



WORKING PAPER

Sustainable Urban Mobility in the NDCs: The Essential Role of Public Transport

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HIGHLIGHTS

- More robust measures on transport decarbonization are needed by 2030 to limit global warming to 1.5 degrees Celsius (°C), including reducing vehicle kilometers traveled and electrifying vehicles.
- Sustainable modes of travel, such as public transport, can and must play a crucial role in reducing the growth of private motor vehicle use. Bus fleets must also be electrified.
- One hundred out of 142 first- and second-round Nationally Determined Contributions (NDCs) submitted, as of December 2021, mention public transport, but only 26 identify targets. Stronger, more ambitious targets will be needed to address sub-national mitigation actions, as well as matched implementation through national policies.
- Five key areas of implementation are identified to encourage more effective NDCs: Commit to funding public transport infrastructure and operations, bus electrification, adaptation, broader sustainability measures in urban transport, and cross-sectoral and sub-national coordination.

EXECUTIVE SUMMARY

Global Climate Action and Public Transport

Public transport is critical to addressing carbon emissions in the transport sector. WRI's *State of Climate Action* report finds that the world needs to decrease the share of motor vehicle kilometers traveled by between 4 and 14 percent compared to a business-as-usual scenario by 2030 and make stronger progress on bus electrification (Boehm et al. 2021). Currently, emissions per passenger-kilometer from electric buses and trains are about one-quarter of those from ride-hailing and less than half of those from private vehicles (Cazzola and Crist 2020). Furthermore, public transport can help people reach jobs, critical services, and opportunities more equitably, as it removes the primary barrier to access, the purchase and maintenance of a car. Areas with

public transport also reap health benefits such as fewer vehicle accidents, reduced pollution, and more active residents who walk and cycle to and from stops.

NDCs are critical for developing and reaching targets in the sector. Of the second generation of NDCs submitted at the end of 2020 with a target date of 2030, 13 percent include targets to shift travel to more sustainable modes, such as public transport, and 43 percent of NDCs include targets on zero-emission vehicles (Changing Transport 2022). With current policies (as of 2020), global emissions are expected to reach 52-58 gigatons of carbon (GtCO₂) in 2030, which leaves a gap of about 15 gigatons (Gt) to reach below 2-degree targets, and about 30 Gt to fall below 1.5-degree targets (United Nations Environment Programme 2021). Current targets place the world on track for a 2.4°C temperature increase by the end of the century, showing the need for continued enhancement of NDCs (Climate Action Tracker 2021). Public transport must play a prominent role in strengthening action.

About This Working Paper

In this working paper, we focus specifically on measures and targets regarding public transport. NDCs with reference to transport have been analyzed and assessed in depth in previous WRI publications; however, few have detailed commitments and targets pertaining to public transport (Fried et al. 2021; Fransen et al. 2019; Welle et al. 2021). For instance, Welle et al. provided guidance on how NDCs can link raised ambition to a green recovery as we come out of the global pandemic and related economic upheaval (2021). Key areas for creating these links include stabilizing and strengthening integrated transport systems within metropolitan areas, avoiding investments in large highway projects, and funding and incentivizing vehicle electrification, particularly electric buses (Welle et al. 2021). Lessons from a post-pandemic economic recovery can be applied to NDCs, especially for countries seeking to decouple economic growth from rising emissions.

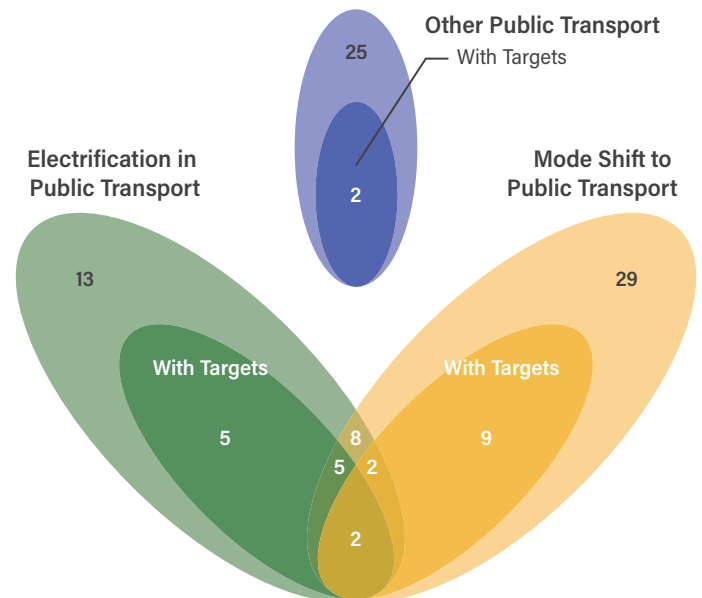
We examine the extent to which the latest NDCs include public transport and identify opportunities for raising ambition in further NDC enhancements. We utilize two NDC tracking tools from SLOCAT and ClimateWatch to assess the inclusion of public transport in mitigation measures and analyze relevant actions. NDCs that only include actions such as expanding bus fleets are categorized as measures, since there are no definitive milestones to track progress. Those that include quantitative values, such as purchasing 100 electric buses, are considered targets.

Key Findings

We find that public transport is reflected in the NDCs as follows:

- **Out of the 142 NDCs representing 168 countries, 100 mention public transport**, yet only 26 identify specific targets for shifting travel, building infrastructure, or electrifying bus fleets (see Figure ES-1).
- **55 NDCs promote a shift from private vehicles to public transit**, but only 13 have identified targets for doing so.
- **35 countries have commitments on electrification of public transport vehicles**, but only 12 contain specific targets.
- **Only 16 NDCs include measures to adapt public transport to the adverse effects of climate change.**
- **Very few NDCs make any reference to informal transport**, which provides most public transport trips in many cities, especially in the Global South.

Figure ES-1 | **Public Transport Measures and Targets in NDCs**



Note: "Other Public Transport" refers to infrastructure expansion and improvement, dedicated funding, upgrading tracking and payment systems, switching to cleaner fuels (biofuel, natural gas), and improving accessibility.

Source: WRI authors.

Opportunities for Enhancement and Implementation

Based on our studies of NDCs as well as public transport literature reviews and policy practices, we have identified five key opportunities for sub-national governments, city leaders, NGOs, and urban planners to enact more quantifiable measures. Actions in these areas will help strengthen NDC commitments to decarbonize transport faster while creating jobs, reducing air pollution, improving road safety, and increasing equity and resilience.

- **Commit to specific mobility action plans and institute robust funding for public transport infrastructure and operations.** By using plans such as sustainable urban mobility plans (SUMPs), funding and financial measures can be linked to targets to abate vehicle travel and can include investments in transit infrastructure and direct support for operations.
- **Initiate a 100-percent transition to clean electric bus fleets.** Specific targets for electrification of buses can be set in NDCs and matched with national support to procure and roll out vehicles.
- **Advance resilience and adaptation measures for public transport.** Adaptation should be integrated into public transport infrastructure to adjust for a changing climate.
- **Beyond public transport, place the broader urban transport system on a sustainable path.** In particular, expand public transport capacity with increased service, routes, and vehicle fleets where needed, integrate transport systems into safe walking and cycling infrastructure and disincentivize unnecessary highway building and private vehicle travel. The goal should be to create climate-friendly urban mobility.
- **Make connections across sectors and support sub-national action.** Governments should work to connect NDCs with appropriate ministries, such as transport and health, as well as tap into the power of cities and states to implement improvements.

INTRODUCTION

To meet global climate goals, urbanized areas need to rapidly lower passenger transport emissions. The sector represents around 24 percent of direct CO₂ emissions from fuel combustion (IEA 2020b) and, without meaningful policy interventions, is expected to grow.

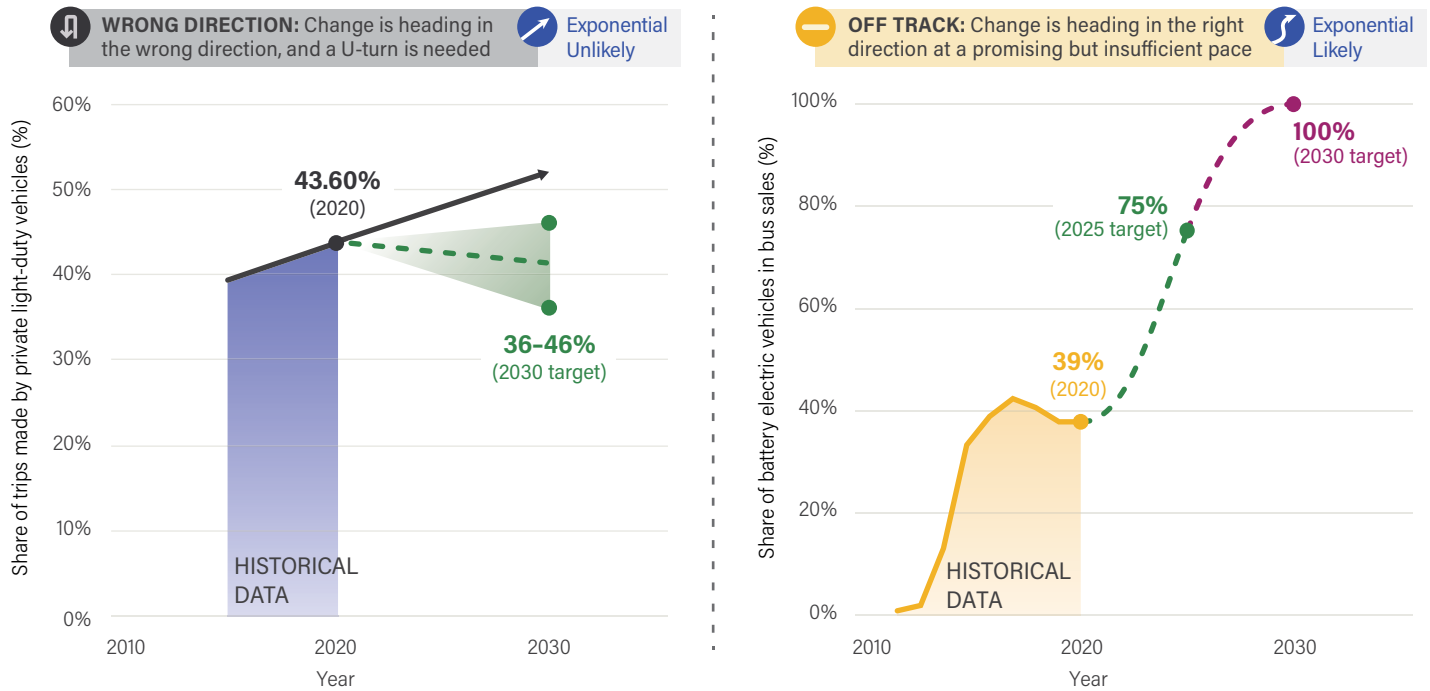
Significant environmental and societal benefits could be achieved through an avoid-shift-improve approach (Bongardt et al. 2019): avoiding unnecessary vehicle travel through shorter trips and land use that reduces dependence on vehicle travel; shifting travel to sustainable modes, such as walking, cycling, and public transport; and improving the efficiency of travel through electrification and greening fuel sources (Dalkmann and Brannigan 2014).

