

TUMI Transport Outlook 1.5°C

A global scenario to
decarbonise
transport

Executive Summary

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The Paris Agreement adopted in December 2015, central aim is to keep global temperature rise this century well below 2°C above pre-industrial levels, and to pursue efforts to limit temperature rise to 1.5°C. Countries and cities around the world have already been rocked by climate change, from unprecedented floods to searing heatwaves and water scarcity, there is an urgent need to implement policies and measures that limit greenhouse gas emissions (GHG) in line with the Paris Agreement and the 2030 Agenda.

The TUMI Transport Outlook 1.5°C outlines the role of the transport sector within these goals as it lays out a plan for exactly how we can achieve the goal of limiting GHG emissions. The transport sector accounts for nearly one-quarter of global energy-related carbon emissions. Climate action in transport is urgently needed because energy-related carbon dioxide (CO₂) emissions are the main driver of climate change (Teske et. al 2019). Transport is responsible for about one quarter of energy related GHG emissions. This is set to increase to one-third by 2050, growing faster than any other sector. Yet a clear-cut path to transformation, one which is backed up with evidence and 'hard' numbers for policymakers around the world, remains missing. To close this gap, TUMI and the University of Technology Sydney have developed a robust scenario study.

This study considers the conditions necessary to achieve the needed emission reductions in the transport sector to align with the Paris Agreement and 2030 Agenda. The study conducts three scenarios: A reference baseline study, in which no changes are implemented in terms of transport, along with a look at those changes that need to take place in order to limit warming to 1.5°C or 2.0°C.



1. Key Recommendations

The TUMI Transport Outlook detects actionable measures for implementation in three key areas to decarbonise transport in line with the 1.5°C threshold as defined in the Paris Agreement. Avoid or reduce the need to travel, shift to more efficient transport modes, as well as improve efficiency through vehicle technology. The remaining window for significant action to decarbonise is confined to 99 months – from 2021 till 2030.

Condensed from global back-casting efforts on energy intensities, carbon emissions, trends, and drivers in 10 world regions, a potential pathway to a decarbonised transport sector based on five international top-level measures for policymakers:

1. Phase-out internal combustion engines by 2030

To achieve the global decarbonisation of transport, it is fundamental to shift to electric mobility powered by renewable energy. To enable the shift towards electric mobility, a phase-out of newly sold internal combustion engine (ICE) vehicles (passenger cars, vans, 2-3 wheelers, city buses etc.) by 2030 is vital. By setting targets, governments can send strong signals to markets and customers to adopt the new technology. Further, mandating efficiency standards for all vehicle types with a 2% annual efficiency improvement target should be set.

OECD countries have been achieving high electrification rates in road transport at a pace of up to 10 years before non-OECD countries. As technology pick-ups electrification of vehicles will materialize in second- and thirdhand vehicle markets. From 2030 onwards, a rapid and accelerating decline of the share of internal combustion engine vehicles in non-OECD markets can be achieved.

2. Elevate walking and cycling

In order to maintain and extend access levels around the globe while curbing passenger kilometre growth, large-scale expansions of quality infrastructure for bicycles and walking are needed. Higher take up of active mobility is supported by following compact regional and urban planning principles. Under the 1.5°C pathway, levels in which up to 50% of trips made by foot or cycling, as seen in sustainable mobility capitals such as Amsterdam and Copenhagen, should be pursued. To achieve a high-quality cycling network, TUMI estimates that governments should build roughly 2 km of segregated cycling lanes per 1.000 inhabitants.

Special emphasis should be put on rapidly growing cities, as this a) allows for interventions in early phases of urban development and b) will determine mobility patterns over long periods of time.

3. Double public transport capacity by 2030

Even though public transport has seen massive hits in ridership during the COVID-19 pandemic, it continues to play a key role as the backbone of urban and interurban mobility. In order to leverage its potential, the capacity of public transport needs to be doubled, with attention paid to service quality, convenience and affordability to (re-)gain acceptance. The integration of shared mobility and last mile transport services can support intermodality between public transport and individual mobility.

4. Electrify at least 70% of railways by 2030

The 1.5°C pathway assumes that about one-third of freight transported via trucks are shifted to rail transport systems; whereas the reference scenario assumes that domestic (inland and coastal) navigation will lose both to rail and road transport systems. The share of electric trains needs to be increased under the 1.5°C scenario, with all diesel locomotives being completely phased out by 2050 across all regions. Therefore, a full electrification (via overhead or battery electric trains) needs to be pursued and by 2030 at least 70% of rail needs to be electrified.

