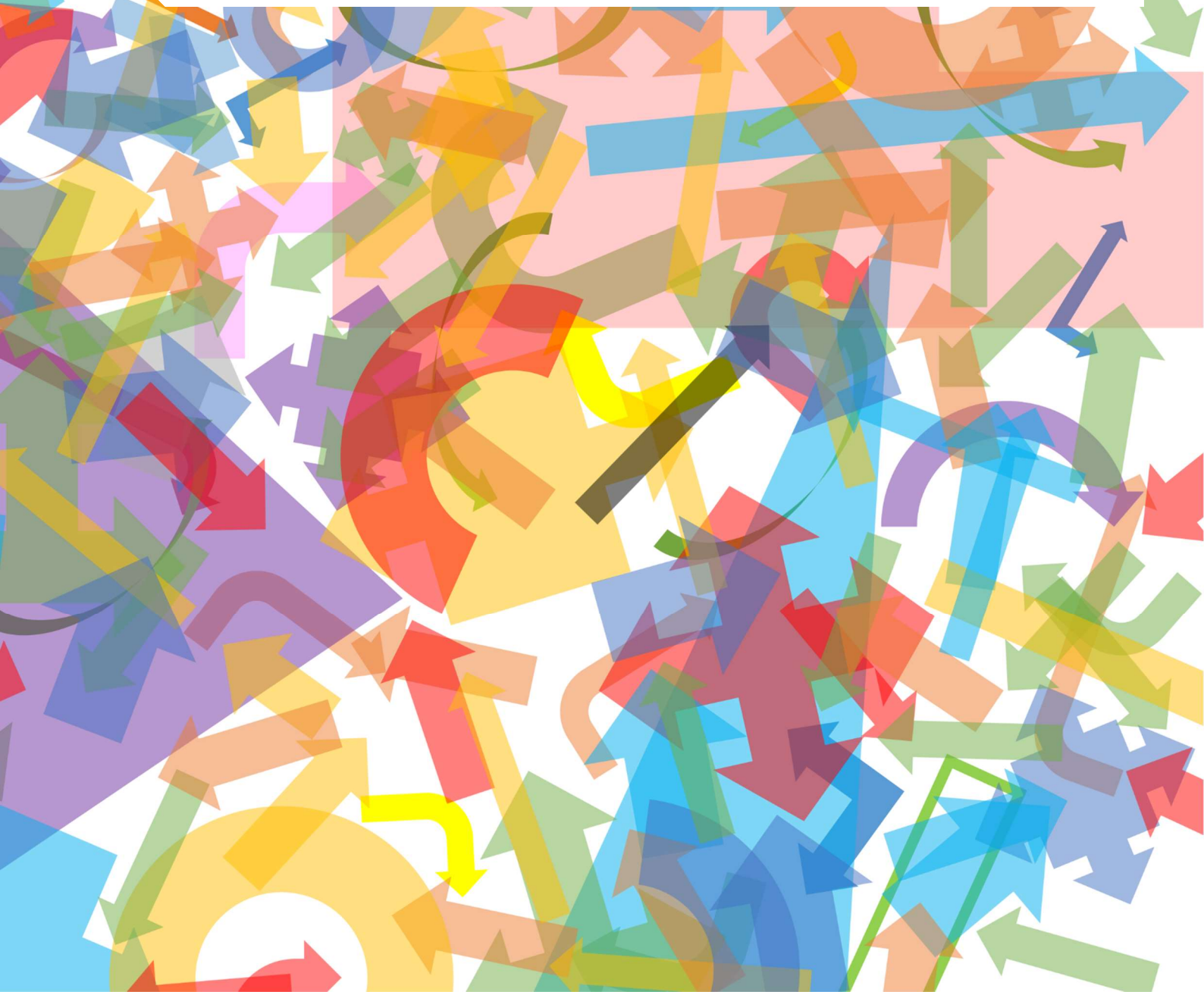
ACTION PLAN FOR DEVELOPING REGIONAL PUBLIC TRANSPORT AND MULTIMODAL TRANSPORT SOLUTIONS

COMMUTING MASTER PLAN REPORT



The preparation of this document is funded by the European Union with assistance from international cooperation projects SUMBA, OptiTrans and *Cities.Multimodal*.

The project 'Sustainable urban mobility and commuting in Baltic cities' (SUMBA) aims to plan urban mobility with regard to everyday commuting which forms a large part of urban traffic volumes. The project will increase the competence of transport planners, update the transportation policy documents of partner cities, and improve the cooperation between cities and adjacent areas in planning and introducing integrated transport solutions. Mobility issues have been addressed regularly in cities around the Baltic Sea region; however, such activity is often focused on the territory of a target city and fails to consider the additional traffic load caused by commuting. As most commuters use personal passenger cars as a means of transport, the impact includes traffic jams, poor air quality, increased demand to reorganise the urban space to meet the needs of car users (parking), etc. These issues are predominately seen in city centres, which are the main destination of commuters. The project is partly funded from the Baltic Sea programme of the European Regional Development Fund.

The OptiTrans project aims to increase the share of public transport in the mobility of urban and suburban areas by increasing the capability of transport arrangers to plan and organise public transport; by introducing innovative solutions to increase the quality of public transport; by raising the awareness of the residents of the city; and by increasing the use of green modes of transport in urban areas. The Tartu City Government aims to develop activities required for raising the level of public transport service and joining public transport with other sustainable modes of transport. The OptiTrans project is partly funded from the INTERREG Europe programme of the European Regional Development Fund.

The aim of the *Cities.Multimodal* project is to make urban mobility more versatile and environmentally friendly. The 10 partner cities involved in the project are developing common measures to decrease the use of personal passenger cars and increase the share of active means of transport in urban transportation. The main focus of the project is to create a so-called multimodal point methodology and to implement pilot projects. A multimodal point is a place in the city where public transport, active transport, shared transport, and personal transport meet, thereby providing the citizens with easy access from one means of transport to another.

Tartu Regional Energy Agency, along with the Tartu City Government, was responsible for coordinating the working group for preparing a mobility plan and for completing the plan. The document includes overlaps with other strategic documents of the Tartu City Government, the most significant being the energy and climate plan *Tartu Energia 2030+*. These overlaps are intentional, as the mobility plan specifies Tartu's previous strategies, forms a part of the action plan of the development plan *Tartu Energia 2030+*, uses similar methodology, and proceeds from the same issues and goals.

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Tartu 2019

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ABSTRACT

This mobility plan continues the process of sustainable planning, climate resilience, and sustainable mobility planning in the city of Tartu as manifested in the urban development plan for 2018–2025 and the master plan 2030+. The mobility plan specifies the transport section of the sustainable energy and climate action plan Tartu Energia 2030+ *(currently under development), proposing the actions and their coordination for the increased multimodality of transportation, improved regional public transport services, and the share of active modes of transportation. The mobility plan also supports the implementation of the bicycle strategic action plan for 2019–2040.*

In Tartu, the transport system has changed drastically over the last 10 years. About 60,000 new passenger cars have entered the streets, roughly one third (18,000) of which are registered in Tartu and two thirds of which commute to the city on a daily basis. As a result, the total amount of cars has more than doubled and private cars have become the main mode of transportation, accounting for 46% of all trips within the city. Intensive car usage has a significant impact on traffic regulation, street safety, the living environment, cost of everyday services, health, and urban planning inside and outside of the city. The mobility plan provides an insight into the main impacts of increased car usage in Tartu, evaluates the impact of car-based urban transport, and presents actions for mitigating the impacts of intensive private car usage.

The key action of the mobility plan is creating multimodal mobility points in the heart of Tartu and its suburbs, and to connect these via sustainable transport modes from within and outside of the city. The mobility points will improve the accessibility of urban services for the users of public transport by making it faster, smoother, and more convenient. The mobility points will improve the integration of public transport systems inside and outside of the city, providing better information and access to ticketing. Implementation of shared travel passes and a common real-time information system, as well as new parking services, support the operation of mobility points.

Implementation of the mobility plan will create an opportunity for mitigating the effects of private car usage in Tartu and help to increase the share of sustainable transport modes in urban transportation. The mobility plan supports the implementation of the sustainable energy and climate action plan Tartu Energia 2030+ *by helping to reduce the energy consumption and environmental impact in the private transport sector by 15%. By implementing sustainable urban development principles and by improving the sustainability of the transport system, the mobility plan supports the implementation of the Tartu general development plan. Preparation of the mobility plan is supported by the European Union under the projects OptiTrans, SUMBA, and Cities.Multimodal.*

1. INTRODUCTION

This mobility plan is based on the activities undertaken by the Tartu City Government to mitigate the environmental and climate impact of the city and to promote green mobility as outlined in the development plan of the city of Tartu for 2018–2025 and the comprehensive plan for 2030+. The programme specifies the transport action plan of *Tartu Energia 2030+*, which forms a part of the development plan being prepared, shaping activities aimed at increasing its multimodality, improving regional public transport links, and increasing the share of non-motorised traffic, as well as procedures for implementing these activities. The mobility plan also supports the implementation of the bicycle traffic action plan for 2019–2040 that is currently being prepared.

Over the last 10 years, traffic has significantly changed in Tartu. The streets of Tartu have seen an influx of approximately 60,000 new passenger cars, 18,000 of which are registered in Tartu and an estimated two thirds visit the city as everyday commuters. This has more than doubled the total number of passenger cars, which now account for 46% of all modes of mobility, making it the main means of transport in the city. Intensive motorisation has a deep impact on the traffic organisation of both the city and nearby areas, as well as on road and street safety, the life environment, people's health, and on shaping of the urban space. The mobility programme gives an overview of the main impacts of intensive motorisation in Tartu, evaluates its extent, and suggests measures for mitigating these impacts.

A key measure of the mobility programme is introducing multimodal mobility points in the centre and outskirts of the city, and to link these with sustainable means of transport within and outside of the city. Mobility points provide users of public transport with faster, more convenient, and smoother access to city services. The development of mobility points involves linking urban and rural public transport systems, as well as faster provision of information and travel rights to users of these systems. Measures for introducing joint tickets and a common real-time information system, as well for creating parking services in the outskirts of the city, support these actions.

By implementing the mobility programme, it will prove possible to reduce the impact of motorisation in Tartu, and to increase the share of green modes of mobility in the city traffic. The mobility programme supports carrying out the goals of the energy and climate programme *Tartu Energia 2030+* by facilitating the reduction of energy consumption and the resulting environmental impact in the private transport sector by 15%. The mobility programme supports implementing the city's development plan by developing the urban space under the sustainability principle and by promoting environmentally friendly mobility. The preparation of the mobility programme is funded by the European Union through international cooperation projects OptiTrans, SUMBA, and *Cities.Multimodal*.

2. OBJECTIVE OF THE PROGRAMME BASED ON THE TERMS OF REFERENCE

The objective of the transport policy of Estonia and the city of Tartu is to ensure available, convenient, safe, and sustainable mobility options to people and companies. A high-quality infrastructure and a smooth transportation system are essential for everyday operations.

Across Europe, the transport sector is responsible for approximately 20% of the total volume of greenhouse gas emissions, 50% of which is a result of passenger transport. In order to reduce the ecological footprint of the transport sector, we must primarily increase the quality and availability of public transport, especially in the outskirts of the city and in rural areas. As a rule, the infrastructure required to develop public transport already exists, which is why the local politics and administrative capabilities play an essential role in developing the field. Linking various environmentally friendly mobility options (bicycle, public transport, e-vehicles), integrated ticket and line systems, better ticket sale options, use of ICT, integrated travel schedules, and user comfort form a key solution to developing the image of public transport and making it more attractive.

Daily commuters cause additional challenges in cities, such as irrational public transport networks, defective non-motorised traffic infrastructure, and insufficient connections between different means of transportation and public transport systems (bus + train, car + train, bicycle + train, bicycle + bus, county and city lines + train lines). Creating more sustainable mobility options for commuters helps to keep the urban environment cleaner.

The city of Tartu is a partner to cooperation projects co-financed by the European Union, such as OptiTrans ('Optimisation of Public Transport Policies for Green Mobility'), SUMBA ('Sustainable urban mobility and commuting in Baltic cities'), and *Cities.Multimodal*, to create green, convenient, and sustainable mobility options for residents, daily commuters, and visitors of the city.

A wider goal of preparing an action plan for developing regional public transport and multimodal transport solutions is to reduce the environmental impact of the transport sector, reduce the public and private sector expenditure related to passenger cars, and thereby increase the quality of the urban and near-urban living environment.

During the preparation of the programme, the aims of the Tartu City Government will be developed and formalised to increase the use of modes of mobility more sustainable than passenger cars in the everyday movements of people.

Setting goals and finding suitable actions is based on the public transport baseline study and risk analysis (SWOT analysis, Annex 1) carried out within the OptiTrans project; mobility programme procedures developed within the project; status quo of transportation system in the Tartu region; and general development goals of the city of Tartu (comprehensive plan, development plan and other development documents of the city).

For achieving high-quality and publicly acceptable results, the action plan plays a significant role in involving different stakeholders.

3. TARGET AREA

3.1. TARTU, AN ATTRACTIVE ECONOMIC CENTRE

The city of Tartu (see Figure 1) is a centre of attraction in South Estonia, providing the surrounding area with a wide selection of services: education, medicine, welfare, security, commerce and business, and much more. Availability of various services (private medicine, higher education, culture, etc.) outside Tartu is hindered or completely lacking. In other cases (commerce, education, medicine, welfare), Tartu provides an alternative to local services and attracts visitors with better quality, more suitable choices, and better prices. Tartu plays an essential role as a regional employer, where the salaries and job selection of employees exceed those offered in rural areas (see Figure 2 and the development strategy of Tartu County for 2040).

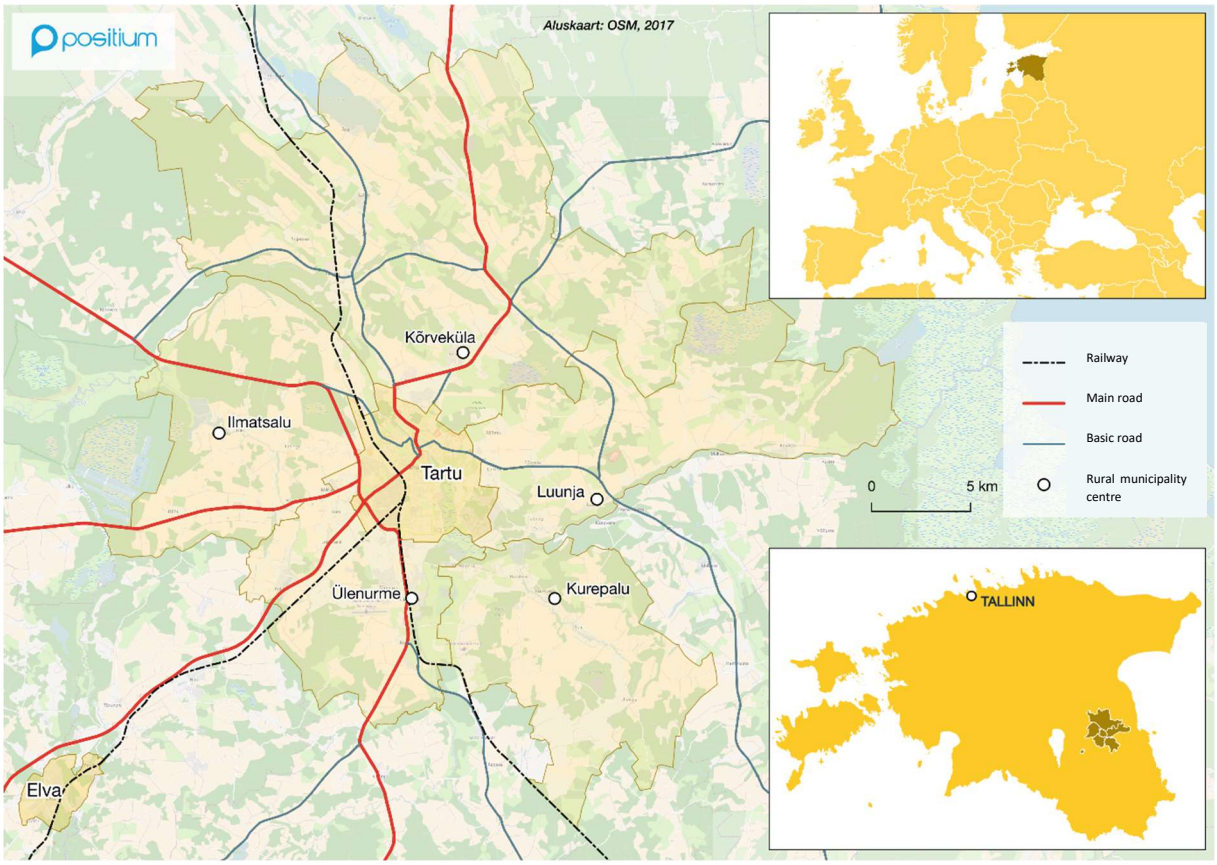


Figure 1. The extended city borders of Tartu

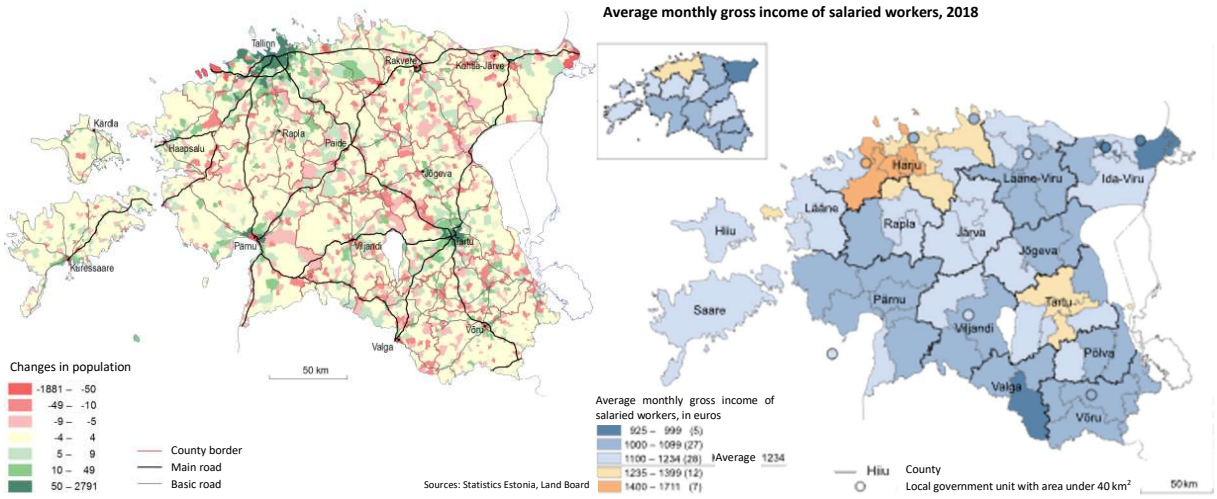


Figure 2. Changes in regional population in 2017–2019 (on the left) and average gross income of salaried workers in 2018 (on the right). Source: Statistics Estonia 2019. Data: from the Land Board and the Estonian Tax and Customs Board in 2018 and 2019.

The central importance of Tartu is amplified by the urban sprawl around Tartu, which has resulted in the construction of new residential areas in rural municipalities near Tartu. The new neighbourhoods are deprived of the classic urban service structure as well as jobs. Therefore, the urban sprawl regions depend entirely on the city's services, are incapable of functioning without them, and increase the daily passenger car traffic volume entering and exiting the city every day.

The so-called marginalisation, which has occurred independently of the urban sprawl, has forced local services like convenience stores, post offices, libraries, community centres, etc. to close their doors in smaller South Estonian settlements, and there is no local alternative to services provided in Tartu. All of the above has resulted in a situation where, for example, a family residing outside of the city commutes to Tartu on business days to go to work, do the shopping, consume necessary services, and return to their residence in the evening. This kind of regular commuting is characteristic of South Estonian traffic patterns, relies on extensive car usage, and takes a heavy toll on Tartu's transport system.

3.2. RELEVANT PARTIES

The Tartu City Government is responsible for organising public urban space, developing the street network, and for ensuring the usability of road and streets in the city. The City Government has the regulative authority to shape the urban space, organise traffic, provide public and municipality transport services, as well as organise parking. The City Government cooperates with other parties and the community to develop the traffic and mobility of Tartu.

Tartu Linnatransport is a municipality company which organises public transport services in the city of Tartu.

Tartumaa Ühistranspordikeskus is a public organisation which organises public transport services in Tartu County.

South Prefecture of the Estonian Police is responsible for the activity of the Police and Border Guard Board in South Estonia, including Tartu and Tartu County. Transport-related activities of the Prefecture include ensuring traffic safety, processing accidents and violations, and conducting traffic monitoring and surveillance. Facilities of the Prefecture are located in Tartu.

The working group Jalgrattalinn Tartu has been a spokesperson of sustainable transport in Tartu for more than 10 years.

Tartu Association of Mobility Activists is a citizens' initiative which stands out for the equal treatment of road users.

The Non-Motorised Traffic Committee of the City of Tartu is a working group within the City Government, tasked with initiating and processing development projects related to non-motorised traffic.

ELRON is the national service provider of passenger train traffic.

The strategic planning unit of the South region of the Estonian Road Administration is active in regional transport projects related to road infrastructure.

The Ministry of Economic Affairs and Communications develops and implements transport policy at the national level.

The adjacent rural municipalities to the city of Tartu organise their transport services within the borders of local government units, except for the county-bound public transport service, which is in the jurisdiction of Tartumaa Ühistranspordikeskus. The adjacent rural municipalities also provide a living environment to the commuting residents of new residential areas.

The Union of Tartu County Municipalities represents the local governments in Tartu County and is a cooperation partner to regional transport development projects.

3.3. SOURCE MATERIALS

Table 1. Source materials

OptiTrans baseline study	study	2018
OptiTrans Tartu Peer Review Report	study	2019
OptiTrans and SUMBA SWOT analysis	analysis	2018
Development plan of the city of Tartu 2018–2025 (integrated transport development plan)	development plan	2018
Urban master plan of Tartu 2030+	urban master plan	2018
Traffic safety programme of Tartu 2017–2025	development plan	2017
Mobility study in the city of Tartu and adjacent areas	study	2018
Strategic action plan for bicycle traffic in Tartu 2019–2040	development plan	2019
CMP mobility programme form, SUMBA	form	2018
Population statistics published by Statistics Estonia	data	2019
Vehicle and public transport usage statistics published by the Estonian Road Administration	data	2019
Tartu traffic monitoring data on the Cumulocity platform	data	2019
Traffic accident statistics published by the South Prefecture of the Estonian Police	data	2019
Fall damage data published by the Tartu University Hospital	data	2019
Tartu Energia 2030+ development plan (draft), TREA	development plan	2019

4. LINKS TO OTHER PROGRAMMES AND PLANS

TRAFFIC SAFETY PROGRAMME OF TARTU 2017–2025 (2017)

VISION: Tartu is a city with safe traffic and no tolerance for any traffic mortalities or serious injuries

STRATEGY: Decrease the number of traffic accidents taking place in Tartu (by 2025) by 50% as an average of three years and achieve a situation where there are no traffic mortalities in Tartu

SUB-OBJECTIVE 1: IMPROVE THE TRAFFIC SAFETY OF PEDESTRIANS
SUB-OBJECTIVE 2: IMPROVE THE TRAFFIC SAFETY OF CYCLISTS
SUB-OBJECTIVE 3: IMPROVE THE TRAFFIC SAFETY OF CHILDREN AND YOUTHS
SUB-OBJECTIVE 4: IMPROVE THE TRAFFIC SAFETY OF MOTORISED ROAD USERS

URBAN MASTER PLAN OF TARTU 2030+ (2018)

Tartu is an increasingly international university town with a unique creative aura and a spatially dense culture and education network.

