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THE ASIAN MODEL FOR IMPLEMENTING THE CIRCULAR ECONOMY IN THE AUTOMOTIVE INDUSTRY (EXPERIENCES FROM JAPAN, KOREA AND CHINA)

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Abstract
The article explores the integration of the circular economy model into the automotive industries of China, Japan, and South Korea. The circular economy serves as a sustainable alternative to the traditional linear model by reducing waste, improving resource efficiency, and encouraging the reuse, recycling, and remanufacturing of materials and products. The study identifies how China has successfully institutionalized circular economy principles through comprehensive state policies, regulatory incentives, and the creation of industrial clusters and technological research centers. Leading Chinese automotive companies such as Geely, BYD, and Chery have implemented circular production systems emphasizing eco-efficiency, remanufacturing, and the expansion of electric vehicle production. In Japan, where resource scarcity and high population density have historically driven innovation, the circular economy has become deeply embedded in manufacturing culture. The country’s advanced recycling systems and sustainable production practices, supported by globally recognized companies such as Toyota and Nissan, demonstrate Japan’s leadership in environmental management. South Korea’s automotive industry, represented by Hyundai and Kia, has achieved significant progress by incorporating circular economy principles through the development of hybrid and electric vehicles and by enhancing technological innovation in production processes. The findings of this study indicate that circular economy adoption not only supports industrial modernization and competitiveness but also contributes to reducing environmental impacts, achieving carbon neutrality, and promoting long-term sustainable development across the global automotive sector.
Keywords: Circular economy, automotive industry, remanufacturing, sustainability, China, Japan, South Korea, green technologies.

Annotatsiya
Maqolada Xitoy, Yaponiya va Janubiy Koreya avtomobilsozlik sanoatlarida sirkulyar iqtisodiyot modelining integratsiyasi tahlil qilinadi. Sirkulyar iqtisodiyot chiqindilarni kamaytirish, resurslardan samarali foydalanish va materiallar hamda mahsulotlarni qayta ishlatish, qayta ishlash va qayta ishlab chiqarishni rag‘batlantirish orqali an’anaviy chiziqli modelga barqaror muqobil sifatida xizmat

qiladi. Tadqiqotda Xitoyda sirkulyar iqtisodiyot tamoyillari davlat siyosati, reglamentlar va texnologik klasterlar tizimi orqali muvaffaqiyatli institutsionallashtirilgani aniqlanadi. Geely, BYD va Chery kabi yirik kompaniyalar ekosamaradorlik, qayta ishlab chiqarish va elektromobillar ishlab chiqarishni kengaytirishga asoslangan sirkulyar ishlab chiqarish tizimlarini joriy etgan. Resurs tanqisligi va yuqori aholizichligi sharoitida innovatsiyalarni erta rivojlantirgan Yaponiya misolida sirkulyar iqtisodiyot ishlab chiqarish madaniyatining ajralmas qismiga aylangan. Toyota va Nissan kabi kompaniyalar tomonidan qo‘llanilgan ilg‘or qayta ishlash tizimlari Yaponiyaning ekologik boshqaruvdagi yetakchiligini ko‘rsatadi. Janubiy Koreyada esa Hyundai va Kia korporatsiyalari gibrid hamda elektr avtomobillar ishlab chiqish orqali sirkulyar iqtisodiyot tamoyillarini ishlab chiqarish jarayonlariga muvaffaqiyatli tatbiq etgan. Tadqiqot natijalari sirkulyar iqtisodiyotning joriy etilishi sanoatni modernizatsiya qilish, raqobatbardoshlikni oshirish, atrof-muhitga salbiy ta’sirlarni kamaytirish va barqaror rivojlanishni ta’minlashda muhim omil ekanini ko‘rsatadi.
Kalit so‘zlar: Sirkulyar iqtisodiyot, avtomobilsozlik sanoati, qayta ishlab chiqarish, barqarorlik, Xitoy, Yaponiya, Janubiy Koreya, yashil texnologiyalar.

