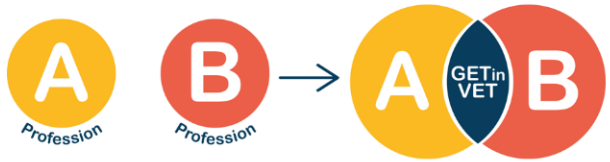
Module 3: Reducing the energy consumption of a residential building with a smart home system

The trainees use statistical data to create an overview of the energy consumption of residential buildings and derive recommendations for the use of a smart home system to reduce the energy consumption of an existing building.

The module's target group is trainees in the vocational fields of electrical engineering and supply engineering as well as IoT-related professions (EQF level 4).

In order to successfully complete the learning module, skills from different professions are required. For this reason, the traditional skills of one trade are supplemented by skills from other trades.



These are specific to this module:

Supply technology:

- Areas of application and function of smart home systems

Electrical engineering:

- Functionality of various heating and heat distribution systems and their control options
- Knowledge of the use and function of smart home systems

IoT specialists:

- Functionality of various heating and heat distribution systems and their control options

All:

- Distribution of residential building's energy consumption and the options for reducing it.
- Professionals learn how to educate their customers about energy savings by using smart home systems and the resulting economic and environmental benefits by switching from a technical role to an advisory role.

The module is designed for a duration of approx. 12 – 14 lessons.

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Teaching Sequence	Description and Material	How to use?
Introduction scenario	The owner of an apartment or small house has heard that it is possible to save energy by using smart home components in their home. They contact an electrician or heating engineer with the following request: “I would like to optimize my home's energy consumption and have heard that this is possible by installing smart home components. Specifically, I have the following questions: • What is the potential to save energy with the help of smart home, and how big is it? • Can you give me a recommendation where a smart home system makes the most sense and where the cost/benefit ratio is most favorable? • Can you tell me how complex the installation of a Smart Home system is and what kind of work I will have to do? • Please suggest a suitable manufacturer and compile a list of	The introductory scenario is about reducing the energy consumption of an old existing building only by installing smart home components. The trainees develop a proposal for this as a basis for an advice for the customer and write it down. The example of the given building can vary from region to region; for Germany, for example, it is a single-storey residential building that was built in the 1980s. **Target groups and levels:** Trainees in the following professions • Electrical engineering • SHK plant mechanic • IoT All at EQF level 4 **Objectives:** The trainees should be able to create a detailed consultation concept for the implementation of a smart home system to save energy, depending on the customer's apartment or house. In principle, energy can be saved with the help of a smart home system in terms of lighting and heat consumption. As heat consumption accounts for by far the largest proportion of energy requirements, it makes sense to start here first.

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	all the components I need for my home. Please send me a written consultation.”	Such a concept can include the following points: • The automatic closing of a thermostatic valve when a window is opened. • Time-controlled temperature reduction. • Control of the thermostatic valves via presence detectors. Optionally, further energy-saving potential can be discussed through automated lighting control or automated control of shutters or blinds.
Tasks	In order to solve the questions of the introductory scenario, the tasks described below must be completed:	**Form of work and use of materials:** The tasks are worked out in groups. In a learning group with members from different sectors (e.g. electrical engineering trainees and HVAC plant mechanics), the groups should be mixed. The material is provided in the form of documents (links and PDF’s). Also, the trainees can research freely. This depends on the time available and the ability of the trainees to carry out free internet research effectively and purposefully.
Task 1:	The trainees analyze the customer order and create a work plan. Competence: The ability to solve problems systematically. Duration: 2h	The creation of a work plan is optional and can be carried out both in the fixed working groups or before together with the whole learning group. The guiding questions serve as orientation for the work steps of the work plan **Material:** • *01a-Scenario task.docx* • *01b-Scenario key questions.docx*

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		• *02-residential building customer.docx*
Task 2:	The trainees describe and interpret the energy consumption of a residential building with the help of national statistics. They derive a recommendation for action to realize the desired energy savings. Competence: The ability to develop a target-oriented solution proposal with the help of verifiable statistical data. Duration: 2h	The statistics show that heat consumption, and in this case heating, accounts for most of the energy required. It therefore makes sense to start with heating when considering potential savings. **Material:** • *03-Energy-consumption-residential-buildings-Germany.docx*
Task 3:	Description of the different types of heating and heat distribution systems Competence: Trainees can name the basic components of a heating system and describe their function. The students explain how the different types of heating and heat distribution systems work	This teaching unit provides an overview of the basic functioning of a heating system and the different heating technologies. On this basis, it is possible to assess where and how heat consumption can be reduced by using smart home components for the existing building (and also for other customer inquiries with other heating systems). **Material:** • *04a-Information Heating systems.docx* • *04b-tasks-Heatingsystems-blanc.docx* • *04b-sample-solution-tasks-Heatingsystems-blanc.docx* **Links to the structure and function of heating systems (selection Germany)**

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	and the differences between them. Duration: 2-4 h	• https://www.baunetzwissen.de/heizung/fachwissen/heizungsanlagen/bestandteile-einer-heizungsanlage-161168 • https://www.buderus.de/de/heizung • https://www.vaillant.ch/privatkunden/ratgeber-heizung/heiztechnologie-verstehen/funktionsweise-einer-heizung/ • https://www.viessmann.de/de/wissen/technik-und-systeme/welche-heizung.html **Links to technical articles and videos about the thermostatic valve function (example Germany)** • https://haustechnik-wissen.de/thermostatventil/ • https://www.youtube.com/watch?v=4Eg613ZBexU • https://www.bosch-smarthome.com/de/de/loesungen/heizen-und-kuehlen/richtig-heizen-und-heizkosten-sparen?srsltid=AfmBOorgV-3CCOmGEgMUs3kaOjBMQzYOeTKOmcgepMX9xcLMmQ6VZVSH
Task 4:	A proposal for the reduction of the heat demand of the customer's residential building with the help of a smart home system. Competence: The trainees interpret technical data of components of smart home systems.	In this teaching unit, the trainees gain an overview of the various automation options of a smart home system. They draw up a list of the necessary components and use company documents to select specific components. They describe how the individual components work and how they interact as a system. **Material:** • *05-Smart-Home-systems.docx*

