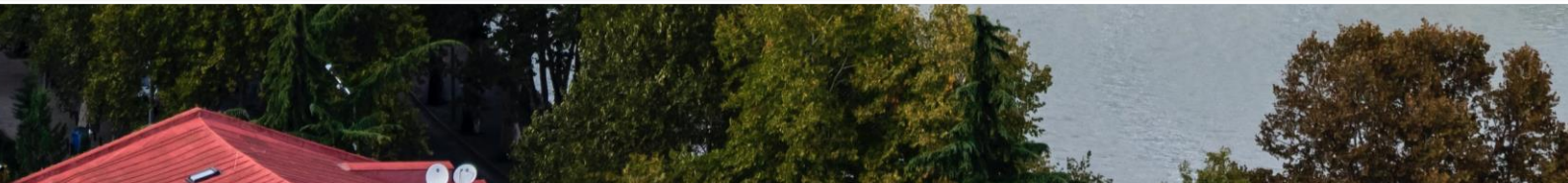
Landscape for mitigation and finance in Georgia's urban mobility sector

Authors:
Swithin Lui, Eduardo Posada

NEW CLIMATE INSTITUTE

February 2022



Landscape for mitigation and finance in Georgia's urban mobility sector

Project number
216065

Authors
Swithin Lui, Eduardo Posada

Acknowledgements
We are grateful for the contributions of Sopio Tsomikuridze (GIZ) for extensive research support and stakeholder engagement; our group of Georgian experts including George Abulashvili, Davit Jaiani, Nino Janelidze, Etuna Lomadze, Lasha Nakashidze, Otar Nemsadze, and Maia Tskhvaradze—who provided much insight and information to lay the foundation of this report—for interviews, survey responses and reviews; and Thomas Day (NewClimate Institute), and Martina Kolb and Jan Rickmeyer (GIZ) for further reviews.

Disclaimer
This report was prepared with the support of the regional program 'Sustainable Urban Mobility in the South Caucasus' (Mobility4Cities) funded by the German Federal Ministry for Economic Cooperation and Development and implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in close cooperation with the Transformative Urban Mobility Initiative (TUMI).
The analysis, results and recommendations expressed in this report represent the views of the authors and not necessarily those of the funder nor the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

Cover picture: Photo by Mostafa Meraji on Unsplash

Download the report
http://newclimate.org/publications/

Table of Contents

Abbreviations

ADB	Asian Development Bank
BAU	Business-as-usual
BEV	Battery electric vehicle
BRT	Bus rapid transit
CDM	Clean Development Mechanism
CIF	Climate Investment Fund
CNG	Compressed natural gas
CSAP	Climate Change Strategy 2030 and 2021-2023 Action Plan
COP	Conference of Parties
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
EU	European Union
EUAA	European Union Association Agreement
EV	Electric vehicle
GCAP	Green City Action Plan
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas/gases
ICE	Internal combustion engine
IFI	International finance institution
ITCS	Intelligent Traffic Control System
ITMO	Internationally Transferred Mitigation Outcomes
ITS	Intelligent transportation system
LDV	Light-duty vehicle
LTS/LT-LEDS	Long-Term Low Greenhouse Gas Emissions Development Strategy
MaaS	Mobility as a Service
MDB	Multilateral development bank
MEPA	Ministry of Environmental Protection and Agriculture
MOF	Ministry of Finance
MRDI	Ministry of Regional Development and Infrastructure
NDA	Nationally Designated Authority
NDC	Nationally Determined Contribution
NECP	National Energy and Climate Plan
NMT	Non-motorised transport
P&R	Park-and-ride
PHEV	Plug-in hybrids
pkm	Passenger-kilometres
SAP	Simplified approval process
SDG	Sustainable Development Goal
SUMP	Sustainable Urban Mobility Plan
TTC	Tbilisi Transport Company
UNDP	United Nations Development Programme

1 Introduction

Since 2021, Georgia has advanced into a new phase of climate mitigation policy planning. The first-ever national 2030 Climate Change Strategy and 2021-2023 Action Plan (CSAP) was adopted by the Government of Georgia in 2021 alongside the update of its Nationally Determined Contribution (NDC) to the Paris Agreement, where Georgia committed to an unconditional target of limiting greenhouse gas (GHG) emissions to 35% below its reference 1990 levels. These strategic documents were the first to be approved by the newly established Climate Change Council, which oversees climate planning and processes.

The transport sector, and specifically the urban mobility subsector, is a continuing focus of climate change mitigation planning efforts. The CSAP and updated NDC, both contain mitigation goals of reducing GHG emissions in the transport sector by 15% below its baseline projections by 2030. Of the key objectives and priority areas for the transport sector listed in the CSAP, the majority are directly related to urban mobility including decarbonising private passenger transport and upgrading infrastructure and planning for non-motorised transport (NMT). To advance planning and cost-benefit decision-making on urban mobility measures, there is a need for comprehensive mapping of mitigation options in the subsector, along with an overview analysis on mitigation potential, abatement costs, the financing landscape, and applicability to the Georgian context.

This report provides an overview of the landscape for mitigation measures in the urban mobility sector in Georgia, and potential access points and strategies for accessing and distributing climate finance.

Section 2 provides an overview of trends and drivers for GHG emissions and trajectories in the transport and urban mobility sector and Georgia's existing climate change commitments. **Section 3** provides an overview of potential mitigation actions in the sector and differentiates them according to the accessibility of the measures, in terms of the marginal abatement costs and readiness for implementation in Georgia. **Section 4** looks at the potential sources of climate finance for urban mobility in Georgia using a framework to consider and prioritise the finance needs of different areas within the sector and discusses challenges and barriers facing the financing and implementation of sub-sector measures. Sections 3 and 4 heavily feature information, insights and recommendations gleaned from a series of interviews conducted with Georgian transport and municipal finance experts in 2021; in-text citations are omitted for readability. **Section 5** highlights the non-climate benefits associated with mitigation action in urban mobility, focusing on synergies with the Sustainable Development Goals (SDGs) and other national objectives. **Section 6** concludes.

2 Urban mobility within Georgia's national circumstances and climate and energy planning

2.1 Trends and emission drivers

The transport sector in Georgia is an economically vital sector due to the country's position as a regional trading hub located in the centre of the Caucasus, providing an essential connecting route between Asia and Europe. Transport activity has been growing rapidly in both the freight and passenger transport subsectors, with freight activity expected to increase by 120% and passenger activity expected to increase by 50% between 2015-2030 (MEPA, 2021b). Freight activity is expected to grow at a stronger pace due to drivers from projected trade demand and gross domestic product (GDP) growth.

According to Georgia's latest emissions inventory, transport sector emissions were approximately 4.2 $MtCO_2e$ in 2017, approximately 23% of economy-wide GHGs (MEPA, 2021b). Total GHG emissions from the transport sector are expected to reach levels of 7.1 $MtCO_2e$ by 2030 under business-as-usual (BAU), up 71% from 2017, as can be seen in Figure 1.

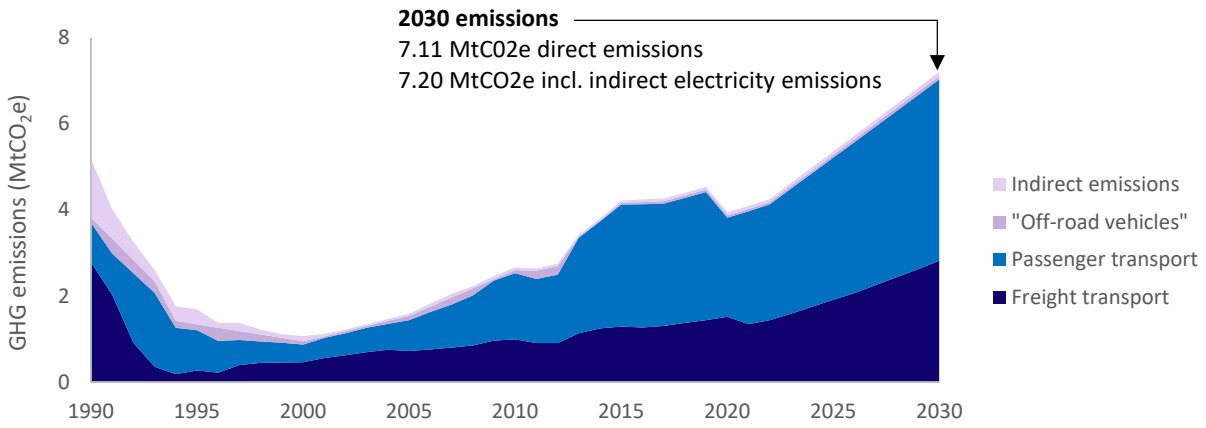


Figure 1: Georgia's projected reference scenario transport sector emissions per category (1990-2030)

Source: Authors' elaboration based on projections and methods from Georgia's CSAP (MEPA, 2021c), supplemented by latest inventory data from Georgia's 4th National Communications (MEPA, 2021b) and COVID-impacts on road-based passenger transport from GeoStat (2021b)

In Georgia's freight subsector, 25 million tons of cargo are transported each year, where 60% of the cargo is transported over road as opposed to rail, sea, or air (MEPA, 2021b). Road freight transport, mainly composed of heavy-duty and light-duty trucks, was responsible for 32% of transport emissions in 2015 (roughly 1.3 $MtCO_2e$). Emissions from freight are expected to grow another 120% by 2030 (MEPA, 2021c).

While passenger activity is expected to grow at a slower rate compared to freight, it is still a larger consumer of energy and source of air pollution. Passenger transport activity reached its highest peak in 20 years in 2019 at 10,382 million passenger kilometres (m-pkm) (serving 260 million passengers), before dropping by roughly 34% in 2020 due to the COVID-19 pandemic (Figure 2) (GeoStat, 2021b; MEPA, 2021b). The most popular means of passenger transport is via road, of which light-duty vehicles (LDVs), or passenger cars, is the primary mode. Registration of LDVs has been growing consistently in

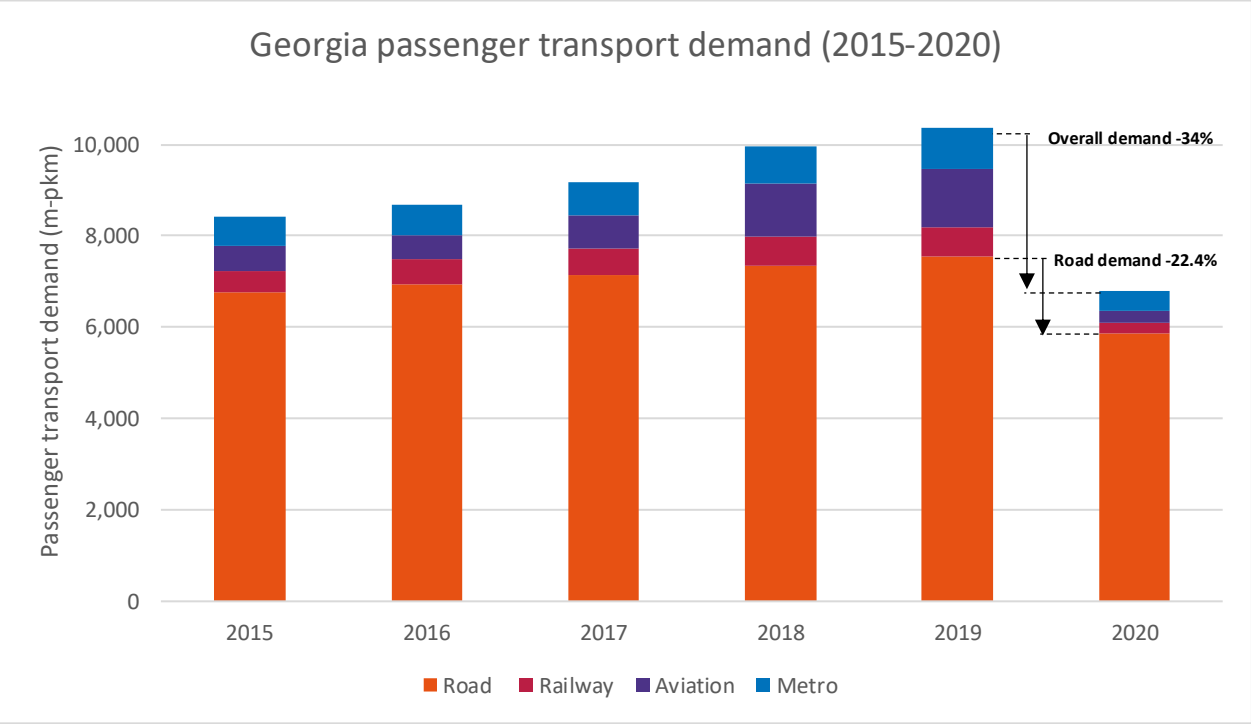


Figure 2: Passenger transport demand in Georgia by mode (2015-2020)

Source: Authors' elaboration based on data from GeoStat (2021b)

line with increasing demand for passenger transport, with a 165% increase in the number of vehicles registered between 2007 and 2019 (MEPA, 2021b). LDVs made up over 70% of the passenger activity in 2020, driven by a fleet of 1.2 million vehicles. Of the LDV fleet driven in Georgia, over 85% of the LDVs registered are over a decade old and thus both inefficient in energy consumption and environmentally pollutive (GeoStat, 2021b; MEPA, 2021c). Other forms of road-based passenger activity, including public transport (buses, minibuses/*marshrutkas*, and metro), still dwarf in comparison.

Much of road-based passenger transport occurs within municipalities in Georgia (a larger share of freight transport occurs inter-city), where the solutions for emissions reductions and its co-benefits are more readily available. Transport activity within cities is also dominated by private LDVs; public transport in 2020 made up only 30% of motorised pkm from buses, *marshrutkas*, and underground metro (MEPA, 2021c). NMT, including cycling and pedestrian activity, has been a primary objective of municipalities but is still underutilised mainly due to a lack of infrastructure and concerns on safety. As a result of the strong forecasted growth in demand, driven by increasing LDV activity, passenger transport emissions are expected to grow by 48% from 2015 levels to approximately 4.2 $MtCO_2e$ by 2030 (MEPA, 2021c).

2.2 Climate change commitments, targets, and plans

Georgia had signalled a new pathway for GHG reductions in the transport sector in 2021, with key commitments, targets, and plans being adopted. In April 2021, the Government of Georgia adopted both its CSAP (MEPA, 2021c) (including the Action Plan for 2021-2023 (MEPA, 2021a)) and its updated NDC in package decree 167 (Government of Georgia, 2021b). Georgia subsequently submitted the updated NDC to the United Nations Framework Convention on Climate Change (UNFCCC) in May 2021 and is in the process of elaborating its Long-Term Low Greenhouse Gas Emissions Development Strategy (LTS/LT-LEDS), a mid-century sector-by-sector vision for climate change mitigation, also to be submitted to the UNFCCC. In addition, Georgia develops National Energy and Climate Plans (NECP) at regular intervals as a Contracting Party to the Energy Community.

2030 Climate Change Strategy and 2021-2023 Action Plan

Georgia's CSAP is a strategic and planning document, including the Action Plan which details short-term mitigation measures to be implemented for the achievement of longer-term emission reduction targets in national climate objectives, such as the NDC, and is due to be updated every two years (MEPA, 2021c). The CSAP, elaborated by the Ministry of Environmental Protection and Agriculture of Georgia (MEPA) sets out national mitigation policy for all major sectors including energy, transport, buildings, industry, agriculture, waste, and forestry, and details sector by sector its projected emissions trajectory (to 2030) under BAU, planned mitigation measures for the upcoming period, and updated projected emissions trajectory (to 2030) if measures were fully implemented.

Under Goal 2 of the CSAP, Georgia aims to reduce GHG emissions in the transport sector to 22% below the reference scenario by 2030 and lists mitigation objectives and priorities for future cycles (Table 1). If Georgia successfully implements its objectives and accompanying mitigation measures, emissions from the transport sector could be reduced under the reference scenario to 5,570 $GgCO_2e$ (5.57 $MtCO_2e$) in 2030 (Figure 1) (MEPA, 2021c).

Of the objectives and priority areas identified in the CSAP, listed in Table 1, the majority are focused on urban mobility. This emphasises the importance of the subsector in the country's development plan, as well as in municipalities' priorities, especially given that dense urban areas will also receive substantial mitigation co-benefits from these measures.

CSAP 2021-2023 objectives	Urban mobility	Inter-city mobility
Increase the share of low- and zero-emission and roadworthy private vehicles in the vehicle fleet	☑	☑
Encourage the reduced demand on fossil fuel and the use of biofuels	☑	☑
Promote non-motorized means of mobility and public transport	☑	
CSAP priority areas for future cycles		
Replacing urban passenger transport with public and NMT	☑	
Replacing inter-city passenger transport with public transport		☑
Improving energy efficiency of private LDVs	☑	☑
Shifting freight from road to rail transport		☑

Table 1: Transport sector objectives and priority areas listed in Georgia's CSAP (MEPA, 2021c)

Nationally Determined Contributions, long-term strategies, and the Paris Agreement

NDCs identify short- and medium-term actions or targets which ratifying Parties commit to for upholding the objectives of the Paris Agreement to limit the temperature increase to 1.5°C above pre-industrial levels (UNFCCC, 2015). Parties are requested to update their NDCs by 2020 and at least every five years thereafter, enhancing their targets in line with developments in national circumstances. In addition, Parties are also requested to revise and strengthen their NDCs before the end of 2022 to be 1.5 °C compatible.

Georgia submitted its Updated NDC to the UNFCCC in May 2021, which outlines Georgia's planned targets and actions up to 2030 (Government of Georgia, 2021a). In paragraph 52, Georgia outlined its commitment to mitigating GHG emissions from the transport sector by 15% under the reference level by 2030, which is slightly less ambitious than in the CSAP.

Parties are also requested to submit an LTS, which outlines countries' plans for the long-term transformation of sectors in line with the goals of the Paris Agreement. The LTS is currently under elaboration led by MEPA and will consist of an economy-wide net-zero target with sectoral benchmarks beyond mid-century. Specific targets or roadmaps for the transport sector are yet to be defined.

National Energy and Climate Plans, and the Energy Community

Since 2017, Georgia has been a Contracting Party to the Energy Community, an international organisation connecting the European Union (EU) and pan-EU countries to improve the stability and security of energy markets within its members (Energy Community, 2021).

As part of the initiative, Georgia is undergoing a series of energy sector reforms in electricity, gas, oil, renewables, and energy efficiency, some of which have indirect implications for transport sector energy and emissions. The only measure directly related to transport, involving a legal framework on biofuels provision (associated with Directive 2009/28/EC) is in the progress of implementation. As part of the Energy Community membership, Georgia is also required to submit an NECP that details how the country would contribute to and implement EU energy-climate targets across the energy sector. In 2021, Georgia's draft NECP was reported to be under stakeholder consultation with public authorities and civil society and is expected to be finalised in 2022 (Energy Community Secretariat, 2021).

3 Measures for climate change mitigation in urban mobility

This section provides an overview of the best practice urban mobility measures available to be implemented or scaled-up within and across Georgian municipalities. The measures selected may be considered good practice due to their efficacy in producing mitigation outcomes globally but may not necessarily be all recommendable in the Georgian context. Measures are grouped into policy packages according to their relevance, common objectives, and their additionality of impact if implemented together. Policy packages are placed under overarching categories according to their objective and theory of change. Each policy package table provides a brief description of the measures, its current or previous status of implementation in Georgia, discourse on its potential mitigation impact and costs (supplemented by international case studies and available data for Georgia), and the key barriers needing to be unlocked for Georgia. Mitigation potentials listed are estimated in isolation to other policies and the order of magnitude—they are shown to enhance the discussion on financing priorities only. Mitigation potentials for policy packages are not shown if estimations are not available due to data availability and uncertainty in the Georgian municipal contexts. Due to the scope of the study, the transport measures included below are limited to the urban mobility subsector only, excluding inter-city freight, aviation, and maritime transport. For more in-depth analysis and modelling exercises on transport sector measures identified as Georgian priorities, see Day *et al.* (2021) and MEPA (2021c).

3.1 Modal shift to public transport and rail

Improve public transport systems and ridership

Measure

To incentivise the shift from private vehicles to public transport, municipal governments must offer public transport systems that are reliable, fast, safe, and well connected. Improvements could be made on both the bus and metro systems (where applicable) and include the expansion and optimisation of routes and lines, the optimisation of the number of public transport carriers, and the improvement of access points to stations. These improvements can be communicated through public information campaigns that highlight the benefits of public transport and are supported through incentives for public transport ridership.

Emission-intensive buses, including the light-bus *marshrutka* fleet, can be replaced with low-emission models operating with higher fuel and emission standards or with electricity. The operation of bus networks can be further improved by establishing priority bus lanes or, in corridors with high transport demand, bus rapid transit (BRT) systems can be built.

