MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Journal of Energy and Environmental Sciences

Impact of Renewable Energy Sources on Climate Change

Penjiyev AM*

Professor, Turkmen State Institute of Architecture and Civil Engineering, Turkmenistan

***Corresponding author:** Penjiyev Ahmet Myradowich, Professor, Institute of Architecture and Civil Engineering, Ashgabat, Turkmenistan, Tel: +99365801754; Email: ampenjiyev@gmail.com

Review Article
Volume 1 Issue 1
Received Date: October 04, 2023
Published Date: November 14, 2023
DOI: 10.23880/jeesc-16000102

Abstract

Based on the analytical analysis of the eco-energy resource potentials of renewable energy sources and climate change, the potential for mitigation and costs, the strategy of Turkmenistan on climate change, energy demand and the greenhouse effect, options for reducing emissions, a heterogeneous class of renewable technologies (solar, wind, bioenergy, geothermal and hydropower). Research to date suggests that climate change is not expected to significantly affect the global technical potential for wind energy development, but changes in the regional distribution of wind energy resources can be expected. Climate change is not expected to have a significant impact on the amount or geographic distribution of geothermal or ocean and marine energy resources.

Keywords: Solar; Wind; Geothermal Energy; Climate Change; Renewable Energy; Turkmenistan

Abbreviations: RES: Renewable Energy Sources; LCAs: Life Cycle Assessments; GHG: Greenhouse Gas; CCS: Carbon Capture and Storage; CO_2: Carbon Dioxide; R&D: Research and Development.

Foreword

Renewable energy sources (RES) can be called the main contender for the status of the energy resource of the future, and this is obvious. The uneven distribution of the world's mineral resources, the rapid growth of the planet's population, political conflicts have led most countries to seek energy independence. This can partly be achieved just through the production of electricity based on renewable energy sources. At the same time, there is an acute issue of reducing the negative impact on the environment and, in particular, minimizing greenhouse gas emissions into the atmosphere, leading to the greenhouse effect.

For example, Life Cycle Assessments (LCAs) of electricity generation show that greenhouse gas (GHG) emissions from renewable energy technologies are generally significantly lower than emissions associated with the use of fossil fuels and, under certain conditions, lower than emissions from fossil fuels with using carbon capture and storage (CCS). Averages for all RES range from 4 to 46 gCO2e/kWh, while averages for fossil fuels range from 469 to 1001 gCO2e/kWh (excluding emissions from land-use change). And this is another advantage of RES, because there are no greenhouse gas emissions in the process of generating electricity and heat [1 - 5] .

The rapid development of energy based on renewable energy is expressed in the improvement of existing technologies and the reduction of capital costs and the cost of electricity generated, and this primarily concerns solar and wind energy.

Introduction

Climate change is one of the main challenges of the 21st century. Its most severe consequences can still be avoided if efforts are made to transform current energy systems. Renewable energy sources (RES) have great potential to replace greenhouse gas emissions from the combustion of fossil fuels and thus to mitigate the impacts of climate change [4-7]. When properly implemented, RES can contribute to social and economic development, providing access to energy, ensuring a reliable and sustainable energy supply, and reducing the negative impact of energy supplies on the environment and human health [1-5].

This article RES and Climate provides an unbiased assessment of the scientific literature on the potential role of renewable energy in climate change mitigation for policy makers, the private sector, academic researchers and civil society. Covers six types of renewable energy available in Turkmenistan - bioenergy, direct solar energy, geothermal energy, hydropower, marine energy and wind energy, as well as their integration into current and future energy systems. They address the environmental and social impacts associated with the introduction of such technologies and provide strategies to overcome both technical and non-technical barriers to their adoption and diffusion [4-10].

Mitigation Potential and Costs

A significant increase in the use of renewable energy by 2030, 2050 and beyond is noted in most of the scenarios considered in 2008. The total renewable energy production was about 64 EJ/year (12.9% of the total primary energy supply), more than 30 EJ/year was accounted for by traditional biomass. More than 50% of the scenarios assume a level of renewable energy use in 2050 of more than 173 EJ/year, in some cases reaching levels of more than 400 EJ/year. Considering that the use of traditional biomass is decreasing in most scenarios, the corresponding increase in the level of renewable energy production (excluding traditional biomass) is predicted to be in the order of three to more than ten times.

