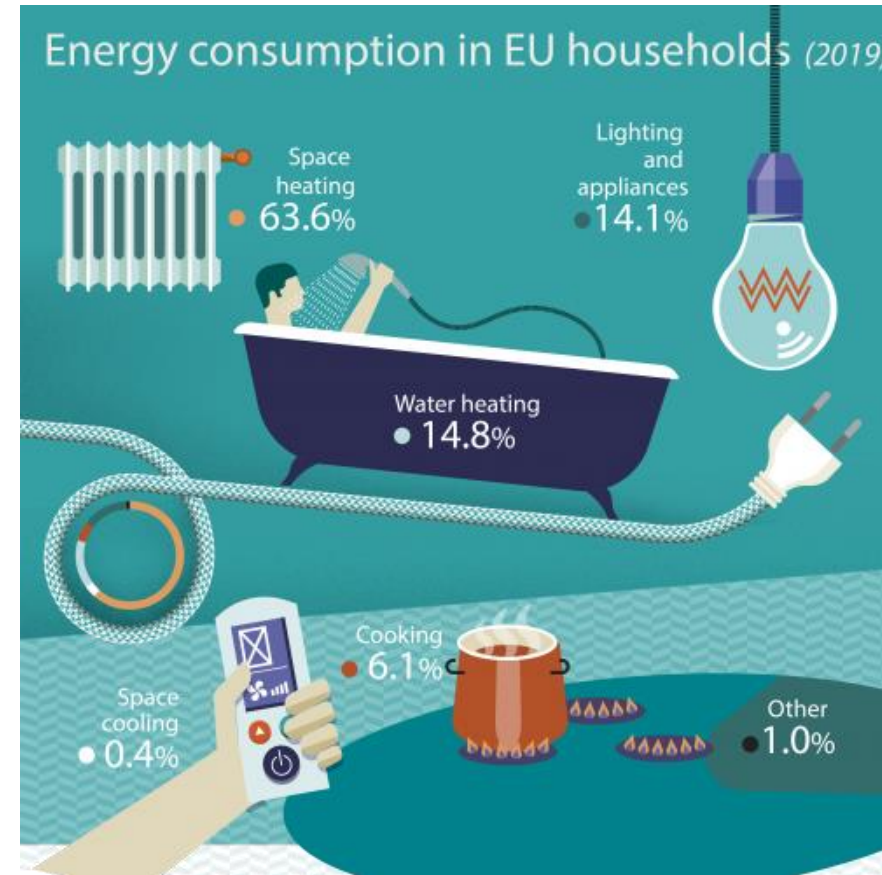


Image Source: Europa Eurostat Statistics



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# Significant Losses in Generation, Storage and Distribution



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The reason 80% of energy in residential buildings is for thermal is due to the **significant losses** in the system:

- Losses in **generation of heat** (inefficiencies of the heat generator)
- Losses in **DHW storage** (insulation levels of tank)
- Losses in **distribution** (insulation levels of pipes) – try to cluster bathrooms to minimise losses
- Energy used for hot water **circulation and pressurisation** (pumps)
- Losses of space heating energy **through the envelope** (U-values, thermal bridging, airtightness and ventilation)



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# Minimum Heat Generator Efficiencies

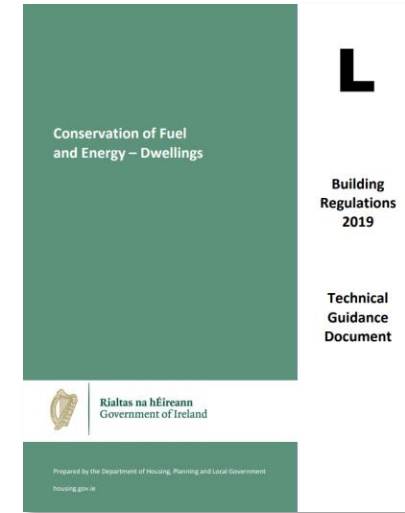


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**Oil and Gas Boiler** - For fully pumped hot water based central heating systems utilising oil or gas, the boiler seasonal efficiency **should be not less than 90%** as specified in the DEAP manual and the associated HARP database

**Biomass** - For fully pumped hot water-based central heating systems utilising a biomass independent boiler, the boiler seasonal efficiency **should be not less than 77%** as specified in the DEAP manual and the associated HARP database

**Storage Heaters** - New or replacement storage heaters should have a **heat retention not less than 45%** measured according to I.S. EN 60531:2000. They should incorporate a timer and electronic room thermostat to control the heat output that are user adjustable.



