ENERGY EFFICIENT BUILDING

MATERIALS OF EXHIBITION ON ENERGY SAVING WITH COMMENTS

ENERGY EFFICIENT BUILDING

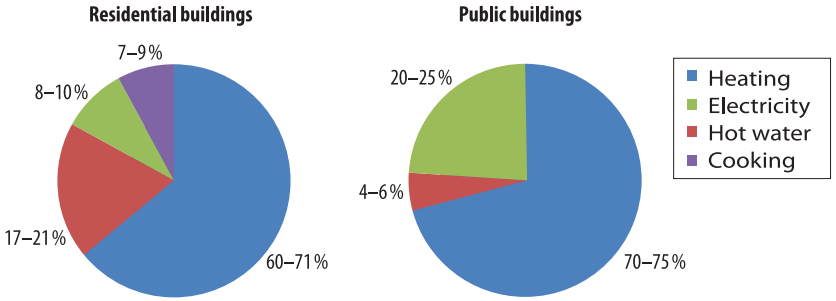
PROBLEMS AND SOLUTIONS FOR EFFICIENT AND ECONOMICAL USE OF ENERGY

More energy services with a lower cost:

energy saving — saving money — comfort — care for nature and climate

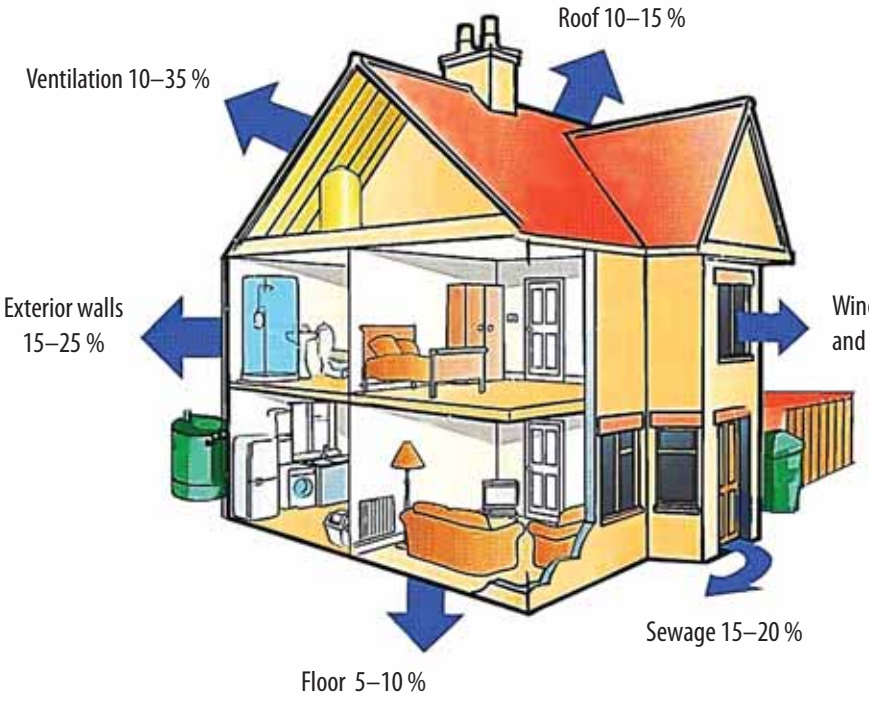
LOSSES OF ENERGY - RESERVES FOR ENERGY EFFICIENCY IN BUILDINGS

Buildings consume one third of the energy produced on the planet. Heat and electricity are the main energy services that we need in buildings. Because of futile waste and inefficient use of energy, we pay its excessive supplies. Excessive energy consumption leads to excessive production of energy mainly by burning fossil fuels. This leads to increased emissions of carbon dioxide and pollutants into the atmosphere, to growing greenhouse effect and to climate change.



