

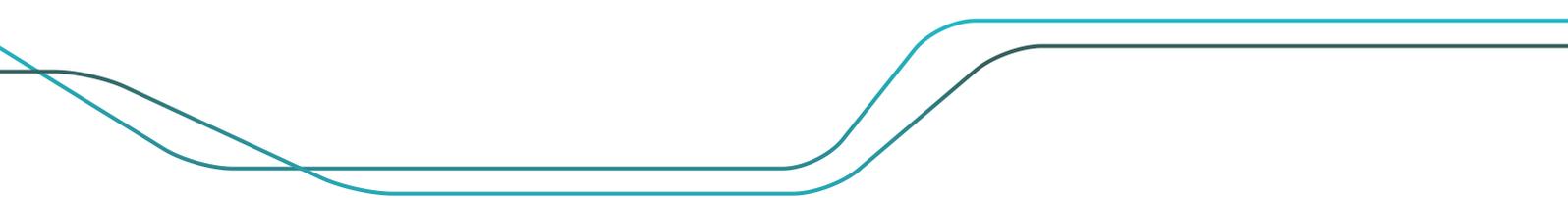
The Path to Zero: A Vision for Decarbonised Transport in Asia

Overcoming Blind Spots and Enabling Change

A Report by the Council for Decarbonising Transport in Asia

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Publications Details

For more information

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We would welcome your input on this report, its findings or more generally on decarbonising transport in Asia. Please mention “NDC TIA Council for Decarbonising Transport in Asia” when contacting us or fill in our short survey at <https://bit.ly/382247s>.

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About the Council for Decarbonising Transport

It is time to fundamentally transform transport in Asia to ensure sustainable development in the region and achieve global climate goals. The Council for Decarbonising Transport in Asia brings together 14 recognised experts, practitioners, and thought leaders from academia, civil society, business, and financial institutions from the Asian region. The Council was set up under the [NDC Transport Initiative for Asia](#) to promote critical dialogue on achieving zero-carbon transport.

All members of the Council have many years of experience in the transport sector in Asia. Many have a long history in advising national and local governments or advocating for improved mobility. Some hold or have held positions within governments or large transport operators. Others have excelled in academic research in the field, including contributing to the IPCC Assessment Reports. Together, they provide a wide set of experience across the transport sector, bringing together views from civil society, business, academia and government.

Through the leadership of these charismatic and influential individuals the council aims to develop and advocate a vision for the complete decarbonisation of transport in the region in line with the objectives of the Paris Agreement.

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Executive Summary



Why now is the moment to act

Failure to act now on climate change will result in significant environmental and economic damage while also increasing the potential for social dislocation and conflict.

Climate change acts as a multiplier on the already increasing pressure from population growth, increasing resource demand, environmental degradation, urbanisation and economic inequality. It can therefore drive political instability that culminates in unrest or conflict – making an already complex challenge even more daunting (Rüttinger et al., 2015).

The transport sector is a backbone of the economy, but is highly vulnerable. Climate change is anticipated have growing and serious impacts on transport infrastructure and services. While transport planners and operators are used to anticipating the consequences of adverse weather, the frequency and severity of extreme weather events have been rapidly increasing (SUTP, 2021).

In the absence of robust action in the transport sector, the goals of the Paris Agreement will slip out of reach.

Transport was responsible for 25% of direct CO₂ emissions from fuel combustion in 2018 (ITF, 2021b), underscoring the importance of abatement action in this sector. Asia was responsible for 27% of global transport sector emissions in that year; between 1990 and 2018 Asian transport emissions jumped 243% (ADB, 2021). Without further action, emissions in Asia are expected to increase another 48% between 2015 and 2050, with the bulk of growth coming from the freight sector and passenger transport outside of urban areas (ITF, 2021b).

The free movement of people and goods – unhindered by climate impacts – is crucial for economic prosperity and a properly functioning modern society.

It is therefore essential to build resilient¹ systems that will continue to function under increasing climate change pressures, especially given stalled progress in mitigation. Yet even with immediate action to slash emissions, significant temperature increases are nearly unavoidable, thus requiring transport systems to adapt to future conditions. Making climate change an integral factor in transport planning, infrastructure design and operations at all decision-making levels will be crucial for a resilient transport sector of the future.

Net-zero pledges by governments and companies that promise to achieve a balance between emissions and removals provide positive momentum.

94% of Asia's transport sector emissions are covered by economy-wide or transport-sector net-zero targets. Numerous companies are setting science-based or net-zero targets, including many businesses in the transport sector. All of these pledges will have substantial impact on the future of transport in Asia. These pledges also reflect changing public perceptions, with growing awareness for the dangers of climate change. In the financial sector, as well, there is a move toward ending fossil fuel financing, enhanced disclosure, issuance of green bonds and carbon trading.

Imagining the future – where we want to go

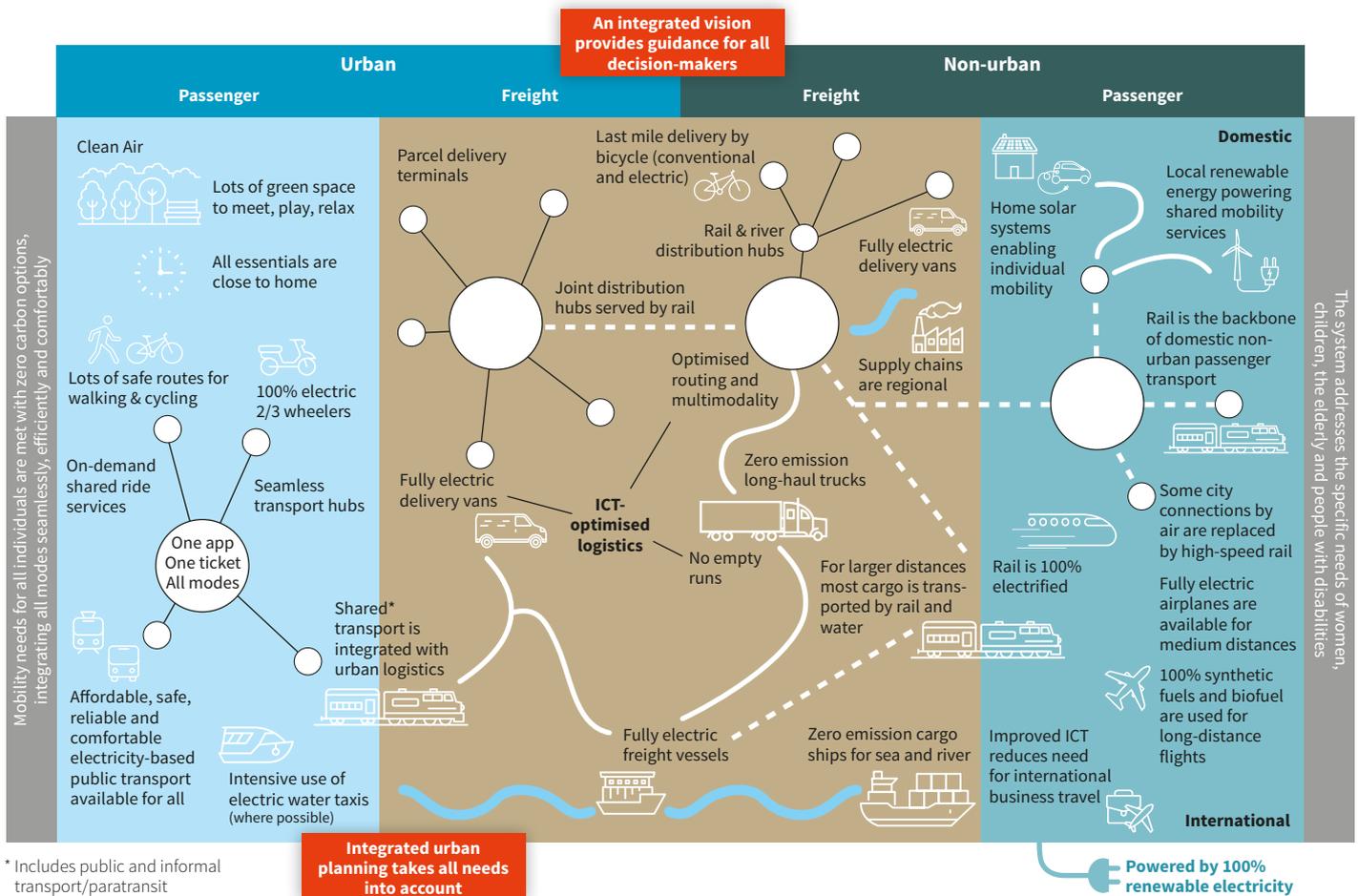
In our vision for 2050, the mobility needs of all citizens are met with zero-carbon options that are integrated in a seamless, efficient and convenient manner.

To achieve this vision and avert the worse impacts of climate change, urgent action is needed. And while change is never easy, the benefits of action will far outweigh the costs. In our vision for 2050, the transport sector is highly efficient and has fully decarbonised. It also ensures better access to mobility for everyone. Various modes of transport are available on demand and seamlessly integrated with flexible payment systems.

Freight will largely be transported by rail and water, and last-mile delivery will be provided by electric trucks, vans and bikes. Logistics companies will streamline their delivery operations with ICT technologies and joint distribution centres.

¹ Resilience is the ability of a system to absorb, withstand, and recover from an adverse event. In the environmental context, resilience encompasses the policy, infrastructure, services, transportation, and planning activities that position municipalities to withstand natural disasters and other impacts of climate change (EESI).

Figure ES1:
Our vision for a sustainable, resilient, low-carbon transport sector



Where we are today

Across Asia, there are many points of divergence in the transport sector. While personal vehicle ownership is still low in the region, it boasts the fastest growth rates globally. Yet there are also large differences between countries. Countries with higher GDPs have motorisation levels comparable to the EU and have experienced lower growth rates over the last few years. The contribution of the transport sector to GDP and the importance of the automotive and petroleum industries varies between Asian countries (ADB, 2021; BP, 2020). Although some Asian countries are significant oil producers, most are net importers, with consumption outstripping production (BP, 2020). In this way, the phasing-out of fossil fuels in transport will not only reduce GHG emissions, but reduce import dependencies.

Emission levels in the sector vary significantly at the country level. Due to their large populations, China and India account for 58% of transport emissions in the region. Per capita emissions from the transport sector vary significantly, from 0.02 t CO₂/capita in Laos to 3.5 t CO₂/capita in Brunei Darussalam, in part due to divergent income levels (ADB 2021, UNDESA 2019, World Bank 2021b).

International climate commitments (NDCs) are lacking ambition and need specific transport targets. As of January 10, 2022, twenty-five Asian countries had submitted updated NDCs or second NDCs. Only four² of these NDCs contain a quantitative GHG target for the transport sector; five³ more contain other types of targets – for example, related to electric and/or hydrogen vehicles or biofuels (TraCS and SLOCAT, 2021).

Long-term Strategies (LTS) submitted to the UNFCCC are still lacking for most countries, but show a good mixture of measures across the Avoid–Shift–Improve framework. So far, eight countries in Asia⁴ have submitted long-term strategies to the UNFCCC, of the 49 LTS submitted thus far.⁵ Japan and Singapore, for example, have comprehensive avoid, shift and improve strategies, with clear related targets.

In most countries, national transport strategies are not yet aligned with broader domestic climate ambition. Only around half of the 34 countries considered in our analysis have a formal, sector-wide transport policy and while many of these include some mention of climate-change mitigation, only four discuss climate change adaptation (ADB, n.d.).

Despite varying improvements to road safety, the health impacts from air pollution and lack of physical movement are on the rise. Increasing motorisation and urbanisation work together to create a number of social challenges, including the health effects of air pollution; fatalities and temporary/permanent injury from vehicle accidents; and the health and economic effects of traffic congestion and sedentary lifestyles (ADB, 2021).

The COVID-19 pandemic has strongly impacted 2020 global and regional GHG emissions from the sector, but without additional action, transport emissions growth is expected to resume. Freight activity fell initially, but demand surged as the pandemic subsided, with developing countries (excluding China) being hit the hardest. In 2020, urban public transport faced strong negative impacts due to lockdown measures and fears over infection. The perception of risk in public transport continues, although studies showed early on that infection risk in public transport is relatively low compared to other public places. Improving public communication surrounding hygiene is key in the post-COVID-19 era. However, active mobility has also gained momentum during the pandemic, which can be leveraged.

The ongoing COVID-19 recovery packages can move things in the right direction. The ongoing pandemic recovery packages represent unprecedented levels of public investment that can be channelled towards decarbonising transport. At the global level, so far only 1.5% of recovery spending devoted to transport is allocated to improving active transport while 13% is dedicated to the stabilisation of public transport systems. This is a lost opportunity.

² Bangladesh, Georgia, Japan and Sri Lanka.

³ Brunei Darussalam, Cambodia, Laos, Nepal and Pakistan.

⁴ Cambodia, China, Indonesia, Japan, Nepal, the Republic of Korea, Singapore and Thailand.

⁵ By January 10, 2022.

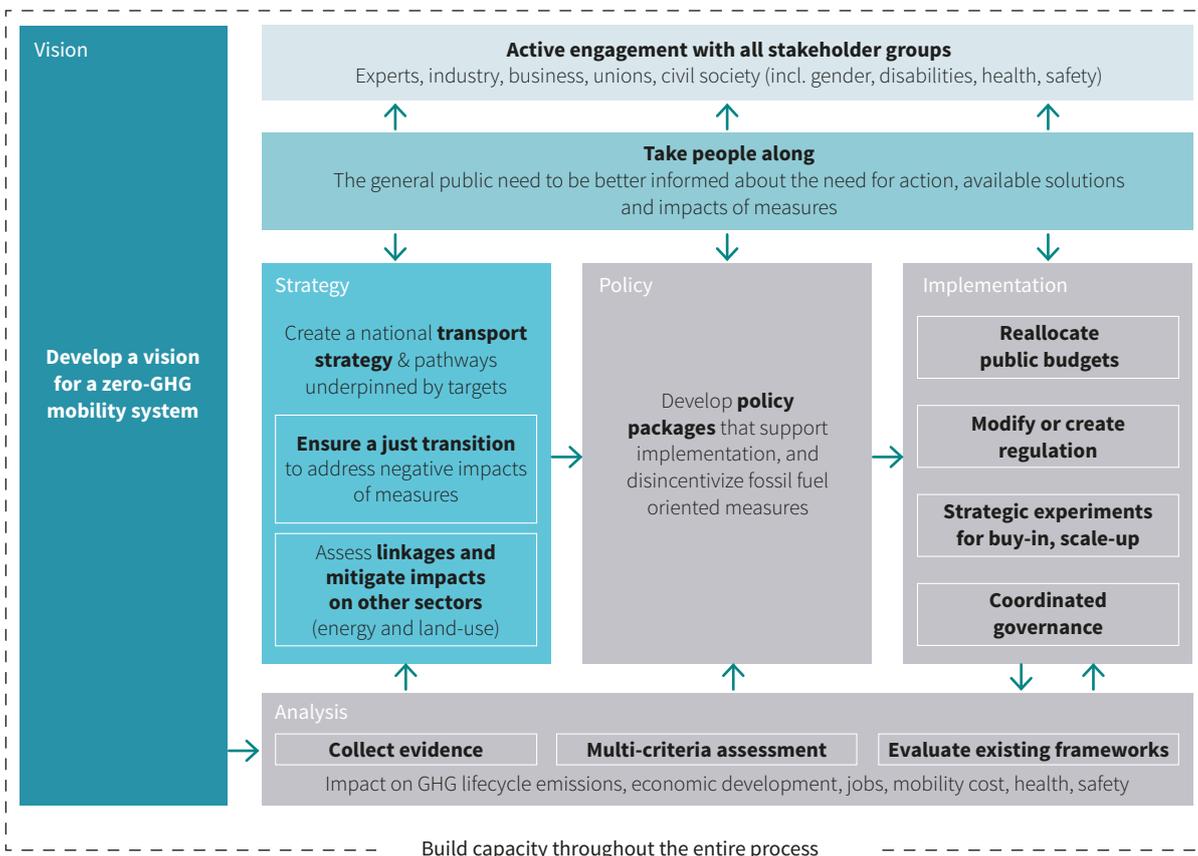
What is needed to get to zero-carbon transport

Ensuring a just transition is essential. In addition to the intended positive effects of a policy measure, there may be a range of risks for various stakeholders. Understanding these effects is crucial to finding tailored solutions that mitigate negative developments and create a more equitable and sustainable system (Conway et al., 2017). Stakeholder dialogue, social protection measures and funds for affected communities are needed, supported by transition funds that help communities move beyond fossil fuel industries. The transition also creates opportunities for job creation and economic growth (ILO, 2015). Governments can ensure that policy frameworks enable and support such opportunities. Investment in public and active transport, for example, can create more jobs than investing in road infrastructure (WRI, 2021).

The tools and technologies for transitioning to a zero-carbon transport system are largely known, but only a balanced avoid-shift-improve approach will deliver.

Many Asian countries today have high shares of public transport, walking and cycling, mostly because of the large number of people who cannot afford private motor vehicles. The goal here must be to maintain such high shares, but make it a choice rather than a necessity. This must be complemented with solutions that reduce the need for transport activity by avoiding trips and reducing trip length; remaining vehicles must also become more efficient and capable of running on low-carbon or zero-energy sources (Agora Verkehrswende et al., 2018; SLoCaT, 2018).

Figure ES3:
Policy and action framework for decarbonising transport



Actions need to be embedded in a consistent framework.

Implementing actions without a long-term vision and strategy risks higher costs later and stranded assets. Strategies need to be translated into concrete policies, while governance mechanisms, actions and regulations need to build on a strategic foundation.

A broad set of instruments is available to support the transformation to a zero-carbon transport system.

The appropriate implementation instruments for local contexts need to be based on a thorough analysis of existing policies. In some cases, existing instruments may need to be adapted or removed if zero-carbon policy instruments are to work.

While some policies require careful analysis and preparation, there are several no-regret instruments that can be implemented immediately.

The task ahead may seem daunting, and setting up the necessary framework, as illustrated in figure ES3, will take some time. However, immediate action is needed, and is possible without compromising future decisions on where to go. Figure ES4 highlights some of the options.

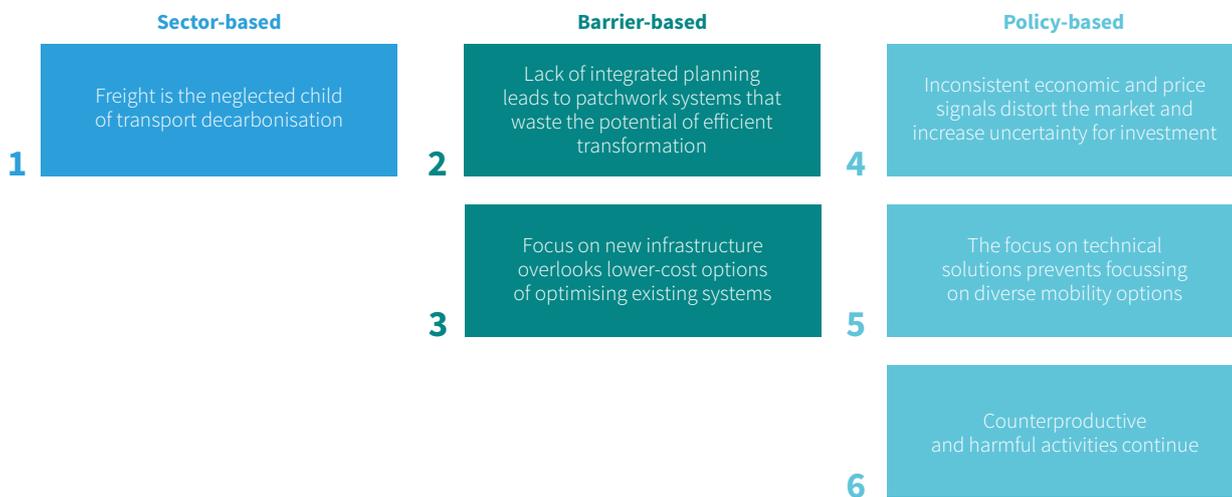
Figure ES4:
No-regret instruments for immediate action

Removing fossil fuel subsidies	Fostering integrated planning	Improving and expanding existing public transport options	Increase vehicle efficiency & reduce vehicle mass	Support mechanisms for electric vehicles & charging infrastructure
Irrespective of future technology choices, fossil fuel subsidies distort the market towards high-polluting solutions. Removal will make all low-carbon solutions more competitive, but will affect people and businesses and needs to be carefully supported by just-transition measures to mitigate negative effects.	Integrating planning of mobility with land-use and economic development provides multiple benefits in avoided congestion, improved access, and reduced air pollution. Effects are not immediate, but efforts will need to start now to enable the sustainability of future systems.	Public transport will form the backbone of zero-carbon mobility, so fast expansion and improvement of services is key to success and can in the first step largely build on improving existing systems.	In the transition to a zero-carbon transport system all vehicles need to be as efficient as possible to ensure enough renewable energy can be produced to power them. It also provides quick reductions and comes at low financial cost to public budgets.	Other technologies may be selected for specific transport segments, but electric vehicles will form the majority of the future 2-/3-wheeler, car and bus fleets. Getting ready now will enable a smooth and just transition.

What is holding back action?

‘Blind spots’ are issues currently receiving inadequate attention given their potential contribution to decarbonisation. These blind spots require explicit consideration in future policy action. Key blind spots are identified in figure ES5. Tackling these issues will be important when designing an enabling environment for sustainable, decarbonised transport.

Figure ES5:
Overview of key blind spots



Enabling the transformation

Solutions must be attuned to the country in question, including its level of urbanisation and the density and size of its cities. Therefore, each country needs to elaborate its own set of policy actions. Asian countries vary enormously – culturally, economically, geographically and politically. Accordingly, when developing problem-oriented strategies to decarbonise the transport sector, one must consider local contexts, including existing transport infrastructure and services, prevailing transport modes, and domestic climate ambition.

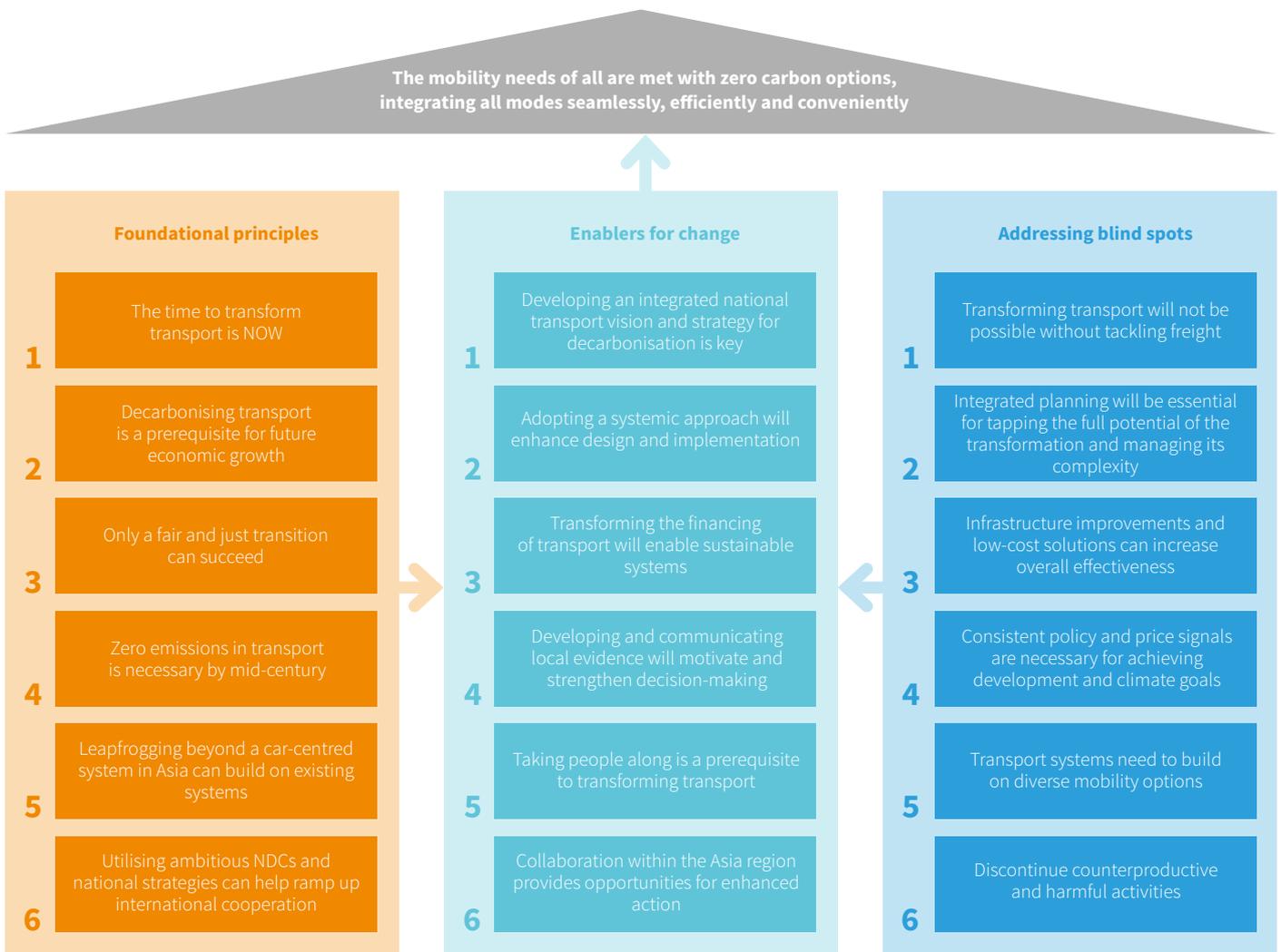
The recommendations summarised in figure ES6 seek to highlight the country-specific features that may be relevant to the implementation of certain key actions. For example, countries with lower per capita income may be better served by focusing on ICT systems and vehicle maintenance instead of new infrastructure. Nevertheless, these recommendations are of a generic nature, so they are generally relevant for the decarbonisation of the transport sector. We hope they inspire countries to reflect on their specific challenges and ‘blind spots’.

Our analysis has identified **six foundational principles** for transitioning to a decarbonised transport system in Asia with sufficient speed to avert catastrophic warming. Taking these considerations into account will help decision-makers to create the appropriate enabling environment for their national context.

Creating the suitable policy framework to drive the transformation towards the envisioned zero-carbon transport system in Asia is paramount. Building on our foundational principles, **six enablers for change** can create a fertile environment and strong momentum for transformative policies and strategies.

Tackling the identified key blind spots will be important when designing an enabling environment for sustainable, decarbonised transport. We outline some strategies that can be used by decision-makers to ensure these issues are adequately considered in national policy contexts.

Figure ES6:
Decarbonising transport in Asia: Pillars for action



A nighttime photograph of a busy city street, likely in Hong Kong. The street is filled with traffic, including several double-decker buses and taxis. Pedestrians are crossing the street at a crosswalk. The scene is illuminated by streetlights and the lights of the vehicles. In the background, there are buildings and signs, including one that says '戲院' (Theater) and '新' (New).

1.

Structure and scope of this report

*Tackling blind spots is key to
delivering sustainable mobility*

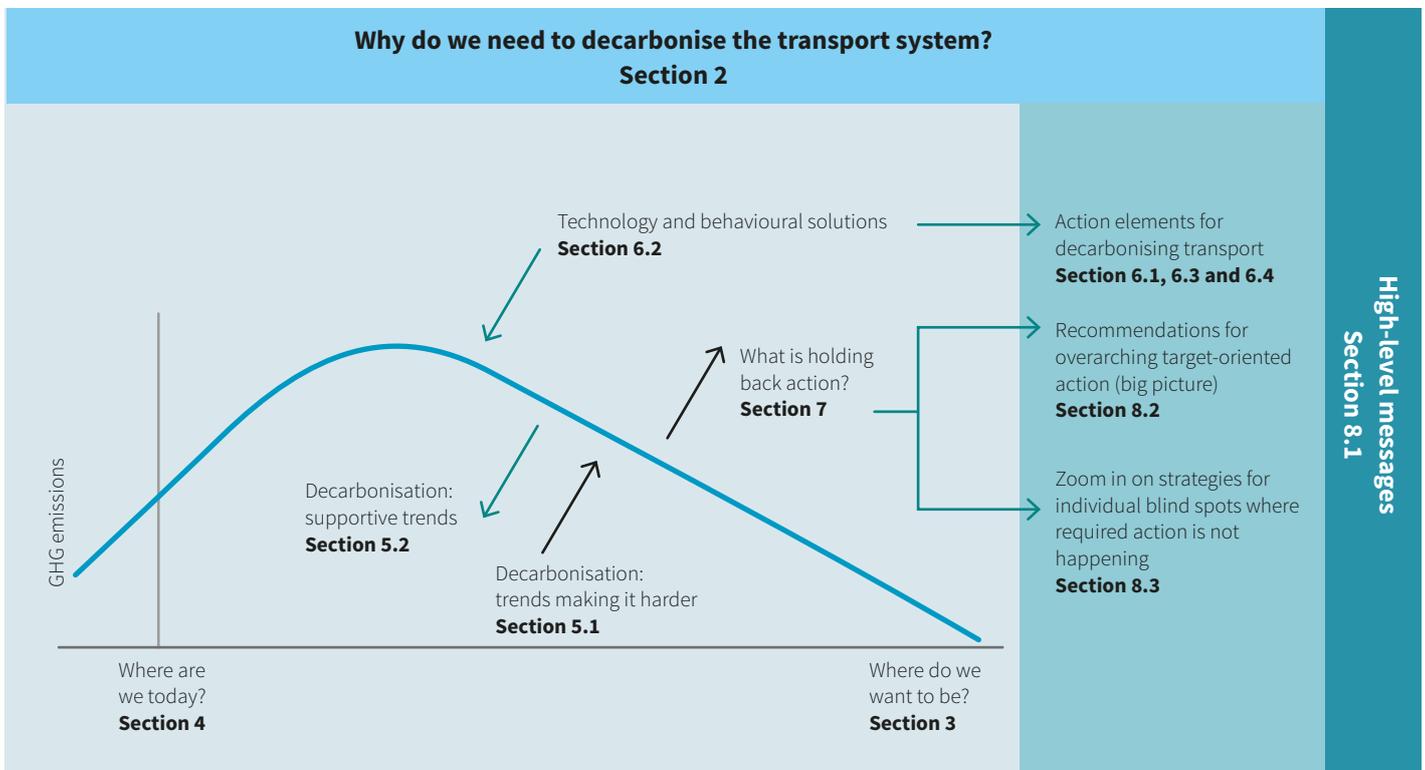
The main objective of this report is to spotlight both the opportunities and challenges associated with achieving zero emissions⁶ in transport by 2050 in Asia. It formulates clear and practical recommendations for how to address issues that have received insufficient attention in the Asian context to date. These ‘blind spots’ must become the subject of discussion and action if zero carbon transport is to be reached by 2050.