Status

Some Georgian cities have recently planned or realised improvements in their public transport systems. Since 2016, Tbilisi has seen the renovation of several arterial streets to include bus-exclusive lanes, such as Cholokashvili Avenue, Chavchavadze Avenue, Rustaveli Avenue, and Pekini Street (Agenda.ge, 2016; Georgian Journal, 2021b). The partial renovation of the city's bus fleet and planned expansion of the metro system have also been completed. As part of bus fleet renewal efforts, a renewal of 380 buses is underway to upgrade the city's bus fleet (Georgian Journal, 2021a); currently, Tbilisi's bus fleet is comprised of 369 12-metre CNG buses, and 220 8-metre and 90 10-metre Euro 6 diesel buses. A previously agreed procurement for 100 electric buses, signalled to be financed by the European Bank for Reconstruction and Development (EBRD), has yet to be realised.

Replacing of the *marshrutka* fleet is also in progress, with 90 Euro-5 minibuses introduced in 2020-2021 and their total replacement (1000 vehicles) planned by the end of 2022 (Agenda.ge, 2021a).

In Batumi, a similar package of measures was planned for implementation between 2018 and 2022. It included measures like the optimisation of bus network routes, the construction of several BRT corridors, and the purchase of 40 new Euro-5 diesel buses and eight electric buses while aiming to retire half of the *marshrutka* fleet by 2022 (Day *et al.*, 2021). The eight electric buses were purchased in mid-2021 with funds from the EU and the EBRD (Agenda.ge, 2021b). At the time of publication, roughly half of Batumi's bus fleet had been renewed.

The public transport systems of other cities are also being renovated; the government purchased 175 new Euro-5 diesel buses for Zugdidi, Rustavi, Kutaisi, Gori, Telavi, and Poti with a loan from the EBRD (Martikian, 2021).

Potential

The package of transport measures implemented in Tbilisi, which also include private vehicle parking fees, was estimated to reduce emissions by 95 $ktCO_2e$/year in 2030 (estimates for emission reductions from a bus fleet renewal for Tbilisi alone are 60 $ktCO_2e$/year after five years (GOPA Infra, 2020a)). In Batumi, the policy package, also including parking tariffs, was estimated to reduce emissions by 10 $ktCO_2e$/year in 2030 (Day *et al.*, 2021).

Costs

The full cost of Tbilisi's bus-system renovation project was EUR 21.3M (Georgian Journal, 2021a), while the expansion and improvement of the metro system involved a EUR 75M loan from the EBRD (Railway Pro, 2020). The latter included the purchase of 10 four-car metro trains and the renewal of tunnel and depot infrastructure.

In Batumi, the cost of optimising the bus network—implementing bus-exclusive lanes in the Chavchavadza and Gorgildze-Baratashvili corridors, limiting *marshrutkas* to the city centre, and building two bus-*marshrutka* transfer terminals—was estimated to cost at least EUR 1.4M (GOPA Infra, 2020b). The construction of a BRT-like corridor of 4.8 km and 24 bus stops was estimated to cost between EUR 412k and 1M, while the renewal of the 105 buses in the city's fleet was estimated to cost between EUR 19M and 26M (A+S Consult, 2017). The recent acquisition of eight electric buses had a cost of EUR 4M (Agenda.ge, 2020a).

Finally, the implementation of a six-month program to promote a public change of perception around public transport has been previously estimated to cost between EUR 51k and 77k in Batumi (AECOM, 2019).

Key barriers

The barriers facing different infrastructure and operational measures to increase public transport ridership vary according to the measure. Infrastructure projects, like many listed above, are associated with high upfront capital investments requiring financial support and loans. Cultural and behavioural barriers implicit in Georgian public transport ridership will also need to be addressed.

Financial incentives for public transport

Measures

To promote the use of public transport against private vehicle use, municipal governments can further subsidise the cost of public transport tickets or establish programs to enhance the financial attractiveness of public transport. Public transport subsidies can also be additionally provided or supported by the national government, as in the case of Germany. Reduced tariffs can be offered to special groups, such as

students and public-school employees, or be offered in timed subscriptions. Funds for these initiatives could be levied from a tax on employers or the private sector, such as in the case of Vienna's metro tax.

Status In Tbilisi, 40-45% of the revenues of the city's public transport operator (Tbilisi Transport Company, TTC) come from subsidies by the City Hall. These subsidies reduce the tariff paid by the users of the system, especially preferential groups: visually impaired people and their companions, school students, district inspectors, police department employees, kindergarten employees, veterans of the armed forces, among others (Kochiashvili, 2021). In late 2021, the City Hall decided to transform the public transport's tariff system by doubling the tariffs from 2022 on and offering cards with special rates for monthly and yearly subscribers, while maintaining the sales of individual tickets and the subsidies for preferential groups (Kochiashvili, 2021). It is unclear if and to what extent this is implemented in other Georgian municipalities.

Potential The emissions reduction potential depends on the elasticity between cost subsidies and the number of passengers transitioning from their cars to public transport in Georgian municipalities, and the distributed share transitioning to each public transport mode.

Costs Ticket subsidies have been an important feature of most public transport systems and can represent the biggest share of the revenue for operating companies (e.g., ticket fares paid by public-transport riders in Paris cover only 27% of investments and operational costs (Île-de-France Mobilités, 2021)).

In Tbilisi, although the TTC was already operating at a loss in 2019, 2020 saw further losses of EUR 42.6M (48% decrease in revenue) due to the reduced public transport ridership during the COVID-19 pandemic. The decreased ridership caused income generated from subsidies from the City Hall to decrease from EUR 19.9M in 2019 to EUR 10.1M in 2020 (Kochiashvili, 2021).

Key barriers Subsidising public transport tickets often require a big financial commitment by municipal governments. Given the loss in revenue for public transport operators during the COVID-19 pandemic, it may be politically difficult for municipal authorities to cover the lost revenues, causing increased tariffs to be covered by users. An increase in subsidies (government spending) has the potential to also add to growing inflationary pressures in Georgia—the country has recently faced above average inflation rates of around 5% in 2019-2020 and almost 10% in 2021 (GeoStat, 2021a)—which could lead to push back from government and disadvantaged civil society groups. To alleviate the social concerns, municipalities can consider implementing subsidies with adjusted pricing structures prioritising higher subsidies for population groups attaining the greatest value from public transport while balancing them with lower subsidies for other population groups. While subsidies to increase public transport ridership offer many non-financial societal benefits (e.g., mobility access, increased disposable income) that also need to be considered, municipalities should reassess the cost-benefit ratio of enhancing this policy measure, compared to other forms of welfare support.

Regulation and management of taxis

Measures Taxis in Georgia currently lacks regulation, where a lack of standards for drivers and pricing, and poor technical conditions affect the quality of the service. The lack of requirements for taxi registration hinders the capacity of municipal governments to improve taxi service quality and safety while reducing emissions in the sector. The

regulation of taxis could also have implications on driving behaviour and traffic management to reduce congestion.

Status The regulation of the taxi sector was planned in Tbilisi's GCAP (EMPRESS, 2017) and has been underway since 2018 (Taktakishvili, 2021) in several stages. Measures introduced already include licences to operate (costs reduced in half for hybrid vehicles and none for EVs), special free parking places allocated for registered taxis, advertised areas marked out for taxis, luminous signs, vouchers for cleaning and painting vehicles, painting taxis white, and technical requirements (Agenda.ge, 2019d). Although these measures have sparked opposition from taxi drivers (JAM News, 2019), the Mayor of Tbilisi announced in 2022 that the final phase of reform (no official details at date of publication) will be implemented during the summer (Rustavi2, 2022). Taxi regulation was also considered in Batumi's Sustainable Urban Mobility Plan (SUMP) (A+S Consult, 2017).

Potential The emissions mitigation potential of this measure depends on the size and composition of the taxi fleet and the scope of the regulations introduced. For instance, stringent technical requirements on emissions or scalable targets to electrify the taxi fleet (see section 3.4) could have a significant mitigation potential, while operational regulations have uncertain and likely minor implications for emissions.

Costs Taxi regulations in Tbilisi were estimated to cost EUR 300k (EMPRESS, 2017).

Key barriers The extent of regulation that municipal governments can introduce for the taxi sector previously experienced challenges regarding the coordination with national authorities (A+S Consult, 2017; OC Media, 2018), although this seems to have been resolved for Tbilisi. Taxi drivers or companies may also oppose and try to weaken regulatory initiatives to lower administrative burden and financial costs.

Park-and-ride (P&R) systems

Measures To reduce the influx of cars from a city's outskirts into city limits, municipal governments can build P&R facilities. These stations seek to facilitate inter-modality within city limits: workers or commuters who frequently travel from other cities and towns can park their cars in the P&R facility and transfer to public transport or biking modes to continue the journey downtown. Tourists can also park their cars in these facilities, reducing the number of cars in the city centre, where most accommodation and visitor attractions are located.

Status Batumi intends to introduce both public and tourist P&R systems as described in its SUMP and Sustainable Transport pre-feasibility report (A+S Consult, 2017; GOPA Infra, 2020b). In its Sustainable Transport pre-feasibility report, Tbilisi also planned two public P&R sites around the city centre (GOPA Infra, 2020a).

Potential The emissions reduction potential depends on the number of passengers transitioning from their cars to public transport or NMT, and the share transitioning to each mode. While P&R facilities can ease traffic congestion and vehicle activity within cities, case studies have also found that if implemented without proper policy guidelines, it can be offset by increased inter-city vehicle activity and emissions (Mingardo, 2013).

Costs In Batumi's SUMP, the cost of implementing a public transport P&R system with 600 parking places was estimated to range between EUR 1.2M and EUR 2.1M (A+S Consult, 2017). For Tbilisi, two P&R sites located north and south of the city centre were estimated to cost EUR 11.6M (GOPA Infra, 2020a).

Key barriers The high upfront capital investments required of this measure represent the main barrier. Coupled with the uncertain and possibly minor impact the measure would have on GHG emission reductions—when also factoring in a possible rebound-effect from increased inter-city private vehicle travel—the political will for implementing this action would also need to consider other metrics. In the circumstances of some municipalities, such as Batumi, the development of P&R facilities aimed at reducing inter-city vehicles into the city centre need to be coupled with effective demand-side policies to synergise with objectives to promote tourism while accelerating mitigation efforts.

3.2 Modal shift to non-motorised transport

Infrastructure for NMT

Measures Municipal governments can design, build, and regulate infrastructure to support the shift from motorised vehicle transport to NMT. NMT infrastructure includes safe pedestrian and biking routes with good coverage of congested city areas with limited road networks. Cycling "superhighways", which cover long, flat distances uninterrupted by intersections, could be introduced in cities to make the transport mode more efficient. Redesigning neighbourhoods could restrict motorised vehicle transit to reclaim space to prioritise NMT instead.

Status The need to support cyclists and pedestrians with new infrastructure was identified in many municipal plans as well as Georgia's national CSAP. Some proposed measures in Batumi were adopted from the city's GCAP, such as the full pedestrianisation of Batumi's Old City during the weekends (AECOM, 2019). The latter sets a trial car-free area in the Old City, allowing only residents and deliveries to enter at certain times, and promotes pedestrian culture. Tbilisi has also seen increasing investments in bike lanes and infrastructure, with the most recent plans announced in 2020 (FIA Foundation, 2020). In this regard, the conceptual design of "superblocks" in Tbilisi was funded in 2021 with a loan from the Asian Development Bank (ADB) (Herz *et al.*, 2021). Superblocks have been popularised in Barcelona, Spain; these consist of areas, larger than a street block but smaller than a neighbourhood, that restricts vehicle transit and creates space for bikes, pedestrians, and local communities (Postaria, 2021). Zugdidi, Rustavi, Kutaisi, and Gori are other Georgian cities that have seen prioritised investments for pedestrian and cycling routes (Day *et al.*, 2021).

Potential It has been estimated that in the city of Bogotá (~7.5M people), 370 km of bike network routes coupled with a 3.3% of modal shift to biking, can reduce 56 $ktCO_2e$/year (Cooke *et al.*, 2019). In Georgia, the equivalent construction of NMT routes and shift in modal share across all municipalities have the potential to reduce emissions by 16 $ktCO_2e$/year.

Costs The cost of 1 km of bike route in Europe has been estimated to be in the EUR 50k-10M range, depending on the built-up area, protected areas, regulations, the scale of works, type of bike path, among others (Buczyński, 2021). The cost of the 370-km bike network in Bogotá has been estimated to be EUR 968M (Cooke *et al.*, 2019), while the construction of 109 km of bicycle lanes in Batumi was estimated to cost between EUR 1.1 and 7.1M (A+S Consult, 2017). The cost of the pilot pedestrianisation of Batumi's Old City was estimated to cost the sum of EUR 65k to 99k (capital costs) and EUR 13k to 20k (operational costs) (A+S Consult, 2017).

Key barriers Cultural and behavioural characteristics in Georgia and within municipalities affect the efficacy of the measure—including cycling skills, perception surrounding safety, and activity under various weather considerations—while infrastructure costs associated with long NMT routes would require substantial investments. In mountainous regions, difficult terrain also presents additional obstacles to building NMT infrastructure (as well as additional behavioural barriers due to increased physical activity). However, this barrier also faces infrastructure for road-based vehicle transport. To increase mobility while increasing climate resilience (and avoiding unnecessary road-based emissions) in mountainous regions, access to NMT plays a vital role.

Financial incentives for modal shift to NMT

Measures To promote a shift away from private motorised vehicles, local governments and the national government can offer incentives for the use of NMT. To promote biking, governments could provide financial incentives such as providing subsidies to purchase new bikes.

Status Financial incentives to promote NMT have so far not been implemented in Georgia.

Potential The emissions mitigation potential from financial incentives is dependent on the scope and size of the incentive implemented, as well as the receptivity of such a policy. Active travel (walking or biking) by one average person in Europe has been estimated to reduce CO_2 emissions by 0.5 t per year when replacing one car-driving trip per day with a bike-riding equivalent for 200 days a year (Brand *et al.*, 2021).

Costs A pilot program that subsidises biking was launched in Bari, Italy, in 2019, initiating a program to support residents in the purchasing of new bikes from EUR 100 to EUR 250, depending on the price of the bike. Additionally, the municipality implemented a pay-per-ride program for participants, paying them EUR 0.2 per kilometre travelled, up to EUR 25 per month (125 km). Non-commuting, short trips were paid EUR 0.04 per km. The project cost a total of EUR 545k for four months (Speak, 2019). At the national level, in late 2020 the Italian government offered a EUR 500 direct contribution towards the purchase of a new bike. Given the success of the programme, which prompted the purchase of 660,000 bikes (Lentepubblica.it, 2021), the Government renovated it in 2021 by allocating EUR 5M for EUR 750 tax credits for people who buy bicycles (Cerri, 2021).

Key barriers Cultural and behavioural characteristics between Georgian regions and within individual municipalities affect the efficacy of the measure. Quality infrastructure coupled with education and awareness campaigns to shift perceptions can help facilitate a modal shift towards NMT. Due to the novelty and innovation of the policy measures in this category, where pilots have primarily been concentrated in Europe (e.g., Italy, France, Belgium, Luxembourg), further feasibility assessments need first be conducted for the case of Georgia. In addition, difficult terrain in mountainous regions also presents additional obstacles to building NMT infrastructure (as well as additional behavioural barriers due to increased physical activity).

Non-financial incentives for biking

Measure Municipal governments can facilitate the adoption of biking as an alternative mode of transport by providing non-financial incentives to incentivise uptake. These include the convenience offered through bike-sharing schemes, bike lanes, the construction of parking spaces, and the provision of bike-friendly adaptations in public transportation

(i.e., bike shelters in stations, bike racks on buses, and bike slides in station stairs). These adaptations facilitate inter-modality: commuters can combine biking and public transport in the same journey, which reduces commuting time and congestion.

Status In 2019, the City of Batumi planned a minor expansion of the Batumivelo bike-sharing scheme: infrastructure was planned to be renovated and expanded from 20 to 45 docking stations (AECOM, 2019). In 2020, the Government of Tbilisi announced plans to introduce a bike-sharing system, citing increased public awareness of the benefits of biking and increased health considerations during the COVID-19 pandemic (FIA Foundation, 2020).

Potential The overall mitigation potential of increasing the share of bike journeys depends on the number of measures implemented to support this mode of transport, and whether they complement each other. It has been estimated that an increase from 1 to 10% in the share of trips by bicycle can reduce the city's GHG emissions by 8.4% in Latin American cities (Wright and Fulton, 2005). In Shanghai, CO_2 savings from over 1 million bike-sharing trips in 2016, with an average of 2.4 km distance travelled, was estimated to be over 25 ktCO_2e/year (Zhang and Mi, 2018).

Costs All convenience measures in this package involve substantial upfront investments, although returns from fuel and time savings are accumulated over the policy timeline. Installation costs of bike-sharing schemes were estimated in the range of EUR 2.5k to 3k, while operation costs range between EUR 1.5k and EUR 2.5k per bike per year (BABLE, no date) (although operating costs are likely to be lower for Georgia). Improvements to Batumi's bike-sharing system were valuated at EUR 8.8 to 12.7M (A+S Consult, 2017).

Key barriers Similar to other policy packages for NMT, the primary barriers needing to be unlocked involve investment requirements and shifting municipal culture and behaviour.

3.3 Phase out fossil-fuel vehicles

Reduce the emission intensity of vehicles

Measures Several measures can be implemented at the national and municipal levels to reduce the emission intensity of vehicle fleets in cities. More stringent emissions standards can be implemented for both light- and heavy-duty vehicles to regulate sales and imports. For the existing fleet, standards to regulate vehicle efficiency on the road can be enforced through the implemented vehicle roadworthiness tests. The standards can be progressively scaled, ultimately phasing out high-emission fossil fuel vehicles. National and municipal governments can also choose to electrify their vehicle fleets (and that of state-owned enterprises) as guaranteed measures to increase investment and reduce the private-sector risk for the electric mobility sector, as well as to progress on mitigation targets.

Status Based on Directive 2009/40/EC, a test for roadworthiness became mandatory for buses and trucks in Georgia in 2018 and was expanded to include all vehicles in 2019. More stringent standards are planned to be introduced to comply with Directive 2014/45/EU, which replaced Directive 2009/40/EC (MESD, 2019).

Feasibility studies have previously been carried out for the introduction of vehicle emission standards for Euro 4 and 5 standards. MEPA has since developed a legal base for the introduction of Euro 5 vehicle emission standards, thus banning imported

vehicles that do not reach those standards (Megrelishvili, 2021). The phaseout of fossil fuel vehicles is not a policy target yet considered in Georgia but would represent the final stages of increasingly stringent emission standards for the vehicle fleet.

Potential The mandatory test for roadworthiness applied nationally was estimated to reduce emissions by 160 $ktCO_2e$/year by 2030 while setting national emission standards for vehicles were estimated to reduce emissions from 245 to 335 $ktCO_2e$ by 2030, depending on the standard applied (Euro 4/5) (Day *et al.*, 2021). Complete decarbonisation of fossil fuel passenger LDV activity within Georgian municipalities could reduce emissions in the order of 2 $MtCO_2e$ per year.

Costs The implementation of measures to reduce vehicles' emission intensity, such as emission standards and vehicle roadworthiness testing, would imply significant upfront costs to the government, in terms of establishing vehicle and engine testing facilities and expertise, but low variable costs in the testing and certification of each vehicle thereafter. The policy measure however generates costs for private residents if no financial compensation/subsidy program is implemented for the purchase of more efficient vehicles. Significant capital investments would be required to upgrade the municipal vehicle fleets, considering that upgrading Tbilisi's waste-collection fleet required EUR 9.6M in 2021 (Martikian, 2021).

Key barriers The upgrading to efficient car models (and banning or scrapping of inefficient models) implies large costs to residents if not supported through fiscal incentives and subsidies. This policy can also be socially regressive if alternative modes of transport are not provided in parallel, given that low-income populations who have longer commutes to work are more dependent on personal vehicles for mobility. In addition, measures aimed at restructuring vehicle imports (particularly inefficient second-hand vehicles) would also require compliance and cooperation with Georgia's private sector.

Redesign tax measures for internal-combustion-engine (ICE) vehicles

Measure Governments can disincentivise the use and purchase of private ICE vehicles through higher taxes. In Georgia, these can include a raise on the latest implemented fuel tax and import taxes for emission-intensive vehicles.

Status In 2017, a nationwide fuel tax was implemented, consisting of increases of GEL 250 per tonne of diesel and gasoline (Agenda.ge, 2017; Parliament of Georgia, 2021). An increased import tax on old vehicles was also implemented in 2020. The increase in taxes is scaled to the age of the vehicle: a 200% tax increase was placed on vehicles older than 12 years, a 120-160% tax increase on vehicles between 10 to 12 years old, and 14% to 80% tax increase on vehicles between six and 10 years old (Parliament of Georgia, 2021). The taxes placed on the newest cars (0-5 years) are higher than older vehicles (6-9 years)—a correction in this tax structure would improve the adoption of more efficient vehicles.

