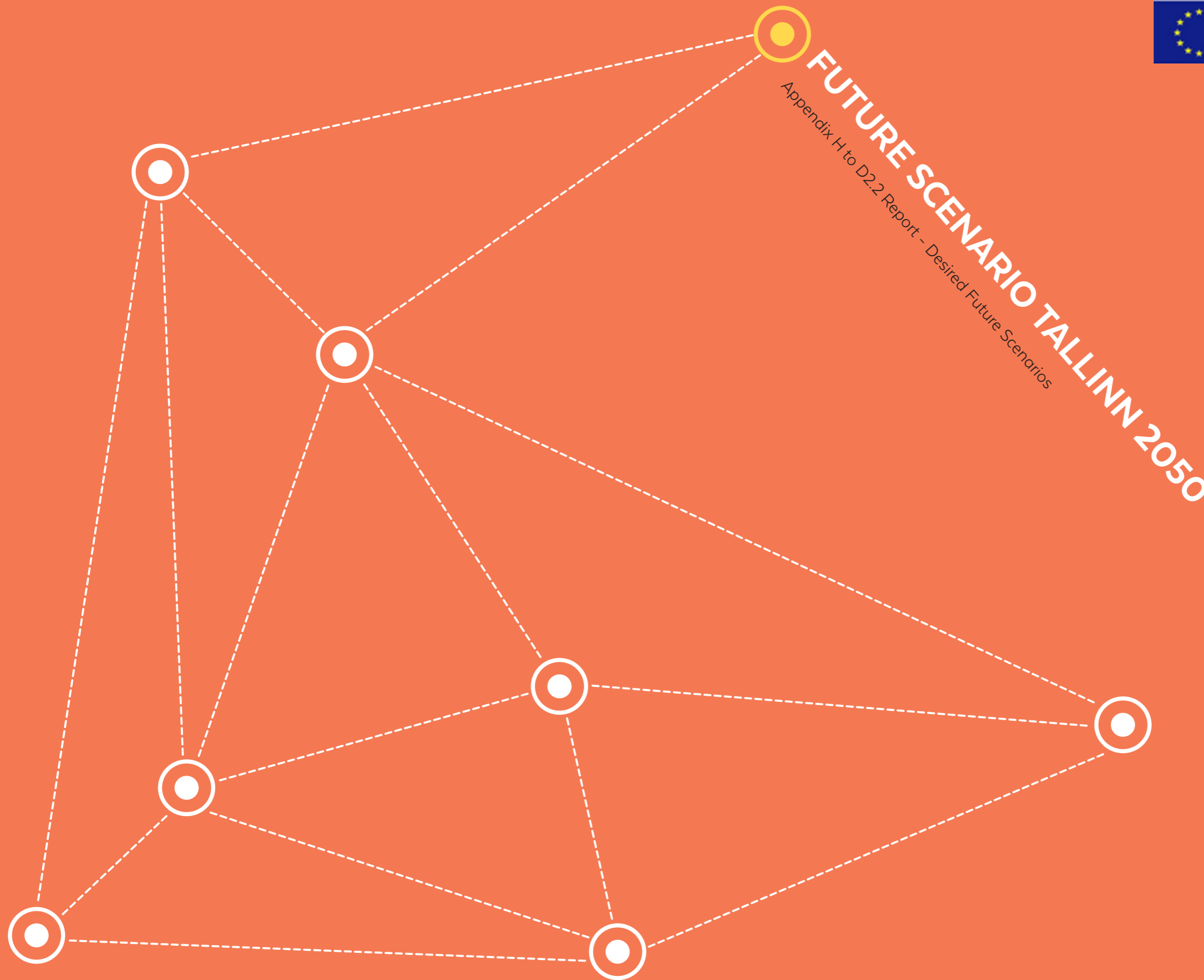




This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649397



15 June 2016

Viljo PELLA & Jaagup AINSALU, Tallinna Keskkonnaamet
Elke DEN OUDEN & Jan-Jaap RIETJENS & Rianne VALKENBURG, TU/e LightHouse



**ROADMAPS
FOR
ENERGY®**

This appendix is part of the D2.2 Report - Desired future scenarios - and contains all results of the vision development activities held in the city of Tallinn.



The R4E project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649397.

Disclaimer: This report presents the views of the authors, and do not necessarily reflect the official European Commission's view on the subject.

Versions of this report:

18 April 2016	Concept for internal check in the city (limited distribution)
15 May 2016	Final version for public distribution
15 June 2016	Final version for public distribution - with minor corrections



