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

AMBITION, VISION & ROADMAP
SMART TRAFFIC MANAGEMENT ISTANBUL

D6.4 Final city report

12 September 2017

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R4E ROADMAPS FOR ENERGY®

AMBITION, VISION & ROADMAP
SMART TRAFFIC MANAGEMENT ISTANBUL

D6.4 Final city report

Leader: TU/e LightHouse

Submission due date: February 2018

Actual submission date: September 2017

Abstract

This report (D6.4) is the final deliverable of the R4E project and contains all relevant project results for smart mobility / smart traffic management in the city of Istanbul.

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

Versions of this report:

18 August 2017	Concept for internal check by R4E partners (limited distribution)
12 September 2017	Final version for public distribution

SMART MOBILITY

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R4E ROADMAPS FOR ENERGY®

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3-day workshop in each city to define specific ambitions per focus area

EINDHOVEN
ISTANBUL METROPOLITAN MUNICIPALITY — public transport, traffic mgt
Newcastle City Council — domestic, non-domestic
Ajuntament de SantCugat
Murcia

Ambition sharing & selecting drivers for change
1-day meeting in Palermo to share the results of the ambition workshops and future telling and to select the drivers for change for WP2

Future Telling
20 interviews with experts on the future of energy in the city in general and especially w.r.t. buildings, mobility and urban spaces, and analysis of the results to define the most important drivers for change

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Scenario workshops
3-day workshop in each city to develop specific desired future scenario's per focus area

EINDHOVEN
Murcia
Newcastle City Council — domestic, non-domestic
Ajuntament de SantCugat
ISTANBUL METROPOLITAN MUNICIPALITY — public transport, traffic mgt

Scenario sharing & selecting topics for roadmaps
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2-day training session for expert partners on methodology and way of working

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Roadmap interviews
collecting expert insights with 20 experts for each focus area

SMART BUILDINGS
- Sustainable technologies
- Sustainable behaviour
- Sustainable organisation

SMART MOBILITY
- Sustainable technologies
- Sustainable behaviour
- Sustainable organisation

SMART URBAN SPACES
- Sustainable technologies
- Sustainable behaviour
- Sustainable organisation

Creation of timelines
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Expert meeting
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Roadmap workshops
2-day workshops in each city to develop specific timelines for the realisation of the desired future scenario's

EINDHOVEN
Murcia
Newcastle City Council — domestic, non-domestic
Ajuntament de SantCugat
ISTANBUL METROPOLITAN MUNICIPALITY — public transport, traffic mgt

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each city identifies projects it has running that will contribute to the realisation of the roadmap, as well as the topics for cross-city learning

Roadmap sharing & cross learning objectives
2-day meeting in Newcastle to share the roadmaps of the different cities, as well as the current projects, and to identify cross-learning objectives

New projects
each city identifies the desired new projects to ensure the timely realisation of its roadmap ambition

EINDHOVEN
ISTANBUL METROPOLITAN MUNICIPALITY — public transport, traffic mgt
Newcastle City Council — domestic, non-domestic
Murcia
Ajuntament de SantCugat

Joint portfolio meeting
3-day meeting in Forli to share the portfolios of the different cities, as well as to prepare for joint projects that support the achievement of common ambitions

Financing opportunities
identifying different opportunities for financing of the city specific and the joint projects

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organising for continued cross city learning

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Strategy & visuals — developing a communication & dissemination strategy, logo's and graphic charter

Event — Palermo

Regular communication activities — electronic project newsletters, other newsletters and information services, project and partner websites, press releases and other media releases, social media

Event — Tallinn

Regular communication activities

Final event — conference in Murcia

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ROADMAPS FOR ENERGY®

Version 4 September 2015

R4E - ROADMAPS FOR ENERGY

SMART MOBILITY

Introduction

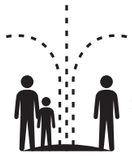
In the Roadmaps for Energy (R4E) project, the partners work together to develop a new energy strategy: their Energy Roadmap. The difference between the regular energy strategies and action plans and these new Energy Roadmaps is the much earlier and more developed involvement of local stakeholders. These include not only those who 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 result is a shared vision, containing the desired, city-specific scenarios and the dedicated roadmaps embedded in each city's specific context. These roadmaps take into account the diversity in the geographies, ecologies, climates, societies and cultures of the eight partner cities in the project: Eindhoven, Forlì, Istanbul, Newcastle, Murcia, Palermo, Sant Cugat and Tallinn.

