Climate-neutral Tallinn

Tallinn Sustainable Energy and Climate Action Plan 2030

Tallinn

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Summary

‘Climate-neutral Tallinn. Tallinn Sustainable Energy and Climate Action Plan 2030’ (Climate-neutral Tallinn) is a cross-sectoral development document that specifies the strategic goal of the development strategy Tallinn 2035 to achieve climate neutrality by 2050 and creates a specific action plan to fulfil the commitment set out in the Covenant of Mayors to reduce greenhouse gas emissions of cities by 40% by the year 2030.

Climate-neutral Tallinn is based on the European Commission’s Green Deal and the European Union’s long-term vision ‘A Clean Planet for all’ which was approved by the Government of the Republic on 3 October 2019 in support of the goal of climate neutrality across the European Union by 2050.

Climate-neutral Tallinn is directly related to the following national strategic development documents: strategy “Estonia 2035”, “Estonia’s National Development Plan of the Energy Sector 2030”, “Estonia’s 2030 National Energy and Climate Plan”, ‘Transport and Mobility Development Plan 2021+’, ‘General Principles of Climate Policy 2050’, ‘Climate Change Adaptation Development Plan until 2030’ and regionally the ‘Harju County Development Strategy 2035+’.

Climate-neutral Tallinn is a comprehensive system of political, economic, technological, educational and administrative activities in order to:

- reduce the climate impact of urban living and management;
- adapt to climate change, as it will not be possible to stop climate change any time soon; and
- do all this in a diversifying, innovative and economically smart manner for the economy and the urban environment.

Climate-neutral Tallinn has set goals for both climate change mitigation and adaptation:

- **To reduce greenhouse gas emissions (hereinafter referred to as GHG) by 40% by the year 2030 and to work towards climate neutrality**
- **To plan actions to better adapt to the changes and risks posed by climate change**

The measures to be taken to achieve these objectives are divided into courses of actions:

- reduction of GHG emissions from buildings
- reduction of GHG emissions from transport
- reduction of GHG emissions from the energy sector
- adaptation to climate change
- raising awareness of climate change and improving administrative capacity to handle it

What changes will the implementation of the action plan Climate-neutral Tallinn bring?

- Use of plug-in hybrid, electric and hydrogen vehicles. Infrastructure has been set up for recharging batteries and refuelling with hydrogen fuel, including the possibility for apartment associations to set up charging stations near their homes.
- A complete shift to the use of non-fossil fuels in public transport.
- An uninterrupted and standard network of cycle lanes covering the entire city has been built and can be used throughout the year.
- Use of factory-produced modules and elements when building and reconstructing buildings, enabling buildings to be reconstructed faster and more energy-efficiently. Recycled materials are also widely used (e.g. insulation and finishing materials made from plastic and textile waste). The buildings have been made climate-resistant to both heat waves and floods.
- District heating areas have been expanded and integrated with district cooling possibilities. The district heating network has been renovated to be energy-efficient and new efficient district cooling networks have been built.
- Residents of Tallinn can participate in cooperative energy production.
- Hydrogen energy solutions are being tested in buildings. Climate-neutral cooling solutions for buildings have been created to cope with heat waves.
- Circular economy is being promoted. Only waste which is not suitable for recycling is incinerated in thermal and power plants.
- The city's green network is connected. It provides both natural diversity and diverse mobility opportunities. This will also improve the health of the city's residents.

- The blue network has been developed in the city – nature-based solutions are used in the restoration of watercourses; rainwater is used as a resource in both construction and landscaping. Drinking water is of high quality and available in public urban areas.
- Risks due to climate change (heat waves, floods caused by rainwater and storms, fires, pathogens) have been mitigated and the population is able to cope with them.

Climate-neutral Tallinn describes not only the activities of the City Government, but also the activities of the state, the private sector and residents. This means that the goals set are achieved jointly and the contribution of the state, the city and the private sector is needed to finance the activities.

A variety of funding sources can be used, including public-private partnership (PPP) and private sector contributions through co-operative involvement.

Funding from European Union funds is also requested for the implementation of the activities, as significant financial resources are allocated for the implementation of the European Green Deal. Examples of such activities are investments in the development of climate-neutral public transport and mobility, the implementation of pilot projects to improve the energy efficiency of buildings and to develop green and blue infrastructure, the implementation of green technology, public information campaigns and environmental education programmes as well as other activities.

The measures of Climate-neutral Tallinn are implemented through the operational programmes of the budget strategy and annual budgets. They identify the cost of the planned activities, the timetable for implementation during the current budget strategy period and the responsible actors but also the indicators set for results/outputs.

The estimated total cost of the implementation of the action plan Climate-neutral Tallinn is €1.5 billion for the public sector until the year 2030, including the cost of already implemented and additional measures.

1. Introduction

‘Climate-neutral Tallinn. Tallinn Sustainable Energy and Climate Action Plan 2030’ (hereinafter referred to as Climate-neutral Tallinn) is a cross-sectoral development document that specifies the strategic goal of the development strategy Tallinn 2035 to achieve climate neutrality by 2050.

Climate-neutral Tallinn renews the climate change mitigation activities of the ‘Tallinn Sustainable Energy Sector Action Plan 2011-2021’ and provides climate change adaptation activities. Activities which are still important in achieving climate neutrality and which have been started earlier will still be continued. The new development document describes how the goal set at the time of joining the Covenant of Mayors to reduce greenhouse gas (mainly CO_2) emissions by at least 40% by the year 2030 (compared with Tallinn’s base year 2007) will be achieved.

Based on the principle of the European Green Deal, the development strategy Tallinn 2035 sets the goal of achieving climate neutrality in Tallinn by the year 2050. This goal is also compatible with the goal set in Estonia to be a climate-neutral country by the year 2050.

Many measures for the more sustainable use of energy resources and the deployment of carbon-free energy sources, which make a decisive contribution to climate change mitigation, are either the responsibility of local authorities or require political leadership for adoption. Local authorities across Europe are at the forefront of climate policy, implementing large-scale mobility, energy efficiency and renewable energy programmes.

Climate-neutral Tallinn contributes to the vision ‘Green City of the World’ and the strategic goals ‘Green Transition’, ‘Whole Tallinn Moves’, ‘Friendly Urban Space’, ‘Home Starts from the Street’ and ‘Creative City of the World’.

2. Vision and aims

Vision: Tallinn is a climate-neutral city in the year 2050

It is comfortable and pleasant to live sustainably in Tallinn. The provision of eco-friendly products and services has become as natural, simple and preferred as possible.

In the energy sector, the use of fossil fuels has been minimised by increasing the share of renewable energy and carbon-free energy sources. In a city that has developed into a multi-centred city, it is possible to reach the desired destination quickly and conveniently by cycling or walking or via public transport. Transport functions on non-fossil fuels.

Clean energy is used in production. The city is covered by a smart electricity grid, which allows electricity producers and consumers to communicate with one another. Smart infrastructure makes energy production and consumption more local. On-site energy production has reduced Tallinn's energy dependence to a minimum and satisfies the transport sector's need for carbon-free electricity.

The circular economy has an indispensable role to play in achieving climate goals. Diversification of waste-sorting options and production and distribution of innovative materials make it possible to recycle most waste. A separate development document will be prepared for the promotion of circular economy in Tallinn. Climate-neutral Tallinn only covers the application of the principles of the circular economy in energy production.

Buildings are resource-efficient and carbon-free energy is used inside them. Making buildings energy-efficient and using smart solutions and different energy sources has been made attractive to home-owners.

Teleworking solutions reduce rush hour traffic congestion and commutes between the city centre and the neighbouring municipalities.

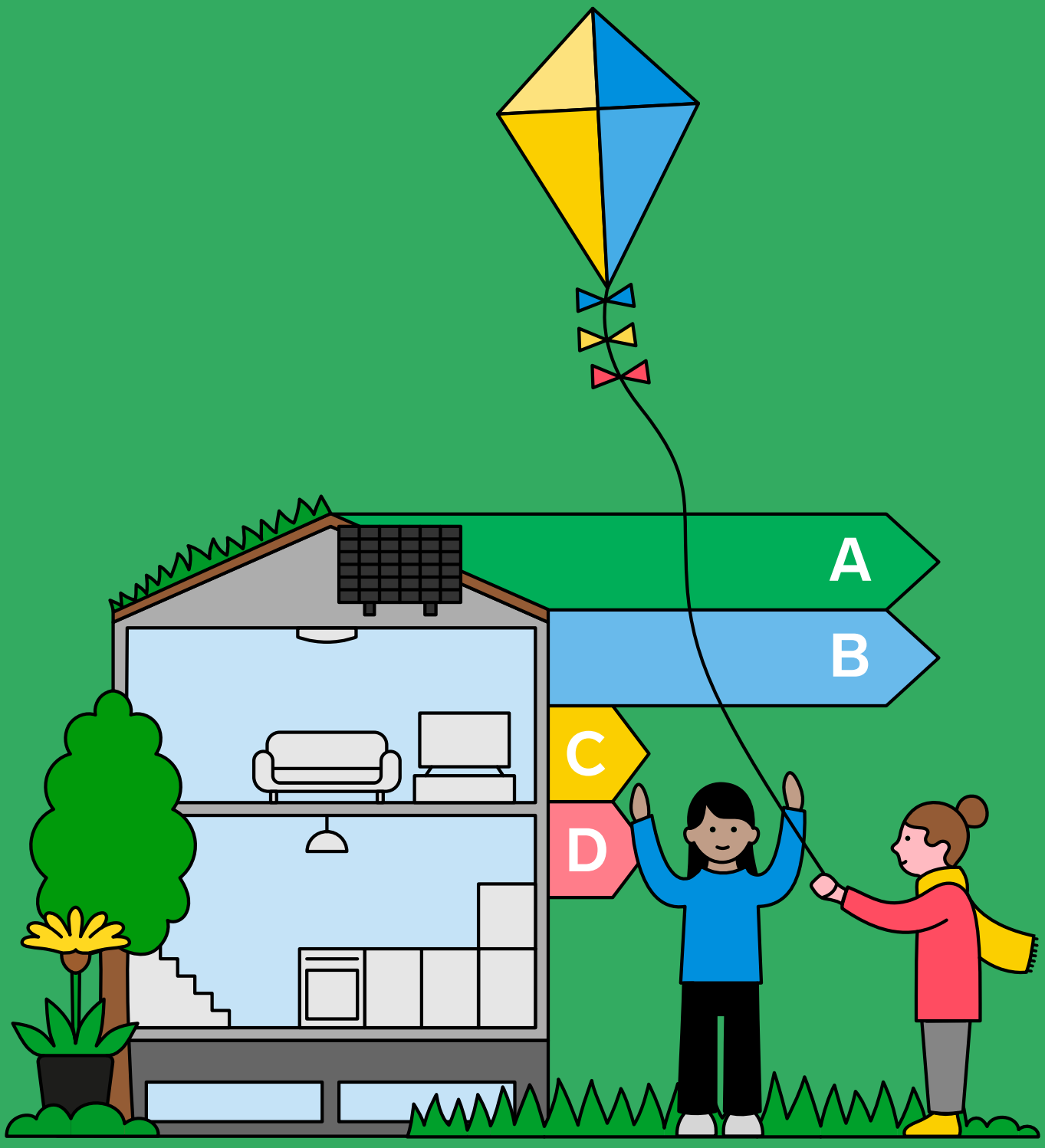
Tallinn adapts to climate change and extreme weather conditions using nature-based solutions and by making buildings and infrastructure more climate-resistant.

Goals for the year 2030:

- **Mitigation of climate change:** The greenhouse gas emissions of the city of Tallinn have decreased by 40% compared with the base year 2007. The total annual greenhouse gas emissions of the city of Tallinn in tonnes of carbon dioxide equivalent must remain below 2361 kilo tonnes in 2030.
- **Adaptation to climate change:** The readiness and capacity of the city of Tallinn to adapt to climate change has increased.

The objectives are described in Chapters 4 and 5, respectively. Adaptation measures also indirectly contribute to reducing emissions.

