CLIMATE ANALYTICS

Linkages between transport policy and other policy areas

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Cutting-edge science, analysis and support to accelerate climate action and keep warming below 1.5°C

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Introduction

New trends and challenges are shaping the transport sector at global and local levels. Resilience, as an interdisciplinary challenge influencing all levels of public authorities, has become a crucial feature of complex urban policy. Another important element of local policy is transport and mobility, which has strong links to various contemporary issues, including climate change, volatile fuel and energy markets, societies' expectations around quality of life, the pandemic and armed conflicts.

Instability in the prices of primary energy carriers, for instance, is a destabilising factor in electricity and transport markets. Furthermore, the impact of the pandemic on the functioning of urban transport systems was manifold and had far-reaching consequences. The collapse in demand for public transport services during lockdowns translated into a drastic reduction in revenue from ticket sales even as many cities tried to maintain or even increase supply during peak times of the day to avoid congestion in vehicles, a source of additional running costs.

A deterioration of the revenue base in Polish municipal governments (partly as a result of unfavourable legal and taxation changes) and rising costs (inflation, fuel/energy prices, salaries) has forced many authorities to decrease the availability of public transport. An analysis of Polish cities noted that “cutting spendings on cleaning services and the transport supply service as a response to the reduced number of passengers would be more devastating for public transport than postponing new infrastructure investments.”[1] A continuation of this trend towards decreased availability of public transport would make private car ownership more desirable and further increase pollution in the transport sector.

Cities should adjust their development paths to current and future issues – treating them not as threats but as opportunities to establish resilient cross-sectoral systems. Four thematic areas and their respective policies present a solid link with transport policy at the local level: climate change, urban development, digitalisation and employment.

[1] D. Krysiński, A. Uss-Lik: The role of current transport expenditure in mitigating the risk of modal shift during Covid-19 – Lessons from Polish cities. ‘Case Studies on Transport Policy’ 2022 no. 10

Climate change

Climate change is a global phenomenon which significantly impacts urban life. At the same time, according to the 2023 IPCC report, "urban infrastructure and activities caused about two-thirds of today's emissions."[2] Climate change and the growing awareness of its consequences have become the starting point for formulating increasingly ambitious policies designed to accelerate the transformation of EU economies and societies. The coming changes require the implementation of a series of measures to phase out fossil fuels from the economies of EU member states. These changes are taking place under difficult economic conditions (COVID-19 pandemic, war in Ukraine), directly impacting the speed of their implementation.

In the EU, climate policy is a principal determining issue in the development of transport. Climate policy aims to reduce emissions of both noise and air pollutants, including greenhouse gases.[3] Transport was identified as an area where significant impacts could be achieved, yet the sector remains highly dependent on fossil fuels.[4] Current EU efforts are pushing transportation development toward zero-emission electric and hydrogen-based technologies.

In February 2021, the European Commission adopted the "Fit for 55" package, outlining how member states can adapt to the inevitable impacts of climate change and become climate resilient by 2050. Within the strategy, the EU committed to climate neutrality by 2050 and a more ambitious emissions reduction target of at least 55% by 2030, compared to 1990 levels.[5] Currently, the transport sector is strongly dependent on fossil fuels, accounting for around 25% of energy-related greenhouse gas (GHG) emissions in the EU.[6] Using a 'well-to-tank' model for calculating emissions, which takes into account the emissions required to produce and transport fuels, the share is even higher.[7]

In recent years, air quality issues have dominated the public debate in Polish cities. The transport sector accounts for a significant amount of emissions, mainly of nitrogen oxides (see **Table 1**). In response, more and more cities are implementing measures that favour electromobility, such as the expansion of paid parking zones and discounted

[3] M. Wołek, A. Jagiełło, M. Wolański (2021). Multi-Criteria Analysis in the Decision-Making Process on the Electrification of Public Transport in Cities in Poland: A Case Study Analysis. *Energies* no. 14

[4] R.W. Wimbadi, R. Djalante, A Mori (2021). Urban experiments with public transport for low carbon mobility transitions in cities: A systematic literature review (1990–2020). *Sustainable Cities and Society* no. 72

[5] European Commission (2023). "EU Adaptation Strategy."