5. Prioritize electricity as the primary fuel for transport

By 2050, all transport fuels need to be carbon neutral and only renewably produced fuels and renewably generated electricity should be in use.

The switch to electric mobility will drastically reduce the global need for oil-based fuels. To meet an increased demand in transport electricity, a corresponding increase in renewable electricity generation should take place. Sustainable biofuels from waste and hydrogen, on the other hand, should be limited to particular and small segments of heavy-duty trucks and machinery, navigation and aviation, as should the use of hydrogen and synthetic fuels to heavy duty machinery, aviation and shipping. Hydrogen and synthetic fuels must be produced by renewable electricity to be compliant with the 1.5°C pathway. The use of biofuel from energy crops is not assumed under the TUMI Transport Outlook pathways.

2. Underlying principles to decarbonise the transport sector

Reduce transport energy demand

Meeting the goal of reducing greenhouse gas emissions in the transport sector as outlined in the 2.0°C and the 1.5°C scenarios requires a change in policy, technology, and behaviour. Supportive policy measures encouraging energy efficiency, incentives for smaller cars, and a swapping of vehicle technologies need to be implemented simultaneous to a reduction in transport need as regards the number of kilometres travelled. Compact regional and urban planning principles, which keep spatial distances between living, working, (local) supplies, services, leisure and educational facilities short can reduce the demand for motorised travel significantly. A stronger focus on 'non-energy' travel-modes such as cycling and walking will further reduce transport energy demand.

Shift of transport modes

A shift of transport modes to efficient modes especially in the expanding large metropolitan areas, is required. Policies enabling active mobility and an increased use of public transport will be key to shift passenger transport to efficient modes. Passenger transport needs to shift from road to rail in order to implement the 1.5°C scenario. This can be accomplished through efficient light rails in cities, commuter trains for short- to medium-distance commutes complimented by high-speed trains that offer convenient services and therefore an alternative to individual car journeys. Similarly, in freight transport a shift from road to rail and from aviation to navigation is key to stay within the 1.5°C scenario.

Improve efficiencies through large-scale electrification

Passenger cars and light commercial vehicles are projected to achieve battery-electric-vehicle (BEV) shares of between 8% and 15% by 2030 globally, with some regions adopting faster than others. This will require a massive build-up of battery production capacity in the coming years. New car sales will be dominated by battery electric passenger vehicles in 2030 under the 1.5°C scenario. As passenger cars with internal combustion engines (ICEs) have an assumed average lifetime of 15 years, however, the existing car fleet will still predominantly be comprised of ICEs.

Working under the assumption that new ICE passenger cars and buses will not be produced after 2030, the 1.5°C scenario shows that BEV will dominate the passenger vehicle fleet of 2050. OECD countries and China are assumed to lead the development of BEV and will therefore have the highest shares, whereas Africa and Latin America are expected to have the lowest. Fuel cell-powered passenger vehicles are projected to play a significantly smaller role than battery electric vehicles and will only be used for larger vehicles.

To decarbonize transport the above-mentioned principles can be integrated and are based on the Avoid-Shift-Improve (ASI) framework, which forms a broadly accepted strategy to transforming transport. ASI focuses on avoiding the need for motorized travel and reducing trip lengths, shifting to energy efficient transport modes and improving vehicle efficiency.