The R4E project focuses on the vision creation and roadmapping capabilities of the individual municipalities. This includes initiating joint activities to drive the development and implementation of innovative energy solutions in cities. In this way the R4E partners learn the process and the roadmap structure. At the same time they gain the skills they need to work independently on their future roadmaps.

The ultimate result is a process that allows the partners to work together in developing the Energy Roadmap to achieve their 'Smart Cities' ambition. Since energy and Smart Cities are too broad to cover in a single project, R4E focuses on three key areas of sustainable energy. These are closely linked to the main responsibilities of the municipalities:

SMART BUILDINGS

SMART MOBILITY



SMART URBAN SPACES

The three focus areas of R4E

Approach

The R4E project follows a 4-step approach:

1. The FIRST step sets the ambitions for the project. The ambitions of the participating cities on sustainable energy and Smart Cities in general are set, as well as the partner cities' choice of two (out of three) focus areas within Smart Energy Savings: Smart Buildings, Smart Mobility or Smart Urban Spaces.

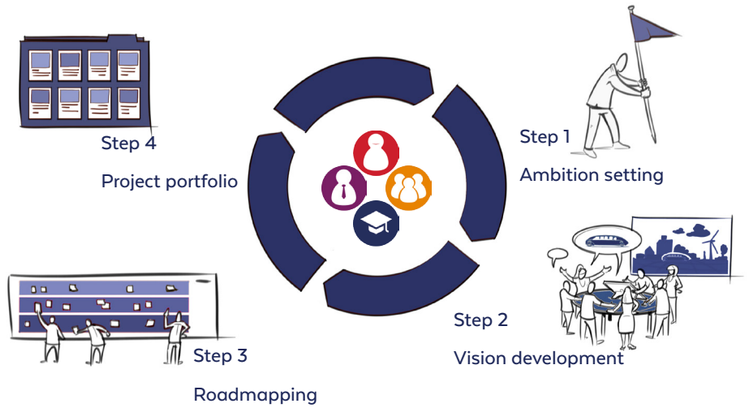
2. The SECOND step is to develop desired city scenarios for the selected focus areas.

3. In the THIRD step, the roadmap is created. This involves identifying existing and future technologies and other developments that will enable the desired future scenarios. The opportunities and developments are plotted on a timeline to show the route and milestones towards the favoured scenarios. The roadmaps contain common parts for all the partner cities, as well as specific parts for the individual cities.

4. In the FOURTH and final step, a project portfolio is generated with new projects and initiatives to reach the ambitions, visions and roadmaps of the cities. This portfolio provides an overview of individual and joint projects, and includes cross-city learning and financial plans.

The approach is characterised by four main elements:

- Backwards planning – the project starts with the development of a shared vision as a starting point for the creation of a well developed path to achieve it.
- Inclusive workshops in the cities – a cooperative process to engage key stakeholders (companies, citizens, public and private organisations and knowledge institutes) within the region in co-creating a clear and well designed implementation plan with a stronger commitment to the joint effort in the realisation phase.
- Expert knowledge is sourced in a practical and usable form during the vision development and roadmapping.
- A visual language is used to easily connect people and share main insights.