3. Climate change mitigation scenarios until the year 2030



Climate-neutral Tallinn has been prepared based on two possible scenarios:

- **Continuation on the same course (SC), i.e. the baseline scenario**, where only the measures that have previously been approved by the state and financed by the city budget of Tallinn will be implemented in order to achieve Tallinn's energy and climate goals by the year 2030. In the field of buildings and industry, transport and energy, the same basic national assumptions apply under the European Union's climate and energy policy framework. In essence, it is a continuation of the current state and Tallinn's climate and energy policy.
- **The scenario of a climate-neutral Tallinn**, where, by the year 2030, additional measures will be implemented in addition to the measures already in place, as set out in this plan.

These scenarios were formulated on the basis of global trends (Figure 1), which, on the one hand, have a direct impact on greenhouse gas (GHG) emissions and, on the other hand, create opportunities to reduce emissions.

The most important trends are as follows:

- global factors, such as urbanisation and migratory pressures, which affect resource use and mobility
- people are willing to change their behaviour (including mobility) for the benefit of the environment if it is convenient for them and the public sector sets an example
- public-private partnerships and solutions using artificial intelligence are becoming increasingly important in urban planning and public services
- the availability of open data increases social inclusion by being a tool for different sectors to participate in the planning process, policy-making and the development of new solutions and to provide the necessary background information
- adaptation to the effects of climate change and new technology (including those based on carbon-free energy sources) will increase energy consumption by the middle of the century despite increases in energy efficiency;
- the increase in the share of renewable energy depends to a large extent on the introduction of carbon-free energy sources
- smart infrastructure makes energy production and consumption more local
- the car industry has made a strong move to increase the share of electric vehicles
- new mobility services complement public transport and active mobility while reducing dependence on private vehicles

- the cost-effectiveness of investments that are important for reducing GHG and air pollutant emissions in cities will be improved
- the circular economy will become an indispensable part of achieving climate goals

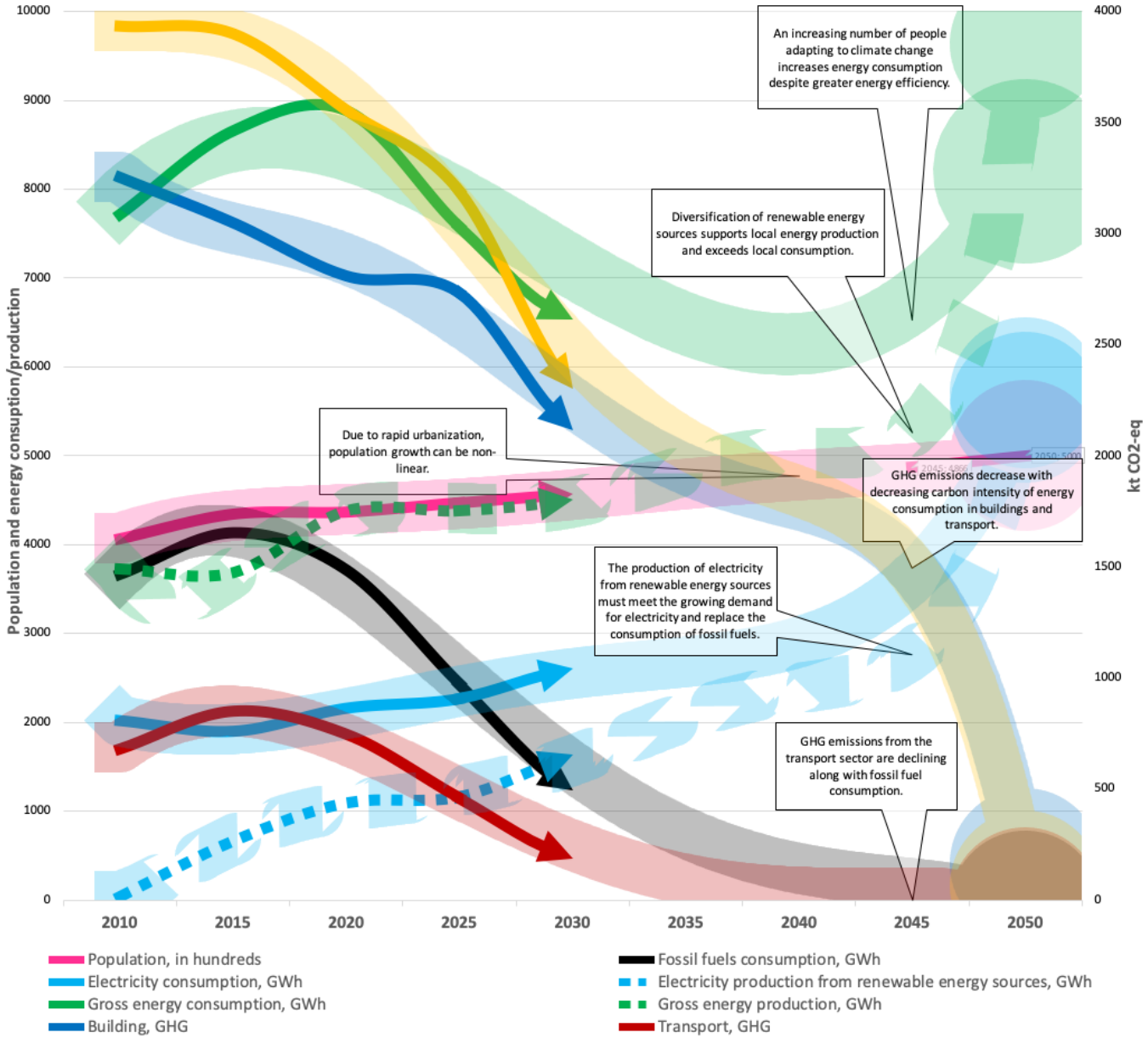


Figure 1. Global trends for 2050

Against the background of the increase in energy consumption in Tallinn in 2007-2015, the growth of energy consumption in buildings was smaller than in the transport sector. GHG emissions from buildings decreased and GHG emissions from the transport sector increased, i.e. carbon intensity or CO_2 emissions per unit of energy consumed decreased only for buildings.

In the SC scenario, the final energy consumption of the transport sector will increase by ca 43% by 2030 compared with 2007, of which 86% amounts to the consumption of fossil liquid fuels. GHG emissions from the transport sector will increase by almost a quarter by 2030 compared with 2007 and will account for 28% of Tallinn's

total GHG emissions. The main challenge in achieving climate neutrality in Tallinn is therefore greenhouse gas emissions from the transport sector.

Tallinn's total annual GHG emissions from final energy consumption and fossil fuel combustion will continue to be around 3029 kt of CO_2 equivalent in 2030 if the trend continues, meaning that emissions would decrease by 23% compared with the base year. In the scenario of continuing on the same trend, the GHG emission reduction target is not achievable.

By guiding the implementation of the action plan and creating opportunities for companies to achieve the goal, the timely implementation of existing and new measures added to the scenario of climate-neutral Tallinn will increase Tallinn's energy efficiency by ca 29% and reduce final energy consumption, including fossil fuel consumption, by 87% compared with the SC scenario. This does mean an increase of ca 216 GWh in the demand for renewable fuels and electricity in the transport sector by 2030 compared with the SC scenario, but the increase in Tallinn's renewable energy production and the share of energy production as an initiative of large companies in the energy sector has so far created a precondition for this in the SC scenario. Increased demand for electricity from renewable energy sources would in turn be a great incentive for the renewable energy projects of private persons, businesses and energy cooperatives. In the case of the climate-neutral Tallinn scenario, additional measures will achieve additional emission savings (17%) compared with the SC scenario. This is necessary to reach the 40% target – total emissions in 2030 must be below 2361 kt of CO_2 equivalent.

If the scenario of climate-neutral Tallinn is implemented, i.e. if existing and new measures are implemented in Tallinn's transport, construction, energy management and land use in a thorough manner and the indirect effects of climate change adaptation measures are taken into consideration (e.g. increased use of rainwater as a natural resource, use of roof and vertical landscaping, increased awareness and its use), then the total GHG emissions of Tallinn will decrease by 1575 kilo tonnes of CO_2 equivalent or 40% by the year 2030 when compared with 2007.

This would meet the commitments made in the Covenant of Mayors as well as improve the living environment of Tallinn and ensure the global competitiveness of climate-neutral Tallinn in the long run. Legislation and the tax system also need to be amended in order to implement the measures designed to achieve the above objectives.

4. Mitigation of climate change

The GHG emissions of the city of Tallinn have decreased by 40% compared with the base year 2007. According to the 2030 monitoring inventory, the total annual GHG emissions of the city of Tallinn in carbon dioxide equivalent (CO_2 equivalent) is less than 2361 kilo tonnes.

Climate-neutral Tallinn addresses the achievement of this goal in three aspects:

1. reduction of GHG emissions from buildings
2. reduction of GHG emissions from the transport sector
3. reduction of GHG emissions from the energy sector

In addition, the implementation of the principles of the circular economy, which is addressed in its entirety in Tallinn's document for the development of the circular economy, helps to achieve the goal.

4.1 Reduction of GHG emissions from buildings

4.1.1 Future needs

A prerequisite for reducing GHG emissions from buildings is to increase the energy efficiency of buildings and the share of renewable energy used in buildings. This is possible through the continuous reconstruction of the buildings, the renewal of technical systems, the construction of new energy-efficient buildings and the implementation of renewable energy technology. Tallinn's combined heat and power plants cover a large part of the building's electricity and heat needs with renewable energy.

The construction of buildings must be based on minimum energy efficiency requirements. At the same time, the city itself builds only energy class A buildings. Such buildings produce renewable energy on site (e.g. the installation of solar panels). If the renovation of old buildings belonging to the city is too expensive due to, for example, the distribution of space or the quality of construction, or does not lead to an energy-efficient solution, they will instead be demolished and replaced with nearly zero-energy or zero-energy buildings. When renovating buildings, factory-produced structural elements are preferred, if possible. Improving the energy efficiency of new and refurbished buildings creates preconditions for cost-effective investments in the transition to clean energy sources.

Energy-efficient technical solutions and measures must meet two criteria:

1. upon the implementation of measures to reduce energy demand, the expediency, technical quality and indoor climate of the building must improve
2. the means used to reduce energy demand must be balanced with energy savings

To mitigate the effects of climate risks, appropriate energy efficiency measures need to be taken, such as the use of suitable materials, renewable energy solutions and green roofs and the choice of façade covering the location of the building on the plot to avoid large unshaded glazing on the south or west side. An energy-efficient building therefore means not only a building with lower GHG emissions than usual but also a good indoor climate (both now and in the future), and the building's functions are guaranteed throughout its intended life.

The various effects of climate change must be taken into consideration in the planning, design and comprehensive renovation of existing buildings.

4.1.2 Measures for the reduction of GHG emissions from buildings

1. Improving the energy efficiency and climate resilience of municipal buildings

Reducing the energy consumption of buildings helps increase energy efficiency and the share of renewable energy and reduce GHG emissions from energy consumption: In addition, innovative solutions will be introduced and the climate resilience of buildings will be increased; this will also extend the service life of the building. The role of the city is to set an example and implement construction pilot projects in municipal buildings. If the city shows that climate change can and must be taken into consideration in the renovation and construction of buildings, it will also encourage the private sector and residents to do the same.

Actions:

- renovation and reconstruction of municipal buildings to at least the level of energy class C
- construction of new municipal buildings as low-energy and near zero-energy buildings and energy-producing buildings (e.g. solar panels (PV), PV + fuel cells)
- use of innovative solutions and technological opportunities (compliance with energy efficiency in procurement, introduction of more energy-efficient digital solutions, preference for energy-efficient solutions produced by local companies) and promotion of green offices in municipal buildings
- building an IT system for the centralisation of building automation and developing guidelines for the design and interconnection of municipal building automation and the design and construction of building automation
- monitoring compliance with the minimum energy performance requirements for municipal buildings during the second or third calendar year of operation of new and renovated municipal buildings
- implementation of model solutions for municipal buildings that take into consideration the risks of climate change
- ensuring the climate resilience of vital services (identifying needs and implementing solutions)

2. Increasing the energy efficiency of apartment buildings

Improving the energy efficiency of apartment buildings will help increase the energy efficiency of the housing stock and the use of renewable energy in these buildings as well as reduce GHG emissions. The comprehensive renovation of buildings is supported by a number of pan-European initiatives under the European Union's Green Deal policy (e.g. the new European Bauhaus). Supporting apartment associations not only from the state but also from the city budget is an ongoing activity that stems from Estonia's long-term building renovation strategy.

