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# Comparative Analysis of National Automotive Policies with a Focus on Sustainable Development: Malaysia, Japan, Korea, China, India, the European Union (EU), and the USA

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**Abstract**

This journal article presents a comparative analysis of national automotive policies, specifically focusing on sustainable development in Malaysia, Japan, Korea, China, India, Europe, and the USA. The study examines the critical aspects of these policies, including their vision and objectives, regulatory frameworks, research and development initiatives, sustainable mobility efforts, and measures to promote environmental sustainability within the automotive sector. The article provides insights into how different countries approach sustainable development in their respective automotive industries by analyzing the similarities and differences among these policies. The findings contribute to a better understanding of the strategies and priorities adopted by these countries to achieve sustainable growth and mitigate environmental impacts in the automotive sector. The research outcomes can inform policymakers, industry stakeholders, and researchers in shaping future automotive policies and fostering international cooperation to address sustainability challenges in the global automotive industry.

**Keywords**: National Automotive Policies (NAP), Development, Camparative, Policy, Sustainability.

## Introduction

The automobile sector impacts worldwide economic development, technical progress, and environmental sustainability (Cioca, 2019; Miglani, 2019; Jia, 2023). This journal article compares the sustainable development strategies of Malaysia, Japan, Korea, China, India,

Europe, and the US in the automobile sector. Vision, goals, regulatory frameworks, research and development, sustainable mobility, and environmental sustainability in the automobile industry are examined (Hosseini, 2023; Zhao, 2023; Badri Narayanan, 2023). The article promotes sustainable practices in the global automobile sector by analyzing commonalities, variations, and best practices across various nations' regulations (NATSUDA, 2017). Malaysia, Japan, Korea, China, India, Europe, and the US have all established regulations to address environmental issues in their automobile industries (Ambiado, 2023). This comparative research illuminates various nations' strategies, goals, and accomplishments in incorporating sustainability into their automobile businesses (Solanki, 2023). Policymakers, industry stakeholders, and automotive researchers may use these insights to influence legislative choices, industry practices, and collaborative activities. The study also promotes worldwide collaboration and information sharing for sustainable automobile development (Drozdova, 2023). By comparing these policies, this study promotes global automobile sector economic development, technical innovation, and environmental stewardship. Vision, goals, regulatory frameworks, research and development, sustainable mobility efforts, and skills development are examined in these various automotive markets (Wade, 2023).

**Research objectives**

This research compares sustainable automobile policies in Malaysia, Japan, Korea, China, India, Europe, and the US. First, compare national automotive policies' sustainable development goals, objectives, and tactics. Second, this paper examines the essential characteristics and procedures of various nations' automotive industry sustainable development policies. This study will highlight successful initiatives and their lessons. Thirdly, evaluating the constraints governments face in adopting sustainable automobile legislation and providing solutions is crucial. This study aims to inform policymakers, industry stakeholders, and academics interested in automobile sector sustainability by meeting these research goals.

**Research Methodology**

The theoretical foundation for comprehending the link between national automotive policy and national sustainable development was built up in this research. Researching books, articles, reports, and government papers provides valuable secondary data. Policy implementation and issues are also examined via content analysis and stakeholder interviews. A thorough evaluation framework is constructed to analyze and compare national car policies. Emissions reduction goals, electric vehicle promotion, renewable energy integration, policy efficacy, industry collaboration, and public participation are examined in this research. Data is rigorously compared after developing the evaluation framework to evaluate each country's automotive rules. This study investigates sustainable automotive development's similarities, contrasts, advantages, and drawbacks. Results are easily communicated using charts and graphs. The end goal of this study is to showcase great methods and findings from the comparative examination, focusing on genuine policy efforts that have helped the car industry develop sustainably. National car policies are compared and analyzed in this study. According to this study, these policies impact sustainable development in the selected countries.

## Literature Review

### The Countrys' NAP analysis

This article investigates the challenges in implementing environmentally friendly and sustainable regulations that are part of the National Automotive Policy in a few nations. These measures aim to reduce the impact that automobiles have on the environment.

### Malaysia

According to the Malaysian Investment Development Authority (MIDA, 2021), Malaysia's National Car Policy (NAP) needs to address environmental and sustainability issues related to the auto industry. The goal of lowering greenhouse gas emissions should be ambitious. According to Songkin (2023), the National Automotive Policy (NAP) in Malaysia places a significant emphasis on promoting the adoption of electric and hybrid vehicles as a means to develop a transportation system that is more environmentally sustainable. The widespread adoption of electric vehicles necessitates the establishment of a resilient network of charging stations. As a result, Alganad (2023) emphasizes that the National Action Plan (NAP) must place a significant emphasis on the availability and accessibility of electric vehicle (EV) charging infrastructure. According to Rahman (2017), carefully recycling batteries can reduce emissions from electric vehicles.

