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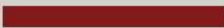


Inclusive Net-Zero Transport in Cities of Gujarat

Stakeholder Consultation Workshop Report 2024

This report stems from a stakeholder consultation workshop focused on the project, Inclusive Net Zero Transport in Cities of Gujarat. The workshop aimed to seek inputs on Net Zero Urban Transport Scenarios and indicators, and present preliminary findings of the fieldwork in Rajkot. Participants included government officials, sector experts, and community representatives. Their diverse perspectives were crucial for gathering constructive feedback to help refine the project's strategy and outline a clear path forward for inclusive net zero transport in the city of Rajkot.

Ahmedabad University, 2024



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ABBREVIATIONS

BAU – Business as Usual
CEEW – Council on Energy, Environment and Water
CMP – Comprehensive Mobility Plans
COP 26 – 26th Conference of Parties
EV – Electric Vehicles
GHG – Greenhouse Gases
IIT – Indian Institutes of Technology
IRADe – Integrated Research and Action for Development
JNNURM – Jawaharlal Nehru National Urban Renewal Mission
LCMP – Low Carbon Mobility Plan
LT – LEDS – Long-Term Low Emission Development Strategies
MoHUA – Ministry of Housing and Urban Affairs
NIUA – National Institute of Urban Affairs
NMT – Non-Motorised Transport
PT – Public Transport
SDGs – Sustainable Development Goals
TAZ – Transport Analysis Zone
TOD – Transit Oriented Development
UNEP CCC – United Nations Environment Programme Copenhagen Climate Centre
UMTA – Urban Mass Transit Authority
UTF – Urban Transport Fund
VKT – Vehicular Kilometres Travelled



INCLUSIVE NET-ZERO TRANSPORT IN CITIES OF GUJARAT

The project 'Inclusive Net-Zero Transport in Cities of Gujarat' emphasises an inclusive approach for achieving net zero emissions within the transport sector. The project is a collaborative effort between Ahmedabad University, Indian Institute of Technology (IIT), Delhi, and UNEP Climate Centre Copenhagen (UNEP CCC). The project is funded and supported by UNEP CCC. The project objectives include developing a detailed approach and methodology, studying the existing transport scenario, and proposing a scenario-based net zero plan for the case city of Rajkot.

The transport sector is a major contributor (10%) of greenhouse gas (GHG) emissions, with road transport alone accounting for 70% of total urban transport emissions. A sustainable and net-zero transport scenario in Indian cities requires a paradigm of **enhance-retain-avoid-shift-improve framework**; that is, **enhance** mobility of those not experiencing one now, **retain** current low trip lengths, **avoid** motorised trips for all, **shift** to public transport and non-motorised transport, and **improve** technology of motorised vehicles. Additionally, net-zero transport needs to interface with Sustainable Development Goals (SDGs) as highlighted in various Intergovernmental Panel on Climate Change (IPCC) reports. The 1.5°C Report and Assessment Report Six of the Working Group III indicates that climate change mitigation efforts must aim to achieve the SDGs. Hence, the former must be assessed for their synergies and conflicts with the latter.

The project approach and methodology aim to achieve net-zero urban transport in Indian cities, in the context of mobility-poverty, through a low-carbon transportation system that improves access for underserved populations. The project outlines three scenarios for 2030, 2040, and 2050: Business as Usual (BAU), a Technology Scenario for Net-Zero Emissions, and an Inclusive Net-Zero Emissions Scenario. The 2050 scenario is expected to link with the 'Viksit Gujarat 20457' vision, whereas India's commitment is to achieve net-zero by 2070. Effective implementation of this plan, require definition of net-zero and net-zero transport within the Indian context, developing pathways for inclusive transport solutions, and creating indicators to track progress.

Project Partners:

- School of Arts and Sciences, Ahmedabad University
- Transportation Research and Injury Prevention (TRIP) Centre, IIT Delhi
- UNEP Climate Centre Copenhagen

Dr. Darshini Mahadevia (Project Lead), Prof. Geetam Tiwari (IIT Delhi), Prof. Deepty Jain (Project Coordinator, IIT Delhi) and Ms. Saumya Lathia¹ form the core project team placed at Ahmedabad University and IIT Delhi, India. UNEP Copenhagen Climate Centre supports and funds the project. The project is grounded in the city of Rajkot in Gujarat, and is conducted in coordination with Rajkot Municipal Corporation officials.

¹ Ms. Saumya Lathia is currently employed as a Chief Minister's Fellow with the Urban Development Department, Government of Gujarat. She continues to engage with the project in an Honorary capacity.

Introduction to the Workshop

The School of Arts and Sciences at Ahmedabad University hosted a one-day stakeholder consultation workshop on September 6, 2024 at Ahmedabad University, Ahmedabad under the project. The workshop intended to gather feedback from various stakeholder groups on the developed methodology and initial project findings.

The workshop objectives were:

- To discuss the concept of Inclusive Net Zero Transport in the Indian context,
- Obtain feedback on the proposed methodology and indicators, and
- Present preliminary findings of the field research conducted in Rajkot

The workshop had representatives from the central and state government, think tanks, community organisations, academic institutions, and consultancy firms. The workshop unfolded with introductory presentations, followed by technical presentations by sector experts and concluded with two roundtable discussions among participants. Participants were also given worksheets to rate the project approach and methodology, and indicators developed. The workshop gathered feedback on the selection of indicators to enhance the developed framework and plan the project strategies ahead.



INAUGURAL SESSION

Welcome Note

Prof. Geetam Tiwari, Professor Emeritus, Transportation Research and Injury Prevention Centre, Indian Institute of Technology, Delhi

Prof. Geetam Tiwari, Professor IIT Delhi with expertise in transportation research and injury prevention, warmly welcomed the participants to the stakeholder workshop with a note on the workshop objectives and emphasised the significance of city-level interventions in realising the goal of net zero transport. This collaborative research involving three key partners - Ahmedabad University, Indian Institute of Technology – Delhi and UNEP Copenhagen Climate Centre - addresses the challenges and opportunities of enabling net zero transport in urban India, through a pilot in the state of Gujarat.

Project Lead: Prof. Darshini Mahadevia, Professor, School of Art and Sciences, Ahmedabad University

Prof. Darshini Mahadevia introduced the project by addressing the need of adopting an inclusive approach in traditional decarbonisation and net-zero models. Explaining the novel approach of the project, she highlighted the uniqueness of the collaboration:

- The research focuses on developing a sectoral, city-level net-zero model; unlike most simulation models that are developed at the national or sub-national level, building a model for urban areas with its granularities and complexities is a leap forward;
- While majority models are Global-North centric, this model is developed based on cities in the Global South, where rapid urbanisation, high level of inequities and exclusions and high concentration of climate vulnerability coincide;
- While numerous new international agendas like the Paris Agreement, New Urban Agenda, UN Sustainable Development Goals exist, their interconnectedness to Climate Mitigation and Adaptation is often underscored. The research focuses on building a robust understanding of co-benefits and conflicts presented when urban areas adopt a Net-Zero model, and aims to mainstream incorporation of UN SDGs into climate mitigation models;
- Since the same team worked on sectoral, city-level Low-Carbon model in 2013, it presents the team with a unique opportunity for assessing temporal trends in transport in the case study city, along with the effectiveness of the Low-Carbon Mobility Plan (2013).

The project aims to create a comprehensive methodology and toolkit, with Rajkot selected as a case study. The unique model developed through this project will serve as blueprint for other cities in South-Asia, especially India, to ease and accelerate their Net-Zero city planning efforts.



Prof. Raghavan Rangarajan, Dean, SAS, Ahmedabad University

Extending a warm welcome to the participants, Prof. Rangarajan, noted that urban centres will play a vital role in emissions reduction over the next three decades. He highlighted that the lessons learnt from Rajkot's initiatives could scale up similar efforts in cities across India. While each city faces unique challenges, he highlighted the significance of an event like the Stakeholder workshop where sharing insights foster innovative strategies for change.

The discussion then steered towards achieving net zero greenhouse gas (GHG) emissions, the urgency of planning for net zero emissions by 2070, and the role of academic and research institutes in accelerating these efforts. Articulating Ahmedabad University's commitment to tackling fundamental issues with an interdisciplinary approach, he discussed the necessity for deep, insightful research to identify root causes and assess the implications of proposed solutions. Emphasising on University's decision to operate without traditional departments, Prof. Rangarajan stated that the University's mission and vision align well with the workshop's objectives, facilitating the convergence of diverse academic perspectives on the topic of net zero emissions. In addition to its four schools—Amrut Mody School of Management, Bagchi School of Public Health, School of Arts and Sciences, and School of Engineering and Applied Sciences—the university hosts specialised research centres, such as the Global Centre for Environment and Energy and the newly established Climate Institute. He emphasised how the subjects addressed in the workshop are of particular relevance to these research centres.

He added that the students are encouraged to engage in research alongside faculty, further enriching the academic environment. As a research-based institution focused on climate change and urban issues, Ahmedabad University provides the necessary resources and technical support for meaningful research, making this workshop a fitting extension of its mission and vision. The session concluded with the need to continue convergence among a variety of stakeholders like public sector, academics, consulting agencies, non-profits and community representatives, for a more holistic approach to some of the century's most pressing issues.

India's Net Zero Vision and Approach

Dr. Debolina Kundu, Director, NIUA

Dr. Debolina Kundu, Director of the National Institute of Urban Affairs (NIUA), opened her discussion on India's Net Zero Vision & Approach by addressing the global commitments made at COP 26 regarding carbon neutrality. It was noted that the United States and the European Union aim for carbon neutrality by 2050, China by 2060, and India by 2070.

Highlighting India's national commitments under the "Panchamrit" framework national goals were outlined, such as increasing non-fossil fuel-based energy capacity to 500 GW, reducing projected carbon emissions by one billion tonnes by 2030, and ultimately achieving net zero emissions by 2070. It was highlighted that the achievement of 50% of the country's energy requirements being met by renewable sources, and the reduction of carbon intensity of the economy to less than 45%, are already declared as Nationally Determined Contributions and approved by the Cabinet.

Key Components of India's Strategy

India's strategy revolves around decoupling economic growth from carbon emissions, **particularly focusing on the transport sector**. Electric Vehicle adoption and transitioning heavy-duty vehicles to green hydrogen are vital in ensuring emission reduction. India's Long-Term Low-Carbon Development Strategy (LT-LEDS) submitted to the UNFCCC identifies seven critical transitions:

- Low Carbon Development of Electricity Systems
- Integrated and Efficient Transport Systems
- Sustainable Urban Design and Energy Efficiency
- Decoupling Economic Growth from Emissions
- Carbon Dioxide Removal Solutions
- Enhancing Forest and Vegetation Cover
- Economic and Financial Needs for Low Carbon Development

The LT-LEDS includes sector-specific action areas targeting power, industry, transport, buildings, and urban sectors. NITI Aayog has established working groups to address various climate change aspects, involving experts from government, finance, industry, and academia. Their findings will culminate in a comprehensive policy handbook to guide India's transition to net zero.

Budget 2024 Initiatives for Net Zero Transport

Initiatives in the 2024 budget aimed at promoting electric vehicles (EVs) and enhancing public transport:

- Significant increase in PM-e-Bus Sewa Scheme funding
- Encouragement for startups and women-led enterprises through financial support
- Promotion of solar-powered decentralised charging stations for EVs

Climate Smart Cities Assessment Framework

The Climate Smart Cities Assessment Framework (CSCAF) was presented as a pioneering initiative that evaluates urban climate action across 28 indicators, promoting the integration of climate strategies into urban planning. From data collected across 96 cities in 2019, the framework is now widely adopted in over 226 cities.