Four step approach of R4E

The R4E partner cities

EINDHOVEN

Gemeente Eindhoven, the Netherlands

- Population: 220,000
- Area: 90 km²

SMART MOBILITY · SMART URBAN SPACES

Newcastle City Council

Newcastle City Council, United Kingdom

- Population: 282,000
- Area: 114 km²

SMART BUILDINGS
- Domestic buildings
- Non-domestic buildings

Comune di Forlì, Italy

- Population: 120,000
- Area: 228 km²

SMART BUILDINGS · SMART URBAN SPACES

Comune di Palermo, Italy

- Population: 885,000
- Area: 160 km²

SMART BUILDINGS · SMART MOBILITY

ISTANBUL METROPOLITAN MUNICIPALITY

Istanbul Metropolitan Municipality, Turkey

- Population: 14,100,000
- Area: 1.830 km²

SMART MOBILITY
- Public transport
- Traffic management

Ajuntament de SantCugat

Ajuntamient de Sant Cugat del Vallès, Spain

- Population: 86,000
- Area: 50 km²

SMART BUILDINGS · SMART URBAN SPACES

Murcia

Ayuntamiento de Murcia, Spain

- Population: 440,000
- Area: 885 km²

SMART BUILDINGS · SMART MOBILITY

Tallinn

Tallinna Keskkonnaamet, Estonia

- Population: 430,000
- Area: 160 km²

SMART BUILDINGS · SMART MOBILITY

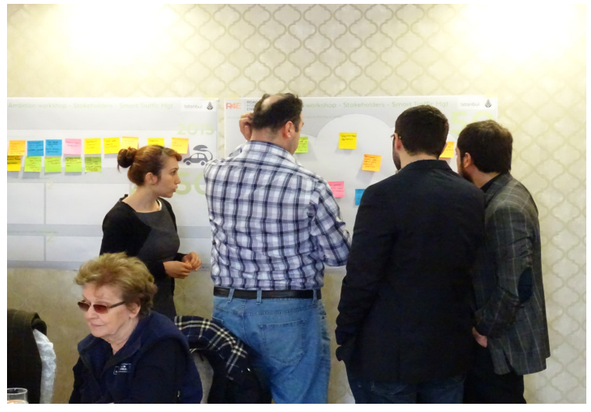
The eight partner cities of R4E

R4E ROADMAPS FOR ENERGY


CODEGEN
R4E
ROADMAPS FOR ENERGY
İSTANBUL BÜYÜKŞEHİR BELEDİYESİ
HORIZON 2020
R4E ENERJİ HARİTALARI PROJESİ
HEDEFLER İSTEKLER ÇALIŞTAYI
HOŞGELDİNİZ


CODEGEN
Engineering & Consulting
Rolling Stock Design and Manufacturing
Turnkey Electromec. Sys.


R4E ENERJİ HARİTALARI PROJESİ
HEDEFLER İSTEKLER ÇALIŞTAYINA
HOŞGELDİNİZ



AMBITION SETTING

SMART MOBILITY

Ambition Setting

The aim of Step 1 is to set the ambitions for the project. An ambition expresses what a city wants to achieve in the future. For this purpose the ambitions of the participating cities on sustainable energy in general are defined and refined in a process of co-creation, using existing policy documents as a basis for workshops with the individual cities. Each city selects two focus areas for which specific city ambitions are defined.

Today's reality

During the kick-off meeting the cities present the current status of their energy policy in general and their selected focus areas in particular. This chapter starts with a summary of this information.

Ambition Workshops

The strategic ambitions for energy-related themes in general and for the selected focus areas in particular are assessed in a series of workshops in each of the partner cities.

The Ambition Workshops consists of 3-day visits to the individual cities, during which several workshops with policy-makers and stakeholders are held to gain a deep understanding of the ambitions and specific contexts of the cities. Through the networks in the cities the local stakeholders (companies, citizens, public and private organisations and knowledge institutes) are invited to participate in the workshops. Together, the participants interactively contribute to the strategic ambitions. See also the pictures of the workshops on the previous page. The results of the Ambition Workshops are reported in similar formats for each of the cities to enable cross learning between the cities.