WRI's *State of Climate Action 2021* report finds that electrification is progressing too slowly and that the gap in needed emissions reductions will have to be met by decreasing motor vehicle travel. Globally, motorization is on the rise, but the percentage of motor vehicle trips (measured in passenger-kilometers) should be cut from its predicted 50 percent by 2030 to between 36 percent and 46 percent. In parallel, public transport vehicles must be electrified rapidly such that electric vehicles make up 75 percent of global bus sales by 2025 (Boehm et al. 2021) (see Figure 1).

Other recent studies show a need to both electrify transport and abate vehicle travel to meet global climate goals. A recent scenario analysis by the Transformative Urban Mobility Initiative finds that for the world to be on a pathway to 1.5°C, cities may need to as much as double public transport capacity by 2030 (Teske et al. 2021). Another analysis by the Institute for Transportation and Development Policy (ITDP) and UC Davis found that we can only meet Paris Agreement goals by shifting to sustainable travel and compact urban development (especially prior to 2035), along with a massive scale-up of electric vehicles (Fulton and Reich 2021).

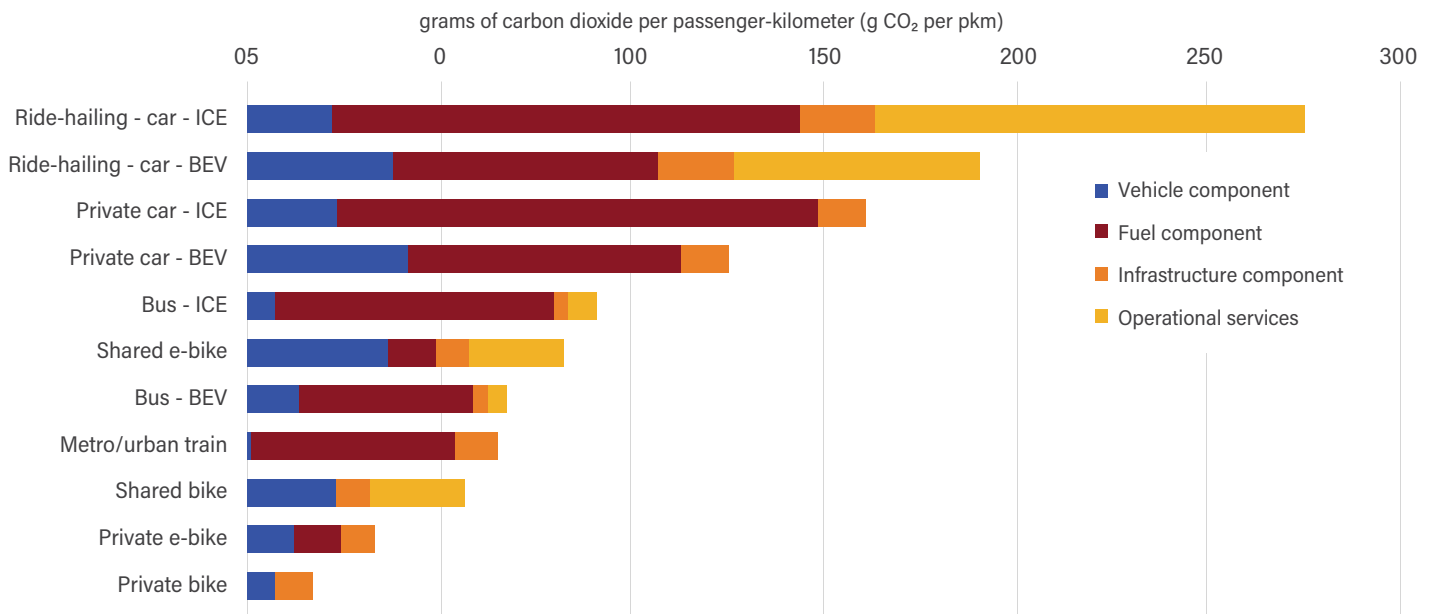
Since every year of continued high-carbon emissions reduces the chances of reaching the 1.5°C goal, it is critical to implement measures that expand public transport, which is currently the most efficient motorized travel mode. According to the International Transport Forum (ITF), emissions per passenger-kilometer from electric buses and trains are currently about one-quarter of those from ride-hailing and less than one half of those from private vehicles (Cazzola and Crist 2020) (see Figure 2).

Figure 1 | Global Travel Shifts and Bus Electrification Needs to Meet Climate Goals



Source: Reproduced from Boehm et al. 2021.

Figure 2 | Greenhouse gas (GHG) emissions per passenger-kilometer (pkm) by transport mode



Note: e-bike = electric bike; ICE = internal combustion engine; BEV = battery electric vehicle.

Source: Cazzola and Crist 2020.

Additionally, if reductions in passenger-kilometer travel demand do not materialize, the share of electric vehicles in the global car fleet would need to more than double from around 20 percent to 45 percent by 2030—probably an unachievable goal—to ensure the same level of emissions reductions (IEA 2021). In the next crucial decade, immense gains can be made by shifting travel to public transport and electrifying fleets.

Expanding public transport infrastructure is also a climate action that provides equity, health, and other sustainable development benefits. Cities are the powerhouses of national economies, and the best way to keep cities healthy and productive is through equitable access to public transport services. In most cases, vulnerable populations, such as low-income communities, children, and the elderly, are the most dependent on affordable public transport services. When extensive, high-quality systems are provided, more people have improved access to opportunities such as jobs, education, and services.

Research has shown that the more public transport is prioritized, the safer are city streets, reducing injuries and fatalities by as much 50 percent in some cases (Duduta et al. 2015). One study from the United States showed that public transport has one-tenth the traffic casualty rate of automobile travel, and residents of transit-oriented communities have about one-fifth the crash casualty rate per capita that automobile-oriented communities have (Litman 2014). In addition, projects such as Bus Rapid Transit (BRT) and bus electrification have been shown to reduce exposure to air pollutants in busy traffic corridors (Litman 2014). Lastly, people who use public transport tend to be more active, and improving public transport in the context of wider improvements to accessible walking and cycling can increase healthy physical activity (Chang et al. 2017).

Given the importance of public transport in meeting climate, health, and equity goals, we are seeking to better understand what role it plays in Nationally Determined Contributions (NDCs) (UNFCCC 2020a). NDCs are the specific policy commitments countries make to meet the goals of the Paris Agreement to stay well below 2°C and strive towards no more than 1.5°C of global temperature rise compared to pre-industrial levels (UNFCCC 2020a). Given the significant share of emissions that originate from the transport sector, every country has an opportunity to leverage public transport, electrification, and active mobility measures to reduce emissions and bridge the gap to achieving these climate goals.

Approach and Methodology

While extensive literature on NDCs exists, only a few publications have examined the NDCs through a transport lens (Fransen et al. 2019; Medimorec 2021; SLOCAT and IsDB 2021; Eichhorst et al. n.d.), and few, if any, cover public transport specifically. In this working paper, we examine the extent to which the latest NDCs (up to January 2022) include public transport, the different ways in which it is mentioned, and the extent to which countries are providing specific targets and measures. We include background information on Paris Agreement governance and provide further information on how NDCs are drafted and implemented, which we obtained from expert interviews.

Data on the role of transport in NDCs was sourced from the “Tracker of Climate Strategies for Transport” dataset from Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Sustainable, Low Carbon Transport (SLOCAT) Partnership.¹ More general data on NDCs was gathered from ClimateWatchData NDC Enhancement Tracker. Within the main “Tracker of Climate Strategies” dataset, we used the “Mitigation” page to filter the data using existing categories. First, we eliminated irrelevant documents to focus on first, second, and updated NDCs; then we used the parameter filter to select all categories relevant to public transport. These include shifting travel to Bus Rapid Transit (*S_BRT*); shifting to public transport (*S_PublicTransport*); expanding and integrating public transport (*S_PTIntegration*); building rapid transport systems, such as light rail and bus priority lanes (*S_PTPriority*); and electrifying vehicles (*I_Emobility*) in the cases where the text refers to electrification of buses and trains. The “Targets” page was used to supplement data in those cases in which we were looking for specific targets related to public transport and mode shift. We then identified a set of key opportunities that can guide countries to continue strengthening national climate action through public transport while also addressing broader development agenda items, such as health, equity, and overall sustainable development.