We have not developed our own decarbonisation scenarios or pathways for Asian countries or the region as a whole, nor have we developed county-specific recommendations. Our analysis builds on existing global and regional scenarios and literature,

and develops a broad vision for the transport sector in Asia (section 3), including recommendations for action (section 8).

To provide additional context, section 4 describes the current status of the transport system and important mediating factors across Asia. Section 5 outlines trends that are likely to influence the development of future mobility systems. Section 6 provides an overview of the solutions available for decarbonising transport. Section 7 takes a look at elements holding back action, and briefly introduces the methodology used to generate our recommendations.

Figure 1
Structure of the report



⁶ In this report, carbon or zero carbon refers to all greenhouse gases from the transport sector, except where explicitly specified. This does not normally include greenhouse gas (GHG) emissions from mobile refrigeration. Emissions estimates do normally not include black carbon (soot) emissions, although these also contribute to global warming. However, many measures that aim to reduce the main GHGs from transport (CO₂, CH₄ and N₂O) also reduce black carbon emissions, so we do not discuss measures that target black carbon specifically.



2.

Why now is the moment for action

Failure to act now will result in significant environmental and economic damage while also increasing the potential for social dislocation and conflict

2.1

Acting on climate change is not a luxury – it is imperative for future economic and social stability

The degree of climate change anticipated under current policies will have severe consequences for the social and economic systems of countries worldwide.

Extreme weather events have been wreaking havoc on infrastructure, significantly disrupting transport systems and economic activity. In coming years, such events are expected to increase in frequency and intensity, with increasingly adverse effects on human health and economic systems. Half of the population in Asia lives in low-lying coastal zones and flood plains with a high risk of flooding and storms (IPCC, 2014).

Other climate-change impacts are causing gradual but inexorable damage, including heat stress to infrastructure and sea level rise, which threatens to make low lying regions uninhabitable. Beyond the injuries and fatalities associated with extreme events, increased global warming will also pose various long-term risks for human health. Health care systems will need to deal with the spread of infectious diseases and other health issues connected to increased temperature. In addition, the productivity of outdoor workers is expected to decline with higher temperatures (IPCC, 2014).

We are already facing significant consequences today. Eighteen of the warmest years on record occurred over the last two decades, worsening food and water security and increasing the frequency and severity of hazardous weather events such as drought and wildfires. Globally, in 2017 alone, disasters triggered by weather and climate-related hazards led to a staggering US\$320 billion in losses. In that same year, devastating floods in South Asia cost over 1,200 lives. Fisheries and aquaculture, important for food security and livelihoods in many Asian countries, are already facing increasing impacts from ocean warming and acidification (IPCC, 2018a).

More frequent flooding, declining crop yields, water shortages and increased mortality from heat are already being observed today in various parts of Asia (IPCC, 2021b, 2021a). Furthermore, the scope and magnitude of the observed impacts have been larger than previously estimated, and are increasingly attributable to anthropogenic climate change (IPCC, 2022b). The World Bank estimates that disruptions to infrastructure, mostly natural disasters and extreme weather events, have already been costing the private sector some US\$300 billion each year. Such disruptions will increase as climate change continues (Hallegatte et al., 2019).

“Every time we get big rains or typhoons, it floods, and everything shuts down for three to four days.”

Nam
restaurant owner, Vietnam

“Climate change impacts and risks are becoming increasingly complex and more difficult to manage.”

IPCC (2022b)

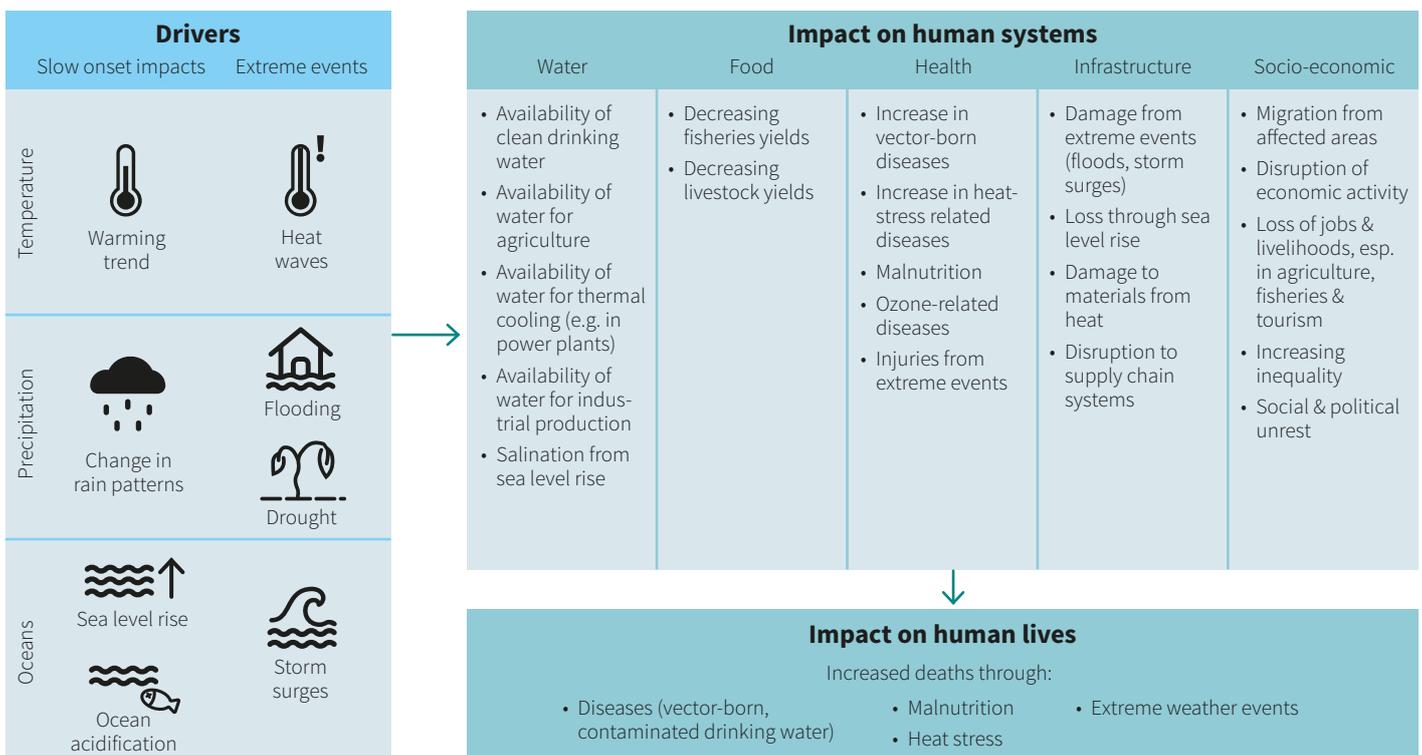
Coastal flooding alone is projected to cost trillions of dollars in damage each year, with annual losses estimated at 0.3–5.0% of global GDP in 2100 given just 2°C of warming. The risks are projected to be highest in South and Southeast Asia, assuming there is no upgrade to current flood protection levels. At 2°C of warming, coral reefs would mostly disappear, causing many types of fish and other reef-dependent species to go extinct. This will directly affect industries such as tourism and fishing, while also adversely impacting many, often disadvantaged, coastal inhabitants (IPCC, 2018a). Coastal infrastructure, especially roads, railways and ports, are increasingly at risk from coastal flooding and sea level rise.

The transport sector is a backbone of the economy – but is highly vulnerable. Climate change is expected to have significant impacts to transport infrastructure. Roads, railways and other transport assets are increasingly jeopardised by storms or flooding. Existing construction materials and techniques may

be poorly adapted to new conditions, and vehicles or technical systems may fail or be destroyed during extreme weather events, causing disruptions to transport activity. In this way, climate change will force changes to public-transport operations while also influencing passenger mobility preferences, as passengers select transport modes that promise better protection from rain or heat. While transport planners and operators are used to anticipating the consequences of adverse weather, the frequency and severity of extreme weather events have been rapidly increasing (SUTP, 2021).

Climate change is most threatening to already fragile social and economic systems. Climate change will jeopardise livelihoods and jobs that depend on natural resources, forcing people to seek alternative sources of income, potentially in other regions. Yet uncontrolled migratory flows can lead to conflict, increasing challenges for governments and civil society (Rüttinger et al., 2015). Climate change is already driving migratory

Figure 2:
Overview of projected impacts of climate change in Asia



Source: Authors' figure based on IPCC (2014, 2018a, 2021b, 2022b), Rüttinger et al. (2015), and the Global Commission on the Economy and Climate (2018).

movements across Asia (IPCC, 2022a). Indeed, the World Bank estimates that without further action, almost 36 million people in South Asia alone could be forced to move within their own countries due to climate change impacts (World Bank, 2018). An overview of the impacts most relevant for Asia is provided in Figure 2.

Given current policies, climate change will endanger economic development and political stability. The cost of ‘half measures’ – that is, taking action, but too slowly, while also sending mixed signals to the market – is rising. Estimates suggest that half-hearted action could lead to US\$12 trillion⁷ of stranded fossil fuel assets by 2035 (The Global Commission on the Economy and Climate, 2018). Climate change also acts as a multiplier on the already increasing pressure from population growth, increasing resource demand, environmental degradation, urbanisation and economic inequality – thus making an already complex challenge even more daunting. Livelihood insecurity, migration and food price volatility can drive political instability and lead to unrest and conflict. The economic and political risk of climate change will vary from country to country, but will hinge in no small part on the responsive measures taken by governments (Rüttinger et al., 2015).

The transition to strong, sustainable, balanced and inclusive growth can address climate change and deliver vast economic and societal benefits. While current economic projections are likely to underestimate the benefits, the Global Commission on the Economy and Climate concluded that bold action could yield direct economic benefits of US\$26 trillion up to 2030 compared to a business-as-usual scenario, thanks to higher GDP growth, the creation of 65 million low-carbon jobs, increased female employment and labour participation, and over 700,000 avoided premature deaths from air pollution (The Global Commission on the Economy and Climate, 2018).

However, the window of opportunity is closing. To take advantage of these benefits, broad statements of intent and incremental steps are not enough. We need bold action with clear policy signals to reduce market uncertainty and unleash private investment (The Global Commission on the Economy and Climate, 2018).

⁷ By comparison, the bail-out of the financial sector during the 2008 financial crisis, which threw over 200 million people in poverty, cost just US\$250 billion (The Global Commission on the Economy and Climate, 2018).



“Low-carbon growth could deliver economic benefits of US\$26 trillion to 2030 – and this is a conservative estimate.”

Global Commission on the Economy and Climate (2018)

2.2 The importance of transport

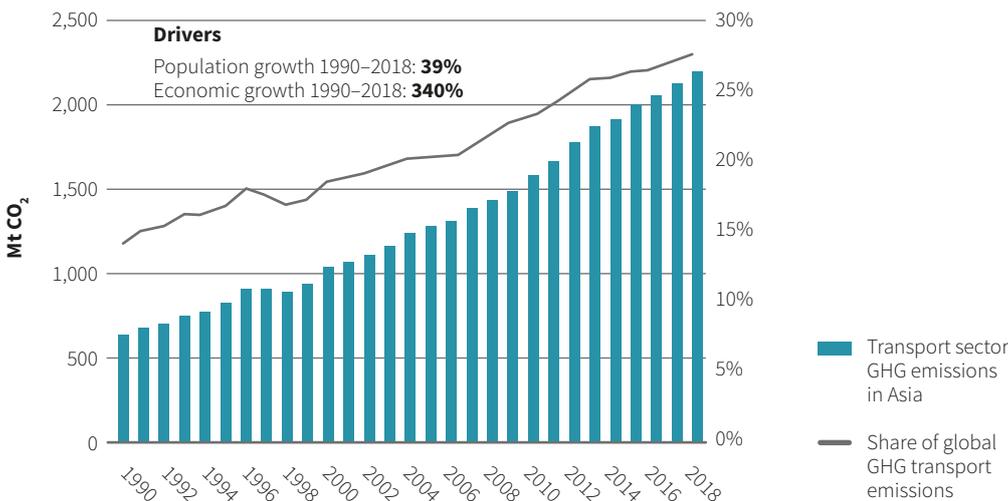
In the absence of robust action in the transport sector, the goals of the Paris Agreement will slip out of reach.

Globally, the gap between current reduction commitments and those necessary by 2030 to keep the global temperature increase below 2°C is 32 Gt CO₂e (UNEP, 2020). However, this gap presumes that all unconditional NDC⁸ commitments will be achieved – which is an unlikely outcome in light of current national policies. Transport was responsible for 25% of direct CO₂ emissions from fuel combustion in 2018 (ITF, 2021b), underscoring the importance of abatement action in this sector. The goal of reducing global emissions to ‘net zero’ only increases the scope of necessary cuts (cf. section 2.4). Particularly rapid action is necessary in transport, as the sector has contributed little to the mitigation effort so far.

In the IPCC scenarios compatible with a 1.5°C temperature increase, global transport sector emissions range between 2.3 and 5 Gt per annum in 2050 (IPCC, 2018b). Based on the latest science, the TUMI Transport Outlook 2021 sets forth a scenario for achieving zero emissions in transport by 2050 and keeping the global temperature rise below 1.5°C. The scenario’s total remaining carbon budget for the transport sector in 2020–2050 is 110 Gt. With no additional policies, this budget will likely be used up around 2030 (Teske et al., 2021).

Despite the need for swift reductions, total GHG emissions in the Asian transport sector are on the rise. Transport sector CO₂ emissions in Asia increased 243% between 1990 and 2018 (ADB, 2021). The region is now responsible for 27% of global sector emissions, up from only 14% in 1990.

Figure 3: GHG emissions from transport and Asia’s share in global transport emissions



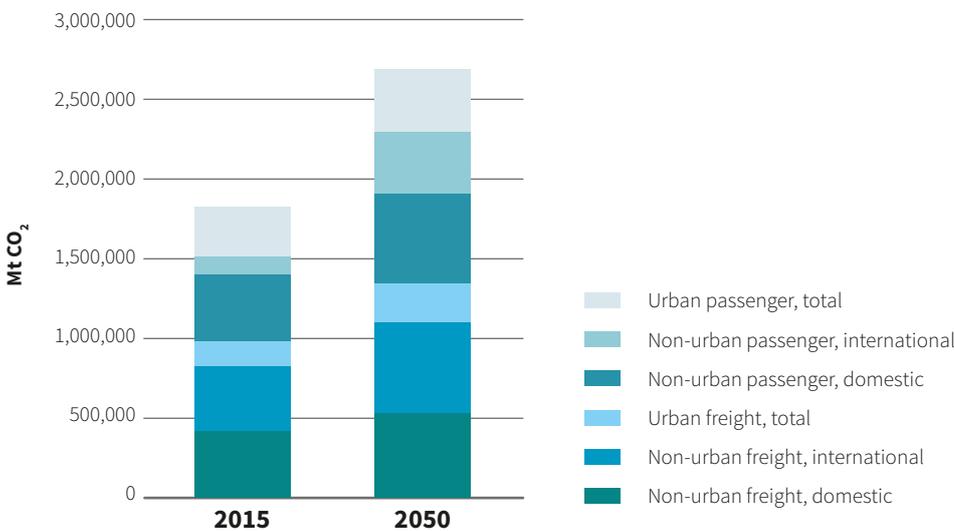
Source: ADB (2021), World Bank (2021b).

⁸ Nationally Determined Contributions (NDCs) are submitted by countries to the UNFCCC under the Paris Agreement and represent the national commitment for greenhouse gas (GHG) reductions. Commitments often also include an adaptation component.

Without further action, demand and emissions will keep rising. In Asia, emissions are expected to increase another 48% between 2015 and 2050.⁹ ITF estimates that passenger transport demand in Asia will increase 197% from 2015 levels by 2050 (compared to 133% growth globally); demand for surface freight will increase by 199% by 2050. Asia already accounted for 39% of global freight activity in 2015. **By 2050, Asia is estimated to represent almost half of global freight activity (46%),** which continues to be dominated by maritime transport (ITF, 2021b).

Transport is also a fundamental sector for achieving the UN’s Sustainable Development Goals. Measures to reduce GHG emissions must be assessed in the wider context of sustainability. Many measures serve to alleviate multiple challenges at the same time; others may solve one issue, while exacerbating others. Transport is directly and indirectly an important element in many of the Sustainable Development Goals and related targets (SLOCAT, 2020b).

Figure 4:
Projected development of GHG emissions in Asia by sector under current policies



Source: ITF (2021).

⁹ Note that the regional definition used by ITF is narrower than that of ADB, so historic data from the previous paragraph and projected data discussed in this paragraph are not directly comparable.



Shri Prakash
The Energy and Resources
Institute, India

“There is a pressing need for further investment in sustainable low-carbon technology in the freight transport sector and to make such changes part of the entire logistics chain, thereby attaining cost effective reforms.”



2.3 Resilience is essential

Global average temperature currently stands at 1°C above pre-industrial levels, and the impacts have already been severe. Furthermore, without decisive action, damage wrought by climate change is expected to grow exponentially worse. Even if all commitments made by countries under the Paris Agreement were to be met, the world would experience an average temperature increase of around [2.7°C](#) by the end of the century (UNFCCC, 2021).

This level of temperature increase is expected to have catastrophic impacts. However, policymakers have yet to systematically consider of the full range of hazards that would threaten lives and livelihoods, as called for by the [Sendai Framework for Disaster Risk Reduction](#). The COVID-19 pandemic has triggered efforts to increase our understanding of economic interdependencies and their vulnerabilities to sudden shocks. Lessons learned from the pandemic can help us to consider anticipated climate change impacts in planning and policy-making. To be sure, climate change impacts are already being felt in many countries, and many of the most vulnerable countries are located in Asia (Sönke et al., 2019), highlighting the need for action in the region.

The free movement of people and goods – unhindered by climate impacts – is crucial for economic prosperity and a properly functioning modern society. Hence, it is essential to build resilient¹⁰ systems that will continue to function under increasing climate change pressures, especially given stalled progress in mitigation. Adaptation efforts increase the resilience of systems and reduce climate risks. In simple terms, one can say that the more we mitigate, the less we will need to adapt. Yet even with immediate action to slash emissions, significant temperature increases are nearly unavoidable, thus requiring transport systems to adapt to future conditions. Many adaptation and mitigation efforts are mutually supportive; policy-makers would be wise to maximise synergies between the two domains.

Making climate change an integral factor in transport planning, infrastructure design and operations at all decision-making levels will be crucial for a resilient transport sector of the future. Planners already consider variations in precipitation and temperature across years, and the risk of flooding or drought, but largely based on historical data. Honest and accurate assessment of the anticipated impacts of climate change will help to minimise the damage ultimately caused by future climate conditions. This requires planners to be aware of potential risks and have the tools and knowledge to address attendant challenges (SUTP, 2021). National governments can assist by conducting local forecasts, by promoting the dissemination of empirical research, and by supporting local capacity development. By way of example, legislators can require the assessment of climate change risks and vulnerability in new infrastructure projects, and they can support local stakeholders with the adoption of national design standards and technical norms.

However, it is important to be clear that there are limits to adaptation, and certain impacts will be impossible to avoid. Some infrastructure may need to be abandoned permanently – for example, roadways besieged by rising sea levels. It is therefore paramount to ensure that new infrastructure takes climate change risks into account. Rather than just spending more, the focus should be on spending better. Indeed, the World Bank estimates that each dollar spent on resilience in low- and middle-income countries will deliver four dollars in benefits (Hallegatte et al., 2019).

¹⁰ Resilience is the ability of a system to absorb, withstand, and recover from an adverse event. In the environmental context, resilience encompasses the policy, infrastructure, services, transportation, and planning activities that position municipalities to withstand natural disasters and other impacts of climate change ([EESI](#)).

2.4 Net-zero pledges provide positive momentum

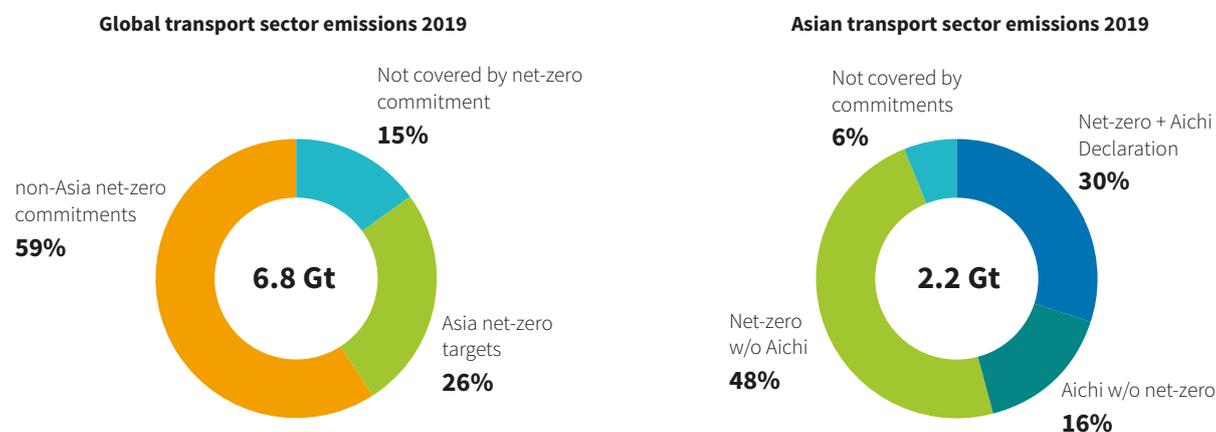
The 14 net-zero targets adopted by Asian countries¹¹ together account for 26% of 2019 global transport sector emissions. Globally, 76 countries have pledged to reduce their national emissions to net zero, most by 2050, while some are targeting a later date – notably China, which aims to realise carbon neutrality before 2060, and India, which has a target year of 2070. Eleven of these countries, covering 30% of Asian transport sector emissions, have also signed the ‘Aichi 2030 Declaration on Environmentally Sustainable Transport – Making Transport in Asia Sustainable’ (2021-2030).¹² Nine additional countries have not announced economy-wide net-zero emissions, but have signed the Aichi Declaration’s net-zero 2050 target for transport. Together, 94% of Asia’s transport sector emissions are covered by economy-wide targets, transport-sector targets or net-zero targets in both areas. This is a promising development – but now governments must work to deliver on these goals.

Decisions taken now will impact the future competitiveness of countries and industries. Irrespective of whether these pledges are made by countries in Asia or elsewhere, if governments are serious in implementing measures to support these pledges, this will have substantial impact on the transport sector in Asia. The automotive industry is in a state of transformation, and other industries are gearing up for the challenge. The exact ramifications that will be felt in each sector will depend on how countries handle the transition. Yet beyond economic risks, this moment of change also offers significant potential for new forms of growth.

Governments are not the only entities taking action. In the private sector, companies are setting science-based and net-zero targets. Vehicle manufacturers around the world have adopted goals for producing electric vehicles, such as [Japanese car manufacturers](#). Some companies have set net-zero targets for their products, such as [Isuzu Motors](#). Furthermore, seven [European truck manufacturers have agreed to stop producing polluting vehicles by 2040](#). A number of airlines have set intensity emission targets, or announced their willingness to achieve net-zero carbon emissions by 2050, including Asian airlines such as [Malaysia Airlines](#), [Sri Lankan Airlines](#) and [Japan Airlines](#). Numerous public transport companies – such as the UK-based [Go Ahead Group](#), which also operates in Singapore – are also getting on board, setting ambitious climate targets.

Pledges made [outside the transport sector](#) will also affect the transport system. In the manufacturing sector, for example, the current trend is toward considering emissions throughout the supply chain, including the transport of upstream or downstream products. Some actors have even pledged to go beyond net zero, setting ‘carbon negative’ or ‘climate positive’ targets, which involve companies removing more greenhouse gas emissions than they emit (e.g. [H&M Group](#), [Inter IKEA Group](#), [Microsoft](#)). As a major epicentre of manufacturing, Asia needs to stay abreast of such developments in order to remain competitive.

Figure 6: Economy-wide and transport sector net-zero commitments in Asia



Source: Based on data from Climate Watch (n.d.); EU JRC & PBL (2020); TraCS and SLOCAT (2021)

¹¹ For a full overview of net-zero targets, NDCs, LTS and other targets, see annex 1.

¹² The Aichi Declaration was adopted in October 2021 at the EST Forum and contains the goal to peak emissions by 2030 and move towards decarbonising the transport sector by 2050 or shortly thereafter. <http://www.env.go.jp/press/files/jp/117025.pdf>.

Around the globe, there are a growing number of pledges to phase out internal combustion engines (ICE) – but such ambition is not yet common in Asia.

A range of jurisdictions have announced plans to eventually ban the sale of new ICE vehicles. Some plans only apply to passenger cars, while others include light-duty vehicles and/or buses. In Asia thus far, only Singapore, Hong Kong, China's Hainan province and Sri Lanka have made some form of ICE phase-out pledge (Wappelhorst, 2021; Wappelhorst & Cui, 2020). While the timeline and scope of these plans differ significantly between jurisdictions, such targets should be welcomed, for they generate momentum to implement more ambitious policies.

2.5 Societies are changing

Growing awareness for the risks of climate change is changing public perceptions. The Asian population is becoming increasingly sensitive to lifestyle sustainability issues and the climate impacts of underlying economic systems. Initiatives such as car-free days in India, Indonesia, Vietnam and other countries, as well as international movements such as Fridays for Future, have been driving awareness for the dangers posed by climate change and the need for individual contributions.

Despite its various negative effects (see section 4.4), the COVID pandemic has further expanded this awareness – not only related to the climate, but also related to other elements of sustainability. This is particularly true in urban areas, which during the pandemic lockdowns experienced cleaner air, massive reductions in noise and congestion-free roads. The challenge will be to harness momentum that has been created and to further empower and enable individuals to make sustainable choices (Budd & Ison, 2020).

¹³ Brazil, the EU, Hong Kong, Japan, New Zealand, Singapore, Switzerland and the UK.

In the financial sector, as well, there is a move toward sustainability. Investors, shareholders, and the broader public have been demanding divestment from climate-harming activities. Many investment and development banks have announced they will stop financing coal, while others have pledged to divest from oil and natural gas. Members of the [Net-Zero Asset Owner Alliance](#), for example, have committed to transitioning their investment portfolios to net-zero emissions by 2050.

In order to enhance transparency surrounding climate-related investment, the [Task Force on Climate Related Financial Disclosure](#) has set forth a series of reporting recommendations. By October 2021, the initiative had over 2,000 supporters, including over 1,000 financial institutions responsible for US\$194 trillion in assets. Additionally, 8 jurisdictions¹³ have announced official reporting requirements in line with these recommendations (TCFD, 2021). An increasing number of countries are also developing 'green' taxonomies to guide public-sector spending. This will have implications for transport-sector finance, by making it harder to finance investments that benefit fossil fuel-based transport and by creating new opportunities to fund sustainable alternatives.

'Green bonds' and carbon trading are becoming increasingly common. According to the Climate Bonds Initiative, the issuance of green bonds doubled in 2021 to reach an all-time high of [US\\$517 billion](#). This trend is anticipated to continue, enabling countries and firms to raise money for the transition to a sustainable transport system. At the same time, carbon pricing schemes continue to be rolled out, providing additional economic incentives. In 2021, China finally launched the largest carbon market in the world; a number of additional countries in Asia are considering the implementation of emissions trading or carbon taxes (World Bank, 2021a).



Dr. Le Anh Thuan

Hanoi University of Science & Technology

“Net-zero pledges align with a high ratio of sustainable energy source scenarios, which ensures impressive green mobility development in transport sector.”

3.

Imagining the future – where we want to end up

We imagined ourselves in 2050...

...and wrote ourselves a postcard



17 April 2050



The
Council for
Decarbonising
Asia

Dear reader,

Now, in 2050, the mobility system is much safer and healthier; roads are less congested, and only contain clean vehicles.

The mobility system now addresses the specific needs of women, gender minorities, children, the elderly and people with disabilities.

Public space is used much more productively and for the benefit of everybody, bringing people closer together.

The last three decades of change have been an incredible achievement!

In our vision for 2050, the mobility needs of all citizens are met with zero-carbon options that are integrated in a seamless, efficient and convenient manner.

