International Transport Forum

Decarbonising Azerbaijan's Transport System

Charting the Way Forward

Decarbonising Transport Initiative

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The International Transport Forum

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Decarbonising Transport in Emerging Economies: The case of Azerbaijan

Azerbaijan is strategically situated at the intersection of the north-south and east-west trade routes between Asia, the Middle East and Europe. Azerbaijan is also one of the world's oldest oil producing regions, and is today both a major producer and exporter of oil and gas in the Caspian Sea region; in 2018, fuels constituted almost 92% of the total exports for Azerbaijan (WITS, 2018). The transport sector in Azerbaijan is a fast-growing sector and makes a significant contribution to the gross domestic product (GDP). At the same time, the sector currently faces a number of challenges, such as: i) lack of co-ordination between the priorities of the government and the measures taken by the main stakeholders; ii) scarcity of data on transport sector emissions; and iii) road safety issues.

In 2018, Azerbaijan recorded a total of 172 400 tonnes of air pollutant emissions, out of which 16 700 tonnes were carbon dioxide (CO_2) emissions. The transport, storage and communication sector accounted for 23.7% of total air pollutant emissions and 4.7% of total CO_2 emissions in the same year (SSCRA, 2020a). The ITF's Decarbonising Transport in Emerging Economies (DTEE) project helps governments of emerging nations to identify ways to reduce their transport CO_2 emissions and meet their climate change goals. Amongst its member countries, ITF has identified Azerbaijan as one of the four countries to benefit from this project, together with Argentina, India and Morocco. With this project, the ITF aims to establish tailored transport CO_2 mitigation pathways for Azerbaijan by overcoming existing barriers, such as capacity and resource constraints, as well as a lack of evidence-based policy analysis. As an implementing partner, the Wuppertal Institute (WI) will work with local authorities to support implementation actions for urban transport.

The objective of this scoping paper is to describe the status of current transport activity, related greenhouse gas (GHG) emissions estimation, networks and main infrastructure projects by mode and current transport policies. According to the current available data, and in consultation with key stakeholders, the next steps of the project are outlined.

Overview of relevant stakeholders and governance structure

In Azerbaijan, urban infrastructure, including transport infrastructure, is managed by various ministries, state committees and state-owned enterprises. Locally-elected municipalities are directly accountable to the people, but normally lack the appropriate finance, capacity and scale to carry out urban service delivery functions (ADB, 2018). In 1999, Azerbaijan introduced a system of self-governance through the election of local municipal councils. Baku and its surrounding areas, for example, has 52 municipalities. Municipalities are charged with responsibility for maintaining local roads, providing social assistance to those with low incomes who are not covered by the State's social programmes, building parks and carrying out urban renovation activities, but in reality, their resources are quite limited (European Stability Initiative, n.d.).

In the case of Baku, the President appoints the mayor as head of the executive power, however, this is the only non-elected mayoral appointment among the Council of Europe member states (Guliyev, 2018). The President also appoints the heads of the eleven administrative districts of the city. The actual distribution of powers between these two tiers are not properly defined in any official document. The City of Baku does not have a council, and thus lacks a proper mechanism for bringing the heads of the districts under

mayoral leadership for effective resolution of cross-district issues (Valiyev, 2013). The Baku Transport Agency (BNA) has responsibility for most of the transport issues in the city.

Table 1 provides core information about the institutions that are usually involved in discussions related to mobility, transport and the environment, and energy. This list is by no means exhaustive, but it provides a useful overview of the key institutions involved with sustainable mobility in Azerbaijan.

Table 1. Relevant Institutions: Sustainable urban transport in Azerbaijan

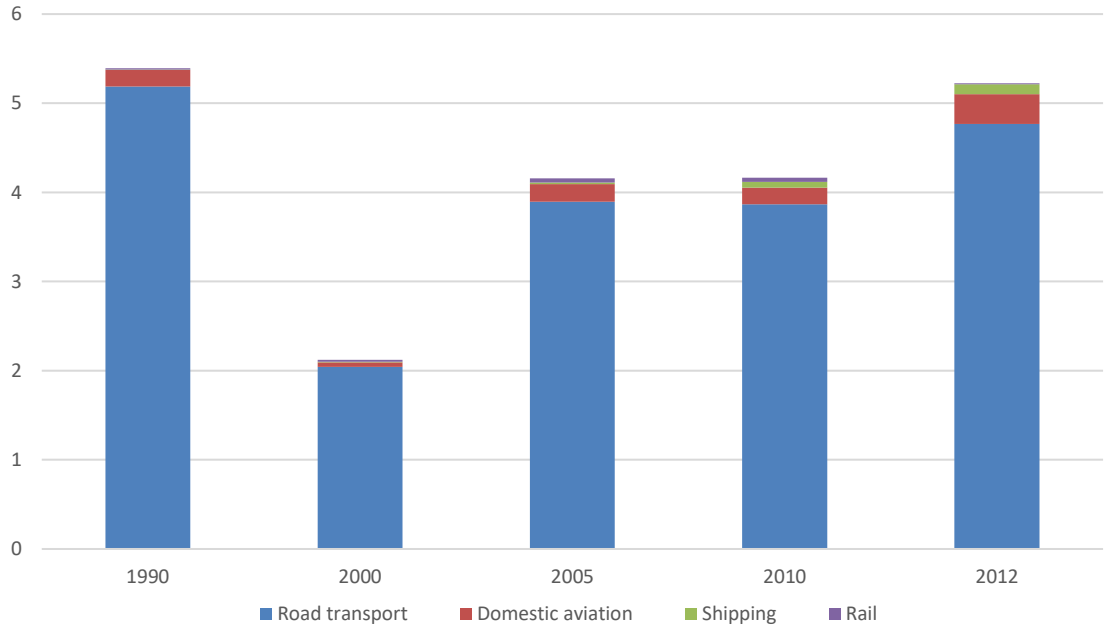
Institution name	Description of relevant role(s)
Azerbaijan State Agency for Automobile Roads	• design, construction, restoration, and repair of highways, bridges, tunnels and other road structures • maintenance of highways and road facilities
Azerbaijan Automobile Federation	• relevant to road traffic safety
Azerbaijan Railways CJSC	• national state-owned rail transport operator
Azerenergy Joint-Stock Company	• management of the production and transmission of electricity
Azerrishig OJSC	• provision of electricity supply to consumers
Bureau of Electricity Transmission	• maintenance and repair of electricity transmission lines, substations, and works connecting new consumers
Energy Supervision Authority	• energy consumption analysis and forecast, installation of meters, operation and maintenance of networks
Ministry of Ecology and Natural Resources	• regulation of activities relating to ecology, environmental protection and the use of natural resources
Ministry of Economy	• in relation to transport; responsible for policies dealing with importation and sales of vehicles and vehicle parts, etc.
Ministry of Energy	• regulation of mining and energy industries
Ministry of Internal Affairs	• synchronisation of existing information systems and databases • improvement of regulatory and legal acts
Ministry of Tax	• relevant to fiscal measures related to promoting sustainable transport
Ministry of Transport, Communications and High Technologies	• oversees priority determination, implementation of state programmes and co-ordination of activities in the transport sector
State Agency for Renewable Energy Sources	• main regulatory institution in the field of renewable energy
State Committee for Urban Planning and Architecture	• regulation of urban construction and development and oversight of architectural activities
State Oil Company (SOCAR)	• production, processing and transport of oil, gas, and gas condensate • marketing of petroleum and petrochemical products • supply of natural gas to industry and the public
State Tourism Agency	• links between tourism (which features high on the government agenda, particularly in Baku) and transport
Tariff Council	• relevant to public transport-related tariffs

