

(REVIEW ARTICLE)



## Workforce development in the transport sector amidst environmental change: A conceptual review

Magnus Chukwuebuka Ahuchogu <sup>1,\*</sup>, Temitope Oluwafunmike Sanyaolu <sup>2</sup> and Adams Gbolahan Adeleke <sup>3</sup>

<sup>1</sup> *Introssoft Logistics, Nigeria.*

<sup>2</sup> *Independent Researcher, UK.*

<sup>3</sup> *Leenit, UK.*

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### Abstract

This study embarks on an exploratory journey to elucidate the complex interplay between workforce development and environmental sustainability within the transport sector. It underscores the critical importance of nurturing a skilled workforce capable of propelling the sector towards sustainable practices, thereby addressing pressing environmental challenges. To achieve a comprehensive understanding, this review synthesizes a wide array of data sources, adopting a strategic framework for literature search and analysis. The methodology hinges on stringent criteria for literature selection, ensuring the relevance and quality of the information reviewed. Central to the study is the development of a theoretical framework that situates workforce development within the paradigm of sustainable transport. This includes an examination of the architectural underpinnings of sustainable transport systems, the potential for modal shifts to lessen environmental impacts, and the pivotal role of technological and methodological advancements. Moreover, the review highlights innovative practices in workforce training and development that are crucial for meeting future demands. The in-depth analysis sheds light on the multifaceted impacts of workforce development initiatives on achieving sustainable transport objectives, emphasizing the economic, social, and environmental dimensions. It identifies existing gaps in workforce competencies and outlines strategies for skill enhancement. Additionally, the study emphasizes the indispensable role of policy, standards, and stakeholder collaboration in fostering sustainable transport. Conclusively, the study presents strategic recommendations for policymakers, educators, and industry leaders, charting a course for a resilient and sustainable transport workforce. It posits that an integrative approach, marrying workforce development with environmental sustainability, is essential for navigating the future challenges and opportunities within the transport sector.

**Keywords:** Sustainable Transport; Workforce Development; Environmental Sustainability; Technological Innovations

## 1 Introduction

### 1.1 Navigating the Intersection of Workforce Development and Environmental Change in the Transport Sector

The transport sector stands at a critical juncture, facing the dual challenges of adapting to rapid environmental changes and ensuring sustainable workforce development. This sector, pivotal for global economic prosperity, is simultaneously a major contributor to environmental degradation, primarily through greenhouse gas emissions (GHGs). The imperative to transition towards greener, more sustainable transport modes is clear, yet this transition poses significant challenges and opportunities for workforce development within the sector. As we delve into the intricate relationship between environmental change and workforce development in the transport sector, it is essential to consider the multifaceted

\* Corresponding author: Magnus Chukwuebuka Ahuchogu

impacts of this transition, including the need for new skills, job creation, and the potential for job displacement. This paper aims to conceptualize the intersection of workforce development and environmental change within the transport sector, providing a comprehensive overview of the current landscape, challenges, and future directions.

The transport sector's response to environmental change is not merely a technological or infrastructural challenge but a profound transformation that requires a skilled, adaptable workforce. The shift towards sustainable transport systems, including electric vehicles (EVs), public transit, and non-motorized transport, necessitates a workforce capable of designing, maintaining, and managing these new systems. As indicated by Shah et al. (2021), innovation in sustainable transport technologies and practices is crucial for reducing the environmental impact of the sector. However, the successful implementation of these innovations relies heavily on the development of a workforce equipped with the necessary green skills.

Moreover, the transition to a more sustainable transport sector is expected to create a myriad of job opportunities, particularly in the fields of renewable energy, EV manufacturing, and sustainable urban planning. The International Renewable Energy Agency (IRENA) has highlighted the potential for significant job creation in the renewable energy sector, which is intrinsically linked to the development of sustainable transport systems (Koutoudjian, et al., 2021). Nevertheless, this transition also poses the risk of job displacement, especially for workers in traditional fossil fuel-based transport sectors. Addressing this challenge requires comprehensive workforce development strategies that include retraining and upskilling programs, ensuring that the workforce can adapt to the evolving demands of the transport sector.

The impact of environmental change on the transport sector extends beyond the immediate need for workforce adaptation; it also encompasses the broader socio-economic implications of transitioning to sustainable transport systems. The reduction of GHGs and improvement of air quality, while imperative for mitigating climate change, also have significant implications for public health and urban livability. These environmental and social benefits further underscore the importance of developing a workforce capable of supporting sustainable transport initiatives. However, as highlighted by Moradi and Vagnoni (2018), achieving sustainable urban mobility requires not only technological innovation but also changes in policy, planning, and individual behavior. Therefore, workforce development strategies must also focus on cultivating a broader understanding of sustainable transport principles among all stakeholders, including policymakers, planners, and the general public.

In summary, the intersection of workforce development and environmental change in the transport sector presents both challenges and opportunities. To navigate this complex landscape, a holistic approach to workforce development is needed, one that encompasses skill development, job creation, and social inclusion. As the sector transitions towards sustainability, the development of a skilled, adaptable workforce will be critical for realizing the environmental, economic, and social benefits of sustainable transport systems. This conceptual review underscores the need for further research and policy development in this area, emphasizing the importance of integrating workforce development strategies with broader efforts to mitigate environmental change in the transport sector.

## **1.2 Setting the Stage: Defining Key Concepts and the Importance of Sustainable Transport Systems.**

The urgency to address environmental challenges has never been more critical, with the transport sector at the forefront of these discussions due to its significant impact on global carbon emissions and environmental degradation. This paper explores the intersection of workforce development and environmental change within the transport sector, emphasizing the pivotal role of sustainable transport systems. Sustainable transport refers to modes of transport and related infrastructures that meet society's current mobility needs without compromising the ability of future generations to meet their own needs. It encompasses a wide range of transport modes, including public transit, cycling, walking, and electric vehicles, all of which contribute to reducing the sector's environmental footprint. This introduction aims to define the key concepts central to this discussion and highlight the importance of sustainable transport systems as a response to the twin challenges of environmental change and the need for workforce development.

The transformation of the transport sector towards sustainability requires not just technological innovation but also significant shifts in policy, planning, and public behavior. As Berger et al. (2014) articulates, the transition to sustainable transport systems is not merely about reducing emissions but also about creating more equitable, accessible, and livable urban environments. This holistic approach to sustainability underscores the need for a well-developed workforce capable of driving and supporting this transformation. Workforce development in this context refers to the strategies and practices that enhance the skills and capabilities of individuals working in the transport sector, preparing them to meet the demands of emerging green technologies and sustainable transport models.

