



# Navigating Change

The Evolving Landscape of the Road Sector in Asia

*This paper was originally presented at the IRF World Congress 2024 held in Istanbul, Turkey in October 2024.*

# Navigating Change: The Evolving Landscape of the Road Sector in Asia

Sudhir Gota<sup>1</sup>, Alvin Mejia<sup>1</sup>, Jamie Leather<sup>2</sup>, Adwait Limaye<sup>1</sup>, Mel Eden<sup>1</sup>, Nestor Benjamin Soco<sup>1</sup>, Julia Funk<sup>3</sup>

<sup>1</sup> Asian Transport Outlook (ATO)

<sup>2</sup> Asian Development Bank (ADB)

<sup>3</sup> International Road Federation (IRF)

## Abstract

The decarbonization of Asia's transport sector presents a unique challenge. Despite possessing nearly 60% of the global population and producing half of the global GDP, Asia has only one-third of the world's road network and transport demand. This significant gap hinders access for millions: 25% of the rural population lacks all-season roads, and 75% of urban residents lack efficient public transit. However, Asia's development needs necessitate further growth in the transport sector. This creates a complex tension: how can transport decarbonization be achieved amidst rising road infrastructure development and activity?

This paper examines this "double-edged sword" of Asian road infrastructure. While roads foster access, connectivity, and economic development, they also contribute to road accidents, air pollution, and climate change. In response to the Paris Agreement and Sustainable development goals, many Asian countries are recalibrating their road policies to navigate the complex challenge. This paper analyses over 500 policy documents from 30 Asian economies, exploring key trends and insights. It examines how Asian low and middle-income countries are balancing access expansion, infrastructure development, and innovative economic instruments with efforts to reduce negative externalities.

## Introduction

The global shift towards net zero emissions, catalysed by the 2015 Paris Agreement, has prompted many countries to commit to economy-wide emission reduction targets, including specific goals for the transport sector. In Asia, roughly half of the countries have announced commitments to net zero emissions, necessitating sector-level implementation strategies.

Achieving the Paris Agreement's goal of limiting global warming to 1.5°C necessitates substantial emission reductions across all sectors and regions. While the exact emission cuts required from the transport sector by 2050 remain under discussion, early estimates suggest a target of 0.2 gigatons for Asia's domestic transport. However, this target could be higher depending on the near-term performance of other sectors and regions. Considering its contribution, the road subsector presents the most potential for significant emission reductions within the transport sector.

However, decarbonizing the road sector in Asia presents unique challenges and opportunities distinct from those in other regions. Despite accounting for 60% of the global population and half of the world's GDP in 2022, Asia possesses only one-third of the worldwide road network and transport demand (ITF, 2023; United Nations Department of Economic and Social Affairs Population Division, 2022; World Bank, 2023). Consequently, the region falls short of achieving two key access-related Sustainable Development Goals (SDGs), with 20% of its rural population lacking all-season road access and 75% of urban residents lacking efficient access to public transit (Gota et al., 2023). Furthermore, the latest

projections indicate that Asia may experience nearly 50% of the global increase in road transport demand for passengers and freight over the next three decades (ITF, 2023). This underscores the need for decarbonization within a growing sector where Asian governments prioritize economic development and poverty alleviation.

Decarbonizing Asia's road sector thus necessitates a multifaceted strategy that balances the need for expanded road infrastructure and increasing passenger and freight activity with environmental sustainability. This dual challenge presents a unique opportunity for Asian policymakers. With a significant portion of road infrastructure yet to be developed and a large part of the vehicle fleet still unmanufactured, policymakers of Asia and the Pacific region have the unique opportunity to incentivize the development of low-carbon road infrastructure and services from the outset.

This paper examines the evolving landscape of the road sector in Asia, capturing key insights, characteristics, consequences, and implications for transport policy, planning, and investments. By understanding the complex interplay of factors shaping this sector, we aim to contribute to developing effective and sustainable low-carbon road decarbonization strategies in the region.

## Methodology

This paper utilizes data that has been collected, collated, and organized by the Asian Transport Outlook (ATO), an initiative that is being supported by the Asian Development Bank (ADB), and the Asia Infrastructure Investment Bank (AIIB). ATO aims to strengthen the knowledge base on transport in Asia-Pacific. The ATO databases encompass national, urban, and project data. The national database includes data for 51 Asia-Pacific economies, while the urban database includes 460 centres (with detailed data for 50 Asian urban centres). These databases contain official and secondary data for various indicators across different transport modes, including roads. Moreover, ATO has a policy database comprising more than 500 policy documents for 25 Asian economies.