Institution name	Description of relevant role(s)
Baku Transport Agency (BNA)	• control and regulation of road passenger transport in Baku • planning for future transport networks • traffic management
Baku Bus LLC	• provision of bus services in Baku
Baku Metro Closed Joint-Stock Company	• natural monopolist in metro passenger transport in Baku
Local executives	• municipalities may adopt programmes of public service delivery and/or create municipal entities in key areas including transport

Current climate goals

According to its nationally determined contribution (NDC) of 2015, Azerbaijan aims at reducing GHG emissions by 35% by the year 2030 (compared to the base year 1990). The sectors covered under this target are: energy, oil and gas, agriculture, waste, transport and land use, land-use change, and forestry (LULUCF). By the year 2012, Azerbaijan had achieved a 29% reduction, mainly from the energy, oil and gas sectors, due to modernisation and deployment of more efficient technologies (Zoï Environment Network, 2017). The State Oil Company of the Azerbaijan Republic (SOCAR) has been focusing on reducing its carbon emissions and exploring ways of fighting climate change. In 2014, Azerbaijan's transport sector was one of the largest contributors to the country's CO_2 emissions (Hajiyev et al., 2015) and road transport is by far the biggest source of CO_2 emissions in the transport sector.

Figure 1. CO_2 Emissions by mode of transport, 1990-2012
(million tonnes CO_2)



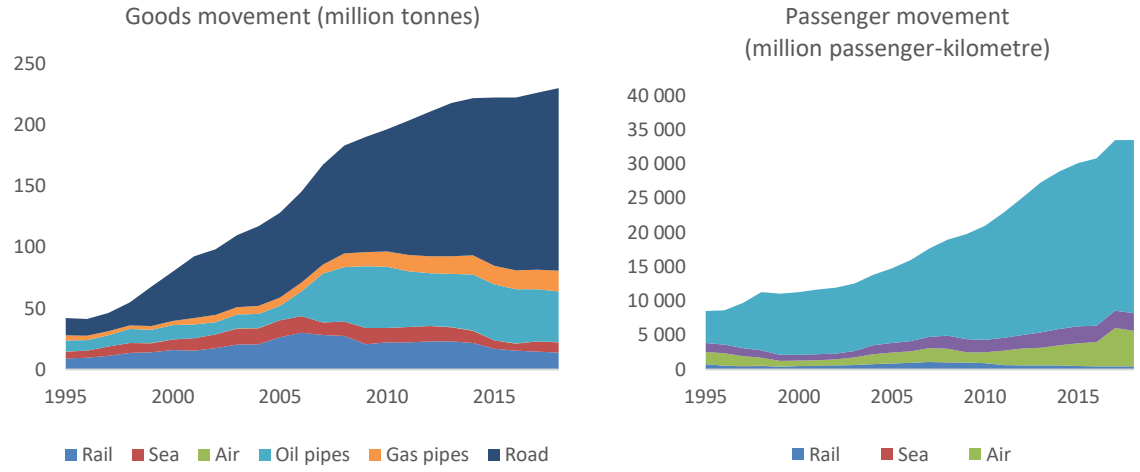
Source: Republic of Azerbaijan (2015).

Overview of the transport sector in Azerbaijan

In 2013, the share of the transport sector's contribution to GDP was 4.7% growing to 6.7% by 2018 (SSCRA, 2020b). During the period 2013-18, Azerbaijan's economy grew by 1.6% on average, with non-oil GDP showing an average growth rate of 3.7%, whereas the transport sector grew by 7% on average over the same period (SSCRA, 2020b). The income from the transport sector grew from AZN 2.8 billion (Azerbaijani *manat*) in 2014 to AZN 4.8 billion in the year 2018 (SSCRA, 2020b). In 2018, the transport sector contributed to 6.3% of value added and employed 8.1% of the labour force.

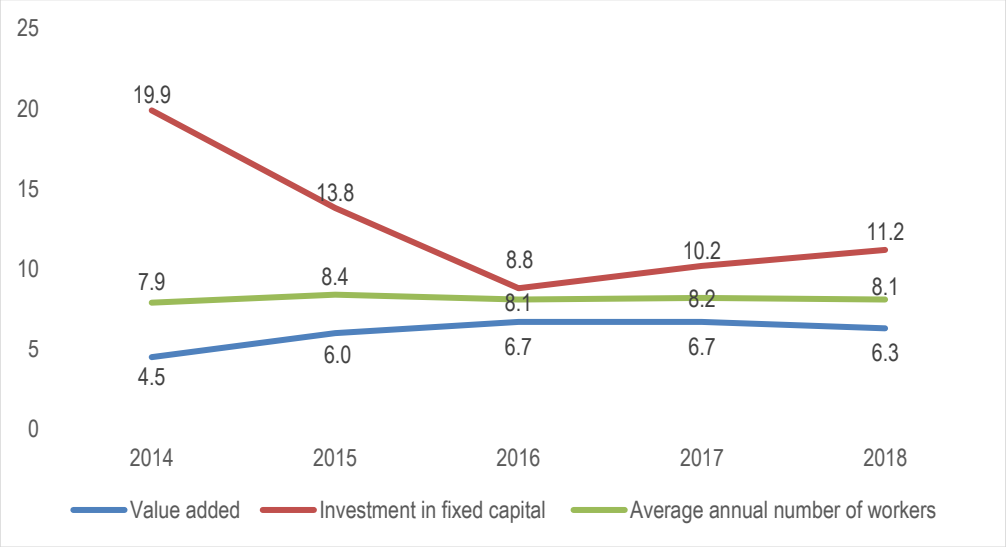
The economy in Azerbaijan has traditionally been heavily dependent on the exploitation of its oil and gas reserves. Azerbaijan has been prioritising the development of non-oil sectors over recent years in order to insure against the instability of oil prices. In 2016, the government of Azerbaijan adopted the Strategic Roadmap for the National Economy which prioritised eleven sectors of the economy and introduced development plans for each of these sectors. The Strategic Roadmap for Logistics and Trade elaborates on some of the transport sector goals. As of January 2019, 27% of the activities under the Strategic Roadmap for the Development of Logistics and Trade have been implemented, 10% have been partially implemented and 63% are expected to be implemented (Center for Analysis of Economic Reform and Communication, 2018).