To mitigate the ecological consequences associated with the sector, the National Action Plan (NAP) must advocate for using sustainable materials and implementing environmentally conscious manufacturing practices (Sulaiman, 2023). According to Fernando (2021), providing grants and tax breaks can incentivize the advancement of environmentally friendly technologies in the automotive industry. In order to mitigate emissions and alleviate traffic congestion, the management of end-of-life vehicles must incorporate recycling and appropriate disposal practices (Sulaiman, 2023; Ali, 2023).

To promote the adoption of environmentally sustainable automobiles, the National Action Plan (NAP) may incorporate various measures, such as tax incentives and subsidies. These measures could encompass tax breaks specifically targeted toward electric vehicle owners and reduced road tax rates for vehicles with low emissions (Hong, 2013; Asadi, 2021). The NAP could promote public awareness and understanding of sustainable transportation through public education. In order to effectively execute, there must be a collaborative effort among various stakeholders, including the government, the car industry, environmental organizations, and the general public (Bong, 2022). The necessity of regularly evaluating and analyzing the NAP is crucial in order to effectively respond to evolving circumstances and meet the objectives of sustainability (Husain, 2022).

### Japan

The Japanese government has taken measures to address automotive sustainability and environmental concerns (Suwa, 2020). Usman (2023) claims that several projects in the automobile sector concentrate on adopting electric vehicles (EVs), reducing pollutants, advancing green technologies, and incorporating renewable energy sources. Nevertheless, the widespread adoption of electric vehicles (EVs) is impeded by several factors, including a scarcity of charging infrastructure, battery production, and recycling challenges, concerns regarding range anxiety, and comparatively higher initial costs (METI, 2020). Setting well-defined targets and applying efficient approaches to reduce greenhouse gas emissions linked to transportation-related activities is critical to maintaining the transportation industry. According to Schulz (2019), it is advisable to promote the utilization of public transportation,

cycling, and automobile sharing, while prioritizing the development of charging infrastructure centered around renewable energy sources.

Tax incentives and reduced taxes could encourage the adoption of environmentally friendly vehicles. Implementing efficient procedures for recycling used cars is essential to reducing the adverse effects on the environment (NEDO, 2022). The dissemination of information to the general public regarding the environmental consequences of the automotive industry and the benefits associated with environmentally friendly modes of transportation is of utmost importance (Gutowski, 2005). Solving global environmental challenges in the automobile industry requires establishing international collaborative efforts focused on emissions regulations, fuel efficiency standards, and sustainable manufacturing practices (Ali, 2023). In the dynamic automotive sector, conducting regular assessments and making necessary policy adjustments is imperative to effectively attain environmental and sustainability goals (Botta, 2020).

**Korea**

South Korea has launched numerous measures to address environmental and sustainable responsibilities in the car sector (Murat et al., 2020). Since legislation and situations vary, use the newest sources. South Korea's National Automotive Policy faces environmental and sustainability issues (Ki, 2021). EV adoption is significant (Choi, 2023). They are charging infrastructure, battery technology, and consumer acceptance that slow electric vehicle adoption. Incentives, subsidies, and infrastructure charges may circumvent these limits (Ihm, 2023)—battery technology and recycling matter (Choi Y. a.-W., 2020). Electric vehicle battery manufacturing, disposal, and recycling in South Korea must be environmentally friendly (Chen, 2022). New battery technologies and recycling are needed for EV industry growth (Shafique, 2023). (Myung, 2020). Thus, South Korea's automotive policy should promote low-emission and zero-emission car technology and lower internal combustion engine emissions (Pearce, 2023).

Green technology and sustainable vehicle development are necessary for progress. R&D on electric and hydrogen fuel cell automobiles, lightweight materials, and eco-friendly manufacturing may enhance industrial innovation (Choi, 2023). Hydrogen fuel cells and electric vehicles provide sustainable transportation (Seo, 2020). Thus, fuel cell automobile growth needs hydrogen infrastructure with recharging stations (Kim, 2023). Public transportation, walking, and cycling may minimize vehicle industry pollution. South Korea should promote integrated and sustainable transportation to reduce traffic and pollution. Tax breaks, subsidies, and government incentives may increase eco-friendly automobile adoption (Estrada, 2023). End-of-life vehicle recycling and disposal reduce environmental impact. Recycle (Yi, 2023).

Promoting eco-friendly goods and processes in car manufacturing may significantly reduce the industry's environmental effects. (Kim S. T.-H., 2023). Environmental concerns need global collaboration. South Korea may work with other governments and organizations on emissions controls, sustainable manufacturing, and green technology (Park, 2023). The government, the automotive industry, research institutions, and environmental organizations must address these implementation issues. The policy must be regularly evaluated and amended to achieve environmental and sustainability objectives in the rapidly evolving vehicle industry (Thurbon, 2023).

