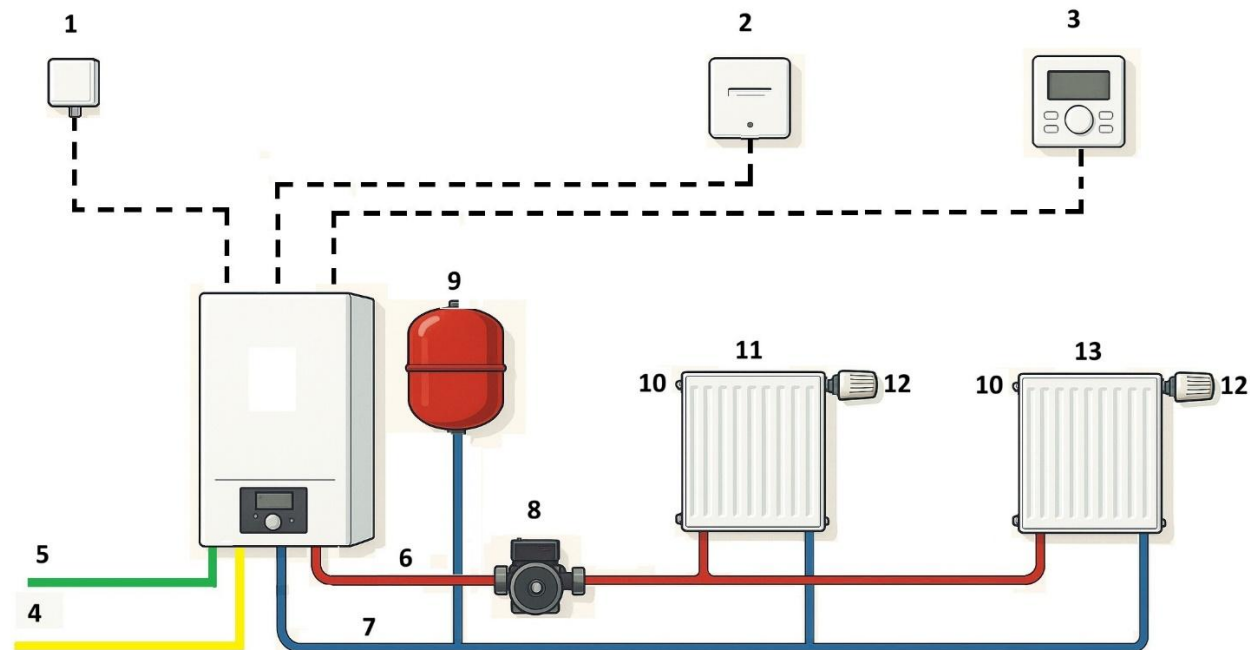


## Modul 3: Reducing the energy consumption of a residential building with a smart home system

### Information Heating Systems, Part I

This graphic shows the structure of a simple heating system



Graphic: ChatGPT

## Information Heating Systems, Part II

The following table shows an overview of the many different heating systems, categorized by primary energy source.

Primary energy source / fuel	Typ of heating	Function	Heat transport and heat transfer in the building	Temperature control
Oil	Oil boiler	Heating water through the combustion of oil	Heat transport through water  Heat dissipation mainly via convection through:	Boiler: Weather-dependent boiler flow temperature (central for each heating circuit)  • Radiators: Thermostate valves • Underfloor heating: temperature-dependent regulation of the flow rate per room or zone using electrically operated valves
Gas	Gas boiler	Heating water through the combustion of oil and utilization of the thermal energy of the burner exhaust gas	• Radiators • Heating coils (underfloor heating)	
Wood	Wood pellets	Heating water through the combustion of wood pellets, wood chips or firewood		
	Wood chips			
	Firewood			
	Stove	Burning wood logs	Heat dissipation through heat radiation	

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Electricity	<p>Night storage heaters</p> <p>Electric radiant heater</p> <p>Electric panel heating: wall heating or underfloor heating</p>	<p>Heat generation through heating rods or heating coils</p> <p>Heating wires in the wall or wallpaper or in the floor</p>	<p>Heat transport through air</p> <p>Heat dissipation through heat radiation</p>	by switching the heating elements or the heating coils on and off (2-point control)
Solar Energy	Collectors (flat-plate collector or tube collector)	Heating of a liquid by the radiant energy of the sun in the solar collectors. The liquid transfers the heat energy to a hot water tank in a heat exchanger, which feeds the heating water circuit.	<p>Heat transport through water</p> <p>Heat dissipation: mainly via convection through</p> <ul style="list-style-type: none"> <li>• Radiators</li> <li>• Heating coils (underfloor heating)</li> </ul>	<ul style="list-style-type: none"> <li>• hot water tank: 2-point control by solar thermal controller</li> <li>• Radiators: thermostatic valves</li> <li>• Underfloor heating: temperature-dependent control Temperature of the flow rate per room or zone using electrically operated valves.</li> </ul>
Ambient heat (earth, air, water)	Heat pump	<p>Extraction of heat outside and release inside the house.</p> <p>Physical principle: Joule-Thomson effect</p> <p>Cooling is also possible by reversing the process</p>		
Ambient heat of the air	<p>Special case air-to-air heat pump:</p> <p>Split air-conditioning system</p>	<p>Works like a heat pump:</p> <p>Cooling and heating possible</p>	Heat transport through air	by switching the split air conditioning system on and off using thermostats (2-point control)
Different energy sources possible	Combined heat and power plant	<p>Heat generation:</p> <p>Utilization of waste heat from a combustion engine or a fuel cell.</p>	Heat transport through water	<p>Flow temperature is specified by the provider and cannot be influenced</p> <ul style="list-style-type: none"> <li>• Radiators: thermostatic valves</li> </ul>

		<p>Power generation:</p> <p>By fuel cell or generator driven by the engine.</p>	<p>Heat dissipation: mainly via convection through</p> <ul style="list-style-type: none"> <li>• Radiators</li> <li>• Heating coils (underfloor heating)</li> </ul>	<p>Underfloor heating: temperature-dependent control Temperature of the flow rate per room or zone using electrically operated valves.</p>
Different energy sources possible	District heating	<p>Use of a fossil thermal power plant, a fossil power plant to generate electricity or a CHP unit.</p> <p>The thermal energy is not generated at the user's location, but is routed to the buildings via a network of district heating pipes.</p>		<p>Flow temperature is specified by the provider and cannot be influenced</p> <p>Temperature control of the radiators:</p> <p>Thermostatic valves</p> <p>Underfloor heating: temperature-dependent regulation of the flow rate per room or zone using electrically operated valves.</p>



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