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ОБЕСПЕЧЕНИЕ ЭНЕРГИЕЙ ЭКОЛОГИЧНЫХ ЗДАНИЙ (ОПЫТ ЛАТВИИ)

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Согласно Латвийскому «Закону об энергоэффективности зданий», при строительстве зданий помимо местных законов и нормативов необходимо учитывать и влияние на окружающую среду и соответствующие экономические факторы, оценив возможность использования источников возобновляемой энергии как альтернативного решения для этих зданий. В статье рассматривается успешный опыт применения этих принципов и стратегий на практике: использование геотермальной и солнечной энергии в условиях Латвии. Администрация Латвийской Северо-Видземской Биосферной Резервации закончила создание Центра по образованию и информированию в вопросах окружающей среды площадью 675 м^2 в городе Салацгрива. Ожидается, что этот центр будет предоставлять местным жителям, предпринимателям и представителям муниципалитетов информацию как о самом резервате, так и о защите природного богатства и возможных инновативных решениях в развитии регионов.

Ключевые слова: энергоэффективность зданий, геотермальная энергия, солнечная энергия.

ENERGY SUPPLY IN THE ENVIRONMENT-FRIENDLY BUILDINGS (LATVIAN EXPERIENCE)

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In accordance with the Latvian “Law on the Energy Performance of Buildings” environmental and economic considerations, as well as binding regulations of the local government and other regulatory enactments, in designing of buildings shall be taken into account the systems, in which RES are used, in order to evaluate the possibility to use them as an alternative solution in these buildings. Paper will describe good experience and practice of this Policy and Strategy how to use opportunities of the geothermal energy and solar energy in Latvian conditions. North Vidzeme Biosphere Reserve in Latvia (NVBR) administration has finished the construction of an Environmental Education and Information Centre with area of 675 m^2 in the town of Salacgriva. The Education and Information Centre is expected to provide local residents, businesses, municipalities and state institutions with information about the natural assets of the reserve as well as about protection of natural resources and the use of innovative solutions in regional development.

Keywords: energy efficiency of buildings, geothermal energy, solar energy.

1. Introduction

Currently, the main sources of heating used in Latvia are derived from non-renewable natural resources and wood or its processed products. Negative side-effects of the use of fossil fuel resources include the greenhouse gas effect to the atmosphere. Furthermore, fossil fuel energy use in the country is limited due to the changing price policies of foreign providers. The use of renewable energy resources (RES) has significant role in Latvia’s energy resource balance already now (Fig. 1).

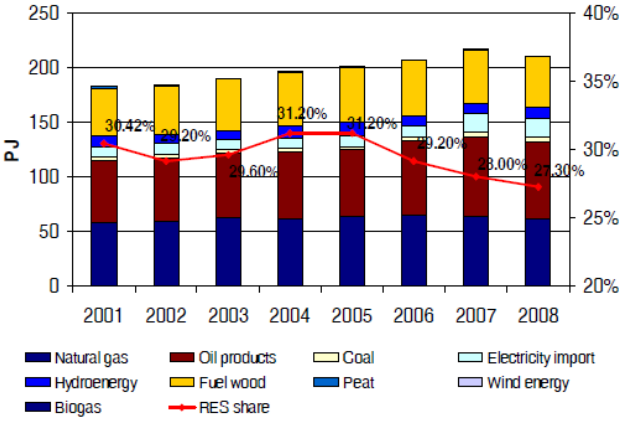

Рис. 1. Динамика потребления первичных ресурсов и распределение ИВЭ в Латвии
Fig. 1. Dynamic of primary resource consumption and RES share in Latvia

Nevertheless, some objective factors like rather big price for RES use technologies, long pay-back period for RES installations, etc. as well as prejudiced factors like the wider community lacks of trust and confidence in new technologies and understanding of the positive aspects of their use to brake more active RES use in Latvia.

Biosphere reservations have been established throughout the world, and their goal is to find economic and technological solutions in maintaining the balance between human activities and natural existence. Biosphere reservations are also education, research and scientific centers.