Provisions on Net Zero Mobility under CSCAF include:

- Promoting the use of electric cars, buses, and trucks
- Invest in the production of green hydrogen for fuelling heavy-duty freight vehicles
- Improve and expand public transportation infrastructure for inter- & intra-city mobility

Climate Action Plans (CAPs)

The importance of Climate Action Plans for mitigating urban emissions was discussed, with 13 cities already drafting their CAPs. These plans outline specific actions to reach net zero targets by 2050. Notable expected reductions in CO₂ emissions were highlighted for cities like Leh, Pune, Junagarh, and Jamnagar.

The NIUA supports compact urban growth by creating an integrated, low-emission Transit-Oriented Development Station Area plan in Pune. This plan identifies solutions to enhance public transport accessibility, advance green corridors, and develop electric vehicle charging infrastructure. The initiative aims to address urban sprawl, improve air quality, reduce traffic congestion, and preserve green spaces. Meanwhile, in Agra, NIUA prioritises enhancing mobility through the public transport network. The program helps the city develop green, low-emission transit corridors to improve public transport accessibility.

Common Measures in the Transport Sector

- Investment in multimodal public transportation networks.
- Improvement of last-mile connectivity using clean fuel options.
- Transition to Electric Vehicles (EVs) and robust EV charging infrastructure.

A commitment to achieve net zero by 2070 while achieving a balance between economic prosperity and climate security in India's ever-growing cities is challenging. Although India's journey toward net zero is complex, coordinated efforts across all sectors, and active participation from a variety of stakeholders – as fostered in this workshop- are vital for achieving that vision. As an organisation dedicated to urban affairs, NIUA plays a pivotal role in catalysing the development of frameworks for sustainable cities and efficient management systems.

Future Directions in NIUA's work:

- Detailed research on electric vehicle market penetration.
- Development of Climate Action Plans for large cities and clusters of smaller towns.
- Strengthening institutional mechanisms for multimodal transport.
- Regular monitoring and evaluation to assess progress.
- Promoting citizen awareness of climate issues and encouraging sustainable practices.



Net-Zero Gujarat: Visions & Insights

Prof. Minal Pathak, Global Centre for Energy and Environment, and Academic Director Climate Institute, Ahmedabad University

Prof. Minal Pathak coordinates the 'Net Zero Gujarat' project at Ahmedabad University in partnership with Council for Energy Environment and Water (CEEW) represented in the workshop by Dr. Vaibhav Chaturvedi, and UNEP CCC. This project will come up with state-level Net Zero Strategy for Gujarat, with a focus on economy-wide transition to net zero emissions. The discussion unfolded with focus on the project findings of Net Zero Strategy for Gujarat (further referred to as 'the project' in this section).

Understanding Net Zero

Achieving net zero emissions requires a significant reduction in carbon dioxide (CO₂) emissions, supplemented by measures to balance any remaining emissions through carbon dioxide removal techniques. Importantly, the project avoids the practice of transferring emissions to neighbouring states—a method that might superficially satisfy net zero criteria but does not address local environmental needs. The project team's goal is to achieve 'true' net zero within Gujarat's borders.

Current Emissions Landscape

Gujarat's emissions profile reveals critical statistics:

- Gujarat boasts a Gross State Domestic Product (GSDP) of USD 250 billion, ranking second among Indian states.
- The state contributes 9% of India's total Greenhouse Gas Emissions (GHG) emissions, positioning it at third position nationally.
- At 3.39 tons of CO₂ equivalent per capita emissions, Gujarat's emissions are significantly higher than the national average of 1.91 tons of CO₂eq.

The "Viksit Gujarat 2047" document outlines ambitious strategies targeting a 90% renewable energy supply by 2047, alongside initiatives to enhance green cover and promote a circular economy—essential as industries remain major emitters.

Long-term Energy Modelling Approach

The project executes a long-term energy modelling approach to strategise net zero in Gujarat. The research team employs a detailed modelling approach that integrates various socio-economic and technological drivers:

- Population Growth: Projections indicate that Gujarat's population will reach 80 million by 2070.
- GDP Growth: The state's economy is expected to grow to 3.5 trillion by 2050, primarily driven by the manufacturing sector, which constitutes 40% of its economic output.
- Technological Factors: The modelling process assesses technology options, costs, and efficiencies, and
- Agriculture and Land use

The Global Change Assessment Model (GCAM) and Long-range Energy Alternatives Planning (LEAP) model are the primary analytical tools. GCAM provides a global perspective on energy dynamics, while LEAP offers detailed simulations for specific scenarios. Initial results were presented to the Global Energy Transition Research

Initiative (GETRI), and feedback from stakeholders is being incorporated into the final scenario narratives.

Urbanisation and Economic Growth

Gujarat is undergoing rapid urbanisation, with current urbanisation levels at 50% and projections indicating nearly 80% by 2070. This urban shift, combined with robust economic growth, is anticipated to significantly increase per capita income and mobility. This urban shift will be accompanied by substantial increases in per capita income by 2050. Such growth will be primarily fuelled by the state's robust manufacturing sector, which accounts for 40% of Gujarat's economic output.

Mobility Trends: The average per capita mobility is expected to increase from 8,060 kilometres (km) in 2018 to 20,000 kms by 2070, driven largely by a growing working-age population.

Vehicle Composition: The current vehicle registration shows a predominance of petrol vehicles, with a projected shift toward increased car ownership as incomes rise. Conversely, the share of two-wheelers is expected to decline with expected economic growth.

Emission Sources and Challenges

Gujarat's emissions profile reveals that the industrial sector is the largest contributor, responsible for approximately 45% of total emissions, followed by public electricity generation at 34% and the transport sector at 10%. The high dependence on fossil fuels complicates the transition to net zero. Key challenges include:

Decarbonising the Industrial Sector: This sector is energy-intensive, particularly in industries like iron and steel, petrochemicals, and chemicals, where technology gaps hinder emissions reduction efforts.

Fossil Fuel Reliance: The current energy mix is dominated by coal, which constitutes 80% of power generation, and petroleum-based fuels heavily used in transportation.

Transport Sector Insights

The transport sector modelling distinguishes between Business as Usual (BAU) and Net Zero scenarios. The analysis highlights:

Current Vehicle Registration Trends: Gujarat has a predominant share of petrol vehicles, with diesel and CNG vehicles following. Future projections indicate a shift towards electric and alternative fuel vehicles in the Net Zero scenario.

Per Capita Mobility Increase: Driven by economic growth, per capita mobility is expected to rise from 8,060 trips in 2018 to 20,000 by 2070. This increase correlates with the growth of the working-age population.

Freight Demand Dynamics: While the BAU scenario predicts an increase in road freight demand, the Net Zero scenario forecasts a reduction in road freight, with a corresponding rise in rail and shipping freight. This shift reflects a strategic transition towards more sustainable modes of transport.

Energy Transition in Transport: The BAU scenario largely relies on oil, while the Net Zero scenario anticipates a decline in oil dependency, with the introduction of electricity,

biofuels, bio CNG, and hydrogen fuel contributing to a significant reduction in CO₂ emissions for both passenger and freight transport.

Sustainable Development Implications

The project recognises that accelerating mitigation efforts within the context of sustainable development poses significant challenges. The timing and depth of these actions will influence potential trade-offs faced by various stakeholder groups. The impacts of the proposed strategies are assessed across three dimensions:

Economic Dimension: Potential shifts in job markets and economic activity must be carefully managed to ensure a just transition.

Distributional Dimension: Ensuring equitable access to benefits and resources in the face of changing industries is critical.

Environmental Dimension: The primary focus is on reducing emissions and improving air quality, yet this must be balanced against potential job losses and disruptions in traditional sectors.

Stakeholder Q&A

During a recent stakeholder consultation, several key questions were raised:

Freight Decarbonisation: There was a query regarding the state's reliance on freight shipping. The response clarified that Gujarat predominantly utilises coastal shipping routes.

Growth Rate Projections: The methodology for government growth rate projections was discussed. It was noted that while not all states have a "Viksit" document, the government employs its own projections alongside scenarios developed by the research team, which currently extend only until 2047.

CO₂ Emission Trends: Stakeholders inquired whether the projected high CO₂ emissions were conservative. Prof. Pathak affirmed that their projections align with the high expectations set by the "Viksit Gujarat" approach.

Demographic Projections Handling: The team explained that they utilised data from the Government of Gujarat and census projections, adjusting vehicle sales estimates based on the anticipated number of vehicles on the road and integrating these with urban mobility projections.

This comprehensive overview underscores the complexity and urgency of Gujarat's transition to a sustainable, net-zero economy while balancing economic growth and environmental stewardship.

Growth rate projection: On the query related to growth rate projections, the response was that the project assumes the state government's own projections upto 2047 used for 'Viksit Gujarat' document. The vehicle estimates were made using population projections and urban mobility projections.

On high CO₂ emissions: The project data presented showed high CO₂ emissions. The response was that these numbers were aligned with the "Viksit Gujarat" approach, which also had high emission numbers in the Business as Usual (BAU) scenario

On future urbanisation pattern in Gujarat: A workshop participant highlighted that high rate of urbanisation will unravel in the small and medium towns of the state and not the metropolitan cities. The manufacturing-based economic growth will lead to

growth of small and medium towns. It is important that net-zero growth strategies should be implemented in the new industrial towns and the small and medium towns.

Gujarat's ambition to expand its industrial base while simultaneously committing to net zero emissions requires transformative changes in energy inputs and innovation. The need for green technology and substantial investments in these is paramount to this transition. The current efforts are insufficient to meet the aggressive targets set forth in the Viksit Gujarat framework. Additionally, land use will play a vital role not only in emissions reduction but also as a carbon sink, further emphasising the need for strategic planning in this area. There is a need to balance growth with sustainability for Gujarat.



Vision For Vikasit Gujarat 2047 and Net Zero Goals

Mr. Bhavya Mehta, Under Secretary, Urban Development Department, GOG

Mr. Bhavya Mehta, Under Secretary, Urban Development Department, Govt. of Gujarat, discusses the "Vision for Viksit Gujarat 2047 and Net Zero goals," which reflects the Government of Gujarat's strategic focus on several fronts. It was emphasised that the government is committed to creating comprehensive policy frameworks that not only promote sustainable development but also aim for carbon neutrality. This strategic focus encompasses various sectors, with particular attention to the transport sector, which plays a critical role in the state's overall emissions profile.

Additionally, it was highlighted that think tanks and administrative bodies play a significant role in this vision. Think tanks are tasked with generating innovative solutions and providing evidence-based recommendations that can inform policy decisions. The administration is essential for translating these ideas into practical applications on the ground, aligning them with economic and political realities. The importance of administrative will was stressed to foster and implement ideas that are viable and impactful.

Mr. Mehta emphasised on the need for strong collaboration between academia and administration with examples from the West, where such partnerships have effectively advanced sustainable transport initiatives. By fostering an integrated approach, research insights and technological advancements can harness actionable strategies that address challenges of urban development and climate action. The administration's focus must be on simple and pragmatic ideas that can be implemented effectively. With the judiciary taking note of the pressing need for refining the urban governance and administration system for better service delivery, Mr. Mehta re-iterated a collective recognition of developing competencies to combat multiple crisis simultaneously.

The importance of collaboration among think tanks, administration, and academia in achieving the ambitious goals outlined in the Viksit Gujarat 2047 initiative was highlighted. By working synergistically, these entities can create a robust framework for sustainable development, driving Gujarat toward net zero targets while navigating the complexities of rapid urbanisation and economic growth.



Transiting Cities in Developing Countries Towards Net Zero Transport Development

Dr. Talat Munshi, Senior Advisor, UNEP Copenhagen Climate Centre

Dr. Talat Munshi, currently serving as a Senior Advisor at the UNEP Copenhagen Climate Centre discussed his ongoing work on an Inclusive Net Zero Transport project in collaboration with Ahmedabad University and IIT Delhi. This initiative forms part of a broader organisational footprint in India, which encompasses four significant projects. One of the broader projects is to develop Net Zero Strategy at the state level, in Gujarat conducted by Global Centre for Environment and Energy at Ahmedabad University.