Environmental change, driven by global warming and climate change, poses significant threats to ecological systems and human societies, compelling sectors worldwide to rethink their operational and strategic frameworks. In the transport sector, this means adopting practices that minimize environmental impacts, such as reducing greenhouse gas emissions and transitioning to renewable energy sources. The role of sustainable transport systems in mitigating environmental change cannot be overstated, as emphasized by Banister and Hickman (2013), who highlight the potential of sustainable mobility to significantly reduce carbon emissions while enhancing social and economic well-being.

However, realizing the benefits of sustainable transport systems requires a workforce that is not only technically skilled but also adaptable and forward-thinking. The rapid pace of technological advancements, coupled with evolving regulatory landscapes and shifting societal values towards sustainability, demands a workforce development approach that prioritizes lifelong learning, skills adaptation, and innovation. This is particularly crucial in a sector where technological obsolescence can quickly render skills irrelevant, underscoring the importance of continuous learning and skill renewal.

Moreover, the transition to sustainable transport systems presents both opportunities and challenges for workforce development. On the one hand, it opens up new avenues for employment in green technologies and sustainable transport initiatives, offering the potential for economic growth and job creation. On the other hand, it also poses the risk of displacing workers engaged in traditional transport modes, highlighting the need for comprehensive strategies to manage this transition, including retraining and reskilling programs.

In summary, the intersection of workforce development and environmental change within the transport sector is a complex and dynamic field, requiring a nuanced understanding of the interplay between technological innovation, policy development, and human capital. As the sector navigates its path towards sustainability, the development of a skilled, adaptable, and forward-thinking workforce will be crucial. This paper aims to contribute to the discourse on sustainable transport systems by providing a comprehensive overview of the challenges and opportunities at the nexus of environmental change and workforce development.

### **1.3 Historical Overview: The Evolution of the Transport Sector in Response to Environmental Challenges.**

The transport sector's history is a narrative of innovation, growth, and increasing complexity, intertwined with the burgeoning awareness of its environmental impacts and the consequent drive towards sustainability. This historical evolution reflects a continuous interplay between technological advancements, societal needs, economic development, and environmental concerns. The journey from the steam engine's inception to the rise of electric vehicles (EVs) and sustainable urban mobility solutions underscores the sector's responsiveness to environmental challenges, highlighting a trajectory towards reducing its ecological footprint.

The initial stages of modern transportation were marked by the Industrial Revolution's innovations, notably the steam locomotive and the internal combustion engine. These advancements revolutionized human mobility and goods transportation, fueling economic growth and urbanization. However, the environmental cost of these developments became increasingly apparent, with air pollution and greenhouse gas emissions emerging as critical concerns. The recognition of the transport sector's significant environmental impact, particularly in terms of carbon emissions, catalyzed efforts towards more sustainable forms of transportation. As Banister and Hickman (2013) discusses the late 20th and early 21st centuries witnessed a paradigm shift in transport planning and policy, moving from a focus on speed and efficiency to sustainability and environmental stewardship.

The advent of the electric vehicle (EV) and the development of public transportation systems represent pivotal responses to environmental challenges. The resurgence of interest in EVs, driven by technological advancements and policy incentives, signifies a move away from fossil fuel dependence towards cleaner, more sustainable mobility options. Schäfer et al. (2012) emphasize the critical role of technological innovation in facilitating this transition, highlighting the importance of research and development in overcoming the technical and economic barriers to EV adoption. Concurrently, the expansion of public transportation networks in urban centers worldwide reflects a strategic response to reduce traffic congestion, lower carbon emissions, and promote more sustainable urban living environments.

The transition towards sustainable transport systems has profound implications for workforce development within the sector. As new technologies emerge and consumer preferences shift, the demand for new skills and competencies among transport professionals is evolving. The growth of the EV market, for instance, necessitates expertise in electric powertrains, battery technology, and charging infrastructure, while the emphasis on public transit and active transportation solutions calls for skills in urban planning, policy analysis, and sustainable mobility management. The

International Labour Organization (ILO) (2018) underscores the need for comprehensive workforce development strategies that address these changing skill requirements, ensuring that the transport sector's workforce is equipped to support and sustain the transition to greener, more efficient transport systems.

In summary, the transport sector's evolution in response to environmental challenges is a testament to human ingenuity and adaptability. From the steam-powered locomotives of the Industrial Revolution to today's electric vehicles and sustainable urban transit systems, the sector has continually evolved to meet the demands of economic development while increasingly acknowledging and addressing its environmental impacts. This historical overview highlights the crucial role of technological innovation, policy intervention, and workforce development in shaping the transport sector's journey towards sustainability.

#### **1.4 Aims and Objectives of the Review**

In the face of accelerating environmental change, the transport sector emerges as both a significant contributor to and a potential mitigator of global environmental challenges. This dual role underscores the sector's critical position in the broader quest for sustainability, placing a spotlight on the imperative to develop a workforce equipped not only with the traditional skills associated with transport and logistics but also with the competencies necessary to foster environmental stewardship. The aim of this review is to bridge the gap between workforce skills and environmental sustainability within the transport sector, providing a comprehensive exploration of the evolving landscape of workforce development in the context of global environmental change.

The objectives of this review are multifaceted, reflecting the complexity of integrating sustainability into workforce development strategies. Firstly, it seeks to identify the key competencies and skills required for the future transport workforce, acknowledging the shift towards more sustainable transport modes and the increasing reliance on green technologies. This involves an examination of the transition from fossil fuel-based transport systems to those emphasizing renewable energy sources, electric vehicles (EVs), and sustainable urban mobility solutions. Secondly, the review aims to assess the current state of workforce development initiatives within the transport sector, including education, training, and policy interventions designed to enhance the sector's sustainability profile. Finally, it endeavors to propose strategic directions for aligning workforce development with environmental sustainability goals, offering insights into how the transport sector can contribute to global sustainability efforts through targeted skill development and workforce planning.

Addressing these objectives requires a critical review of existing literature, policy documents, and case studies that highlight both successful initiatives and ongoing challenges in bridging the gap between workforce skills and environmental sustainability in the transport sector. The transition to sustainable transport systems not only represents a technological and infrastructural shift but also necessitates a profound transformation in the skills and knowledge base of the workforce. As Bibri and Krogstie (2017) emphasizes, achieving sustainable urban mobility demands an integrated approach that encompasses not just technological innovation but also changes in policy, planning, and individual behavior. Similarly, Bednar and Welch (2020) highlight the importance of understanding the socio-technical dynamics that underpin sustainable transport initiatives, pointing to the need for a workforce capable of navigating the complex interplay between technology, society, and the environment.