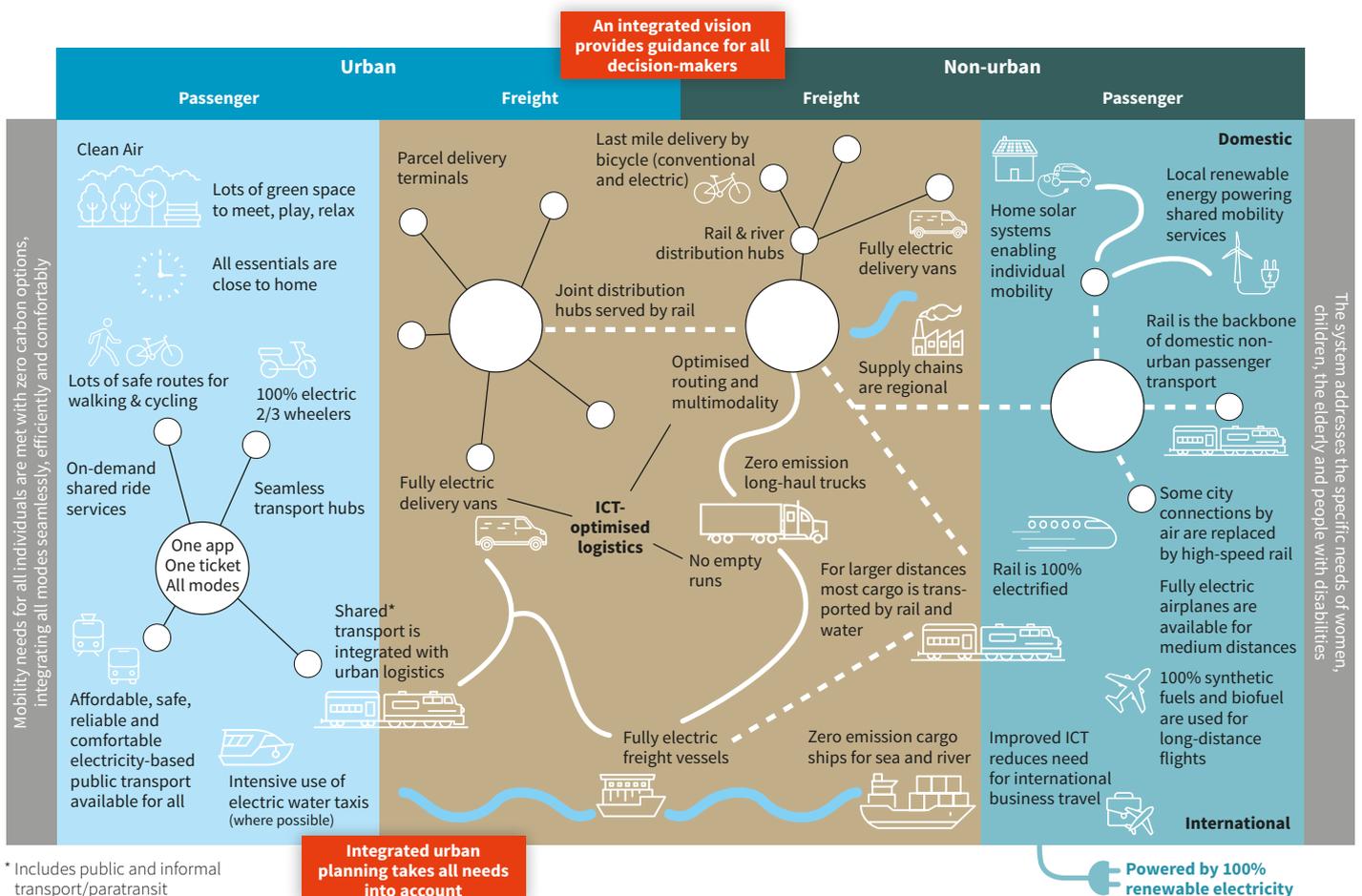
To achieve this vision and avert the worse impacts of climate change, urgent action is needed. And while change is never easy, the benefits of action will far outweigh the costs. In our vision for 2050, the transport sector is highly efficient and has fully decarbonised. It also ensures better access to mobility for everyone. Various modes of transport are available on demand and seamlessly integrated with flexible payment systems. The majority of passenger trips will rely on shared mobility, including in particular public transport, walking and cycling.

The passenger vehicle fleet will be completely electric and run on renewable power. Households, especially in rural areas, will produce their own renewable energy, making them self-sufficient.

Freight will largely be transported by rail and water, and last-mile delivery will be provided by electric trucks, vans and bikes. Logistics companies will streamline their delivery operations with ICT technologies and joint distribution centres

Figure 7 illustrates our vision for a sustainable, resilient and low-carbon transport sector.

Figure 7:
Our vision for a sustainable, resilient, low-carbon transport sector





4.

Where we are today

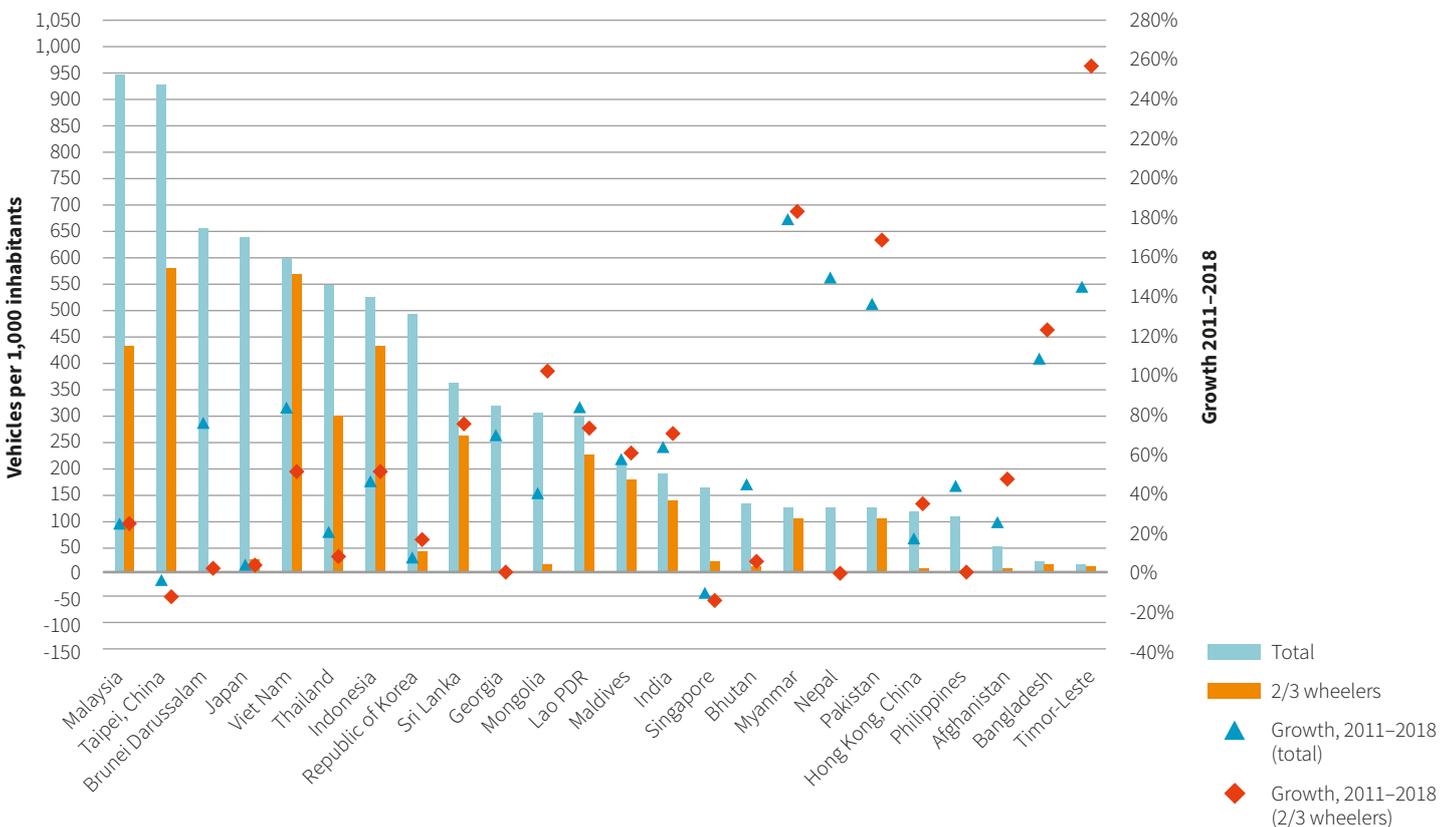
*Despite some progress,
climate action in the transport sector
is still lagging*

4.1 The transport sector in Asia – one region, many points of divergence

Motorisation rates are still closely linked to economic development. While personal vehicle ownership is still low in Asia, it boasts the fastest growth rates globally. Yet there are also large differences between countries. Countries with higher GDPs have motorisation levels comparable to the EU and have experienced lower growth rates over the last few years (see Figure 8). Most countries with high motorisation growth rates also show high GDP growth rates. Many low and middle income countries still rely heavily on two- and three-wheelers for motorisation, including India, Indonesia, Pakistan and Vietnam.

Individual passenger vehicles have become bigger and heavier over time, with [SUVs](#) and similar models enjoying strong sales growth. Even among electric vehicles, SUVs are a particularly popular vehicle class (IEA, 2020). However, in many Asian markets, mini-cars have high sales rates, especially in Japan, China and India.

Figure 8: Motorisation rates in selected countries in Asia in 2018

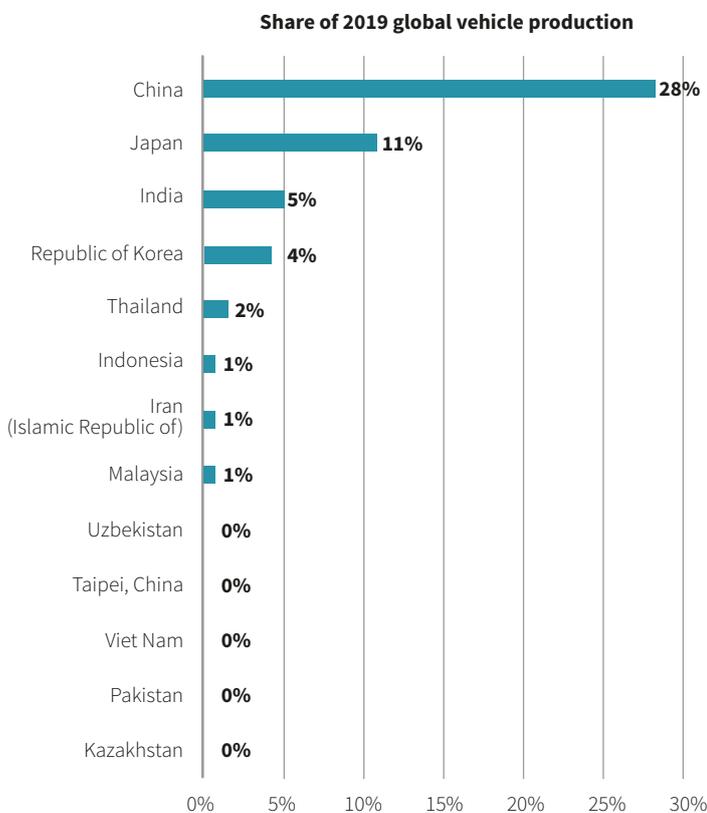


Note: Data on 2/3 wheelers are not available for all countries.
Source: Adapted from ADB (2021).

Paratransit¹⁴ and high shares of walking and cycling are still common in many Asian countries. Paratransit often serves as the main mode of public transport in smaller cities, city peripheries and rural areas, providing first and last mile connectivity. However, the role of the informal sector for employment is often ignored and not reflected in the official statistics. Especially in lower income countries, transport

services are often provided by the informal sector, and informal services are often the sole mobility option for low income and rural populations (Baffi & Lannes, 2021). Particularly in developing Asia, many people rely on walking or bicycles as a primary form of transportation – but usually because of a lack of other options, in most cases for financial reasons. The challenge will be to design systems that make walking and cycling a choice rather than a necessity.

Figure 9:
Automotive industry in Asia



Source: based on (ADB, 2021)

As a major economic player, the automobile industry will impact policy decisions. The automotive industry often has substantial political influence, as it is responsible for a large number of jobs, both directly and indirectly. Together, four Asian countries produced 48% of the vehicles sold in 2019, with 28% coming from China alone. Another nine countries in the region have automotive manufacturers that mostly supply the domestic market.

The direct contribution of the transport sector to GDP varies between Asian countries, but ranges between 4% and 11% (ADB, 2021). In terms of employment, the transport sector employs between 2% and 13% of the workforce.

Various Asian countries also have significant petroleum industries, posing an additional challenge for decarbonisation. Oil production and refining is an important economic activity in some countries of the region. Accordingly, efforts to transition away from fossil fuels must include a vision for the future of impacted companies and workers. For example, industry workers should be provided with opportunities to re-train for new roles in the green economy. Although some Asian countries are significant oil producers, most are net importers, with consumption outstripping production (BP, 2020), as illustrated in Figure 10. In this way, the phasing-out of fossil fuels in transport will not only reduce GHG emissions, but reduce import dependencies.

¹⁴ For a definition and discussion of paratransit see the 'key concepts' section.

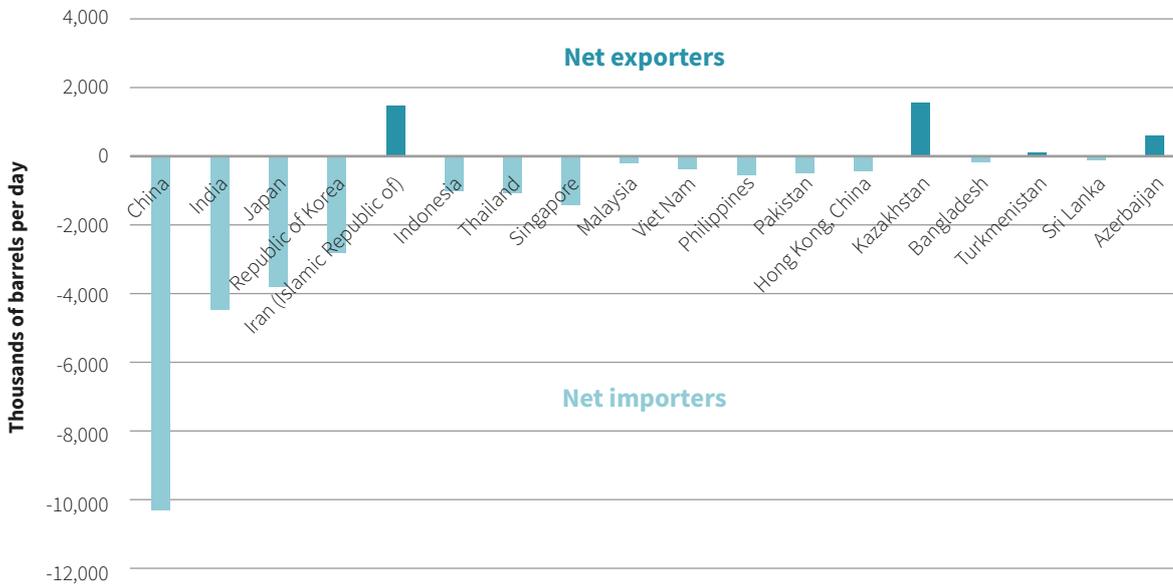


Shri Prakash

The Energy and Resources
Institute, India

“The need is to ‘retain’ and strengthen sustainable transport solutions instead of a ‘shift’ strategy in Asian cities.”

Figure 10:
Net balance of trade for petroleum in 2019 in selected Asian countries



Source: BP (2020).

4.2 Despite some progress, Asia is not prepared to curb transport emissions growth

While transport emissions in Asia are responsible for 27% of global emissions in the sector, emission levels vary significantly at the country level. Due to their large populations, China and India account for 58% of transport emissions in the region. In general, there is a strong connection between population and total emissions, as illustrated in Figure 11. Per capita emissions from the transport sector also vary significantly, from 0.02 t CO₂/capita in Laos to 3.5 t CO₂/capita in Brunei Darussalam, in part due to divergent income levels (Figure 11). These statistics underscore that the decarbonisation strategies pursued in each country will need to be attuned to domestic motorisation levels and mobility patterns.

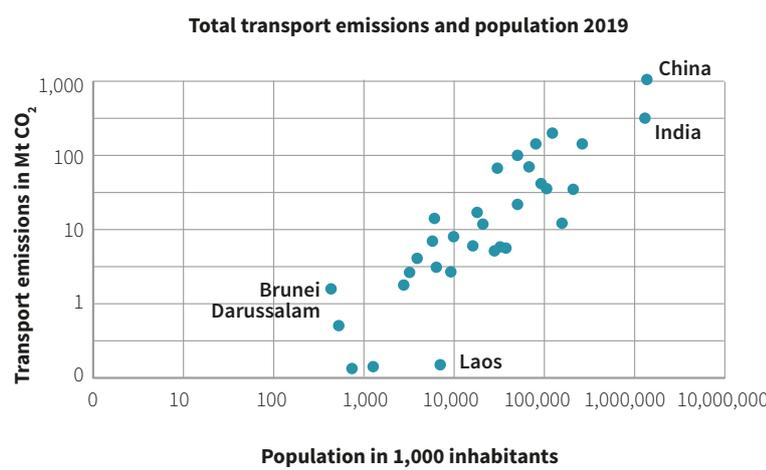
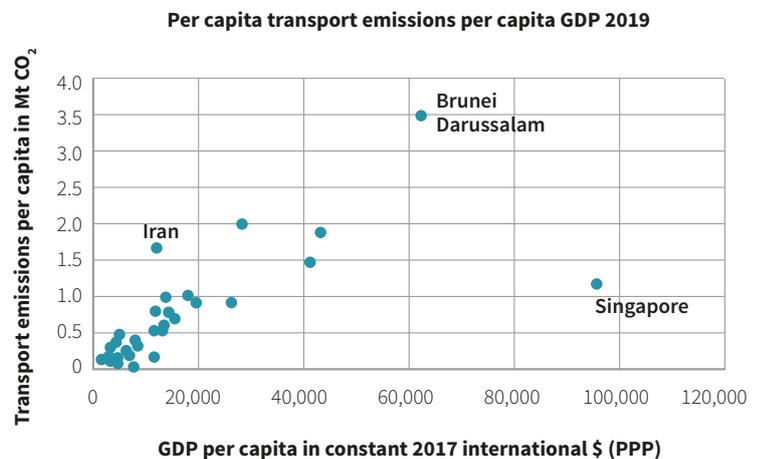
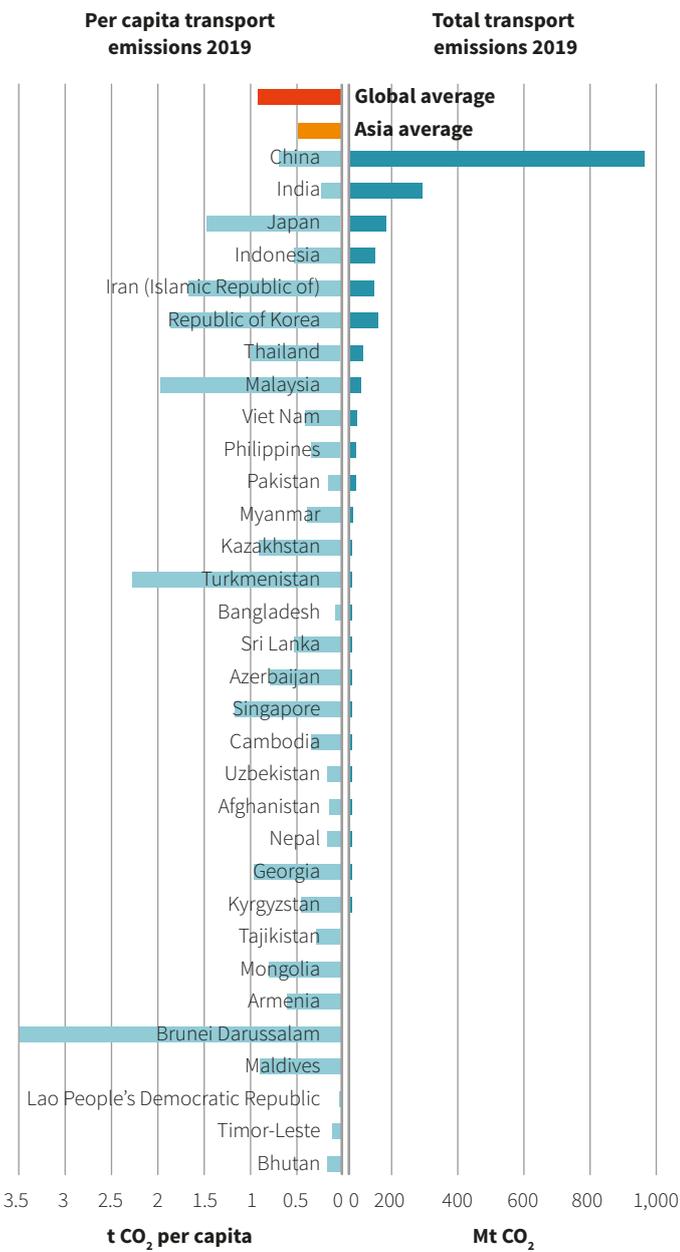
Even with continued urbanisation, emissions from urban transport are not the main problem. In 2015, just over 6% of GHG emissions came from international passenger transport in Asia, while urban transport represented almost 18% of total sector emissions. But emissions from international passenger

transport are anticipated to grow by 245% up to 2050 if no further action is taken. This growth is equivalent to the total transport sector emissions of India in 2018 and would take the share of international passenger transport up to 15% of total emissions by 2050. Also, domestic non-urban passenger transport is expected to grow faster than urban passenger transport (ITF, 2021b).

Under current policies, international freight, within the region as well as to and from the region, non-urban passenger transport, and domestic non-urban freight transport are expected to represent two-thirds of emissions by 2050. Based on the long distances involved, international freight activity already represented 70% of freight transport in Asia in 2015 and its share is projected to further increase to 76% by 2050. Without addressing these subsectors, full decarbonisation will remain out of reach.

Figure 11:

Total and per capita transport emissions by country and relationship of total transport emissions with per capita GDP (top right) and per capita transport emissions with population (bottom right)



Source: Authors' figure based on ADB (2021), UNDESA (2019), World Bank (2021b).

International climate commitments (NDCs) are lacking ambition and need specific transport targets. As of January 10, 2022, twenty-five Asian countries had submitted updated NDCs or second NDCs. Only four¹⁶ of these NDCs contain a quantitative GHG target for the transport sector; five¹⁷ more contain other types of targets – for example, related to electric and/or hydrogen vehicles or biofuels (TraCS and SLOCAT, 2021).

Long-term Strategies (LTS) submitted to the UNFCCC are still lacking for most countries, but show a good mixture of measures across the Avoid–Shift–Improve framework.

So far, eight countries in Asia¹⁸ have submitted long-term strategies to the UNFCCC, of the 49 LTS submitted thus far.¹⁹ Japan and Singapore have comprehensive avoid, shift and improve strategies, with clear related targets. For example, Singapore has set specific transport objectives, such as zero growth in private vehicles; 9 of 10 journeys based on walking, cycling or riding public transport; and conventional vehicle phase-out by 2040 (NCCS, 2020). China has proposed a balanced mix of strategies, without quantifying targets for the sector or individual activities (China, 2021). The Republic of Korea has pledged to become climate neutral, but has not broken this down into individual targets for sectors or modes, and is focusing more on shift and improve strategies (Dalkmann, 2020; Republic of Korea, 2020). Other countries in Asia, such as Vietnam, are currently in the process of developing long-term strategies.

In most countries, national transport strategies are not yet aligned with broader domestic climate ambition.

Of the 34 Asian countries analysed,²⁰ 29 have some form of national transport vision statement.²¹ Fifteen of these visions cite the goal of ‘sustainability’, while seven foresee ‘green’ or ‘environmentally friendly’ transport, without clearly addressing climate change. Uzbekistan is the only country that specifically calls for phasing out hydrocarbons in the sector. Only around half of the 34 countries considered in our analysis have a formal, sector-wide transport policy, and most of these policies were adopted prior to the 2016 Paris Agreement. While many of the transport policies include some mention of climate-change mitigation, only four discuss climate change adaptation (ADB, n.d.).

Explicit targets to phase-out internal combustion engine (ICE) vehicles are still rare in Asia.

Singapore aims for 100% zero-emission vehicle sales by 2030, while Hong Kong and Japan are aiming to achieve 100% share of electric vehicles in new passenger vehicle sales by 2035 (Hong Kong Environment Bureau, 2021; IEA, 2021b). Indonesia has [announced](#) plans to only permit the sale of electric cars and motorbikes by 2040. China is aiming to achieve a sales share for ‘new energy vehicles’ of 20% by 2025 (Cui et al., 2021) and 40% share by 2030 (China, 2021). Brunei Darussalam, Cambodia, Laos, Nepal and Pakistan have included transport electrification targets in their latest NDCs (see Figure 12). Malaysia and the Philippines, for their part, have set absolute targets for the size of the electric vehicle fleet (Bathan-Baterina & Dematera, 2020).

¹⁶ Bangladesh, Georgia, Japan and Sri Lanka.

¹⁷ Brunei Darussalam, Cambodia, Laos, Nepal and Pakistan.

¹⁸ Cambodia, China, Indonesia, Japan, Nepal, the Republic of Korea, Singapore and Thailand.

¹⁹ By January 10, 2022.

²⁰ For a full list of countries, see annex 4.

²¹ For a full overview of national policies, see annex 2.

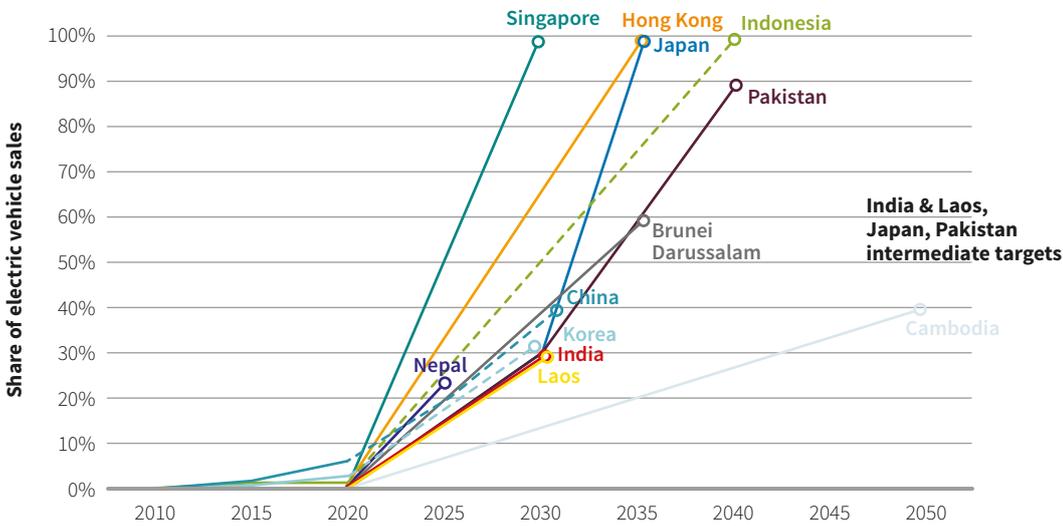


Glynda Bathan-Baterina
Clean Air Asia

“While future high-emitters from the transport sector will come from non-urban areas, solutions for urban transport emissions will continue to be relevant because of the continued increase of urban populations, especially in developing Asia.”

Figure 12:

Historical and targeted electric vehicle shares in new passenger vehicle sales



Sources: Bathan-Baterina & Dematera (2020), China (2021), Cui et al. (2021), Hong Kong Environment Bureau (2021); IEA (2021b), Japanese Ministry of Environment (2021) and latest NDCs of Brunei Darussalam, Cambodia, Laos, Nepal and Pakistan.



Sri Lanka has announced the goal of replacing all government vehicles with electric or hybrid models by 2025. Sri Lanka also plans to extend this requirement to all privately owned vehicles by 2040, although this is not yet official policy. At the provincial level, Hainan Province in China has pledged to phase out the sale of conventional passenger cars, light commercial vehicles, buses and coaches by 2030 (Wappelhorst & Cui, 2020).

In the area of freight transport, electric medium- and heavy-duty trucks are still few in number, but some countries are starting to support their adoption. Pakistan aims to have 90% of new heavy-duty trucks electric by 2040, and Hainan Province in China wants 50% of its sanitation vehicles to be electric by 2020 (Wappelhorst & Rodríguez, 2021). There are various measures governments can take to support the transition in freight, including setting targets for new vehicle sales and providing purchase incentives for commercial vehicles. However, subsidies for electric vehicles should be carefully considered with a view to their distributional effects, especially given limited government resources.

A growing number of countries are implementing measures to support efficiency and low-carbon fuels, but additional countries need to get on board. In terms of concrete policies to support the decarbonisation of freight, only 13 Asian countries²² have adopted fuel economy standards

for light-duty vehicles (LDVs), in nine cases based on the ASEAN-wide standard for LDVs. Only China, India and Japan have fuel economy standards for heavy-duty vehicles (HDVs) (ADB, 2021; TransportPolicy.net, n.d.). As the freight vehicle fleet will remain dependent on fossil fuels for many years, there is a clear need for additional policy action in this area. Only 8 countries in the region have biofuel mandates (ADB, 2021).

Support for electric vehicles is broad and growing, with visible results. Twenty countries have some form of policy in place to encourage adoption, including purchase incentives and reduced taxes, import duties or registration fees (ADB, 2021). China is using new-energy vehicles (NEV) mandates to require the increased sale of NEV from manufacturers (Rokadiya & Yang, 2019). Thanks to EV support measures, China was the world's largest market for battery electric and hybrid cars up to 2019, and is still the world's leader in electric buses, boasting 98% of the global stock. In 2020, EV car sales in Europe overtook those in China for the first time (IEA, 2021b).

Most electric two- and three-wheelers are still sold in Asia, and 25% of these are already electric, with many countries having specific incentives for this vehicle class, such as India's FAME II scheme²³ and China's ban on non-electric models in some cities (IEA, 2021b).

²² For details see annex 2.

²³ Faster Adoption and Manufacturing of Electric Vehicles scheme in its second, currently operational version.



Many countries in Asia, including China, India, Pakistan and Vietnam, are also using policy instruments to stimulate electric vehicle production in their countries (Government of Pakistan, 2019; IEA, 2021b). Indonesia, Thailand, Malaysia and the Philippines have set concrete production targets (Bathan-Baterina & Dematera, 2020).

Fossil fuel subsidies support unsustainable practices.

Countries in Asia and around the globe have traditionally subsidised fossil fuels in order to encourage economic development. Only a few countries in Asia have undertaken substantial reforms to drastically reduce subsidies and allow freely fluctuating prices. India, for example, has completely eliminated its subsidy of transport fuel – which represented

98% of subsidies in 2013 – and even recently increased taxes on transport fuel in 2020 to raise funding for recovery programmes (OECD/IEA, 2021; OECD, 2021). Indonesia reformed its subsidies in 2015, drastically reducing support for transport fuels, and, in 2017, for electricity in higher-income households. However, many subsidies have been reinstated as part of pandemic recovery efforts (OECD, 2021). Asia is seeing increasing subsidies for electric vehicles and a resulting uptake in the new technology. While this is encouraging, it points to the increasing need to also phase-out fossil fuel subsidies in electricity generation and to provide enhanced support for renewable energy.

“Apart from managing travel demand, increased vehicle efficiency through a fast replacement of internal combustion engines or ICE vehicles with electric vehicles will be paramount to reduce transport pollution and GHG emissions. Asian countries are well placed to step-up in the international race to phase out ICE vehicles. The EV market also presents new business and local job opportunities for countries in Asia.”



