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RENEWABLES IN ENERGY SUPPLY OF NATIONAL FORESTRY UNIVERSITY OF UKRAINE

The necessity of switching to alternative energy sources in NFU of Ukraine has been argued. The influence of the delivery of public services on the environment, public health and energy resources has been characterized. With the load on the environment diagrams an integrated index – index of environmental energy supply has been defined.

Keywords: *energy, life cycle, environmental code.*

Introduction. For a long time, humanity is clearly not aware of the fact that natural resources are limited and the human impact on the environment has both short and long term. Today the vast majority of people understand that the production of goods and services not only lead to the depletion of natural resources, but also the emergence of a variety of environmental problems. Significant efforts of scientists and practitioners aimed at solving old and prevent new environmental problems.

One of the components of eco-efficiency tools should be an analysis of the life cycle of services. The concept of life cycle considers products/services from the beginning of their physical appearance and until terminated their operation.

In today's socio-economic environment, material flows and processes occur in a linear pattern [3]. But on an infinite time interval material passed through the technosphere, newly returned to the environment as a raw material.

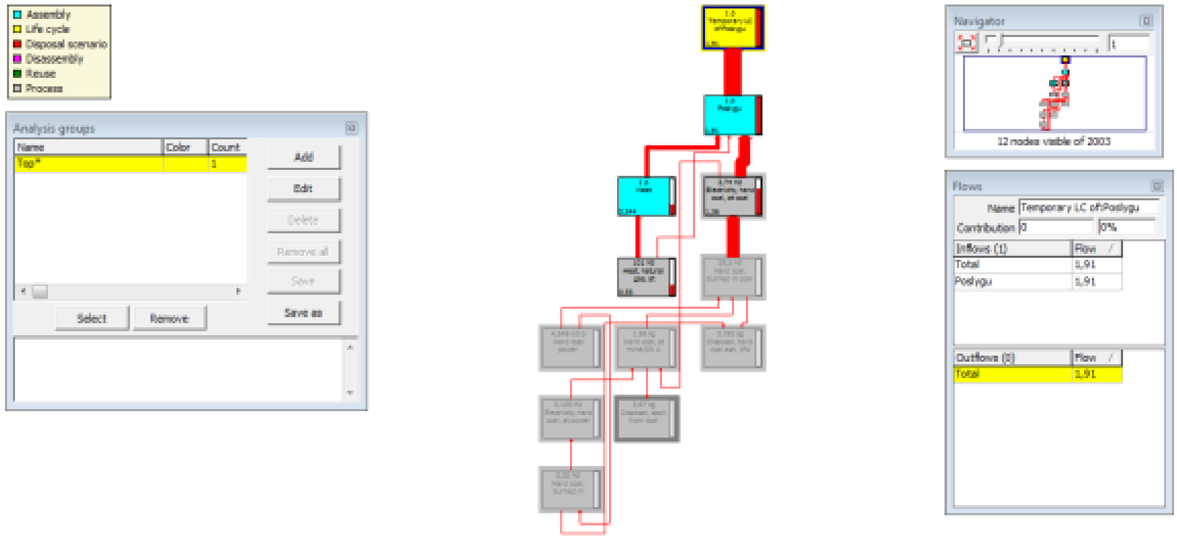
Materials and methods. Take into consideration complex project of transition to biofuels from food waste of boiler room and dining NFU of Ukraine, installing solar panels on the roofs of hostels and five wind turbines in the arboretum of the university. It was hypothesized that the conducted energy conservation measures will result in at 37–43%.

For the analysis of the environmental impact of the life cycle of communal services of NFU of Ukraine were analyzed following indicators: basic materials needed for the power supply for the university buildings and dormitories, each constituent components and raw materials, which are considered as inputs, the process of transportation, directly heating process accompanying the product life cycle (outputs). Indicators were grouped into two groups: essential natural resources (gas, minerals), technical and technological means [4, 7].

To simulate and analyze complex life cycles systematic method it was used software SimaPro, which is a tool for collecting, analyzing and monitoring of environmental performance of products and services.