## State and Trends: Road Transport Sector in Asia-Pacific

In 2022, Asia and the Pacific contributed 37% of the total GHG emissions of road transport. Road transport GHG emissions contributed 88% of the total transportation-related (excluding international) GHG emissions in the same year. Within Asia, road transport GHG emissions have been growing at 3.3% per year since 2000, the fastest among the different transport sub-sectors. This underscores the critical need for the complete decarbonization of the road sector to meet ambitious emission targets (European Commission. Joint Research Centre., 2023)

Road construction has continued to expand in the last decade, growing at an average of 2.5% per annum since 2010, outpacing overall population growth (0.9% per annum) and economic growth (6% per annum) during the same period. However, overall vehicle growth is outpacing road construction growth as the vehicle fleet in Asia has grown by about 7.3% per annum.

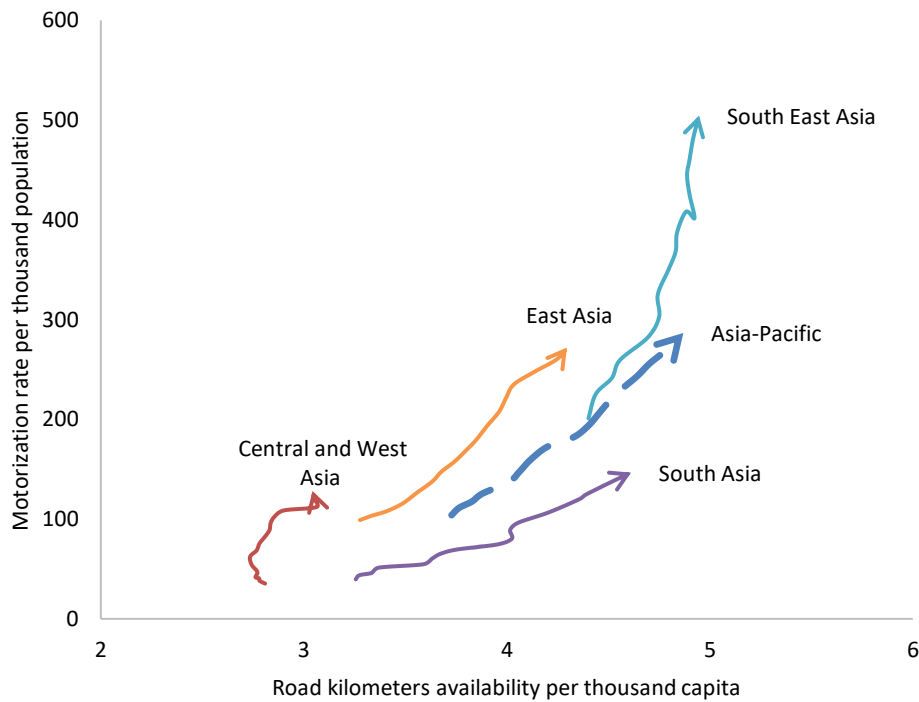


Figure 1. Motorization rate (vehicles/1000 people) and Road Kilometres/capita  
Source: Own analysis based on country statistics

The strong motorization trends in the region may very well be a response to the prevalence of low levels of accessibility to transport services. Many parts of developing Asia also still suffer from limited access to transport. It is estimated that around 1.8 billion people in Asia-Pacific do not have proper access to transportation services in urban and rural areas.<sup>1</sup> The prevalence of such issues related to primary access to transportation services remains a crucial motivation for the continued expansion of road infrastructure in the region.

Decarbonization policies in the region must also be cognizant of the different trajectories countries take regarding motorization paths. Figure 2 below depicts the diversity of motorization pathways in the region as characterized by the preference between smaller 2-wheelers and cars (light-duty vehicles or LDVs), and the scale by which countries are motorizing.

<sup>1</sup> Estimated based on figures derived from United Nations Department of Economic and Social Affairs (2023) and (Sustainable Development Solutions Network, 2023) and as per the SDG definitions (SDG 11.2 and 9.1.1). Access to public transport is defined in SDG indicator 11.2 as convenient when a low-capacity public transport stop (e.g. a bus stop) is accessible within 500 meters' walking distance along the street from a reference point such as a home, school, workplace, market, etc. and/or 1 km to a high-capacity system (e.g. rail, metro, ferry). SDG Indicator 9.1.1 measures rural access to transport infrastructure by the proportion of the rural population who live within 2 km of an all-season road. (United Nations Statistics Division, 2021).