**China**

The China National Automobile Policy tackles automotive sustainability and environmental issues (Ying, 2023). As laws and circumstances change, existing resources must be considered. The plan emphasizes electric vehicles (EVs) and charging infrastructure to boost EV sales and fulfill ambitious targets by 2023 (Peng, 2023). Conservation requires responsible battery recycling (Tang, 2023). China's growing industrialization and urbanization have caused air quality and pollution problems, especially in the automobile sector (Nyakuma, 2023). The policy should minimize internal combustion engine emissions and promote low- and zero-emission cars (Jiang, 2023). China might subsidize electric automobiles, hydrogen fuel cells, and green business research and development (Venkatraja, 2022).

Hydrogen fuel cell automobiles are a sustainable alternative to electric cars (Qian, 2023). Public transit and intelligent mobility alleviate congestion and pollution (Tan, 2023). Electric and green car owners get subsidies, tax refunds, and registration perks (Song, 2023). Environment-friendly car recycling and disposal should be rewarded (Li, 2014). Car manufacturers may also lessen their environmental effects by using eco-friendly materials and sustainable production practices (Wang, 2023). China can work with other countries on pollution management, sustainable manufacturing, and green technology to solve environmental challenges (Sheng, 2023). Policy execution requires strict environmental law enforcement. Governments, corporations, research institutes, and environmental organizations must collaborate to meet car sustainability goals and adjust policies (Liu, 2015).

**India**

Environmental and sustainability measures have targeted India's automobile industry (Singh, 2023). India's National Automotive Policy has environmental and sustainability concerns. The government's promoting electric vehicles (EVs) hinders India's automotive policy's environmental sustainability—government-targeted EV sales. Creating a reliable charging infrastructure, improving battery technology, and gaining public acceptance owing to high up-front prices and range anxiety will make the shift difficult (Ratra, 2023). Electric car growth requires adequate charging infrastructure. India's vehicle strategy should encourage private investment in cities and roadside charging stations (Sharma, 2022). Like other nations, India must address the environmental effects of battery production, recycling, and disposal. The policy should promote battery recycling and sustainable battery technology research (Asokan, 2023). India's automotive industry, which pollutes and generates greenhouse gases, should adopt cleaner vehicle technology, tight emissions laws, and internal combustion engine emission reductions (Digalwar, 2022).

Green technologies and sustainable automobile development are crucial. The Indian government may support electric cars, hydrogen fuel cells, and eco-friendly company R&D (Vapiwala, 2023). Electric and other eco-friendly automobile owners may get subsidies, tax rebates, and other financial incentives; thus, India's policy should encourage public transit and sustainable mobility (Singh et al., 2023). Recycling and discarding old cars lessen pollution. Recycle, reward. Sustainable automobile manufacturing may lessen environmental impacts. India requires green supply chains and manufacturing (Sureshkumar, 2023). Sustainable mobility and the automobile industry's environmental implications must be taught. The policy may educate people about eco-friendly driving and autos. Environmentalism necessitates worldwide cooperation (Chawla, 2023). India can collaborate on green manufacturing, environmental legislation, and technology. The government, the auto industry, academia, and environmental organizations must address these

implementation issues. The ever-evolving car industry in India needs a legislative review and reform to achieve environmental and sustainability goals (de Xavier, 2023) due to the rapid pace of change in the industry.

**European Union (EU)**

EU legislation aims to green the car industry (Rukanova, 2023). EU regulations are comprehensive, although European nations have their own (Rukanova, 2023). Europe's National Automotive Policy may face environmental and sustainability challenges (Ryner, 2023). Vehicles now meet or exceed stringent emission standards, reducing emissions of harmful gases and air pollutants. Maintaining these standards in Europe's diversified automobile sector takes much work. Several European countries are promoting EVs to minimize fossil fuel use (Corradi, 2023). Chargers, batteries, and user acceptability hinder EV adoption (Foley, 2010). Electric automobiles need ubiquitous charging. To provide dependable charging, countries, and communities must collaborate. To develop battery technology and recycling, battery manufacture, recycling, and disposal must be ecologically benign (Foley, 2010). Recycled batteries cut electric vehicle pollution.