Yossapong Laonual
King Mongkut's University of
Technology Thonburi

4.3

Climate action will benefit from addressing the wider benefits of sustainable transport

Despite varying improvements to road safety, the health impacts from air pollution and lack of physical movement are on the rise. Increasing motorisation and urbanisation work together to create a number of social challenges, including the health effects of air pollution; fatalities and temporary/permanent injury from vehicle accidents; and the health and economic effects of traffic congestion and sedentary lifestyles. Fatality rates from road accidents decreased by 3% globally and 5% in Asia between 1990 and 2016, but the situation varies strongly between countries. Some countries have managed to reduce fatalities by up two-thirds (e.g. Japan), while others have seen increases of up to 54% (e.g. India) (ADB, 2021).

Almost 240,000 deaths were attributed to particulate matter (PM2.5) and ozone from transport emissions in Asia in 2015 (ADB, 2021). Furthermore, the 50 world cities with the worst PM2.5 pollution were all in Asia (IQAir, 2019). In many Asian countries the sector is increasingly contributing to NO_x and SO_x emissions. Globally, physical inactivity is estimated to have resulted in [US\\$54 billion](#) in direct health care costs in 2013. The cost of congestion is also growing and has been estimated at over US\$350 billion per year, based on lost productivity and health impacts. In some cities, such as Beijing and Bangkok, congestion is estimated to cost as much as 5% of GDP (The Global Commission on the Economy and Climate, 2018)!

Access is improving, but not for all. There are still many people without adequate access to elementary goods and services, especially in rural areas. Access to all-season roads in rural areas is linked to the economic development level of the country, with high-income countries in the region having 89–100% access and low income countries 56–67% (ADB, 2021). In urban areas, those with very low incomes can be priced out of new systems or displaced due to increased property values around transit systems (UNDP, 2019).

Inclusive and equitable mobility requires more in-depth analysis. Mobility options do not always reach or meet the needs of the poorest and most vulnerable, especially women, girls and other genders (UNDP, 2019), and the special needs of the disabled are often neglected (Leonard Cheshire Disability, 2020). Universal accessibility is mandated in almost every country's national disability laws. Furthermore, there are numerous disability associations who advocate for universal accessibility. However, the actual mobility needs of these groups are rarely factored into planning and investment decisions, despite analysis that shows the need for mobility aids, as well as improved access by foot, bicycle, and public transport. Additional efforts are needed to better understand how mobility systems can better serve all groups (UNDP, 2019), with a focus on the empowerment and employment opportunities that can result from improved safety, affordability, accessibility and reliability.



Dr. Kalpana Viswanath
Safetipin

“It is only when we improve access for the most vulnerable and those who are excluded while planning that transformation will take place towards more sustainability. For example, public transport should reach peripheries of cities as well as low income neighbourhoods to ensure equity and access.”

Myth 1: Mobility access and jobs in the transport sector are gender neutral

Limitations to transport access and safety are estimated to be the greatest obstacle to women's participation in the labour market in developing countries, reducing their participation probability by [15.5 percentage points](#).

Women currently have lower ownership of and access to personal vehicles than men, making them more dependent on walking, public transport and paratransit. Unsafe mobility options and patriarchal socio-cultural norms may further restrict women's mobility. Restrictions may be placed on travel times, distances and modes in different socio-cultural contexts. Conversely, women may be forced to travel due to the unavailability of private sanitation facilities, which can compel women in lower income settlements to use community toilets or the peripheries of settlements in rural areas, placing themselves at risk of harassment and violence.

Women also have different mobility patterns. They make shorter trips, with travel characterised by trips associated with (often unpaid) household and care-related work and chain trips, i.e. they combine multiple purposes

and destinations in a single journey. Moreover, they frequently travel with dependents (children or the elderly) and carry groceries. Women's travel during off-peak hours of public transport may result in longer waiting times, where frequency is reduced during such times, and sometimes necessitate the use of paratransit or other more expensive modes of transport. Technology enabled new mobility services (such as ride hailing, carpooling, bike sharing, micro mobility) have offered additional transport options.

Statistics in India indicate that women walk more than men to work (Census of India, 2011), and are more likely to use paratransit than men. In Pakistan, women are 150% more likely to use paratransit modes like rickshaws and qingqis (motorcycle-rickshaws) than men, and when travelling beyond walking distance, they are 30% more likely to use public transport than men (Sajjad et al., 2017). In Shizuoka, Japan, most public transport users are female. Their travel patterns were observed to be more diverse in space and time than that of male passengers (Liu et al., 2020). In Sri Lanka, women who use ride hailing

as their primary mode of transport are 40% more likely to use it than men (IFC, 2020).

Discrimination and violence can endanger mobility for women and gender minorities. Women face sexual harassment in public spaces, which can be visual, verbal or physical. Gender minorities experience sexism and may be denied equal treatment, or may face sexual harassment and violence on public transport by passengers and service providers alike. Transwomen may not be permitted to occupy seats reserved for women; gender minorities may be refused travel or charged more on paratransit.

From an employment perspective, the transport sector is male dominated. Women constitute less than 20 percent of the transport workforce globally. Most women and gender minorities employed in the sector work as support staff for the maintenance of facilities. They are poorly represented in management and leadership positions; as frontline workers in passenger and freight transport; and as asset owners.



Anjlee Agarwal

Samarthyam National Center
for Accessible Environments

“Improved accessibility allows for the greater use of non-motorized vehicles (NMV), reduces fatalities and promotes overall well-being. It will help prioritize walkability and NMV traffic over motorized traffic, a need that cannot be ignored for a safe and equitable commute.”

“The largest opportunity for job generation is expanding public and active transport.”

WRI (2020)

4.4 Impacts, opportunities and risks of the COVID-19 pandemic for mobility systems in Asia

Economic recovery and persistent inflation are a concern in Asia after multiple waves of the COVID-19 pandemic.

All countries in Asia have experienced significant economic losses. Recurrent outbreaks of the virus have impacted recovery efforts and remain a major concern. Negative GDP effects due to restricted transport activity and lower transport-sector employment are anticipated across the region (ADB, 2020). The IMF reduced its 2021 economic growth forecast for Asia to 6.5% and although a few countries in the region, such as China and Vietnam, are estimated to retain positive growth rates, the crisis has impaired growth across the region. Persistent inflation is expected from higher commodity prices and shipping costs, coupled with continued supply-side disruptions (IMF, 2020).

Freight activity fell initially, but demand surged as the pandemic subsided. The pandemic has affected trade across the region, with developing countries (excluding China) being hit the hardest. Estimates suggested that the overall reduction in economic activity in early 2020 would have a sizeable impact on global freight, leading to a 36% reduction compared to pre-COVID levels (ITF, 2020a). However, by early 2021, the cost of shipping containers from China to South America had jumped 443% compared to the median for this route, driven amongst other factors by a shortage of containers and ships caused by the pandemic (UNCTAD, 2021). As in other countries, the increase in e-commerce spending and demand for door-to-door logistics solutions is expected to drive demand in Asia (DHL, 2021).

Published by the Association of Southeast Asian Nations (ASEAN), the COVID-19 Recovery Guidelines for Resilient and Sustainable International Road Freight Transport Connectivity in ASEAN identify the establishment of a regional communication platform as a priority response to the COVID-19 pandemic, together with accelerated implementation of existing ASEAN agreements and regional and transport cooperation instru-

ments, digitalisation, standardised procedures and capacity building in the sector (ASEAN, 2021). The Asian Development Bank, for its part, underscores the need for gender responsive policies and programmes in relation to pandemic recovery (ADB, 2020).

Improving public communication surrounding hygiene is key in the post-COVID-19 era. In 2020, urban public transport faced strong negative impacts due to lockdown measures and fears over infection. Data suggests that globally public transport witnessed the largest decline in mobility, with a 76% decline in April 2020 (SLOCAT, 2020a). In China, public transport ridership had dropped to half of 2019 levels by March (ITF, 2020b), but largely recovered by the end of 2020 (Earley & Newman, 2021). Results from a survey in India observed that 36% of the respondents using metro rail before COVID-19 would prefer to shift to other options, mostly personal motor vehicles (TERI, 2020). This perception continues, although studies showed early on that infection risk in public transport is relatively low compared to other public places, such as offices, gyms, schools and music events. In the UK, a study by the national rail safety body found that the risk of contracting COVID on a train was lower than the risk of dying in a road accident. With appropriate measures, especially wearing masks, this risk decreases even further (UITP, 2020).

National funding and support programmes will be crucial for the financial sustainability of public transport (ITF, 2021a) and to cover the additional cost of implementing hygiene measures (UITP, 2020). Clear policies that favour public transport, improved hygiene solutions and good communication will be important for reviving and expanding ridership. Public information campaigns should focus on debunking the myths around public transport, and emphasise it as a safe mode of travel for passengers.





Example:

South Korea leveraged the COVID-19 pandemic to announce its [Green New Deal](#) in July 2020, a national strategy to create 659,000 jobs and help the country overcome the economic crisis while addressing climate and environmental challenges. The national government will commit approximately USD 61 billion over five years (2020-25) to boost renewable energy capacity to 42.7 GW, expand the green mobility fleet to 1.33 million electric and hydrogen-powered vehicles, refurbish public rental housing and schools to make them zero-energy, and transform urban areas into smart green cities.

The Daejong Transport Corporation has used these funds to undertake accessibility improvements with the vision of creating barrier-free roads and metro systems, taxi services and information systems.

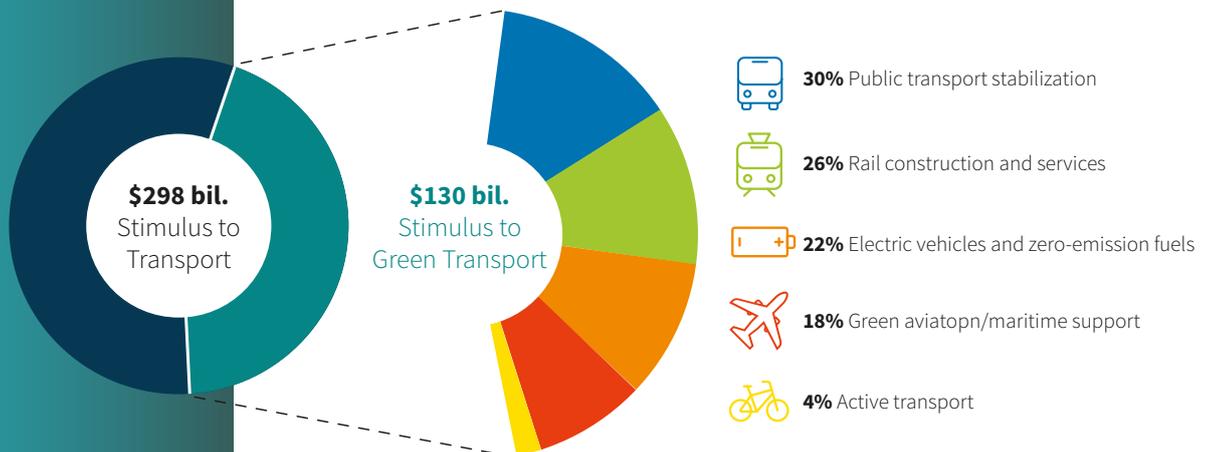
Myth 2: Recovery packages focusing on sustainable transport will not yield employment and jobs

COVID-19 pandemic has altered the financing landscape, increased the financing gap for green infrastructure. Many governments feel the need to support established industries, despite their negative effects on climate, health, or social justice.

The IEA estimates that the employment effect of recovery programs in the transport sector is highest for investments in walking and cycling infrastructure and for charging stations. Nevertheless, many recovery packages concentrate

on airlines and automotive industry (ADB, 2020). New research suggests that investing in public and active transport can create up to 21 times more jobs than investing in road infrastructure while reducing long-term maintenance costs and improving health, safety and equal access. Similarly, investment in EV infrastructure can create local jobs, which is especially interesting for countries without a traditional automotive industry, although not to the same extent as active and public transport (WRI, 2021).

Figure 13: Share of 'green' transport investment in recovery-package spending on transport



*Source: WRI

Active mobility has gained momentum, which can be leveraged. There is some [evidence](#) that people are shifting away from using private motorised vehicles to walking and cycling. [Beijing](#), for example, saw a near doubling in bikeshare usage after the lockdown was lifted. Cities can leverage the shift to walking and cycling by making emergency infrastructure permanent and creating safer pedestrian and cycling environments. Simultaneously, the use of invisible infrastructure, such as low speed limits and pedestrian-oriented traffic signals, can strengthen this approach (ITF, 2021).

The sale of personal motor vehicles may resume to pre-COVID-19 levels. The sale of new and used personal motor vehicles is expected to return to pre-pandemic levels. In China, for instance, sales had already rebounded beyond 2019 levels by June 2020. Also, electric cars sales have been more stable, and are expected to be higher than in 2019. New studies suggest that motorisation may have gone back to or even exceeded pre-COVID levels in cities around the world (ITF, 2020b).

The pandemic has strongly impacted 2020 global and regional GHG emissions from the sector, but without additional action, transport emissions growth is expected to resume. It is very likely that those who moved from public transport to personal vehicles during the pandemic will continue using these vehicles in favour of public transport or active mobility options, especially if the vehicle was newly purchased due to fear of infection.

The ongoing COVID-19 recovery packages can move things in the right direction. The ongoing pandemic recovery packages represent unprecedented levels of public investment that can be channelled towards decarbonising transport. At the global level, so far only 1.5% of recovery spending devoted to transport is allocated to improving active transport while 13%

is dedicated to the stabilisation of public transport systems. The large majority, comprising 56%, is dedicated to 'grey transport', including aviation and ICE vehicle manufacturing bailouts without conditionality, tax repeals, emission standard rollbacks and road construction (WRI, 2021). This is a lost opportunity.

Government recovery strategies must leverage their resources to attract investment in transport decarbonisation from various non-public sources, including public-private partnerships, financial institutions (pension funds, commercial banks, etc.) and capital markets (ADB, 2020).

Massive change can be triggered if needed. The large recovery investments and the rapid changes in behaviour observed over the last year demonstrate that fast change is possible. The challenge now is how to harness these experiences to move from 'change by disaster' to 'change by design'.²⁴

Reducing fossil fuel subsidies can provide substantial resources for the transition to low-carbon transport systems. In 2019, total fossil fuel subsidies in China, for example, were 50% higher than energy-related spending during the COVID pandemic. Indonesia, for its part, spent US\$19 billion on fossil fuel subsidies in 2019, compared to only US\$823 million in response to COVID (EnergyPolicyTracker.org, 2021; García-Herrero & Tagliapietra, 2021). So, while budgets allocated to recovery measures appear huge, fossil fuel subsidies are equally large, representing significant shares of GDP in many countries (IEA, 2021a). Additionally, carbon pricing instruments not only steer demand, but can provide additional government revenue that can be invested in further transformation measures. In both cases, some share of funds should be used to minimise the harmful social effects of increased energy prices.

²⁴ Quote from Dr. Lisa Ruhrort during Transport and Climate Change Week.

5.

What will influence future developments

Current trends are sending mixed signals



5.1 Some trends that can hinder decarbonisation

Shifting age structures will require special attention.

As the population in some parts of Asia continues to age, UNESCAP estimates that by 2050 one-fifth of the population in the Asia Pacific region will be over 65, up from 11.2% in 2013 (UNESCAP, 2013). In some countries, the share could be as high as one-third (Rep. of Korea, Singapore). Countries like Japan are retrofitting and designing their transport infrastructure and services to comply with the needs of the elderly (ITF, 2020c). A focus on road safety is needed for seniors. Moreover, public transport options may be more difficult to use for seniors if not properly designed, and new mobility solutions may be more difficult to access for generations that did not grow up with smart phones and the internet.

Increasing incomes and better roads encourage private motorisation. In developing parts of Asia, larger cars, mini-buses, pick-ups and light-duty trucks for the transport of multiple people are common, but private car ownership is still low. As the economy develops, more people will be able to own a car (PwC, 2015). Section 4.1 shows that motorisation is linked to economic growth and individual income. The increasing availability of disposable income, improved convenience through more and better road systems and concerns about safety when walking and cycling, have motivated more and more people to buy their own vehicle. Higher incomes are also allowing more people to travel by air.

Vehicle weight keeps increasing. There is a clear preference for larger and more luxurious cars and SUVs (PwC, 2015). In China, for example, sales of SUVs and crossovers reached a share of [46.6%](#) in September 2020. Additionally, the weight of individual models has increased over time. These developments offset the efficiency improvements achieved through technological advances. Reducing vehicle weight and/or reducing vehicle weight per passenger through ride sharing can result in substantial reductions of GHG emissions (OECD/ITF, 2017), while lowering fuel costs, air pollution and road usage.

The effects of e-commerce depend on the amount of bundling and the volume and mode of private transport that is replaced. Increasing online trade, especially when combined with cost-free delivery and distributed warehouses, has the potential to increase freight activity. E-commerce retailers are increasingly active as logistics service providers. In the early years of e-commerce, online purchases concentrated on items unavailable in the consumers' area (ITF, 2019). Today, partly as the result of the COVID pandemic, people have also been buying day-to-day products and groceries. Technology developments – such as the 'Internet of Things' – could see household appliances automatically re-order products, further increasing freight activity, especially if unbundled and supported by automated vehicles and drone deliveries. Effects on sustainability will depend on the distance of individual shipments, the amount of delivery bundling and the reduction in the volume and mode of private transport for shopping.

The demand for transport is growing amid increases in global and regional trade. Today, 70% of international transport is by sea. The total demand for maritime freight roughly doubled over the past two decades, while other modes have seen more moderate increases. With current trade and growth patterns, total demand is expected to more than double by 2050 (ITF, 2021b).

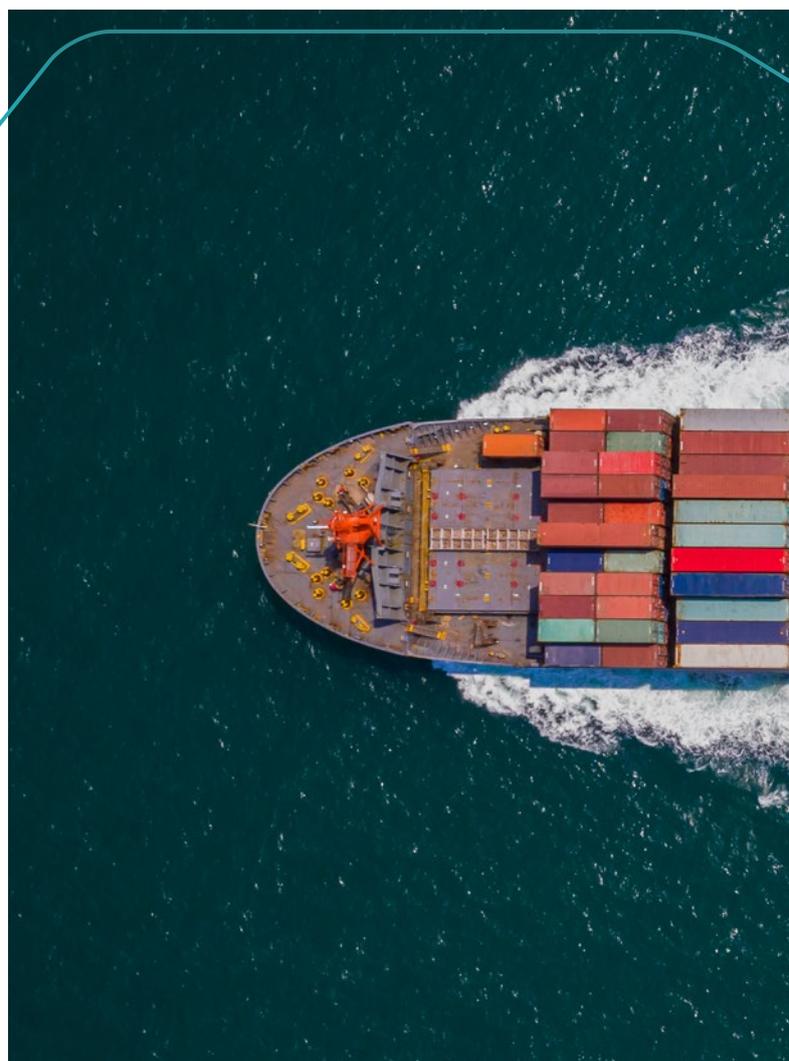
Urbanisation puts pressure on urban planners to ensure safe, healthy and timely mobility. As city populations grow, transport planners must struggle to ensure that all socio-economic groups have equal mobility access. In contrast to rural populations, people in cities also face higher risks with regard to air pollution and vehicle safety. The share of people living in urban areas in Asia has already grown from under one-third in 1990 to just over half in 2020. By 2050, two out of three people in Asia are expected to live in urban areas (UNDESA, 2014).

5.2 Trends that make decarbonisation easier

Electrification is growing rapidly in many Asian countries, especially among two- and three wheelers. Electric two-wheeler fleets are growing, especially in China and India, which had 300 million and 0.6 million two-wheelers, respectively, in 2019. The fleet of electric three-wheelers stands at 50 million in China and 1.5 million in India. The electric bus market is dominated by China, with almost 600,000 buses and a sales share of 27%. The sale of electric buses increased in Japan by almost 200% (most of them fuel-cell vehicles) and in the Republic of Korea by 470% (most of them battery-electric vehicles) (IEA, 2021b). India now provides support for electrification under its FAME II scheme, which aims to support 7,000 electric buses.

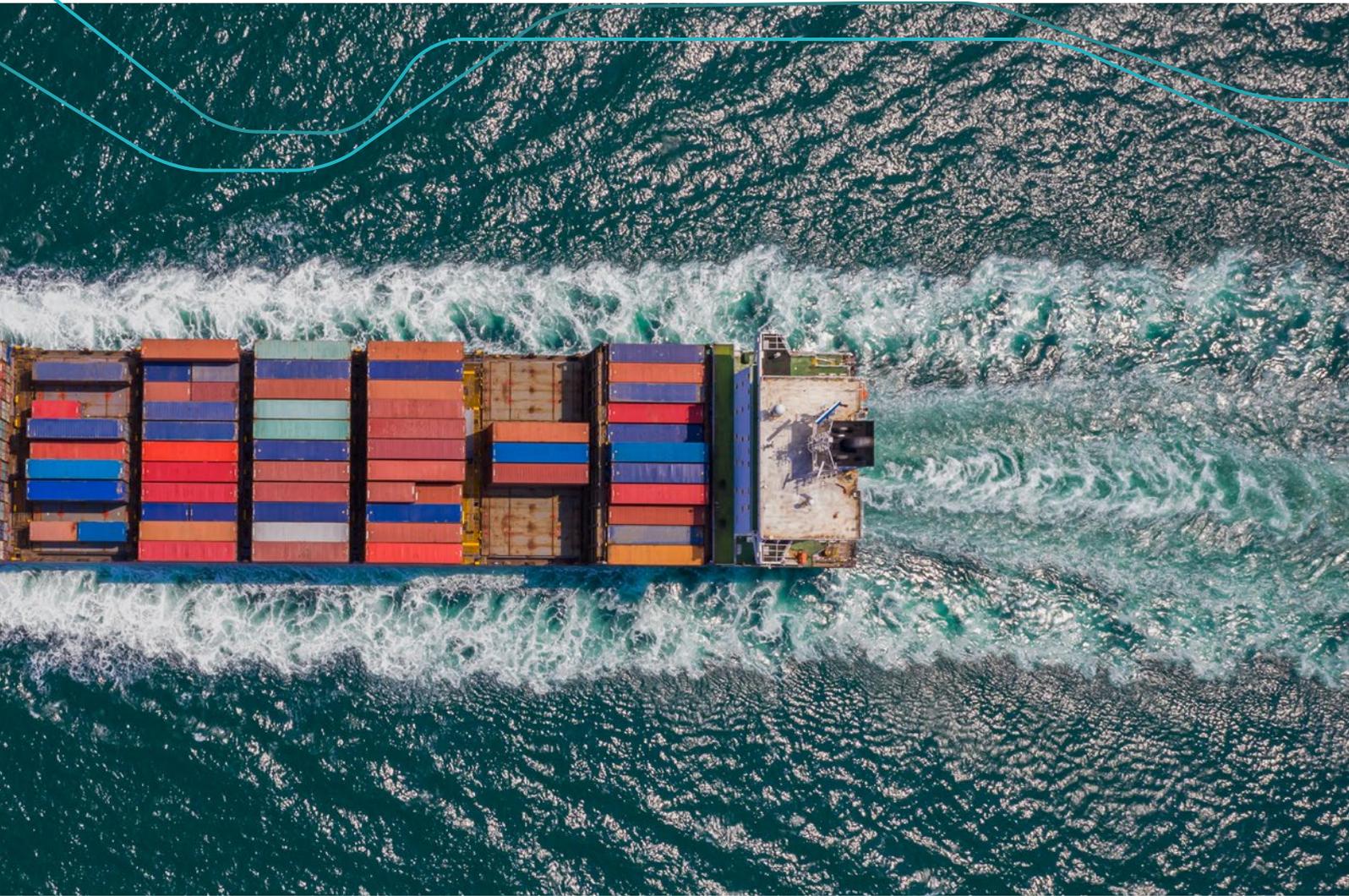
Electric car sales have grown exponentially over the past 15 years, starting from practically zero and reaching a global stock of 10 million passenger cars at the end of 2020, the vast majority of which are located in the US and China. China still has the largest fleet, although in 2020 sales in Europe exceeded those of China for the first time. Japan is the only exception, which has seen decreasing sales and stock since peaking in 2017. Electric truck sales are still low, but growing, with an increasing diversity of models across all segments, including medium- and heavy-duty trucks (IEA, 2021b).

The success of electrification is based on a mix of policy interventions and technological advancements that reduce the total cost of owning an electric vehicle and that provide extended range, faster charging and an increased range of models. A recent study looking at different models in China, Japan and the Republic of Korea found that electric alternatives had lower total costs of ownership for most models with low mileage and all models for high mileage use (avicenne Energy, 2021). Electrification also offers a good opportunity for countries to build out their own electric vehicle industry. Together with the needed investment in and maintenance of charging infrastructure, this can provide new industrial opportunities, especially for countries without a traditional automotive industry.



The fuel efficiency of motor vehicles has improved in recent years and will continue to do so. Fuel efficiency and greenhouse gas emission standards are a major driver of this trend (ICCT, 2020a). Even countries that do not have their own efficiency standards are often affected, as standards elsewhere impact the availability of vehicles, especially when a large share of vehicles are used imports. Efficiency labelling has also helped to make fuel efficiency a factor when deciding what vehicle to purchase. For passenger vehicles, however, the efficiency gains of recent decades have been largely outweighed by increasing vehicle weight (OECD/ITF, 2017).

Moving from global to regional supply chains could reduce global freight activity. The [Regional Comprehensive Economic Partnership](#) was signed in November 2020 and consists of ten Southeast Asian countries along with South Korea, China, Japan, Australia and New Zealand, covering nearly a third of the global economy. This will have important implications for trade in the region, especially given the likely restructuring of



global value chains to make them more resilient in the wake of the COVID pandemic. A [‘nearshoring’ or ‘reshoring’ strategy](#) with less trans-continental and more regional or local supply chains will shorten the average transport distance. In conjunction with the new Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific, which came into force on 20 February 2021, the new trade agreement is likely to increase trade volumes within the region (UNESCAP, 2020).

Reduced fossil fuel demand could reduce maritime trade volumes. Under current policies, coal demand is expected to drop 25% below 2020 levels by 2050, and could drop to 50% if current pledges are achieved and up to 90% in a net-zero world. Oil and gas demand is expected to remain high under current policies, but to decline if pledges are implemented, although not as drastically as coal (IEA, 2021d). Reduced demand will reduce transport for coal, oil and gas (Halim et al., 2018), although some of this may be offset by trade in hydrogen.

“It is time for change. The tipping point for net-zero carbon emission mobility is being reached in several vehicle types and we must support and accelerate the phasing out of ICE-vehicles across Asia and the Pacific.”



James Leather
Asian Development Bank

Teleworking can reduce travel demand, and increased flexibility in working hours can reduce peak demand.

Working from home is not new – it was common as early as the 1970s. However, modern internet and ICT technologies have made it easier and more acceptable. Teleworking uptake varies substantially depending on region, sector, social conventions and skill levels and – before COVID – was most prevalent in industrialised countries. Especially in urban centres, widespread teleworking can reduce travel demand, especially at peak times, thereby reducing congestion, accidents and emissions (ITF, 2019). Positive experiences during the pandemic could keep teleworking levels high. However, its effects on non-work-related trips will need to be considered, because additional trips for shopping or dropping off children may lead to reduced effectiveness. On the other hand, increased flexibility in working hours can reduce peak traffic, congestion and demand for additional transport infrastructure.

The scaled-up adoption of 3D printing could massively disrupt traditional manufacturing processes and trade patterns.

The ability to easily produce intermediate products or certain consumer goods could reduce world trade and demand for freight. Adoption rates will depend on many factors, but under the assumption of mass adoption the technology could reduce freight CO₂ by 27% by 2050 relative to the current policy scenario (ITF, 2019). However, the economic and social impacts of the mass adoption of 3D printing need to be considered and the negative effects must be mitigated where possible. Economies relying on cheap labour will be especially affected, and will require significant investment in human capital (UNESCAP, 2020).



5.3 Trends that could go both ways

‘New mobility’ has improved transport access, but it is not automatically low-carbon. A wide range of different technology-driven concepts falls under the term ‘new mobility’. Some of these, such as ride-hailing, move ordering to more flexible mobile phone apps, but they build on more traditional services, such as taxis, and are essentially the same. Vehicle sharing is not a new concept, but instead of the conventional rental, the new services work through apps, include bikes and scooters, are more flexible and are often more conveniently located. All these services, with or without drivers, can reduce the number of vehicles produced, reduce the need for parking space and fill gaps in public transport, but they should not be designed to replace public transport, walking or cycling.

Women, for example, constitute a majority of the user base for new mobility services in Indonesia, with nine percent of women in Indonesia saying that they would have been unable to cover their transport needs without it. In addition, identifying ways of recruiting and retaining more women drivers could create non-traditional sources of income and asset ownership for women (IFC, 2018). However, new mobility services have also seen incidents of violence and harassment against women, and as in public transport clear steps are needed to make women safe.