Figure 2. Movements in Azerbaijan for goods (million tonnes) and passengers (million passenger-kilometres), 1995-2015



Source: Based on State Statistical Committee of the Republic of Azerbaijan (2020a).

Figure 3. Impact of transport on the economy of Azerbaijan, 2014-18 (% change from previous year)



Source: Based on State Statistical Committee of the Republic of Azerbaijan (2020a).

Freight transport overview

According to the State Statistical Committee of the Republic of Azerbaijan, 235 million tonnes of goods were transported in 2019 (SSCRA, 2020a). Whilst road transport is the main mode of freight transport (65% in 2018), pipelines also represent a major share of this figure (about 25% of the total), which is in line with Azerbaijan's profile as an oil and gas producer and exporter. Excluding pipelines, road transport accounts for 88% of goods transported, followed by rail, sea and air transport at 8.6%, 3.4% and 0.1%, respectively. Over the period 2014-19, the total volume of goods transported increased by 5.6%. This arose largely from a 17% increase in road freight transport, while transport via rail and sea decreased over the same period. The upward trend in freight transport by roads will undoubtedly be a challenge to Azerbaijan meeting its NDC targets. The turnover of goods in the transport sector has slightly decreased from 93 531 million tonne-kilometres in 2014 to 89 749 million tonne-kilometres in 2019.

Table 2. Freight transport in Azerbaijan by mode of transport, 2014-19
(% change from previous year)

	2014	2015	2016	2017	2018	2019
Rail	-5.8	-21.6	-9.4	-5.9	-4.1	9.1
Sea	-13.7	-33.3	-12.4	43.7	-1.3	-27.5
Air	-0.8	3.2	24	8.1	20.2	-12.0
Pipeline	5.1	-0.2	-3.4	-3.6	-2.5	0.3
Road	2.1	7.0	2.8	2.4	3.1	4.0

Source: Based on State Statistical Committee of the Republic of Azerbaijan (2020a).

Passenger transport overview

In 2019, similarly to freight transport levels, road transport accounted for 88% of passengers, followed by the metro at 11%, with air, sea and rail accounting for minor shares. Over the period 2014-19, passenger transport increased by 11%. Unlike in the case of freight transport, all modes of passenger transport have shown an increase over this period. Passenger turnover in the transport sector increased from 28 905 million passenger-kilometres to 33 866 million passenger-kilometres during the same period (SSCRA, 2020a).

Table 3. Passenger transport in Azerbaijan by mode of transport, 2014-19
(% change from previous year)

	2014	2015	2016	2017	2018	2019
Rail	0.4	-25.2	5.0	25.9	14.1	35.5
Sea	7.1	-40.0	122.2	-15.0	-6.0	37.5
Air	7.5	1.7	9.0	19.1	1.7	12.7
Road	4.7	3.6	2.5	1.8	1.5	2.6
Metro	4.3	3.0	-2.0	5.2	1.0	2.6

Source: Based on State Statistical Committee of the Republic of Azerbaijan.

Rail Transport

Rail transport in Azerbaijan is operated by Azerbaijan Railways Closed Joint-Stock Company (ADY), which was established in 2009 and is the national provider of both freight and passenger rail services across the country. As of 2019, the rail network in Azerbaijan had a total of 2 140 kilometre of operational lines, out of which 1 169 kilometres were electrified (SSCRA, 2020a). The same year, the network transported 15.2 million tonnes of goods and 3.8 million passengers (SSCRA, 2020a). The main railway network in Azerbaijan consists of four routes: i) 488 kilometres of double-track electrified line on the Trans-Caucasus route from Bala Jari to the Georgian border at Beyuk–Kasik; ii) 206 kilometres of electrified double-track line from Baku to the border of the Russian Federation (hereafter 'Russia') at Yalama; iii) Alyat to Horadiz which is electrified and partially double tracked; and iv) Osmanli to Astara which is electrified for the first 17 kilometres (ADB, 2017).

ADY experienced a downward trend during 2015-16 due to worn out infrastructure, coupled with economic recession. As a response, in 2017, ADY laid out a business plan for the period 2017-22 which focused on renovation of infrastructure and organisational restructuring, in order to decrease costs and improve services to increase competitiveness. In addition to the business plan, the government has directed resources towards the finalisation of the Baku-Tbilisi-Kars Railway and the development of the Astara (Azerbaijan) and Astara (Islamic Republic of Iran [hereafter 'Iran']) railways. The ongoing Sumgayit-Yalama railway section rehabilitation project is an important project that aims to reconstruct the 166.5-kilometre-long main railway line, repair 2 side tracks at the station, install new railroad switches, and other renovation, overhaul and repair of related infrastructure.

Road Transport

The main institution for roads in Azerbaijan is the Azerbaijan State Agency for Automobile Roads (ASAAR), which was set up in 2017 and is responsible for the design, construction, operation, repair and maintenance of state highways and other road facilities. The total length of the road network in Azerbaijan in 2019 was 19 176 kilometres, out of which 4 789 kilometres are roads of national importance and 14 387 kilometres are local roads (World Bank, 2020). In 2019, the road network in Azerbaijan transported 155 million tonnes of goods and 1.8 billion passengers (SSCRA, 2020a). In 2019, a total of 54 road construction and reconstruction projects, including 5 of national importance, 39 inter-village, and 10 settlement roads in Baku were completed, and in 2020, construction and repair of 893.2 kilometres of roads to villages and settlements near 29 cities and districts of the country, including 12 districts of Baku city were planned (ASAAR, 2019).

Primary issues in the road sector include modernisation of road maintenance and asset management, improvement of road protection and axle load control, improved financial sustainability of the road sector, introduction of national technical and design standards based on best international practices, improved road safety standards and road user information systems. Road safety is also a key issue faced by the transport sector in Azerbaijan. The State Program of Azerbaijan Republic on Road Safety for 2019-2023 addresses these road safety concerns. The Program aims at improving road safety, reducing the number of road accidents and, in turn, also reducing the socio-economic damage caused by preventable road casualties.

The Program lays special emphasis on environmental aspects, by promoting the use of ecologically clean vehicles and ensuring the implementation of environmental and biodiversity preservation requirements in the design, construction, repair and reconstruction of motorways. It calls for the adaption of the quality of fuel to Euro-4, Euro-5, Euro-6 and other standards to encourage cleaner vehicles. Measures to establish appropriate infrastructure for encouraging the use electric vehicles are also included in this Program.