Public transit, cycling, and walking may minimize traffic and pollution. Urban mobility requires better public transportation and bike-sharing (Attias, 2017). Subsidies may boost eco-car usage. Harmonizing European reward schemes is time-consuming (Rukanova et al., 2023). Efficient end-of-life vehicle recycling and disposal reduces waste and environmental damage. Localize recycling. Intelligent Transport Systems and Connected Vehicles increase traffic, pollution, and efficiency (Pichler, 2021). Green Production Sustainable automotive manufacture and materials may lessen environmental effects. Green technologies, alternative fuels, and environmentally friendly cars need R&D (Yilmaz, 2017). European environmental concerns need international collaboration, coordination, and policy alignment. Best practices may be shared internationally. Green car adoption involves customer awareness and education (Rezvani, 2015). Europe's diversified automotive sector and economic growth make a National Automotive Policy difficult. The EU, governments, manufacturers, research institutes, environmental groups, and others must work together to green the vehicle industry.

**USA**

The sustainability and environmental measures within the car sector in the United States have been discussed by (Wells, 2017). The following implementation challenges may affect the US auto industry's environment and sustainability (Mayyas, 2019). Cars need strict fuel efficiency requirements to reduce greenhouse gas emissions and improve fuel economy. Administration-to-administration legal changes may impact producers and consumers. Environment-friendly electric vehicle adoption must be accelerated (Li et al., 2019). EV adoption requires overcoming charging infrastructure, battery technology, and customer acceptability. Electric vehicle adoption requires charging infrastructure, but state-local cooperation is challenging (Nicholas, 2019).

Battery manufacture, recycling, and disposal must consider environmental consequences. Eco-friendly battery recycling and research are crucial. Green technologies, transportation, and R&D are essential (Ghosh, 2020). Government funding may encourage electric cars, hydrogen fuel cell vehicles, and eco-friendly enterprises. Subsidies and incentives may boost electric and eco-friendly car sales—state-specific, time-varying incentives (Barwick, 2023). Automotive and environmental regulation changes between

administrations may affect firms' long-term planning and investments in sustainable technology.

Public transit, carpooling, and alternate mobility may alleviate congestion and pollution. Green transportation requires sustainable urban mobility infrastructure. Car recycling and disposal reduces pollution. Recycle, reward. Intelligent Transport Systems and Connected Vehicles increase traffic, pollution, and efficiency (Lazarus, 2023). Greener production and renewable resources may lessen the car sector's environmental impact. Green car adoption involves customer education. Federal, state, and automotive manufacturers, research institutes, environmental groups, and other stakeholders must work to address these implementation challenges (Javadnejad, 2023). Greening the US automotive industry requires a consistent National Automobile Policy that supports long-term sustainability objectives.

**The National Automotive Policy on sustainability issues faced by Malaysia, Japan, Korea, China, India, EC, and USA.**

The sustainability issues in the car industries of Malaysia, Japan, Korea, China, India, the European Commission (EC), and the USA have been addressed through various policies. However, it is essential to note that these policies may have changed since the latest news and government sources need to be consulted for up-to-date information.

The National Automotive Policy (NAP) promotes developing and utilizing Energy-Efficient Vehicles (EEV) in Malaysia. Hybrid and electric automobiles are encouraged to reduce carbon emissions and fossil fuel use. The policy also emphasizes research into greener car technologies. Japan has been actively working on sustainability in its car industry. The Japanese government and manufacturers have heavily invested in Research and Development (R&D) to improve fuel economy, reduce emissions, and promote electric and hybrid cars. They also advocate the use of energy-efficient fuels and lightweight materials. Manufacturers focus on electric and hydrogen-powered cars in South Korea, and the government supports eco-friendly cars and automotive technology R&D. China, the world's largest auto market, faces significant sustainability challenges due to rapid vehicle ownership and urbanization. China has set ambitious goals for Electric Vehicle (EV) adoption to combat air pollution and carbon emissions and has been promoting battery and charging technology. Air pollution and energy usage issues have also plagued India's car sector. The Indian government has set targets for electric vehicle adoption and offers financial incentives to encourage people to buy them.

The European Commission has been actively addressing environmental issues in the automotive sector across its member states. The implementation of Euro 6 emissions standards has been successful in reducing car greenhouse gas emissions. The EC also promotes electric car charging infrastructure and clean vehicle development. In the USA, automakers have faced sustainability challenges. Restrictions on fuel economy and emissions are enforced by the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency (EPA).

Additionally, state rules encourage the adoption of electric automobiles. Each country has its own National Automotive Policy and sustainability measures to address environmental challenges in the automotive sector. Government policies and actions are crucial in providing the latest data and shaping the industry's future direction. Referring to the latest news and government sources is essential for the most current information.