Results and discussion. We have analyzed the environmental impact assessment process, providing utilities with gas of NFU of Ukraine. Analysis process consists of the following five elements: characterization, damage assessment, normalization, weighting, identifying environmental index.

Gradually the program were made on individual data parameters specifying composite materials, components and processes that accompanied them. After date inputprocess, tree was built to identify the weak points of the analysis (Fig. 1). Red lines (or thermometers) show the impact on the environment, which is formed in each process [4].



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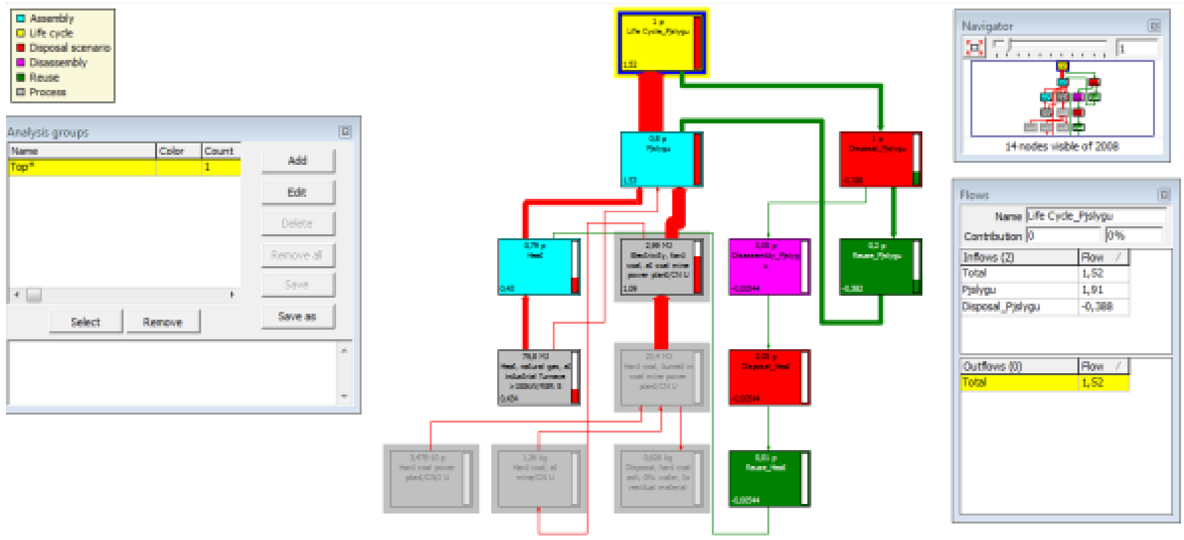

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Figure. 1. **Process treee of power supply of university:**

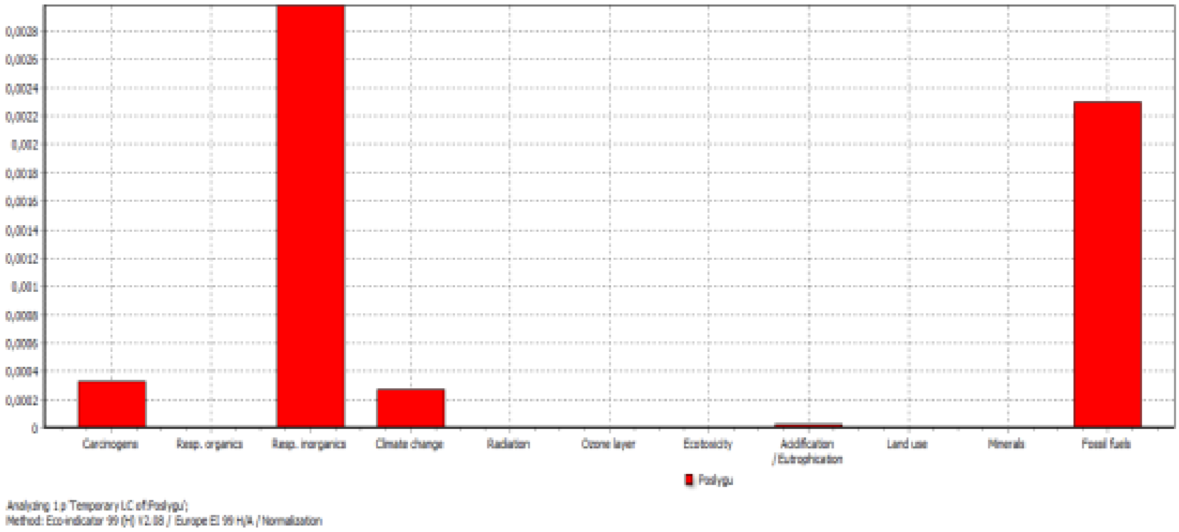
***A* – existing condition, *B* – using alternative energy sources**