Along with the neighbouring rural municipalities and urbanisation towards the Nõo and Elva direction, Tartu has become a unified and spatially cohesive urban region.

For most of the day, the city centre of Tartu is a lively, pedestrian-friendly, human-dimensioned public space with a wide range of annual living, learning, leisure, shopping, and business options.

Tartu is a city of ‘smart’ jobs.

The old town and built-up areas of cultural and environmental value have been tidied up and the urban space boasts a modern, dignified, and durable architectural language.

Tartu considers climate change. Sufficient greenery is planted, and rainwater is steeped into the soil to mitigate the impact of downpours, several days of rain, storms, and periods of extreme heat.

Tartu is a community-focused city where civic organisations play a key role in the development of city districts, every city district has an active centre, and where there is space for joint activities.

Tartu is a city with a cohesive network of green and recreation areas. The backbone of the network is River Emajõgi, its riverbanks and floodplain areas. Riverbanks are accessible and passable throughout the city territory. Alleys are emphasised as green elements.

Tartu is a city where public transport and non-motorised traffic are of high priority. The non-motorised road network is continuous and covers the whole urban region; rail transport has been planned and implemented, where possible. Traffic passing through the city centre and residential areas has been directed to main streets.

In the city environment, Tartu prefers apartment buildings. Preschools, schools, and sporting and leisure options are located as close as possible to residents.

DEVELOPMENT PLAN OF THE CITY OF TARTU 2018–2025 (2018)

VISION: TARTU IS A CITY OF ACTIVE, CREATIVE, AND HAPPY PEOPLE

Tartu is a university town, the mental capital of Estonia and the city of youth, as well as a service centre with a smart business environment. It is a safe and inspiring city close to nature and with a unique cultural heritage, which forms an attractive travel destination.

A CITY WITH AN INSPIRING LIVING ENVIRONMENT

9. Tartu has an inspiring, synergistic, and safe urban space that is used and developed according to sustainability principles.
10. The technical infrastructure of Tartu is economical and public services are user-oriented.
11. Tartu has an environmentally friendly mobility environment which considers the needs of all modes of mobility and has been integrated into the international transport network.

STRATEGIC ACTION PLAN FOR BICYCLE TRAFFIC IN TARTU 2019–2040

The bicycle traffic vision for 2040: bicycles are the preferred mode of transportation throughout the year, and walking is the preferred mode of mobility – residents of Tartu run their daily errands mostly by bike or on foot. We wish to raise the share of cyclists by approximately 1% per year and reduce the use of passenger cars by approx. 1% per year. Measures of the strategy are as follows:

1. Fewer cars in overall traffic (primarily during rush hours).
2. Improved air quality and lower noise levels in the city.
3. Larger number of cyclists.
4. Fewer absent days due to illness.
5. Greater cyclist satisfaction.
6. More students use bicycles.
7. Higher average speed and safety of cycling.
8. Bicycle traffic does not drop as rapidly during the winters as it does now.
9. More days when cycling paths are safe for use.

10. Safe bicycle parking options are provided at workplaces, educational institutions, and apartment buildings.
11. The length of roads designated for bicycle traffic grows and cycling paths are established by the recreational areas near Tartu (such as Elva, lakes of Vooremaa, Otepää, and Vooremäe).
12. In the beginning of plans and design projects, the interests of pedestrians and cyclists are defined.

TARTU COUNTY DEVELOPMENT STRATEGY 2040

13. Planned traffic management and modern mobility environment

13.1. Strengthening suburban centres (see Figure 2) under the principle of proximity to home: basic school, preschool, and cafeteria are all located near the bus station and car/bicycle park.

13.1.1. Planning and developing service centres in Kõrveküla, Vahi, Lähte, Luunja, and Tõrvandi, and extending the 'park and ride' system at the Elva, Nõo, and Tabivere train stations.

13.2. Adapting public transport to the needs of mobility and to the changing administrative and operational areas.

13.2.1. Public transport management will continuously adapt to relocating companies and residences.

13.2.2. Developing need-based transport system in rural areas and introducing new logistic solutions to broaden mobility options.

13.2.3. Interlinking and synchronising passenger trains and the public transport system of the city and county of Tartu.

13.2.4. Intensifying and speeding up train traffic between Elva, Põlva, Jõgeva, and Tartu.

13.2.5. Adding a train stop in Tabivere on Elron's express lines between Tallinn and Tartu to prevent passengers from the northern areas of Tartu County from needing to travel to Tartu or Jõgeva.

13.2.6. Implementation of smart parking organisation (car parks, bike shelters, safety) and parking spaces in suburban centres and office areas.

13.3. Organising transit and suburban traffic.

13.3.1. Gradual construction of the outer roundabout of the city of Tartu.

13.3.2. Construction of the inner roundabout according to the comprehensive plan of the city of Tartu.

13.3.3. Linking the inner and outer roundabout and linking the outer roundabout with state motorways.

13.3.4. Preparing a specified plan of the Tallinn-Tartu-Võru-Luhamaa route.

13.3.5. Preparing a specified plan of the Tallinn-Tartu-Valga route.

13.4. Making intersections, crossings, and railway crossings safer based on the traffic safety analysis.

13.5. Continuous reconstruction of gravel road pavements at the pace of 50 km per year.

13.6. Further development of non-motorised roads according to the county plan.

13.6.1. Gradual construction of the non-motorised road network in the cities of Tartu and Elva.

13.6.2. Construction of non-motorised traffic facilities in suburban centres.

TARTU ENERGIA 2030+ (TO BE COMPLETED)

Vision of the energy and climate programme *Tartu Energia 2030+* is as follows: Tartu is a smartly developing community and a pioneer of green energy! The development plan foresees preparing an action plan to reduce CO_2 emissions by at least 40% by 2030. The development plan includes sustainability measures in six areas: energy, transport, buildings, data, governance, and climate. The transportation chapter suggests measures for climate change mitigation (CCM) and climate change adaptation (CCA):

CCM 1. Transport planning forms an integral part of climate, energy, environmental, health, and economic planning.

CCM 2. Use of non-motorised traffic and public transport has increased as passenger car usage decreases

CCM 3. The share of moving and parking cars in urban space has declined

CCM 4. The multimodal traffic hub links different means of transport

CCM 5. The hinterland is linked to the city via sustainable transport solutions

CCA 1. Integrated urban regions
CCA 2. Active city
CCA 3. Natural survivors
CCA 4. Services for all

The action plan provides for developing the main strategic measures into nine operational programmes along with a strategic support action of the good practice of involvement.

A1. Active Physical Movement plan
A2. Strategic bicycle traffic action plan for Tartu
A3. Motorisation reduction action plan
A4. Integrated transport management programme
A5. Electromobility programme
A6. Public transport plan for Tartu
A7. Multimodal mobility plan
A8. Integrated Urban Region programme
A9. Implementation and updating the traffic safety programme of Tartu 2017–2025
A10. Application of the Good Practice of Involvement

Due to the citizens' avid interest in sustainable means of transport, the guiding principle of the action plan is to enable mobility: establish the necessary infrastructure for active mobility; ensure the safety of mobility; reduce the number of passenger cars in the streets; develop fast bus and tram links; improve the integration of modes of mobility; bring services closer to people; develop innovative services. Over the period, sustainable, i.e. non-motorised mobility will account for 70% and car transport for 30% of total mobility. Private transport emissions will be reduced by 15% compared to the year 2010, and public transport will become emission-free.

5. INVOLVING THE COMMUNITY

The action plan has been developed in the process of co-creation, which included mapping the relevant parties, involving them in preparations, and evaluating results jointly. Preparing the action plan is coordinated with preparing the *Tartu Energia 2030+* development plan, and a joint involvement model has been created for both processes based on the active involvement of the community in policy-making. The involvement process started by mapping the parties, defining the organisations and associations related to mobility in Tartu, and by inviting these parties to take part in the preparatory process. In practice, the involvement model saw dedicated workshops for reviewing the transport management aspects and analysing the situation in Tartu. In addition to workshops, public discussions were held to give an overview of the working group's activity, introducing its results, discuss with the public, and to gather ideas and suggestions. The action plan has been compiled as a result of ideas and proposals of both the working groups and public discussions.

Table 2. Meetings and discussion topics

12/12/2017	Public discussion: SWOT analysis of transportation in the Tartu region
15/10/2018	Public discussion: Vision workshop 1 of *Tartu Energia 2030+*
19/11/2018	Public discussion: Vision workshop 2 of *Tartu Energia 2030+*
15/02/2019	Thematic workshop: challenges and risks in the transport of Tartu 1.
28/03/2019	Thematic workshop: challenges and risks in the transport of Tartu 2.
23/05/2019	Thematic workshop: the strategy and impact of transport

	12/06/2019	Public discussion and thematic workshop: the strategy and impact of transport
	11/07/2019	Thematic working group: measures
	01/10/2019	Public discussion and introduction of measures

6. CURRENT SITUATION

According to EUROSTAT, Estonian motorisation exceeds the European average (550 vs 512 passenger cars per 1,000 residents in 2017), and among Eastern European countries, the rate of passenger cars is second behind Poland (see Annex 1). Similarly to other regions in Estonia, the number of cars registered in Tartu has increased over time, reaching a record 45,236 passenger cars in 2018, which means 469 cars per 1,000 residents. Compared to 2007, the level of motorisation has reached 41% and there are 17,779 additional passenger cars in the city space. The actual number of passenger cars entering the city on a daily basis is probably even higher (an estimated 30,000–40,000 passenger cars), but up to now, the city did not apply measures to measure it in detail. Measurements have been started with motion sensors installed within the international cooperation project SUMBA, and according to the initial measuring results, the volume of traffic entering and exiting the city totals 80,000 units per day, which accounts for approximately 40,000 vehicles – one vehicle per two measurements on average (see measurement data in Annex 8). These details are used for predicting future traffic flows; the data are validated on the ArcGis platform and published in the updated version of the mobility programme. In order to specify the results of analysis, the level of detail in future measurements must be improved by separating the directions of mobility and types of vehicles, which are unfortunately not reflected in any reliable measurement data at the moment.

The share of passenger cars registered in Tartu per 1,000 residents is illustrated by the following graph.

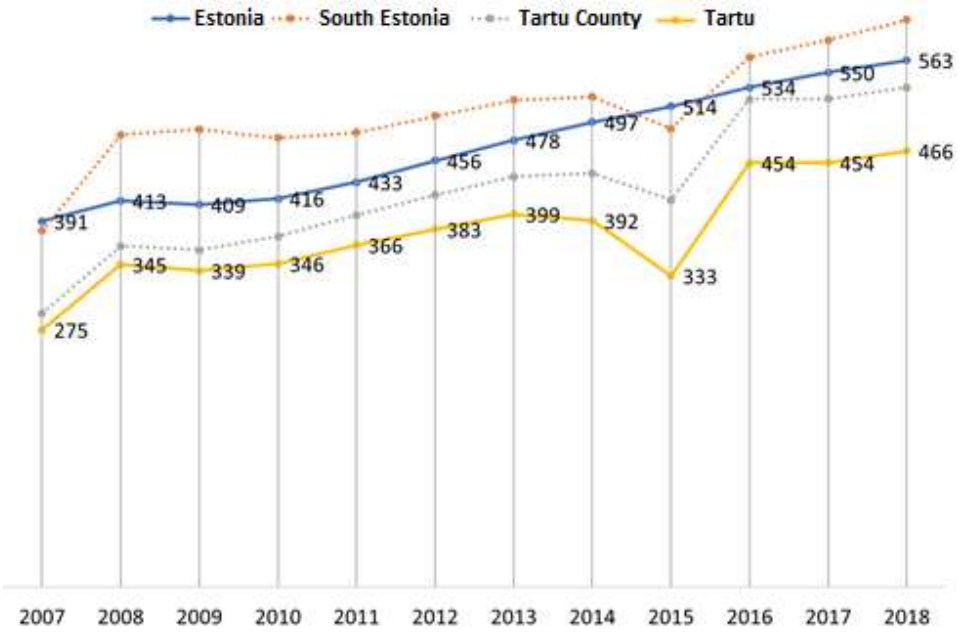


Figure 3. The share of passenger cars per 1,000 residents in Estonia, South Estonia, Tartu County, and the city of Tartu in 2007–2018. Source: *Tartu Energia 2030+*, TREA 2019. The data are from the Estonian Road Administration and Statistics Estonia.

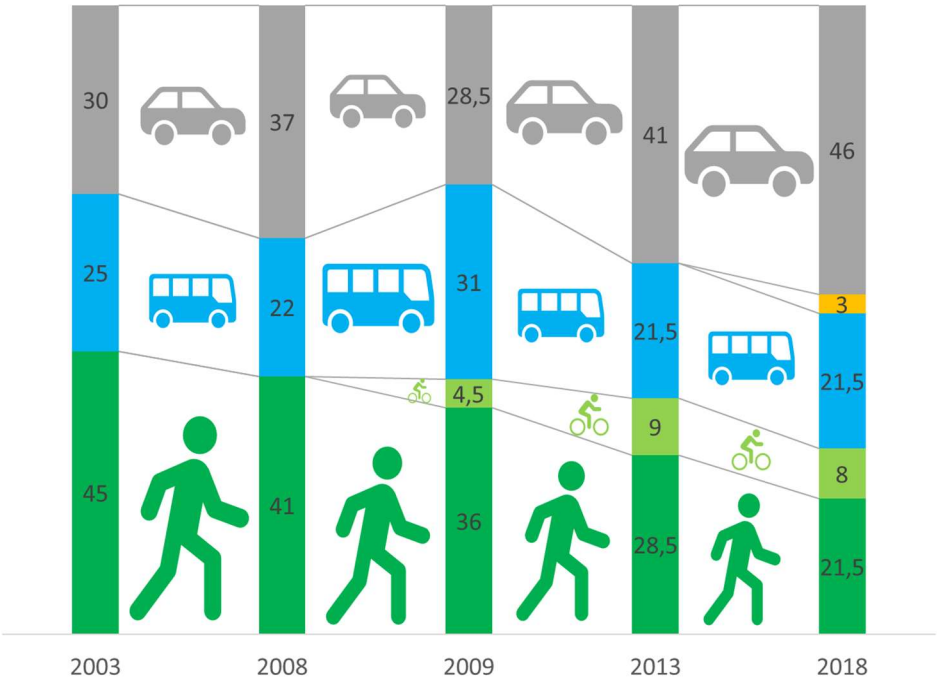


Figure 4. Distribution of modes of mobility in Tartu in 2003–2018. Source: *Tartu Energia 2030+*, TREA 2019. The data are from the strategic action plan for bicycle traffic in Tartu 2019–2040 and HeiVäl OÜ 2019.

As a result of the Tartu Mobility Survey[1] based on a poll conducted among the citizens in 2018 (see the Tartu mobility survey, Skepast & Puhkim OÜ, Psience OÜ 2018), the urban modal split of modes of mobility at the time of the study was as follows: 40% of the respondents travelled by passenger car (as a driver or passenger), 29% moved on foot, 15% travelled by bike, and 11% used the city's public transport. The results may be compared with results of other long-term studies (see Figure 4), which – when using a different method – differ in numbers, but express similar overall distribution of modes of mobility.

More than 50% of the citizens and residents of nearby rural municipalities who responded to the traffic survey listed benefits of passenger cars, such as the opportunity to organise the transport of people and things, destination distances, travel times, comfort, and freedom of choice. To a lesser extent, the advantages of using a passenger car mentioned included unsatisfactory public transport, the privacy of cars, and travelling by car as a passenger. In the case of 22% of the respondents, the reason is job-related obligation and in 6%, the reason is impaired mobility. Respondents also listed obstacles to travelling by car, such as high maintenance costs, the existence of healthier alternatives, high parking fees, absence of driving licences, and high car prices. To a lesser extent, the reasons mentioned included the small amount of time saved, the satisfactory condition of public transport, and fear of participating in traffic.

According to the opinion of citizens, car usage could be reduced by better cycling and walking paths (see Figure 5). Public transport fares are also somewhat significant. Residents of adjacent regions are more interested in faster public transport solutions and suitable lines, better non-motorised roads, independent mobility of children and other family members, a joint ticket system, and better park-and-walk and park-and-travel options.

Advantages of travelling on foot include a healthy lifestyle, good access to destinations, environmental friendliness, and low expenses. To a lesser extent, the listed benefits included independence, habit, unsatisfactory public transport, absence of driving licences, comfort, and speed. Obstacles to moving on foot are long distances, faster alternatives, and the need to carry things or people. Smaller obstacles noted were more

[1] Mobility study report in the city of Tartu and adjacent areas, Skepast & Puhkim OÜ, Psience OÜ 2018

convenient alternatives, lack of non-motorised roads, lack of road safety, and insufficient lighting. Walking is impaired in the case of 5% of the respondents.

Figure 5. Factors decreasing the use of passenger cars in Tartu and the adjacent areas based on the poll results organised within a mobility study. Impact scale: 5 definite impact; 4 likely impact; 3 hard to tell; 2 unlikely impact; 1 definitely no impact. These data are from the report of the mobility study in the city of Tartu and adjacent areas 2018 (Skepast & Puhkim OÜ, Psience OÜ 2018).

As the main advantages of using bicycles, the respondents listed a healthy lifestyle, environmental friendliness, good access to destinations, low expenses, and independence. To a smaller extent, they valued saved time, comfort, unsatisfactory public transport, habit, and absence of driving licences. As the main obstacles, respondents listed weather conditions, the need to carry things/people, traffic hazards, lack of non-motorised roads, inconvenience, and the need to change clothes. Lesser obstacles were fear of theft, lack of storage facilities in the destination, and bad working condition of their vehicle. 16% of respondents failed to point out any advantages.

The main factors that facilitate using public transport, as listed by the respondents, included suitable schedules, lines, stops, good access to destinations, and small expenses. Fewer respondents highlighted environmental friendliness, absence of driving licences, comfort, time saved, and habit. 10% of respondents failed to point out any advantages. The main obstacles to using public transport listed include bus intervals, unsuitable schedules, lines or routes, passenger's dependence on bus times, the need to carry things and people, and the low speed of travel. Lesser obstacles include inconvenience, crowded buses, absence of night lines, lack of transfer options, the ticket system, absence of morning lines, access to information, and unsuitability for travelling with a pram or a wheelchair.

If the obstacles were eliminated and if respondents could choose their desired modes of mobility, the mobility distribution in Tartu would be as follows (see Figure 6): 39% of the respondents would prefer to move by (rental) bike, 23% on foot, 23% by public transport, 13% by car, and 2% would choose another option.

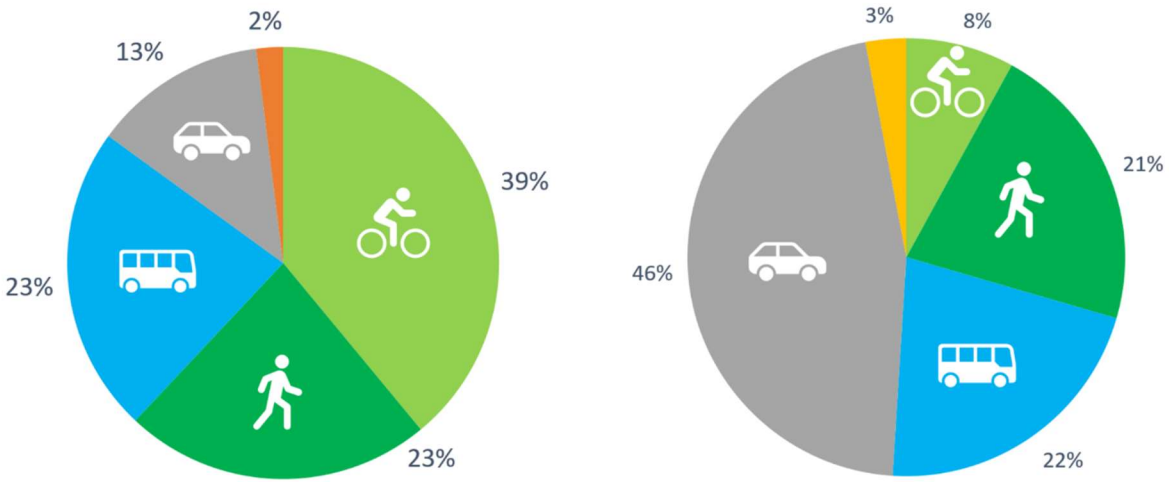


Figure 6. The desired (on the left) and actual (in 2018, on the right) distribution of modes of mobility. Data: The strategic action plan for bicycle traffic in Tartu 2019–2040 (HeiVäl OÜ 2019, page 10) and the mobility study in the city of Tartu and adjacent areas (Skepast & Puhkim OÜ, Psience OÜ 2018, page 72).

6.1. Motorisation in Tartu and adjacent areas

Car use has been growing in Tartu (see Figures 3 and 4). This is caused by several advantages created for car users by the existing traffic management:

- → Car is a fast option for travelling between city districts. In Tartu, the door-to-door travel times remain under 20 minutes for car users. This is more than two times faster than the time provided by public transport (up to 45 minutes), and in the case of an average or long distance, it is faster than travelling on foot or by bicycle.
- → Convenient access points have been established for cars. Access to all the relevant services in the city and adjacent areas is very good by car, while pedestrians and cyclists need to make their way between cars. For those with impaired mobility, access to services without a car is insufficient or lacking. At preschools and schools, children and youths are brought 'to the doorstep', which poses a risk to other mobility groups and reduces the youths' skill to act independently in traffic situations.
- → Cars are safe. Car users have an upper hand compared to other road users and they dictate the general traffic behaviour and perceived safety of city traffic. When different modes of mobility meet on unregulated intersections, car traffic has an advantage and is not obligated to give way to non-motorised road users. In most cases, cars are involved in severe traffic accidents in Tartu, but the 'guilty party' is often the pedestrian or cyclist.
- → Cars are weather-proof. Even at times of heavy snow and slippery roads, road maintenance and road safety is better on carriageways than it is on non-motorised roads or pavements, where the snow and ice prevention is poor or lacks completely.
- → Motorways and road infrastructure are in good order. Even if pavements and non-motorised roads are absent in certain city districts, the motorways are constructed and maintained.
- → Parking is cheap for car users. If there are no parking spaces, the vehicle may be parked on street land or pavements, while the worst punishment for wrong parking is a small fine. In courtyard areas, the car can be left 'by the door'. Parking near services (shops, hospitals, service offices) is usually closer to entrances than a bus stop or a bicycle parking area.