The main types of energy consumed in residential and public buildings

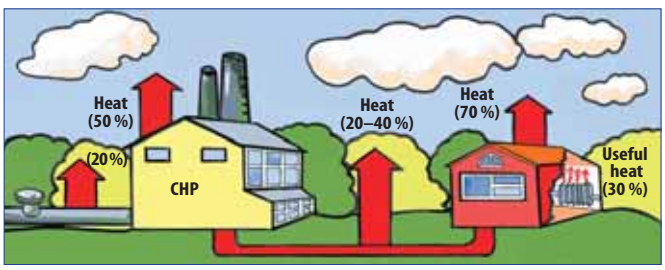
ASSESMENTS FOR LOSSES OF THERMAL ENERGY IN BUILDINGS



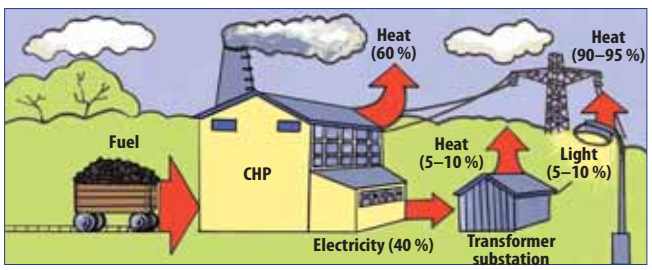
Energy losses in buildings can account for up to 70 %. These losses can be reduced by owners or management companies. Basically these are losses of heat.

Electricity losses due to inefficient appliances and inefficient use of them can reach 30–40 % of electricity consumption.

ENERGY IS LOST AT ITS PRODUCTION, ITS TRANSPORTATION, AND ITS CONSUMPTION



Losses of heat



Losses of electricity

WHERE DOES THE ENERGY GO TO?

The exhibition materials with comments presented here show technical possibilities of reducing energy consumption through the use of energy efficiency measures in buildings in the temperate continental climate of northern Europe. About one third of the energy on the planet is consumed in buildings. Reducing energy consumption, energy efficiency measures reduce financial expenses for energy without reducing comfort in houses, as well as reduce negative impact of the energy sector on the environment and climate. These measures are applicable both in residential and public buildings, as well as in offices and domestic premises of industrial buildings.

Energy enters houses in a variety of ways. For example, *in a residential house: with heating up to 70 % (during the heating season); hot water (if it is supplied from the outside or for the energy expended for its heating, about 12 %); with gas or electricity used for cooking (about 7 %); with electricity consumed by lighting and other electrical appliances in the house, except for electric stoves (about 5 %, and more than a third of this falls on the fridge); with the solar radiation (it heats exterior walls, and inner space if goes through windows, approximately 5 %); with people who are in the house (each person is equivalent to a heating device of about 100 watts, about 5 %).*

Not all of the energy is effectively used for its intended purpose. For example, incandescent light bulbs convert only less than 5 % of the energy into light, while the rest is converted into heat.

Heat leaves the house in vain, through walls, floor and roof, with warm sewage and ventilation. All these losses can be reduced and used.

Energy losses can be reduced

To decide how to reduce energy losses, one shall first find the ways of losses, perform energy audit (see the last page of this booklet) — either with the help of invited experts or independently.

Some causes of losses are visible to the naked eye. For example, cold inner wall surface in winter shows without any audit that the wall is poorly insulated or that it has «bridges of cold». Voids around window frames and doors and in joints of blocks of panel buildings are also causes of heat losses. If one sees icicles on the roof in winter, it means that the heat is lost through the poorly insulated roof. If water temperature in the heating system and in hot water system changes from floor to floor, it means that pipes are poorly insulated and lose the heat somewhere.

Too high temperature in the house also means heat losses, inefficient use of energy, which can be avoided by adjusting the heating. The use of air conditioners during the hot season is very energy consuming. Awnings over windows, blinds and insulation help to protect buildings from overheating in summer and to reduce the use of electricity for air conditioning.

Complex approach

The best energy efficiency result in an apartment building will be achieved if the measures are aimed at improving the whole building — **improving thermal insulation characteristics** of wallings, all common premises and private apartments, improving **heating efficiency** by using all existing "internal" resources, **saving and efficient use of electricity and water**. The materials of our exhibition describe all these possibilities.

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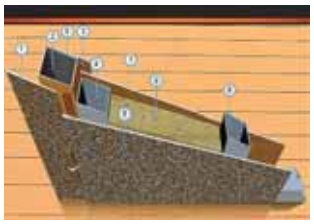
DECREASE OF HEAT LOSSES

Thermal insulation and reduction of losses from drafts and ventilation saves up to 90 % of the energy used for heating in buildings!