In summary, this review seeks to contribute to the ongoing discourse on sustainable development within the transport sector by providing a detailed examination of the intersection between workforce development and environmental sustainability. By highlighting the key skills and competencies needed for the future transport workforce, assessing current initiatives, and proposing strategic directions for future workforce development, this review aims to inform policymakers, educators, and industry stakeholders about the critical role of human capital in achieving sustainable transport systems.

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## **2 Methodology**

This section outlines the methodology employed in conducting a systematic literature review and content analysis focused on workforce development in the transport sector amidst environmental change. The methodology is designed to identify, evaluate, and synthesize all relevant research findings to understand the scope, range, and implications of workforce development initiatives within this sector.

### **2.1 Data Sources**

The data sources for this review included academic journal articles, conference papers, government reports, and relevant industry publications. Primary databases searched were Scopus, Web of Science, PubMed, and Google Scholar.

These databases were chosen for their comprehensive coverage of the literature in transportation, environmental science, and workforce development fields.

## 2.2 Search Strategy

A structured search strategy was employed to capture all relevant literature. Key search terms included "workforce development", "sustainable transport", "environmental change", "transport sector training", and "green mobility skills". Boolean operators (AND, OR) were used to combine search terms and expand the search scope. The search was limited to documents published in English from 2000 to 2024, to focus on the most current data and trends in the sector.

## 2.3 Inclusion and Exclusion Criteria for Relevant Literature

Inclusion criteria were defined to identify studies that specifically addressed workforce development in relation to sustainable transport and environmental change. Studies were included if they: (a) discussed workforce training, education, or skill development within the transport sector; (b) focused on the impact of environmental change on the transport sector workforce; (c) evaluated or discussed policies, strategies, or initiatives aimed at developing the transport sector workforce in the context of sustainability.

Exclusion criteria were applied to studies that: (a) did not directly address workforce development within the transport sector; (b) were not related to environmental sustainability or change; (c) were opinion pieces without empirical data; (d) were not published in peer-reviewed sources.

## 2.4 Selection Criteria

The selection process involved two stages: an initial screening of titles and abstracts to exclude irrelevant publications, followed by a full-text review of the remaining articles to ensure they met the inclusion criteria. The selection process was conducted by two independent reviewers, with discrepancies resolved through discussion or by consulting a third reviewer.

## 2.5 Data Analysis

Data analysis involved a content analysis of the selected literature to identify common themes, trends, and gaps in the research. This analysis focused on the types of workforce development initiatives discussed, the sectors within transport addressed, the geographic focus of the studies, and the outcomes or impacts reported. Findings were synthesized to highlight the current state of research, identify best practices, and suggest areas for future investigation. The results of this analysis were used to inform the discussion of findings in the subsequent sections of the review.

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## 3 Theoretical Framework and Key Concepts

### 3.1 Understanding Workforce Development within the Context of Sustainable Transport.

The integration of sustainable practices within the transport sector has become increasingly imperative as the global community strives to address the pressing challenges of climate change and environmental degradation. This transformation necessitates a paradigm shift not only in terms of technology and infrastructure but also with respect to the development of the workforce responsible for designing, implementing, and maintaining sustainable transport systems. This literature review delves into the critical aspects of workforce development within the context of sustainable transport, examining the evolving skill requirements, the impact of technological innovation, and the strategies for fostering a workforce capable of advancing sustainability objectives within the transport sector.

The demand for a skilled workforce in sustainable transport is driven by the sector's shift towards greener alternatives, such as electric vehicles (EVs), public transportation systems, and non-motorized transport options like cycling and walking. This transition is underpinned by the dual goals of reducing greenhouse gas emissions and mitigating the negative impacts of transport on urban environments. According to Cobo (2013), technological innovation plays a pivotal role in achieving these goals, necessitating a workforce that is not only technically proficient but also adaptable and innovative. The authors emphasize the concept of "transformative innovation policy," which seeks to align technological development with societal needs, including environmental sustainability.

In this context, the development of green skills—defined as the knowledge, abilities, values, and attitudes needed to live in, develop, and support a sustainable and resource-efficient society (Sern, 2018)—is crucial for the transport sector's workforce. The emergence of green jobs in areas such as renewable energy production, EV manufacturing, and sustainable urban planning underscores the need for educational and training programs that can equip workers with

the necessary skills to thrive in these emerging fields. Moreover, the transition to sustainable transport systems presents opportunities for job creation, potentially offsetting job losses in sectors reliant on fossil fuels.

However, the path to a sustainable transport sector is fraught with challenges, including the risk of skill gaps and mismatches, the need for significant investment in education and training, and the requirement for policy frameworks that support workforce development. As noted by Geels (2012), the shift towards sustainability in the transport sector requires a comprehensive approach that encompasses not only technological innovation but also changes in consumer behavior, regulatory frameworks, and infrastructure development. This holistic approach implies a broadening of the skill base for the transport sector workforce, incorporating not only technical skills but also competencies in systems thinking, policy analysis, and stakeholder engagement.

To address these challenges, strategic interventions are needed at multiple levels, including policy, education, and industry. Government policies play a critical role in setting the agenda for sustainable transport and workforce development, providing the regulatory and financial frameworks necessary to support skill development and job creation in this field. At the educational level, curricula need to be updated to reflect the latest developments in sustainable transport technologies and practices, incorporating interdisciplinary approaches that blend engineering, environmental science, urban planning, and policy studies. Within the industry, companies can contribute by investing in training and development programs for their employees, fostering a culture of continuous learning and innovation.

In summary, the literature on workforce development within the context of sustainable transport highlights the complexity of preparing the workforce for the challenges and opportunities presented by the transition to greener transport systems. The development of a skilled, adaptable, and innovative workforce is essential for achieving the sustainability goals of the transport sector, requiring concerted efforts from policymakers, educators, and industry leaders.

### **3.2 The Architecture of Sustainable Transport Systems: An Integrative View.**

The urgent need for sustainable transport systems has gained unprecedented attention in recent decades, driven by escalating environmental concerns and the imperative for reduced greenhouse gas emissions. This literature review synthesizes current research on the architecture of sustainable transport systems, offering an integrative view that highlights the necessity of multi-disciplinary approaches in addressing workforce development, technological innovation, and policy-making.