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Source: Ref P.24 – Building Regulations 2019

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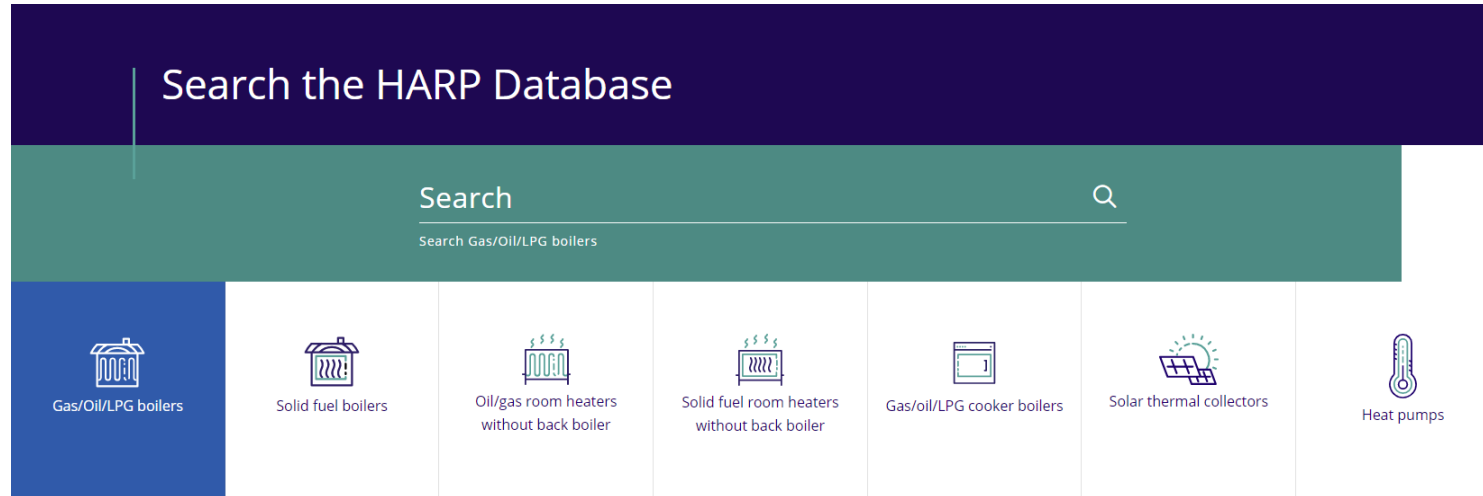
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# The HARP Database



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- The Home Heating Appliance Register of Performance (HARP) is a **product efficiency database for home heating appliances** used in Ireland.
- The HARP database provides BER Assessors and contractors with specific product efficiency information for use when **calculating BER assessments**.



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Image Source: SustainableEnergy Authority Ireland

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Heating systems should be effectively controlled so as to ensure the efficient use of energy by limiting the provision of heat energy use to that required to satisfy user requirements.

## Minimum Level of Control:

- Automatic control of space heating on the basis of room temperature
- Automatic control of heat input to stored hot water on the basis of stored water temperature
- Separate and independent automatic time control of space heating and hot water



And

- Shut down of boiler or other heat source when there is no demand for either space or water heating from that source



## Main Objective:

Operate the heat distribution system at the lowest temperature that will meet the comfort requirements – this will optimise the energy efficiency of the home

## Three Control Options:

1. **Weather Compensation:** most efficient form of control. The output temperature from heating source is adjusted according to outside air temperature.
2. **Room Thermostat:** thermostat in the house can be used in conjunction with an outside air temperature sensor to influence the curve control function.
3. **Fixed Temperature:** heating switched on and off by an in-built return temperature sensor and always operates up to its maximum working temperature. Does not offer optimum savings from the heating source.