Line thick shows the process load on environment by Eco-indicator 99 system. On this picture is displaid as an integrated indicator – the environmental index, which allows us to take one estimate for the entire life cycle. This is the sum of all individual eco–points or partial indexes for all processes of life cycle energy. Computational procedure is performed by summing the weighing results phases of the life cycle.

Feature of the program is the ability to identify important and less important processes (identifying «hot spots») [6]. In our case, the «hot spots» are losing gas leaks through windows, no insulation of walls, door frames leaks and other issues related to the loss of heat and gas transport over long distances from source to consumer. On the way to the consumer lost a significant amount of energy is also a direct consequence of the lack of insulation.

The next step is to continue the life cycle analysis based on characterization. They are groups of inputs and outputs that are distributed among eleven impact categories according to the methodology Eco-indicator 99. Characterization of the relative strength adverse impacts of each of the relevant components of the life cycle of communal services and energy is to determine the proportion of carcinogens, respiratory agents, climate change, radiation effects on the ozone layer, eco-toxicity, of fossil fuels and changes in land use, minerals, acidification / eutrophication (Fig. 2). You can follow a positive trend, namely the rational use of generated heat and good insulation structural materials has a positive environmental effect, in economical use of natural resources.

The difference in the results of the analysis is a graph all processes related to energy savings are negative, the flow process is not a bad thing, but only shows the positive, desirable from the standpoint of environment processes. The point is that substances captured or not emitted in significant amounts, saves resources, and therefore does not put a negative environmental impact on the environment through depletion of resources and due process of extracting the necessary raw materials and emissions.



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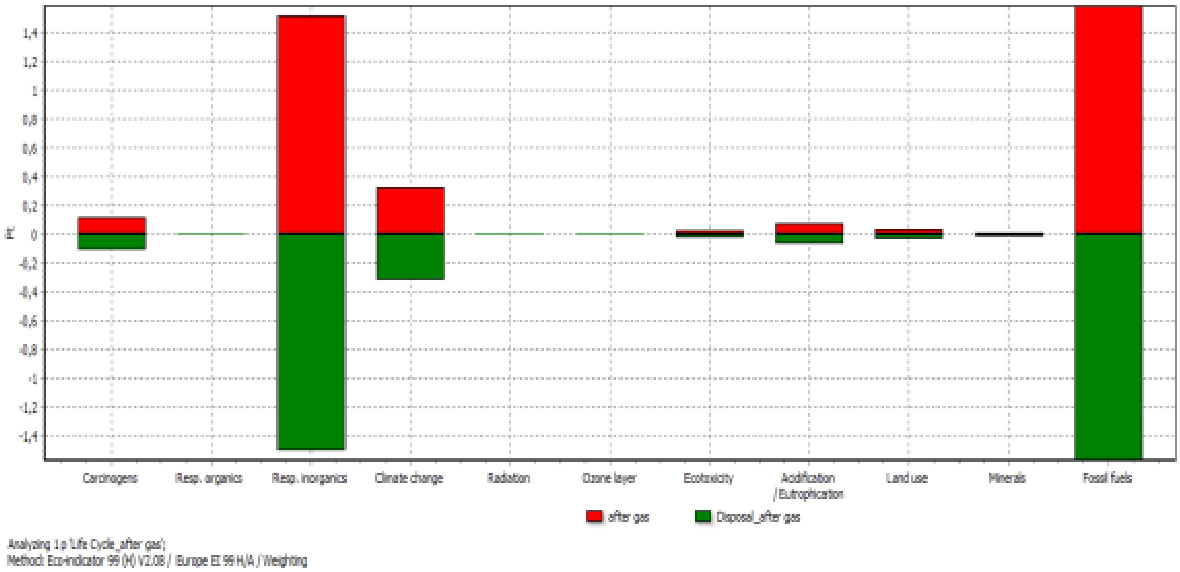