Аннотация

В статье исследуется процесс интеграции модели циркулярной экономики в автомобильную промышленность Китая, Японии и Южной Кореи. Циркулярная экономика выступает устойчивой альтернативой традиционной линейной модели, направленной на сокращение отходов, повышение эффективности использования ресурсов, а также стимулирование повторного использования, переработки и восстановления материалов и продукции. В исследовании показано, что Китай успешно институционализировал принципы циркулярной экономики благодаря государственной политике, нормативным стимулам и созданию промышленных кластеров и технологических исследовательских центров. Такие ведущие китайские компании, как Geely, BYD и Chery, внедрили системы циклического производства, основанные на экологической эффективности и расширении производства электромобилей. В Японии, где нехватка ресурсов и высокая плотность населения исторически способствовали инновациям, циркулярная экономика стала неотъемлемой частью производственной культуры. Продвинутые системы переработки и устойчивого производства, реализуемые компаниями Toyota и Nissan, демонстрируют лидерство Японии в сфере экологического менеджмента. Автомобильная промышленность Южной Кореи, представленная компаниями Hyundai и Kia, добилась значительного прогресса, внедрив принципы циркулярной экономики через развитие гибридных и электрических автомобилей и технологические инновации в производстве. Полученные результаты показывают, что внедрение циркулярной экономики способствует не только модернизации промышленности и повышению конкурентоспособности, но и снижению экологических последствий, достижению углеродной нейтральности и долгосрочному устойчивому развитию мирового автосектора.
Ключевые слова: Циркулярная экономика, автомобильная промышленность, реманufактура, устойчивое развитие, Китай, Япония, Южная Корея, зелёные технологии.

Introduction

The endless nature of human needs and the limited availability of resources-one of the most fundamental issues in economics-have long required the proper allocation of available resources.

For years, the world economy’s reliance on the linear model has, on one hand, heightened the risk of resource scarcity, while on the other, industrial production has led to harmful gas emissions, which in turn have caused environmental hazards and climate change. Beginning in the 1970s, scientists started proposing circular economy models as

solutions to these very problems [1]. Since then, the "produce, consume, and dispose" model has gradually been replaced by a new approach.

Subsequently, during the 1990s, these concepts began to evolve with the introduction of the "green" economy. This concept was first proposed in 1989 by a group of leading eco-economists in the British Parliament [2], and within a few years, it became one of the primary objectives not only for economic policy but also for addressing climate change and guiding several international organizations.

In 2008, UNEP initiated its first international efforts on green economy by announcing its ongoing support for green production practices aimed at preserving the planet’s ecosystem and its resources for future generations.

In later years, the circular economy-considered the logical progression of a green economy-began to permeate several sectors of the global economy, including the automotive industry. In this Work, the foreign experiences of this model and the opportunities for implementing them in Uzbekistan's automotive sector will be examined.

Literature Review

The concept of the circular economy (CE) emerged as a response to the limitations of the traditional linear “take-make-dispose” model, which heavily depends on finite resources and leads to ecological degradation. The term “circular economy” has been widely discussed in environmental economics since the 1970s, when Boulding [1] first introduced the metaphor of “Spaceship Earth,” emphasizing the planet’s closed ecosystem and the necessity of recycling and resource regeneration. The subsequent decades witnessed the evolution of sustainability paradigms, including the green economy and industrial ecology, which became integral to modern environmental policy frameworks [2].

The Ellen MacArthur Foundation (EMF), one of the most influential institutions in circular economy research, defines the CE as an economic system designed to eliminate waste and continually regenerate resources [3]. According to EMF, this model aims to decouple economic growth from resource consumption and to promote restorative and regenerative industrial processes. Similarly, scholars such as Albaladejo, Franco Henao, and Mirzao [4] have highlighted that CE implementation requires multi-level cooperation between policymakers, enterprises, and consumers, focusing on both technological innovation and social awareness.