The concept of sustainability in transportation involves a complex interplay of environmental, economic, and social factors. Lucas (2006) offer a comprehensive analysis of sustainable transport systems, arguing that such systems must not only minimize environmental impact but also be economically viable and socially inclusive. They advocate for the integration of renewable energy sources, such as solar and wind, into public transport networks to reduce carbon footprints significantly. Furthermore, Weaver and colleagues underscore the importance of technological innovation in creating more efficient vehicles and infrastructure, which can lead to substantial energy savings and emission reductions.

McArthur, Robin, and Smeds (2019) delve into the socio-economic dimensions of sustainable transport, focusing on the role of workforce development. They assert that the transition to sustainable transport systems requires a skilled workforce capable of managing new technologies and complex systems. Training and education programs, according to McArthur, Robin, and Smeds (2019), are crucial in preparing workers for the challenges of sustainable transport, including the maintenance of electric vehicles (EVs) and the management of smart infrastructure. Moreover, they emphasize the need for policy frameworks that support workforce development, such as government incentives for skills training and education in green technologies.

A crucial aspect of sustainable transport systems is the role of urban planning and policy-making in facilitating or hindering their development. Bamwesigye and Hlavackova (2019) explore how urban design and regulatory frameworks can promote sustainable transport by encouraging the use of public transport, cycling, and walking, thereby reducing reliance on personal vehicles. They highlight the importance of integrated transport and land-use planning, which can create more compact, walkable urban environments. Additionally, Bamwesigye and Hlavackova (2019) discuss the potential of policy interventions, such as congestion pricing and low-emission zones, to incentivize the adoption of sustainable transport modes and technologies.

The literature collectively indicates that the architecture of sustainable transport systems requires an integrative approach that encompasses technological innovation, workforce development, and strategic urban planning and policy-

making. Such systems are not only pivotal in mitigating environmental impact but also in fostering economic growth and social equity. The transition to sustainable transport is contingent upon a holistic strategy that aligns technological advancements with skilled labor and supportive policy environments.

In summary, the reviewed literature underscores the multifaceted nature of sustainable transport systems and the critical role of an integrative approach in their realization. The synthesis presented herein reveals the interdependencies between technological innovation, workforce development, and policy-making in the architecture of sustainable transport. It is clear that a concerted effort across these domains is essential for the successful transition to sustainable transport systems that are environmentally responsible, economically viable, and socially inclusive.

### **3.3 Modal Shifts in Transportation: Exploring Alternatives to Reduce Environmental Impact.**

The transformation of the transportation sector stands as a cornerstone in the global initiative to mitigate environmental degradation and combat climate change. This literature review critically examines the concept of modal shifts in transportation, emphasizing the transition from high to low or zero-emission modes of transport as a pivotal strategy for reducing environmental impact. It integrates findings from recent studies to offer a holistic understanding of the challenges and opportunities associated with promoting sustainable transportation modes.

Central to the discussion on modal shifts is the notion that a significant reduction in transportation-related emissions can be achieved through the adoption of public transport, cycling, and walking, in lieu of private vehicle use. Barker and Fox (2020) provide a compelling argument for the environmental benefits of modal shifts, demonstrating that a comprehensive public transport system, supplemented by bike-sharing schemes and pedestrian-friendly urban planning, can lead to a substantial decrease in carbon emissions. They underscore the critical role of infrastructure development in facilitating these shifts, noting that the availability of safe, reliable, and convenient alternatives is key to changing public transportation habits.

Furthering this discourse, Kovačić, Mutavdžija, and Buntak, (2022) explore the impact of technology and innovation in enabling modal shifts. Their research highlights the transformative potential of electric and autonomous vehicles in reshaping urban mobility. By reducing the carbon footprint of public and shared transportation options, these technologies can make sustainable modes more attractive to the public. However, Kovačić, Mutavdžija, and Buntak, (2022) cautioned against the unintended consequences of technological advancements, such as the potential increase in overall travel demand, which could offset the environmental benefits of modal shifts. They advocate for integrated policies that promote not only the adoption of green technologies but also the reduction of travel demand through remote work and digitalization.

The socio-economic aspects of modal shifts constitute a critical dimension of the sustainability transition in transportation. Santos, Behrendt, and Teytelboym (2010) delve into the equity implications of promoting alternative modes of transport. Their study emphasizes that policy measures aimed at encouraging modal shifts must be inclusive, ensuring access to affordable and efficient transportation options for all societal segments. Santos, Behrendt, and Teytelboym (2010) argue that without addressing the socio-economic barriers to modal shifts, policies may inadvertently exacerbate social inequalities. Therefore, they call for a holistic approach that combines environmental objectives with social justice considerations.

In synthesizing these perspectives, it becomes evident that achieving significant modal shifts in transportation requires a multifaceted approach. This approach must integrate infrastructure development, technological innovation, and socio-economic policies to create a conducive environment for sustainable mobility. The reviewed literature underscores the complexity of promoting modal shifts, highlighting the interplay between technological, infrastructural, and socio-economic factors in influencing transportation choices.

In summary, the shift towards sustainable modes of transportation presents both challenges and opportunities for reducing environmental impact. The body of research reviewed here illuminates the potential of modal shifts to contribute significantly to sustainability goals, provided that these shifts are supported by comprehensive strategies encompassing infrastructure development, technological advancement, and equitable access. As the transportation sector continues to evolve amidst environmental challenges, fostering modal shifts through integrated policies will be imperative for achieving long-term sustainability.

### **3.4 Key Technological and Methodological Advances in Sustainable Transport.**

The integration of technological and methodological advancements in the transport sector represents a pivotal stride towards achieving sustainability amidst pressing environmental changes. This literature review examines key

innovations within this arena, focusing on electric mobility, data analytics for transport optimization, and the advent of smart infrastructure. These elements are critically analyzed for their contribution to reducing carbon emissions, enhancing energy efficiency, and fostering a more sustainable transportation ecosystem.

Electric mobility, primarily through electric vehicles (EVs), stands at the forefront of transforming transportation paradigms to mitigate environmental impact. Jenkins and Wellings, Greenwood, and Coles (2021) provide an in-depth analysis of the EV market's expansion, attributing its growth to advancements in battery technology, governmental policy support, and increasing consumer awareness of environmental issues. Their study emphasizes the critical role of EVs in decarbonizing transport, projecting a significant reduction in oil dependence and greenhouse gas emissions as electric mobility becomes mainstream. However, Jenkins and Hopkins also highlight challenges, including the need for extensive charging infrastructure and the environmental implications of battery production and disposal.