Entrance doors

Installing insulated doors

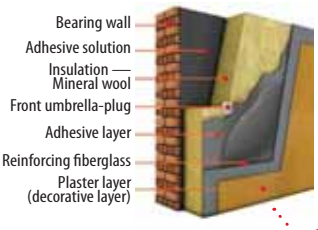


1. Steel casing
2. Door frame of profile pipe
3. Seal
4. Frame of profile pipe
5. Steel casing
6. Door (steel sheet)
7. Interior finishing
8. Stiffening rib
9. Insulation

Exterior walls

Installation of layers of insulation materials and ventilated facade

Insulating "sandwich" with mineral wool

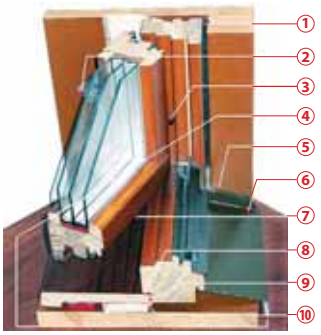


Entrance doors

Installation of door closers, building tambours

Windows

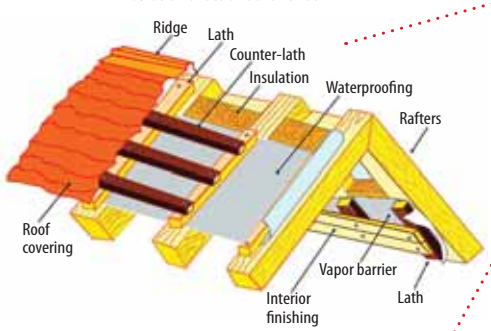
Installing double-panes and insulation using a grooved sealing technology



1. Vapor-permeable sealing tape
2. Anchor plate (for wooden box)
3. Decorative cap for wall screws (grommets)
4. Vapor-permeable sealing tape, noise reduction gasket
5. Protected by silicone sealant
6. Plastisol, galvanization etc.
7. Windowsill
8. Windowsill groove
9. Protected with silicone sealant
10. Vapor-proof tape

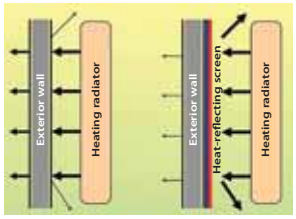
Roof and attic

Insulation of attic floor and roof



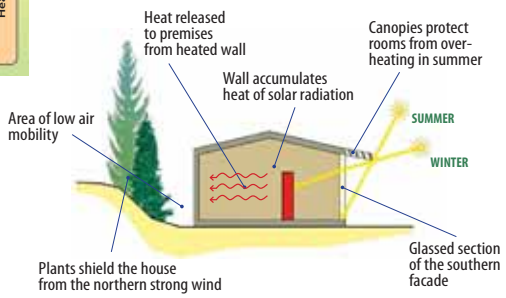
Reducing heat losses through walls behind radiators

Mounting aluminum foil on foam insulation material behind radiator



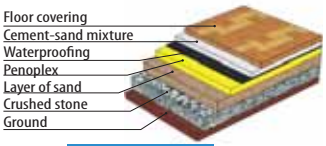
Using local conditions

Planting trees and constructing outbuildings by the windward side of the house, locating the house under elevation

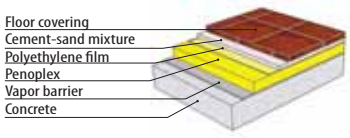


Floor of the bottom storey

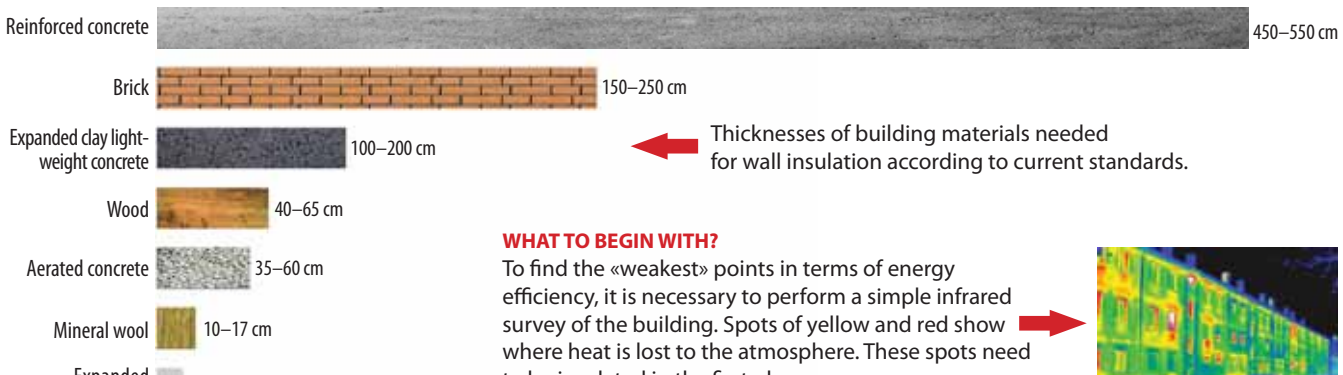
Insulation of the floor of the bottom storey and basement



Floors on the ground



Floors of the bottom storeys



Thicknesses of building materials needed for wall insulation according to current standards.