In Asia, the integration of CE principles has been particularly prominent in industrial sectors, especially in automotive manufacturing. China, Japan, and South Korea have emerged as leading examples of CE application in the automotive industry. Research by Cao et al. [5] demonstrates that China’s remanufacturing sector—supported by government policies, regulatory incentives, and technological innovation—has significantly improved the reuse and recycling of vehicle components. The country’s approach emphasizes remanufacturing clusters, industrial symbiosis, and eco-industrial parks, which collectively form the backbone of its circular industrial transformation.

Japan’s approach to the circular economy differs due to its geographical and socio-economic context. Studies by the Institute for Environmental Studies [6] emphasize Japan’s long-standing tradition of resource efficiency driven by high population density and resource scarcity. Japan’s circular practices are embedded in its manufacturing culture, exemplified by companies such as Toyota, Nissan, and Honda, which have pioneered lean production, eco-design, and zero-waste manufacturing systems. By recycling over 98% of its metals and

incorporating environmental management systems into all stages of production, Japan has positioned itself as a global leader in sustainable industrial innovation [7].

In contrast, South Korea’s circular economy development has been driven by its technological advancements and state-led industrial policies. The Hyundai and Kia corporations have implemented closed-loop supply chains, focusing on the recycling of parts and the integration of hybrid and electric vehicle (EV) production [8]. The Ministry of Environment of South Korea introduced the “Automotive Resource Circulation” policy, which incentivizes recycling, remanufacturing, and energy recovery. This policy framework has been instrumental in supporting the nation’s transition toward low-carbon mobility [9].

Moreover, comparative analyses conducted by international institutions highlight that the CE is not limited to environmental benefits but also promotes economic resilience and competitiveness. The UNEP Green Policy Platform [10] underscores that the CE contributes to job creation, innovation, and sustainable growth, making it a key driver in achieving the UN’s Sustainable Development Goals (SDGs). Thus, while the Asian models of CE implementation differ in institutional structure, they share a common foundation: the integration of circularity into industrial modernization, environmental protection, and technological advancement.

In conclusion, the literature indicates that the success of circular economy adoption in the automotive industry depends on a synergistic combination of governmental regulation, corporate strategy, and technological innovation. China’s policy-driven remanufacturing framework, Japan’s culture of resource efficiency, and South Korea’s technology-oriented approach collectively demonstrate that the CE is not a singular model but a flexible system adaptable to diverse national contexts. This comparative understanding provides valuable lessons for emerging economies, including Uzbekistan, aiming to integrate sustainability and industrial competitiveness into their automotive sectors.

Research Methodology

This research employs a comparative qualitative methodology to analyze the implementation of the circular economy (CE) in the automotive industries of China, Japan, and South Korea. The methodological framework is based on descriptive, analytical, and comparative approaches, allowing for a systematic examination of how different industrial systems have integrated CE principles into production processes, waste management, and technological innovation. Primary and secondary data sources were utilized, including official reports, academic journals, industrial databases (e.g., Statista, CEIC Data), and corporate sustainability documents from major automotive manufacturers such as Toyota, Hyundai, Kia, BYD, and Geely. The study focuses on identifying policy instruments, industrial clusters, and corporate strategies that have contributed to successful CE adoption in each country. The research process includes three stages: (1) identification of key regulatory and institutional frameworks supporting CE; (2) evaluation of production and remanufacturing models within leading automotive enterprises; and (3) comparative synthesis of technological, economic, and environmental outcomes.

By applying a cross-country comparative method, the study ensures a holistic understanding of how economic structure, innovation capacity, and government policy influence CE effectiveness. The findings are interpreted within the broader context of sustainable

industrial transformation and environmental economics, providing a theoretical basis for potential adaptation of these models in emerging economies, including Uzbekistan.

Analysis and results

The circular economy model not only supports economic growth but also improves environmental conditions. Compared to the linear model, it offers several advantages. In striving for sustainability, every society aims to combine economic production with environmentally safe manufacturing. The circular economy is built on similar ideas, concepts, and scientific research. These concepts include industrial ecology, industrial ecosystems, industrial symbiosis, clean (environmentally friendly) production, production systems, product-service systems, eco-efficiency, natural capitalism, efficient economics, and various aspects of “zero emissions.”