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	The trainees select a provider, and all components required for heating control and describe their basic functionality The trainees justify the selection of components with regard to the customer's desire for energy savings through smart home systems. Duration: 4 h	• *06-Blanc-Consultation-Concept.docx* • *06-Sample-consulting-concept.docx* **Links (example Germany):** • https://www.bosch-smarthome.com/de/de/produkte/ • https://www.busch-jaeger.de/systeme/busch-freeathome • https://homematic-ip.com/de • https://www.philips-hue.com • https://fritz.com/produkte/smart-home/
	Optional: Further options for saving energy in a residential building by using a smart home system	Further possibilities arise, for example, through the use of • Intelligent lighting (time and presence-controlled) • Intelligent actuators for controlling shutters, blinds and awnings (time and presence-controlled)
Documentation	Creation of digital documentation with all the necessary information that can be handed over to the customer	The documentation takes the form of a written document. A blank paper can be provided as a structuring aid. *(6-Blanc-Consultation Concept.docx)* The results of the work are presented by the working groups.

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		This can take the form of a role play, for example, in which some of the trainees take on the role of the customer and others the role of the advising expert. The role of the customer can also be taken on by the teacher. The presentation can also take the form of a short talk in which each group answers one of the client's questions and the members of the other groups comment and add to it.
Assessment	Evaluation of the written concept created for the customer to reduce the heat demand. • A further competence check can be carried out by: • Online with a quiz tool (self-evaluation) • Online multiple-choice test • Conventional paper-based multiple-choice test • Partial task as part of a class assignment	Assessment of the written documentation and / or the technical quality of the answers in the role play. A multiple-choice test is recommended if an individual grade is to be determined for each student. A more “playful” performance assessment can be carried out using an online quiz such as Kahoot!. **Material:** • *07-question-assessment.docx* • *07-sample-question-assessment.docx*
Reflection/evaluation	**Proposals:** • Evaluation: with an online survey • Reflection discussion: with the learning group	An online survey can be carried out using MS Forms or similar software. **Material:** • *08-question-evaluation.docx*

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

Scenario:

The owner of an apartment or small house has heard that it is possible to save energy by using smart home components in their home. They contact an electrician or heating engineer with the following request:

“I would like to optimize my home's energy consumption and have heard that this is possible by installing smart home components.

Specifically, I have the following questions:

1. What is the potential to save energy with the help of smart home, and how big is it?
2. Can you give me a recommendation where a smart home system makes the most sense and where the cost/benefit ratio is most favorable?
3. Can you tell me how complex the installation of a Smart Home system is and what kind of work I will have to do?
4. Please suggest a suitable manufacturer and compile a list of all the components I need for my home.

I would ask you for a written consulting concept.”

Tasks:

Answer the 4 questions posed by the customer and formulate the desired counselling concept in writing.

Instructions:

- As a first step, create a work plan with specific work steps that are required to provide qualified answers to the customer's questions.
- if you have compiled all the information required to answer the customer's inquiry, create the written consultation concept.
- You can use document *6-Blanc-Consultation Concept.docx* as the basis for the written documentation.

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Links to smart home providers (selection Germany):

https://www.bosch-smarthome.com/de/de/produkte/

https://www.busch-jaeger.de/systeme/busch-freeathome

https://homematic-ip.com/de

https://www.philips-hue.com

https://fritz.com/produkte/smart-home/

Links to the structure and function of heating systems (selection Germany)

https://www.baunetzwissen.de/heizung/fachwissen/heizungsanlagen/bestandteile-einer-heizungsanlage-161168

https://www.buderus.de/de/heizung

https://www.vaillant.ch/privatkunden/ratgeber-heizung/heiztechnologie-verstehen/funktionsweise-einer-heizung/

https://www.viessmann.de/de/wissen/technik-und-systeme/welche-heizung.html

Links to technical articles and videos about the thermostatic valve function (selection Germany)

https://haustechnik-wissen.de/thermostatventil/

https://www.youtube.com/watch?v=4Eg613ZBexU

https://www.bosch-smarthome.com/de/de/loesungen/heizen-und-kuehlen/richtig-heizen-und-heizkosten-sparen?srsltid=AfmBOorgV-3CCOmGEgMUs3kaOjBMQzYOeTKOmcgepMX9xcLMmQ6VZVSH

Scenario

- *01a-Scenario task.docx*

Information sheets

- *02-residential building customer.docx*
- *03-Energy consumption residential buildings GER.docx*
- *04a-Information Heating systems.docx*
- *05-Smart-Home-systems.docx*

Tasks and Blancs for Documentation:

- *01b-Scenario key questions.docx*
- *04b-tasks-Heatingsystems-blanc.docx*
- *06-Blanc-Consultation Concept.docx*

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Additional instructions:

If you have not created the work plan for answering the customer enquiry yourself, you can use the following work steps as a guide when completing the task.

Document the results of your work in writing.

1.1 Using the statistical data, describe the energy consumption of a residential building.

1.2 Explain in which area you would first recommend measures to reduce energy consumption.

2.1 Get an overview of the basic function of the different heating systems.

2.2 Then describe the operation of the heating system installed in the customer's home and the heat distribution system in this building.