As a result of rapid motorisation, functional areas designated for safe mobility in the city centre, which are so characteristic of Nordic and Central European countries, have not been developed in Tartu, and attempts to develop such areas have been tangled up by restricting car traffic in the city centre (see Chapter 6.8. Pedestrian city centre). Motorisation is also facilitated (according to the respondents of the mobility study) by the slowness

of public transport, which is made even slower by the large number of cars in the street. Despite continuously growing investments and safer and greener city buses, public transport has not been separated from car traffic, and the travel speed of buses (see Chapter 6.5. Public transport in the city and adjacent areas) and the share of public transport in city traffic have not been increased.

Figure 7. Transport corridor for non-motorised rural road users

Motorisation in rural areas is caused by the same factors as in the city, but is even more accelerated by sparse public transport service, longer distances, and lack of an active mobility infrastructure nearby and outside the city. Regional and near-urban public transport fails to meet the needs of passengers, is not sufficiently available to passengers, and is not linked to the urban transport system and services (i.e. the travel destination). Active mobility and non-motorised traffic options are limited and do not provide users with safe access to services. Most motorways lack safe and secluded infrastructure intended for non-motorised road users. Pedestrians are forced in the edge of motorways, the surface of which is uneven or lacking, and where mobility is unsafe (see Figure 7). At snowy times, motorways become impassable for non-motorised road users, because snow and ice prevention is insufficient on roadsides and road shoulders. The problem is reinforced by high speed limit on roads passing small settlements, the unwritten rule of car traffic to travel at least at the permitted speed limit (or slightly faster), and drivers' high risk behaviour upon overtaking.

The impact of motorisation is wide and varied, but it may also be hidden or manifest itself over a long period. Motorisation has a direct impact on city traffic and traffic behaviour of people – more and more errands are run by passenger cars and citizens of Tartu are less prepared to move on foot. Motorisation has a direct impact on the growth of traffic density by reducing the safety of other modes of mobility, speed, and efficiency of movement. Improving traffic culture and vehicle safety has helped to reduce the number of severe accidents, but there are still numerous car accidents in Tartu (see Figure 8).

Figure 8. Traffic accidents in Tartu in 2014–2018. Source: *Tartu Energia 2030+*, TREA 2019. The data are from the Police and Border Guard Board.

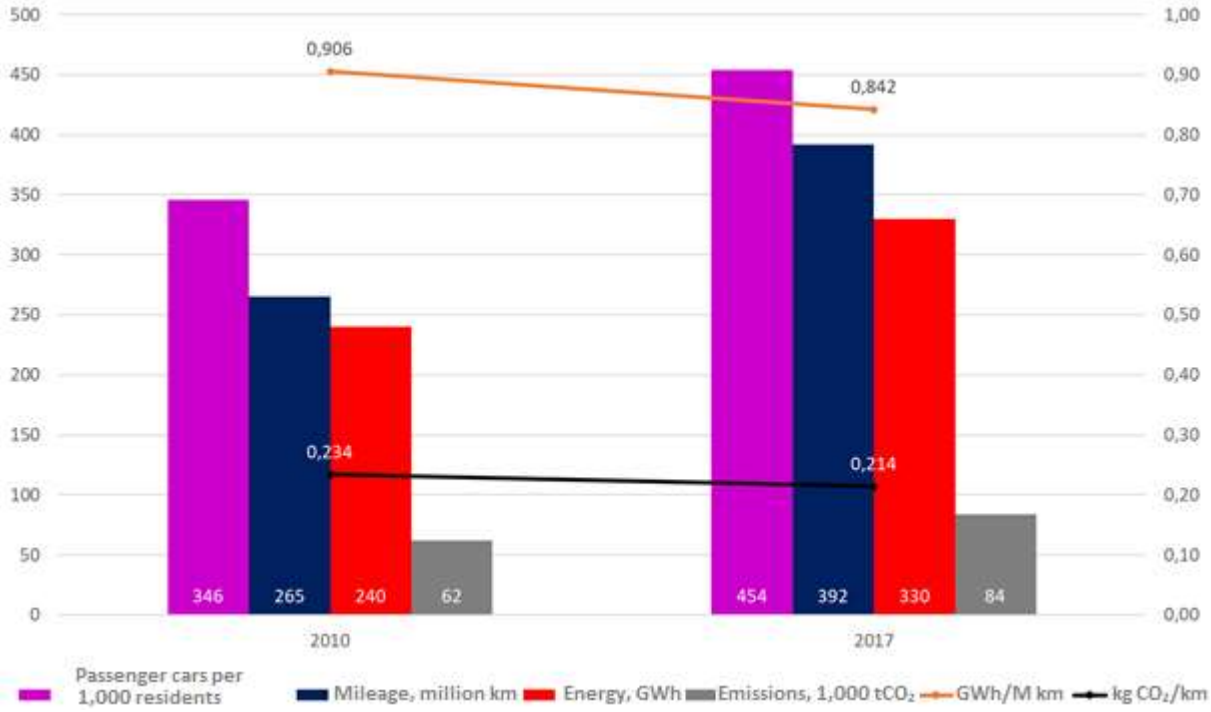


Figure 9. Motorisation, mileage, energy consumption, and emissions in the private transport of Tartu in 2010–2017. Source: *Tartu Energia 2030+*, TREA 2019. The data are from the Estonian Road Administration and Statistics Estonia.

Motorisation increases fuel consumption in the city (see Figure 9) and has a significant impact on air quality and the living environment. Motorisation also changes the use of urban space by monopolising the street space and

parking spaces. The motorised lifestyle is transferred onto next generations, who will not adapt to different modes of mobility in the city. Motorisation reduces the quality of other modes of mobility, thereby reproducing motorisation. This is a worrisome future perspective, because the traffic hazard, which is being continuously increased, may result in passenger cars remaining the only safe modes of mobility in the city. Motorisation is expensive for the city because it requires investments in improving the infrastructure and mitigating the direct and indirect impacts of motorisation.

6.2. THE CITY OF CAR PARKS

In turn, extensive motorisation dictates the specific use of city space. Parking and stopping passenger cars lining the public street area is a typical sight in all city districts and traders, developers, and service providers are trying to accommodate the large volume of vehicles by creating larger car parks. This is not enough, and new large car parks by the university hospital in Maarjamõisa, the Lõunakeskus shopping centre in the FI city district, the campus of the University of Life Sciences, and elsewhere have quickly filled up.

Cars filling up the street space affect the maintenance and order of city streets. As there is no practice in place for removing the cars that block street maintenance vehicles, street cleaning and snow clearing cannot be performed to an equal quality throughout the Tartu street corridor. The issue is especially severe on the edges of carriageways and on pavements, where owners of adjacent lots ought to be responsible for maintenance. The result is an uneven quality of road surfaces, which is not safe for non-motorised road users. As a rule, this places the elderly and citizens with impaired mobility in a difficult situation, because a badly maintained street may mean a partial or complete cut-off from required services.

6.3. THE CITY OF SHOPPING CENTRES

Car-centred mobility has an impact of people's behaviour outside the transport sector. The wide spread of shopping centres is one of the complex by-products of motorisation, being its cause and effect at the same time. The high rate of motorisation in Tartu is manifested in the large number of shopping centres, which has an impact on the general management of city planning and traffic organisation. Large shopping centres require a big number of parking spaces and substantial links to thoroughfares. Therefore, the city of shopping centres is also a city of car parks, instead of being a city of pedestrians with a network of much smaller shops. This is also visible in the heart of Tartu, where traditional trading has gradually been replaced by a specific service structure: entertainment facilities, alcohol shops, restaurants, and hotels (see Chapter 6.8. Pedestrian city centre).

The traffic solution of shopping centres is mostly car-centred and inconvenient for other groups of road users. While some downtown shopping centres have also paid attention to servicing pedestrians and those with impaired mobility, then pedestrians need to make their way between cars looking for a parking space and poorly marked walking area to visit other supermarkets. In addition to the actual traffic problems caused by shopping centres, they create an image of dominance of car use in city traffic and raise a new generation of car users.

Shopping centres play a major role in the mobility patterns of commuters that visit Tartu on a daily basis. There, they perform their daily shopping (food, clothes, essential goods), consume basic services, spend time, entertain themselves, and by paying for all the above, shopping centres become major service providers and benefactors of the urbanised, marginalised, and motorised lifestyle.

6.4. CITY IN THE LIVING ROOM

In the Internet era, we prefer indoor activities and wish to consume as many services as possible without leaving home. As a result of large shopping centres, the spread of indoor car parks, and increasing motorisation, people use the option of consume services and purchase goods, entertainment, and leisure activities without going outside, replacing the living room with car dealerships, shopping centres, indoor gyms, or cinema complexes. The primarily indoor lifestyle has a negative impact on people's health, and as they get older, physically inactive

people suffer from various health issues. International studies[23] carried out in the UK and the US also break down the gender division of the indoor lifestyle. While in the 1970s, women spent their free time indoors, then now, the main group staying inside are the men. The problem is worse among growing youths, whose physical activity has declined over the years and who are accepting the indoor lifestyle as a new norm which is hard to break as an adult.

One of the changes that supports indoor lifestyle is the growing share of online shopping, which severs shopping from the related physical mobility. Online shopping enables ordering goods and consuming services without leaving home and by using courier services. In addition to consumer goods, ordering ready-made food is gaining popularity in Tartu, and food couriers cooperate with all the main restaurants in the city. The parcel robot service has also been tested in Estonia (as a pilot project), and based on the experience of other countries, we may also see the application of light aircraft in providing everyday parcel services. Online commerce and parcel couriers increase the impact of the indoor lifestyle on our daily behaviour and reduce the need of active physical movement even more. Packing ready-made food and semi-finished products also involves the need to use plastic packaging, which, in turn, increases the production of plastic waste in the city.

6.5. PUBLIC TRANSPORT IN THE CITY AND ADJACENT AREAS

Developing public transport in the city has been a preference of transport management (see the comprehensive plan of the city of Tartu up to 2030). Tartu was the first city in Estonia to use the new bus fleet with a high environmental standard (EURO 5; now replaced by standard EURO 6), which stands out in traffic and includes buses suitable for servicing people with impaired mobility. Diesel-fuelled buses have been replaced by environmentally friendly gas-fuelled buses. Users have enjoyed the beneficial innovation of the implementation of an electronic ticket system and real-time information system along with information boards in the heart of town and important highways. The electronic travel card also allows travelling on county lines, and in addition to Tartu, it can be used in the Tallinn public transport network.

Work is undergoing to renew the line network. Tartu bus traffic was updated on 1 July 2019 by introducing the new line network, changing bus schedules and locations of stops, replacing the bus fleet, and operations were taken over by the new service provider AS GoBus. The markings and design of buses were changed, but the familiar red shade remained (see Figure 11). As a result of these changes, new line buses operating on natural gas (temporarily also an electric bus, which has now been decommissioned) are now used in the Tartu public transport. New validators were introduced for purchasing and validating tickets; these allow buying tickets by contactless bank cards as well. The statistics of bus use before and after these innovations can be seen on Figure 9. Changes in public transport coincided with opening the Smart Bike Share service (see Chapter 6.9. Bicycle use in Tartu), which had an impact on the use of buses during the summer months.

Despite innovations, the public transport service has not become significantly faster than before. Waiting times at stops and travel times are still long. Bus speeds in city traffic have decreased due to motorisation and cannot compete with the connection speeds of car transport (or even walking speed in some areas). The city has attempted to improve the situation by creating bus lanes in a few places, but it has not resolved the issue as a the whole. The passengers' higher expectations of comfort and the renewed service are not reflected in an increased interest of travellers in the public transport of Tartu (see Figure 10). Using public transport is also affected by the gradual reduction of pedestrians in Tartu's city traffic.

[2] Gershuny & Oriel Sullivan. What We Really Do All Day: Insights from the Centre for Time Use Research. Pelican, 2019

[3] Hamermesh, D. S. Spending Time: The Most Valuable Resource. Oxford, 2019

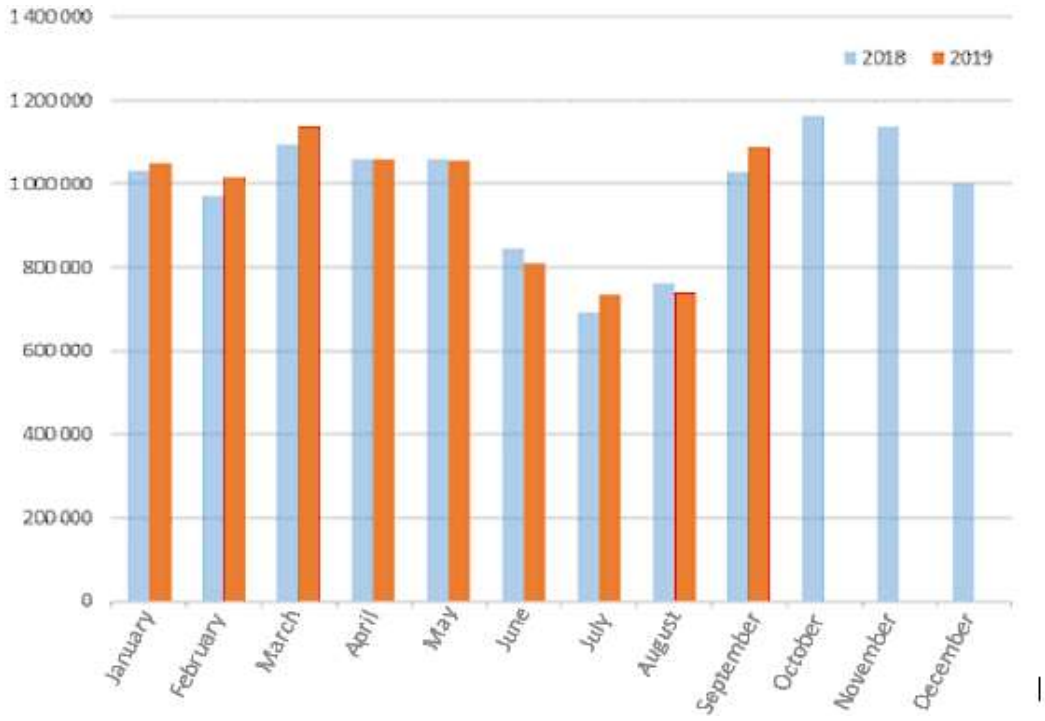


Figure 10. Number of registered trips by Tartu public transport. The data are from the Tartu City Government.

Figure 11. Urban and rural bus lines in a joint stop in front of St. Paul's Church in July 2019

New green line buses introduced by AS GoBus also operate on rural lines; they stand out in traffic by colour (see Figure 11) and partly run on natural gas. The electronic travel card also allows travelling on county buses, and rural transport is free of charge for passengers. Introduction of free-of-charge travel right has steeply increased the use of public transport on county lines (see Figure 12). Still, this has not brought about a significant reduction of car use on city-bound motorways. The reasons have not been studied comprehensively, but the assumption is that car users do not trust the public transport service enough to give up their cars, or the line network and bus schedule still fail to meet their needs. County buses fail to meet the needs of people with impaired mobility; there is also no real-time information system in county bus stops to notify passengers; the stop names are not declared on the buses; and passengers are not notified of an upcoming stop. The bus station is located in a car park behind a shopping centre away from the heart of town, it is poorly linked to the city's public transport, and is hard to find for visitors. The bus station facility (see Figure 13) is closed for passengers in the evening and at

night, thereby reducing the safety of bus transport. The bus station services approximately 4,000 arriving and departing passengers per day.

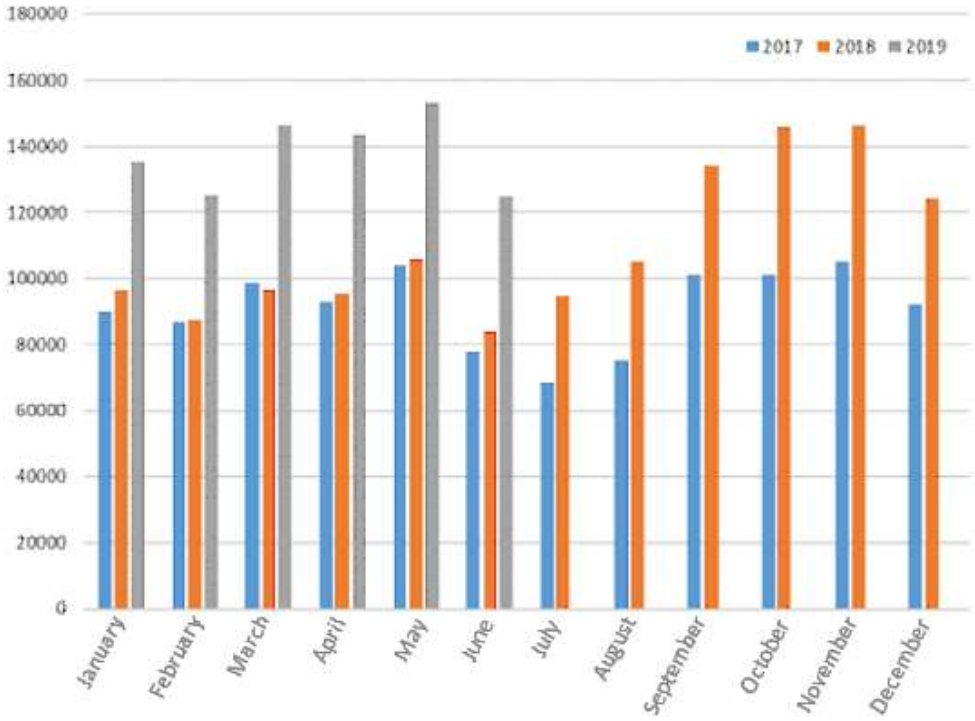


Figure 12. Number of passengers that arrived in Tartu by South Estonian rural bus lines in 2017, 2018, and 2019 (incomplete). The data are from the Estonian Road Administration.

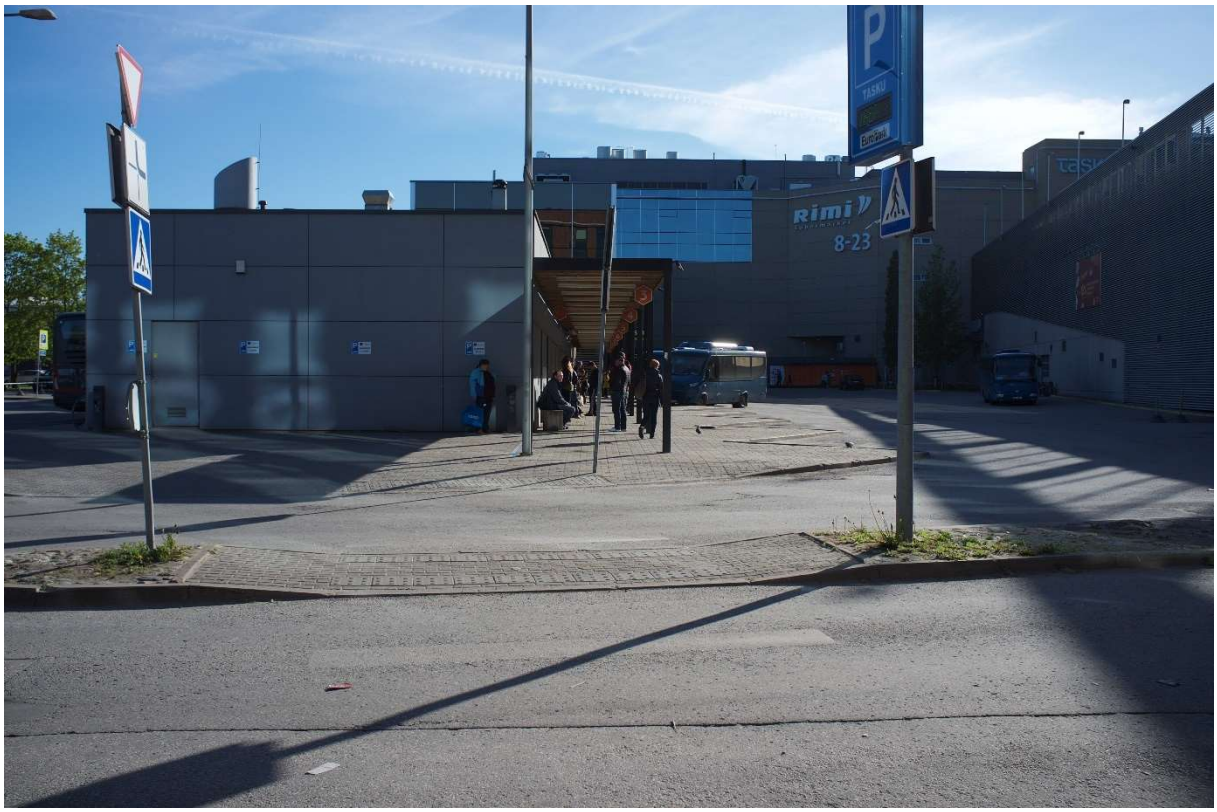


Figure 13. Tartu rural line bus station along with a waiting and service area in the courtyard of the Tasku shopping centre.

Public transport systems of the city and the county are still separated (see the OptiTrans Peer Review Report 2018), which is only slightly compensated by a joint travel card and a few common stops in the city (see Figure 10). These systems are still being planned, developed, and managed separately. Different bus fares apply. There is no central bus station with fast and convenient transfer options or links to other modes of mobility.

Figure 14. The Kärkna train stop and waiting area is a typical example of passenger train stops

Chassis of passenger trains has been renewed and the current service provider ELRON operates with new notably marked small trains, which are especially suitable for near-city traffic and less passenger-friendly for covering long distances. Compared to county buses, the train links are faster and more convenient – the train cars are spacious, well-lit, and ventilated; screens display information about upcoming stops; and passengers can enter the train with a bicycle (on certain lines only), prams, or wheelchairs. (Disabled) toilets are available for train passengers. The railway platforms have also been renewed. Unfortunately, shelters constructed on the train platforms (see Figure 14) are not suitable for use in the Nordic climate and do not provide sufficient shelter to passengers in cold seasons. Train links are significantly faster than bus links, but trains are not as frequent as buses (and trains do not always follow the arrival schedule, thereby complicating the linking of city line buses with passenger train services). For example, the active Elva-Tartu line is serviced by 4 transit trains on business days, while 49 buses travel on that line – the difference is more than 12 times. The Tartu-Tallinn line is operated by 10 trains compared to 37 line buses. Similar differences occur in case of other destinations as well, and it can be said that the passenger train service has not followed the increase in demand. Due to the low frequency of train services, the trains are overfilled in peak hours, which, in turn, lowers the user comfort of the service. In the summer of 2019, ELRON announced that they no longer wish to service passengers with bicycles on busier lines, thereby reducing the attractiveness of the service even more (as an alternative, some bus operators have started providing the option to transport bicycles). The advantage of classic railway transport – to increase the train assembly by adding cars to overburdened lines – has not been seized on the used chassis. ELRON does not offer international train links in Tartu, leaving a big gap in the activity of Tartu as an international centre of education and culture.