Actions:

- ongoing complete reconstruction of apartment buildings (improving the indoor climate and exterior look of buildings) with the support of the city, taking into consideration energy efficiency requirements and opportunities (e.g. in areas of cultural and environmental value)
- support for the renovation of apartment buildings in areas of cultural and environmental value, defined as valuable individual objects, recognised as cultural monuments or located in heritage conservation areas in order to preserve their value
- advising apartment associations to support own initiative and increase energy efficiency

3. Innovative renovation and construction of buildings

This measure will help increase energy efficiency and reduce GHG emissions. Innovative (modular) renovation and construction of buildings is important to reduce heat loss in buildings under renovation (ensuring the required indoor climate) and to extend the life of the buildings. Simplification of works allows the volume of renovation to be increased.

Actions:

- development and implementation of optimal technical parameters for climate-resistant modular renovation and the concept of demand-based and zoned indoor climate management in municipal institutions
- promotion of climate-resistant building materials and solutions (including modelling) and collection of statistics on modular renovated buildings
- implementation of pilot projects for climate-resilient modular renovation of municipal buildings

- development and implementation of a financial instrument for the renovation of factory-produced modular elements and for increasing development, production, installation and export capacity

4. Renewable energy co-generation pilot projects for new and fully refurbished buildings

This measure is important for reducing GHG emissions. The implementation of pilot projects will help increase the share of renewable energy in energy consumption and the use of renewable energy sources in local co-generation using fuel cells. Hydrogen is increasingly being used in fuel cells to produce heat and electricity, and this is important in the transition to clean energy.

Actions:

- preparation of an analysis of the potential for building-based co-generation and the use of fuel cells in Tallinn
- implementation of pilot projects for renewable co-generation of electricity and heat in new and refurbished buildings (e.g. PV + fuel cells) or the use of fuel cells

5. Improving the climate resilience of existing buildings through information and support measures

The share of buildings in need of comprehensive renovation in Tallinn is extensive, but there is currently no overview of their resilience to climate change. Knowledge of the condition of buildings will make it possible to develop specific renovation and reconstruction guidelines and support measures to help make buildings more resilient to climate change and to extend the life of buildings, especially during complete renovations. The choice and use of materials becomes important. The guidelines will help make buildings more resilient to climate change during reconstruction.

Actions:

- a study on the climate resistance of buildings
- development of guidelines for the renovation and reconstruction of buildings to ensure their climate resilience
- supplementation and/or development of support measures
- recognition of successful renovation and reconstruction projects

6. Guidance and recognition of new buildings

The measure is important for increasing the climate resistance of buildings and extending the service life of buildings. The planning (planning and design) of new buildings in the city takes into consideration the risks related to climate change. Successful new private buildings that take into consideration the risks of climate change are also recognised.

The risks associated with climate change can lead to situations that have a major impact on everyday life (e.g. power outages due to extreme weather events). It is therefore necessary to ensure the autonomy of buildings, which helps them withstand the changing climate.

Actions:

- development of guidelines for the design of new buildings (including solutions ensuring autonomy), taking into consideration the risks associated with climate change (compilation of existing good examples, both local and international, and the implementation of a pilot project and preparation of guidelines)
- recognition of new private buildings designed to take into consideration the risks of climate change
- development, promotion and demonstration of innovative solutions to ensure the autonomy of buildings

4.2 Reduction of GHG emissions from the transport sector

4.2.1 Future needs

In order to achieve an overall 40% reduction in GHG emissions by 2030, the growth trend of the transport sector requires a reduction of 495 kt of CO_2 equivalent or 72%. This was due to an increase in the vehicle fleet and its mileage, which has not been offset by the introduction of carbon-free fuels in the transport sector. If the trend continues, then due to the growth of transport and car use, the GHG reduction targets set in place in the Estonian climate policy and by Tallinn under the Covenant of Mayors will not be met or meeting these targets will become increasingly difficult and costly.

A reduction in GHG emissions is possible if the number of cars and their mileage do not increase significantly and a large-scale switch to carbon-free fuels takes place. As the population of Tallinn's urban area is growing significantly and the demand for transport increases, it is important to increase the share of public transport and active modes of transport in order to limit the growth of mileage. At the same time, the safety and ease of use of an alternative to the car – the use of cycle and pedestrian lanes and public transport – strongly depends on weather conditions. If the winter maintenance of cycle and pedestrian lanes and the weather protection of public transport stops are improved, taking into consideration weather conditions, then the usability, safety and comfort of cycle and pedestrian lanes and public transport would be ensured even in the dark and with bad weather.

With regard to the introduction of carbon-free fuels, the public sector must set an example in renewing its vehicle fleet and encourage the creation of an environment in which the private sector can also switch to vehicles using alternative fuels.

In order to achieve fast and convenient public transport, it is necessary to reduce connection times, upgrade the route network, increase the attractiveness of rolling stock and better integrate public transport with other modes of transport. All rolling stock will be converted to carbon-free fuels by 2035. The next generation of public transport is electric vehicles, which are fuelled by clean energy – green electricity and hydrogen. Energy use in transport will be reduced through the development of both cycle and pedestrian lanes and public transport. The general situation of public transport and traffic in the city will be constantly monitored and, on the basis of the monitoring data, the routes will be reorganised so that they would meet cycle and pedestrian lanes more.

In order to increase the attractiveness of active modes of transport, it is necessary to build a safe and comfortable infrastructure in accordance with the comprehensive plans of the districts and Tallinn's bicycle strategy to ensure its year-round maintenance and bicycle parking opportunities. In particular, the development of charging infrastructure must be possible when the private vehicle fleet adopts carbon-free fuels. As a whole, urban planning based on the 15-minute city concept, enabling sustainable mobility and raising awareness of the possibility of using different modes of transport, is also important.

When assessing the environmental impact of development documents, plans and projects in the field of mobility and when resolving freight transport, the effects of climate change need to be considered and mitigation options must be planned.

Due to its maritime location and position as a capital, all major modes of transport are represented in the Tallinn area. Different modes of transport and services and user groups may be affected differently by weather phenomena. The main factors affecting climate change in the transport system are security of connection; connection speed, travel time, delivery time and security of supply; condition and reliability of transport infrastructure and transport ICT equipment, need for maintenance; road safety and security; freight and storage safety; the cost of transport and mobility; movement and driving comfort; energy consumption and energy efficiency in transport. When comparing modes of transport and transport users, road transport and transport using the street network and the movement of people, the elderly in particular are in the most danger due to infrastructure disruptions and the risk of slippery, flooded or congested road sections.

In order to reduce environmental pollution, Tallinn will continue to implement the current parking policy, with the aim of reducing the number of cars parked on the streets in the Old Town and the City Centre, expanding the car-free area and implementing general and temporary parking restrictions and progressive parking fees.

4.2.2 Measures for the reduction of GHG emissions from the transport sector

7. Spatial planning and mobility management to reduce forced traffic and car use

This measure is important for reducing GHG emissions. The introduction of sustainable mobility will help make urban space more sustainable, safer and more people-centred (lower level of car traffic will improve the safety and connectivity of all modes of transport). To this end, forced movements, the time and money spent on movement and the negative health effects of transport (noise,

pollution, lack of physical activity, stress) are reduced and walking and cycling are encouraged and made safe in the city centre of Tallinn and other centres and in the vicinity of educational, cultural and sports institutions. The principles of environmentally friendly operations are applied in city institutions. The environmental impact assessment of transport strategies, plans and projects and the solutions of freight transport logistics must take into consideration the effects of climate change and plan mitigation activities, above all, to reduce emissions. It is also necessary to avoid the construction of commercial real estate and housing development in areas with public transport deficiencies. All mobility must be oriented towards the priority use of public transport when planning development areas. Therefore, the public transport network must be dense and have convenient connections, and it must be launched at the same time as a new building is built.

In addition to creating the physical conditions needed to improve mobility, there is a need to raise awareness and quantify its impact on human behaviour.

Actions:

- planning a settlement structure that promotes sustainable mobility and is independent of the private car (development of spatial development principles and guidelines, preparation of studies and analyses, integrated planning of mobility solutions for new jobs, centres and social infrastructure)
- purchasing land in places of strategic importance for balanced mobility
- introduction of sustainable transport and mobility in public institutions and companies
- development and implementation of the principles of mobility management plans in urban institutions (e.g. use of cycle and pedestrian lanes and public transport) and raising awareness and monitoring impacts
- comprehensive street planning taking into consideration different modes of transport, reconstruction of streets and construction of new ones based on the street-type principle

8. Fast and convenient public transport

This measure is important for reducing GHG emissions. The development of a route network and connecting facilities will help make urban space more sustainable, safer and more people-centred, reduce car use and forced movements, the time and money spent on mobility and the negative health effects of transport (noise, pollution, lack of physical activity, stress). As part of a comprehensive mobility system, additional ‘Park and Travel’ car parks will be built in public

transport stops, train stations and other junctions in the direction of Tallinn, in cooperation with neighbouring municipalities.

The measure will help diversify the opportunities for the independent movement of schoolchildren and reduce the fragmentation and lack of synergy between public transport services.

Actions:

- planning and development of a new route network (including development of rail transport)
- planning convenient public transport transfer nodes to connect different modes of transport (including light traffic, trains, urban and county transport, 'Park and Travel' system) and development of transfer nodes
- improving the accessibility of public transport in accordance with universal design
- making public transport rolling stock attractive (lighting, cleanliness, suitable indoor climate)
- design of public transport stops in a user-centric and weatherproof manner and installation of real-time information boards at stops
- development of an integrated route network and convenient transfer possibilities in the capital region

Increasing the share of new and greener rolling stock and developing the infrastructure to support it is crucial to reducing GHG emissions. The transition to electricity and hydrogen transport will help increase the share of renewable energy in energy consumption, implement innovative services, improve public-private partnership in development activities and reduce dependence on international supplies of transport fuels. The production and use of clean energy in the city is important for energy security.

The measure sets a goal to phase out carbon-based fuels in the transport sector of Tallinn transport in the future. An urban environment with low-carbon vehicles and suitable infrastructure, combined with an increase in the share of renewable energy and energy efficiency in the transport sector, will reduce emissions of greenhouse gases and ambient air pollutants as well as urban noise. Thus, moving away from carbon-based fuels will save on the cost of meeting environmental targets. One way to save transport costs for residents of the city is to increase the energy efficiency of the vehicle fleet. In order to reduce the transport costs of the urban population, it is also necessary to increase independence from the international supply of transport fuels, giving priority to the development of local sustainable and renewable fuels and energy sources, energy carriers and infrastructure. The savings in transport costs have a positive

effect on Tallinn's revenue base and on the economy in general through the consumption of transport-dependent products and services and their security of supply. This measure supports the establishment of an extensive network of electric car charging stations in the city.

The use of renewable fuels in urban transport helps increase the share of renewable energy in energy consumption, reduce the negative health effects of transport (noise, pollution, lack of physical activity, stress), solve freight and service logistics problems and reduce dependence on international transport fuel supplies. By 2035, public transport will be free of fossil fuels.

Actions:

- creation of cycling and light mobility systems in cooperation with the private sector
- integration of mobility services with public transport (including ride-sharing and taxi services)
- acquisition of public transport rolling stock that uses alternative fuels (biomethane, electricity, hydrogen)
- integration of the short-term car rental system into the mobility environment of Tallinn and its organisation in cooperation with the private sector
- introduction of the last mile service through testing of autonomous vehicles
- expansion of alternative fuelling infrastructure in cooperation with the private sector
- organisation of a travel planning service combining different modes of transport in cooperation with the private sector
- preference for zero-emission or low-emission vehicles in the procurement of urban and public transport services (e.g. public transport, taxi and other transport services, vehicles of the city, such as vehicles of the Social and Health Board and the Municipal Police Department, landscaping equipment)
- development of a comprehensive renewable fuel solution in Tallinn's waste management (waste and sewerage → biogas → biomethane → fuel for public transport and the city's service vehicles)

10. Convenient and safe bicycle traffic

This measure is important for reducing GHG emissions in the city. Increasing comfort and safety (e.g. additional crossings and traffic lights, locations of stops) will increase walking and the use of bicycles and light mobility devices, which in turn will help make the urban space more environmentally friendly, safer and more people-centred. Safety also means perceived security.

