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BIM4Energy Project

Title: Awareness of energy saving

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1 – Aims

Global warming is a real and very current problem that society is facing. If we do not intervene with rigorous measures, the effects of climate change can be devastating. The construction field is responsible for the release of significant amounts of greenhouse gases while the increase of energy performance of buildings and decrease of greenhouse gas emissions are the key solution needed to be applied to the construction sector for mitigating climate change. Household energy consumption represents a significant share of global energy usage, highlighting the importance of understanding the factors that influence energy use and identifying potential strategies for conservation. Therefore, this tutorial will provide insight into all aspects of energy management with specific emphasis on energy efficiency as well as renewable energy.

The objectives of this *Awareness of energy saving* tutorial are as follows:

- To understand the importance of saving energy;
- To understand the key concepts related to saving energy;
- To understand what are the main obstacles in the effort to save the energy;
- To understand how they can overcome the obstacles that interfere with the effort to save energy.
- To know what the saving methods are and how to put them into practice;
- to know which are the financing programs for energy saving measures
- To know best practices regarding energy saving and renewable energies

2 - Learning methodology

The teacher will give an explanation about saving energy and energy efficiency about 30 minutes.

Students will read this tutorial and follow the steps shown in the tutorial, namely:

- The necessity of energy saving;
- Key concepts related to energy saving
- Main obstacles in the effort of energy saving and solutions to overcome these obstacles
- Several main methods and strategies to save the energy and for energy efficiency;
- Main programs, measures and several equipment for energy efficiency;
- Best practices regarding energy saving and renewable energies

In order to evaluate the success of the application, a questionnaire will be held for the students.

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3 - Tutorial duration

The implementation described in this tutorial will be carried out through the BIM4ENERGY Project website by self-learning.
3 lessons hours are suitable for this training.

4 – Necessary teaching recourses

Computer room with PCs with internet access. It will be necessary a video projector.
Required software: Microsoft Office.

5 – Contents & tutorial

5.1 – The necessity of energy saving

Energy efficiency and renewable energy sources are an important basis for sustainable development, because they contribute to the protection of the environment and the climate, to the creation of local jobs and economic growth, to the security of energy supply, to independence from energy price fluctuations, as well as social cohesion and innovation. The instruments used in the policy for energy efficiency are: legislative provisions, especially directives setting quality norms, norms applicable to industrial procedures (emissions, design, exploitation norms), action programs in favour of energy efficiency, financial aid programs.

Energy is indispensable for life on Earth. It exists everywhere and is the cause of the production of numerous phenomena: movement, light, sound, heat, etc. Unlike artificial energy sources, obtained by man by transforming one form of energy into another form of energy (examples: engines, thermal power plants, wind power plants, etc.), primary energy sources are energy sources existing in nature and which can be used directly. Energy is a scalar quantity that represents the ability of a system to perform mechanical work when changing from one state to another. Today's society is a big consumer of energy in various forms, in industry, transport, agriculture, in the household, etc. Energy consumption per capita is considered an indicator of the standard of living. The increase in the standard of living cannot take place without a corresponding increase in energy consumption.

The concern for the rational use of energy is also justified by the increase in the costs of the energy carriers determined by the increasing effort made to extract the sources, but also by the need to limit the adverse effects of energy on the environment. It is obvious that energy efficiency can be considered, at present, as the most easily available, the least polluted and the cheapest solution.

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Awareness of energy saving

Limiting the level of environmental pollutants and maintaining raw materials and energy reserves for future generations are the main targets of energy efficiency analysis through the lens of the sustainable development concept.

Buildings in the EU are responsible for 40% of energy consumption and 36% of greenhouse gas emissions.

An important area to improve efficiency is the heating and cooling of buildings and domestic hot water, which represents 80% of household energy consumption.

The European Commission has proposed an update of the directive on the energy performance of buildings in 2021.

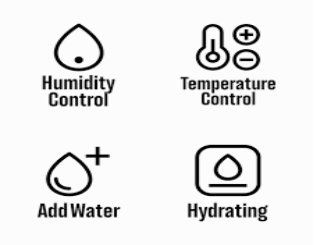
In March 2023, European Parliament approved plans for a climate-neutral building sector by 2050. Rules to improve the performance of buildings include measures to help reduce energy bills and energy poverty.

All new buildings should be zero-emission from 2028. For new buildings occupied, operated or owned by public authorities, the deadline is 2026.

Making EU buildings more energy efficient and reducing dependence on fossil fuels through investment in renovation will reduce the energy consumption of buildings and emissions in the sector by 2030.

The updated legislation also provides for improving the exchange of information on energy performance in the construction sector, among building owners and occupiers, as well as with financial institutions and public authorities.

The energy saving provides several key benefits:



- **Temperature Control, Humidity control, lighting control**: When you are interested in saving energy you may install some management systems for energy saving.

- **Comfort and Productivity**: A comfortable indoor environment can significantly improve your mood, productivity, and overall well-being.

- **Lower costs**: when you save energy or use energy for regenerable sources you have lower prices or even no costs for lighting for example, or to heat the water

- **You can earn money**: being a prosumer (A prosumer is both a consumer and a producer of electricity, and the surplus is injected into the grid and compensated by the supplier with whom it has a contract)

- **Inexhaustible Sources:** Renewable sources such as the sun and wind are virtually inexhaustible and do not depend on finite resources.

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- **Reduction of emissions:** the use of renewable energy and energy saving minimizes greenhouse gas emissions and contributes to combating climate change.

- **Diversification of energy sources:** switching to alternative sources reduces dependence on traditional sources such as fossil fuels, which are susceptible to price volatility and depletion.

In essence, **energy saving and using regenerable sources** contribute to a better quality of life.

5.2 Key concepts related to energy saving. Literature review

Energy saving is a generic term that includes all measures aimed at reducing energy consumption. These measures can be divided into sufficiency measures and efficiency measures.

- Energy efficiency means achieving savings by using less energy to achieve the same result. This is often achieved through technical innovations (eg electrical appliances having a better energy efficiency class). Energy efficiency also requires the use of green, renewable energy sources

- Sufficiency implies savings resulting from reduced use. This usually requires behavioural changes (examples: turning off lights, closing doors, installing own energy management systems, using renewable sources, closing doors). Energy sufficiency is the central aspect of energy saving projects in public buildings. (DOGERLOCH, Stephan. ,2020).

The Microsoft Encarta Dictionary (2005) define awareness as knowing something, having knowledge of something because you have observed it or somebody has told you about it, noticing or realizing something, mindful that something exists because you notice it or realize that it is happening, knowledgeable, well-informed about what is going on in the world or about the latest developments in a particular sphere of activities. In this paper, awareness refers to having knowledge or realizing something.

Energy awareness is significant in energy conservation program (Vesma, 2002, Wong, 1997, Mohamed El Halimi *et al*., 2000). Williams (1993) states that one of the most successful means of motivating employees to conserve energy is through awareness. Besides that, according to Camp (2005), staff awareness plays a crucial role in reducing utility bill and can make a big impact and therefore, raising awareness is large part of the solution.

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Awareness of energy saving

Energy awareness is essential for encouraging behavioural changes and fostering a culture of energy conservation within communities (Baidoo, A.N.A.; Danquah, J.A.; Nunoo, 2024). Energy awareness involves understanding and being conscious of energy usage, sources, and the effects of energy consumption on both the environment and the economy. It includes knowledge of energy-efficient practices, awareness of renewable energy sources, and an understanding of the personal and societal impacts of energy use (Gadenne, D.; Sharma, B.; Kerr, D.; Smith, 2011). In the literature, four possible options to enhance energy awareness are distinguished. This can first be done through Education and information campaigns (Owusu, P.A.; Asumadu-Sarkodie, 2016), including school programs, public service announcements, and informational websites that educate the community on energy issues. The European Union Energy Efficiency Directive (Directive (EU) 2023/1791), provides measures to improve energy awareness through public awareness campaigns. Second, Feedback Mechanisms, which provide real-time feedback to residents on their energy usage through smart meters and energy dashboards, have been shown to increase energy awareness and help residents understand their consumption patterns and identify opportunities for energy savings (Fischer, C., 2019; Geelen, D.; Mugge, R.; Silvester, S., 2019). Froehlich discovered that in-home feedback technology can lead to an average reduction in energy consumption by 10–15% when feedback is provided more frequently and with greater data granularity, such as detailed energy usage data for specific appliances. Casals et al. demonstrated that gamification also stimulates energy savings, resulting in an electricity saving of 3.46%.

A study by D'Oca et al. (D'Oca, S.; Corgnati, S.P.; Buso, 2014) showed that the implementation of automated home appliances timely informs users about energy consumption, uses persuasive communication, and personalizes energy-saving prompts, resulting in reducing electricity consumption in homes on average by 18% to 57% [Froehlich, J., 2009]. Third, Local initiatives and community-based programs encourage collective energy-saving behaviours [Heiskanen, E.; Johnson, M.; Robinson, S.; Vadovics, 2010]. Finally, through Technological interventions, the adoption of energy-efficient appliances and renewable energy technologies also contributes to greater energy awareness by making energy savings more visible and tangible [Dietz, T.; Gradner, G.T.; Gilligan, J.; Vandenbergh, M.P., 2009]. However, factors such as behavioural inertia, information overload, and economic constraints can impede efforts to increase energy awareness and promote energy-saving actions [Wilson, C.; Dowlatabadi, H, 2007]. As population growth and urbanization drive increased energy demand, understanding current energy consumption patterns is vital for sustainable development. Consequently, energy consumption has emerged as one of the key factors in managing development toward sustainability [Gyberg, P.; Palm, J., 2009].

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Awareness of energy saving

Residential energy consumption varies significantly across regions, influenced by factors such as climate, building design, socio-economic status, and cultural practices. According to Newell and Raimi [Newell, R.G.; Raimi, D., 2020], residential energy consumption represents about 25–30% of total final energy consumption worldwide. Energy consumption patterns are heavily influenced by climatic conditions, building characteristics (age, size, and insulation quality), and socio-economic factors such as income levels and access to energy-efficient technologies. Higher-income households often have more appliances and larger living spaces, leading to increased energy consumption [Brounen, D.; Kok, N.; Quigley, J.M., 2012].

There are numerous strategies available for reducing energy consumption in residential areas. In addition to behavioural changes, adopting energy-efficient appliances, home insulation, the integration of renewable energy, and smart home technologies represent viable options for energy saving [Pérez-Lombard, L.; Ortiz, J.; Pout, C., 2008].

To mitigate environmental impacts and enhance energy efficiency in households, the implementation of Energy-saving solutions in households may be considered critical.

Numerous energy-saving options are available to residents, ranging from behavioural changes and technological advancements to home improvements and renewable energy integration. This has led to a stream of research showing the many opportunities to cut down on energy use in households. De Almeida et al. [De Almeida, A.; Fonseca, P.; Schlomann, B.; Feilberg, N., 2011] concluded that existing technologies and improved behaviour can achieve up to 48% in energy savings. Encouraging residents to adopt energy-conscious behaviours can result in significant energy savings.