3. Describe which smart home components can be used to control or regulate the heating in the customer's residential building

4. Compile a list of the smart home components required for heating control from a provider of your choice for the customer's given residential building. For this purpose, you can use document *6-Blanc-Consultation Concept.docx* as the basis for the written documentation

5. Based on your work results from steps 1 to 4, create a written counselling concept in which the four customer questions from the scenario are answered. For this, you can use the document *6-Blanc-Consultation Concept.docx*

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Information: Customer's residential building

The drawing (Fig. 1) shows the floor plan of the customer's single-storey residential building. It was built in the 1980s. The existing heating system consists of a gas boiler and panel radiators (Fig. 2 and Fig. 3) apart from the bathroom and toilet. The bathroom and toilet are heated by underfloor heating for reasons of comfort. Bathroom radiators are also installed here (Fig. 4).

The heating is controlled via an external thermostat to regulate the flow temperature and a room thermostat in the living room. The flat radiators all have thermostatic valves.

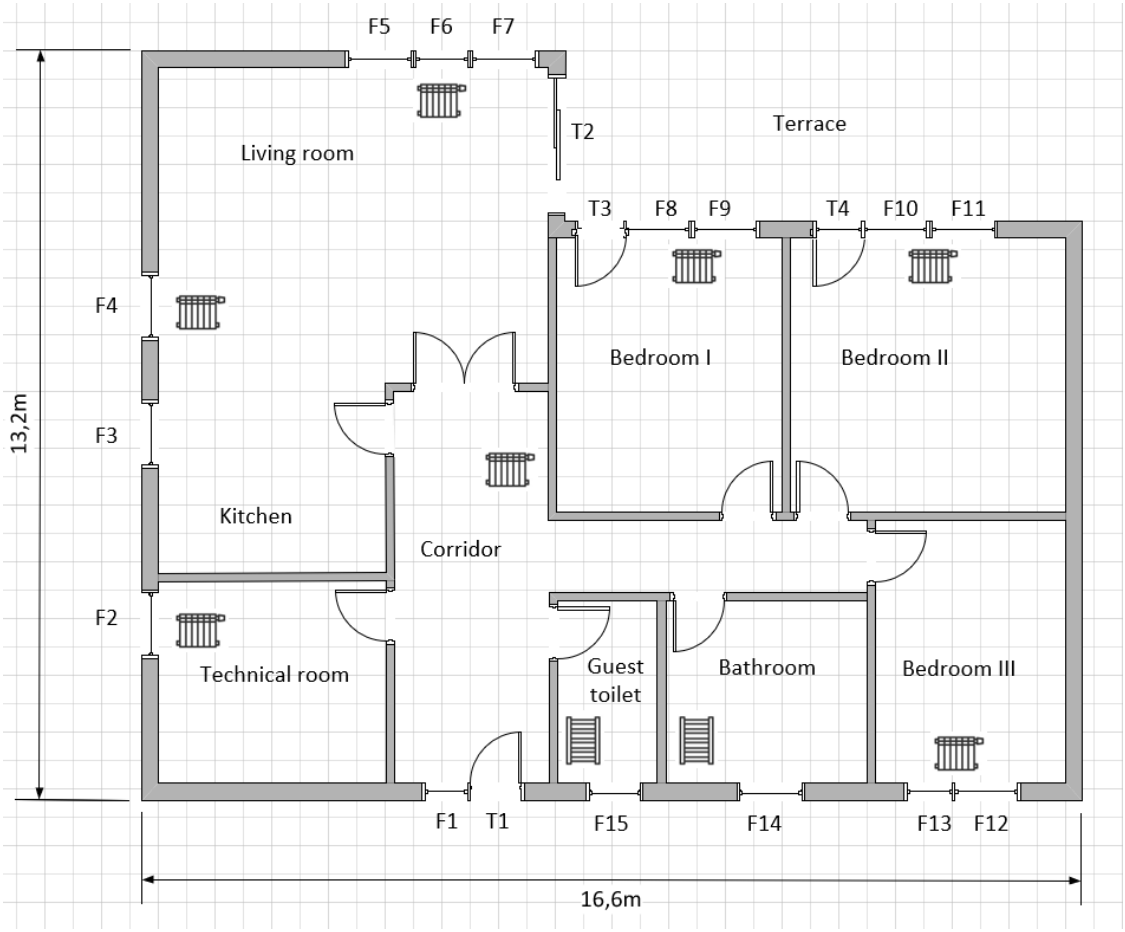

Fig. 1, floor plan

Drawing: M. Sorger

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Fig. 2 and 3: Flat radiators