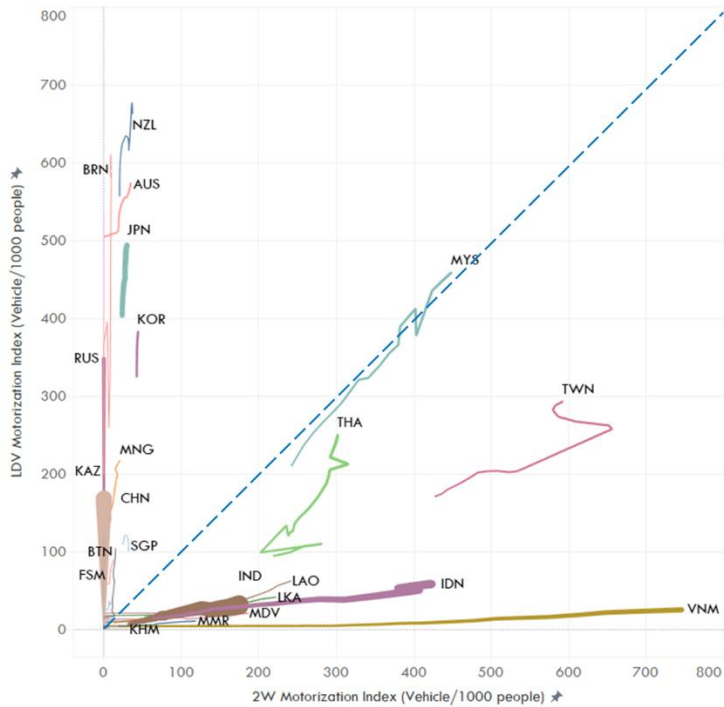


Figure 2. Motorization rates (vehicles/1000 people) LDVs and 2wheelers  
 Source: Own analysis based on country statistics

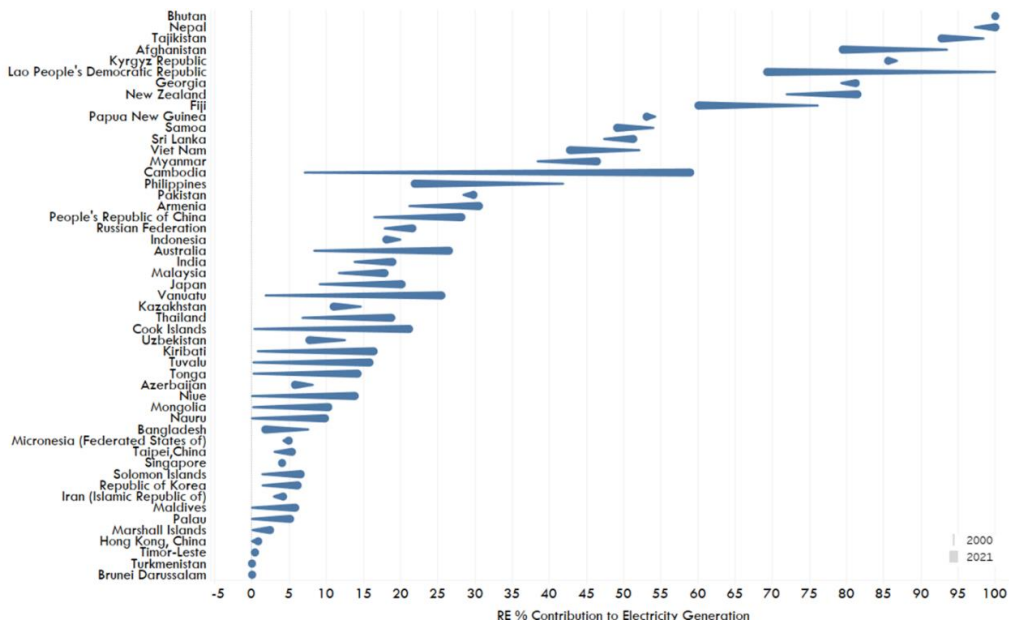


Figure 3. Percentage (%) Contribution of Renewable Energy Sources in Electricity Generation in Asia-Pacific  
 Source: Own visualisation based on data from International Renewable Energy Agency (2024)

The available data compiled by the UN on road electricity consumption shows that for those countries which have relevant data entries, the average percentage (%) share of electricity in road energy consumption is 0.44%, with China having the maximum share at 2.08% (United Nations Statistics Division, 2024). Based on data from (International Renewable Energy Agency, 2024) only twelve out of forty-nine countries in Asia-Pacific have electricity grids wherein at least 50% of the generation is supplied by

renewable energy.<sup>2</sup> The average % contribution by renewable energy in electricity generation in grids in Asia-Pacific is 29.5%, lower than the global average of 35%.