The main sources for thermal energy production are fossil fuel and the fuel wood or its processed products today in Latvia. Fossil energy resources are not available in Latvia, so that their use involves the dependence on the main supplier, on the variable position of the price policy and supply security from it. Similarly, a negative side effect such kind of resources are greenhouse gases emissions into the atmosphere. Renewable resources take an important place in Latvian primary resources in the energy balance.

North Vidzeme Biosphere Reserve in Latvia (NVBR) administration has finished the construction of an Environmental Education and Information Centre with area of 675 m^2 in the town of Salacgriva in 2009. This project was funded by the European Economic Area and Norwegian Government Financial Mechanism. The Centre will serve as a model for environment-friendly renewable energy use. Within the framework of the project equipment for geothermal energy use for space heating and cooling was installed, as well as solar energy collectors – for hot water. Such systems have high efficiency and this option was selected with the aim to reduce the management costs of Environmental, Education and Information Centre.

An air heat pump of reverse compression type is built into the air handling units that using air heat carrier from the rooms heat the outdoor air. Fully autonomous and economical operation air handling system is obtained.

It is important to evaluate the solutions that used technology will create the smallest possible impact on the environment in the constructing of environment friendly building, while providing a needed comfort for the people.

Installing additional heat exchanger may use the ground collectors for cooling refrigerant preparation in range 15-200 °C. If there is a need for greater cooling capacity or lower refrigerant temperature, then have to choose reverse heat pump, which in ground collector in winter receives heating, but in summer return in cooling process created unnecessary heat. First saving option is to reduce the rooms' pollution; the second is to understand the air circulation caused by energy consumption determinants. When this preparing is done, then mechanical ventilation with controlled air exchange, heat and moisture recovery is a logical choice.

1.1. Solar radiation in Latvia

The duration of solar radiation depends from seasons, climatic conditions and geographical position. Yearly global radiation may to reach 2200 kW·h/m^2 on a horizontal surface in solar zone regions. In North Europe solar radiation is 1100 kW·h/m^2 with maximal radiation in Sprin-Summer (Fig. 2). Considering directed radiation quantity, system efficiency, losses and etc., in Latvia yearly can get a 400-450 kW·h per 1 m^2.

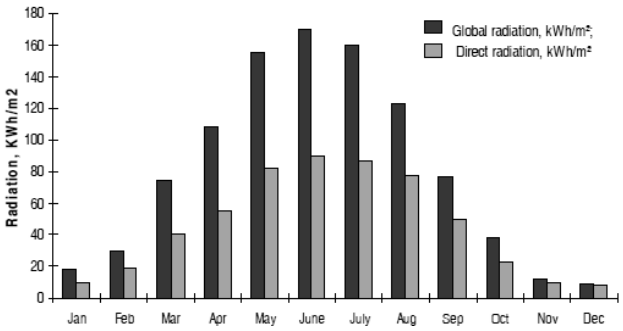

Рис. 2. Солнечное излучение в Латвии
Fig. 2. Solar radiation in Latvia

1.2. Geothermal energy in Latvia

In Latvian conditions it is possible to use for heat energy production such kinds of RES like biomass, the sun and geothermal energy. Solar heat can get during the day and the highest amount is in the summer. The heat of ground, starting with reach of freezing depth, is to be used all year. For example, in order to reach 50 kW of heat power would to construct 11 vertical ground holes collectors, each 100 m deep drilling, which would require ground works in area approximately 400 m^2. The same power could be getting from horizontal collectors from 1 to 1.5 meters deep with area of 2000 m^2. Very important issue is protection of groundwater, because by the deep drilling of holes for pipe lying can be damaged water horizons, drilled city utilities, or damage to soil can be discharged refrigerant. Therefore, design and built works

must be managed with special care. Accountable in situations as a heat carrier used for human maintenance, harmless substances, water, salt and alcohol liquids.

