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Stop Global Warming

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Abstract

In this article, the author made an attempt to analyze the causes and consequences of climate warming on Earth. How real are the threats and what is the deadline for the response of mankind to them. An informal scientific presentation provides a brief overview of the impact of various factors on climate change and the proposed methods of combating global warming. A key, promising, according to the author, project that logically follows from the above analysis and which has not been paid due attention to yet, has been considered in detail. The article used materials from the media and reference publications and scientific publications.

Key words: global warming; hot box.

Facts and Hypotheses

For many years, enormous material and human resources have been involved in the study of climate issues. Scientists have collected and processed huge amounts of information indicating global warming. However, attempts to formulate a unified strategy to combat warming have so far failed. The Kyoto Protocol, and then the Paris Agreement on the Control and Reduction of Carbon Dioxide Emissions, for the most part remained unfulfilled [1, 2].

Hot battles between eco-activists and industrialists attract general interest. Some require an immediate cessation of emissions and transition to carbon-free technologies. Others are concerned that such a transition will be very expensive and take a lot of time, because modern industry has been created for many decades and occupies the lion's share in providing energy, and "clean" energy has unstable and dispersed resources. They believe that ongoing political, economic and technological modernization, rather than radical restructuring of society, is a solution to the problem of global warming, and a way to adapt to new conditions [3, 4].

Since "consent is a product with complete non-opposition of the parties" [5], a solution should be sought that satisfies the interests of both parties. At the same time, neither the economy nor the environment should suffer. In other words, reconcile Gretta Tunberg and President Donald Trump [6].

Few doubts the reality of global warming on Earth. The facts speak for themselves. The ice cover in the Arctic Ocean in winter has been declining over the past 40 years — an average of 12% every decade [7].

The four lowest values since 1979 also occurred in the last five-year period. The annual loss of Antarctic ice sheet volume increased from 1979 to 2017 by at least six times. According to the level of glacier melting, the last five years have also become a record for the entire history of observations [7, 8]. The predicted rise in ocean water by scientists, and the associated flooding of individual islands, is already a reality. The speed with which global climate changes occur on the planet is amazing. This speed can be judged by the conclusion

reached by the researchers: the warming of the oceans in the period from 1987 to 2019 amounted to 450% compared with the period from 1955 to 1986 [7, 9].

An impressive fact is that in February 2020 the temperature in Antarctica reached a record + 20 ° C [10, 11, 12]. Thinking about the possible causes of thermal imbalance on the planet, we can put forward several hypotheses:

1. The amount of energy supplied by our Sun is increasing.
2. The earth warms up from the receipt of heat from the inside.
3. Climate change is associated with a change in the Earth's orbit.
4. The activities of mankind, leading to an increase in the content in the atmosphere of greenhouse gases.

However, the first two hypotheses are not supported by scientific evidence. And the third is based on events that lasted for hundreds of thousands of years, and could hardly lead to such a rapid warming.

The main and currently accepted hypothesis is the violation of the heat balance between the supply of solar energy and its removal due to an increase in the content of greenhouse gases in the atmosphere [13]. The most significant greenhouse gases in the atmosphere are: water vapor, carbon dioxide, hydrocarbons (methane), nitrogen oxides. These gases were always present in the atmosphere as a result of evaporation from the oceans, volcanic activity, forest fires, etc., however, as a result of human activity (burning of fossil fuels - coal, oil and natural gas), the carbon dioxide content is steadily and sharply increasing [14].

The Greenhouse effect

What is the essence and danger of the greenhouse effect, which leads to warming? The greenhouse effect is an increase in the temperature of the lower layers of the planet's atmosphere compared to the effective temperature of the planet's thermal radiation observed from space [14, 15]. Simply put, the greenhouse effect is the blocking of the Earth's atmosphere by the removal of heat into space. The local, temporary greenhouse effect, we can observe with the help of clouds. If the night is cloudy, then in the morning it will be less cool than with a clear cloudless sky, a clear sky on a winter night is a sign of cooling. The reason is that clouds reflect the thermal radiation of the earth, retaining heat.