NATIONALLY DETERMINED CONTRIBUTIONS AND TRANSPORT

NDCs set out countries' intentions and plans to address climate change under the 2015 Paris Agreement. Collectively, the impact of NDCs, if fully implemented, will determine whether the world can peak greenhouse gas (GHG) emissions by mid-century and avert the irreversible effects of climate change by keeping the global average temperature rise below 2°C, preferably 1.5°C, compared with pre-industrial levels (UNFCCC 2020b).

Submissions of NDCs are scheduled to happen every five years (e.g., 2020, 2025, 2030) and the term “NDC enhancement” is used to capture the idea of NDC progression reflecting the countries’ “highest possible ambition” (UNFCCC 2020a). The intention is that increased enhancement will bring them more closely into alignment with the goals of the Paris Agreement to mitigate greenhouse gases, maximize resilience by adapting to climate change, incorporate relevant opportunities to strengthen implementation, and improve transparency (Fransen et al. 2017). Unfortunately, the latest UNFCCC’s synthesis reports repeatedly highlight that NDC mitigation goals are far from where they need to be, demonstrating the need for further enhancements and international cooperation with the next round of NDC submissions (UNFCCC Secretariat 2021; 2016).

In a previous working paper, WRI provided guidance for updating NDCs in the transport sector. Guidance included recommendations to fill previous gaps in existing NDCs by accelerating electrification; amplifying “avoid” and “shift” solutions, such as public transport, walking, and cycling; and more comprehensively addressing freight emissions (Fransen et al. 2019). In the first round of NDC submissions at the outset of the Paris Agreement in 2015, public transport measures were not prominent, and, for this reason, the authors recommended focusing on this area. Furthermore, they suggested linking raised ambition to a green recovery coming out of the global pandemic and economic upheaval, and they noted that key strategies included stabilizing and strengthening public transport within metropolitan areas; avoiding investments in large highway projects; and funding and incentivizing vehicle electrification, particularly electric buses (Welle et al. 2021).

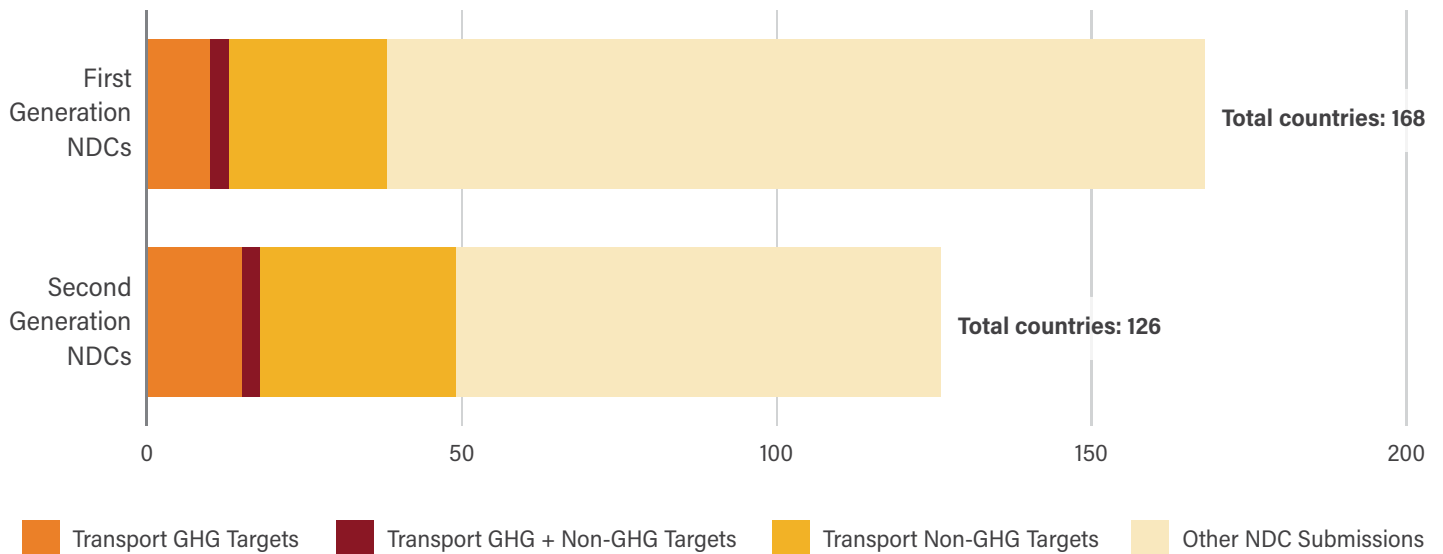
As of the end of 2021, countries had indeed progressed to include more measures in transport in their NDCs. However, more progress on avoid-shift actions is still needed—now even more urgently. An analysis of the second round of NDC submissions from GIZ and SLOCAT found the following:

- The countries that have submitted new NDCs collectively account for 73 percent of global emissions from transport (Changing Transport 2022). However, most of the countries with targets are small, and many of the highest emitters fail to set targets for reducing emissions from the transport sector.
- Thirty-nine percent of second-round NDCs contain transport targets as opposed to only 21 percent in the first submissions (Medimorec 2021) (see Figure 3).
- Eighteen second-round NDCs have a transport GHG mitigation target (14 percent of all second-round NDCs), and a total of 76 non-GHG transport targets were found across all NDCs.² A GHG target is one that includes a direct reference to CO₂ (or equivalent) reduction, such as Japan’s target for transport emissions to be at 163 million tCO₂ by 2030. A non-GHG target has a quantifiable goal without a direct reference to emissions, such as Chile’s target for “58 percent private vehicles by 2050 to be electrified.” The NDCs with targets cover only 3.6 percent of global transport emissions (Changing Transport 2022).

Importantly, however, this research finds that the “percentage of mode share targets reduced significantly between the first and second round of NDCs” and that “transport mitigation measures continue to lean towards system efficiency improvements over transformation” (Medimorec 2021). Furthermore, actions outlined in NDCs are not sufficiently aligned with national policies to implement real change and reduce emissions.

Only 18 second-round NDCs link transport to specific Sustainable Development Goals (SDGs) (Medimorec 2021). SDGs are the UN’s 17 goals for sustainable development that focus on key issues, like poverty eradication, health, equality within and among countries, terrestrial and marine ecosystems, and climate change. Connecting climate action to the SDGs can bring about change beyond technology transitions and help create a healthier, more equitable world. Sustainable transport is main-

Figure 3 | Number of Countries That Include Transport Targets in First and Second Generation NDCs



Source: GIZ, updated November 2021.

streamed across several SDGs, especially those related to food security, health, energy, economic growth, infrastructure, poverty alleviation, and cities and human settlements (Tun et al. 2021) (see Figure 4).

This provides a good basis for further exploration of specific actions to improve public transport in NDCs, including the degree to which countries are or are not raising ambition through, for example, targets for rapid transport infrastructure, bus electrification, mode share targets, and improved goals for adaptation and resilience. In the second-round NDC submissions, more countries have committed to non-GHG targets related to the transport sector, but since these are still vague, they have not led to major CO₂ reductions. Thus far, every country has an opportunity to enhance ambitions to reduce or limit emissions; to enable the transformation of transport systems away from private motorized travel towards cleaner, more sustainable modes; and to improve the health and safety of transport users (SLOCAT 2022).

PUBLIC TRANSPORT IN THE NDCS

As stated in the methodology section, we utilized two NDC trackers to gather data on public transport measures from the most updated NDC document for each country across first, second, and updated NDCs. We then narrowed the search to identify how many NDCs mention public transport and further disaggregated these data to isolate countries that identify specific targets on mode share shifts, fleet electrification, and adaptation. The aim of this section is to summarize the ways in which public transport is integrated into NDCs and to identify gaps and opportunities for further enhancement. The analysis has resulted in the following key findings.

Findings

Out of the 142 NDCs representing 168 countries, 100 specifically mention public transport as a tool for reducing transport emissions. Of these, several outline specific non-GHG-related targets for 2030. Targets included, for example, electric buses making up a certain percentage of bus purchases, expanding public transport infrastructure or rail lines by several kilometers, and shifting a percentage of road traffic to rail. There are also measures that encourage cleaner mobility, increased efficiency, the promotion of electric vehicles, and reduced transport demand. These aims, which remain broad and unmeasur-