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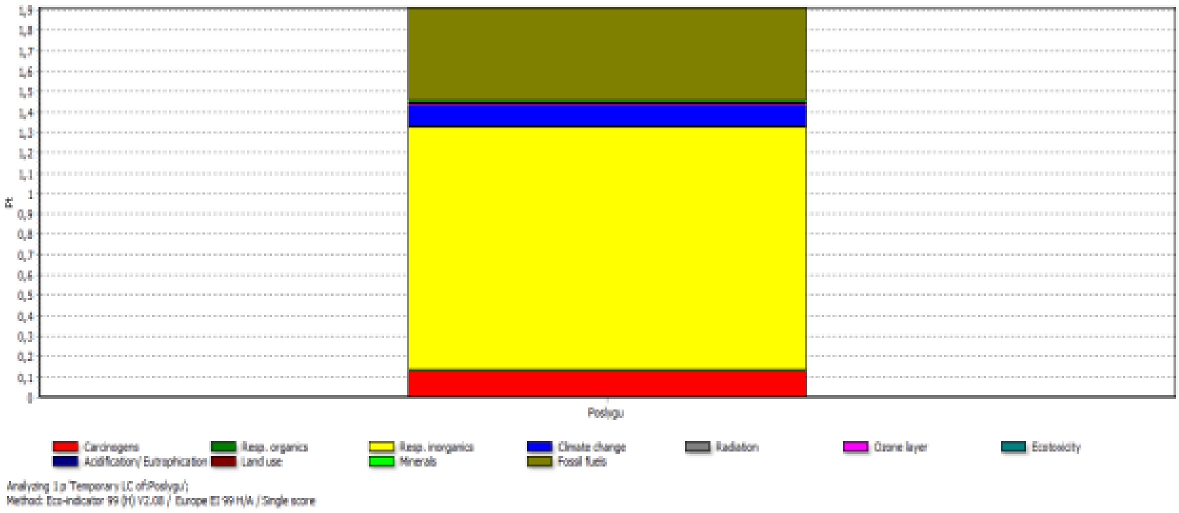
Figure. 2. **Life cycle assessment of energy:**

***A* – existing condition, *B* – using alternative energy sources**

As computational procedures used for data aggregation in the impact categories are used ecological models to compare different contributions to the same environmental problems. This task can be accomplished by using equivalence factors specified models using alternative energy sources (Fig. 3).



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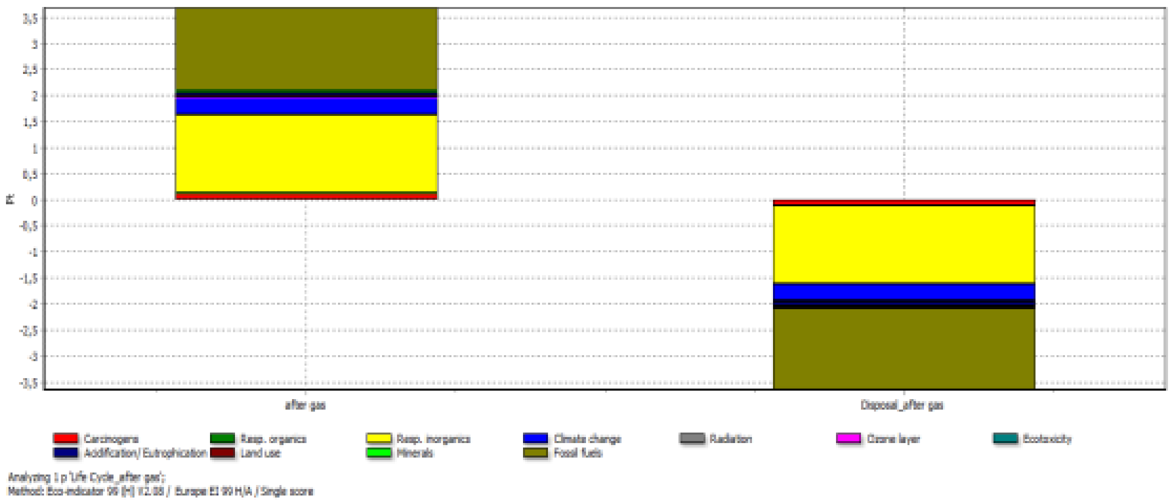

