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RESOURCE EFFICIENCY AND ENVIRONMENTAL SUSTAINABILITY IN MODERN INDUSTRIAL DEVELOPMENT

Turabekova Gulirano
A Senior Teacher, Tashkent State Technical University

Abstract
This research examines resource efficiency and environmental sustainability in industrial development, focusing on construction sector analysis and renewable energy implementation. The study analyzes current resource consumption patterns, environmental impacts, and sustainable development strategies through 2024.

Keywords: Modern economy, industry, industrial development, resource, effectiveness, environmental sustainability.

Introduction

Contemporary industrial development necessitates environmental sustainability as a fundamental requirement rather than an option. Resource recycling and reuse in production processes demonstrate both economic efficiency and environmental benefits, addressing critical global challenges.

Literature Review

The current level of resource consumption and environmental degradation represents a significant challenge for industrial systems in the 21st century. Recent research frameworks, including T. Graedel's sustainability model, emphasize maintaining resource utilization below natural regeneration rates. Wei Li's (2005) research expanded this concept by examining both continuous resource management and minimal environmental impact parameters.

According to the 2024 United Nations Environment Programme report, organizations have achieved 85% of their environmental protection targets, including climate change mitigation, disaster prevention, and waste management initiatives.

Methodology

This study employs quantitative analysis of resource consumption patterns and environmental impact assessment in the construction industry, particularly focusing on concrete production facilities.

Results

Among the industrial sectors with the highest consumption of natural resources, the construction industry stands out. Since the main resource-intensive sector in the construction industry is the reinforced concrete segment, a large amount of resources are spent on the

production of primary concrete products. Here is information on the resource consumption required to produce 1 ton of cement, the main raw material of the construction industry:

- Raw materials: 2 tons (limestone and soil)
- Energy consumption: 4 GJ (equivalent to 131 m^3 natural gas)
- CO_2 emissions: 1 ton
- Nitrogen oxide: 3 kg
- Airborne particulates: 0.4 kg
- Non-energy thermal gases: 5% of total emissions

During the production of cement and its structures, structural and non-structural harmful substances are released into the environment.

Sources of non-structural harmful substances:

- various gases emitted from the engine during the transportation of raw materials necessary for the production process: hydrocarbon oxide, nitrogen oxide, hydrocarbon, nitrogen dioxide, sulfur dioxide;

At each stage of the production of cement, industrial dust is released into the environment. Cement dust has an adverse effect on human skin, causes fibrogenic damage to lung tissue. Adverse effects resulting from the alkaline environment of cement dust are accompanied by obstructive changes in the respiratory tract. Studies conducted in the last decade have shown that a high incidence of throat and esophageal cancer has been identified among personnel directly involved in the cement production process in the construction industry.

Also, the active use of energy resources in the production of TBM is a major part of the process, and the quality of the product largely depends on its mixing and drying processes.

Today, the demand for energy resources in the world is increasing by an average of 50% every quarter century. In particular, today each person consumes 2 kW of energy per day (10 kW in the USA). In order for the biosphere to withstand such a volume of energy consumption, we need to reduce pollution by 10 times. Therefore, as a solution to such an urgent problem, it is necessary to turn to renewable energy - "green" and nuclear energy, that is, carbon-free energy. Renewable energy sources, which are considered high-tech, reliable and relatively cheap energy suppliers, by the end of 2016, compared to 2015, provided more than 8.7% of their consumption, i.e. 2006 GW of power.

The majority of greenhouse gas emissions are generated by North America, Europe, China, and industrially developed countries in the Far East. In December 2015, an agreement was signed in Paris, France, to prevent climate change, approved by 195 countries, and entered into force worldwide in November 2016.