Figure 4 | **Transport-Related SDG Targets and Corresponding Approaches**

SDGS	SDG TARGETS	POTENTIAL MOBILITY ACTION AREAS
 <p>Health & Well-being</p>	<ul style="list-style-type: none"> • By 2030, halve the number of global deaths and injuries from road traffic accidents • By 2030, substantially reduce the number of deaths and illnesses from pollution 	<ul style="list-style-type: none"> • Speed calming and management measures • Safety training and equipment for drivers • Transport modes and tech that improves air quality
 <p>Gender Equality</p>	<ul style="list-style-type: none"> • Achieve gender equality and empower all women and girls 	<ul style="list-style-type: none"> • Inclusive labor and employment in mobility and transport operator sector • Enforcement and accountability to eliminate sexual harassment
 <p>Affordable, Reliable, Sustainable and Modern Energy for All</p>	<ul style="list-style-type: none"> • By 2030, double the global rate of improvement in energy efficiency 	<ul style="list-style-type: none"> • Renewable energies and resources in the entire lifecycle of vehicle production to end of life disposal • Compact, connected, and coordinated urban growth based on well-integrated land use and transport planning
 <p>Inclusive and Sustainable Economic Growth for All</p>	<ul style="list-style-type: none"> • Achieve higher levels of economic productivity through diversification, innovation • Focus on high-value-added and labor-intensive sector 	<ul style="list-style-type: none"> • Investment in a variety of mobility systems to provide direct job creation opportunities
 <p>Resilient, Inclusive Infrastructure</p>	<ul style="list-style-type: none"> • Develop quality, reliable, sustainable, and resilient infrastructure that is equitable, to support economic development and human well-being 	<ul style="list-style-type: none"> • Robust and reliable public transport with inclusive access, particularly to low-income areas • Affordable mass transit and last-mile connectivity
 <p>Make Cities Inclusive, Safe, Resilient and Sustainable</p>	<ul style="list-style-type: none"> • By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, notably by expanding public transport, with special attention to the needs of those in vulnerable situations • By 2030, reduce the environmental impact of cities, particularly in areas of air quality and waste management 	<ul style="list-style-type: none"> • Bike and pedestrian infrastructure that is safe, complete, and integrated with mass transit • Open data to improve trip planning, transit operation, and service planning
 <p>Climate Action</p>	<ul style="list-style-type: none"> • Implement the Paris Climate Change Accord, which seeks to rationalize inefficient fossil-fuel subsidies in accordance with national circumstances 	<ul style="list-style-type: none"> • Adoption of e-mobility and stricter emission standards • Emphasis on sustainable, non-motorized modes of transport

Source: WRI Authors.

able, make up most NDC commitments. Examples include “Prioritize public transit” or “Introduce BRT” (UNFCCC 2022). While these goals demonstrate the intention to improve infrastructure and transport options, they lack accountability, quantitative targets, and ways to track progress (see Figure 5).

Only six countries mention emissions reduction as part of their NDC public-transport commitments,³ and one additional country, Jordan, has set a target to reduce GHG emissions by 2–14 percent through compact city planning and public transportation. Two countries have targets for both electrification and mode shift. Israel aims to shift 20 percent of private transport to public modes and will purchase only electric municipal buses starting in 2026. Jordan also plans to increase the share of commuters using public transport to 25 percent, to purchase 73 electric buses, and to engage in emissions reduction targets in its five major cities.

Of the 100 NDCs that mention public transport, 55 promote a shift from private vehicles to public transit. Only thirteen countries have quantitative targets related to mode shift. For example, India’s first NDC⁴ vows to shift 45 percent of road transport to rail; Bangladesh will shift 10–25 percent of

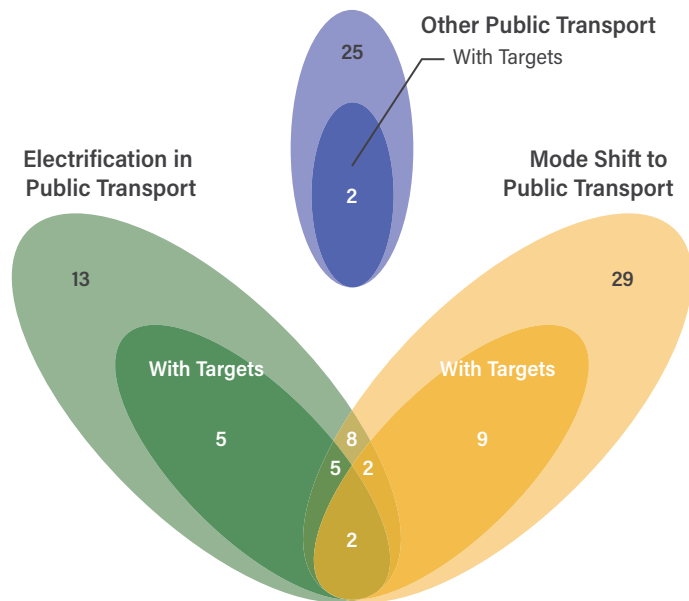
passenger-kilometers from road to rail using underground metro systems; and Malawi strives to increase the share of passenger transit from 10 percent to around 30 percent by 2040. Most NDCs, however, use vague terminology: Andorra “prioritizes” public transport; Mexico states an opportunity for the “encouragement of alternative transportation systems;” and Singapore is “taking steps to make public and shared transport the preferred mode of travel” (UNFCCC n.d.). While these measures demonstrate the importance of convenient and accessible public transit, the scale of the commitment remains unclear.

Other countries commit to initiatives or targets to construct high-volume transit that will make public transportation more accessible and convenient. Measures to improve and expand infrastructure will likely induce a mode shift away from private vehicles. By 2030, Rwanda will construct 17 km of BRT corridor and six modern interchanges with dedicated lanes for use during rush hour, and Sri Lanka will introduce BRT for the Galle Road Corridor. In addition to implementing BRT or mass rapid transit (MRT), Myanmar will electrify transit, and Nepal will construct 200 km of electric rail network to support public commuting.

Thirty-five countries have commitments on electrification of public transport vehicles. Electrification applies to multiple modes of transport, including two-wheel motorcycles, three-wheel rickshaws, vans, buses, trolleys, rail, and even water transport and helicopters. Twelve countries mention electrification measures in the public transport sector but do not specify the vehicle type; 15 specify intentions to introduce or expand electric bus fleets; 7 countries intend to electrify or refurbish electrified rail lines; and 2 countries integrate electrification with rapid transit (see Table A.2. in Appendix A).

Looking at electrification targets from countries with ambitious or exemplary language in their NDCs, Nepal aims for electric vehicles to make up 20 percent of all four-wheel public vehicle sales by 2025, while Panama has set the same target for 2030. Costa Rica’s NDC states that at least 8 percent of public buses will be electric by 2030, but sets the more ambitious commitment in its National Decarbonization Plan that 85 percent of all public transport be zero emission by 2050 (Government of Costa Rica 2018). Along with setting measurable targets, coupling electrification with clean, renewable energy sources is critical to linking public transport with climate goals. Countries making strong commitments include the Marshall Islands, which are introducing solar-charged electric lagoon transport, and Costa Rica, which will begin operation of its renewable-powered TELCA electric rail line in 2022 (Smith 2022).

Figure 5 | **Public Transport Measures and Targets in NDCs**



Note: “Other Public Transport” refers to infrastructure expansion and improvement; dedicated funding; upgrading tracking and payment systems; switching to cleaner fuels (biofuel, natural gas); and improving accessibility.

Source: WRI Authors.

We found that no NDCs mention measures in the informal or semiformal transport sector. Angola is the only country to recognize the informal transport sector in its NDC. The country acknowledges that popular “Candongueiros” (old vans used for informal transport) contribute to pollution in cities but identifies no measures to address them. The informal sector is a dominant mode of transport in many countries in the Global South and leaving it out of climate measures fails to address potentially the oldest, most polluting vehicles on the road. Meanwhile, 34 NDCs include language about other informal economic sectors: workforce, housing, education, waste collection, and even water sources. Similarly, NDCs do not address import regulations applying to used public transit vehicles. Only Antigua and Barbuda establish efficiency standards for all imported vehicles, and Mauritius committed to phasing out subsidies and incentives for the importation of diesel buses. Others have age restrictions on vehicles, but it’s unclear if these refer to trucks and buses as well.

NDCs of some of the largest countries with the highest vehicle kilometers traveled (VKT) lack commitments to reduce emissions and support a shift to public transit. The United States has one of the highest rates of VKT per capita, yet its NDC only promises to “make more choices available to travelers, including transit, rail, biking, and pedestrian improvements to reduce the need for vehicle miles traveled” (United States of America 2021). Other large nations with high rates of motorization are also failing to lead in this area. Australia only plans to improve vehicle efficiency and does not address public transport. China plans to quicken the construction of large-capacity public transport infrastructure and, although it has significantly scaled up rapid transit infrastructure in recent years, it does not have targets for the scope of the investment. Canada, however, has made a target to invest CA\$3 billion annually in permanent public transit funding beginning in 2026-27.

Of 78 countries with adaptation measures in their NDCs, 16 include public transit adaptation. The world is witnessing an increasing rate and intensity of extreme weather events, from wide-spread heat waves and flooding to localized tornadoes and fires, each requiring innovative solutions to maintain the resilience of transport infrastructure. Overall, transport adaptation measures in NDCs are vague, with very few specifically addressing the risks facing public transport. A few countries highlight the fragility of the transport system and a need for “transportation technologies that are resilient to the adverse effects of climate change, in particular for roads and mass transportation” (Government of Mexico 2020). Another emphasizes “creating affordable, reliable and accessible transport services to the community” (Republic of Rwanda 2020). Cambodia notes that increased public transit infrastructure can be critical during

emergency events. An additional 20 countries have measures that could be related to public transport, such as upgrading public infrastructure; protecting roads from flooding; reducing mobility disruptions; and climate-proofing critical infrastructure, such as bridges, tunnels, airports, and powerhouses.

OPPORTUNITIES FOR ENHANCEMENT AND IMPROVED IMPLEMENTATION

In this section, we reflect on our analysis, draw upon existing transport literature and on-the-ground policy practices, and identify several key opportunities for sub-national governments, local authorities, NGOs, and urban planners to raise ambition through public transport in the NDCs. In addition to findings from our NDC analysis, we used results from a previous paper on the role of transport in green recovery to develop recommendations for NDC enhancement in the public transport sector (Welle et al. 2021).

Some nations may include public transport mitigation measures in their NDCs but do not match ambitions with national policies to implement them. In addition, some countries may have national policies in place to promote public transport that are not linked to their NDCs, in which cases the NDCs fail to reflect the full extent of emissions-reduction efforts. This issue looms larger at the sub-national level, where cities or provinces may be improving public transport outside the framing of NDCs at the national level. Here we identify five steps for enhancing NDCs to encourage the implementation of targets relating to transport systems.