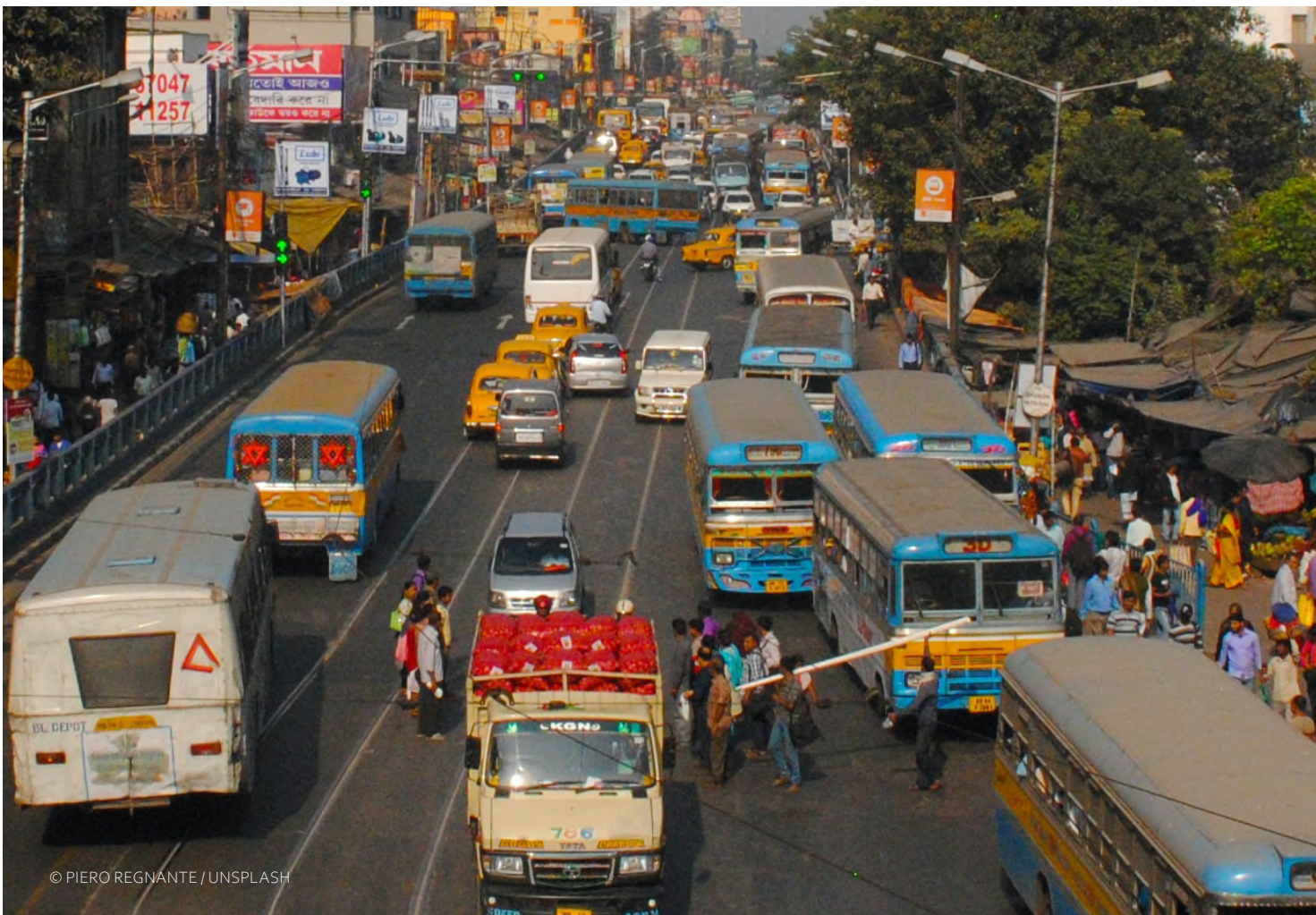
3. Calculated Pathways in the TUMI Transport Outlook

All three scenarios are not forecasts but rather projections under different assumptions. They have been calculated based on the IEA World Energy Outlook 2020 Stated Policies scenario and two pathways which limit energy-related carbon emissions from the transport sector within the carbon budget for 2.0°C and 1.5°C (67% likelihood) according to the latest IPCC AR6 carbon budget (IPCC 2021).

The **'Reference'** case, based on the IEA Stated Policies Scenario (IEA 2020) until 2040, with extrapolation to 2050, assumes that there will be no major changes in the global transport sector across all transport modes. Electrification of road transport will remain at a relatively low level and there will be no major shift from individual to public transport and active mobility (cycling & walking). Growth in the share of the commercial road vehicle fleet and of the fleet of two- and three-wheel vehicles with electric powertrains will be small, as will the increase in further rail electrification. Aviation and navigation (shipping) will remain fully dependent on conventional kerosene and diesel, respectively. The results of the Reference case are within the same order of magnitude as the IEA scenario, but does not claim to model all results exactly.

The **2.0°C scenario**: Sees a cumulative carbon budget of 130 Gt CO₂ between 2020 and 2050 for the global transport sector. Minimal progress in electrification is assumed through 2025, with a strong increase towards 2030, encouraged by purchase incentives, carbon pricing, EV credit systems, and tightened CO₂ fleet emission targets. OECD will take the lead in implementing electric mobility, leading to the decarbonisation of the entire sector. This scenario also assumes supportive policy measures encouraging energy efficiency, electrification and the use of public transport to be implemented by 2030.