# Controls: Heat Pump Response Time



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- With output temperatures from heat pumps between 35°C and 55°C, the **response time of the heating system is long.**
- Heat pump systems are therefore designed to **maintain a stable temperature** rather than be able to raise the temperature quickly immediately before occupation.
- **Night setback** can be used but with a setback of only 2°C to 4°C.



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# Optimum Position for Room Thermostat

- For larger dwellings (example, over 100m<sup>2</sup>), **independent temperature control** should be provided for zones that normally operate at different temperatures, e.g. living and sleeping
- Thermostats should be located in a position **representative of the temperature** in the area being controlled
- Position thermostat so that it is **not unduly influenced** by other heat sources and appliances, draughts, direct sunlight or other factors



## 2005 study:

- 14 million circulators fitted in the EU per year
- Consuming 50 billion kWh!
- Accounting for 23 million tons of CO<sub>2</sub> emissions



## EU EcoDesign Directive

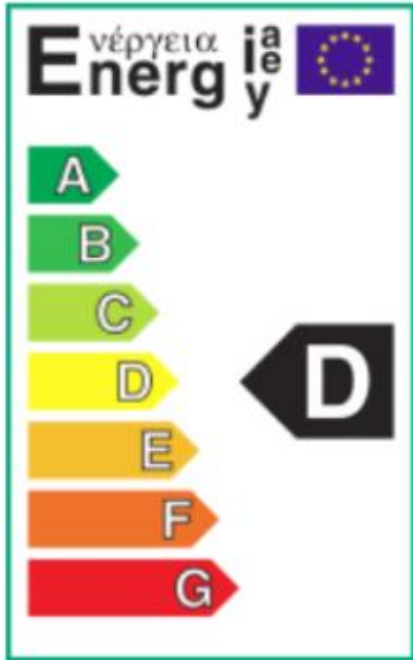
- Specifies requirements for the environmental design of energy-using products, including circulation pumps:
- 641/2009 and 622/2012: Glandless stand-alone circulators and glandless circulators integrated in products.



# Circulation Pumps Energy Labelling



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Class	Energy Efficiency Index (EEI)
A	$EEI < 0.40$
B	$0.40 \leq EEI < 0.60$
C	$0.60 \leq EEI < 0.80$
D	$0.80 \leq EEI < 1.00$
E	$1.00 \leq EEI < 1.20$
F	$1.20 \leq EEI < 1.40$
G	$1.40 \leq EEI$



- Compares efficiency of circulation pump to a 2002 model
- 'A' rated pumps are 60% more efficient than a 2002 model
- From 2005, **EEI has to be  $< 0.23$**  (required for 'CE' marking)



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Image Source: Left and middle: EC.Europa.EU / Right - Grundfoss