Contents Appendix H

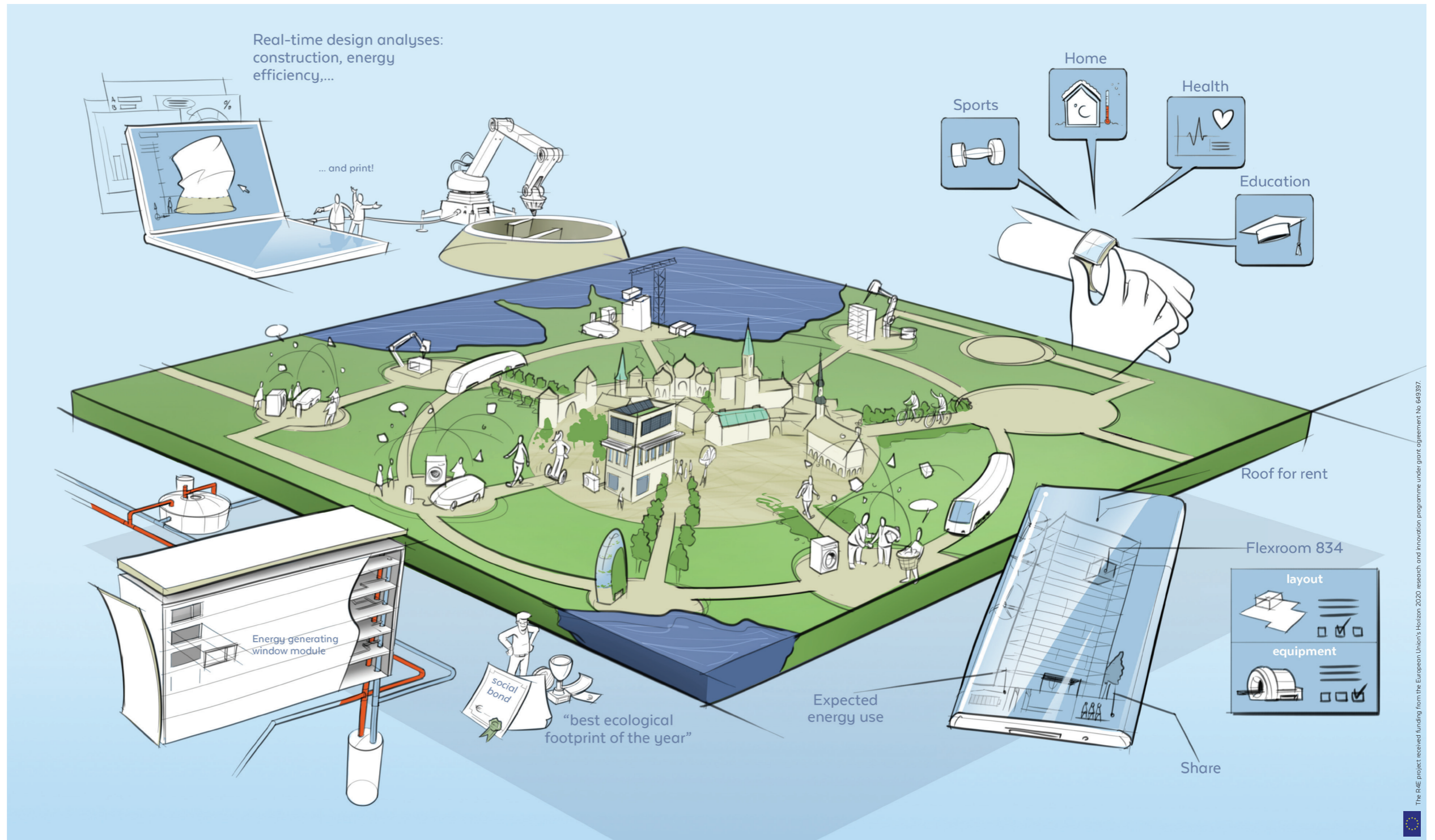
<i>Desired future scenario Smart Buildings</i>	H 4
<i>Desired future scenario Smart Mobility</i>	H 5
<i>The making of the desired future scenario</i>	H 7
<i>Ambition: Smart buildings and smart people in energy-neutral Tallinn 2050</i>	H 8
<i>Drivers for change for the future of Smart Buildings in Tallinn 2050</i>	H 9
<i>Ambition: Smart mobility enables an enjoyable living environment in Tallinn 2050</i>	H 10
<i>Drivers for change for the future of Smart Mobility in Tallinn 2050</i>	H 11
<i>Contributions</i>	H 13

SMART BUILDINGS AND SMART PEOPLE IN ENERGY-NEUTRAL TALLINN 2050

In 2050, people in Tallinn value sustainable behaviour and renewable energy. They take individual responsibility for energy saving, and the remaining energy demand is affordable for all. Renewable energy sources such as heat pumps, biofuels and energy from the sea enable a CO₂-neutral city.

All existing buildings have had a far-reaching renovation and modernisation, with respect for their historical heritage. All the energy systems are automated and connected. Smart materials and equipments contribute to an energy-neutral city.

Integrated and flexible city planning values an energy-efficient smart city. Planners have the knowledge and awareness to work at an integrated system level. Their work takes into account all relevant issues, and provides the flexibility to adapt to changing situations. These policies are implemented through specific, integrated district plans.



Elements of the desired future scenario are:

Distributed services

Services in Tallinn are distributed in decentral hubs around the city, with logical clusters of services according to the needs of the people in the area. The hubs are connected by free (self-driving) public transport and light traffic highways for safe and comfortable commuting by (e-)bike. Households enjoy sharing facilities for sauna, laundry and mobility. The newest technologies for generating electricity and charging devices are widely available.

Prefab building modules

Buildings are constructed and renovated with prefab building blocks using state-of-the-art, sustainable and energy-efficient materials. Smart technical systems are integrated in the modules, so technical rooms are small. The blocks allow flexible additions to buildings to add extra space or change functionalities (e.g. accommodating changes in schools). New technologies such as 3D printing allow high flexibility and custom design for architectural freedom.

Smart public services

Public services (home care, medical care, sports training, education etc.) are remotely accessible. Smart solutions enable service delivery at home (e.g. measuring blood pressure). An integrated system (like a web portal) offers access to services from all companies, and makes it easy to search for and find the right ones. The use of artificial intelligence allows tuning to individual needs, and providing useful services and incentives (e.g. comparing ecological footprints).

Flexible use of public buildings

Public buildings (schools, churches, theatres) in Tallinn are used intensively. People can book rooms, buildings and equipment for different purposes through an online portal, e.g. using schools in the evening for computer training for adults, yoga classes in a gym or office rooms for short-term rental by start-ups. The buildings are showcases of energy efficiency and provide energy for the community (e.g. as carriers of PV panels for shared use) and energy education.

Sophisticated renovation

All buildings are deeply renovated with the newest technologies for energy efficiency, and are connected to CO₂-neutral district solutions for heating and electricity generation. Flexible funding schemes and incentives (e.g. tax breaks or prizes) drive people to achieve the highest saving with the best indoor climate through renovation and behavioural change. Local government demonstrates and encourages good practice, and provides temporary housing during renovation.

