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"Challenges and Innovative Solutions of Life Safety in Ensuring Sustainability in Economic Sectors"

Automated Energy Saving Technology for Providing of Stability

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Abstract: *Fuel and energy resources of our planet are not unlimited, the increase in the consumption of fuel and energy resources is associated with the growth of the Earth's population.*

This article presents general directions, offers energy saving technologies with the use of IT. Buildings consume a significant amount of energy to maintain comfortable living conditions for residents, which implies heating the premises and preparing hot water, ventilation and air conditioning / cooling, as well as electricity supply for the needs of lighting and other household appliances. There are advanced technical solutions for buildings that reduce energy consumption, carbon dioxide emissions and energy losses, while ensuring maximum thermal comfort and safety for occupants. In general, such technologies either reduce energy consumption or increase the efficiency of its use.

Keywords: *Fuel and energy resources, noise insulation, waterproofing, motion sensors, calorimeter, gas analyzer, insulation, glazing, Smart home, energy-efficient, energy supply.*

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Introduction

Recently, effective planning during the construction phase has become increasingly important and includes effective eco-design planning, building orientation, effective use of the green plant system for the roof and facades of the building, use of shading, planning of natural lighting and ventilation, etc. Modern building regulations determine requirements for engineering systems of the building and establish limits on the thermal characteristics of enclosing structures, which also reflect the most optimal energy consumption in terms of technical and economic conditions. [1] Building Codes provide guidelines for new construction and for retrofitting existing buildings to create energy-efficient buildings through an integrated, holistic design approach that will increase the lifespan of the building, reduce energy consumption, and contribute to a better, healthier, more comfortable environment for people, their life and work. There are several technological options that, along with energy-efficient solutions, also support sustainability measures, reduce operating costs and environmental impact, and increase the adaptability, durability and resilience of buildings. [3] Analyzing the market of proposed equipment and energy saving technologies for residential, administrative, municipal buildings and educational institutions, it is possible to identify the automated technology "Smart Home", known as "Smart home (house)". It is a complex

engineering control system for all structural units present in the house (heating, water supply, air conditioning, security, fire alarm systems, etc.). Obviously, the main criteria of the system include reliability, ease of management and rational use of energy resources. In addition, an affordable automation system is needed to comfortably control a smart home.

- enclosing structures and structure of the building; insulation, glazing, tightness and cold bridges;
- heating of premises;
- centralized air conditioning/cooling;
- water heating and cooling;
- instruments and equipment;
- lighting.

Below are some examples of energy-efficient measures (the list of technologies is not prescriptive, and the applicability of each technology depends on the specific region, its climatic conditions and other factors) that can be implemented in order to make buildings efficient and productive: Thermal protection in order to improve the properties of enclosing structures and building structure:

- thermal insulation of the building's enclosing structures;
- replacement of outdated windows and doors with modern energy-efficient ones;
- increasing the tightness of buildings (as part of increasing the tightness, appropriate ventilation of the premises should be organized);
- Improvement of structural details to reduce cold bridges in the enclosing structures of buildings.

Reduction of heat loss in buildings:

- restoration and sealing of interpanel joints of walls and ceilings during the reconstruction of a panel building;
- installation of additional entrance groups (halls, wind verandas) with double doors;
- installation of automatic door closers;
- installation of heat recuperators to limit heat loss in the ventilation system and supply fresh and clean air.

Improvement and optimization of internal heat supply systems, reduction of energy consumption:

- thermal insulation of heating system pipelines, hot water risers, and distribution systems of the heating system;
- installation of automatic individual heating points of the heat supply system;
- installation of thermostats on the heating system;
- installation of balancing valves on the risers of the heating system;
- installation of heat and hot water boilers with automatic control of external conditions;
- use of circulation pumps for heating, hot water supply systems with built-in or external frequency converters;
- installation of reflective insulation behind radiators;
- hydropneumatic or chemical cleaning of heat supply systems, including basic equipment.

Reduce or optimize energy consumption:

- replacement of luminaires and lamps in internal and external lighting systems;
- use of presence sensors or daylight sensors to monitor lighting;

- use of highly efficient electric heating/cooling equipment (heat pump);
- optimization of elevator energy consumption with the installation of frequency converters;
- the use of frequency converters in engineering systems of buildings to optimize the operation of fans, pumps and other relevant equipment;
- installation of energy-efficient household appliances;
- installation of photovoltaic heating and energy supply systems (solar panels).[2]

Lighting control system: the role and effect in energy saving, the main elements.