But since the clouds are not completely transparent to visible light, during the day, on the contrary, they create cool weather.

Contrary to the opinion imposed by the media, the greenhouse effect is not evil, but a blessing for life on Earth. If there were no greenhouse effect and greenhouse gases in the atmosphere, the average temperature on the Earth's surface would be close to minus 19 °C. In fact, it is + 14 °C [16, 17].

However, the effect of the greenhouse effect on temperature should not be underestimated. A good example and model of the greenhouse effect is a device called a “hot box”. The device is a box, all walls of which are covered with thermal insulation, and the upper part is covered with glass. The inner surface of the box is painted black. Sunlight passing through the glass heats the black walls inside the box. The heat remains inside due to the opacity of the glass for thermal radiation. The effectiveness of this process is evidenced by the fact that with proper insulation of the walls and the installation of double-layer glass, the temperature in the box can reach + 120 °C. In this device, glass plays the role of greenhouse gases [18]. Transferring the analogy of the described effect to the earth's surface, it can be imagined that the warming resources only due to the greenhouse effect are very significant. This is without taking into account other factors, which will be considered later.

Greenhouse gases.

Since carbon dioxide is considered to be the main culprit of warming, let us dwell on its properties.

Carbon dioxide, also known as carbon dioxide (CO_2), is a colorless gas one and a half times heavier than air. In small quantities, it can dissolve in water, forming a weak carbonic acid.

CO_2 plays a key role in photosynthesis, in which plants absorb sunlight from carbon dioxide and release oxygen under the influence of sunlight. Earth's atmosphere contains about 0.03% carbon dioxide [19]. Natural sources of CO_2 emissions into the atmosphere are: volcanic activity, forest fires, peat fires, decay of organic materials such as wood, emissions from the oceans, respiration and digestion of animals. The anthropogenic source of carbon dioxide in the atmosphere is the burning of fossil fuels (coal, petroleum products, natural gas). An indirect factor in the increase in CO_2 content is deforestation, which leads to a decrease in its absorption. According to the authors, although the total anthropogenic emission of CO_2 does not exceed 8% of its natural annual increase, its concentration is increasing on an ever-increasing scale [20].

Water vapor is the main source of the greenhouse effect. Although this fact is well

known, water vapor is not considered to be the culprit of climate warming. Since it is very difficult to fix a global increase in atmospheric humidity, it is more convenient for science to consider that an increase in the concentration of water vapor does not occur. This postulate can be called into question on the basis of the following considerations:

- when burning petroleum products, gas, wood, in addition to carbon dioxide, water vapor is also formed;
- steam is released in most technological processes (including nuclear power plants);
- with climate warming and ocean temperature, water evaporation increases;
- with an increase in the concentration of CO_2 in the atmosphere, the moisture capacity of the air increases, which enhances the greenhouse effect.

Other gases.

The main sources of methane are processes of anaerobic decay (in swamps, intestines of herbivores). High-temperature processes (fuel combustion, volcanic eruptions, lightning discharges) emit nitrogen oxides into the atmosphere. The concentration of such gases in the atmosphere varies in millionths of a percent, although their greenhouse activity exceeds tens and hundreds of times CO^2 activity [21].

The role of the sun

The sun is the main source of energy on our planet. Solar energy is primarily supplied to Earth in the form of visible light. Small amounts of ultraviolet and infrared rays are mostly absorbed by the atmosphere. Therefore, our vision perceives precisely the visible part of the spectrum of sunlight. After absorption of part of the energy by the atmosphere, an energy of about 1000 W per square meter reaches the earth's surface [22]. Then, on average, about 30% of this energy is reflected back into space. The rest of the planet heats up or is stored by plants in the form of organic substances [22].