The importance of developing complementary strategies was emphasised at both the state and city levels. This dual focus led to the establishment of the Inclusive Net Zero Transport in Cities of Gujarat project, awarded to Ahmedabad University and IIT Delhi. Rajkot Municipal Corporation played a crucial role in offering their support, which has allowed the team to implement their work effectively within the city. The interplay between these projects enables reflection on what is transpiring at the state level and how it translates to actions at the city level.

Another project mentioned involves collaboration with CEPT University in Ahmedabad, focusing on Nature-Based Solutions for both mitigation and adaptation measures. The need for significant efforts in this area was stressed, examining both greenfield and brownfield pilot projects. Another project addressing Loss and Damage in Ahmedabad and Surat investigates strategies to cope with extreme climatic events.

The urgency of action in light of rising global temperatures was highlighted, particularly in Asia and Africa, necessitating the implementation of net zero strategies. Net Zero was defined as achieving a balance where an equal amount of carbon dioxide is removed from the atmosphere as is released, thus preventing an increase in net emissions. This balance is critical for maintaining the planet's long-term average temperature below the 1.5° Celsius threshold- a goal aimed at achieving so by 2050.

Identifying transport sector as a major contributor to greenhouse gas emissions, with road transport alone accounting for 70% of total urban transport emissions, the discussion focused on strategies to reduce the necessity for travel and shift individuals to sustainable transport modes. The goal is to create scenarios that facilitate the use of cleaner transport technologies encapsulated in the Avoid-Shift-Improve framework.

- **Avoid** unnecessary travel whenever possible
- **Shift** travellers to sustainable transportation options like walking, cycling, or public transit
- **Improve** transportation technologies, emphasising electric vehicles and advanced biofuels

Insights from an earlier study on Rajkot's transport dynamics showcased that if 17% to 18% of road space is allocated to non-motorised transport (NMT), it could accommodate 50% of mobility needs. Transitioning from one transport mode to another, such as from cars to two-wheelers, conserves space that can then be repurposed for greening and enhancing NMT infrastructure. Pivoting the discussion to electric vehicles, Dr. Munshi indicated that while electric vehicles in India are currently energy-intensive, there are multiple pathways to decarbonise electricity, making transport electrification a viable strategy within the broader **Net Zero Transport** framework.

The project outline includes four key components:

- Reviewing existing literature related to Net Zero Transport.
- Developing a contextual methodology tailored to analyse Indian cities.

- Mapping existing skills within the sector, identifying gaps, and planning for capacity building.
- Creating a **Local Energy and Emissions Planning (LEEP)** model for Rajkot.

With similar work being undertaken in other countries of the Global South, global relevance of their respective strategies and initiatives would frame a more comparative understanding of effective net zero pathways, policies and programs.

Discussion

Questions: *Is the framework applicable to freight emissions?*

Answer: *We will target passenger transport only; freight may be addressed later, focusing on technology aspects.*

Questions: *How can we reduce freight emissions?*

Answer: *For example, during COVID-19, food security in India was maintained by freight. Several cities shifted to growing partial food locally as the food chains were disturbed due to lockdowns. Thus, localisation of production of certain essential items will provide security, in case of food, leading to enhancement of local employment on one hand, and reduction in emissions from freight transport on the other. Some out-of-the box solutions were required. Employment growth and large-scale globalisation reduce freight requirements. Manufacturing-based growth is not feasible in large metropolitan cities, but retaining the current mode of transport (50% NMT) in smaller cities can help control urban sprawl and local political economies. Freight is complicated, and the key is whether the mode increases or reduces travel.*

Questions: *How can cities influence and change urban form?*

Answer: *Changing urban form involves improving NMT infrastructure. In case of Gujarat, where growth is predominantly manufacturing-based, it would not be feasible in large metropolitan cities. Instead, growth will occur in the small and medium towns, which can retain its current mode of passenger transport (where over 50% NMT mode shares are common. In these towns, efforts need to be made to curtail sprawl, which will be beneficial for reducing emissions from passenger as well as freight transport. For instance, increasing density and shifting e-commerce companies to use NMT for deliveries can create employment opportunities for low-income people and benefit the city's economy. There could also be efforts to source some goods locally. However, all these interventions will require addressing local political economies around land.*

Net-zero efforts in transport will also require a lot of localisations of economy, contrary to current assumed vision of globalisation-based David Ricardo's philosophy of comparative advantage in economic development.



TECHNICAL SESSION

Net Zero Transport Landscape in India

Dr. Vaibhav Chaturvedi, Senior Fellow at CEEW, moderated this first technical session presenting the concept of Net Zero Transport in Indian context, indicators of Net Zero transport, and the project methodology and preliminary findings. Dr. Chaturvedi introduced the topic, "Net Zero Transport Landscape in India."

Net-Zero Transport Conceptualisation (Need & Approach)

Prof. Geetam Tiwari, Professor, Emeritus, Transportation Research and Injury Prevention Centre, Indian Institute of Technology, Delhi

Prof. Geetam Tiwari, Professor Emeritus at the Transportation Research and Injury Prevention Centre, Indian Institute of Technology Delhi, delivered a detailed presentation on the approach towards the conceptualisation of Net Zero in India's transport landscape. The discussion unfolded by introducing the "Net Zero Urban Mobility Concept," emphasising the importance of embedding "Safe Mobility and Accessibility" within the broader strategy for achieving Net Zero transport goals. She highlighted that all policy measures must first ensure safety and work toward reducing the carbon intensity of motorised transport.

Review of National-Level Models

The session included the presentation of national-level models developed by different studies and discussed the key findings from the existing studies or reports. The data from the models of CEEW, IRADe, CSTEP, PNNL, etc. which projected vehicle activity, transport demand, and energy requirements along with their respective emission projections and emission reduction scenarios were presented.

One such comparison focused on a study by the International Council on Clean Transportation (ICCT), which projected vehicle activity between 4,000 billion and 10,000 billion km. Assumptions from the Integrated Research and Action for Development (IRADe) model were incorporated to demonstrate how high vehicle activity rates lead to increased energy demand, primarily due to traffic congestion. This comparison highlighted the pressing need for policies addressing vehicle numbers, energy efficiency, and congestion management.

Understanding Carbon Emissions: Models and Scenarios

Several models and scenarios were examined to evaluate carbon emissions, focusing on the Business as Usual (BAU) scenario. It was reported that CO₂ emissions in this scenario ranged from 800 to 2,300 TTW-Mt/year (Tank-to-Wheel megatonnes per year). Interestingly, the CEEW and IRADe models produced comparatively lower CO₂ emission values. However, it was stressed that projections from different models showed a wide range in vehicle activity, varying from 3,500 billion to 9,000 billion vehicle-km/year. This spread revealed the complexity of accurately predicting the future trajectory of vehicle activity and emissions.

High-Ambition Scenario: Public and Rail-Based Transport

High ambition transport scenarios for the future assumed shift to public transport, either road-based public transport or rail-based public transport. In this, the data source used was Climate Action Tracker. The graphs on projected modal share for urban passenger transport in 2050, showed increase in the share of buses along with rail-based transport. The share of bicycles increased and two-wheelers share decreased. Further, in the High-

Ambition Scenarios, the emission reduction to net zero in the road-based public transport occurred through largely transition to EVs (nearly half the reduction), followed by land-use interventions and alternative fuels (16% each), and another 15% by modal shift and improved efficiency. In the rail-based nearly half the emission reduction occurred through modal shift, followed by urban planning interventions and electrification (about 16% each), followed by shift to alternative fuels and improved efficiency. However, road-based public transport with option of EVs increased energy requirements to 2,500 terawatt hours in 2050 as against the requirement 1,500 terawatt hours in case of rail-based public transport. Hence, the Net Zero Urban Transport as a concept is essentially dependent of decarbonisation of electricity at the national level. However, cities can propose options assuming that this national-level change would occur and hence focus on land use interventions, modal shift, and increasing efficiency. Modal shift to Non-Motorised Transport (NMT) and public transport will require improvement in infrastructure related to both as well as behavioural changes.

Prof. Tiwari ended her presentation by suggesting Retain-Avoid-Shift-Improve (R-A-S-I) Framework. The Retain-Avoid-Shift-Improve (R-A-S-I) framework involves:

- Retaining short trips and mobility through NMT in urban areas,
- Avoiding shifts to private vehicles and longer trips,
- Shifting to public transport and NMT,
- Improving technology through the adoption of EVs and more energy-efficient vehicles.

Achieving Net Zero in India's transport sector requires a multifaceted approach, integrating urban planning, public transport, and technological innovation to reduce carbon emissions while ensuring accessibility and safety. While shifting people to public transport requires large-scale urban infrastructure provision and a shift away from road-based transport solutions. Enabling an urban form where majority trips can be taken through NMT will require land-use and zoning changes to enable more mixed-use development.

Policy Landscape for Net-Zero Transport: Insights from Policy and Program Mapping

Prof. Darshini Mahadevia, Project Lead Net Zero Transport

Prof. Darshini Mahadevia, Project Lead for Net Zero Transport, presented findings from the project's Transport Policy and Program Mapping. Emphasising the critical role of governance in achieving Net Zero transport, particularly within the complex realm of policymaking, Prof. Mahadevia emphasised on Governance being pivotal to the project's success.

Why Net Zero Transport?

Urban transport contributes significantly to greenhouse gas (GHG) emissions. India plays a significant role in the global efforts to reduce these emissions. The challenges posed by urbanisation and transport systems in India were highlighted, stating that achieving Net Zero was crucial due to the country's rising motorisation, traffic congestion, and air pollution.

National and Subnational Policy Focus

The project explored 37 national and subnational policy frameworks, focusing on several key areas:

- Mass transit systems,
- Public transport electrification,
- Non-Motorised Transport (NMT),
- Road safety, and
- Travel demand management

These areas form the core of India's efforts to transition toward a more sustainable and inclusive transport system. Further, India's urban transport policies were discussed, reviewing various initiatives such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Bus Rapid Transit Systems (BRTS) projects, which later evolved under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT). It was noted that JNNURM had a higher allocation of funds from the central government, signalling strong support for sustainable urban transport initiatives.

National Electric Mobility Mission and Electrification Challenges

Under National Electric Mobility Mission, the transition to electric vehicles (EVs) was identified as a key strategy for reducing emissions. However, this transition comes with challenges, including the availability of electricity and the need for the decarbonisation of electricity generation itself. Without these considerations, the shift to EVs alone will not fully address the underlying issues of GHG emissions from transport.

Insights from Policy Mapping

A detailed breakdown of the policy landscape was discussed, noting that a multitude of policies exist at both national and state levels. An overview of the landscape of urban transport policy instruments categorised by different types of interventions and scopes revealed:

- 32% are Regulatory: These include rules and directives that influence behaviour, such as land-use planning and heavy motor vehicle (HMTV) regulations.
- 37% are Economic: This category consists of taxes, subsidies, and funding for infrastructure and operations, like road networks and charging infrastructure for electric vehicles.
- 22% are Informative: This involves awareness campaigns, data collection for

- accessibility goals, and educational initiatives for urban planners.
- 9% are Governance: Focused on establishing new institutions (e.g., Urban Mass Transit Authority - UMTA), processes like road safety cells, and funding mechanisms such as the Urban Transport Fund (UTF).

The lack of governance-focused policies is a critical issue in the urban context, where multiple institutions and overlapping policies create complexity. Furthermore, many policies (64%) are non-mandatory, which limits their enforceability. Additionally, 59% of policies indirectly affect cities, influencing transport modes and urban sprawl in ways that are not always easily controlled.

Gujarat and Urban Planning

Further, regional policy initiatives were discussed, specifically highlighting Gujarat's "Viksit Gujarat 2047" strategy, which prioritises the *development of public transport such as metro and bus systems*. The importance of carefully evaluating the choice between metro rail and bus systems in the context of urban transportation was highlighted. It was also mentioned that other initiatives like rooftop solarisation and the increasing adoption of electric vehicles are essential.