Picture: M. Sorger

Fig. 4: Bathroom radiator

Picture: M. Sorger

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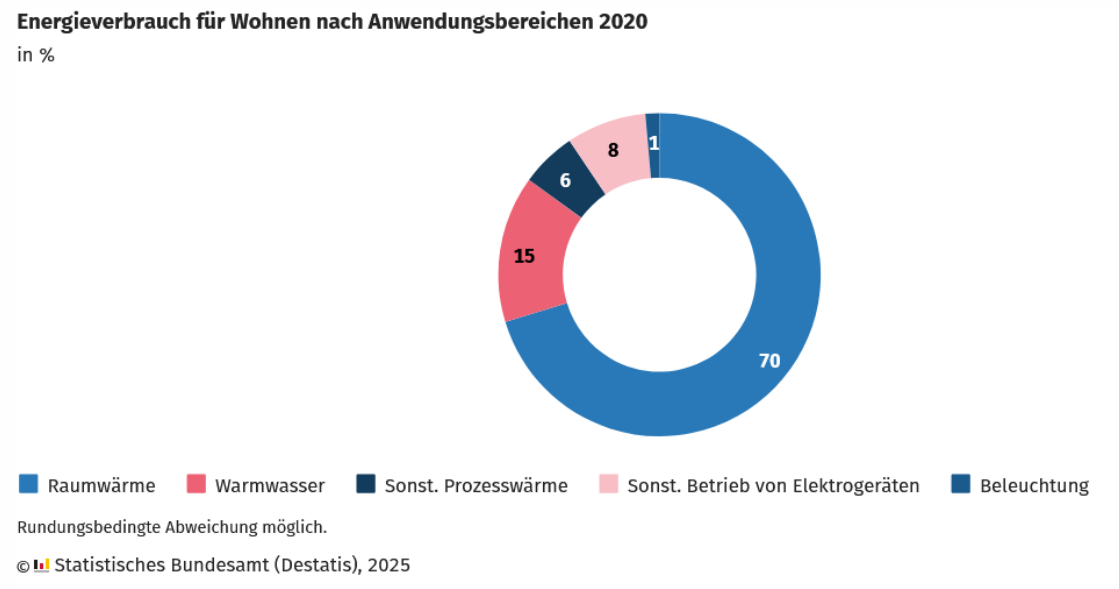
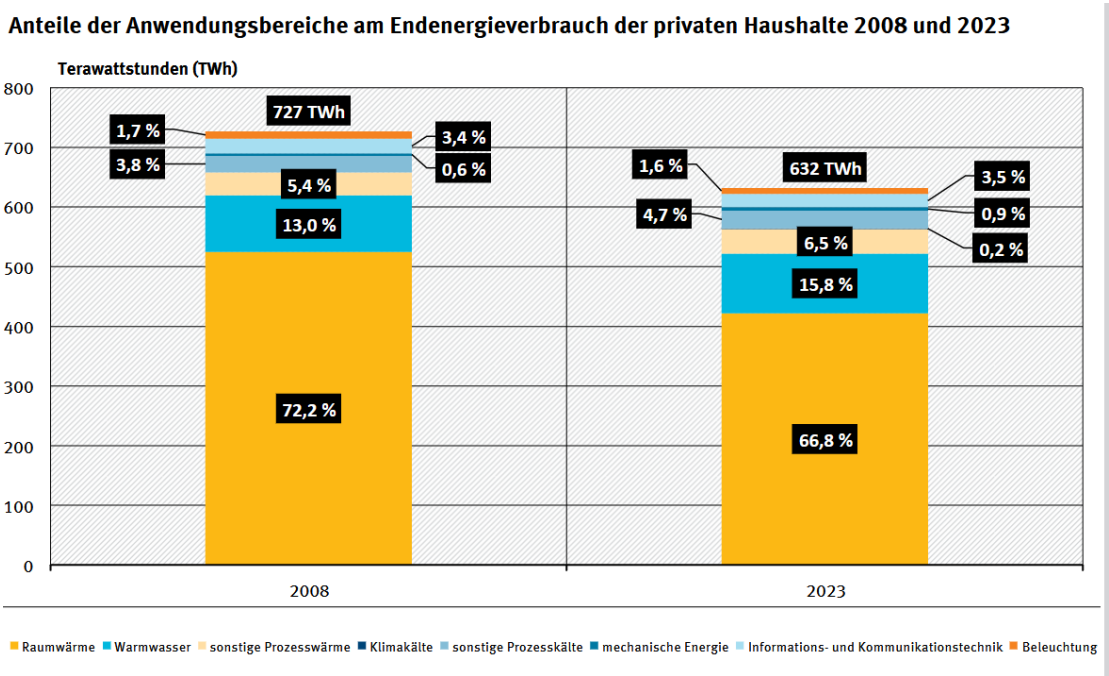
Information: Energy consumption of private households in Germany



Link: https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/12/PD22_542_85.html



Link: https://www.umweltbundesamt.de/daten/private-haushalte-konsum/wohnen/energieverbrauch-privater-haushalte

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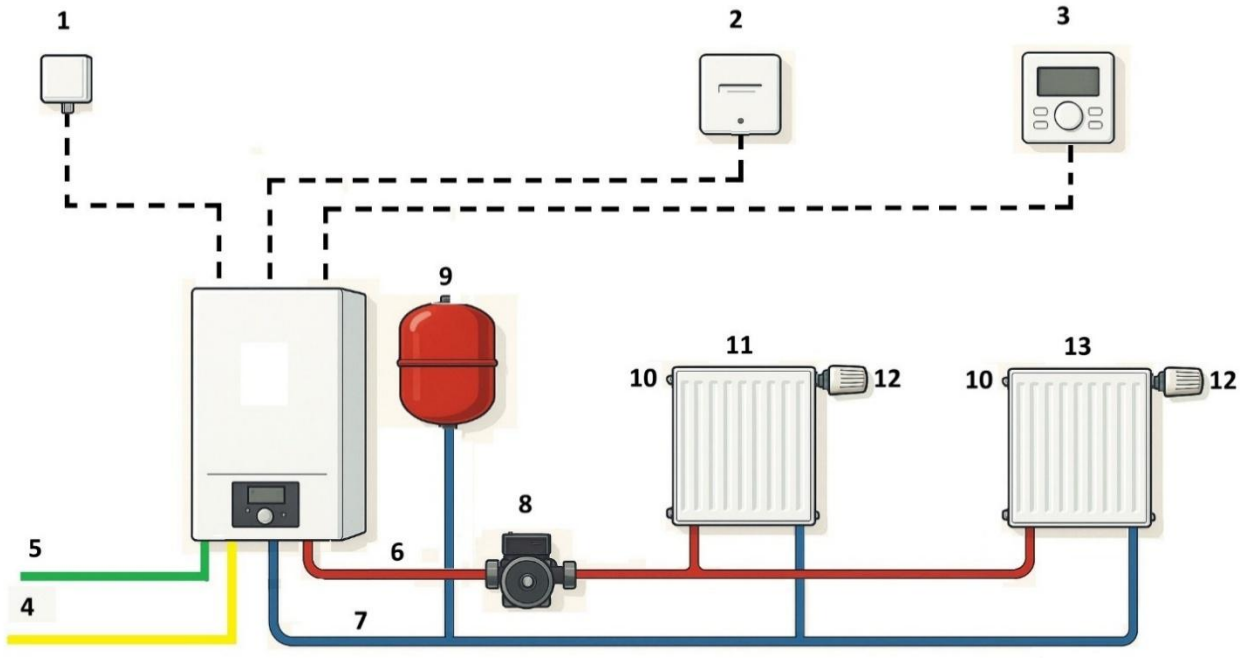
Information Heating Systems, Part I