Potential The fuel tax was estimated to reduce emissions by 380 $ktCO_2e$/year by 2030, while the import tax for old vehicles was estimated to reduce emissions by 150 ktCO2e/year during the same period, assuming both policies remain implemented and are not repealed (Day *et al.*, 2021).

Costs Neutral costs. The tax revenues generated from purchases of carbon-intensive fuel or vehicle purchases can be used to offset the emissions produced from fuel and vehicle sales. The tax revenue could be reinvested as a double dividend to support other

measures with dual goals of enhancing mobility access and mitigation, such as the development of renewable energy or public and non-motorised transport solutions.

Key barriers The costs of these policies are passed down to citizens without additional support, with the largest impacts placed on low-income residents. Unlocking the barriers for these measures require that the policies are designed progressively to create net positive benefits for the population (through reinvestment of the tax revenue). While the taxes would increase the travel costs of citizens, reinvestment into the development of renewables or alternative modes of transport, for example, can lead to overall cheaper energy and transport costs that outweigh the taxes as well as increased energy independence.

Support the adoption of biodiesel

Measures Increasing the production, sales, and consumption of biodiesel would generate fewer emissions from conventional diesel vehicles. An expansion of the current production in Tbilisi can be considered, as well as scaling up biodiesel fuel for use in other municipalities.

Status Implementation of this policy began in Tbilisi in 2019, with an initial production of 10 tons of B10 biodiesel (90% diesel, 10% biodiesel) per month (to be increased) from the private sector to be consumed by personal vehicles. B5 and B7 mixtures were also sold, while the construction of a large-scale biodiesel plant is planned for 2023 (MEPA, 2021a). The policy is expected to have been fully implemented by 2021, contributing to Georgia's renewable energy fuels target stipulated in the EU Association Agreement (EUAA) (see section 5.2) (Day *et al.*, 2021). While biofuel production has insofar been limited to Tbilisi, expansion of this policy on a national scale would bring this beyond municipal jurisdiction.

Potential The initial biodiesel production policy (10 tons per month) was estimated to reduce emissions by 8 $ktCO_2e$/year in Georgia (Day *et al.*, 2021) but the potential would be larger if production is raised and also fuel types are expanded to cover other vehicle types. Costa Rica and Indonesia currently possess the strongest global biodiesel blending mandates of 20% (IATA, no date). If Georgia was to implement such a biofuel mandate, mitigation potential from diesel cars could reach upwards of 31 $ktCO_2e$/year under present activity demand.

Costs Biodiesel production costs, including feedstock costs, are estimated between EUR 0.52-0.95 per litre and are forecasted to decrease over time and differ according to geographical location and supply chains (IRENA, no date).

Key barriers Large-scale production of biofuels are associated with considerable limitations that should be considered before policymaking. Biofuel production competes for environmental resources, with the potential to cause water and land scarcity, deforestation, and biodiversity loss. The use of feedstocks for fuel can also raise food prices and lower food security, as land area and feedstocks are redirected for biodiesel. The scale-up of biodiesel as a sustainable mitigation measure is also constrained due to its limitation in suitability to certain vehicle types, as well as its marginal improvement in emissions savings over conventional diesel (Datta *et al.*, 2019). These considerations should first be analysed and addressed to unlock barriers and potential benefits.

3.4 Electrification

Financial incentives for electric vehicle (EV) uptake

Measures National or city governments can offer tax exemptions and subsidies to incentivise the adoption of EVs and hybrids. For example, these can take the form of purchase subsidies, lower loan rates, lowering or removal of toll and parking fees and taxes (i.e., registration, road, or VAT) for personal EVs and ride-hailing services with electrified vehicle fleets, and compensation payments for drivers who switch from fossil fuel vehicles.

Status Excise tax reductions for the purchase of vehicles were applied in Georgia nationally in 2017. Reductions were 100% for EVs, 60% for hybrids no older than six years, and 50% for hybrids older than six years (IEA, 2020; Parliament of Georgia, 2021). However, this policy is due to be repealed citing high costs for the national government. To electrify the taxi fleet, Batumi's GCAP suggested leasing low-emission vehicles to private operators (AECOM, 2019). Free parking for charging electric taxis was implemented in Tbilisi in 2017 (Georgian Journal, 2017).

Potential The mitigation potential of replacing an ICE vehicle with an EV depends on the emission intensity of the electric grid used to charge the EV, the activity profile of the vehicle, and the type of fuel being replaced with electricity. A ride-hailing battery electric vehicle (BEV) can save more CO_2 emissions than a private BEV because it travels a longer annual distance (Hall *et al.*, 2021). For instance, in Europe vehicle lifetime savings have been estimated to be 85 tCO_2e for ride-hailing BEVs and 30 tCO_2e for private BEVs (Hall *et al.*, 2021). In Georgia, Batumi's SUMP estimated that emissions reductions from replacing an ICE taxi with an EV would be 5 tCO_2/year (A+S Consult, 2017).

In Georgia, the excise tax reductions toward the purchase of EVs and hybrids, implemented nationwide by 2020, were estimated to have an emission reduction potential of 405 $ktCO_2e$/year by 2030, assuming the policy is not repealed (Day *et al.*, 2021). Emission savings from EVs and plug-in hybrids (PHEVs) in Georgia are larger than the global average due to a relatively low emissions intensity of the electric grid.

Costs Global cases of tax reductions and subsidies from governments range widely and could be as high as EUR 9.5k per car as in Romania, or as low as EUR 2.2k in California (United States) (CAT, 2020). Due to Georgia's potentially high relative emission savings from replacing ICE vehicles with EVs and PHEVs, marginal abatement costs for Georgia may also be lower.

Key barriers High expenses (through subsidies) or loss of revenue (through tax breaks) make this an expensive policy. Georgia has already realised the cost implications as they are considering repealing the policy due to growing government debt. National or city governments will need to draw from additional resource pools to finance the EV transition if it becomes a priority. In the long term, the costs associated with the policy do not necessarily go down with greater EV adoption. This can be seen in the case of Norway, which has led globally in market share sales for EVs (financed from decades of oil and gas exports) but now faces revenue loss from decreasing numbers of taxable ICE cars on the road (Meaker, 2021). One policy design alternative to keep government costs neutral is to incentivise EV uptake not by providing preferential breaks to low-emission vehicles, but to establish larger taxes on high-emission vehicles (see section 3.3). This policy stays revenue-neutral for the government (while contributing to mitigation efforts) even when taxable high-emission vehicles are replaced since no tax

breaks are given for EVs. However, this measure results in higher vehicle costs for consumers.

Infrastructure and services for EVs

Measures To facilitate the deployment of EVs, municipal governments can develop infrastructure and services to reduce barriers and increase incentives for driving EVs. Measures include the installation of public charging stations for EVs (or offering subsidies for private EV charger installations), the creation or commission of service and repair centres with trained technicians, and non-financial incentives such as access to bus lanes and high-speed lanes on motorways.

Status Public EV charging stations have existed in Tbilisi since 2016, as the result of cooperation between E-Space, a private company, and the Tbilisi government (Gugunishvili, 2016). An action including 15 new charging stations was included in Batumi's SUMP (A+S Consult, 2017) and later in its GCAP (AECOM, 2019). Although installations for EV charging in cities are not yet commonplace in Georgia, E-Space has continued installing public and private chargers across the country (E-Space, no date). Private ride-hailing companies have also installed chargers to support the functioning of their EV fleets (e.g., the private company AiCar installed 10 charging stations in Batumi in 2019 (Agenda.ge, 2019a)).

Potential The potential of these measures depends crucially on how overall support, financial and non-financial, can drive consumer preferences toward EV uptake. The density of charging points accessible is a key factor for increased EV uptake and usage (Xue *et al.*, 2021), although the relationship between charger density and uptake remains highly context-specific (e.g., depending on the charging speed of public chargers, location planning of chargers within municipalities and travel corridors, pricing tariffs, and availability of home and workplace chargers). The emissions abatement potential will be greater as more electricity in the grid originates from renewable energy sources.

Costs The cost of creating a fast-charging network of 15 new public charging stations in Batumi was estimated to be EUR 300k to 450k (A+S Consult, 2017). Regarding private installations, subsidies could be offered to partially cover individual costs.

Key barriers A lack of a central coordination entity and consolidated strategy, at the national or municipal levels, are major barriers to kickstarting markets to electric vehicle chargers (which typically require substantial public involvement and funding). A managing entity and master plan that addresses infrastructure and network targets, location optimisation, affordability and subsidies, charger types, implementation roadmaps, open access to charging data, and other guidelines are critical to generating confidence from both private-sector producers and consumers alike.

Targets for EV market penetration

Measures Ambitious national targets for sales, imports and market shares for low-emission vehicles can be set to guide policies and roadmaps for eventual electrification of municipalities' vehicle fleets. Municipalities themselves can also choose to initiate EV fleet targets, such as in the case of New Delhi, India (ETAuto, 2019). These targets can apply to the import and sale of hybrids and EVs, as well as to the replacement of different vehicle fleets in the city.

Status No official policy targets have been legislated in Georgia, although ex-Prime Minister Mamuka Bakhtadze announced at the launch of the 'Green Policy – Eco-friendly

Transport' project in 2018 an intention to replace 90% of Georgia's vehicle fleet with electric cars in 10 years (Agenda.ge, 2018). This is an extremely ambitious target, given that EVs still represented less than 1% of the market share of all LDVs in 2019 (MEPA, 2021c). Georgia is due to produce its first electric car in a new EV production plant in Kutaisi and will ramp up production from an initial 5,000 cars to 40,000 cars annually (50% for the domestic market and 50% for export to the EU) (Agenda.ge, 2019c, 2021c).

There are ongoing plans from MEPA to incentivise the adoption of EVs across state-owned enterprises and public administrations. No Georgian municipalities have yet to realise EV penetration targets.

Potential The ambition and scope of the targets determine their mitigation potential. If Georgia follows through with the highly ambitious intention to saturate 90% of the vehicle fleet with EVs by 2030, emission reductions from displaced ICE vehicles within municipalities have the potential to reach almost 2 $MtCO_2e$/year (excluding indirect electricity emissions).

Costs Setting targets on itself does not generate costs, but the cost of replacing an emission-intensive fleet is high and to be borne by consumers. Support programs by the national and local governments, including options outlined in this section, can help facilitate the transition.

Key barriers The political will to implement such a policy target can be complicated due to its implications for automobile imports and potentially higher costs (for low-emission models) borne by voting consumers. To unlock the subsequent barriers, the government can offer incentives and support, which could generate potential high governmental costs, or create education and awareness campaigns to shift behavioural preferences towards low-emission vehicles, and the associated co-benefits.

3.5 Avoid and reduce transport demand

Fees to regulate intracity transit

Measures Financial measures can be used to disincentivise the use of high-emission vehicles in cities. The most impactful measures include implementing a congestion charge for private vehicles in dense urban areas and a heavy-vehicle charge for freight within the urban perimeter through the establishment and enforcement of low-emission and green urban zones. Low- to no-emission vehicles that pass certain standards, such as in the case of EVs, can be exempted from charges so to promote a fleet-wide transition to low-emission mobility.

Status No fees on the transit of vehicles within cities have so far been implemented in Georgia. The establishment of a low-emission zone in Tbilisi was planned in Georgia's Ambient Air Quality Management Plans (Megrelishvili, 2021); however, due to challenges in enforcement, the measure was not implemented. As part of a policy package being implemented with KfW, Batumi is considering the establishment of a car-free zone in its city centre.

Potential London, United Kingdom, implemented a city congestion charge in 2003 that has reduced road transport CO_2 emissions by ~16% in the city's restriction zone. The zone initially encompassed a 22 km^2 area (since expanded) covering 200,000 residents and 1 million daily working commuters in the city centre. The measure led to a 20% decrease in four-wheeled traffic in the zone and emissions reductions of 100 $ktCO_2$/year. The

policy further indirectly initiated a modal shift of around 40k trips a day from private vehicles to public transport (C40, 2011). In 2021, London expanded its Ultra-Low Emissions Zone to cover most of the city; in this zone, all vehicles (including cars, vans, minibuses, motorcycles, and trucks) need to pay a charge depending on the vehicle's emission standards and weight (Mayor of London, 2021). A similar scale of emissions reductions from the creation of low emission zones, if implemented in congested areas of all Georgian cities, have the potential to be in the order of 38 $ktCO_2$/year.

Switzerland has a similar charge on the transit of heavy vehicles (>3.5 t of gross weight), albeit aimed at inter-city travel, which was estimated to reduce national CO_2 emissions from road transport by 6% or 140 $ktCO_2$/year (Egger and Oehry, 2002; FOEN, 2020).

Costs Low to neutral cost. Initial costs are required for the planning and implementation of charges in municipal areas, and continuous operational costs are required for monitoring. However, these charges generate revenue for local governments, which can then be invested in other urban mobility solutions. In London, the congestion charge cost EUR 187M to implement and EUR 105M to operate annually, while generating a surplus of EUR 142M per year (C40, 2011). In Switzerland, operational costs of the heavy-vehicle charge were estimated to be 4-6% of EUR 1bn yearly revenues (Egger and Oehry, 2002).

Key barriers Monitoring and enforcement will bring both initial and ongoing costs and administrative resources to municipal governments. While this can be a neutral or low-cost measure if costs are offset through the generation of revenues from vehicles charged, costs will be passed through to municipal residents. The implications for freight charges are also likely to be met with resistance from the industry and construction sectors.

Urban planning strategies to reduce private vehicle use

Measures By updating urban planning and land-use strategies, private and motorised transport demand can be significantly reduced, thereby reducing carbon-intensive passenger transport and infrastructure. Cities like Batumi and Tbilisi have recently developed new urban mobility plans. These cities can accelerate their implementation, while other urban centres can tender for technical assistance on these initiatives to guide future mobility strategies. Urban planning can focus on establishing better connections to public transport and NMT, thereby avoiding emissions and maximising socio-economic benefits, while dense or polluted areas can implement green zones.

As part of renewed urban land-use strategies, implementing green zones offers the possibility to create a modal shift towards alternative modes of transport and restrict the transit of emission-heavy vehicles (also discussed above). Restrictions on vehicles can include air quality standards that allow only low-emission vehicles into urban areas and the elimination of parking spaces for private vehicles. Improved public spaces for walking and biking in these zones can set the framework for similar initiatives around the city. These could include "superblocks" (mentioned in section 3.2), which redesign neighbourhood areas to restrict vehicle transit and create areas for pedestrians, cyclists, and communities.

Status Batumi saw the completion of its mobility-centred SUMP in 2017 (A+S Consult, 2017). In 2019, Batumi's GCAP recommended measures like the development of a new urban land-use master plan and the creation of "greenways", which link green spaces and promote pedestrianisation of mobility corridors (AECOM, 2019); the renewal of the land-use master plan has been ongoing since 2021 (City Institute Georgia, 2021). The

development of a SUMP for Tbilisi was proposed in 2017 (EMPRESS, 2017) and is expected to be completed by 2022 (Ramboll Group, no date). The land-use master plans for Tbilisi and Gori were renewed in 2018 (City Institute Georgia, 2021).

Georgia has plans underway for the zoning of air quality standards nationwide and across several municipalities (Megrelishvili, 2021), including the installation of an automatic air monitoring network in Tbilisi, Rustavi, Batumi, and Kutaisi (UNDP, 2020). The list of monitored substances include those emitted from urban vehicles, such as PM, No_x, SO_2 and CO. Although green zones for the regulation of those emissions have not yet been proposed in Georgia, monitoring air quality standards could serve as the first step for regulation of air standards in municipalities, thus requiring the curbing of emissions from urban mobility. The plans are being developed by MEPA, in line with the EU directives (2008/50/EC and 2004/107/EC amendment to the Georgian Law on Ambient Air Protection).

Other urban planning measures like removing parking spaces for emission-intensive vehicles, while offering free parking spaces for EVs—the latter was introduced in Tbilisi as part of the new zonal parking system (Agenda.ge, 2021d)—could complement these initiatives.

Potential

In 2012, creating a green zone of 2 km^2 in Santiago (Chile) was calculated to generate savings of 14 $ktCO_2$ over 10 years (Henríquez *et al.*, 2012). This zone incorporates measures like the prioritisation of EV use by restricting emission-intensive vehicles, increasing cycling with new infrastructure, and the redesign/management of traffic.

A small "greenways" pilot in Batumi, a set of corridors renovated with green public spaces that would link the Batumi Boulevard with other green areas, was estimated to mitigate ~29 tCO_2 over its lifetime (AECOM, 2019).

Costs

The ongoing renewal of Batumi's urban land-use master plan was estimated to cost EUR 257k to 515k in its GCAP (AECOM, 2019). A small pilot for the "greenways" would cost EUR 110k to 165k. The total investment required for the implementation of a green zone depends on the individual measures considered and the size of the zone. As an example, Santiago's 2 km^2 green zone was estimated to cost EUR 15.7bn (Henríquez *et al.*, 2012).

Key barriers

The elaboration of urban mobility or land-use plans require substantial technical assistance and costs to develop in a systematic and comprehensive manner. Depending on the individual measures specified within the planning strategies and establishment of green zones, infrastructure and administrative costs and city planning resource needs could exceed the capabilities of municipalities without substantial financial and technical support.

Zonal parking tariffs for personal vehicles

Measures

Zonal parking tariffs can serve to reduce demand for the use of private vehicles in cities. Zoning allows regulators to set differential parking rules and fees to disincentivise driving in congested areas, allowing space for alternative transport modes, and reducing emission and pollution levels in key areas. Low- to no-emission vehicles, such as EVs, can be exempted from these tariffs, so to promote the transition to low-emission mobility.

Status

The redesign of parking systems has been previously recommended for several cities in Georgia, including Tbilisi and Batumi. In Batumi's SUMP, the revamp included measures such as the reorganisation of on-street parking, the improvement of parking

enforcement, the introduction of a parking guidance system, and the development of off-street parking in the city centre (A+S Consult, 2017). Tbilisi launched a zonal hourly parking system in the central district in 2019 (Agenda.ge, 2019b), which has been expanded to other districts since (Agenda.ge, 2020b, 2021d). The implementation of zonal parking tariffs can be expanded in Georgian cities with congested traffic areas, although this measure would be less relevant for smaller municipalities.

Potential Reorganising on-street parking has been previously estimated to reduce private vehicle activity by increasing the cost of driving private vehicles. In Batumi, this policy is being implemented in a bundle including bus network optimisation and bus fleet renewal, with an estimated emissions reduction potential of 10 $ktCO_2$/year after full implementation (Day *et al.*, 2021). Another bundle for Tbilisi including the zonal parking system, the renewal of the bus and metro fleet, and bus lane prioritisation, was estimated to reduce emissions by 95 $ktCO_2$/year by 2030 (Day *et al.*, 2021).

Costs The organisation and zoning of on-road parking for Batumi was estimated to cost EUR 120k to 223k in 2017, with an additional EUR 258k to 354k for enforcement equipment, including patrol cars and a video-based control system (A+S Consult, 2017).

Key barriers No significant barriers were identified, although minor barriers include pushback from commuters and drivers facing higher tariffs as well as increased monitoring and enforcement costs.

3.6 Technology to enhance low-emission mobility

Facilitate inter-modality and optimise traffic with modern technology

Measures Modern Intelligent Traffic Control Systems (ITCS) allow for the real-time monitoring of traffic conditions and the operation of the public transport system, thus enabling regulators to optimise traffic and better coordinate a comprehensive transportation system. Data collected through these systems can also be made public so that developers can generate additional travel applications and services. A connected transportation system serves as the basis for a Mobility as a Service (MaaS) program, in which the public and private sectors collaborate to offer a monthly flat rate that allows the user to use all public modes of transport (trains, bikes, taxis, shared cars, etc.).

An ITCS includes the upgrade of the city's traffic lights with a smart, algorithm-based system that adapts the duration of stoplights based on real-time traffic conditions (Steinbuch, 2020). This helps reduce congestion and vehicle idling and accelerating, thus reducing vehicle emissions. The traffic light system can also be programmed to give priority to cyclists and pedestrians, thereby incentivising the use of NMT. For instance, if a wave of cyclists approaches an intersection, the stoplight system can react by setting the green light for longer, thus creating "green waves" that reduce travel times.

Status An ITCS was proposed in 2020 for Batumi and Tbilisi (GOPA Infra, 2020b). The systems would include real-time monitoring of traffic, parking management, public transport monitoring, traffic light coordination, a MaaS platform, among other subsystems. The feasibility studies have been completed, but Batumi's ITCS has since been parked due to renegotiation on investment deals due to a shifting of priorities during the COVID-19 pandemic. For Tbilisi's ITCS, the system would build on the city's smart traffic lights, of which 75 were first installed in 2015 (Agenda.ge, 2015) although the loan agreement for has yet to be signed.