WHAT TO BEGIN WITH?

To find the «weakest» points in terms of energy efficiency, it is necessary to perform a simple infrared survey of the building. Spots of yellow and red show where heat is lost to the atmosphere. These spots need to be insulated in the first place.

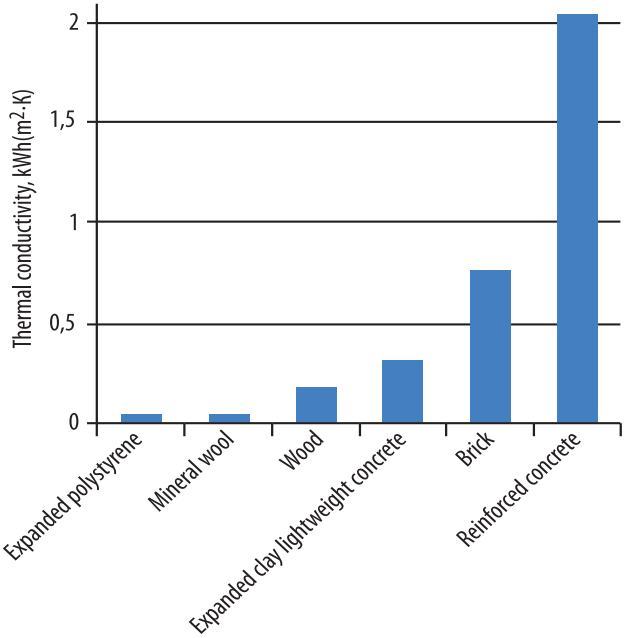
Choose materials for thermal insulation of your apartment or house with the least toxicity to protect your health and the environment!

HOW TO REDUCE HEAT LOSSES IN THE BUILDING?

The buildings erected according to old construction standards, especially high-rise buildings of 1960–1980-ies, have low energy efficiency. Their external walls, roofs and cellars are insulated insufficiently. Additional exterior insulation is the most effective way to improve thermal properties of such houses. This is a big and usually expensive work. It can be combined with major building repairs.

Some solutions can help to insulate an appartment house without significant investments. Install a closer on the front door, organize a vestibule at that door if possible. All this will reduce heat loss at the entrance. One shall also insulate windows on the staircase and constantly monitor their condition.

When choosing the type of material and its thickness to insulate houses, one shall take into account their thermal conductivity. Examples of thermal conductivities for different materials are shown in the figure.



Much can also be done in apartments to reduce heat losses.

Heat losses through windows are often reduced by installing glass panes. This is the best way to do it now. Glass panes efficiently retain heat due to the fixed air contained between hermetically sealed frames.

One can do without installing double-glazed windows. Conventional wooden window can be substantially insulated by using grooved sealing technique, in which synthetic sealings, including tubular profiles, are mounted in a specially made groove. One can seal the remaining slots by special paper or cloth.

It is necessary to get rid of the slits both in the outer and the inner window frames, to create the space isolated from the environment between them. The air layer "locked" in it will serve as protection from the cold. The slits between window glass and frame can be eliminated with silicone sealant. Of course, one shall immediately replace cracked windowpanes.

It is necessary to fill slits between window frames and walls with construction foam or with some insulating material (mineral wool etc.).

Special windowpanes can be used in double-glazed windows covered with metal oxides which reduce heat losses through the window, while the amount of transmitted sunlight does not change. These glasses are called energy-saving or low-emission ones. The earlier development was glasses with hard coating. They are inferior in energy-saving characteristics to more modern glasses with soft coating.

One can use mineral wool, polystyrene, penoplex, foam, and plywood for insulation of walls in an apartment. Economical and very effective solution is location of bookshelves and wardrobes by outer walls.