[6] R. J. Thorne et. Al (2021). Facilitating adoption of electric buses through policy: Learnings from a trial in Norway. *Energy Policy* no. 155

[7] Woo, J.R. et. al. (2017), Well-to-wheel analysis of greenhouse gas emissions for electric vehicles based on electricity generation mix: A global perspective. Transportation Research Part D. *Transp. Environment* no. 51

or free rates for low- and no-emission vehicles. In Warsaw, the number of parking spaces in the paid parking zone increased between 2015 and 2021 from 21,600 to 51,600 spaces, covering 8.3% of the total city area.[8] In some cases, low emission zones (LEZs) have also been implemented.

Transitioning to electromobility is an important measure in decarbonising the transport sector and is one of the leading trends transforming public transport worldwide. In Poland, its impact can be seen locally through avoided emissions from road transport, but due to electricity production based mainly on fossils, these effects are not seen nationwide. On the other hand, the gradual increase in renewables makes electromobility a viable long-term mitigation option even in current fossil fuel-based economies.

Electric city buses are increasingly being purchased in Poland. In 2016, electric buses represented only 1% of the new fleet purchased, while in 2021 electric buses made up 37%.[9] The largest fleets of electric buses are operated in Warsaw and Krakow, but the city of Jaworzno has the highest share of electric vehicles in the supply of public transport. Jaworzno was the first municipality to introduce battery-powered electric buses in Poland in 2015. In addition to electric buses, there are 15 tram systems and three trolleybus systems operating in Poland. The country's newest tram system has been operational since 2015.

Electrification of public transport has strong public support. Developments to increase the quality of public transport services is a necessary but insufficient condition for reducing urban communities' dependence on private cars. The development of a consistent parking policy and solutions promoting active mobility (walking and cycling) is also essential. Some of these measures are related to the reallocation of street space and are typically covered under urban planning analysis.

The leading city in the development of low emission zones is Kraków, where the clean transport zone development process is divided into stages to be achieved by 2030. In the first stage, the LEZ will cover a limited area inside the city's second ring road. Starting on 1 July 2024, the LEZ will not be accessible for cars that comply with EURO 1 and EURO 2 standards registered before 1 March 2023.[10]

At the beginning of 2023, plans to create a low emission zone were also presented by Warsaw. The capital intends to limit the access of older cars to the inner city centre in

[8] Own calculation based on: Warsaw Public Roads Authority. Annual Report 2015, Warsaw 2016, and Warsaw Public Roads Authority. Annual Report 2021, Warsaw 2012

[9] A. Jagiełło, M. Wołek, W. Bizon: Comparison of tender criteria for electric and diesel buses in Poland – Has the ongoing revolution in urban transport been overlooked? A manuscript submitted to *Energies* , 19.03.2023

[10] M. Fijak: Kraków. Strefa Czystego Transportu już w 2023 roku [MAPA]. Smog LAB. 14 March 2023.

mid 2024.[11] Public consultations are currently ongoing. A public consultation process for a low emission zone was also launched Wroclaw in March 2023.

Table 1 Share of transport as a source of total emissions in selected Polish cities[12]

City	PM10	PM2.5	NOx	SOx	Benzopyrene
Warsaw	18.3%	15.5%	48.8%	0.002%	0.8%
Lublin	12.7%	10.7%	43.4%	0.27%	0.5%
Gdansk	10.4%	8.9%	41.6%	0.16%	0.4%

Urban planning

The spatial distribution of primary functions (e.g., housing, work, education, shopping) creates a demand for transport. Spatial development is long-term in nature, while the way in which it is organised varies from country to country. However, it has a significant impact on inhabitant and visitor travel behaviour.[13] A lack of collaboration between municipalities governing the core metropolitan area and its less urbanised areas motivates uncontrolled suburbanisation.

Rural municipalities earmark significant space for housing development in spatial development conditions and directions studies and local plans (the main urban planning documents in force in Poland). As a result, rural and suburban areas acquire new residents quickly, a significant proportion of whom move from the metropolitan core area. However, development of suburban areas is not accompanied by proper planning and investments in the transport sector. The low supply of public transport services strengthens the role of the private car in commuting from suburban areas to the city centre.