Figure 15. Façade of the Tartu Train Station along with a city bus and taxis stopping in front of the station

The Tartu Train Station, which was closed for a long period (see Figure 15), has been renovated and reopened to visitors. Similarly to the bus station, the train station is not open 24/7 and does not allow waiting for the next train safely at night. Access to the station is granted to those of impaired mobility (but is not very convenient, which is typical to the historical building). In the immediate vicinity of the station, there are a bicycle parking area, a city bus station, a taxi stop, the ELMO car rental, and a rental point for city bikes. In the future, the station has high potential to become a mobility point that links different means of transport.

6.6. NON-MOTORISED TRAFFIC IN THE CITY AND ADJACENT AREAS

Tartu has several advantages for using non-motorised traffic: the city has a suitable size and shape for non-motorised traffic and features numerous green mobility corridors. As a rule, the soft climate allows for using non-motorised modes of mobility (travelling on foot and by bike) throughout the year. Tartu accommodates many students and academic workers who could move on foot or by bike between buildings and campuses. Residents of Tartu value the good environmental condition and high quality of life. The recent high interest in using the Smart Bike Share illustrates the potential of non-motorised road use in Tartu (which is also evident in the results of the Tartu mobility study, see Figure 6).

To develop non-motorised traffic, notable efforts have been made in the city and adjacent areas of Tartu. The non-motorised traffic infrastructure (see Annex 2) has been continuously developed by constructing new roads, car parks, and maintenance points. Five non-motorised roads have been established by city-bound motorways, allowing visitors to come to town on foot, by bike, or with another non-motorised vehicle. Still, the non-motorised traffic has difficulties competing with advantages created for cars in Tartu's traffic management, such as good access to services, traffic safety, or fast door-to-door arrival times in the case of longer distances (bicycles are competitive in shorter sections and are cheaper than using cars). The benefits of using non-motorised traffic are rather general (such as smaller pollution/noise and healthy lifestyle) or very specific, being related to a certain route, distance, street type, city district, etc.

- → Physical movement related to walking or riding a bicycle helps to improve our health indicators and manage stress. Active movement in cooler seasons lowers the risk of viral diseases.
- → In short distances, moderate walking may be the fastest way of travelling from door to door. For example, in urban regions, where it is possible to go to work, shop, and consume services within the region, distances are short and residents are more willing to walk or ride bicycles.
- → Non-motorised traffic is environmentally friendly and does not pollute the air or produce greenhouse gases.
- → Non-motorised traffic requires less street space and provides modes of mobility to more people along with an operational public transport.
- → The total expense of non-motorised traffic is the smallest, it is the most sustainable, most flexible, and smoothest way of arranging everyday mobility, also in emergency situations.
- → Non-motorised traffic is suitable for linking to other modes of mobility (trains, buses, bike share) and a smooth transfer to regional and international connections.
- → Non-motorised mobility is a social activity and helps to bring neglected people out from the isolation of their home.
- → Non-motorised traffic is feasible for most groups of society and is therefore the most democratic way of organising mobility in the city.
- → Non-motorised traffic separated from car transport is the safest method of mobility in the city, but there are only a few such areas in Tartu.

In addition to general and specific benefits, active mobility (wheelchair, walking/jogging, biking, skateboard / roller skates) and the use of motorised vehicles (moped, electric bike, electric scooter, electric skateboard) have different effects. We see that walking is declining, while the use of bicycles and motor vehicles is increasing.

The challenge of developing non-motorised traffic is poor maintenance of pavements and cycling paths. This has been highlighted by the citizens who responded to the mobility survey as well as experts[4]. The quality of pavements, footpaths, and non-motorised roads in Tartu is poor, especially in the winter, and falls behind the quality of carriageways. Such preference of motor vehicles in road maintenance endangers non-motorised road users and complicates non-motorised traffic use in the city. The insufficient snow and ice prevention makes using non-motorised roads impossible at the times of heavy snow (see Figure 20). The maintenance of carriageways is much better, but in the winter period, it is not sufficient for their alternative use for non-motorised traffic. The existing situation sends the road-users a clear message that the mode of mobility preferred by the local government is motorised vehicle traffic. According to respondents of the Tartu mobility study, the main condition for reducing car use is improving the condition of non-motorised roads.

As the share of non-motorised traffic in city transport has gradually declined and continues the downward trend (see Figure 4) despite investments and recent developments (the impact of the bike share is unknown, but the initial data are presented in Annex 7), it may be said that although the efforts made have had positive effects, the potential of non-motorised traffic has not been realised in Tartu. The reasons for the decline in non-motorised traffic in Tartu have not been studied in depth, but experience shows that the cause is a complex of factors, where traffic management plays a large role in motorisation, making mobility unsafe, inconvenient, and slow for non-motorised road users and restricts their access to services. The mainly car-based mobility between the city and rural areas (in both commuting and weekend travel) and people's indoor lifestyle are likely to play a role as well. An additional factor facilitating motorisation is probably the barriers restricting mobility between city districts (the river and railway corridor). Passing these barriers has been made more convenient and safer for car users compared to non-motorised road users, who still find it difficult.

[4] for example see OptiTrans baseline study from 2018 and its aggregate analysis in Annex 1

6.7. WALKING IN TARTU

Tartu has developed as a varied community of a historical old town and suburbs located less than an hour's walk away. Therefore, Tartu is especially suitable for moving on foot and walking has played a significant role in the city's mobility. Out of all methods of mobility, the share of walking in city transport (see modal split in Figure 4) has declined the most (altogether 52% since 2007). Walking has handed its role as a dominating method of mobility over to passenger cars and shares the second to third place in the top modes of mobility with public transport. This represents the changing position of pedestrians in the streets of Tartu – moving on foot has become less comfortable, more difficult, and notably more dangerous.

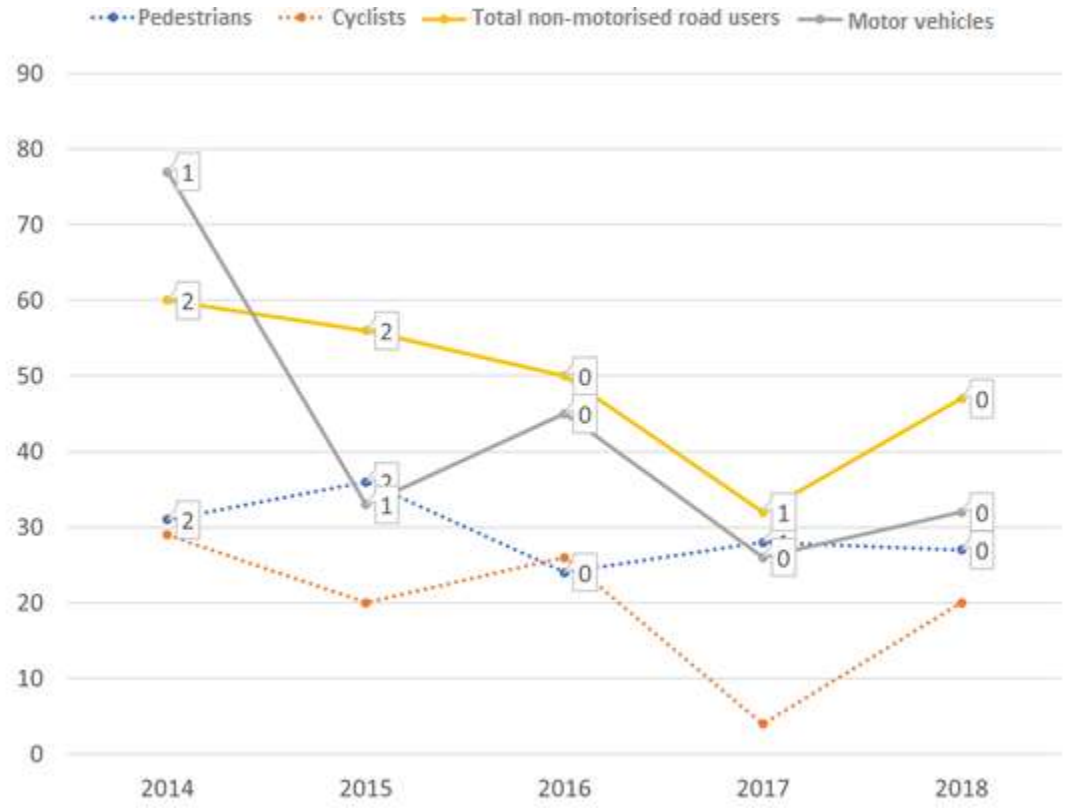


Figure 16. Number of people injured in traffic accidents in Tartu. The data labels show the number of traffic deaths. Source: *Tartu Energia 2030+*, TREA 2019. The data are from the Police and Border Guard Board.

A decrease in the number of pedestrians and the simultaneous raise in the volume of car users is both a direct and indirect cause and effect. The growing traffic density caused by motorisation has raised the pedestrians' risk awareness, which may force them to use cars. Up to now, development of cycling paths has been performed at the expense of pavements and pedestrians. Developing non-motorised roads with mixed use only reduces the slow-moving pedestrians' safety. In conclusion, walking declines due to people's overall attitude to prefer indoor leisure activities and reluctance to go outside (see Chapter 6.4. City in the living room).

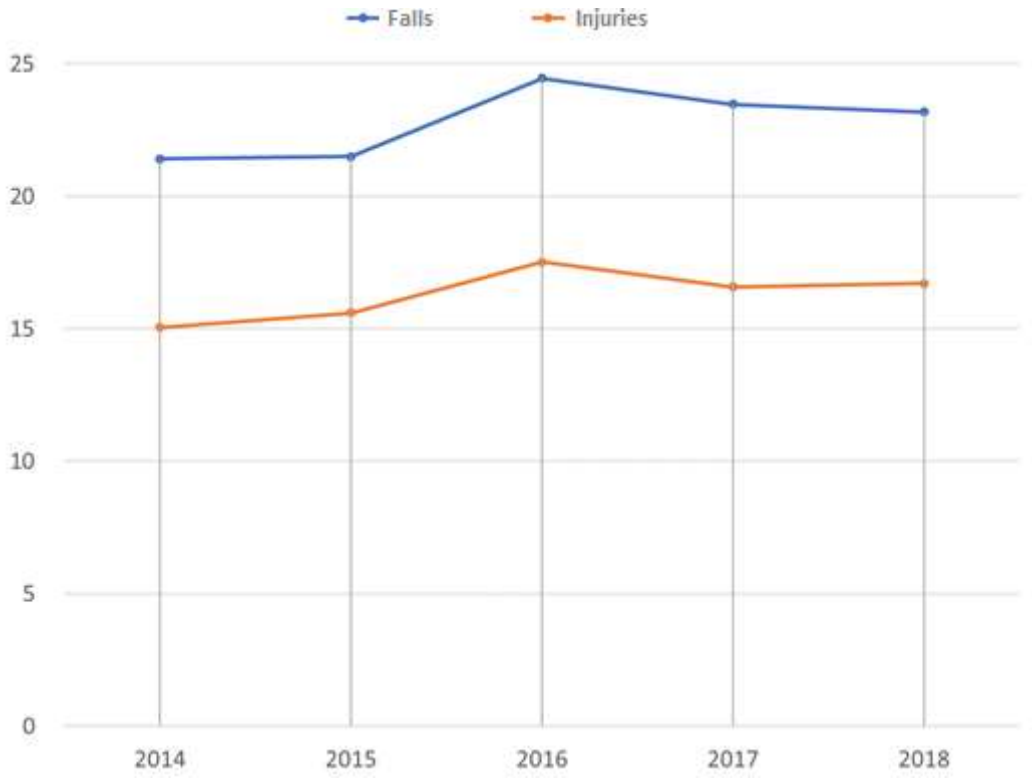


Figure 17. Rate of falls damages requiring treatment caused by winter road conditions per 1,000 non-car owners in 2014–2018. Source: *Tartu Energia 2030+*, TREA 2019. The data are from the Tartu University Hospital, the Estonian Road Administration, and Statistics Estonia.

6.8. PEDESTRIAN CITY CENTRE

Figure 18. Active car traffic is characteristic of walkways in the Tartu downtown

Tartu has tried to once again facilitate non-motorised traffic in the city centre, and it has been partly successful. Still, car traffic passing through walking zones, such as in the Küütri, Gildi, Munga, and Ülikooli streets has not

been restricted and continues to reduce the safety of walking streets. The issue is aggravated by uncoordinated service transport in walking zones (see Figure 18). The fact that services become fewer and one-sided (hotels, restaurants, alcohol and pubs) in the old town shows that the heart of town is not valued enough among walkers to create a critical volume of customers required for service variety. One-sided services reshape the image of old town, making it more focused around tourists and nightlife and less a pleasant and safe place of recreation.

The cropping up of new shopping centres has resulted in forming a new shopping district on the Riia-Turu intersection, which has changed people's interest in moving about the heart of town. Many merchants active in the city centre have preferred to move their shops into large supermarkets located in the heart of town (or further), which, in turn, decreases people's interest in the downtown walking area. New shopping centres enable visiting the city centre without leaving indoor spaces (see Chapter 6.4. City in the living room), thereby reducing the citizens' physical activity.

6.9. BICYCLE USE IN TARTU

On 8 June 2019, Tartu launched the first Estonian cross-city bike share service, which includes 240 bicycles and 510 electric bikes in a total of 69 car parks / loading docks across town. The bike share service can be used with the electronic bus card (an additional contract is required), supported by a mobile application which allows users to look up the locations of car parks, the condition of parked bikes, service times, distance covered, consumed energy, etc. The service is also supported by a public online map application (see Figure 19).[5]

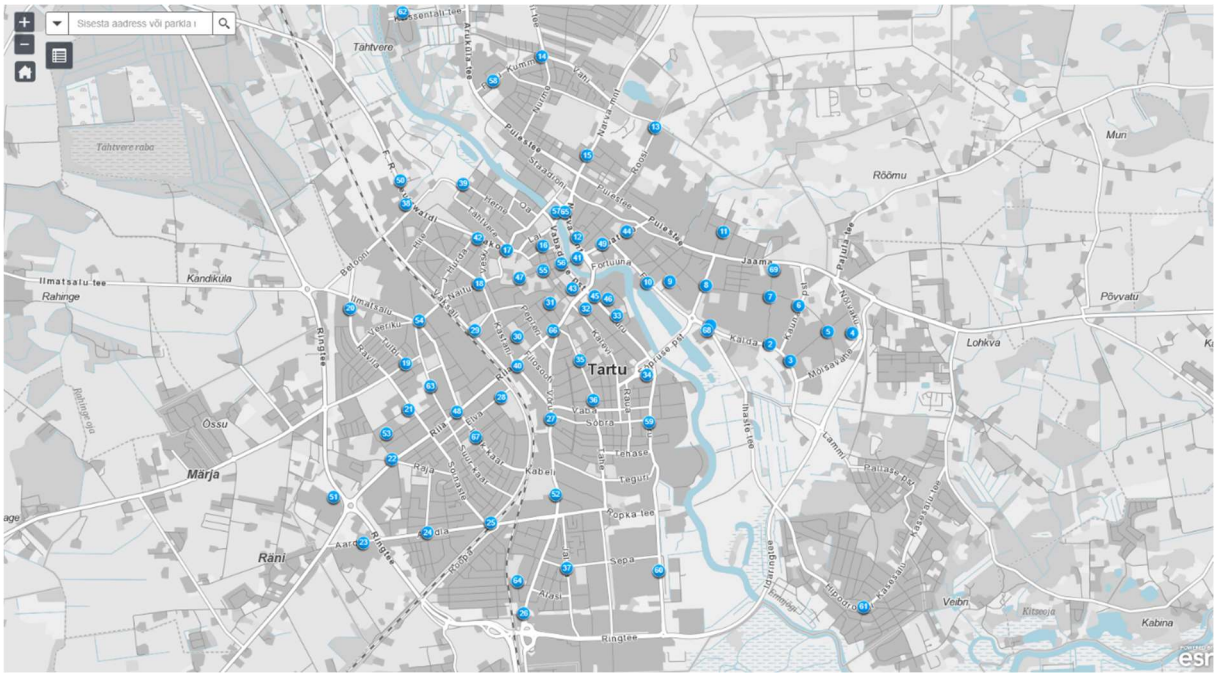


Figure 19. Locations of the Tartu Smart Bike Share stations and free bikes in the bike share map application.

The direction the city has taken by mixed road use and developing non-motorised roads by separating them by simple lines, creates artificial boundaries for faster road users (bicycles and roller skates) and endangers slow walkers (children, the elderly, people with impaired mobility). To drive safely, faster road users must reduce their speed and that decreases the capacity and speed of roads. Travel speed reduces and danger grows at intersections with carriageways, because non-motorised traffic does not have priority. Every intersection means the need to stop moving and a potential hazard situation, even when roads cross with less important alleys, cul-de-sacs, or access roads. Mixed-use non-motorised roads do not satisfy slow-moving pedestrians/walkers, who sense danger in fast-manoeuvring cyclists. Adding electric motor vehicles to non-motorised roads only sharpens

[5] https://tartu.maps.arcgis.com/apps/webappviewer/index.html?id=17f942d67348476da26a538ee3ccf9b6

the risk awareness of slow road users and due to the larger speed and mass of e-vehicles, the potential outcomes of non-motorised traffic accidents are more severe. Out of existing solutions, the non-motorised road on Kesk Street and the new non-motorised road ensemble at the Vaksali and Näituse streets can be deemed satisfactory, because cyclists are separated from pedestrians and move at the same pace and priority as car traffic.

All new non-motorised roads constructed in the adjacent areas of the city are intended for mixed purposes, which does not ensure safe cycling. The roads have improved the possibilities of residents of nearby areas to travel to town but are not actively used as a daily transport corridor. One reason may be the roads' bad connection to the heart of town, which confuses road users and compromises the traffic speed and safety. Only one of the five city-bound non-motorised roads has a satisfactory connection with the city centre. It must be noted that the constructed non-motorised roads only reach a few kilometres outside the city border, which does not meet the mobility needs of the outreach of Tartu, and is not suitable for running daily errands (15–25 km by bike and 30–45 km by electric bike, i.e. an hour's ride), while the Lähte road is a pleasant exception. For additional information, see detailed assessments on a ten-point scale and the total score on the scale of poor-lacking-satisfactory-good-excellent (see Annex 6 Assessment of non-motorised roads in Tartu).

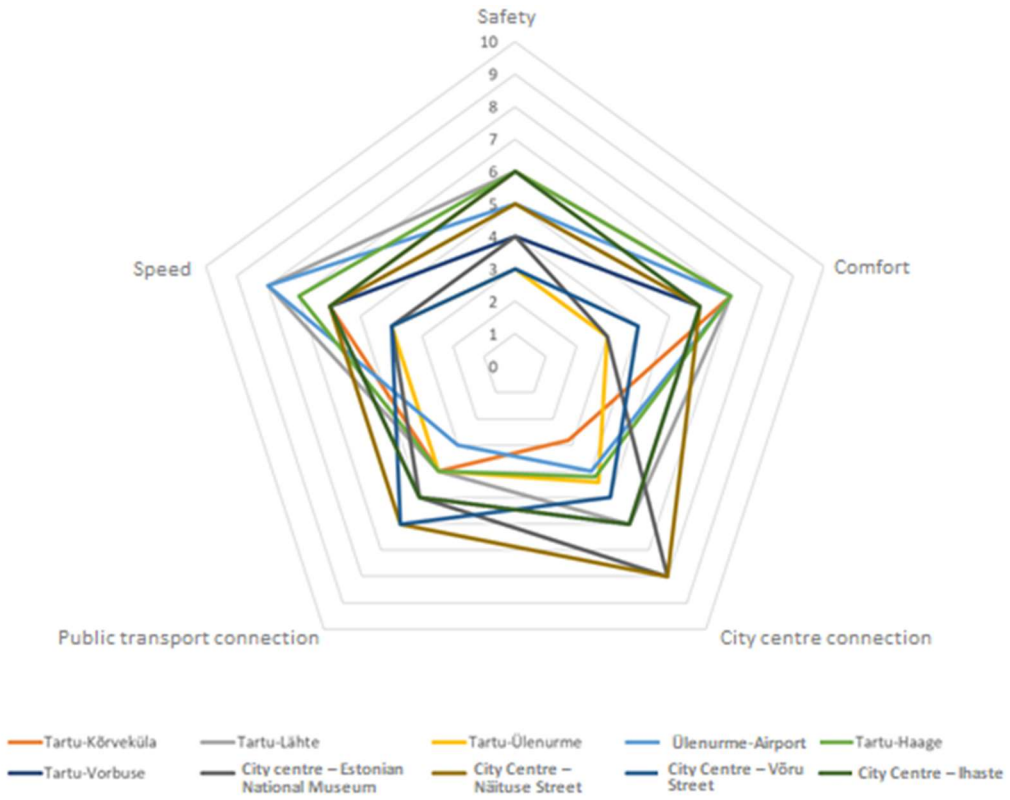


Figure 20. Outcome of the cycling path assessment in a single graph

Table 3. Outcome of the assessment of cycling paths in Tartu and adjacent areas

	Security	Comfort	City centre link	Public transport link	Speed	Average	Score
Suburban							
Tartu-Kõrveküla	6	7	3	4	6	5	Satisfactory
Tartu-Lähte	6	7	6	4	8	6	Satisfactory
Tartu-Ülenurme	3	3	4	4	4	4	Lacking
Ülenurme-Airport	5	7	4	3	8	5	Satisfactory
Tartu-Haage	6	7	4	4	7	6	Satisfactory

Tartu-Vorbuse	4	6	6	5	6	5	Satisfactory
Urban							
City centre – Estonian National Museum	4	3	8	5	4	5	Satisfactory
City Centre – Näituse Street	5	6	8	6	6	6	Satisfactory
City Centre – Võru Street	3	4	5	6	4	4	Lacking
City Centre – Ihaste	6	6	6	5	6	6	Satisfactory

Bicycle traffic is also still hindered by the high curb stones stopping the flow on non-motorised roads; installing these stones has been a long practice of Tartu street construction. By now, the city has started to remove these obstacles, but the result is far from satisfactory. Traffic solutions on intersections also pose an obstacle, because non-motorised road users do not get priority, even if a non-motorised road running along the main street (or the main carriageway) crosses a side street.