China, one of the largest economies in Asia and the global market, has been rapidly adapting this model across all sectors-including the automotive industry. Since the early 2000s, China has accepted the circular economy as a national priority. In production processes based on circular economy concepts, reducing waste generated during manufacturing, improving resource efficiency, and promoting the reuse, recycling, and remanufacturing of products and materials have become integral parts of production and lifestyle.

China has turned the circular economy into a strategic element in automotive manufacturing and remanufacturing processes. Remanufacturing of vehicles involves restoring outdated transport means to their original condition or enhancing their performance through advanced technologies and techniques.

According to data from the Ellen MacArthur Foundation, reprocessing an existing product requires 60 % less energy and 70 % less material than manufacturing a new one. This, in turn, nearly halves the product’s cost and reduces environmental waste by 80 %. Components recovered from IT equipment, machinery, and vehicles contribute to more efficient energy use and help prevent various climate change or pollution processes.

China possesses a high potential and large market for remanufacturing. Currently, there are over 365 million vehicles in the country [4]. The domestic automotive repair and maintenance market is valued at approximately USD 157 billion and shows promising prospects for growth [4]. The following are some key aspects that have driven growth in China’s automotive remanufacturing industry:

1. Financial and Regulatory Incentives within the System for Collecting Used Vehicles and Equipment.

In the early 2000s, when collecting vehicles that had reached the end of their service life was considered an unsolvable problem, the National Development and Reform Commission and the Ministry of Finance implemented the “Swap the Old for Remanufacturing” policy in 2013. This policy significantly impacted the number of vehicles submitted for remanufacturing and, by 2016, increased the overall remanufacturing rate by 5 %.

The policy provides subsidies to enterprises that collect end-of-life vehicles and their parts, as well as to companies that assemble vehicles and equipment for remanufacturing. Additionally, it offers buyers a 10% discount on remanufactured products compared to new ones, thereby encouraging the purchase of remanufactured goods.

Moreover, the regulations on used vehicles, which originally allowed only the recovery of raw materials such as metals, were revised in 2019 following new industry insights. The 2001 regulation, designed to prevent illegal remanufacturing by limiting recovery to items that could only be reprocessed and sold as metal, had hindered the growth of automotive remanufacturing. According to the latest regulations, five main vehicle components (engine, transmission, gearbox, chassis, and front and rear axles [5]) may now be sold directly to certified remanufacturing enterprises. These changes have broadened the scope of the industry and created a more favorable environment for increasing the rate of restoring end-of-life vehicles.

2. Pilot Programs and Industrial Clusters for Promoting Best Practices and Sector Development. Starting in the early 2010s, the Chinese government initiated several pilot projects to test the market potential for vehicle remanufacturing and identify ways to support the sector. For example, in 2014, the Ministry of Industry and Information Technology (MIIT) published a list of 20 experimental enterprises licensed to sell remanufactured products. These products, ranging from construction machinery to agricultural equipment, were required to meet or exceed the quality standards of new products. Companies had to fulfill strict requirements regarding production capacity, management systems, and repair capabilities, as well as agree to periodic monitoring.

The success of these pioneer enterprises encouraged many small and medium-sized businesses to enter the sector, and by 2016 the number of pilot companies had reached 76.

As interest in remanufacturing grew, specialized industrial parks were established. In 2015, the State Council announced a plan to set up more than 100 industrial zones dedicated to this purpose. For instance, the Shanghai Lingang Remanufacturing Industrial Park, founded in 2013, rapidly attracted over 200 remanufacturing companies and generated an annual revenue exceeding USD 189 million by year’s end [4]. By 2016, international companies also began operating in these parks; for example, Daimler-Benz chose Chinese remanufacturing and service parks for its operations in the Pacific and Asia regions.

3. State Funding for Technological Advancement and Standardization. Remanufacturing requires advanced technological systems and expertise. Since 2003, China has invested in upgrading specialist skills through the “National Laboratory for Remanufacturing Key Technologies” program. To date, the program has awarded 40 Chinese and international patents to its team of academics and researchers, published nearly 900 articles, and issued 18 national standards for remanufacturing.