Simple actions, such as turning off lights when they are not in use, lowering thermostat settings, and reducing the use of high-energy appliances, can significantly reduce energy consumption. Studies have shown that behavioural changes alone can lead to energy savings of 5–15% in households [Darby, S., 2006; Stankuniene, G., 2021]. Furthermore, adopting energy-efficient appliances and smart home technologies is one of the most effective strategies for reducing household energy consumption. Appliances such as programmable thermostats, smart meters, home energy management systems, and appliances with energy star ratings allow residents to optimize their energy consumption [Tamas, R.; O'Brien,W.; Santana Quintero, M., 2023]. Improving home insulation in walls, roofs, and floors and sealing leaks and installing energy-efficient windows will decrease the need for heating and cooling, resulting in significant energy savings [Sadineni, B.; Srikanth, M.; Boehm, R.F., 2011]. Passive solar design, natural ventilation, and using high-performance building materials help reduce energy requirements for heating and cooling [Bulbaai, R.; Halman, J.I.M., 2021]. Key additional energy-saving options include installing rooftop

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solar PV systems and integrating other renewable energy sources, such as solar water heaters. PV solar systems enable residents to generate their own energy, reducing dependence on grid power and lowering energy bills. Meanwhile, solar water heating systems further decrease household energy consumption and greenhouse gas emissions.

A significant body of the literature, such as that by [Oorschot, J.A.W.H.; Hofman, E.; Halman, J.I.M., 2016; Gianfrate, V.; Piccardo, C.; Longo, D.; Giachetta, A., 2017; Elsharkawy, H.; Rutherford, P., 2018], emphasizes the importance of retrofitting social housing with energy-efficient technologies to reduce overall consumption. Retrofitting involves upgrading existing buildings with improved insulation, energy-efficient windows, photovoltaics, heat pumps, and other installations. This can be particularly impactful in social households, where residents may lack the financial resources to invest in energy-saving initiatives independently.

Most managers still do not pay much attention to the benefits of raising energy awareness. This is because facility managers and plant operators tend to be sceptical of behavioural approach and have little understanding of them and their potential (Geller, Richard and Peter, 1982). Because of that, 'lack of awareness' becomes one of the reasons of energy inefficiency. According to Yik and Lee (2002),one of the key barriers to improving energy efficiency of buildings is lack of knowledge and motivation of the operation and maintenance (O&M) staff. In their other research, Yik et al. (2002) pointed out that the key barrier to energy efficiency improvement in existing buildings is the knowledge. Awareness is defined as knowledge, lack of knowledge also means lack of awareness.

Key Term	**Definition**
Energy Security	Energy security is an umbrella term that covers many concerns linking energy, economic growth and political power. The energy security perspective varies depending upon one's position in the value chain. Consumers and energy-intensive industries desire reasonably priced energy on demand and worry about disruptions. Major oil producing countries consider security of revenue and of demand to be integral parts of any energy security discussion. Oil and gas companies consider access to new reserves, ability to develop new infrastructure, and stable investment regimes to be critical to ensuring energy security. Developing countries are concerned about the ability to pay for resources to drive their economies and fear balance of payment shocks.

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Power companies are concerned with the integrity of the entire network with emphasis on safety and reliability.

Policymakers focus on the risks of supply disruption and the security of infrastructure due to terrorism, war or natural disaster. They also consider the volumes of security margins – the amount of excess capacity, strategic reserves, and infrastructure redundancy. Throughout the value chain, prices and supply diversity are critical components of energy security.

Energy Conservation

Energy conservation is the saving of energy by any means including energy efficiency – it could also entail being more frugal – for example, turning lights off when not in use or providing information of ways to reduce energy. Some of the common meanings associated with energy conservation include:

- Using less energy in a particular application

- Finding ways to purchase forms of energy at lower cost. This is usually accomplished by negotiating with energy providers or by using energy under less costly conditions. (Paradoxically, the latter method may increase energy consumption considerably.)
- Shifting to different energy sources of lower price
- Using "free" or "renewable" energy sources
- Shifting to energy sources that are more desirable, or less undesirable, regarding non-efficiency concerns such as availability and pollution. Such shifts typically involve serious compromises.
- Conserving water and materials, as well as energy sources

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Energy Efficiency

Energy efficiency refers to the efficient conversion and use of energy and is a measure of the productivity provided per unit of energy consumed. It employs devices and practices, which result in less energy being used for the same task and function. An example would be a fluorescent bulb as opposed to an incandescent bulb. Other ways in which energy efficiency can be enhanced are through retrofits and capital improvements.

Technological advances have allowed for increases in energy efficiency, reducing energy demand while increasing economic activity. Studies have indicated that energy savings of 20 – 30% could be obtained globally over the next 3 decades through improvements in energy using technologies and energy supply systems. Furthermore, technological advances will allow companies to enhance profits because of the reduction in energy use and materials. Direct costs will be minimized through less resource inputs and lower disposal costs. Resource efficiency can enhance productivity, streamline production and improve workplace conditions.

Energy Management

Energy Management is defined as the steps taken to minimize usage and wastage of energy.

An Energy Management Programme is the process (a coordinated set of activities) for implementing measures to ensure responsible energy use through:

- Policy setting
- Energy auditing
- Behavioural change through awareness campaigns and training
- Identifying and implementing technical and procedural solutions
- Planning for future facilities and services
- Periodic Review for continuous improvement

An Energy Management System (EMS) is a control system (often computerized) designed to regulate the

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energy consumption of a building by controlling the operation of energy consuming equipment, appliances and systems, such as for ventilation and air conditioning, lighting an and water heating.

Other Terms Related to Energy

Acid Rain - This occurs when oxides of nitrogen, sulphur and carbon react with rainwater

Air Pollution - The presence of contaminants or pollutants in the air that do not disperse properly and interfere with human health or welfare, or produce other harmful environmental effects, such as global warming and acid rain

Alternative Energy - Also referred to as environmentally preferable sources of energy and may include low impact hydro power, geothermal, biomass, solar and wind

Ambient Temperature - Refers to air temperature. It usually means the outside air temperature

Energy Consumption - The amount of energy used. The term excludes electrical generation and distribution losses

Energy Conservation Technology - Equipment that produce the same level of end-use services (lighting and heating) with less energy. They include technologies such as fuel cells, energy-efficient appliances, lighting, and vehicles

Energy Resources - Anything that can be used as a source of energy

Fluorescent Lamp - A tubular electric lamp that is coated on its inner surface with phosphor. It contains mercury vapour that provides ultraviolet light which causes the phosphor to emit visible light. Examples include compact fluorescent bulbs and regular fluorescent tubes

Geothermal Energy - Natural heat from within the earth which can be extracted from reservoirs, for example, geysers, molten rock and steam spouts

Global Warming - Phenomenon that occurs because of the build-up of emissions of carbon dioxide and other greenhouse gases which causes an increase in global temperatures. It has been identified by many scientists as a major global environmental threat

Greenhouse Gases - Carbon dioxide, nitrous oxide, methane, low-level ozone, water vapour and chlorofluorocarbons (CFCs). When these gases accumulate in the atmosphere they contribute to the greenhouse effect

High-Intensity Discharge (HID) Lamps - HID lamps use an electric arc to produce intense light. They also require ballasts, and they take a few seconds to produce light when first turned on because the ballast needs time to establish the electric arc. They are commonly used for outdoor lighting and in large indoor arenas. The three most common types of HID lamps are mercury vapor, metal halide, and high-pressure sodium

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Hydropower - *Power* obtained from the movement of masses of water. Hydropower plants convert the energy contained in flowing water, like rivers and streams, into electricity

Incandescent Light - Incandescent light is produced by a tiny coil of tungsten wire that glows when it is heated by an electrical current. The three most common types of incandescent lights are standard incandescent, tungsten halogen, and reflector lamps.

Kilowatt (kW) - A unit of measure of the amount of power needed to operate equipment, equivalent to one thousand (1,000) watts

Kilowatt-Hour (kWh) - A measure of electrical energy equivalent to power consumption of 1000 watts for 1 hour. It is the most used unit of measure indicating the amount of electricity consumed over time

Leaking Electricity - The energy drawn by electronic equipment that consume power [e.g. TVs, VCRs, telephone answering machines, cordless phones etc.] when they are turned off or in stand-by mode, while connected to a source of supply.

Lumen - A measurement of light output from a lamp. For example, a 100-watt incandescent lamp produces about 1750 lumens.

Occupancy Sensor - A control device that senses movement in each space, used to turn lights on or off.

Renewable Energy - Resources that are inexhaustible or can be regenerated over time. These include solar, wind, geothermal, hydropower and biomass. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents and ocean thermal gradients.

Retrofit - To modify (machinery, vehicles or equipment) to incorporate changes and developments after manufacture

Smog - A fog made heavier and darker by smoke and chemical fumes; also a photochemical haze caused by the action of solar ultraviolet radiation on atmosphere polluted with hydrocarbons and oxides of nitrogen from automobile exhaust

Solar Power - Electricity generated from solar radiation

Thermostat - An automatic control device designed to be responsive to temperature and typically used to maintain set temperatures by cycling the HVAC system

Watt - A unit of measure of electric power at a point in time, as capacity or demand

Environmentally Sound Sources of Energy

Environmentally preferable energy sources are usually referred to as renewable forms of energy as they are sustainable energy sources that cause relatively few environmental impacts and pose a low risk to human health. Environmentally preferable energy sources include:

- Solar
- Wind
- Low impact hydropower

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- Geothermal
- Biomass

5.2 – Main obstacles in the effort of energy saving and solutions to overcome these obstacles

Energy awareness is the understanding of energy consumption and how to save the energy. Awareness in residential buildings and in public building is centred on the consumption of gas and electricity. It involves knowing how much energy appliances use, how efficient they are and how activities affect energy consumption.

We can distinguish three categories of obstacles that make it difficult to carry out building renovation strategies:

Legislative obstacles

o The existence of several public administration authorities with responsibilities in the field buildings, with no correlation between their duties and departmental regulations.
o Lack of an integrated national strategy for implementing sustainable energy solutions.

Economic obstacles
o Insufficient funds for building renovation works;
o The insufficiency of private investments in the rehabilitation of buildings;
o High costs of energy service companies (ESCO);
o Demand for technology and reduced energy consumption for buildings, which leads to prices mayors;
o Execute the redecoration of the reduced quality decal;
o Subsidized energy prices.

Deficit of skills and professional training
o Lack of skilled workers in the use of energy efficiency technologies and systems and the disintegration of renewable energy sources.

Deficit of knowledge how to save the energy or how to improve the building energy management

Energy awareness is affected by several factors. One of these factors is the visibility of energy consumption.

