

# Technologies for Reducing Greenhouse Gases

E. M. Ozdamirova<sup>1</sup> and D. S. Chankaeva<sup>2</sup>

<sup>1</sup>Kadyrov Chechen State University, 32 Sheripova Street, Grozny, Russia

<sup>2</sup>Grozny State Oil Technical University named after M.D. Millionshchikov, Grozny, Russia

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**Abstract:** Of all the problems facing humanity, climate change is the most important, especially since the rate of its change is increasing and, according to experts, the climate situation will worsen. Climate change is inextricably linked to the degradation of the Earth's biosphere. The article discusses technologies for reducing greenhouse gases. Greenhouse gases are the collective name for a number of gases that can trap the planet's thermal radiation. In the visible range, they remain transparent, while absorbing the infrared spectrum. There is no definite formula for greenhouse gases. Some links between the energy sector and the rest of the economy are taken into account. Like capital or labor, energy enters production functions in industrial sectors directly as an end product and indirectly as a raw material.

## 1 INTRODUCTION

The problem of climate change and the danger of global and regional impact has become one of the most actively discussed topics in the world. However, due to the novelty and unusual nature of the problem, even ecologists find it difficult to understand all its details. In addition, the sensationalism of many newspaper publications and the linkage of the Kyoto Protocol to various political issues, alas, do not help to understand the essence of the problem.

The earth's atmosphere has the ability to let the sun's rays through, while retaining thermal radiation from the surface. The result is heat accumulation. The accumulation of gases and other emissions in the atmosphere exacerbates this process, triggering the greenhouse effect mechanism.

This global problem has existed for a long time. But with the development of technologies that increase emissions into the atmosphere, with an increase in the number of cars and a general deterioration in the environment, it is becoming increasingly relevant. According to statistics, the average temperature of the planet has increased by 0.74° over the past century alone. At first glance, this seems like quite a bit. But even such an increase has already led to irreversible climate change (Korobova, 2020).

Who discovered the mechanism of the greenhouse effect? For the first time this definition was used in

1827 by J. Fourier. On this topic, he even wrote a voluminous article in which he considered various schemes for the formation of the earth's climate. It was Fourier who first put forward and confirmed the idea that the optical properties of the earth's atmosphere are similar to those of glass.

Later, the Swedish physicist Arrhenius, while studying the infrared properties of water vapor and carbon dioxide, put forward the theory that their accumulation in the atmosphere can cause an increase in the temperature of the entire planet. Subsequently, on the basis of these studies, the concept of the greenhouse effect arose.

## 2 MATERIALS AND METHODS

Greenhouse gases are the collective name for a number of gases that can trap the planet's thermal radiation. In the visible range, they remain transparent, while absorbing the infrared spectrum. There is no definite formula for greenhouse gases. Their percentage may change constantly. So what are greenhouse gases?

The main greenhouse gases are:

1. Carbon dioxide. The longest living in the atmosphere, as a result of this, its constant accumulation occurs;

2. Methane. Due to a number of properties, it has a stronger activity. According to Wikipedia, its level in the atmosphere has increased by more than 150 times since 1750;
3. Nitrous oxide;
4. Perfluorocarbons - PFCs (Perfluorocarbons - PFCs);
5. Hydrofluorocarbons (HFCs);
6. Sulfur hexafluoride (SF6).

Greenhouse gases lead to significant climate changes, by their nature, the sources of their formation can be divided into 2 large groups:

**Man-made.** They are the main cause of the greenhouse effect. These include various types of industry that use the combustion of hydrocarbon fuels, the development of oil fields, emissions from automobile engines.

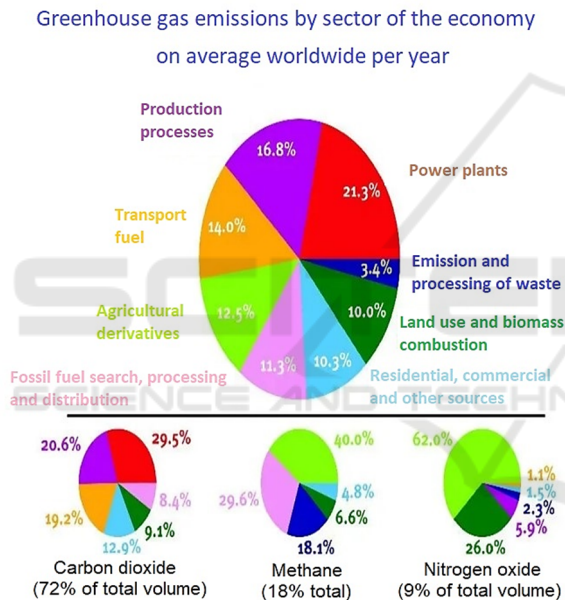


Figure 1: Greenhouse gas emissions by sectors of the economy on average throughout the world per year.

**Natural.** They play a secondary role. Most of the natural greenhouse gases enter the atmosphere during volcanic eruptions. Also in this group can be attributed evaporation of the oceans and large forest fires.

The main reason for the development of the greenhouse effect on Earth are gases accumulating in the atmosphere. Exceeding their concentration leads to a change in the heat balance.