In addition, in 2017 MIIT developed an action plan for Smart Remanufacturing (2018–2020) to support breakthroughs in key technologies such as disassembly, damage detection, and reconditioning processes. Subsequently, the government funded the establishment of over 100 high-tech enterprises, research centers, and service centers, and helped develop information platforms and industrial clusters to expand China’s remanufacturing activities. Crucially, MIIT now issues official certificates for remanufactured products, guaranteeing that their functionality and quality are equivalent to-or even exceed-those of new products. This has improved both the market visibility and legitimacy of these certified products.

Over the past decade, Chinese automotive companies and the overall automotive manufacturing industry have evolved based on these concepts, turning China into the world’s largest automotive producer and the market with the highest demand for vehicles.

Today, the automotive sector is one of the primary drivers of China’s economy. The country is home to several major brands, which are briefly discussed below.

In China’s automotive industry [6], the traditional “Big Four” companies-FAW Group, Dongfeng, SAIC Motors, and Chang’an-operate alongside several relatively younger companies such as Geely, Beijing Automotive Group, Brilliance Automotive, Guangzhou Automobile Group, Great Wall Motors, BYD, Chery, and JAC Motors.

For instance, Geely, known as the owner of Sweden’s Volvo, is the largest private-sector manufacturer in China. Founded in 1986, Geely has grown to become one of China’s leading automotive producers. In 2022, Geely Holding produced over 2.3 million vehicles and employed more than 120,000 people [7].

According to Geely’s 2022 “Sustainable Development” report, the company has outlined several notable ESG (Environmental, Social, and Governance) initiatives [8]. The report states that the company aims to achieve carbon neutrality by 2030 and full carbon neutrality across its value chain by 2045. This strategy focuses on six main areas:

- Compatibility,
- Addressing climate change,
- Resource conservation and efficiency improvement,
- Safe mobility,
- Sustainable value chains,
- Employee and community well-being.

Another notable aspect is that Geely’s production of environmentally safe electric vehicles has been growing steadily. While Geely sold 640,000 electric vehicles in 2022, this figure rose to 980,000 in 2023 [9]. In addition to these achievements, Geely actively supports sustainable production and circular economy concepts by directly implementing them into its manufacturing processes.

For example, the Zeekr 009 model, produced using sustainable materials, is an eco-friendly vehicle with over 30% of its components made from plant-based [10] materials. Similarly, Volvo’s EX90 model, produced under the Geely umbrella, is composed of 15% recycled steel, 25% recycled aluminum, and 48 kg of recycled plastic and bio-based materials [11].

BYD, founded in February 1995, is not only well-known in China but also globally. Today, BYD is one of the leading manufacturers of electric vehicles and the sole battery producer for the EV sector in China [12]. In the post-COVID-19 period, BYD’s electric vehicles have experienced high sales both domestically and internationally. According to Statista, while the company sold 387,957 vehicles in 2020, this figure increased to 713,437 in 2021 and reached 1,796,625 in 2022 [13].

In the fourth quarter of 2023, BYD surpassed Tesla to become the world’s best-selling battery electric vehicle manufacturer. Moreover, since the first quarter of 2023, BYD has been the best-selling automotive brand in China, overtaking Volkswagen – a title it has held since the liberalization of China’s automotive industry. Since 2021, BYD has been expanding its light vehicle exports to Europe, Southeast Asia, Oceania, and South America.

Chery is another active participant among Chinese automotive companies in producing eco-friendly vehicles. Chery’s electric and hybrid models feature state-of-the-art electric motors, high-capacity batteries, and regenerative braking systems, all contributing to outstanding performance and efficiency. These vehicles significantly reduce CO_2

emissions. With a competitive price range, rapid charging capabilities, and advanced safety features, Chery’s eco-friendly lineup offers more convenient and appealing sustainable mobility and automotive management.