2. Methods and Results

Project goal: The goals of the project were to increase North Vidzeme residents and businesses' understanding of the use of environmentally friendly energy sources and options for their sustainable management. The project process includes the set-up of a reverse cycle modulated compression system - ground source heat pump equipment for room heating and cooling and solar panels (Fig. 3). Publicity of the project will include renewable resource seminars for the community and provision of information about process experiences to those interested.

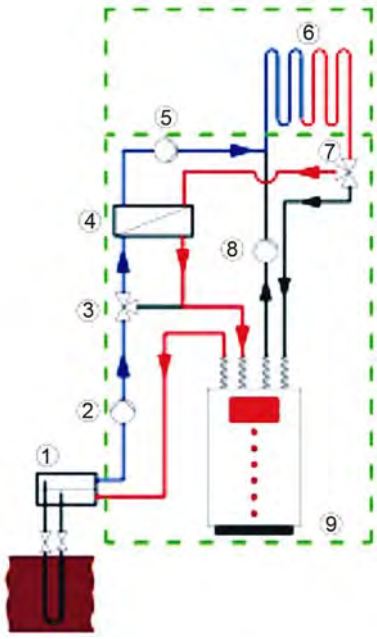

Рис. 3. Упрощенная схема (без резервуара для сохранения тепла, солнечного коллектора и емкости для подогрева воды, резервных соединений к имеющимся бойлерам). Обозначения: 1 – тепловой зонд почвы; 2 – главный циркуляционный насос; 3 – 3-режимная клапанная система, нагрев/охлаждение; 4 – охлаждающий теплообменник; 5 – охлаждающий циркуляционный насос; 6 – система отопления здания; 7 – 3-режимная клапанная система, нагрев/охлаждение; 8 – вторичный циркуляционный насос; 9 – тепловой насос

Fig. 3. Simplified scheme (without heating accumulation tank, solar collectors and hot water heating tank, reserved connection to existing heating boilers). In Figure: 1 –ground heat probe and collector well; 2 – primary circulator pump; 3 – three-way valve switching arrangement, heating/cooling; 4 –cooling heat exchanger; 5 – cooling circulation pump; 6 – heating circuit of the building; 7 – three-way valve switching arrangement, heating/cooling; 8 –secondary circulations pump; 9 – heat pump

The most popular by operational principle of heat pumps is compression type, because such technologies were sufficiently tested and it is opportunity to provide qualitative technical services.

With increasing of alternative energy solutions, which are used for geothermal resources, technically economic motivation makes difficulties of information deficiency about thermo physical properties of ground depth deeper than 5-10 m. Like acting building constructors pile bearing capacity by the determination, it is also possible to make inspection hole and test result to determine the expected heat power given by one hole. This is done by a special measuring equipment and measuring temperature changes in the several numbers of overnight periods. Such measurements allow identifying more precisely the specific ground conditions and calculating the required number of vertical ground collectors.

Energy savings through compression modular equipment were used with reverse cycle heating in building and solar collectors for hot water production up to 90 MW·h/ year. Characteristics of system:

– CO_2 reduction (if takes as the basis of fossil fuel use) – 56.6 tones/year;

– Number of holes created for space heating and cooling – 11;

– Solar collector's area for production of 500 l hot water – 18 m^2.

3. Conclusions

Recommendations for RES effective and rational use were prepared.

The realized project made it possible to clarify the main important aspects of heat pumps use like

– protection of groundwater and communications;
– ground heat energy balance over the years;
– efficiency of compression cycle;
– heat pumps view in development technologies.

The Environmental Education and Information Centre fulfilled its function to promote the state's viewpoint of the importance of the use of renewable energy resources. Investments in this project were an economically viable option in addition the realized project helps to reduce yearly maintaining costs.

As a result of the project it has become clear that the energy independence of Salacgriva from imported energy resources is an invaluable and nationally important issue, which could be as a model to other countries.

The project also includes informational events that promote the advantages of the renewable energy use for heating especially heat pumps rational use in combination with solar collectors.

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