Maritime transport and ports

The regulatory body that oversees maritime transport in Azerbaijan is the State Maritime Agency (SMA). The SMA has developed a strategy for implementing International Maritime Organisation (IMO) instruments for 2016-21. One of the main goals of the strategy is the prevention of pollution from ships. The measures to achieve this goal include: i) ensuring compliance with international regulations on management of ship generated waste; ii) strengthening the weak emission standards in MARPOL Annex VI[1], for both new and existing ships; iii) maximising technological advancements to improve pollution preparedness and response capabilities; iv) improving awareness of minimising the residue and waste generated on ships; and v) strengthening sanctioning policy against polluting vessels.

Baku International Sea Trade Port is a major multi-modal hub for Azerbaijan that links maritime transport with its highways and railways. In 2010, the government of Azerbaijan approved the construction of the Port of Baku at Alyat (Baku International Sea Trade Port). The construction of the port will be completed in three phases and at the completion of the current second phase, the cargo handling capacity of the Port of Baku will increase to 25 million tonnes of general cargo, including 500 000 twenty-foot equivalent units (TEU) in containers (Port of Baku, 2020a).

In 2019, the Baku International Sea Trade Port became the first port in the Caspian region to be awarded the European Sea Ports Organisation (ESPO) Port Environmental Review System (PERS) *EcoPorts* certificate[2] (PR Newswire, 2019). In 2019, the Organization for Security and Co-operation in Europe (OSCE) along with the Port of Baku launched the project "Promoting Green Ports and Connectivity in the Caspian

Sea Region". On-going projects at the Port of Baku that support its transition to becoming a green port include: i) a waste management programme; ii) low-carbon investment through Leadership in Energy and Environmental Design (LEED) building; iii) more efficient and/or renewable power supply for cargo-handling equipment; and iv) cold ironing[3].Potential future projects include further improving energy efficiency, implementing shore-to-ship power and transitioning to cleaner energy (notably liquefied natural gas [LNG], thermal and hydrogen), supporting a circular economy and improving logistics and accessibility (Port of Baku, 2020b).

Air Transport

The State Civil Aviation Agency (CAA) is the central regulatory body, exercising control, state policy and regulation in the field of civil aviation in Azerbaijan. Its functions include development of aviation policy, co-operation with the International Civil Aviation Organization (ICAO), increasing competitiveness of the air transport market, compliance with national regulations, maintenance of the state register of civil aircrafts.

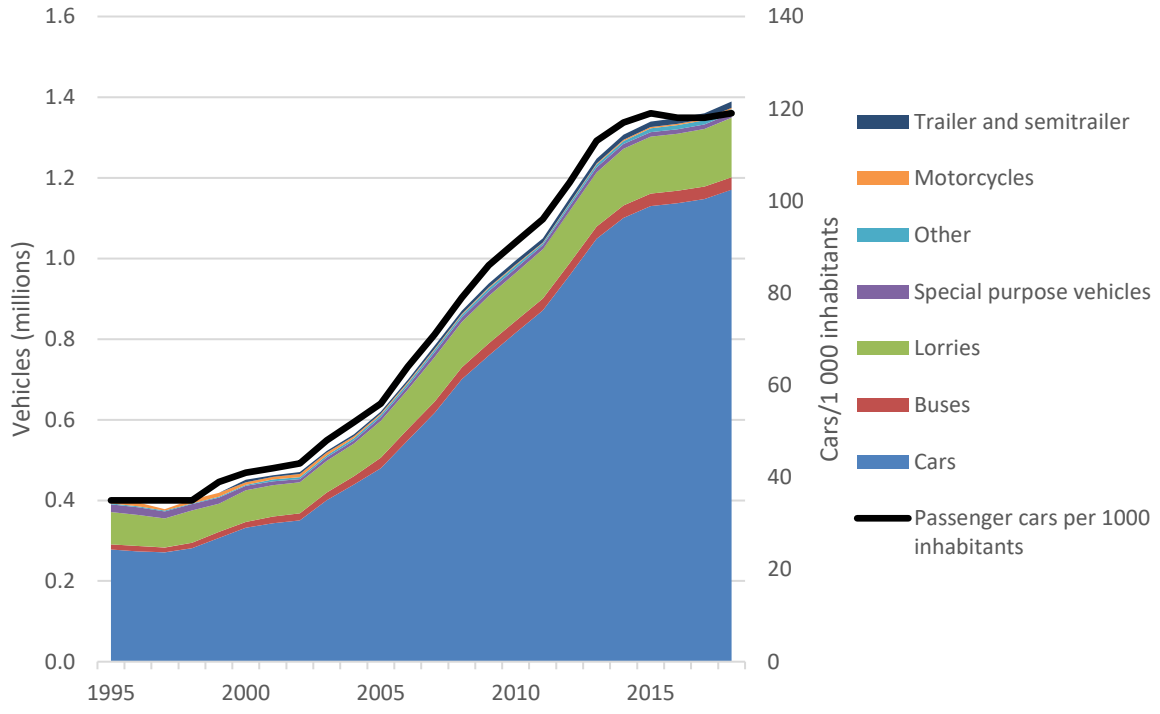
In 2019, 2.7 million passengers and 183 000 tonnes of goods were transported through the airways in Azerbaijan (SSCRA, 2020a). Of this, international travel accounted for 2.08 million passengers and national travel for 624 000 passengers (domestic traffic represents 23% of the air passenger volume). 181 000 tonnes of goods out of the total freight transport were accounted for by international freight (domestic freight traffic is only 1% of the goods transported by air). There are six passenger airports in the country: Baku, Nakhchivan, Ganja, Lankaran, Gabala, and Zaqatala, and all have international status. However, out of the six airports, only Baku, Nakhchivan and Ganja airports are currently fully functioning.

Azerbaijan Airlines is currently working on developing a strategic plan to take them to 2030. This plan will set targets so as to provide continuous development and improvement for the civil aviation sector, adequately meet the needs of the public and to put in place new and better services in the sector.

CO_2 impacts of the transport sector

In 2014, Azerbaijan's transport sector had one of the largest shares in the country's CO_2 emissions (Hajiyev et al., 2015) and in 2013 road transport accounted for 91% of the total emissions from the transport sector (Government of Azerbaijan, 2018a). In 2018, there were 138 motor vehicles per 1 000 inhabitants, an increase from 100 motor vehicles per 1 000 inhabitants in the year 2008 (SSCRA, 2020a). Since motor vehicles are the main mode of transport for both goods and passengers, the transport sector contributes significantly to air quality issues in the country. As a response, in 2014, Azerbaijan put in place vehicle import restrictions allowing imports only if vehicles meet or exceed the Euro-4 ecological standards. This restriction has proven to be one of the key measures in reducing emissions in the transport sector (Government of Azerbaijan, 2014). However, even after the implementation of the Euro-4 standards, the age and structure of passenger cars has continued to decline (Huseynov, 2019). In 2017, 72% of the passenger cars in Azerbaijan were over 10 years old (SSCRA, 2020a.

Figure 4. Number of vehicles by type (millions) and rate of car ownership (per 1 000 inhabitants), 1995-2015



Source: Based on State Statistical Committee of the Republic of Azerbaijan.