Another form of mobility is app-based and aims at pooling ridership. In both cases, modern ICT technology, data and appropriate regulatory frameworks are essential.

Autonomous driving will only support decarbonisation in combination with shared and electric mobility. Over the past years, industry has been developing vehicles with automated driving functions, starting from driver support systems to fully autonomously operating vehicles. Automatisations is expected to improve access and increase efficiency and road security. But experts are divided on whether these positive effects can in fact be achieved and caution against potential negative effects such as increased transport volume and a move away from public transport, especially for autonomous cars (Hochfeld et al., 2020; UC Davis & ITDP, 2017). By contrast, the autonomous use of rideshare services and public transport can significantly reduce overall system costs (UC Davis & ITDP, 2017).

High-speed rail can serve as an alternative for flights but maybe come at a high cost. High-speed rail is not new and was first used in Japan in the 1960s, with speeds of around 300 km/h. The uptake of the technology will largely depend on cost developments, the willingness of customers to pay for extra speed and the cost of competing modes, especially short-haul flights. High-speed rail can provide an alternative to planes or cars, especially for medium-length distances.

Ultra-high-speed rail systems based on electro-magnetic systems can theoretically operate at speeds between 500 km/h (Maglevs) and 1,200 km/h (Hyperloops). Ultra-high-speed rail systems could potentially improve regional accessibility. Ridership would shift from traditional rail, car and short-haul flights. The impact on GHG emissions is projected to be low and within Asia mostly concentrated in China and India (ITF, 2019). The high investment cost of ultra-high-speed rail systems can potentially use up funds in lower income countries that could be deployed more effectively for other measures.

Slowly but surely, electricity generation is decarbonising in most countries in Asia, but the overall picture is still mixed. Power systems are increasingly incorporating renewable energy thanks to new policies and the decreasing cost of renewables, especially solar power. Globally, the CO₂ intensity of power generation in 2020 – the CO₂ emissions per unit of electricity produced – was around 91% of the intensity that prevailed in 2000. In Asia, most countries have also decreased their intensity. Nepal has almost fully decarbonised its power sector and Singapore reduced its CO₂ intensity by 50% between 2000 and 2020. However, some countries have also registered increases in carbon intensity. Vietnam has experienced the largest increase, with intensity rising 50% in 2000–2020. Increases in carbon intensity – albeit of a lower level – can also be observed in the Philippines, Sri Lanka, Malaysia, Japan and Indonesia (IEA, n.d.). Japan and Malaysia, by contrast, have managed to reduce their carbon intensity over the past few years. To be sure, when combined with growing electrification, increases in carbon intensity stand to undermine decarbonisation efforts in the transport sector.

6.

What is needed to get to zero-carbon transport

*Only a balanced avoid-shift-improve
approach as part of a just transition
can deliver the necessary change*



6.1 Ensuring a just transition of the economy is essential

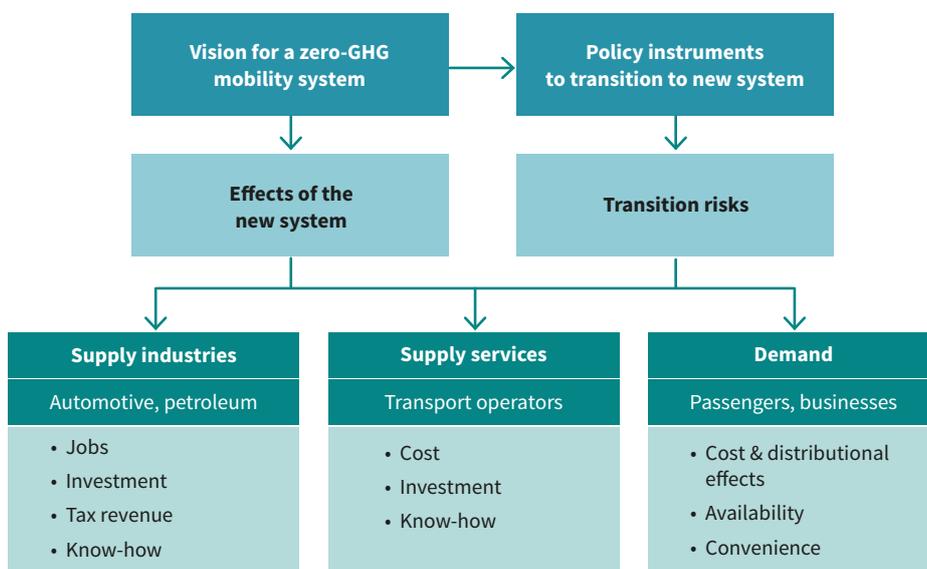
As new products and technologies enter the market, old ones are replaced and sometimes whole industries vanish. The consequences can be especially disruptive if they affect large shares of the population or if they are concentrated in specific regions where much of the economy was dependent on these industries. Such transitions happen naturally over time and are often spurred by technological development. But they can also be triggered by conscious policy decisions.

When transitions are based on policy, the intended positive effects can come with a range of risks for different stakeholders. Some are based on the way the new system is envisaged. For instance, one type of transition might make certain industries or job types obsolete. Another might have regulation and price instruments that negatively impact the poor or specific businesses. Figure 14 highlights some of the most common risks relevant

for the transport sector. To buffer negative effects and avoid social unrest, it is important that the transitions are equitable and just. They must involve the “deliberate effort to plan for and invest in a transition to environmentally and socially sustainable jobs, sectors and economies” (Just Transition Centre, 2017).

Taking stock is the foundation of a just transition. The transformation to zero-carbon mobility systems will require drastic changes for the suppliers of vehicles and transport services, though it will also impact the mobility options available to everybody. Some policy instruments to achieve the transformation will have unintended consequences. Assessing these effects and their impact on different areas of society is crucial to finding tailored solutions that mitigate negative developments and create a more equitable and sustainable system (Conway et al., 2017).

Figure 14:
The risks of moving to zero-carbon transport systems



Source: Authors' illustration based on Conway et al. (2017), ILO (2019), Just Transition Centre (2017)



Using the transition to create a more just and equitable system will increase support. Current transport systems are far from just and equitable. Many, especially lower income, countries in Asia still have high shares of the population with inadequate access to transport and, by extension, to jobs and essential services such as healthcare and education. Existing fossil-fuel centred systems mostly benefit the richer and male adult segments of the population, as shown in Indonesia's self-report on fossil fuel subsidies (Republic of Indonesia, 2019), while poorer households and women bear higher risks from related health and safety problems. Creating future systems that address these issues will motivate thinking on how to overcome transition risks. We need to start thinking **now** about those systems and how to make them an integral part of the transition process.

Turning risks to opportunities by transforming the transport industry. The transition requires large investments in new industries and sustainable infrastructure with opportunities for job creation and economic growth (ILO, 2015). Investment in public and active transport can create more jobs than

investing in road infrastructure. EV infrastructure development and the manufacture of electric vehicles can create new local jobs, which is especially interesting for countries without an automotive industry (WRI, 2021). Refineries can find new opportunities in the co-processing of advanced alternative fuels (IEA Bioenergy, 2019) and use their expertise to move towards the exclusive production of advanced biofuels. The automotive industry can find new business models in areas such as mobility services, battery rental and grid stability that provide on-going revenue streams instead of one-off sales. Traditional manufacturers, such as Toyota and Hyundai, as well as start-ups are already launching subscription-based car services (McKinsey, 2021).

Small and medium businesses require specific support. Large companies often have the means to become early adopters of new technologies. While some smaller businesses are more flexible, many lack the finance, skills and capacity needed to capture new opportunities arising from the transition. Here additional support may be required, tailored to the specific needs of affected business groups.



“Managed well, transitions to environmentally and socially sustainable economies can become a strong driver of job creation, job upgrading, social justice and poverty eradication.”

ILO (2015)

Myth 3: Decarbonising transport will cost jobs

The automobile industry is responsible for between 4 and 11 per cent of GDP in Asian countries. Decarbonising the energy and transport sector can create new jobs in the Asia-Pacific region, which already accounts for more than 5.8 million jobs in renewable energy, or approximately 60 per cent of the 9.8 million employed in the sector worldwide (with 40 per cent in China and around 9 per cent in India).

The ILO has estimated that by 2030 an additional 14.2 million (net) green jobs could be generated in the Asia-Pacific region, provided that countries shift to renewable energy sources, that energy efficiency standards are increased in building and construction and that transportation shifts to (renewable) electric sources (ILO, 2019).

ILO has estimated the employment opportunities that will result from the transition to green and healthy transport in Europe and Central Asia by 2030. It found that vehicle electrification targets would predominantly benefit Asia due to its dominance in the manufacturing of electric components and batteries. The introduction of a voluntary or mandatory target to make 50 per cent of all new vehicles fully electric and to ban internal combustion engines for light commercial vehicles would generate around 7 million and 7.3 million jobs in Europe and Central Asia, respectively (ILO, 2020).



Stakeholder dialogue, social protection measures and funds for affected communities are needed for a just transition. These tools can help further climate ambition and ensure that the longer-term opportunities of a just transition can be realised while minimising negative short-term effects. They complement the required macroeconomic, industrial, sectoral and labour policies that enable the transformation towards a zero-carbon transport system (ILO, 2015).

Stakeholder dialogue is key. Affected communities and stakeholder groups must have a seat at the table, working together with industry, businesses, environmental groups and government to bring together industrial strategy, innovation, deployment of clean technologies and investment in green infrastructure, along with the measures we need to smooth out the transition (Conway et al., 2017; Just Transition Centre, 2017). Bringing on board representatives of groups that face disadvantages in the current system, such as women, the elderly and those with disabilities, will enable future systems that are safer, more equitable and accessible for all.

Protecting individuals that are adversely affected will require training and social security systems. Workers that are set to lose their jobs – for example, in the petroleum industry – need skills that allow them to find work in other sectors. Especially where current work is largely based on unskilled labour, measures are needed to strengthen the educational and vocational system and provide re-training opportunities. Conversations about the right measures should involve affected workers and take into account their preferences and aspirations (Conway et al., 2017; Rosemberg, 2017).

Modern low-carbon technologies, such as EVs, can provide opportunities for higher-skilled work, while additional jobs in infrastructure construction and transport operation offer lower-skill work. It is important to ensure that women have the same opportunities in capacity building activities for these future technologies and that incentives are tailored to suit the diverse needs of women and other groups (ILO, 2015).

Transition funds can help communities move beyond fossil fuel industries. Governments can expect the private sector to contribute to the initial transition costs, but public funds will be needed to help areas where the economic impact of fossil fuel industries is high (Conway et al., 2017). If funds are to be successful in the long-term, they must go towards measures supported by the affected communities (Rosemberg, 2017).

6.2 Technical and behavioural changes can get us where we want to go, provided we act fast

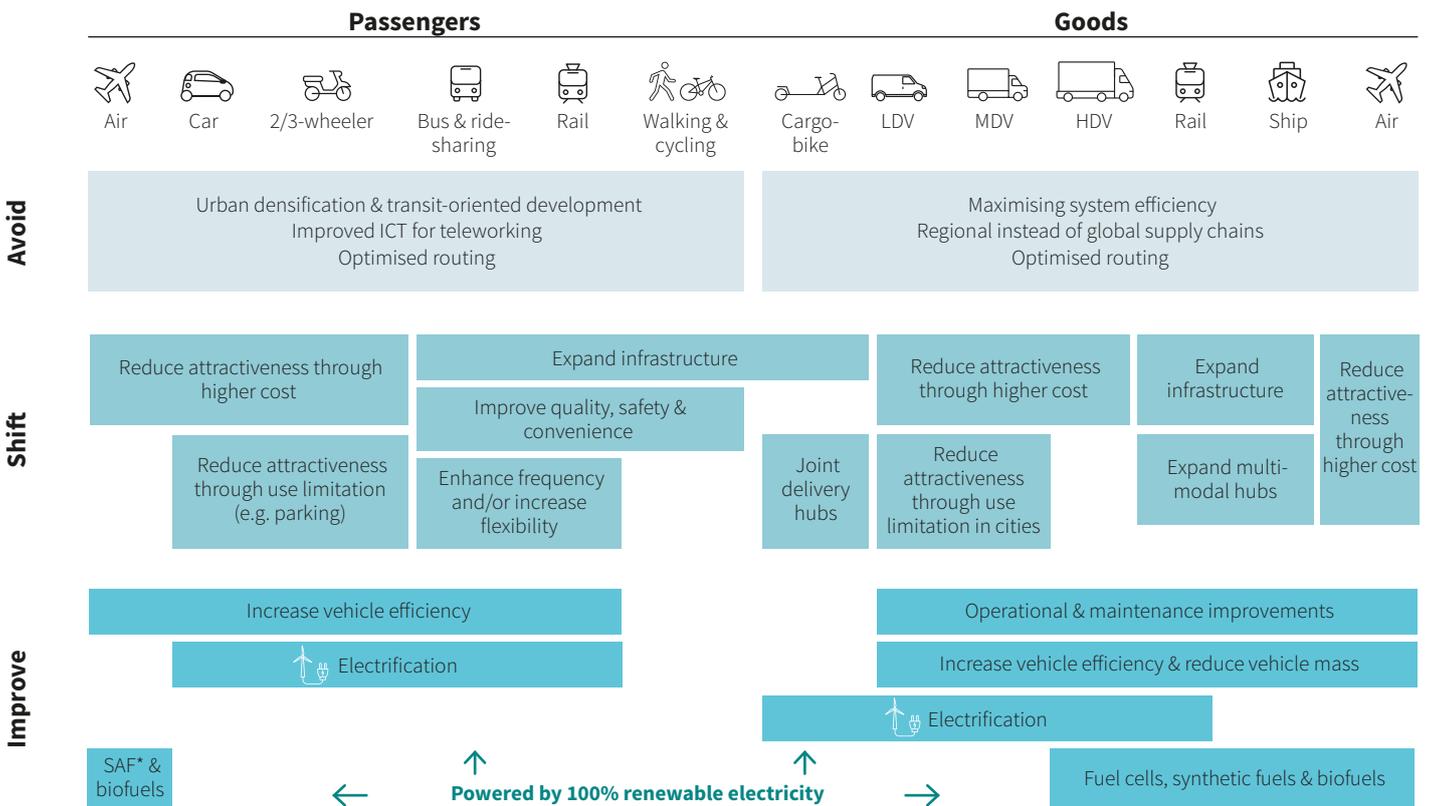
Getting close to zero emissions in the transport sector by 2050 is technically feasible. While many 1.5°C decarbonisation scenarios still assume substantial GHG emissions from transport in 2050 (ICCT, 2020b; OECD/ITF, 2021a), more recent scenarios envision deeper reductions. According to the IEA's Net Zero Scenario, **transport emissions in 2050 can fall to 0.7 Gt CO₂e, including GHG emissions from the generation of electricity used in transport with existing technologies** (IEA, 2021c). A recent scenario for the transport sector developed on behalf of the Transforming Urban Mobility Initiative (TUMI) envisions the achievement of zero emissions by 2050 without the need for removals (Teske et al., 2021).

Activities to reduce GHG emissions in the transport sector are often characterised using the **Avoid-Shift-Improve (ASI) framework**. 'Avoid' solutions aim to reduce the need for transport activity by avoiding trips and reducing trip length, while 'shift' solutions work to enhance levels in the use of more efficient and sustainable modes of transport, thus creating a change in mobility patterns. For instance, many Asian countries today have high shares of public transport, walking and cycling, mostly because of the large number of people who cannot afford private motor vehicles. The goal here must be to maintain such high shares, but make it a choice rather than a necessity. 'Improve' solutions aim to make remaining vehicles more efficient and capable of running on low-carbon or zero-energy sources (Agora Verkehrswende et al., 2018; SLoCaT, 2018). Figure 15 provides an overview of the technical and behavioural measures needed to get there.

“The bottom line is that a sector that is almost exclusively dependent on a single energy source, petroleum, operating on infrastructure that represents trillions of dollars of investment over many decades, must change substantially in little more than a generation.”

ICCT (2020b)

Figure 15:
Overview of technical and behavioural solutions to decarbonise transport



Source: Author's illustration based on IEA (2021c), ITF (2021b), SLOCAT (2021), TDA (2018), Teske et al. (2021).

Sustainable urban planning is key for cities in Asia.

There are many well-established solutions for sustainable urban mobility planning, such as transit-oriented-development (TOD). Implementing them with require a two-pronged approach: managing growth in large mega-cities as well as guiding the growth of small and medium-sized cities. National legislation and budgets need to support cities in planning and implementing low-carbon urban development.

Some proven measures to increase the sustainability of freight are in the interest of freight operators and customers. These include improving load factors, reducing the empty running of trucks, optimising routing and reducing the energy needs of vehicles. All of these measures make operators more competitive and reduce prices for customers, but their potential is not yet fully utilized (ITF, 2019). Truck ownership is often highly fragmented – many operators own only one truck, so the implementation of optimisation measures is challenging and reliant on close engagement.

Promoting shared transport and active mobility while making individual motorised transport less attractive is essential. To promote rail, public & shared transport and active mobility, a two-pronged approach will be most effective: the coverage, frequency and quality of service must be enhanced and combined with measures that discourage individual motor transport. Examples include ICE bans in cities, limiting vehicle registration or use, zone or road-based congestion charges, road taxes, parking management and fiscal incentives.

Shifting freight to rail, waterways and short-sea shipping is essential. Rail and waterways are the most carbon efficient modes of freight transport, and they also reduce air pollution and congestion. Supporting a shift requires substantial increase in infrastructure investment (ITF, 2019) for expansion as well as the establishment of multi-modal hubs that make transfer to last-mile delivery vehicles efficient. In India, for example, modal shift of freight to rail could potentially reduce freight emissions by 46% by 2050 (TERI, 2021). Similarly, a shift to coastal and inland shipping is a mitigation measure in Vietnam’s NDC and in its [National Green Growth Strategy](#).

Remaining vehicles will need to be as efficient as possible and only as heavy as needed. Even with dramatic systematic changes it is predicted that more than 1.5 billion internal combustion engine (ICE) vehicles will be sold globally over the next 30 years. To enable full decarbonisation, these vehicles need to be as efficient as possible (ICCT, 2020b). At the moment, vehicle mass for passenger cars is steadily increasing, which counters technological improvements in energy efficiency. This means promoting vehicles that are suited to usage contexts and discouraging oversized vehicles. With the practice of exporting used cars to lower income countries, impacts from vehicles need to be seen over their entire lifetimes, and effects on sustainability in recipient countries need to be considered.



Dr. Gyeng Chul Kim
Daejeon Transportation
Corporation

“People in many Asian cities buy cars due to the inconvenience in public transportation. This is a major obstacle to decarbonization. City administrations and public transport authorities must improve the quality of service for ALL. ICT can help in analysis and service provision, achieving sustainable and convenient public transport services.”

Myth 4: New mobility is always 'green'

The recent 'sharing economy' boom is expected to revolutionise urban transport systems and enable easy access to goods and opportunities. The sharing economy aims to boost efficiency and flexibility by providing access to – instead of ownership of – underused goods and services, coordinated through web-based applications. Built on the concept of the sharing economy, transportation network companies (TNCs) have emerged as a new mode of transport that has significantly affected urban mobility in the past decade, even though TNC trips remain a small fraction of the overall miles travelled.

On the one hand, TNCs can serve as a flexible supplemental mobility option for transit riders in case of emergency and in areas with no or low transit services, while also offering a similar but cheaper alternative to reliance on private vehicles. On the other hand, TNCs may squeeze out public transit by offering easy-access to on-demand mobility services, leading to more congestion, more travel and lower passenger occupancy rates on the road.

A study by the SMART Lab at the Massachusetts Institute of Technology, using survey data from several US cities, found that approximately half of TNC trips are

ones that would otherwise have been made by walking, cycling, PT or would not have been made at all. Even for TNC trips in place of private vehicle trips, the miles in private vehicles taken off the road are far outweighed by TNC vehicle miles due to the substantial quantity of dead miles (miles travelled without a passenger) accrued by the latter. Dead miles account for at least 40.8% of TNC miles (Diao et al., 2021).

This highlights the need for careful regulation and incentive schemes if new mobility services are to complement public transport and reduce the amount of private motorised vehicles on the road.

Electrification plays a central role in decarbonising road vehicles.

There is a broad consensus on the need for the direct electrification of light-duty vehicles, including two- and three-wheelers, as well as light trucks. In China, for example, many types of battery-electric alternatives are expected to be cost-competitive before 2030, or even earlier provided that the right support schemes are in place (ICCT, 2021a). For heavy-duty trucks, the direct use of battery electricity may need to be supported through fuel cells and alternative fuels, but recent studies show that in Europe, under existing policies, electric tractor-trailers for heavy long-distance hauling can achieve cost parity with their diesel counterparts over the next five years (ICCT, 2021b). However, there are still other technology options on the table for heavy-duty vehicles, including fuel cells, catenary or on-road charging and the use of renewable-based

synthetic fuels. For ships and airplanes, direct electrification is an option for smaller vessels and shorter distances. As with freight, the technology options are less clear, require more upfront investment and are not yet cost-competitive.

The electrification of road transport will require a charging infrastructure, the integration of charging into power grids, and systems to reuse and recycle batteries. Managing charging patterns will play an important role in integrating renewable electricity with electric mobility, as will ICT technology in delivering flexibility and ensuring grid stability (IEA, 2020). Infrastructure requirements for other solutions, such as fuel cells or ammonia for shipping, are different and will soon require decisions regarding the preferred future technology.

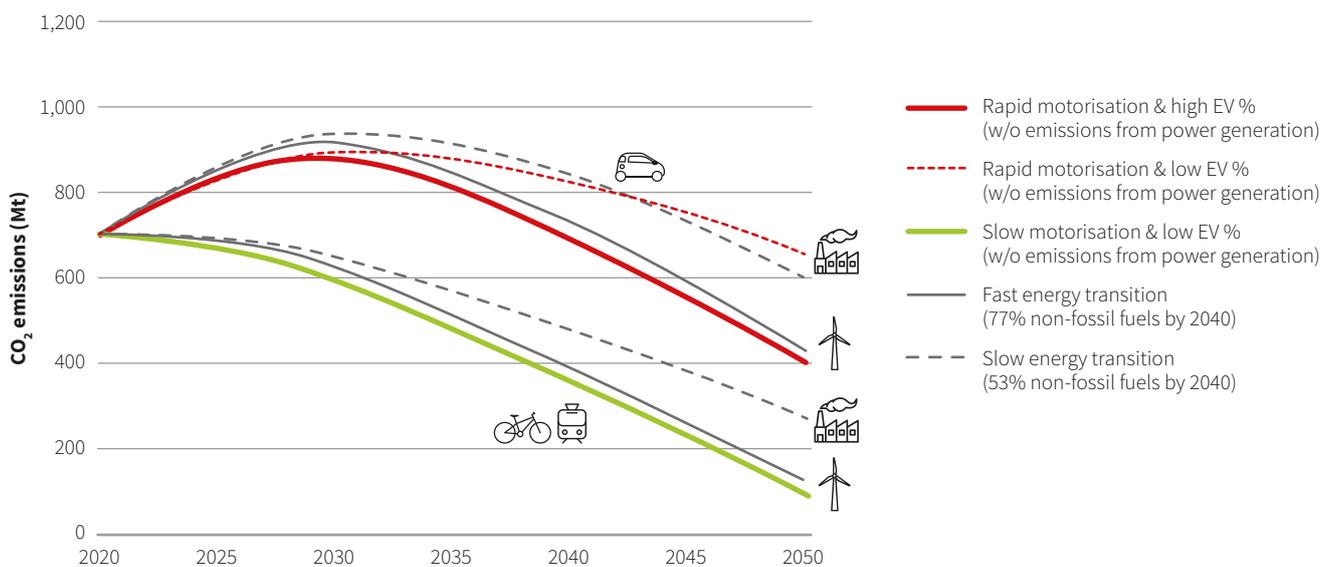
Myth 5: Electric vehicles are the magic bullet

The rising CO₂ emissions in Asia's transport sector are linked to a growing population with increasing disposable incomes and near-total reliance on fossil fuels (ADB, n.d.). Electric vehicles and the share of energy generated from renewable sources will play a key role in decarbonising the transport sector. However, electrification alone will not suffice to achieve zero-carbon transport.

An assessment by the World Bank on different pathways to the decarbonisation of China's road transport sector revealed that even with an EV market share of over 80 percent, a full energy transition to renewable sources by 2050 and soaring motorisation rates, transport emissions would still be about half of their current level (red solid line in Figure 18). While an improvement from the status quo, it would be far from carbon neutrality, which China has pledged to reach by 2060. This also does not consider the impacts of increasing motorisation on road safety, space allocation in cities, accessibility, and congestion.

Alternatively, transport sector emissions in 2050 would be less than 15% of the current level if China reduced its motorisation rate and achieved an aggressive market share of EVs (the green solid line in Figure 18). With this scenario, achieving net zero by 2060 would be more feasible. The emission reductions that can be achieved through slower motorisation can be higher than what can be delivered by an aggressive EV market strategy alone. When it comes to decarbonising the transport sector, electrification is necessary but not sufficient.

Figure 16:
Well-to-wheel GHG emissions from road transport in China under different scenarios



Source: Adapted from Jung Eun "Jen" Oh (2021).

Rail electrification is equally important, but requires a different infrastructure and deals with fewer individual operators. It has the potential to substantially reduce emissions, especially for long-distance passenger transport and freight, where direct electrification remains a challenge. Rail electric infrastructure can also serve other vehicles. For example, train stations can provide charging points for buses or shared micro-mobility.

High levels of electrification reduce air pollution, particularly in cities, but need to be supported by avoid-and-shift measures to address congestion and safety concerns. A strong focus on technology can lead to a system that does not necessarily address congestion, access and equity challenges, leaving behind population groups that cannot afford to buy their own motor vehicles. Only a balanced approach across the ASI framework will be able to address these challenges while decarbonising the sector through the large-scale improvement of demand management, urban planning and shared mobility solutions. Countries in Asia have made strides in this direction. Consider the expansion of high-speed rail in China, [which plans to cover 40,000 km of lines](#), or [India's goal of building metro-rail systems in 100 cities](#).

Alternative low-carbon fuels are a key element in decarbonising aviation and maritime transport. The availability of sustainably produced biofuels and renewable electricity-based hydrogen, ammonia and electrofuels, including sustainable aviation fuel, is limited and should be concentrated to use cases where other options, such as the direct use of electricity, is either economically or technically unfeasible (ICCT, 2020b). Electrification for aviation and shipping is still in its infancy, but the first electric ferries are operating in Europe, and [in 2020 a fleet of 8 vessels was launched in Bangkok](#), along with prototypes for short-distance planes. Full electrification will mostly play a role in domestic and regional transport with lighter ships/airplanes, while the rest will rely largely on alternative fuels and efficiency measures for decarbonisation.

Remaining energy use will need to be renewable. Using more efficient modes of transport and reducing the energy needs for individual vehicles are essential measures to enable a high penetration of renewable energy sources. As transport sector demand grows, electricity needs to move towards the generation of renewable electricity. Across Asia, grid emission factors vary substantially based on the share of fossil fuels – particularly coal – in electricity generation (IEA, 2018). Plans are targets for the expansion of renewable electricity also have an important impact on grid emission factors. So far, only China, Singapore and a few other countries in the region have managed to continuously decrease their grid emission factor since the year 2000. The [Glasgow Climate Pact](#) is the first international treaty to call for the phase-down of unabated coal and a phase-out of fossil fuel subsidies. This can provide new momentum for delivering renewable power in the transport sector.

“Taking steps towards decarbonization through the adoption of electric vehicles will make sure that the energy source will come from renewable energy and be accompanied by the sustainable management of end-of-life vehicles as well as second-life batteries and battery recycling.”



Yossapong Laonual
King Mongkut's University
of Technology Thonburi



“Predictable, coherent, long-term policy signals are essential to spur innovation, open markets, lower financing costs and attract private investment.”

**The Global Commission on the Economy and Climate
(2018)**

6.3 Actions need to be embedded in a consistent framework

Implementing actions without a long-term vision and strategy risks higher costs later and stranded assets.

It is essential that each country develop a long-term vision of a future mobility system in line with the country’s overall decarbonisation strategy. This will need to be driven by climate change mitigation and adaptation considerations as well as by improving access, liveability and employment. A modern, just and competitive zero-carbon transport ecosystem by mid-century requires careful planning. The underlying strategies – shifting to more efficient transport modes and to the increased use of electricity, biofuels and synthetic fuels – require much greater integration across the energy and land-use sectors.

Strategies need to be translated into concrete policies, while governance mechanisms, actions and regulations need to build on a strategic foundation.

Figure 17 illustrates the elements of a framework to support the successful implementation of zero-carbon, sustainable mobility systems. Robust evidence and information are key for successful policies, as are the active engagement of stakeholder groups and efforts to inform the broader public about planned changes and their effects. All of this will require additional capacity at multiple levels and will involve government officials, experts, transport operators, drivers and workers.