India, China, and Indonesia roughly account for 65% of the total vehicles registered in Asia.<sup>3</sup> These countries are served by electricity grids with low contributions from renewable sources. Asia (in particular, due to China) has been a forerunner in terms of the transition to e-mobility globally, as 64% of the 13.6 million electric cars, and 80% of the 47 thousand e-buses sold in 2023 were in Asia. However, Asia has a long way to go regarding total vehicle stock. IEA (2024) estimates that China has reached 7% electrification in its car stock, while India is at 0.3%. China is leading globally in bus electrification, reaching 25% in 2023.

Another issue that is intertwined with climate impact mitigation is climate adaptation and resilience. Asia's transportation infrastructure is disproportionately affected by the negative impacts of climate change. It is estimated that the region bears around 60% of the annual damage brought about by events due to climate change (and other natural hazards) while only having less than 40% of the world's transport infrastructure (Koks et al., 2019). Within Asia, road infrastructure accounts for more than 60% of the annual losses due to climate change and natural hazards (Coalition for Disaster Resilient Infrastructure, n.d.).

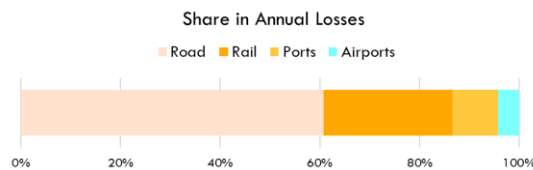


Figure 4. Share (%) in Annual Losses (USD) Due to Major Hazards

Source: Own visualization based on data from Coalition for Disaster Resilient Infrastructure (n.d.)

One positive development is related to air pollution from road vehicles. For example, particulate matter 2.5 - fine particles that can get deep into the lungs and the bloodstream – from road transportation has declined since the turn of the century. This can be attributed to various factors, particularly technological ones, such as adopting more stringent vehicle emission standards and fuel quality standards. The share of vehicle registrations in countries with Euro 4 or above emission standards has increased from 9% in 2010 to 89% in 2023.

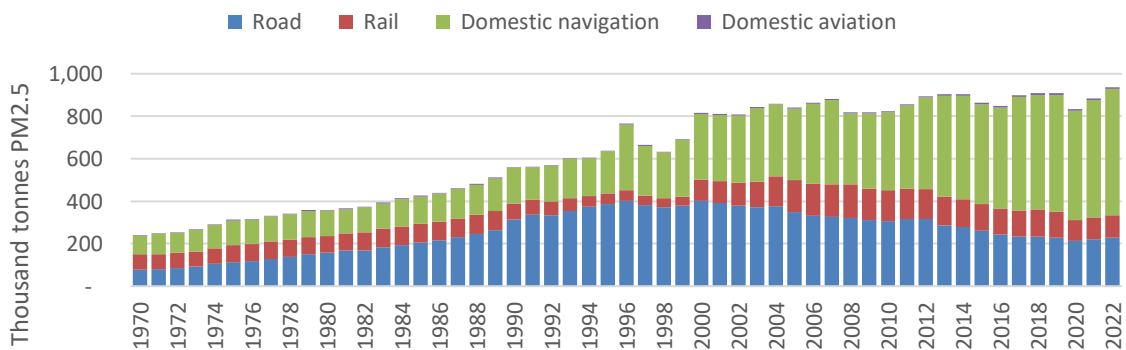


Figure 5. PM2.5 Pollution Loading by Mode

Source: Own visualization based on data from Ferrario et al. (2022)

<sup>2</sup> The selection of the countries is based on the geographical scope adopted by the Asian Transport Outlook project.

<sup>3</sup> Including 2 and 3 wheelers, light and heavy-duty vehicles. Estimated by the ATO team based on available country statistics.

## Evolving Road Sector Policies

The road sector policy evolution was considered through the lens of a policy tracker developed by the Asian Transport Outlook (ATO). The policy tracker provides a clear picture of ambition, targets, and policies in countries' national and urban policy documents, combining transport sector plans with other related sub-sectoral and connected policy documents such as energy plans, industrial plans, national decarbonization strategies, etc.

The policy database is not just a collection of policies but, in a way, a tracker that utilizes various lenses to categorize and analyse policy documents. Such an exercise has been applied to 25 Asian developing member countries with about 500 policy documents, showing several interesting trends. We are generally observing the expansion and diversification of road transport policy measures. The chart below depicts the evolution of keywords between policy measures that had been collected and published up to 2010 (left) and post-2010 (right). The evolution of the keywords depicts that the policy measures are diversifying and have included more dimensions aside from the focus on fuels and infrastructure.