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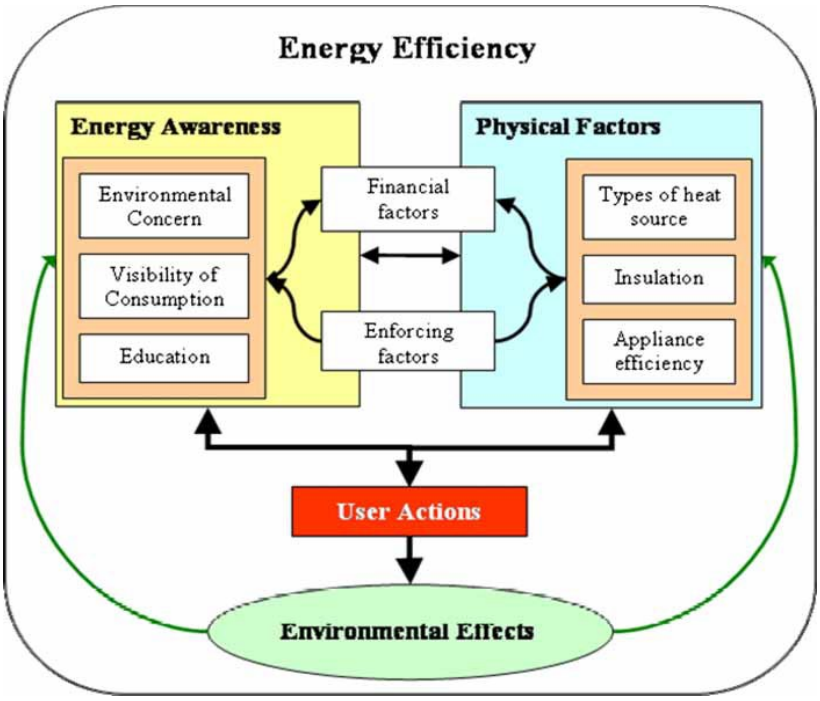
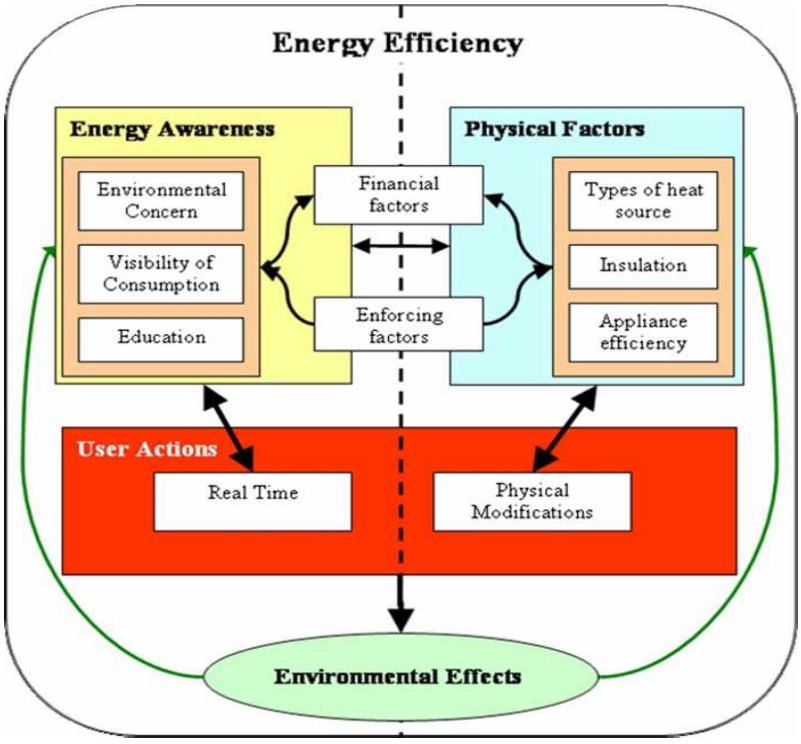


It has been estimated that increased visibility can reduce energy consumption by up to 20%. Factors that increase energy awareness by their nature are financial and enforcing ones. Depending on how financially concerned occupants are greatly affects energy consumption. Environmental impacts may also increase energy awareness as more people are starting to think about what effect their energy use has on the environment. This factor varies and very much depends on how ecologically minded an individual is

Physical factors



There are huge amounts of energy saving measures that homeowners could apply to increase energy efficiency. The list below details the most common and effective physical changes that could be made to a house:

Increase insulation: Loft, cavity wall, reflective material behind radiators, hot water tank jacket, draught proofing, double glazing, etc.

Use energy saving appliances: Energy saving light bulbs, energy efficient washing machines/boilers – buy 'energy saving recommended logo' products, etc.

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How can we overcome these obstacles or barriers?

First, we could reclassify the categories of obstacles presented previously into 2 large categories: obstacles that are not directly related to us and on which we can intervene in time, indirectly and obstacles that are related to us, on which we can intervene directly, in a short time, often with minimal effort. This last category is directly within our power and here we will refer to the actions and measures taken in our home or workplace to reduce energy consumption.
The public authorities run various campaigns to raise awareness of the importance of energy saving, campaigns that also contain practical, immediate solutions that require minimal effort, to rationalize energy. Such campaigns take place either online, on television and radio stations, on the websites of institutions or energy companies, or door-to-door through flyers and posters. (you can see: https://arhiva.anre.ro/ro/eficienta-energetica/informatii-de-interes-public/info-eficienta-energetica1386850500/proiecte/campania-de-crestere-a-gradului-de-constientizare-privind-eficienta-energetica-dg-just-in-parteneriat-cu-anre ; https://www.distributie-energie.ro/category/campanii/
chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://immromania.eu/wp-content/uploads/2024/02/Ghid-pactic-_-reducerea-consumului-si-costurilor-cu-energia-in-sectorul-IMM.pdf

In the analysis of the impact on the environment that a product has, both the materials from which it was made and the process it went through to reach the store shelves are considered. From food to electronics, everything went through a process that required the use of electricity. In this tutorial we offer you 10 steps by which you can save electricity and thus reduce your footprint on the environment. Some of the methods proposed by us also help you save on your monthly bill.

1. Turn off the light

How many times have you left home and left the light on? This has not only affected the planet, but also your electricity bill. For example, at the office you can make a habit of turning off the light in rooms where there is no one.

2. Use motion sensors

Motion sensors are very useful in suitable spaces such as on the staircase of the building or at the entrance to the courtyard. The light turns off automatically after a time set by you when no one passes in front of the sensor.

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3. Buy LED bulbs

They help you save electricity, last longer and are safer for our health than a neon one, especially for the health of the eyes because of the type of light they provide.

4. *Unplug electronics when not in use*

Did you know that you can pay an extra 36 euros /year on your electricity bill if you leave appliances plugged in when you're not using them? According to a company that operates in the field of electricity, an appliance in stand-by can consume between 40% and 70% of the energy it would consume during operation. To reduce the loss of electricity, choose efficient household appliances, energy class A, and unplug the appliances you are not using.

5. *Wash laundry or dishes if the machine is full*

Make sure the washing machine is always full, not only do you save electricity, but it also saves water. Moreover, the lower the temperature you wash, the lower the energy consumption. If possible, choose the shortest washing program.

6. *Keep electronics in good working order*

Well-maintained electrical appliances work efficiently and don't use more electricity than they should.

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8. Install a programmable thermostat

By automating the heating process of the house, you can significantly reduce the heating and electricity bill. For example, you can set the thermostat to a lower temperature when you are away from home for several hours.

9. During the day, use natural light to the maximum to illuminate the rooms.

10. Choose curtains made of transparent fabrics and blinds in light colours.

11. Illuminates only the place in the room where you carry out your activity.

12. Choose for several lower wattage light sources placed in several places that you can use for lighting, rather than having one high wattage light source placed on the ceiling.

13. For large lighting sources, use switches with continuous adjustment of the supply voltage. In this way you can continuously adjust the light intensity of the lighting source and therefore - the electrical energy consumed. (https://hartareciclarii.ro/noutati/10-pasi-prin-care-poti-economisi-energie-electrica/)

14. Paint your walls into warm colours to create brighter natural environments;

15. Wipe the lamps 3-4 times a year, dirt reduces the efficiency of the light.

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16. Photovoltaic panels

Photovoltaic solar panels are an option increasingly requested by companies that want to save energy and be less dependent on the increases and decreases in the price of electricity. Although total energy independence is very difficult to achieve, companies can save between 40 and 70% of the electricity bill through self-consumption. On the other hand, when the solar panels produce more energy than is necessary for the company's activity, the surplus energy can be transferred to the distribution network, obtaining compensation for it.

17. Staff training

Train your staff on the importance of saving electricity in a company and establish rules and protocols for the efficient use of resources. Collect and clearly distribute the responsibilities of each employee.

18. Use automation

In the world of home automation, there are sensors that adjust the intensity of the light when people are in the room or that turn off the lights when there are no people in the room. There are also sensors that detect the amount of sunlight and adjust the intensity of the bulbs according to this, to obtain a lighting adequate with the lowest energy expenditure.

19. Replace consumer appliances

The maintenance of light bulbs, devices and equipment in the company is essential, because devices in poor working condition consume more energy. Buy products with low energy consumption, to save in the long term. Old appliances tend to consume more than the new generation ones.

20. Rational use of air conditioning

It is necessary for the temperature in the office to be ideal, but do not to use the air conditioning in excess. As a rule, summer should be around 23-24 degrees Celsius, but these figures are indicative and must consider the activity of the employees. Check the air conditioners quarterly.

21. Compare electricity tariffs

We have a liberalized market, so you can collaborate with the supplier who offers you the lowest price for electricity, which best suits the company's needs.

22. Replacement of the heating system, if it is old

23. Thermal insulation of the home to avoid energy losses and turn it into a passive house.

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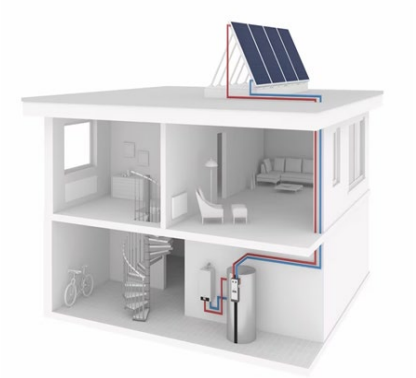
5.3. - Several main methods and strategies to save energy and for energy efficiency

In addition to the methods mentioned in the previous point for saving energy, there are also more complex solutions and strategies, which require more consistent investments for the energy efficiency of the building and for the use of renewable energy sources. In the previous point we mentioned solutions for overcoming some obstacles that stand in the way of energy saving, simple solutions that many people do not think to apply.

Now at this point of the tutorial we present more complex, broader strategies and solutions, which involve saving energy and at the same time using renewable sources. These solutions also require slightly larger investments of time and money, but the benefits are visible and the reductions on invoices are very large. Also, the impact on the environment is positive. There are for individuals, but also for legal entities, a series of programs with non-refundable funds in which the contribution of money or the beneficiary's contribution is low or even financially non-existent.

Some of program calls for energy efficiency, saving energy and using regenerable energy are in the NATIONAL RECOVERY AND RESILIENCE PLAN (PNRR): *State aid scheme with the objective of supporting investments in high-efficiency cogeneration in the district heating sector ; State aid SCHEME with the objective of supporting investments for the installation of new electricity production capacities from renewable wind and solar energy sources, with or without integrated storage facilities* or other call : *RePowerEU, Investment: 7 – Voucher grant scheme for improving the energy efficiency of households, Axis I – Renovation targeting energy efficiency combined with the installation of solar panels on single-family residential buildings, only for energy-poor households and for vulnerable energy consumers.* The most accessed programs by individual beneficiaries are the greenhouse type programs. The public authorities carry out frequent campaigns to raise awareness among the population about the benefits of an energy efficient building and about the utility of using renewable energy solutions, much more practical and with very low costs. These energy efficiency programs carried out by the European states also have a component that focuses on raising awareness and explaining the importance of energy saving and the use of renewable energy sources.



In the following paragraphs, we try to present some solutions and strategies of combined measures to increase the energy efficiency of a building, regardless of whether it is residential or public

Collectors are the most visible components of solar thermal energy solution. In addition to vacuum tube collectors, Viessmann also offers

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flat collectors for residential, commercial and local authority buildings. The two collector versions are similar in that they use free and almost universally available solar energy for heating and domestic hot water.
In addition, they are made of materials resistant to corrosion and UV rays. However, the design and functional principle of solar collectors differ.

Heat pumps solution
Heat pumps are the first choice for those who want to reduce their heating bills and generate heat in a more environmentally responsible way. After all, the environment provides heat pump heating with the unlimited and free supply of energy it needs.