Uzbekistan, as a full member of this international agreement, adheres to its terms. As a practical result of fulfilling the conditions specified in the Agreement, in accordance with Appendix No. 1 to the Resolution of the President of the Republic of Uzbekistan No. 4477 of October 4, 2019, as indicated in Article 1 of the Strategy for the Transition of the Republic of Uzbekistan to a “Green” Economy for the Period 2019-2030, the Republic of Uzbekistan ratified the Paris Agreement in 2018 and accepted the obligation to reduce its relative emissions of greenhouse gases per unit of gross domestic product by 10 percent from 2010 levels by 2030, in accordance with the share determined at the national level.

It should be noted that even before Uzbekistan joined the Paris Agreement, legislative documents were developed and adopted aimed at rational use of natural resources, further increasing energy efficiency in the production process, encouraging the use of renewable energy sources, and introducing product reuse. In particular, the Resolution No. PP-3012 "On measures to further increase energy efficiency and renewable energy in economic sectors and the social sphere in 2017-2021", signed by the President of the Republic of Uzbekistan on May 26, 2017, pays great attention to the development and consistent use of renewable energy sources in the national economy, as well as reducing energy intensity in industrial sectors.

The large scale of production and its low energy efficiency are one of the serious obstacles to the sustainable development of the Uzbek economy. At the same time, the average primary energy consumption per capita in Uzbekistan is 5 times lower than in the USA and 2.5 times lower than in Russia.

The development of carbon-neutral energy, solar energy, wind energy, biogas, geothermal energy, as well as nuclear, hydrogen, electrochemical, biofuel and other types of energy has led to the development of renewable energy sources. The development of renewable energy is one of the most striking events in human history after the agricultural and industrial revolutions.

The production of TBM is closely related to the implementation of sustainable development strategies for the construction industry and is relevant for the following important problems:

1. Environmental change;
2. Energy supply and energy security.

In accordance with the decision of the Paris Agreement on the Environment, it is determined to reduce greenhouse gas emissions into the atmosphere, ensuring that the average temperature of the Earth's atmosphere does not increase by more than 1.60 ° C.

The technical potential of renewable energy in Uzbekistan is 179.8 million gtoe per year. The amount of energy produced using alternative renewable energy sources (excluding centralized hydroelectric power plants) is less than 1%. In developed countries, this indicator represents 10% or more of the total volume of energy generation (Iceland - 95%, Denmark - 50%, Germany - 28%).

Both steam and gas turbine technologies are being consistently implemented in Uzbekistan. This allows almost doubling the efficiency of primary energy resources and at the same time reducing fuel consumption in the power system by 30-40%. Uzbekistan has very large reserves of renewable energy. The total volume of renewable energy resources in Uzbekistan (hydro resources, solar, wind, geothermal, biomass) is 170 billion tons of t.o., of which 256 million tons of t.o. are considered economically profitable, and currently only 0.31% has been developed. The solar energy per square meter of the territory of the Republic of Uzbekistan is about 1500 - 1900 kWh / m2, which is approximately equal to 0.22 tons of t.o. (Table 1.5.)

Table 1.5. Forecast data on solar power plants planned to be completed in Uzbekistan by 2030

Solar Stations	Forecast	
	Installed capacity	MW Annual electricity production, GW*h
Guzor	100	226
Pop	100	159
Qibrai	10	22
Sherabad	100	222
Guzor	130	890

There are more than 261 waste collection sites in Uzbekistan, where an average of more than 7 million tons of waste is collected annually. Each ton of waste in fractions has the potential to release 250 m3 of gas, which amounts to 1.5 billion m3 of gas per year. This can be used to generate heat and electricity.

In recent years, the market for CWM in Uzbekistan has undergone significant changes. As a result of scientific research and implementation of projects, the demand for the use of CWM in industrial sectors is increasing. Today, the main participants in the market are LLC "Solar", "Foton", "Intellect-Dialog" and other enterprises.

Conclusion

Uzbekistan, due to its natural climate and geographical location, has all the opportunities to take a leading position in the world in the production and use of CWM. For this purpose, not only foreign investors, but also local investors' capital, internal financing reserves of the authorities, support of entrepreneurs, i.e. public-private sector cooperation, should be organized. It is necessary to develop the legal basis for the reuse of resources by the state, and to improve the legal framework.

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