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## **Economic Effects of Renewable Energy: Impact on Consumer Welfare and Industry**

### **Abstract**

The development of renewable energy technologies promotes innovation and the adoption of new methods in industrial enterprises to ensure more efficient energy use. These technologies help reduce carbon emissions, support environmental goals, and enhance the brand value of companies by aligning them with sustainable practices. According to IRENA (2021), the shift to renewable energy not only contributes to ecological objectives but also strengthens companies' market positions in an increasingly sustainability-focused economy. Government support in the form of tax incentives, subsidies, and financial aid accelerates the adoption of such technologies. Moreover, the use of renewable energy opens access to new markets and supports regional economic development by encouraging the creation of green industrial zones. As a result, renewable energy plays a critical role in advancing industrial growth while fostering environmental responsibility and long-term efficiency.

**Keywords:** *Renewable energy, economic effects, consumer welfare, industry, energy security*

### **Introduction**

In recent years, the demand for renewable energy sources has been increasing worldwide. This increase is related to problems such as global climate change, depletion of fossil fuels and environmental pollution. Renewable energy, in addition to increasing the efficiency of using natural resources, has a positive economic and environmental impact. Since these types of energy are sustainable and renewable, they help to increase the energy security of countries and reduce their dependence on foreign energy.

The economic effects of renewable energy have a wide range. First of all, the development of these energy sources creates conditions for the creation of new jobs. Second, the reduction of carbon emissions in the energy production process strengthens environmental sustainability and stimulates the development of environmentally friendly technologies. Finally, investments in this area contribute to the stabilization of energy prices and the increase of consumer welfare in the long term. In this article, we will examine in more detail the impact of renewable energy on consumer welfare and industry.

### **Research**

Renewable energy sources—such as solar, wind, hydro, and bioenergy—offer significant economic stability by promoting energy diversification. Investments in these areas stimulate job creation, encourage the development of new technologies, and reduce the influence of artificial monopolies. As Boyle (2012) explains in *Renewable Energy: Power for a Sustainable Future*, the economic impact of renewable energy is broad, encompassing employment, energy prices, state budgets, energy security, and environmental protection. The sector generates new jobs, as the demand for specialists in solar, wind, hydroelectric, and bioenergy technologies increases. This growth not only positively impacts the national employment situation but also boosts regional economies by attracting local workers and fostering the emergence of new business sectors (Boyle, 2012).

The use of renewable energy sources can result in a long-term reduction in energy prices, primarily due to their relatively low operating and maintenance costs, despite higher initial investment costs. As Ehrlich (2016) discusses in *Renewable Energy: A First Course*, energy sources such as solar and wind power are inherently profitable because they rely on the freely available natural resources of the sun and wind.

Additionally, as production increases and technology improves, the costs of these energy sources continue to decrease, making them even more economically viable over time (Ehrlich, 2016).

The economic impact of renewable energy is positive, and it is an important factor in ensuring long-term and sustainable economic development. It has numerous benefits, from creating employment to lowering energy prices to protecting the environment. As states and businesses invest more in the renewable energy sector, this impact will increase.

The development of renewable energy sources will not only contribute to the economy's flexibility and sustainability but also foster innovation and technological advancements. As MacKay (2009) explains in *Sustainable Energy - Without the Hot Air*, the use of solar and wind energy, in particular, presents significant opportunities for countries with favorable natural conditions. Azerbaijan, with its abundant geographical and climatic advantages, is well-positioned to harness solar and wind energy efficiently. The country benefits from between 2400-3200 hours of sunshine annually, far surpassing many developed countries like the USA and Central Asia, where solar energy potential ranges from 2500-3000 hours per year. This makes solar energy a viable option for electricity and heat production across various regions of Azerbaijan. Wind energy also holds great promise, with an estimated 800 MW of annual wind energy reserves, capable of generating 2.4 billion kWh of electricity annually. The utilization of wind energy not only bolsters electricity generation but also promotes environmental protection, as wind power is a clean, sustainable source. Areas such as the Absheron Peninsula, the Caspian Sea coast, and other wind-suitable regions are ideal for constructing wind power plants due to their high average wind speeds (MacKay, 2009).