Potential These systems and tools can incentivise the use of public transport by making it more reliable and easier to use, increasing the average travel speed of motorised transport by ~10%. It has been estimated to potentially reduce 11 $ktCO_2e$/year in Batumi (GOPA Infra, 2020b). If an ITCS was fully implemented and optimised in Tbilisi, emissions from the transport sector have the potential to be reduced by approximately 130 $ktCO_2e$/year (GOPA Infra, 2020a).

The potential of a smart traffic lights system to reduce emissions depends on the conditions of the road (e.g., speed limit) and the number of users. Using an agent-based simulation, the introduction of a green wave was estimated to reduce emissions by 5-7% in a road section with a high density of commuters in Graz, Austria (Bloder and Jäger, 2021).

Costs The cost of implementing the ITCS for Batumi was estimated to be EUR 6M in 2020, including the urban traffic control system (i.e., smart traffic lights), which amounts to EUR 1M (GOPA Infra, 2020b). In Tbilisi, a roughly equivalent implementation was estimated to cost EUR 24.4M, of which the smart traffic lights system would cost EUR 8M.

Key barriers Substantial needs for technical expertise, modern technologies, and capital costs represent the primary barriers for this measure. Reproducing this measure in smaller municipalities could have diminishing marginal returns for reducing traffic congestion and emissions (due to the large investments needed to improve efficiency of transport systems with lower demand). For smaller municipalities, the cost-benefit analysis of such a measure should be assessed in comparison with other urban mobility measures or policies targeted enhanced welfare.

3.7 Optimise freight load

Increase freight transport efficiency

Measure Emissions in freight transport can be lowered by reducing freight trips running on sub-optimised loads. For this purpose, municipalities can implement consolidation centres for freight at the city outskirts, which allow for the sharing of trucks between companies and the optimisation of freight traffic. Digital apps can be used to match loads to empty trucks.

Status The European Commission is looking into regulating emissions in the heavy-duty vehicle fleet, and some actions have been initiated to reduce freight emissions in Georgia. An intermodal, EU-funded container terminal had been initially planned to be built in Tbilisi (TRACECA, no date).

Potential By implementing a freight consolidation system, the city of Bristol, United Kingdom, saw a peak reduction of 70-80% of onward truck trips into the city (Travelwest, no date). In 2014, the introduction of the London Boroughs Consolidation Centre reduced vehicle trips by 46% and CO_2 emissions by 41% (Mayor of London, no date). Increasing freight efficiency has previously been estimated to potentially reduce a country's national transport GHG emissions by 1-4%, depending on a country's market size (PPMC, no date).

Costs Existing software applications could be used to match loads with trucks in consolidation terminals, but the construction of such terminals would require capital investments. The planned inter-modal terminal for Tbilisi costs approximately EUR 41M (TRACECA, no

date). Gains in freight transport efficiency would reduce costs over time in fuel and automobile savings as well as generate numerous co-benefits, such as time and health savings, for municipal populations.

Key barriers High upfront capital required for the construction of freight terminals make is the primary barrier and is likely to require sizable financial support or loans. This is particularly difficult in the current period of Georgia due to high government debt and redirection of resources towards pandemic recovery.

3.8 Overview of the spectrum of potential action

Figure 3 provides a summary overview of 34 potential individual measures for GHG emission reductions for the urban mobility sector, evaluated within the 18 policy packages in sections 3.1-3.7. These measures are categorised according to the overarching policy objectives and whether they are a regulation policy or an infrastructure/technological measure. The figure provides a framework to quickly and intuitively assess and visualise important criteria for the measures' financing and implementation. According to the scope of the paper, a simplified analysis is employed to provide order-of-magnitude assessments for policy prioritisation exercises and discussion among policymakers and specific measures can be followed up on with more expansive feasibility and cost-benefit analyses.

Approach

The measures are mapped to their marginal abatement costs (not overall costs) and readiness to be implemented in the Georgian context, to indicate the accessibility of different measures. The index values showing the readiness of implementation for Georgia were collected via stakeholder surveys. Based on survey respondents' experiences and knowledge in the sector, respondents assessed for the 34 individual measures: 1) the "ease of political implementation" based on whether the measure was a priority for financing for municipal governments, the central government, both, or neither (see section 4.2 for discussion on the financing governance structure of Georgia), and 2) timescale of potential implementation (technological maturity) based on whether the measures have been previously implemented successfully in Georgian municipalities, if feasibility studies have been completed for less mature measures, or whether they have insofar only been discussed at an inception and incubation stage. The assessment for each measure was supplemented with an additional indicator for technological maturity according to available case examples from the latest international practice. Assessment values across the indicators were averaged for each measure to provide the y-axis value ranges in Figure 3.

Mitigation potentials are illustrated in the figure via bubble size for each measure. Mitigation potentials for Georgia were estimated with a simplified approach via several methods: 1) by applying evaluated ex-post impacts from international case studies to the context of Georgian municipalities (by using Georgian data on city populations, transport mode shares, fuel shares, and more); 2) scaling down national-level transport emission impacts from previous policy evaluations (e.g., CSAP) to only cover municipalities (excluding inter-city and rural transport); and 3) scaling up municipality emission impacts from previous evaluations (e.g., GCAPs, SUMPs) to cover all municipalities. For a range of measures, mitigation potentials are not available for the context of Georgian municipalities (marked with an "?" symbol) due to no data availability and the presence of uncertain variables heavily specific to Georgia municipality contexts. As an illustrative example for a vehicle congestion charge in Georgian municipalities (Section 3.5), the policy area coverage and emissions impact (100 $ktCO_2/yr$) of London's congestion charge was first established using case study information (C40, 2011; Mayor of London, 2021), while London's transport emissions per road-based vehicle mode were taken from its latest available inventory (Greater London Authority, 2019). In parallel, the aggregated emissions of Georgian municipalities' transport sectors by mode were estimated and projected with municipal inventory and

public socioeconomic and transport data using PROSPECTS+ (NewClimate Institute, 2019) and the bottom-up activity-based methodologies and assumptions described in Day et al. (2021). As the last step to establishing the potential order-of-magnitude emission impacts on implementing road vehicle charges in dense city areas, the emissions impact of London's policy was scaled to the potential impact of Georgian municipalities' applicable road-based transport emissions.

Cost estimates were derived from international case studies and project appraisal exercises conducted for Georgian municipalities' urban mobility plans, such as those described in Section 3, and supplemented with the latest scientific literature. To establish the marginal abatement cost, cost values were divided over the emission reduction potential of the measure (unless marginal abatement costs were provided directly). The range of cost values for urban mobility measures was then assigned to the x-axis categories in Figure 3 based on a logarithmic scale. However, the costs shown do not cover those from indirect externalities and further cover those only borne by governments (municipal or national) rather than individuals and households.

While the scope of the approach above is simplified in its use of assumptions and data treatment, it provides an accurate ballpark analysis to suit the purpose of the exercise to provide input to the framework mapping the landscape of urban mobility measures (according to its mitigation and financing considerations) relevant for Georgian municipalities.

Results and discussion

The overview of Figure 3 shows that none of the available measures discussed are currently standard practice across all Georgian municipalities, although many measures (in the second row) are readily implementable from both a regulatory and technological perspective. Some of the measures with more readiness have already been introduced in selected municipalities but have yet to be rolled out nationally. Inversely, there are many mitigation measures, particularly those with large emission reduction potentials, still not yet suitable for Georgia either from a political or technological/infrastructure standpoint. Most measures are categorised in between, with reasonable readiness to be implemented in Georgia. Measures within these bands with larger mitigation potentials and lower marginal abatement costs can be prioritised for deeper evaluation.

While measures with large potentials for municipalities have typically been associated with those considered for implementation at the national level in Georgia (e.g., those in electrification or phase-out of fossil vehicles), this need not be the case. As described in Section 3, there have also been examples of implementation of these measures at the municipality level internationally. Many measures with significant mitigation potentials, such as *Mp1* (*bus/marshrutkas optimisation and renewal), A1 (congestion charge in dense city areas) and T1 (ITCS),* are typically considered only at the municipal level.

Practice readiness of Urban Mobility measures in Georgia

Modal shift to public transport			**Phase out FF vehicles**			E5	T	Service centres for EVs
Mp1	T	Bus/marshutka optimisation and renewal	P1	R	Phase out ICE vehicles	E6	T	Installation and subsidies for charging stations
Mp2	T	Metro optimisation and renewal	P2	R	Fuel tax increase on fossil fuels	E7	T	Traning programs for EV technicians
Mp3	R	Education information campaigns	P3	R	Import tax increase on inefficient vehicles	**Avoid and reduce transport demand**		
Mp4	R	Financial incentives for public transport	P4	R	Biodiesel blending and production targets	A1	R	Congestion charge in dense city areas
Mp5	R	Regulation of taxis	P5	T	Emission quality standards for LDVs	A2	R	Zonal parking tariffs
Mp6	T	Optimise public transit accessibility	P6	T	Vehicle tests for roadworthiness	A3	R	Remove parking spaces in high congestion areas
Mp7	T	Park and Ride facilities	P7	R	Low-emission fleets for government and SOEs	**Tech for low-emission mobility**		
Modal shift to NMT			P8	T	Emission quality standards for HDVs	T1	T	Intelligent Traffic Control Systems
Mn1	T	New cycling/pedestrian routes	**Electrification**			T2	T	Open-source data for transport planning apps
Mn2	T	Bike-sharing scheme	E1	R	Financial incentives for low-emission/EV taxis	T3	T	Live-time monitoring of transport and traffic
Mn3	R	Financial incentives for non-motorised transport	E2	R	EV production and sales target	T4	T	Mobility-as-a-service program
Mn4	T	Bike-friendly adaptations to public transport	E3	R	Financial incentives for EVs, PHEVs, hybrids	**Optimise freight load**		
			E4	R	Demand-side incentives for EVs	O1	T	Freight consolidation centres

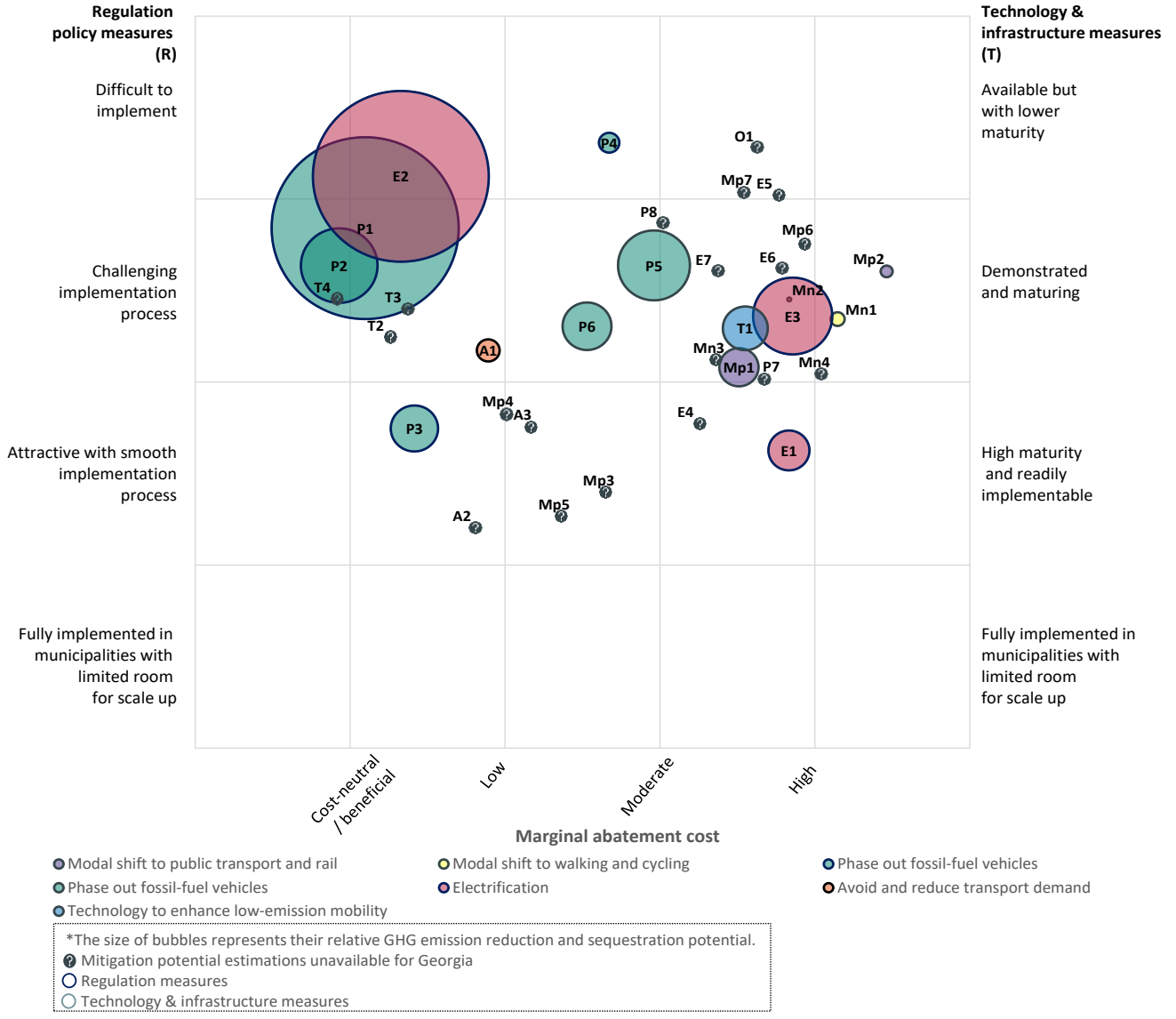


Figure 3: Overview of climate change mitigation potential in the urban mobility sector in Georgia

Source: Authors' elaboration based on analysis in sections 3.1-3.7 and data from expert interviews and surveys conducted on practice readiness of measures in Georgia

Modal shift to public transport: While public transport measures such as *Mp1 (bus/marshrutkas optimisation and renewal)* and *Mp2 (metro optimisation and renewal)* (for Tbilisi) have been a priority of municipalities' urban mobility plans, they have insofar not been implemented in full or scaled up to an optimal level (within, and across municipalities). The measures possess sizable mitigation potential while also improving mobility and generating mitigation co-benefits (see section 5.1). Previous successful initiatives (even if partially) make these relatively ready and attractive to implement. Measures to restructure the public transport system, also including *Mp6 (optimise public transit accessibility)* and *Mp7 (P&R facilities)*, however, come with large abatement costs while technological and infrastructure needs and longer project timelines make them less readily available.

The remaining public transport regulation measures offer other complementary actions cheaper to implement, although its implications for emissions reductions are uncertain for Georgia. Regarding *Mp4 (financial incentives for public transport)*, the effects of reducing public transport costs on increasing public transport ridership (Bly and Oldfield, 1986) and decreasing personal vehicle use (TCRP, 2004) have long been understood to have potentially large impacts on transport demand. Coupled with *Mp3 (education awareness campaigns)*, the two measures as a policy package have been shown to increase annual bus users by 110% in Oyama City, Japan while maintaining bus revenues (Azami *et al.*, 2021). For *Mp5 (regulation of taxis)*, the mitigation potential is dependent on the approach to regulation; if involving incentives or requirements on electrification or emission-intensity, mitigation potentials can be significant (e.g., see *P6* or *E1*). The high readiness of implementation and low abatement costs of all three measures imply they could be pursued with more priority.

Modal shift to NMT: All NMT measures show good readiness to be implemented in Georgia, and many initiatives have already started in municipalities. While they are politically attractive and technologically ready, these measures come with large investment needs and relatively lower returns on emissions reductions. A modal shift towards cycling modes, from measures such as *Mn1 (new cycling routes)* and *Mn2 (bike-sharing schemes)*, could offer "low-hanging fruit" for emission reductions. While the marginal abatement costs may be higher for smaller municipalities (due to large infrastructure needs yet reduced emissions reduction potentials) this may offer an immediate advantage over other measures (requiring even greater investment needs, e.g., metro, BRT, electrified public transport). Populations in smaller and rural municipalities may also have a greater dependency on NMT modes for transport to access public services and other drivers of social mobility, such as enhanced labour opportunities.

If Georgian municipalities continue their growth trends in urban population (GeoStat, 2021c) and behavioural acceptance of NMT modes (FIA Foundation, 2020), these measures could yield yet even greater impact. While NMT measures provide lower relative returns on emissions reductions, the many co-benefits (e.g., health from exercise, reductions in air pollution, noise, and traffic) (see section 5.1) are not yet considered; a more expansive cost-benefit analysis could evaluate NMT measures with higher priority.

Phase out fossil fuel vehicles: A range of regulatory and technological measures exist in this category. The most ambitious long-term regulatory measure, *P1 (phase out)*, has a large mitigation potential but is less ready to implement due to the lack of readiness in the domestic automobile sector (production and imports) and insufficient supporting policies for residents. *P2 (fuel taxes)*, *P3 (import taxes)*, *P4 (biodiesel)*, *P5/P8 (emission-quality standards),* and *P6 (vehicle tests)* also have high mitigation potentials and have been planned or implemented to some degree in Georgia at the national level but are also challenging (less ready) due to the high costs borne for citizens as well as enforcement challenges. Despite low costs for the government, the measures are not immediately ready to be implemented or scaled up without additional supporting mechanisms for populations. While these measures are typically under national jurisdiction, municipalities can apply political pressure on the initiatives directly (with supporting mechanisms) or indirectly through implementing policies such as transit fees (see *A1*).

Electrification: The regulatory measures for electrification could have a high emissions impact. *E2 (EV production and sales target)* could be a national policy objective, although municipalities can also implement EV targets for modal share or vehicle registrations. This measure would have large emission

and air pollution benefits to municipalities and positive economic benefits for manufacturing sectors. Although Georgia's intentions on accelerating national EV fleet shares (90% by 2028) were announced previously, the realisation of policy targets to this level of ambition has low readiness for Georgia given the early stages of EV-supporting infrastructure and possible removal of excise taxes to support populations. *E1* and *E3 (financial incentives for EVs, PHEVs, and hybrids for LDVs and taxis)* carry large mitigation potential for Georgian municipalities and are attractive politically if the issue of high government costs could be solved. The technology/infrastructure measures (*E5 – service centres, E6 – charging stations, and E7 – training programs*) have also high upfront costs and uncertain mitigation potentials for Georgia (as effectiveness depends heavily on planning and municipal-specific context) but are critical pre-requisites for a shift towards e-mobility. Given the high costs but necessity for e-mobility, strong policy signals supporting EVs from municipalities (such as *E2*) would reduce the uncertainty risk for private sector providers and international financiers of infrastructure.

Avoid and reduce transport demand: These regulatory measures are all considered readily implementable within Georgia. *A1 (congestion charge in city centres)* is likely to be the most challenging to implement given both the enforcement and monitoring needs of municipal governments, as well as the sensitivity from increased costs for residents. However, both these challenges can be alleviated if the charge revenues are recycled effectively to increase resources for enforcement and create benefits in other forms for residents. Further, there is a low marginal abatement cost associated with the measure due to the recovery of costs and substantial emission reduction potential from shifting private vehicle activity to public transport and the optimisation of freight trips in logistics. The other measures in this category have been trialled and implemented in various municipalities to date but are not yet ubiquitous. As they are regulatory measures requiring minor resource investments or have the potential to become financially viable through generating revenues (i.e., through transit charges or parking fees), costs of implementation are low. A reduction in traffic will also bring co-benefits to municipalities. Low infrastructure and technology costs coupled with high political attractiveness (due to general environmental and social benefits) make these measures "low-hanging fruits" to be implemented.

Technology to enhance low-emission mobility: The technology measures here have become increasing priorities for international finance in large Georgian municipalities in recent years, although the extent of the technical expertise and infrastructure required remains potentially challenging. While the measures can be considered individual measures, they are most effective if bundled as a policy package and implemented in full as they complement positive synergies to each other. *T2 (open-source data)* and *T3 (live transport and traffic data)* have uncertain mitigation potentials on their own, although their low-cost nature and necessity as a prerequisite to *T1 (ITCS), T4 (MaaS)* and other advanced transport planning initiatives make it an attractive priority in this category. The measures are however could be challenging to implement due to the technical expertise required. *T1 (ITCS)* is a high-infrastructure and thus high-cost measure, although the effectiveness of the technology has already been demonstrated. Its high potential for transport efficiency gains and thus, emissions reductions, make it an attractive policy. *T4 (MaaS)* on the other hand, is a low-infrastructure, low-cost measure that could increase and distribute ridership across all transport modes. While mitigation potentials are unavailable for Georgia, simulations modelling the effect of MaaS for the city of Zurich, Switzerland suggest the initiative could reduce transport-related energy consumption by 25% (Becker *et al.*, 2020).