This full-fledged heating system needs very little drive and pump energy to make this energy usable. A heat pump works independently of fossil fuels and actively contributes to reducing CO2 emissions and protecting the climate.

Heat pumps for domestic hot water

Domestic hot water heat pumps or domestic hot water heat pumps use the thermal energy already present in the environment to produce domestic hot water. They are also suitable for optimal consumption of self-generated energy from photovoltaic systems and can be coupled to an existing air distribution system.

The structure and working principle of the heat pump for domestic hot water
A domestic hot water heat pump consists of a unit that contains all the important components for the heat recovery process. These include the evaporator, compressor, condenser and domestic hot water cylinder. Depending on the version, an additional

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solar heat exchanger will be integrated, which allows the connection of solar collectors.

The heat pump obtains energy for heating from the surrounding environment. For this reason, it is also called ambient heating. But how does a heat pump work? The principle is like that of a refrigerator - only in reverse. While a refrigerator extracts thermal energy from the food, i.e. from inside the refrigerator, and conducts it outside, a heat pump does the opposite. This extracts thermal energy from the environment outside the building and makes it usable for indoor heating. In addition to indoor or outdoor air, a heat pump is able to extract thermal energy from groundwater and soil.
The structure and working principle of the heat pump
Regardless of the ecological energy source exploited, the heat pump system consists of three parts:
Heat source system: extracts energy from the environment
Heat pump: Converts heat from the environment into usable energy
Heat distribution and storage system: distributes and stores heat in the building

Only in interaction do the components of a heat pump make use of energy from the environment. The process starts with the heat source system. In the case of geothermal heat pumps, a mixture of water and antifreeze - the soil - circulates here, which is heated. Air-to-water heat pumps, on the other hand, draw in outside air via a fan. Soil and outside air then pass into the actual heat pump. In the so-called refrigeration cycle, the pump raises the temperature level before the heat is transferred to the distribution system consisting of heating panels or radiators, or is temporarily stored in a buffer or hot water tank.
How a ground/water heat pump works?
Like all other heat pumps, the ground/water heat pump works on the same principle: First, thermal energy is extracted from the ground and then transferred to the refrigerant. It evaporates and is further compressed with the help of a compressor. This increases not only its pressure but also its temperature. The resulting heat is absorbed by a heat exchanger (condenser) and transmitted further to the heating system.

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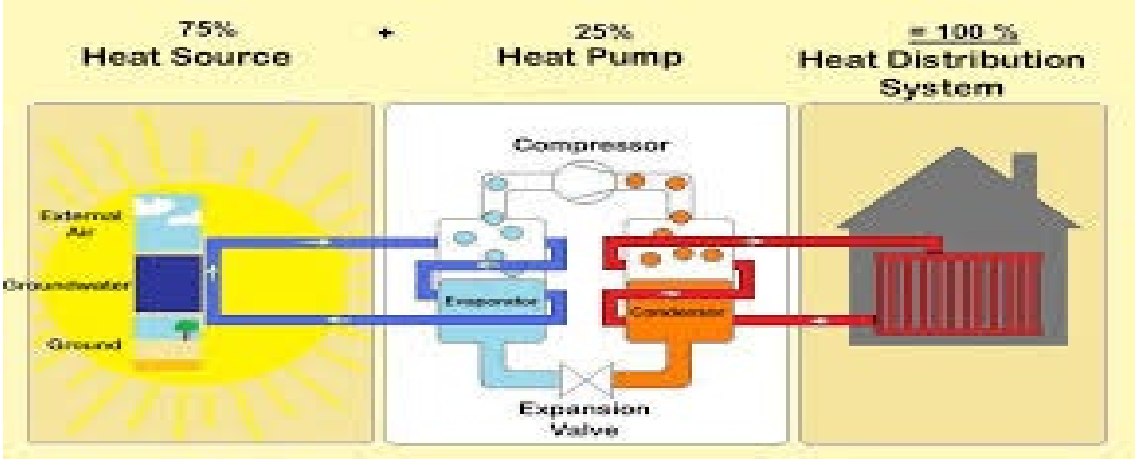

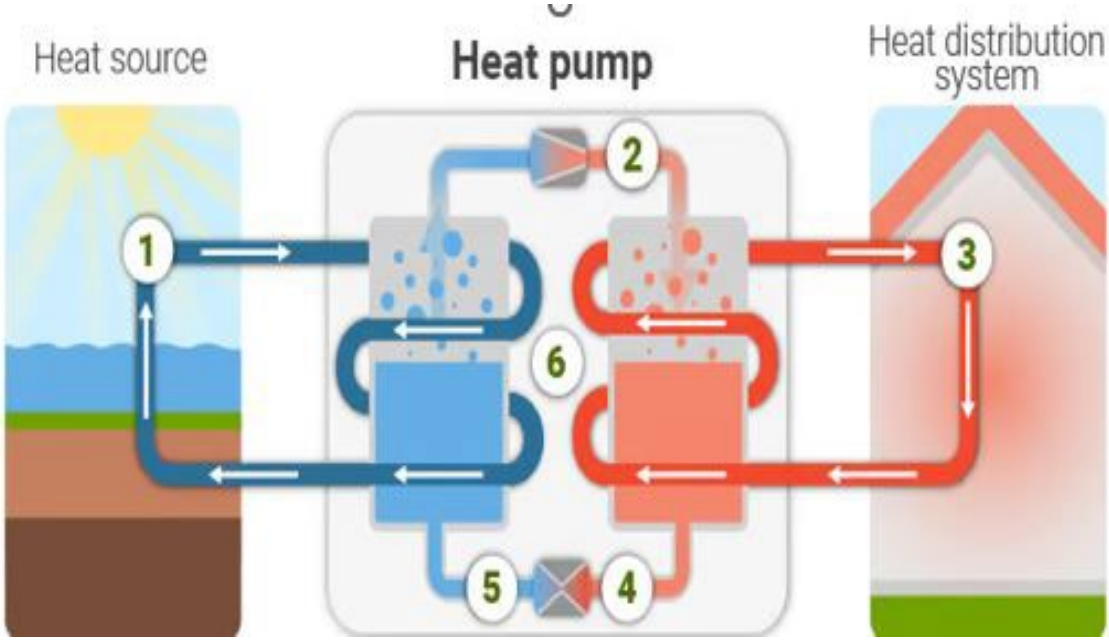

Smart home Solution

When it comes to digitization, one term comes up repeatedly: Smart Home. It is a term that does not have a simple definition. By smart home, most people mean a smart home where objects communicate with each other and can be controlled via internet-enabled mobile devices such as smartphones, tablets and voice assistants. However, there is much more to it than that. A smart home also allows things like energy flows to be optimally measured and observed over time. This can help identify potential savings for you. But how does a smart home actually work and how can heating systems be integrated into it?

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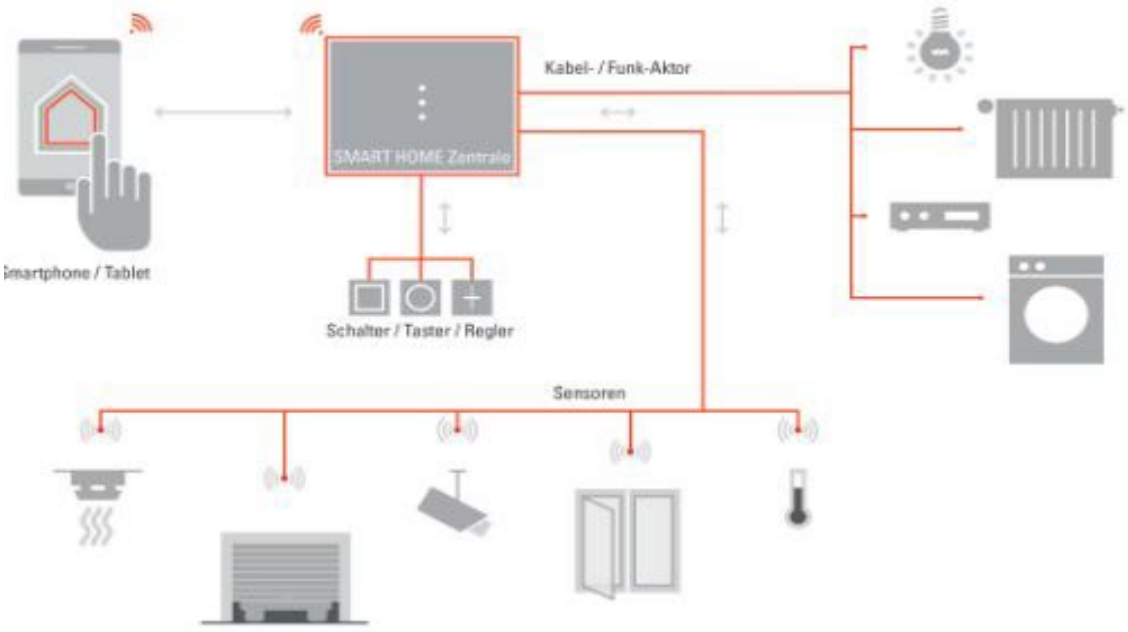

Introduction: The application is started using a smartphone or tablet. The user interface opens and displays numerous functions, including setting the desired temperature. By touching the relevant interface, the application user can issue a command.

Processing: Every smart home has a Smart Home control centre. In the case of the application, this is also called the web interface. The command issued via Wi-Fi (the desired temperature must be reached) is received and processed by this control centre. In addition to Wi-Fi, Smart Home devices also use other transmission standards such as Bluetooth, Z-Wave and KNX, the latter being a wired solution.

Output: After processing, the command is executed using an output device. In our example, this is the heating system, which will transport the heating water to the radiators until the specified desired temperature is reached. Depending on the output device, the application user will be informed about the progress and result of the command.

In addition to the above example, there are other areas of application for Smart Home devices in practice, such as light bulbs, music systems and entrance doors. Other examples are robot vacuum cleaners, smart washing machines, surveillance cameras and even coffee machines. In use, homeowners pursue several goals, but among the most important are saving energy, increasing comfort and safety.