Figure 17:
Policy and action framework for decarbonising transport

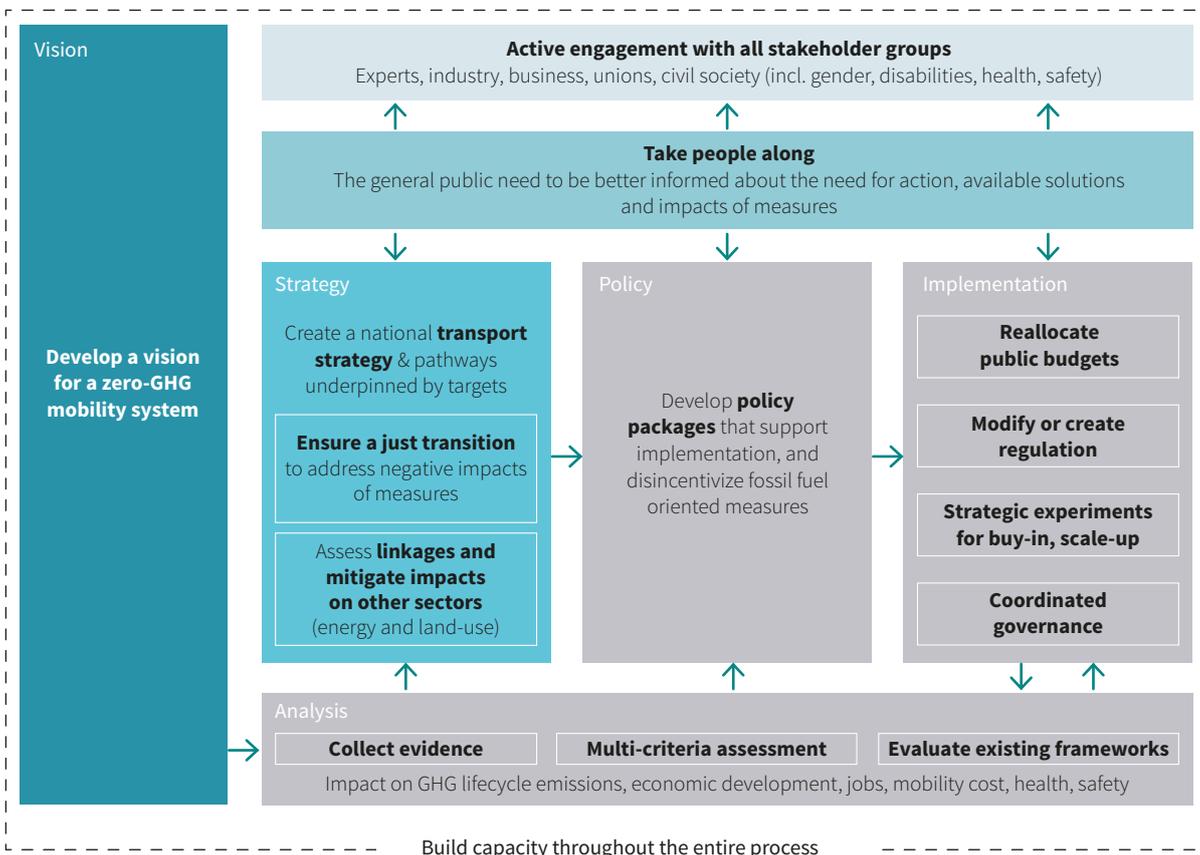
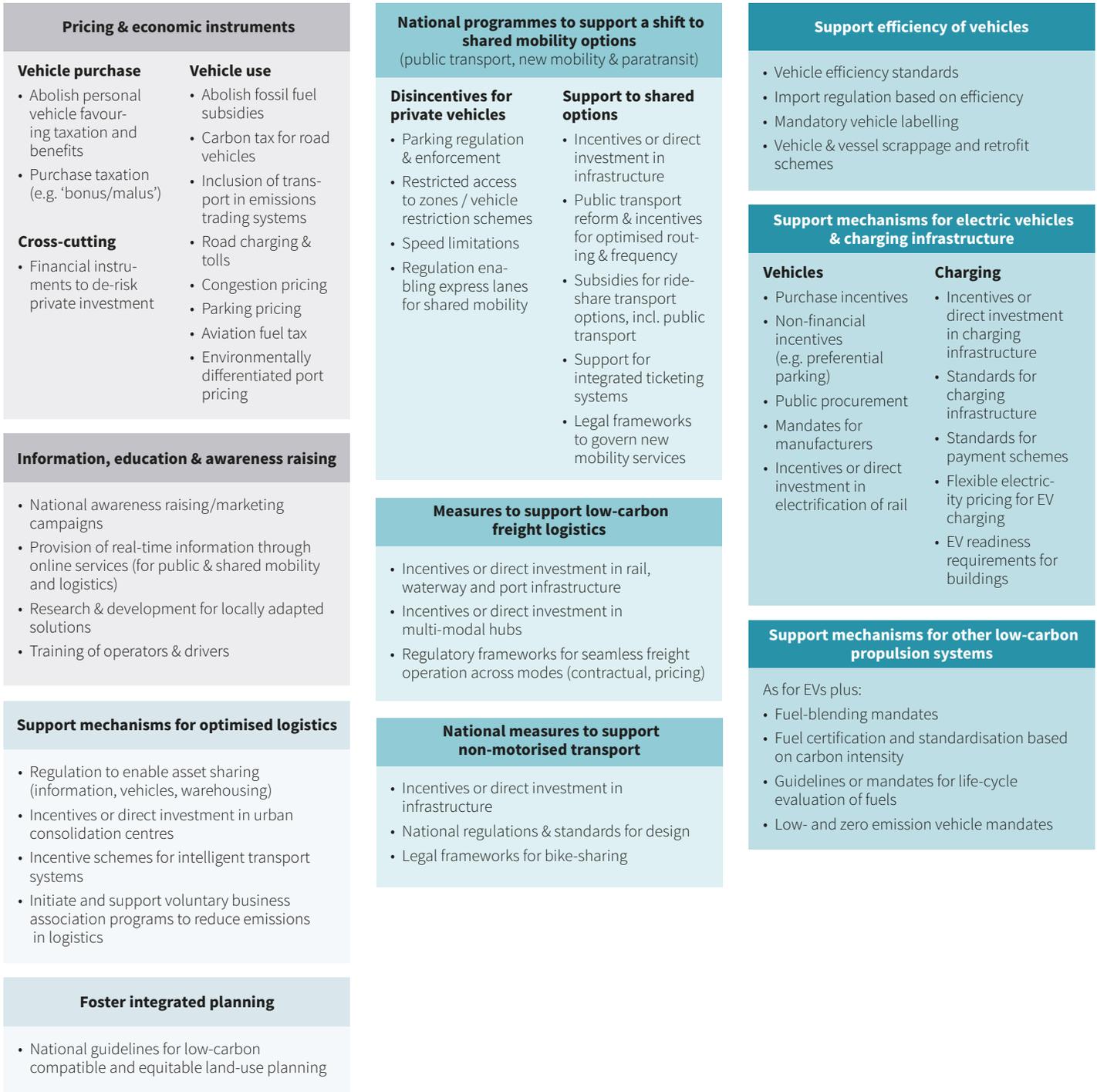


Figure 18:
Policy instruments to support decarbonisation in transport



Cross-cutting instruments
 Instruments to support avoid strategies
 Instruments to support shift strategies
 Instruments to support improve strategies

Source: Author's illustration based on Agora Verkehrswende et al. (2018), IEA (2021c), ITF (n.d.), and Teske et al. (2021).

“There is a need for a massive transformation in the policy maker’s priorities in view of very small window open in order to attain the target of net-zero carbon emission to be achieved in the next 28 years.”

Shri Prakash
The Energy and Resources Institute, India

6.4 Policy instruments to motivate action are well-established

A broad set of instruments is available that support the transformation to a zero-carbon transport system. Figure 18 identifies the most commonly recommended instruments. Some have been implemented and tested in many parts of the world for years with well-established effectiveness, such as vehicle efficiency standards. Others are newer and will need to be adapted carefully to local contexts, such as parking regulations to encourage public transport. Many only work in consolidated packages, such incentives to use EV vehicles and support for a charging infrastructure.

Appropriate implementation instruments for local contexts need to be based on a thorough analysis of existing frameworks. All of these instruments will need to fit into the existing policy and regulatory framework of the country. In some cases, existing instruments may need to be adapted or removed if zero-carbon policy instruments are to work. A lack of taxation for certain transport modes, such as aviation, distorts the market and makes alternatives, such as rail, less competitive. Likewise, today’s rigid electricity pricing can hinder the implementation of innovative charging infrastructure that supports grid balancing.

Technology can help transition systems. Introducing new technology can be an ideal vehicle to review and update governance structures, especially since new technologies such as electric vehicles or new mobility systems (e.g. ride hailing) often require coordination across sectors and between actors that have not been collaborating in the past (REN21 & FIA Foundation, 2020). This opens opportunities for institutional reform and enhanced participation of stakeholders, with much of the technical know-how and understanding of needs being available only outside of government agencies. Data sharing frameworks and open data of public interest can lead to innovative solutions that trigger private sector engagement and investment.

While some policies require careful analysis and preparation, there are several no-regret instruments that can be implemented immediately. The task ahead may seem daunting, and setting up the necessary framework as illustrated in Figure 17 will take some time. But immediate action is needed, and it is possible without compromising future decisions on where to go. Figure 19 highlights some of the options.

Figure 19:
No-regret instruments for immediate action

Removing fossil fuel subsidies	Fostering integrated planning	Improving and expanding existing public transport options	Increase vehicle efficiency & reduce vehicle mass	Support mechanisms for electric vehicles & charging infrastructure
Irrespective of future technology choices, fossil fuel subsidies distort the market towards high-polluting solutions. Removal will make all low-carbon solutions more competitive, but will affect people and businesses and needs to be carefully supported by just-transition measures to mitigate negative effects.	Integrating planning of mobility with land-use and economic development provides multiple benefits in avoided congestion, improved access, and reduced air pollution. Effects are not immediate, but efforts will need to start now to enable the sustainability of future systems.	Public transport will form the backbone of zero-carbon mobility, so fast expansion and improvement of services is key to success and can in the first step largely build on improving existing systems.	In the transition to a zero-carbon transport system all vehicles need to be as efficient as possible to ensure enough renewable energy can be produced to power them. It also provides quick reductions and comes at low financial cost to public budgets.	Other technologies may be selected for specific transport segments, but electric vehicles will form the majority of the future 2-/3-wheeler, car and bus fleets. Getting ready now will enable a smooth and just transition.



7.

What is holding back action

*Tackling blind spots is key
to delivering sustainable mobility*

7.1 Methodology

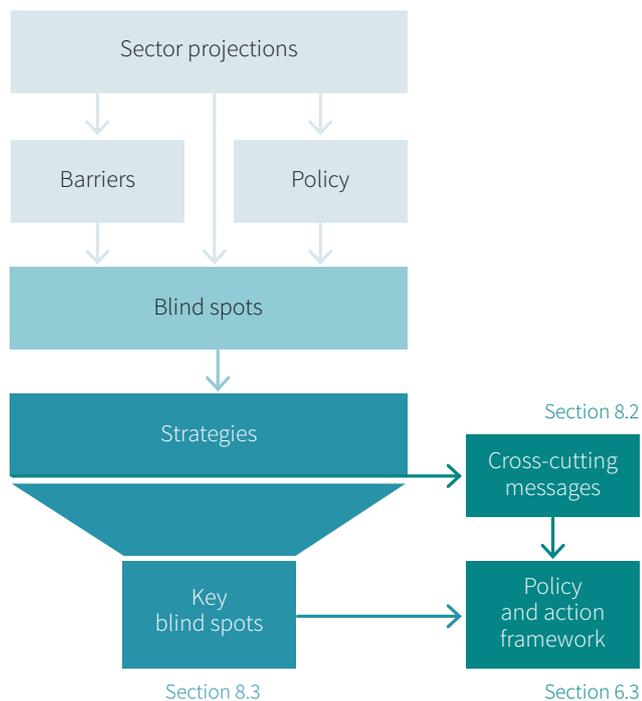
The main objective of this report is to highlight key opportunities and challenges associated with achieving zero carbon transport in Asia by 2050. It also formulates clear and practical recommendations on how to tackle areas where strategy development, discussion and action is lacking – what we call ‘blind spots’.²⁵

The analysis started by looking at individual sectors and sub-sectors within transport and examining known barriers and policy solutions. Overall, 28 blind spots were identified, some cross-cutting, others sector-specific. (We summarise them below.) Next, we identified strategies that help to address each

of the identified blind spots. Some strategies address multiple blind spots and can thus deliver critical momentum for required transformation. These strategies are reflected on in section 8.2 and are the basis for defining the policy and action framework introduced in section 6.3. An illustration of the attendant methodology is provided in Figure 21.

Some of the identified blind spots are not fully addressed by the cross-cutting strategies, but they are essential to keep in mind with regard to the policy and action framework in general. These key blind spots and possible strategies to address them are discussed in section 8.3.

Figure 20: Methodology overview



²⁵ Blind spots are areas that do not yet receive adequate attention in relation to their potential contribution to decarbonisation.

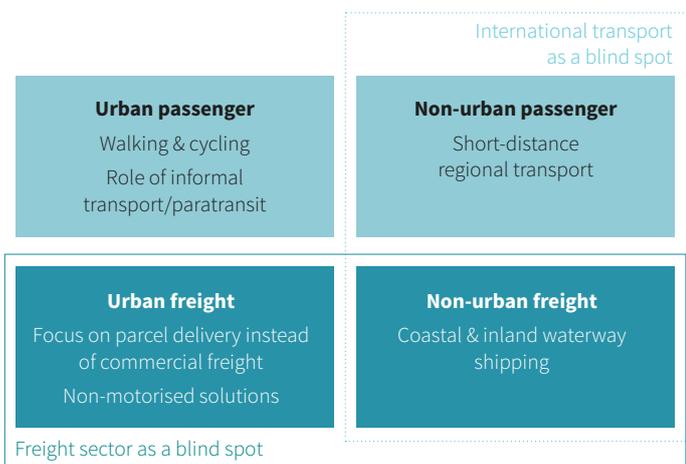
7.2 Sectors: Freight is the elephant in the room

There are a number of blind spots in urban and non-urban passenger and freight transport, where whole sub-sectors are neglected in policy implementation. These are shown in Figure 22.

Many of them relate to areas where action is required by a multitude of actors with a host of small-scale actions or careful policy steering, rather than large-scale prestigious investment projects. Addressing non-motorised mobility for freight and passengers, for example, appears to be less attractive to decision-makers than building metro lines or supporting cutting-edge vehicle technology. The same is true for freight, where a fragmented system of competing operators make policy intervention a challenge. Additionally, technological options for heavy-duty and maritime freight are still under development.

Similarly, international transport is projected to account for over a third of transport sector emissions in Asia by 2030 and efforts to coordinate action at the international level have so far fallen short. Coordination is also needed at the regional level, given the importance of interregional trade as a driver of Asian freight demand.

Figure 21:
Sector-based blind spots



7.3 Policies: Implemented frameworks continue to support unsustainable options

A key element in policy-making is to create an economic framework that drives desired behaviour. With some notable exceptions, current policies in most Asian countries still encourage the use of fossil fuel-based individualised transport through, for example, fossil-fuel subsidies. But economic and price incentives don't stop at the gas station. There are many ways to influence mobility choices, from purchase taxes, registration fees and annual vehicle taxes to parking fees, road tolls based on emissions or vehicle size, and the cost of shared alternatives. To date, however, only a few countries have made use of these tools to steer mobility choices.

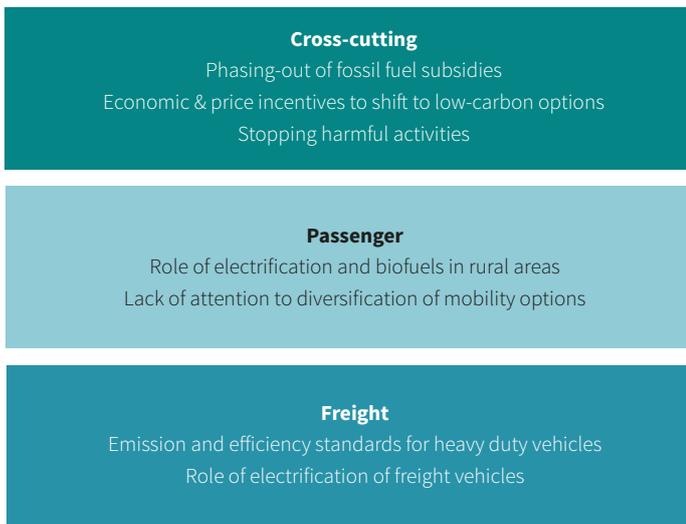
At the policy level, most countries show a clear lack of attention to the diversification of options. Development often concentrates on improving infrastructure for cars. Shifting the focus to a mix of different modes will deliver better mobility and help reduce the negative effects of transport.

For rural passenger transport and freight, the extent that they can be electrified and the role of biofuels in the future energy mix are not yet clear, hindering the implementation of policies and incentives.

Especially in the absence of a clear technology path for heavy-duty transport, it is essential that the internal combustion engines used in the freight sector be as efficient as possible. While this also makes economic sense, regulation requiring minimum energy or GHG emission standards is lacking. Credit lines should be made available so that operators can procure modern, high-efficiency vehicles.

7.4 Barriers: Politics and lack of coordination are at the heart of inaction

Figure 22:
Policy-based blind spots



Lack of coordination is another key barrier,²⁶ though it is often overlooked. This includes coordination between different actors within the transport sector, between different sectors and across different policies and regulations. The result is a fragmented policy framework that in many cases sends contradictory signals.

The motivation for GHG reduction measures in rural areas is low, in part because the auxiliary benefits of policy action, such as improved air quality, are less salient. There is also a lack of engagement with non-government stakeholders. Similarly, greater efforts are needed to ensure that the broader public is informed about what is at stake, the choices available, their consequences, and the options for mitigating negative effects. Finally, while countries often seem to prefer large and highly prestigious projects, there is a pressing need to devote additional attention to pursuing the cost-effective if dull work of optimising existing systems.

For example, empty truck runs and sub-optimal routing can be avoided, and under-utilised rail tracks can be used much more efficiently.

Figure 23:
Barrier-based blind spots



²⁶ For a full overview of barriers, see annex 3.

8.

Enabling

transformation

Agreeing on commonalities while accommodating diversity

As outlined in section 4.1, Asian countries vary enormously – culturally, economically, geographically and politically. Accordingly, when developing problem-oriented strategies to decarbonise the transport sector, one must consider local contexts, including existing transport infrastructure and services, prevailing transport modes, and domestic climate ambition.

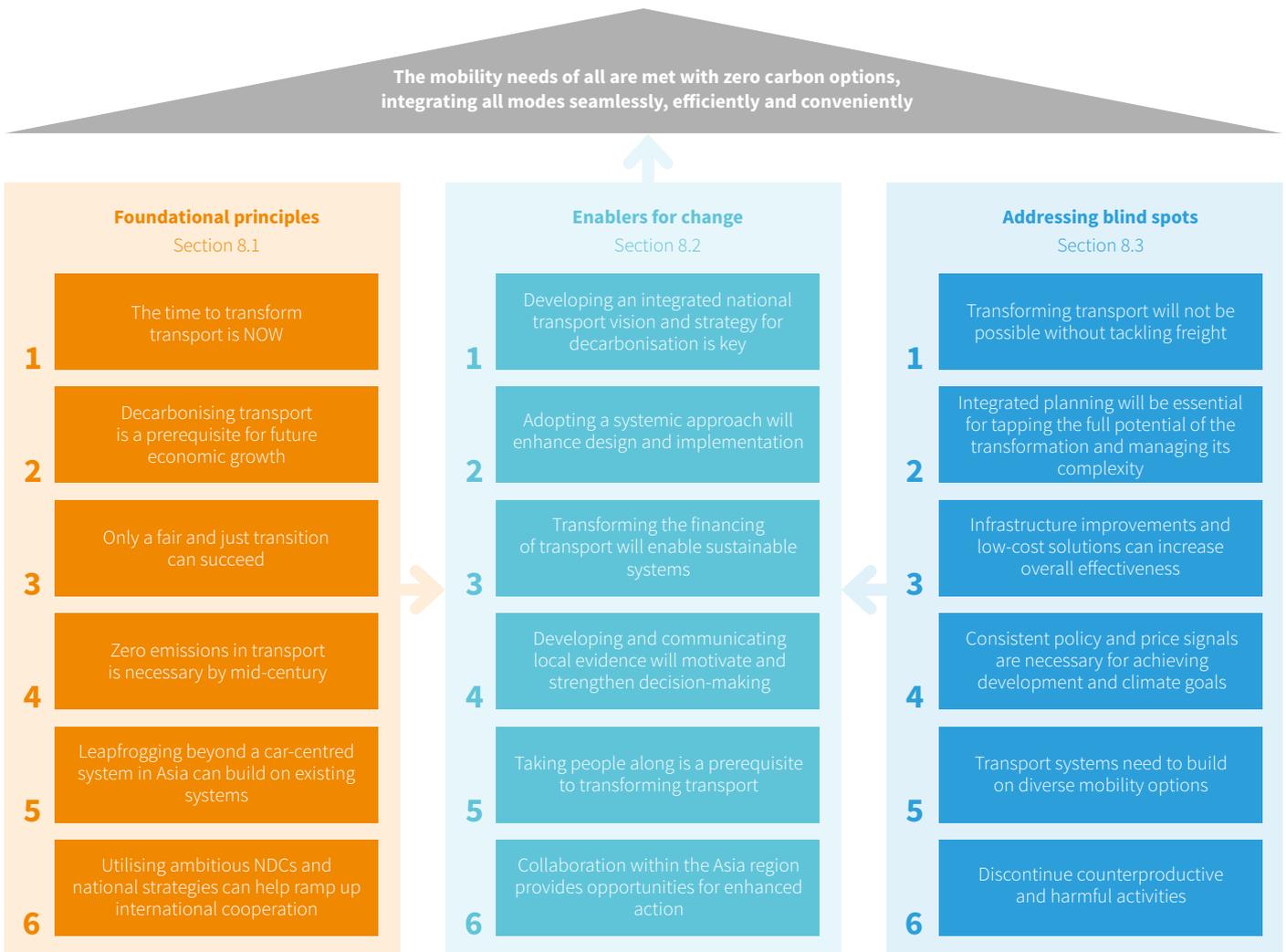
Therefore, each country needs to elaborate its own set of policy actions. Solutions must be attuned to the country in question, including its level of urbanisation and the density and size of its cities.

The recommendations in the following subsections seek to highlight the country-specific features that may be relevant to the implementation of certain key actions. For example, countries with lower per capita income may be better served by focusing on ICT systems and vehicle maintenance instead of new infrastructure.

Nevertheless, these recommendations are of a generic nature, so they are generally relevant for the decarbonisation of the transport sector. We hope they inspire countries to reflect on their specific challenges and ‘blind spots’.

This section summarises three sets of findings and strategies developed during our analysis. Section 8.1 presents key principles for a successful transformation of the transport sector. All six principles are important for planning a more sustainable and decarbonised transport system. Section 8.2 outlines opportunities for facilitating change. Finally, section 8.3 elaborates on section 7, developing strategies to address important ‘blind spots’ – that is, often-overlooked issues that governments need to consider to when developing future transport systems.

Figure 24:
Decarbonising transport in Asia: Pillars for action



8.1

Foundational principles for transport decarbonisation

This section discusses six foundational principles for transitioning to a decarbonised transport system in Asia with sufficient speed to avert catastrophic warming. Taking these considerations into account will help decision-makers to create the appropriate enabling environment suitable for their national context.

1

The time to transform transport is NOW

Failure to act now will result in high costs from infrastructure damage, economic disruption and increased potential for conflict.

Transport systems are slow to respond to policy, as infrastructure often requires years for planning and construction, and users are reluctant to change habits.

The window of opportunity is closing:

Without decisive action in the next few years, the cost of inaction will increase. The momentum of growing national climate ambition and social awareness should be utilised to solve the multiple challenges facing current mobility systems.

Establishing an enabling environment needs to start now – action can't wait until everything is in place:

Immediate action is possible without compromising future decisions on where to go. No-regret options include:

- Removing fossil fuel subsidies
- Fostering integrated planning
- Improving and expanding existing public transport options
- Increasing vehicle efficiency and reducing vehicle weight
- Supporting electric vehicles & charging infrastructure

2

Decarbonising transport is prerequisite for future economic growth

The transition to a sustainable, balanced and inclusive growth model can address climate change while delivering considerable economic and social benefits.

Decarbonisation offers tremendous potential to build better, fairer and more sustainable mobility systems while also generating economic growth. The required investment in infrastructure and new technologies can strengthen local economies and value creation.

A cleaner, safer and less congested transport system can reduce the health impacts of transport while also cutting productivity losses from long commutes and traffic congestion. Enhanced efficiency can also help to make businesses more competitive.

Countries with existing automotive and petroleum sectors can build on their know-how to harness the opportunities presented by new technologies and business models. However, transformation will require re-skilling the labour force, and dedicated policy will be needed to ensure a fair transition to the new system.

Net oil importing countries can reduce expenditures on fuel imports and use associated savings to defray the initial cost of the transition.

3

Only a fair and just transition can succeed

Emphasising the creation of a just and equitable transport system will help to ensure broad public support for change.

Mobility impacts individuals in a society in a variety of ways, shaping not only our quality of life, but also the economic relationships in which we are embedded. The fundamental transformation of a transport system thus has far-reaching effects on society and the economy.

Ensuring an improved system that provides fair access to all individuals will be vital for guaranteeing long-term public support for the transformation process. Equally important is to ensure that those most affected by the transformation are not left behind.

Social dialogue, social protection measures and funds to help affected communities are required for a just transition.

It is essential to involve those that face the negative consequences of today's system, including women and young people, and those that will be affected by change, such as low-income households, or workers in the fossil fuel or automotive industries.

4

Zero emissions in transport is necessary by mid-century

According to most models, reaching zero emissions in the transport sector will depend in part on carbon offsets: that is, the reduction or removal of carbon dioxide emissions in other sectors.

However, direct carbon capture from the atmosphere is still unproven at scale. And there are limitations to the use of forests and soils as carbon sinks. The uncertainties surrounding the offsetting of transport emissions only emphasize the need for robust emissions reductions in the transport sector.

Accordingly, to achieve full decarbonisation by mid-century, ambitious intermediate targets at the national level are needed. The adoption of such targets can help transport decision-makers to implement adequate measures.

More developed countries will need to take initiative, with others following suit as swiftly as possible.

5

Leapfrogging beyond a car-centred system in Asia can build on existing systems

Many Asian countries are ideally situated to leapfrog to a multi-modal, shared transport system.

Most countries in Asia rely heavily on walking and cycling for transport needs. In such countries, transport systems are not yet built around cars. Accordingly, such systems – despite their current deficits – can serve as a foundation of an improved, low-carbon system.

Improving and expanding existing transport systems can turn an involuntary reliance on cycling or walking to a deliberate choice among shared and non-motorised solutions.

Countries in Asia that already have a high level of dependence on personal vehicles should consider adopting instruments that make alternate modes of transport more attractive and personal car ownership less desirable.

To be sure, a change in popular mindsets will also be required for the transformation to succeed, for cars are still seen as an enticing symbol of status and wealth.

Governments can help to encourage sustainable attitudes by enlisting the help of strategic partners, such as civil society organisations.

6

Utilising ambitious NDCs and national strategies can help ramp up international cooperation

Featuring transport explicitly in international commitments can draw the attention of financial backers and technical supporters.

A growing number of public and multi-national donors are looking to support countries with high climate ambition. The [NAMA Facility's Ambition Initiative](#) is one such example. For Asian countries, the [Asian Development Bank's commitment to fully align its operation with the Paris Agreement](#) is particularly relevant. The adoption of clear and ambitious targets and strategies can help to guide donors, enhance cooperation between countries with similar challenges, and enhance learning from best practice.

Ambitious and clear strategies and targets can reduce uncertainty for private investors. While larger infrastructure investment is often in public hands, the transformation of the transport sector is also presenting numerous investment opportunities for the private sector, for private companies will need sufficient capital to design and manufacture electric vehicles, charging infrastructure, and alternative fuel production facilities.

Ensuring stable frameworks that make such investments profitable will enhance private investment in low-carbon solutions.

8.2

Creating an environment for change: moving from silos to systems

Creating the appropriate policy framework to drive the transformation towards the envisioned zero carbon transport system in Asia is paramount. Building on our foundational principles, the following six enablers can create a conducive environment as well as strong momentum for transformative transport policies and strategies

1

Developing an integrated national transport vision and strategy for decarbonisation is key

Fragmented transport policy frameworks are often one factor preventing ambitious decarbonisation action. On the one hand, there may be lack of alignment between climate, energy and transport policies. On the other, transport policies themselves may be incomplete or send conflicting signals.

The adoption of a strong vision for a balanced, multimodal and sustainable transport system can provide the guidance necessary for the creation or revision of policies and measures. Such a vision can rally much needed support from a broad set of stakeholders – but only if it is centred around people, and not cars, and only if it aims to ensure equitable, healthy and safe mobility for all.

The decarbonisation strategy to be adopted will depend on each country's starting point. Countries with already high per capita emissions and motorisation rates must focus on the transition to decarbonised systems. By contrast, countries that today largely rely on shared and non-motorised transport should focus on innovation and early intervention, to ensure a low-carbon development pathway for the transport sector.

A sustainable vision must ensure that key blind spots are addressed. While the specifics will vary between countries, the required deep decarbonisation will not be possible without a balanced approach that encompasses extensive use of shared mobility and non-technology solutions, such as enhanced urban planning.

Effective implementation requires clear targets, including targets for GHG emissions, access, air pollution and safety. Clarifying the contribution to be made by different sub-sectors, such as the hard-to-abate freight sector, will further strengthen implementation, but the strategies should also be clear on the planned policy instruments for reaching defined targets.

2

Adopting a systemic approach will enhance design and implementation

Numerous factors will be crucial for the success of the transformation, including enhanced capacity at all levels, improved information availability, the active participation of all stakeholders, a consistent policy framework and sufficient funding support. While the tools and technologies that can be leveraged to transition towards a zero-carbon transport system are largely known, their successful implementation requires the right 'enabling frameworks'. Capacity building, an expanded knowledge base, and public opportunities for participation will be important for the implementation of local solutions, especially when measures affect a large part of the population.

Solution strategies will benefit from considering the increasing complexity of modern societies. Mobility is a crucial foundation for economic activity, and is interwoven in every aspect of our lives, particularly in urban areas. At the same time, available energy sources and land use patterns influence the decarbonisation options that are available. While many solutions are of a purely technological nature and sector-specific, such as electric vehicles, solutions in other areas – such as land-use planning – have much broader impacts. Accordingly, policy measures in such areas must be carefully developed and considered in collaboration with relevant stakeholders while also giving attention to potential knock-on effects.

Local and regional players, working in close collaboration with national governments, will be essential participants in the transition process.

3

Transforming the financing of transport will enable sustainable systems

The public sector spends billions each year on transport. Most of this money goes to expanding and maintaining infrastructure, particularly roads. At the same time, many countries are still subsidising fossil fuels and/or granting tax breaks to unsustainable transport modes.

The transformation can only be successful if public budgets are aligned with a zero-carbon and sustainable transport vision. Critically reviewing existing spending and reallocating budgets could go a long way given prioritisation of low-cost solutions for sustainable transport and exploitation of their full potential.

Moving from indiscriminate subsidies to targeted support for those in need will support social justice while providing consistent market signals for greater decarbonisation. General subsidies often benefit higher-income households more than the poor, particularly energy subsidies. Lower-income households use less energy and less frequently own a motor vehicle. Nevertheless, such households expend a higher share of their income on energy and transport. Increases in energy or mobility costs can be counterbalanced for households in need through direct transfers or by offering alternative, affordable mobility options.