The **1.5°C scenario**: Assumes the same technical and behavioural change measures as the 2.0°C scenario, but implementation will be faster, with a global cumulative carbon budget of 110 Gt CO₂ until 2050. An earlier and more rapid ramp-up of electric powertrain penetration is required, as are supportive policy measures encouraging energy efficiency, electrification and the use of public transport, which must be implemented by 2025. 'Active mobility' policies that encourage cycling and walking, as well as measures that reduce the need for long work commutes are needed to achieve the reduction in global transport demand.





4. Carbon budget

The remaining carbon budget for a 1.5°C compatible transport sector globally equates with 3 years of current global energy related carbon emissions.

The TUMI Transport Outlook aims to remain with a clearly defined carbon budget to achieve the Paris Climate Agreement. The global carbon budget for the transport sector – based on the presented analysis – is estimated with 110 Gt CO₂ between 2020 and 2050 – about 28% of the remaining carbon budget of 400 Gt CO₂. Most of this carbon budget – 20% to 25% of the total global carbon budget – is estimated to be required for the road transport sector.

Table 1. Global Cumulative energy-related CO₂ emissions [GtCO₂] between 2020 and 2050 under the 1.5°C for the four main sectors: Buildings, industry, power generation and transport

Cumulative energy-related CO ₂ emissions [GtCO ₂]		
Global	2020–2050	Transport Sector
		Share of cumulative emissions 2020-2050
		[%]
Industry	77	19%
• Cement	9	2%
• Steel	19	5%
Transport (including power for transport)	110	28%
• Aviation (incl. international)	11	3%
• Navigation (incl. international)	14	3%
• Rail	3	1%
• Road	82	21%
Power (excluding power for transport)	107	27%
Building/Other sectors	93	23%
Other Conversions & losses	13	3%
Total Actual CO₂ Emissions	400	100%

Carbon dioxide emissions are calculated on the basis of the primary energy fuel demand for oil and gas and the total electricity demand in the transport sector. In regard to fossil fuels, the primary energy demand for each transport mode includes all losses. For the electricity demand of battery-electric vehicles, electric train and the production of synthetic and hydrogen fuels with electricity, the CO₂ emissions are calculated with the regional CO₂ intensity for the year of calculation under the same scenario.

Carbon dioxide under three scenarios

The global energy related carbon dioxide emissions have to be reduced drastically in order to avoid increasing emissions. The following figure 1 contrasts the two 1.5°C and 2°C scenarios against the Reference scenario. Through urban policies, electrification and the additional measures mentioned above, the global transport sector can be decarbonised completely.