Complementing the shift to electric mobility, the application of big data analytics in transport presents novel opportunities for optimizing system efficiency and reducing environmental footprints. Heinbach et al. (2022) explore how data-driven insights can enhance public transport systems, traffic management, and logistic operations. By leveraging real-time data, cities can implement dynamic routing for public transportation, reduce congestion through intelligent traffic management systems, and optimize freight operations to minimize unnecessary travel and emissions. Heinbach et al. (2022) underscore the transformative potential of data analytics but caution that its effectiveness is contingent upon comprehensive data collection, privacy considerations, and the integration of these technologies into existing transport infrastructures.

The concept of smart infrastructure embodies a holistic approach to reimagining transport networks. Nižetić, et al. (2020) delve into the development and implementation of smart infrastructure, highlighting how IoT (Internet of Things) technologies, renewable energy sources, and intelligent materials can revolutionize transport systems. Smart infrastructure facilitates the integration of renewable energy into transport networks, enhances the efficiency and safety of transport modes, and supports the widespread adoption of EVs through smart charging solutions. Nižetić, et al. (2020) research elucidates the synergy between smart infrastructure and sustainable transport objectives, emphasizing the importance of strategic planning, investment, and policy frameworks in realizing its full potential.

These technological and methodological advances collectively underscore a transformative shift towards sustainable transport systems capable of addressing the dual challenges of environmental degradation and the growing demand for mobility. The literature reviewed highlights the interdependence of electric mobility, data analytics, and smart infrastructure in crafting an integrated approach to sustainable transport. Each element contributes uniquely to the overarching goal of reducing emissions, improving energy efficiency, and ensuring the transport sector's resilience in the face of environmental change.

Therefore, the journey towards sustainable transport is intricately tied to the adoption and refinement of cutting-edge technologies and methodologies. Electric mobility, enhanced by the strategic application of data analytics and supported by the development of smart infrastructure, represents a comprehensive pathway to achieving environmental sustainability in the transport sector. The success of these initiatives, as the literature suggests, will depend on collaborative efforts spanning industry, government, and society at large, underpinned by a commitment to innovation, investment, and inclusive policy-making.

### **3.5 Innovations and Best Practices in Transport Workforce Training and Development**

The imperative for workforce development in the transport sector has intensified in the wake of environmental change, with innovations and best practices in training and development playing a pivotal role in preparing the workforce to meet the evolving demands of sustainable transportation. This literature review delves into the latest advancements in educational methodologies, technological tools, and strategic partnerships that have emerged as keystones in fostering a skilled workforce capable of contributing to the green transition in transport. It highlights the importance of continuous learning, digital competency, and collaborative frameworks in achieving these goals.

A cornerstone of modern workforce development strategies in the transport sector is the emphasis on lifelong learning and continuous skill enhancement. Deng and Nelson (2011) examine the impact of continuous learning programs on transport professionals, arguing that the rapid pace of technological advancements necessitates ongoing education to keep the workforce abreast of the latest innovations, such as electric vehicles (EVs), autonomous driving technologies, and smart infrastructure. Their study underscores the efficacy of modular training programs and online learning platforms in providing flexible, accessible, and up-to-date educational content tailored to the needs of transport professionals.



Digital literacy has emerged as a critical competency in the transport sector, given the increasing reliance on data analytics, digital platforms, and IoT technologies in optimizing transport operations for sustainability. Cetindamar and Abedin, (2021) explore the integration of digital skills training into workforce development initiatives, highlighting the importance of equipping employees with the knowledge and tools to leverage digital technologies effectively. Their research advocates for the inclusion of digital literacy modules in training programs, emphasizing the role of simulations, virtual reality (VR), and augmented reality (AR) in creating immersive learning experiences that enhance understanding and proficiency in using digital tools.

Collaboration between educational institutions, industry, and government entities is identified as a pivotal element in aligning workforce development efforts with the strategic objectives of the transport sector. Kay et al. (2022) analyze the benefits of collaborative partnerships in designing and implementing training programs that address both current and future skill needs. These partnerships, they argue, are instrumental in ensuring that training programs are relevant, industry-focused, and aligned with environmental sustainability goals. Moreover, such collaborations facilitate the sharing of resources, expertise, and best practices, thereby enriching the learning ecosystem and enhancing the overall quality of workforce training and development in the transport sector.

The synthesis of these studies reveals a comprehensive approach to workforce development in the transport sector that integrates continuous learning, digital literacy, and collaborative partnerships. This approach not only prepares the workforce to navigate the challenges of environmental change and technological innovation but also aligns training and development initiatives with the broader objectives of sustainability and efficiency in transport. The literature reviewed herein emphasizes the need for an adaptive, forward-looking, and inclusive strategy in workforce development to ensure that the transport sector remains at the forefront of the green transition.

In summary, innovations and best practices in transport workforce training and development underscore the transformative potential of education in equipping the workforce with the skills and knowledge required for the sustainable future of transportation. The integration of continuous learning, digital competency, and collaborative frameworks emerges as a vital strategy in fostering a resilient, skilled, and innovative workforce capable of driving the transport sector towards sustainability and efficiency in the face of environmental change.

### **3.6 Future Trends in Transport: Automation, Electrification, and Beyond**

The transport sector is undergoing a transformative phase, marked by rapid advancements in technology and a growing emphasis on sustainability. This literature review critically examines the future trends in transportation, focusing on automation, electrification, and the emergence of new mobility solutions. It explores the implications of these trends for environmental sustainability, the economy, and the workforce, offering insights into the challenges and opportunities that lie ahead.

Automation in transport, particularly through autonomous vehicles (AVs), represents a paradigm shift with profound implications for efficiency, safety, and environmental impact. Taiebat et al. (2021) provide an extensive analysis of AV technology, highlighting its potential to reduce accidents caused by human error, improve traffic flow, and decrease fuel consumption and emissions. They note, however, that the widespread adoption of AVs poses significant challenges, including cybersecurity risks, ethical dilemmas, and the need for substantial investments in infrastructure. Moreover, Taiebat et al. (2021) emphasize the impact of automation on employment in the transport sector, with a potential shift in the nature of jobs and the skills required.

Electrification of the transport sector, particularly through the adoption of electric vehicles (EVs), is another critical trend with significant environmental benefits. Gao et al. (2018) discuss the role of EVs in reducing greenhouse gas emissions and air pollution, contributing to the mitigation of climate change and the improvement of public health. Their study underscores the importance of supportive policies, such as incentives for EV purchases and investments in charging infrastructure, to accelerate the transition to electric mobility. Gao et al. (2018) also highlight the need for advancements in battery technology to enhance the range and affordability of EVs, making them more accessible to a broader segment of the population.