Internalising the total cost to society, including damage to the climate and human health, in pricing for different transport modes and fuels will help to steer behaviour towards sustainable solutions. Current fossil fuel prices are significantly detached from their full cost to society. Internalising such externalities based on the ‘polluter-pays principle’ with the help of taxes or other economic instruments will make sustainable options more competitive.

Pandemic recovery spending that is not yet dispersed can help speed up the transition. It is not sufficient to allocate a share of the pandemic recovery to ‘green’ and ‘sustainable’ activities. It is equally important to refrain from investing in activities that are at cross purposes with sustainable development.

4

Developing and communicating local evidence will motivate and strengthen decision-making

Decision-makers are often forced to take action despite limited knowledge about a situation or set of relationship. Such information deficits are the bane of good policy outcomes, for when robust data are lacking and few independent studies have been performed, vested interests may hijack the debate, advancing narratives or perspectives that do not serve the public good.

Reliable public data and independent expert analysis are an important foundation for informed decision-making.

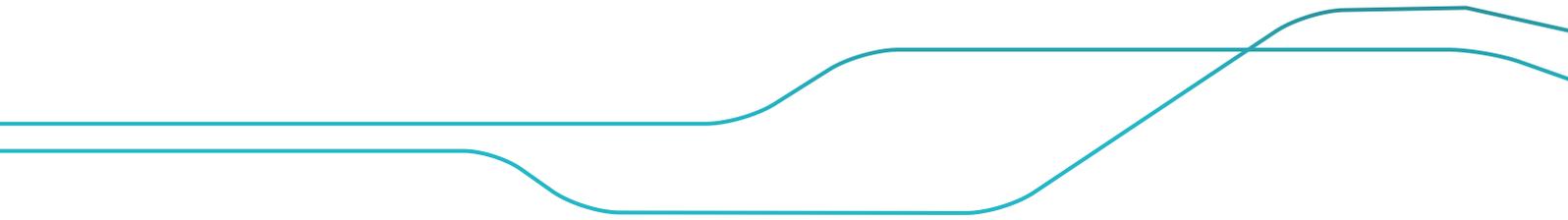
Data gathered by private entities that are valuable for policy decisions – such as data maintained by shared mobility providers – can be absorbed into public databases given the passage of legal frameworks that preserve confidentiality. These data can then furnish an important basis for studies on the transport sector conducted by academic researchers, government departments and policy think tanks.

Studies that examine all effects of policy measures at the local and national levels can strengthen policy formation.

The findings generated by studies on policy impacts in other countries or regions of the world may not always be applicable to a given local context. It is therefore paramount to assess effects in each specific context and to consider all positive and negative impacts. The adoption of national guidelines for such analysis can help institutions to examine the full spectrum of potential effects.

When examining different options using multiple criteria, a lifecycle approach will yield more effective results. When researchers seek to calculate the climate benefits of various measures, considering their full lifecycle will provide more robust results.

Information campaigns should be launched to disseminate evidence. Communicating the pros and cons of policy instruments and actions, their local impact, and measures taken to alleviate negative consequences will enhance public awareness and support, and is particularly important as an accompaniment to controversial decisions.



5

Taking people along is a prerequisite to transforming transport

Mobility is deeply interwoven in our economic and personal lives. Thus, any proposal to change to the existing system is sure to attract critical scrutiny. While there are many existing shortcomings in the transport sector, the public often opposes reform measures, particularly when livelihoods are potentially at stake. In extreme cases, resistance to reform can culminate in social unrest. It is therefore crucial to understand the motivations underlying opposition to reform measures, and to develop strategies that allow naysayers to be transformed into advocates for change.

Policy assessments are inherently subjective. Public opinion regarding potential policy measures in the transport sector is often dominated by personal financial and lifestyle concerns. Additional criteria that inform individual assessments include the potential policy's effects on convenience, social justice, and health & safety. The weighting of these elements will vary based on the individual's cultural background, available transport alternatives, and individual preferences.

Communication and engagement supported by evidence is key. Engaging with a wide set of societal groups from business to civil society can help policymakers to better understand the needs and concerns of represented groups, thus enabling the design of appropriate policies. Such engagement can also build trust and understanding, allowing stakeholder representatives to act as message multipliers. Such outreach must build upon robust data and empirical evidence on all of the anticipated socioeconomic effects of policy measures. Ensuring a broad set of voices are engaged in the dialog process will improve the quality of implemented policies and will help disseminate new narratives concerning the need for a sustainable transport system. This, in turn, requires the provisioning of sufficient funding for stakeholder engagement and communication.

Accelerated action and enhanced participation can go hand in hand. A range of no-regret measures can be implemented immediately, such as vehicle efficiency standards and EV support schemes. At the same time, enhanced stakeholder participation can support the elaboration of a collective vision and strategy for a decarbonised transport sector.

6

Collaboration within the Asia region provides opportunities for enhanced action

While most of the policy actions to decarbonise transport are being taken at the local or national level, there are also numerous opportunities for international collaboration within regions.

Using international platforms for collaboration and exchange will enhance knowledge and strengthen national strategies. In October 2021, twenty-one national governments signed the Aichi 2030 Declaration on Environmental Sustainable Transport, which aims to trigger transformational change in the Asian transport sector. The declaration provides a common platform for EST members to report on progress made in achieving international climate commitments. The signatory nations have also agreed to exchange knowledge regarding enabling policies, institutional frameworks, and financing mechanisms.

Similarly, the Asian Development Bank recently initiated the Asian Transport Outlook, which seeks to strengthen the international knowledge base on transport. This open-access platform collects important transport data and policy information, allowing each country to track the international implementation of the SDGs and the Paris Agreement. The platform also contains information concerning regional initiatives such as the EST (ADB, 2021).

Strengthening connectivity and creating common markets and policies will benefit regional economies and can support national decarbonisation. National governments can already take advantage of existing policy partnerships, such as the Association of Southeast Asian Nations (ASEAN), which has nine member countries. Among other activities, ASEAN has established a fuel economy platform, which led to a [Fuel Economy Roadmap](#) for light-duty vehicles. Building on this roadmap, the International Transport Forum (ITF) and UNEP have started to support the development of a regulatory framework for ASEAN member states.

The transport-sector activities being undertaken by UNESCAP is another example of regional collaboration. The Committee on Transport aims to help countries identify transport policy options that are in alignment with the SDG Agenda, including a trans-Asian railway initiative, an initiative for inter-island shipping and maritime transport, and the harmonisation of transport standards.

Regional policy approaches can help overcome national challenges, especially in smaller countries. As most of the countries in Asia have access to the aforementioned initiatives and other regional collaborative forums, countries can use existing platforms to articulate their particular challenges. For example, while regulations on used vehicles may be difficult for small countries to implement, a coordinated regional approach can strengthen the enforcement of used-vehicle rules. EV infrastructure development is another topic area that promises to benefit from regional coordination.



Myth 6: Reducing fossil fuel subsidies depresses economic growth and disproportionately affects the poor

The transport fuel mix in Asia has barely changed in the last twenty years. Oil accounted for 91% of the fuel mix in 2000, and 88% in 2019 (ADB, 2022 forthcoming). Developing Asia is home to much of the world's energy poor, with some 615 million people having no electricity and about 1.8 billion burning firewood, charcoal, and crop waste for their daily needs.

The Asian Development Bank modelled the impact of eliminating fossil fuel subsidies in Asia, using three countries as an example: India, Indonesia and Thailand. In these countries, subsidies constituted 2.7%, 4.1% and 1.9% of GDP in 2012. The study found that the maxi-

imum impact would be felt by the energy sector and energy-intensive industries. However, higher fossil fuel prices would drive improvements in energy productivity and reduce energy demand. In all three countries, reform was projected to cause larger macroeconomic impacts in the short term than in the medium to long term. The long-term GDP impacts were estimated to be marginal or even positive when all savings were reallocated back to households. However, reform outcomes were mediated by numerous factors, including subsidy volumes, subsidised fuel types, their role in the energy mix and economy, and domestic energy infrastructure.

This implies that governments should be able to reduce subsidies and use a portion of savings to compensate households for higher energy prices without hurting the economy. However, shielding the poor from the adverse impacts of higher energy prices will require a major redesign and strengthening of government safety nets. New and augmented programs will also be necessary to ensure the poorest are protected.

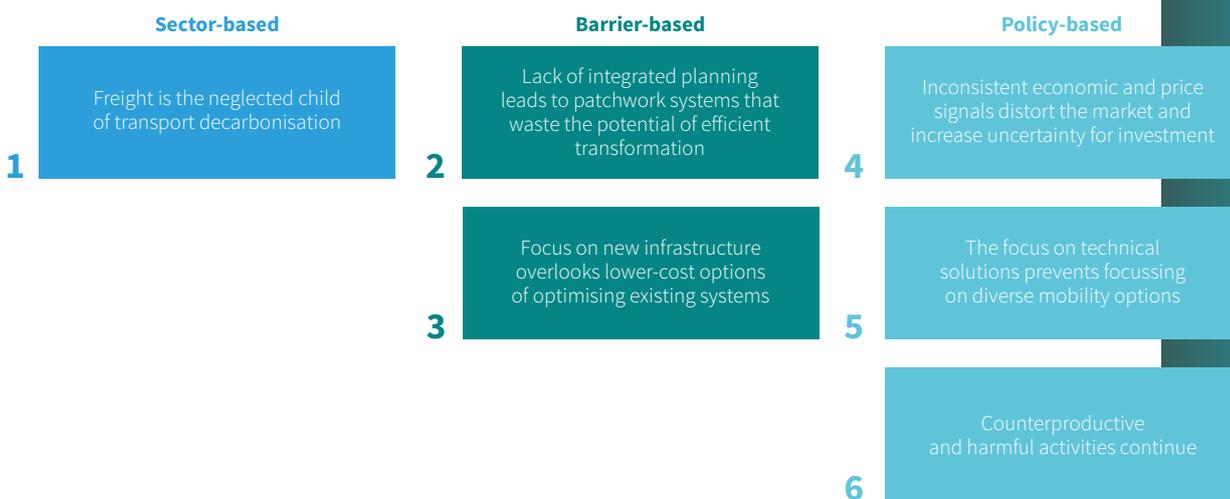
Adapted from ADB (2016)

8.3 Addressing blind spots

This section outlines strategies for addressing important ‘blind spots’ – that is, issues that are currently overlooked or underrated, but which will be essential for the decarbonisation of the transport sector. Tackling these issues will be important when designing an enabling environment for sustainable, decarbonised transport. Figure 25 provides an overview of the discussed blind spots.

In the following, we discuss why addressing each blind spot is essential for the transformation of the transport sector towards zero-carbon mobility. We also outline some strategies that can be used by decision-makers to ensure these issues are adequately considered in national policy formation.

Figure 25:
Overview of key blind spots





Example:

In October 2021, Japan announced it would aim to achieve net-zero GHG emissions in international shipping by 2050. To attain this goal, the Japanese government will promote the development of zero-emission ships that run on hydrogen or ammonia. Viet Nam, for its part, will strive to reduce freight's dependency on road transport and increase reliance on rail and inland waterways. Meanwhile, Fiji hopes to achieve a 40% reduction in emissions from domestic maritime shipping by 2030 (TraCS and SLOCAT, 2021).



Shuai Ren
G7 Connect Inc

“Freight and logistics are too complex for any single stakeholder to solve in isolation.”

1

Transforming transport will not be possible without tackling freight

Freight transport is projected to be responsible for half of transport emissions in Asia by 2050 (ITF, 2021b). Nevertheless, few policies are in place to address this challenge.

Solutions to decarbonise freight will vary depending on the national context. However, in all countries, decarbonisation will require the logistical optimisation of freight delivery in combination with a shift from road transport to lower carbon modes (including in particular water and rail). For urban and short-distance freight, reliance on electric vehicles is a feasible technical option.

Strategies for addressing this blind spot:

- Ensure that both urban and non-urban freight are specifically considered in government NDCs and overall transport strategies, and that they make an adequate contribution to GHG emission reductions.
- Improve data collection in the freight transport sector to enable governments and industry stakeholders to guide policy making and improve logistics.
- Develop or strengthen existing fuel efficiency or emission standards for trucks as part of a national freight strategy.
- Establish or strengthen institutions or departments of government responsible for freight decarbonisation.
- Promote active dialog between policymakers, freight operators, and business representatives in order to harness the expertise of each group and develop tailored solutions, ideally as part of formal platforms for exchange. Create partnerships between the national government and industry leaders to tackle the sector's complex challenges.
- Enhance the knowledge base on the cost and employment effects of different mitigation options through dedicated institutions or as part of a mandate for government departments that deal with the freight sector.
- Build knowledge and capabilities among government institutions, including ICT tools for optimising logistics.
- Build knowledge and capabilities among transport operators related to enhanced operations and maintenance, ICT solutions, and new technologies.
- Establish national funding mechanisms to help industry recover the high up-front cost of investment in innovative technologies and equipment.

2

Integrated planning will be essential for tapping the full potential of the transformation and managing its complexity

What we really need is a revolution in urban transport – including a sharp reduction in motorized travel and the establishment of a broad mix of clean and convenient mobility options.

Integrated transit-oriented planning, both at the local and regional levels, can foster compact urban areas while reducing travel distances. By providing safe and convenient travel alternatives, transit planning can also discourage personal vehicle use. However, this will involve significant changes to existing planning processes to orient them to the transport sector. It will also require leveraging new technologies.

Strategies for addressing this blind spot:

- Create National Urban Mobility Policies (NUMPs) to guide Sustainable Urban Mobility Plans (SUMPs) at the local level as instruments to plan for mobility systems, integrated into spatial planning activities.
- Incorporate transit-oriented development in city development plans, with regulations for mixed use, greater restrictions on parking, people-oriented urban design, and higher density housing around mass transit stations. Simultaneously, it is crucial to provide adequate open space and other public amenities.
- Provide national funding programmes to help implement local action.
- Establish institutional spaces to draw attention to thematic areas such as walking, cycling and freight, but also create spaces that enable integration between different transport modes.
- Create personal incentives for individual government officials to engage in transport-related cooperative activities – for example, by making such activities an explicit area of responsibility or performance target.



Example:

Pioneering cities in the promotion of urban cycling, such as Bogota and London, have dedicated roles in leadership positions, such as Walking and Cycling Commissioners who report directly to the mayor. Such ‘special advocates’ help to focus attention on non-motorised transport within government transport authorities. To enhance coordination between administrative departments, the City of Los Angeles, for example, has a Chief Sustainability Officer who reports directly to the mayor.



Alok Jain
Trans-Consult Ltd

“High density transport hubs such as TODs provide an intuitive framework to reduce the carbon footprint through agglomeration of economic activities within a walkable or bicycleable distance and immensely improve quality of life. Zero-emission high capacity modes like metros can provide hub-to-hub connectivity creating efficient linear cities. An integrated approach goes far beyond the carbon footprint of the transport sector to help cities achieve their overall zero-carbon goals.”



Example:

The Philippine government has introduced the Public Utility Vehicle Modernization Program to renew and modernise the country's minibuses ('jeepneys'). An early-stage evaluation of the program concluded that beyond triggering replacement of more than 180,000 jeepneys, the program has led to industry consolidation and a reform of the franchising system, thus abolishing unsustainable industry practices with negative impacts on users, operators and the environment. It is projected that once fully implemented, the program has the potential to reduce annual GHG emissions by around 1.73 MtCO₂ while also slashing harmful particulate emissions caused by the jeepney sector by 90% (GIZ, 2019).

3

Infrastructure improvements and low-cost solutions can increase overall effectiveness

Among policymakers there is a strong bias towards new infrastructure projects, despite the tremendous potential to optimise existing systems at a much lower cost. Especially in low and middle-income countries, road and rail systems can be improved through enhanced operations and maintenance, in part thanks to the adoption of modern ICT systems.

Potential measures in this domain include new speed limits, better coordination between freight and passenger transport providers to improve service quality and maximise capacity usage, and improved traffic management systems. For countries with railway infrastructure, existing railway lines can be improved to allow for higher speed travel. Another option is to augment the frequency of train service.

Strategies for addressing this blind spot:

- Establish multi-criteria assessment as the basis for infrastructure project approval; important criteria include lifecycle GHG emissions and the cost of alternative, non-investment solutions.
- Create space for exchange and cooperation within sectors that feature a large number of individual operators.
- Develop multi-modal solutions as a 'quick win' for utilising existing infrastructure.

4

Consistent policy and price signals are necessary for achieving development and climate goals

A range of policy instruments influence price formation in markets and thus have a signalling effect for market actors. Taxes are the most common instrument with a price signalling effect, yet there are many interventions that steer market behaviour, such as government-controlled energy prices, emission trading systems, and public parking fees. Such interventions can be a useful tool for nudging behaviour and encouraging desirable economic and social development. In other cases, price interventions may be justified by the need to account for the ‘external costs’ of an economic transaction (such as the air pollution or climate damage caused by consuming fossil fuels).

Problems may arise, however, when external costs are not fully ‘internalised’ in the transaction between economic actors, or if price signals have countervailing effects, encouraging contradictory behaviours or technologies. This may lead to wasted public funding or increased uncertainty for investors.

Accordingly, policymakers should perform a careful review of pricing instruments and potential reform of existing policies in order to eliminate conflicting signals and enhance the effectiveness of public spending. Insofar as reform entails adverse effects for certain segments of society, one may need to consider targeted relief measures. Such relief measures also require careful assessment, including coordination with affected stakeholders.

Strategies for addressing this blind spot:

- Develop a knowledge base on the socio-economic costs and benefits of pricing measures and potential reforms, differentiated by stakeholder group in each national and local context.
- Clearly communicate how the revenues are being invested in sustainable modes of transport or to alleviate negative effects on disadvantaged stakeholder groups.
- Conduct campaigns that engage individuals at all levels of society in order to raise awareness for the benefits of pricing measures.



Example:

Some countries in Asia have introduced pricing measures to internalise external costs and encourage desirable transport choices. Hong Kong, for example, has a high [initial registration tax](#) for personal vehicles. The tax rate is 46% of the vehicle’s value up to HK\$150,000 (approx. US\$19,200), and 86% on the next HK\$150,000. Singapore has a vehicle quota system (VQS) which is based on the allocation of a limited supply of [certificates of entitlements](#) (COE). Shanghai, Beijing and Guangzhou have also introduced vehicle quota systems.



Example:

Singapore's Land Transport Master Plan 2040 aims to create a multi-modal system that reduces travel times while promoting inclusive access and public health.

5

Transport systems need to build on diverse mobility options

No single project, mode of transport, or technological solution can enable the full decarbonisation of the transport sector. Replacing all vehicles with electric alternatives, for example, will not deliver sufficient reductions in GHG emissions (nor solve the other challenges modern transport systems face). Indeed, high-speed rail, metro systems and the electrification of vehicle fleets all represent partial solutions. For this reason, policymakers must look beyond individual technological solutions and consider the transport system as an integrated whole. Existing examples show that this is possible and provides multiple benefits.

To achieve zero-carbon transport, action on multiple fronts is required: beyond changes to infrastructure and the adoption of clean technologies, passenger and freight transport systems need to become better integrated, and transport demand must be shifted to more sustainable modes.

Strategies for addressing this blind spot:

- Develop integrated national transport strategies that prioritise greater reliance on renewable energy, and conduct assessments to better understand the benefits of different transport modes and technological options.
- Consult with the private sector when exploring alternative modes of transport, ideally by establishing dedicated platforms that enable regular dialogue to take place. When necessary, government financial support should be provided to incentivise action by the private sector.
- Support development of the knowledge base on the local benefits of multi-modal systems in terms of improved access, equity, economic opportunity, health and safety as well as reduced congestion and air pollution.

6

Discontinue counterproductive and harmful activities

Introducing new technologies and systems that enable a sustainable transport sector is just one part of the puzzle. We must also discontinue the practices that gave rise to the challenges we face today, including in particular excessive reliance on road infrastructure, privately owned passenger vehicles, and fossil fuel subsidies.

Currently, governments continue to invest heavily traditional transport infrastructure, including in particular roads. While roads and airports do in fact represent one element of the sustainable transport system of the future, policymakers would be wise to reallocate a share of the current investment in these areas to more sustainable alternatives, including public transport systems; rail, walking and cycling infrastructure; and shared mobility services.

Urban planning plays an essential role in this context. Roadways, for example, can be re-designated for walking, cycling or public transport. With the long-term integration of transport planning into broader urban planning contexts, significant reductions in trip length and duration can be achieved.

The common practice in many countries of granting subsidies and tax breaks for the use of fossil fuels and other polluting activities continues to distort the market for low-carbon solutions. Such subsidies are counterproductive and could be reallocated to sustainable transport solutions or to help low-income households adapt to the transformation of the sector. In this context, it is also important to consider how municipal zoning rules, building codes and road design guidelines can perpetuate a car-centric transport sector. Accordingly, law and regulations should be reassessed and potentially reformed in line with the broader goal of enabling sustainable transport systems.

Strategies for addressing this blind spot:

- Conduct a comprehensive analysis of existing policy frameworks and identify policies and regulations that support unsustainable practices.
- Create incentive structures for government officials that favour the phase-out of harmful activities.
- Establish regulations that limit harmful activities and create an effective framework for enforcement.
- Establishment regular data collection on all modes of transport, including freight activities, walking and cycling, to ensure informed policy decisions.



Example:

Seoul's [Cheonggyecheon Stream Restoration project](#) is an example of removing a flyover built in the 1990s to revive and create open space in the central business district of the city. In 2008, the area had 64,000 visitors per day, and property prices in a 50 m vicinity increased by 30–50%.



*“Every fraction of a degree matters.
Every voice can make a difference.
And every second counts.”*

António Guterres

UN Secretary-General at press conference
of the launch of the IPCC report (2022)



References



- ADB. (n.d.).** *A new perspective on transport and climate change in Asia.*
- ADB. (2016).** *Fossil Fuel Subsidies in Asia: Trends, Impacts, and Reforms.*
- ADB. (2020).** *Guidance Note on COVID-19 and Transport in Asia and the Pacific (Issue July).*
- ADB. (2021).** *Asia Transport Outlook.* <https://data.adb.org/dataset/asian-transport-outlook-database>
- Agora Verkehrswende, GIZ, & REN21. (2018).** *Towards Decarbonising Transport 2018 - A Stocktake on Sectoral Ambition in the G20.* www.agora-verkehrswende.de
- ASEAN. (2021).** *Guidelines for Resilient and Sustainable International Road Freight Transport Connectivity in ASEAN.* <https://asean.org/storage/asean-covid-19-guidelines.pdf>
- avicenne Energy. (2021).** *Asia Pacific Automotive ICE vs EV Total Cost of Ownership.* <https://nickelinstitute.org/media/8d940a130fba0e3/avicenne-study-tco-ap-automotive.pdf>
- Baffi, S., & Lannes, J.-P. (2021).** *Understanding Paratransit: Defining and diagnosing paratransit for sustainable mobility planning. MobiliseYourCity.* [https://www.mobiliseyourcity.net/sites/default/files/2021-11/Understanding Paratransit.pdf](https://www.mobiliseyourcity.net/sites/default/files/2021-11/Understanding%20Paratransit.pdf)
- Bathan-Baterina, G., & Dematera, K. (2020).** *Role of policymaking in mainstreaming electric mobility in Southeast Asia. Clean Air Asia.* [https://cleanairasia.org/sites/default/files/2021-06/Policy Brief - Mainstreaming E-Mobility in SE Asia.pdf](https://cleanairasia.org/sites/default/files/2021-06/Policy%20Brief%20-%20Mainstreaming%20E-Mobility%20in%20SE%20Asia.pdf)
- Black, W. R. (2010).** *Sustainable Transportation: Problems and Solutions.* Guilford Press.
- BP. (2020).** *Statistical Review of World Energy, 2020 | 69th Edition (Vol. 69).* <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf>
- Budd, L., & Ison, S. (2020).** *Responsible Transport: A post-COVID agenda for transport policy and practice. Transportation Research Interdisciplinary Perspectives, 6,* 100151. <https://doi.org/10.1016/j.trip.2020.100151>
- China, P. R. of. (2021).** *China 's Mid -Century Long-Term Low Greenhouse Gas Emission Development (unofficial translated version).* [https://unfccc.int/sites/default/files/resource/China's Mid-Century Long-Term Low Greenhouse Gas Emission Development Strategy.pdf](https://unfccc.int/sites/default/files/resource/China's%20Mid-Century%20Long-Term%20Low%20Greenhouse%20Gas%20Emission%20Development%20Strategy.pdf)
- Climate Watch. (n.d.).** *Net-Zero Tracker.* [https://www.climatewatchdata.org/net-zero-tracker#:~:text=To avoid the worst climate,adopting net-zero emissions targets.](https://www.climatewatchdata.org/net-zero-tracker#:~:text=To%20avoid%20the%20worst%20climate,adopting%20net-zero%20emissions%20targets.)
- Conway, M., Tang, R., & Schulz, S. (2017).** *Setting an International Policy Agenda for Just Transitions.* Findings of the 58th Strategy for Peace Conference. <https://www.stanleyfoundation.org/publications/pdb/SPCCCPDB318.pdf>
- CSIS, & CIF. (2020).** *Just Transition Concepts and Relevance for Climate Action (Issue June).* https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/justtransition_final.pdf
- Cui, H., Hall, D., & Lutsey, N. (2021).** *Update on the global transition to electric vehicles through 2019 (Issue July).* International Council on Clean Transportation. <https://theicct.org/publications/update-global-ev-transition-2019>
- Curran, S. J., Wagner, R. M., Graves, R. L., Keller, M. & Green, J.B. (2014).** *Well-to-wheel analysis of direct and indirect use of natural gas in passenger vehicles.* *Energy, 75,* 194-203, <https://doi.org/10.1016/j.energy.2014.07.035>.
- Dalkmann, H. (2020).** *Climate Action and Resilience in Transport.*
- DHL. (2021).** *Road Freight En Route To Brighter Future Beyond Covid-19.* <https://lot.dhl.com/road-freight-en-route-to-brighter-future-beyond-covid-19/>
- Diao, M., Kong, H., & Zhao, J. (2021).** *Impacts of transportation network companies on urban mobility.* *Nature Sustainability, 4(6),* 494–500. <https://doi.org/10.1038/s41893-020-00678-z>
- Earley, R., & Newman, P. (2021).** *Transport in the Aftermath of COVID-19: Lessons Learned and Future Directions.* *Journal of Transportation Technologies, 11(02),* 109–127. <https://doi.org/10.4236/jtts.2021.112007>
- Energypolicytracker.org. (2021).** *Energy Policy Tracker.* https://www.energypolicytracker.org/search-results/?_sfm_sector=Mobility
- EU JRC, & PBL. (2020).** *Emission Database for Global Atmospheric Research (EDGAR), release version 6.0.* European Commission Joint Research Centre (JRC), PBL Netherlands Environmental Assessment Agency. https://edgar.jrc.ec.europa.eu/report_2021#data_download

- García-Herrero, A., & Tagliapietra, S. (2021).** *For the climate, Asia-Pacific must phase out fossil-fuel subsidies.* <https://www.bruegel.org/2021/05/for-the-climate-asia-pacific-must-phase-out-fossil-fuel-subsidies/>
- GIZ. (2018).** *Reference Document on Transparency in the Transport Sector.*
- GIZ. (2019).** *Reforming the (semi-) informal minibus system in the Philippines.* https://www.changing-transport.org/wp-content/uploads/2019-11_GIZ_Jeepney-Modernisation_Early-Evaluation_final.pdf
- Government of Pakistan. (2019).** *National Electric Vehicle Policy.* <https://doi.org/10.32473/ufjur.v23i.128716>
- Halim, R. A., Kirstein, L., Merk, O., & Martinez, L. M. (2018).** *Decarbonization pathways for international maritime transport: A model-based policy impact assessment.* *Sustainability*, 10(7). <https://doi.org/10.3390/su10072243>
- Hallegatte, S., Rentschler, J., & Rozenberg, J. (2019).** *Life-lines: The Resilient Infrastructure Opportunity.* World Bank Group. <https://doi.org/10.1596/978-1-4648-1430-3>
- Hochfeld, C., Pützscher, M., Wanko, M., Jung, A., Enskat, M., Mettke, C., Hörtner, C., Uhl, J., Major, M., Sohm, S., Wolff, C., & Loane, M. (2020).** *Transport for under two degrees – the way forward.*
- Hong Kong Environment Bureau. (2021).** *Hong Kong EV roadmap (Issue March).* https://www.enb.gov.hk/sites/default/files/pdf/EV_roadmap_eng.pdf
- ICCT. (2020a).** *Chart library: Passenger vehicle fuel economy.* <https://theicct.org/chart-library-passenger-vehicle-fuel-economy>
- ICCT. (2020b).** *Vision 2050 - A strategy to decarbonize the global transport sector by mid-century.* https://theicct.org/sites/default/files/publications/ICCT_Vision2050_sept2020.pdf
- ICCT. (2021a).** *Total Cost of Ownership for Heavy Trucks in China: Battery-Electric, Fuel Cell Electric, and Diesel Trucks.* www.theicct.orgcommunications@theicct.org
- ICCT. (2021b).** *Tractor-Trailers in Europe: Battery Electric versus Diesel (Issue November).* <https://theicct.org/wp-content/uploads/2021/11/tco-bets-europe-1-nov21.pdf>
- IEA. (n.d.).** *Data and statistics.* <https://www.iea.org/data-and-statistics>
- IEA. (2018).** *CO₂ grid emission factors.*
- IEA. (2020).** *Global EV Outlook 2020.* <https://doi.org/10.1787/d394399e-en>
- IEA. (2021a).** *Energy subsidies. Tracking the impact of fossil-fuel subsidies.* <https://www.iea.org/topics/energy-subsidies>
- IEA. (2021b).** *Global EV Outlook 2021 - Accelerating ambitions despite the pandemic.* <https://iea.blob.core.windows.net/assets/ed5f4484-f556-4110-8c5c-4ede8bcba637/GlobalEVOutlook2021.pdf>
- IEA. (2021c).** *Net Zero by 2050 A Roadmap for the Global Energy Sector.* <https://iea.blob.core.windows.net/assets/4482cac7-edd6-4c03-b6a2-8e79792d16d9/NetZeroBy2050-ARoadmap-fortheGlobalEnergySector.pdf>
- IEA. (2021d).** *World Energy Outlook 2021.* <https://www.iea.org/reports/world-energy-outlook-2021>
- IEA Bioenergy. (2019).** *'DROP-IN' BIOFUELS: The key role that co-processing will play in its production.*
- IFC. (2018).** *Driving Toward Equality: Women, Ride-hailing, and the Sharing Economy.*
- IFC. (2020).** *Women and Ride-hailing in Sri Lanka.* https://www.ifc.org/wps/wcm/connect/REGION__EXT_Content/IFC_External_Corporate_Site/South+Asia/Resources/Women+and+Ride-hailing+in+Sri+Lanka
- ILO. (2015).** *Guidelines for a just transition towards environmentally sustainable economies and societies for all.* www.ilo.org/publns
- ILO. (2019).** *Green Jobs and a Just Transition for Climate Action in Asia and the Pacific.* www.ilo.org/publns
- ILO. (2020).** *World employment and social outlook: trends 2020. In International Labour Organization.*
- IMF. (2020).** *Regional economic outlook update. Asia and Pacific: navigating the pandemic : a multispeed recovery in Asia.* International Monetary Fund. <https://www.imf.org/en/Publications/REO/Issues/2020/10/30/Regional-Economic-Outlook-October-2020-Asia-and-Pacific-Navigating-the-Pandemic-A-Multispeed-49794>