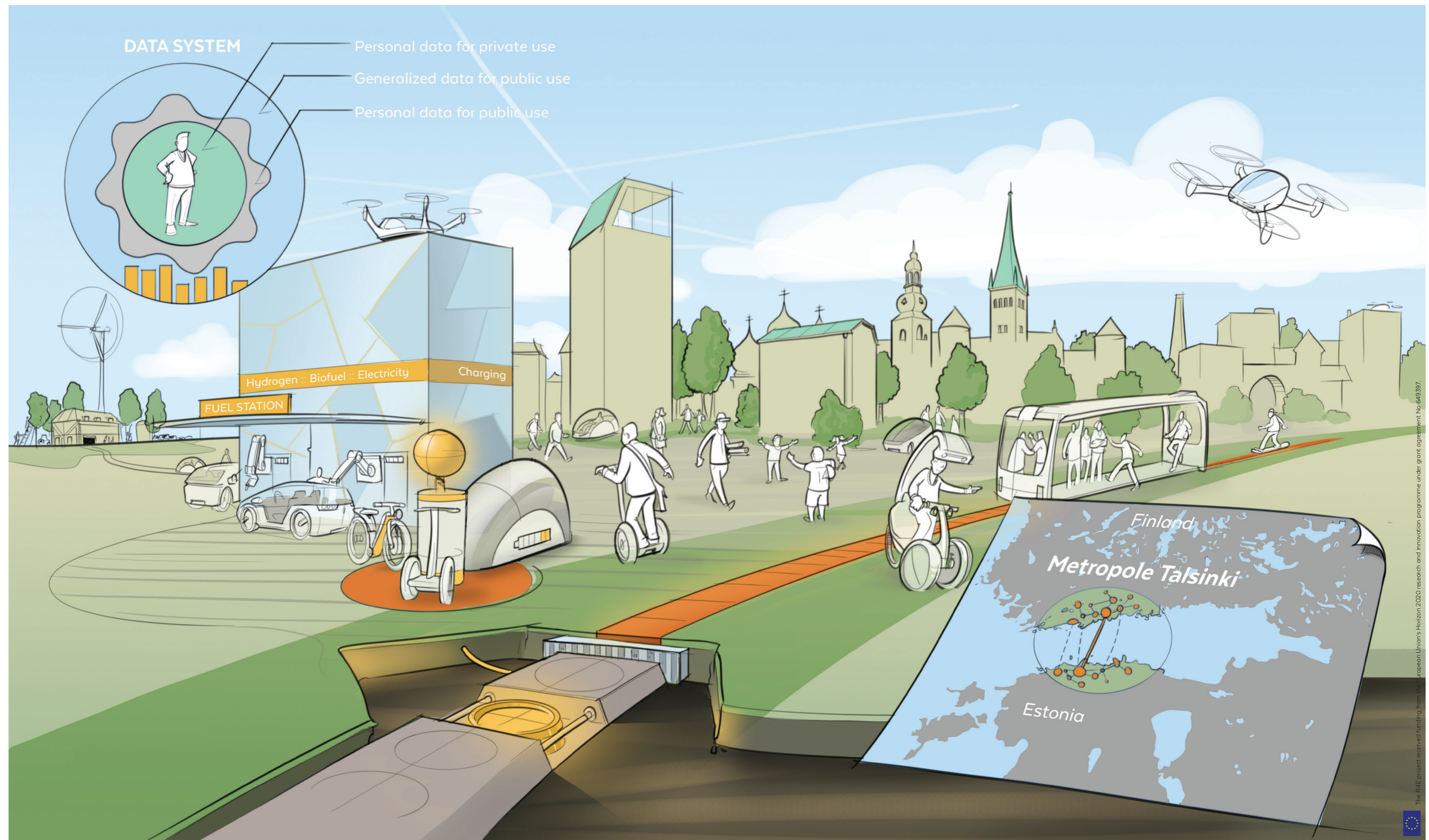


SMART MOBILITY ENABLES AN ENJOYABLE LIVING ENVIRONMENT IN TALLINN 2050

In 2050, citizens in Tallinn enjoy an attractive, clean and quiet living environment that encourages sustainable behaviour. The cityscape is dense, so all services are within easy reach or are provided in the home. More public space is allocated to living, and less to motorised transport.

Smooth, seamless public transport connects all the city areas. Smart planning is used to respond dynamically to the changing demand for the transport of people and goods. The transport and ticketing systems around the Baltic Sea are integrated in a way that is simple, comfortable, affordable (free), clean and fast.

Planning and decision-making processes are based on open collaboration that includes different views and knowledge sources. Tallinn is recognised as a front-runner in openness. Citizens are aware of their roles, and actively take part in making decisions that influence their living environment.



Elements of the desired future scenario are:

Human scale squares

The city's streets and squares are designed around people. The urban environment is safe, attractive and suitable for a wide range of social interactions. The design of the spaces, with an extensive network of cycle tracks and pedestrian-only areas, gives clear priority to walking, cycling and new modes of personal mobility like self-driving bikes and wheelchairs. This ensures easy accessibility for all citizens.

Vehicles on renewable energy

All vehicles, bikes and cars are shared, self-driving and adaptive to the available infrastructure. A shared electrical vehicle system provides the city with renewable energy storage by allowing access to the vehicle batteries. The smart infrastructure collects information from the vehicles for the central system, through which users receive relevant information such as traffic signs, traffic information and navigation suggestions.

Innovative public transport

Different energy-efficient mobility modes include more flexible infrastructure, like trams with magnetic tracks for midrange distances between the neighbourhoods. The non-disruptive infrastructure allows shared use by all vehicles. For longer distances, an integrated public transport system covers Estonia, Scandinavia and the Baltic States, based on superfast and energy-efficient solutions.