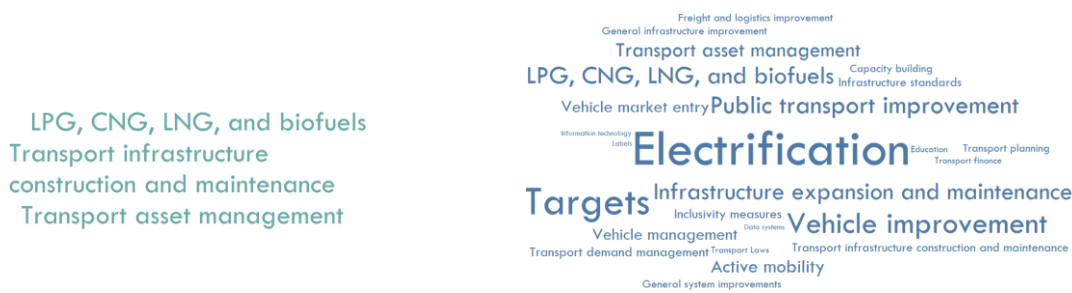


Figure 6. Count of Topics (Up to year 2000 – Left) and (2010 onwards – right)  
Source: Own visualisation using ATO's policy database<sup>4</sup>

The ATO policy database also utilizes a framework for tagging the policy measures based on whether they are focused on technologies, plans, institutions, economic measures, operational measures, informational measures, or regulations, or whether they are cross-cutting. The cumulative distribution of policy measures shows that regulations still dominate the landscape of road transport policy measures.

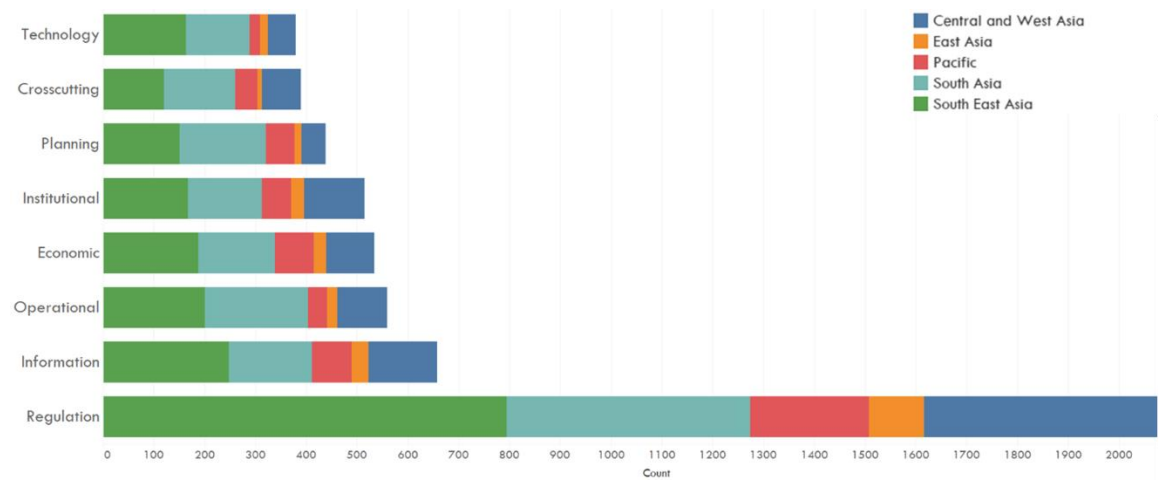


Figure 7. Types of Road Sector Policy Measures in Asia Pacific  
Source: Own visualisation using ATO's policy database

<sup>4</sup> Currently contains policies for 25 developing countries in Asia-Pacific.



Specific targets have also been related to the decarbonization of the road transport sector. The review of the policies for the twentyfive countries shows that ten countries have adopted net zero targets, the majority of them essentially have economy-wide targets, and twelve have transport sector-specific GHG emission targets. There are also related targets related to modal shift and energy consumption in the transport sector.

Table 1. Targets related to the Decarbonisation of Road Transport in Asia-Pacific

Countries	Net Zero Targets	Economy-wide Emissions Reduction Target	Transport Sector-wide Emissions Target	Modal Shift Targets	Energy Consumption in Transport Targets
Azerbaijan					
Bangladesh					
Bhutan					
Cambodia					
Indonesia					
Kazakhstan					
Kyrgyz Republic					
Lao People's Democratic Republic					
Malaysia					
Maldives					
Marshall Islands					
Mongolia					
Nauru					
Pakistan					
Palau					
Papua New Guinea					
Philippines					
Solomon Islands					
Sri Lanka					
Thailand					
Timor-Leste					
Uzbekistan					
Vanuatu					
Viet Nam					

Source: Own analysis based on the ATO policy database.