This graphic shows the structure of a simple heating system



Graphic: ChatGPT

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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: • Radiators • Heating coils (underfloor heating)	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		
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	Night storage heaters Electric radiant heater Electric panel heating: wall heating or underfloor heating	Heat generation through heating rods or heating coils Heating wires in the wall or wallpaper or in the floor	Heat transport through air Heat dissipation through heat radiation	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.	Heat transport through water Heat dissipation: mainly via convection through • Radiators • Heating coils (underfloor heating)	• hot water tank: 2-point control by solar thermal controller • Radiators: thermostatic valves • Underfloor heating: temperature-dependent control Temperature of the flow rate per room or zone using electrically operated valves.
Ambient heat (earth, air, water)	Heat pump	Extraction of heat outside and release inside the house. Physical principle: Joule-Thomson effect Cooling is also possible by reversing the process		
Ambient heat of the air	Special case air-to-air heat pump: Split air-conditioning system	Works like a heat pump: Cooling and heating possible	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	Heat generation: Utilization of waste heat from a combustion engine or a fuel cell.	Heat transport through water	Flow temperature is specified by the provider and cannot be influenced • Radiators: thermostatic valves

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		Power generation: By fuel cell or generator driven by the engine.	Heat dissipation: mainly via convection through • Radiators • Heating coils (underfloor heating)	Underfloor heating: temperature-dependent control Temperature of the flow rate per room or zone using electrically operated valves.
Different energy sources possible	District heating	Use of a fossil thermal power plant, a fossil power plant to generate electricity or a CHP unit. The thermal energy is not generated at the user's location, but is routed to the buildings via a network of district heating pipes.		Flow temperature is specified by the provider and cannot be influenced Temperature control of the radiators: Thermostatic valves Underfloor heating: temperature-dependent regulation of the flow rate per room or zone using electrically operated valves.

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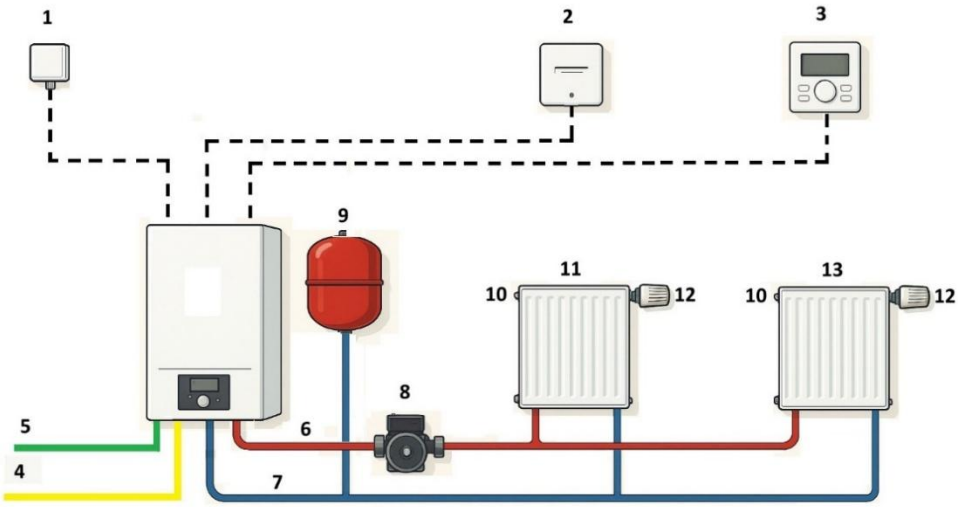
Components of a heating system, task:

1. Name the components shown in positions 1 to 13 in the heating diagram.
2. Briefly describe the function of the components.



Pos.	Name	Task
1		
2		
3		
4		
5		

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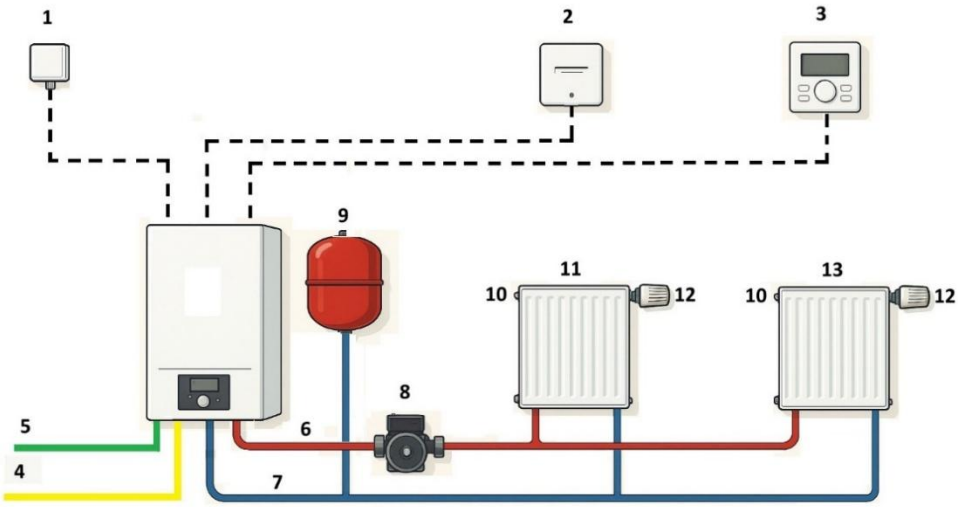
Components of a heating system, task:

3. Name the components shown in positions 1 to 13 in the heating diagram.
4. Briefly describe the function of the components.