Metropole Talsinki

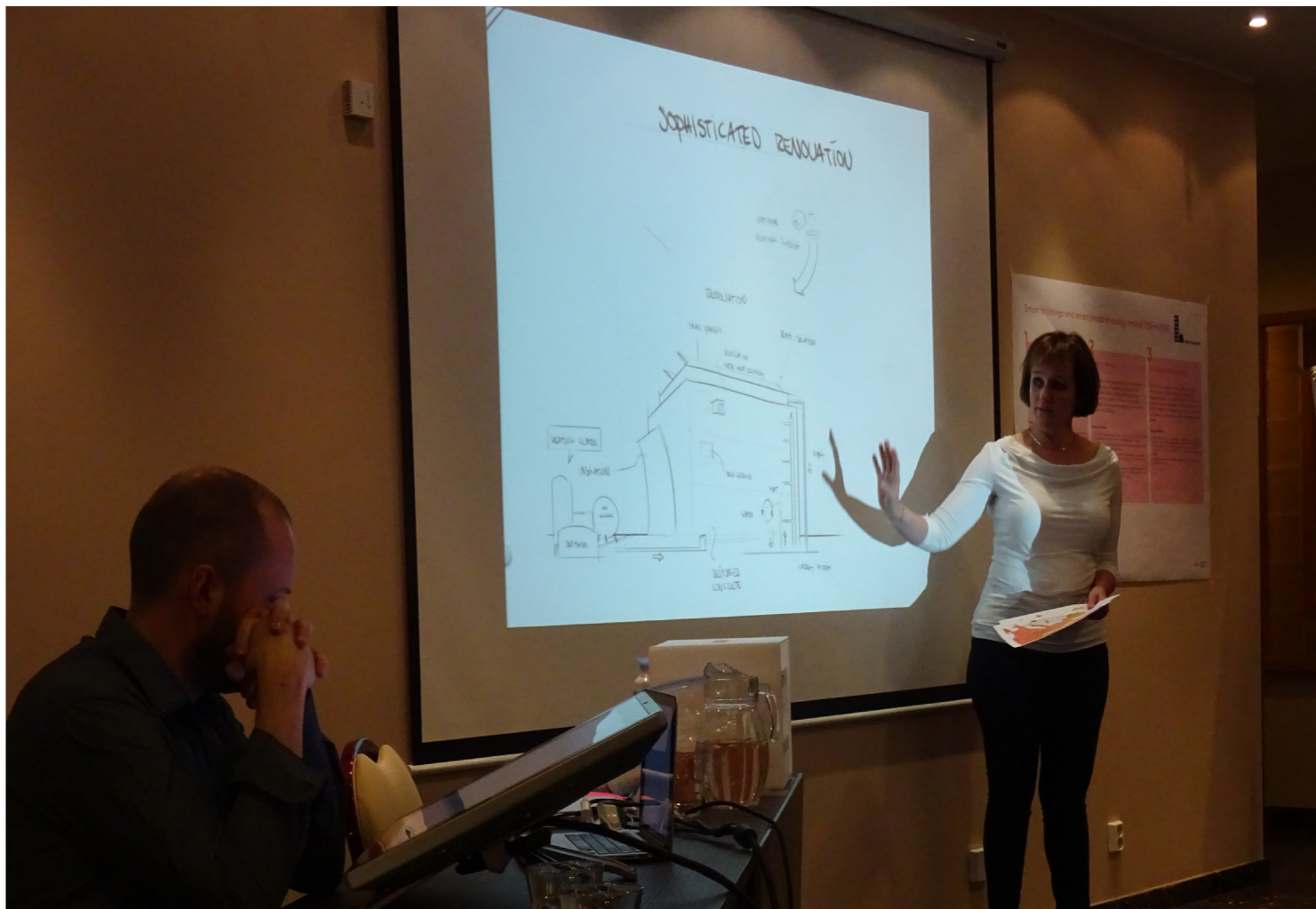
Tallinn and Helsinki together form one big metropolis, with the advantages of economy of scale. This also provides advantages for direct goods logistics connections to Helsinki and beyond. Tallinn is a key hub between mainland Europe and Helsinki. The airport in Tallinn and a high speed transportation system provide fast, comfortable and reliable links for people and goods, and have a positive impact on the labour market and economics.

Data system

The 'Smart Department' of Tallinn collects and analyses real-time information for use in smart algorithms that optimise the system based on people's needs. The system is used for decision-making and planning purposes, such as parking & charging of e-vehicles and use of public transport lines. All kinds of applications use the resulting information to provide users with valuable services.



Creating the visual of the desired future scenarios





The making of the desired future scenario

The approach

In the Roadmaps for Energy (R4E) project, the partners work together to develop a new energy strategy: their Energy Roadmap. The difference between the regular energy strategies and action plans and these new Energy Roadmaps is the much earlier, better developed involvement of local stakeholders. These include not only those who will benefit from the new strategy, such as the citizens themselves, but also relevant research and industry partners. They offer a much clearer view of the future potential of the city in terms of measures and technologies, as well as of the challenges presented by today's situations in the cities. The aim is to create a shared vision containing the desired, city-specific scenarios and the dedicated roadmaps to be embedded in the context of each city.

The R4E project follows a four step approach:

1. Set the ambitions of the participating cities on sustainable energy and Smart Cities, as well as their choice of three Smart Energy Saving focus areas: 1. Smart Buildings; 2. Smart Mobility; and 3. Smart Urban Spaces.
2. Develop scenarios for the selected focus areas.
3. Create the roadmap. Identify existing and future technologies and other developments – these will enable the desired future scenarios. Plot the opportunities and developments on a timeline, showing the route and milestones towards the desired scenarios. The roadmaps contain common parts for all the partner cities, as well as specific parts for the individual cities.
4. Create a portfolio of new projects and initiatives to achieve the ambitions, visions and roadmaps of the cities. This portfolio shows the shared and individual projects, and includes a cross-city learning plan and a financial plan.

Step Two: Vision development

The aim of Step 2 is to develop visions for the cities in the selected focus areas. A vision is based on a long-term perspective on the world – in this case we are focusing on 2050. Two main activities are taking place in this step: Future Telling research and the development of desired future scenarios.

Future Telling

The first part of the vision development activity is to identify Drivers for Change that influence the future of Smart Cities in general, as well as Smart Buildings, Smart Mobility and Smart Urban Spaces in particular. The Future Telling research method is an approach to create context-related possible future scenarios in a creative, imaginative way. Future Telling research consist of a structured method to map expertise and ideas of thought leaders from the Smart Cities domain. Through interviews and analysis leading to the Drivers for Change for liveable and smart cities in 2050. This research and the 18 Drivers for Change are described in the report Future Telling 2050 D2.1 Report – Drivers for Change.

Developing desired future scenario's

Out of the 18 Drivers for Change for smart and sustainable cities, the cities have chosen the most important Drivers for Change to be included in their further vision development. Together with the Ambitions, which the cities set in Step 1, the desired future scenarios for the focus areas will be developed in city scenario workshops. The ambitions are described in the Ambition Setting D1.1 Report – Specific ambitions of the R4E partner cities.