- IPCC. (2014).** *Assessment Report 5: Impacts, Adaptation, and Vulnerability*. In *Quarterly Journal of Economics* (Vol. 88, Issue 1). <https://doi.org/10.2307/1881805>
- IPCC. (2018a).** *Global Warming of 1.5 °C an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*. International Panel on Climate Change (IPCC). <http://www.ipcc.ch/report/sr15/>
- IPCC. (2018b).** *Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. IPCC SPECIAL REPORT Global Warming of 1.5 oC*. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf
- IPCC. (2021a).** *Assessment Report 6. Climate Change 2021: The Physical Science Basis. Regional fact sheet - Asia*.
- IPCC. (2021b).** *Assessment Report 6. Climate Change 2021: The Physical Science Basis. Summary for Policymakers*. <https://www.ipcc.ch/report/ar6/wg1/>
- IPCC. (2022a).** *Assessment Report 6. Climate Change 2022: Impacts, Adaptation and Vulnerability. Fact sheet - Asia*. https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_FactSheet_Asia.pdf
- IPCC. (2022b).** *Assessment Report 6. Climate Change 2022: Impacts, Adaptation and Vulnerability*. <https://doi.org/10.4324/9781315071961-11>
- IQAir. (2019).** *World Air Quality Report*. <https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2019-en.pdf>
- ITF. (n.d.).** *Transport Climate Action Directory*. <https://www.itf-oecd.org/transport-climate-action-directory-measures>
- ITF. (2019).** *Transport Outlook 2019*. <https://doi.org/10.1787/edd9d55b-ru>
- ITF. (2020a).** *How Badly Will the Coronavirus Crisis Hit Global Freight?*
- ITF. (2020b).** *Re-spacing Our Cities For Resilience*. <https://www.itf-oecd.org/covid-19>
- ITF. (2020c).** *Road Safety Annual Report 2020*.
- ITF. (2021a).** *Covid-19 and Transport: A Compendium*. <https://www.itf-oecd.org/sites/default/files/covid-19-transport-compendium.pdf>
- ITF. (2021b).** *Transport Outlook 2021*. <https://www.itf-oecd.org/itf-transport-outlook-2021>
- Japanese Ministry of Environment. (2021).** *The Long-term Strategy under the Paris Agreement*. https://unfccc.int/sites/default/files/resource/Japan_LTS2021.pdf
- Jung Eun “Jen” Oh. (2021).** *The 500-million-vehicle question: What will it take for China to decarbonize transport?* https://blogs.worldbank.org/transport/500-million-vehicle-question-what-will-it-take-china-decarbonize-transport#_ftn7
- Just Transition Centre. (2017).** *Just Transition*. Prepared for the OECD. <https://www.oecd.org/environment/cc/g20-climate/collapsecontents/Just-Transition-Centre-report-just-transition.pdf>
- Leonard Cheshire Disability. (2020).** *Get on board 2020* (Vol. 53, Issue 1).
- Liu, S., Yamamoto, T., Yao, E., & Nakamura, T. (2020).** *Exploring Travel Pattern Variability of Public Transport Users Through Smart Card Data: Role of Gender and Age*. <https://doi.org/10.1109/TITS.2020.3043021>
- McKinsey. (2021).** *Asias Consumers on the Move: The Future of Mobility*. <https://www.mckinsey.com/featured-insights/future-of-asia/asias-consumers-on-the-move-the-future-of-mobility>
- NCCS. (2020).** *Charting Singapore’s low-carbon and climate resilient future*. <https://unfccc.int/sites/default/files/resource/SingaporeLongtermlowemissionsdevelopmentstrategy.pdf>
- OECD/IEA. (2021).** *Update on Recent Progress in Reform of Inefficient Fossil Fuel Subsidies That Encourage Wasteful Consumption*.
- OECD/ITF. (2017).** *Lightening Up: How Less Heavy Vehicles Can Help Cut CO₂ Emissions*. International Transport Forum.
- OECD/ITF. (2021a).** *ITF Transport Outlook 2021*. https://read.oecd-ilibrary.org/transport/itf-transport-outlook-2021_16826a30-en#page1
- OECD/ITF. (2021b).** *Transport indicators. International Transport Forum and OECD Stat*. http://stats.oecd.org/Index.aspx?DataSetCode=ITF_INDICATORS
- OECD. (2021).** *OECD Inventory of Support Measures for Fossil Fuels: Country Notes*. https://www.oecd-ilibrary.org/environment/oecd-companion-to-the-inventory-of-support-measures-for-fossil-fuels-country-notes_5a3efe65-en

PwC. (2015). *Riding Southeast Asia's automotive highway* (Issue November).

REN21 & FIA Foundation. (2020). *Renewable Energy Pathways in Road Transport*.

Republic of Indonesia. (2019). *Indonesia's Effort to Phase Out and Rationalise Its Fossil-Fuel Subsidies. In general, higher-income households use more energy and benefit disproportionately from general subsidies.* [https://www.oecd.org/fossil-fuels/publication/Indonesia G20 Self-Report IFFS.pdf](https://www.oecd.org/fossil-fuels/publication/Indonesia%20Self-Report%20IFFS.pdf)

Republic of Korea. (2020). *2050 Carbon Neutral Strategy of the Republic of Korea* (Issue December).

Rokadiya, S., & Yang, Z. (2019). *Overview of global zero-emission vehicle mandate programs.* April 2019, 1–15. <https://theicct.org/publications/global-zero-emission-vehicle-mandate-program>

Rosemberg, A. (2017). *Embedding Just Transition in Long-term Decarbonization Strategies: Why, What, and How.* World Resources Institute (WRI). <https://www.wri.org/climate/expert-perspective/embedding-just-transition-long-term-decarbonization-strategies-why-what>

Rüttinger, L., Smith, D., Stang, G., Tänzler, D., & Vivekananda, J. (2015). *A New Climate for Peace: Taking Action for Climate and Fragility Risks.* <https://climate-diplomacy.org/magazine/conflict/new-climate-peace>

Sajjad, F., Anjum, G. A., Field, E., & Vyborny, K. (2017). *Gender equity in transport planning: Improving women's access to public transport in Pakistan* (Issue March).

SLoCaT. (2018). *Transport and Climate Change Global Status Report 2018.* Partnership on Sustainable, Low Carbon Transport (SLoCaT).

SLoCaT. (2019). *Sustainable Transport: Critical driver to achieve the SDGs.* Partnership on Sustainable, Low Carbon Transport (SLoCaT). https://slocat.net/wp-content/uploads/legacy/u13/vnr_2019_infographic.pdf

SLOCAT. (2020a). *Impacts of COVID-19 on Mobility on urban mobility* (Issue May). https://slocat.net/wp-content/uploads/2020/05/SLOCAT_2020_COVID-19-Mobility-Analysis.pdf

SLOCAT. (2020b). *Transport and Voluntary National Reviews.* <https://slocat.net/vnr/>

SLOCAT. (2021). *Tracking Trends in a Time of Change: The Need for Radical Action Towards Sustainable Transport Decarbonisation, Transport and Change Global Status Report – 2nd edition.* www.tcc-gsr.com

Sönke, K., Eckstein, D., Dorsch, L., & Fischer, L. (2019). *Global climate risk index 2020: Who suffers most from Extreme weather events?* <https://doi.org/978-3-943704-04-4>

SUTP. (2021). *Adapting Urban Transport to Climate Change. In Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities.* <https://changing-transport.org/publication/sourcebook-on-adapting-urban-transport-to-climate-change/>

TCFD. (2021). *Task Force on Climate Related Financial Disclosure: 2021 Status Report.* https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Status_Report.pdf

TDA. (2018). *Decarbonising transport by 2050. Transport Decarbonisation Alliance.* http://tda-mobility.org/wp-content/uploads/2018/12/EY_TDA-Manifesto.pdf

TERI. (2020). *Impact of Covid-19 on Urban Mobility in India: Evidence From a Perception Study.*

TERI. (2021). *COP26 Charter of Actions: Rallying the Global Community for an Equitable Climate Agenda* (Vol. 89, Issue 2). Editors: Shailly Kedia, Nivedita Cholayil, Anuradha Mathur and Shreyas Joshi. Supported by Bloomberg Philanthropies, Rockefeller Foundation, Shakti Sustainable Energy Foundation and Tata Cleantech Capital Limited.

Teske, S., Niklas, S., & Langdon, R. (2021). *TUMI Transport Outlook 1.5°C - A global scenario to decarbonise transport.* <https://www.transformative-mobility.org/assets/publications/TUMI-Transport-Outlook.pdf>

The Global Commission on the Economy and Climate. (2018). *The New Climate Economy.* https://newclimateeconomy.report/2018/wp-content/uploads/sites/6/2018/09/NCE_2018_ExecutiveSummary_FINAL.pdf

TraCS and SLOCAT. (2021). *Transport in NDCs Database.*

- TransportPolicy.net. (n.d.).** *JAPAN: HEAVY-DUTY: FUEL ECONOMY.* <https://www.transportpolicy.net/standard/japan-heavy-duty-fuel-economy/>
- UCDavis, & ITDP. (2017).** *Three Revolutions in Urban Transportation.* UCDavis & Institute for Transportation and Development Policy. <https://www.itdp.org/wp-content/uploads/2017/04/ITDP-3R-Report-FINAL.pdf>
- UITP. (2020).** *Public transport is COVID-safe.* <https://cms.uitp.org/wp/wp-content/uploads/2020/10/Policy-Brief-PTisCOVID-Safe.pdf>
- UNCTAD. (2021).** *Container Shipping in Times of Covid-19: Why Freight Rates Have Surged, and Implications for Policymakers Policy.* https://unctad.org/system/files/official-document/presspb2021d2_en.pdf
- UNDESA. (2014).** *World Urbanization Prospects. In Undesa.* <https://doi.org/10.4054/DemRes.2005.12.9>
- UNDESA. (2019).** *World Population Prospects. 2019 Revision.* <https://population.un.org/wpp/>
- UNDP. (2019).** *Gender and NDCs: Country Progress and Key Findings.*
- UNEP. (2020).** *Emissions Gap Report 2020.*
- UNESCAP. (2013).** *Population trends in Asia and the Pacific. United Nations Economic and Social Commission for Asia and the Pacific, November, 1–4.*
- UNESCAP. (2020).** *Asia-Pacific Trade and Investment Trends 2020/2021.* [https://www.unescap.org/sites/default/d8files/knowledge-products/APTIT Trade in goods_21Dec.pdf](https://www.unescap.org/sites/default/d8files/knowledge-products/APTIT%20Trade%20in%20goods_21Dec.pdf)
- UNFCCC. (2021).** *Nationally determined contributions under the Paris Agreement. Synthesis report by the secretariat.* <http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf>
- Wappelhorst, S. (2021).** *Update on government targets for phasing out new sales of internal combustion engine passenger cars.* In International Council on Clean Transportation. <https://theicct.org/>
- Wappelhorst, S., & Cui, H. (2020).** *Growing momentum: Global overview of government targets for phasing out sales of new internal combustion engine vehicles.* <https://theicct.org/blog/staff/global-ice-phaseout-nov2020>
- Wappelhorst, S., & Rodríguez, F. (2021).** *Global overview of government targets for phasing out internal combustion engine medium and heavy trucks.* International Council on Clean Transportation. <https://theicct.org/global-overview-of-government-targets-for-phasing-out-internal-combustion-engine-medium-and-heavy-trucks/>
- World Bank. (2018).** *Groundswell: Preparing for Internal Climate Migration.* <https://academiccommons.columbia.edu/catalog/ac:7pvmcvdnf1>
- World Bank. (2021a).** *State and Trends of Carbon Pricing 2021.* In State and Trends of Carbon Pricing 2021. <https://doi.org/10.1596/978-1-4648-1728-1>
- World Bank. (2021b).** *World Development Indicators. The World Bank Group.* <https://data.worldbank.org/>
- WRI. (2021).** *Steering a Green, Healthy, and Inclusive Recovery through Transport.* <https://www.wri.org/research/green-recovery-transportation>

Key concepts



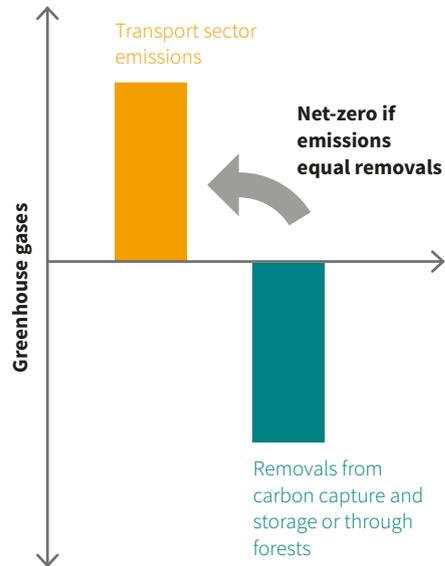
Net-zero vs. zero GHG emissions

Net-zero emissions means that a given sector still has annual GHG emissions, but that these emissions are offset by reductions elsewhere. Such offsets can be achieved in other sectors, including in particular forests, or through technologies that actively remove carbon emissions from the atmosphere. The term ‘carbon neutrality’ is also used as a synonym for ‘net zero’.

There are a number of concerns related to the economic and technical feasibility of removing and sequestering GHG emissions from the atmosphere. The distinction between the two concepts is therefore important for understanding the impacts of trajectories on the overall mitigation effort.

The term **zero emissions** refers to reducing GHG emissions in a sector to zero, without the need to actively remove GHG emissions from the atmosphere elsewhere (i.e. no offsetting is necessary).

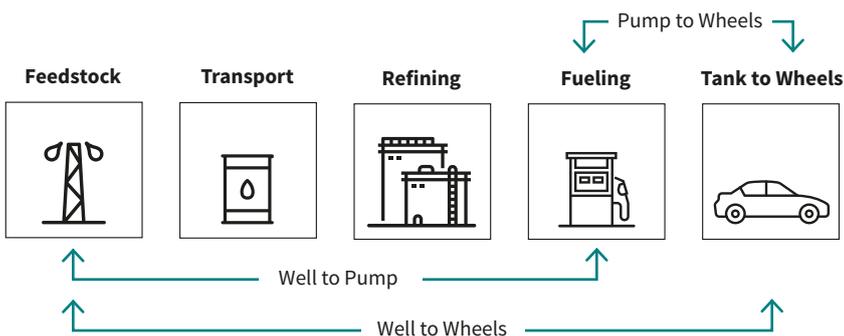
Figure 26:
Illustrating the concept of ‘net-zero’



Well-to-wheel vs. tank-to-wheel emissions

To be able to correctly interpret GHG emission information provided in scenarios and other publications, it is important to understand what they include. There are a number of used concepts, depending on which part of the overall value chain is included, as illustrated in **Tank-to-wheel** (downstream) emissions only include direct GHG emissions from the combustion of fuels in vehicles. This excludes any emissions generated in the production of these fuels, particularly for the generation of electricity. The emissions for power generation are assumed to be accounted for in the energy industries sector.

Figure 27:
Concept of well-to-wheel vs. tank-to-wheel



Own illustration based on Curran et al. (2014)

Tank-to-wheel (downstream) emissions only include direct GHG emissions from the combustion of fuels in vehicles. This excludes any emissions generated in the production of these fuels, particularly for the generation of electricity. Emissions from power generation are assumed to be accounted for in the energy sector.

Well-to-wheel (downstream and upstream) emissions explicitly include emissions from fuel production, including electricity generation. Ideally, they also include indirect emissions from fuel production, which can be substantial – for example, from land-use change for biofuel production.

This means that not all scenario data are directly comparable if different footprint scopes are used. It also means that any analysis regarding the relative importance of sectors needs to take this into account, especially with higher shares of electrification. For a realistic assessment of the GHG impact of the transport sector, the assumptions made regarding the degree of power-sector decarbonisation are essential (see also GIZ, 2018; ICCT, 2020 footnote 12).

Both of these concepts relate to the fuel used to power the vehicles and do not consider the emissions from the construction and disposal of vehicles, including batteries.

Blind spots and barriers

Barriers are factors that prevent action or that reduce the effectiveness of measures taken to decarbonise the transport sector. In this report, **‘blind spots’** are areas that do not yet receive adequate attention in relation to their potential contribution to decarbonisation. In this sense, lack of awareness, means or political will to overcome a certain barrier could be a blind spot, but also individual measures or subsectors that play an important role for decarbonisation could constitute a blind spot.

Just transition

Policies to address climate change are increasingly urgent, but they must ensure that workers and communities are not neglected; indeed, workers and communities must contribute to and benefit from current and future transitions. In that sense, the concept of ‘just transition’ not only looks at the distributional effects of measures, but also recognises the needs of a wide variety of stakeholders, while calling for them to be heard and influence decision-making (CSIS & CIF, 2020).

Paratransit and informal transport

Paratransit describes “transport services that are not regulated by the public authorities and that are operated by private operators, with little or no organisation, and that use various types of vehicles, from carts to motorbike taxis, tricycles, minibuses...” It is characterised by a complex and fragmented system of actors, with operators organised to varying degrees (Baffi & Lannes, 2021).

The term ‘informal transport’ is also often used to describe paratransit, although technically the term ‘informal’ refers to all economic activities that are – in law or practice – not covered or insufficiently covered by formal arrangements. This includes contributing family workers and is also used more generally to describe precarious working arrangements (ILO, 2020).

Paratransit is often seen as standing in competition with officially operated public transport systems. However, it often provides the only available and affordable method of transport for many individuals, especially in lower-income countries. The sector also provides a substantial amount of jobs in parts of the world. Its fragmentation and flexibility can offer opportunities for the design of transport systems, supplementing higher-capacity modes, such as metros and BRT systems, to provide feeder services that are low cost and locally adapted (Baffi & Lannes, 2021).

Sustainable mobility/transport

Sustainable transport can be understood as “meeting the transport needs of current generations without compromising the ability of future generations to meet those same needs” (Black, 2010). This includes not only the need to reduce GHG emissions, which will compromise future generations. It also means ensuring that transport systems are safe to use, provide access for all and do not harm people through air pollution or noise.



Nationally Determined Contributions (NDCs) and Long-term Strategies (LTS)

In the context of the Paris Agreement, countries agreed to submit [long-term low GHG emission strategies](#) to the UNFCCC. By February 2022, 50 countries had submitted such strategies, with the latest being Cambodia in December 2021. These strategies aim to outline the path chosen by the country to reduce their GHG emissions in the long-term, with most countries developing their strategy until 2050.

Nationally determined contributions are also submitted to the UNFCCC in the context of the Paris Agreement. Unlike the LTS, NDCs are submitted regularly, every five years. They represent each country's commitment for GHG emission reductions in the short-term. The nature of the commitments vary and include absolute emission limits, reductions below a defined historic emissions level, reductions below projected business-as-usual emissions or intensity-based targets. Some countries have committed to a set of actions instead of setting GHG emission targets.

Initial NDCs were mostly submitted in the run up to the climate conference in Paris in 2015. Since then, most countries have submitted an update of their NDC. Most contain targets for 2030.

Abbreviations



Acronym	Definition
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
ASI	Avoid-Shift-Improve
FAME	Faster Adoption and Manufacturing of Electric Vehicles scheme
GDP	Gross Domestic Product
GHG	Greenhouse gas
HDV	Heavy-duty vehicle
ICCT	International Council on Clean Transportation
ICE	Internal combustion engine
ICT	Information and communication technology
IEA	International Energy Agency
IFC	International Finance Corporation
ILO	International Labour Organisation
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ITF	International Transport Forum
LDV	Light-duty vehicles
LTS	Long-term strategy
MRV	Monitoring, reporting and verification
NDC	Nationally determined contribution
NEV	New energy vehicle
OECD	Organisation for Economic Co-operation and Development
SLOCAT	Partnership on Sustainable, Low Carbon Transport
SUV	Sport utility vehicle
TERI	The Energy and Resources Institute (India)
TOD	Transport-oriented development
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollar

Annex 1 Overview of transport targets by country

	Documents submitted to the UNFCCC			In NDC or LTS ²	
	Initial NDC ¹	NDC update ²	LTS ²	GHG transport target	non-GHG transport target
Afghanistan	X				
Armenia	X	X			
Azerbaijan	X				
Bangladesh	X	X		X	
Bhutan	X	X			
Brunei Darussalam	X	X			X
Cambodia	X	X			X
China	X	X	X		X
Georgia	X	X		X	
India	X				
Indonesia	X	X	X		
Iran	X				
Japan	X	X	X	X	X
Kazakhstan	X				
Kyrgyzstan	X	X			
Lao PDR	X	X			X
Malaysia	X	X			
Maldives	X	X			
Mongolia	X	X			
Myanmar	X	X			
Nepal	X	X	X		X
Pakistan	X	X			X
Philippines	X	X			
Republic of Korea	X	X	X		X
Singapore	X	X	X		X
Sri Lanka	X	X		X	X
Tajikistan	X	X			
Thailand	X	X	X		X
Timor-Leste	X				
Turkmenistan	X				
Uzbekistan	X	X			
Viet Nam	X	X			

Sources:

¹ <https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx>

² <https://changing-transport.org/tracker/>

³ https://sdgs.un.org/sites/default/files/2021-10/UNCRD_14th%20EST_Aichi%202030%20Declaration-20%20Oct%202021-ADOPTED_0.pdf

⁴ <https://data.adb.org/dataset/asian-transport-outlook-database>

⁵ <https://cleanairasia.org/sites/default/files/2021-06/Policy%20Brief%20-%20Mainstreaming%20E-Mobility%20in%20SE%20Asia.pdf>

Net-zero commitments		Specific targets ⁴ (national and international)		
Net-zero economy-wide pledge ²	Aichi Declaration ³	E-mobility	Rail	Mode share
	X	X	X	
			X	
	X	X	X	X
X	X	X		
	X	X		X
	X	X		
X		X		X
		X		
X	X		X ¹	
	X	X	X	X
	X		X	
X	X	X	X	
X			X	
				X
X	X	X	X	
X	X	X		X
X	X	X		X
X	X	X		X
	X	X		X
		X		X
	X	X ⁵	X	
X		X	X	X
X		X		X
X		X		X
X	X	X	X	X
		X	X	X
X	X		X	

Annex 2

Overview of transport policies by country

	National transport vision statement ¹			National transport strategy ¹	
	Exists	Sustainability featured in vision	Climate featured in vision	Published	Climate mitigation featured in strategy
Afghanistan	X	no	no	post-Paris	qualitatively
Armenia	X	yes	no		
Azerbaijan	X			pre-Paris	
Bangladesh	X	no	no	pre-Paris	
Bhutan	X	yes	'green'	post-Paris	both
Brunei Darussalam	X	yes	no	post-Paris	both
Cambodia	X	no	no		
China	X	yes	'green'	post-Paris	
Georgia	X	no	no		
India	X				
Indonesia	X	no	no	post-Paris	
Iran	X				
Japan	X	yes	no	pre-Paris	
Kazakhstan	X	no	no		
Kyrgyzstan	X				
Lao PDR	X	yes	no		
Malaysia	X	yes	no	post-Paris	both
Maldives	X	yes	no		
Mongolia	X				
Myanmar	X	yes	'environmentally friendly'	pre-Paris	
Nepal	X	yes	no	pre-Paris	qualitatively
Pakistan	X	yes	'environmentally friendly'	post-Paris	qualitatively
Philippines	X	yes	'environmentally friendly'	post-Paris	qualitatively
Republic of Korea	X	no	no		
Singapore	X	no	no	post-Paris	both
Sri Lanka	X	no	no	post-Paris	qualitatively
Tajikistan	X	no	no	pre-Paris	qualitatively
Thailand	X	yes	no	post-Paris	both
Timor-Leste	X	no	no	post-Paris	
Turkmenistan	X	no	no		
Uzbekistan	X	no	phase-out of hydrocarbons		
Viet Nam	X	no		pre-Paris	
Hong Kong, China	X	yes	'environmentally friendly'		
Taipei, China	X	yes	'green'		

Sources:

¹ All information unless explicitly specified from <https://data.adb.org/dataset/asian-transport-outlook-database>

² https://theicct.org/sites/default/files/publications/HDV%20Stage%203%20Fuel%20Consumption%20Standard_ICCT_20160708.pdf

³ <https://theicct.org/pv-fuel-economy/>

⁴ <https://theicct.org/publications/fuel-consumption-stds-hdvs-india-update-201712>

⁵ <https://www.iea.org/policies>

Climate adaptation featured in strategy	Policy instruments in place ¹		
	Fuel economy standards	EV incentives	Biofuel mandates (biodiesel bioethanol)
		tax	
	ASEAN LDV		
	ASEAN LDV	import (planned)	
	national LDV/HDV ^{2,3}	purchase NEV mandate	0% 4%
	national LDV/HDV ^{3,4}	purchase, tax, manufacturing ⁵	0% 10% ⁵ by 2022
	ASEAN LDV	tax	30% 5%
both	national LDV	purchase, tax	
		import, registration, tax	
		import	
	ASEAN LDV		
	ASEAN LDV	tax, import	10% 0%
		import	
		tax	
	ASEAN LDV		
qualitatively		import	
qualitatively		import, manufacturing	
	ASEAN LDV		
	national LDV ³	purchase	2% 10%
	ASEAN LDV	registration	3% 10%
qualitatively			
	ASEAN LDV	tax, manufacturing	7% 5%
		import	
		manufacturing	0% 5%
		registration	
		tax	1% 0%

Annex 3

Overview of barriers for ambitious decarbonisation policies

The barriers identified below are based on a literature review and the experience of council members. In principle, there are six large groups of barriers to the adoption and implementation of measures to decarbonise transport. They apply to different

degrees to countries, based on their individual situation and can vary in relevance and detail between passenger and freight transport and urban and non-urban mobility.

<p>Policy</p> <p>Regulatory</p> <ul style="list-style-type: none"> • Conflicting policies, legislation & regulation (incl. lack of updates) • Unclear policies • Informal transport is not recognised as a mode of transport <p>Institutional</p> <ul style="list-style-type: none"> • High administrative burden • Unclear responsibilities • Lack of horizontal and vertical coordination • Limited participation of user groups, civil society organizations representing different constituencies • Limited women and gender minorities in the sector at all levels <p>MRV</p> <ul style="list-style-type: none"> • Lack of effective, gender and socially inclusive MRV systems to inform decision-making 	<p>Politics</p> <p>National & international level</p> <ul style="list-style-type: none"> • Decarbonising transport is not a priority • Conflicting priorities • Vested interests of incumbent industries • Distortion of facts related to economic and social effects of measures • Real and perceived public opinion <p>Individual level (decision-makers)</p> <ul style="list-style-type: none"> • Need to address interests of constituencies • Election cycles not matching long-term strategies • Lack of empowered women and gender minorities in decision-making positions 	<p>Technology</p> <p>Technology availability</p> <ul style="list-style-type: none"> • Technology still under development • Access to technology • Technology not economically competitive <p>Infrastructure</p> <ul style="list-style-type: none"> • Lock-in through existing infrastructure • Limitations based on climate
<p>Capacity & knowledge</p> <p>By type of capacity</p> <ul style="list-style-type: none"> • Capacity to design & manage integrated transport/energy infrastructure • Manufacturing capacity and related skills (e.g. electric vehicles) • Capacity to apply new technology • Limited understanding of small, informal passenger and goods transport networks and supply chains, and the gender differentials • Transport is perceived as infrastructure not a service • Communication and information dissemination with the public • Multi-disciplinary working <p>By stakeholder group</p> <ul style="list-style-type: none"> • Policy-makers • Implementing institutions • Financing institutions, esp. commercial banks • Private and public operators 	<p>Societal & cultural</p> <p>Societal</p> <ul style="list-style-type: none"> • Vehicle ownership as status symbol • Demographic structures with increasing elderly populations • Lack of awareness and consideration of gender, social inclusion and user needs <p>Cultural</p> <ul style="list-style-type: none"> • Cultural perceptions & restrictions for individual user groups and/or modes 	<p>Economics & finance</p> <p>Economics</p> <ul style="list-style-type: none"> • Lack of business models for the private sector • Lack of business models for public sector investment <p>Finance</p> <ul style="list-style-type: none"> • Restricted public budgets • Lack of incentive / opportunity for private investment • Limited access to international public and private funding • Available finance going to fossil fuel activities

Annex 4

List of countries & regions analysed

The following countries & regions are included in Asia, based on the ADB definition:

Afghanistan	Pakistan
Armenia	Philippines
Azerbaijan	Republic of Korea
Bangladesh	Singapore
Bhutan	Sri Lanka
Brunei Darussalam	Taipei, China
Cambodia	Tajikistan
China	Thailand
Georgia	Timor-Leste
Hong Kong, China	Turkmenistan
India	Uzbekistan
Indonesia	Viet Nam
Iran (Islamic Republic of)	
Japan	
Kazakhstan	
Kyrgyzstan	
Lao People's Democratic Republic	
Malaysia	
Maldives	
Mongolia	
Myanmar	
Nepal	