**Framework cOmparison**

**1- The comparison of the sustainable development goals, objectives, and strategies of Malaysia, Japan, Korea, China, India, EC and USA NAP.**

Comparison of the sustainable development goals (SDGs), objectives, and strategies of Malaysia, Japan, Korea, China, India, the European Commission (EC), and the United States (USA) automotive policies. However, specific policies might have evolved or changed since then. It is best to refer to official government sources and up-to-date reports for the latest information.

| Country | Sustainable Development Goals | Objectives and Strategies |
|---|---|---|
| Malaysia | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities<br>SDG 13: Climate Action | • Develop and deploy energy-efficient vehicles (EEVs) to minimize carbon emissions and fossil fuel use.<br>• Promote greener automobile technology research.<br>• Improve public transportation for urban sustainability.<br>• Encourage electric and hybrid car adoption through incentives. |
| Japan: | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities<br>SDG 13: Climate Action | • Fund research to enhance conventional car fuel economy and improve pollution.<br>• Promote electric and hybrid vehicle development and adoption.<br>• Develop hydrogen fuel cell car technology and infrastructure.<br>• Promote lightweight vehicle construction to save energy. |
| Korea: | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities<br>SDG 13: Climate Action | • Develop and promote electric and hydrogen fuel cell cars to minimize air pollution and carbon emissions.<br>• Fund sustainable automobile technology research and development.<br>• Promote eco-friendly automobiles via incentives and policies.<br>• Improve public transportation infrastructure for sustainable urban mobility. |
| China: | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities<br>SDG 13: Climate Action | • Promote electric automobiles to reduce air pollution and carbon emissions.<br>• Promote battery and charging technologies for electric transportation.<br>• Set high goals for the production and sales of electric cars.<br>• Fund sustainable transportation research. |
| India: | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities<br>SDG 13: Climate Action | • Promote electric and hybrid cars to reduce emissions and enhance air quality.<br>• Provide electric car subsidies and incentives.<br>• Invest in sustainable vehicle technology research and development.<br>• Improve public transit for urban mobility. |
| European Commission (EC): | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities | • Reduce car greenhouse gas emissions by enforcing Euro 6 emissions regulations.<br>• Promote electric and alternative fuel vehicle research.<br>• Promote electric car charging facilities. |

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| | SDG 13: Climate Action | • Encourage public transit and sustainable urban planning. |
| United States (USA): | SDG 7: Affordable and Clean Energy<br>SDG 9: Industry, Innovation, and Infrastructure<br>SDG 11: Sustainable Cities and Communities<br>SDG 13: Climate Action | • Reduce carbon emissions by regulating vehicle emissions and fuel efficiency.<br>• Incentives and tax credits for electric and hybrid automobiles.<br>• Invest in the research and development of technologies for sustainable vehicles.<br>• Promote EV charging facilities. |

While all these nations share sustainable development goals, their economic, technical, and environmental environments may affect their aims and policies. These nations adapt their policies to solve automobile sector difficulties as sustainability remains a worldwide issue. Refer to each country's policies and activities for the latest information.

**2- The assessment of Malaysia, Japan, Korea, China, India, EC and USA NAP that encourage sustainable automobile growth and highlight best practices and lessons learned.**

Assessing the National Automotive Policies (NAPs) of Malaysia, Japan, Korea, China, India, the European Commission (EC), and the United States (USA) that encourage sustainable automobile growth reveals various best practices and lessons learned. Here is an overview of their strengths and areas of improvement

| Country | Best Practices | Lessons Learned |
|---|---|---|
| Malaysia | Malaysia's NAP focuses on:<br>• Supporting energy-efficient vehicle (EEV) development and adoption, promoting hybrid and electric vehicle adoption to reduce carbon emissions and fossil fuel consumption.<br>• Encourages clean car technology research and development. | • Malaysia can further enhance its NAP by strengthening its charging infrastructure and expanding the support network for electric vehicles (EVs).<br>• Emphasizing public-private partnerships could accelerate the growth of sustainable mobility solutions. |
| Japan: | Japan NAP focuses on:<br>• Innovation and substantial investment in R&D to enhance fuel economy, lessen emissions, and develop cutting-edge electric and hybrid car technology.<br>• The focus on hydrogen fuel cell vehicles is commendable, explore alternative clean energy sources. | • Japan can further bolster its NAP by promoting the adoption of EVs through a robust charging infrastructure and financial incentives.<br>• International collaborations in research and technology exchange can foster global sustainability efforts. |
| Korea: | Korea's NAP focuses on:<br>• Emphasis on the development and adoption of electric and hydrogen fuel cell vehicles.<br>• Focus on R&D in sustainable automotive technologies highlights a commitment to technological advancement. | • Korea can leverage its technological expertise to support the local manufacturing of EV components, reducing dependence on imports.<br>• Promoting EV adoption in public transportation, fleets, and government vehicles can set an example for sustainable mobility. |
| China: | China's NAP focuses on:<br>• Electric vehicle production and sales, making it the largest market for EVs.<br>• Investment in battery technology and charging infrastructure. | • China can work on further diversifying its EV models to cater to different consumer needs and preferences.<br>• Maintaining a stable supply of raw materials for EV batteries; therefore, |