City scenario workshops

The desired future scenarios for the selected focus areas in the cities are created in a series of workshops held in each of the partner cities. These Scenario Workshops consist of a 3-day programme in each city, and include sessions with policy-makers and stakeholders to develop a rich, contextual scenario for the city. Local stakeholders (companies, citizens, public and private organisations and knowledge institutes) are invited to take part in the workshops through the networks in the cities. The results of the Scenario Workshops are reported in the same format for each of the city, facilitating cross-learning between the cities.

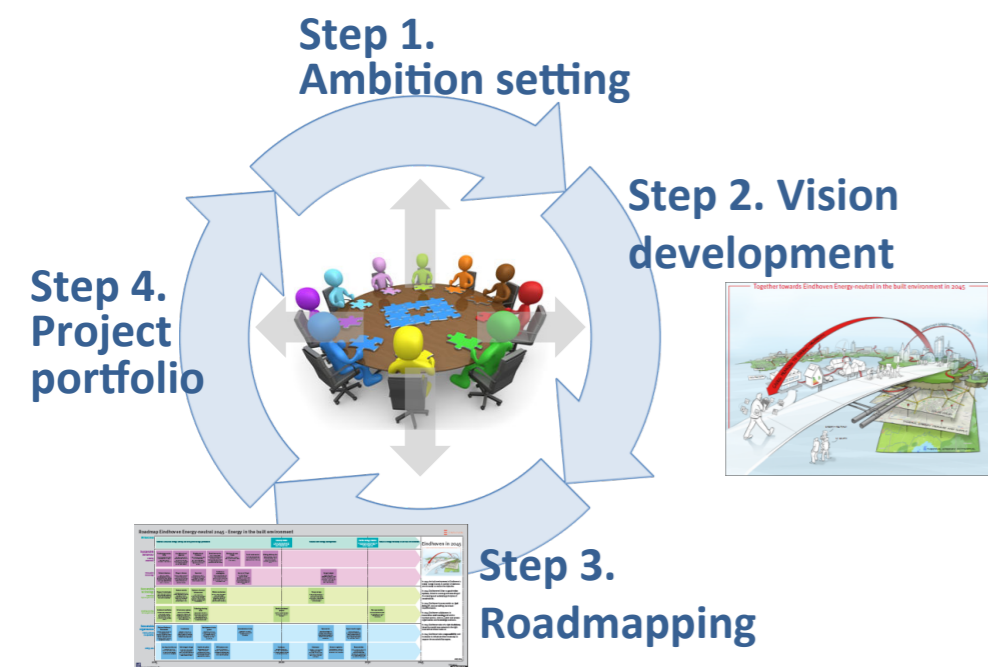
Two sessions are held for each focus area. In the morning session the outline for the vision and the desired future scenario is developed. The main stakeholders work with the set ambition for the focus area and the selected Drivers for Change to understand their impact on the city in 2050. Together, the participants define the main elements of the vision. Then, in the afternoon session a broad spectrum of stakeholders are invited to enrich the desired future scenario with specific additions. Based on the outlined vision they carry out a further in-depth exploration of the main elements of the vision in-depth.

In all the sessions, the participants will interactively build a visualisation of the desired future scenario. See also the pictures of the workshops.

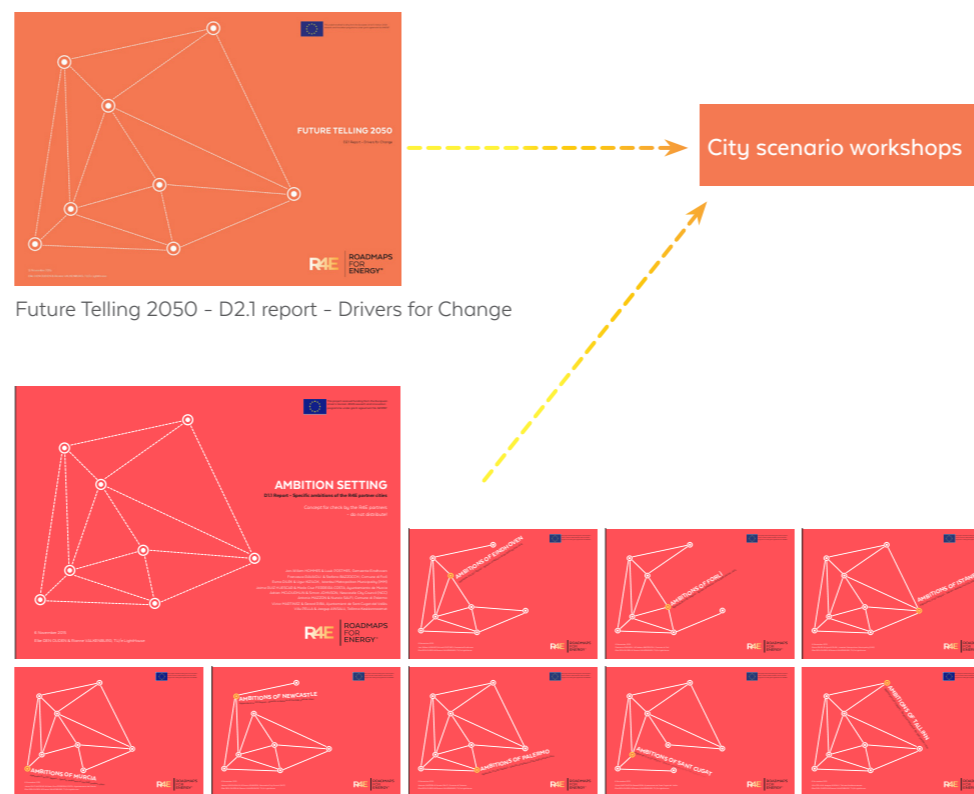
Day 1 - Focus area 1	Day 2 - Focus area 2	Day 3 - Reporting
Outlining the vision <ul style="list-style-type: none"> Exploring the Drivers for Change in relation to the future of the city Selecting the main elements of the vision 	Outlining the vision <ul style="list-style-type: none"> Exploring the Drivers for Change in relation to the future of the city Selecting the main elements of the vision 	Project team working session to prepare the report of the Scenario Workshop
Enriching the desired future scenario <ul style="list-style-type: none"> Exploring the future of the city and the main elements of the vision Enriching the vision with specific additions 	Enriching the desired future scenario <ul style="list-style-type: none"> Exploring the future of the city and the main elements of the vision Enriching the vision with specific additions 	

Program of the ambition workshops

The result of the vision development step is a visualisation of the desired future scenario. The visual is explained in this report and the main elements of the vision are described. The following pages also provide the background of the scenario: the ambition of the focus area, copied from the Ambition Setting D1.1 Report – Specific ambitions of the R4E partner cities and the selected Drivers for Change for each focus area, copied from the Future Telling 2050 D2.1 Report – Drivers for Change.