This measure will help reduce car use, the time and money spent on mobility and the negative health effects of transport (noise, pollution, lack of physical activity, stress), diversify the ability of schoolchildren to move independently, reduce the fragmentation and lack of synergy in public transport and improve the quality of the existing road network. Movement on cycle lanes also means driving with light mobility devices (scooters, self-balancing vehicles).

The safety and ease of use of cycle and pedestrian lanes also depend on weather conditions. Taking these into consideration and taking the appropriate measures will ensure the usability and safety of cycle and pedestrian lanes in the dark season and increase the comfort of cycle and pedestrian lanes regardless of weather conditions. An attractive, noise-free and pollution-free urban space also promotes walking and the use of bicycles or light mobility devices.

Actions:

- construction of a comprehensive core and health network of cycle lanes
- design of bicycle-friendly and safe school roads
- creation of bicycle parking areas in all areas and centres and support for the creation of parking facilities close to home and school
- promotion of a culture of bicycle and light mobility device use and promotion of safe driving
- support for the use of work bicycles in city institutions
- aligning and, if possible, raising the level of maintenance of cycle and pedestrian lanes, increased supervision
- ensuring the passability of cycle and pedestrian lanes throughout the year (e.g. maintenance with maintenance robots)
- increasing the share of cycle and pedestrian lanes with the city's maintenance responsibility
- improving the quality of existing cycle and pedestrian lanes, including their markings

11. Reduction of the impact of traffic risks due to weather conditions

In order to reduce the traffic risks associated with rapidly changing and extreme weather conditions, prompter information on weather conditions, a more adequate response to extreme weather events and the sharing of information between transport system operators and road users are needed. Road users are quickly informed of traffic conditions and changes in traffic management by the display of

dynamic and adaptive traffic information; weather-related speed limits are also set.

Actions:

- development of a road weather condition monitoring system, the development of a road maintenance response system and the enhancement of response capacity
- dynamic/adaptive traffic management depending on traffic and weather conditions
- speed limit reduction in residential areas and centres

12. Diversion of peak road use to reduce emissions

The objectives of this measure are to increase energy efficiency, reduce GHG emissions, decrease the noise of the urban space and make the urban space more economical, safer and more people-oriented. The measure is important for reducing car use in the city (centre) and will significantly reduce the concentration of fine particles in urban air.

This innovative measure in the field of transport is also described as a course of action (sustainable financing) in the Tallinn Mobility Plan 2035. As a result, approximately 14% of the total GHG emission reduction target will be achieved by the year 2030.

In the case of road use regulation, changes in national legislation are followed. The aim is to guide people to choose more environmentally friendly modes of transport or to offset the negative effects of their choices on health and the environment.

Actions:

- dynamic rush hour regulation on congested streets depending on the vehicle's energy class

13. Development of an environmentally friendly parking policy

This measure will help reduce emissions from energy consumption in the transport sector, implement innovative services and improve joint public-private partnership development activities. This is an innovative measure in the field of transport, as a result of which approximately 10% of the total GHG emission reduction target will be achieved by the year 2030.

New principles of parking management will be introduced, which will support the achievement of mobility objectives and will be based, among other things, on the level of public transport connections. In the case of new developments, mostly underground car parks or parking garages will be built, outdoor car parks will be landscaped

and, in areas where this is geologically possible, they will be covered with a water-permeable surface. The concept of a well-established zero-emission zone is also being tested in many cities, allowing, for example, only zero-emission vehicles to be used in certain urban areas.

Actions:

- possible differentiation of parking based on time period and duration, engine power or parking load
- establishment of regulation of parking spaces for commercial premises
- analysis of the extent of the paid parking area
- in areas with good public transport connections, a reduction in the standard of parking spaces to be built, giving priority to the creation of short-term parking opportunities
- implementation of the zero-emission zone concept
- adherence to a parking policy that takes into consideration the principles of sustainable urban planning, including the differentiation of parking standards, taking into consideration the proximity of public transport lines and main centres

4.3 Reduction of GHG emissions from the energy sector

4.3.1 Future needs

Climate-neutral Tallinn refers to local electricity generation, heat and power co-generation, hydrogen production from electricity and district heating and cooling under energy management. In parallel with the reduction of GHG emissions, the goal is to increase the security of energy supply, especially in the production of electricity. This is possible in particular through the production of local solar electricity and the co-generation of electricity and heat from biomass. There is also a need to develop local energy production, thanks to which residents of the city can also participate directly through energy cooperatives. Energy cooperatives allow people to produce and consume green energy themselves flexibly and by spreading risks, thereby offering an alternative to individual small-scale production and dependence on large producers.

Hydrogen is a clean and secure energy carrier that can be used as a fuel for energy. It does not emit emissions on site and can be produced from (renewable) electricity and fossil fuels with low carbon emissions. This way, completely emission-free energy is achieved, which is a viable solution for energy transformation and the green transition. By 2050, Tallinn should therefore be a hydrogen-powered city. The streams of clean energy (solar, wind) converted in predominantly cooperative production units are stored in hydrogen, which is used both in transport and in heating buildings and supplying electricity via a software network.

In addition to solar electricity, it is necessary to continue producing energy from non-recyclable waste. Although GHG savings are thereby small, as the waste is preferably recycled, it reduces the amount of waste stored.

The expansion of the district heating network must be continued and the construction of the district cooling network must begin. In 2030, Tallinn's district heating energy must be at least 90% produced from biomass and non-recyclable waste, and natural gas (preferably green gas) must still be used to cover peak loads. In 2020, 80% of Tallinn's district heating energy was produced from biomass and waste and the peak load was covered by natural gas.

Tallinn's energy supply systems are currently largely secured against the effects of climate change. In general, the impact on the sector can be assessed as rather small, as both cable lines and heating mains are mostly underground and are therefore barely, if at all, affected by climate factors. However, the wider use of renewable

energy sources and local energy production can lead to unknown effects. In the long run, rising temperatures will reduce the need for heating but will increase the need for cooling. Thereby, access to district cooling becomes more important.

In 2020, there will be approximately 64,000 street luminaires in Tallinn, of which 14,000 will be LED luminaires. It is planned for all old sodium luminaires to be replaced in the next decade. It is estimated that the replacement of each luminaire provides energy savings of approx. 570 kWh/y.

4.3.2 Measures for the reduction of GHG emissions from the energy sector

14. Diversification of renewable energy sources and awareness raising

With the support of this measure, a goal is set on how to satisfy Tallinn's growing (renewable) energy needs in the future and to harmonise peaks in energy production and consumption, preferably using the production of property operated by community renewable energy cooperatives at the place of consumption. The measure will support the implementation of legislation enabling cooperative renewable energy production by creating an awareness-raising and practical output demonstrating the cost-effectiveness and security of supply problems of a local cooperative distribution network that meets the needs of distributed and stored renewable energy and consumption. It is important to launch pilot projects (e.g. on the basis of the closed Pääsküla landfill). The return on renewable energy production resources and local distribution network investments for cooperatives can be over 8% based on the renewable energy needs (of the place of consumption), and the pay-back period is 15 years, with the advantage for commercial associations being an income tax refund.

As a result of this measure, approximately 22% of the total GHG emission reduction target set for 2030 will be achieved, provided that the electricity produced from renewable energy sources as a result of the measure is consumed by the transport sector.

Actions:

- compiling and mapping of data on surfaces suitable for the use of solar energy and increasing awareness and capacity for the use of solar energy in local electricity supply
- promoting the deployment of integrated green hydrogen technology

- development of a model for the creation and support of community energy cooperatives (e.g. through storage of hydrogen) producing electricity from solar panels, including the development and implementation of a financial instrument (e.g. capital guarantee)
- increasing the share of electricity produced from renewable energy sources in city institutions

15. Application of circular economy principles in energy production

In order to reduce GHG emissions, it is important to use resources as economically as possible. This measure contributes to the circular economy by producing energy from bio-waste and wastewater and using waste that is not suitable for recovery in the production of heat and electricity.

Actions:

- promotion of the circular economy and reusable materials (especially in construction)
- waste sorting (based on the circular economy road map), diversification of sorting options and expansion of the network
- preparation of the Tallinn waste inventory, including the waste transport inventory, for the determination, systematisation and monitoring of the Tallinn regular GHG emission inventory
- use of non-recyclable waste in energy production
- energy production from bio-waste and wastewater

16. Expansion of district heating areas and increasing the efficiency of the heating network

Expansion of district heating areas and increasing the efficiency of the heating network will help increase the share of renewable energy in energy consumption and the local production of heat from renewable energy sources. The European Union has identified district heating as a priority heating option, as it enables the use of carbon-free energy sources, including co-generation and industrial waste heat. The use of predominantly carbon-free district heating is important for reducing GHG emissions in the city of Tallinn.

Actions:

- preparation of analyses for the expansion of district heating areas and increasing the efficiency of the heating network (including analysis of the possibilities and efficiency of the use of wastewater heating solutions in apartment buildings)

- renovation of district heating networks to reduce heat loss
- connection of small district heating areas to the Tallinn district heating network
- renovation of the heating network of small district heating areas and pre-insulation of district heating pipes
- transition of co-generation plants and district heating boilers to renewable fuels and increasing the efficiency of co-generation plants using waste heat (including day storage units)

17. Pilot projects for district cooling of new and completely refurbished buildings and development of the district cooling network

Pilot projects for district cooling of new and completely refurbished buildings and development of the district cooling network will help increase the local production of heating and cooling from renewable energy sources. Promoting district cooling is important for resource efficiency. Higher energy efficiency in district cooling ensures lower energy consumption and GHG emissions and reduces noise in urban areas. Promoting district cooling helps reduce the impact of heat islands and GHG emissions from refrigerant leakage.

Actions:

- implementation of pilot projects for district cooling of new and completely refurbished buildings (e.g. Fahle Park, Ülemiste City)
- analysis and planning of district cooling network expansion
- connecting urban authorities in the district cooling area to the district cooling network instead of local solutions

18. Improving the economy and quality of street lighting

This measure will help increase energy efficiency and reduce GHG emissions. Improving the economy and quality of street lighting is important to make urban space more sustainable, safer and more people-centred. Guidable outdoor lighting with motion sensors allows electricity consumption to be reduced.

Actions:

- further development of the outdoor lighting control system to ensure the necessary lighting at night with minimal electricity consumption
- preparation of a cost-benefit analysis for the introduction of more economical luminaires and sensor systems in outdoor lighting

- replacement of all outdoor luminaires based on old technology with LED luminaries
- identification of priority and heavily used but insufficiently lit street sections
- use of a sensor system in outdoor lighting without compromising the accessibility and security of public spaces
- when replacing outdoor luminaires, improving the lighting quality for lighting cycle and pedestrian lanes in the dark season

4.4 Relationships between the directions and links with other development documents

Measures under Climate-neutral Tallinn to mitigate and adapt to the effects of climate change meet the goals of the UN Plan of Action 2030 and the Sustainable Development Goals to:

- ensure access to affordable, reliable, sustainable and modern energy for all (7)
- build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation (9)
- make cities and human settlements inclusive, safe, resilient and sustainable (11)
- take urgent action to combat climate change and its impacts (13)

The comprehensive implementation of Climate-neutral Tallinn fulfils the commitment made in the Covenant of Mayors, improves Tallinn's living environment, increases Tallinn's international competitiveness and contributes to the following goals of the development strategy Tallinn 2035: 'Green Transition', 'Whole Tallinn Moves', 'Friendly Urban Space', 'Home Starts from the Street' and 'Creative City of the World'.

The energy efficiency and climate-proof design of buildings support the direction that the energy sector takes. Buildings as a whole are affected by land use and urban planning, mobility and health measures (e.g. lack of proper ventilation causes overheating of buildings, including hospitals, childcare facilities and care homes). In addition, the impact on buildings can be reduced through better treatment and use of rain water. Climate-adapted buildings help reduce wind corridors on the streets (this can be affected, for example, by the volume and layout of buildings) and the negative impacts on road users; less land-based transport infrastructure diversifies the building environment and reduces flood risks.