The share of RES in the global primary energy supply differs significantly in the scenarios. In most of the scenarios, the share of RES is more than 17% of the supply of primary energy in 2030, increasing to more than 27% in 2050. The scenarios with the highest share of renewable energy consumption reach about 43% in 2030 and 77% in 2050 [3-5,11-16].

Strategy of Turkmenistan on Climate Change

Strategy of Turkmenistan on climate change Turkmenistan is taking practical steps in the field of climate change: the introduction of modern technologies in all spheres of the economy reduces greenhouse gas emissions; adopted the National Strategy on Climate Change, the National Strategy for the Development of Renewable Energy until 2030 and the new Law of Turkmenistan "On Renewable Energy Sources"; Millions of trees are planted every year in the country [1,2,4-9,14].

Certain work is underway to fulfill the obligations under the Paris climate agreement. The commitments it proposes are confirmation of the ambitious goal: of Turkmenistan to reduce: greenhouse gas emissions by 2030 in key sectors of the economy. Particular attention in this context is given to reducing methane emissions. In this regard, the Turkmen side welcomes the new initiative on the Global Methane Commitment and expresses interest in its detailed study with a view to possible substantive participation. Turkmenistan plans to achieve in the medium term a zero growth in greenhouse gas emissions starting from 2030, and in the long term - an annual significant reduction. Our country expects to achieve these indicators both at the expense of its own financial resources and with technical and financial support from international organizations and financial institutions.

Energy Demand and the Greenhouse Effect

Energy demand and the greenhouse effect Related services to ensure socio-economic development and improve human well-being and health is growing. All societies need an energy supply to meet basic human needs (eg: lighting, cooking, spatial comfort, movement and communication) and to maintain production processes. Since 1850, the global use of fossil fuels (coal, oil and gas) has increased and dominated the energy supply, resulting in a skyrocketing carbon dioxide (CO_2) emission.

Greenhouse gas (GHG) emissions from energy supply have contributed significantly in the past to increasing atmospheric concentrations of GHGs, thus creating the 'greenhouse effect'. That in the middle of the 20th century, the increase in global average temperature was largely caused by the observed increase in concentrations of anthropogenic greenhouse gases. According to recent data, fossil fuel consumption accounts for the majority of global anthropogenic GHG emissions. Emissions continue to rise and by the end of 2010 CO2 concentrations were over 39% above pre-industrial levels. emission reduction options. RES can help speed up access to energy, especially for the 1.4 billion people without access to electricity and another 1.3 billion people using traditional biomass. Basic levels of access to a modern energy supply can bring significant benefits to a community or household [3-6,15,16].

In many developing countries, decentralized renewable energy networks and the incorporation of renewable energy into centralized grids have expanded and improved access to energy. In addition, non-electric renewable energy technologies also offer opportunities for upgrading energy supply systems, for example, the use of solar energy for heating water and drying agricultural products, biofuels for transportation, biogas and modern biomass for heating, cooling, cooking and lighting, and wind for pumping water. The number of people without access to a modern energy supply is expected to remain unchanged until appropriate domestic policies are implemented, which, if necessary, can be supported or supplemented by international assistance.

There are many options for reducing GHG emissions from the energy system while meeting global demand for energy supply. Some of the options are, for example, energy conservation and energy efficiency, moving away from fossil fuels, renewable energy, nuclear power and carbon capture and storage (CCS). A comprehensive assessment of a portfolio of mitigation options would include an assessment of their respective mitigation potential, as well as their contribution to sustainable development and any associated risks and costs. This article focuses on a review of scientific papers on the application of renewable energy technologies that can play a role in climate mitigation and sustainable development [4-9].

Turkmenistan has great resource potential for climate change mitigation, and RES can provide broad benefits. When properly implemented, renewable energy technologies contribute to social and economic development, access to energy, security of energy supply, as well as reduce negative impacts on the environment and human health. In most cases, increasing the share of renewables in the energy mix will require policies to stimulate changes in the energy system. In recent years, the use of renewable energy technologies in the world has increased dramatically, and according to forecasts, their share will increase significantly in the most ambitious scenarios of international mitigation projects. More political action will be needed to increase the necessary investment in technology and infrastructure.

Heterogeneous Class of Renewable Technologies

RES constitutes a heterogeneous class of technologies: direct solar energy transformations use the energy of solar radiation to produce electricity using photovoltaic cells and concentrate solar energy to produce thermal energy (heating or cooling using either passive or active means), to meet the needs for direct lighting and for potential production of fuel that can be used for transport and other purposes.