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| | | balancing expansion with sustainable resource management is necessary. |
| India: | India's NAP focuses on:<br>• Reducing vehicular emissions and improving air quality<br>• Promoting electric and hybrid vehicles.<br>• Implementation of incentives and subsidies to encourage interest in EVs. | • India can develop a comprehensive strategy for recycling EV batteries to address potential environmental challenges associated with battery waste.<br>• A stronger emphasis on public transportation and sustainable urban planning can complement the adoption of EVs. |
| European Commission (EC): | The EC's NAP focuses on:<br>• Strict emissions standards and fuel efficiency regulations,<br>• Promoting a reduction in greenhouse gas emissions from vehicles.<br>• Support for research and development of clean vehicle technologies and charging infrastructure encourage market growth. | • The EC can work on harmonizing regulations and standards across member states to create a consistent and unified market for sustainable vehicles.<br>• Enhancing cooperation and knowledge exchange among European countries can accelerate sustainable mobility solutions. |
| United States (USA): | The USA's NAP focuses on:<br>• Sets emissions standards and fuel efficiency regulations,<br>• Addressing the impact of vehicles on climate change.<br>• Incentives and tax credits for electric and hybrid vehicles in promoting ev adoption. | • The USA can invest further in public charging infrastructure to alleviate range anxiety and increase EV adoption.<br>• Continued support for domestic manufacturing of clean vehicle components can strengthen the nation's automotive supply chain. |

These countries have made commendable efforts to promote sustainable automobile growth through their respective NAPs. Their best practices and lessons learned can serve as valuable references for other nations seeking to develop comprehensive and effective policies to address sustainability challenges in the automotive industry. However, continuous evaluation and improvement of these policies are essential to meet the ever-evolving needs of sustainable transportation.

### 3- The evaluation of Malaysia, Japan, Korea, China, India, EC and USA NAPs sustainable automobile policy implementation issues.

Evaluating the implementation issues of the National Automotive Policies (NAPs) for sustainable automobile growth in Malaysia, Japan, Korea, China, India, the European Commission (EC), and the United States (USA) reveals various challenges and opportunities for improvement. Here are some standard implementation issues observed across these countries

| Country | Issues |
|---|---|
| Malaysia | - Limited Charging Infrastructure: Malaysia needs help expanding the charging infrastructure for electric vehicles (EVs), which can hinder the widespread adoption of electric mobility.<br>- Slow Transition: Despite the NAP's focus on energy-efficient vehicles, transitioning to cleaner technologies might face resistance due to consumer preferences for conventional vehicles. |
| Japan: | - High Costs: The high cost of advanced automotive technologies, such as hydrogen fuel cell vehicles, poses challenges to widespread adoption. |

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|---|---|
| | - Infrastructure Development: Ensuring sufficient hydrogen refueling stations and charging infrastructure for EVs remains a hurdle in some regions. |
| Korea: | - Infrastructure and Range Anxiety: Although Korea promotes electric and hydrogen vehicles, developing a comprehensive charging and refueling infrastructure is essential to alleviate range anxiety and encourage adoption.<br>- Cost Barriers: The higher cost of eco-friendly vehicles than conventional counterparts can deter potential buyers. |
| China: | - Battery Supply Chain: The supply chain for essential battery components like lithium and cobalt has been a source of worry due to China's dominance in the EV industry.<br>- EV Market Saturation: As the largest EV market globally, managing the demand and ensuring sustainable growth poses challenges for the Chinese automotive industry. |
| India: | - Charging Infrastructure: Insufficient EV charging infrastructure remains a significant barrier to EV adoption, especially in smaller cities and rural areas.<br>- Awareness and Education: The general public may need more awareness and knowledge about EVs, impacting their acceptance and adoption. |
| European Commission (EC): | - Inconsistent Regulations: Harmonizing regulations and standards across EU member states can be challenging, leading to variations in policy implementation.<br>- Market Fragmentation: Differences in national incentives and subsidies may lead to market fragmentation and disparities in EV adoption rates. |
| United States (USA): | - Policy Uncertainty: Changes in government priorities and policies can create uncertainty for automakers and investors, impacting long-term planning and investments.<br>- Interstate Variation: Variations in state-level policies and incentives can lead to uneven growth in EV adoption across the country. |

**Opportunities for Improvement**

i. Collaboration and Knowledge Sharing: These countries can benefit from sharing best practices and lessons learned to accelerate the implementation of sustainable automobile policies.
ii. Investment in Infrastructure: Governments can allocate resources to develop robust charging and refueling infrastructure to support the transition to electric and hydrogen vehicles.
iii. Incentives and Support: Enhanced financial incentives and support for manufacturers and consumers can stimulate sustainable vehicle adoption.
iv. Research and Development: Continued investment in research and development will drive technological advancements and reduce the costs of sustainable automotive technologies.