Non-Motorised Transport and Urban Space Allocation

For non-motorised transport (NMT), the need for cities to translate NMT plans into actionable urban space allocations was stressed upon. It is essential that green infrastructure and open spaces are embedded within development control regulations and land use planning. This shift in the transport paradigm must be reflected in statutory urban plans, which play a crucial role in making cities more climate-resilient and adaptable to the impacts of extreme weather events induced by climate change.

Enhance-Retain-Avoid-Shift-Improve Framework

The "Enhance-Retain-Avoid-Shift-Improve" (E-R-A-S-I) framework for inclusive Net Zero transport was introduced:

- Enhance mobility for those with low access today,
- Retaining short trips and mobility through NMT in urban areas,
- Avoid unnecessary shifts to private transport,
- Shift to public transport and NMT,
- Improve transport technology by transitioning to EVs and higher energy-efficient vehicles.

In an earlier report on the Low Carbon Mobility Plan for Rajkot, changes in per capita CO₂ emissions assessed based on different transport interventions reveal:

- Land-use avoid policies could reduce emissions by nearly 40%.
- Shifting to NMT (Non-Motorised Transport) could lead to a further reduction of 50%.
- Shifting to Public Transport (PT) also offers a significant reduction, close to 50%.
- Technological advancements, such as EVs and improved transport efficiency, further contribute to emission reductions.

Prof. Mahadevia stressed that urban planning is central to this approach, involving land use planning, regulations, urban design, and housing policies. Urban planning interventions could have a significant impact, where 40% of emissions reductions from transport came from land-based interventions promoting public transport and NMT. Using a case of Rajkot BRTS's success in improving women's mobility, Prof. Mahadevia concluded the presentation with a note on how inclusive policy making can drastically improve accessibility and mobility of the vulnerable groups. Prof. Mahadevia highlighted the importance of expanding the traditional ASI (Avoid-Shift-Improve) framework in the context of Indian cities, to include E-R-A-S-I (Enhance-Retain-Avoid-Shift-Improve) to

ensure that vulnerable groups with low mobility like women, children, elderly and differently-abled experience enhanced mobility.



Key findings of the Inclusive Net zero Transport Indicators

Prof. Deepty Jain, Project Coordinator, Net Zero Transport, IIT Delhi

Prof. Deepty Jain, Project Coordinator for the Net Zero Transport initiative at IIT Delhi, delivered a presentation on the key findings of the Inclusive Net Zero Transport Indicators. The discussion began with a global literature review, emphasising the scope of Net Zero transport strategies across various sectors, including road and rail-based freight and passenger systems.

Net Zero Transport was defined as *"A system that encourages low carbon modes of transport providing safe mobility and accessibility for all, reduces the carbon intensity of the motorised modes and integrates nature-based solutions and circular economy concept to offset waste generation and emissions"*. The definition thus encompasses the low carbon transport scenario and carbon capture strategies. Additionally, the inclusion of energy and carbon capture, utilisation, and storage (CCUS) technologies in these strategies was highlighted.

Literature Review and Global Policy Analysis

Analysis of seven international policies was presented to understand the indicators used by different countries to monitor their progress toward sustainable transportation. These indicators helped to gauge how well these nations were advancing their Net Zero goals, providing valuable insights into transport decarbonisation and the promotion of sustainable urban mobility.

Defining Net Zero Transport for Indian Cities

Further, the framework for Net Zero Transport in Indian cities was presented, emphasising that achieving this goal goes beyond merely reducing carbon emissions. Prioritising safe mobility and accessibility for all is critical. The essential features of Net Zero Transport in India must include:

- Reducing carbon intensity of motorised modes.
- Integrating nature-based solutions in urban mobility systems.
- Embedding the concept of a circular economy, which promotes sustainable resource use in transportation.

Retain, Avoid, Shift, Improve Technology, and Eliminate Waste Framework

The approach is structured into five main categories: Avoid, Retain, Shift, Improve Technology, and Eliminate Waste. Each category includes specific strategies aimed at reducing emissions and waste in urban transport systems.

Retain: Aims to retain existing sustainable travel behaviours by providing active mobility infrastructure (such as walking and cycling lanes), space allocation, and parking management. Vehicle purchase taxes and strategic land-use planning are tools used to retain or encourage environmentally conscious travel choices.

Avoid: Focuses on reducing the need for travel or unnecessary journeys through land-use planning. This can include zoning regulations, promoting mixed-use developments, and ensuring proximity to essential services.

Shift: Encourages shifting to more sustainable modes of transportation. This includes implementing measures like fuel taxes, road pricing, and subsidies to make public or non-motorised transport options more attractive. Policies such as speed limits and public awareness campaigns support the shift towards greener transport options.

Improve Technology: Focuses on improving technological solutions in transport to lower

emissions, such as emission standards, enhanced safety standards, and refining production processes. Improvements in fuel efficiency are also targeted, contributing to the reduction of carbon footprints.

Eliminate Waste & Emissions: This category aims at eliminating residual emissions and waste through carbon sequestration methods and promoting recycling and recovery systems, ensuring that emissions and material waste are managed efficiently and sustainably.

Global Strategies for Net Zero Transport

The strategies for achieving net zero transport were presented as defined in 130 peer-reviewed articles. The strategies were grouped in five categories as technology, planning, net zero (CCUS), economic, regulatory and information and based on sectors - road, railways, freight and passenger and also inclusive of energy and carbon capture utilisation and storage (CCUS). These strategies are further classified according to the level of intervention – city level and state/national level.

Major thrust on the strategies such as electrification, battery swapping and management, alternate fuel and public transportation system etc. was found. The key findings reflect that structural changes in urban planning and model shift towards encouraging the use of public transportation systems are required as technology is not enough in itself to achieve the target.

State and National-Level Strategies

The role of state and national-level strategies was further discussed. The need for expanding the renewable energy share in transport was discussed, exploring alternative fuels, and revising regulatory frameworks such as emission standards and permits. These strategies would complement urban-level initiatives and drive larger systemic changes toward Net Zero Transport.

Monitoring Progress and Indicators

Indicators used in seven countries were presented that are associated with sustainable mobility, net zero targets and transport planning. A list of indicators was proposed to be used for measuring and achieving net zero transport in Indian cities. The list includes indicators of- Accessibility & Mobility, Infrastructure and Land use, Safety & Security, Environmental Impacts, Economic Response (investments and tax policies), Electrification and Circular Economy. This list is an extension of the existing proposed list of indicators in revised comprehensive mobility planning toolkit as adopted by MOHUA.

These indicators included metrics across key domains:

- Accessibility and mobility: Measuring how accessible and efficient urban transport systems are.
- Infrastructure and land use: Focusing on green infrastructure and land use to support sustainable urban environments.
- Safety and security: Ensuring that transport systems are safe for all users.
- Environmental impacts: Assessing the contribution to emissions reductions and ecosystem preservation.
- Economic response: Evaluating the economic feasibility and efficiency of Net Zero strategies.
- The importance of specific indicators for tracking progress were discussed, in areas like electrification and the introduction of new energy vehicles.

Stressing the importance of a holistic approach, Prof. Jain stated that Net Zero Transport

must integrate not only technological solutions but also strategic urban planning, policy intervention, and sustainable development practices. The presentation provided a robust framework for Indian cities to achieve inclusive, low-carbon, and accessible transportation systems, aligning them with global Net Zero aspirations. Strategies and Indicators covered in the presentation were later discussed in-depth in the roundtable discussions.

Project Methodology & Fieldwork

Ms. Saumya Lathia, Chief Minister's Fellow, Urban Development Department Project Coordinator, Net Zero Transport, Ahmedabad University

Ms. Saumya Lathia delivered a presentation on the **approach and methodology** of the Net Zero Transport project. The presentation discussed the key steps involved, emphasising the comprehensive framework that guided the team throughout the project's development. The methodology was divided into six broad categories (listed below), out of which the first four were briefly discussed. The session detailed out the secondary and primary data collection phases.

- **Project Inception:** An inception workshop was conducted between 1st and 3rd of April 2024 to scope the project. Detailed discussions on existing datasets and tools, area delineation, Rajkot's demographic and economic growth patterns, overall energy consumption and modelling frameworks were discussed.
- **Area Delineation:** Several administrative boundaries were overlaid (like Rajkot Municipal Corporation boundary, Rajkot Urban Development Area boundary, Rajkot Master Plan boundary, etc.) to frame the study area. Major commuting centres in the surrounding area were identified, along with upcoming road infrastructure projects like Outer Ring Road. Upcoming settlements with growth potential were identified for discussions with RMC officials. Application of FSI and TDR policies was considered with the Zonal Development Plan changes for new zones. The study area was delineated 7km beyond the 2nd Ring Road, towards settlements like Shapar.
- **Literature Review:** Over 100 publications were reviewed to assess Net zero transport in practice, including grey literature, white papers, reports, national mobility plans and policy reviews. Key strategies, pathways and indicators were developed based on this.
- **Policy Mapping:** 37 national and state-level urban transport policies were identified and analysed to assess their effectiveness in delivering 17 SDGs and 169 targets and GHG emission reduction.

Secondary Data Collection: This stage involved identifying data requirements and data sources, understanding city fabric and layout and seeking city authorities' approval for data collection. The secondary data collection phase lasted approximately one month and involved extensive coordination with various departments, particularly the RMC (Rajkot Municipal Corporation) office. During this phase, the team gathered both qualitative and quantitative data, identified key data sources, and evaluated potential areas for further primary data collection. The importance of making several site visits prior to the primary data collection phase was highlighted. These visits provided the team with the opportunity to evaluate the city's roads, junctions, and overall infrastructure. It was noted that their engagement with RMC officials during this stage helped secure the necessary permissions for conducting on-ground research. Data was collected from 17 departments and agencies, with interviews of 22 officers and 5 in-depth key personnel interviews.

Primary Data Collection: The primary data collection phase spanned around two to three months, covering most of the summer season. This phase involved a detailed infrastructure audit, a Bus Rapid Transit (BRT) user survey, and household surveys. It was described how the team performed a thorough on-site assessment of various transportation-related infrastructures, examining critical elements such as road conditions, intersections, and traffic flows.

Infrastructure Audit: Infrastructure audit was conducted 17 sub-areas, covering 53 clusters, 188 stretches spread across the study area. The audit contained 67 parameters

covering aspects of road quality, road safety, street design, access to public transport, universal access, shade and relief from extreme heat, etc.

- *Preparation:* this involved identification of study boundary considering RUDA's 30-year expansion plans, inclusion of surrounding districts, dividing the study area into 17 sub-areas based on arterial roads and identifying 53 Unique clusters & 188 Stretches to conduct the infrastructure audit
- *Pilot:* several pilots were conducted- one with the core team in Ahmedabad and other with the team of surveyors from Rajkot universities on audit forms, terms, concepts, and infrastructure elements. Pilot tests conducted by teams on 8 city stretches (1 stretch per 4 people), and feedback from pilots led to adjustments in audit forms
- *On-Field:* The team was divided into groups of four; Each team had at least one native language speaker, teams were assigned clusters within one or more sub-areas. Physical copies and KML files (for Google Earth & Locus Applications) of the clusters were provided to each surveyor group. Each group used a device with sensors for air quality, temperature, and geolocation. Data was collected both in the cloud and on the device, allowing real-time monitoring. Noise was measured with the Noise Tracker app, and distances were measured with tapes and phone apps like "Measure".
- *Post-Field:* Data collected in spreadsheets was cleaned and physical forms were digitised. A unique ID was assigned to each audited stretch, and were mapped using GIS software with their unique IDs

Household Surveys: Detailed household surveys capturing travel patterns, socio-economic characteristics and asset ownership was administered. 1,374 Households and a total of 3,473 people were surveyed, ensuing a representative sample in the context of caste, religion and income groups.