Achievements in Green Technologies. Chery’s commitment to environmental sustainability goes beyond just offering electric and hybrid vehicles. The brand heavily invests in research and development programs, continuously exploring new methods to enhance innovations and environmentally friendly technologies. As a result, the integration of circular economy practices in its production processes continues to grow [14].

After China, the USA, and India, Japan is the world’s fourth-largest automotive market. The Japanese automotive industry comprises globally renowned companies such as Toyota, Honda, Nissan, Mazda, Suzuki, Subaru, Daihatsu, and Mitsubishi. The automotive sector is vital to Japan’s economy, accounting for 2.9 % of its GDP and 13.9 % of its manufacturing output. However, since the mid-1980s, Japanese automotive manufacturers began producing vehicles outside Japan, and today about two-thirds of Japanese vehicles are produced overseas.

In 2022, Japan sold 3,448,272 new passenger vehicles. There are three types of passenger vehicles in Japan: standard, compact, and Kei (the smallest “light” vehicles that qualify for special regulatory, tax, and insurance benefits) [15]. Kei vehicles are especially popular because they are economical to buy and maintain.

Japan plans to phase out traditional fuel-powered vehicles by 2035. In 2022, battery electric vehicles (BEVs) sales in Japan amounted to 58,813 units. Despite doubling in sales compared to 2021, BEVs still represent only 1.7 % of overall vehicle sales. Nevertheless, the shift to electric vehicles not only opens up new business opportunities but also improves environmentally friendly production processes.

No other country has taken earlier steps toward a circular economy like Japan. Under conditions of limited resources, Japan maximizes production efficiency and minimizes resource consumption by effectively organizing product lifespans and recycling processes-serving as a prime example for other nations.

In Japan’s automotive industry, in addition to traditional vehicle production, luxury cars are also manufactured. Lexus, owned by Toyota, is among the world’s most renowned luxury brands, offering high-end vehicles that combine luxury with performance. Similarly, Acura and Infiniti, affiliated with Honda and Nissan respectively, are well-known luxury brands [16]. Japanese manufacturers also have a long history of producing iconic sports cars such as the Mazda RX-7, Nissan Skyline GT-R, Toyota Supra, and Honda NSX. In a survey among sports car enthusiasts, the Nissan GT-R was voted the best Japanese sports car of all time, while the Mazda MX-5 earned the title of the world’s best-selling sports car.

Overall, the global automotive industry can look to Japan’s experience as a model for integrating circular economy practices into production processes. Japan’s recycling performance is outstanding: the country recycles 98 % of its metals, and during the early 2000s-when the green economy was not yet a major agenda-only 5 % of Japan’s waste was not recycled, whereas in some of the most advanced European countries, such as Great Britain, this figure was 48 %. In the first decade of the 21st century, Japan’s recycling of electrical and electronic products significantly outpaced Europe’s 30-40 % recycling rates.

Several factors contributed to the incorporation of circular economy practices into Japanese production processes, and by 1991 Japan had embarked on a full transformation. These factors include:

High Population Density and Limited Land: Due to Japan's mountainous and volcanic terrain, available land is scarce. In the 1950s, this spurred the search for alternative solutions for space utilization, and by the 1990s, concerns over dioxins (which harm the immune system, cause reproductive and developmental issues, and increase cancer rates) forced a shift away from waste incineration.

Scarcity of Natural Resources: Although Japan is a major industrial manufacturer on the global market, it possesses very limited natural resources and mineral wealth. This scarcity has long encouraged the development of remanufacturing and reuse, which in turn has led the government to emphasize the circular economy in its policies.

Collaborative Business Culture: Japanese business culture places a strong emphasis on both quantitative outcomes and cooperative actions [17].

Nissan is one of Japan's largest automotive manufacturers. Founded in 1933, the company has consistently strived to produce innovative, convenient, and impressive technologies, vehicles, and services that stand apart from the rest, as stated on its official website.

Nissan's international expansion began in the 1950s, when the company started seeking consumers beyond its domestic market. At that time, Nissan's management recognized the unmet demand for small cars-initially marketed under the Datsun brand-in major markets such as Australia and the USA. Nissan first showcased its Datsun Bluebird model in Los Angeles in 1958.

