Achieving renewable energy goals through the utilization of renewable resources

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Abstract. This article examines the important role of renewable natural resources to ensure the sustainable economic development of the CIS member states. A new stage is taking place in the cooperation of the Commonwealth States in using renewable clean energy in the light of the adoption of the Priority Plan to implement the Concept for Cooperation of the CIS Member States by using the Renewable Energy Sources in 2021-2022. In this article, special attention is paid to renewable energy sources, as well as the prospects for the development of hydrogen markets. In addition, long-term scenarios for development of low-carbon energy based on renewable energy sources for states are proposed.

1 Introduction

All countries of the world to one degree or another suffer from global and local environmental problems. They are solved by supranational institutions such as the UN and its subordinate structures, national governments, non-profit organizations, as well as private companies [13].

The issues of global sustainable development are attracting more and more attention of the world community and international organizations, they are recorded in the documents of the OECD, IMF, World Bank, WTO and in the reports of corporations. [14]

At present, fossil fuels are the main source of energy. However, most countries of the world are aimed at increasing usage of renewable energy sources to improve their energy and environmental safety and fulfill their obligations under the Paris Agreement [1]. Researches show that the transition to renewable energy significantly reduces the negative impact on the climate [2]. The demand for renewable energy and green hydrogen will continue to grow in order to achieve carbon neutrality and the development of renewable energy. The geopolitical and energy crises caused by the COVID-19 epidemic have highlighted concentration risks of fossil resources and technologies that have led to creation of more secure trade links in the energy sector. This has brought a new impetus to diversify and search for alternative energy sources.

Within the framework of the CIS, countries cooperate to use renewable resources through the mechanisms of multilateral and bilateral cooperation that have been worked out.

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earlier. The countries of this region attach high importance to the transition to “green” growth and the achievement of climate goals. This is due to both external factors, such as strict compliance with the requirements of carbon regulation in the world markets and the requirements of foreign investors for national projects, as well as internal problems that countries have already faced, such as acid rain and droughts in Central Asia caused by negative anthropogenic impact on the environment and climate. The priorities of the States parties in this matter are similar.

The rising costs of hydrocarbons over the next two years have stressed the need for international cooperation in improving energy efficiency and the transition to new and renewable energy. The CIS member states actively cooperate in the nuclear energy engineering and the use of renewable energy sources, technologically improve motor fuel and create conditions for the production of related equipment. In addition, they cooperate in using natural resources, the development of forestry and environmental protection, which significantly reduces the negative impact on the climate [3]. As a part of this cooperation, various events are held to exchange experience and share the best practices in the field of renewable energy, energy efficiency and waste management, as well as equipment exhibitions of leading manufacturers from the CIS countries [4].

Despite the economic difficulties associated with the pandemic and sanctions, the cooperation with the CIS countries in the green economy continues to develop in 2021-2022. As for the trade turnover, there is a noticeable increase in mutual interest in the integrated and rational use of natural resources [5]. The trade volume with the CIS countries has increased by 30% to USD 96 billion in 2021 that made it possible to replace a part of the lost trade volumes with the traditional partners. In the first half of 2022, an additional 7% growth was recorded with a total turnover of USD 46 billion [6].

2 Materials and methods

The research materials contain the results identified under the published reports and analytical materials of international organizations, specialized analytical publications, data from foreign and Russian news agencies, as well as interviews and articles by leading analysts and experts.

The following research methods were used in the work:

- Comparative approach.
- Classification.
- General conclusion.
- Semantic and statistical analysis.

3 Results and Discussion

For the period from January 1, 2010 to January 1, 2023, the installed generating capacity of renewable energy facilities in the CIS countries increased by more than 26000 MW and amounts to 77867 MW, including hydropower. Particularly significant growth was recorded in solar and wind energy, the installed capacity of wind farms in the CIS countries grew from 15 MW to 3610 MW, and the installed capacity of solar energy increased from 5 MW to 4477 MW. Some countries have already established scientific, technical and technological platforms to develop renewable energy and are taking measures to transform their energy systems to integrate a high proportion of wind and solar generation. The planned indicators for the development of wind and solar generation in the participating countries for the coming decades range from 6 to 50% of the annual output of national
energy systems. This raises questions about the sufficiency of renewable energy to achieve these goals.

In the sustainable development scenario, the reduction in energy consumption can be achieved by reducing coal use and increasing the nuclear energy consumption, renewable energy and hydrogen (Figure 1). Regardless of the scenario, the key factor of decarbonization will be the widespread use of renewable energy generation while carbon capture and storage technologies (for coal, gas generation and bioenergy) will be an additional solution that will lead to noticeable results only after 2040. Among all types of renewable energy, the largest growth is expected in hydropower, followed by solar, wind and bioenergy. Hydropower is already playing a significant role in the energy balance of the CIS member states, thanks to the large hydropower plants in Russia. At the same time, other alternative energy sources will grow rapidly, but starting from a very low level. Therefore, in the next ten years, the share in the energy balance will not exceed a few tenths of a percent.

![Key challenges in the energy sector of the world and CIS countries until 2050](image)

**Fig. 1.** Installed RES power plant capacity in CIS by energy sources (technologies), MW.

CO\(_2\) emissions in the CIS countries are rising simultaneously with the economic growth. After 2010, most countries returned to high emissions, as they did in 1990. However, the emissions level varies from country to country: The highest level of emission has Kazakhstan, Russia and Turkmenistan while Armenia, Georgia, Kyrgyzstan and Tajikistan have relatively low CO\(_2\) emissions [7-8].