- *Preparation:* Base year for population and housing census projections set as 2024, 13 years after the 2011 census. Total projected population was estimated at approximately 2.5 million, translating to a sample size of 0.25% for the inner city and 1% for the peripheral areas. The city was divided into 8 groups with an average of 190-220 surveys per group. Sampling was modified based on availability in each ward as seen on Google Earth.
- *Pilot:* Survey forms were developed in both printable and Google Forms formats. Pilot surveys were conducted in Ahmedabad to test the questionnaire. Forms were revised based on feedback to clarify questions. Sections like household information and travel diary were combined for conciseness.
- *On-Field:* Surveyors were organised into 8 team of 4, each initially provided with vehicle. Teams received soft copies of ward boundaries and SEG distribution. 'Locus Maps' was used to view ward boundaries on mobile phones and ensure surveys were conducted within assigned areas.
- *Post-Field:* Data was triangulated to verify samples collected using different methods. Spreadsheet data was cleaned, and physical forms were digitised. Gaps in ward numbers were corrected.

BRTS User Surveys: A total of 200 BRTS user surveys were collected

- *Preparation & Pilot:* this involved identifying ten busiest BRTS bus stations and peak/non-peak hours for the survey. 2013 Ahmedabad BRTS User Questionnaire was modified to include questions on universal access, safety, and extreme weather, while maintaining similarities for comparative analysis. Conducted an internal pilot to test form functionality and question clarity.

- *On-Field:* First round of user surveys conducted from 8:00 AM to 12:00 PM, classified as Peak Hour Surveys; Issues with the Google form was fixed after the first 4 samples; teams were instructed to photograph and upload station images. Additional permissions and temporary ID cards were obtained from Rajkot Rajpath Limited office due to BRTS officers denying access. Surveys from 12:00 PM to 4:30 PM were classified as non-peak hour, and those from 4:30 PM to 6:30 PM as Peak hour.

The primary data phase allowed the team to gather robust, field-based insights that complemented the findings from the secondary data analysis. Concluding with a note on logistics, and technical challenges of building a sectoral urban net-zero model, Ms. Lathia emphasised that the collaborative efforts with RMC officials and other stakeholders played a crucial role in ensuring the quality and comprehensiveness of the data.



Insights from Fieldwork

Prof. Darshini Mahadevia, Project Lead Net Zero Transport

Prof. Darshini Mahadevia delivered a presentation on findings from the fieldwork offering preliminary insights into Rajkot's urban transport landscape and travel preferences. Rajkot Municipal Corporation (RMC) played a key role by providing the necessary data, and a representative from the Traffic Department of the RMC was present during the discussions. The study also draws on contributions from Rajkot Rajpat Limited, a Special Purpose Vehicle focused on public transport, including the city bus service and the Bus Rapid Transit System (BRTS).

Urban Planning and Transport Analysis Zones (TAZ)

An initial review identified Rajkot's advantage of having around 370 Transport Analysis Zones (TAZs), a vital element in urban planning. While TAZs simplify planning in smaller cities like Rajkot, there is an expectation for growth by 2050 and 2070, necessitating forward-looking strategies. This is why the study extended the city's boundary by 7 km beyond the periphery, including three ring roads, the third currently under development. The findings noted that growth is concentrated along the southern side near the Junagadh Road and Shapar industrial estate. It was emphasised that this southern expansion highlights a shift in the city's economy, transitioning from small-scale manufacturing and agricultural sectors to large-scale industries, including the automobile sector and exports.

City-Specific Growth Dynamics and Terrain Considerations

The study underscored the importance of adapting methodologies to reflect Rajkot's unique growth patterns and its surrounding terrain. The terrain beyond the city's boundaries consists of hard rock barren landscapes, posing potential challenges for urban sprawl. These factors must be carefully considered as Rajkot continues to grow.

Current Public Transport and Future Plans

The review of Rajkot's public transport system revealed that the BRTS is planned to extend over 63.5 km but currently operates only 10.7 km. With 18 buses in service and two more corridors in development, there is significant scope for expansion. Additionally, the municipal bus service operates a fleet of 90 buses, with a strong emphasis on electrification. Recent acquisitions included 100 electric buses, of which 75 have been delivered, and the RMC plans further expansion in public transport. Despite this, the study also observed a growing number of private two-wheelers and four-wheelers. Electrification remains limited, with electric vehicles accounting for just 3.21% of two-wheelers and 0.3% of four-wheelers, while the majority of vehicles adhere to Bharat IV and VI standards. Diesel remains dominant in the auto-rickshaw segment, with no electric rickshaws currently in use.

Transport Characteristics and Socioeconomic Differences

The analysis of Rajkot's transport characteristics revealed that the average trip length has increased to 10-11 km across socioeconomic groups, although the highest frequency of trips occurred in the 1 to 5 km range. This increase could be attributed to outliers inflating the average. Women's trip rates are notably low, at 1.0 across all income groups, with trip rates for higher-income women particularly low. This finding aligns with the observed trend of lower workforce participation among higher-income women. In contrast, lower-income women exhibit higher trip rates due to greater workforce engagement.

Trip purposes also varied significantly between men and women. For men, 87% of trips

were work-related, whereas for women, only 37.4% were work trips. Instead, women primarily made trips for shopping and social purposes, especially in relation to the BRTS, where one-third of women's trips were for social reasons, while men predominantly used it for work. These differences highlight the need to consider gender-specific travel patterns in transport planning.

Mode Share and Gender Disparities

The study confirmed that walking constitutes 60% of women's trips, while 55% of men's trips involve two-wheelers. These patterns have remained consistent over the past decade, with similar trends observed in other cities like Vishakhapatnam and Udaipur. The gender disparity in mobility must be considered in future transport planning efforts, particularly in addressing safety concerns in public transport.

Women's Safety in Public Spaces

A critical issue highlighted is the safety of women in public spaces and transport systems. Other studies on women's safety in Indian cities have shown that this is an ongoing concern. For example, a study on Sabarmati Riverfront, envisioned as a safe public space, revealed that 52% of women faced harassment there. These findings stress the need to integrate safety considerations for women into urban and transport planning policies.

Preliminary Emissions Analysis

While a detailed emissions analysis is still underway, preliminary data collected for Rajkot indicates that this will be an important component of the study. Future analysis will focus on understanding the emissions implications of Rajkot's growth, particularly in relation to public and private transport usage.

In summary, the findings highlight key aspects of Rajkot's urban growth, transport patterns, and gender disparities in mobility. The city's expansion, evolving economic base, and transport challenges call for tailored urban planning methodologies that reflect both current dynamics and future growth projections. Addressing gender-specific travel behaviours and safety issues remains a priority in the development of Rajkot's transport policies.





PANEL DISCUSSION

Mr. Mayur Khimsuriya, Assistant Manager at the Rajkot Municipal Corporation (RMC), shared his insights on the Rajkot transportation project. He provided a comprehensive overview of the city's existing transportation system, highlighting the two operating systems: the Rajkot Mass Transit System (RMTS) and the Bus Rapid Transit System (BRTS). He also discussed a non-motorised transport scheme focused on cycle sharing and mentioned that a survey for a parking management system is currently underway to enhance efficiency.

Mr. Khimsuriya elaborated on the charging system for buses, confirming that the buses use charging guns rather than battery swapping. This led to a discussion among participants about the need for expanded charging infrastructure for private vehicles in Rajkot.

Dr. Vijay Anadkat, Senior Fellow at WRI India, opened his remarks by praising the study, describing it as a pilot initiative for net-zero transport that could inspire similar research in other cities. He discussed the daily dynamics in Rajkot, noting that many residents return home for afternoon naps before returning to work.

Dr. Anadkat shared insights from the BRTS project, particularly the positive outcomes from the pilot run along the Blue Corridor, which has proven to be both profitable and sustainable due to its entirely electric operations. He reflected on various schemes and projects, noting how the increased number of operating buses has bolstered public transport usage. Additionally, he mentioned a feasibility report comparing metro networks and trip lengths in Rajkot with those in Ahmedabad. He highlighted the importance of inclusivity, emphasising the need for further development in this area.

Mr. Vivek Chandran, Director of Climate Insights at the Shakti Sustainable Energy Foundation, acknowledged the presentations' progression from macro to national and then city-level perspectives. He noted that previous and current studies on Rajkot illuminate transformation patterns and provide evidence to inform policy actions.

He discussed the importance of specifying strategies across different governance levels, arguing that such clarity would facilitate the adoption of effective strategies. Mr. Chandran also underscored the need for inclusivity and equality within net-zero strategies, emphasising their co-benefits. He critiqued various studies' models and highlighted the IRADe study for its unique GDP calculations. Additionally, he shared his experiences from a study conducted by Climate Tracker, pointing out the challenges of translating national data to the city level. He advocated for a bottom-up approach to data collection in Gujarat, which could enhance clarity for other states.

Dr. Saket Sarraf's from PS Collective proposed several initiatives. He recommended establishing a feedback loop to study fuel costs and congestion, which would help understand the demand for private vehicles and encourage shifts to alternative modes of transport. He stressed the need for clear policies regarding electrification to monitor carbon content throughout the day and during charging. Dr. Sarraf emphasised the importance of effective communication about energy efficiency's impact on decarbonisation, as various perspectives could change its implications.

He also addressed the relationship between shared mobility and autonomous vehicles, highlighting their mutual effects. Finally, he noted that behavioural change significantly influences vehicle demand, which could pressure policymakers.

Shri Bhavya Mehta, Under Secretary of the Urban Development Department, Government of Gujarat, highlighted the need to consider both conventional and non-conventional sources for electrification, particularly for bus charging. He emphasised multimodality, noting that diverse public transport options are essential for improving accessibility. He identified three critical factors affecting transport accessibility: cost, timeliness, and ease of use.

Additionally, he discussed the economy's role in vehicle selection for net-zero transport and emphasised the need to enhance women's safety on buses in Rajkot. He proposed that the state incentivise the decentralisation of charging infrastructure.

Mr. Mayur Khimsuriya concluded the session by thanking the team for conducting the study, acknowledging that government officials often lack the time to gather data directly from the public. He expressed his support for future initiatives.



ROUNDTABLE DISCUSSION

THEME 1- Net Zero Transport Pathways for Urban India

Discussants	Discussion Questions
Dr. Vaibhav Chaturvedi	Are these strategies relevant to achieve Net Zero at the city-level?
Dr. Vijay Anadkat	What is the current state of readiness for implementing the different decarbonisation strategies?
Ms. Krishna Desai	What are the policy requirements to implement these strategies?
Prof. Mohit Dev	What are common challenges in implementing these strategies?
Dr. Rajshreeben Swaminarayan	What existing supportive policies are needed to achieve Net-Zero at the city level?
Shri Bhavya Mehta	Are the pathways and strategies showcased enough to achieve Net-Zero Transport?
Officers from Gujarat Urban Development Mission (GUDM), GUDC & GUDI	Any other pathways or strategies that may have a higher potential to driving Net-Zero Transport?

The first roundtable discussion starts with participants filling out forms that list strategies. Session moderators Dr. Darshini Mahadevia and Dr. Deepty Jain clarify participants' queries regarding the forms and strategies. The session aims to explore net-zero pathways for urban transport, focusing on key decarbonisation strategies such as Electrification, Alternate Fuels (including biofuels and synthetic fuels), Infrastructure (like Metro, BRT, and cycling paths), and Behavioural Change. The provided list of strategies and discussion questions helps streamline the conversation.

Dr. Vaibhav Chaturvedi, a Senior Fellow at CEEW, opens the discussion by questioning the decision-making levers and the roles of state and local governments in shaping transport policies. He emphasises the need to identify the appropriate decision-making governance level and engage with both urban and state governments. Dr. Chaturvedi also addresses the importance of establishing connections between macro top-down and bottom-up studies, arguing that although these studies may seem to suggest trade-offs, they often do not. He advocates for interaction between different studies.