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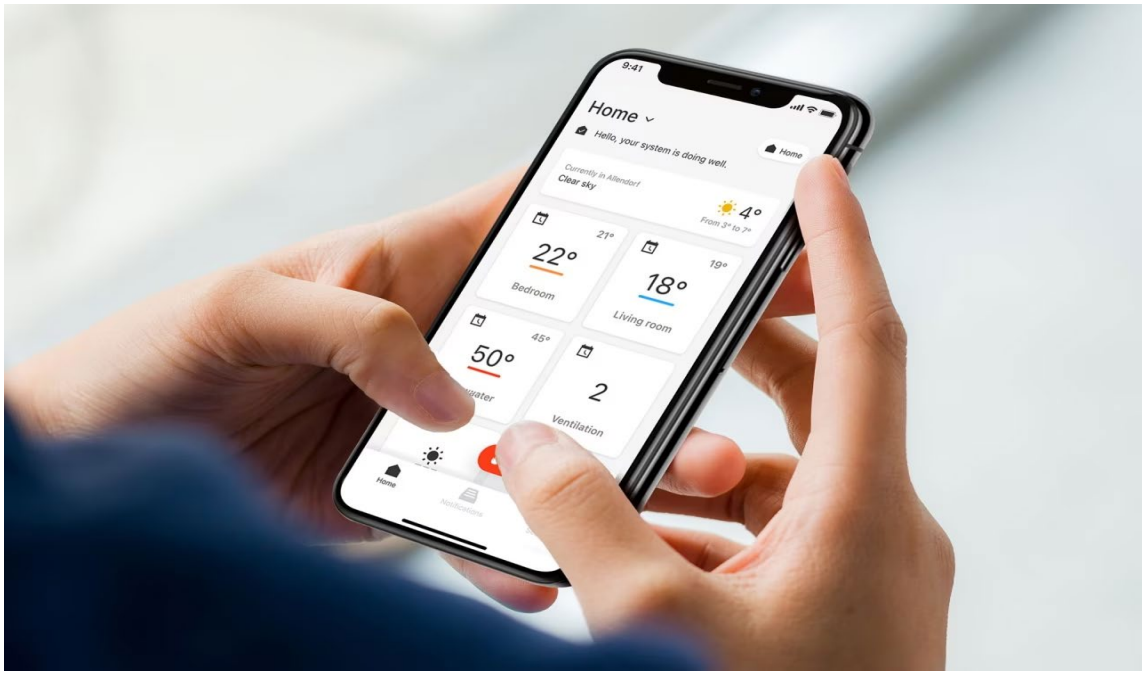

With the decrease in the feed rate, installing systems for self-consumption makes more and more sense. However, it is important that the new system is adapted to the house and the electricity demand, so that it is also economical. To ensure that self-generated, environmentally responsible electricity always finds a consumer, it pays to have a uniform energy solution. Some examples are:

Photovoltaic system + energy storage unit + heat pump

The energy from the PV system is stored by the energy storage unit and consumed directly by the electricity consumers such as the heat pump. In case of an energy surplus, the energy is temporarily stored in the battery of the energy storage unit and released again when needed. Thus, the home and the heat pump are mostly powered by electricity generated sustainably and efficiently on the roof.

Photovoltaic system + energy storage unit + heater with fuel cells

With a photovoltaic system and a fuel cell heater, you get two energy generators that complement each other perfectly. During the summer, the photovoltaic system generates electricity for the house (and optionally for an electric vehicle). In winter, the fuel cell heater provides more electricity due to the operating time. This means that your home (and optionally your electric vehicle) can be powered from your own

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energy resources all year round. This increases self-sufficiency on the one hand and reduces electricity costs on the other.

Photovoltaic system + energy storage unit + electric heating system and domestic hot water

In an all-electric system, the energy generated by the photovoltaic system is used for electric heat generators such as infrared heating, underfloor heating or domestic hot water heating. In the event of a surplus of energy, it is temporarily stored in the energy storage unit. Thus, a home that has both electric space heating and domestic hot water heating can achieve a high degree of self-sufficiency and sustainability and can enjoy the advantages of infrared heat with low standby consumption.

Retrofitting an energy storage unit into an existing photovoltaic system

System operators receive a fixed payment for 20 years for the electricity they export to the grid. Once the Renewable Energy Sources Act subsidy for your existing PV system expires, the public grid operators are no longer required to accept the electricity you produce. In addition, 'direct trading', whereby self-generated energy is sold on the electricity exchange, is not necessarily feasible. The high degree of flexibility of the components allows an existing photovoltaic system to be combined with an energy storage unit as a system solution in this case. If necessary, the system can be easily expanded with additional battery modules.

In addition to the usual household appliances that require electricity, we can increase self-consumption with an electrically operated domestic hot water heat pump, for example. It is the perfect complement for the pleasant comfort of hot drinking water. Using self-generated electricity only results in lower running costs. The mechanical ventilation system, electrically operated, also increases our sense of well-being and comfort at home and contributes significantly to the preservation of the building structure with fresh, clean air and an optimal level of humidity.

How big does the energy storage unit need to be?

Whether it is a new system or an existing system, it all depends on the right size of the energy storage unit. The energy storage unit should have enough capacity to power a household with solar electricity from evening to morning. The size or storage capacity of an energy storage unit depends on both the annual electricity consumption and the rated power of the existing or planned photovoltaic system. The following rule can be

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used as a guide: 1 kWp PV = 1 kWh battery = 1 000 kWh of electricity consumed in the household.

Example 1 with heat pump
Household + heat pump: 8000 kWh
PV = 8 kWp

Energy storage unit = 8 kWh

Example 2 with heat pump and electric vehicle
Household + heat pump + electric vehicle = 12,000 kWh
PV = 12 kWp

_____
Energy storage unit = 12 kWh

Hydronic balancing for optimal heat distribution
Radiators in a building often do not heat up evenly. The greater the distance from the heat generator or the thinner the heating pipes, the greater the resistance encountered by domestic hot water as it flows through the system. This means that not everywhere gets the same amount of water, causing some radiators to heat up more than others. This means that it takes a lot of energy to heat each room to the required temperature.

To ensure that all radiators in a given system are supplied with the exact amount of heat required for each individual room, a procedure known as hydronic balancing must be carried out.

Independent studies have shown that hydronic balancing of a heating system increases energy efficiency by up to 15 percent. This not only saves energy, but also reduces heating costs. (https://www.viessmann.ro/)

5.4. Several equipment to use regenerable energy for energy efficiency

In Europe, the energy of the incident solar rays is 200...1000 W/m2, depending on the latitude, the period of the calendar year and the climatic conditions. Solar collectors are used for capturing this radiant energy of the sun to heat closed spaces, for hot water production, or for use as the energy source in a refrigeration system.

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A system for converting solar energy into thermal energy must be optimal from a point of view of performance, acquisition and operation costs and durability. The classical structure of a system water heating using solar radiant energy consists of the following components.

One or more solar collectors, which can be flat, with evacuated tubes, or with tubes with direct water heating;
2. The heat transfer system and the (re)circulation system; heat exchanger (if is the case, depending on the type of installation);
3. Hot water storage system;
4. The command-and-control system;
5. The auxiliary heating system, which provides additional heat in situations where solar radiation is not enough. Usually, it consists of an electrical resistance or a natural gas heating equipment.

Solar heat supply systems can fall into two broad categories: active and passive.
Active ones use command and control systems and pumps to circulate the water or agent thermal through the solar collector and are divided into two subcategories:
- Direct active solar systems, which pump dedicated water for further use to the solar collector. They are recommended for use in geographic areas where they do not exist the danger of frost. Otherwise, the system must be emptied before the period begins cold.
- Indirect active solar systems, which have a closed circuit through which an agent circulates thermal (water, usually mixed with an antifreeze), of which the solar collector is also a part.

From the point of view of maintenance, reliability and cost price, passive systems are more advantageous than the active ones as they do not have electrical components, being simpler constructively.
However, there are disadvantages that must be considered when purchasing or designing one passive system:
- They have a lower efficiency than active systems;
- The water tank must be placed higher than the solar collector.
- Since there is no frost protection, it does not work in cold weather (it is necessary evacuating the circuit and taking it out of operation during the winter);
- In regions with hard water, lime deposits form over time on the entire water circuit.
- Does not provide protection in case of overheating. This phenomenon occurs on sunny days, when not the hot water produced by the system is consumed.

Collectors with evacuated tubes

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The solar collectors in this category are made up of collector tubes arranged in parallel (see the figure before). Each tube is made of borosilicate glass with good mechanical resistance and has a wall double, the space between the walls being emptied to stop heat loss through thermal transfer between the inside of the collector tube and the medium. To maintain the vacuum, it is deposited inside the wall double, at the lower end, a silver barium film. This will absorb several gases that may be emitted during the life cycle of the tube, such as CO, CO2, N2, O2, H2O and H2, thus maintaining the vacuum state. When this state is lost, the film changes colour from silver to white, providing an easy way to identify faulty tubes. From these principles, several constructive variants have been developed.

Compared to flat panels, vacuum tubes have a slightly lower efficiency in perfect conditions sunny, but are more effective in cold and very cold periods, as well as in cloudy weather. Over the course of a year, the performance of collectors with evacuated tubes can be up to twice as much higher than in the case of flat panels, at the same surface exposed to solar radiation.

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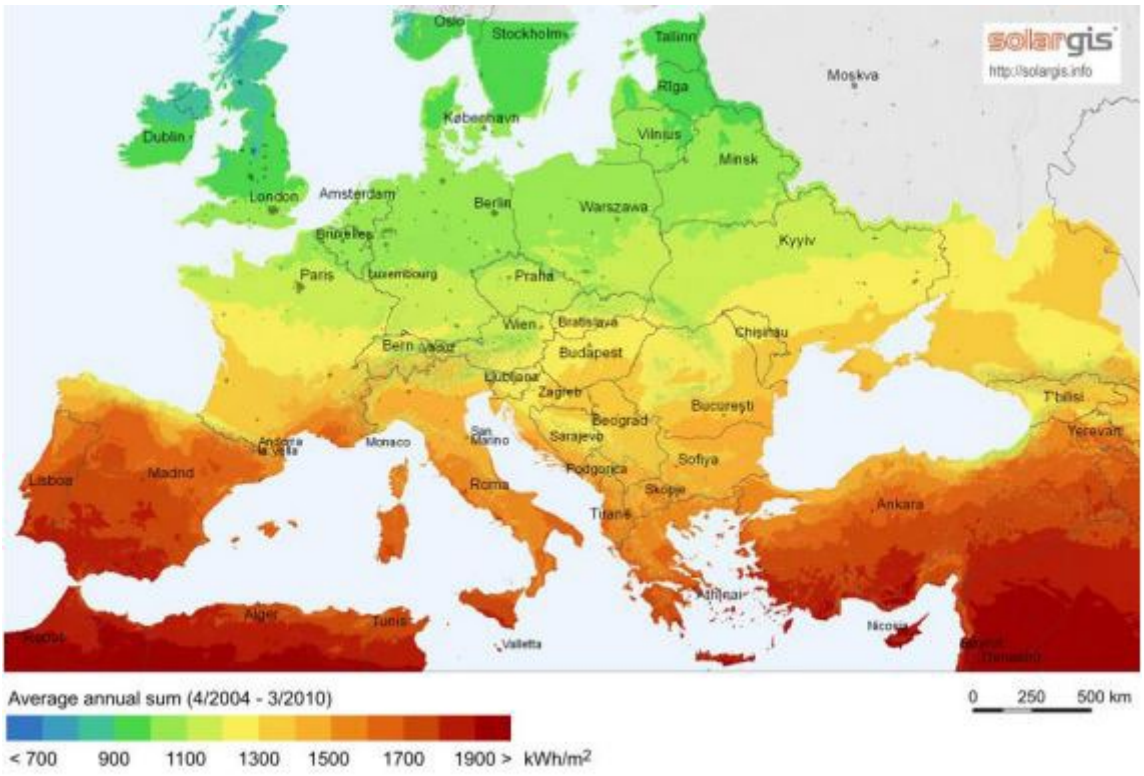

Photovoltaic cells

The material most frequently used in the construction of photovoltaic cells is silicon. at present their yield generally reaches values of 25% under standard conditions.

To be of practical use, the solar cells (adjacent figure) must be connected to each other in modules (solar panels).

Usually, each module includes a set of 36 cells if it is intended to charge 12 V batteries, or 60 cells when the destination is residential applications. For large commercial applications the modules will usually have several 72 solar cells. The increase in the number of cells per module is accompanied by the increase in voltage and generated power.