Overview of the main international transport corridors

Azerbaijan's geostrategic location makes it an important junction between Asia, the Middle East, Europe and the Mediterranean region. Hence, Azerbaijan is a part of several international projects that make it an essential transit link. The two main corridors are the North-South Transport Corridor and the East-West Transport Corridor.

The East-West Transport Corridor

The East-West Baku Georgian Road, also known as the Silk Road Azerbaijan, is a part of the European Union's Transport Corridor Europe-Caucasus-Asia Program (TRACECA). Under the project, Azerbaijan acts as a bridge between Europe and Caucasus with Central Asia and plays an important role in the development of international trade flows along the corridor. The road corridor includes: i) the 860-kilometre road from Baku to the Red Bridge at the Georgian border which continues to Tbilisi and then to the ports of Poti and Batumi on the Black Sea; ii) the corridor from Baku to Nakhchivan; and; iii) the 300-kilometre road from Yevlakh to the Georgian border, passing through Shaki and Zagatala and then continuing to Tbilisi (TRACECA, 2020). In 2018, 4.4 billion tonne-kilometres and 6.8 billion passenger-kilometres were transported through the road network of TRACECA (SSCRA, 2020a). The two main railway corridors are the Baku-Tbilisi-Kars line and to the Baku-Horadiz line. As of October 2019, the Baku-Tbilisi-Kars line had accounted for 275 000 tonnes of freight transport since operations began (Caspian News,

2020). According to ADY (2018), it is expected that this line will transport 6-8 million tonnes in 2022, increasing to 17 million tonnes per year.

The North-South Transport Corridor

The North-South Transport Corridor (NSTC) is a 7 200-kilometre-long multi-modal international corridor for freight between India, Iran, Afghanistan, Armenia, Azerbaijan, Russia, Central Asia and Europe. The NSTC plays a very important role in strengthening Azerbaijan's role as a transit hub in the region. In Azerbaijan, the NSTC encompasses both road and railway projects. One of the core elements of the corridor is the Russia-Azerbaijan-Iran rail line, 505 kilometres of which lies in Azerbaijan (World Bank, 2020).

Currently the NSTC in Azerbaijan comprises of: i) the Baku-Yalama (Russian border) connection of 192 kilometres; ii) the Baku-Osmanly connection of 129 kilometres; and iii) the Osmanly-Astara connection of 189 kilometres (ADY, 2019). The other projects that have been completed so far include: i) the 8.3-kilometre-long railway line connecting Astara station in Azerbaijan with the Astara station in Iran; ii) a new road, also with a length of 8.3 kilometres, along the above-mentioned rail line; iii) the rail bridge over the Astarachay river; and iv) a road with a length of 1.4 kilometres from the railway bridge over the Astarachay river up to the cargo terminal on the territory of Iran (MTCHT, 2020). According to the Ministry of Transport, Communications and High Technologies (MTCHT, 2020), after the completion of the projects along the corridor, the volume of expected cargo traffic is estimated to be 5 million tonnes per year at the first stage increasing to 10 million tonnes in the future.

Overview of the main challenges of the transport sector today

Over the last few years, the government of Azerbaijan has rolled out various plans for specific transport sub-sectors in order to improve transport infrastructure for both freight and passenger transport. Azerbaijan is also a key part of various international transport corridors, which has spurred the development of its road and railway infrastructure. However, the transport sector still faces a number of challenges that need to be tackled.

Lack of a national transport strategy covering all modes of transport and laying down the goals for the sector acts as an impediment to further development. This has led to a lack of co-ordination between the priorities of the government and the measures taken by the main stakeholders in the Azerbaijan transport sector (World Bank, 2020). While transport sub-sectors have devised their own strategic plans that do sometimes have environment-related provisions, there is no overarching transport sector plan that lays down a pathway for the sector to meet its NDC targets.

The scarcity of data on emissions acts as another major hurdle in Azerbaijan. Publicly available data shows emissions from different sectors and also differentiates between emissions from mobile and stationary sources. Although mobile sources mostly comprise of vehicles, locomotives, sea vessels and aircrafts, they also include other sources, such as construction equipment (Government of Azerbaijan, 2018a). There is also no available data on how much the transport sub-sectors contribute to emissions. The inability to provide such data to the public leads to a scarcity of assessment studies on the environmental impact of the transport sector. This has further led to a lack of emissions forecasts and appraisal of cost-benefits of key projects in the sector.

Azerbaijan faces substantial challenges when it comes to road safety: in 2016, there were approximately 2 600 road accidents, which resulted in 759 fatalities (UNECE, 2016). Some of the main causes of road

safety issues in Azerbaijan include a lack of national strategy, enforcement problems, interruptions to funding for road safety programmes, lack of updated data and research for analytical purposes (for the public as well as for policy makers), and a lack of public road safety education and awareness (Hayat, 2016). In response, the government has laid out the State Program of Azerbaijan Republic on Road Safety for 2019-23, which is briefly discussed in this paper.

Transport sector emissions reduction policy ambitions

Azerbaijan's NDC has emphasised the significance of environmentally friendly forms of transport; it identifies transport as one of the priority sectors for mitigation action. Some of the measures and intended outcomes relating to sustainable transport include: i) an increased use of electric vehicles for public transport and electrification of railway lines; ii) improved transport management systems; iii) expansions to the metro network; and iv) an increase in the number of underground and surface pedestrian crossings (Government of Azerbaijan, 2015).

Azerbaijan has set aside a significant amount of funding towards developing the transport sector; USD 8.5 billion in 2008 and USD 2 billion in 2010. However, a large part of the funding was directed towards the development of highway infrastructure, which is unlikely to contribute to a reduction in CO_2 emissions from the sector (UNEP, 2012). During the period 2011-16, the government of Azerbaijan planted 549 000 trees and decorative bushes in plots of land along highways in order to mitigate the effect of the release of harmful pollutants in the atmosphere (Government of Azerbaijan, 2018a). Various programmes discussed earlier in this section have environment-related provisions and targets. However, these are not clearly defined and no data have been published regarding the progress on such targets. It is therefore difficult to assess the advancements made by the transport sector when it comes to meeting climate change objectives.

Urban transport

Urban transport, as in any emerging economy, plays a key role in facilitating and accelerating the development of Azerbaijan's economy. As such, putting adequate focus on decarbonisation, while taking into consideration other goals, such as the provision of high-quality, accessible, mobility services and healthy environments, is key towards achieving holistic sustainability in the transport sector in Azerbaijan.

As of 2019, 53% of the 9.9 million population are living in urban areas, with 2.2 million (23% of the total population) living in the capital City of Baku (SSCRA, 2020a). Aside from the City of Baku, there are only two other cities with more than 300 000 inhabitants, Sumgayit and Ganja. The urban population has been growing at an average rate of 1.6% per annum for the last ten years (SSCRA, 2020a).