Addressing the implementation issues and leveraging opportunities will be crucial for these countries to achieve sustainable development goals in the automotive sector. The ever-changing global landscape and technological advancements will heavily influence the future of sustainable transportation.

**Shortages and weaknesses of current NAPs**

The following are some common shortages and weaknesses in the implementation of the National Automotive Policies (NAPs) for sustainable automobile growth in Malaysia, Japan, Korea, China, India, the European Commission (EC), and the United States (USA):

| Country | shortages | weaknesses |
|---|---|---|
| Malaysia | **Charging Infrastructure:** Charging stations for EVs are still in short supply, which slows the mass uptake of electric transportation. **Consumer Awareness:** More awareness and education about the benefits and features of sustainable vehicles may help consumers choose energy-efficient options. | **Slow Adoption of Electric Vehicles:** Despite the NAP's focus on energy-efficient vehicles, adopting electric vehicles (EVs) has been relatively slow, partly due to limited charging infrastructure and consumer awareness. **Insufficient Incentives:** There might need to be more than the level of financial incentives and support for EV adoption to overcome the price gap between conventional and sustainable vehicles. |
| Japan: | **High Costs**: Initial costs for hydrogen fuel cell automobiles and other sustainable automotive technologies may be exorbitant. **Infrastructure Development:** Expanding hydrogen refueling stations and EV charging infrastructure needs further attention. | **High Costs**: The higher costs associated with advanced sustainable automotive technologies may limit their affordability for the general population. **Limited Hydrogen Infrastructure:** While Japan promotes hydrogen fuel cell vehicles, the availability of hydrogen refueling stations still needs to be improved, hindering widespread adoption. |
| Korea: | **Charging Infrastructure:** A lack of comprehensive charging infrastructure across the country challenges electric vehicle adoption and usage. **Consumer Acceptance:** Limited awareness and acceptance of electric and hydrogen vehicles can slow their market integration. | **Infrastructure Challenges:** Inadequate charging infrastructure and hydrogen refueling stations can restrict the growth of EV and hydrogen fuel cell vehicle markets. **Lack of Consumer Awareness:** Limited public awareness about sustainable vehicles and their benefits can slow the transition to cleaner mobility solutions. |
| China: | **Battery Supply Chain:** The increasing demand for electric vehicles has put pressure on the supply chain for critical battery materials like lithium and cobalt. **Charging Infrastructure:** Despite progress, more than the charging infrastructure might be required to support the rapidly growing number of electric vehicles. | **Overreliance on Incentives:** The heavy reliance on government incentives for EV adoption might create a dependency on subsidies, leading to market uncertainties when incentives are phased out. **Battery Supply Concerns:** Concerns regarding the availability of crucial battery materials, which might cause supply chain issues, have been |

| Country | shortages | weaknesses |
|---|---|---|
| | | prompted by the brisk expansion of the EV industry. |
| India: | **Charging Infrastructure:** Inadequate charging infrastructure, especially in rural areas, remains a significant hurdle for widespread EV adoption. **Affordability**: The higher upfront cost of electric vehicles than conventional vehicles is a barrier for price-sensitive consumers. | **Charging Infrastructure Gap:** A lack of widespread and reliable EV charging infrastructure can deter consumers from purchasing electric vehicles. **Manufacturing Capacity:** Scaling up manufacturing capacity for EV components and batteries might be a challenge for the Indian automotive industry. |
| European Commission (EC): | **Regulatory Fragmentation:** Differences in regulations and incentives across European countries can lead to a fragmented market for sustainable vehicles. **Charging Infrastructure:** Developing an extensive and interoperable charging network is crucial for encouraging electric vehicle adoption. | **Disparities in Policy Implementation:** The diversity of policy approaches and incentives across EU member states can create market fragmentation and uneven growth of sustainable vehicles. **Resource Management:** Addressing the environmental impact of battery materials and ensuring sustainable resource management remains essential. |
| United States (USA): | **Charging Infrastructure:** The inconsistent availability of charging infrastructure discourages cross-country EV adoption but makes long-distance EV travel more difficult. **Policy Uncertainty:** Changing political priorities and policy shifts can create uncertainty for automakers and investors. | **Varied State-Level Regulations:** The absence of consistent federal policies on sustainable vehicles and differing state-level regulations can create uncertainty for automakers and consumers. **Charging Infrastructure:** In certain regions, the availability of public charging infrastructure might need to be improved, affecting EV adoption rates. |

These shortfalls demonstrate the need to tackle fundamental issues to deploy NAPs successfully and sustainably. Improved areas include charging infrastructure, consumer awareness, technical developments, and regulatory support for sustainable transportation alternatives. NAPs must be evaluated and updated often to react to changing market conditions and vehicle technology. Governments, companies, and stakeholders must work together to fix these deficiencies. To meet NAP sustainability objectives, charging infrastructure, public awareness, regulatory simplification, and technology must be improved. Monitoring, evaluating, and updating rules will help the automobile sector manage novel challenges and seize new possibilities.