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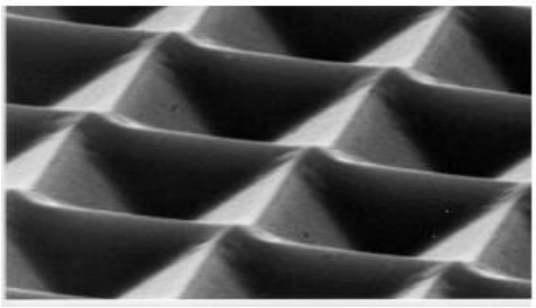

Manufacturers use a variety of techniques to maximize the amount of light incident on photovoltaic cells. Thus, the surface of the cell can be textured, for example in the form of pyramids with the tip down, so that the light radiation is reflected to a greater extent on the walls of the cell and as little as possible back into the environment.

To estimate the operating performance of a photovoltaic system, it is necessary to know the incident irradiance in the area and at the location angle, which implies the existence of a history of irradiance in that area. Also, during exploitation, numerous factors intervene affect the performances reported under standard conditions, the most important being degradation over time of photovoltaic cells, the deposition of dust and other impurities on the panels, shading and heating cells. The estimation involves the following steps:

- Associating an individual coefficient to each influencing factor, depending on the losses which it causes. For example, if the inverter causes 10% loss,
the coefficient associated with it will have the value 0.9 (90%, meaning what remains of the energy emitted after passing through the inverter).
- A global coefficient is calculated for the entire photovoltaic system, by multiplication to all the individual coefficients, obtaining a system yield that does not however, it takes into account losses due to temperature increases. According to statistics, the global coefficient is around 0.77.
- The global coefficient is corrected with the influence of the operating temperature. There are numerous statistics based on which temperature correction coefficients result (for example 0.91 is reported as the usual correction value for 45°C), but various equations from specialized literature that consider the operating temperature in system performance evaluation, called translation equations.

- The global coefficient is multiplied by the yield under the standard conditions mentioned by manufacturer on the photovoltaic panels and the yield of the entire system is obtained under the conditions actual exploitation.

Heat pumps

Heat pumps do not require heat sources with high temperatures, their operation being based on the relatively constant temperature of the soil at depths starting from less than two meters and reaching up to 100 m and, where the legislation allows, reaching up to 160 m. Towards the surface, the soil temperature is 10 - 16°C, being lower than the air temperature during the summer and raised during the winter. Seasonal temperature variations disappear at depths between 7 and 12 m due to its thermal inertia. The soil is used as a heat reservoir, so in the summer these systems can evacuate the heat from the buildings giving it to the ground, and in the winter the heat from soil is taken up, amplified and 'pumped' into the buildings. The intermediary

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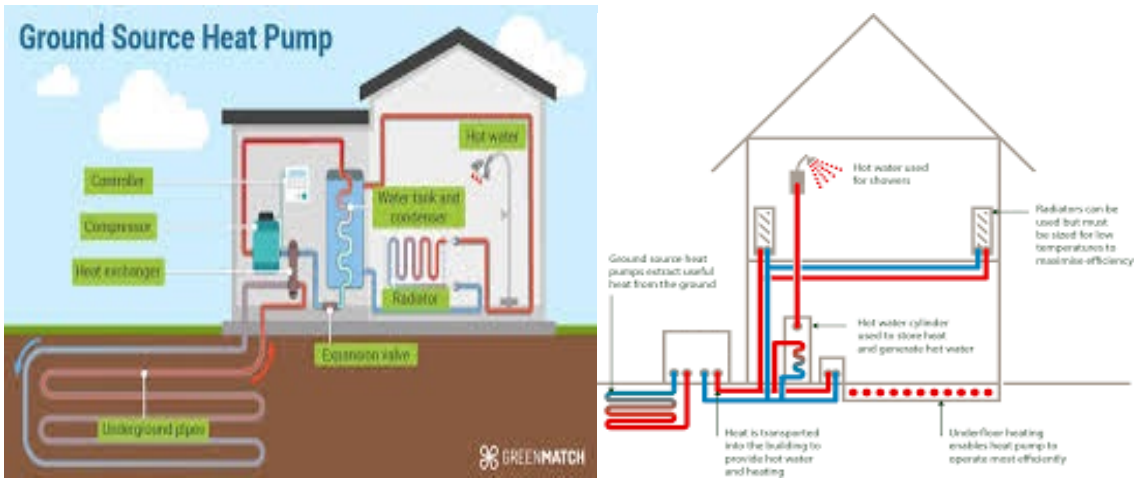
agent used for the transfer heat is water mixed with an antifreeze, which circulates through a pipe system with the role of heat exchanger, usually buried several meters in the ground. Antifreeze can be propylene glycol or denatured alcohol. Since it has the least polluting effect in the event of leaks in the ground, propylene glycol is the only one accepted for these applications in an increasing number of European countries. (Edmond MAICAN, 2015)



Heat pump function

5.5. Best practices and advice regarding energy saving and renewable energies, to increase the awareness for energy saving

5.5.1. Some advice to improve the energy efficiency inside buildings and reduce the consumption

Maintenance of the heating system

When it gets colder outside, it's also time to start putting on the radiators. It's not uncommon for annoying noises to occur and sometimes loud gurgling or gurgling noises. This is caused by air in the radiators. Apart from noises, another clear indication of this is when the heating system does not heat up completely, i.e. the radiators remain completely or partially cold. The correct action in this case is to bleed the heating system. If you don't do this, some rooms will remain cold and the generated thermal energy will be wasted, because air bubbles in the heating system prevent the heat from being distributed properly. We will explain with some clear instructions how you can easily empty the heating system yourself.

Why should you clean your heating system?

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A heating system is basically a closed heating circuit that transports hot water. The starting point is the boiler or heat generator. There, the water is heated before being sent through a system of pipes and tubes to the appropriate rooms, where it then flows through radiators. These, in turn, emit heat into the surrounding air.

For trouble-free operation, domestic hot water must be able to be optimally distributed. But this is not possible if there is air in the system. This is because air conducts heat much less efficiently than water. This in turn means that some radiators get hotter than others. An annoying side effect is the gurgling noise that deprives many homeowners of a good night's sleep. In addition, small air bubbles affect the efficiency of the system.

Bleeding your heating system will ultimately save you money. Because a radiator that is not supplied with enough domestic hot water consumes more energy. To reach the required temperature, the thermostatic valve is usually set harder, which implies higher costs.

What do you need to clean the heating system?
Before you get down to bleeding your heating system yourself, you need to have a few things ready. These are usually found in every household.

You will need the following tools to clean the heating system:

a glass, a cup or a mug
a rag or cloth
a radiator bleed key
You can buy the bleed wrench for a reasonable price from your heating contractor or a DIY or plumbing store. This is usually a standard dial spanner. It may also be possible to open some drain valves using a standard slotted screwdriver. You will need the cloth and the container to catch the hot domestic water that escapes.

Step by step guide
To properly clean your heating system, all you need are the tools mentioned above and the following 7 short steps. Once you have all the tools ready, you can begin:

If you are the owner of the house, you should turn off the circulation pump if possible.
Now wait approx. 30 to 60 minutes for all the air bubbles to collect in the radiators.
Before starting the actual cleaning process, first turn on the radiators to the highest setting.

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Place the cloth under the radiator so that it catches any water that leaks from the vent valve. Alternatively, you can wrap the cloth directly around the valve.
Now insert the key and hold the container under the vent valve. Open the radiator valve slowly with the wrench, but do not open it all the way. It usually takes half a turn or less before you hear it hiss. Caution: the air coming out can be hot, so keep a safe distance.
When the hissing becomes quieter and eventually stops, the water will begin to drain. The radiator is now vented and you can close the vent valve. This must be done quickly or too much water will run out.
If you have turned off the circulation pump, do not forget to turn it on again. Also check that the water pressure in the heating circuit is still adequate.

Save energy and reduce heating costs

A heating system is a closed system in which domestic hot water heated by the heat generator circulates. However, in practice, air can enter the system, for example by diffusion or when work is carried out on the heat generator. Air bubbles form that prevents the heat from being evenly distributed in the radiator. As a result, it is not uncommon for strange or annoying noises to occur. If this happens, the radiator must be vented. Our guide to bleeding your heating system shows you how to do it and what to look out for.

Ventilate properly and reduce heating costs
Proper ventilation of rooms is also considered one of the most effective means of saving energy. Important: When ventilating the room, open the windows fully for a short time (about five minutes) instead of leaving them slightly open for a long time. Windows that are slightly open bring in some fresh air, but let a lot of heat out. Turn off the heating while you ventilate the room. Repeat the process up to three times a

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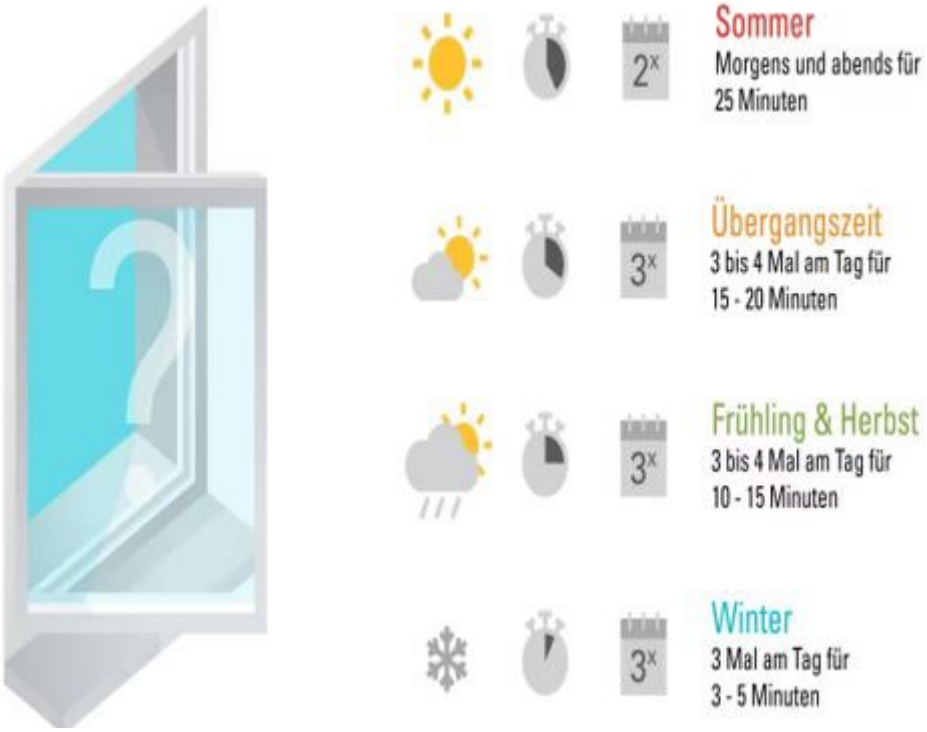
day if possible. Depending on the season, you can also air for more than 5 minutes.



Not every room needs to be equally warm

The perception of heat is always subjective. One person may like it very hot and the other a little cooler. However, one thing is certain: it does not have to be the same temperature everywhere in the house or apartment. After all, the rooms are used in different ways and are also heated indirectly, for example by the people in them or by the operation of electrical appliances.

Keep temperatures at the following levels:

In the playroom, in the office and in the living room 20 - 22 degrees Celsius, in the kitchen and in the bedroom about 18 degrees Celsius, and in the hall 15 degrees Celsius. The savings potential shows how important the right room temperature is: if you reduce the room temperature by just one degree Celsius, this reduces heating costs by up to six percent - at least in an older building. In the case of new buildings, the savings may be lower.

Technical measures to reduce heating costs

To save energy and reduce heating costs in the long term, the tips already mentioned are not enough. In practice, the best savings potential comes from a combination of

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correct heating practices and technical optimization. The latter includes hydronic balancing and regular maintenance of the heating system by a specialist.