[11] City of Warsaw (2023) "Low emission zones."

[12] Based on the data provided by "Roczna ocena jakości powietrza w województwie pomorskim. Raport wojewódzki za 2021". Regionalny Wydział Monitoringu Środowiska w Gdańsku, Główny Inspektorat Ochrony Środowiska, Gdańsk 2022, "Roczna ocena jakości powietrza w województwie mazowieckim. Raport wojewódzki za 2021". Główny Inspektorat Ochrony Środowiska, Warszawa 2022, Strategy of the electromobility development in Lublin 2021. Note: values in rows do not sum up to 100%

[13] M. Wołek: Sustainable mobility planning in Poland (2018). Zeszyty Naukowe Uniwersytetu Gdańskiego. Ekonomika Transportu i Logistyka vol. 76

The change in residential settlement patterns depends on specific market segments. The trend of 'escaping from the city' is highly harmful and may exacerbate the negative consequences of uncontrolled suburbanisation processes as indicated in the strategic documents developed by each city mentioned above. Interest in 'out-of-town' real estate is also addressed in the National Urban Policy for Poland adopted in 2022 (**Table 2**). The commercial real estate segment in central parts of large cities is not expected to slow down,[14] especially in the case of investment in rental apartments, although, many companies have introduced hybrid working patterns, which may encourage people to move out to the suburbs.

In the long term, the impact of autonomous vehicles on urban spaces should be envisaged, although it strongly depends on the type of vehicle and assumptions in the theoretical models. The increased mileage of individual automated vehicles is expected to reduce public transport and active modes of transport. Moreover, the mass deployment of automated vehicles could lead to a more dispersed urban growth pattern. On the other hand, shared automated vehicle fleets could reduce the demand for parking spaces and private vehicles. In the case of public transport fleets, automation will increase their efficiency and improve the spatial structures of a city.[15]

Possible measures in the transport sector to slow down or stop urban sprawl processes include:

- Strengthening Polish urban planning regulations in relation to urban mobility.
- Strengthening collaboration between local governments and adopting new Sustainable Urban Mobility Plans (SUMPs) not only for cities, but for urban functional areas. This would help to mitigate the issues of suburbanisation and depopulation.[16]
- Implementing the compact city concept (as stated in the 2022 National Urban Policy).

The promotion of the close proximity city model, in opposition to urban sprawl, contains many benefits which include less dependence on individual car transport; lower emissions of harmful substances, particularly nitrogen oxide; reduced energy consumption and CO_2 emissions; better public transport services; increased accessibility in urban areas; and more economical planning and use of infrastructure.[17] Several cities address the topic of 'a 15-minute city' concept in their strategic documents (e.g. Legnica).[18] For cities with a population of over 200,000 inhabitants, the compact city concept is being

[14] R. G. Smith (2021). Why skyscrapers after Covid-19? *Futures* no. 134

[15] A. Soteropoulos, M. Berger, F. Ciari (2019). Impacts of automated vehicles on travel behaviour and land use: an international review of modelling studies. *Transport Reviews* vol. 39, no. 1

[16] Outcomes from the workshop 'Wyzwania dla zrównoważonego transportu' for regional and local authorities in Poland, June 2022

[17] City of short distances final version – to be completed later, based on the Technical Report

[18] The Legnica City Council act nr Nr XLIX/560/22 (28.11.2022) on the adoption of "The Strategy of Development of City of Legnica 2030 Plus"

applied in the central urban zone (e.g. Radom).[19] It includes such elements as implementing the mixed-use of the city area rule in specific, critical urban areas, especially around newly built railway stops and multimodal hubs. Of great importance is also spatial planning and real estate development at the municipal level focused on accessible public transport and compact urban space, allowing for expansion of active modes of transport, especially cycling and walking.