Commit to specific mobility action plans and institute robust funding for public transport infrastructure and operations.

Governments should move beyond general references to support public transport and make targeted commitments; for example to implement sustainable urban mobility plans (SUMPs) that contain national and/or city-level plans and clear signals to improve public transport infrastructure and financing (see Figure 6 for a sample roadmap with specific policies, targets, and incentives). Ideally, these plans should be linked to goals on abating private vehicle travel.

Funding for public transport could be made available by re-directing financial flows from unsustainable investments, such as fossil fuel subsidies, to more sustainable assets or by tapping other economic instruments, such as vehicle taxes, road pricing

ing, and fuel taxes. Further support can be provided through National Urban Mobility Plans, which include target setting and investment plans. While local governments are often responsible for managing public transport in cities, national governments can provide an enabling environment, funding and supporting policies that develop quality rapid transport infrastructure and ensure operational support.

Many national governments directly finance the construction of rapid transit infrastructure, particularly BRT, Light Rail Transit, and Metro. Recent data, however, suggests that outside of China, countries are building less rapid transit than they were 10 years ago (Hook 2021) (see Figure 7).

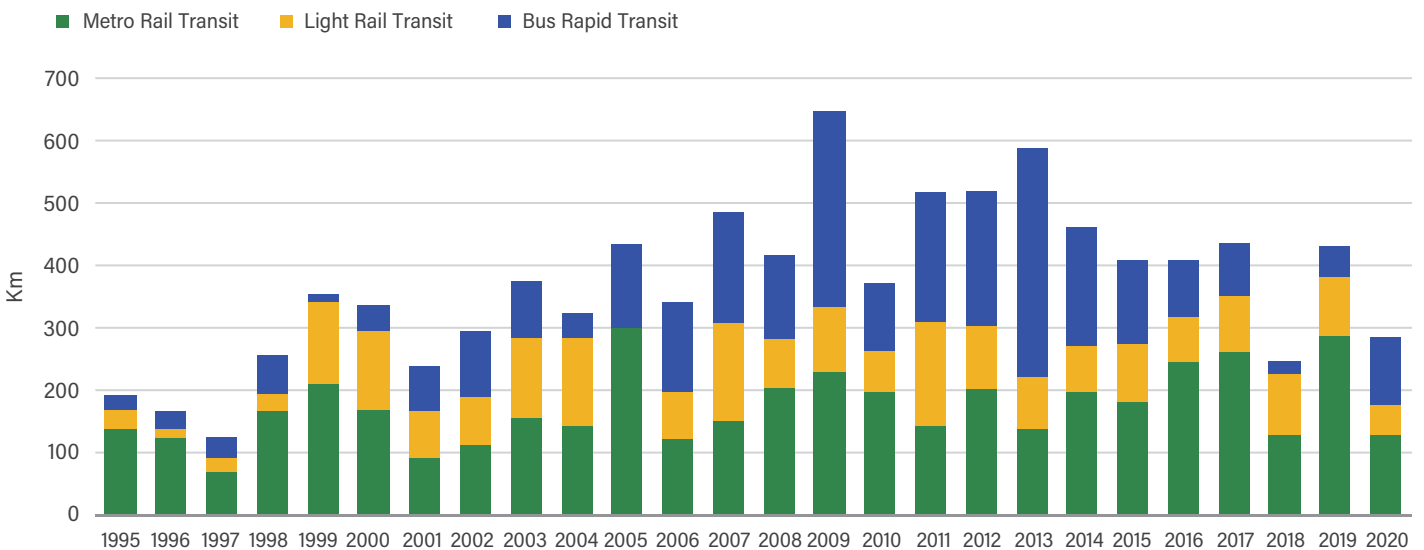
While multiple countries have national financing programs in place to support public transport projects, they are rarely connected to NDC measures. Canada provides a good example of making a specific commitment on financing public transport, noting that it will “dedicate \$3 billion annually in permanent public transit funding beginning in 2026-27” (Government of Canada 2021), a policy not just in its NDC but one announced by Infrastructure Canada (Infrastructure Canada 2021). Other opportunities exist for more ambition, such as establishing national public transport funding programs, as some countries have done (Owen et al. 2012). For example, India’s current NDC notes that the country will “approve construction of 39 urban transport and mass rapid transport projects,” but it may

Figure 6 | A Sample Roadmap with Specific Policies and Targets

CASE	EXAMPLE ROADMAP	POLICIES	TARGETS
Santiago, Chile	Plan for the Prevention and Decontamination of Atmospheric Pollution for the Santiago Metropolitan Region (2017)	<ul style="list-style-type: none"> Coordinate zero-emission vehicles (ZEV) and low-emission vehicle purchase incentives Promote a regulatory framework to determine vehicle energy efficiency standards 	<ul style="list-style-type: none"> 2018: Develop an incentive strategy for ZEV and low-emission vehicles 5% of new taxi registrations must be electric (timeline unclear)

Source: Adapted from Liu et al. 2022.

Figure 7 | Global Kilometers of New Rapid Transit (excluding China)



Source: Adapted from Hook 2021.

be able to raise ambition through policies already under consideration. The national government is considering a proposal to finance, acquire, operate, and maintain over 20,000 clean fuel buses for cities across the country (Singhvi et al. 2021). If adopted, this measure could easily be added as a new non-GHG target in India’s NDC to better reflect the full extent of India’s actions and potential for emissions reductions in the coming years. Indonesia recently launched a national public transport financing program with the World Bank, which could lead to a strengthened NDC (World Bank 2022). The United States refers to public transport generally, but, since the submission of its NDC, it has passed major legislation funding public transport infrastructure. This legislation could provide the basis for setting new targets that work towards a determined minimum of public transport infrastructure to be built (even though it still may be inadequate to meet emissions reduction goals by 2030).

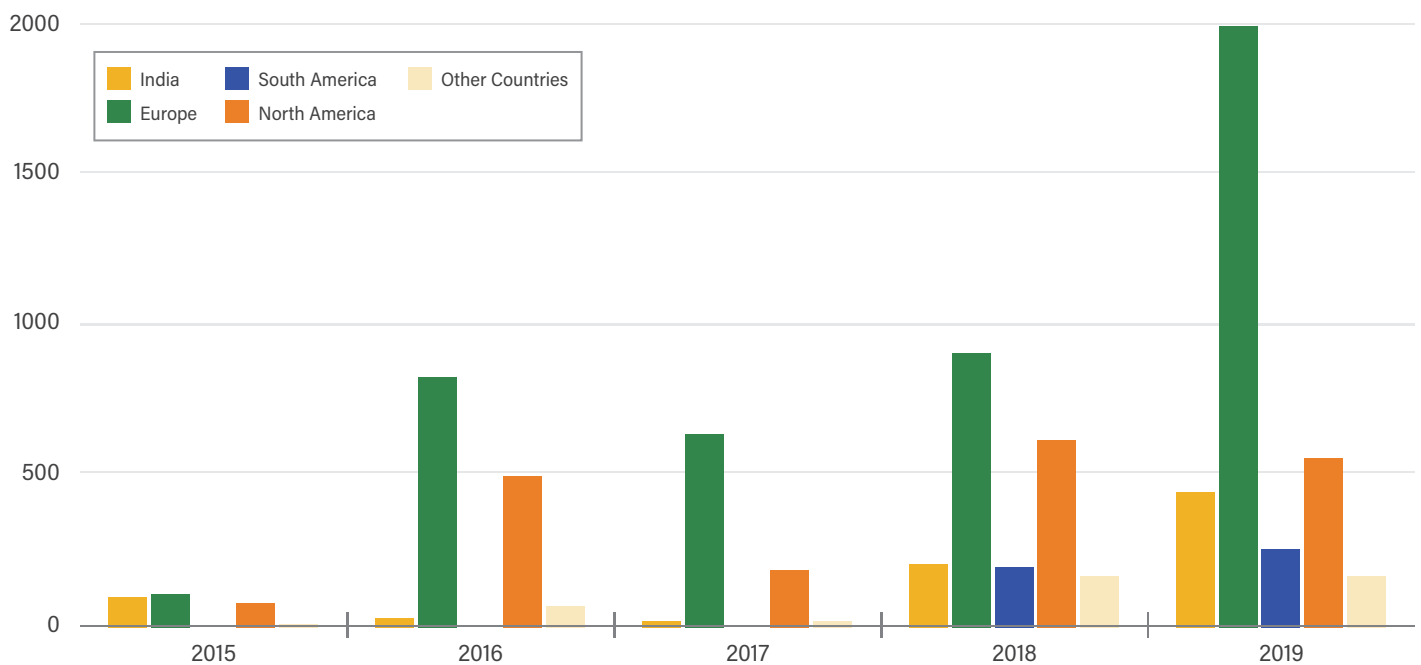
Unfortunately, despite the importance of expanding and improving infrastructure, the global pandemic has led to lower ridership and hampered the ability of public transport operators to maintain previous levels of reliable service (Welle et al. 2021). While there are increased reservations about the safety of public transport, it is still a critical service that connects people with opportunities. National governments can directly aid cities and

transit agencies by relieving the pressure to break even from fare revenue. In Mexico, the government is considering a proposal that includes a plan to finance the semi-formal transit providers who conduct a major portion of public transport trips in cities. The funding would be tied to incentives for increasing their integration into the wider system (Hernández and Davidson 2022). If realized, such measures could be added to strengthen Mexico’s NDC. Furthermore, since the global pandemic has disrupted public transport revenues across many nations and cities, such measures may be crucial to ensuring that trips do not shift to private vehicles and worsen emissions. While there are no identifiable NDC measures on funding operations, their addition would signal a recognition of the role the sector plays in mitigating climate change.