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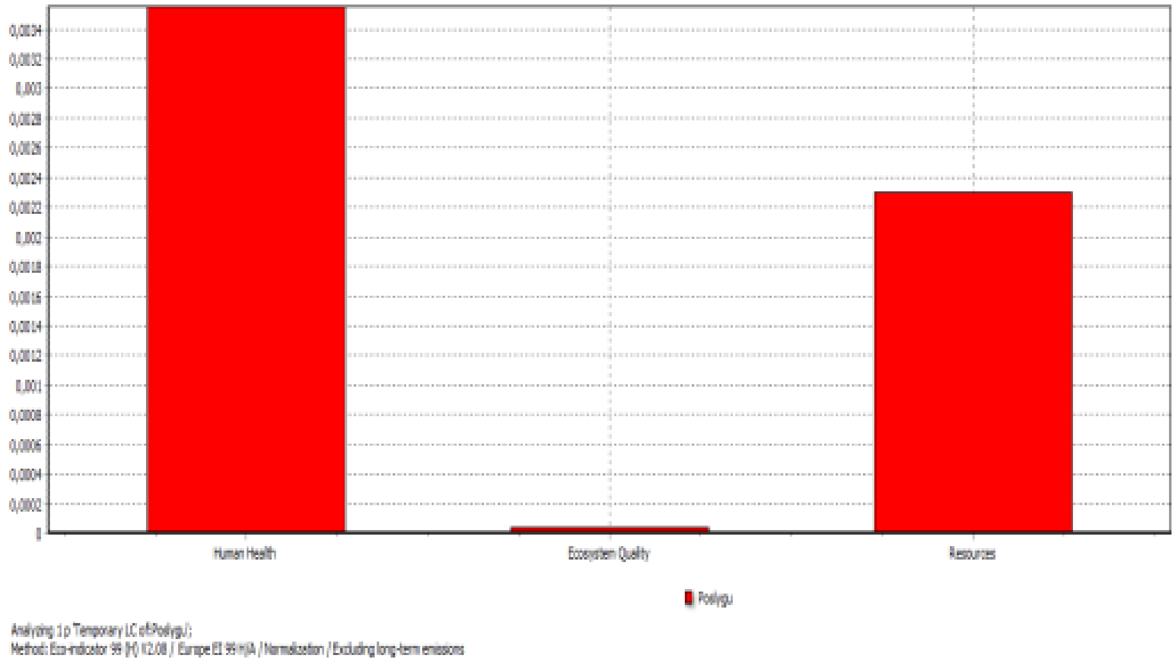
Figure. 3. **Life cycle assessment of processes of energy–based environmental index:**

***A* – existing condition, *B* – using alternative energy sources**

The graph shows typical results of the specification of power utilities and scripts creation and dissemination of results. Colors show the contribution of services and waste that accompany it. The greatest negative impact on the environment arise from emissions of greenhouse gases, which makes the corresponding impact on eco–toxicity and climate change. Similarly, we can evaluate the environmental impacts in the following stages of analysis: assessing losses, normalization, weighting, identifying environmental index.