The degree of development of solar application technologies ranges from research and development (R&D) (eg: solar-derived fuels) to relatively off-the-shelf and off-the-shelf (eg: passive and active solar heating and silicon wafer photovoltaic) technologies.

Many, but not all, technologies are modular in nature, allowing them to be used in both centralized and decentralized energy systems. Solar energy is volatile and somewhat unpredictable; although the time profile of solar power output under some circumstances correlates relatively well with energy demand. Thermal energy storage offers opportunities for improved energy output management for some technologies such as solar energy concentrations and direct solar heating [5-8,11-13].

Wind Power

Wind power uses the kinetic energy of the air flow. The main application relevant to climate change mitigation is the generation of electricity by large wind turbines located on land (land) or in sea or fresh water (coastal). Onshore wind energy technologies are already being produced and applied in large Scales. Offshore wind energy technologies have great potential for continuous technical improvement. Wind-based electricity is variable and, to some extent, unpredictable, but experience and detailed studies in many regions of the world have shown that the integration of wind power does not usually create insurmountable technical barriers [5-8].

Bio-Energy

Bioenergy can be obtained from a variety of biomass feedstock's, including cotton biomass and agricultural waste, as well as animal waste; forest plantations with a short turnover of felling; energy crops; organic component of municipal solid waste and other types of organic waste. Through a variety of processes, this feedstock can be used directly to generate electricity or heat, or it can be used to create gaseous, liquid or solid fuels. The range of bioenergy technologies is wide and the level of their technical development varies considerably. Some examples of commercially available technologies are small and large boilers, domestic heating systems based on granular fuels, and the production of ethanol from sugar and starch.

Advanced biomass integrated gasification combined cycle power plants and lignocellulose-based transport fuels are examples of technologies that are in the pre-commercial stage, while algae-based liquid biofuels and some other bioconversion techniques are in the R&D stage. Bioenergy technologies are finding their way into centralized and decentralized installations, with traditional biomass currently the most widely used in developing countries. Bioenergy typically offers continuous or controlled energy production. Bioenergy projects usually depend on the availability of local and regional fuel supplies, but recent developments show that solid biomass and liquid biofuels are increasingly entering international trade [4-9].

Geothermal Energy

Geothermal Energy uses the available thermal energy from the Earth's interior. Heat is extracted from geothermal reservoirs using boreholes or other means. Reservoirs that are naturally hot enough and permeable are called hydrothermal reservoirs, and reservoirs that are hot enough but enhanced by hydraulic stimulation are called enhanced geothermal systems (AGS). Once on the surface, liquid of various temperatures can be used to generate electricity or more directly in areas where thermal energy is needed, including district heating or the use of lower temperature heat from shallow wells for ground source heat pumps for heating or cooling. Hydrothermal power plants and thermal applications of geothermal energy are technically developed technologies, while UGS projects are in the stages of demonstration and pilot testing, also going through the R&D stage. When geothermal power plants are used to generate electricity, they typically provide a constant output [4-9].

Sea Energy

Sea energy is derived from the potential, kinetic, thermal and chemical energy of sea water, which can be converted to provide electricity, thermal energy drinking or water. A wide range of technologies are possible, such as tidal dams, underwater turbines for tidal and ocean currents, heat exchangers for converting ocean thermal energy, and various devices for harnessing wave energy and salinity gradients. Ocean energy technologies, with the exception of tidal dams, are undergoing demonstration and pilot testing, and many require additional R&D. Some technologies have variable energy output profiles with varying levels of predictability (eg: wave, tide amplitude and current), while other technologies may be capable of near-constant or even controlled operation (eg: ocean thermal energy and salinity gradient). Hydropower uses the energy of water moving from higher to lower levels, mainly to generate electricity. Hydropower projects include dam projects with reservoirs, natural flow projects of rivers and streams, and are carried out continuously at the project scale. This diversity gives hydropower the ability to meet large centralized urban needs as well as decentralized rural needs [5].

Hydropower

Hydropower technologies are developed technologies. Hydropower projects use a resource that changes over time. However, the controlled energy output provided by reservoir hydropower facilities can be used to meet peak electricity demand and help balance renewable energy systems. The operation of hydroelectric reservoirs often reflects their multiple uses, such as drinking water supply, irrigation, flood control and drought control, as well as navigation and power supply.

Will Climate Change Affect Renewable Energy?