Four step approach of R4E



Ambition Setting - D1.1 report - Specific ambitions of the R4E partner cities

Ambition: Smart buildings and smart people in energy-neutral Tallinn 2050

1

Sustainable behaviour and renewable energy

In 2050, people in Tallinn value sustainability. Their behaviour and energy usage are based on individual responsibility. That means their remaining energy demand is affordable for all. It is achieved by renewable energy sources, such as heat pumps, biofuels and energy from the sea. Thanks to all these measures, Tallinn is a CO₂-neutral city.

Strategic ambitions

- In 2050 the citizens of Tallinn have guaranteed affordable heating. More renewable sources for heat production, such as bio-fuels, and heat plants, are used. The realised hospital is a demonstrator where a good climate is realised that is affordable in a smart way.
- In 2050 smart solutions and smart behaviour has led to a strong reduction of energy consumption. The remaining energy use stems from the newest renewable energy systems for energy production to achieve high energy efficiency.
- In 2050 the people of Tallinn regard the city as being open to the sea. The sea is also used as a heating source for a CO₂ neutral city.

2

Energy-neutral city

In 2050, Tallinn is an energy-neutral city. All the existing buildings are deeply renovated and modernised, while respecting their historical heritage. All the city's energy systems are automated and connected, which supports new services. The energy-saving measures include smart materials and equipments.

Strategic ambitions

- In 2050 all buildings and districts in Tallinn use zero-energy. The heritage and history of older buildings is respected, also when new purpose is given to buildings.
- In 2050 all energy used in buildings comes from renewable sources. Smart materials and equipment are applied to save energy.
- In 2050 all buildings in Tallinn have automation systems that are connected and easy to understand. These smart systems also provide new IT-based services, such as guidance or information.
- In 2050 all existing buildings in Tallinn are deeply renovated and modernised. They reach high energy classes and all energy systems are connected and online. Soviet time apartment blocks are either demolished or renovated.

3

Integrated, flexible city planning

In 2050, land use planning in Tallinn values an energy-efficient smart city. Planners have the knowledge and awareness to work at an integrated system level. Their work takes into account all the relevant issues, and provides the flexibility to adapt to changing situations. These policies are implemented in practise through specific, integrated district plans.

Strategic ambitions

- In 2050 land use planning in Tallinn is done on an integrated system level, taking into account all sustainability issues, demographic changes, and mobility demands. The planning is also flexible to adapt to developments we do not know yet. The administrative units create specific district plans to integrate and implement these policies.
- In 2050 we gained the knowledge and awareness to plan the city of Tallinn as an energy efficient smart city.

Drivers for change for the future of Smart Buildings in Tallinn 2050

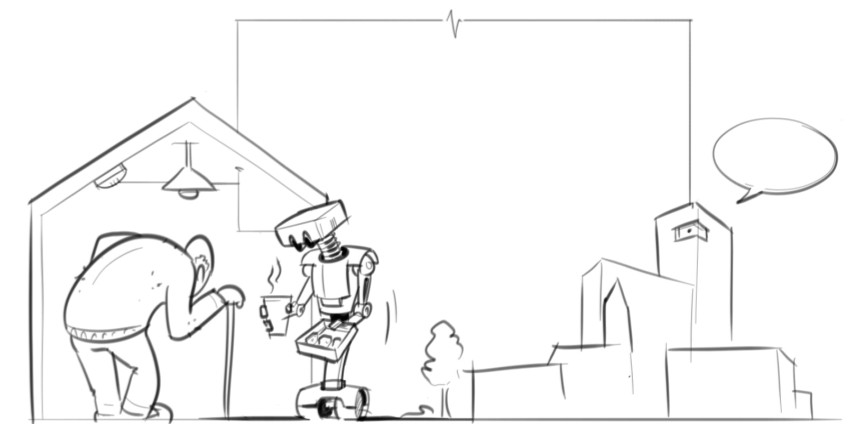
Enabling human development

In 2050, city residents are resilient, and can consciously adapt their behaviour to enable personal development. The middle class have largely disappeared. People have found new ways to live meaningful lives, building on opportunities at all levels - from local to global. They can handle large amounts of information to make personal choices. Smart, human-centric city environments provide inspiring places for lifelong learning.



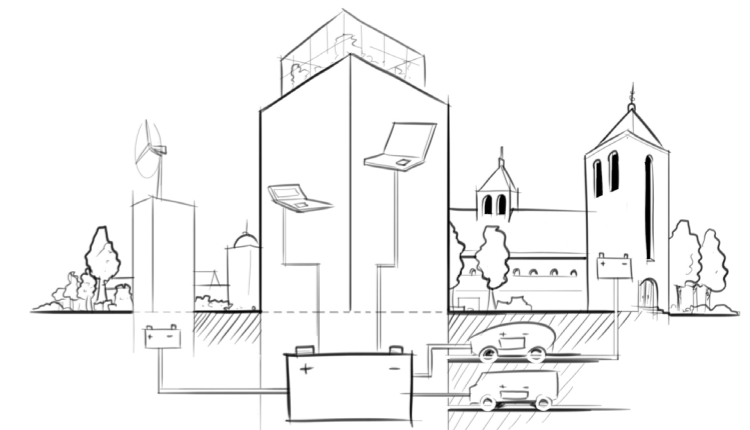
Technology with a human focus

In 2050, we've mastered the challenge of ever more complex, multifunctional systems and the need to make them easier to use. Those systems are user-focused: that means users can understand how the systems work, and how their own behaviour affects sustainability and energy use. Robotics and smart (home care) systems support living at home, helping people to live healthier lives and to stay in their homes longer as they get older. There's a range of available solutions that plug-in directly to the city's open energy platform.