Satisfying the growth in the demand for renewable electricity in transport and providing the necessary space for the production of local renewable electricity are related to the courses of action taken for transport and buildings. The development of infrastructure for alternative fuels (including electricity and hydrogen) is also linked to energy and buildings.

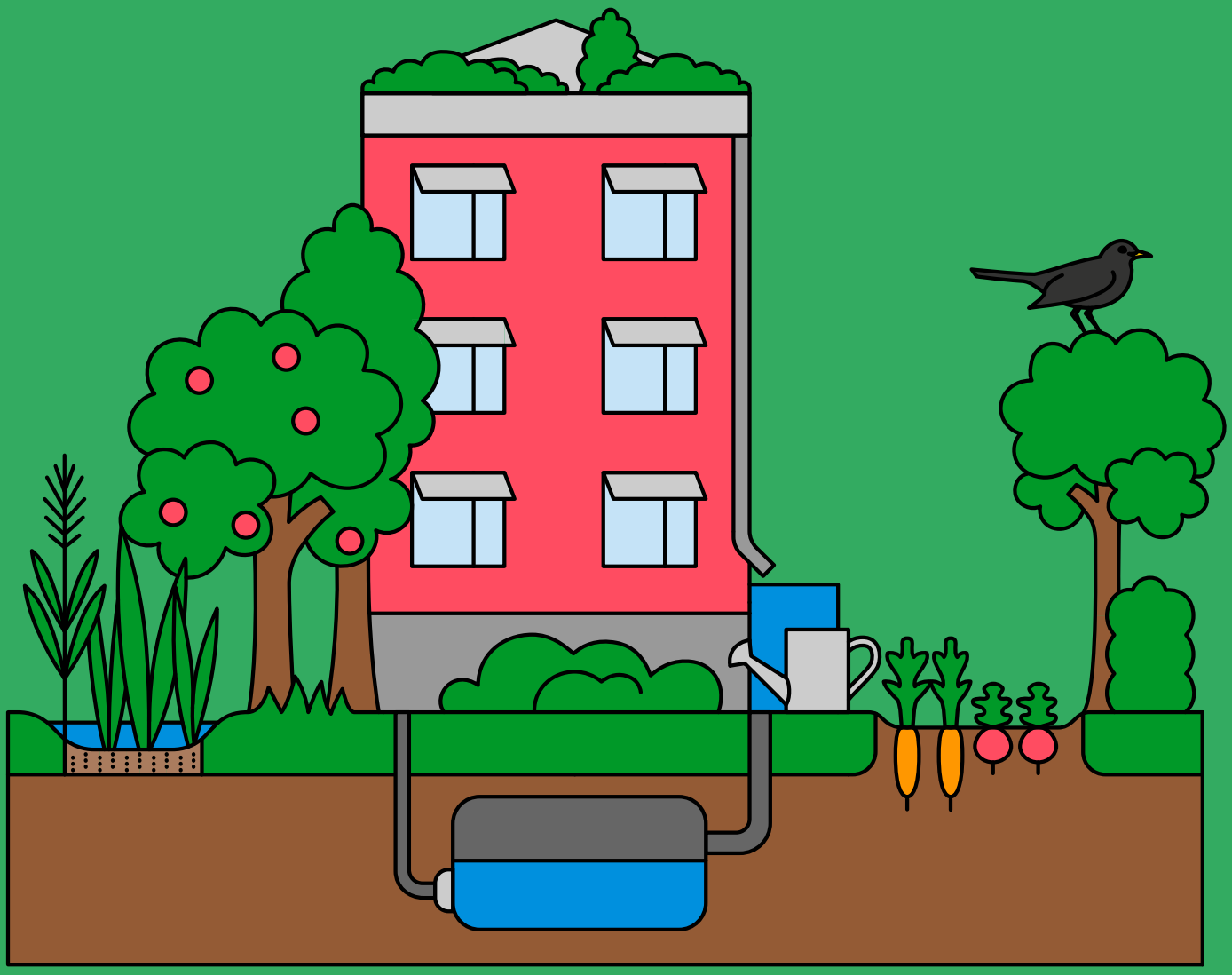
Land use and planning that takes into consideration the need to adapt to climate change also supports the adaptation of transport infrastructure – carefully planned landscaping (multi-storey, species-diverse landscaping) reduces the impact of wind and heat waves

on road users and prevents excessive rain water from accumulating on the streets. When transport infrastructure needs less land, it is possible to use the vacated land as a natural area and preserve biodiversity. Transport infrastructure as a paved area is one of the main causes of excessive rain water accumulation, but it also allows excess rain water to be managed and buffered.

Climate-adapted transport infrastructure reduces traffic risks. As a result, the number of sick days and premature deaths related to both road accidents and falls is reduced, active walking, cycling and light mobility are encouraged throughout the year, therefore having a positive effect on both mental and physical health. Weatherproof public transport and infrastructure with lower heat island impacts reduce the negative health effects associated with extreme weather events.

The smooth operation of the transport system in changing and extreme weather conditions is essential both for the functioning of tourism and for ensuring the functioning of the city's main functions in an emergency.

5. Adaptation to climate change



Goal: The readiness and capacity of the city of Tallinn to adapt to climate change has increased.

Climate change is a long-term process and, although the impact of many decisions and spatial solutions will be felt in the distant future, it must be ensured now that decisions take into consideration the specificities of the future climate. It is therefore important that by 2030, the city's vulnerability to the effects of climate change is reduced in all key areas of the development strategy, as both the effects and the magnitude of those effects may increase in the future. The main goal of adapting to climate change is to increase the city's resilience to climate change and its ability to adapt to climate change, so adaptation measures must be both strategic and spatial and based on up-to-date climate risks.

5.1 The main climate risks affecting the city of Tallinn

There are no major climate risks in Tallinn which endanger the lives of the residents and cause significant economic damage. Due to the geographical location and urban nature of the city, the vulnerability of coastal areas to floods and storms, the formation of heat islands and floods caused by precipitation are the most important medium-level risks (Figure 2).

	Existing risk		Future risk		
Climate risk	Probability of manifestation	Extent of impact	Expected change in intensity	Expected change in frequency	**Time of manifestation**
Heat wave	Medium	Medium	↑	↑	2020
Cold wave	Low	Low	↓	↓	2020
Sea level rise	Low	Low	—	—	2030
Storm surge	Low	Low	✣	↑	2030
Heavy rainfall	Medium	Medium	↑	✣	2020
Flood due to showers	Medium	Medium	↑	✣	2020
Storm	Medium	Medium	✣	✣	2020
Strong wind	Medium	Medium	✣	↑	2020
Drought and water scarcity	Low	Low	—	—	2030
Seawater intrusion into groundwater	Low	Medium	✣	✣	2030
Forest fire	Low	Low	—	—	2020
Vector prevalence	Medium	Medium	↑	↑	2020

Figure 2. Climate risks manifested in Tallinn

↑ Growing
↓ Decreasing
— No change
✣ Change unknown

Although there have been no significant changes in precipitation or in the frequency of precipitation exceeding 30 mm, large variations and some increases in peaks can be seen from year to year. According to the national climate forecast, a large increase in precipitation and the frequency of precipitation exceeding 30 mm is expected, which is why this scenario has also been taken into consideration in the assessment of Tallinn's climate risks, especially due to the leveraging effects of changes in Tallinn's urban space.

Risks from climate change, including an increase in extreme climate events, affect the city's public space, transport, buildings, water management, energy management, the environment, health and tourism. In addition, several sectors are also affected by the increase in the number of ice days, the decrease in the duration of snow cover and the increase in wind speed.

5.2 Climate change adaptation measures

5.2.1 Land use and planning measures

In particular, land use and urban planning measures will help reduce the impact of climate change on water management, health, transport and buildings. The city can take into consideration the needs of adaptation to climate change in land use and construction conditions in the comprehensive plan, detailed plan and design conditions. The conditions set in the comprehensive plans are related to the impregnation of greenery and rain water, e.g. limiting the increase in the proportion of paved areas, green network planning, nature-based solutions, landscaping percentage and landscaping-related requirements (Figure 3).

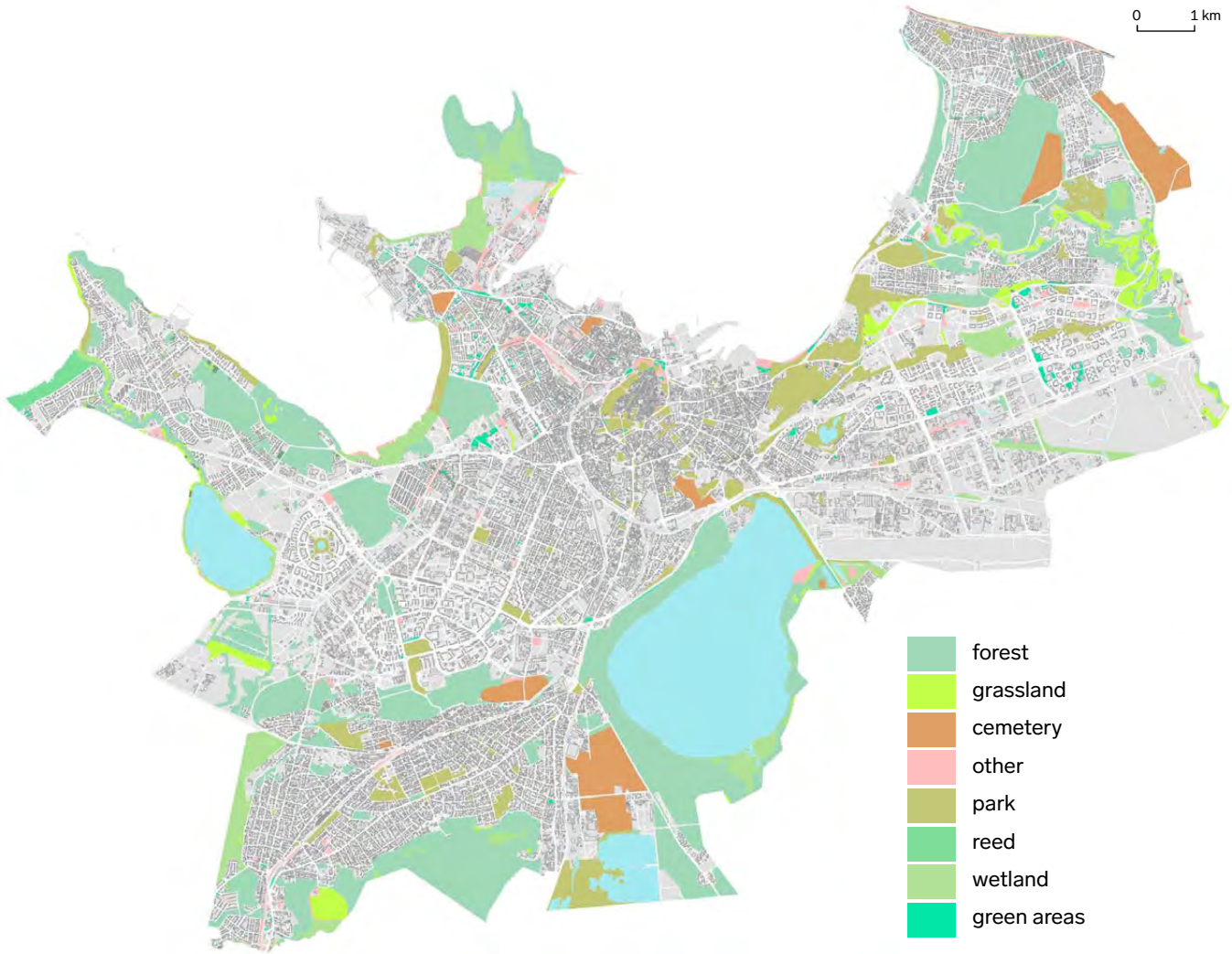


Figure 3. Tallinn's Green Infrastructure (GI) by GI types. (Tallinn City Planning Department, 2019)

The design conditions can also set requirements for the use of materials and nature-based solutions and so on. Smart planning can reduce the city's vulnerability to the risks of climate change, such as floods due to increased rainfall, coastal floods caused by

more frequent storms and wind corridors exacerbated by erosion, heat islands and wind speeds. In the case of the sea, it is possible to mitigate the effects of floods caused primarily by storm surges (Figure 4). To do this, it would first be necessary to identify the key issues – the impact on health, business and buildings, including cultural heritage. As a solution, nature-based solutions can be used (conservation of wetlands and reed beds in areas prone to flooding) and land use and construction conditions can be set (e.g. designation of construction exclusion zones and planning of green areas, construction of promenade and beach fortifications).