For more transparent results all influence can be compound into three categories, namely: health: carcinogens, respiratory agents, climate change, radiation, ozone, eco–toxicity, quality of ecosystems acidification/eutrophication, land use, natural resources: minerals, fossil fuels.

In Fig. 4 we see that the greatest impact of gas and air pollution given by the natural resources and human health.



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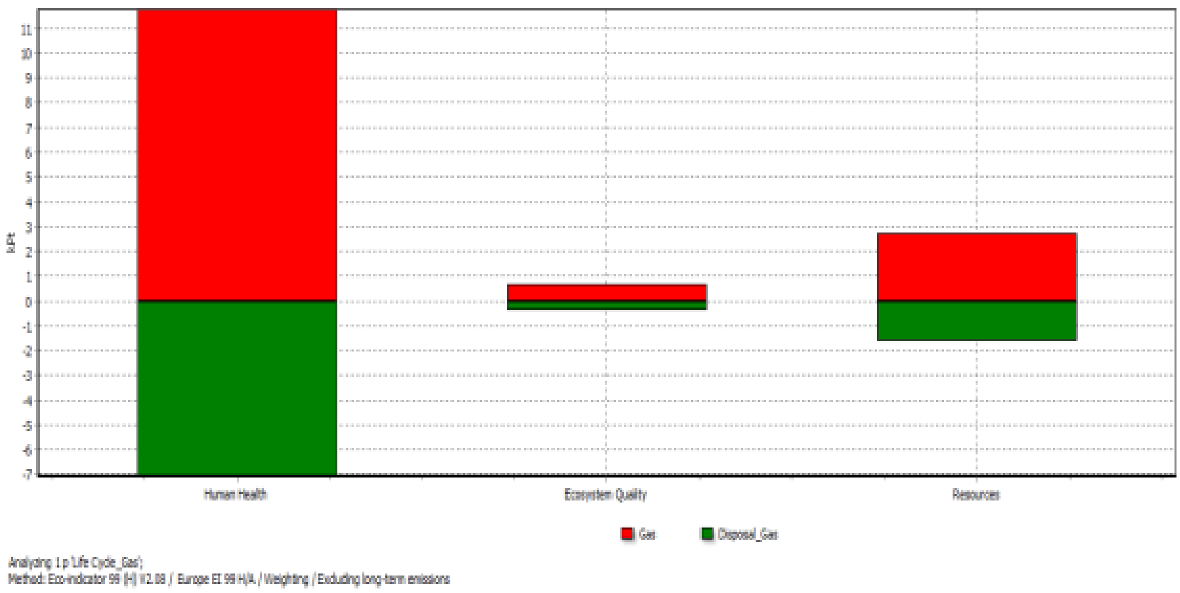

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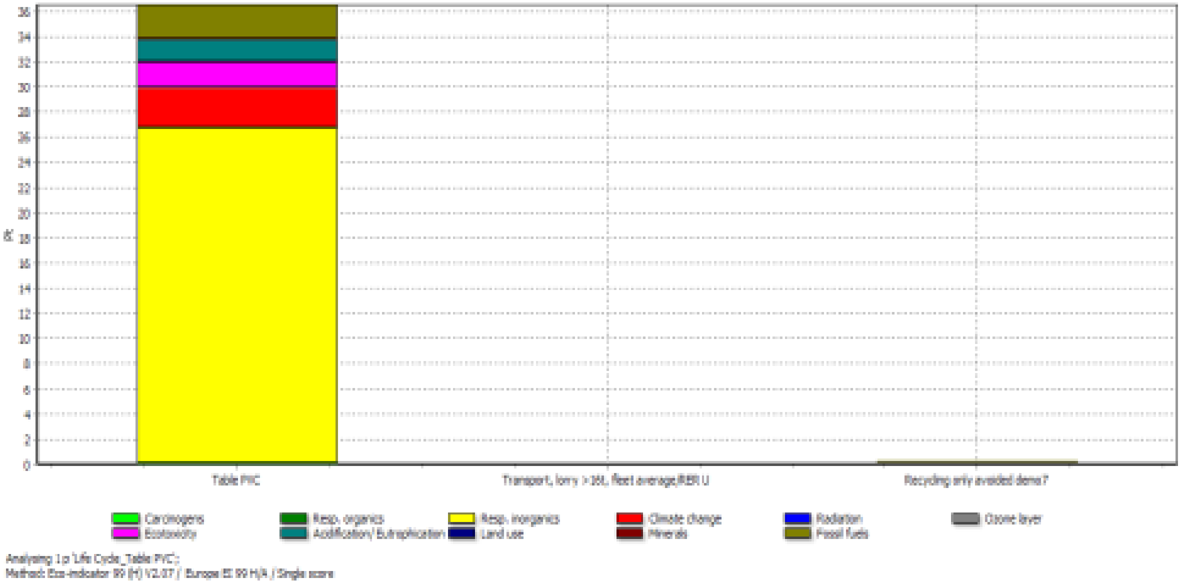
Figure. 4. **Life cycle assessment of energy processes in the three combined categories of environmental impacts:**