We rarely wonder how huge this energy is. The analogy with the energy of nuclear explosions is very impressive in this regard. Let's try to make a calculation. Initial data: - the energy of the explosion of an atomic bomb dropped on Hiroshima amounted to 63,000,000,000,000 (6.3 × 1013) joules [23];

- 1 J = 1 W / s; - 1 kW / h = 3.6 × 106 J;
- Conditional insolation time by the "standard sun" - 5 hours / day;
- solar power - 1 kW / m^2;

Then, in 5 hours, 5 kW / h of energy will fall on a plot of land per 1 square meter. For a year

this amount will make 1800 kW / h. If we take a section of 100 × 100 meters, then 1.8 × 107 kW / h, or (1.8 × 3.6 × 1013) = 6.48 × 1013 joules, will “fall” onto it.

Thus, thanks to the sun, conventionally, one atomic bomb gradually falls onto the earth's surface the size of a football field over a year.

Another impressive calculation carried out by an international group of scientists showed that the energy of the explosion of 5 atomic bombs is spent every second on heating up the ocean, observed in recent decades [23].

The role of industrial energy.

Speaking of warming, one should consider the issue of the influence of human activity with a direct impact on the ambient temperature. This refers to the burning of fossil fuels and nuclear energy. In the process of this activity, direct heating of air, water, etc. takes place. (heat generation). In addition, electrical and mechanical energy is generated, which also eventually turns into heat.

To understand the question “Who is in charge here?”, We turn back to the calculation. According to the Statistical Yearbook of World Energy, the global energy consumption in 2019 approached 15,000 Mtoe, (Mtoe – million tons of oil equivalent) [24, 25]. These 15 billion tons included oil, natural gas, coal, biomass, electricity, and heat.

If we take into account that 40 ÷ 45 megajoules of energy are obtained from one kilogram of oil products [26], then it is easy to calculate that in 2019 6 × 1020 joules were generated on the planet. This number with twenty zeros is colossal in itself, but what does the contribution of energy to the heating of the planet look like in comparison with the usual sunlight. But it looks very modest. The sun for a year sends us the same amount of energy in total to a site of 30 × 30 kilometers. This is slightly larger than the area of Kiev (Ukraine).

Balance in nature

Huge amounts of energy coming from the sun do not lead to catastrophic changes due to mechanisms that maintain equilibrium in nature. Earth is a closed system in which the processes of creation and destruction, the transition from one state to another and vice versa, occur simultaneously. In the Earth’s biosphere (land surface, oceans, atmosphere) there are several most important cyclic processes called cycles. The most famous ones are: the water cycle, the oxygen cycle, the CO_2 cycle. On the example of carbon dioxide, it looks like this: - CO_2 entering the atmosphere is used by plants to grow biomass. Over time, the biomass

either burns or rot, releasing the same carbon dioxide.

Significant amounts of CO_2 are absorbed by the ocean. The solubility of CO2 in water depends on temperature, so the ocean either absorbs CO_2 (in cold water), then emits it (when the water is heated). There are also organisms in the ocean (phytoplankton) that use carbon dioxide for their growth. Moreover, according to some estimates, the oceans supply from 20 to 50% of oxygen, respectively producing it from carbon dioxide [27].

Now, about the thermal equilibrium on Earth:

As for energy, our planet continuously receives a huge amount of energy from the Sun and we can talk about thermal equilibrium only if excesses of this energy are compensated either by absorption and storage (for example, into coal), or sent back to space. Both the receipt of solar energy and its removal outside the planet are carried out using radiation.

The mechanism is as follows. The sun's rays penetrating into the atmosphere and to the surface of the land or ocean are partially absorbed by them, partially reflected back into space. The fraction of reflected energy depends on the blackness of the surface. The darker parts of the planet (oceans, forests, fields, mountains) absorb most of the sun's rays and at the same time heat up more. White surfaces (snow and ice) reflect most of the visible rays and remain cold.

The magnitude of the "albedo" is evidence of the amount of solar energy absorbed by the surface. It characterizes what percentage of solar energy is reflected by a given surface. The average albedo values for various types of land surface in percent (%) are [28]:

Fresh dry snow	85–95	Fields of rye and wheat	10–25
Contaminated snow	40–50	Cotton fields	20–25
Sea ice	30–40	Meadows	15–25
Dark soils	5–15	Coniferous forests	10–15
Wet gray soils	10–20	Deciduous forests	15–20

The albedo of the water surface is on average smaller than most natural land surfaces and depends on the angle of incidence of the rays, on the height of the Sun, the ratio of direct and scattered radiation, and the waves of the sea surface. The albedo of the ocean surface for diffuse radiation varies between 5–11% [29].