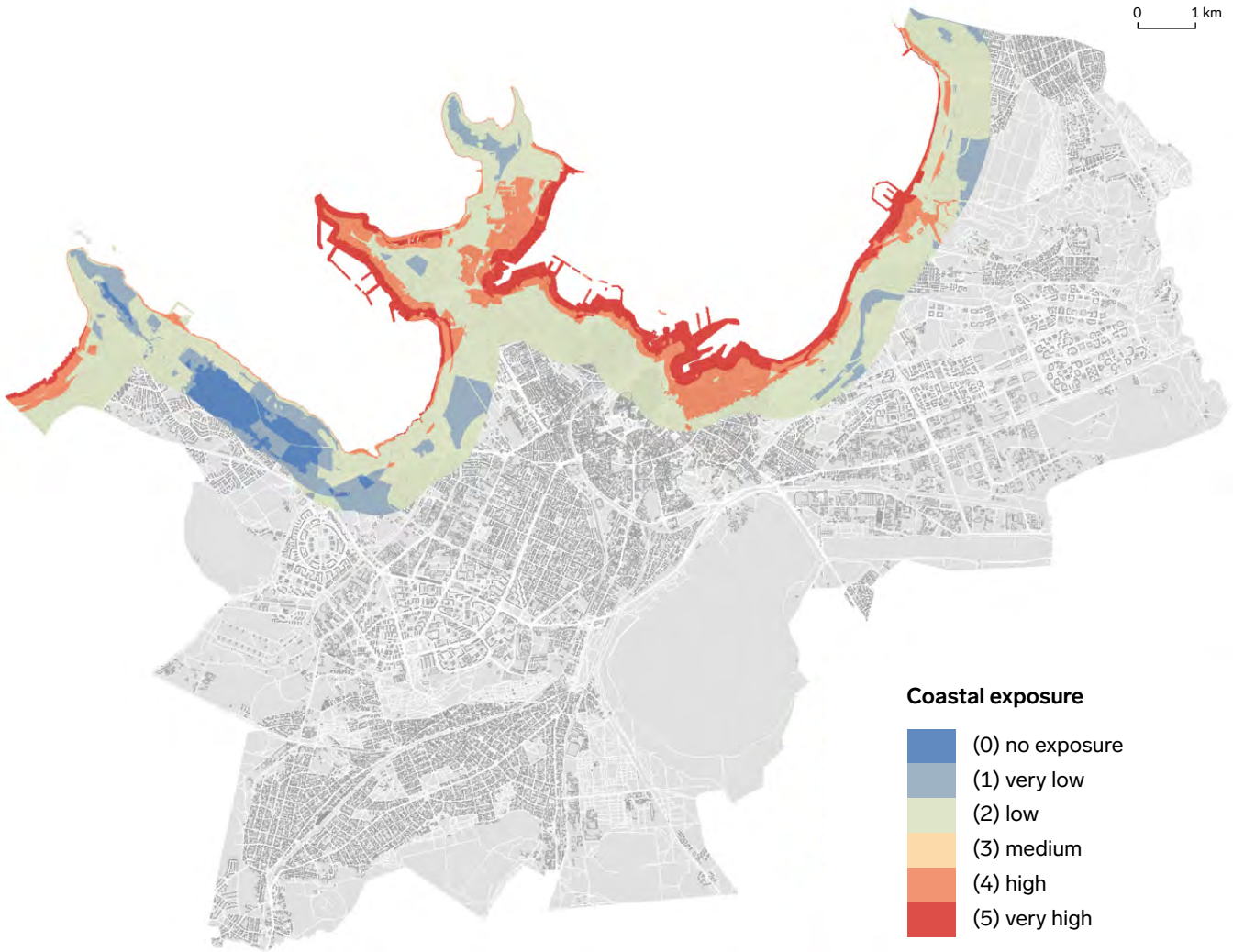


Figure 4. Coastal areas at risk of flooding in Tallinn and their exposure to storm surges.

19. Connected and functioning green infrastructure

The required proportion of landscaping must be specified in the comprehensive plans in order to ensure the climate resilience of areas with different management purposes. The planning of the city's landscaping and biodiversity is based on the city's green and blue network and the green factor of the plans. With the help of

the green factor, requirements can be set for the design of new development areas and the transformation of existing ones in order to ensure a sufficient number of ecologically active areas on the plots and to minimise the number of paved areas. The growth of the share of public green areas is also important. This measure supports the reduction and mitigation of the effects of both floods caused by rain water and the city's heat islands and contributes to the preservation of biodiversity.

When planning streets and parking areas or reconstructing the existing transport infrastructure, the need to minimise the impermeable surface must be taken into consideration. This can reduce two risks related to climate change: the risk of flooding due to excessive rain water and the amplification of heat islands due to paved surfaces. When planning and designing infrastructure, it is necessary to set a requirement to reduce paved areas and give preference to water-permeable pavements.

For existing and new planned areas and street space, it is important to ensure a sufficient proportion of landscaping to reduce the vulnerability of these areas and the transport system to the effects of extreme weather events, rain water floods and heat islands. This is equally important in the construction of new residential areas as well as in the construction and reconstruction of public space and infrastructure objects.

Actions:

- development of a methodology for calculating the climate threshold/landscaping percentage taking into consideration climate risks for the preparation of comprehensive plans
- the development of a green factor concept (including both biodiversity and rain water flood and heat island mitigation components) and the establishment and monitoring of a model area based thereon
- creation of missing links in green infrastructure
- increase in the share of high greenery in street landscaping (including car parks)
- use of pavements that support the natural impregnation of rain water and encourage its use
- applied research and analysis (including identification and use of climate-resistant and climate-resilient and disease-resistant plant species, systematic mapping of heat islands and micro-climate and planning of risk mitigation measures in plans and projects)

20. Consideration of marine flood risk and coastal erosion in planning

Due to increasing erosion, recreational areas and buildings are at risk, which is why monitoring coastal processes and assessing the impact of coastal erosion in the city is important. Coastal monitoring is necessary to design science-based and sound measures to reduce the impact of coastal erosion and to plan coastal protection.

A monitoring system needs to be developed and implemented to prevent rain water floods. The incidence of torrential rains has been on the rise and climate forecasts show an increase. Adequate information on the spatial distribution and relationships of floods is needed for planning and construction decisions. Monitoring data helps calibrate spatial models and monitor real changes. In addition to monitoring flow rates, it is important to map floods.

Actions:

- setting land use and construction conditions in the plans that mitigate flood risks (number of storeys, choice of material, open areas, etc.)
- Planning and conducting monitoring of the Tallinn coast, including creation of a database (monitoring in addition to state monitoring)
- coastal erosion impact assessment (modelling) and, where appropriate, the design of coastal protection measures

5.2.2 Health-related measures

Climate change adaptation measures which enable local authorities to reduce health vulnerabilities are mainly related to urban planning (including greenery, water and landscaping planning, conditions for public buildings, avoidance of segregation) and information and awareness-raising. Cooperation between the state and the city must be intensified in organising monitoring, financing and disseminating information to the population. In the latter case, district governments play a major role.

Due to the increase in heat waves, more attention must be paid to the factors influencing the city's micro-climate, such as increasing the share of areas with higher albedo and high landscaping through spatial planning and construction techniques. One of the most effective ways is to expand the green and blue network and improve their quality. The vulnerability of the area (Figure 5) to the effects of heat waves depends on the age of the population of the area (children and the elderly are most affected by heat waves) and social status (economic opportunities, level of education). As more

vulnerable groups are more likely to have less awareness and poorer economic opportunities, the city must support them in coping with the dangers of heat waves.

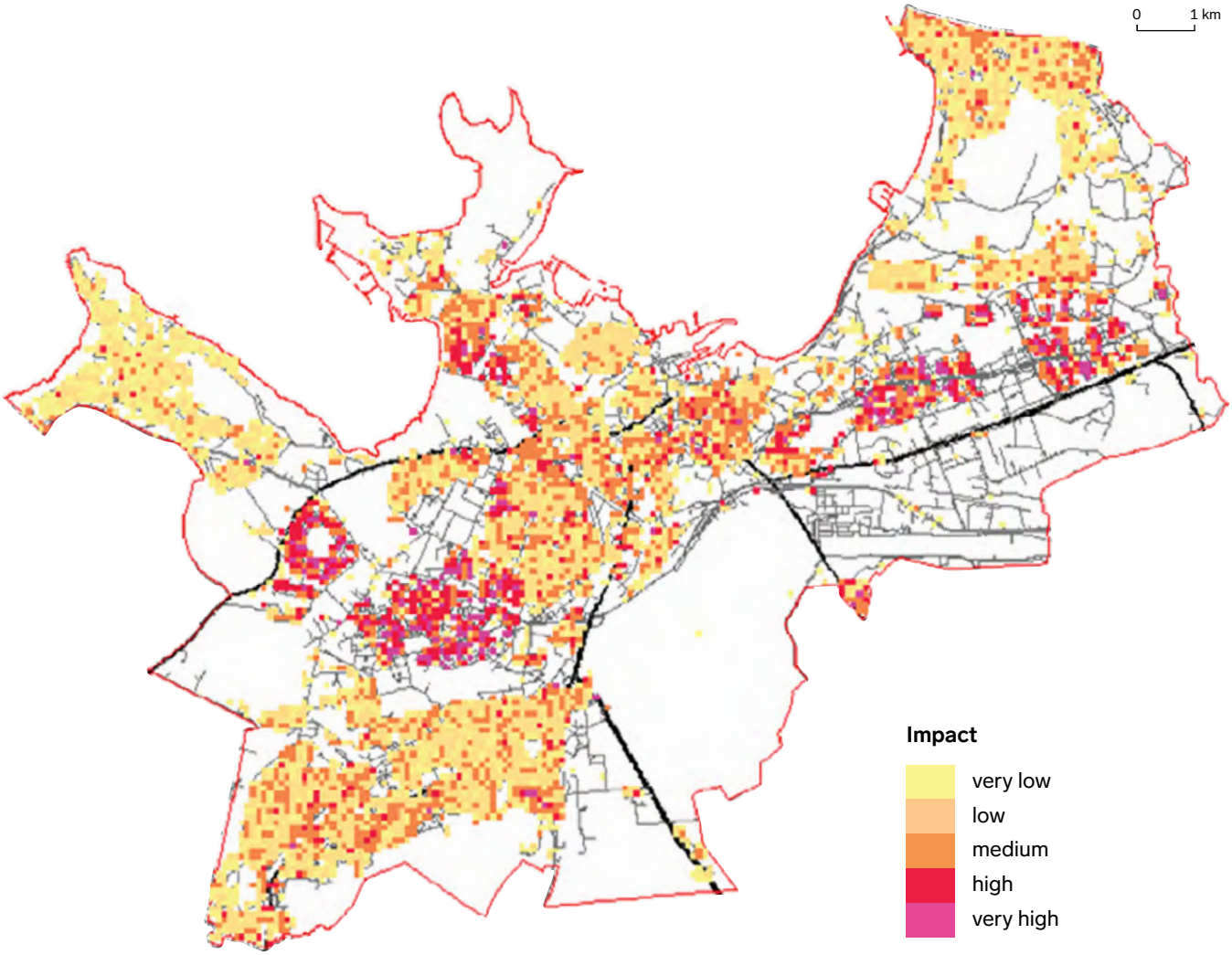


Figure 5. Vulnerability to Urban Heat Island (UHI) effect in Tallinn. The impact is greatest in areas where a large part of the population belongs to risk groups and also the UHI effect is strong. Source: University of Tartu (2016).

21. Increasing the preparedness of the city and its inhabitants to cope with the health risks associated with climate change

The approach to emergencies in Tallinn's risk analysis will be supplemented to take into consideration climate forecasts and vulnerability analyses based on spatial data.