Regular heating system maintenance extends the life of your heating system and ensures reliable, trouble-free operation. This is the only way to ensure that the energy from the fuel is used efficiently and cleanly, thereby protecting the environment and saving on heating bills - without compromising the high comfort of heating and domestic hot water.

The boiler, burner and control unit form a system like that of a car engine. If your car ran for the same amount of time as your boiler, it would cover more than 60,000 kilometres in a year. And all car owners know that they need to carry out a service at regular intervals. Therefore, your heating system should be serviced at least once a year, just like your car.

The benefits of regular maintenance

Regular maintenance not only saves energy, but also reduces heating costs. According to experts, potential input energy savings of five to seven percent can be achieved

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compared to the energy consumption of a maintenance-free heating system. This means that considerably less heating resources must be used. Therefore, carrying out an overhaul of the heating system ensures environmentally responsible operation.

- ✓ Greater efficiency and extended life of the heating system
- ✓ Reduction of heating costs
- ✓ Greater reliability of operation of the heating system
- ✓ High and constant level of comfort for heating and domestic hot water
- ✓ Heat generated with low CO2 emissions thanks to economical and ecologically responsible exploitation
- ✓ Conservation of resources through efficient use of input energy

Cut your heating costs with energy saving tips

Tight joints on all windows and doors

Tight joints in windows and doors are indispensable for economical heating. Before the heating season, you should check the gaskets and replace them if necessary.

Insulation of heating pipes even in heated rooms

Insulating heating pipes is simple and does not involve a lot of work or expense. It also allows you to save energy.

The use of thermostatic valves for radiators

Regularly check the operation of the thermostatic valves. A lazy or even stuck thermostat will reduce heating power. To save energy, it is advisable to fix any problem

Using water-saving faucets in toilet tanks reduces water consumption. A conventional water tank uses three times more water than a tank with a water-saving pull button (one pull consumes about 9 litters of water).

Faucet repairs

Repair leaking taps immediately, otherwise water consumption will become very high.

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Correct connections

It is recommended to use water-saving showers and taps.

Take a shower instead of a bath

Filling a bathtub uses three times as much water and energy. In addition to heating energy, the provision of hot water is an important factor in household energy consumption.

Save water when doing laundry

No pre-wash

Always wash with a full load. Avoid pre-washing and wash at 60 °C instead of 90 °C. Pre-washing is only necessary for heavily soiled laundry.

Use business cycles

Use economy cycles if your washing machine or dishwasher has such cycles. They sometimes require a bit more time, but they help save water and therefore energy.

Air drying

A tumble dryer uses twice as much energy as a washing machine for the same amount of laundry. So, if possible, it is best to leave the laundry to dry in a drying room or outside.

Ditch air conditioners that use a lot of energy

Air conditioning ensures pleasant temperatures on hot summer days. However, appliances are real energy consumers. If more days are used per year, they will increase electricity costs. A significantly cleaner alternative is the heat pump with cooling function. In winter, it reliably and economically heats the rooms. In summer, it cools the rooms in a pleasant way. For more information, see Natural and Active Cooling.

Produce your own electricity with a photovoltaic system

Photovoltaic systems are now available in many designs and power sizes. If the orientation and position of your home's roof is right, a system can be installed quickly and economically. You can feed the electricity it generates into your local grid and you'll even get paid for it. Or you can simply use it yourself. In this case, you no longer need to worry about how to save electricity.

Heating system in summer mode

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Heating the rooms and ensuring the supply of domestic hot water requires energy. The price for this is reflected in fuel costs. The more energy consumed, the higher these costs. Especially with fossil fuels, high energy demand is also associated with emissions. This is because burning gas and oil releases CO2. If you set your conventional heating system to summer mode, you can not only save costs, but also reduce CO2 emissions. Since the summer months are hot anyway, this is not even associated with less comfort.

The time chosen depends on the weather
There is no general rule as to when you should switch your heating system to summer mode. Weather conditions are the most important factor. However, the typical heating season in rentals is a good starting point. It starts on October 1 and ends on April 30. Consequently, the beginning of May is a good time to check whether the limited operation of the heating system is sufficient.

The heating system - which is the most suitable for you?

Prepare properly for the purchase of the heating system
If you want to renew your heating system, the first step is comprehensive preparation. This is because planning is everything. First you need to answer some questions for yourself. After all, there are so many heating technologies to choose from. In addition, it should match the conditions of the building as well as the individual preferred heating behaviour of the occupants and their ideas.

What criteria are most important to you?
Should it be a heating system with renewable energies or should classic oil and gas energy sources be considered?
How much space is available to store fuels or the entire system?
Do you need a combination of different systems?
How much should the heating system cost anyway?

Finding the right installer
As already mentioned, choosing a heating system is not so easy. After all, it's not just about personal preferences, like deciding between fossil and renewable energy sources. It is rather that the heating system is also adapted to the conditions in the house - and these are more restrictive in the case of existing buildings than in the case of new construction. Among other things, it must be determined what the heat

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demand is. In addition, the heating system must operate economically. The boiler should be neither too small nor too large for this purpose.

Activating the night discount on a heating system

Night reduction is a method of reducing the heating power at a certain time. It's about reducing the more advanced daytime setting temperature to a lower temperature level at night. In modern heating systems, reduction is one of the standard programs and can be found there as 'economy mode' or 'time program'. It is also often referred to as low functioning. The night reduction is set directly on the heating control. Those without access to it can control the heat output of the heat generator either manually or via programmable thermostats - but only indirectly. This is because changing the thermostat only controls the flow of domestic hot water, but not the actual heating power of the heat generator. When it makes sense to do a night rollback and what alternatives there are, you will find out in the article below.

Optimal night downgrade setting

In principle, there is a certain set temperature, which is preset on the heating system. As a rule, this is about 20 degrees Celsius. During the day, however, there is always heat loss through the building envelope, for example when doors or windows are opened. These losses are normal and occur in new buildings or well-insulated existing buildings. Such heat losses were considered in advance in the calculation of the heating load, in order to adapt the heating system individually to the building. To ensure that the desired temperature in the individual rooms remains constant, the heating system is always reheated. Unless you determine otherwise by setting the radiator thermostat in individual rooms and for specific periods of time. In the case of night setback, this nominal temperature is deliberately set lower. The aim here is to reduce heat loss and therefore heating costs.

Creating the night recoil as a time phase

For the night reduction function to work, the heating operation must be divided into several sections, so-called time phases. Depending on the heating system, up to eight-time phases can be selected. In addition to room heating, time programs can also be set for domestic hot water preparation and for the domestic hot water circulation pump (if present).

An example with four-time phases:

Time phase 1: 06:45 to 12:15 with a normal room temperature (approx. 20 degrees Celsius)

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Time phase 2: 13:00 to 18:00 with reduced room temperature (approx. 16 degrees Celsius)
Time phase 3: from 18:15 to 22:15 with normal room temperature
Time phase 4: from 22:15 to 06:30 with reduced room temperature
Important: Between the time phases, the room heating is usually at reduced temperature. For information on how the heating system behaves between time phases, see the instructions for use provided.

To activate the night setting
The function is pre-installed in almost all Viessmann heating systems. As an example, I have chosen an older model here. The image shows the 'Heating time menu' using a Vitotronic control unit as an example.

In principle, you should decide in advance when the night setting should start and by how many degrees you want to reduce the set temperature. In addition, the following factors determined the night setback in a heating system. They also influence the duration and amount of this temperature reduction:

Heat demand
Use of the building (if different from that of a single-family home)
state of the building (energy state and specific thermal inertia of the building)
heating curve (current settings)
weather conditions (outside temperatures)

Holiday program for heating

On the other hand, plant owners can use the program to enter arrival and departure dates for each individual heating circuit. This means that they can actively influence the heating characteristics of the heat generator. The holiday schedule of a Viessmann heating system specifically affects central heating, domestic hot water heating, heating output and energy consumption:

Central heating:
For the heating circuits in the 'Heating and domestic hot water' operating program, the holiday program heats the rooms to the set reduced ambient temperature.
For heating circuits in the 'Domestic hot water only' operating program, there is no room heating. However, the frost protection for the boiler and the domestic hot water cylinder is active.
Preparation of domestic hot water:

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If holiday mode is activated for all heating circuits, there is no domestic hot water heating. However, the frost protection for the domestic hot water cylinder is active.
Note: In the factory settings, the holiday program starts at 00:00 h on the day after your departure and ends at 00:00 h on the day you return. This means that the set time program is active on the day of your departure and the return. The time can also be set individually on some models. To manually end the program, please follow the instructions.

The holiday program reduces the heating power
When the holiday program is activated, the system maintains a lower set room temperature. It only heats up to a previously set reduced room temperature. This temperature must not fall below 16 degrees Celsius.

The holiday program helps you save energy
The vacation program feature of a Viessmann heating system gives system owners the opportunity to save energy during their absence by heating only as much as is needed. Contrary to what the name suggests, the program is not intended exclusively for use during 'holidays of several weeks' in the traditional sense. If system owners know they will be away - even just for a few days - they can activate the vacation schedule and thus save on heating costs.

Room temperature at thermostat setting
Setting a thermostat correctly also means heating each room differently. After all, it doesn't have to be the same hot everywhere. There are standard values that occupants and homeowners can use as a guide when adjusting space heating. These are:
Living room: 20 to 22 degrees Celsius
Bedroom: 16 to 18 degrees Celsius
Hall and kitchen: 18 degrees Celsius
Children's room: 22 degrees Celsius
Bath: 23 - 24 degrees Celsius

Since the perception of heat is subjective, everyone can, of course, decide for themselves how warm they want it to be. However, for economic and ecological reasons, it is worth paying attention to the right temperature. Because reducing the temperature by just one degree Celsius in all rooms can reduce heating costs by up to six percent - at least in an old building.

Room thermostat for individual room control

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In addition to the thermostatic radiator valve, there is also the room thermostat. It allows individual settings for separate rooms. It is important to consider the positioning of the room thermostat when installing it. It should not be exposed to sunlight or intense heat from a radiator. If it is, the temperature of the room it is recording will be too high. A location that is too cold should also be avoided. Otherwise, the system will try to reach too high a temperature.

5.5.2. Best practices examples regarding awareness of energy saving:

The annual organization of 'Smart Energy Days': These annual events are a suitable framework in which through a suite of public events (thematic competitions, presentations/project launches in the field of energy , seminars / conferences, exhibitions, performances) to bring to the public stage the most important achievements and actions related to the environment and the sustainable use of energy.

Annual education campaigns for the rational use of energy resources, the purchase of efficient appliances and the production of green energy: the annual campaigns, creating the appropriate framework for educating a wide public category (students, homeowners, consumers) on issues related to savings of energy, protecting the environment through the correct disposal of waste, purchase possibilities of efficient equipment, etc.

Promotion of school competitions on responsible energy management and carbon footprint reduction: Projects financed by European programs will take place in the coming years and are aimed at the practical training of citizens regarding the avoidance of waste of energy at home, at work, in schools

Consultancy centre in the field of energy consumption efficiency and green energy production: It must be create a consultancy centre on energy-related issues where, through modern information means, the public as well as public institutions and private companies can to find appropriate answers to the different information requested

Training for stakeholders on energy management in buildings

Promotion of projects and school competitions on the topics of efficient use of energy and reduction of the carbon footprint

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GREEN ENERGY FAIR, SEPTEMBER 21-22 IN ALBA IULIA. GREEN ENERGY SOLUTIONS, INNOVATIONS, FREE CONSULTATION

The fair is aimed at the public, local public authorities and potential investors. It aims to raise awareness of the importance of using energy-efficient technologies and equipment, as well as 'green' energy production solutions, an essential aspect for sustainable development.