Figure 21. During the winter snow clearing, cycling paths in Tartu turn into impassable snowbanks

Paradoxically, the current traffic management makes the carriageway the most suitable option for riding a bike, because it enables moving at a similar speed and space in snow-free seasons. Carriageways are better maintained than non-motorised roads and they afford road-users smooth and priority access to services in all city districts. The traffic culture of drivers has improved over the years, which ensures safe mobility on most roads in Tartu. Nevertheless, the carriageway infrastructure is far from ideal, and in some cases, it may be unsafe or dangerous to cyclists. The following should be considered in particular:

- → Cyclists move at the edge of carriageways, where there are also manholes and street inlets of rainwater pipes. The hatches and edges of these manholes are not necessarily level with the road and may be very uneven, potentially causing the cyclists to lose balance.
- → Drivers sometimes overtake cyclists in a dangerous way and do not leave the cyclists the necessary space for manoeuvring. The issue is especially severe in case of the traffic culture of professional drivers (trucks, taxis) and bus drivers.
- → In difficult traffic situations of dense traffic and high speeds, cyclists may go unnoticed by drivers or be hard to follow.
- → Methods of slowing down traffic are not common on streets and intersections, and in sections, motor vehicles move near (or over) speed limits even inside urban regions.
- → The current joint use markings have also been applied to road surfaces of a few roads crossing with carriageways. These markings may go unnoticed.
- → The poor ice and snow clearing does not allow using these roads for cycling all year round.

Read a thorough overview of bicycle transport in Tartu in the strategic bicycle traffic action plan of Tartu[6].

6.10. INNOVATION IN TRAFFIC MANAGEMENT

Rapid development of information and management technologies has brought along significant changes in the traffic organisation of Tartu, such as the improved availability of public map applications (along with accompanying travel planning and related services, accommodation, catering, etc.); implementing real-time information systems in bus traffic (see Figure 22); development of travel planning services in the public transport of the city and county; implementing a joint electronic bus card in Tartu, regional transport, and the bike share service. New technologies give a better overview of service operation and create better conditions for developing and managing services.

Figure 22. Real-time information board at the Soola I bus stop in August 2019

[6] Tartu strategic bicycle traffic action plan for 2019–2040, HeiVäl OÜ 2019

Tartu has started the automatic counting of modes of mobility, gathering the counting results in a unified database. The advantage of the database is gathering high-quality, real-time basic information required for transport management, and analysing the information allows engaging in long-term transport strategies, as well as operational traffic management. The new arrangement helps to modernise traffic management in the city, and forward traffic density information to road users, who can thereby plan their movements better. To achieve better datasets, the number of counting points must be increased, and the real-life information system and bike share databases must be integrated in the joint database. It is recommended to publish all the collected data and invite the developer community to create data processing services which could help users understand the data better.

Innovation in public transport makes long-established services more user-friendly, which helps passengers using the services save time and energy. The real-time information boards communicate reliable information about the upcoming arrival (or delay) of buses and help bus users take better advantage of their waiting time or plan their movements. The joint bus card (see Figure 23) grants travelling rights in city and county line buses as well as use of the bike share bicycles (and is valid in Tallinn's public transport), creating better conditions for introducing multimodal transport management. Introducing travel rights by using a universal card makes way for the future integration of transport services and developing new combined services (universal hour ticket, route ticket, etc.).

Innovative ticket systems have a long history in Tartu. Tartu has tested an ID ticket, a mobile ticket, and smartphones using the NFC (Near Field Communication) technology, and starting from June 2019, payments can be made by validating distant-read bank cards (the so-called contactless payments, which are supported by all the larger banks operating in Estonia). The national ID-card platform is being updated to add a distant-read element to smart cards used for identification. Variety of options helps to adapt services better to changing needs. At the same time, the growing number of payment methods could confuse users, reduce the intuitive quality of services, and disperse the resources required for the future maintenance and development of services. Instead of continuous diversification of services in the next stage of development, more attention should be paid to the better integration of payment methods, ensure their safety, and seek approval to use them for as many services as possible. For the better integration of transport services in the future, the bus card system must be linked to the regional and railway transport between counties and cities, thereby creating a universal payment platform for public transport services that would be valid across Estonia.

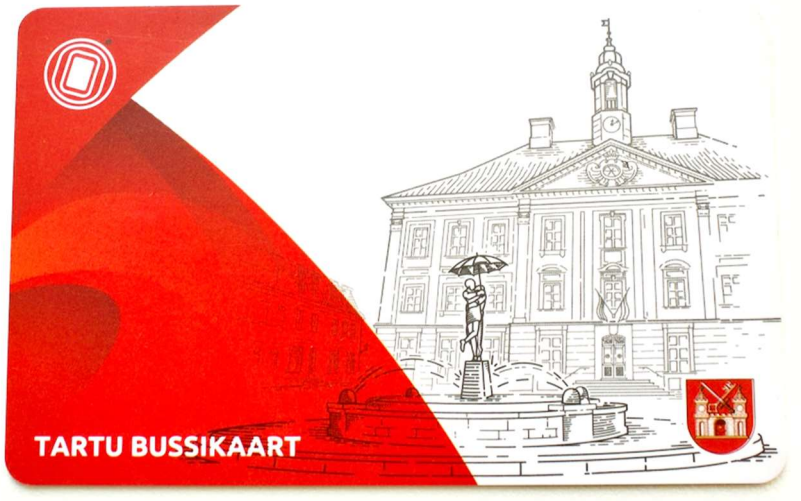


Figure 23. The Tartu bus card gives the right to travel by urban and rural bus lines as well as by the Smart Bike Share service.

6.11. MOBILITY AND SCHOOLS

Schools play an important role in shaping our mobility habits. In Tartu, educational services are closely linked to activity needs, and the study periods of schools impact the volume of mobility. Location of schools and hobby schools in urban regions, their links with residential areas, and access to public transport and non-motorised modes of mobility determine the young people's mobility patterns both during and after their studies. Car-based mobility leaves an impression on the youths' skills to cope independently in a traffic situation as a pedestrian/cyclist/passenger. Active mobility, however, helps to grow independence, improve the general physical form, and cope with increasing school stress.

7. SUMMARY AND CONCLUSIONS

We are witnesses to growing car use and dropping walking habits in the mobility of Tartu, while cycling is on the rise and bus use declines. The flexibility, multimodality, and sustainability of the transport system have decreased, giving way to motorisation and its effects: growth of traffic density, noise, pollution, and monopolisation of street space by cars and other motor vehicles. The widespread car use has also caused an increase in energy consumption and a wide environmental impact of the sector. Poor maintenance of non-motorised roads involves a risk to the life and health of non-motorised road users, which, in turn, reduces people's readiness for active physical movement and their access to everyday services, especially in the case of people with impaired mobility. Motorisation recreates motorisation, is handed down to next generations, and worsens the quality of other modes of mobility. It is a process that aggravates the living environment, life quality, and urban space uncontrollably, preventing Tartu from carrying out its future visions.

The issues of non-motorised traffic are related to the lacking conditions of roads and streets, as well as bad connectivity and poor maintenance. Constructing new non-motorised roads has not brought about a notable solution, because the chosen path of developing mixed-use roads fails to satisfy the needs of any stakeholder. Results of the mobility study and the success story of the recently launched bike share service illustrate the citizens' interest in green and healthy non-motorised traffic, but they also illustrate the challenges: we lack cycling paths between city districts that would enable moving fast without jeopardising pedestrians.

Allowing the downtown walking streets to cross with active car traffic is a missed opportunity to create a pedestrian city centre and a Nordic-style shopping street. Colourful shopping streets have been replaced by anonymous shopping centres, which go hand-in-hand with the motorised lifestyle and consumption culture. The old town, which has lost its reputation as a safe place of recreation, is becoming an unsafe nightlife and tourist zone where residents are not welcome after working hours.

Introduction of a new bus fleet in Tartu's traffic in 2014 and 2019 has made the bus transport safer, but has not had a significant impact on the speed of bus links. The user comfort of the service has also been improved by introducing the bus information system and an electronic bus card. Renewing the public transport network has created a new situation in public transport service provision, the results of which are unknown today. Reduced walking and growing motorisation shares have gone hand-in-hand with lower bus use.

The mobility of Tartu is impacted by transport crossing city borders, with jobs and services available in the city serving as an incentive because the counties often lack alternative options. Today, a large part of that mobility takes place by car, which increases the negative impact of motorisation on the roads and streets of Tartu. Awarding free travel rights on county public transport has increased bus use but has not had a notable impact on decreasing car traffic. Despite constructing the first few non-motorised roads in the outskirts of the city, these have not been popular among local residents as a daily mobility route. The issues include lacking links of the non-motorised roads with the city centre and the poor condition of the inter-city cycling path network.

Innovation in the monitoring and notification of public transport has created a functional bus information system. An equally important innovation is the introduction of joint travel cards on city and county lines. The bike share

platform and its IT support system have been launched very well. As a combination, these elements enable creating new services in the future that are better targeted at satisfying the needs of passengers. In addition, new databases enable improving the overview of transport systems in Tartu and make speedier management decisions. An unavoidable step would be to integrate the existing data collection and ticket systems and join them with the regional and railway services.

8. FUTURE SCENARIOS

The existing mobility programme shares the vision of *Tartu Energia 2030+*:

TARTU IS A SMARTLY DEVELOPING COMMUNITY AND A PIONEER OF GREEN ENERGY!

This vision will be carried out by focussing on increasing the efficiency of transport energy consumption and on reducing its environmental impact. The strategy proceeds from earlier development plans and continues Tartu's activities to develop green mobility. The vision is founded on the following strategic goals:

Tartu has an inspiring, synergistic, and safe urban space that is used and developed according to sustainability principles. Development plan of the city of Tartu 2018–2025

Tartu has an environmentally friendly mobility environment which considers the needs of all modes of mobility and has been integrated into the international transport network. Development plan of the city of Tartu 2018–2025

Tartu is a city where public transport and non-motorised traffic are of high priority. The non-motorised road network is continuous and covers the whole urban region; rail transport has been planned and implemented, where possible. Traffic passing through the city centre and residential areas has been directed to main streets. The comprehensive plan of Tartu 2030+

Bicycle is the preferred mode of transportation throughout the year, and walking is the preferred mode of mobility – residents of Tartu run their daily errands mostly by bike or on foot. Strategic action plan for bicycle traffic in Tartu 2019–2040

Decrease the number of traffic accidents taking place in Tartu (by 2025) by 50% as an average of three years, and achieve a situation where there are no traffic mortalities in Tartu. Traffic safety programme of Tartu 2017–2025.

For the most part of the day, the city centre of Tartu is a lively, pedestrian-friendly, human-dimensioned public space with a wide range of annual living, learning, leisure, shopping, and business options. The comprehensive plan of Tartu 2030+

Starting from 2010, transport fuel consumption and the related emission of greenhouse gases has gradually grown in Tartu (the development plan *Tartu Energia 2030+* includes a more thorough analysis). The main growth derives from the private transport sector (see Figure 16); the local government can mainly influence it by indirect measures, such as organising traffic and parking, shaping the street space, notifying road users, etc. According to the measures outlined in the development plan *Tartu Energia 2030+*, the target is to reduce emissions caused by private transport by 15% compared to 2010. In case of partial or incorrect application of the measures, energy consumption and emissions will not decrease in private transport, its growth trend may continue, and targets may not be met. The share of sustainable transport also depends on the implementation of these measures, which can be used as a general indicator in assessing the sustainability of traffic in Tartu. The estimated distribution of modes of mobility and its changes in case of different scenarios are depicted in Figures 24, 25 and 26:

0. The 'lazy' scenario will not change the current transport organisation

1. The ‘moderate’ scenario addresses energy consumption and slowing the growing emissions
2. The ‘busy’ scenario will reduce private transport emissions by 15% by compared to 2010.

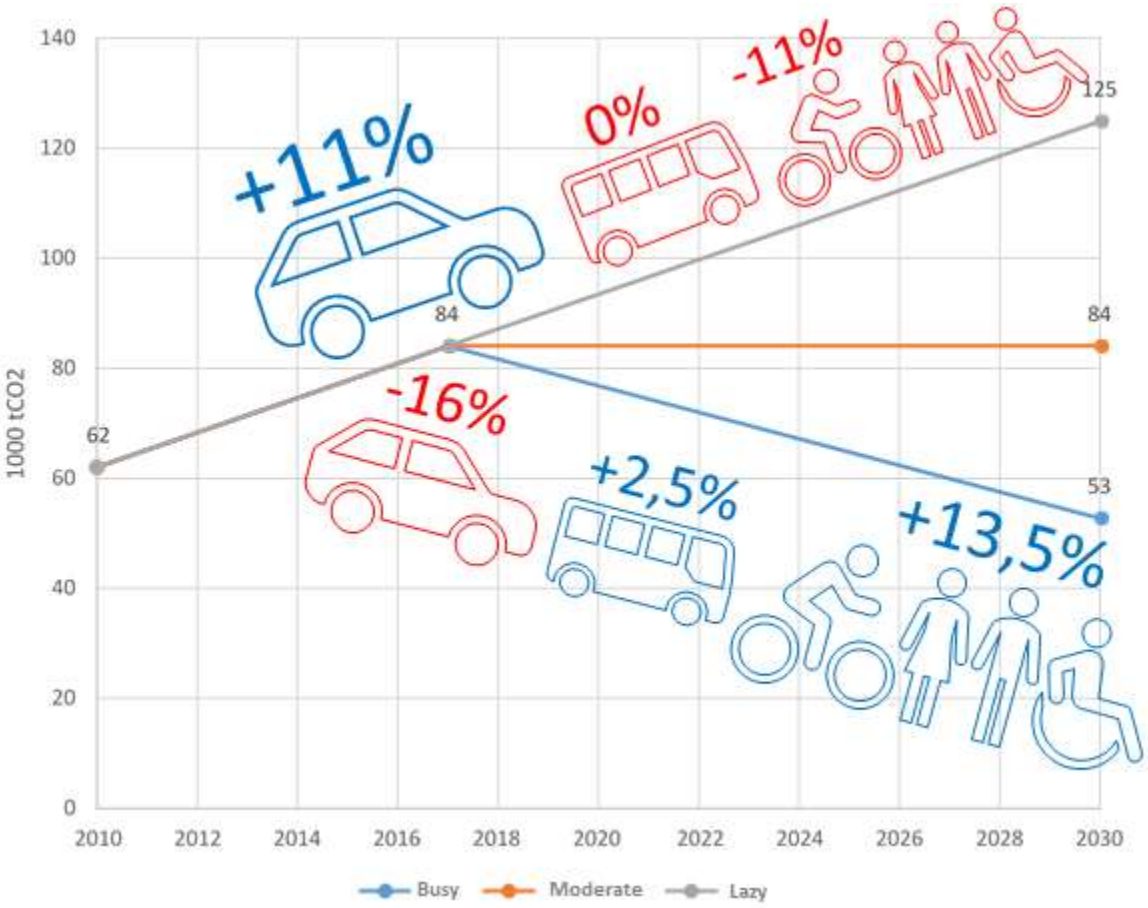


Figure 24. The Tartu private transport emission scenarios in 2010–2018 along with an estimation for 2030. The icons depict estimated changes in the distribution of methods of mobility. TREA carried out the analysis and forecast based on data from the Estonian Road Administration.

0. or the lazy scenario does not foresee significant changes in the city’s transport organisation. Former activities practised in the management of public transport and the development of bicycle infrastructure will continue. A growth in car traffic and the declining share of sustainable transport in everyday city traffic will continue, and by 2030, 20,000 passenger cars owned by the citizens of Tartu will be added on the city streets (as well as twice as many cars owned by daily commuters). The total count of cars on the streets of Tartu exceeds the number of residents. The share of car traffic in daily mobility reaches 57% and the share of physical activity on city streets is reduced to 18.5%. The share of public transport will still account for 21.5% of mobility (see Figure 25). New highways constructed to accommodate car traffic will continue to reshape the city space, monopolising more room for constructing new carriageways, but the overall traffic speed will drop regardless.

1. or the moderate scenario also foresees measures which will stop the growth of energy consumption in city transport. If this scenario is implemented, the city will be able to prevent the increase in using passenger cars and create advantages for active mobility and public transport. The distribution of mobility methods will remain similar to the existing situation: car traffic dominates with 46%, followed by public transport and walking with 21.5%, and bike use with 8% (see Figure 25).

2. or the busy scenario foresees a reduction in private transport energy consumption by 15%. Upon implementing this scenario, all mitigation and adaptation measures described in the development plan document of *Tartu Energia 2030+* must be implemented in full. Car traffic will account for 30% of everyday

mobility by 2030 and 13% by 2040. The rate of cars will be reduced to 300 vehicles per 1,000 residents. The share of public transport reach 24% by 2030 and 30% by 2040. The share of active mobility will grow up to 40% by 2030 and 49% by 2040 – approximately 50% of everyday movements will be made on foot or by bike (see Figures 25 and 26).

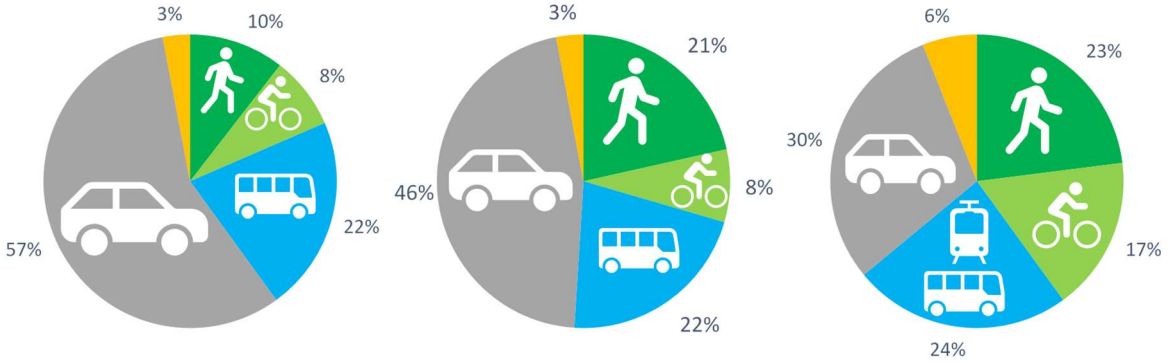


Figure 25. Expected distribution of modes of mobility in 2030 in case of a lazy (on the left), moderate (in the middle), and busy scenario

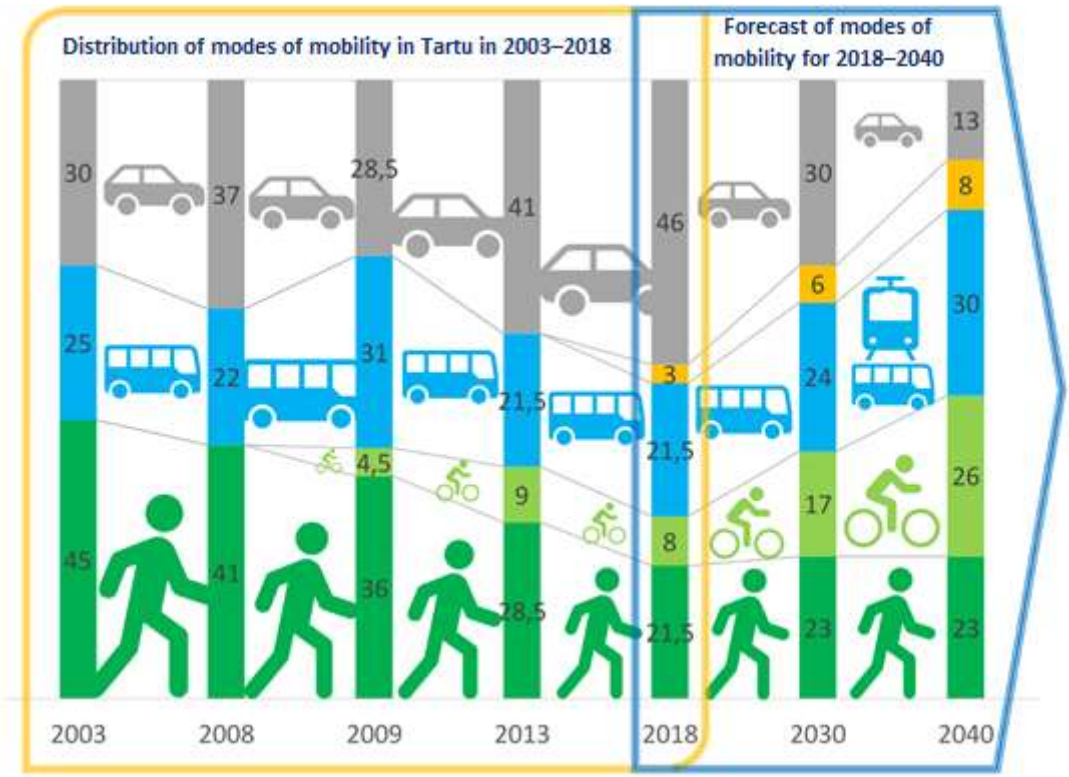


Figure 26. Distribution of modes of mobility and estimation up to 2040. Source: *Tartu Energia 2030+*, TREA 2019.

As the citizens' interest in green means of transport is big, the guiding principle of the *Tartu Energia 2030+* action plan is to enable mobility:

- → Create the infrastructure required for active mobility;
- → Ensure the safety of mobility;
- → Reduce the number of passenger cars in the streets;
- → Develop fast bus and tram links;
- → Link different mobility methods better;
- → Bring services closer to people;

→ Develop innovative services.

Over the period, sustainable, i.e. non-motorised mobility will account for 70% and car transport for 30% of total mobility. Instead of carriageways, fast cycling paths and slow pavements will be constructed. Out of new transport technologies, electric buses and trams will be introduced, and the recharging infrastructure of electric vehicles will be developed further. In terms of mobility methods, the largest development is expected for bicycle transport, the share of which in total mobility is 17% in 2030 and 26% in 2040. The role of public transport will grow in the city and after linking it to the adjacent areas, South Estonia, and other regions. In order to join different needs of mobility seamlessly, a multimodal transport hub will be created at the heart of town, supported by mobility points located in the suburbs (and elsewhere). On-demand transport in the county enables increasing the role of public transport in cross-border mobility. By extending bike share services to the nearby rural municipalities, the share of active physical mobility will increase in cross-border commuting. Innovation in transport organisation will continue by extending the real-time information system to the county lines, as well by applying joint passenger validation and joint tickets to different transport services (and by also involving support services). Similarly to preparing the development plan, its implementation will be carried out in cooperation with the community, involving stakeholders and by planning, preparing, conducting, and assessing their results together.