Climate change will affect the volume and geographic distribution of the technical potential of RES, but studies on the scale of such possible effects are in their infancy. Due to the fact that renewable energy is largely dependent on climate, global climate change will affect the resource base of renewable energy [5-8,11-13]. Will climate change affect renewable energy? Climate change will affect the volume and geographic distribution of the technical potential of RES, but studies on the scale of such possible effects are in their infancy. Due to the fact that renewable energy is largely dependent on climate, global climate change will affect the resource base of renewable energy.

The future technical potential of bioenergy may be influenced by climate change through impacts on biomass production, such as through changes in soil conditions, rainfall, crop yields and other factors. The overall impact of a global mean temperature change of less than 2°C on bioenergy technical potential is expected to be relatively small on a global basis. However, significant regional differences can be expected, and the uncertainties are larger and more difficult to assess compared to other RES options due to the large number of feedback mechanisms involved.

For solar energy, although climate change is expected to affect the distribution and variability of cloud cover, the impact of these changes on the overall technical potential will be small. For hydropower, the overall impacts on global technical capacity are expected to be slightly positive. However, the results also point to the possibility of significant fluctuations across regions and even across countries. Research to date suggests that climate change is not expected to significantly affect the global technical potential for wind energy development, but changes in the regional distribution of wind energy resources can be expected. Climate change is not expected to have a significant impact on the amount or geographic distribution of geothermal or ocean and marine energy resources [4-8,11-13].

Conclusion

Thus, the use of local renewable energy resources can reduce the need for fossil fuels in some cases by up to 80 percent. Significant energy savings can be achieved by introducing innovative technologies, from primary energy production to final consumption. The task of introducing renewable energy sources is one of the most relevant and promising for the development of the desert territories of Turkmenistan. Its solution will improve the efficiency of the use of fuel, energy and material resources in the production of a wide range of industrial and agricultural products reduce the energy consumption of fossil fuels and mitigate anthropogenic pressures on climate change [3-7,11-16].

References

1. Berdimuhamedov GM (2018) Turkmenistan is on the path to achieving sustainable development goals. Turkmen State Publishing Service, Ashgabat, Turkmenistan, pp: 468.
2. Berdimuhamedov GM (2022) Electric power of Turkmenistan. Turkmen State Publishing Service, Ashgabat, Turkmenistan, pp: 130.
3. Zalikhanov AM (2021) Climate change and energy: influence, forecast and consequences. Journal of environmental protection and energy science pp: 62-68.
4. Penjiyev AM (2012) Climate change and the possibility of reducing anthropogenic loads. Penjiyev AM (Ed.), LAP LAMBERT Academic Publishing, Germany, pp: 164.
5. Penjiyev AM (2023) Eco-energy resources of renewable energy sources: monograph. Moscow, Russia, pp: 400.
6. Penjiyev AM (2014) Renewable energy and ecology (summarization of articles). Alternative energy and ecology 8(148): 45-78.
7. Penjiyev AM (2009) Prospects for alternative energy and its environmental potential in Turkmenistan. Alternative energy and ecology 9(77): 131-139.
8. Penjiyev AM (2012) Platform for strategic partnership in the Central Asian region to mitigate climate change. AM Penjiyev v Alternative energy and ecology 7: 88-94.
9. Penjiyev AM (2012) Consequences of climate change in Central Asia and the possibility of mitigation based on renewable energy sources. Alternative energy and ecology 5-6(102-110): 197-207.
10. Penjiyev AM (2012) Environmental problems of energy and the role of alternative energy sources in the Central Asian region. Alternative energy and ecology 4(108): 101-116.
11. Vissarionov VI, Deryugina GV, Kuznetsova VA, Malinin NK (2008) Solar energy: a textbook for universities. Under general ed. IN AND. Vissarionova. M MPEI Publishing House, Russia, pp: 276.
12. Strebkov DS, Pendzhiev AM, Mamedsakhatov BD (2012) Development of solar energy in Turkmenistan. M GNU VIESKh, Moscow, Russia.
13. Penjiyev AM (2017) Fundamentals of GIS in the development of renewable energy: monograph. LAP LAMBERT Academic Publishing, Germany, pp: 308.
14. Penjiyev AM (2014) Ecological problems of desert development: monograph. LAP LAMBERT Academic Publishing, Germany, pp: 226.
15. Renewable energy sources and mitigation.
16. IPCC Sixth Assessment Report Impacts, Adaptation and Vulnerability Climate change in 2022: impacts, adaptation and vulnerability.