Initiate a 100-percent transition to clean electric bus fleets.

While a handful of countries include national commitments to electrify public transport buses, across the globe, opportunities abound to scale up (see Figure 8). In particular, specific targets for bus electrification should be developed and national programs should support cities in achieving these targets (Li et al. 2019).

Figure 8 | **New Electric Bus Registration by Country/Region (excluding China), 2015-19**



Source: IEA 2020a.

Not only would electrifying public bus fleets globally help reduce emissions, it would also greatly improve services and health. Research on urban bus fleets in 20 megacities shows that battery electric buses have lower lifecycle GHG emissions than diesel buses even with current electricity grids and have significantly lower emissions in cities that use renewable sources of energy (Dallmann et al. 2017). Electric buses are also less costly to run, with lower total capital and maintenance costs (C40, BNEF 2018).

Programs from China and Chile have shown how governments can support the procurement of these buses where operators may not have otherwise been able to fully cover upfront costs. Chile provides an excellent example of an NDC matched with national policy and implementation. The country's NDC seeks to electrify 100 percent of its public transport buses by 2040. To implement this goal, the country established a program under which the Ministry of Transport and Telecommunications works with local transport agencies, other ministries, and private partners to provide funding for the procurement of electric buses (World Bank 2020).

Advance resilience and adaptation measures for public transport.

Extreme weather events and heat are becoming more common, and most countries still lack planning to make public transport systems more resilient. Programs to fund public transport infrastructure at the national level (like those mentioned above) can include requirements for boosting resilience of public infrastructure in the sector. NDCs can help move the process forward. For example, NDCs can be linked to the Principles of Resilient Infrastructure, a collaborative effort led by the UN Office for Disaster Risk Reduction to describe key actions and guidelines to improve resilience in the face of climate change (UNDRR 2022).

In the last few years, the world has witnessed dramatic weather events that have wreaked havoc on public transport and threatened the lives of the people using it. For example, subways in China, the United States, Japan, and the United Kingdom have all been challenged by flooding. Heat is another major threat to the transportation system. Pavement and cables can buckle, and high temperatures can prove unbearable for people riding in more informal systems. In Portland, Oregon, the city's public transit authority shut down its trams in the summer of 2021 because the extreme heat melted its power cables (Gordon 2021). Experts note that the harm caused by such weather events may also discourage people from using mass transport (Tabuchi and Schwartz 2021).

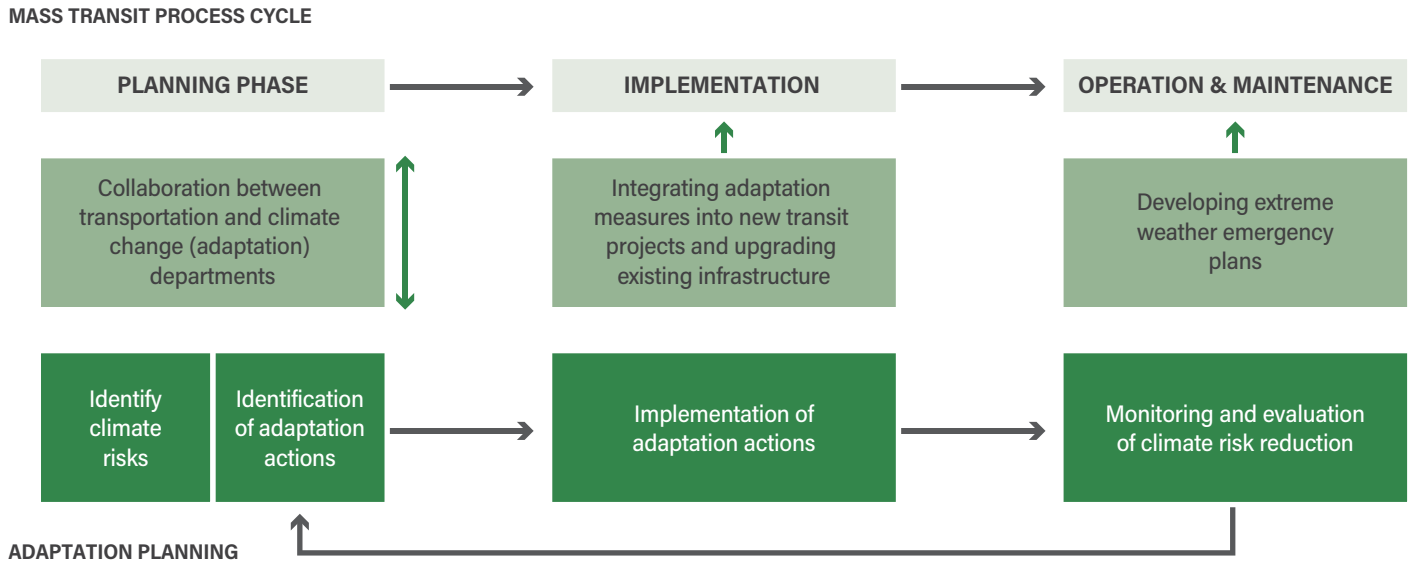
Improving resilience starts with a network criticality analysis to identify the most vital segments of a transport system, followed by vulnerability assessment to target potential risks. As outlined by C40, specific measures around public transport adaptation include avoiding its placement in flood-prone areas, flood-proofing BRT or metro stations, adjusting to extreme heat through shading stations and transit corridors, and thoroughly insulating power supplies to cope with sea level rise or higher temperatures (C40 Cities Climate Leadership Group 2019). NDCs can play an important role by promising to integrate adaptation into planning, implementation, and operations of public transport (see Figure 9).

Place the broader urban transport system on a sustainable path.

While this paper is primarily concerned with how public transport has been included (or excluded) in NDCs, there are broader urban mobility policies that help shape the sector. NDCs should strengthen targets to reduce overall vehicle travel and dependence on private vehicle ownership, identify goals for walking and cycling, encourage compact development and discourage investment in unnecessary urban highways, and promote public transport.

Historically, many countries have pursued urban growth and highway expansion policies that have hindered public transport and encouraged private vehicle travel. For example, in the United States, past policies subsidized new homes in car-oriented suburbia, tore down urban neighborhoods to build freeways, and cut public transit (Fitzgerald and Agyeman 2021). Planning for the movement of private vehicles is dominant in many cities around the world, from the construction of large highways in Nairobi to elevated highways (*segundos pisos*) in Mexico to expressways built along the waterfront in Mumbai. If climate action policies support high quality public transport but continue to expand large infrastructure and planning for private vehicles, there will likely be a growth in carbon emissions.

Figure 9 | Integrating Adaptation in Public Transport



Source: C40 Cities Climate Leadership Group 2019.





Make connections across sectors and with sub-national action.

Policymakers developing more robust NDCs are often located within environmental or foreign ministries that are responsible for climate change policy or relations with the United Nations under the Paris Agreement. However, transport is often a sector that falls under a ministry of transport, infrastructure, or urban development. It is crucial that strong collaboration exist across these ministries to ensure that NDCs are not superficial nods to ideal measures, such as vehicle electrification or modal shift, but are connected to actual policies and programs that make implementation feasible.

More directly linking NDCs to the global sustainable development agenda is also crucial. If leaders are seeking the required system change in the transport sector, they also need to take actions that improve equity, such as increasing access to jobs and opportunities, and that improve health, such as enhancing road safety and reducing air pollution. Public transport connects to several Sustainable Development Goals, including health and well-being, gender equality, inclusive and sustainable economic growth, resilience, and thriving cities. Malawi’s NDC is a good example of a country that identifies relevant ministries for implementation and notes where SDGs may connect (Republic of Malawi 2021) (see Figure 10).

NDCs do not encompass the full climate action of a nation, as they reflect politically agreed-upon commitments (Coglianese 2019), and do not necessarily reflect sub-national actions. However, cities and states are acting—many in a more determined way than their own national governments—to address climate change in the transport sector. Efforts include electrification of bus fleets, dedication of more space to public transport, and provision of primary financing for public transport. It is crucial that national governments coordinate with and enable local governments to bolster and complement their own commitments and programs.

Figure 10 | Malawi's NDC Indicating Ministries Associated with NDC Measures

NDC MEASURE	LINE MINISTRY (FOCAL POINT)	OTHER KEY IMPLEMENTING ENTITIES	TOTAL ESTIMATED FUNDING	ADAPTATION AND RESILIENCE CO-BENEFITS	ALIGNMENT WITH SDGS
<p>Modal shift: private to passenger transport— Increasing the share of passenger transport from around 10% at present to around 30% in 2040, reducing GHG emissions from gasoline and diesel use.</p>	MOTPW, MOLG (Department of Road Traffic and Safety Services).	Passenger Associations, Bus Operators Associations, City Councils, private transport costs.	US\$ 138 million	Increased resilience of transport infrastructure. Improved health and reduction of harmful local air pollutants, enhancing resilience of population to disease and adverse climate impacts.	   

Source: Republic of Malawi 2021.

CONCLUSION

The clock is ticking on whether the world can deliver the climate action needed to keep global temperature rise to well below 2 degrees and strive toward 1.5 degrees, as sought under the Paris climate agreement. Public transport is a tool that can be used now to reduce car dependence, commute times, traffic fatalities, transport emissions, and inner-city noise pollution, making cities better places to live. As countries are being asked to come again to COP27 in Egypt in November 2022 with more ambitious NDCs, there is a chance to use this moment to increase implementation.