With the reflection of visible light, everything is clear. What happens to that considerable part of the light energy that is absorbed by the earth's surfaces? Dark surfaces are heated by this energy. When heated, dark bodies begin to “glow” with infrared light invisible to us. These infrared rays (sometimes called thermal radiation), like the visible ones, can leave the planet.

However, there are obstacles for infrared rays that are transparent to visible rays. These are silicate glasses and the so-called. greenhouse gases. Greenhouse gases, which are gases consisting of complex molecules, are an obstacle to the return of Earth's thermal radiation back into space.

The reader may ask: - But what about the removal of heat from the surface due to convection, when the heated air rises, thereby taking away the heat? The fact is that this heat remains in the atmosphere of the planet, causing its strong disturbances (hurricanes, tornadoes). In order for any body to leave the planet, it must have a speed equal to the first cosmic (about 7.8 km/s), and the heated air molecules do not reach this speed, so they will forever remain in captivity of Earth's gravity. However, in nature there is nothing permanent, and the climate is no exception. In the history of the Earth there were periods of both warming and cooling.

It is not the fact of global warming itself that causes the alarm, but its rapid growth caused by the activities of mankind. The effects of global warming are stronger and come faster than scientists had expected 10 years ago. And as the situation worsens, the risk that these changes will become irreversible increases. It is very likely that the warming process is becoming a chain reaction. The greenhouse effect causes air heating, which contributes to the melting of the ice cover of the Arctic and Antarctic regions, as a result, the area of light reflection by glaciers decreases, the amount of heat that remains on the planet increases the additional heat leads to a new melting of the ice cover, etc. [30].

If this is so, then earthlings have cause for alarm, because in a similar way, only in the reverse order, the “ice age” began.

And as you know, chain reactions are accelerated without limits to catastrophic speeds. Examples - natural radioactive decay, acquiring a chain mechanism, turns into a nuclear explosion; gas burning turns into an explosion when gas is mixed with air.

Methods of dealing with warming.

If humanity was able to upset the balance in the Earth’s climate, and realized how this is done,

then we are therefore able to correct our mistakes. Since global warming, methods must be global. While we are at the stage of discussion of possible methods of struggle, since we have not yet reached the unity of all countries on this issue. The Paris Carbon Reduction Agreement does not apply. And although some advanced countries are making efforts in this direction, this is clearly not enough.

The main proposed control methods can be divided into four groups:

1. Limitation of energy consumption by the population of the Earth, by reducing the need for comfort, flying on planes, meat consumption, economical farming.
2. Limiting greenhouse gas emissions by switching to alternative energy sources, since it is the burning of fossil fuels, and energy is the largest source of carbon dioxide emissions.
3. Extraction of excess CO_2 from the air by its absorption by plants or industrial processing from emission sources.
4. The creation of "umbrellas" above the Earth, obscuring part of the sunlight.

Let's consider in more detail.

1. Indeed, part of the Earth's population has reached a standard of living, suggesting an almost unlimited consumption of the planet's resources. And thanks to scientific and technological progress and the globalization of the economy, new countries are joining the “consumption community”. People want to live better, more comfortable, more interesting. Therefore, it is too early to hope that in the near future the majority of people willing to limit their needs will appear. At the same time, thanks to information globalization, the ideas of limiting needs and protecting nature are gaining more and more supporters.
2. The idea of switching to alternative energy sources is one of the most realistic ideas, and is being realized in reality thanks to the support of governments around the world. So far, apart from nuclear energy, neither wind nor solar energy have a significant impact on reducing emissions. Affected by low concentration and instability of energy sources, but the dynamics of the development of solar power plants inspire optimism.
3. The absorption of carbon dioxide by plants is the most natural way to extract it from the air. However, deforestation, fires, the onset of deserts, inhibit these processes. Of course, the planting of hundreds of millions of trees can positively affect the exchange of CO_2, but then, after several decades, these trees will die, rot or burn, and return some of the carbon dioxide to the atmosphere. Industrial plants for the extraction of carbon dioxide from flue gases in thermal power plants exist long.