Day 1	Day 2	Day 3
Interview with policy makers	Workshop with stakeholders focus area 1	Project team working session to establish scope
Workshop with strategy department	Workshop with stakeholders focus area 2	Preparing main content of concept report

Programme of the Ambition Workshops in the cities

Joint Ambition Workshop

In a joint meeting in Palermo, the cities shared their ambitions and held in-depth discussions to understand the common and specific aspects of their ambitions. The main aim of the Joint Ambition Workshop is to enable cross-city learning. In this way the cities gain a deeper understanding of the Ambition Setting process, and can improve their own ambition with inspiration from others.

The Joint Ambition Workshop is a 1-day workshop that finalises the activities of Step 1 and prepares for Step 2.

Morning Finalising Step 1	Presentation of the cities ambitions · Each city presents their ambition for the focus areas
	Learning from each other's ambitions · In-depth discussion on common and specific ambitions
Afternoon Preparing for Step 2	Presentation of the Drivers for Change · Sharing of results of Future Telling research
	Understanding the Drivers for Change · Exploring the relevance for the focus area and selection of drivers for scenario workshops

Programme of the Joint Ambition Workshop

Introduction to Istanbul

Introduction to the city

Istanbul is like a state on its own. With a population of almost 14 million, it is larger than 23 European countries. The metropolitan area falling under the responsibility of the Metropolitan Municipality is 5,389 km^2, extending for 165 km from east to west, with a north-to-south distance of 45 km.

For centuries, Istanbul has always had a very strategic position along the historical Silk Road and naval routes between the Mediterranean and the Black Sea. This strategic location has helped the city to develop a cosmopolitan population.

Istanbul is the largest city in Turkey. The officially registered population is 13.8 million as of 2014, which is about 18% of Turkey's population. This means one in five Turkish citizens live in Istanbul. Istanbul is also the third-largest metropolitan area in Europe, after London and Moscow.

Istanbul Metropolitan Municipality has a massive budget, which is larger than those of 18 of the 29 Turkish ministries. The consolidated budget generally increases by 7.7% each year, and for 2013 it was around USD 12 billion. Of this figure, USD 8 billion is the investment budget, and around half of this budget is dedicated to transport.

So far, the municipality has succeeded in solving all its problems for the foreseeable future (i.e. water supply, pollution, housing etc.), except for transport: traffic congestion within the city is a growing problem, which is why the Metropolitan Municipality has dedicated almost half of its resources and energy to solve the transport problem.

Thanks to the recent excavations in Marmaray which had repercussions in many circles, we now know that the city's history goes back to the Neolithic Age. It has a history of eight thousand five hundred years.

There are 2.5 million vehicles throughout the metropolitan area and 1.8 million of these vehicles circulate on the roads every day.

The transportation network length has witnessed a sharp increase since 2004, and currently amounts to 25.000 km.

Average travel time in vehicles is now 45 minutes, while it was 53 minutes in 2004. This decrease basically owes to transport investments of the Metropolitan Municipality, and the Municipality aims to reduce this figure down to more tolerable levels.

Car ownership per 1.000 residents is 133 automobiles, which is growing as more and more people are better off in Turkey. This figure is a bit higher than Turkey's average (which is 96/1.000) but still quite low when compared to other OECD countries such as USA (812/1.000), Italy (656/1.000), Japan (599/1.000) France (576/1.000), Spain (564/1.000) Germany (586/1.000), UK (515/1.000) (figures for the year 2002). But here we should note that the figure was only 67 in the year 2000, so it is almost doubled in every decade.

So, this is the time to solve this traffic problem, and past experience as well as the case of huge metropolises show that, no matter how large and long are the roads you build, you'll not be able to solve the traffic congestion problem, unless you create a backbone transport network which is based on railways. That's why the Municipality's strategy is to build high-capacity lines throughout the city and promise people guaranteed trip durations from one location to another.