Automation of energy-saving lighting (AESL) can be performed taking into account the implementation of the following scenario: "Turning on and off the light by motion sensor". The main passageways of the house are equipped with motion sensors, which allows the system to automatically turn on and off the lights when motion is detected or missing. The paired operation of motion sensors with light sensors allows you to turn on the light only when natural light becomes insufficient.

The use of AESL for apartment buildings can reduce the consumption of electricity for lighting stairwells and vestibules, since in practice this lighting can work all night without need. An example of the use of AESL on the K2000T controller is presented on the manufacturer's website and the calculation of savings and payback are given in the reports.

Climate control system: role and effect in energy saving, main elements.

Climate control in the "Smart House" is carried out by the impact on the engineering systems of heating, ventilation and air conditioning of the premises. For control, temperature sensors installed outside and inside the room, a controller, a thermostat, servo drives installed on the valves of the heating circuit and on the air valves of supply and exhaust ventilation.

The implementation of climate control algorithms directly affects the optimal mode of energy consumption of climate systems. At the same time, the simultaneous operation of the air conditioner and the heating system is excluded, which does not allow energy consumption. However, the air conditioner can work in conjunction with the installed underfloor heating, which maintains the set temperature at the bottom of the room.

The climate control system allows you to save energy spent on heating by reducing the temperature at night in deserted rooms and bedrooms, minimize the operation of the equipment during the absence of the owners by adjusting the user's work algorithms ("daytime absence", "vacation"). The greatest effect of energy savings is obtained in houses with autonomous boiler systems, since the controller controls the boiler room equipment, which reduces gas consumption for heating.

Control and control system for engineering systems and electricity.

Control (protection) against leaks of water supply, heating and gas systems is carried out with the help of sensors and a controller, which receives information from the sensors, is analyzed according to the algorithms laid down and a signal is sent to the servo drive of valves and taps. Control (monitoring) of consumed resources is similar to protection against leaks, a metering device with pulse output monitors the consumption of energy carriers and water, the controller analyzes and offers solutions for saving, but can also block valves or disconnect sockets from the network according to the algorithm laid down, preventing excessive consumption of resources.

This system can include automated measuring and information system for electric power fiscal metering (AMIS EPFA), which will facilitate the collection and monitoring of electricity consumption data from common house and individual commercial metering devices for management and energy supply companies.

Controlling water and gas leaks ensures safety first and then savings. Monitoring and management of consumed resources allows you to determine the priority areas of energy saving and performs a restrictive function of consumption.[3]

Calorimeter

The determination of the heat capacity with a calorimeter of modern production makes it possible to fix the value under study with an accuracy of ten to one hundredth of a percent. The range in which this device can operate ranges from 0.1 to 3500 Kelvin. The type of calorimeter device is very diverse. It can be determined by the nature of the process that is being studied, as well as its duration. Another important parameter for determining the type of mechanism is the area of temperatures in which the measurements take place, as well as the amount of heat measured.

In answering the question of what a calorimeter is, it is important to mention the purpose of this device for determining power. Such an apparatus, unlike an integrator, must be endowed with a significant heat transfer capacity. This is necessary so that it can remove the amount of heat that is injected into it. It follows that the state of the calorimeter is in mRotary measurement. The main function of the calorimeter is to study the data of temperature changes and determine the presence of defects in the heat exchange process. There are various ways to classify these devices, associated with specific parameters that differ sharply from each other. A wide variety of metals can serve as a material for manufacturing, for example, there are copper calorimeters, lead, steel and others. In addition to pure substances, alloys can also be used. [4]

Waterproofing bath

Rarely does anyone have doubts that the device of waterproofing the floor in the bathroom is certainly an important and necessary component of high-quality and durable repairs. In addition to the fact that high humidity is constantly observed in the bathroom, it is not yet necessary to exclude the possibility of various emergency situations. There are many ways to protect intermediate floors from dampness.

It is always necessary to protect the floor from water in the bathroom, especially for residents of multi-storey buildings.