**Findings**

The findings shed light on the efforts made by these countries to foster sustainable development within their automotive sectors. Each country's policies are tailored to suit its unique economic, technical, and environmental background, with a strong focus on achieving Sustainable Development Goals (SDGs). These goals encompass promoting affordable and renewable energy sources, driving industrial innovation, creating sustainable cities, and taking decisive climate action. The study suggests several vital strategies to support sustainable development in the automotive industry. Firstly, there is a recommendation to accelerate the adoption of electric and hybrid vehicles, encouraging cleaner and more eco-friendly transportation options.

Secondly, substantial investments in research and development of cleaner technologies are crucial to advance sustainable practices within the automotive sector. Additionally, expanding charging infrastructure is essential to facilitate the broader adoption of electric vehicles. Tighter emissions and fuel efficiency requirements also significantly reduce greenhouse gas emissions and mitigate automobile pollution.

However, the study identifies particular challenges in implementing these policies, such as limited charging infrastructure, the high cost of sustainable technology, and inconsistencies in legislation. Continuous evaluation, flexibility, and international cooperation are emphasized to address global sustainability concerns as the automobile industry evolves. Promoting public awareness, embracing circular economy principles, and fostering public-private partnerships can expedite the implementation of sustainable automobile policies.

**Conclusion**

The research underlines the critical importance of sustainable automobile policies in achieving global environmental, energy, and green mobility objectives. Collaboration among governments, industry stakeholders, and the general public is crucial for developing a more sustainable and resilient automotive sector. Policymakers are encouraged to be proactive, agile, and innovative in tackling technological and environmental challenges to ensure a thriving industry and a sustainable planet.

**Suggestions**

The following proposals and recommendations may be taken into account to enhance the present National Automotive Policies (NAPs) and solve the shortfalls in implementing sustainable car policy in Malaysia, Japan, Korea, China, India, the European Commission (EC), and the United States (USA).

1. Enhance Charging Infrastructure: Invest in developing robust and widespread charging infrastructure for electric vehicles. This will help alleviate range anxiety and encourage consumers to adopt electric mobility.
2. Financial Incentives and Support: Provide attractive financial incentives and subsidies for purchasing sustainable vehicles to bridge the price gap between conventional and sustainable options. These incentives can include tax credits, reduced registration fees, and financial assistance for research and development.
3. Public Awareness and Education: Promote sustainable cars' environmental and economic advantages via public awareness initiatives. Raising awareness can increase demand and acceptance of eco-friendly mobility solutions.
4. Research and Development: Increase investments in research and development for advanced automotive technologies, including battery technology, fuel cells, and

lightweight materials. This will lead to technological advancements and cost reduction for sustainable vehicles.

5. Strengthen International Collaboration: Facilitate international collaboration and knowledge exchange among countries to share best practices and experiences in sustainable automobile policy implementation. This can accelerate progress and help overcome common challenges.
6. Harmonize Regulations: Work towards harmonizing regulations and standards across regions or states within countries. Consistent policies will create a level playing field and foster a more unified and efficient market for sustainable vehicles.
7. Support Local Manufacturing: Provide support and incentives for local manufacturing of sustainable vehicle components, batteries, and charging infrastructure. This will boost the domestic industry and reduce dependence on imports.
8. Circular Economy and Recycling: Implement policies to promote the recycling and proper disposal of batteries and other vehicle components. This will address environmental concerns associated with battery waste and encourage a circular economy approach.
9. Public-Private Partnerships: Encourage public-private partnerships to address sustainable automobile implementation challenges collaboratively. This can leverage the strengths of both sectors and foster innovation and investment.
10. Long-Term Policy Stability: Ensure long-term policy stability and continuity to provide certainty and confidence to automakers, investors, and consumers. Consistent and predictable policies will foster a conducive environment for sustainable automotive growth.
11. Focus on Smart Mobility Solutions: Emphasize the development of intelligent mobility solutions, such as connected and autonomous vehicles, to optimize transportation efficiency and reduce environmental impact.

By adopting these suggestions and recommendations, countries can strengthen their NAPs and accelerate the implementation of sustainable automobile policies. Creating a greener, more sustainable automotive future requires collaborative efforts, innovation, and a long-term commitment.

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