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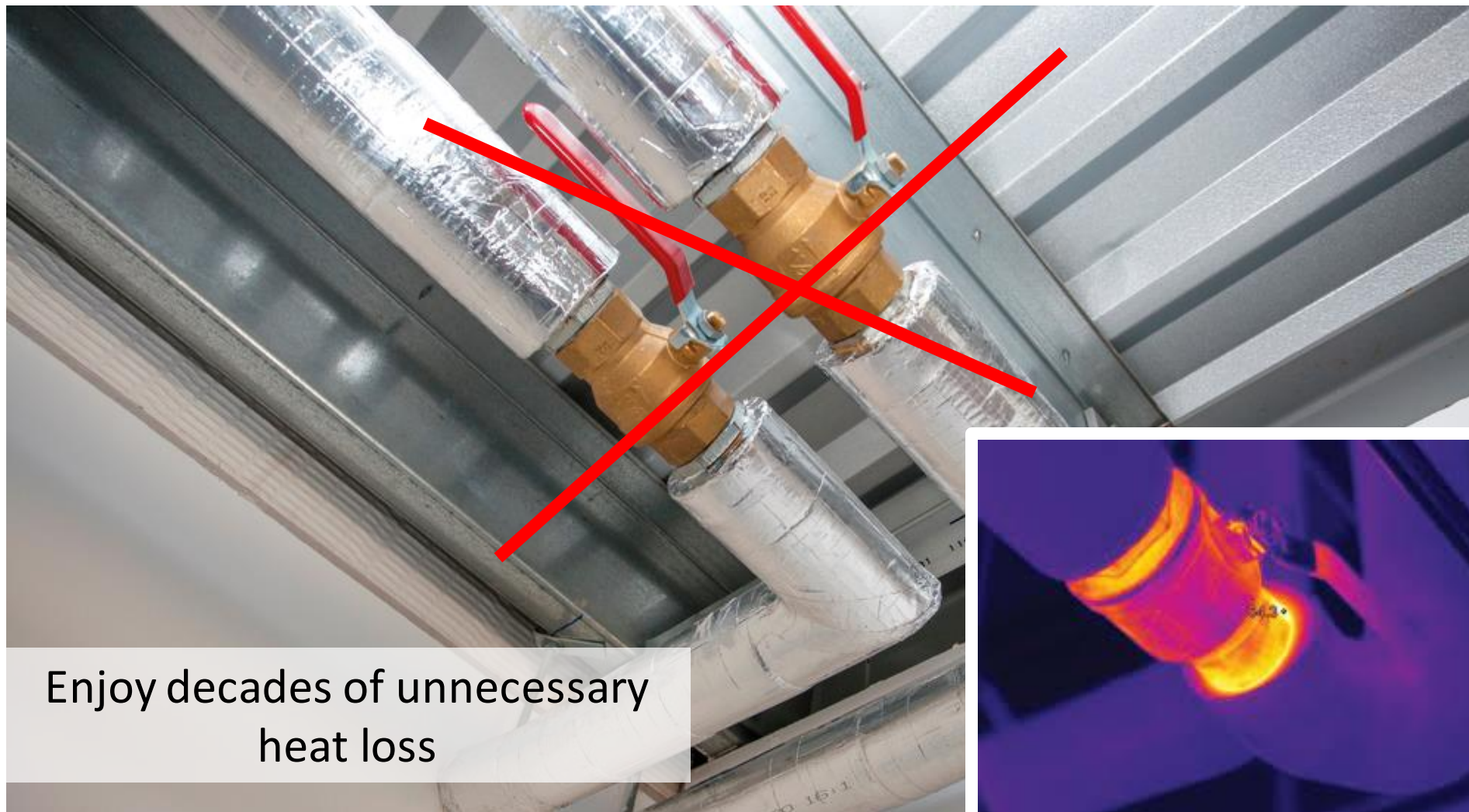
- **Variable speed pumps** adjust to heating demand – more efficient
- Try to **minimise friction losses** in the system – will reduce pump size and therefore electricity use
- Circulation pumps **use between 40 to 80 kWh/year** (based on 4,000 hours per year)



# What's Wrong Here?



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Enjoy decades of unnecessary  
heat loss