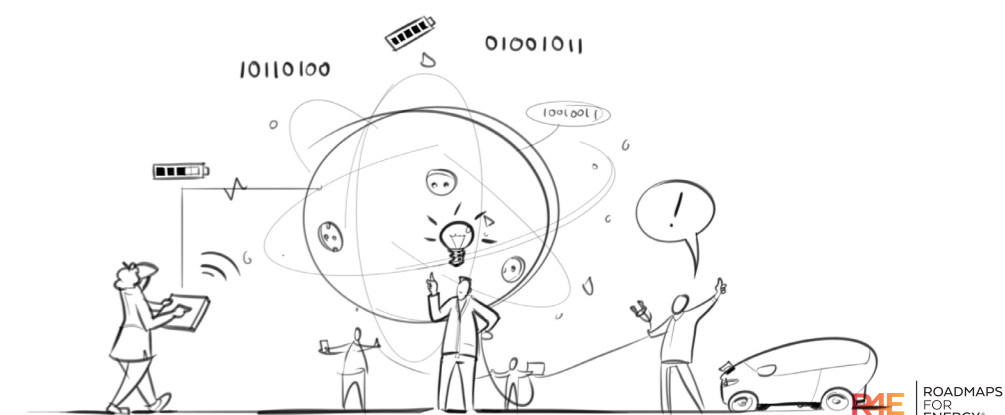
Better buildings

In 2050, new buildings combine historical qualities and new technologies, creating maximum comfort and functionality for their users. Historical expertise in building for specific local climates is used to design solutions for new buildings, and for thoughtful upgrading of those already existing. The latest technologies and materials are applied to make buildings self-sufficient or even energy positive, contributing to abundant of renewable energies in cities. Policies aim at improving the quality of neighbourhoods and strengthening the sense of community, and not only at reducing energy consumption.



Democratised energy systems based on open data

In 2050, energy systems are open, bidirectional, multi-purpose platforms on which (renewable) energy and energy management services are open to all. Entrepreneurs have developed business models that provide value for them, for their users and for society at large. Citizens can choose freely from a range of available options. The system ensures privacy and security of users, who are always in control. Ambient energy networks provide connectivity for (wireless) access to data and energy. Increased computing power and artificial intelligence make system resilient: self-organising, self-sustaining and self-learning.



Ambition: Smart mobility enables an enjoyable living environment in Tallinn 2050



1

Enjoyable living environment

In 2050, citizens of Tallinn enjoy an attractive, clean and quiet living environment that encourages them to behave sustainably. More and integrated green and blue areas, with an extensive network of cycle tracks and pedestrian-only areas enables people to commute conveniently by bike or on foot.

The cityscape is dense, so all services are within easy reach or are provided in the home. More public space is allocated to living, and less for motorised transport.

Strategic ambitions

- In 2050 Tallinn is a liveable city where citizens get their services in walking/biking distance or at home. The city is planned for humans: user friendly facilities and more green areas invite more sustainable behaviour. People choose to walk/bike to commute.
- In 2050 the city of Tallinn has a good urban space where people are invited to move differently (more sustainable) resulting in an attractive, clean and quiet environment and liveable streets. More public space is allocated to living, and less to motorized traffic. The green and blue areas in the city are well integrated.
- In 2050 the city scape is more dense, more functions are available within easy reach. More priority is given to pedestrians 'above the ground'. Space is freed up for buildings and places by putting transportation underground (e.g. parking). The city is build in a way that it enables to use foot, bike and public transport.
- In 2050 the bicycle routes in the city are connected. The number of streets in the city centre that are pedestrian-only is increased. Tram and bus provide good connections to the centre. Car use is discouraged through limitations in lanes and parking fees. There is more lively boat traffic and water taxis.

2

Smooth, seamless public transport

In 2050, the citizens of Tallinn all have access to smooth, seamless public transport that connects all the city areas. Smart planning is used to respond to the (dynamic) demand for the transport of people and goods. The transport and ticketing systems around the Baltic Sea are integrated in a way that is simple, comfortable, affordable (free), clean and fast.

Strategic ambitions

- In 2050 the connections in the city centre of Tallinn and to the neighbourhoods are very good, so all people can reach their destination fast with public transportation (in less time than cars).
- In 2050 the people of Tallinn experience smooth and seamless mobility that better connects all areas of the city by different transport modes (e.g. an extended tram network). The system responds to the demands of goods & people by smart planning to arrive at the desired destination (in the city and outside) reliably and safely.
- In 2050 the green card for free public transport is used widely, not only in Estonia, but also in Helsinki.
- In 2050 the public transportation system around the Baltic Sea is integrated in such a way that it is simple, comfortable, cheap/free, clean and fast.

3

Open, collaborative decision-making

In 2050, planning and decision-making processes are based on open collaboration that includes different views and knowledge sources. Tallinn is recognised as an front-runner in openness. Citizens are aware of their roles, and actively take part in making decisions that influence their living environment.

Strategic ambitions

- In 2050 the planning and decision making process in Tallinn is knowledge based. Administrative organisations and departments collaborate to have an integral view. The people are aware and take their responsibility by actively taking part in decisions that influence their living environment.

Drivers for change for the future of Smart Mobility in Tallinn 2050



Better living at a human scale

In 2050, urban systems and spaces are designed on a human scale. Everyday activities are within walking or cycling distance. Communal spaces strengthen social cohesion, giving people the freedom to follow the activities they value most. The city offers an excellent living environment in the European tradition, merging high-quality urban space with nature, culture, the economy and social coherence. Good living means enjoying time with friends, and social life is further supported by availability of public devices in communal space. These enable new forms of communicating, blending the virtual and real worlds in these areas.