Some notable examples and key policy trends are summarised below.<sup>5</sup>

### 1. Emphasis on Sustainable Infrastructure Development –

- a. Papua New Guinea Updated NDC 2020 proposes that national roads and drainage infrastructure be built to climate-resilient codes and standards
- b. Sri Lanka's First Nationally Determined Contribution proposed climate-resilient building designing and alternative materials for construction
- c. Bhutan National Environment Strategy proposes planning the alignment of new roads carefully to avoid areas of ecological sensitivity, as well as cultural heritage sites, and minimizing the destabilization of slopes by avoiding full cuts, using excavators rather than bulldozers, and limiting blasting or using controlled blasting techniques, adding log or boulder barriers to control excavated material rolling downhill during construction, managing water flow carefully, stabilizing slopes with retaining structures, and undertaking bio-engineering for revegetation with retained topsoil.
- d. Viet Nam Road network planning for 2021-2030, vision to 2050 proposes prioritizing the application of new environmentally friendly technologies and nature-based solutions to minimize adverse environmental impacts.

<sup>5</sup> The following structure is partially based on Achieving the Aichi 2030 Declaration Goal 6 National Access and Connectivity- Road: Policy Action Recommendations ([https://uncrd.un.org/sites/uncrd.un.org/files/15th-est\\_pr\\_goal6-roads.pdf](https://uncrd.un.org/sites/uncrd.un.org/files/15th-est_pr_goal6-roads.pdf))

- e. Lao PDR Updated Nationally Determined Contribution promotes ecosystem-based adaptation solutions.

## **2. Enabling Renewable Energy Sources in the Road Transport Sector**

- a. Several countries (e.g. Indonesia, Marshall Islands, Nepal, Palau, Papua New Guinea, Philippines, Solomon Island, Sri Lanka, Thailand, Uzbekistan, Vanuatu, Vietnam) have policy documents that explicitly mention the utilization of renewable energy in road transportation.
- b. Countries have adopted varying levels of targets in terms of reaching specific levels of electricity generation contribution from renewable sources.
- c. Palau's Voluntary National Review (VNR) mentions an ideal mix of land use and transport integration (including active mobility infrastructure), combined with public transport and marine transport that are powered by renewable energy.
- d. Off-grid /on-site and in-vehicle charging of electric vehicles are also being aspired by several countries such as Papua New Guinea, Marshall Islands, Nepal. Several Asian countries are actively working to electrify their road networks. Cambodia's EV Roadmap 2022 focuses on strategically developing public EV charging infrastructure and encouraging private sector investment. The Philippines aims to add 66,500 EV charging stations by 2028, as outlined in its Comprehensive Roadmap for the Electric Vehicle Industry (2022). Malaysia plans to establish 9,000 AC charging points and 1,000 DC charging points by 2025, supported by tax incentives under the Green Income Tax Exemption, according to its Low Carbon Mobility Blueprint 2021-2030.

## **3. Prioritising Road Asset Management Policy and Strategy** – Many Asian countries are strengthening Road Asset Management, which is crucial in pursuing road sector decarbonization. Effective management of road infrastructure, optimizing road design and maintenance, and integrating innovative technologies to enhance the efficiency of vehicles are critical. Furthermore, resilient road infrastructure is vital for disaster risk reduction, protecting vital transportation routes, and ensuring the continuity of essential services. Some examples of policy recommendations include

- a. Azerbaijan State Program of Azerbaijan Republic on Road Safety for 2019-2023 proposes the Preparation of 5-year action plans by relevant organizations for coordination during the design, construction, repairs, and reconstruction of motorways and presenting it to a single supervisory body for road safety, preparation and approval of a single action plan on design, construction, repairs, and reconstruction of motorways on the base of proposed activity plans.
- b. Timor-Leste Strategic Development Plan 2011-2030 proposes developing a comprehensive road maintenance program.

## **4. Treating Road Network Investment Plans as One Component of Integrated Multimodal Transport Systems** – Countries have started thinking of Lifecycle planning principles to guide the development of rolling, long-term plans that align with the broader asset management strategy. A comprehensive investment plan identifies and prioritizes road maintenance backlogs to ensure a good level of service and identifies and allocates funding sources for the maintenance and renewal of the existing road network. For example, Cambodia National Strategic Development Plan 2019-2023 proposes strengthening the quality of maintenance,

repair, and construction work and ensuring the flow of the national budget on the routine maintenance and periodic maintenance of the network road network.