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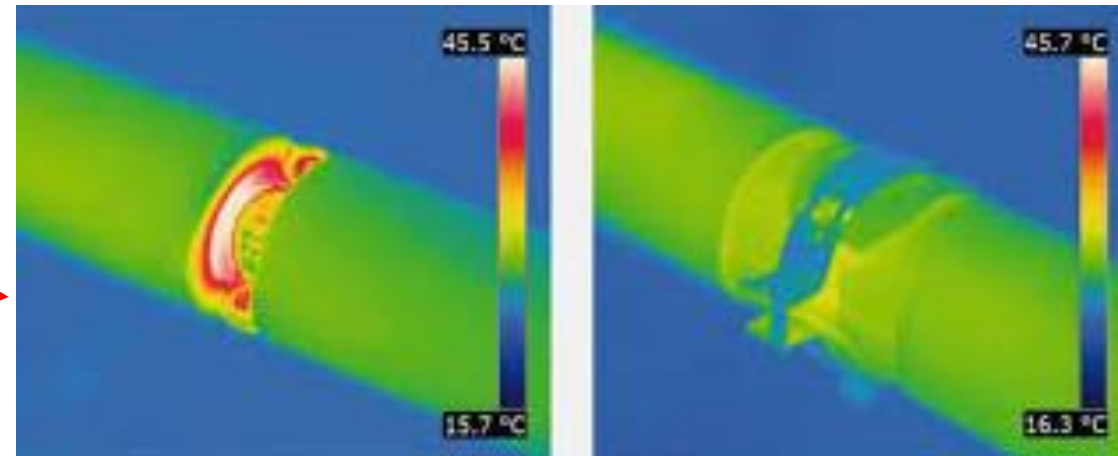
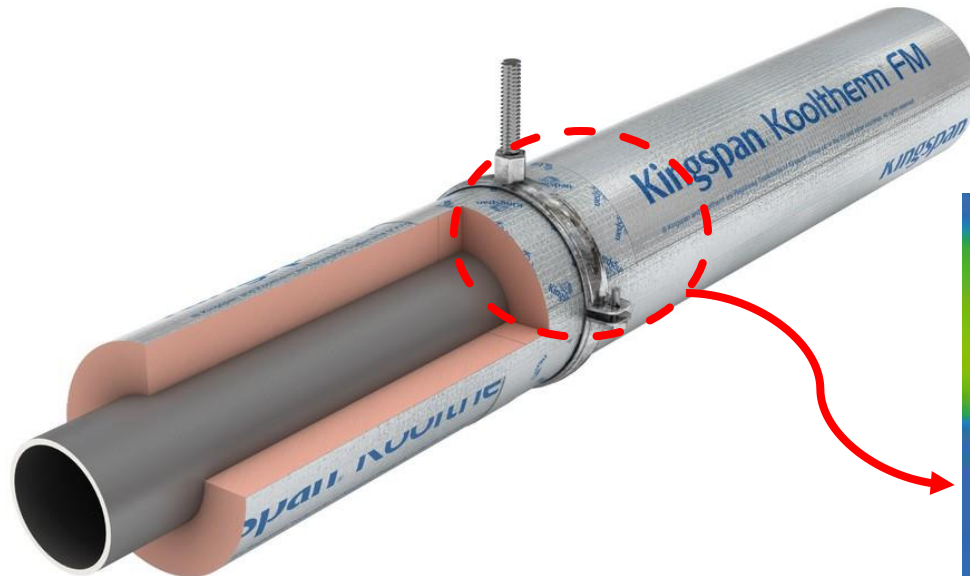
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# Simple Pipework Insulation Solutions



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Insulated support brackets



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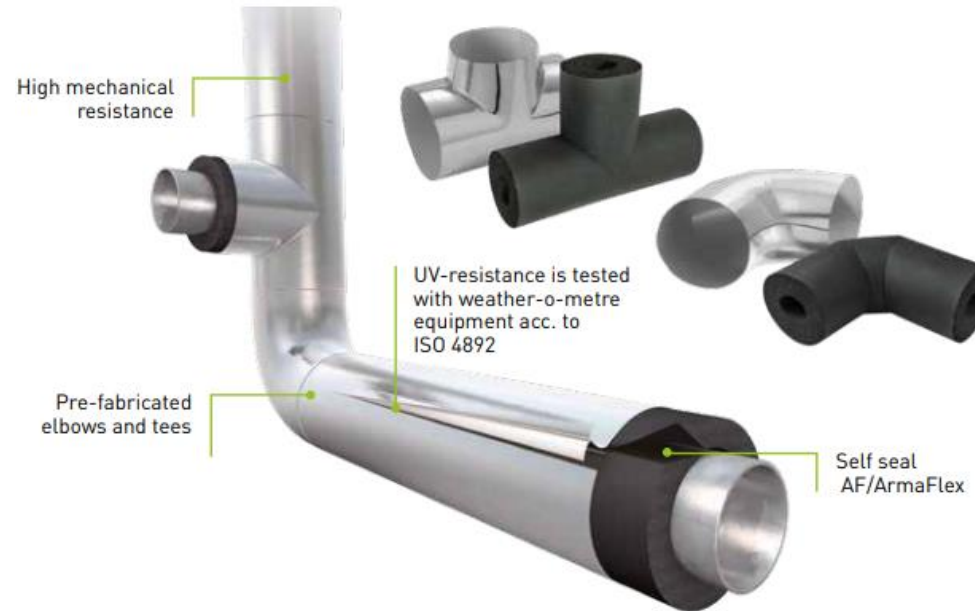
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# Innovative Pipework Insulation Solutions