Optimise freight load: *O1 (freight consolidation centres and optimal freight loading)* can be an important measure to reduce pollution-heavy truck transit within city limits and improve traffic congestion. However, this technology/infrastructure measure would require high levels of costs and likely be applicable only for larger municipalities. Due to the extent of infrastructure requirements and lack of the previous implementation in Georgia, it would be a challenging measure to implement.

4 Financing mitigation actions in urban mobility

The transport sector accessed and generated an average of $173 billion of climate finance and investment (e.g., government budgets, development, state and commercial finance instruments, multilateral funds, private investment, and household revenue) per year globally, or 31% of the world's share, in 2019 and 2020. Of this, 48% of resources for transport measures were delivered through international public financing, 42% through private financing, and 9% through public domestic budgets (Naran *et al.*, 2021). Low-carbon transport has been the fastest-growing sector for climate finance investment with almost half of investment going towards private road transport solutions (including BEVs and electric chargers), through large momentum from government subsidies and decreasing technology costs, while investments into public transport and rail experience slow growth (Naran *et al.*, 2021).

However, the accessibility of climate finance for transport measures experiences unique challenges. The issues are primarily three-fold: 1) difficulties in applying robust measurement, reporting and verification methods to transport measures and emission reductions; 2) tendency for climate finance to deprioritise projects that can be funnelled through other channels and objectives (i.e., pursuing mobility and accessibility rather than mitigation); and 3) climate finance often targets projects with short-term benefits, while many transport measures require long timescales to both develop infrastructure and policy, but also to foster the cultural and behavioural shifts needed. In result, there remains a significant global financing gap for low-carbon transport projects (Peralta Quiros and Mehndiratta, 2017).

Financing for urban mobility measures, which typically lie under the jurisdiction of cities and municipalities, also face additional barriers as local institutions, particularly in developing and emerging economies, face complex and administration-heavy processes to finance applications, appraise projects, and prove bankability (AFD, 2021). Both urban mobility and transport measures, in general, remain critically deficient in global climate finance, with the former possessing an estimated financing gap of $1.83 trillion annually (SLOCAT, 2021).

The different measures presented in section 3 can be categorised within different project stages, which can be used as a framework to guide how measures can be effectively financed. Proven technologies in established markets that present low investment risks and relatively safe returns can be financed by private investors or businesses directly. On the other hand, new "pioneering" technologies that are perceived as riskier might require public funding with no return expectations to demonstrate their potential for wider implementation. In between these two extremes, different measures with risk profiles can be implemented using different financing sources, including combinations of public and private funding.

A mapping of the measures in section 3 along respective project development stages is shown in Figure 4 to link measures with optimal types of financing instruments and ultimately increase finance flows towards urban mobility projects in Georgia. Measures are mapped to the stages according to the Georgian context (i.e., a "transitioning" measure for Georgia may not be considered "transitioning" elsewhere). The framework mapping measures to project development stages and financing instruments in Figure 4 is applied from Day et al. (2022), a complementary paper discussing the readiness of climate-smart agriculture practices for Georgia. Additional detail on the framework can be found in the complementary paper and the Annex (Table 2 and Figure 8).

The framework is a simplified concept that only partially considers additional, non-financial barriers (which are discussed in sections 3 and 4.2). While this framework is conceptualised for technology and infrastructure measures only due to their relevance across financing schemes, regulatory measures are specifically relevant for technical assistance financing across all project stages. Depending on how regulations are implemented, specific individual measures subsumed could also require investments requiring other types of arrangements.

Practice readiness of Urban Mobility measures in Georgia

Modal shift to public transport			Phase out FF vehicles			Tech for low-emission mobility		
Mp1	T	Bus/marshutka optimisation and renewal	P5	T	Emission quality standards for LDVs	T1	T	Intelligent Traffic Control Systems
Mp2	T	Metro optimisation and renewal	P6	T	Vehicle tests for roadworthiness	T2	T	Open-source data for transport planning apps
Mp6	T	Optimise public transit accessibility	P8	T	Emission quality standards for HDVs	T3	T	Live-time monitoring of transport and traffic
Mp7	T	Park and Ride facilities	Electrification			T4	T	Mobility-as-a-service program
Modal shift to NMT			E5	T	Service centres for EVs	Optimise freight load		
Mn1	T	New cycling/pedestrian routes	E6	T	Installation and subsidies for charging stations	O1	T	Freight consolidation centres
Mn2	T	Bike-sharing scheme	E7	T	Traning programs for EV technicians			
Mn4	T	Bike-friendly adaptations to public transport						

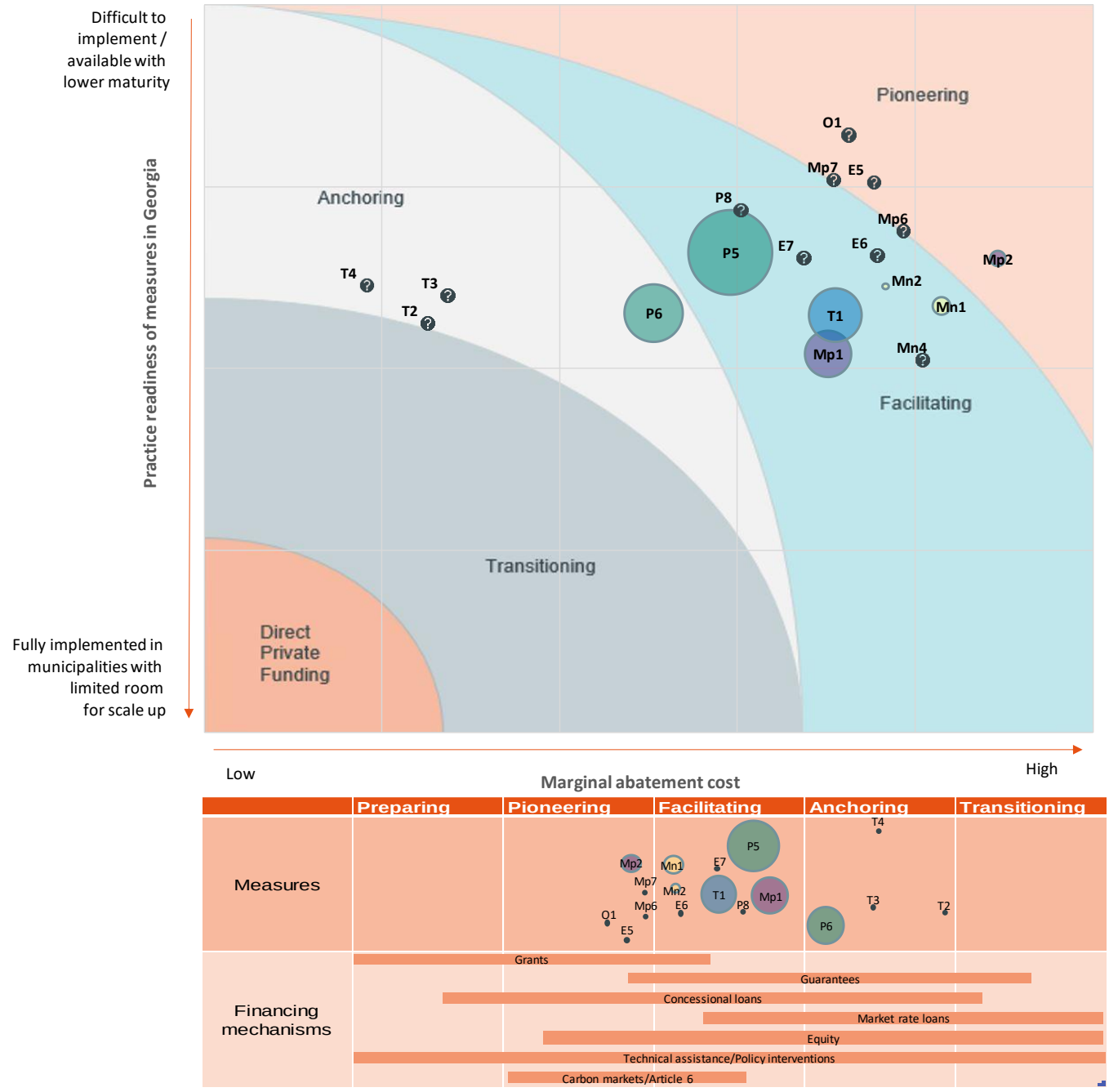


Figure 4: Urban mobility (technology and infrastructure only) measures in their corresponding development stages

4.1 Potential climate finance sources for Georgian municipalities

This section provides an overview of potential sources for municipalities seeking finance for the urban mobility measures discussed in Section 3. Viewed alongside Figure 4, municipalities can strategize finance streams and sources according to the development stages of prioritised measures.

4.1.1 Climate-specific funds linked to the UNFCCC

Green Climate Fund (GCF)	
Description	The GCF was created from the UNFCCC climate negotiations as the main financing arm for ambitious and transformative projects for climate change mitigation and adaptation.
Type of support available	The GCF finances and co-finances projects over four stages of development: 1. Transformational planning and programming: by promoting integrated strategies, planning and policymaking to maximise the co-benefits between mitigation, adaptation, and sustainable development. 2. Catalysing climate innovation: by investing in new technologies, business models, and practices to establish a proof of concept. 3. De-risking investment to mobilize finance at scale: by using scarce public resources to improve the risk-reward profile of low-emission, climate-resilient investment and crowd-in private finance. 4. Mainstreaming climate risks and opportunities into investment decision-making to align finance with sustainable development: by promoting methodologies, standards and practices that foster new norms and values.
Relevant recent projects in urban mobility	⟩⟩ $300M (93% loan, 7% grant) to support investment in COVID-19 green recovery measures, including urban mobility interventions in public transport and NMT systems, electric vehicle infrastructure and energy efficiency in five ASEAN countries. ⟩⟩ $270M (93% loan, 7% grant) to develop an 85-km electric light-rail transit system, which will be powered by 98% renewable electricity, and increase inter-modal public transport connectivity in San José, Costa Rica. ⟩⟩ $137M (97% loan, 3% grant) to finance the development of electric mobility operators, including the deployment of electric buses and two- and three-wheelers in India. ⟩⟩ $49M (76% loan, 24% grant) to install a BRT system operated by a biomethane hybrid bus fleet, deploy electric bike taxis, and foster last-mile connectivity via NMT in Karachi, Pakistan.
Current involvement in Georgia	The GCF has four active projects in Georgia with $105.1M in total financing. Active urban mobility projects include: ⟩⟩ $98M (75% loan, 25% grant) to support the Green Cities Facility to develop and implement GCAPs in Batumi and Tbilisi. Measures supported include the expansion of metro cars and infrastructure modernisation in Tbilisi.
Overview of application/ financing process	The GCF has in place a simplified approval process (SAP) for smaller-scale, uncontroversial transport-sector projects up to a value of $10M (GCF, 2019). The SAP involves a shortened application process and technical guidelines, which could benefit resource-constrained municipalities. There are two key areas eligible for the sector: 1) Adoption of new technologies, including higher efficiency engines and standards, alternative fuels, road traffic systems and electric and hybrid technologies, which apply to both public and private urban mobility. 2) Modal shift, including urban planning, technology, and infrastructure measures to reduce dependence on LDVs and improve sustainable transport utilisation. Funding proposals are usually developed in cooperation with the GCF Secretariat. Proposals must be presented to the GCF Board through an Accredited Entity and have the endorsement of

the Nationally Designated Authority (NDA), in this case, MEPA. The board can evaluate and approve projects in each of the four annual board meetings.

Global Environment Facility (GEF)	
Description	The GEF serves as a financial mechanism to five conventions: the UNFCCC, the Convention on Biological Diversity, the Stockholm Convention on Persistent Organic Pollutants, the UN Convention to Combat Desertification, and the Minamata Convention on Mercury.
Type of support available	The GEF delivers grants through implementing agencies, often with a co-financing amount from other organisations.
Relevant recent projects in urban mobility	⟩⟩ $3.6M grant to develop a national strategy for electric vehicles, including feasibility studies, purchase of electric buses, and development of charging stations and NMT infrastructure in Tashkent, Uzbekistan. ⟩⟩ $1.8M grant to support policy instruments and feasibility studies for piloting electric bus and LDV systems, and capacity building programs in Jamaica. ⟩⟩ $1.6M grant to support feasibility and proof-of-concept projects for installation of 350 electric chargers and development of charging market policy and regulatory framework and fiscal policies to incentivise EV uptake in Ukraine.
Current involvement in Georgia	Over the years, the GEF has provided over $39M in grants (with $195M in co-financing) for 30 projects in Georgia. For urban mobility measures, this has included support for the development of fuel economy policies at the national level, as well as sustainable urban transport plans and feasibility studies for the City of Batumi and the Achara region. There are currently 13 approved projects in different stages of execution. Active urban mobility projects include: ⟩⟩ $1M grant to assess electric urban transport and green city development needs and develop demonstration projects for electric mobility and NMT in Kutaisi.
Overview of application/ financing process	Funding from the GEF is accessed through the implementation agencies. In Georgia, these are the Food and Agriculture Organisation (FAO), the International Fund for Agricultural Development (IFAD), the World Bank, the UN Development Programme (UNDP), the UN Environment Programme (UNEP) and the UN Industrial Development Organisation (UNIDO). Funding should be requested by the national government's Operational Focal Point (MEPA) through one of these agencies.

NAMA Facility	
Description	The NAMA Facility was jointly established between the Department for Business, Energy and Industrial Strategy of the United Kingdom and the Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany. It channels donor funds to support developing countries in implementing mitigation measures.
Type of support available	The Facility consists of regular calls for project proposals with an evolving set of eligibility criteria and themes for focus. The latest call, the "Ambition Initiative – Round Two" will run with its deadline until April 30, 2022, and will focus on sectors explicitly included in the latest NDC submissions. The Facility emphasises innovation piloting for early-stage technological applications.
Relevant recent projects in urban mobility	⟩⟩ EUR 5.5M to develop NMT and P&R facilities and provide capacity building and technical assistance to local governments in five pilot cities in Indonesia. ⟩⟩ EUR 9.3M to support transport sector transition through 50 measures in public transport systems, NMT, and modernisation of the vehicle fleet in Peruvian cities.

Current involvement in Georgia	N/A
Overview of application/financing process	Application and project processes for the NAMA Facility are typically led by government ministries, with activities closely tied to national climate change commitments. MEPA could play a role in application processes given that Georgia has had limited to no prior experience with executing projects with the Facility, has no executive authority for transport sector projects and that the Facility's latest call targets implementation of updated NDCs (NAMA Facility, no date).

4.1.2 Multilateral Development Institutions with climate-related funding

Asian Development Bank (ADB)	
Description	The ADB is owned by 68 member countries—of which 49 are from Asia. It aims to achieve a prosperous, inclusive, resilient, and sustainable Asia and the Pacific while sustaining efforts to eradicate extreme poverty.
Type of support available	ADB includes transport as one of its key sectors and themes, assisting developing Asian countries in building low-carbon, safe, accessible, and affordable transport systems. Like other multilateral development banks (MDBs), it provides loans, grants, equity investments, and guarantees. ADB also manages the Cities Development Initiative for Asia multi-donor trust fund, which works with secondary Asian cities to prepare bankable and sustainable infrastructure investments.
Relevant recent projects in urban mobility	ADB's project portfolio typically focuses on highways, roads, and railway developments, and are regional or inter-city in nature. Recent examples of urban mobility projects include: ⟩⟩ $500M loan for expanding the metro railway network in Bangalore, India. ⟩⟩ $200M loan for developing infrastructure and adopting smart technologies to reduce traffic congestion and improve logistics in Shaanxi, China. ⟩⟩ $926M loan to enhance the design, maintenance, and technologies to manage the metro rail system in Mumbai, India.
Current involvement in Georgia	ADB involvement in Georgian transport is primarily focused on regional and cross-country connectivity, including several improvement projects on the North-South Corridor (Kvesheti-Kobi), East-West Highway (Shorapani-Argveta), and broader South Caucasus region. A new Railway Green Bond Project with Georgian Railway JSC was approved in June 2021. ADB had previously worked closer to urban mobility issues in Georgia, having approved a five-tranche financing facility for the Sustainable Urban Transport Investment Programme for up to $300M. The tranches focused on a range of projects including metro expansion and modernisation, road upgrades and urban planning, in several cities including Tbilisi, Batumi and Anaklia.
Overview of application/financing process	For its engagement with Georgia, the ADB has developed a Country Partnership Strategy (2019-2023) and a Country Operations Business Plan (2021-2023). The Ministry of Finance is the main counterpart in the country.

European Bank for Reconstruction and Development (EBRD) / European Investment Bank (EIB)	
Description	The EBRD is owned by 70 countries, as well as the EU and EIB. It strives to develop a healthy investment climate and promote environmentally and socially sound and sustainable development. The EBRD is active in about 40 countries across the Southern and Eastern Mediterranean, Central and Eastern Europe, and Central Asia.
Type of support available	Transport is one of EBRD's key priority sectors, with 170 current active portfolio projects consisting of EUR 8.4 billion in loans and investments. Eastern Europe and the Caucasus receives 21% of transport sector investment. In addition to EBRD's

	Transport Sector Strategy (2019-2024), the bank also has a Municipal and Environmental Infrastructure Sector Strategy (2019-2024), which covers urban mobility projects and the Green Cities Programme. EBRD's core strategy for urban transport until 2024 will focus on public transport infrastructure, fleet renewal and electrification, and digital solutions in ticketing, traffic management, and information systems. Like other MDBs, EBRD provides loans, equity investments and guarantees with a focus on the private sector.
Relevant recent projects in urban mobility	⟩⟩ EUR 17M loan to acquire and implement smart traffic management systems, construct a traffic management centre and acquire new trams in Sarajevo, Bosnia and Herzegovina. ⟩⟩ EUR 15M loan for the purchase of 100 new CNG (Euro 6) buses to expand and renew the public transport fleet in Mersin, Turkey. ⟩⟩ EUR 250M loan for upgrading and electrification of a high-capacity metro system in Alexandria and Abou Qir, Egypt.
Current involvement in Georgia	⟩⟩ EUR 83M loan to the City of Tbilisi for the acquisition of a new bus fleet (200 18-m CNG buses) and construction of a new bus depot. ⟩⟩ EUR 75M loan to expand and renew the metro system through the acquisition of 40 metro cars and rehabilitating a metro depot in Tbilisi. ⟩⟩ EUR 2.5M loan to the City of Batumi to improve the city's public transport system. ⟩⟩ EUR 19M loan to the Municipal Development Fund of Georgia for the purchase of 175 Euro 5 diesel buses in Kutaisi, Gori, Telavi, Zugdidi, Rustavi, and Poti.
Overview of application/financing process	For its engagement with Georgia, the EBRD has approved its latest "Strategy for Georgia" in 2016. Applications for financing typically go through the local partner finance institutions of EBRD. The EBRD may also provide direct financing and support for SMEs through several loaning and equity facilities.

The World Bank / International Finance Corporation	
Description	The World Bank was created in 1944 to support the reconstruction after World War II. It is composed of several institutions and hosts several funds, including the GEF and the Climate Investment Fund (CIF). The CIF also contains the Clean Technology Fund, which promotes scaled-up financing for low-carbon technologies. The World Bank, alongside the EIB, also implements the City Climate Finance Gap Fund, which provides advisory and technical assistance for strategy development, analytics, project conceptualisation, and financing strategy for urban development and climate action measures.
Type of support available	The World Bank Group provides a wide range of support through its different modalities: IBRD provides financial development and policy financing, IDA provides zero-to low-interest loans and grants, IFC mobilizes private sector investment and provides advice, and MIGA provides political risk insurance (guarantees). It can finance infrastructure, policy development or provide grants for developing and scaling productive activities. The World Bank launched the Global Facility to Decarbonise Transport, a new multi-donor trust fund, in 2021 to support client countries with transitioning their transport sector towards zero emissions by 2050.
Relevant current /past projects in urban mobility	⟩⟩ $940k grant to prepare a transition to electric bus fleets through piloting and capacity building schemes in select cities in Brazil. ⟩⟩ $115M to reconfigure priority road corridors, install an ITCS, and upgrade bus infrastructure in Ulaanbaatar, Mongolia.
Current involvement in Georgia	The World Bank currently has no active urban mobility projects in Georgia, with the only active transport projects involved in improvements of the East-West Highway Corridor.

Overview of application/financing process	Engagement with the World Bank is best done through the local office, as it is the place that coordinates the support to the country. While support can be given through different entities or organisations, all funding is requested through the Georgian Ministry of Finance.