Dr. Vijay Anadkat, Senior Fellow at WRI India, focuses on non-conventional energy sources, particularly solar energy, given that Gujarat enjoys over 300 sunny days a year. He highlights the importance of municipal corporations in implementing net-zero strategies at the city level. Citing examples from Surat, where the government has invested in windmill plants for electricity generation, and Rajkot, where a solar electric vehicle plant operates, Dr. Anadkat argues for policies that support electrification and charging infrastructure. He stresses that climate change and disaster management should factor into the adoption of net-zero strategies.

Next, he emphasises the need for capacity building and skill development. Dr. Anadkat proposes setting phased targets, suggesting that cities start with lower targets, such as net 30, and gradually progress to net 70 and finally net zero. He argues that starting with high standards may lead to failures in many cities. He also recommends incentivising government staff to use public transportation and bicycles, offering allowances for public transport and extra time for biking. To implement net-zero policies effectively, Dr. Anadkat advocates for the “4 Ps” — Public-Private Partnerships and Public Participation, highlighting that public engagement is crucial for the success of any system.

Ms. Krishna Desai, a Technical Expert at Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), speaks about a multi-pronged approach to net-zero transport, which should include strategies such as electric vehicle adoption, increased public transport usage, clean energy promotion, and restrictions on private vehicles. She notes the need for coordinated efforts among local, state, and national agencies, especially given the current lack of decentralisation in many cities. Ms. Desai argues for better urban planning to reduce trip lengths from central business districts (CBDs) and to enhance the integration of land use with transport systems, thereby decreasing private vehicle use while promoting public transport. She highlights her ongoing work with the Rajkot Municipal Corporation to improve the public transport system and emphasises the importance of capacity building for local stakeholders, particularly concerning electric vehicles and charging infrastructure. Awareness campaigns can further support the shift from private to public transport. Digitalisation, such as providing real-time bus information, can also encourage greater public transport usage.

Prof. Mohit Dev, an Assistant Professor at SPA Bhopal, offers insights from both user and transport planner perspectives. He identifies user concerns regarding electric vehicles, such as power sources, charging infrastructure, and associated costs. He believes that addressing these doubts through user education is key to successful strategy implementation. Prof. Dev supports the idea of phased targets for achieving net-zero goals.

Dr. Rajshreeben Swaminarayan, General Manager of the Gujarat Urban Development Institute, views net-zero transport as a national issue that requires intense focus. She discusses the negative attention electric vehicles have received on social media, which could hinder their growth. Drawing a parallel to the AIDS campaign, Dr. Swaminarayan emphasises the need for a national branding campaign for electric vehicles that fosters acceptance rather than imposition. Such a campaign must be grounded in scientific evidence and supported by influential figures, including politicians and celebrities. She also points out the social stigmas associated with public transport usage and stresses the importance of gradual behavioural change for strategy adoption. Continuous, subtle advocacy for net-zero strategies is necessary to guide public acceptance.

Shri Bhavya Mehta, Under Secretary of the Urban Development Department in Gujarat, connects his thoughts to Dr. Swaminarayan's by addressing the image of electric vehicles on social media. He highlights how videos can spread misinformation and create myths. He stresses the importance of understanding bureaucracy and aligning stakeholders' interests to combat misleading information.

Upendra Kumar, an officer from the Gujarat Urban Development Mission (GUDM), echoes concerns about social media's influence on public perception. He emphasises the need for influential figures to support net-zero campaigns and advocates for investments in first and last-mile connectivity.

Dr. Vaibhav Chaturvedi concludes the discussion by noting that India's public transport

system lacks aspirational appeal, which may explain the government's limited investment in the sector. He warns that promoting public transport could negatively impact car manufacturing and job growth, necessitating careful consideration of these trade-offs.

The roundtable discussion on strategies concludes with a call for improved financing and action implementation at the local level, highlighting the need for better urban governance and transportation reforms to achieve net-zero transport.

Insights from Stakeholder Consultation for Net-Zero Pathways & Strategies

This section presents a detailed analysis of pathways and strategies for achieving net-zero transport, based on the perspectives of three key stakeholder groups: Governments, Think Tanks, and Institutions. The strategies are assessed across three dimensions: Relevance, Policy Readiness, and Implementability, offering a comparative view of how each stakeholder group values these strategies. These insights are crucial for understanding where stakeholder alignment or divergence occurs, and for identifying potential areas of focus or improvement in the journey towards net-zero transportation.

All the workshop participants belonging to different stakeholder groups were asked to score the strategies in Relevance, Implementability and Policy Readiness on a scale of 1 to 5 (1 being the least and 5 being the most applicable). The results were further translated into graphs to draw the following analysis.

Key Observations:

Top Strategies:

- Modal Shift/Transition received the highest total score, indicating broad support across relevance, implementability, and policy readiness.
- Electrification, Low Carbon Vehicle Technology, and Public Transport Infrastructure also scored high, reflecting strong support and perceived feasibility.

Moderate Scoring Strategies:

- Battery Management, Charging Infrastructure, and Non-Motorised Transport Infrastructure have medium scores, suggesting that while relevant, there are some challenges in implementability or policy readiness.
- Carbon Capture and Recycling and Recovery of End-of-Life Vehicles also fall in this range, showing a mixed perception of their feasibility.

Low Scoring Strategies:

- Restricting Night Driving and Banning Internal Combustion Engine (ICE) Vehicles had the lowest scores overall, particularly in policy readiness and relevance. This suggests potential resistance or practical challenges associated with these strategies.
- Regulate Speed Limits also scored low in relevance and implementability, likely due to perceived difficulties in policy enforcement.

Component-wise Analysis:

Policy Readiness:

- Strategies such as Public Transport Infrastructure, Modal Shift, and Electrification show better alignment with current policies, reflecting their implementation readiness at the government level
- Conversely, strategies like Restricting Night Driving and Banning ICE Vehicles have lower policy readiness, indicating either the absence of supportive frameworks or the complexity in mandating such policies.

Implementability:

- Charging Infrastructure and Public Transport Infrastructure score high in implementability, likely due to existing frameworks or technological feasibility.
- On the other hand, Restricting Night Driving and Vehicle Lifetime Restrictions are perceived as difficult to implement, possibly due to societal resistance or logistical challenges.

Relevance:

- Electrification, Modal Shift, and Public Transport Infrastructure are deemed most relevant, suggesting that stakeholders see these as central strategies for addressing

the discussed issues.

- However, Regulating Speed Limits and Restricting Night Driving are perceived as less relevant, potentially because they may not directly address the overarching objectives of the initiative.

Perceptions by Stakeholder Type:

• High Consensus on Core Strategies: Across all three stakeholder groups, there is broad agreement on the high relevance, policy readiness, and implementability of Electrification, Public Transport Infrastructure, and Awareness Campaigns. These strategies offer clear benefits for emissions reduction and have established pathways for policy adoption and implementation. Governments, think tanks, and institutions alike recognise the potential for large-scale impacts, making these strategies central to the net-zero transport agenda.

• Divergence on Restrictive Measures: Strategies such as Banning ICE Vehicles and Restricting Night Driving show divergence in stakeholder views. Think tanks and institutions are more supportive of these measures, seeing them as necessary for long-term emissions reductions. However, governments are more cautious, likely due to concerns about public resistance, economic disruptions, and the political challenges of implementing such policies.

• Technological Optimism: All stakeholders show strong support for Battery Management, Low Carbon Vehicle Technology, and Charging Infrastructure. These strategies benefit from ongoing technological advancements, growing private sector involvement, and increasing public awareness. Governments, think tanks, and institutions view these technologies as critical for achieving net-zero transport, and they are seen as highly implementable and policy-ready.

• Challenges for Carbon Capture and Land Use: Both Carbon Capture and Land Use strategies rank lower across all stakeholder groups in terms of relevance, policy readiness, and implementability. This suggests that these strategies are either not fully understood, lack technological maturity, or face significant policy and financial barriers. Further research, demonstration projects, and advocacy may be required to bring these strategies into mainstream transport decarbonisation efforts.

Perceptions by Subject-Area Expertise:

The responses from stakeholders, representing diverse professional backgrounds, provide valuable insights into their perceptions of the proposed strategies for Rajkot's net zero transport plan. Offering a comprehensive look at how different professional groups assess the feasibility and importance of each strategy, we present the findings for identified sectors- (i) Energy, Environment, and Climate, (ii) Health and Education, (iii) Transport Planning, (iv) Urban Development, (v) Sustainable Development, (vi) Water, Sanitation & Hygiene (WASH), (vii) Waste Management:

1. Energy, Environment, and Climate: This group sees relevance in broad-based systemic changes like electrification and public transport investments but recognises technical hurdles in implementing more niche strategies like carbon capture and non-motorised transport.
2. Health and Education: Health professionals value strategies that can indirectly improve health through environmental benefits but appear less convinced about the relevance of restrictive driving measures or speed regulation.
3. Transport Planning: This sector is highly focused on infrastructure improvements and sees these as foundational to the transition toward net zero, with some reservations

about the feasibility of more aggressive vehicle restrictions.

4. Urban Development: This sector's responses reflect a high appreciation for integrated planning solutions, such as land use reform and public transport expansion, while less enthusiastic about strategies that could disrupt current urban mobility patterns (like banning ICE vehicles).
5. Sustainable Development: High level of confidence in Battery Management and Carbon Capture strategies, but indicated low-to-moderate readiness for strategies related to Land Use and Investments, indicating that while stakeholders recognise the long-term benefits, the current policy environment may not fully support immediate action.
6. WASH: This sector showed the least engagement with traditional transport-related strategies, emphasising that cross-sector coordination will be critical to aligning WASH with broader sustainable transport goals.
7. Waste Management: Stakeholders are focused on strategies directly related to resource efficiency and recovery, such as recycling, partnerships, and awareness campaigns, showing a lower interest in transport regulation.

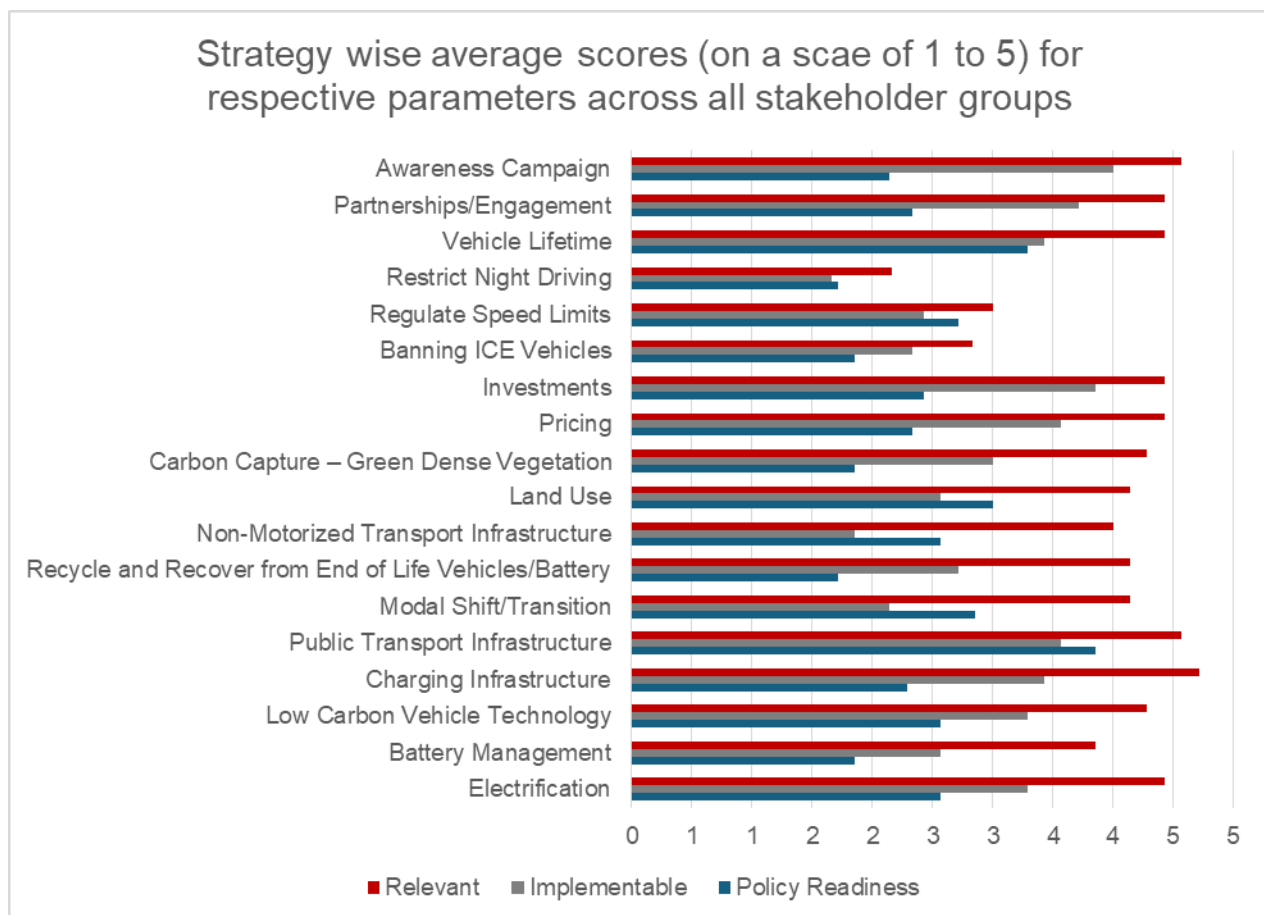


Figure 1 Strategy wise average scores (on a scale of 1 to 5) for respective parameters across all stakeholder groups