5. **Promoting Performance-Based Contracts** - Countries are increasingly considering performance-based contracts (PBCs) for road asset management due to their potential to deliver several key advantages. Unlike traditional contracts focusing on inputs or completed tasks, PBCs tie payments to achieving specific performance targets, such as road quality, safety, or user satisfaction. This shift in focus incentivizes contractors to prioritize efficiency, innovation, and long-term sustainability. For example, the Sri Lanka Public Investment Program 2021 proposes introducing alternative funding mechanisms such as output and performance-based road maintenance.
6. **Adopt a Digital Strategy for Roads** – Many countries recognize digital strategies have immense potential to revolutionize road infrastructure and management. By embracing intelligent transportation systems, data analytics, and smart sensors, countries are trying to transform roads into safer, more efficient, and sustainable road networks. For example, the Vanuatu Roads for Development Program recommends developing and implementing a fit-for-purpose digitalization strategy to improve information management and automate key business and work processes in systems such as the Road Asset Management System.
7. **Identifying rural areas with the highest potential for development** through road infrastructure is now a strategic priority. Countries are adopting sophisticated tools to pinpoint optimal investment areas, ensuring maximum impact. For instance, Cambodia's Rural Roads Policy prioritizes regions with a high density of rural poor and those with significant development or tourism potential while also considering transport connectivity. This multifaceted approach emphasizes economic, social, and environmental factors to determine road development priorities, ensuring a holistic and effective strategy for rural growth. Another example includes the Bhutan National Transport Policy - Policy Protocol Report, which recommends specifying asset performance indicators for each road class, developing a scientific assessment of present conditions, and rationally determining its priorities for maintenance interventions.
8. **Developing Disaster Preparedness Plans** - Developing Disaster Preparedness Plans for road infrastructure is now a critical strategy for countries aiming to enhance resilience and minimize disruptions in the face of natural disasters. By proactively identifying vulnerabilities in road networks and outlining mitigation measures, nations can ensure quicker response and recovery times after catastrophic events. For example,
  - a. Vanuatu National Policy on Climate Change and Disaster-Induced Displacement 2018 proposes developing a relocation plan based on a comprehensive assessment of the different needs of men, women, children, and vulnerable and minority groups, including social-cultural dimensions.
  - b. Sri Lanka National Road Master Plan 2021-30 proposes the development of a Disaster Planning System (DPS) that allows recording information related to natural disasters such as flooding, landslides, river/sea erosion, etc. Sri Lanka National Transport Policy of Sri Lanka 2017 suggests using disaster impact assessment to identify adverse effects and incorporate mitigatory measures at the planning and design stages. Identify alternatives for any emergency (evacuation or diversion).
9. **Adopting green solutions in road infrastructure development and operations** - The Asian Development Bank's Green Roads toolkit offers practical solutions for developing green roads and guiding sustainable planning, construction, and maintenance.(Asian Development Bank,

2024) Designed to support national teams/governments, it helps identify suitable green road practices aligned with existing policies and objectives, considering each country's unique context. The toolkit's primary goal is to assist in assessing the current environment and identifying areas for improvement, facilitating broader green road implementation.

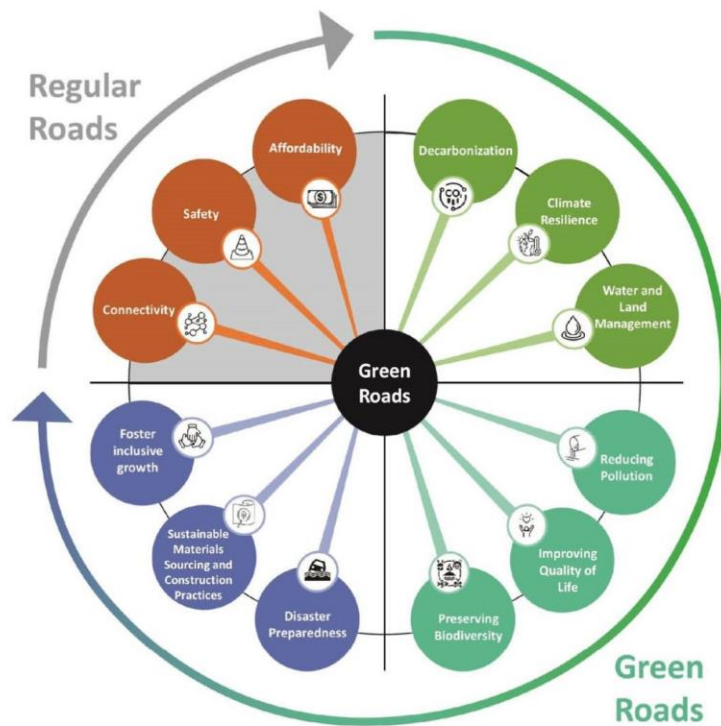


Figure 8. Green Roads Toolkit  
Source: (Keller, 2024)