Pos.	Name	Task
1	Outdoor sensor	Measurement of the outside temperature
2	Room sensor	Measurement of the room temperature
3	Romm controller	Combination controller/operating unit; regulates the flow temperature of the heat generator depending on the outdoor and room sensor
4	Gas connection heat generator	Fuel supply for the heat generator
5	Power connection Heat generator	Supply of electrical energy for the heat generator
6	Pipe flow	Pipes for transporting the hot water to the radiators
7	Return flow	Pipes for transporting the cold water back to the heat generator

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8	Heating pump	Ensures the transport of water in the heating circuit
9	Membrane expansion vessel	Ausgleich temperaturbedingter Volumenschwankungen im Heizungskreislauf
10	Vent valve Radiator	Equalisation of temperature-related volume fluctuations in the heating circuit
11	Radiator	Release of thermal energy to the room air mainly by convection
12	Thermostat valve	Regulates the volume flow of hot water through the radiator and thus the amount of heat energy emitted.
13	Radiator	Release of thermal energy to the room air mainly by convection

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Information Smart-Home-Systems

Below you will find an overview of the most important components of a smart home system and a short description of how this system works.

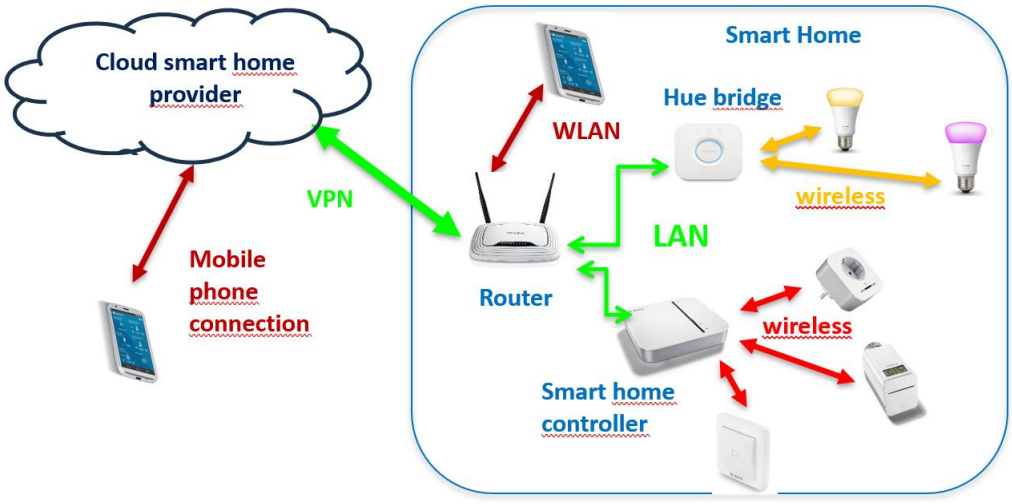
Smart home systems are offered by various providers and can usually be easily retrofitted by replacing existing components in an electrical installation. (e.g. replacing changeover switches then with smart switches or replacing conventional light sources with smart light sources). Operation can be carried out as before via switches or additionally via an app on a mobile device or through previously programmed automation.

In addition to the range of functions and compatibility, the storage location of the data differs between the systems of the various providers. This can be stored either in the smart home controller or in the provider's cloud.

A smart home system always consists of a controller, sensors and actuators and an operating and programming unit. Programming the smart home controller determines which sensor controls which actuator and when. The controller is usually programmed using an app on a smartphone or tablet.

Communication between the controller and smart switches, lights, presence detectors, etc. takes place wirelessly via radio, while communication between the controller and the provider's cloud takes place via the Internet.

Communication between the app on a mobile device and the smart home controller takes place within an apartment or house via Wi-Fi. Access from outside is via the mobile network to a server in the provider's cloud and from there via a VPN internet connection to the customer's router (see graphic).



Communication between Smart Home Components and mobile devices. Drawing: M. Sorger

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Note:

Smart home components from different manufacturers are only partially compatible with each other. This must be considered when planning a smart home system. Some manufacturers enable cross-manufacturer communication via so-called “bridges. The bridge function can be implemented as a separate bridge or as part of the smart home controller.

Cross-manufacturer standards have been developed and are in the introductory phase, e.g. “Matter”.

Further information can be found in the manufacturers' technical specifications.

Components of a Smart-Home-Systems

Basically required are:

- Smart-Home-Controller
- Internet access to the provider`s cloud and Wi-Fi for in-house communication with the apps on mobile devices
- Smartphone or Tablet with manufacturer apps for operation and programming

Optional:

- With some providers: Touch screen permanently installed in the home for programming and operation

Heating controll

Minimum equipment:

- Smart radiator thermostat (replacement for the conventional thermostatic valves on the radiators)
- Door / window contact (reed contact for monitoring a window for opening)

Optional:

- Presence detector
- A wall thermostat or a room thermostat (only offered by some manufacturers)
- Controller for underfloor heating (only offered by some manufacturers)

Light controll

- Smart light sources (dimmable, color and color temperature adjustable)
- Smart switches (switching operations by manual operation on site or via app or via programmed scenarios, e.g. time control or coupling with presence detector)
- Smart dimmers (dimming of lamps by manual operation on site or via app or via programmed scenarios, e.g. time control or coupling with presence detector)
- Presence detectors
- Switchable sockets (e.g. for switching floor lamps with conventional light sources)