Flexible insulation covers



Pre-Formed Tees and Bends



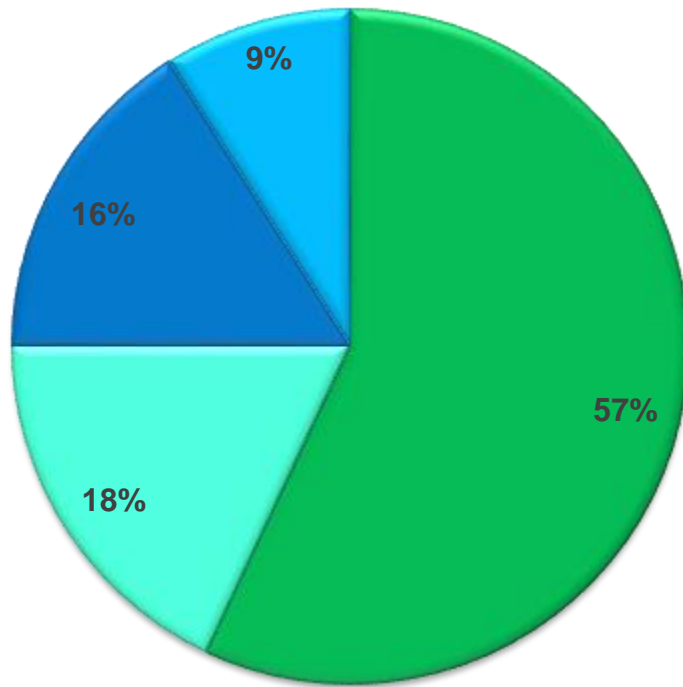


## 2. Water Heating



# 90% of Domestic Hot Water is Used in the Bathroom

**Domestic Hot Water Use  
(%)**



■ Showering ■ Bath Water ■ Bathroom Taps ■ Kitchen Sink

Data from the Energy Saving Trust, based on a survey of 86,000 households

- This extensive survey of UK homes shows that showering uses the most domestic hot water in most houses
- As showering is the highest user of domestic hot water, efforts should be made to improve the efficiency of showering