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EFFICIENT AND ECONOMICAL HEAT SUPPLY

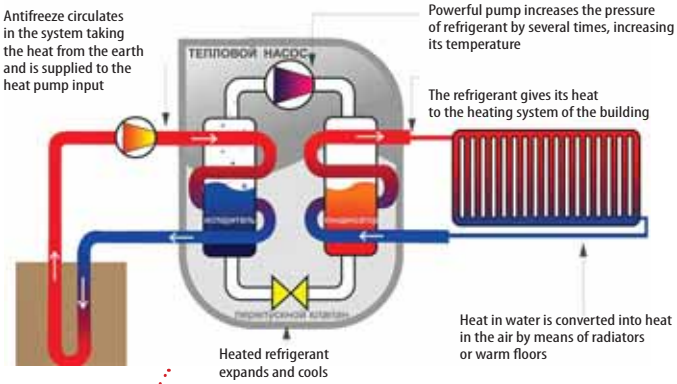
In theory, central heating is more energy efficient than the individual one.
But in practice, there are considerable losses of energy both at production and transportation of heat to a consumer.
Therefore it is reasonable to consider local sources of heat

Local gas boilers

Experience shows that the cost of a heating season with a local boiler is two times lower and the pay-back period is 3.7 years (4 heating season)

Heat pump

The use of heat accumulated outside (in the air, water, or soil) for heating. 1 kWh of electrical energy consumed by a heat pump produces 3 to 5 kWh of thermal energy

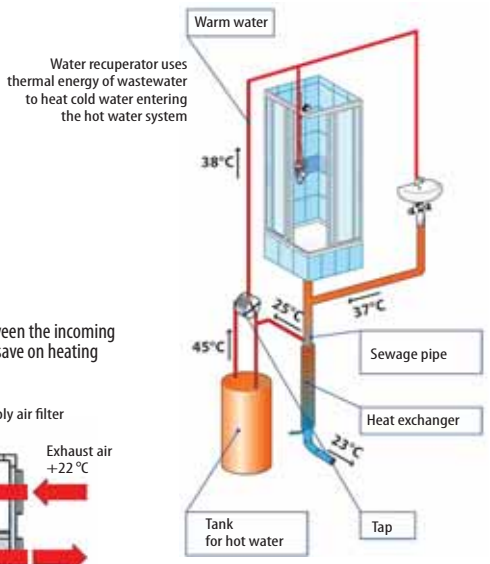


Local boilers on biofuel

Disposal of waste (pallets and briquettes from waste wood, paper, wood chips, and bark) and eliminate the warehousing or destruction costs. The efficiency is up to 85 % at the 100 % burning

Water recuperator

Heats tap water by heat of wastewater from sinks and shower (35–37 °C), returns up to 65 % of wastewater heat

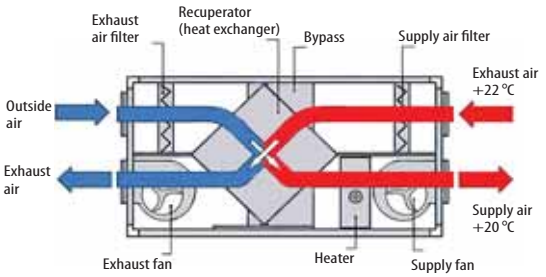


Solar collectors

Allow to accumulate and convert solar energy into heat transferring it to heat carrier

Air recuperator

Flow-exhaust ventilation system with heat exchanger between the incoming and outgoing air holds 25 to 35 % of heat and allows to save on heating



THE EFFICIENCY OF HEAT SUPPLY IN BUILDINGS CAN BE IMPROVED

by installing a heat control unit with automatic adjustmnt of the heat transfer agent temperature in dependence on the outside temperature.
Savings reach 50 %.

INDIVIDUAL HEAT CONTROL INCREASES COMFORT AND REDUCES COSTS

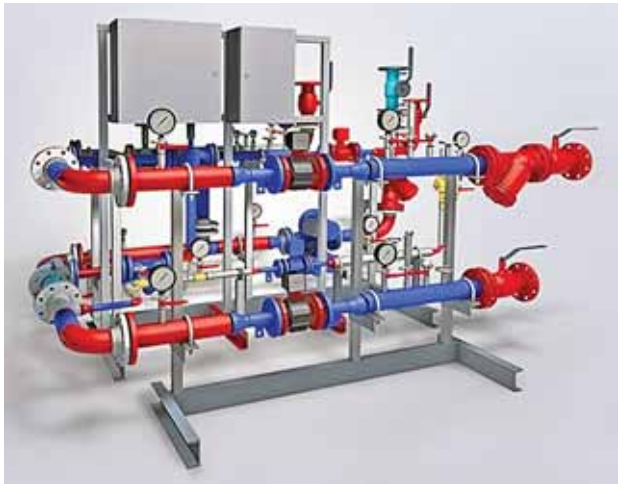
The experience of European countries and Russia shows that heat savings due to individual control and monitoring reach 20–35 %, average reduction of payments — 25–55 %, and for some tenants — up to 70 %.