Conclusion:

The results of this stakeholder workshop highlight key areas of alignment and divergence

in terms of strategic priorities. The stakeholder-wise analysis highlights a strong alignment on the relevance and feasibility of key strategies such as Electrification, Public Transport Infrastructure, and Awareness Campaigns. These are viewed as essential components of any net-zero transport roadmap due to their scalability, technological readiness, and alignment with public and governmental interests. Policy-makers should focus on enabling the high-scoring strategies while addressing the concerns or barriers linked to the lower-scoring ones.



THEME 2- Indicators Development for the Net Zero Transport

Discussants	Discussion Questions
Mr. Vivek Chandran	Please reflect the data availability and measurability of the sets of indicators. Please reflect on the relevance of the sets of indicators at the city level. Are these indicators being relevant to existing Net-Zero or Transport policies? Can urban local bodies adopt these sets of indicators and measure them on a regular basis? Since various sets of indicators exist like SDG indicators, Service Level Benchmarks, State Development Indicators, etc. how do we navigate that and develop Net-Zero Indicators? What are the governance and institutional mechanism needed to mandate the use of these indicators? Under each sub-category (that relates to your area of expertise), please propose an indicator that can lead to Inclusive Net-Zero Transport.
Dr. Himani Jain	
Dr. Abhijit Lokre	
Prof. Mayank Dubey	
Dr. Saket Sarraf	
Officers from Planning Division, General Administration Department, GoG	

The second roundtable discussion begins similarly to the first, with participants filling out forms listing indicators. Moderated by **Dr. Talat Munshi**, this session explores net-zero transport indicators derived from existing transport vision and mission documents, along with sector plans. These indicators encompass sub-categories such as GHG emissions, energy efficiency, air quality, social inclusion, and green and blue infrastructure, providing a foundation for discussion.

Mr. Vivek Chandran, Director of Climate Insights at Shakti Sustainable Energy Foundation, opens the discussion by addressing data availability. He notes that many indicators are embedded in policies, making them measurable. He emphasises the adoption of technologies like Automatic Number Plate Recognition (ANPR) for vehicle-level data collection. However, he identifies a significant challenge in obtaining trip-level data to study travel patterns. He further discusses the relevance of indicators like recycling, recovery, and carbon capture at the urban level, suggesting that these can be adapted to meet specific city requirements. Mr. Chandran points out the lack of differentiation between carbon emissions from the transport and industrial sectors, arguing that urban-level adaptation measures, such as tree planting, are crucial regardless of net-zero targets. He also highlights the disconnect experienced by lower-power states due to inadequate resources and mandates at the urban local planning (ULP) level. Regarding pre-existing indicators, he advocates for their use but emphasises the importance of their application and data collection.

Dr. Himani Jain, Senior Program Lead at CEEW, advances the conversation by advocating for restrictive policies or economic instruments aimed at personal vehicles to promote public transportation and non-motorised transport. She suggests that economic

instruments, such as taxes on private vehicles, can drive investment in public transport infrastructure. Dr. Jain also discusses urban freight, emphasising the need for indicators to track trips undertaken by gig workers, which can encourage non-motorised transport and reduce carbon footprints. She highlights the significant volume of daily trips from small to medium cities to larger urban hubs, proposing that clustering smaller cities around larger ones can reduce these trips and their associated impacts.

Dr. Abhijit Lokre, Co-Founder of The Urban Lab, adds to the discussion on data, pointing out existing gaps. He proposes utilising GST data as a valuable resource for freight, albeit acknowledging its limited availability at the central level. Dr. Lokre emphasises the inconsistency of data across states and cities, which complicates national comparisons. He suggests employing the Avoid, Shift, and Improve (ASI) Framework without categorising it under the mobility heading. Dr. Lokre raises questions about measuring risk exposure within safety and security indicators, suggesting the Toolkit for Comprehensive Mobility Plan for proposed indicators and measurement methods. He recommends including average access times to public transport and differentiating indicator frequencies based on their applicability across various contexts.

Prof. Mayank Dubey, Assistant Professor at SPA Bhopal, comments on the importance of freight transport indicators, advocating for parallel development of public transport indicators. He emphasises the need for indicators like per capita trip rates and average trip lengths in the context of freight transport, which can provide insights into city size and manufacturing town dynamics. Prof. Dubey points out biases against freight transport in regulations and suggests that parallel indicators can help illustrate economic gains despite restrictions. He echoes Dr. Lokre's views on the potential of GST and E-Way bills for capturing intercity freight data. He also addresses discrepancies between model data and actual outcomes in transport studies.

Dr. Saket Sarraf from PS Collective shifts the focus to different perspectives on indicators. He suggests dividing indicators into three segments: those used by policymakers for accountability, those for daily city operations, and those for academic analysis. This segmentation could enhance the effective utilisation of indicators. Dr. Sarraf agrees with Dr. Lokre on the importance of quality and consistency in data and underscores the need for creative data collection methods, incorporating new technologies like AI and big data.

Officials from the Planning Division of the General Administration Department of Gujarat discuss the initiation of data collection processes by government bodies. They report having 20 to 25 percent of the necessary data based on the discussed indicators, emphasising the importance of sample surveys to fill gaps. They propose creating competitive incentives among cities to enhance data collection and reflect differences in performance. They also advocate for indicators that measure tangible outcomes, such as tree survival rates and public transport usage.

Dr. Munshi adds a suggestion for an indicator measuring green space per individual, inspired by practices in Vietnam. Another official recommends tracking parking availability at public transport stations to assess public transport needs and usage. Participants are invited to propose additional indicators, with suggestions including those related to municipal staff capacity and management efficiency in public transport systems.

The session concludes with Dr. Mahadevia thanking all speakers, discussants, participants, and the core team for their time and contributions.

Insights from Stakeholder Consultation on Indicator Development for Net-Zero Transport

Stakeholder perceptions regarding the relevance of various indicators related to environmental sustainability and transport metrics. The data provides insights into how stakeholders prioritise specific indicators, as illustrated in the accompanying graph.

Environmental Indicators:

- Annual Tree Planting Rate: 21 stakeholders affirmed the relevance of this indicator
- Percentage of Land Area Dedicated to Parks: Here, 22 stakeholders found this indicator relevant
- Percentage of Scrapped Vehicles Properly Recycled: A high number (24) found this indicator relevant

Transport and Mobility Indicators:

- Number of Charging Points per sq.km: This indicator was considered relevant by 22 stakeholders
- Share of Electric Vehicles (EVs): 24 stakeholders viewed this indicator as relevant

Employment Metrics:

- Percentage of Disabled Persons Employed in the Freight Sector: Equal responses were observed here, with 13 stakeholders affirming relevance and 13 opposing.
- Women's Participation in the Sector's Labour Force: 18 stakeholders confirmed this as relevant, with 8 dissenting.
- Employment Opportunities Generated by the Transport Sector: 18 stakeholders found this indicator relevant, with 8 against.

Service and Infrastructure Indicators:

- Electric Vehicle Incentives: 20 stakeholders indicated the relevance of this indicator, while 6 disagreed.
- Average Cost per Ton-KM: 20 stakeholders saw this as relevant, with 6 dissenting.

Safety Features:

- Percentage of Buses and Stops with CCTV and Lighting: 23 stakeholders affirmed the relevance, while 3 disagreed.
- Percentage of Transport Facilities Designed for Disabled Persons: A strong consensus was noted, with 25 stakeholders considering this relevant and only 1 dissenting.

Public Transport Metrics:

- Average Waiting Time for Public Transport Services: This was highly relevant for stakeholders, with 26 affirmations and no dissent.
- Public Perception of Walking and Cycling Facilities: 18 stakeholders found this indicator relevant, while 8 disagreed.
- Urban Roads with Walk and Bicycle Infrastructure: 24 stakeholders indicated relevance, with 2 dissenting.
- Travel Cost to Income Ratio: This metric received 24 affirmations and 2 dissenting opinions on its relevance.

Analysis reveals a predominantly positive view among stakeholders regarding the relevance of the assessed indicators. Many indicators related to environmental sustainability and public transport were viewed as crucial by a significant majority. However, some indicators, particularly regarding employment metrics and public perceptions of infrastructure, elicited mixed responses, suggesting areas where further engagement or clarification may be beneficial. The findings highlight the importance of

focusing on these relevant indicators to align future initiatives with stakeholder expectations and priorities.

Analysis of Measurability of Indicators:

Environmental Indicators:

- Annual Tree Planting Rate: 18% of stakeholders indicated that this indicator is measurable, while 7% disagreed.
- Percentage of Land Area Dedicated to Parks: A strong 25% affirmed measurability, with only 1% opposing.
- Percentage of Scrapped Vehicles Properly Recycled: Here, 20% responded positively about measurability, with 5% stating otherwise.

Transport and Mobility Indicators:

- Number of Charging Points per sq.km.: 23% of stakeholders view this as measurable, with 3% disagreeing.
- Share of Electric Vehicles (EVs): 24% indicated measurability, while 2% did not.

Employment Metrics:

- Percentage of disabled persons employed in the freight sector received 20% support for measurability, with 6% against.
- Women's participation in the sector's labour was seen as measurable by 24%, with 2% dissenting.
- Employment opportunities generated by the transport sector had 23% agreement on measurability.

Service and Infrastructure Indicators:

- Electric Vehicle Incentives: 22% found this measurable, with 4% disagreeing.
- Average Cost per Ton-KM: 18% indicated measurability, but 8% opposed.
- Safety Features: The percentage of buses and stops equipped with CCTV and lighting had 24% affirmative responses, with 2% dissent.
- Transport Facility Quality: 25% rated the measurability of transport facilities, with 1% disagreeing.

Public Transport Metrics:

- Average Waiting Time for Public Transport Services: 25% found this measurable, while only 1% did not.
- Public Perception of Walking and Cycling Facilities: 18% indicated measurability, with 8% against.
- Urban Roads with Walk and Bicycle Infrastructure: 23% affirmed measurability, with 3% dissenting.
- Travel Cost to Income Ratio: 20% found this measurable, while 6% disagreed.