Urban transport has been growing at approximately 5% during the period 2009-18. Of the 2 billion passenger boardings in 2018, 77% were recorded as urban transport movements (20% suburban and 3% interurban). Of those urban transport boardings, 80% were on buses, 15% on the metro and 5% in taxis. Bus boardings grew at 5.38%, while taxi boardings grew at 6.88% and metro boardings at 1.27% (SSCRA, 2020a). In 2018, there were 1.37 million vehicles registered in Azerbaijan, 84% of which were cars and 95%

of these cars are private passenger cars. Overall vehicle registration growth between 2009-18 is estimated at 4.45% per annum (SSCRA, 2020a). Political and economic changes brought about by the post-Soviet era led to increasing car ownership, which was estimated to be at 119 vehicles per 1 000 people nationally in 2018 (SSCRA, 2020a). This is much lower than car ownership in the European Union, which was 610 motor vehicles per 1 000 inhabitants in 2018 (ACEA 2018).

There are 4.8 million motorised trips conducted in the City of Baku each day, which implies that each inhabitant makes an average of two motorised trips per day (ADB, 2015). Public transport in Baku comprises of the metro, buses, railways and minibuses. The Baku metro network is currently comprised of 36.63 kilometres of double track lines and carried more than 222 million passengers in 2017, which represents a daily ridership average of 650 000. The bus system in the Baku Metropolitan Region has 147 bus lines, which are currently run by 36 private operators, as well as by the state. The network is comprised of 5 119 kilometres of routes and serves around 1.6 million passengers per day (World Bank, 2018).

The City of Baku plays a prominent role in the economics, culture and politics in Azerbaijan. Baku is intended to become a main tourist destination, as well as an economic powerhouse, and as such there has been a supply-driven strategy and massive investment towards constructing various facilities and grand projects in the area. (Valiyev, 2013). As people relocate to seek higher standards of living, the propensity for rural to urban migration, coupled with the necessity to address the needs of internally displaced persons, have led to increased population densities in Baku and its suburban areas (Sadigov, 2018; ADB, 2018). The average salaries in Baku are said to be three to five times higher than in rural areas (SSCRA, 2017). The City of Baku's population is estimated to increase to 3.8 million by 2030 (State Committee on Urban Planning and Architecture, 2016). Baku has great socio-economic importance for the country. In 2011, 71% of the GDP was said to have been produced in Baku (Valiyev, 2013). The Asian Development Bank (2018) estimates that Baku and the surrounding Absheron economic region accounts for 92% of the national industrial output.

Sumgayit is the second largest city in Azerbaijan, located about 31 kilometres north-west of Baku. In 2018, it is estimated that there were 341 000 inhabitants in the city, with an administrative area of 83 square kilometres. The Baku suburban rail (operated by the Azerbaijan Railways) was recently extended to Sumqayit to facilitate passenger movement between the two cities. Ganja is the third largest city, with an estimated population of 330 000 (SSCRA, 2015) in an area of 170 square kilometres. Baku, Sumgayit, and Ganja together comprise a third of the country's population.

Overview of the main urban transport challenges in Azerbaijan

Negative externalities are a consequence of fossil fuel burning in the transport sector. The Third National Communication of Azerbaijan (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC) identifies transport as an important source of GHG emissions. Road transport vehicles are estimated to produce 91% of the total CO_2 emissions in Azerbaijan (Republic of Azerbaijan, 2015). While there are no disaggregated values for such emissions for urban areas, the fact that cities (particularly Baku) have disproportionately high motorisation indexes seems to imply that mobile sources are also significant sources of urban air pollution in Azerbaijan. Official statistics for the City of Baku state that car ownership in the City was as high as 98 out of 100 families in 2018 and this will undoubtedly have an effect on air pollution levels (SSCRA, n.d.).

Rising private car ownership, coupled with growing pressures brought about by increasing urbanisation, such as an ageing public transport system and difficulties in urban planning, has led to major challenges in urban transport, particularly in Baku (Jafarli, 2018). The government of Azerbaijan reports that motorised

vehicles have increased by 67.5% during the period 2008-17, and that there are still many vehicles with outdated standards.

As the majority of passenger (88.2%) and freight transport (63.9%) are being performed by road vehicles, improvements in road safety have been a priority for the government which has launched a state programme on road safety (Government of Azerbaijan, 2018b). The State Road Police department recorded 619 road accidents in Baku in 2018, with 212 fatalities. Upgrading of fleets are of a higher priority in urban agglomerations outside of Baku where there are less developed urban transport systems and significantly older, and potentially less safe and more polluting vehicle fleets (communication with J. Sluijter of ADB, 9 January 2020).

Other developments may also have been contributing to the motorisation trends. There have been signals of the declining profitability of the public transport sector, for example, the weakening of the Azerbaijani *manat* increases fleet repair and maintenance costs, which are highly dependent on imported technical equipment, which may then trigger a cycle involving the depreciation of the transport fleet and diminishing competition, which can then lead to lower service quality (CESD, 2018). The official statistics state that total profits for the bus sector, for example, are increasing (44% in 2017 against 2013) while spending on passenger transport has also been increasing at faster rates (74% between 2013-17), and bus ridership growing, albeit at a slower pace (13%)[4]. Bertelsmann Stiftung (2018) discusses other factors implicated in the rising costs of different forms of transport. The lack of public financing for other modes, such as trams and trolleybuses, made these completely unfeasible from the early 2000s. The disappearance of the trams and trolleybuses negatively impacted the environmental performance of Baku's public transport system. However, the current fare of bus and metro ridership are among the lowest in the world, at only USD 0.11 per ride. Baku Metro, for example, receives around USD 17.6 million per year for subsidising ridership. While government subsidies are high for public transport, other significant sources of funding are also needed (Jafarli, 2018).

Providing equitable, high quality public transport services throughout the urban areas of the country is also a current challenge. Due to the relatively low population densities in other urban agglomerations in the country, they are not yet experiencing urban transport issues that are widely known in the Baku area, such as congestion in many arteries, disorganised on-street parking and severe crowding on public transport (ADB, 2018). A recent study focusing on non-motorised transport (NMT) in Baku highlights the importance of walking in the daily lives of the citizens, and the need to improve pedestrian and cycling facilities in the city (World Bank, 2019).

The lack of integrated strategic urban planning and management are at the core of the challenges in transport planning. The Asian Development Bank (ADB, 2018) identifies the provision of basic, low-cost improvements to existing urban transport systems such as bus prioritisation, improved bus terminals, pedestrianisation and traffic management as key infrastructure investment needs for the country's transport sector. Urban transport transformation and management also faces institutional challenges due to complexities and gaps in the organisational setups and distribution of responsibilities. Locally elected municipalities that are directly accountable to both the national parliament and the people do exist, but they normally lack the appropriate finance, capacity and scale to carry out urban service delivery functions (ADB, 2018).