In addition, water energy plays a crucial role in Azerbaijan's renewable energy sector. Hydroelectric power plants (HPPs) are a significant contributor to the country's environmentally friendly energy production, accounting for approximately 17.8% of Azerbaijan's total energy production. As Timmons (2017) explains in *The Economics of Renewable Energy*, the growth of small HPPs could further enhance Azerbaijan's energy supply, making a larger contribution to its overall energy mix. The development of more small-scale HPPs would increase the country's capacity to produce clean, renewable energy from water sources.

Azerbaijan also holds potential in the use of biomass and geothermal energy. Biomass energy is primarily derived from agricultural and industrial waste, providing an opportunity for heating buildings and other local applications. Meanwhile, geothermal energy, especially in regions like the Greater and Lesser Caucasus Mountains and the Absheron Peninsula, holds promise for supplying thermal energy to local communities (Timmons, 2017).

Azerbaijan holds significant potential for development in the field of renewable energy, with the expansion of this sector being crucial for ensuring energy security, addressing environmental challenges, and driving economic growth. As Bassetti and Cingolani (2015) discuss in their article *The Impact of Renewable Energy on Economic Growth and Employment: A Review of the Literature*, investments in renewable energy can stabilize energy prices in the long term, providing consumers with access to more affordable energy sources. Furthermore, the creation of new jobs and economic activities within the renewable energy sector enhances consumer purchasing power, driving economic progress.

Renewable energy also plays a vital role in ensuring the sustainability and competitiveness of the industrial sector. By lowering energy costs, industrial enterprises can reduce production costs, enabling them to produce cheaper, higher-quality products. Additionally, the shift to green technologies ensures the long-term sustainability of the industrial sector by mitigating environmental risks (Bassetti & Cingolani, 2015).

As this sector develops, countries apply various subsidies and tax breaks to this area. These subsidies can initially be provided using state budgets or taxpayer funds. However, in the long term, the use of renewable energy reduces the costs of energy imports for countries, which has a positive impact on the state budget.

Renewable energy sources increase energy security because they can be obtained locally. This reduces countries' dependence on foreign energy suppliers and achieves a more independent energy supply. This is especially important economically for countries with weak energy resources.

Renewable energy production generates significantly lower carbon emissions compared to fossil fuels, helping to mitigate global warming and positively impacting the environment. As Kannan and Suresh (2017) highlight in their article *Industrial Energy Efficiency and Renewable Energy: A Critical Review of Existing Literature and Research*, environmental protection also brings economic benefits. By reducing pollution, health costs and investments in environmental restoration can be minimized in the long term.

Moreover, the renewable energy sector is attracting substantial investment, both domestically and internationally. Technological advancements and innovations in this field stimulate ongoing research and development to discover new energy solutions. This fosters economic growth, as emerging technologies lead to more cost-effective and efficient energy production (Kannan & Suresh, 2017).

The impact of renewable energy on the industrial sector is multifaceted and leads to changes in the sector. This impact is related to the change in energy supply on the one hand, and to the innovations associated with the application of renewable energy technologies on the other. The impacts on the industrial sector can be listed as follows:

The application of renewable energy can significantly reduce energy costs for industrial enterprises. Sources such as solar and wind energy offer lower long-term operating costs compared to traditional energy sources. As Johnson and Cooper (2019) discuss in *Renewable Energy and the Industrial Revolution: Historical and Modern Perspectives*, industrial enterprises that adopt solar panels or wind turbines can cut energy expenses and achieve long-term financial benefits, especially in sectors with high energy demand.

Additionally, since renewable energy sources are locally available, industrial enterprises can reduce their dependence on foreign energy suppliers. This diminishes the risks associated with energy supply disruptions and price fluctuations in global markets, providing stability and security in energy supply. As a result, companies benefit from a more reliable energy source, ensuring the continuity of operations and minimizing potential economic losses due to energy shortages (Johnson & Cooper, 2019).

The development of renewable energy technologies is encouraging innovation and the application of new technologies in industries. Industrial enterprises are looking for new methods for more efficient energy use, which stimulates technological developments. Companies that use innovations in the field of renewable energy are also implementing new methods to ensure more efficient use of energy, for example, the development of energy storage technologies and the optimization of energy use (Esgerova & Abbasova & Ibrahimova & Hasanov, 2025).

As the manufacturing and industrial sectors transition to more environmentally friendly energy sources, they demonstrate their commitment to “green” and environmentally responsible practices. This can enhance their market value, as modern consumers and business partners increasingly prefer to engage with companies that prioritize sustainability. As the International Renewable Energy Agency (IRENA) (2021) highlights in *Renewable Energy and Jobs – Annual Review 2021*, adopting renewable energy not only supports environmental goals but also boosts the brand value and reputation of companies. This shift towards sustainability can offer a competitive edge in an increasingly eco-conscious market.

The use of renewable energy significantly reduces the carbon footprint and overall pollution of industrial enterprises, which has a profound impact on the industrial sector. This is especially relevant for countries committed to reducing carbon emissions and addressing global warming. As Kuchukahmetoghlu (2017) discusses in *Renewable Energy Sources and their Future*, renewable energy helps enterprises comply with emission quotas, thus avoiding potential fines for exceeding pollution limits (Ahmadova, 2019).

Moreover, renewable energy technologies provide industrial enterprises with the opportunity to enter new markets. Enterprises that offer green energy products and services can capture a larger share of the growing market for environmentally friendly products, giving them a competitive advantage as consumer demand for sustainable and responsible products continues to rise (Kuchukahmetoghlu, 2017).

Renewable energy projects are often supported by governments through various forms of incentives, such as tax breaks, subsidies, and financial assistance. Industrial enterprises can leverage

these opportunities to attract investment, accelerating the adoption of renewable energy technologies and allowing companies to implement these technologies under favorable conditions. As Abdullayev et al. (2024) highlight in their study *Global Challenges of Regional Management in The Modern World: The Main Factors Shaping the Infrastructure Base of Regional Management*, such governmental support plays a crucial role in enabling industrial enterprises to transition to renewable energy efficiently and cost-effectively (Abdullayev et al., 2024).

The implementation of renewable energy can accelerate industrial development in certain regions. Industrial enterprises are likely to be established in areas that can take full advantage of solar and wind energy, resulting in positive impacts on the local economy. Additionally, renewable energy sources help reduce dependencies in supply chains, promoting regional economic growth. As Guney (2018) discusses in *Environmental Economics and Energy Policies*, the adoption of renewable energy encourages industrial enterprises to implement more sustainable and efficient resource management. For instance, optimizing energy consumption in production processes, incorporating energy storage systems, and developing industrial parks powered by renewable energy can lead to more efficient and environmentally friendly production practices (Guney, 2018).

The impact of renewable energy on the industrial sector is very positive and long-term. This transition benefits industrial enterprises both financially and environmentally and socially. The transition from traditional energy sources to more cost-effective and sustainable alternatives also increases the competitiveness of enterprises and increases the overall efficiency of the industrial sector (Adigozalova & Mammadova, 2020).

Investing in the renewable energy sector is crucial for Azerbaijan to increase its economic sustainability. As Cevdet Öztürk points out in his article "The Place of Renewable Energy in the Turkish Economy and Sustainable Development", renewable energy sources not only increase consumer welfare but also ensure the sustainable development of the industrial sector. In addition, increasing economic efficiency and protecting the environment once again emphasize the importance of renewable energy. In this context, investments in this area are of strategic importance for Azerbaijan from both an ecological and economic perspective (Ozturk, 2020).

## Conclusion

The results of this study shed light on the impact of renewable energy sources on consumer welfare and industry. The development and use of renewable energy sources mainly increases the economic impacts related to energy supply, providing consumers with cheaper and more sustainable energy options. This has positive results, especially in terms of reducing energy prices and stabilizing energy supply.

At the same time, the application of renewable energy sources for the industrial sector creates significant financial savings and technological developments. This also has a positive impact on job creation and economic growth. The renewable energy sector, by increasing innovation and new job opportunities, changes industrial structures, and provides more environmentally and economically efficient alternatives to traditional energy production.

In addition, the wider application of renewable energy sources reduces energy dependence within the country, minimizes the demand for foreign energy resources, and creates conditions for a more secure and sustainable supply of energy. This also serves to increase economic independence.

Overall, the economic impacts of renewable energy sources are broad and they positively shape not only the energy sector but also the economy as a whole, increasing social welfare and ensuring sustainable development. However, for this process to fully materialize, investments, technological developments and public policy support are essential.

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