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Roller shutter controls and blind controls

- Smart switches (switching operations by manual operation on site or via app or via programmed scenarios, e.g. time control)
- Sensors for wind speed
- Sensors for brightness

Security technology

- Presence detector
- Window and door contacts
- Smoke detectors
- CO_2 detectors
- Sirens (usually integrated into smoke detectors)
- Video cameras (indoor and outdoor)

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

Documentation of the consulting concept

Consultant:

Date:

Concept:

1. What is the potential to save energy with the help of smart home, and how big is it?
2. Can you give me a recommendation where a smart home system makes the most sense and where the cost/benefit ratio is most favorable?
3. Can you tell me how complex the installation of a Smart Home system is and what kind of work I will have to do?
4. Please suggest a suitable manufacturer and compile a list of all the components I need for my home.

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

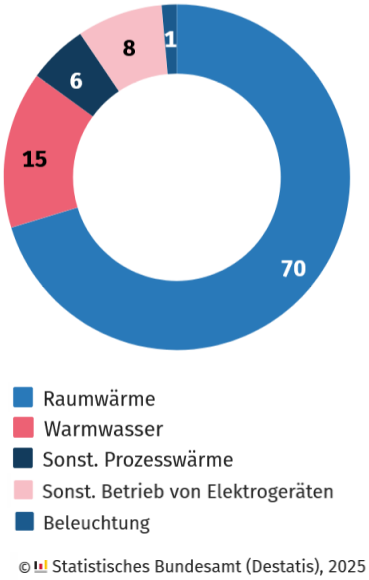
Notes on possible answers to the customer's questions

1. *What is the potential to save energy with the help of smart home, and how big is it?*

   The following can be derived from the statistics on energy consumption in residential buildings (see graphs):

   Heating (space heating) accounts for by far the largest energy consumption at 70%. The other items are also hot water (15 %) and other process heat (6 %). This is followed by other electrical appliances at 8 % and lighting at just 1 %.

   This means that the most sensible place to start reducing energy consumption is with heating. The second starting point is to reduce hot water consumption.



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2. *Can you give me a recommendation where a smart home system makes the most sense and where the cost/benefit ratio is most favorable?*

   The area of application with the most favorable cost-benefit ratio is the replacement of radiator thermostats on panel radiators and bathroom radiators. The heat output can be controlled or regulated individually for each radiator: This can be done according to different parameters:

   - Individual time control
   - Coupling to windows and patio doors. If a window or patio door is open, the smart thermostats close
   - Coupling to presence detector

   The underfloor heating can also either be controlled or regulated by smart controllers for the underfloor heating circuits. Alternatively, an existing thermostat can be replaced by a smart thermostat for underfloor heating. Smart controllers or smart thermostats offer the same control and regulation options as smart radiator thermostats.
   However, it should be noted that smart components for underfloor heating systems are only offered by a few smart home manufacturers and that underfloor heating systems react much more slowly.

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3. *Can you tell me how complex the installation of a Smart Home system is and what kind of work I will have to do?*

Internet access for communication with the manufacturer's cloud is a neccessary for installation.

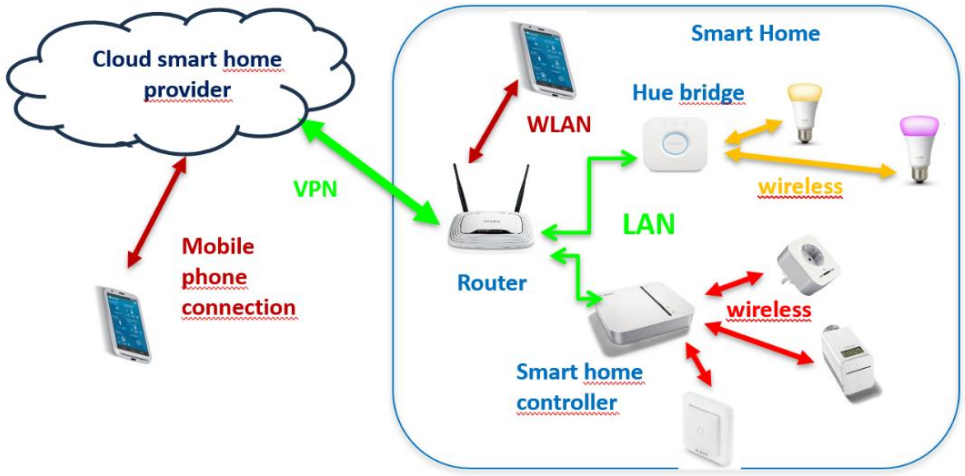
Useful is a WLAN access for communication between mobile devices such as smartphones or tablets and the smart home controller for programming and operating the smart home components.

The smart home controller is either connected to the internet router via LAN or, depending on the provider, integrated into the Wi-Fi router. The Smart Home Controller requires a 230 V power supply via a socket.

Communication between the Smart Home Controller and the smart sensors and actuators is wireless, depending on the manufacturer, using different radio protocols.

The sensors and actuators are powered by a battery or via the existing power connection (e.g. if toggle switches are replaced by smart switches).

It is not usually necessary to lay electrical cables. The installation effort is therefore low.