4.1.3 Bilateral Development Funding (foreign direct investment)

KfW Development Bank	
Description	KfW is a German state-owned investment and development bank. KfW development bank finances projects in Sub-Saharan Africa, North Africa, the Middle East, Asia, Latin America, and South-East Europe on behalf of the German Federal Government and the EU.
Type of support available	KfW has a strong focus on municipal infrastructure and sustainable transport. In 2020, KfW had committed to projects worth EUR 4.2 billion towards achieving SDG 11 (sustainable cities and communities), with mobility a key focus.
Relevant recent projects in urban mobility	⟩⟩ EUR 80M loan for promotion and development of low-emission mobility technologies and infrastructure, including electrification and NMT, for cities in Colombia. ⟩⟩ EUR 200M loan for building a subway network (lines and stations) in Lanzhou, China. ⟩⟩ EUR 265M loan to improve operations and efficiency of the tram system in Rio de Janeiro and the metro system of Salvador de Bahia in Brazil.
Current involvement in Georgia	⟩⟩ $100M for development of ITCS and P&R transfer terminals in Batumi and Tbilisi (pending), and previously EUR 260k and EUR 220k, for Batumi and Tbilisi respectively, to provide technical assistance assessing various urban mobility measures in (road network information, metro, BRT and bus networks, P&R facilities, car-free zones, cycling network design, ITCS).
Overview of application/financing process	Projects and proposals through KfW Development Bank are initiated by partner country governments, typically through the Ministry of Finance, which are reviewed by the Federal Ministry for Economic Cooperation and Development of Germany before initiating project cycle phases including bilateral negotiations, intergovernmental agreement, project appraisal, feasibility studies, and tendering.

L'Agence française de développement (AFD)	
Description	AFD funds and accelerates objectives towards achieving SDGs in France's overseas territories and an additional 115 countries, focusing on climate, biodiversity, peace, education, urban development, health, and governance.
Type of support available	AFD supports mobility and transport, including infrastructure, services, and regulations. The agency primarily finances mass public transport infrastructure, small-scale and informal transport, NMT, and electric mobility.
Relevant recent projects in urban mobility	⟩⟩ EUR 93M loan to support the implementation of the final phase of a tramway line, including the construction of two stations and 1.1 km of tram tracks in Istanbul. ⟩⟩ EUR 5.4M grant (co-financed) to facilitate improvement of public transport through the development of SUMPs and ITSCs, as well as the country's first tramway in Peruvian cities. ⟩⟩ EUR 250M loan for the development of a metro line, among other initiatives, in Surat, India.
Current involvement in Georgia	AFD has been active in primarily supporting Georgia to structure the energy efficiency sector in line with the EU's Third Energy Package, amounting to co-financing of EUR 205.5M from 2018-2020.

	Transport projects with AFD involvement have included the modernisation of the Azerbaijan-Georgia-Turkey railway line. AFD has limited involvement insofar for urban mobility projects in Georgia but is financing the development of appraisal studies and calls for tenders for the Sarajishvili-Zghvisubani cable car line in Tbilisi. AFD and Georgia have signed a new Partnership Agreement on Cooperation Program for 2021-2023, providing EUR 483M of loans (EUR 33M in the form of grants), for four main sectors, one of which is urban development and connectivity. Since 2012, AFD has committed EUR 480M towards sustainable development projects in Georgia.
Overview of application/financing process	In 2016, the Tbilisi agency opened to manage projects in the South Caucasus. Sovereign loans, and financing through AFD's French Local Authorities Financing Facility (SDGs and climate initiatives in partner countries) can be initiated through the local AFD office.

4.1.4 Carbon Markets under the Paris Agreement's Article 6

The Paris Agreement's rulebook on Article 6 was agreed in Glasgow during COP26, providing overarching guidance for countries to engage in markets for Internationally Transferred Mitigation Outcomes (ITMOs). This succeeds the Clean Development Mechanism (CDM) as the main market mechanism linked to the UNFCCC negotiation process to address global emissions.

As all countries have committed to using domestic resources to cover their emission reduction targets under the Paris Agreement, the main value of market mechanisms such as ITMOs lies in financing technological measures in early commercialisation stages with higher abatement costs (thus placed under the *pioneering* and *facilitating* stages in Figure 8 of the Annex); these are unlikely to be implemented as part of countries' unconditional portion of the NDC. While some countries, including Georgia, have started signing bilateral agreements to cooperate under the Article 6 framework, some factors should be considered:

- Under the CDM, purchasing countries were interested in low-cost mitigation projects. Now that all countries have committed to reducing their emissions, seller countries should focus on receiving support for some of the more difficult (expensive) measures to implement, which they are not able to deliver themselves through their own financing or bankability metrics.
- Countries are expected to increase ambition every five years as they update their NDCs under the ambition ratchet mechanism, and possibly annually starting 2022. If mitigation outcomes are transferred to other countries, emission reductions from sellers would not count towards the country's new reduction targets.

It is therefore recommended that international climate finance is sought for the implementation of mitigation projects, ideally without transferring emission reductions to other buying countries. New trends in corporate strategies are already taking this voluntary approach, with private actors willing to make donations for the deployment of emission-reduction technologies (NewClimate Institute, 2020; WWF and BCG, 2020; Klarna, 2021; Milkywire, 2021). This could become an interesting source of funding for Georgia, and although it is not yet widespread, it is likely to become more available if countries on the receiving end proactively seek this kind of finance. If an agreement is to be made to transfer emission reductions, it should be for high-cost, high-innovation measures that promote genuine technology transfer to Georgia.

4.2 Overcoming barriers to access climate finance in Georgia's urban mobility subsector

To source financing for and implement urban mobility measures effectively across Georgian municipalities, a variety of barriers concerning fiscal, political, cultural/behavioural, and social equity aspects must be unlocked. The presence of these barriers for urban mobility measures is discussed in detail in section 3 and summarised below in Figure 5.

Policies		Potential barriers for uptake				
Category	Measure	Financial / regulatory costs	Monitoring / enforcement	Cultural / behavioural	Social equity	Bureaucratic / political
Modal shift to public transport	Bus/marshutka optimisation and renewal					
	Metro optimisation and renewal					
	Education information campaigns					
	Financial incentives for public transport					
	Regulation of taxis					
	Optimise public transit accessibility					
	Park and Ride facilities					
Modal shift to NMT	New cycling/pedestrian routes					
	Bike-sharing scheme					
	Financial incentives for NMT					
	Bike-friendly adaptations to public transport					
Phase out fossil-fuel vehicles	Phase out ICE vehicles					
	Fuel tax increase on fossil fuels					
	Import tax increase on inefficient vehicles					
	Emission quality standards for LDVs					
	Emission quality standards for HDVs					
	Vehicle tests for roadworthiness					
	Low-emission fleets for government and SOEs					
	Biodiesel blending and production targets					
Electrification	EV production and sales target					
	Financial incentives for EVs, PHEVs, hybrids					
	Financial incentives for low-emission / EV taxis					
	Demand-side incentives for EVs					
	Service centres for EVs					
	Installation and subsidies for charging stations					
	Traning programs for EV technicians					
Avoid and reduce transport demand	Congestion charge in dense city areas					
	Zonal parking tariffs					
	Remove parking spaces in high congestion areas					
Technology to enhance low-emission mobility	Intelligent Traffic Control Systems					
	Open-source data for transport planning apps					
	Live-time monitoring of transport and traffic					
	Mobility-as-a-service program					
Optimise freight load	Freight consolidation centres					

Figure 5: Summary overview of potential barriers needing to be unlocked for financing and implementation of urban mobility measures

Note: Orange areas refer to the presence of a perceived barrier while grey areas refer to the lack of a barrier. For more detail and discussion, refer to section 3.8

In addition to measure-specific barriers, there also exist overarching challenges impeding financing of urban mobility mitigation measures in Georgia. The information presented in the remainder of this section is heavily based on a series of interviews conducted with Georgian experts in urban mobility, finance, and municipal mitigation actions.

National circumstances

Georgia is still feeling the effects of the COVID-19 pandemic, where the economy was hit hard with disruptions in international tourism (around 20% of GDP) and global supply chain logistics, as well as a depreciation of the Georgian Lari exchange rate (since stabilised) (Daoudi and Vepsäläinen, 2020; KfW, 2020). While the economy contracted by 6.2% in 2020 due to the pandemic, the ADB estimated a rebound with 8.5% growth in 2021 and another 6.5% in 2022 (ADB, 2021). Even so, much of Georgia's national budget remains earmarked for economic recovery and social protection measures in the next years. Coupled with increasing government debt—Georgia's debt almost reached the legal limit of 60% of the country's GDP in 202—Georgia's room to take on further loans for climate change mitigation efforts, or finance them through national and municipal budgets, may be constrained in the short term, especially for investment-heavy infrastructure loans (Bakradze, 2021). The situation is similar for

municipalities. The City of Batumi, for example, currently has up to EUR 50M a year in debt to repay, an amount comparable to its annual share of the national budget. Of the measures discussed in this report, the short-term constraint on large-investment measures and municipal budgets can impede the improvement of public transport systems and fleets, the central or municipal provision of financial incentives and subsidies (e.g., public transport and EV purchases), infrastructure for NMT, and measures requiring high monitoring and enforcement costs (e.g., congestion charges) or technological expertise (e.g., ITCS).

The financial circumstances affecting the national and municipal governments also affect citizens. According to a poll by the National Democratic Institute (NDI), since the start of the pandemic (until summer 2021), 68% of citizens report lower disposable income for goods and services, while 21% of the population have either lost their job or experienced salary reductions (CRCC Georgia, 2021). Thus, urban mobility measures with the potential to pass substantial costs to citizens (e.g., taxes on fuels and inefficient vehicles, transit charges) should be scrutinised or subsidised, particularly in light of recent unrest around the globe due to fuel price increases (Kuwamoto and Hanafusa, 2022).

To alleviate this constraint, proposals for financing urban mobility measures could consider several enabling factors:

1) Policies and measures implemented have greater political attractiveness if they are socially positive or neutral and bring benefits to Georgia's citizens. The considerations are two-fold: on one hand, direct financial costs on the consumer side should be negative or neutral (e.g., financial incentives for modal shift towards public transport); on the other, more accessible analysis and education awareness surrounding the co-benefits offered to citizens from low-emission transport solutions would also help improve this perception (i.e., even if there are minor financial costs involved, there may be overall savings from improved health, greater mobility, and time savings). Education and awareness of issues further enable civil society to proactively create public pressure for such beneficial measures and alleviate the cultural barriers associated with public and NMT.

   Where socially regressive policies are decided to be the best mitigation measure to be implemented, policymakers can either offer financial support for citizens to create the necessary behavioural change and re-invest any revenues from taxes or charges back into mobility (or other) measures that bring overall benefits to populations.

2) Urban mobility measures proposed should focus on long-term projects, particularly for measures that in parallel assist the green economic recovery and target greater participation from the private sector, which is not as economically constrained. Long-term projects and private-sector intervention help release pressure on governments with extended payback times on loans and allow the economy to recover as economic sectors become more resilient over time to the recent economic setback. In addition, less costly projects may also be more politically attractive due to the mounting debt concerns.

Institutional setup

A continuous barrier facing transport-sector mitigation is the spread of responsibilities across different ministries and municipalities for transport strategy and implementation, rather than establishing a single coordinating entity. While the ministries of Economy and Sustainable Development (MESD), Regional Development and Infrastructure (MRDI), Internal Affairs (MIA), Finance (MoF), and Environmental Protection and Agriculture (MEPA) all play various roles in the transport sector, a single mandated coordinating entity would improve the coordination for implementing projects and financing mechanisms. This would also enable greater consolidation and standardisation for strategizing Georgia's long-term

transport strategies. Consolidated national plans and technical guidance can kickstart progress on best practice implementation of measures concerning NMT, EV infrastructure and services, taxi regulation, and reducing fleet emission intensities while keeping alignment with national objectives. Without strong long-term policy signals from official authorities, the pursuit of e-mobility and phaseout of ICE vehicles may be challenging.

Regarding mitigation measures in the wider transport sector, finance access can be better unlocked as MEPA, the ministry responsible to uphold Georgia's climate mitigation action, possesses only a limited jurisdiction on implementation of transport projects (mainly to air pollution). This could be a primary reason for the small focus on climate (mitigation, adaptation, resilience) within previous and existing transport projects.

For urban mobility specifically, financing and implementing measures lie within the jurisdiction of municipalities. With their government structure and autonomy over transport measures, headed by city halls and transport departments, municipalities are the most active implementers of urban transport measures but also the largest proponents of policies with clear climate mitigation benefits. This is unsurprising, given the amount of literature and research showing the benefits of transport sector mitigation for city liveability (e.g., Hosking *et al.*, 2011; Shaw *et al.*, 2014; Sustainable Mobility for All, 2017). Within Georgia, most climate finance is only readily available for Tbilisi and Batumi, since their status as economic hubs and large population municipalities make foreign investments more bankable with lesser risks in repaying loans.

A primary internal barrier facing municipalities, however, is the lack of human capital available for accessing climate finance, even for Tbilisi and Batumi. Often-cited challenges from interviews—but also previous evaluation studies on municipal mitigation action (e.g., VICLIM, 2018)—include the desire for greater national involvement to support municipalities in bureaucratic proposal and planning processes; more technical, planning, and fundraising capabilities for municipal departments; better access to technical expertise and support from domestic academia and private consulting to support appraisal and feasibility studies; greater alignment of foreign consultant execution with national and municipal objectives; and less turnover of qualified staff, given that municipalities often compete with the higher-paying private sector over technical specialists. To alleviate these barriers, a concerted effort could focus on building institutional capacities within municipal governments (rather than individual expertise to minimise technical brain drain) and strengthening vertical integration with national institutions (and ideally a transport entity).

Financing procedure for municipalities

Information gathered from stakeholder interviews suggests Georgia's process for financing municipal measures adds to the administrative burden of city governments. The primary methods for funding urban mobility measures involve taking loans or grants from international finance institutions (IFIs) or sourcing from the municipality's share of the national budget. Local commercial banks are also available, but more challenging terms for loan agreements have, in cases, made this an undesirable avenue for municipalities. For projects needing external finance, municipalities generally go through a proposal phase developed internally or with technical assistance, a proof-of-concept phase involving feasibility studies and pilot demonstrations at a small scale, before a full proposal to scale-up can be administered. Finance and project proposals need to be first in alignment with municipal-level objectives before being considered for approval at the national level, where projects are reviewed also for their compliance with national strategies and priorities. Only with national approval can the proposal process begin with international financiers, which comes with additional resource needs and technical know-how. Municipalities are thus both unable to independently define and propose measures that require external finance and yet also unable to independently take loans from IFIs.

The bureaucratic process adds additional workload to the tight resource constraints of municipalities. While this barrier affects all Georgian municipalities, it disproportionately constrains smaller and rural towns given the large differences in municipal budgets, technical expertise, private operator preferences, and diminished value of the return of projects. Big cities have greater access to municipality development funds and infrastructure projects from IFIs and MRDI, while small cities are restricted in the threshold amount in taking loans, excluding most high-investment infrastructure projects. Even cities such as Kutaisi and Rustavi, two of the top four most populated cities in Georgia, are interested at the government level to develop SUMPs but have been unable to attain desired funding. Kutaisi was also unable to become a Green Cities member under the EBRD, due to its exclusion of specific participation criteria.

Financing options for these cities' measures then default to allocation through the national budget, although there remain challenges in proving the worth of their urban mobility projects in competition with larger cities and national priorities, as well as an already constrained domestic budget. Several options, such as building institutional capacity through focusing technical assistance in smaller Georgian cities, coordinating, and implementing public transport projects at the national level, and establishing a national fund to award municipal projects, could be helpful for municipalities to implement urban mobility measures with a lower administrative burden.

5 Benefits of decarbonisation in the urban mobility subsector

This section explores the linkages and synergies between climate change mitigation actions in the Georgian urban mobility subsector and the country's other strategic and development objectives. In the first subsection, the discussion focuses on the synergies between mitigation actions and the SDGs of the 2030 Agenda of the United Nations. In the second subsection, the discussion focuses on the synergies with the national objectives of the Georgian government.

5.1 Synergies with Sustainable Development Goals

In 2015, the UN General Assembly adopted the 2030 Agenda, which includes a set of 17 SDGs to be achieved by 2030. In 2017, these goals were substantiated with 169 concrete targets and 232 indicators. The SDGs were set as successors to the Millennium Development Goals, which ended in 2015. In comparison to the latter, the SDGs have a broader scope and crucially focus more strongly on issues of sustainability, justice, inequality, and peace, applying to all countries irrespective of their income level. Although the SDGs are not legally binding, all governments are expected to set national development strategies that allow them to achieve the goals by 2030.

Progress towards mitigating climate change (SDG 13 on climate action) contains fundamental links that help enable the achievement of all SDGs; in other words, it would not be possible to achieve the other SDGs without climate action (e.g., Gomez-Echeverri (2018), Fuso Nerini et al. (2019), Zhenmin and Espinosa (2019), and Ransom et al. (2021)). Through emission reductions in the urban mobility subsector, a range of positive externalities from mitigation or co-benefits can be achieved. In the transport sector, reducing emissions through the measures described in section 3 could provide roughly 100 positive synergies spilling over to advance the progress of other SDGs (Figure 6).

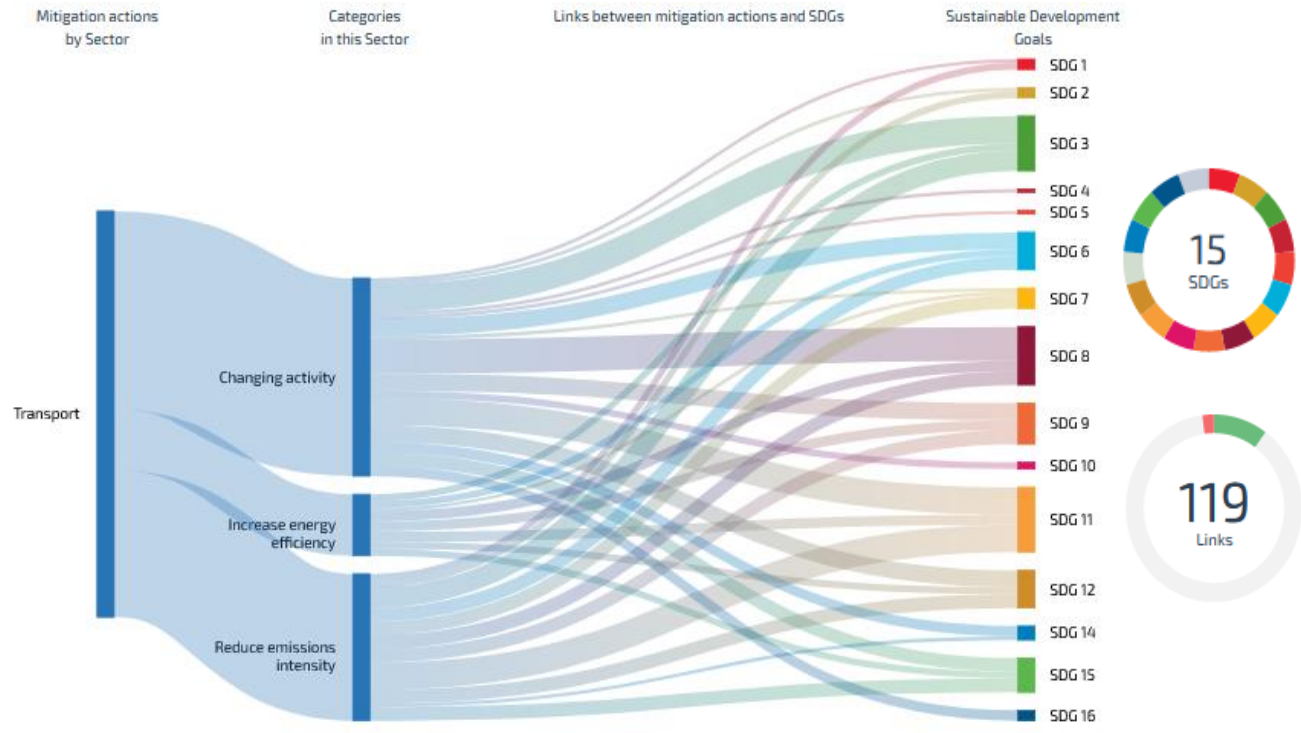


Figure 6: Mapping of linkages between transport mitigation measures and SDGs

Source: SDG Climate Action Nexus Tool (Gonzales-Zuñiga *et al.*, 2018)

Urban mobility mitigation co-benefits include, for example:

- Increasing time savings, productivity, and leisure time of populations from reduced traffic congestion—such as through measures aimed at increasing vehicle occupancy and shifting to public and NMT.
- Improving road safety and lowering the rate of road accidents—such as through measures aimed at reducing traffic volumes and safe infrastructure for pedestrian walking and cycling.
- Improving fuel savings—such as through measures aimed at increasing the efficiency of LDV fleets and public transport, as well as electrifying transport modes.
- Improving health and economic productivity from reduced air and noise pollution impacts—such as through measures in shifting to the public, non-motorised, and electrified transport modes.

The urban mobility measures described in this paper have particularly large co-benefit impacts on SDGs 3, 7, 8, and 11, which are detailed further in Figure 7.

Target 3.4. By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.