One of the main obstacles to reducing CO\(_2\) emissions and transitioning to new energy generation technologies in developing countries is the relationship of these indicators to the economic growth (GDP). Empirical studies across countries show that, other things being equal, a 1% reduction in GDP per capita corresponds on average to a 1% reduction in CO\(_2\) emissions per capita [9]. This phenomenon also occurs in some CIS countries [10]. Figure 2 shows that in the new policy and sustainable development scenarios, the carbon intensity of the GDP of the CIS member states may decrease.

All scenarios for the development of the CIS member states suggest reducing the direct dependence between the dynamics of CO\(_2\) emissions and economic growth. In the basic scenario, this gap will not be very noticeable, but it will be significant in the other two scenarios. It will require a major restructuring of the economy to overcome this dependency that is typical for developing countries.
At the moment, the share of renewable energy sources (RES) in the energy balance of the CIS countries and the entire Commonwealth remains extremely low. However, all CIS member states have adopted state support programs for renewable energy sources and interaction in this area is regulated by relevant concepts and plans. Joint research programs, development and technology transfer can significantly contribute to the achievement of the stated goals. The Interstate Council for Cooperation in Science, Technology and Innovation plays an important role in this process [11].

It is extremely important to continue cooperation in scientific research and development between the CIS member states to create a common technological base for the future. For this purpose, since 2022, multilateral scientific projects have been implemented in priority areas of the fundamental research. The list of these projects was approved by the CIS Council of Heads of Government in May 2022 and included seven projects related to environmental management, environmental protection, the study of climate change and the creation of new solutions for using fossil fuels and water resources. Besides, one project is devoted to energy, including nuclear, alternative and renewable energy, as well as mechanical engineering and instrumentation, which aimed at developing new technologies to extract uranium from ores. Existing research and development in these areas presents the potential for collaboration on a wide range of tasks related to the green growth. This might lead to new technological solutions protected by intellectual property rights in the CIS countries, which in the future may reduce dependence on imports of equipment for green growth from the third countries.

However, it is necessary to overcome a number of technical, financial and other obstacles for the large-scale introduction of generation facilities based on renewable energy sources (RES) in the energy system. For example, when the share of renewable energy sources with intermittent production, such as solar and wind energy, exceeds threshold of 15%, basic restructuring of the energy system and the introduction of new tools to maintain the reliability of energy supply will be required. Errors in RES reservation can lead to serious losses. It is necessary first of all to strengthen interconnections and increase the flexible reservation share in the power system in order to avoid possible damage related to an increase of renewable energy with the production method that is incompatible with the reliable operation of the power grid. However, it will require significant costs to create an appropriate infrastructure in the energy and gas transportation systems, as well as for its maintenance due to additional fuel consumption. But the economic benefit from reducing
the potential damage to consumers makes it possible to justify the strategy and scope of introducing renewable energy and optimization of gas supply in the electric power industry.

4 Conclusion

In conclusion, it should be noted that the cooperation of the CIS member states in using renewable energy sources and combat climate change is intensifying. Despite the creation of institutional mechanisms and large projects in the low-carbon energy, the potential for interaction in this area has not yet been fully realized. Further development can be provided by medium and small companies producing equipment for renewable energy and providing services in the energy sector and housing - communal services, both in the domestic market of the CIS member states and internationally. To support joint "green" projects of the CIS, which have a high economic and integration potential, concessional financing mechanisms are needed, and potential investors need special guidelines that will help in administrative procedures and legal regulation.

There is surplus generating capacity in the CIS member states, for example at the Belarusian nuclear power plant, which can be used to produce low-carbon "orange" hydrogen. The inclusion of hydrogen in the CIS economy, especially in the transport sector, will require cooperation in the creation of hydrogen and hybrid engines and infrastructure to refuel vehicles. Some of these technologies have already been developed in the past.

It is important that cooperation within the CIS covers all the stages of technology creation - from research and development to their implementation and transfer. It is expedient to establish national planning institutions for future energy and advanced research centers in the Commonwealth to ensure effective cooperation. Such institutes can carry out tasks to prepare and publish annual reviews of the main technical and economic indicators of power plants using renewable and alternative energy sources.

As a part of cooperation in education, exchange programs for students, schoolchildren and teachers aimed at training about environmental growth and sustainable development can be established. As an example of interaction in this area, one can cite the international project "Power of the Mind", implemented by the Ministry of Education of Russia in the CIS countries. Also, in order to promote environmental issues, cooperation programs between companies and additional educational institutions can be organized, offered in the format of full-time, distance or blended learning.

It is proposed to consider the following measures to develop renewable energy in the CIS member states for long-term planning:

- Working out of short-term and medium-term plans and programs to develop the energy sector, taking into account the dynamics of development and the cost of new renewable and clean energy technologies.
- Establishing a unified methodology to assess the renewable energy potential in the CIS member states, as well as the fuel and environmental effects of these potentials and developing recommendations for uniform information requirements.
- Coordinating modernization of energy systems using generation based on renewable and new energy sources.
- Implementing agreed measures to compensate fluctuations in variable renewable energy sources, including increasing the flexible capacities and improving the gas transmission system.

Achieving sustainable economic development on a global scale will require wise use of resources, technology, economic incentives and strategic policy planning at the local and national levels[15].
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