This year, special attention will be paid to renewable energy production systems, especially in the context of the launch of the Green House Photovoltaic Program.

Also, visitors will be able to see exhibited electric vehicles, electric bicycles, solar panels, heat pumps, thermal plants and many other solutions based on renewable energy.

Smart metering systems 8,000 residential buildings in City of Alba Iulia, Romania (private individual homes of citizens) Work preparation phase by the electricity distribution operator

Implementation of Green House' or similar programs for residential buildings

Increasing the energy efficiency of residential buildings (apartment blocks) 1,215 apartments in Alba Iulia City, using various envelopment methods

5.5.3. Some facts from an European project dedicated to energy saving and using regenerable energy

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Awareness of energy saving

Norway grants

GREENER
supportinG incReasEd knowlEdge oN rEnewable eneRgy and energy efficiency in Alba Iulia

Innovation Norway

Funding source: 2014-2021 Norwegian Financial Mechanism, Energy Programme in Romania, Focus area: Increased knowledge on renewable energy, energy efficiency – Awareness raising general public and Training

Project partnership:

- Alba Iulia Municipality (Romania) as Project Promoter;
- Alba Local Energy Agency (Romania) as Project Partner;
- Norsk Energi (Norway) as Project Partner;
- Technical University of Cluj-Napoca (Romania) as Project Partner.

Project duration:

February 2023 – April 2024

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Project rollup

Norway grants

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Innovation Norway

General objective of the project

To contribute to the sustainable development of Alba Iulia Municipality (AIM) by developing and implementing a series of actions focused on increasing the knowledge of renewable energy, energy efficiency and energy security for the local community of Alba Iulia and proximity, during 12 months

Project leaflet

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Awareness of energy saving

Norway grants

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Innovation Norway

Project results:
3 training sessions (public, private sector and citizens) organized in Alba Iulia, for 70 people

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Innovation Norway

Project results:
1 public awareness campaign organized in Alba Iulia and proximity: APULUM Caravan, disseminated at local radio

Duration: 17-18 October 2023

Speakers: Marius Soflete and Vlad Ciobanu

No. of participants: +300

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Promotional materials for APULUM Caravan:

200 smart plugs at the public event

200 Car kits with solar charging at schools

Promotional materials for the project:

300 leaflets

1 roll-up

1 final video of the project

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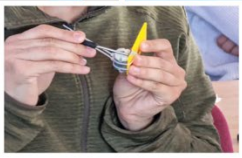

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Project results:

1 study on local energy communities (UTCN) and 1 study on energy poverty (AIM)

As a public document, the study on energy poverty provides an analysis of the current local situation and highlights real and coherent conclusions to the general public (any public, private and NGO entities that can further contribute to the set objectives of the project). Based on the data provided by the study, interested institutions, companies or individuals and legal entities can implement, from their own funds or from non-reimbursable funds, projects to increase knowledge on renewable energy, energy efficiency and energy security, low-emission mobility, climate neutrality, etc.

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Innovation Norway

Project results:

1 hybrid event organized for SMEs participating in training sessions - Green Demo Day, organized on the 7th of December 2023

Green Demo Day was a public competition for innovative ideas in the field of energy efficiency, aimed at small and medium-sized enterprises (SMEs) based or operating in Alba Iulia, which design, implement or want to implement energy efficiency projects and/or solutions.

4 submitted project proposals

2 winners

Prize: study visit in Oslo, Norway

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6. References

1. Baidoo, A.N.A.; Danquah, J.A.; Nunoo, E.K.; Mariwah, S.; Boampong, G.N.; Twum, E.; Amankwah, E.; Nyametso, J.K. (2024). ”Households’ energy conservation and efficiency awareness practices in the Cape Coast Metropolis of Ghana”. *Discov. Sustain.*, 5;
2. Brounen, D.; Kok, N.; Quigley, J.M. (2012) „Residential energy use and conservation: Economics and Demographics”. *Eur. Econ. Rev.*, 56, pp. 931-945;
3. Bulbaai, R.; Halman, J.I.M. (2021).”Energy-efficient building design for a tropical climate: A field study on the Caribbean island Curacao”. *Sustainability*, 13, p. 132;
4. Camp, A. (2005). Counting Every Drop. *Facilities Management*, 12(4), pp. 16-17;
5. Casals, M.; Gangolells, M.; Macarulla, M.; Forcada, N.; Fuertes, A.; Jones, R.V. (2020) „Assessing the effectiveness of gamification in reducing domestic energy consumption: Lessons learned from the EnerGAware project”. *Energy Build.*, 210, pp. 109-753;
6. D’Oca, S.; Corgnati, S.P.; Buso, T. (2014) „Smart meters and energy savings in Italy: Determining the effectiveness of persuasive communication in dwellings”. *Energy Res. Soc. Sci.*, 3, pp. 131-142;
7. Darby, S. (2006). *The Effectiveness of Feedback on Energy Consumption*; Environmental Change Institute, University of Oxford: Oxford, UK;
8. De Almeida, A.; Fonseca, P.; Schlomann, B.; Feilberg, N. (2011). „Characterization of the household electricity consumption in the EU, potential energy savings and specific policy recommendations”. *Energy Build.*, 43, pp. 1884-1894;
9. Dietz, T.; Gradner, G.T.; Gilligan, J.; Vandenbergh, M.P. (2009) „Household actions can provide a behavioural wedge to rapidly reduce US carbon emissions”. *Proc. Natl. Acad. Sci. USA*, 106, pp. 18452-18456;
10. *Directive (EU) 2023/1791*; European Parliament and of the Council of 13 September 2023 on Energy Efficiency and Amending Regulation (EU) 2023/955. European Union: Brussels, Belgium, 2023. Available online: http://data.europa.eu/eli/dir/2023/1791/oj (accessed on 15 August 2024);
11. DOGERLOCH, Stephan. *Manual. (2020). PROIECTE DE ECONOMISIRE A ENERGIEI. PENTRU ȘCOLI DIN LANDUL SAXONIA- ANHALT.*, p.2;
12. Elsharkawy, H.; Rutherford, P (2018). „Energy-efficient retrofit of social housing in the UK: Lessons learned from a Community Energy Saving Programme (CESP) in Nottingham”. *Energy Build.* 172, pp. 295-306;
13. Fischer, C. (2008). „Feedback on household electricity consumption: A tool for saving energy?” *Energy Effic.*, 1, pp. 79-104;

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14. Froehlich, J. (2009). „Promoting Energy Efficient Behaviours in the Home through Feedback: The Role of Human Computer Interaction". *Biometrika*, 73, pp. 13-22;
15. Gadenne, D.; Sharma, B.; Kerr, D.; Smith, T. (2011) „The influence of consumers' environmental beliefs and attitudes on energy saving behaviours". *Energy Policy*, 39, pp. 7684-7694;
16. Geelen, D.; Mugge, R.; Silvester, S. (2019) „The use of apps to promote energy saving: A study of smart meter–related feedback in the Netherlands". *Energy Effic.*, 12, pp. 1635-1660;
17. Gianfrate, V.; Piccardo, C.; Longo, D.; Giachetta, A. (2017). „Rethinking social housing: Behavioural patterns and technological innovations". *Sustain. Cities Soc.*, 33, pp. 102-112;
18. Gyberg, P.; Palm, J. (2009). „Influencing households' energy behaviour—How is this done and on what premises?" *Energy Policy*, 37, pp. 2807-2813;
19. Heiskanen, E.; Johnson, M.; Robinson, S.; Vadovics, E.; Saastamoinen, M. (2010). „Low-carbon communities as context for individual behavioural change". *Energy Policy*, 38, pp. 7586-7595;
20. Edmond MAICAN (2015), *Renewable energy systems*, PRINTECH, BUCUREŞTI;
21. *Microsoft Encarta Dictionary* (2005). Microsoft Corporation. (Software);
22. Mohamed El Halimi, Nadeem Biwaz, Kamaruzzaman Sopian and Mohd Yusof Hj Othman (2000*). A Sustainable Energy Future for Malaysia. In: Kamaruzzaman Sopian and Mohd Yusof Hj Othman. Advances in Malaysia Energy Research 1999*. Kuala Lumpur: Institute Tenaga Malaysia, pp. 31-43;
23. Newell, R.G.; Raimi, D. Global (2020)„Energy Outlook Comparison Methods: 2020 Update". *Resources for the Future. Report 20-06*;
24. Oorschot, J.A.W.H.; Hofman, E.; Halman, J.I.M. (2016) "Upscaling large scale deep renovation in the Dutch residential sector: A case study". *Energy Procedia*, 96, pp. 386-403;
25. Owusu, P.A.; Asumadu-Sarkodie, S. *A review of renewable energy sources, sustainability issues and climate change mitigation*. Cogent Eng. 2016, 3;
26. Pérez-Lombard, L.; Ortiz, J.; Pout, C. (2008). „A review on buildings energy consumption information". *Energy Build.*, 40, pp. 394-398;
27. Sadineni, B.; Srikanth, M.; Boehm, R.F (2021) „Passive building energy savings: A review of building envelope components". *Renew. Sustain. Energy Rev.*, 15, pp. 3617-3631;
28. Stankuniene, G. (2021). „Energy saving in households: A systematic literature review". *Eur. J. Interdiscip. Stud.*, 13, pp. 45-57;
29. Tamas, R.; O'Brien,W.; Santana Quintero, M. (2023). „Developing Thermostat User Mental Models to Inform Energy-Saving Design". In *Environmental Science and Engineering, Proceedings of the 5th International Conference on Building*

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Energy and Environment, COBEE, Montreal, QC, Canada, 25–29 July 2022; Wang, L.L., Ge, H., Zhai, Z.J., Qi, D., Ouf, M., Sun, C., Wang, D., Eds.; *Springer*: Singapore;

30. Vesma, V. (2002). „Power to the People Facilities Management". *Facilities Management*. 9(5);
31. Williams, M. A. (1993). *Initiating, Organizing, and Managing Energy Management Programs in.: Wayne C. Turner. Energy Management Handbook*. Liburn: The Fairmont Press, Inc. Chapter 2;
32. Wilson, C.; Dowlatabadi, H. (2007). „Models of Decision Making and Residential Energy Use". *Annu. Rev. Environ. Resour*. 32, pp. 69-203;
33. Wong, S.S.M. (1997). *Energy Conservation and Human Behaviours: The Professional Faculties Building in The University of Calgary*. University of Calgary: Master Degree Project.
34. https://www.roenef.ro/wp-content/uploads/2018/09/EPG_ROENEF_Studiu-eficienta-energetica-in-cladiri.pdf
35. https://hartareciclarii.ro/noutati/10-pasi-prin-care-poti-economisi-energie-electrica/
36. https://www.viessmann.ro/ro/solutii.html

7 - Deliverables

To evaluate the success of the tutorial, students will have to answer an online questionnaire.

8 - What we have learned

- The necessity of energy saving;
- Key concepts related to energy saving
- Main obstacles in the effort of energy saving and solutions to overcome these obstacles
- Several main methods and strategies to save the energy and for energy efficiency;
- Main programs, measures and several equipment for energy efficiency;
- Best practices regarding energy saving and renewable energies

Thank you for your attention!

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