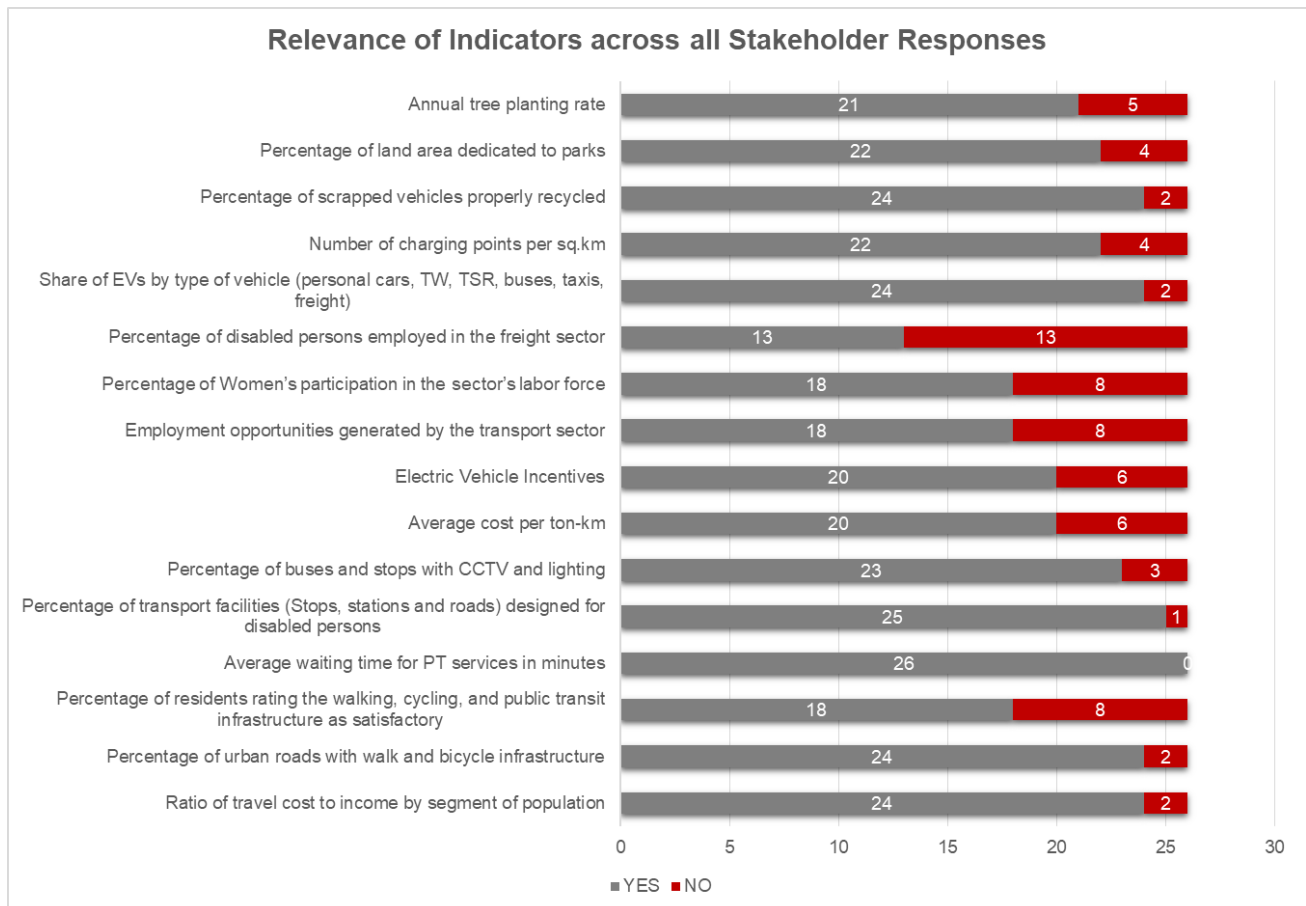


Figure 2 Relevance of Indicators across all Stakeholder Responses

Perceptions by Stakeholder Type:

- **Infrastructure-Related Indicators are perceived as Highly Measurable:** Across all stakeholder groups, there is strong agreement on the measurability of infrastructure-related indicators, such as CCTV on buses, EV incentives, and public transport facilities. These indicators likely involve clear, tangible data, making them easier to track and quantify.
- **Social Inclusion Indicators Show Divided Perceptions:** Indicators related to the employment of women and differently-abled persons in transport sector received varied responses. While all groups recognised the importance of these metrics, there were concerns about the challenges in consistently measuring them, particularly due to the variability in available data across regions or sectors.
- **Subjective Metrics are Difficult to Measure:** Public perception indicators, such as residents' ratings of walking, cycling, and public transport services, received mixed responses from all groups. This highlights the difficulty in translating subjective opinions into quantifiable data, which may require more robust data collection methods, such as regular surveys or citizen engagement tools.
- **Cost Indicators Raise Questions about Feasibility:** Cost-related indicators like Average cost per tonne-km and Ratio of travel cost to income showed the greatest variation in responses, particularly among institutional stakeholders and think tanks. These metrics, though essential, may be challenging to track accurately due to need for comprehensive data across multiple income segments or transport modes.

- The responses suggest that future efforts to track transport sector performance may need to focus on improving data collection mechanisms for subjective and socially oriented indicators, particularly those related to employment diversity and public perceptions of transport infrastructure. Additionally, developing more standardised methodologies for cost-related indicators could help address concerns about their measurability, particularly among institutions and think tanks.

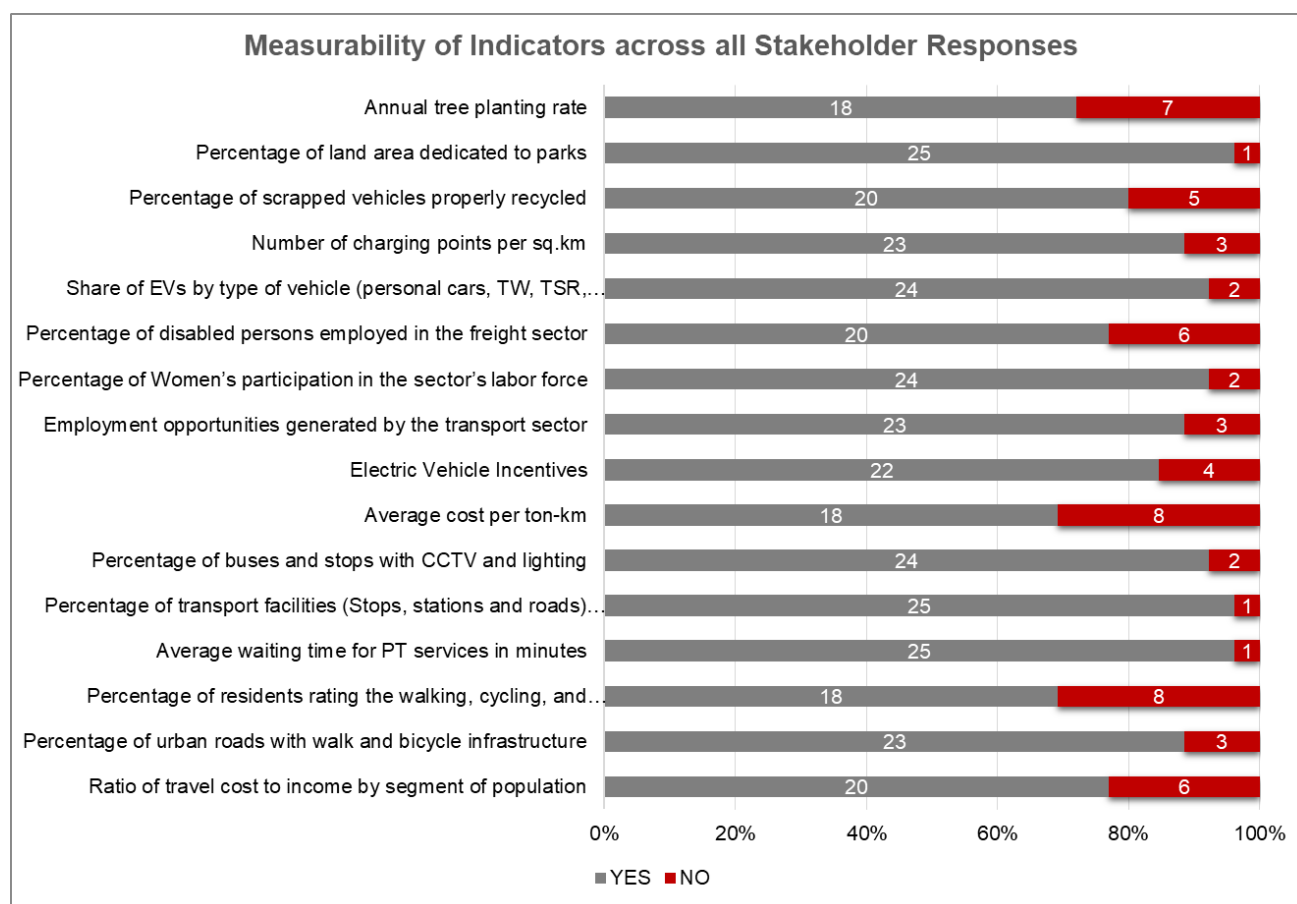


Figure 3 Measurability of Indicators across all Stakeholder Responses

Conclusion:

Overall, the analysis reflects a generally positive perception regarding the measurability of these indicators, particularly in the context of environmental initiatives and transport services. Stakeholders demonstrate a strong inclination towards the ability to measure certain key performance indicators, although there remains a minority that expresses uncertainty or disagreement. The results suggest a need for further engagement with stakeholders to address concerns and enhance the frameworks for measuring these indicators effectively.



APPENDIX: List of Participants

S.No.	Name	Institutional Affiliation
1	Dr. Abhijit Lokre	The Urban Lab, Ahmedabad
2	Ajay Bhattad	Deloitte
3	Akash Soni	Ahmedabad University
4	Bhavya Patodi	Ahmedabad University
5	Prof. Darshini Mahadevia	Ahmedabad University
6	Dr. Debolina Kundu	National Institute of Urban Affairs, India
7	Prof. Deepty Jain	Indian Institute of Technology, Delhi
8	Divya Namborthini	Gujarat Urban Development Mission
9	Garima Munjal	Ahmedabad University
10	Prof. Geetam Tiwari	Indian Institute of Technology, Delhi
11	Hemant Chouhan	Gujarat Urban Development Mission
12	Dr. Himani Jain	Council for Energy Environment and Water, Delhi
13	Hitesh Patel	Gujarat Urban Development Mission
14	Kopal Agarwal	Ahmedabad University
15	Krishna Desai	GIZ
16	Prof. Kushdeep Malhotra	Ahmedabad University
17	Prof. Mayank Dubey	School of Planning and Architecture, Bhopal
18	Mayur Khimsuriya	Rajkot Municipal Corporation
19	Prof. Minal Pathak	Ahmedabad University
20	Prof. Mohit Dev	School of Planning and Architecture, Bhopal
21	Nandini Sharma	Indian Institute of Technology, Delhi
22	Nilesh Prajapati	GIZ
23	Pooja Paghadar	Gujarat Urban Development Mission
24	Pooja Save	CEPT University
25	Prof. Priyadarshi Shukla	Ahmedabad University
26	Dr. Rajeshreeben Swaminarayan	General Manager Gujarat Urban Development Institute (GUDI)
27	Dr. Saket Sarraf	PS Collective
28	Ms. Saumya Lathia	Urban Development Department (UDD), GoG
29	Shri Bhavya Mehta	Urban Development Department (UDD), GoG
30	Shri Kapil Dayma	General Administration Department - Planning (GAD), GoG
31	Sweta Delwadia	Gujarat Urban Development Mission
32	Dr. Talat Munshi	UNEP Copenhagen Climate Centre
33	Uday Kumar	Gujarat Urban Development Mission
34	Ujjwal Pratap	Gujarat Urban Development Mission
35	Upendra Kumar	Gujarat Urban Development Mission
36	Dr. Vaibhav Chaturvedi	Council for Energy Environment and Water, Delhi
37	Vayomini Khajuria	Deloitte

38	Dr. Vijay Anadkat	World Resources Institute, India
39	Vivek M. Chandran	Shakti Foundation



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