Table 2 Suburbanisation in public policy relating to urban areas in Poland

Level	Area	Document	Description
National	Poland	National Urban Policy (2022)	One of the eleven challenges for Polish cities was identified as 'countering the processes of chaotic suburbanisation driven by an attempt to improve living conditions and the relatively lower real estate prices outside urban areas'. However, this is taking place against a backdrop of large land resources in the cities. A specific feature of Poland is that classic suburbanisation, or movement from city centres to the suburbs, is augmented by strong additional population streams from other places in the country and increasingly from abroad. Moreover, the pandemic strengthened the interest in owning a home outside the city.
Regional	Lesser Poland Region	Strategy of development „Małopolska 2030" (2020)	Spatial chaos, increased investment costs, rising barriers to new projects, and increasing social problems (e.g., reduced level of residents' integration and mono-functionality of space) are the effects of uncontrolled suburbanisation. It also entails additional costs for the local authorities of suburban municipalities, e.g. in connection with the need to build extensive infrastructural networks and organise transport. It is a source of air and noise pollution. In a broader sense, suburbanisation threatens the rural spatial arrangements developed over the centuries.
Metro-politan	Gdansk Gdynia Sopot Metrop olitan Area	Strategy of the Gdansk Gdynia Sopot Metropolitan Area (2015)	One of the most critical determinants of the development of a metropolitan area is the concentration and dispersion of settlements within the metropolis, involving the outflow of inhabitants from the urban core and other cities forming the metro area.

[19] The Radom City Council act nr LXXXI/757/2022 (29.08.2022) on the adoption of "The Strategy of Further Development of City of Radom - Radom 2030"

Urban	Legnica	Strategy of development „Legnica 2030 Plus” (2022)	The document identifies depopulation of urban areas as the fundamental problem of Poland's medium-sized cities.

Employment policy

Employment policy ought to influence emissions from the transport sector in two ways. First, employment policy needs to adapt to the new requirements for those employed in the transport sector. Second, policy should utilise the opportunities resulting from remote or hybrid employment.

Adapting employment policy to new skills needed in transport

Significant changes are currently taking place in terms of the specialities and professions needed in the transport sector. Job losses due to the spread of autonomous operation of certain public transport vehicles is often brought up as an example of the negative consequences of technology development. Road automated vehicles are in varied test stages. Their future impact on the labour market remains unclear, but it could be assumed that their increasing market penetration could lead to decreased employment among drivers. While self-driving buses may not become a widespread option in the coming decade, rail traffic may have greater potential in this area. Unmanned trains and subways are already operational in several cities worldwide.

Further job losses may result from electrification of passenger vehicles. Currently, the automotive industry is one of the main sectors of the Polish economy. In addition, due to their simplicity, electric vehicles require much fewer mechanic skills, which could drive further employment decrease in the vehicle repair sector. However, these job losses can be mitigated or even compensated with new jobs in the electric vehicles sector. Poland is currently one of the largest producers of electric buses and the largest producer of batteries for electric vehicles in Europe. In addition, there are numerous companies investing in the construction of electric vehicles in Poland. However, to take advantage of the new opportunities resulting from the shifts from combustion vehicles to electric ones, employment policy must support reskilling and upskilling of those already employed in the sector.

At the same time, transport decarbonisation will result in job creation in the sector and beyond. There is also growing demand for employees in new specialisations: data analysts, computer scientists for programming artificial intelligence algorithms, operating robotic workstations, or supervising automation equipment. Smart mobility and sector-coupling driven by digitalisation will require completely new sets of skills (see next section) that transport companies will need to have at their disposal.

Beyond the transport sector, numerous new jobs will be created in the production of electric batteries and the entire hydrogen production and distribution chain. Global automotive lithium-ion battery demand doubled in 2021 (driven mainly by electric car sales in China), reaching 340 GWh[20] and is expected to grow even faster over subsequent years. The share of Li-ion battery factories in Europe is anticipated to increase from 6% in 2021 to 18% in 2026.[21] As the number of batteries produced and their capacity increase, battery recycling and 'second life' management could create additional employment if the appropriate policies are implemented.

Facilitating hybrid and remote employment

Part-time working from home, or other hybrid or remote working arrangements, is also a sustainable change for the transport sector. These arrangements reduce the number of vehicles on the road and emissions from commuting. Shifting lenses can allow companies and employees see the principle of teleworking as part of climate policy, rather than just company policy. Current post-COVID-19 experience shows that companies are open to flexible hours and hybrid employment. Collaboration between companies, employees and public transport authorities offers promise in enacting measures related to 'transport demand management'.