Istanbul is the city of massive projects: The most famous one is probably Marmaray, known as the «project of the century».

This high-capacity rail transport project consists of the construction of an undersea rail tunnel under the Bosphorus strait as well as the modernization of suburban rail lines along the Sea of Marmara from Halkalı on the European side to Gebze on the Asian side. The procurement of new rolling stock for suburban passenger traffic is also part of the project. Construction started in 2004, with an initial target opening date of April 2009. After multiple delays, the projected started revenue services in October 2013, and so far it's doing quite well, carrying about 130 thousand riders per day. However, Marmaray will have its real meaning when its overground section is opened in late 2015.

The Eurasia Tunnel Project, The Istanbul Strait Road Crossing Project will be constructed between Kazlicesme and Goztepe districts along a 14.6-km route including a 5.4-km twin-deck tunnel that will cross the Bosphorus beneath the seabed, with the aim to ease the city's traffic pressure.

The Third Bosphorus Bridge is a planned suspension bridge located at the northern end of the Bosphorus, north of the other two bridges, in Istanbul. The tender was held in May 2013, and the bridge will be completed by the summer of 2015. It will have a total of 8 motor lanes, plus 2 tracks for high speed rail.

The 3rd Airport: The new airport will be built in a build-operate-transfer model and the winning bidder would have operating rights of the airport for 25 years. The new airport would have a total passenger capacity of 150 million per year. Once completed in 2017, it's going to be the biggest on earth with 6 runways.

Istanbul Canal is the name of the artificial sea-level waterway, which is proposed to be built by the government on the European side of the city. The new waterway would bypass the current Bosphorus. Istanbul Canal aims to minimise vessel traffic in the Istanbul Strait.

SMART MOBILITY

Statistical figures about transportation in Istanbul in general are as follows: The road system currently accounts for about 84 percent of overall transport in Istanbul.

This includes the elements of private cars, IETT public buses, privately-owned public buses, the BRT system, minibuses, taxis and company buses.

The share of rail-based transportation is about 13 percent, which was only 8 percent just a few years ago. All urban rail operators in Istanbul are public, and are performed by TCDD (i.e. the state railways) as the suburban commuter line, IETT (predominantly the bus operator but also provides railway transport in two historical, short-distance lines) and Istanbul Ulasım, which is affiliate company of Istanbul Metropolitan Municipality. Last but not least, Istanbul has also waterborne transport mode by almost 3.3 percent, which comprises the private operators IDO and private boats, and the public operator Sehir Hatları (i.e. City Lines).

In line with Istanbul's Transport Master Plan designed in 2007, the future vision of the Municipality consists in changing the balance in favor of the second one—increasing the share of rail-based modes up to more than 50 percent, in order to have a sustainable, liveable city.

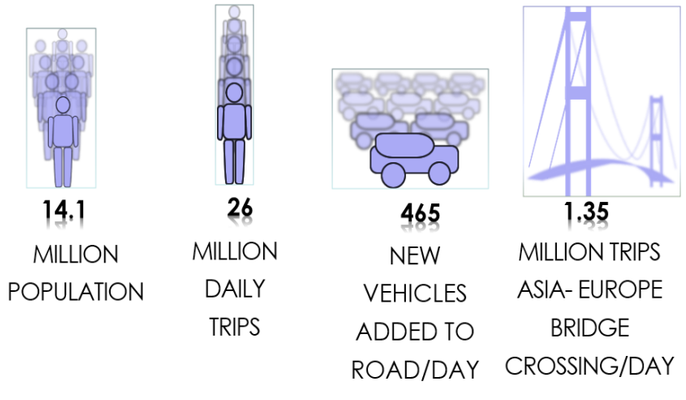
Under normal circumstances, we have a 10 percent increase in the ridership every year. However, in extraordinary years when we open a new line, this figure could be higher, which was the case in 2013 with the opening of M3 and M4 lines.