The health effects of climate change are linked to an increase in heat waves, an increase in the spread of diseases transmitted by transplants, a deterioration in air quality, an increase in trauma due to slipperiness and a deterioration in the quality of drinking and bathing water. The city can support coping with these effects mainly through information and awareness-raising and support for groups at risk. The design and interior design of buildings using contactless solutions (doors, sanitary ware, etc.) play an important role in controlling the spread of pathogens. During a heat wave, it

is necessary to know how to behave in order to better withstand it. Both cities and the World Health Organization (WHO) have made such recommendations to the public, health professionals, social workers and planners.

The measure will provide guidance to social workers, property managers, healthcare professionals and other target groups to raise awareness and better manage the dangers of heat waves (e.g. frequent consumption of drinking water and ability to use ventilation and cooling systems).

Actions:

- supplementation of the city's development documents and risk analysis to mitigate the health risks associated with climate change, including supplementation of the city's risk analysis to increase epidemiological and medical preparedness for new threats
- implementation of information activities (provision of operational information to the population, e.g. in the case of heat waves or deterioration of ambient air quality, preparation of instructions for behaviour during heat waves)

22. Adaptation of the city's welfare institutions to cope with extreme weather conditions

People in the care institutions belonging to the city (orphanages, nursing homes) are exposed to heat waves. The city does not have an overview of the existence or condition of the ventilation and cooling systems of these buildings. Finding out the situation and adapting buildings to heat resistance will reduce the impact of heat waves on vulnerable groups.

Actions:

- compiling and monitoring an overview of the internal climate situation in care institutions
- installation of ventilation and cooling systems in care institutions

5.2.3 Water management measures

Local governments can reduce risks and support adaptation to climate change by making drinking water available in urban areas and carrying out research and monitoring to ensure the quality and availability of drinking water.

In order to mitigate floods caused by rain water, more attention will be paid to increasing the share of water-permeable pavements, developing a segregated sewerage system and making better use

of rain water as a resource. In the case of rain water reservoirs, it is also important to maintain good ecological status and continuously improve the quality of rain water discharged into reservoirs.

The problem of rain water floods can usually be solved either by temporary storage of excess water (e.g. increasing the accumulating volume of water bodies, construction of ponds or ditches) or by rapid drainage (e.g. construction of ditches or rain water systems). In order to quickly drain all the water, the water pipes must be designed and built taking into consideration the maximum flow rate, which makes buildings large and expensive. In order to temporarily hold and buffer water, existing watercourses must be maintained, but in addition, places must be created where water is temporarily collected and from which water flows to the destination only when the high water begins to run out and the flow rate decreases. Sufficient information is needed to plan solutions (including nature-based ones).

23. Availability of drinking water as a resource in a changing climate

Warmer weather, especially heat waves, and prolonged droughts increase the need for water consumption. Knowledge of Tallinn's water consumption forecasts makes it possible to ensure the city's readiness to ensure that high-quality drinking water is available to residents and tourists even in extreme weather conditions and droughts. In order to ensure clean water as a strategic resource, the city's shareholding in AS Tallinna Vesi must be maintained. The regional study of hydrogeological conditions and the mapping of the risk of seawater inflow, taking into consideration the water abstraction volumes of neighbouring municipalities consuming water from the same aquifer or the water resources of Ülemiste, increases the readiness to ensure the availability of high-quality drinking water. According to the climate forecast, the occurrence of heat waves will increase in Tallinn. In order to mitigate the risks, it is important to provide the residents with free drinking water and make it available in urban areas as well, thus reducing waste generation. It is possible to add drinking water taps to smart apps (e.g. Refill, Refill My Bottle) to make it easier to find them.

Due to the increase in precipitation and torrential rain due to climate change, the risk of potential pathogens, parasites, hazardous substances and nutrients being transferred to the surface water system needs to be mapped and mitigated. In addition, attention needs to be paid to algal toxins and parasites (their monitoring is addressed in the National Climate Change Adaptation Development Plan), focusing on water systems that use surface water as drinking water.

Actions:

- implementation of more effective protection measures for Lake Ülemiste and the catchment area, among other things, to reduce the risk of pathogens, nutrients and hazardous substances entering surface water systems that use drinking water
- mapping, design and installation of drinking water taps (including determination of locations in urban areas and development of a unified, clearly identifiable and durable drinking water solution), disclosure of information
- carrying out analyses and studies to ensure the availability of drinking water in a changing climate:
  - an analysis and model of the capacity of existing water treatment systems to deal with the treatment of water-borne pathogens, hazardous substances and nutrients in the event of a flood risk
  - an analysis of water consumption forecasts for residents of Tallinn until 2050, taking into consideration the pressure on water resources from neighbouring municipalities
  - a study of regional hydrogeological conditions on the risk of seawater inflows into groundwater aquifers under reduced pressure, considering regional water consumption, in particular the amount of water consumed by neighbouring municipalities (development of a methodology and study)
  - an analysis of surface water treatment, in the course of which the available water resources (including the potential for the use of water bodies in the changing climate conditions) and the raw water quality (including its change over time and water treatment technology, including consumption trends, technological changes) are analysed

24. Development and monitoring of a separated flow rain water system

The capacity of joint flow drainage pipelines may not be sufficient with increased rates of rain water, while separated flow systems generally operate without interference. In addition, a large amount of rain water puts a burden on wastewater treatment systems. With a certain amount of rainfall, the existing rain water drainage system is sufficient, but in the case of heavy rainfall, the pipeline cannot receive all of the rain water. Sustainable drainage systems (SuDS) complement pipeline solutions and reduce the city's vulnerability to rain water flooding. The role of the city is to set an example in the use of sustainable drainage systems, including the transformation of street space to increase the buffering capacity of rain water as well as the use of water-permeable materials.

GIS databases and analyses help to understand the spatial occurrence of floods and their links to drainage systems, drainage beds, precipitation and altitude (Figure 6) and provide decision-makers with useful information on flood mitigation options in priority areas, helping them choose the right flood prevention and management solutions. In addition, it is important to set up a monitoring system, the data of which will help calibrate the models and monitor real changes.

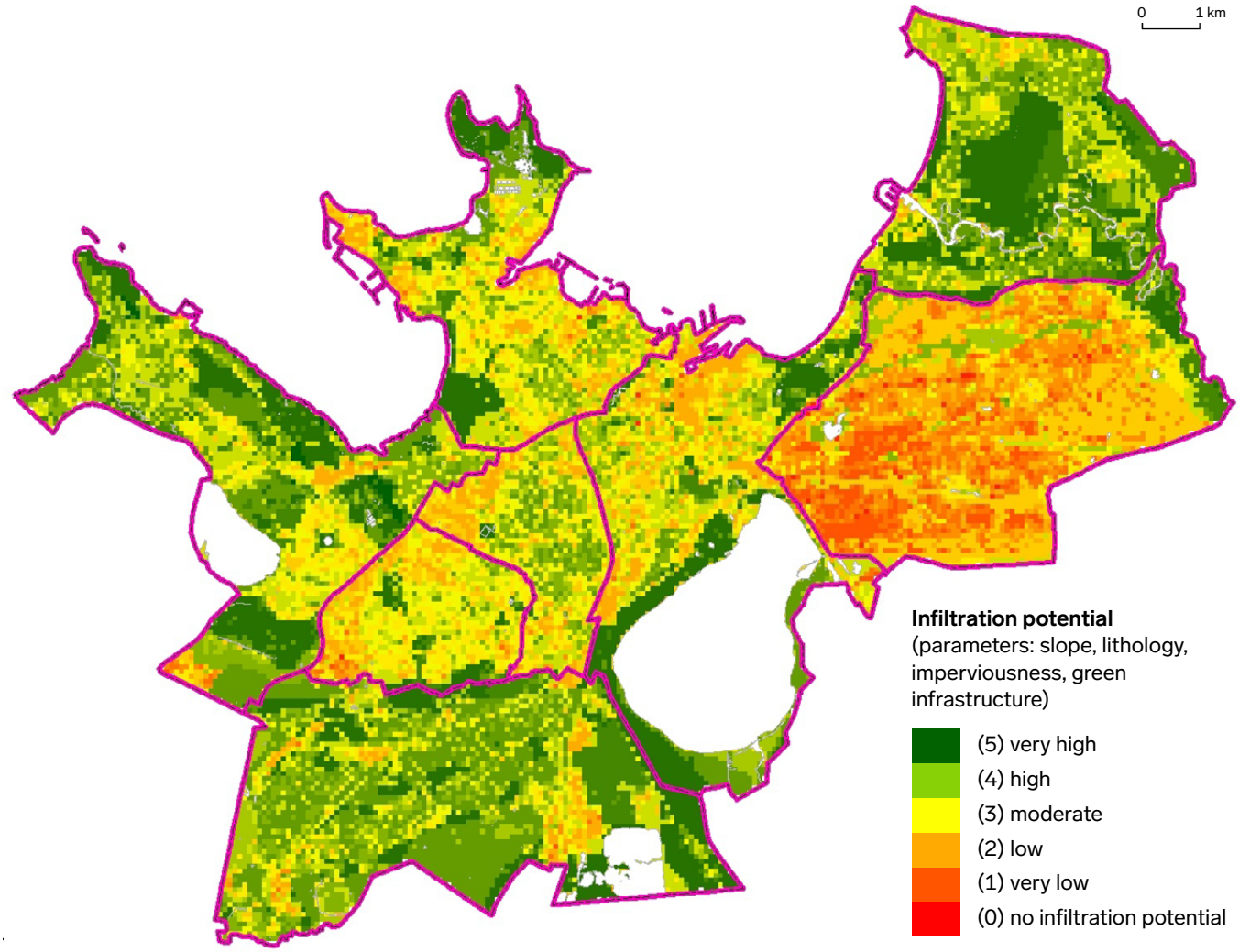


Figure 6. Infiltration potential in Tallinn (2018), expressed on a gualitative scale.

City legislation must encourage rain water treatment in urban green spaces (both private and public land). A large proportion of paved areas (including car parks), the inability of the drainage systems to cope with the amount of run-off and torrential rains cause extensive flooding in Tallinn. In order to better organise the drainage system and cover the related investments, the city must develop and implement a rain water charging system that would stimulate the user of the rain water service to reduce the amount of rain water directed to the system through in-plot measures. At the same time, activities which increase the use of sustainable solutions in the city must be encouraged.

Actions:

- conversion of joint flow rain water systems to systems with separated flow
- design, construction and monitoring of test areas with sustainable drainage systems
- preparation and supplementation of city legislation necessary for rain water management
- mapping of catchment area-based rain water areas, creation of a GIS database and compilation (development, calibration) of catchment area-based rain water models
- development (including data generation) and implementation of a rain water monitoring system

25. Greater use of rain water as a natural resource

Reducing rain water flow and prolonging the flow time by impregnation helps reduce the pressure on piping systems and thus reduce rain water floods and their effects. Green roofs and vertical landscaping help alleviate the impact of rain water floods and heat islands and also support biodiversity conservation. As such solutions have so far been little used, the city has an important role to play in establishing demonstration sites.

Actions:

- setting requirements for the collection and drainage of local rain water in new developments and implementation of nature-based solutions
- identification and implementation of opportunities for more optimal use of rain water as a resource (for irrigation, in indoor systems, e.g. toilets)
- preparation of instructional materials for the use of nature-based solutions (for the creation of new green and blue infrastructure)
- design, construction and monitoring of roof and vertical landscaping demonstration projects

5.2.4 Environmental and biodiversity-related measures

Projected changes in climate parameters (increase in rainfall, increase in average annual temperature, increase in sea level, increase in extreme weather events, decrease in sea ice and snow cover in winter, increase in wind speed) affect biodiversity and ecosystems and the benefits and services they provide to society. A coherent and well-maintained network of green spaces, ecosystems, communities and species is more resilient to climate change and also has a better ability to recover. Thus, the main measures are the

protection of biodiversity (both inside and outside protected areas) and ensuring the coherence of the green network. This requires information on ecosystems, species and habitats and the ecosystem services they provide and the effects of climate change. This data can be obtained through research and monitoring. It is important to prevent the introduction of alien species, including invasive alien species, to provide information and to control the spread of existing invasive alien species and repel those species. In the case of water bodies, measures to protect against pollution, nutrient loads, the introduction of alien species and geomorphological changes need to be stepped up to reduce the effects of climate change.

26. Biodiversity conservation and monitoring

Determining the biodiversity situation makes it possible to make decisions that ensure a good quality of life for the people of Tallinn despite the increase in climate risks.