However, the carbon dioxide obtained is expensive, the technology is energy intensive and it is used in industry (it practically returns to the atmosphere). The idea of injecting carbon dioxide into storage seems utopian, because it is expensive and does not solve the problem, but only puts off.

4. The idea of partially hiding from the sun's rays finds many supporters among inventors. They propose to create a real "umbrella" in space, which will cast a shadow on the Earth. Spray aerosol from dust particles or ice crystals in the atmosphere.

Such ideas belong to the field of geoengineering, it is difficult to assess their effect on the balance in nature, so this is more of a fantasy than reality [31]. For example: a space umbrella should be located hundreds of kilometers away, so its size should be huge. And still, the shadow from it will be completely blurred due to the phenomenon of diffraction (rounding by light). As for cloud shadowing of aerosols, such cases were observed during large volcanic eruptions. Then it really became cooler, but at the same time, due to lack of light, crop yields decreased.

The problem is being studied by scientists around the world [32]. Huge arrays of information have been accumulated. Part of the information through the media is broadcast by journalists in a simplified or sensational form [33]. A “public awareness” of the problem is being formed, which begins to dominate, influencing the direction of research through financing science, in the direction of the fashion trend.

Is there such a thing on global warming? And will it not turn out that we have worked out a “false goal” for a long time, engaged in the fight against carbon dioxide. What if a multi-year campaign to plant billions of trees is a waste of valuable time.

The inventors have such a method - mentally increase or decrease the object to a value convenient for analysis. Let's try to imagine life on Earth as an ordinary person. For a long time, a person lived ascetic, content with satisfying the natural needs for food, clothing. But then technological progress came and people began to eat a lot and tasty, to dress warmly and fashionably. Just there was a shortness of breath, and it became hot. It would be necessary to limit oneself in nutrition and remove a warm coat. But - habit, prestige, they do not allow this to be done.

Then the search for a solution to the problem begins. The reasoning is as follows: - since we wore the analogue of a fur coat - animal skins before, and it wasn’t so hot, it was not the fur coat that was to blame, but the synthetic shirt, which appeared recently. It is

impossible to do without a fur coat - you will freeze in winter. Let's look for synthetic materials for shirts. While there is a search in this direction, a person loses health from overheating and overeating. Such a crude reception makes it possible to look at the problem in the usual categories.

So, overeating - (uncontrolled consumption) leads to diseases - (environmental pollution), and also contributes to overheating from excess calories consumed with food - (emissions of heat and greenhouse gases by industry). It becomes obvious that if human life style is not changed, (which is very difficult to do), you must either reduce the influx of heat, (shield yourself from the sun) or increase it from the water, (remove the fur coat).

Alternative program

The project proposed by the author, tentatively called "Reflection of the Planet", is based on the well-known idea - to reflect part of the sunlight back into space by artificially increasing the Earth's albedo. The name of the project, chosen by the author, in translation into English has a double meaning: - reflection (reflection) and reflexion (reflection, reflection, reflection). Thus, the awareness by mankind of responsibility for the fate of the planet is emphasized.

The essence of the project is to place mirror reflectors of sunlight in the middle and low (close to the equator) latitudes. Reflectors can be installed in areas not suitable for plant growth (deserts, plateaus, etc.).

Reflective surfaces are either horizontally or obliquely to the sunny side. The optimal angle of inclination is close to the latitude of the terrain. In addition, it is envisaged to introduce a norm in construction - to paint in white or silver colors flat and inclined to the south (in the northern hemisphere), or to the north (in the southern hemisphere) of the roofs of houses and industrial buildings. The development of the project could be the creation of offshore platforms with mirror decks.

Such a project has several advantages:

1. The placement of reflectors at low latitudes can compensate for the loss of ice area in the Arctic latitudes several times larger scales, since in the polar regions the sun shines at a large slope, and therefore, the reflected energy density is lower. Closer to the equator, the sun shines almost vertically and gives maximum energy input. Relatively speaking, if snow lay on the equator, then it would reflect 2 times more energy than the same snow near the pole. This means that the loss of Arctic ice can be compensated by a half-reflector.