Additionally, the ozone layer can also be involved in this process. Under the influence of freon and nitrogen oxides, which are also included in the list of greenhouse gases, it begins to rapidly break

down and become thinner. As a result, the level of hard ultraviolet radiation increases dramatically. Thus, the greenhouse effect and the destruction of the ozone layer are a chain of interrelated events that have a significant impact on the biogeocenosis of the entire planet (Temnov, 1987).

The main causes of the greenhouse effect include:

The rapid growth of industry using oil, gas and other fossil hydrocarbons as energy sources. They account for about half of all gas emissions.

Mass destruction of forests. In the process of photosynthesis, trees absorb carbon dioxide and produce oxygen, forests are the "lungs of the planet", their destruction is fraught with a sharp increase in the amount of carbon dioxide in the atmosphere.

Development of agriculture. As a result of the decay of animal waste products, a large amount of methane is produced, which is one of the most aggressive greenhouse gases.

In addition to human activities, natural causes can also contribute to the enhancement of the greenhouse effect. For example, large volcanic eruptions or mass burning of forests. An increase in temperature on the Earth's surface as a result of the thinning of the ozone layer leads to increased evaporation of moisture, which also aggravates the situation. The relationship between the greenhouse effect and the ozone layer has long been proven. An increase in the concentration of water vapor in the atmosphere is a fundamental factor in the development of the problem (Temnov, 2000).

Depending on the development scenarios, the technological foundation of the global economy needs to be fundamentally upgraded.

Below is a brief overview of recent research on technological progress in key economic sectors.

Unfortunately, Russia lags far behind most developed countries in terms of energy efficiency and energy conservation. We have a huge potential to reduce greenhouse gas emissions, which is a relatively low-cost potential.

On the one hand, we must do it resolutely - reducing emissions, because without that - the President and the Administration will not be able to achieve accelerated economic growth, economic restructuring and doubling of GDP without improving the energy efficiency of the Russian economy.

Energy supply will continue to be dominated by fossil fuels and traditional combustion technologies.

Improvements can be achieved by increasing the efficiency of power plants, co-firing coal and biomass, adding biogas to natural gas, replacing coal fuel with natural gas, and more.

The following technologies are considered the most promising:

gas technology. Units based on a steam-gas combined cycle (natural gas combined "cycle, NGCC) or CCGT" GTU.

Use the gases produced during the combustion of fuel

Used to generate steam to drive steam turbines to generate electricity. Efficiency can be increased by as much as 60% by increasing flame temperature and steam pressure, as well as more complex steam cycles. Main problems: high temperature materials, efficient cooling system (Schreiber, 1977).

### 3 RESULTS AND DISCUSSION

New corner technologies include steam parameters for supercritical and ultra-supercritical (SSC) circulating boiling technologies (up to 700°C and 37.5 MPa).

layer and efficiency over 50%.

Pre-gasification plants for various types of solid hydrocarbon fuels (to produce synthesis gas consisting of a mixture of hydrogen and carbon monoxide), as well as conversion cycles similar to CCGT "GTU" (yield up to 50%) can also have an effect.

The problem with new materials that can work at such temperatures and pressures.

The low-temperature swirling combustion technology (LBT) is based on the aerodynamics of the flow in the furnace - most of the fuel enters the bottom of the furnace, and the air goes up.

The use of energy and heat pumps further increases efficiency through the use of low temperature thermal energy.

Micro and micro cogeneration. The modern way of life of the population requires the effective use of semi-autonomous decentralized power supply systems based on micro and micro power plants / CHP.

Their power ranges from a few kilowatts (for small kitchen appliances such as refrigerators) to multi-megawatt appliances for entire villages or industrial sites. The calorific value can reach tens and even hundreds of kilojoules per hour, and the overall efficiency can exceed 75% (Egamov, 2015).

### 4 CONCLUSIONS

Energy is a crucial economic input circulating in most economies, widely utilized as a production factor and consumed in different forms by households. Due to inter-sectoral linkages and the wide impact of energy-related policies on the remaining sectors and all economic agents, general equilibrium modelling is an appropriate tool to assess energy and environmental policy scenario.

Several linkages between energy sector and the rest of economy are taken into consideration. Similarly to capital or labor, energy enters production functions in industrial sectors directly as a final product and indirectly as a raw materials. In case of households, energy consumption enters utility function through housing and transport services. Produced electricity is supplied only to a single sector (electricity distribution) because nobody except this single sector should buy electricity directly from producers. Future modification of the model should takes into account consider to implement bottom-up part for heating sector, international trade, unemployment, more disaggregated sectors representation, prosumer energy, motor fuels black market, distinguish between capital stock and land in natural resources sectors, sectoral emission coefficients (Porfiriev, 2010).

It is estimated that in European countries, about 95% of households use personal heating system.

there are various ways to solve the problem of the greenhouse effect. The main thing is that the struggle should be conducted at the international level. To correct the current situation, the efforts of all mankind are needed. Gas emissions are a global problem, it concerns the entire planet as a whole, and not individual countries.

In general, Russia has a huge and still unused reserve for reducing the carbon footprint of products due to existing protective and other categories of forests on agricultural land. Forests located on agricultural land are of great importance for the absorption of greenhouse gases (Porfiriev, 2010).

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