***A* – existing condition, *B* – using alternative energy sources**

Fig. 5 presents the final results of the life cycle impact of gas through the ecological index that reflects.



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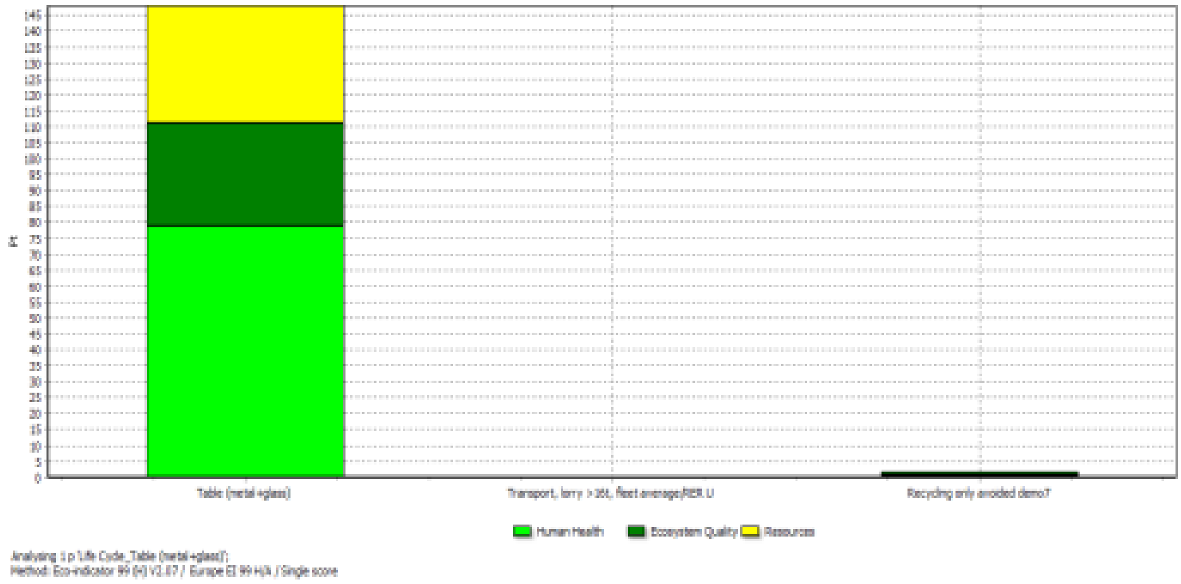

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Figure. 5. **Environmental Code of processes of energy:**

***A* – existing condition, *B* – using alternative energy sources**

The figure shows that the environmental index for utility services without the use of alternative sources of energy is – 1.91, after the transition to renewable energy – 0.07. So, due to inefficient use of energy the greatest environmental impact couse greenhouse gases (yellow and red part of the graph correspond to the level of pollution by harmful substances).

For this process were calculated ecological footprint that may arise in the future (Fig.6).