Based on observations of the first and second round of NDC submissions, it has become clear what makes for a well-crafted document. An ideal NDC connects national and sub-national policies; includes data on current transport sector emissions and articulates ambitious yet feasible emissions reduction targets; and has additional non-GHG targets for electrification, mode

shift, and investments in public transport on the national and sub-national level. Targets should have a clear path to implementation, with measurable milestones to track progress. Furthermore, the document should demonstrate an awareness of the nation's economic and political context: measures should address the informal sector when relevant, and, in the case of developed countries, reducing private vehicle ownership and passenger kilometers traveled should be emphasized. Finally, the NDC should address mitigation and adaptation measures to prepare for the changes brought by climate change and acknowledge the risks of damage to the transport sector and the second-hand impacts on health, safety, and the economy.

APPENDIX A: COUNTS OF PUBLIC TRANSPORT IN NDCS

The following tables provide the number of NDCs that include public transport, organized by category, as well as a list of countries where electrification of public transport is mentioned.

Table A.1 | **Count of Countries with Public Transport in NDCs**

TOTAL NUMBER WITH PUBLIC TRANSIT IN NDCS	100
Public Transit that does not fit categories	27
Quantitative targets (not electrification or mode shift)	5
All countries that mention electrification (measures and targets)	35
All countries that mention mode shift (measures and targets)	55
Only have measures to electrify transit (no targets, no mode shift)	13
Only have measures for mode shift (no targets, no electrification)	29
Both electrification AND mode shift measures (no targets)	8
Only electrification targets (includes countries with mode shift measures but no targets)	10
Only mode shift targets (includes countries with electrification measures but no targets)	11
Both electrification and mode shift targets	2

Note: Total number does not sum to 100 due to overlap across the categories. For exclusive categorization see Table A.3.

Source: WRI Authors.

Table A.2 | **Country/Territory Categorization Breakdown for Electrification of Public Transport in NDCs**

CATEGORY	COUNTRIES/TERRITORIES
General Electrification*	Azerbaijan, Burundi, Cabo Verde, Chile, Ethiopia, Fiji, Honduras, Mauritius, Mexico, Qatar, Uruguay, Uzbekistan
Electric Buses	Barbados, Belize, Congo, Costa Rica, Dominican Republic, Israel, Jordan, Panama, Rwanda, Seychelles, Sierra Leone, South Sudan, Sri Lanka, Syrian Arab Republic, Vanuatu
Electric Rail	Bangladesh, Costa Rica, Ecuador, Nepal, South Sudan, Sri Lanka, Zimbabwe
Rapid Transit	Bhutan, Myanmar
Others	Marshall Islands**, Kyrgyzstan***

Note: *vehicle type not specified; ** electric lagoon transport; *** trolleybuses

Source: WRI Authors.

Table A.3 | Country/Territory Categorization Breakdown for Public Transport in NDCs

CATEGORY	COUNTRIES/TERRITORIES	COUNT
E measures only	Azerbaijan, Bhutan, Burundi, Ecuador, Fiji, Honduras, Kyrgyzstan, Marshall Islands, Mauritius, Qatar, Syrian Arab Republic, Uruguay, Uzbekistan	13
E targets only	Belize, Dominican Republic, Nepal, Panama, Vanuatu	5
E targets and MS measures	Cabo Verde, Chile, Congo, Costa Rica, Seychelles	5
E targets and MS targets	Israel, Jordan	2
E measures and MS measures	Barbados, Ethiopia, Mexico, Myanmar, Rwanda, Sierra Leone, South Sudan, Sri Lanka	8
E measures and MS targets	Bangladesh, Zimbabwe	2
MS targets only	Albania, Brunei Darussalam, Burkina Faso, China, India, Madagascar, Malawi, Nicaragua, Nigeria	9
MS measures only	Andorra, Bahamas, Cambodia, Democratic Republic of the Congo, Egypt, Equatorial Guinea, Guatemala, Guinea, Iraq, Japan, Laos, Lebanon, Lesotho, Monaco, Palestine, Saudi Arabia, Singapore, South Africa, Sudan, Suriname, Tajikistan, Thailand, Timor-Leste, Togo, United Arab Emirates, United Republic of Tanzania, United States of America, Venezuela, Viet Nam	29
Other measures	Angola, Armenia, Bahrain, Brazil, Cameroon, Colombia, Côte d'Ivoire, Republic of Korea, Gabon, Gambia, Ghana, Kuwait, Liberia, Mongolia, Morocco, Mozambique, Pakistan, Papua New Guinea, Paraguay, Peru, Republic of Moldova, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Senegal	25
Other targets	Djibouti, Canada	2

Legend: E = Electrification, MS = Mode Shift

Source: WRI Authors

APPENDIX B: DEFINITIONS

Table B.1 | **Definitions**

CLEAN FUELS	Compressed natural gas, electric, or hybrid powered motorized vehicles
INFORMAL TRANSPORT	This subsector covers a large variety of services that fills the lack of official or regulated transport services in developing urban areas. The industry is characterized by a scattered production structure and various working situations. Services may include taxis, minibuses, school buses, employee buses, company buses, and much more. Informal transport services use a variety of vehicles from vans to two- or three- wheelers.
PUBLIC TRANSPORT	Public transport modes can transport a larger number of passengers, typically along a fixed route. Transport modes include bus (and BRT), metro, tram, and rail systems. In some cities, paratransit services supplement these routes by offering individualized rides with minibuses to improve accessibility.
RIDE-HAILING	For-hire vehicle services with drivers that use smartphone apps to connect drivers with passengers. Examples include taxi, Uber, Lyft, Didi, and others.

ENDNOTES

1. The dataset is available here: <https://changing-transport.org/tracker/>.
2. An NDC can include non-GHG mitigation targets.
3. Equatorial Guinea, Guatemala, Nicaragua, Sierra Leone, Sri Lanka, and United Republic of Tanzania.
4. India has not submitted a second or updated NDC.

REFERENCES

- Boehm, S., K. Lebling, K. Levin, H. Fekete, J. Jaeger, R. Waite, A. Nilsson, et al. 2021. "State of Climate Action 2021: Systems Transformations Required to Limit Global Warming to 1.5°C." Washington, DC: WRI. <https://www.wri.org/research/state-climate-action-2021>.
- Bongardt, D., L. Stiller, A. Swart, and A. Wagner. 2019. "Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)." Eschborn, Germany: GIZ. https://www.transformative-mobility.org/assets/publications/ASI_TUMI_SUTP_iNUA_No-9_April-2019.pdf.
- C40, BNEF. 2018. "Electric Buses in Cities: Driving towards Cleaner Air and Lower CO₂." BNEF. <https://about.bnef.com/blog/electric-buses-cities-driving-towards-cleaner-air-lower-co2/>.
- C40 Cities Climate Leadership Group. 2019. "Reducing Climate Change Impacts on Mass Transit." Policy Brief.C40 Cities. https://www.c40knowledgehub.org/s/article/Reducing-climate-change-impacts-on-mass-transit?language=en_US.
- Cazzola, P., and P. Crist. 2020. "Good to Go? Assessing the Environmental Performance of New Mobility." Corporate Partnership Board Report. Paris, France: International Transport Forum. <https://www.itf-oecd.org/sites/default/files/docs/environmental-performance-new-mobility.pdf>.
- Chang, A., L. Miranda-Moreno, J. Cao, and B. Welle. 2017. "The Effect of BRT Implementation and Streetscape Redesign on Physical Activity: A Case Study of Mexico City." *Transportation Research Part A: Policy and Practice* 100 (June): 337–47. doi:10.1016/j.tra.2017.04.032.
- Changing Transport. 2022. *Online Seminar: What Role Does Transport Play in Countries' Climate Plans?* <https://www.youtube.com/watch?v=1XKoJyPnu6E>.
- Climate Action Tracker. 2021. "Glasgow's 2030 Credibility Gap: Net Zero's Lip Service to Climate Action." Climate Action Tracker. <https://climateactiontracker.org/publications/glasgows-2030-credibility-gap-net-zeros-lip-service-to-climate-action/>.