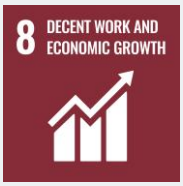
- The measures incentivise a shift from private vehicles to NMT, promoting exercise and reducing health issues such as cardiovascular diseases and obesity.
- The measures reduce the emission intensity of vehicles (e.g., by increasing the adoption of biofuels or electrifying the vehicle fleet) and the use of private vehicles thus reducing adverse effects of pollution on respiratory health.

Target 7.1: By 2030, ensure universal access to affordable, reliable, and modern energy services.

- The measures improve public transport quality and connectivity and build safe infrastructure for accessible means of NMT.

Target 7.3: By 2030, double the global rate of improvement in energy efficiency.

- The measures improve energy efficiency and fuel savings by, for instance, upgrading old private and public vehicle fleets, introducing fuel performance standards, and increasing utilisation rates of passenger and freight transport.



Target 8.2: Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value-added and labour-intensive sectors.

- The measures reduce the overall commuting time with reduced road congestion and enable a faster, more reliable, and better-connected public transport system, which improves time savings and allows for greater economic productivity.
- The measures encourage solutions that generate technological upgrading, diversification and innovation, increasing overall economic productivity and creation of new economic sectors. For example, new electric vehicle markets can stimulate domestic production and employment in the manufacturing sectors.

Target 8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.

- The measures require investments in new infrastructure and technologies that create jobs in construction, information technologies, and manufacturing industries along the whole supply chain.

Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations.

- The measures aim to promote a modal shift from private vehicles to public transport, the expansion of public transport infrastructure, the improvement of its quality, and the provision of inter-modality solutions.

Figure 7: Synergies between SDG targets and mitigation actions in the Georgian urban mobility subsector

5.2 Synergies with national objectives

The EUAA was signed in 2014 and came into force in 2016 to establish a closer relationship between Georgia and the EU. The Agreement requires Georgia to implement reforms and align regulations and standards to comply with several EU directives. The achievement of these reforms is of high priority to the Georgian government, as it serves as a basis for further integration between the EU and Georgia and eventual accession to the EU. The continued implementation of mitigation measures in Georgia's urban mobility subsector can help achieve many EUAA directives.

Directive 2008/50/EC on ambient air quality and cleaner air sets limit values for local air pollutant concentrations, such as annual mean limit for particulate matter (PM10) in any location of 40 μg/m^3. In 2022, this was measured to be 58.5 μg/m^3 in Tbilisi (IQAir, 2022). The Directive requires that, by 2022, air pollution zones be drawn, including measurement and assessment protocols. By 2023, air quality plans must be in place for all zones exceeding the limit. To achieve these goals, an important milestone was reached at the end of 2020, with the installation of air quality monitoring stations in Tbilisi, Rustavi, Kutaisi, and Batumi, supported by the UNDP (UNDP, 2020). Reducing air pollution is a strategic objective of the National Environment and Health Action Plan of Georgia (2018-2022) (NCDC, 2018), which prioritises the establishment and preservation of a safe environment as a constitutional right, and the Third National Environmental Action Programme of Georgia (2017-2021), which aims to "ensure that air is clean and safe both for human health and the environment throughout Georgia" (MEPA, 2018).

Given that approximately 80% of local air pollution in Tbilisi was attributable to road transport in 2017 (Karchkhadze, 2017), measures that reduce emissions in the transport sector will contribute to this objective. Most of the Georgian LDV fleet has a high emission intensity, with most vehicles being older than 10 years (MEPA, 2021c). Public transport is also emission-intensive, as it often relies on outdated bus models and *marshrutkas*. Many of the measures recommended in this report aim at improving the emission intensity of transport vehicle modes, and thus are essential for the improvement of air quality in line with the EUAA. For LDVs, measures include the financial incentives for the electrification of the vehicle fleet, the installation of EV chargers, the introduction of higher performance standards on cars, and the renewal of vehicle fleets. Emissions from freight transport can also be reduced with the introduction of cleaner performance standards on high-duty vehicles and the optimisation of logistics and utilisation rates. For public transport, the reforms that will help improve air quality are underway in several cities but can be continued to be upscaled; measures include the renewal of the bus and *marshrutka* fleet and all the measures that disincentivise the use of private vehicles and incentivise a modal shift towards public transport.

Policies in the urban mobility sector can be proposed and implemented by local governments, which have a better understanding of the urban context. By promoting a stronger enabling of local governments in the financing and implementation of mitigation actions in this sector, Georgia can also achieve progress in strategic goal 1 of its Decentralisation Strategy 2020-2025, "Increase the role of self-government in managing a substantial share of public affairs" (MRDI, 2019).

6 Conclusion

This report considers 18 urban mobility policy packages relevant for implementation or scale-up within Georgian municipalities to reduce GHG emissions and create mitigation co-benefits and provides an overview of the applicable financing sources and streams to realise them.

Of the policy packages and individual measures explored, many "low-hanging fruit" are available to Georgian municipalities, with high political or technological readiness, high mitigation potentials, and neutral to low abatement costs for the government. Measures in this category primarily include those in public transport and "avoid and reduce demand" policies, while cheap, high mitigation impact options include regulation measures in electrification and phasing out fossil fuel vehicles. Of the measures with higher abatement costs, electrification and NMT measures show growing readiness both politically and technologically due to their potential to enhance economic productivity and socio-economic welfare. Many measures have also been partially implemented or studied in select Georgian municipalities, reducing the administrative burden for acceleration or replication in other jurisdictions. However, municipal governments need to consider the wider implications from the array of mitigation measures aside from cost, readiness, and mitigation potential; most measures come with unique barriers to adoption or detrimental knock-on effects for citizens. Especially in the aftermath of the pandemic's economic impacts, measured proposed need to be cautiously assessed within each municipal context and addressed with targeted policy design to achieve mitigation goals and social benefits together. Policies coupled with socially progressive mechanisms and awareness campaigns on mitigation co-benefits and revenue recycling are attractive ways forward.

A large range of technology and infrastructure measures remain in need of financing across the spectrum of developmental stages for Georgian municipalities and there exist an array of applicable international finance sources with substantial project portfolios in Georgia and strategic interests in urban mobility. However, significant barriers impede the accessibility of this finance for municipalities. Detailed preparation is needed to access project funding, and project appraisal efforts need to be coordinated and discussed with national policymakers, international finance institutions, and external partners.

The administrative and coordination capacity required, as well as technical expertise with specific financial institutions and project types, are burdensome for resource-constrained municipalities. While large municipalities such as Tbilisi and Batumi are generally successful in efforts to access financing, many smaller municipalities do not fit the criteria for investment from international donors without support from national government mechanisms. To even reach an advanced project development stage, large technical assistance streams are often needed to carry out pre-requisite project appraisal, feasibility studies, cost-benefit analysis, and financing proposals. The lack of a national transport coordinating entity in Georgia exacerbates the resource constraints on municipalities, and further causes a shortage of national strategies, policy signals, investment plans, and implementation guidelines that give confidence to investors and financiers and lubricates finance flows. Setting up a national coordinating entity for transport to support municipal project development efforts, the building of institutional capacity for municipalities (particularly smaller ones), and the establishment of a national fund to coordinate and award municipal projects could help further enable finance access for municipal urban mobility projects in Georgia.

References

A+S Consult (2017) *Integrated Sustainable Urban Mobility Plan of Batumi*. Batumi, Georgia: A+S Consult GmbH. Available at: https://www.ge.undp.org/content/georgia/en/home/library/environment_energy/sustainable-urban-mobility-plan-of-batumi-city.html.

ADB (2021) *Georgian Economy Forecast to Grow 8.5% in 2021 and 6.5% in 2022 — ADB*. Asian Development Bank. Available at: https://www.adb.org/news/georgian-economy-forecast-grow-8-5-2021-and-6-5-2022-adb (Accessed: 12 January 2022).

AECOM (2019) *Batumi Green City Action Plan*. AECOM. Available at: https://www.ebrdgreencities.com/assets/Uploads/PDF/7ee2e697bc/Batumi-GCAP-Eng.pdf.

AFD (2021) *'MobiliseYourCity': Climate Financing for Sustainable Urban Mobility in South Asia*, *Agence Française de Développement*. Available at: https://www.afd.fr/en/actualites/mobiliseyourcity-climate-financing-sustainable-urban-mobility-south-asia (Accessed: 12 January 2022).

Agenda.ge (2015) *Smart traffic lights reduce gridlock in Tbilisi*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2015/179 (Accessed: 12 January 2022).

Agenda.ge (2016) *New bus lanes in Tbilisi ensure faster, safer drive*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2016/2310 (Accessed: 9 February 2022).

Agenda.ge (2017) *New Tax Code for Georgia: What rules comes into play?*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2017/5 (Accessed: 12 January 2022).

Agenda.ge (2018) *Gov't launches 'Green Policy – Eco-friendly Transport' project: What's in store for Tbilisi?*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2018/2188 (Accessed: 12 January 2022).

Agenda.ge (2019a) *AiCar launches car sharing service in Batumi*, *Agenda.ge*. Available at: https://www.agenda.ge/en/news/2019/2238 (Accessed: 12 January 2022).

Agenda.ge (2019b) *Hourly paid parking starts in Tbilisi, with varying fees per zone*, *Agenda.ge*. Georgia. Available at: https://www.agenda.ge/en/news/2019/2088 (Accessed: 12 January 2022).

Agenda.ge (2019c) *New factory to produce electric cars in Georgia from 2020*, *Agenda.ge*. Available at: https://agenda.ge/en/news/2019/971 (Accessed: 12 January 2022).

Agenda.ge (2019d) *New rules for taxis in Tbilisi takes effect today*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2019/2630 (Accessed: 11 January 2022).

Agenda.ge (2020a) *Electric buses to be added to public transport fleet in Batumi, west Georgia*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2020/2161 (Accessed: 9 February 2022).

Agenda.ge (2020b) *Zonal hourly parking on Pekini Avenue, nearby streets to be free for neighborhood residents, people with disabilities, owners of electric vehicles*, *Agenda.ge*. Georgia. Available at: https://www.agenda.ge/en/news/2020/2579 (Accessed: 12 February 2022).

Agenda.ge (2021a) *90 new minibuses and 20 buses will run in Tbilisi starting September 22*, *Agenda.ge*. Georgia. Available at: https://agenda.ge/en/news/2021/2669 (Accessed: 9 February 2022).

Agenda.ge (2021b) *Batumi first city in S. Caucasus to have electric buses thanks to EU*. Georgia. Available at: https://agenda.ge/en/news/2021/2122 (Accessed: 11 January 2022).

Agenda.ge (2021c) *Kutaisi electric car factory to produce first vehicles in 2022*, *Agenda.ge*. Available at: https://agenda.ge/en/news/2021/421 (Accessed: 20 January 2022).

Agenda.ge (2021d) *Zonal hourly parking to be introduced in Gldani, Samgori, Saburtalo districts, near Station Square*, *Agenda.ge*. Georgia. Available at: https://www.agenda.ge/en/news/2021/2126 (Accessed: 12 January 2022).

Azami, T., Nakagawa, K. and Taniguchi, A. (2021) 'Effect of Low-Cost Policy Measures to Promote Public Transport Use: A Case Study of Oyama City, Japan', *Sustainability*, 13(6160). doi:https://doi.org/ 10.3390/su13116160.

BABLE (no date) *Bike Sharing System*. Available at: https://www.bable-smartcities.eu/explore/solutions/solution/solution/bike-sharing-system.html (Accessed: 12 January 2022).

Bakradze, N. (2021) *Georgia's debt reaching legal limit*, *Eurasianet*. Available at: https://eurasianet.org/georgias-debt-reaching-legal-limit (Accessed: 12 January 2022).

Becker, H., Balac, M., Ciari, F. and Axhausen, K. (2020) 'Assessing the welfare impacts of Shared Mobility and Mobility as a Service (MaaS)', *Transportation Research Part A: Policy and Practice*, 131, pp. 228–243. doi:https://doi.org/10.1016/j.tra.2019.09.027.

Bloder, E. and Jäger, G. (2021) 'Is the Green Wave Really Green? The Risks of Rebound Effects When Implementing "Green" Policies', *Sustainability*, 13(10), p. 5411. doi:10.3390/su13105411.

Bly, P. and Oldfield, R. (1986) 'The effects of public transport subsidies on demand and supply', *Transportation Research Part A: General*, 20(6), pp. 415–427. doi:https://doi.org/10.1016/0191-2607(86)90078-6.

Brand, C., Götschi, T., Dons, E., *et al.* (2021) 'The climate change mitigation impacts of active travel: Evidence from a longitudinal panel study in seven European cities', *Global Environmental Change*, 67, p. 102224. doi:10.1016/j.gloenvcha.2021.102224.

Buczyński, A. (2021) *The Costs of Cycling Infrastructure*. Brussels, Belgium: European Cyclists' Federation. Available at: https://ecf.com/news-and-events/news/how-much-does-cycle-track-cost.

C40 (2011) *London's Congestion Charge Cuts CO2 Emissions by 16%*, *C40 Case Study*. Available at: https://web.archive.org/web/20210531210839/https:/www.c40.org/case_studies/londons-congestion-charge-cuts-co2-emissions-by-16 (Accessed: 16 September 2021).

CAT (2020) *Decarbonising the Indian transport sector: pathways and policies*. Climate Action Tracker. Available at: https://climateactiontracker.org/publications/decarbonising-indian-transport-sector-pathways-and-policies/.

Cerri, M. (2021) 'Nuovo bonus mobilità, a chi spetta e come funziona. Serve la rottamazione', *Il Giorno*, 2 November. Available at: https://www.ilgiorno.it/economia/bonus-mobilità-biciclette-monopattini-1.6988363 (Accessed: 10 February 2022).

City Institute Georgia (2021) *Projects*. Available at: http://cityinstitute.ge/projects/ (Accessed: 9 February 2022).

Cooke, S., Koinange, C. and Zuidgeest, M. (2019) *Calculating the potential climate value of Non-Motorised Transport projects in African Cities*. Nairobi, Kenya: UN Environment. Available at: http://www.airqualityandmobility.org/PDFs/ClimateValue_NMT.pdf.

CRCC Georgia (2021) *Public Attitudes in Georgia*. National Democratic Institute. Available at: https://www.ndi.org/sites/default/files/NDI Georgia - Poll Results - July 2021 Poll - ENG - FINAL %281%29.pdf.

Daoudi, H. and Vepsäläinen, M. (2020) *The Impact of COVID-19 on trade and structural transformation in Georgia*. United Nations Economic Commission for Europe. Available at: https://unece.org/fileadmin/DAM/trade/StudiesRegulatoryProceduralBarriersTrade/ThematicPublications/Impact_COVID-19_Georgia.pdf.

Datta, A., Hossain, A. and Roy, S. (2019) 'An Overview on Biofuels and Their Advantages and Disadvantages', *Asian Journal of Chemistry*, 31(8 SE-Articles), pp. 1851–1858. Available at: https://asianpubs.org/index.php/ajchem/article/view/375.

Day, T., Gonzales-Zuñiga, S. and Lui, S. (2021) *Decarbonisation scenarios for the transport sector in Georgia*. Available at: https://newclimate.org/2021/01/25/decarbonisation-scenarios-for-the-transport-sector-in-georgia/.

Day, T., Lopez Legarreta, P. and Schiefer, T. (2022) *Climate smart agriculture practices in the context of Georgia's mitigation efforts*. NewClimate Insitute. Available at: https://newclimate.org/wp-content/uploads/2022/02/NewClimate_Georgia_ClimateSmartAgriculturePractices.pdf.

E-Space (no date) *Map*. Available at: https://e-space.ge/en/map/ (Accessed: 12 January 2022).

Egger, D. and Oehry, B. (2002) *Heavy Vehicle Fee / LSVA (Switzerland)*. Switzerland: BESTUFS, Rapp AG. Available at: https://silo.tips/download/heavy-vehicle-fee-lsva-switzerland.

EMPRESS (2017) *Green City Action Plan Tbilisi 2017-2030*. Available at: http://www.tbilisi.gov.ge/page/green-city?lang=en.

Energy Community (2021) *Who we are*. Available at: https://www.energy-community.org/aboutus/whoweare.html (Accessed: 11 January 2022).

Energy Community Secretariat (2021) *Georgia: Annual Implementation Report*. Energy Community Secretariat. Available at: https://www.energy-community.org/implementation/Georgia.html (Accessed: 11 January 2022).

ETAuto (2019) 'Delhi rolls out electric vehicle policy; targets 5 lakh EV registrations by 2024', *ETAuto.com*, December. Available at: https://auto.economictimes.indiatimes.com/news/industry/delhi-rolls-out-electric-vehicle-policy-targets-5-lakh-ev-registration-by-2024/72939676.

FIA Foundation (2020) *Tbilisi invests in bicycling infrastructure as public awareness of benefits grows*. Available at: https://www.fiafoundation.org/blog/2020/july/tbilisi-invests-in-bicycling-infrastructure-as-public-awareness-of-benefits-grows (Accessed: 17 December 2021).

FOEN (2020) *Switzerland's Fourth Biennial Report under the UNFCCC*. Bern, Switzerland: Swiss Federal Office for the Environment. Available at: https://unfccc.int/sites/default/files/resource/CHE_BR4_2020.pdf.

Fuso Nerini, F., Sovacool, B., Hughes, N., *et al.* (2019) 'Connecting climate action with other Sustainable Development Goals', *Nature Sustainability*, 2(8), pp. 674–680. doi:10.1038/s41893-019-0334-y.

GCF (2019) *Simplified Approval Process (SAP) Technical Guidelines: Transport*. Incheon, Republic of Korea: Green Climate Fund. Available at: https://www.greenclimate.fund/document/sap-technical-guidelines-transport.

Georgian Journal (2017) *Electric taxis to serve passengers in Tbilisi*, *Georgian Journal*. Available at: https://georgianjournal.ge/society/33192-electric-taxis-to-serve-passengers-in-tbilisi.html (Accessed: 12 January 2022).

Georgian Journal (2021a) *New Buses and Minibuses to Operate in Tbilisi*, *Georgian Journal*. Available at: https://georgianjournal.ge/society/37373-new-buses-and-minibuses-to-operate-in-tbilisi.html (Accessed: 9 February 2022).

Georgian Journal (2021b) *Three-Kilometer Bus Lane Introduced on Rustaveli Avenue*, *Georgian Journal*. Georgia. Available at: https://georgianjournal.ge/society/37079-three-kilometer-bus-lane-introduced-on-rustaveli-avenue.html (Accessed: 9 February 2022).

GeoStat (2021a) *Consumer Price Index (Inflation)*, *Price statistics*. Available at: https://www.geostat.ge/en/modules/categories/26/cpi-inflation.

GeoStat (2021b) *Environmental Indicators*. Georgia. Available at: https://www.geostat.ge/en/modules/categories/565/environmental-indicators (Accessed: 11 January 2022).

GeoStat (2021c) *Population*, *Population and Demography*. Available at: https://www.geostat.ge/en/modules/categories/41/population (Accessed: 19 January 2021).

Gomez-Echeverri, L. (2018) 'Climate and development: enhancing impact through stronger linkages in the implementation of the Paris Agreement and the Sustainable Development Goals (SDGs)', *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376(2119), p. 20160444. doi:10.1098/rsta.2016.0444.

Gonzales-Zuñiga, S., Roeser, F., Rawlins, J., *et al.* (2018) 'SDG Climate Action Nexus tool (SCAN-tool)'. Available at: http://ambitiontoaction.net/scan_tool/.

GOPA Infra (2020a) *Georgia Sustainable Transport for the City of Tbilisi: Pre-Feasibility Report*. Tbilisi, Georgia: GOPA Infra GmbH.

GOPA Infra (2020b) *Sustainable Transport for the City of Batumi – DRAFT Pre-Feasibility Report*. GOPA Infra GmbH.

Government of Georgia (2021a) *Georgia's Updated Nationally Determined Contribution (NDC)*. Georgia. Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Georgia First/NDC Georgia_ENG WEB-approved.pdf.

Government of Georgia (2021b) *On the Approval of Georgia's Renewed National Level of Contribution (NDC) for the UN Framework Convention on Climate Change in Georgia, the 2030 Climate Change Strategy of Georgia and the 2021-2023 Action Plan of the Georgian Climate Change 2030 Strategy*. Georgia. Available at: https://matsne.gov.ge/ka/document/view/5147380?publication=0.

Greater London Authority (2019) *London Energy and Greenhouse Gas Inventory (LEGGI)*, *London Datastore*. Available at: https://data.london.gov.uk/dataset/leggi (Accessed: 20 January 1991).

Gugunishvili, N. (2016) *First Electric Vehicle Charging Stations Open in Tbilisi*, *Georgia Today*. Available at: http://gtarchive.georgiatoday.ge/news/5075/First-Electric-Vehicle-Charging-Stations-Open-in-Tbilisi (Accessed: 12 January 2022).