EFFICIENT HEATING IN A BUILDING

A condominium or building owner can:

— insulate all owned/controlled heat networks and reduce all other heat losses in the house (see pages 4–5);

— install individual accounting and automatic control unit for heating that adapts heating to the outside temperature. This will help to prevent overheating, to reduce the consumption of mains water, to level the temperature in distant parts of the heating system.



As a result, heat consumption will be reduced by 10–50 %.

The payback period is about 20 months of the heating season

Important! *Controlling of heating is only possible if the house has a closed heating system. With other types of heating, large-scale modernization is needed.*

Individual heat controlling in separate premises of the building

Advantages:

— normalization of heating in the house, the possibility to maintain comfortable temperature in apartments;

— possibility to save heat in the apartments;

— possibility for residents to pay only the actual heat consumption, within the principle "less heat consumed — less payed".

For proper controlling the heating in a separate apartment or room, one needs:

A) parallel (two-pipe) distributing heating system in the house and individual apartment heat entries;

B) installation of thermostatic radiator controls to each heating radiator;

C) individual heat meters for each apartment.

Buildings with sequential heating system need replacing the system by parallel one. In principle, there is a simple variant to switch off a radiator in one-pipe (sequential) system as well. For this purpose, each radiator shall be equipped with a «bypass» and a mechanical switch which directs water either to the radiator or to the «bypass.» This option can help prevent overheating, but it does not allow to install individual meters and thermostatic controls, and therefore does not motivate tenants to reduce heat consumption.

Independent sources of thermal energy for buildings

Independent heating eliminates losses of heat at its transportation.

Autonomous renewable energy plants (solar collectors, geothermal heat pumps, local boilers) are not cheap, but after the end of the payback period they reduce heating costs because they do not need fuel.

With autonomous heat supply, the required heat generation is directly related to heat saving results. Everyone is interested in reducing costs, and this motivates owners and users of premises, and control specialists to undertake the whole complex of heat saving measures in all premises.

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EFFICIENT AND ECONOMICAL USE OF ELECTRICITY

Energy efficient use of the fridge
(locate it in a most cool place,
do not put hot food in it)

Installation
of motion detectors in common areas
(entrances, staircases and so on).
They turn off the light in the absence of movement

The maximum use of natural lighting

Complete shutdown of electrical appliances
from the network, avoiding the use of stand-by mode

Application of timers, dimmers,
switches with a delay and circuits
with several switches

Bright finish of walls and ceiling

The use of LED lamps
instead of incandescent lamps

The use of electrical appliances only
with energy class A or higher

AUTONOMOUS POWER SUPPLY

Additional measures to enhance energy efficiency of building include installation of solar photo-voltaic sources and wind turbines. Typically, photo-voltaic elements are mounted on the roof, but there are options for their placement on the walls and even on the road surface. Wind turbines are rational for remote individual houses in the open countryside or on hills at the distance from the power lines more than 500 m.

EFFICIENT USE OF ELECTRICITY

Installation of motion sensors that turn off lights in the stairwell and other common premises when nobody is there in apartment houses can save electricity consumption in common premises by more than 20 times. However, the main reserves of energy efficiency in buildings are located in apartments.

Electric cookers are the largest consumers of electricity. Do not keep them switched on, if nothing is cooked. Use cookware with bottoms equal to the size of the hotplates; if a pot bottom is smaller than a hotplate, a lot of energy is wasted. Turn off cookers in advance, because hotplates remain warm for a few minutes. When heating soup, pour the needed portion into a small pot and warm only this small portion. Do not boil a full kettle, use just the right amount of water.

After cookers, refrigerators are most «voracious.» Do not place them near radiators, cookers, or some other heating appliances, on a warm floor or so that they are exposed to direct sunlight. Keep the refrigerator radiator clean (dust on the radiator increases energy consumption) and do not lean the refrigerator radiator against a wall.

Do not put hot or warm food in the fridge. Do not keep the refrigerator door open for a long time, wondering what to eat, think in advance what you want to take out and do it quickly. If you want to defrost a product, replace it from the freezer to the refrigerator in advance (a few hours); this will allow the refrigerator not to consume electricity for a long time.

All household electrical appliances are marked with the energy class. The best classes are: A ++, A +, A, and the worst one is G. Buy household appliances of the class not lower than A.

Turn off lights when you leave a room. Switch off electrical appliances from outlets when not in use. Electronic equipment in stand-by mode consumes up to one-third of the nominal value, and up to 8 % of all electricity.