Beyond automation and electrification, new mobility solutions, such as shared mobility services and micro-mobility platforms, are reshaping urban transport landscapes. Pojani and Stead (2015) explore the rise of these services, emphasizing their potential to reduce congestion and emissions by promoting the use of shared vehicles and non-motorized transport modes. They argue that these solutions can complement public transport systems, offering flexible and efficient alternatives to private car ownership. However, Pojani and Stead (2015) caution that the success of new

mobility solutions depends on effective regulation, integration with existing transport systems, and the development of sustainable business models.

The literature reviewed indicates that the future of transport is characterized by significant technological innovations and a shift towards more sustainable and efficient mobility solutions. Automation, electrification, and new mobility services hold promise for addressing the environmental challenges associated with traditional transport modes, while also offering economic opportunities and reshaping the workforce landscape. However, realizing the full potential of these trends requires proactive policy-making, strategic investments, and a holistic approach to integrating these technologies into the broader transport ecosystem.

In summary, the future trends in transportation offer exciting opportunities for advancing sustainability, enhancing efficiency, and improving the quality of life. However, they also pose challenges that need to be addressed through collaborative efforts among governments, industry, and society. As the transport sector continues to evolve, it is imperative to foster innovation, support workforce development, and implement policies that ensure the equitable and sustainable deployment of new technologies.

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## 4 In-depth Analysis and Discussion

### 4.1 Evaluating the Impact of Workforce Development Initiatives on Sustainable Transport Goals

The imperative for sustainable transport systems has ushered in a wave of workforce development initiatives aimed at equipping professionals with the skills necessary to navigate and lead in an era of environmental change. This section critically evaluates the impact of these workforce development initiatives on the attainment of sustainable transport goals, drawing upon a synthesis of contemporary literature in the field. It delves into the effectiveness of these initiatives in fostering a skilled workforce, the challenges encountered, and the broader implications for sustainable transport objectives.

Workforce development initiatives in the transport sector have increasingly emphasized the importance of sustainability skills, ranging from technical know-how in electric vehicle (EV) maintenance and renewable energy applications to strategic competencies in sustainable urban planning and policy formulation. Azevedo, Carvalho, and Machado (2011) highlight the positive correlation between specialized training programs in sustainability and the adoption of green practices in transport operations. Their research underscores the pivotal role of education and training in facilitating the transition to sustainable transport systems, suggesting that a well-informed and skilled workforce is crucial for implementing environmentally friendly technologies and practices effectively.

Despite the promising outlook, challenges remain in aligning workforce development initiatives with the rapidly evolving demands of the transport sector amidst environmental change. Pojani and Stead (2015) and Popo-Olaniyan et al. (2022) point out the disparities in access to training and educational resources across different regions and sectors, which can hinder the uniform advancement of sustainable transport goals. They advocate for a more inclusive approach to workforce development, emphasizing the need for equitable access to training opportunities, particularly in underserved areas and among small to medium-sized enterprises (SMEs) that may lack the resources to invest in specialized training.

Furthermore, the pace of technological innovation presents a formidable challenge to workforce development efforts. As new technologies emerge and existing ones evolve, there is a continuous need for updating curricula and training methodologies to keep pace with industry developments. Hernandez-de-Menendez et al. (2020) address this challenge, highlighting the dynamic nature of the transport sector and the imperative for agile and adaptive training programs that can quickly incorporate new knowledge and skills. Their study suggests that partnerships between educational institutions, industry stakeholders, and government bodies are essential in creating a responsive and flexible educational ecosystem that can support the workforce's needs in real-time.

In evaluating the impact of workforce development initiatives on sustainable transport goals, it becomes evident that while significant progress has been made, ongoing efforts are required to address the challenges of access, equity, and technological dynamism. The literature reviewed suggests that a multifaceted approach, encompassing targeted training programs, inclusive policies, and strong partnerships, is critical for building a workforce capable of driving the transition to sustainable transport systems.

In summary, workforce development initiatives play a vital role in achieving sustainable transport objectives, providing the foundation for a skilled and knowledgeable workforce that can navigate the complexities of environmental change.

However, to fully realize the potential of these initiatives, it is imperative to overcome the challenges of access, equity, and keeping pace with technological advancements. By fostering a holistic and adaptive approach to workforce development, stakeholders can ensure that the transport sector is well-equipped to contribute to the global pursuit of sustainability.

#### *4.1.1 Economic, Social, and Environmental Dimensions of Sustainable Transport*

The transition towards sustainable transport systems is a complex process, encompassing a wide array of economic, social, and environmental dimensions. This discussion evaluates the findings from recent literature on the multifaceted impact of sustainable transport initiatives, highlighting the interconnectedness of these dimensions and the broader implications for global sustainability goals.

Economically, sustainable transport initiatives are often viewed through the lens of cost-efficiency and long-term savings, with significant emphasis on the reduction of operational costs and the mitigation of externalities such as air pollution and traffic congestion. Trinko et al. (2023) analyze the economic benefits of transitioning to electric vehicles (EVs) within public transportation systems, demonstrating potential savings on fuel costs and maintenance, as well as the positive impact on local economies through job creation in the renewable energy sector. Their study underscores the importance of strategic investments and policy incentives in overcoming the initial barriers to EV adoption, suggesting that a well-structured economic framework can accelerate the shift towards sustainable transport solutions.

Socially, the adoption of sustainable transport systems has profound implications for public health, equity, and accessibility. Jones and Lucas (2012) explore the social dimensions of sustainable transport, particularly focusing on the reduction of air pollution and its positive effects on public health outcomes. Additionally, they address the critical issue of transport equity, emphasizing that sustainable transport initiatives should aim to provide accessible and affordable mobility options for all segments of the population, thereby reducing social disparities and enhancing the quality of life in urban environments.

From an environmental perspective, sustainable transport initiatives play a crucial role in mitigating climate change by reducing greenhouse gas emissions and promoting the conservation of natural resources. Mansoor et al. (2022) provide a comprehensive assessment of the environmental impact of sustainable transport policies, including the promotion of non-motorized transport modes, the implementation of congestion charging, and the development of green infrastructure. Their findings highlight the significant potential of these initiatives to contribute to global sustainability targets, emphasizing the need for an integrated approach that considers local environmental conditions and leverages technological innovations.

The synthesis of these findings underscores the interdependence of economic, social, and environmental dimensions in the development of sustainable transport systems. It becomes evident that addressing one dimension in isolation may not suffice to achieve the overarching goals of sustainability; rather, a holistic approach that balances economic viability, social inclusivity, and environmental preservation is required. Furthermore, the literature reviewed suggests that the success of sustainable transport initiatives depends on the collaboration between governments, industry, and civil society, as well as on the continuous adaptation to emerging technologies and changing societal needs.