Hall, D., Nicholas, M. and Bernard, M.R. (2021) *Guide to electrifying ride-hailing vehicles for cities*. 15. International Council on Clean Transportation. Available at: https://theicct.org/publications/ride-hailing-cities-guide-mar2021.

Henríquez, P., Osses, M., Silva, H., *et al.* (2012) *Santiago Transport Green Zone*. Santiago, Chile: Sociedad Consultora Sistemas Sustentables. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/205028/STGZ-Publicaci_n.pdf.

Herz, T., Erdene, O. and Wright, L.F. (2021) 'ADB Business Opportunities: Project Pipelines on Transport Sector'. Asian Development Bank, p. 17. Available at: https://events.development.asia/system/files/materials/2021/09/202109-project-pipelines-central-west-asia-department.pdf.

Hosking, J., Mudu, P. and Dora, C. (2011) *Health in the green economy: health co-benefits of climate change mitigation – transport sector*. Edited by E.R. Fletcher. Geneva: World Health Organization. Available at: https://apps.who.int/iris/bitstream/handle/10665/70913/9789241502917_eng.pdf.

IATA (no date) *Facft Sheet 6: Examples of ground transport biofuel mandates around the world*. International Air Transport Association. Available at: https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/biofuel-mandates_fact-sheet6-biofuel.pdf.

IEA (2020) *Georgia 2020 - Energy Policy Review*. International Energy Agency. Available at: https://www.iea.org/reports/georgia-2020.

Île-de-France Mobilités (2021) *Funding*. Available at: https://www.iledefrance-mobilites.fr/en/about-us/funding (Accessed: 11 January 2022).

IQAir (2022) *Air quality in Tbilisi*. Available at: https://www.iqair.com/georgia/t-bilisi/tbilisi (Accessed: 13 January 2022).

IRENA (no date) *Biodiesel*, *International Renewable Energy Agency*. Available at: https://www.irena.org/costs/Transportation/Biodiesel (Accessed: 12 January 2022).

JAM News (2019) *Georgia's response to taxi regulations - the 'Schmaxi'*, *JAM News*. Available at: https://jam-news.net/georgias-response-to-taxi-regulations-the-schmaxi/ (Accessed: 12 January 2022).

Karchkhadze, K. (2017) 'Promotion of biodeisel in Georgia'. Trondheim, Norway: Ilia State University. Available at: https://poweringthefuture.un.org/content/documents/pres/Ilia_State_University.pdf.

KfW (2020) *Georgia: The collapse of international tourism hits the Caucasus republic hard*. Available at: https://www.kfw-entwicklungsbank.de/International-financing/KfW-Development-Bank/About-us/The-Corona-situation-in-our-external-offices/Georgia/ (Accessed: 12 January 2022).

Klarna (2021) *GiveOne: the 1% pledge*. Available at: https://www.giveone.com/pledge (Accessed: 22 July 2021).

Kochiashvili, N. (2021) *Tbilisi City Hall to Introduce Subscription System for Public Transport from February*, *The Messenger Online*. Georgia. Available at: http://www.messenger.com.ge/issues/5055_december_24_2021/5055_natalia.html (Accessed: 11 January 2022).

Kuwamoto, F. and Hanafusa, R. (2022) 'Kazakhstan crisis reveals risk to autocrats from high fuel costs', *Nikkei Asia*, 8 January. Available at: https://asia.nikkei.com/Politics/Kazakhstan-crisis-reveals-risk-to-autocrats-from-high-fuel-costs.

Lentepubblica.it (2021) *Bonus bici 2021: cos'è, come funziona e chi può richiederlo*, *Lentepubblica.it*. Available at: https://www.lentepubblica.it/cittadini-e-imprese/bonus-bici-2021/#Bonus_bici_2021_le_iniziative_a_livello_regionale (Accessed: 10 February 2022).

Martikian, L. (2021) *EBRD supports upgrade of municipal vehicle fleet in Tbilisi*, *European Bank for Reconstruction and Development*. Available at: https://www.ebrd.com/news/2021/ebrd-supports-upgrade-of-municipal-vehicle-fleet-in-tbilisi.html (Accessed: 12 January 2022).

Mayor of London (2021) *The Mayor's Ultra Low Emission Zone for London*. Available at: https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/mayors-ultra-low-emission-zone-london (Accessed: 16 December 2021).

Mayor of London (no date) 'The London Boroughs Consolidation Centre – a freight consolidation success story'. London, p. 2. Available at: https://content.tfl.gov.uk/lbcc-case-study.pdf.

Meaker, M. (2021) 'Norway Is Running Out of Gas-Guzzling Cars to Tax', *WIRED*, November. Available at: https://www.wired.com/story/norway-electric-vehicle-tax/.

Megrelishvili, N. (2021) 'Developments of Georgia in Ambient Air Quality Management'. Ministry of Environmental Protection and Agriculture of Georgia, p. 18. Available at: https://unece.org/sites/default/files/2021-04/Georgia_final.pdf.

MEPA (2018) *Third National Environmental Action Programme of Georgia (2017-2021)*. Tbilisi, Georgia: Ministry of Environmental Protection and Agriculture of Georgia. Available at: https://mepa.gov.ge/En/Files/ViewFile/1605#:~:text=The Third National Environmental Action Programme of Georgia was developed,of local and European experts.

MEPA (2021a) *2021-2023 Action Plan of Georgia's 2030 Climate Strategy*. Tbilisi, Georgia: Ministry of Environmental Protection and Agriculture. Available at: https://mepa.gov.ge/En/PublicInformation/32027.

MEPA (2021b) *Fourth National Communication of Georgia to the UNFCCC*. Tbilisi, Georgia: Ministry of Environmental Protection and Agriculture of Georgia, United Nations Development Programme, Global Environmental Facility. Available at: https://unfccc.int/sites/default/files/resource/4 Final Report - English 2020 30.03_0.pdf.

MEPA (2021c) *Georgia's 2030 Climate Change Strategy*. Tbilisi, Georgia: Ministry of Environmental Protection and Agriculture of Georgia. Available at: https://mepa.gov.ge/En/Files/ViewFile/50123.

MESD (2019) 'Periodic Technical Inspection in Georgia'. Tbilisi: Ministry of Economy and Sustainable Development of Georgia, p. 14. Available at: https://unece.org/fileadmin/DAM/trans/main/wp29/Khmaladze-PTIproblems.pdf.

Milkywire (2021) *Climate change mitigation beyond offsetting*. Available at: https://www.milkywire.com/climate-transformation-portfolio (Accessed: 13 January 2022).

Mingardo, G. (2013) 'Transport and environmental effects of rail-based Park and Ride: evidence from the Netherlands', *Journal of Transport Geography*, 30, pp. 7–16. doi:https://doi.org/10.1016/j.jtrangeo.2013.02.004.

MRDI (2019) *Decentralization Strategy 2020-2025*. Georgia: Ministry of Regional Development and Infrastructure of Georgia. Available at: https://mrdi.gov.ge/pdf/5e468e292b317.pdf/Decentralization-strategy-ENG.pdf.

NAMA Facility (no date) *Key Features*. Available at: https://www.nama-facility.org/call-for-projects/ambition-initiative-round-two/key-features/ (Accessed: 13 January 2022).

Naran, B., Fernandes, P., Padmanabhi, R., *et al.* (2021) *Preview: Global Landscape of Climate Finance 2021*. Climate Policy Initiative. Available at: https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Global-Landscape-of-Climate-Finance-2021.pdf.

NCDC (2018) *National Environment and Health Action Plan of Georgia 2018-2022 (NEHAP-2)*. Georgia: National Center for Disease Control and Public Health of Georgia. Available at: https://test.ncdc.ge/Handlers/GetFile.ashx?ID=951a795c-ab20-4bdd-8f32-57959e3e1728.

NewClimate Institute (2019) *PROSPECTS+*. Available at: https://newclimate.org/2018/11/30/prospects-plus-tool/.

NewClimate Institute (2020) *Our climate responsibility approach - A new approach for organisations to take responsibility for their climate impact*. Cologne: NewClimate Institute. Available at: https://newclimate.org/climateresponsibility.

OC Media (2018) *Taxi licensing 'to become mandatory' in Georgia*, *OC Media*. Georgia. Available at: https://oc-media.org/taxi-licensing-to-become-mandatory-in-georgia/ (Accessed: 12 January 2022).

Parliament of Georgia (2021) *Tax Code of Georgia*. Georgia. Available at: https://matsne.gov.ge/en/document/view/1043717?publication=129.

Peralta Quiros, T. and Mehndiratta, S. (2017) *Climate finance: why is transport getting the short end of the stick?*, *Transport for Development*. World Bank Blogs. Available at: https://blogs.worldbank.org/transport/climate-finance-why-transport-getting-short-end-stick (Accessed: 12 January 2022).

Postaria, R. (2021) *Superblock (Superilla) Barcelona—a city redefined*, *Cities Forum*. Available at: https://www.citiesforum.org/news/superblock-superilla-barcelona-a-city-redefined/ (Accessed: 10 February 2022).

PPMC (no date) *Improve freight efficiency (e.g. reduce empty load running by freight trucks) through route optimization, asset sharing between companies, and increased use of ICT solutions*. Paris Process on Mobility and Climate. Available at: http://www.ppmc-transport.org/implement-eco-driving-training-supported-by-on-board-devices-for-car-bus-and-rail-fleet-operators/ (Accessed: 12 January 2022).

Railway Pro (2020) 'EBRD loan approved for Tbilisi metro modernisation', *Railway Pro Magazine*, May. Available at: https://www.railwaypro.com/wp/erbd-loan-approved-for-tbilisi-metro-modernisation/.

Ramboll Group (no date) *Preparing the Sustainable Urban Mobility Plan for Tbilisi*. Available at: https://ramboll.com/projects/group/planning-and-implementing-sustainable-urban-mobility-plan-sump-in-tbilisi (Accessed: 12 January 2022).

Ransom, C., Haran, V. and Baddour, O. (2021) *Climate Indicators and Sustainable Development: Demonstrating the Interconnections*. Geneva, Switzerland: World Meteorological Organization (WMO). Available at: https://library.wmo.int/doc_num.php?explnum_id=10804.

Rustavi2 (2022) *We will be ready for the third phase of taxi reform by the end of the summer – Kakha Kaladze*, *Rustavi2*. Available at: https://rustavi2.ge/en/news/221204 (Accessed: 10 February 2022).

Shaw, C., Hales, S., Howden-Chapman, P. and Edwards, R. (2014) 'Health co-benefits of climate change mitigation policies in the transport sector', *Nature Climate Change*, 4(6), pp. 427–433. doi:10.1038/nclimate2247.

SLOCAT (2021) *Tracking Trends in a Time of Change: The Need for Radical Action Towards Sustainable Transport Decarbonisation*. SLOCAT Partnership on Sustainable Transport, Low Carbon Transport. Available at: https://tcc-gsr.com/wp-content/uploads/2021/06/Slocat-Global-Status-Report-2nd-edition_high-res.pdf.

Speak, C. (2019) *Bari becomes first Italian city to pay people to bike to work*, *The Local*. Italy. Available at: https://www.thelocal.it/20190212/bari-becomes-first-italian-city-to-pay-people-to-bike-to-work/ (Accessed: 12 January 2022).

Steinbuch, M. (2020) *Smart Traffic Lights*, *Innovation Origins*. Available at: https://innovationorigins.com/en/smart-traffic-lights/ (Accessed: 16 December 2021).

Sustainable Mobility for All (2017) *Global Mobility Report 2017 - Tracking Sector Performance*. Washington, D.C. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/28542/120500.pdf?sequence=6.

Taktakishvili, N. (2021) 'Tbilisi Mayor announces next step of taxi reform', *Business Media Georgia*, June. Available at: https://bm.ge/en/article/tbilisis-meria-bavshvta-dabadebis-dgis-centrebs-5000-5000-larit-daexmareba/83952.

TCRP (2004) *Transit pricing and fares: traveler response to transportation system changes*, *TCRP Report 95*. Washington D.C, US: Transit Cooperative Research Program.

TRACECA (no date) *Logistics City Tbilisi*. Available at: http://www.traceca-org.org/en/investments/investment-projects/detail/?tx_tracecainvprojectstable_pi3%5Buid%5D=30&cHash=2cdba963e82855bb065e63208d4d8623 (Accessed: 12 January 2022).

Travelwest (no date) *Freight consolidation*. Available at: https://travelwest.info/projects/freight-consolidation (Accessed: 12 January 2022).

UNDP (2020) *Georgia strives to improve air quality in cities*. Available at: https://www.ge.undp.org/content/georgia/en/home/presscenter/pressreleases/2020/air-quality-monitoring.html (Accessed: 12 January 2022).

UNFCCC (2015) *Paris Agreement*. Paris: United Nations Framework Convention on Climate Change. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

VICLIM (2018) *Recommendations for local and vertically integrated climate change mitigation actions and policies in Georgia*. Tbilisi, Georgia: Deutsche Gesellschaft für Internationale Zusammenarbeit.

World Economic Forum (2019) 'From Funding to Financing Transforming SDG finance for country success', (April). Available at: http://www3.weforum.org/docs/WEF_From_Funding_to_Financing.pdf.

Wright, L. and Fulton, L. (2005) 'Climate Change Mitigation and Transport in Developing Nations', *Transport Reviews*, 25(6), pp. 691–717. doi:10.1080/01441640500360951.

WWF and BCG (2020) *Beyond Science-Based Targets: A Blueprint for Corporate Action on Climate and Nature*. World Wide Fund For Nature, Gland, Switzerland and Boston Consulting Group, Boston MA, USA. Available at: https://wwfint.awsassets.panda.org/downloads/beyond_science_based_targets___a_blueprint_for_corporate_action_on_climate_and_nature.pdf.

Xue, C., Zhou, H., Wu, Q., *et al.* (2021) 'Impact of Incentive Policies and Other Socio-Economic Factors on Electric Vehicle Market Share: A Panel Data Analysis from the 20 Countries', *Sustainability*, 13(5). doi:10.3390/su13052928.

Zhang, Y. and Mi, Z. (2018) 'Environmental benefits of bike sharing: A big data-based analysis', *Applied Energy*, 220, pp. 296–301. doi:https://doi.org/10.1016/j.apenergy.2018.03.101.

Zhenmin, L. and Espinosa, P. (2019) 'Tackling climate change to accelerate sustainable development', *Nature Climate Change*, 9(7), pp. 494–496. doi:10.1038/s41558-019-0519-4.

Annex I Framework for assessing finance mitigation measures in urban mobility

The framework and information on financing described below is taken from Day *et al*., (2022), produced and repackaged for this paper. The framework provides a conceptual basis to map the financing maturity status of potential urban mobility measures for Georgia, described in Section 3, from which specific financing strategies can be further elaborated (Section 4).

Status and financing needs of measures

Table 2 provides an overview of the different stages of technology maturity or project readiness and the roles that private and public (including climate finance) sources can play in their implementation.

Stage	Description	Private sector role	Public sector /climate finance role	Financing options
Preparing	New technologies, feasibility exercises	Low. High risk that the project will not happen. Seed or venture capital for R&D	Upfront costs to reduce uncertainty, increase transparency and build project pipeline	Grants, repayable grants or highly flexible loans
Pioneering	Early-stage projects. Not necessarily commercially viable, although promising. High risk and high transaction costs	Seed or venture capital to test new ideas/markets/business models	Little to no return expectations. Reduce risk or provide advisory services	Grants, repayable grants, concessional loans, junior equity, flexible debt
Facilitating	Low returns relative to risks. Not necessarily viable for private investors only	Returns below commercial rates, investment only with risk lowering instruments	Subordinate position with higher risk, low-cost leverage to enable private capital to meet risk-return thresholds	Equity, flexible debt
Anchoring	Known technology, still high perceived risk	Macro or sectoral risks, but market exists and technology and returns are viable	Can provide funding on similar terms as private investors to provide comfort, act as "stamp of approval" and help "crowd-in" private funds	Concessional or market rate debt, equity
Transitioning	Move funding pools looking to invest in development into a pipeline of sizeable/scalable projects that fit investor requirements	Increase local market knowledge or pipeline, improve inefficient markets	Low, but involvement can provide certainty to private investors	Market rate debt, equity

Table 2: Project development stages and financing options (adapted from World Economic Forum, 2019)

Figure 3 in section 3.8 evaluated all measures based on the readiness of the practice in Georgia and its emission abatement costs. Project development stages closely relate to practice readiness, considering that financing opportunities improve as a technology becomes better known. For the purpose of this

analysis, we consider the technology readiness a good proxy for investment risk. Similarly, abatement cost can be considered in climate finance as a proxy for project returns, considering that some of the mechanisms used do not expect high (if any) returns, but are rather interested in the climate impact of their investments.

Figure 8 shows the areas where the intersection of practice readiness and abatement costs relates to the project development stages explained in Table 2. Unknown or unavailable technologies with high abatement costs are unlikely to be implemented by private investors and are therefore more suitable to "pioneering" finance, namely technical assistance, grants, and seed funding. Measures that might be more common practice but are currently cost prohibitive could then benefit from "facilitating" mechanisms, such as climate finance taking a larger portion of the risk in the form of subordinate debt or junior equity. "Anchoring" mechanisms can help the measures with promising abatement costs that need further (regional) exposure to lower the perceived risks and attract the interest of a broader set of investors. Once implemented, technologies that fit the country's needs and circumstances and deliver the expected returns can gradually "transition" towards the bottom-left corner of the diagram and become standard practices that offer low abatement costs. These measures should be the first to be implemented as part of the country's NDC and ideally would not require concessional or climate funding.

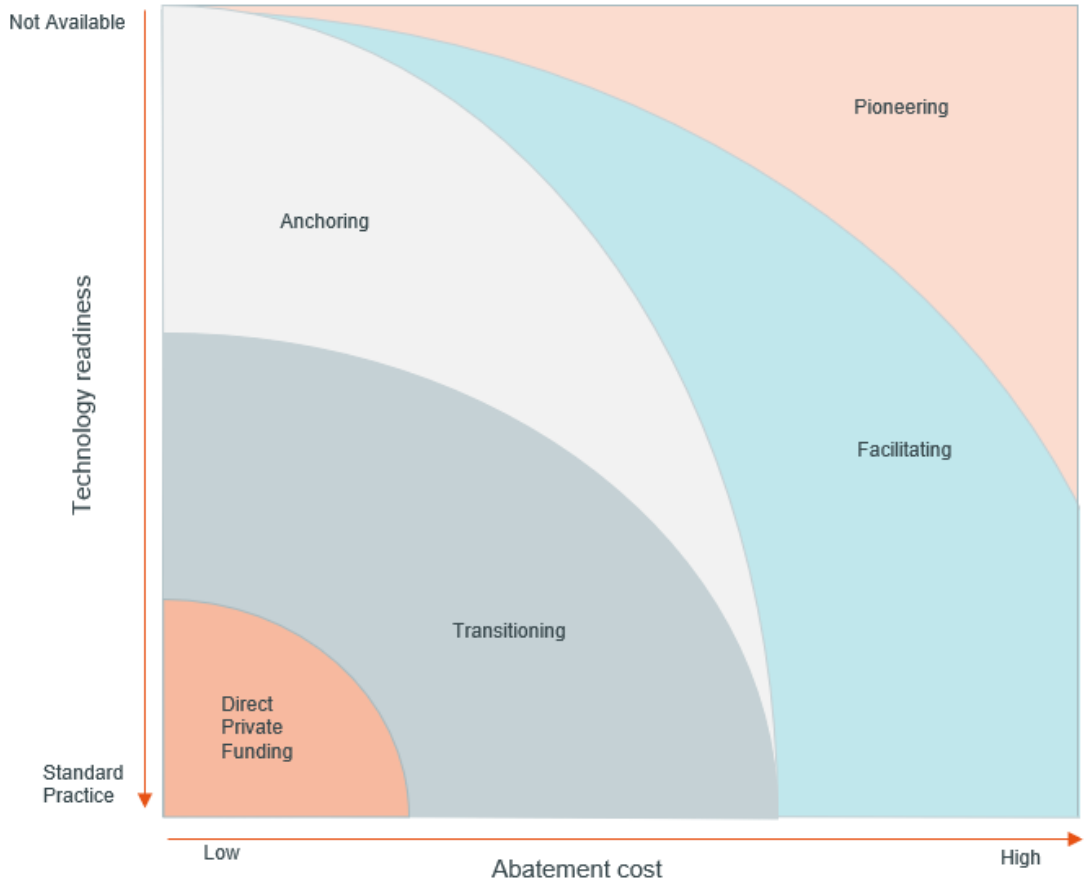


Figure 8: Project development stages

NewClimate – Institute for Climate Policy and Global Sustainability gGmbH

Cologne Office
Waidmarkt 11a
50676 Cologne
Germany

T +49 (0) 221 999833-00
F +49 (0) 221 999833-19

Berlin Office
Schönhauser Allee 10-11
10119 Berlin
Germany

E info@newclimate.org
www.newclimate.org