Monitoring the condition of urban communities helps assess the extent to which the city of Tallinn as an ecosystem is able to withstand and recover from problems caused by climate risks (increase in extreme weather conditions, increase in average annual temperature, alien species, etc.). Based on the impact of climate change on biodiversity, mitigation actions can be planned and implemented. The use of innovative biodiversity monitoring solutions (automated and image-based tools and solutions to generate open data flows) will make monitoring much more cost-effective in the future. Involving the population in data collection and ensuring the good status of biodiversity or green spaces helps establish a link between the population and the surrounding nature and ensure that green spaces are available and meet the expectations of the local community.

Actions:

- performance of analyses and studies for the planning of biodiversity conservation activities:
  - basic research on biotopes and biota status for mapping and assessing urban biodiversity, including inventory and assessment of communities in under-explored areas (e.g. waste land, non-protected areas) and mapping of the distribution of alien species threatening the natural balance
  - applied research on cohesion of green areas
  - an analysis of building materials and construction solutions to increase richness of species and the wellbeing of urban life
  - an analysis of the extent, effects and mitigation options of light pollution

- the use of innovative biodiversity monitoring solutions (automated and image-based tools and solutions to generate open data flows) and the aggregation of monitoring data into a publicly accessible database
- involvement of residents in the mapping of Tallinn's biodiversity
- implementation of pilot projects for building solutions that increase richness of species
- planning and implementing measures to support biodiversity due to climate change in the environmental conservation development plan
- development and implementation of biodiversity-enhancing management policies in green areas with various functions

5.3 Links with other courses of action and development documents

Measures under the climate adaptation plan Climate-neutral Tallinn meet the goals of the UN Plan of Action 2030 and the Sustainable Development Goals to:

- ensure healthy lives and promote wellbeing for all at all ages (3);
- ensure availability and sustainable management of water and sanitation for all (6);
- make cities and human settlements inclusive, safe, resilient and sustainable (11);
- take urgent action to combat climate change and its impacts (13); and
- protect, restore and promote sustainable use of terrestrial ecosystems (15).

Land use and urban planning are affected by transport, water management, buildings, health, the natural environment and biodiversity as well as the capability to manage emergencies.

Rising air temperatures and increasing heat waves are affecting the city's microclimate, the mitigation of the effects of which has been reflected in urban planning and biodiversity. The outside air temperature also affects the indoor climate of buildings, the improvement of which is reflected in the building measures. The increase in ice days is leading to an increase in accidents due to slippery conditions, including falls, the prevention of which has been reflected in the measures in the transport sector. The increase in precipitation and the increase in torrential rains mainly affect health through the possible deterioration of the indoor climate and the

quality of drinking water in buildings, which is why these problems are addressed as part of the section covering buildings and water management.

Water systems and management are strongly influenced by land use and urban planning in a changing climate. The decisions made here have both direct and indirect effects on water quality and rain water and sewerage systems. Measures to prevent congestion of drainage systems caused by storms and heavy rainfall and the consequent risk of pollution of water bodies are planned as part of the section on water management and health.

Land use and urban planning measures (ensuring a coherent and functioning green infrastructure and establishing additional landscaping to cope with excessive rain water and reduce the amount of heat islands) and water management measures (design of demonstration areas involving sustainable drainage systems) contribute to the preservation of biodiversity and the natural environment and the provision of ecosystem services.

6. Measures to increase awareness and administrative capacity related to the effects of climate change

For the implementation of Climate-neutral Tallinn, measures are planned to improve the awareness of various target groups and the administrative capacity of the agencies, to update the legal framework and development documents and to develop and implement a monitoring system. Support measures of the city must contribute to the achievement of climate goals, so it is necessary to assess the impact of existing support measures and make the necessary additions.

27. Raising the awareness of different target groups and developing cooperation

Better awareness of different target groups about increasing energy efficiency and about the risks of climate change is very important for the implementation of all the measures and activities of Climate-neutral Tallinn. Thus, awareness of Climate-neutral Tallinn needs to be increased in all directions. The uptake of new solutions often depends on user awareness – if people are not sufficiently aware of new solutions (e.g. energy-saving technology) and if there is no desire, skill or opportunity to be environmentally friendly, innovative solutions may not be implemented. In order to raise awareness, training and information days should be organised for target groups and pilot projects should be implemented.

Actions:

- advising of apartment associations, home-owners and property developers (organising trainings and compiling support materials) on climate change risks and how to deal with them
- raising awareness of energy efficiency (training of energy consumers to change their consumption patterns and innovative solutions for more efficient energy use)
- raising awareness among residents of the city through events and campaigns (e.g. climate month, climate change events for kindergartens and schools) or integrating climate change into regular events (e.g. health fair, car-free day)
- creation of a green transformation network with companies and development of pilot projects
- development of cooperation with research institutions, preparation and planning of medium-term climate change research

28. Updating the legal framework and development documents and improving the administrative capacity of the departments

The need to adapt to climate change must be taken into consideration when drafting and updating urban development documents and legislation, and aspects of adaptation to climate change must be reflected in mitigating climate risks. Climate-neutral Tallinn is based on the development strategy Tallinn 2035 and its implementation is affected by the following city development documents:

- Tallinn comprehensive plan and comprehensive plans of city districts
- Tallinn's environmental strategy up to 2030, which will be replaced by the environmental conservation development plan 2030 being drafted
- Tallinn Public Health Development Plan 2017-2021
- Tallinn Waste Management Plan 2017-2021
- Tallinn Public Water Supply and Sewerage Development Plan (being drafted)
- Tallinn's emergency risk analysis
- Tallinn Rain Water Strategy 2030
- Tallinn's 'Action plan of greenery in Tallinn for 2013-2025'
- Tallinn Bicycle Strategy 2018-2027
- Tallinn Region. Sustainable Urban Mobility Plan 2035 (being drafted)

Actions:

- increase in the capacity of urban officials to make sectoral decisions in the light of climate change
- review and supplementation of existing development documents and legislation and, in the case of new legislation, taking into consideration aspects of climate change for the implementation of Climate-neutral Tallinn
- development of legislation supporting the achievement of climate neutrality in cooperation with the state
- review of the conditions of Tallinn's support measures for climate change mitigation and adaptation
- regularly updating the operational programme of Climate-neutral Tallinn

29. Development and implementation of a monitoring system as part of the plan Climate-neutral Tallinn

In order to monitor the implementation of the plan Climate-neutral Tallinn and to evaluate its success, it is necessary to develop a monitoring system, including to define the indicators alongside the

baseline and target levels. Based on the European Green Deal, it is important to improve energy efficiency and increase the share of renewable energy in production and consumption. A monitoring system based on open data presupposes an adequate assessment of consumption. Preliminary performance indicators for measures are presented in a summary table of measures, but many of them need to be clarified both methodologically and in terms of the baseline and target levels. Activity output indicators are presented and updated in the annual operational programmes.

An important input for monitoring is provided by a periodic urban GHG emission inventory based on final fuel and energy consumption in accordance with SECAP guidelines and the IPCC methodology, which takes into consideration the 2007 GHG emission inventory of Tallinn and the 2015 monitoring inventory. The development and implementation of the monitoring system as part of the plan Climate-neutral Tallinn is coordinated by the Tallinn Strategy Centre.

Actions:

- development of the monitoring system as part of the plan Climate-neutral Tallinn and data collection/compilation (including collection of open data and development of an analysis platform)
- regular updating of the Tallinn GHG emission inventory
- preparation of an analysis of the possibilities of achieving carbon neutrality in Tallinn

7. Implementation of Climate-neutral Tallinn

7.1 Implementation and monitoring

The goals of and courses of actions under Climate-Neutral Tallinn are based mostly on the basic documents of the Covenant of Mayors and the SECAP guidelines. Climate-Neutral Tallinn has been prepared based on the goals of the development strategy Tallinn 2035, especially the goal of the green transformation.

The measures and activities are largely based on the 'Tallinn Environmental Strategy up to 2030', the 'Sustainable Energy Management Plan for Tallinn, 2011-2021', the 'Tallinn Region. Sustainable Urban Mobility Plan 2035', Tallinn's application to be the European Green Capital and other city development documents. New measures have also been added to Climate-neutral Tallinn, taking into consideration their synergistic effects on climate change mitigation and adaptation as well as their innovation and risk-based nature.

The plan Climate-neutral Tallinn is implemented by most of the city's agencies, and its implementation is coordinated and monitored by the Strategy Centre in cooperation with relevant undertakings.

The financial resources necessary for the implementation of Climate-Neutral Tallinn are planned according to the city's budget possibilities in the budget strategy and the city budget, specific activities along with the budget are specified in the implementation plan of Climate-Neutral Tallinn approved by the city government annually after adopting the budget.

The estimated total cost of the implementation of the action plan Climate-neutral Tallinn is €1.5 billion for the public sector until the year 2030, including the cost of already implemented and additional measures. Public expenditure is presented in millions of euros by measure. The implementation of the measures is also expected to increase public revenues through potential tax revenues or quota revenues from the trading schemes of GHG emissions.

Monitoring of Climate-neutral Tallinn is based on the reporting rules of the Covenant of Mayors. Monitoring is performed in three stages:

Stage I. The implementation of the activities planned as part of Climate-neutral Tallinn are reviewed annually. The effectiveness of the plan will be assessed at the same time as the evaluation of the effectiveness of the development strategy of Tallinn is performed. The annual review of Climate-neutral Tallinn covers only the goals and activities related to the municipal sector.

Stage II. Pursuant to the rules of the Covenant of Mayors, the City Government reviews the measures and actions under Climate-neutral Tallinn and their relevance every two years and, if necessary, amends or supplements them. Based on this, the Tallinn Strategy Centre submits a report to the Secretariat of the Covenant of Mayors every two years.

Stage III. Every four years, a full inventory report is conducted to monitor energy consumption and CO_2 emissions data, assessing the achievement of the goals set in the plan Climate-neutral Tallinn and in particular the reduction of CO_2 emissions.

In order to regularly assess the impact of Climate-neutral Tallinn, a monitoring solution must be created that allows the automatic processing of raw data and collection on the city's data platform. Where possible, cross-use of data with external databases is ensured. The main metrics are public and displayed on the city's website. This allows the city to do research and create new services.

When collecting qualitative data, long-term systematic target group surveys must be added to the current practice of random welfare surveys, which create an overview of people's long-term consumption habits and preferences for movement in Tallinn. Based on the practice of other countries, it is recommended to conduct long-term target group studies in cooperation with local research institutions, ensuring the comparability of the results with the research results of other cities.

In connection with the advent of new business forms and technology, it is necessary to regularly review and, if necessary, update the plan Climate-neutral Tallinn. The need to amend the plan may also be caused by changes in both national and European Union legislation. The success of the development document will be assessed and the action plan will be adjusted as necessary, but at least every four years. In order to change the measures and actions,

the summary table of measures under Climate-neutral Tallinn will be updated, which will be reapproved after the activities are updated and will be an integral part of Climate-neutral Tallinn.

7.2 Implementation risks

The main risks of implementing the plan Climate-neutral Tallinn are related to administrative failure and insufficient and inconsistent funding as well as unexpected changes in the economic environment. Financing risks are also directly related to political risks and may result from annual changes (changes in preferences and/or political priorities) in budgeting. These risks can lead to disruption and ineffectiveness. Political risks are related to the change of political will in the City Council and the City Government.

Risks are mitigated by the consistent and transparent monitoring of the success of the scheme, with regular cost-effectiveness analyses, clear presentation of changes in indicators and energy consumption indicators and communication and explanation of research results to city management. Such presentations and cooperation will harmonise the awareness of the departments; for this purpose, separate actions are planned as part of the planned measures and the operational programme.

Administrative risks may result from inconsistencies in the management of the network of implementers of the plan (actual executors: city authorities, private companies, population), such as shortfall or non-cooperation and insufficient communication. There may also be a risk of administrative changes in city authorities and politicisation of management at both city and state levels. The latter may in turn lead to a change in responsible staff.

Such risks are mitigated by the establishment of a cross-sectoral steering committee or working group composed of representatives of the city's authorities and non-city stakeholders. It must include a consistent feedback system. In addition, working groups may be set up to exchange information and develop substantive cooperation.

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