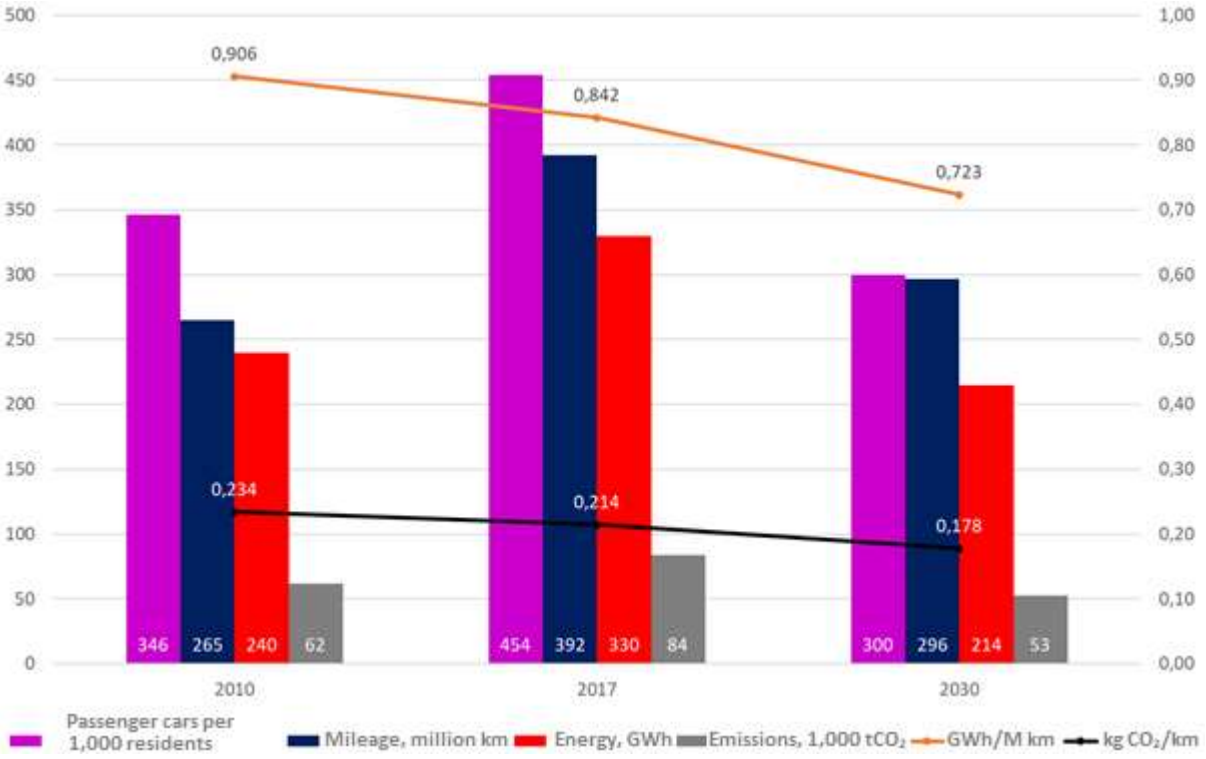


Figure 27. Motorisation, vehicle mileage, energy consumption, and emissions in the private transport of Tartu along with a forecast for 2030. Source: *Tartu Energia 2030+*, TREA 2019. The data used are from the Estonian Road Administration and Statistics Estonia.

The *Tartu Energia 2030+* development plan develops the main strategic measures into nine operational programmes (see Figure 28) along with a strategic support action of implementing the good practice of involvement. Out of the nine operational programmes, one (the traffic safety programme of Tartu) has been already prepared and will be updated by 2025. The remaining 8 are to be prepared over the years following the completion of the development plan. These operational programmes form a complete whole, the different parts of which support achieving the goal, i.e. reducing energy consumption and emissions in city transport.

Based on the terms of reference, this programme focuses on two aspects of mobility in Tartu and its outreach: a) multimodality of mobility, i.e. the variety of mobility methods used, and b) the role of regional public transport. Special attention is paid to decreasing the impact of city-bound mobility from the suburbs and rural regions, incl. commuting. In the *Tartu Energia 2030+* transport action plan, these goals are achieved by the multimodal mobility plan (A7), which will be prepared next. Specific tasks required for developing public transport will be gathered in the future public transport plan of Tartu (A6).

Figure 28. Transport action plan of *Tartu Energia 2030+*. Source: *Tartu Energia 2030+*, TREA 2019.

9. PREPARING THE MULTIMODAL MOBILITY PLAN

This document is the multimodal mobility plan (A7) to be prepared as part of the *Tartu Energia 2030+* action plan, the energy and climate programme of Tartu, which proposes activities for combining different methods of mobility during a single journey, thereby creating a mobility model which meets people's needs better and reduces their car use. Cross-use of different mobility methods has been a tradition in Tartu based on the large impact of walking and public transport on the mobility of the city and adjacent areas, which enabled satisfying the need for transport with a smaller number of vehicles and at lower traffic density. Today, walking has been increasingly replaced by the dominating use of passenger cars, as a result of which, the multimodality and flexibility of transport system (combining different mobility methods or public transport services during a single journey) is declining. It is especially visible in the mostly car-based mobility across the city borders. By combining different methods and services of mobility, the multimodal mobility model enables using the advantages of all methods of mobility (for example, by combining walking with public transport or bike share, one still benefits from the healthy impact and environmental friendliness of walking, while increasing the extent and speed of mobility in longer distances) and overcome their disadvantages, resulting in mobility services which meet the users' needs better.

The mobility plan also foresees the development and wider use of innovative technological measures (a joint validation card and a real-time information system) that support multimodality. The plan supports achieving the goals of the strategic action plan for bicycle traffic in Tartu in 2019–2040, which is being prepared, by promoting the important role of bicycle traffic in city traffic. The mobility plan also supports preparing operational programmes of the transport action plan *Tartu Energia 2030+*: Active Physical Movement plan, the motorisation reduction plan, and the public transport action plan (actions A1, A3, and A6 of the transport action plan *Tartu Energia 2030+*), which, in turn, support implementing the mobility plan activities.

9.1. OPERATIONAL PROGRAMMES A1, A3, AND A6 SUPPORTING THE MOBILITY PLAN

The **Active Physical Movement plan (A1)** helps to increase the share of active movement (on foot, by bike) in urban mobility. The objective of the plan is to improve active mobility options within the city by improving mobility safety and road quality. In addition, the actions of the plan help to raise awareness about the options and benefits of active movement among the citizens. Implementing the plan will have an impact on carrying out the objectives of the *Tartu Energia 2030+* action plan, and the success of all other operational programmes (including the present mobility plan) will depend on it. The objective of the plan is to increase the share of sustainable transport, i.e. non-motorised transport, to 70% of all mobility.

In order to reduce the negative impact of motorisation, operational programmes of *Tartu Energia 2030+* will include the **motorisation reduction plan (A3)**, which will give an overview of activities that reduce motorisation and define the importance of and procedure for implementing these activities. Implementing the plan will reduce the use of fossil transport fuels, emissions resulting from the use of fuels, pollution, noise caused by car transport, vibration, danger to the life and health of road users, and the use of public city space. Upon implementing the plan, journeys made by passenger cars will not exceed 30% of all mobility, and the share of passenger cars will remain within the limits of 300 cars per 1,000 residents. Surveys show the citizens' great interest in active mobility, which is why motorisation will be reduced while providing residents and visitors with good non-motorised traffic and public transport solutions. Key activities of the motorisation reduction action plan: 'Creating car-free zones and logistics restrictions in the walking streets of the city centre' and 'Closing up the city centre to passenger cars passing through by 2030', as well as additional activities proposed during the preparation of the plan, will have a direct effect on the implementation of this mobility plan.

The objective of the **public transport plan (A6)**, which is being prepared, is to increase the popularity of public transport as an everyday mode of mobility among the residents of Tartu. Public transport is a comfortable, fast, and safe mode of mobility, which grants access to all city services. The role of public transport in supporting other mobility methods is also important for the multimodal mobility model, for it adapts to the pedestrians' needs when covering large distances. The public transport service is developed along with near-urban, regional, national, and international public transport services. Public transport will use low-emission energy sources – biogas, electricity, or hydrogen produced from renewable energy sources. Key activities of the public transport plan, namely 'developing the priority and lanes of public transport', 'integrating the management of national, regional, county, and city public transport systems', and 'introducing a tram system', as well as additional activities proposed during the preparation of the plan, will have a direct effect on implementing this mobility plan.

9.2. MEASURES FOR MITIGATING CLIMATE CHANGE

This mobility plan supports the action plan *Tartu Energia 2030+* and its climate change mitigation measures CCM 4. 'The multimodal traffic hub links different means of transport' and CCM 5. 'The hinterland is linked to the city via sustainable transport solutions'. These measures will create the necessary service and support structure for developing public transport services, as a result of which, the use of passenger cars and the resulting environmental impact will be reduced.

STRATEGY CCM 4. THE MULTIMODAL TRAFFIC HUB LINKS DIFFERENT MEANS OF TRANSPORT

Including:

CCM 4.1. The multimodal hub will link different means of transport in the city centre
CCM 4.2. The multimodal hub will join new means of transport to be developed (such as trams, river transport, etc.)
CCM 4.3. Frequent air transport is linked to the city's transport network

CCM 4.4. A joint ticket system, travel planning, and real-time vehicle monitoring systems have been created for public mobility services
CCM 4.5. The real-time information system covers most of the city and is extended to the adjacent rural municipalities
CCM 4.6. Local mobility points have been created in the suburbs for improving transport connections

The strategy is based on issue I4 of the *Tartu Energia 2030+* transport action plan, 'The consistency of means of transport (multimodality) is poor', which has a grave negative effect on the access to city services. Complicated links between different modes of mobility have caused an additional time and energy expenditure and reduced people's readiness to use these links. Measures of the strategy link different public transport services, redefining the role of public transport in developing the role of public transport in the city.

STRATEGY CCM 5. THE HINTERLAND IS LINKED TO THE CITY VIA SUSTAINABLE TRANSPORT SOLUTIONS
Including:

CCM 5.1. The access of residents of nearby urban regions to the city by public transport and non-motorised traffic is good
CCM 5.2. Priority access to services has been created for public transport users and active road-users
CCM 5.3. Multimodal mobility points connect commuters with other modes of mobility
CCM 5.4. A public transport terminal has been constructed in the city centre: it ensures safe and comfortable access, travel information, a weather-proof waiting area, access to other means of transport, and other support services
CCM 5.5. New methods of transport management have been introduced: on-demand transport, travel share, car share
CCM 5.6. On-demand stops and on-demand transport resolve the needs of mobility if the main lines fail to do so
CCM 5.7. Public transport fees do not exceed 1 euro per journey and a monthly ticket should cost the same as it does in the city, i.e. 16 euros
CCM 5.8. The acceptable and recommended time of walking is 15 minutes (or a distance of 1 km) per journey
CCM 5.9. On-demand stops meet the safe mobility requirements
CCM 5.10. The average speed outside settlements does not drop under 50 km/h
CCM 5.11. Public transport systems are interlinked and jointly managed

The strategy is based on issue I3 of the *Tartu Energia 2030+* transport action plan, 'Insufficient access of the residents of nearby urban regions to the city', which has a grave effect on access to the city services and service quality. Issue I3 causes motorisation and therefore has a harmful impact on the environment and people's health. The important factor is the complete dependence of new regions of urban sprawl on the city's services and the resulting need for daily commuting. In addition, great dependence on the city's services has become characteristic of more distant communities as well, because they have lost the capability of providing these services locally. Measures of the strategy support the position of Tartu as a centre of attraction in South Estonia, whereas the direct and indirect environmental impact of commuting and regional migration is reduced.

10. MOBILITY PLAN

Based on the terms of reference, this report proposes activities which could decrease the use of passenger cars in city-bound mobility by 2030. Creating mobility points in the city centre and suburbs takes centre stage, which is supported by innovation in public transport organisation (introducing a joint information system for county lines and city buses), extending the city's public transport and bike share services to adjacent rural municipalities, creating fast bicycle and bus connections between the city centre, the train station, and the Maarjamõisa hospital campus.

10.1. MOBILITY POINTS

Joining different modes of mobility in the city centre by creating a multimodal mobility point and bus terminal will connect all mobility services in a central location in the city centre along with necessary support services: a safe waiting area open 24/7, tourist information, travel planning/booking, ticket services, etc. Access to the mobility point is ensured by sustainable means of transport, it is located in the immediate vicinity of walking streets in the city centre, and public and commercial services will be brought close to the hub, thereby mitigating the need of forced mobility. The mobility points will include parcel and ordering service points (parcel robots, parcel machines, etc.) along with easy access to public transport; have storage and maintenance facilities of personal bicycles or other means of transport; and provide other important and up-to-date information about the city or the community that is not only related to transport. The mobility point will consider prospective public transport solutions and will enable users to access railway transport and river transport.

The location of the central mobility point is the Turu-Riia intersection and its vicinity. In order to enable new functions, a spatial plan will be prepared for reorganising the city space around the intersection, the traffic solution of the street and junction areas, reserving a sufficient territory and providing priority access to means of public transport and non-motorised traffic. The new spatial plan will be selected as a result of an international architectural competition. A spatial study will be conducted together with the public survey for developing the multimodal mobility points.

Local mobility points will be developed in the outskirts of the city (Nõlvaku, Põllu, Lõunakeskus, Ringtee, Ropka), which will decrease the volume of private transport heading to the city centre and will be combined with bike share and park-and-ride solutions. In addition, a mobility point will be constructed in the Maarjamõisa city district, providing users of public transport priority access to health care services.

10.2. INTERCONNECTED PUBLIC TRANSPORT SERVICES

Interconnected Public Transport Services are removing the artificial gaps between different transport services and will provide a seamless experience for the end-users. Existing gaps are caused by different managerial practices of the public transport service providers and are originated from different nature of public mobility services (city vs rural vs regional vs international transport etc). Existing system of multiple service providers will be replaced by one single service provider that will also work closely with the national and international services as well as local bicycle sharing and active transport groups. New service provider will be responsible for public transport services in City and in County of Tartu as well as fostering the innovation, developing new services, implementing new technologies, monitoring and quality control of the services and cooperation with the community for improving the quality of the public transport services. A survey will be prepared for mapping the needs and requirements of the commuters. Development program will be prepared for analysing suitable management models for the new service provider, also supporting the other stakeholders with capacity building for continuing innovation. Extended City Bike System (see 10.9.) and Rapid Cycling Network (see 10.10) will support the accessibility of new public transport services. Unified ICT platform will be created incorporating the supporting online services for traffic information, real-time monitoring of services, travel planning, on-demand (and other demand based) services, ticketing, private car parking (park-and-ride etc), traffic safety etc. Unified real-time monitoring system (cee 10.4.) will be developed and with the display stands in mobility points and bus stops. Mobility Points will be developed (see 10.1.) for connecting different transport modes in City of Tartu.

In the first phase will be integrated Tartu´s bike-share information with Google's travel planner service, and the next phase will test the compatibility of real-time transport modes of different transport modes by installing 2-3 information kiosks at important transport nodes.

10.3. Rapid Public Transport Services

Rapid Public Transport Services will improv the overall speed of public transport modes by connect different districts inside and outside the city borders with the new rapid transport services that are designed to carry passengers through the urban traffic load. RPT system is supported by the city regular bus lines. Two types of transport technologies will be used: dedicated traffic lines for shuttle buses (high capacity electric buses) and a light rail transport system. These measures can ensure the speed and quality of public transport services not depending on the traffic load on the streets and by this offering appealing alternative for private car usage in city and suburban areas. Rapid Public Transport Services will provide increased accessibility for the public transport services to the main services of the city by interconnecting the Multimodal Mobility Points (will be created in 10.1.) and connecting these with city centre, train station, hospital and university campuses.

For assessing the cost, gain and specific needs of the new transport services, a feasibility study will be conducted in first phase. Addition to this, a public survey will be conducted for assessing the public acceptance of new interruptive technologies. As a first pilots shuttle connections between the city centre and railway station and airport will be conducted.

10.4. Public Transport Monitoring System

Similarly to public transport within the city, a real-time information system will be introduced for public transport lines outside the city (county lines), and it will be integrated with the joint bus information system, which will include travel information, travel planning, and booking / on-demand stop / ticket purchase applications. The electronic information boards of county lines will be installed in joint stops (Kaubamaja, Pauluse, etc.), as well as in the mobility points to be created.

Integration of county lines with the information system will be carried out upon updating the system, which will improve the operational reliability of the current city bus information system and its integration with other data platforms. The county line information system will display additional information for implementing on-demand transport solutions: free spaces on the bus, route, location, distance from a stop, etc., and the system will also enable three-way communication between the stop, the public transport control centre, and the en-route bus. The information system will also provide bus drivers and passengers with weather information and traffic safety notifications. Installation of first 2-3 electronic informational boards to test integration and compatibility of informational systems will be made as a pilot project.

10.5. Extended City Public Transport Services

In order to improve the access of adjacent regions to Tartu, public transport lines will be extended to the new urban regions in the outskirts of the city by integrating them with the city's public transport network. The existing bus stop network will be used where possible, and new stops will be added, if necessary. The stops will be equipped with security cameras and vandalism-secure infrastructure, and the local community will be involved to prevent vandalism. The stops will also be equipped with real-time information boards that will display city and county line information. Analysis of the need for extended services will be conducted in the beginning of the action.

10.6. Linked transport hubs

The mobility point to be constructed in the city centre will be linked with the train station and airport to provide smooth connection to regional and international journeys. Public shuttle lines will move between the train station and the mobility point at 15-minute intervals from 6 a.m. to 9 p.m. Shuttle lines between the airport and the mobility point will move at 15-minute intervals in conjunction with the flight schedule, enabling passengers to arrive to and depart from the airport 1.5 hours before the planes depart or land. Similar shuttle lines will link all the mobility points to be created, ensuring buses with a 15-minute departure interval. These shuttle buses will only stop at the future mobility points. Using a shuttle bus is free of charge for transit passengers (the fee is

included in the connection or hourly ticket prices). Information concerning shuttle buses is displayed in Estonian, Russian, and English. With shuttle buses, a fast direct-link system will be added to the existing public transport network, which meets the needs of migration between city districts and the future park-and-ride service users better.

10.7. ROUTE TICKET

The route ticket is valid for one-way journeys and covers bus lines and bike share. In the future, regional public transport, including train traffic, will be integrated into the same system. A route ticket is the next stage of introducing new transport services, which include on-demand transport, travel share, car share, mobility as a service (MaaS), short-term car rental, and bike and scooter share services.

10.8. PARK-AND-GO SOLUTIONS

The park-and-ride tickets give passengers who park their passenger cars a right to travel by public transport and bike share services, which will reduce car traffic between city districts. The park-and-ride car park locations will be adapted to the locations of suburban mobility points, providing visitors arriving by car with direct access to the inter-city public transport network.

10.9. EXTENDED CITY BIKE-SHARING NETWORK

Extending the bike share service to adjacent regions of the city will be carried out in the following stages: Kõrveküla, Vahi, Ülenurme, Tõrvandi, Veibri, Lohkva. Also Rahinge, Märja, Haage, Ilmatsalu. The extension will support constructing non-motorised roads in the adjacent areas of the city, such as the non-motorised road to be constructed from Tartu to Rahinge (by the Ilmatsalu road), etc. By extending the area, new recharging docks and bikes will be added, and the service area will widen. Recharging docks will be constructed in cooperation with the local government, following the needs of the non-motorised road network and non-motorised road users. The recharging docks will be equipped with security cameras and vandalism-secure infrastructure, and the local community will be involved to prevent vandalism. Three new bike-sharing stations will be installed to neighbouring villages outside of the city border.

10.10. RAPID CYCLING NETWORK

In order to link the mobility point with other city districts, fast bike lanes will be constructed between the city centre and other city districts, enabling non-motorised road users to travel at an equal (or higher) speed with car traffic. The first fast connections will be established between the city centre and the train station, and between the city centre and the Maarjamõisa campus, which will involve completing the ongoing reconstruction works of the Vanemuise Street. Creating bicycle links will involve their maintenance 24/7 and throughout the year to ensure travel safety and monitor and measure their use. Fast bicycle connections play an important role in improving access to future mobility points. First pilot activities include the reconstruction works of the Vanemuise Street and construction of tunnels through the railway duct on Riga Street.

10.11. BICYCLE LIBRARY

To increase the use of bicycles, a bike rental following the Nordic concept of so-called bicycle libraries will be introduced, which will provide users with a wide selection of bikes for different occasions, starting from heavy-duty cargo bikes to light fold-away bikes and fast electric bikes. The bicycle library will supplement the activity of the already functioning bike share service, providing users with bigger freedom of choice and flexibility when choosing a mode of mobility. Bicycle libraries will belong in the composition of all seven mobility points to be

created. Additional information on the innovative solution that promotes the use of bicycles is available on the website of the Växjö City Government (in Sweden)[7] [8].

10.12. ACTION PLAN TABLE

Table 4. Mobility plan activities

No.	*Action*	*Time*	*Budget*	*Responsible department*	*Parties*
1	Mobility points				
2	Interconnected Public Transport Services				
3	Rapid Public Transport Services				
4	Public Transport Monitoring System				
5	Extended City Public Transport Services				
6	Linked transport hubs				
7	Route ticket				
8	Park-and-go solutions				
9	Extended City bike-sharing Network				
10	Rapid Cycling Network				
11	Bicycle library				

11. INDICATORS AND METRICS

As a rule, data related to the city government investments and fixed costs will be measured: use of public transport; use of roads/streets (incl. entering/exiting traffic flow); modal split of mobility; parking volume; air quality; fuel consumption of buses; etc. The measuring point locations will be selected so that the data will form a general picture of the use of roads and streets, the traffic flow, and its impact.

The data will be processed automatically: all the collected information is gathered on a single data management platform, the algorithms of which will perform real-time data-mining and analysis. Data collected in databases are available for cross-using and comparison with national (e.g. data collected by the Estonian Road Administration and Statistics Estonia) and private (e.g. data collected by transport, parking, and mobile communication providers) data banks. The existing separate city transport databases (e.g. the public transport information systems, traffic counters, etc.) are gathered on a common platform by using a standardised methodology, thereby harmonising the format, collection and storage procedure, and level of precision of data, as well as the created metadata.

The measurement results are public, while ensuring the integrity of personal data and people's right to privacy by anonymity of data. Numeric data is displayed in real-time on the city's website and as automatic notifications in social media (for example, 'Yesterday, Tartu saw an influx of a record number of 66,666 vehicles' or 'Caution!'

[7] http://mosaik.vxonews.se/article/bicycle-library-opens-in-vaxjo
[8] https://www.vaxjo.se/cykelbiblioteket

Between 8.08 a.m. and 8.18 a.m., the line buses in Annelinn may be overfilled; choose an earlier or later connection, if possible').

The largest possible amount of raw data is made available to the public to promote the creation of third-party applications for data analysis. Without the benefit of a large number of consumers, Tartu can still become a test area of new data applications. To achieve that, Tartu cooperates with companies active in data processing and communication.

Upon the collection of qualitative data, random surveys will be accompanied by long-term target group studies, which will give an overview of mobility method preferences and causes for their changes in Tartu over several decades. Studies carried out over a long period of time may provide a better overview of people's traffic behaviour, which may largely differ from responses to an irregular quick poll. Based on the practice of other countries, long-term target group studies will be conducted in cooperation with local research institutions, they will be prepared and conducted in a methodological way, and their results can be compared to study results from other regions and countries. Long-term studies help to create a methodological background for conducting short-term surveys or information campaigns in the future.

12. MONITORING AND UPDATING THE MOBILITY PLAN

Implementing the mobility plan will be the responsibility of the transport office of the Department of Communal Services, which will observe the implementation of the mobility plan and report the achieved results. The annual reporting of the mobility plan will follow the City Government's existing procedure for reporting on development plans. The report summaries will be prepared and submitted to supervisors of the international projects OptiTrans, SUMBA, and *Cities.Multimodal* according to the method specified in the projects. Internally, the mobility plan reports will be submitted to the supervising committee of the climate and energy programme *Tartu Energia 2030+*, which will include them in the joint report of the Covenant of Mayors. Success stories and good lessons of the mobility plan will be published on the Sustainable Tartu website along with supporting picture and multimedia materials. In addition, publishing the results of the mobility plan will follow the communication plan of the *Tartu Energia 2030+* development plan.