Such changes are currently being implemented in individual member states (e.g. Poland), including an update to labour law regulating the rules on remote working (including the employer covering part of the costs of remote working). There are no such regulations at the EU level.

An implementation of current technological advances is recommended to encourage the acquisition of new skills and tools in the use of information technology. This applies to both top management and employees in direct operational positions. The role of vocational schools in training should be strengthened. In addition, the principles of lifelong learning should be implemented in the educational policies of cities and local governments, especially in the formation of general digital and technical competencies.

Digitalisation policy

The rapid advance of digitalisation and new IT solutions is causing a technological revolution throughout the transport industry. Smart transport and mobility are synonyms of modern, integrated, and sustainable forms of travelling for the benefit of passengers and public transport operators. Companies are constantly looking for and implementing novel solutions to reduce turnaround times and be more cost-effective. On the other hand, smart mobility is a fundamental part of the smart city concept.

[20] IEA (2022). Global Electric Vehicle Outlook 2022.

[21] Bloomberg NEF (2021). Electric Vehicle Outlook 2021.

Info-communication solutions specifically developed for public transport systems are called "Intelligent Transport Systems" (ITS). These solutions are designed to manage traffic and assist road transport to increase capacity of busy roads, reduce journey times and ensure user safety. A smart transport system also can provide real-time data for passenger information systems making public transport more attractive to the user. For the transport operator, ITS represents more efficient use of infrastructural resources and improved traffic safety. For public transport authorities, an ITS could be a valuable tool supporting reliability and punctuality of services.

Successful implementation of innovative transport solutions depends on having a data-driven strategy. Implementation of process automation based on machine learning, as well as artificial intelligence, the Internet of Things and the construction of fifth generation 5G networks are becoming increasingly important.

Developments in the information technology and information sharing economy in the field of transport also offer ways to deliver personalised transport services to target audiences and facilitate everyday travel. Mobility as a Service (MaaS) solutions, which integrate multiple modes of transport into a single system and allow people to choose the best way to travel within a town on their mobile phones, are gaining popularity. Cities are increasingly interested in MaaS and its potential to accelerate changes in the transport sector.[22]

The critical part of each MaaS system is a smart digital platform, which integrates all modes and travel operators. MaaS provides an opportunity for more efficient use of existing resources, including cars, public transport and shared modes. A shift from traditional private operation of cars to a more collective use will result in the development of new transport behaviour patterns.[23] The private sector has driven the first market adoption of MaaS.

A key question for the future is who will own and benefit from the massive load of data generated by the users of different modes of collective, individual and shared transport. On the one hand, the private sector is more flexible and offers quicker market implementation. However, a number of the companies in this field based outside of the EU, which raises data protection concerns. On the other hand, public ownership of data provides an extremely valuable platform for the improvement of mobility-related decision processes.

In Poland, the private sector has been expansive in developing apps and other tools to make it easier for the passengers to purchase transportation services and access passenger information. The implementation of the MaaS covers many other areas and

[22] I. Lopez-Carreiro (2020). Urban mobility in the digital era: An exploration of travellers' expectations of MaaS mobile-technologies. *Technology in Society* no. 63

[23] G. Lyons, P. Hammond, K. Mackay (2019). The importance of user perspective in the evolution of MaaS. *Transportation Research* Part A no. 121

stakeholders. An integrated approach to delivering a single platform needs to overcome many legal, contractual, financial and social barriers.[24]

Rational digitalisation is one of the key challenges in the transport sector primarily because of the real benefits in terms of reducing disruption in supply chains and transport. Making the transport sector 'smart' is already a dominant development trend in the industry and among the cities, although it differs in scale and scope of the transport digitalisation.

Conclusions

Transport and mobility are fundamental elements of the resilience of the urban areas addressed at every level of its functioning. Investment in transport policy infrastructure is even more important during turbulent times with accelerating climate change.

Particularly at the local and metropolitan level, four thematic areas and related policies have a strong link with transport policy. These are climate change, urban development, digitalisation and employment. Climate change and the growing awareness of its consequences are the starting point of this transformation.