Use washing machines and dishwashers only when fully loaded. In one cycle of operation, a machine consumes the same amount of energy and water irrespective of its load. If the load is not complete, the machine will have to run more frequently.

Turn off the iron in advance and finish iron laundry before it gets cold. Use heat-reflecting ironing boards.

Do not use electric heaters and do not warm your apartment with the help of electric cookers. Instead, insulate your apartment as explained in pp. 5 and 7.

Use LED bulbs for lighting instead of incandescent lamps. Incandescent lamps give more heat than light; they convert to light only 2–5 % of the consumed energy. LED lamps produce seven to ten times more light for the same power. Although they are more expensive, their lifetime is several times longer, they even do not break when falling. The expenses will be payed back in a few months, and further you will save!

Warning: energy-saving fluorescent lamps, both tubular ones and with E27 and E14 caps, contain some amount of mercury. They cannot be disposed of in the normal trash, but shall be brought to special collection points as hazardous waste. It is better to abandon them at all in favor of the use of LED lamps.

Make the most of natural light. Do not turn on the light, if there is light outside the window, locate yourself closer to the window. Do not close window curtains in the daytime. Use sunlight in combination with artificial lighting.

Using scattered light, the light reflected from walls and the ceiling, saves up to 80 % energy. A white wall reflects up to 80 % of direct light, a black one — only 9 %.

Use local lighting instead of general one, if you do not need the latter. Wash windows, lamps and lampshades. Dusty glass absorbs up to 30 % of light. Choose lamps with less light-absorbing (opaque) elements.

Different devices also help to save energy: timers for switching power on and off, dimmers (regulators of illumination brightness), schemes with two or three circuit-breakers for the same lamp (for example, in different parts of the hall or on different staircase landings).

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SAVING WATER

Saving water is both savings energy spent on water treatment and transportation, sewage and wastewater treatment and saving energy spent on water heating

Aerator

Aerator adds air in water, thus keeping the water jet pressure strong, but significantly reducing water flow. Aerator saves water when being installed on the shower by 60 %, on the tap in washing sink — by 70 %, in kitchen sink — by 50 %

Water-saving (massage) shower head

Reduces water consumption by controlling shower holes. This increases the water pressure, produces massage effect and gives the feeling of water supply adequacy. Water-saving shower head allows to save up to 50 % of consumed water when taking shower

Water taps with photosensors

Switch on water only when hands are close to the tap and switch it off otherwise. Taps with motion sensors prevent wasting many liters of water, even if one constantly forgets to shut the water off when brushing teeth or washing hands

Portion taps

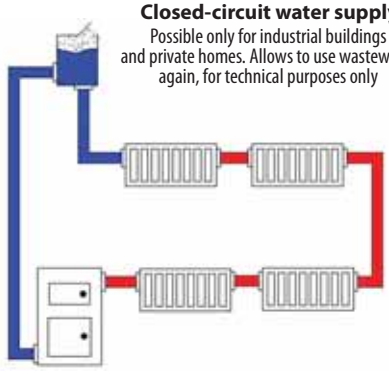
Automatically shut off water in a shower or tap after a set time period. Good for use in public buildings

Water-saving appliances

Choose home appliances that save water. For example, a dishwasher is though an expensive, but effective way to save water and energy by washing dishes. Toilets with two flushing modes also help to save water

Closed-circuit water supply

Possible only for industrial buildings and private homes. Allows to use wastewater again, for technical purposes only



Behavioral methods to save water:

- monitor the state of plumbing in your apartment and timely repair failures, especially repair leaking taps;
- when choosing faucets give preference to lever ones;
- washing dishes, do not keep the tap water running constantly. One can wash dishes in the sink with closed drain filled with water;
- use dishwasher and washing machine only when fully loaded;
- when brushing your teeth or soaping in the shower, turn off the water;
- take shower; it needs 5 to 7 times less water than taking a bath.

ENERGY-EFFICIENT WATER CONSUMPTION IN A BUILDING

Water treatment processes, its delivery to the consumer, disposal and treatment of wastewater consume considerable energy. Therefore, the less water is consumed, the less energy is spent.

Heating water requires especially great amount of energy. Immediately after using hot water in a shower or sink, it is discharged into the sewer system, without giving its heat for heating premises (as opposed to all other forms of energy coming into the house), so it is especially important to save hot water.

Be attentive and do not use more water than necessary for washing, showering or bathing, laundry, washing dishes or floor. If you feel that the water in a shower or faucet is too cold, better reduce the flow of cold water instead of increasing the flow of hot water.