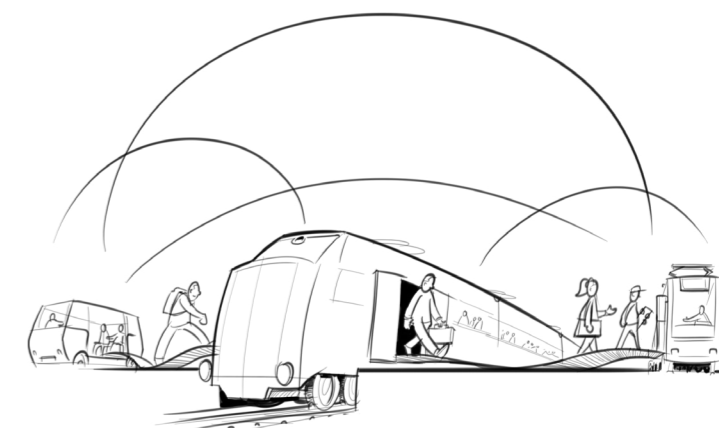
Experience, experience, experience

In 2050, city residents travel because they like the experience. For short (hyper-local) distances by walking or cycling, to reach places on a daily human scale. And for longer (hyper global) distances, the whole planet can be reached within a few hours. Even space travel could be an option! There's a range of convenient, clean mobility options, making use of abundant renewable energy. Travel has never been easier - it provides seamless connections from where you are to where you want to go. Services focus on what people need, and not on the available systems.



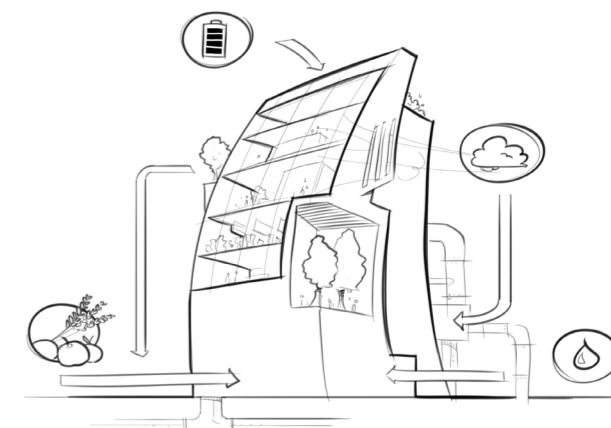
Valuing public transport

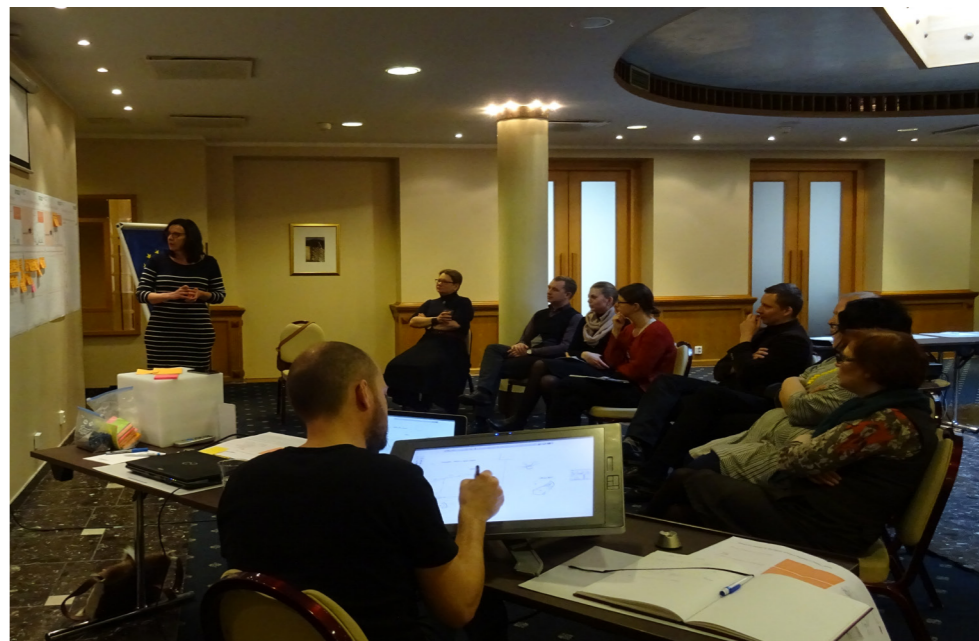
In 2050, cities offer attractive, seamless mobility options: these give everyone access to everywhere. New investment structures and revenue models ensure that the city values (such as inclusiveness) are ingrained in system design. Cities actively influence operators to ensure high levels of customer satisfaction and service quality.



Regenerating resources in a circular economy

In 2050, the circular economy ensures self-sufficiency of cities. Renewable energy is abundant, and this ensures a secure supply of vital resources for life (energy, water, food and clean air), although other resources may still be scarce. Cities have implemented circular systems to regenerate all the resources needed by their populations. These mechanisms are based on small-scale, local solutions, enabled by changed decision-making levels.







Contributions

We would like to thank the participants for their contribution to the scenario workshops

- Jaagup Ainsalu Tallinn Transport Department
- Dago Antov Tallinn University of Technology
- Pille Arjakas Tallinn Energy Agency
- Rasmus Armas Elektrilevi Ltd
- Andres Jaadla Estonian Union of Co-operative Housing Associations
- Mari Jüssi Stockholm Environment Institute
- Targo Kalamees Tallinn University of Technology
- Anu Kalda Tallinn Transport Department
- Tõnu Karu Tallinn Energy Agency
- Ülo Kask Tallinn University of Technology
- Janno Kauts Tallinn City Office
- Kristel Kibus Tallinn City Office
- Kerli Kirsimaa Stockholm Environment Institute Tallinn Centre
- Tiit Laiksoo Tallinn Transport Department
- Hannu Lamp Environmental Investment Centre
- Liivar Luts Tallinn Transport Department
- Andres Meesak Estonian Solar Energy Association
- Viljar Meister Tallinn City Office
- Väino Olev Tallinn City Office
- Kaarel Põldemaa Tallinn Transport Department
- Triin Sakermäe Tallinn Environment Department
- Marit Sarapuu Tallinn Transport Department
- Kaur Sarv Ministry of Economic Affairs and Communications
- Martin Siimer Tallinn City Property Department
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