Energy-saving windows

According to experts, through the windows, the share of the area of which on the facades of residential buildings is about 20%, a significant amount of heat still "leaks", which in the total balance of heating costs of the building is 30-40 and even 50%. Manufacturers of modern structures from PVC profile, fiberglass, wood, aluminum provide maximum tightness, heat and sound insulation by increasing the coefficient of resistance to heat transfer of the profile and window box. However, most of the windows are double-glazed windows. [5]

Currently, special, highly efficient heat-shielding double-glazed windows have been developed, which allow to increase the coefficient of resistance to heat transfer to 2 or more. This is a glass with a special coating: hard or soft. The hard coating is resistant to any climatic influences, and it is applied in the process of glass production by the so-called pyrolytic method or high-temperature pyrolysis (the solution that is sprayed on the glass evaporates and a durable coating remains on its surface). The soft coating is less resistant to weathering, it is applied in vacuum chambers by spraying. Glass with soft coating is installed only inside the double-glazed window, with hard - both inside and outside. Coated glass emits significantly less heat than usual, which explains its heat-saving properties. Heat loss can also occur due to convection transfer (up to 15%), which is greater the greater the width of the inner air chamber. This also happens in double-glazed windows, if the distance between the glasses exceeds 16 mm. The optimal ratio: 4x16x4x16x4 (4 mm glass thickness, 16 mm - air chamber). Filling with inert gases (krypton or argon) in combination with the use of low-emission glass allows to achieve high efficiency in heat saving. Certified double-glazed windows are sealed construction, it works for more than 20 years without gas leakage.

Energy-saving floors

Underfloor heating can be divided into water and electric. The principle of operation, due to which the surface is heated, is hidden in the name itself. A wide range of applications received electric. The latest modern developments of manufacturers in this direction allow the use of any floor covering.

The technique of saving electricity is embedded in the thermostatic elements. Profitability is about 40% of electrical energy. The disadvantage of these floors can be attributed to a short service life (15 years). Infrared flooring differs from traditional minimats and resistive cables and has a number of advantages. More than 90% of the radiation of the energy-saving warm floor of the far infrared range (wavelength from 5 to 198-20 microns) passes through the floor covering, heating not only the room, but also objects and the human body. The heating of the room is uniform not only due to radiation, but also due to the secondary convection of heated objects. The temperature of the room is important in order to create a favorable atmosphere, comfort and a special microclimate. The person must feel comfortable. The temperature at which a person feels good when using infrared radiation is 4-5 degrees lower than when using traditional sources of space heating. It is in the range of infrared radiation that the most intense absorption of heat occurs. In addition, a warm floor increases the concentration of negatively charged ions in the room by 4 times, which is much more effective than numerous analogues - various generators, modern complex systems. Another plus is the absence of noise, smell, vibration, dust during the operation of the infrared floor heating. Harmful electromagnetic radiation is minimally emitted from such systems.

Thermal insulation of pipes

Basement heating pipes of apartment buildings need to be insulated so that heat is not lost on the way to the consumer, and the temperature of the radiators in the premises remains high. To do this, the lines are covered with thermal insulation elements

The principle of operation of the heating system is that the air in the room is heated with the help of a coolant (water circulating through pipes and radiators). The water gives off heat and is returned to heat back into the boiler.

If the heating system inside the apartment does not need additional insulation, then outside it is simply necessary. The pipe through which hot water flows cannot freeze even in severe cold, some are sure. However, the pipe is insulated not for this reason, but in order to minimize heat loss.

Often, the boiler room, which heats the building (or several buildings), is located separately from it - at a distance of tens, or even hundreds of meters. Heat enters the houses through separate highways, sometimes of considerable length. As long as it reaches the consumer, the water temperature decreases. In addition, the walls in the houses are often cold, and the glass in the windows is cracked, as a result of which there is a low temperature in the entrances. To avoid heat loss, the pipeline is "wrapped" in the basements of the apartment building, in attics and stairwells - so that heat is not lost, and the batteries remain hot. [6]

Sometimes you have to deal with the fact that the pipes in the entrance were not initially insulated or the coating is outdated. Due to the old mistakes that were made during the installation of heating networks, heat loss can reach 50 percent. This increases the costs of consumers and shortens the service life of the pipeline, turning the thermal insulation of heating networks into an up-to-date solution.

At the present stage of life, energy efficiency is the most important principle of work in all spheres of consumption, since all the resources of the earth are exhaustible. At the same time, there are simple rules that can significantly increase the energy efficiency of households and pay less for electricity, heat and gas. Actually, the construction of an energy-efficient house that is comfortable for year-round living: keeping warm in winter and cool in the hot months is the most effective step towards energy efficiency and nature protection.

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