**10. Promoting Knowledge Sharing and Regional Transport Initiatives** – To effectively address the evolving challenges of the road sector in Asia, enhanced collaboration among international organizations, regional bodies, and national governments is crucial. By establishing joint initiatives focused on decarbonizing road transport, stakeholders can pool resources and expertise to tackle cross-border connectivity issues and promote regional integration. Regional initiatives such as the High-Level Environmentally-Sustainable Transport (EST) Forum in Asia, established in 2005, serve as valuable platforms for high-level policy dialogue and knowledge sharing among relevant ministries, as coordinated by the United Nations Centre for Regional Development (UNCRD-DSDG/UN DESA, n.d.). Advanced economies and international institutions can be pivotal in offering technical assistance and knowledge transfer on sustainable infrastructure development, renewable energy integration, and resilient road planning. Capacity-building initiatives, workshops, and webinars can disseminate best practices and lessons learned, empowering regional stakeholders to implement effective strategies for a greener, more efficient road sector.

## Summary

The paper discusses the challenges and opportunities in decarbonizing the road sector in Asia. It highlights the region's unique context, with a large population and growing economy but limited road infrastructure. The paper emphasizes that decarbonizing Asia's road sector requires a balanced approach considering

the need for expanded and resilient road infrastructure while prioritizing environmental sustainability. It also discusses the evolving landscape of road sector policies in Asia, highlighting key trends and insights from various policy documents. These trends include focusing on sustainable infrastructure development, enabling renewable energy sources, prioritizing road asset management, integrating road network investment plans with multimodal transport systems, promoting performance-based contracts, adopting digital road strategies, identifying rural areas with high development potential, developing disaster preparedness plans, adapting green roads toolkit and promoting regional knowledge sharing and regional road transport Initiatives.

## References

- Asian Development Bank. (2024). *Green Roads Toolkit*. <https://data.adb.org/dataset/green-roads-toolkit>
- Coalition for Disaster Resilient Infrastructure. (n.d.). *Global Infrastructure Risk Model and Resilience Index*. GIRI. <https://giri.unepgrid.ch/facts-figures/building-infrastructures>
- European Commission. Joint Research Centre. (2023). *GHG emissions of all world countries: 2023*. Publications Office. <https://data.europa.eu/doi/10.2760/953322>
- Ferrario, F. M., Crippa, M., Guizzardi, D., Muntean, M., Schaaf, E., Banja, M., Pagani, F., & Solazzo, E. (2022). *EDGAR v6.1 Global Air Pollutant Emissions*. <http://data.europa.eu/89h/df521e05-6a3b-461c-965a-b703fb62313e>
- International Renewable Energy Agency. (2024). *IRENASTAT*. <https://pxweb.irena.org/pxweb/en/IRENASTAT/>
- ITF. (2023). *ITF Transport Outlook 2023*. OECD. <https://doi.org/10.1787/b6cc9ad5-en>
- Keller, G. R. (2024, April). *Building Climate Resilience into Road Development” Green Roads Toolkit for the Asia-Pacific Transport Sector*. <https://events.development.asia/system/files/materials/2024/03/202403-building-climate-resilience-road-development-green-roads-toolkit-asia-pacific-transport.pdf>
- Koks, E. E., Rozenberg, J., Zorn, C., Tariverdi, M., Vousdoukas, M., Fraser, S. A., Hall, J. W., & Hallegatte, S. (2019). A global multi-hazard risk analysis of road and railway infrastructure assets. *Nature Communications*, 10(1), 2677. <https://doi.org/10.1038/s41467-019-10442-3>
- UNCRD-DSDG/UN DESA. (n.d.). *Environment—Environmentally Sustainable Transport (EST)*. Retrieved June 27, 2024, from <https://uncred.un.org/content/environment-est>
- United Nations Department of Economic and Social Affairs Population Division. (2022). *World Population Prospects*. <https://population.un.org/wpp/>
- United Nations Statistics Division. (2024). *UNdata Energy Statistics Database*. <http://data.un.org/Explorer.aspx>
- World Bank. (2023). *GDP, PPP (current international \$)*. World Bank Open Data. <https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD>