

ECONOMIC SCIENCES

DEVELOPMENT OF THE CIRCULAR ECONOMY IN DEVELOPED COUNTRIES USING THE EXAMPLE OF THE USA: IMPACT ON SUSTAINABLE DEVELOPMENT STRATEGIES

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Abstract

The article examines the development of the circular economy (CE) in the USA and its impact on sustainable development (SD) strategies. It explores the transition from a linear to a circular model aimed at reducing waste, minimizing resource use, and lowering emissions. The paper analyzes examples of successful initiatives in waste recycling, renewable energy, and sustainable construction, supported at both governmental and corporate levels. It discusses obstacles and challenges to the full implementation of circular practices, including economic, regulatory, and cultural aspects. The author makes a conclusion of the necessity for a comprehensive approach and coordinated efforts to achieve SD.

Keywords: circular economy (CE), sustainable development (SD), waste recycling, renewable energy, sustainable construction, economic strategies, environmental initiatives.

Introduction

The circular economy (CE) is an innovative model of economic development focused on minimizing waste and maximizing the efficient use of resources. Unlike the traditional linear model, based on the principles of «production – consumption – disposal», the CE is built on closed production-consumption cycles, where materials and products retain their value for as long as possible. The transition to a CE is becoming increasingly relevant in the context of global environmental and economic challenges, including the depletion of natural resources, environmental pollution, and climate change.

Developed countries, particularly the USA, play a significant role in promoting CE principles. As one of the world's largest economies, the USA has substantial resources and technological potential. In recent decades, the country has actively implemented initiatives aimed at developing the CE, including measures for waste recycling, carbon dioxide emission reduction, and the creation of sustainable production chains. These efforts are aimed at integrating circular principles into sustainable development (SD) strategies, which seek to balance economic growth, social well-being, and environmental protection.

The aim of this article is to analyze the processes of implementing the CE in the USA and their impact on SD strategies. The paper will discuss the main principles of CE, examine successful practices of USA companies, and identify the barriers and challenges the country faces on its path to SD.

Main part. Theoretical aspects of the CE

The concept of the CE began to take shape in the 1970s when ecologist John Bennington and economist Walter R. Stahl proposed ideas aimed at closing production cycles and reusing resources. During this period, theories such as «closed ecosystems» and the «materials loop» also emerged, advocating for a shift away from the linear economic model towards a system where the waste of one process becomes a resource for

another. These ideas formed the foundation of the modern CE where the primary goal is the sustainable use of resources.

In the following decades, with the strengthening of the environmental agenda, the CE came to be seen as one of the key tools for SD. According to the OECD, by 2022, more than 30 countries, including the USA and the European Union, had adopted strategies for transitioning to a CE. Projections indicate that the transition to the CE by 2030 could generate economic growth of \$4,5 trillion and save up to \$700 billion worldwide [1].

In the USA, the origin of the CE idea can be traced back to environmental activism and laws during the 1970s in response to the growing awareness of environmental issues like pollution and resource depletion. Waste management programs were implemented and the Environmental Protection Agency (EPA) was founded in this era to promote principles of sustainable development and resource conservation.

In the modern era, government support is crucial for the development of the CE. This support includes tax incentives, subsidies, grants for the implementation of environmentally friendly technologies, and waste recycling programs, all of which contribute to a faster transition of enterprises to sustainable production and consumption models. For example, the «Solid Waste Infrastructure for Recycling» grant program allocates \$55 million annually from 2022 to 2026 [2].

The CE principles focus on developing a sustainable and efficient production and consumption system that reduces waste and maximizes resource utilization. For example, waste minimization principle aims to decrease waste amounts by practicing recycling, reusing, and recovering materials. The waste recycling rate in the USA was 44 in 2024, higher than Canada's rate of 24,4 [3].

Another rule of CE involves prolonging the longevity of products and materials by repairing, upgrading, and reusing them. In 2022, Fortune calculated that the worldwide automotive repair and refurbishment industry was worth \$60,78 billion. It is forecasted that the

amount will rise from \$65,49 billion in 2023 to \$126,42 billion by 2030, showing an annual growth rate of 9,9% [4].

The «product cycle» concept is a key component of the CE, covering all stages of a product's life, from creation and manufacturing to usage and disposal. In contrast to the linear model, the CE strives to maximize the lifespan of products and materials in circulation. This is achieved by designing products with recycling and repair in mind. For example, according to Precedence, the green electronics manufacturing market size was \$16,93 billion in 2023. The growth rate is projected to be 26,13%, with the market size reaching \$155,89 billion by 2032 [5].

Thus, the CE is an essential tool for transitioning to SD models, especially in developed countries like the USA [6]. Integrating circular principles and technologies into various economic sectors requires not only government initiatives but also the active involvement of businesses and society as a whole.

Circular economy in the USA

As per a 2021 Executive Order by the USA President, the federal government pledged to generate and

sustain employment by advancing clean energy and sustainable infrastructure. By the year 2030, federal agencies must purchase electricity that is completely free of carbon, and by 2035, all light-duty vehicles must not produce any emissions.

These initiatives strive to decrease greenhouse gas emissions by 65% from 2008 levels while also boosting employment opportunities in clean technology and sustainable energy industries. In 2023, the number of clean energy jobs increased significantly, surpassing the growth rate in other sectors by more than double (4,9% compared to 2%), resulting in the creation of 149,000 new positions. This growth is due to increased federal and private investments in constructing solar and wind power plants and expanding recycling infrastructure [7]. Latino and Hispanic workers made up nearly one-third of new energy positions, increasing by 79,000 from 2022. This supports Sustainable Development Goal (SDG) 8 «Decent work and economic growth» and SDG 10 «Reduced inequalities». According to the USA Department of Energy report, the highest number of clean energy positions is in California (fig. 1).

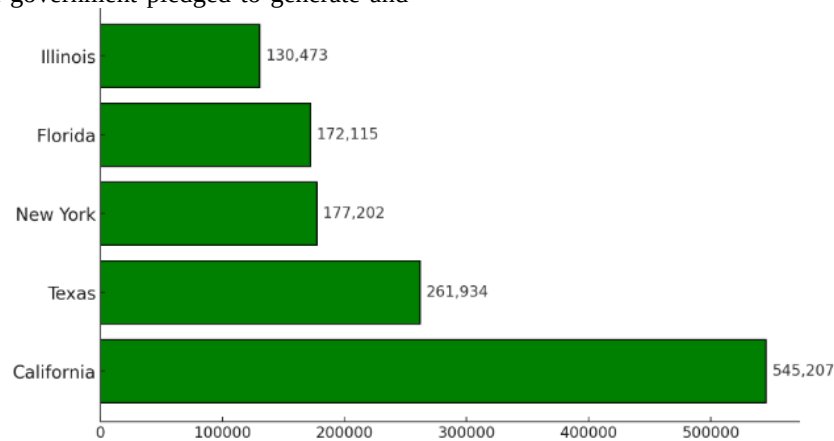


Figure 1. Number of clean energy positions across states in 2023

The new jobs created within the framework of the CE require employees to have high qualifications in technical and engineering fields related to the operation and maintenance of recycling equipment, management of renewable energy facilities, and skills in implementing environmentally sustainable technologies. These positions often demand specialized education or additional professional training covering competencies such as operating recycling and waste management systems, maintaining solar and wind energy installations, and using data management for resource optimization. At the same time, a significant portion of these positions is available at an entry level, enabling the inclusion of vulnerable populations by providing them with

access to economic opportunities and prospects for professional growth in the field of sustainable development.

An example of the CE's growth in the USA is the development of electric vehicle (EV) infrastructure, supported by the 2021 Infrastructure Investment and Jobs Act and the 2022 Inflation Reduction Act. As of February 2024, there were over 61,000 public EV charging stations in the USA, with 31% located in California [8]. Studies show that 64% of Americans live within 2 miles (3,2 km) of a public charging station (fig. 2).

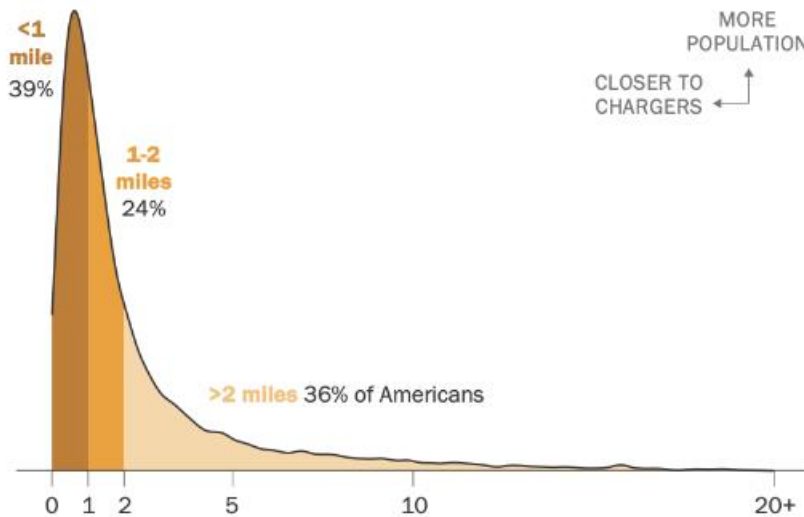


Figure 2. Distance to nearest EV charging station, miles

Federal sustainable building programs, like the «Assisting Federal Facilities with Energy Conservation Technologies» (AFFECT), plan to construct and upgrade over 200 million square meters of zero-emission buildings by 2030, fostering sustainable communities and reducing energy consumption. In 2024, \$104 million was allocated to energy-saving and clean energy projects across 31 federal sites.

The USA circular economy demonstrates a comprehensive approach to SD, integrating economic, social, and environmental initiatives. Through government support and private investment, the country actively develops clean energy, EV transport, and sustainable building infrastructure [9]. Implementing such programs strengthens the economy, reduces social and environmental risks, and highlights how the CE can be a key driver of change towards a more sustainable and equitable society.

Impact of the USA circular economy on SD strategies

The USA' SD strategies aim to achieve environmental, social, and economic sustainability by reducing pollution, enhancing energy efficiency, and developing green technologies. The USA is particularly vulnerable to significant climate risks and is situated in a zone of «climate hazards», which includes frequent extreme weather events such as hurricanes, wildfires, floods, droughts, and extreme temperatures. The application of circular principles not only helps manage the consequences of such climate disasters but also prevents them by reducing carbon footprints and slowing global warming. For example, using recycled materials in manufacturing instead of extracting new resources reduces emissions and minimizes the destructive impact on ecosystems [10].

As part of the strategy to achieve net-zero carbon emissions by 2050, the EPA aims to increase the recycling rate of household and industrial waste to 50% by 2030, focusing on plastics, paper, and electronics recycling. The Department of Energy (DOE) manages the Circular Economy Initiative, which funds innovative technologies for the reuse of critical materials such as

rare earth elements and batteries. This helps reduce dependence on imports and supports the creation of sustainable supply chains.

At the state and city levels, circular strategies are actively implemented. In California, Senate Bill SB 1383 was enacted to reduce methane emissions from organic waste by 40% by 2030, involving the development of composting and food waste recycling infrastructure. New York City's «Zero Waste» program aims to achieve zero waste levels by 2030. This initiative involves investments in recycling construction materials and textiles, as well as educational programs to raise public awareness.

Corporations in the USA are also actively promoting the CE. **Apple**, for instance, adopts circular principles in its business strategies, utilizing recycled materials in production and establishing closed loops for battery recycling, in turn diminishing its environmental impact and decreasing the use of fresh resources. Approximately 20% of the materials used in Apple products in 2022 were sourced from recycled or renewable sources, with features like 100% recycled aluminum in device enclosures and 73% recycled rare earth elements in magnets for products such as iPhones and MacBooks [11]. In the retail industry, companies such as **Patagonia** have created initiatives for reusing and repairing products to prolong their lifespan and decrease waste. In 2023, Patagonia fixed more than 60,000 clothes through its Worn Wear initiative at the repair center located in Reno, Nevada.

As we can see, the CE in the USA is a crucial component of the country's SD plan, involving collaboration among the federal government, states, and private industry to establish a CE that reduces waste, generates employment opportunities, and boosts economic progress.

Challenges in implementing CE principles in the USA

The implementation of the CE in the USA faces several challenges and difficulties associated with the diversity of economic, regulatory, and natural conditions. Despite active efforts from the government and businesses, there are numerous barriers that limit the

development of circular models and hinder the full transition to sustainable practices (table 1).

Table 1.

Features of Implementing the CE in the USA		
Challenge	Description	Examples
Diversity and Fragmentation of Legislation	In the USA, CE initiatives are often regulated at the state and city levels, leading to inconsistencies in rules and standards. This complicates coordination and the application of unified approaches across the country, as different regions may have their own priorities and limitations.	In California, SB 1383 aims to reduce methane emissions from organic waste, while central states like Oklahoma and Texas have fewer CE measures, creating a national imbalance in efforts.
High Initial Investments and Lack of Infrastructure	The implementation of recycling technologies and sustainable production processes requires significant investment. In some regions, particularly in rural and less developed areas, recycling and reuse infrastructure is weak.	In Midwestern states like Nebraska and Iowa, there is insufficient capacity for recycling plastic and organic waste. This leads to a dependence on transporting materials to other regions, increasing costs and carbon footprint.
Lack of Cultural and Consumer Awareness	Some Americans do not recognize the importance of recycling and sustainable consumption, which complicates the transition to a CE. Cultural and educational barriers prevent the implementation of new sustainable practices.	In rural areas and small towns, such as those in Mississippi or Alabama, the lack of secondary recycling facilities and information campaigns limits the development of a CE.

The implementation of the CE in the USA is complicated by several barriers, including the diversity of the legislative framework, high costs associated with developing infrastructure, and cultural differences that slow the transition to more sustainable practices. Efforts to raise public awareness and increase funding for infrastructure modernization can help eliminate these obstacles and ensure the successful development of the CE in the country.

Conclusion

The development of the CE in the USA contributes to the integration of environmental, economic, and social aspects into sustainable development strategies. One of the most important outcomes of implementing circular principles has been the creation of new jobs in areas such as waste recycling, renewable energy, and sustainable construction. As noted in the article, investments in solar and wind energy and the expansion of recycling infrastructure led to the creation of approximately 149,000 new jobs in the clean energy sector in 2023 alone. This supports both economic stability and the achievement of SDG 8, which focuses on promoting decent work and economic growth.

The implementation of CE involves specific skill requirements for employees, particularly in technology and recycling. These requirements include specialized technical training and the development of skills needed to work with innovative technologies. Since some of these positions require entry- and mid-level qualifications, they are accessible to vulnerable populations, including ethnic minorities and socially disadvantaged groups.

Thus, the CE in the USA not only reduces the carbon footprint and conserves natural resources but also creates a substantial economic contribution by expanding employment opportunities. The effective imple-

mentation of circular models requires coordinated efforts at all levels – from federal to local – and aims to build a more sustainable and equitable society.

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