Inspired by this success, Nissan later entered Middle Eastern markets as well. In 1957, vehicles under the Nissan brand were first sold in Saudi Arabia.

Over time, Nissan established numerous subsidiaries in various countries. Today, Nissan operates over 31 plants worldwide and offers its products and services in more than 190 countries. Nissan employs over 150,000 people globally. The table below **(Table 1)** presents the number of vehicles sold by Nissan and their total value.

Table 1

Number of vehicles manufactured by Nissan automotive company during the period of 2018-2022 [1]

Years	Number of manufactured cars	Revenue (billion $)	Cost (billion $)	Profit (billion $)
2018	5,522,548	104,4	87,2	17,2
2019	4,791,600	91,4	78,1	13,3
2020	4,198,806	71	61,5	9,5
2021	3,820,543	69,2	58	11,2
2022	3,305,204	79,9	67	12,9

Toyota was founded in 1937 by Kiichiro Toyoda and has since become one of the major automotive manufacturers. The company began its operations with the production of engine-powered vehicles and introduced its first passenger car in 1937. During the 1960s,

[1] Compiled by the author based on the data from the "Factory Warranty List."

as Japan's economy expanded and middle-class incomes increased, Toyota launched the "Toyota Corolla"- a car specifically designed for this growing demographic-which quickly became one of the world's best-selling automotive brands. The rapid growth of the Japanese economy facilitated Toyota's expansion into global automotive markets. Consequently, according to Forbes and Fortune magazines, Toyota is recognized as one of Japan's largest companies and was acknowledged as the ninth-largest company in the world in 2020.

Toyota is also one of the pioneers in the automotive industry to initiate environmentally friendly and efficient production processes. The following table **(Table 2)** provides statistical data on the vehicles produced by Toyota.

Table 2

Number of cars manufactured by Toyota during the period of 2018-2022[2]

Years	Number of manufactured cars	Revenue (billion $)	Cost (billion $)	Profit (billion $)
2018	10,602,559	253,4	210,9	42,5
2019	10,456,593	256,2	213,7	42,5
2020	9,919,759	226,5	191,5	35
2021	10,381,258	238,6	199,1	39,5
2022	10,558,367	258,4	219	39,4

South Korea. The history of South Korea's automotive industry dates back to the early 1950s. Korean automotive manufacturing initially developed under the influence of American and Japanese companies. In 1962, the South Korean government enacted the "Automotive Policy for Development" law, which restricted the entry of foreign companies into the Korean automotive market-except for those engaged in joint ventures with local enterprises. This policy was designed to support the development of new domestic startups and to nurture local automotive manufacturers.

In the same year, there were three major automotive manufacturing companies in South Korea: "Kyeongseng Precision" (which later changed its name to Kia Industry), "Ha Dong-hwan Automobile Industry," and "Saenara Automobile."

The period from the 1970s to the 1990s marked significant progress in the development of the Korean automotive industry and its expansion into global markets. The Pony model [18], produced by Hyundai Motor Company, was initially exported to Ecuador and later to Venezuela, Canada, and several other countries in South and North America. This model became one of the most successful and popular vehicles of its time.

Thus, South Korea, which initially developed its automotive industry by assembling imported parts, today ranks fifth in the world by production volume and sixth by automotive exports. Its major automotive manufacturers now include GM Korea, Hyundai Motor Group (and its affiliate Kia Corporation), and Renault Korea Motors. In 2023, South Korean automotive companies produced 4,243,597 vehicles [19].

Although "Hyundai Motors" was founded in 1947, it began its core operations in 1967. Like many South Korean automotive companies, Hyundai Motors initially operated in partnership with foreign companies (notably Ford Motors). The first vehicle produced jointly by Hyundai Motors and Ford Motors was the Cortina model.

[2] Compiled by the author based on the data from the "Factory Warranty List."

Hyundai Motors began independent production in 1974 - a milestone significantly influenced by George Turnbull, the former manager and director of British Leyland's Austin Morris division.