Never allow that water flowes in vain. Do not rinse the laundry in the flowing water. It spends a huge amount of water, not mentioning the fact that the rinsing quality is low. Rinse in a bowl or other container. Do not throw debris into the toilet; after that we flush, thus consuming water. When cooking, use only the minimum necessary amount of water.

Very economical is the «English» way of washing dishes. In this case the drain hole in the sink is closed, and dishes are first washed in soapy water and then rinsed in clean water.

There are many simple devices to use water in energy-efficient way. These include mixers with aeration, mixers with restrictors of flow and water temperature, and adjustable shower heads.

One can heat hot water by solar collectors as described in pages 6 and 7. A significant part of the energy lost in vain with warm wastewater can be recycled and used in the house with the help of recuperation systems, as described also in pages 6 and 7. These are two ways to make a very significant contribution to the energy efficiency in buildings.

You got acquainted with the exhibition which tells about many ways to save heat and electricity. If you manage to implement all the measures necessary for your conditions, there is a big chance that your home will become energy efficient.

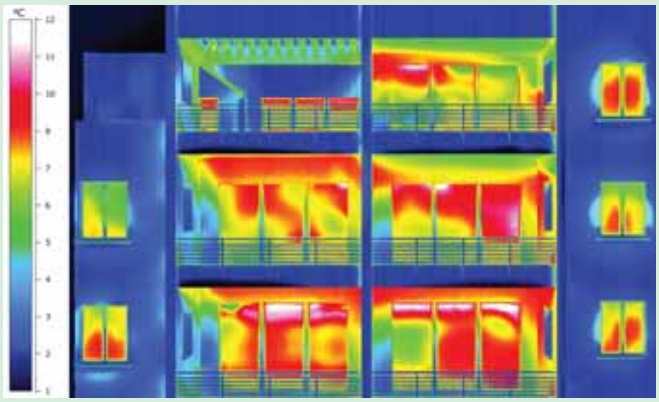
ENERGY EFFICIENT PASSIVE AND ACTIVE HOUSES

Energy efficient building is the building with low energy consumption, in which all the energy saving measures have been correctly and successfully implemented.

If a building does not need energy supplies from outside for heating and has no heating devices, it is called a «passive house.» This means that the heat generated by electrical appliances, hot water and people in the building, received from sunlight through windows and on outer walls, as well as generated by solar collectors installed on the house, is sufficient for heating and producing hot water.

If a building is not only self-sufficient with energy for its own normal operation, but also produces energy excess by using autonomous renewable energy sources (photovoltaic panels, wind turbines, etc.) that can be supplied in electricity network, it is called an «active house.»

ENERGY AUDIT



Energy audit of a building includes analysis of energy supply systems and identification of unreasonable losses of energy. Energy audit results are reflected in the energy performance certificate or technical report, which also provides recommendations how to improve energy efficiency.

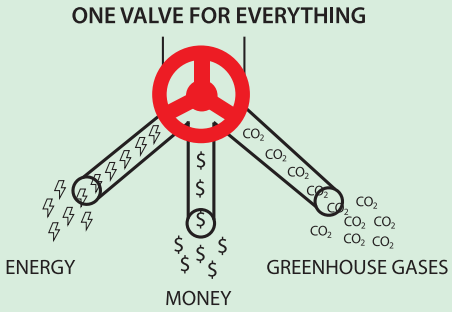
The basis of the thermal survey is scanning a building with a thermal imager (the instrument recording the object's surface temperature in the infrared range). In a picture of the building made in infrared range, red and yellow colors show locations of heat leaks. When shooting from inside, cold colors (blue and black) show where does "cold come" from. Professional energy audit is carried out by specialists who have licenses for this activity, but you can buy a small thermal imaging camera, and perform amateur energy audit of your house or apartment yourself. This will show where it is necessary to increase energy efficiency in the first place.

ENERGY CERTIFICATION OF BUILDINGS

At energy certification, buildings get the energy efficiency class similar to how appliances are labeled. Energy certificate of a building is issued by an authorized organization and reflects parameters of energy efficiency according to the existing standards.

Certification is carried out at the stages of design and construction of buildings, their commissioning, placing on sale, leasing, and at energy renovation (reconstruction leading to improvement of energy efficiency of the building). Energy certification of buildings is already performed in many countries of the European Union and other countries. High class of energy efficiency of a building increases its market value.

Most important is that living in a house with a high class of energy efficiency, one pays less for heating and thus lives in comfort with low energy consumption and makes smaller contribution to the greenhouse effect and climate change.



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