# Do we make the most out of our hot water?



Water comes out of the shower head at approximately 40°C

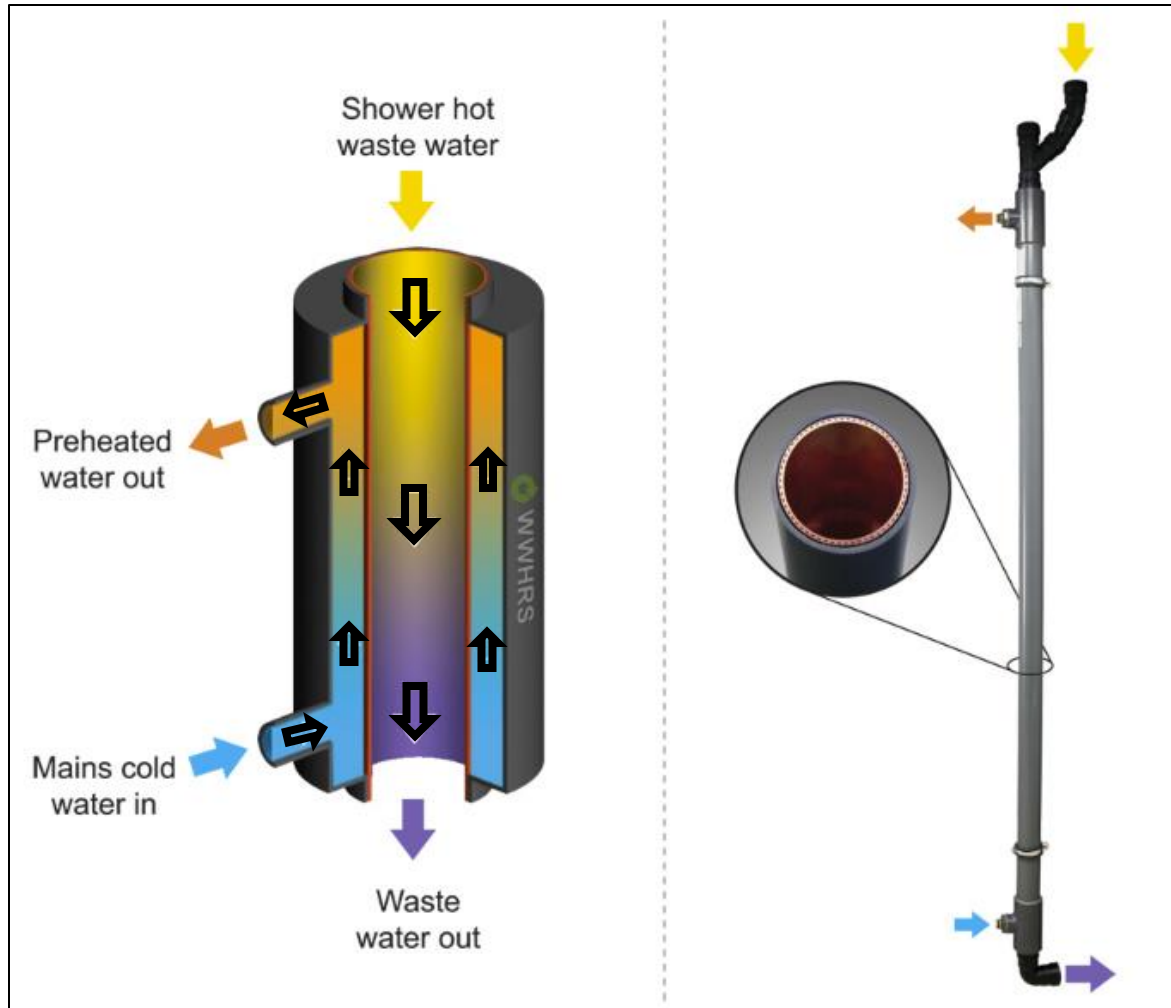
Waste water goes down the drain at approximately 35°C - 38°C



# Waste Water Heat Recovery



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- This is the Recoup Pipe+HE
- As hot water from the shower passes down the inside of the Pipe+HE,
- cold water is fed upwards through the PVC pipe
- Heat will move from the hot waste water into the colder fresh water, preheating it



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Image Source: recoupwwhrs

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# Waste Water Heat Recovery - Schematic