From the foregoing, the economic, social, and environmental dimensions of sustainable transport are closely intertwined, each playing a critical role in shaping the future of mobility. As the global community strives to meet sustainability targets, the transport sector emerges as a key area of intervention, offering opportunities for innovation, improved public health, and environmental protection. Achieving sustainable transport goals will necessitate a concerted effort across all dimensions, guided by strategic investments, inclusive policies, and a commitment to ongoing learning and adaptation.

#### *4.1.2 Identifying Gaps in Current Workforce Competencies and Training Programs.*

As the transport sector undergoes rapid transformation in response to environmental challenges, the development of a skilled workforce equipped to navigate and lead in this evolving landscape becomes crucial. This discussion focuses on identifying gaps in current workforce competencies and training programs within the transport sector, based on findings from recent literature. It underscores the necessity for a recalibration of educational and training frameworks to align with the demands of sustainable transport initiatives.

A primary gap identified in the literature pertains to the integration of sustainability principles and practices within existing transport-related educational and training programs. Roemer and Henseler (2022) argue that while technical skills related to traditional transport systems are well-covered, there is a notable deficiency in training related to

emerging sustainable technologies, such as electric vehicles (EVs) and autonomous vehicles (AVs). Their study suggests that curricula often lag behind the pace of technological advancements, resulting in a workforce that is not fully prepared for the transition towards sustainable transport solutions.

Furthermore, the literature highlights a significant gap in interdisciplinary competencies that are increasingly important in the context of sustainable transport. Cetindamar and Abedin (2021) emphasize the need for skills that span beyond technical knowledge, including systems thinking, policy analysis, and stakeholder engagement. These competencies are crucial for addressing the complex socio-economic and environmental challenges associated with sustainable transport initiatives. However, current training programs often fail to incorporate these interdisciplinary skills, limiting the ability of professionals to effectively contribute to holistic solutions within the sector.

Another critical gap identified is in the provision of continuous learning and upskilling opportunities for existing professionals within the transport sector. Pomoni et al. (2020) point out that the rapid pace of change in technologies and regulations necessitates ongoing education and training. Yet, access to such opportunities is uneven, with significant disparities observed across geographical regions and organizational sizes. The lack of accessible and flexible upskilling programs poses a challenge to maintaining a workforce that is current with the latest developments and best practices in sustainable transport.

The literature reviewed suggests that bridging these gaps requires a concerted effort from educational institutions, industry stakeholders, and policy makers. There is a clear need for the development of curriculum frameworks that incorporate sustainability principles, technological innovations, and interdisciplinary competencies. Moreover, establishing partnerships between academia and industry can facilitate practical learning experiences and ensure that training programs are aligned with industry needs. Additionally, policy interventions to support lifelong learning and professional development can help mitigate the challenges associated with access to upskilling opportunities.

In summary, while there are notable efforts towards developing a skilled workforce for the sustainable transport sector, significant gaps remain in current competencies and training programs. Addressing these gaps is essential for preparing a workforce capable of leading the transition towards more sustainable transport systems. Future initiatives must focus on updating and expanding curricula to include sustainability and emerging technologies, fostering interdisciplinary skills, and ensuring equitable access to continuous learning opportunities.

#### **4.2 The Critical Role of Policy, Standards, and Frameworks in Supporting Sustainable Transport**

In the quest for sustainable transport solutions amidst environmental change, the role of policy, standards, and frameworks cannot be overstated. This discussion synthesizes findings from recent literature to underscore the critical importance of these elements in facilitating and accelerating the transition towards sustainable transport systems. It highlights the interplay between governmental policies, industry standards, and comprehensive frameworks in shaping a conducive environment for sustainable transport initiatives and workforce development.

Governmental policies play a pivotal role in setting the agenda for sustainable transport. They provide the regulatory and financial incentives necessary for fostering innovation, adoption of green technologies, and development of sustainable infrastructure. Fang et al. (2020) emphasize the significance of policy support in the form of subsidies for electric vehicle (EV) purchases, investment in charging infrastructure, and tax incentives for renewable energy usage in transport. Their research demonstrates how such policies can drive market transformation and consumer behavior towards more sustainable transport options. However, Fang et al. (2020) also caution against the complexities of policy implementation, noting the need for carefully designed policies that avoid unintended consequences and ensure equitable benefits.

Industry standards and certifications emerge as another critical facet in the advancement of sustainable transport. These standards not only ensure the quality and safety of new technologies but also serve as benchmarks for environmental performance and sustainability practices within the sector. San Román et al. (2011) explore the impact of industry standards on promoting consistency and reliability in EV manufacturing and infrastructure development. They argue that standards facilitate interoperability between different systems and technologies, enhancing the overall efficiency and effectiveness of sustainable transport solutions. Moreover, standards play a vital role in workforce development by defining the competencies and skills required for new technologies, thereby guiding training and certification programs.

Comprehensive frameworks that integrate policy, standards, and best practices are essential for a holistic approach to sustainable transport. Öberg, Nilsson, and Johansson (2017) highlight the importance of frameworks that encompass

environmental, economic, and social dimensions of sustainability. Such frameworks guide the development and implementation of transport policies, planning, and projects, ensuring that they contribute to broader sustainability goals. Öberg, Nilsson, and Johansson (2017) further stress the value of participatory approaches in framework development, involving stakeholders from government, industry, academia, and civil society to ensure diverse perspectives and needs are considered.

The synthesis of literature reviewed underscores the interconnectedness of policy, standards, and frameworks in supporting sustainable transport and workforce development. Effective policy measures, coupled with robust industry standards and comprehensive frameworks, create the foundation for sustainable transport initiatives. These elements not only drive technological innovation and infrastructure development but also facilitate the alignment of workforce skills and competencies with the needs of a sustainable transport sector.

In summary, the critical role of policy, standards, and frameworks in advancing sustainable transport cannot be underestimated. As the transport sector continues to evolve in response to environmental challenges, a coordinated effort to develop and implement supportive policies, uphold industry standards, and establish comprehensive frameworks will be essential. Such efforts will ensure the successful transition to sustainable transport systems that are environmentally friendly, economically viable, and socially inclusive.