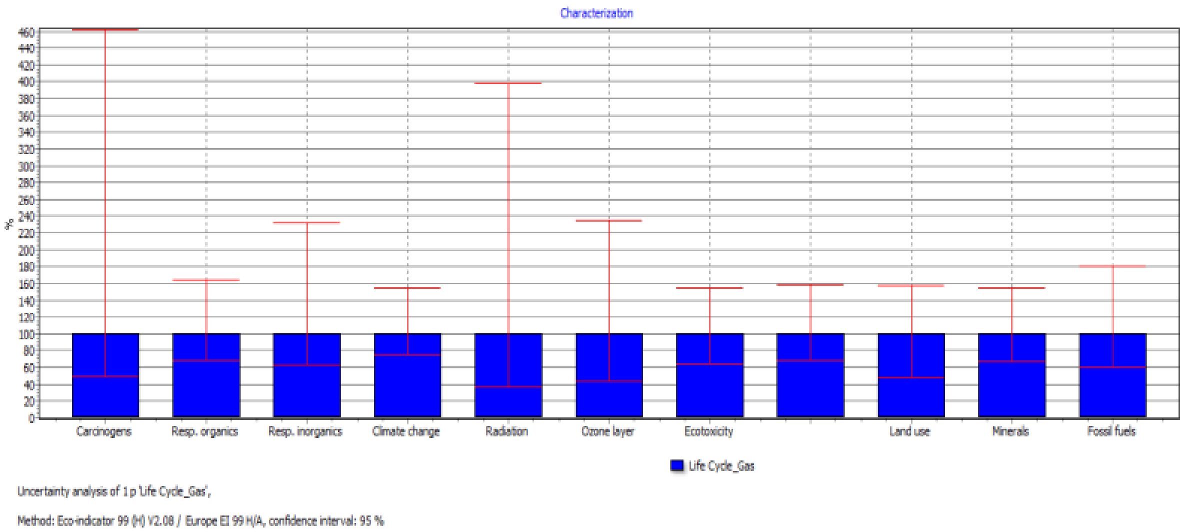

Figure. 6. **Defining ecological footprint of public services**

With the obtained results it is clear that services with lesser index carry less impact on the environment.

Conclusions. Proposed action of switching power supply of universities to alternative energy sources help reduce costs in all phases of the life cycle energy as we reach:

– reduce consumption of raw materials at 27–32 %;

– increase of productivity of transporting products to 78–85 %;

– reducing emissions of harmful and potentially harmful substances: carbon dioxide CO_2 – 31,49 tons, sulfur dioxide – SO_2 – 1,2 tons, nitrogen oxides NO_x – 28,14 tons, carbon monoxide CO – 28,14 t, solids – 47,53 t, soot and ash – 0,12 m;

– environmental load index decreased by 1,84 points.

Environmental code without using alternative energy is – 1.91, after the transition to renewable energy – 0.07. Thus, the object with a smaller index has less impact on the environment.

Thus, studies have allowed us to undertake a full review of life cycle energy services. Excessive branching of processes treee enables us to see the life cycle scenarios of process utilities of University.

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МОДЕЛЮВАННЯ КОМПЕНСОВАНОГО АСИНХРОННОГО ДВИГУНА В ПРОГРАМНОМУ СЕРЕДОВИЩІ MATLAB SIMULINK

Дослідження присвячене моделюванню асинхронного двигуна з внутрішньою ємнісною компенсацією реактивної потужності в програмному середовищі MATLAB Simulink на основі рівнянь електричної рівноваги кіл статора і ротора двигуна. В роботі наголошено на особливостях створення моделі з урахуванням можливості побудови механічної та робочих характеристик двигуна.

Ключові слова: *асинхронний двигун, компенсація реактивної потужності, моделювання двигуна, механічна, робочі характеристики.*

Розвиток електронно-обчислювальної техніки, зокрема поява спеціалізованих програмних пакетів, дали змогу полегшити вирішення складних алгебраїчних рівнянь що описують фізичні процеси перетворення енергії. Свій подальший розвиток