2. For the implementation of the project there is an inexpensive and effective material - polished aluminum foil or foil-coated polymer films. The reflection coefficient of the foil reaches 95-97%, which is comparable with silver mirrors. Foil covered with transparent glass will be protected from dust and moisture for a long time. The foil applied to fiberglass can be spread on the southern slopes of the mountains, and after serving its time, go to restore the coating.
3. Any person will be able to take part in the implementation of the project. Nothing will stop me from painting the roof of the house white or putting several sheets of glass with glued foil on the roof of the garage, or in extreme cases, putting an old mirror on a doghouse. Perhaps a sense of ownership in a common cause can unite people in a desire to preserve nature on Earth.
4. Aluminum mirrors can be installed on panels that can later be used to install solar panels.
5. Reflecting roofs of houses will prevent their heating and will reduce the energy consumption for air conditioning.
6. The project will not cause resistance from industrialists, since it does not require restructuring of industry and fundamental technical innovations, and if funding is available, it can create new jobs and make a profit.
7. It is difficult to imagine what objections eco-activists can raise against this project. Indeed, in fact, it's just a big world game with "sunny bunnies".

Implementation of the project will allow you to get the fastest effect due to the effect not on indirect factors (to reduce CO_2 emissions, which affect the greenhouse effect, which allows the planet to cool down), but on the direct factor (to reduce the energy input from the Sun). Compared to other projects that require a lot of time to implement and get a positive effect, such as planting trees (plant trees, grow them, support growth, wait until they absorb carbon dioxide), the installed reflectors will start working immediately and practically do not require maintenance. The ability to immediately receive a proportional, predicted effect, which directly depends on the area of the installed reflectors, will remove the deadline for humanity in connection with the threat of global warming. In the meantime, humanity will have the opportunity to achieve the introduction of "clean technologies" in a natural way by developing scientific and technological progress.

On the impact on the climate.

Like the global projects listed above, the Reflection of the Planet project can be called geoengineering, so it is difficult to predict the consequences of its implementation. In

this sense, in the presence of critical adverse effects, reflectors can be easily dismantled and removed.

Consider one of the scenarios. Suppose reflector fields (like solar panels) are set in a hot desert and on a cold plateau. In both cases, a local location will be created with a lower surface temperature. But, if in a hot desert this will provide an opportunity for comfort for animals and plants, then on a cold plateau it will become even colder. In both cases, the temperature difference will cause a daytime wind., Which contributes to the mixing of air. Such a phenomenon can be observed in the summer on the beach, when on a sunny day a small shadow from the cloud passes, which is accompanied by a light breeze.

If it's really bold to fantasize, then by placing reflecting platforms in places of origin of tropical cyclones, we can mitigate this danger.

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Figure 1. Scheme of the „Hot box”