The Covid-19 pandemic, as in other countries, has had an impact on urban transport in Azerbaijan. Reorganisation of passenger transport, together with intensive measures, such as strict quarantine periods and mandatory wearing of personal protective equipment, were implemented to ensure passenger and operators' health and safety. Public transport ridership and revenues will most likely have dropped during the pandemic, adding new challenges on the finances of transport authorities.

Current actions towards the sustainability of urban transport in Azerbaijan

Through its first intended nationally determined contribution (INDC), Azerbaijan targets a 35% reduction in GHG emissions against 1990 levels (Republic of Azerbaijan, 2017). The INDC mentions the following measures for addressing GHG emissions from the transport sector, many of which directly relate to urban transport: i) use of environmentally friendly forms of transport; ii) enhancement of the use of electric vehicles in public transport; iii) electrification of railway lines and the transition to alternative current system in traction; iv) improvement and expansion of the scope of intelligent transport management systems; v) development of the metro transport system and increase in the number of metro stations; and vi) reduction in traffic jams due to the construction of road junctions and underground and surface pedestrian crossings.

Several examples are now being implemented that are in line with the said priority measures. The BNA has been developing an urban transport masterplan in co-operation with the State Committee for Architecture and Town Planning (communication, 14 November 2019). The plan intends to deliver improvements in urban mobility, road safety, and the provision of environmentally friendly mobility options, including the provision of bike lanes and pedestrian zones. Eighteen-and-a-half kilometres of physically segregated cycling infrastructure have recently been approved, and the BNA is aiming to eventually develop an integrated cycling network. Phase 1 of the Master Plan (up to 2027) also aims to focus on immediate measures to improve public transport in Baku.

The BNA has also implemented reforms in the city's public transport system since its establishment in 2015. Prior to 2015, there were 57 private bus operators in Baku, this has now been reduced to 36. By 2022, diesel buses will be phased out in Baku and will be replaced with buses running on cleaner fuels such as compressed natural gas (CNG). As of November 2019, over 300 CNG buses have been delivered and the BNA is expecting 300 more. The BNA is also interested in the electrification of the bus fleet, but recognises the current gaps in the readiness of the city's infrastructure for e-buses. The BakuBus LLC of BNA was established in 2015 to improve the bus services in Baku. Its buses are at least Euro 5, and are equipped with modern sensors and card readers (e.g. for the Baku Card).

Figure 5. New compressed natural gas buses in Baku

Source: Photo by Alvin Mejia (2019).

Similar updates in master plans and actions towards sustainable urban transport are also ongoing in other cities. For example, the development of the Ganja Master Plan was commenced in February 2020. The

said Plan will take a holistic approach in the development of transport infrastructure, public spaces and utility systems in the city (State Committee on Urban Planning and Architecture, 2020).

The DTEE project shall look further into appropriate measures and opportunities towards strengthening the realisation of decarbonisation and sustainability in the urban mobility sector in Azerbaijan. This process is currently being initiated through a series of surveys and interviews with potential city partners which will highlight the strengths, gaps, and opportunities for realising decarbonisation, resilience and wider sustainability in the urban transport sector in the country.

Proposals for project focus and related quantitative analysis

From the previous transport data analysis, it is recommended that the proposed approach for DTEE Azerbaijan includes both passenger and freight activity, given their relative significance.

For passengers, due to the differences in behaviours, a distinction needs to be made between urban and interurban trips.

For freight activity, the approach will be mainly focused on interurban activity, both domestic and international, as very few data are available for the urban freight sector.

Urban passenger modelling approach

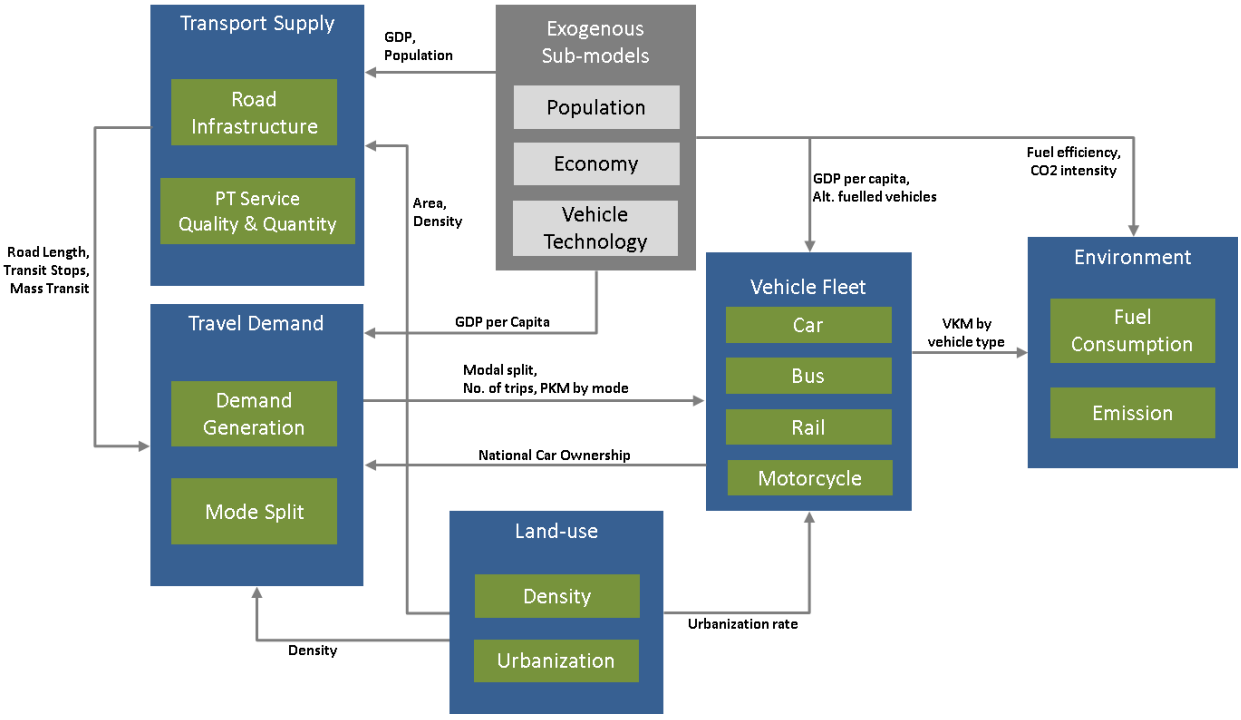
According to the level of detail in the available data in Azerbaijan, a macroeconomic approach is the preferred approach for estimating CO_2 emissions from urban transport. This type of approach is the one used in the ITF global model for urban passenger transport (ITF, 2017a). Each city with over 50 000 inhabitants is represented by a line of information in the database, with details of the average distance for each mode of transport, by class of distance. There is neither network nor origin-destination (OD) representation (or very aggregate), which then does not allow for transport infrastructure project assessment, but only macroscopic analysis of the impact of policy measures on main transport indicators, such as the average travel cost, time, and CO_2 emissions per mode. Even if information from household travel surveys is useful in adapting the model to the local context, this type of model needs less extensive data than in the classic four-step transport model approach. This model mainly needs some validation data, such as the total mileage made by each mode of transport (mode shares).