Updating the mobility plan will be carried out in conjunction with updating the transport action plan of the *Tartu Energia 2030+* development plan. Upon the completion of the new operational programmes (Active Physical Movement plan A1, motorisation reduction action plan A3, public transport plan for Tartu A6), the mobility plan's chapters covering non-motorised traffic, motorisation, and public transport will be updated. Upon completing all the ten operational programmes by 2024, a consolidated single document will be prepared of operational programmes of the transport action plan, which will include harmonising the structure and layout of the operational programme document with the requirements of the new document.

12.1. MAIN INDICATORS

Table 5. Main indicators of the mobility plan

Indicator	***Unit***	***Frequency***	***Target level***
Number of buses;	pc	5 years	
Number of cars per 1,000 residents;	pc	year	< 300
Number of bicycles per 1,000 residents;	pc	year	
Total number of public transport line kilometres and covered kilometres;	km	year	
Total number of kilometres covered by car;	km	year	

Number of cars entering/exiting the city on a daily basis;	pc	24 hours	
Share of car transport in traffic visiting the city on a daily basis;	%	24 hours	
Total number of kilometres covered on foot;	km	year	
Number of pedestrians entering/exiting the city on a daily basis;	pc	24 hours	
Share of walking in traffic visiting the city on a daily basis;	%	24 hours	
Total number of kilometres covered by bicycle;	km	year	
Number of cyclists entering the city on a daily basis;	pc	24 hours	
Share of cyclists in traffic visiting the city on a daily basis;	%	24 hours	
Number of public transport users entering the city on a daily basis;	pc	24 hours	
Share of public transport users in traffic visiting the city on a daily basis;	%	24 hours	
Multimodality in city traffic;	%	24 hours	
Entering/exiting multimodality;	%	24 hours	
Transport energy consumption per resident;	kWh	year	
Transport emissions per resident;	kgCO2	year	
Average distance and travel time on foot;	km, min	year	
Average distance and travel time by bus;	km, min	year	
Average distance and travel time by bicycle;	km, min	year	
Average distance and travel time by car;	km, min	year	
Door-to-door travel time by sustainable transport;	km, min	year	20
Door-to-door travel time by car;	km, min	year	45
Kilometres covered on foot and the share of walking in total city mobility (modal split);	km, %	year	23%
Kilometres covered by bus and the share of bus rides in total city mobility (modal split);	km, %	year	24%
Kilometres covered by bicycle and the share of bike rides in total city mobility (modal split);	km, %	year	17%
Kilometres covered by car and the share of car rides in total city mobility (modal split);	km, %	year	30%
Kilometres covered on foot and the share of walking in total entering/exiting mobility (modal split);	km, %	year	
Kilometres covered by public transport and the share of public transport rides in total entering/exiting mobility (modal split);	km, %	year	
Kilometres covered by bicycle and the share of bicycle rides in total entering/exiting mobility (modal split);	km, %	year	
Kilometres covered by car and the share of car rides in total entering/exiting mobility (modal split);	km, %	year	
Traffic volume of daily commuting;	pc	year	
Public transport costs per person;	euros	year	
Public transport fees per person;	euros	year	
Car transport costs per person;	euros	year	
Car transport fees per person;	euros	year	
Number of severe traffic accidents and the number of traffic deaths;	pc, pc	year	0

Transport energy consumption across sectors (private, public and service transport);	GWh	4 years	214
Transport energy consumption across types of fuel (diesel, petrol, gas, electricity, biogas);	GWh	4 years	
Transport emissions across sectors.	1,000 tCO_2	4 years	53

13. ANNEXES

ANNEX 1. Analysis of the Tartu transportation system conducted within the OptiTrans project

ANNEX 2. EUROSTAT data on the ratio of passenger cars in the Member States of the EU

ANNEX 3. Non-motorised traffic scheme of the Tartu comprehensive plan

ANNEX 4. Information brochure for the Tartu Smart Bike Share

ANNEX 5. Direct mail brochure for the new Tartu bus line network

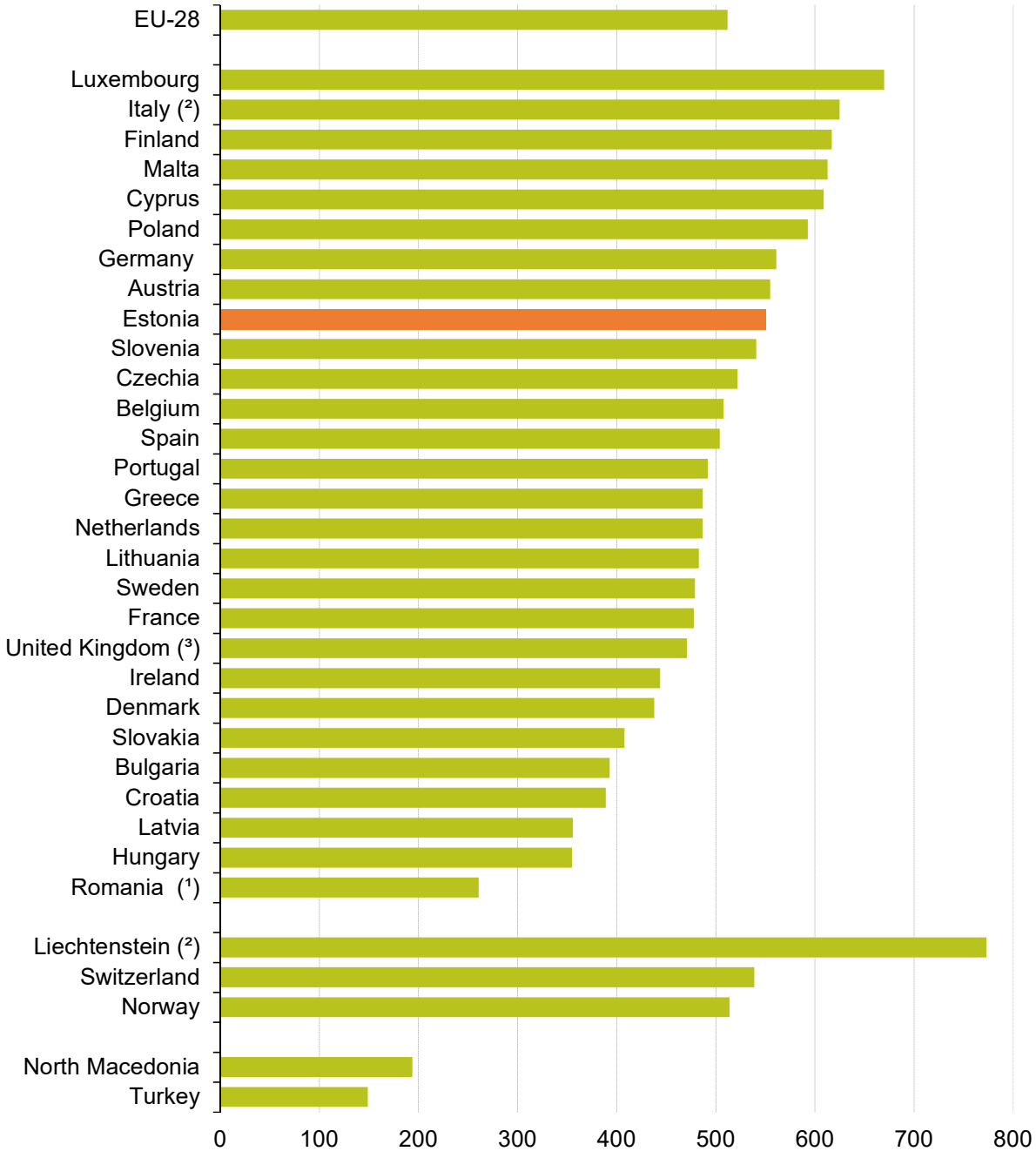
ANNEX 6. Assessment of non-motorised roads in Tartu

ANNEX 7. Counting non-motorised road users within the SUMBA project

ANNEX 8. Measuring traffic density within the SUMBA project

TUGEVUSED-OHUD	TUGEVUSED	NÕRKUSED	VÕIMALUSED-NÕRKUSED
Ühistranspordi ja kergliikluse arendamiseks juba tehtud ning tulevikus tehtavad jõupingutused/investeeringud võimaldavad vähendada autostumist linnas ja suurendada säästlike transpordiviiside kasutust; jalgrattateede arendamise kava elluviimine loob märkimisväärselt paremad tingimused jalakäijatele ning jalgratturitele; Busside liinivõrgu järjepidev arendamine võimaldab parandada ühistranspordi ühendusi ja hoida selle atraktiivsust; hea koostöö huvigruppidega aitab parandada liikluskultuuri ja planeerida paremini lähtuval kasutajast taristut.	Üldiselt sujuvalt toimiv transpordisüsteem; kompaktne linn; kvaliteetne bussitransport (uued bussid, madalapõhjalised, keskkonnasõbralikud); IT-lahenduste kasutamine ühistranspordis (piletisüsteemid, reaalajasüsteem); tihe bussipeatuste võrgustik; bussi- ja raudteejaam on kergesti kättesaadavad; busside liinivõrgu arendamine; arenev kergliiklusteede võrgustik; rattamajade rajamise toetamine; hästi toimiv parkimine; soodne bussipileti hind; aktiivsed kogukonnad; bussiliinid on hea katvusega; uuendusmeelsus; aktiivne tegelemine transpordiküsimustega (sh. kergliikluskomisjon); kvaliteetne teede- ja tänavate võrgustik.	Ebapiisavalt raudtee- ja jõe ületuskohti; Konfliktsed ristumised raudteega; ühistranspordi kiirus liiga madal; busside intervallid liiga pikad; bussiliinid ei ole seotud linna lähipiirkondade elamualadega; sõidu- ja kõnniteede katendid halvas olukorras; suur osa liiklusest kulgeb läbi kesklinna; madal liikluskultuur; kergliiklus on linnaruumis liiga madala prioriteediga; suurte sõidukite parkimiskorraldus ebapiisav; erinevad pileti- ja maksesüsteemid (erinevates transpordiliikides); bussi- ja raudteejaam nõrgalt seotud; ühistranspordi sõltuvus muust transpordist (puuduvad prioriteedisüsteemid); jalgrattateede võrgustik on katkendlik; Riia-Turu ristmik kergliiklejatele suletud; linnaplaneerimine puudulik; vähene teavitustöö; IT-süsteemid tõrguvad (reaalaja infosüsteem); puudub keskne linnaliinide bussiterminal.	Senisest aktiivsem ja süsteemsem teavitustegevus võimaldab parandada liikluskultuuri ja tõsta säästlike liikumisviiside (jalakäimine, jalgrattasõit, ühistransport) mainet ning kasutatavust; uute IT süsteemide juurutamine ja olemasolevate sihipärane arendamine võimaldavad parandada eelkõige ühistranspordi kasutusmugavust ning siduda erinevaid pileti- ja maksesüsteeme; linnaruumi planeerimisel lähtuda kergliikluse ja ühistranspordi prioriteetidest; autoliikluse piiramine eelkõige kesklinna piirkonnas annab võimaluse kergliiklejatele ja soodustab ühistranspordi kasutust;
Ühistranspordi saavutatud tase (kvaliteet, piletite hind) väärib hoidmist ja edasiarendamist; olemasolevat bussiliinide võrgustikku tuleb pikendada linnalähialadele (elamurajoonid) ja korrigeerida liinivõrku selliselt, et see vastab olemasolevatele ning tulevastele arengutele linnaruumis ja linna ümbruses; hea teede ning tänavate võrgustik (sh. valminud Idaringtee etapid) võimaldavad suunata autoliiklust kesklinnast mööda; aktiivsete kodanike, huvirühmade ja kogukondade kaasamine liikluskorralduslikesse aruteludesse võimaldab leida lahendusi säästlike liikumisviiside laiemaks kasutamiseks; uuendusmeelsus, tehnoloogilised arengud ja hea koostöö huvigruppidega võimaldab arendada välja nõudetranspordisüsteemi ning jagamismajanduse (sõidujagamine, rattaringlus) lahendusi.	Uute elurajoonide teke soodustab nõudetranspordi arendamist ja jagamislahenduste juurutamist (autojagamine, rattaringlus); rongiliikluse tihendamine annab võimaluse rongi- ja bussiliikluse paremaks sidustamiseks; linnalähedased elurajoonid annavad võimaluse kergliikluse- ja ühistranspordi arenguks ning erinevate transpordiliikide paremaks sidustamiseks; autoliikluse takistamine mõjub soodsalt ühistranspordi ja kergliikluse arengule; IT valdkonna arengud võimaldavad integreerida uusi lahendusi transpordisüsteemi (integreeritud piletisüsteemid, reaalajasüsteemid, integreeritud makselahendused, boonussüsteemid säästlikele liiklejatele, liiklusstatistika) ja parandada kasutusmugavust;	Auto kasutamine liiga mugav ja pärsib säästlikemate transpordiviiside arengut; kehvalt funktsioneeriv ühistransport (busside ületäituvus, graafikust mittekinnipidamine, pikad intervallid busside vahel, määrdunud bussid) kahandavad ühistranspordi mainet; erineva taseme transpordilahendused (linn, maakond, riik) ei ühildu; puudulik või kehvalt planeeritud taristu (katkendlikud jalgrattateed, korrektselt valgustama ülekäigurajad, arvukad ringristmikud, vähene sildade arv) takistab säästlike transpordilahenduste arengut; ühistranspordi kvaliteedi paranedes hakkavad seda rohkem kasutama senised jalakäijad ja jalgratturid, mitte autokasutajad; mootorikütuste hinnakõikumised põhjustavad ootamatuid lisakulusid ja avaldavad survet ühistranspordi piletihinnale; säästlikud transpordilahendused konkureerivad omavahel; madal liikluskultuur takistab kergliikluse arengut; välised regulatsioonid takistavad plaanide elluviimist.	Valminud Idaringtee osa võimaldab suunata autoliiklust kesklinnast eemale; kesklinna senisest suuremas mahus avamine kergliiklusele (Riia-Turu ristmik, Vabaduse pst....) parandab kergliiklejate võimalusi, vähendab autoliiklust ja loob eelduse linnaliinide bussiterminali rajamiseks , mis omakorda tõstab ühistranspordi atraktiivsust ja prioriteeti; hästiplaneeritud investeeringud taristusse (eelkõige kergliiklusteede rajamine ja olemasolevate teede ning tänavate katendite korrastamine) tõstab kergliikluse atraktiivsust; hästi läbimõeldud ja selgelt prioriteetidest (kergliiklus, ühistransport) lähtuv planeerimistegevus võimaldab pikas perspektiivis saavutada jätkusuutliku ja inimsõbraliku transpordisüsteemi.
VÕIMALUSED-TUGEVUSED	VÕIMALUSED	OHUD	NÕRKUSED-OHUD

ANNEX 2. EUROSTAT'S DATA ON THE RATE OF PASSENGER CARS IN THE MEMBER STATES OF THE EU

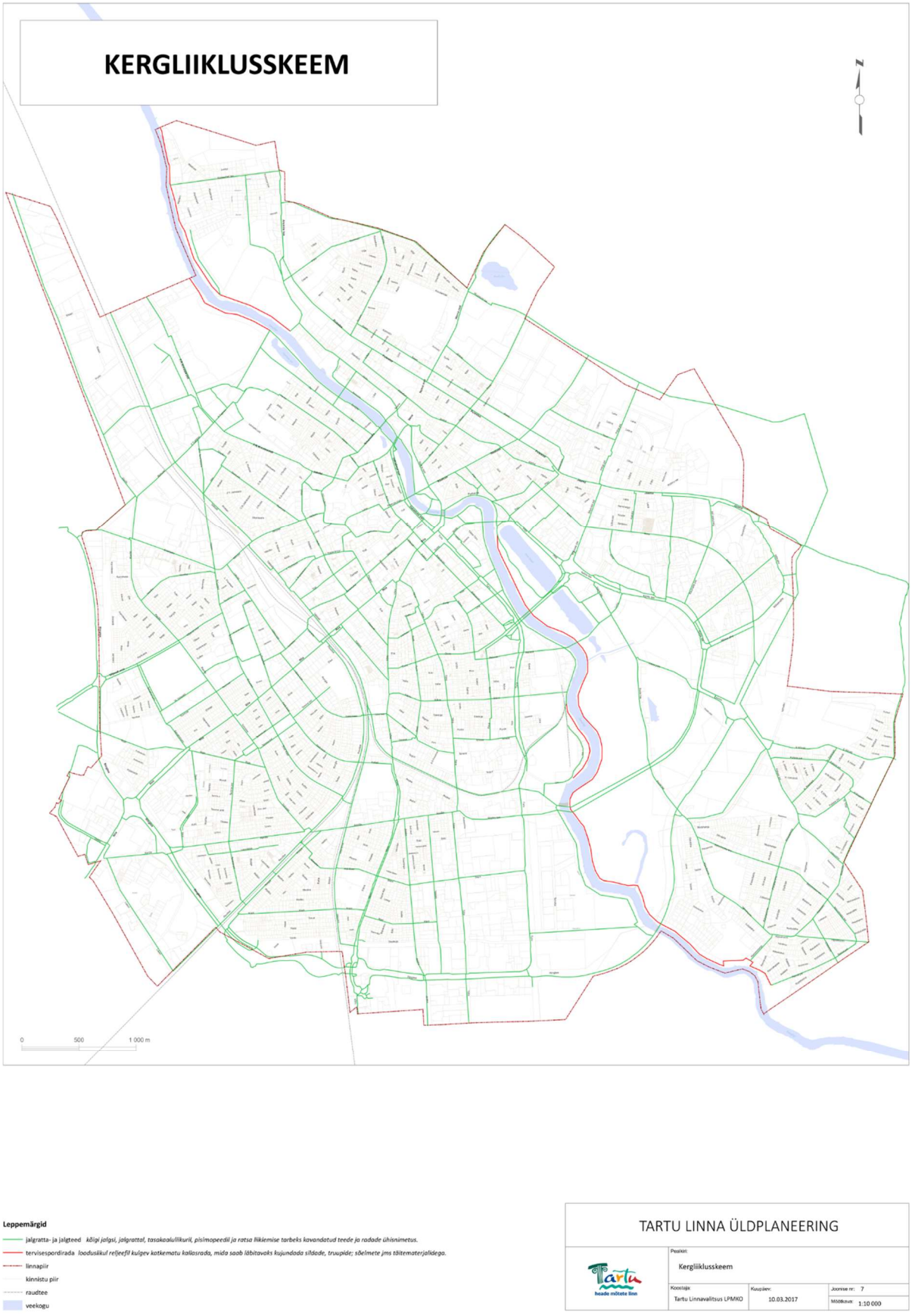


→ (¹) 2015 data instead of 2016
→ (²) 2016 data instead of 2017
→ (³) Great Britain only.

Source: Eurostat (*online data code*: road_eqs_carhab) 2019

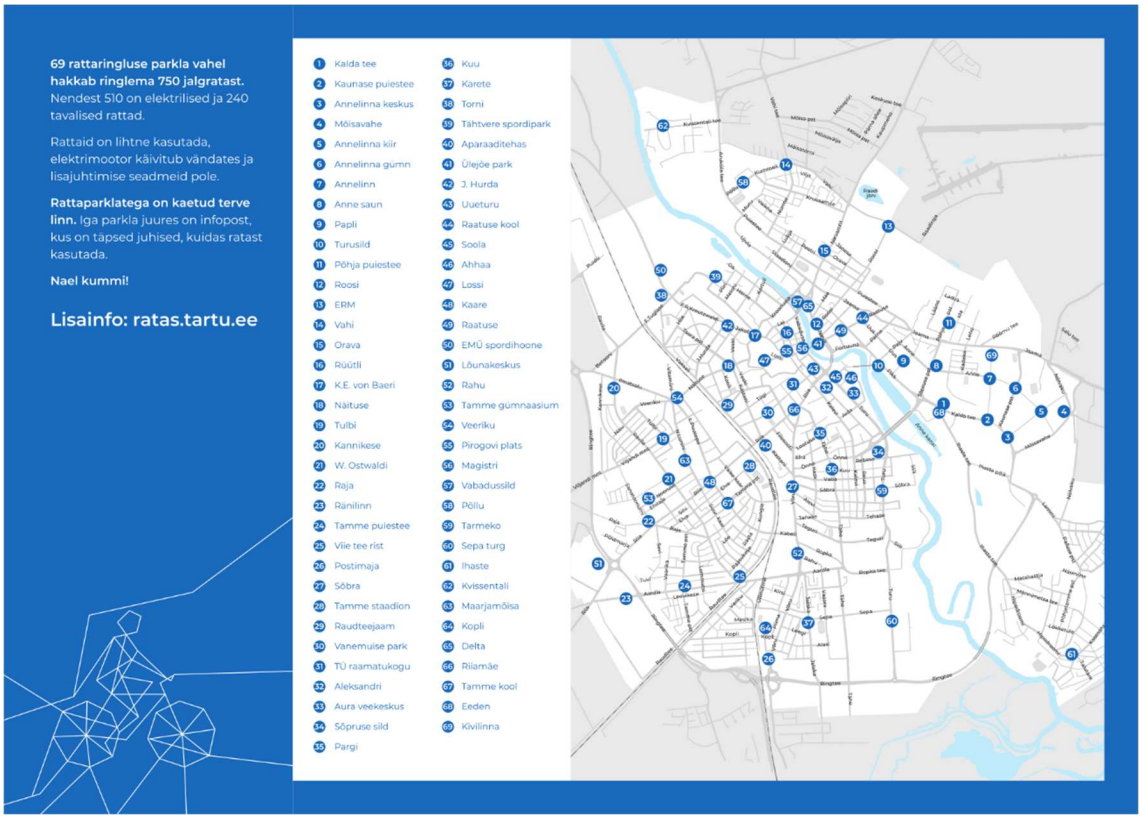
[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU#Overview]

ANNEX 3. NON-MOTORISED TRAFFIC SCHEME OF THE TARTU COMPREHENSIVE PLAN

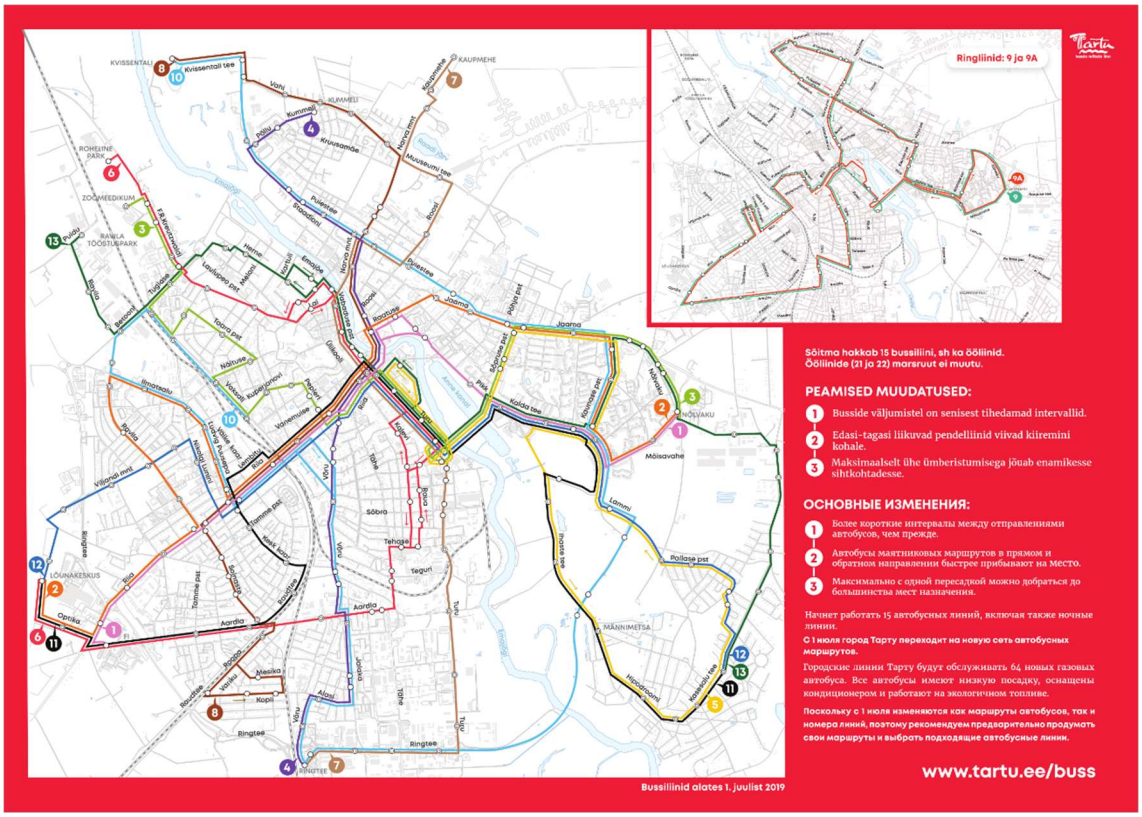


Source: Master plan of the city of Tartu up to 2030+ (Tartu CG 2017).