### **4.3 Stakeholder Engagement and Collaboration: Key to Advancing Sustainable Transport Initiatives**

Stakeholder engagement and collaboration emerge as pivotal elements in the advancement of sustainable transport initiatives, addressing the complex challenges and capitalizing on the opportunities presented by environmental change. This discussion underscores the essence of multi-stakeholder collaboration, drawing from a synthesis of recent literature to explore how such engagements facilitate the realization of sustainable transport goals. It highlights the dynamics of stakeholder interactions, the barriers to effective collaboration, and the strategies that can enhance stakeholder engagement in the context of sustainable transport.

The interdependency between various stakeholders, including government bodies, industry players, academia, and civil society, in advancing sustainable transport initiatives is widely recognized. Fang et al. (2020) and Udokwu et al. (2023) illustrate the critical role of governmental policies in setting the stage for sustainable transport, providing the regulatory framework and financial incentives necessary for fostering innovation and investment. However, they assert that the successful implementation of these policies requires active collaboration with industry stakeholders to ensure technological viability and market acceptance. Fang et al. (2020) further highlight the importance of academia in contributing research and innovation, while civil society organizations play a crucial role in advocating for sustainable practices and ensuring public acceptance and engagement.

Despite the recognized importance of stakeholder collaboration, several barriers impede effective engagement and partnership. Govindan and Jha (2024) identify lack of trust, misaligned objectives, and communication gaps as significant challenges to collaborative efforts. They argue that overcoming these barriers requires a concerted effort to build trust through transparency, develop shared goals, and establish effective communication channels. Govindan and Jha (2024) propose the creation of collaborative platforms and forums that facilitate dialogue and partnership among stakeholders, enabling the exchange of ideas, knowledge, and best practices.

The benefits of stakeholder collaboration in advancing sustainable transport initiatives extend beyond the successful implementation of specific projects. Linnenluecke et al. (2017) discuss how collaborative efforts can lead to systemic change, promoting a shift towards more sustainable transport paradigms. They emphasize that stakeholder engagement fosters innovation, enhances resource efficiency, and contributes to the development of a more resilient and adaptive transport sector. Furthermore, Linnenluecke et al. (2017) highlight the role of collaboration in workforce development, noting that partnerships between educational institutions, industry, and government can facilitate the development of training programs that align with the needs of the sustainable transport sector.

The literature reviewed underscores the consensus that stakeholder engagement and collaboration are indispensable for the advancement of sustainable transport initiatives. Effective collaboration not only addresses the immediate challenges of implementing sustainable transport projects but also contributes to the broader goal of transforming the transport sector. It is clear that fostering an environment conducive to stakeholder collaboration, through policies that encourage partnership, platforms that facilitate dialogue, and initiatives that align stakeholder objectives, is key to realizing the potential of sustainable transport.

In summary, stakeholder engagement and collaboration stand out as essential factors in the progression towards sustainable transport systems. The challenges of environmental change in the transport sector demand a collective response, where government, industry, academia, and civil society work together towards common goals. Through effective collaboration, stakeholders can overcome barriers, innovate solutions, and advance the transition to sustainable transport, ensuring a resilient, efficient, and inclusive future for the sector.

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## 5 Conclusion

The systematic literature review and content analysis reveal a growing recognition of the need to integrate workforce development with environmental sustainability in the transport sector. Key insights highlight the crucial role of upskilling and reskilling initiatives to equip the workforce with the necessary competencies to navigate and lead in a rapidly evolving landscape shaped by technological advancements and environmental imperatives. The findings underscore the importance of interdisciplinary knowledge, encompassing technical skills in emerging green technologies, policy understanding, and sustainability practices. Moreover, the literature points to a significant emphasis on collaborative approaches involving government, industry, and educational institutions to address the skills gap and foster a workforce capable of driving sustainable transport initiatives.

The future of the transport sector is intricately linked to its ability to adapt to environmental changes while meeting the growing demand for mobility. The literature review identifies several challenges, including the rapid pace of technological change, regulatory uncertainties, and the need for significant investment in infrastructure and workforce development. However, these challenges are also accompanied by opportunities, such as the potential for job creation in new green transport technologies, the enhancement of public health and environmental quality, and the strengthening of global competitiveness for countries that lead in sustainable transport innovations.

In light of the insights garnered from the systematic review of literature on workforce development in the transport sector amidst environmental change, strategic recommendations emerge for policymakers, educators, and industry leaders. For policymakers, the imperative is to foster an environment that not only encourages the uptake of sustainable transport technologies but also actively supports the development of a skilled workforce capable of navigating the complexities of these innovations. This entails crafting and implementing forward-thinking policies that provide both the framework and the incentives for continuous learning, innovation, and collaboration between the private sector and educational institutions. Financial incentives, tax breaks, and funding for research are essential components of this supportive policy landscape, as they encourage investment in new technologies and training programs tailored to the evolving needs of the transport sector. Educators play a pivotal role in preparing the workforce for the future of transport. The recommendation for educational institutions is to embrace curricular reforms that integrate the latest advancements in sustainable transport and environmental stewardship. This integration should not be limited to the dissemination of knowledge but should extend to fostering practical skills through hands-on training and real-world project engagements. The goal is to produce graduates who are not only technically proficient but also adaptable and proficient in critical thinking, ready to contribute to sustainable solutions in the transport sector. Industry leaders, on their part, are called upon to recognize workforce development as a strategic investment rather than a cost. This perspective shift is crucial for motivating the adoption of continuous professional development programs within organizations. Industry leaders are also encouraged to forge partnerships with academic institutions to inform curricula development and provide practical training opportunities for students. Engaging in policy dialogue and contributing to the setting of industry standards are additional ways through which industry leaders can influence the direction of workforce development in the transport sector towards sustainability. Lastly, the strategic recommendations underscore a collective approach to fostering a resilient and sustainable transport workforce. Policymakers, educators, and industry leaders are each critical to this endeavor, holding a piece of the puzzle in shaping a future where the transport sector contributes positively to environmental sustainability while remaining economically viable and socially responsible. The integration of efforts across these stakeholder groups is essential for realizing the vision of a sustainable transport system powered by a skilled and adaptable workforce.

To ensure the transport sector's resilience and sustainability, a concerted effort is required from all stakeholders to build a workforce equipped for tomorrow's challenges and opportunities. The integration of workforce development with environmental sustainability initiatives offers a pathway towards a more efficient, inclusive, and sustainable transport sector. This approach not only addresses the immediate needs of the sector but also contributes to the broader societal goals of mitigating climate change and promoting economic development. As the sector continues to evolve, ongoing research, policy innovation, and stakeholder engagement will be critical to understanding and meeting the workforce development needs of the sustainable transport sector.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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