From the ITF urban passenger model described in Figure 6, it would be possible to extract a simplified version into Excel. The main inputs and variables that could be modified for policy assessment are: population, GDP, average income, urban sprawl, average travel distance, trip rates, road supply, fuel price and taxes, road tolls, cost of parking, car ownership, average vehicle occupancy, public transport (PT) stop supply, existence of mass transit, PT ticket price, energy intensity, and carbon intensity.

This approach can also include a vehicle stock module to estimate the fleet energy and fuel consumption and related emissions. For that purpose, data on the existing vehicle fleets, ideally with yearly mileage by

type of energy, age and/or size of vehicle, are essential to estimate the impact of taxes and incentive on vehicle purchase and CO_2 emissions.

Figure 6. Structure of the ITF global model for urban passenger transport



Source: Chen and Kauppila (2017).

Life cycle assessment of transport mode and vehicles.

A life cycle assessment (LCA) is a calculation method that evaluates the energy use and environmental impacts of a product or a service, taking into account the different contributions enabling its existence, use and disposal: design, production (including materials and energy acquisition and transport to the production facilities), use and operation, maintenance and repair, and end-of-life treatment (such as reuse, recycling or disposal). A recent work of ITF, published in September 2020, presents such an analysis using worldwide averages (ITF, 2020), including impacts of operation and maintenance activities that are specific to new mobility services.

This type of approach is complementary to the macroeconomic model, by focusing on the representation of energy and well-to-wheel GHG emissions to help gain a more holistic understanding of the implications of changes in transport modes, vehicles and fuels. It also allows CO_2 emissions to be calculated per vehicle-kilometre which can be used in the macroeconomic model, instead of using exogenous values.

Interurban passenger modelling approach

Interurban passengers include two different types of traffic: domestic and international travel.

For domestic passengers, the main modes used are road (car or bus), some rail, and a very small share of air transport. The possible modelling approaches depend on the level of knowledge of the flows between

the main cities. So far, interurban trip volumes are not known at the OD level and can only be estimated at a global level, in passenger-kilometres, or at best at the corridor level for the main axis. In this case, only very macroscopic analysis can be made, the main possible analysis being about vehicle fleets and their emissions. Mode split can also be included as an exogenous variable.

By contrast, international passengers travel almost exclusively by plane. The GHG emissions from international air travel mainly depend on the policies set at the international level, hence, they are considered outside of the scope of this project.

Freight modelling approach

As with passenger models, freight flows can be distinguished between domestic exchanges within the country, and international exchanges with other countries, including flows that are transiting through the country. The relative importance of international flows, and the scarcity of the information about domestic freight, lead us to focus on the international flows.

Developing an analysis for international freight based on international corridors, taking into account the main international inland routes through Asia, and the concurrency with the maritime alternative for different groups of OD will be useful. The main transport variables could be taken into account in the mode and route choice, including the time and cost of each alternative. The total (potential) international trade between those groups of countries will be considered as an exogenous variable. The elasticity of the trade volumes according to the utility of inland alternatives compared to sea could be extracted from the ITF global freight model. This model could be used to test main freight transport policies, taking into account the impact they also have outside of Azerbaijan.

Charting the way forward towards transport decarbonisation in Azerbaijan

The DTEE project will support relevant national and local authorities in Azerbaijan, in their efforts towards decarbonising the transport sector. Activities supporting the decarbonisation of transport will be aligned with other transport policy priorities at the forefront of the agenda. Particular attention will be given towards the alignment of the project's recommendations to the relevant sustainable development objectives, such as increased access to opportunities and services, fostering cleaner and healthier environments, and attaining safer mobility. The aim is to examine decarbonisation measures within the context of these goals, at the same time considering the changes being brought about by the Covid-19 pandemic, in order to provide holistic insights to the authorities.

A common assessment framework and visualisation tool will be produced by the DTEE project by the end of 2021. It will be developed in accordance with the needs of the authorities and will utilise local data, whenever possible, in order to produce relevant policy scenarios for decarbonisation. The tool shall cover all transport modes.

Given the role and importance of urban and interurban transport in Azerbaijan, the tool shall take into consideration developments in both transport sub-sectors, and help to identify appropriate measures that support the decarbonisation of transport, thus contributing to the goals of the Republic.

The project will also enhance the efficacy of local authorities by evaluating and strengthening transport policies through capacity building and training. At least one policy workshop and one technical training

workshop will be conducted in Azerbaijan, which will cover relevant topics at the national and urban level. A blended e-Learning programme will further support the capacity building and networking activities. The materials produced will also be used for wider outreach at the regional level. The e-Learning materials produced will be available even after the project has completed and support the local authorities into the future.

The project also enables policy dialogue between key decision makers regarding the adoption and application of appropriate decarbonisation measures. The DTEE project will link national and local policies and actions towards consolidated recommendations for transport decarbonisation. The project is using a scoping survey to facilitate the selection of cities that should be targeted for participation, and dialogues will be organised between those cities and the Ministry of Transport, Communications and High Technologies. Assessment studies will examine the urban transport needs, governance, institutional frameworks and policies, and decarbonisation opportunities in the participating cities. These studies will be conducted with a view to delivering both broad urban transport decarbonisation policy recommendations, as well as city-specific recommendations that are aligned with wider national policy objectives. The discussion of these recommendations will be integrated into the policy workshops to be organised by the DTEE during 2021.

Notes

1 MARPOL Annex VI of the International Maritime Organization limits the main air pollutants contained in ship exhaust gas, regulates shipboard incineration, and the emissions of volatile organic compounds from tankers.

2 EcoPorts is an environmental initiative by the European port sector that aims to increase awareness on environmental protection as well as improving environmental management of ports.

3 Cold ironing is the process of providing shore side electrical power to a ship at berth while its main and auxiliary engines are turned off.

4 The growth in profit figure is taken from CESD (2018) p.6, while the spending and ridership values are taken from SSCRA (2020a).

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International Transport Forum

Decarbonising Azerbaijan's Transport System

This paper reviews opportunities and challenges for mitigating greenhouse gas emissions from Azerbaijan's transport sector. It provides an overview of Azerbaijan's transport system and reviews the country's existing policies and future plans for reducing CO2 emissions from transport. The paper also provides an overview of the data on transport activity and emissions available for Azerbaijan, and the tools used by government agencies for assessing them. Finally, it proposes options for further action in the context of ITF's "Decarbonising Transport in Emerging Economies" (DTEE) project.

This is the initial scoping paper for Azerbaijan within the ITF "Decarbonising Transport in Emerging Economies" project, funded by Germany's Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

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and Nuclear Safety
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