- Coglianesi, C. 2019. "Pledging, Populism, and the Paris Agreement: The Paradox of a Management-Based Approach to Global Governance." *Maryland Journal of International Law* 34 (5): 139-180. https://scholarship.law.upenn.edu/faculty_scholarship/2120.
- Dalkmann, H., and C. Brannigan. 2014. "GIZ Sourcebook 5e Transport and Climate Change." Eschborn, Germany: GIZ. doi:10.13140/2.1.4286.8009.
- Dallmann, T., L. Du, and R. Minjares. 2017. "Low-Carbon Technology Pathways for Soot-Free Urban Bus Fleets in 20 Megacities." Working Paper. Washington, DC: ICCT. <https://theicct.org/publication/low-carbon-technology-pathways-for-soot-free-urban-bus-fleets-in-20-megacities/>.
- Duduta, N., C. Adriaola-Steil, D. Hidalgo, T. Lindau, V. John, and C. Wass. 2015. "Traffic Safety on Bus Priority Systems." Washington, DC: WRI. <https://wrirosscities.org/research/publication/traffic-safety-bus-priority-systems>.
- Eichhorst, U., D. Bongardt, E. Löhr, N. Perera, and N. Hill. n.d. "Transport in Nationally Determined Contributions (NDCs)—Changing Transport." Synthesis Report. <https://changing-transport.org/publication/transport-nationally-determined-contributions/>. Accessed March 17, 2022.
- Fitzgerald, J., and J. Agyeman. 2021. "Removing Urban Highways Can Improve Neighborhoods Blighted by Decades of Racist Policies." *The Conversation*. Blog. September 2021. <http://theconversation.com/removing-urban-highways-can-improve-neighborhoods-blighted-by-decades-of-racist-policies-166220>.
- Fransen, T., E. Northrop, K. Mogelgaard, and K. Levin. 2017. "Enhancing NDCs by 2020: Achieving the Goals of the Paris Agreement," November. doi:https://doi.org/10.1163/9789004322714_cclc_2017-0020-024.
- Fransen, T., B. Welle, C. Gorguinpour, M. McCall, R. Song, and A. Tankou. 2019. "Enhancing NDCs: Opportunities in Transport." Working Paper. Washington, DC: WRI. <https://www.wri.org/research/enhancing-ndcs-opportunities-transport>.
- Fried, T., B. Welle, and S. Avelleda. 2021. "Steering a Green, Healthy, and Inclusive Recovery through Transport." Washington, DC: WRI. <https://www.wri.org/research/green-recovery-transportation>.
- Fulton, L., and T. Reich. 2021. "The Compact City Scenario—Electrified." New York: ITDP. <https://www.itdp.org/publication/the-compact-city-scenario-electrified/>.
- Gordon, A. 2021. "The Heat Wave Is Literally Melting Portland's Infrastructure." *Vice*. Blog. June 28, 2021. <https://www.vice.com/en/article/k78gk3/pacific-northwest-heatwave-portland-seattle-melting-infrastructure>.
- Government of Canada. 2021. "Canada's 2021 Nationally Determined Contribution under the Paris Agreement." UNFCCC NDC Registry. <https://unfccc.int/NDCREG>.
- Government of Costa Rica. 2018. "National Decarbonization Plan." UNFCCC. <https://unfccc.int/sites/default/files/resource/NationalDecarbonizationPlan.pdf>.
- Government of Mexico. 2020. "Contribución Determinada a nivel Nacional." UNFCCC NDC Registry. <https://unfccc.int/NDCREG>.
- Hernández, J., and A. Davidson. 2022. "Why Mexico Needs a Federal Funding Program for Semiformal Transport." *TheCityFix*. Blog. February 2022. <https://thecityfix.com/blog/why-mexico-needs-a-federal-funding-program-for-semiformal-transport/>.
- Hook, W. 2021. "Global Expansion of Rapid Transit Slows... Outside of China." *Reorientations*. Blog. March 22, 2021. <https://reorientations.medium.com/global-expansion-of-rapid-transit-slows-outside-of-china-d02989695c00>.
- IEA. 2020a. "New Electric Bus Registrations by Country/Region, 2015–2019." Paris: IEA. <https://www.iea.org/data-and-statistics/charts/new-electric-bus-registrations-by-country-region-2015-2019>.
- IEA. 2020b. "Tracking Transport 2020—Analysis." Paris: IEA. <https://www.iea.org/reports/tracking-transport-2020>.

- IEA. 2021. "World Energy Model Documentation." Paris: IEA. https://iea.blob.core.windows.net/assets/bc4936dc-73f1-47c3-8064-0784ae6f85a3/WEM_Documentation_WEO2020.pdf.
- Infrastructure Canada. 2021. "Backgrounder: A Plan to Permanently Fund Public Transit and Support Economic Recovery." Government of Canada. <https://www.canada.ca/en/office-infrastructure/news/2021/02/a-plan-to-permanently-fund-public-transit-and-support-economic-recovery.html>.
- Li, X., C. Gorguinpour, R. Sclar, and S. Castellanos. 2019. "How to Enable Electric Bus Adoption in Cities Worldwide." Washington, DC: WRI. <https://www.wri.org/research/how-enable-electric-bus-adoption-cities-worldwide>.
- Litman, T. 2014. "A New Transit Safety Narrative." *Journal of Public Transportation* 17 (4): 114–35.
- Liu, K., S. Ly, E. Jackson, H. Steimer, S. Cassius, X. Li, E. Myers, L.H. Duarte, and L. Freehafer. 2022. "Developing an Electric Mobility Roadmap: International Experiences from Subnational Case Studies for Vietnamese Cities." Working Paper. Washington, DC: WRI. <https://www.wri.org/research/developing-electric-mobility-roadmap-international-experiences-subnational-case-studies>.
- Medimorec, N. 2021. "Climate Strategies for Transport: An Analysis of Nationally Determined Contributions and Long-Term Strategies." SLOCAT. <https://slocat.net/wp-content/uploads/2022/01/Climate-Strategies-for-Transport-An-Analysis-of-NDCs-and-LTS-SLOCAT-December-2021.pdf>.
- Owen, B., A. Carrigan, and D. Hidalgo. 2012. "Evaluate, Enable, Engage: Principles to Support Effective Decision Making in Mass Transit Investment Programs." EMBARQ. <https://wrirosscities.org/research/publication/evaluate-enable-engage-principles-support-effective-decision-making-mass>.
- Republic of Malawi. 2021. "Updated Nationally Determined Contributions." Carbon Counts Report. Malawi: UNFCCC. <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Malawi%20First/Malawi%20Updated%20NDC%20July%202021%20submitted.pdf>.
- Republic of Rwanda. 2020. "Updated Nationally Determined Contribution." UNFCCC NDC Registry. <https://unfccc.int/NDCREG>
- Singhvi, A., C. Wolff, and R. Sahay. 2021. "Innovative Investments Could Decarbonize Transport in India. Here's How." June 18. World Economic Forum. <https://www.weforum.org/agenda/2021/06/investments-decarbonize-transport-india/>.
- SLOCAT. 2022. "The NDCs Hall of Fame." SLOCAT. Blog. May 2022. <https://slocat.net/ndcs-hall-of-fame/>.
- SLOCAT and IsDB (Islamic Development Bank). 2021. "Transport, Climate Action and Sustainable Development: Synergies across NDCs and VNRs in IsDB Member Countries." Jeddah, Kingdom of Saudi Arabia: IsDB. <https://www.isdb.org/sites/default/files/media/documents/2021-07/Transport%2C%20Climate%20Action%20and%20Sustainable%20Development.pdf>.
- Smith, K. 2022. "Cabei Opens the Door to a Railway Revival." *International Railway Journal*. Blog. January 2022. https://www.railjournal.com/in_depth/cabei-opens-the-door-to-a-railway-revival/.
- Tabuchi, H., and J. Schwartz. 2021. "Climate Crisis Turns World's Subways into Flood Zones." *The New York Times*, July 22, sec. Climate. <https://www.nytimes.com/2021/07/22/climate/subway-design-flooding-china.html>.
- Teske, S., S. Niklas, and R. Langdon. 2021. "TUMI Transport Outlook 1.5°C—A Global Scenario to Decarbonise Transport." TUMI, GIZ, BMZ. <https://outlook.transformative-mobility.org/>.
- Tun, T.H., T. Fried, C. Kanuri, A. Oursler, A. Davidson, and B. Welle. 2021. "Impact-Driven Investing in New Mobility Enterprises: Perspectives from Kampala, Uganda, and Hyderabad, India." Working Paper. Washington, DC: WRI. <https://www.wri.org/research/impact-driven-investing-new-mobility-enterprises-perspectives>.
- UNDRR (United Nations Office for Disaster Risk Reduction). 2022. "Principles for Resilient Infrastructure." Geneva, Switzerland: UNDRR. <https://www.undrr.org/publication/principles-resilient-infrastructure>.

UNFCCC. 2020a. "Nationally Determined Contributions (NDCs)." UN Climate Change. <https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/nationally-determined-contributions-ndcs#eq-1>.

UNFCCC. 2020b. "The Paris Agreement." UN Climate Change. September. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>.

UNFCCC. n.d. "Nationally Determined Contributions Registry." <https://unfccc.int/NDCREG>.

UNFCCC Secretariat. 2016. "Synthesis Report on the Aggregate Effect of INDCs." UN. <https://unfccc.int/process/the-paris-agreement/nationally-determined-contributions/synthesis-report-on-the-aggregate-effect-of-intended-nationally-determined-contributions>.

UNFCCC Secretariat. 2021. "Nationally Determined Contributions under the Paris Agreement. Revised Note by the Secretariat." Pre-session document. Glasgow Climate Conference. <https://unfccc.int/documents/307628>.

United Nations Environment Programme. 2021. "The Heat Is On—a World of Climate Promises Not Yet Delivered." Emissions Gap Report 2021. UNEP. <https://wedocs.unep.org/bitstream/handle/20.500.11822/36990/EGR21.pdf>.

United States of America. 2021. "The United States of America Nationally Determined Contribution" UNFCCC NDC Registry. <https://unfccc.int/NDCREG>.

Welle, B., T. Fried, and M. Finch. 2021. "A Practical Framework for Aligning NDC Enhancement and COVID-19 Recovery: Detailed Transport Sector Approaches." Expert Note. Washington, DC: WRI. <https://www.wri.org/publications/practical-framework-aligning-ndc-enhancement-and-covid-19-recovery-detailed-transport>.

World Bank. 2022. "New Project Will Support Improved Mobility and Accessibility in Indonesia's Bandung and Medan Metropolitan Areas." Press Release. June 2022. <https://www.worldbank.org/en/news/press-release/2022/06/01/new-project-will-support-improved-mobility-and-accessibility-in-indonesia-bandung-and-medan-metropolitan-areas>.

World Bank. 2020. "Latin America Clean Bus in LAC—Lessons from Chile's Experience with E-Mobility." Washington, DC: World Bank. <https://documents1.worldbank.org/curated/en/656661600060762104/pdf/Lessons-from-Chile-s-Experience-with-E-mobility-The-Integration-of-E-Buses-in-Santiago.pdf>.

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.



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