Communication structure smart home

Graphic: M.Sorger

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4. *Please suggest a suitable manufacturer and compile a list of all the components I need for my home*

The following points should be considered when selecting a suitable provider:

- Scope of the components offered:
  The choice of manufacturer depends on whether the customer wants to carry out further automation in their home in addition to the desired heating control. This could range from lighting control, control of roller shutters and shading, fire and burglar alarms to smart control of household appliances, integration of a PV system and garden irrigation.
- Compatibility:
  It should be noted that smart home components from different manufacturers are not always compatible with each other. A common communication standard ("Matter") is currently being introduced.
- Storage location of the data:
  User data (when what is switched on, when residents are at home and when not, storage of video recordings, etc.) can either be stored locally in the smart home controller or in the provider's cloud.
- Ongoing costs:
  There are smart home providers that require the use of a subscription.

The Bosch smart home system was selected for the following reasons:

- The data is stored locally in the smart home controller.
- There are no running costs.
- Underfloor heating can be integrated via smart thermostat
- There is a large selection of both smart home components and household appliances.
- Components support the Matter standard.
- Lighting control with Phillips Hue can be carried out via the Bosch app.

Link: https://www.bosch-smarthome.com/de/de/produkte/alle-produkte/

Components required for the heating control of the existing building:

Quantity	Component	Type	Function / task	Installation location

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1	Smart-Home-Controller	*Smart Home Controller II*	Control of communication between actuators and sensors as well as app and actuators / sensors Storage location for the parameters (e.g. times, temperatures) Storage location for scenarios	technical room
9	Smart radiator thermostat	*Heizkörper-Thermostat II*	Controls the flow rate of hot water according to the parameters stored in the controller (setpoint temperature, time, status of windows and doors, people in the room, etc.)	2 x Living room 1 x Bedroom I 1 x Bedroom II 1 x Bedroom III 1 x Bathroom 1 x Guest toilet 1 x Corridor 1 x technical room
18	Door/window contact	*Tür-/Fenster-kontakt II weiß*	Gives a signal to the controller as to whether a door or window is open. In relation to the heating control, the thermostats in the corresponding room then receive the command to close.	6 x Living room (Door T2, Windows F2 to F7) 3 x Bedroom I (Door T3, Windows F8, F9) 3 x Bedroom II (Door T4, windows F10, F11) 2 x Bedroom III (windows F12, F13) 1 x Bathroom (Window F14) 1 x Guest toilet (Window F15) 1 x technical room (Window F2)
1	Thermostat for underfloor heating	*Raum-thermostat II 230V*	Controls the valves for the underfloor heating coils. This thermostat replaces the conventional thermostat. It can be	1 x Guest toilet and Bathroom

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			controlled via the controller or the app.	
4	presence detector	*Bewegungsmelder*	Monitors whether a person is in a room	1 x Living room 3 x Bedroom I, II, III
	App for smartphone and / or tablet		The app enables e.g. Programming scenarios (time or action-controlled).	

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

Suggestions for assessment: (more than one answer is possible)

Which measure can save the most energy in an old building?

1. Insulation of the facade
2. Reduction of the room temperature by 1 °C
3. Roof insulation
4. Installation of smart thermostats to control the temperature of radiators

Which energy-saving measure is the most cost-effective?

1. Insulation of the facade
2. Reduction of the room temperature by 1 °C
3. Roof insulation
4. Installation of smart thermostats to control the temperature of radiators

Where can the most energy be saved in a private household?

1. Lighting
2. hot water
3. heating
4. Electrical household appliances

Which smart home components may only be installed by a qualified electrician?

1. Door / window contact
2. Smart Home controller
3. Smart radiator thermostat
4. Wall thermostat with 230V switching contacts

For which heating systems can the heat output not be controlled or regulated via smart home?

1. Heat pump
2. wood-burning stove
3. District heating
4. Solar collectors

How can a smart thermostat be operated in the event of a WLAN router failure?

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1. With the app on a tablet
2. With the controls on the thermostat
3. With an app on a cell phone
4. If the WLAN router fails, the thermostat can no longer be operated.

How can a smart thermostat be operated in the event of an internet failure? Tablet and mobile phone are in the local WLAN.

1. With the app on a tablet
2. With the controls on the thermostat
3. With an app on a cell phone
4. If the WLAN router fails, the thermostat can no longer be operated.

Can smart home components from different manufacturers be combined with each other?

1. Only components from one manufacturer can be used.
2. When combining components from different manufacturers, a common communication standard such as Matter is required.
3. A combination between manufacturers with different communication standards is possible if there is a bridge to translate the communication standards.
4. Components from different manufacturers can be used together in a smart home system

Add further questions 😊

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

Suggestions for assessment: (more than one answer is possible)

Which measure can save the most energy in an old building?

- ✓ Insulation of the facade
5. Reduction of the room temperature by 1 °C
6. Roof insulation
7. Installation of smart thermostats to control the temperature of radiators

Which energy-saving measure is the most cost-effective?

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- ✓ Reduction of the room temperature by 1 °C
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Module 3: Reducing the energy consumption of a residential building with a smart home system

Suggestions for evaluation the learning situation

1. In which everyday professional situations do you work together with other trades?
2. To what extent does your cooperation with other plants make sense? Please rate on a scale from 1 to 10 (1 being the lowest and 10 the highest score)
3. Did you have prior knowledge in the field of energy saving in residential buildings? Please rate on a scale from 1 to 10 (1 being the lowest and 10 the highest score)
4. Have you been able to expand your knowledge in the field of energy saving in residential buildings?
5. Did you have prior knowledge in the field of heating technologies? Please rate on a scale from 1 to 10 (1 being the lowest and 10 the highest score)
6. Have you been able to expand your knowledge in the field of heating technologies?
7. Did you have prior knowledge in the field of smart home? Please rate on a scale from 1 to 10 (1 being the lowest and 10 the highest score)
8. Have you been able to expand your knowledge of smart homes?
9. Were the materials provided sufficient?
10. Were the materials provided helpful?
11. Was the time available to complete the learning situation sufficient?
12. Was the form of group work with participants from different trades helpful?

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