Global: Transport energy-related carbon dioxide until 2050

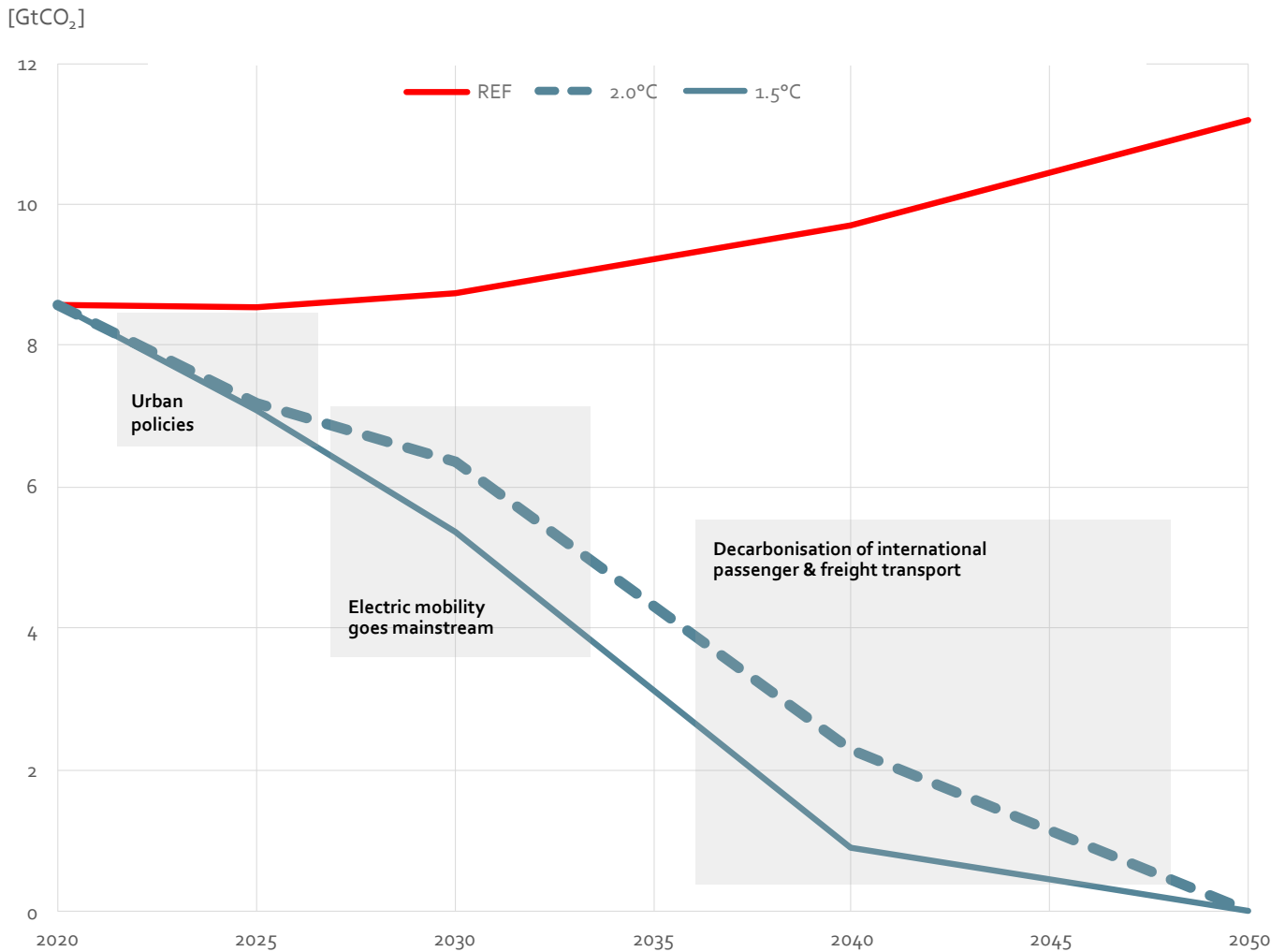


Figure 1. Global: Transport energy related carbon dioxide emissions until 2050

Regional breakdown

Energy-related CO₂ emissions of the transport sector vary significantly by region and OECD countries have by far the highest emissions – both in total and in relation to the population in those countries. OECD North America would emit around 63 GtCO₂ between 2020 and 2050 under the reference case – a pathway that assumes no major changes in the transport sector over the next 30 years.

Compared to the global carbon budget, to stay with a 67% likelihood under 1.5°C of 400 GtCO₂ for the same timeframe, the global transport sector under the reference case would consume 74% of the total budget, leaving only 26% for all other sectors such as buildings, food and agriculture, industrial production and all other economic activities.

Under the reference case, OECD North America, OECD Europe and OECD Pacific, with around 15% of the global population, the transport sector would take up 26% of the total carbon budget. Restructuring the transport sector is without alternative. Under the 1.5°C pathway, the transport sector will have about a quarter (110 Gt) of the total carbon budget (400 Gt) required to achieve the Paris Climate Agreement Goals. Under the 1.5°C scenario OECD North America, OECD Europe and OECD Pacific, would see total emissions add up to 50 Gt CO₂ – around 45% of the remaining carbon budget for the transport sector (110 Gt).





Transformative Urban Mobility Initiative

The Transformative Urban Mobility Initiative (TUMI) is the leading global implementation initiative on sustainable mobility, formed through the union of 11 prestigious partners. TUMI's vision are thriving cities with enhanced economic, social and environmental performances in line with the New Urban Agenda, the Agenda 2030 and the Paris Agreement. TUMI is based on three pillars: innovation, knowledge, investment.

TUMI Partners are the Asian Development Bank (ADB), C40 Cities – Climate Leadership Group, Development Bank of Latin America (CAF), Federal Ministry for Economic Cooperation and Development (BMZ), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, ICLEI – Local Governments for Sustainability, Institute for Transportation & Development Policy (ITDP), Kreditanstalt für Wiederaufbau (KfW), SLOCAT Partnership on Sustainable Low Carbon Transport, UN-Habitat, World Resources Institute (WRI). TUMI is implemented by GIZ and funded by the German Federal Ministry for Economic Cooperation and Development (BMZ).



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