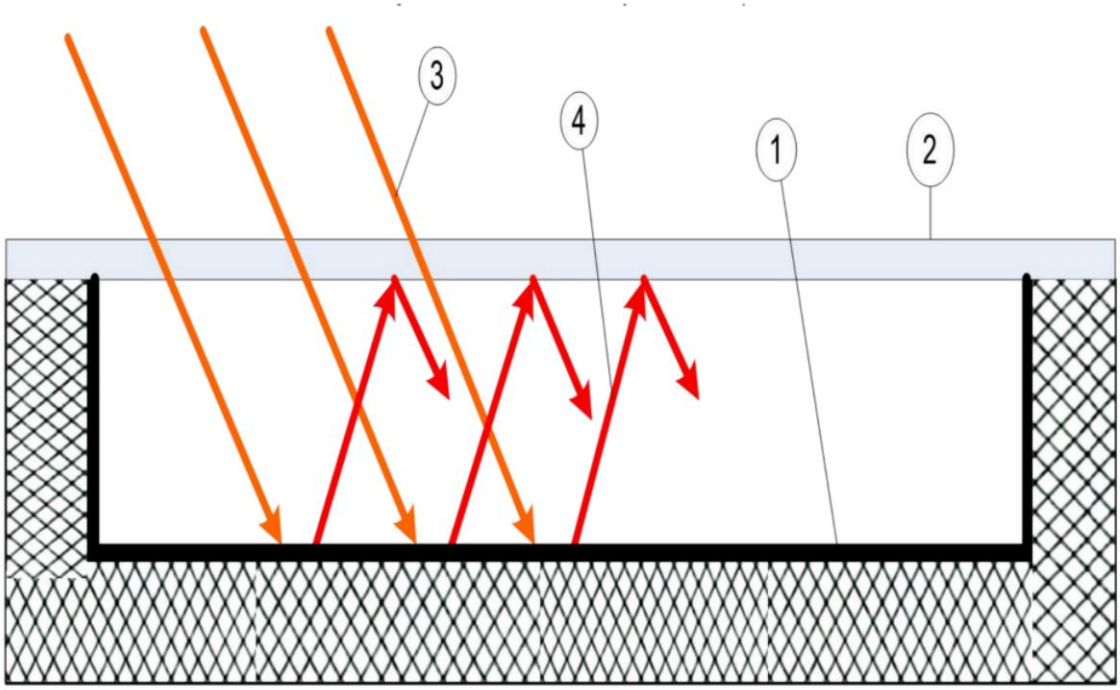
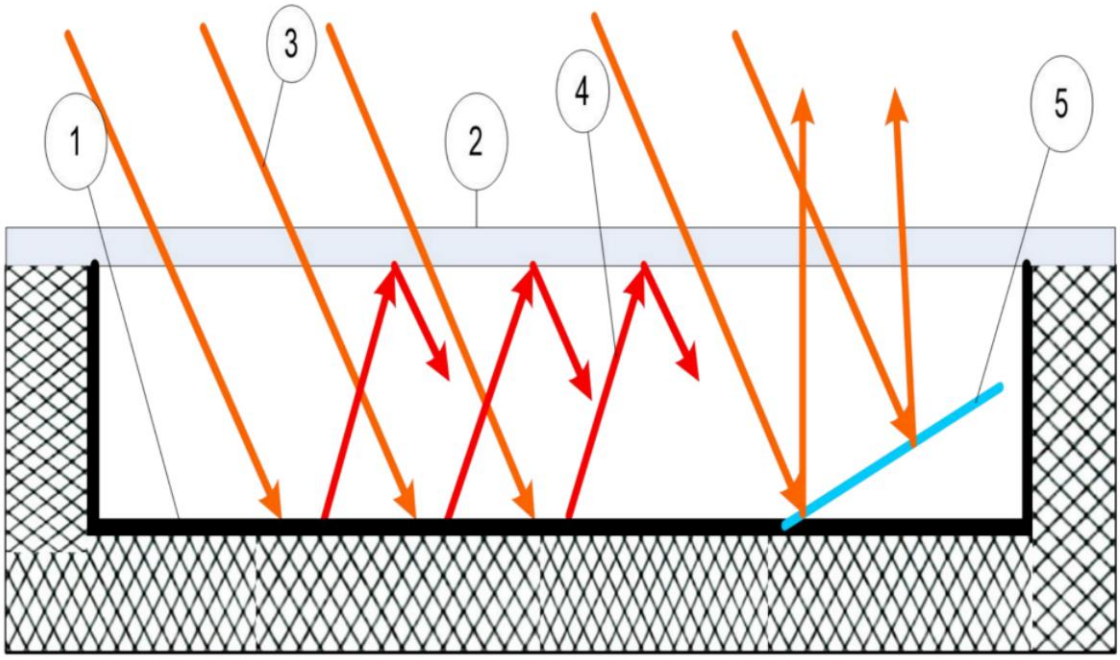


Figure 2. Scheme of the „Hot box” with a reflector



1 - black surface (surface of the Earth); 2- glass (greenhouse gases in the atmosphere); 3 - sun rays; 4 - thermal radiation of the Earth; 5- reflector on the surface of the Earth