In 1975, the "Pony" model (pictured above) was introduced shortly after Hyundai Motors began operating independently, quickly gaining widespread acclaim. This model was not only popular in South Korea but also experienced rapid sales in international markets such as Ecuador and the Benelux[3] countries. It is noteworthy that this was the first model in the history of Korean automotive manufacturing.

Hyundai Motors entered the U.S. markets in the mid-1980s [20]. In 1986, the Hyundai Excel model was exported to the United States-marking the first Hyundai model to enter the American market. That same year, the model was featured in Fortune magazine's "Top 10 Best Products" list.

The next model to penetrate the American market was the Hyundai Sonata, produced in 1988, which was also the first model developed using Hyundai's own technology.

In addition, to enhance production efficiency and reduce its environmental impact, Hyundai Motors has gradually integrated circular economy elements into its manufacturing processes. In 1991, Hyundai Motors introduced its first pure electric vehicle project, known as the "Sonata Electric Vehicle." By the end of 1992, the company set a goal to test six electric-powered models.

At the 1995 Seoul Auto Show, the "FGV-1" hybrid electric vehicle was unveiled. Four years later, in 1999, production of the second-generation hybrid vehicle (FGV-2) began.

From 2009 onward, Hyundai Motors officially started manufacturing hybrid vehicles. Models in this series include the Avante, Santa Fe Hybrid, Sonata Hybrid, and Hyundai i20.

Kia Motors. In the 1960s, Kia Industry began assembling its first automobiles in partnership with Japan's Mazda. By 1974, Kia Motors had started producing passenger vehicles, and in the 1980s, it expanded into global markets. The company entered the U.S. market in 1987.

In 1981, Kia Motors was forced to halt its passenger vehicle production. That year, the South Korean government instructed Kia Motors to shift its focus to the production of light commercial vehicles, citing excessive competition in the passenger car market. This policy remained in effect until 1986 [21]. After this period, Kia resumed passenger car production and introduced the Kia Pride (a rebadged version of the Mazda 121).

By the late 1980s, Kia Motors had established a foothold in the American market. In 1992, it launched its U.S. dealership network, and in 1994, the introduction of the Kia Sportage significantly strengthened the brand's position [22]. By 1995, Kia Motors had nearly 100 dealerships across the United States, selling 24,740 vehicles that year.

Following the 1997 Asian financial crisis, Hyundai Motors acquired 51% of Kia Motors' shares. Today, Hyundai owns approximately two-thirds of Kia Motors.

Below is a statistical table (Table 3) showing vehicle production by Kia Motors.

[3] The trio consisting of countries such as Belgium, Luxembourg, and the Netherlands

Table 3

Number of cars manufactured by Kia Motors during the period of 2018-2022 [4]

Years	Number of manufactured cars	Revenue (billion $)	Cost (billion $)	Profit (billion $)
2018	2,812,294	48,6	41,4	7,2
2019	2,772,076	50,3	42,2	8,1
2020	2,606,832	54,4	45,3	9,1
2021	2,777,056	58,7	47,9	10,8
2022	2,903,619	68,9	54,3	14,3

Conclusion and Recommendations

The comparative analysis of China, Japan, and South Korea demonstrates that the circular economy has become a critical driver of transformation in the modern automotive industry. Each country's approach reflects its unique economic, environmental, and technological conditions, yet all share a common goal – achieving sustainable industrial growth through resource efficiency and waste minimization. China's success in promoting remanufacturing through financial incentives, policy reforms, and industrial clustering illustrates how strong government involvement can accelerate circular economy development. Japan's long-standing commitment to recycling and efficiency serves as a global benchmark for integrating sustainability into production systems. South Korea's advancements in electric and hybrid vehicle manufacturing highlight the role of technological innovation in achieving eco-friendly mobility solutions. In conclusion, the transition toward a circular economy ensures not only economic resilience and industrial competitiveness but also environmental preservation and social responsibility. The experience of these three leading Asian economies provides valuable insights for other nations seeking to balance industrial expansion with environmental sustainability in the automotive sector.

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