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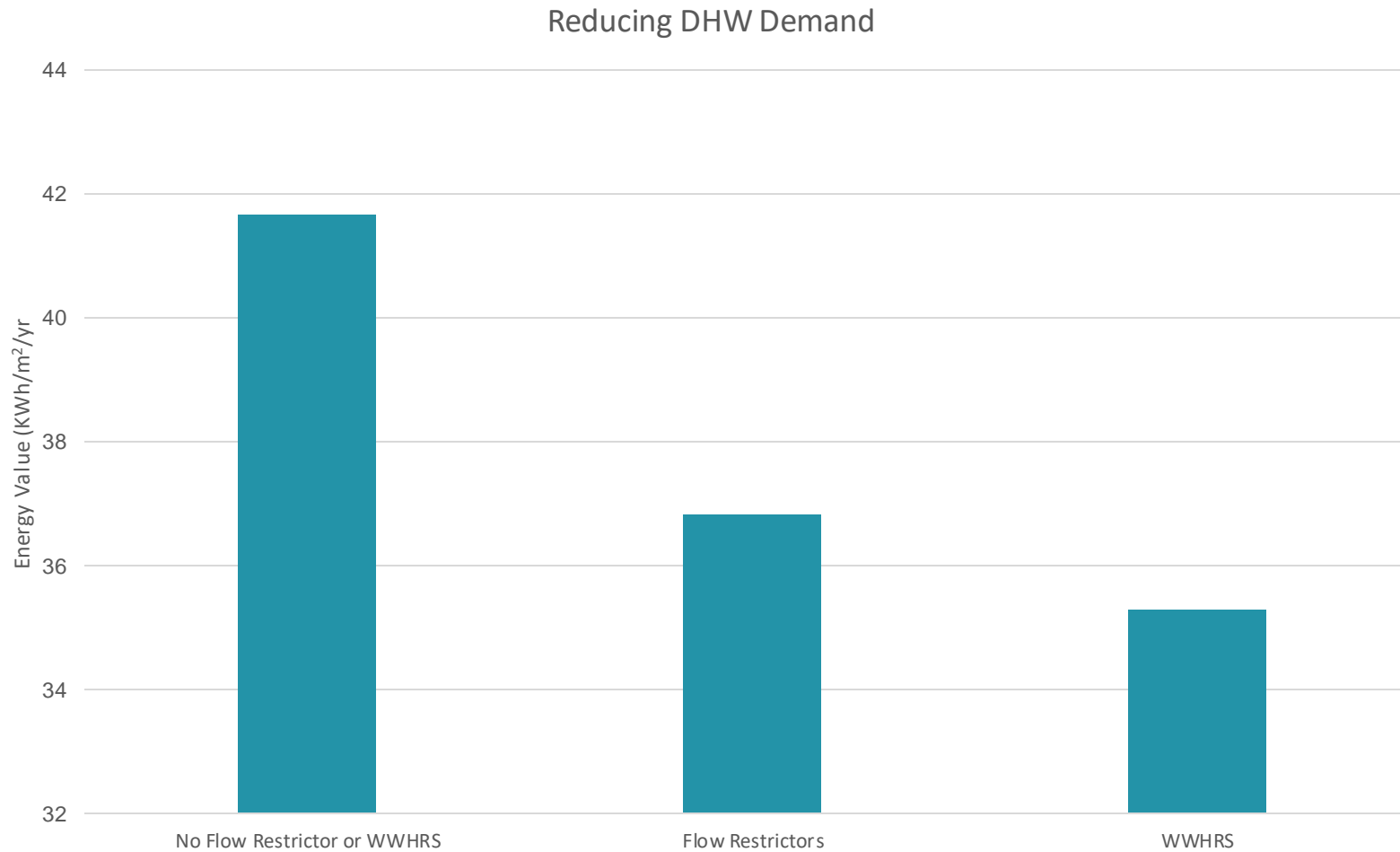
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# Reducing Domestic Hot Water Demand



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# Legionella Prevention

- Legionella is a naturally occurring bacteria found in freshwater – it can cause serious illness or even be fatal
- The bacteria is dormant below 20°C
- The bacteria is killed through thermal disinfection – **heating up to 60°C.**
- Be aware that most heat pumps do not heat water up to 60°C, so supplementary electric heating will be required (immersion).
- Minimise number of ‘dead-legs’ and keep pipes as short as possible to reduce volume of stagnant warm water







# Thank You

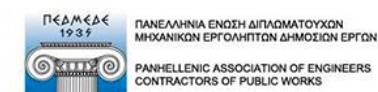
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