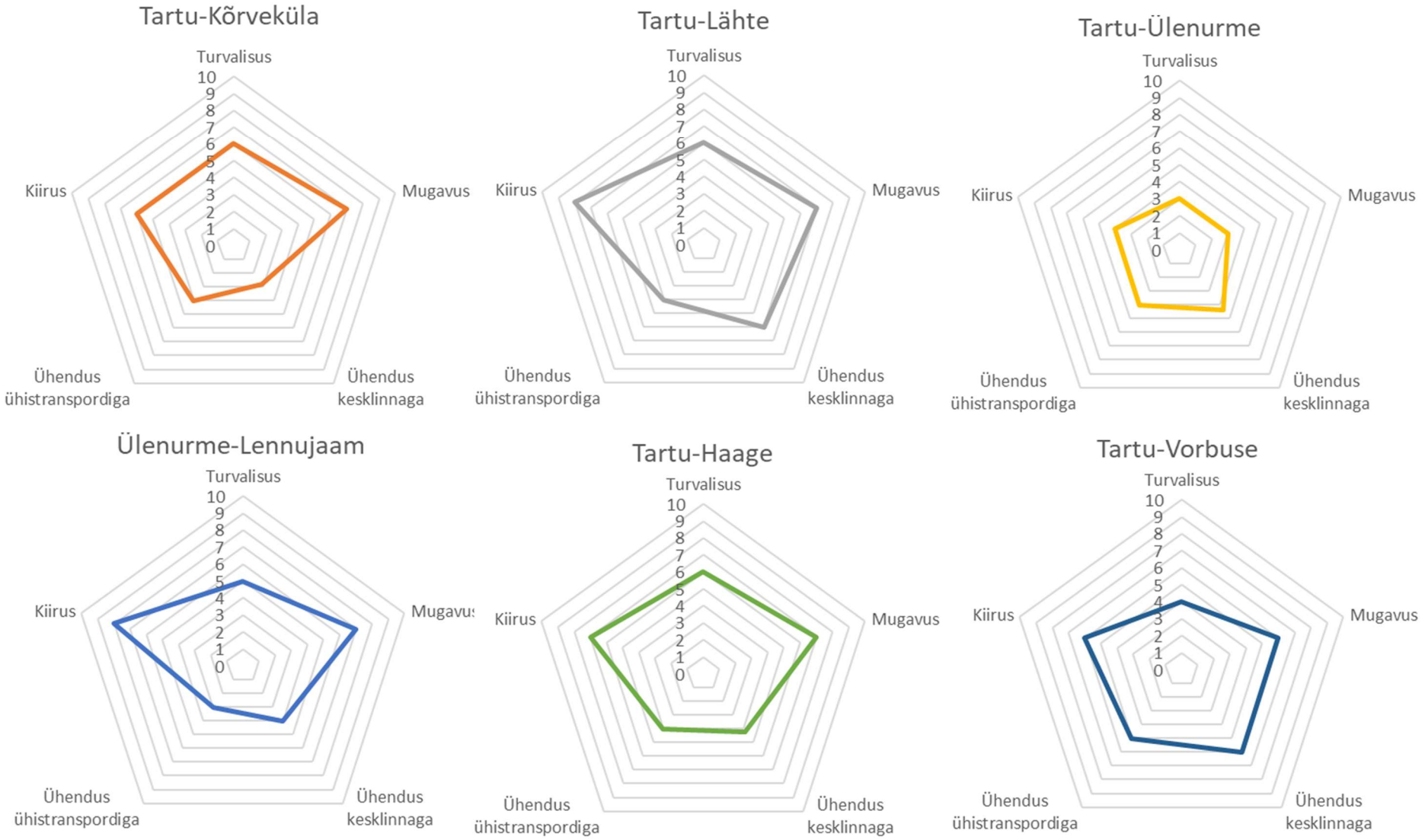
ANNEX 4. INFORMATION BROCHURE OF THE TARTU SMART BIKE SHARE

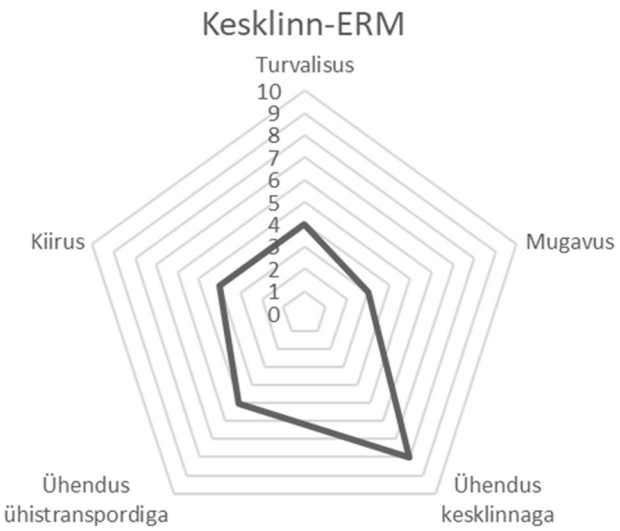


ANNEX 5. DIRECT MAIL BROCHURE FOR THE NEW TARTU BUS LINE NETWORK



ANNEX 6. ASSESSMENT OF NON-MOTORISED ROADS IN TARTU




Kesklinn-ERM
Turvalisus
10
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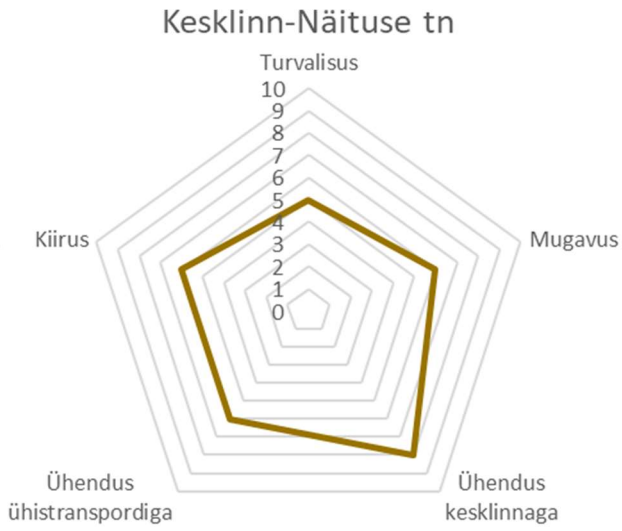
0
Mugavus
Ühendus kesklinnaga
Ühendus ühistranspordiga
Kiirus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Turvalisus
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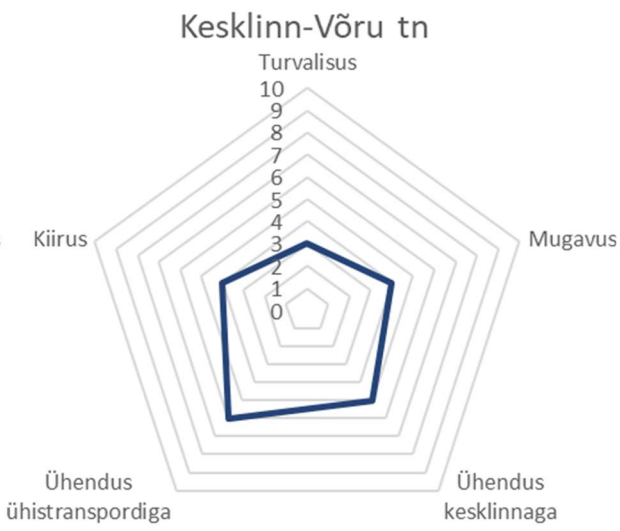
Ühendus ühistranspordiga
Kiirus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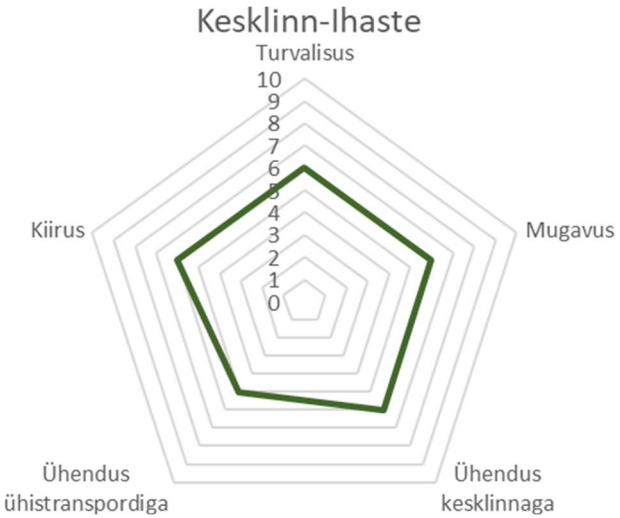
Kiirus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Turvalisus
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Mugavus
Ühendus kesklinnaga
Ühendus ühistranspordiga
Kiirus

ANNEX 7. COUNTING NON-MOTORISED ROAD USERS WITHIN THE SUMBA PROJECT

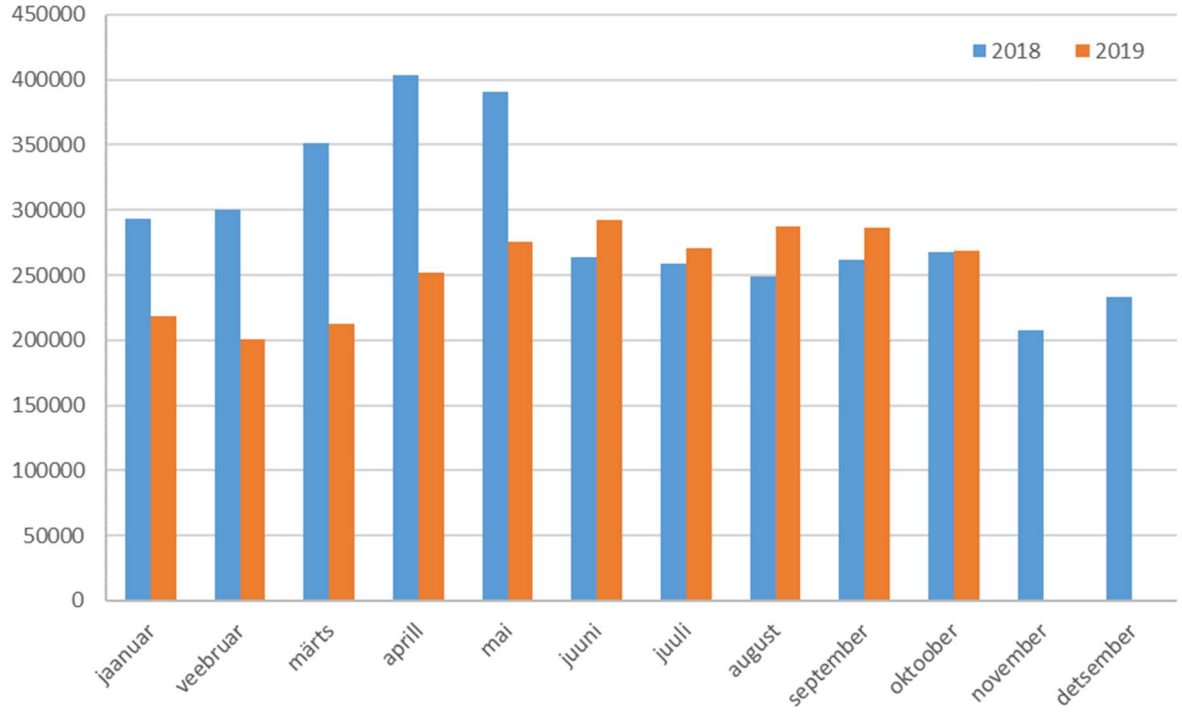

Figure L7.1 Counting pedestrians with motion sensors in 2018 and 2019 (as at 31 October 2019)

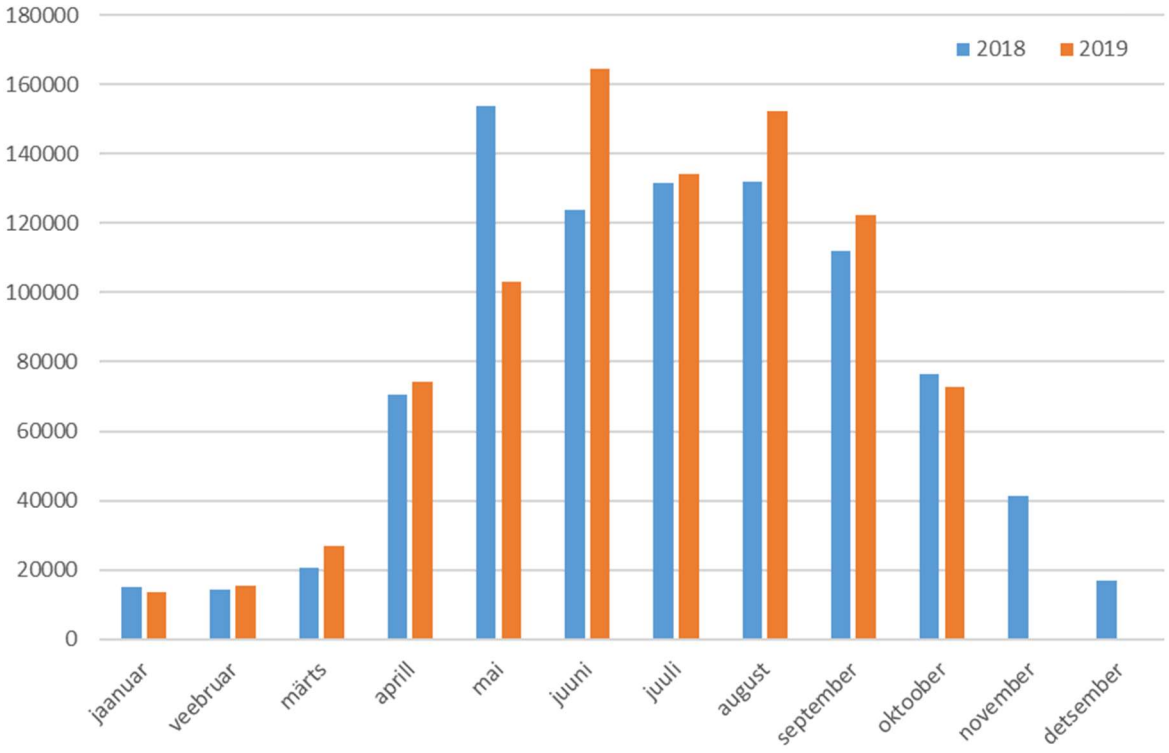

Figure L7.2 Counting cyclists with motion sensors in 2018 and 2019 (as at 31 October 2019)

ANNEX 8. MEASURING TRAFFIC DENSITY WITHIN THE SUMBA PROJECT

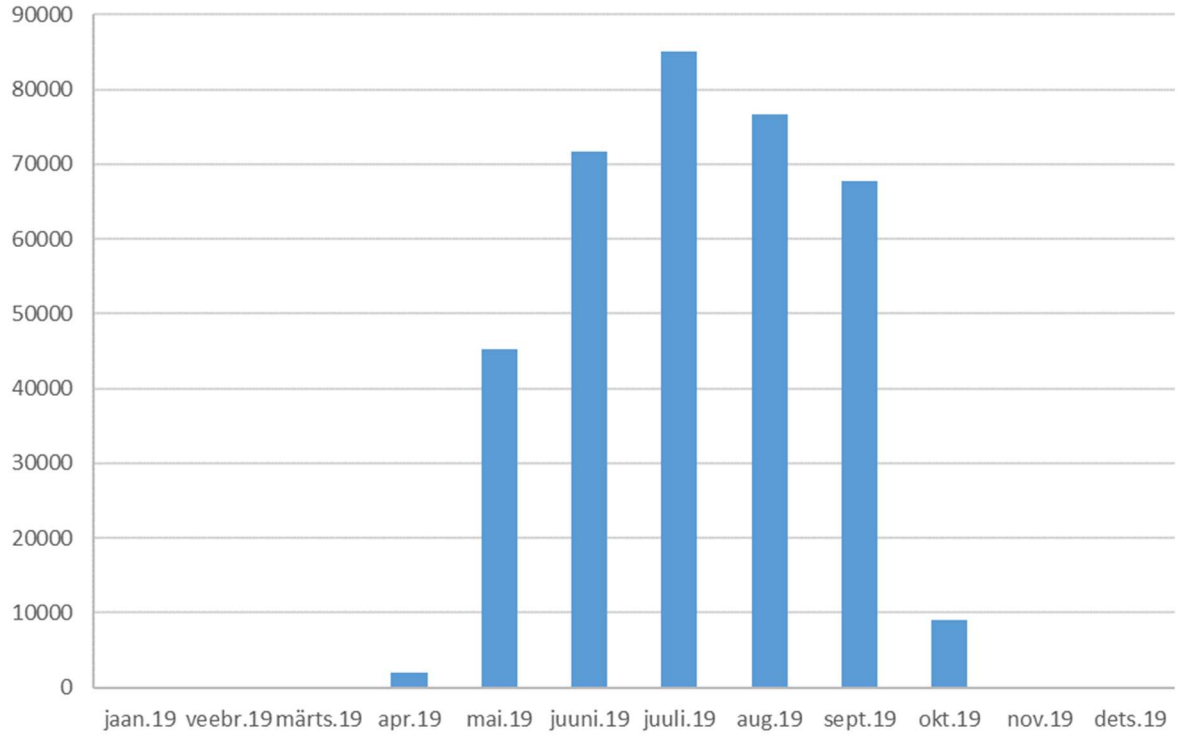

Figure L8.1 Measuring the traffic volume with motion sensors in 2019 (as at 3 October 2019). The Figure depicts average measuring results of twenty-four hours. Measurements were started in April with 7 counters, adding 4 counters in May, 3 counters in June, and an additional 1 in September. Since October, data were collected with 15 counters.

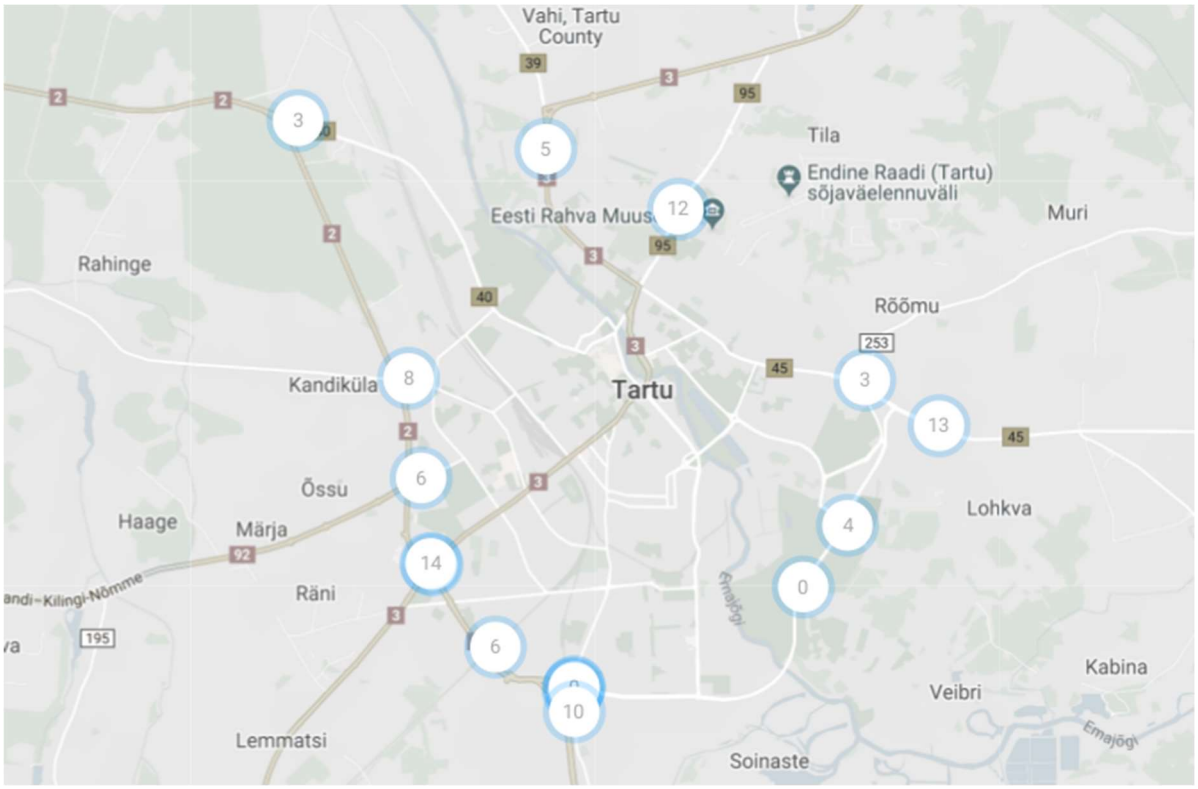

Figure L8.2 Locations of motion sensors