Throughout the year 2013, we carried a total of more than 402 million passengers.

For the entire transport system of Istanbul, we have an integrated smart ticket called IstanbulCard. The card was developed and put into practice by Belbim which is the information technology company of the Istanbul Metropolitan Municipality. This is the last-generation ticketing system based on RFID technology. It's valid for all transport modes within the city and allows you transfer opportunity of five consecutive times within two hours. Plus, for the second, third, fourth and fifth validations you have discount, i.e. pay more or less half of the original price.

IstanbulCard was introduced on March 2009 and since then it has been doing quite well, even winning the most prestigious European award in the field.

Currently, our IstanbulCard usage ratio is about 92 percent, while the remaining 8 percent represents the token usage—for single journeys within our network we use plastic RFID tokens.



Istanbul Metropolitan Municipality (IMM)

Istanbul is one of the world's fastest-growing megacities, both with 14 million population and its strategic location. 27% of national GDP, 60% of Turkish trade and 40% of national tax revenues come from Istanbul. Besides being at the heart of the Turkish economy, Istanbul has many universities which make the city attractive for thousands of students from all over Turkey. Istanbul is located at the intersection of Asia, Europe and Africa, which makes it an international trade hub. In addition, thanks to its good accessibility from countries all over the world countries, many international organizations and exhibitions take place each year in Istanbul. As a result, there is a growing demand for all types of facilities in Istanbul especially for transportation.

The Istanbul Metropolitan Municipality:

- Serves as the municipal government centre for of Turkey's thriving transcontinental hub
- Carries out local administrative tasks in Istanbul
- Provides public services for a population of around 14 million

Has 25 municipal enterprises, 2 subsidiary public utility corporations and a total of 43,500 employees.

Mobility and Transportation

Istanbul Metropolitan Municipality (IMM) allocates considerable amount of budget for transportation and effective traffic management projects every year. Even if new transportation facilities and projects are introduced, it doesn't satisfy the mobility needs of inhabitants. For this reason, IMM supports the projects which will help manage traffic effectively and optimize the use of transport network and deliver a sustainable environment for next generations. Within the scope of IMM's strategic plans, IMM gives importance to smart management and energy efficiency topics for its new projects and deployments in Istanbul.

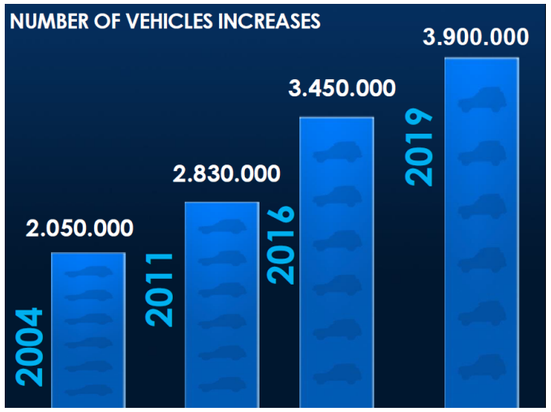
Goals by near future

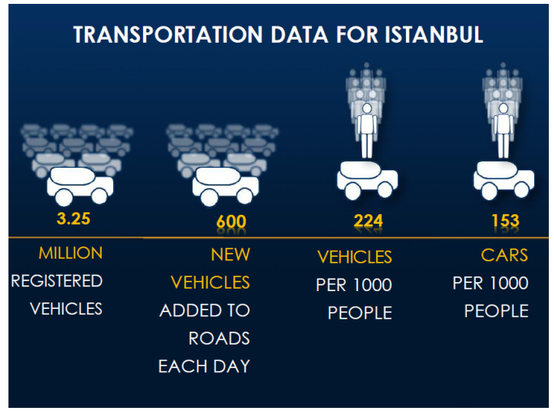
Istanbul has defined a number of goals, as shown in the images to the right.

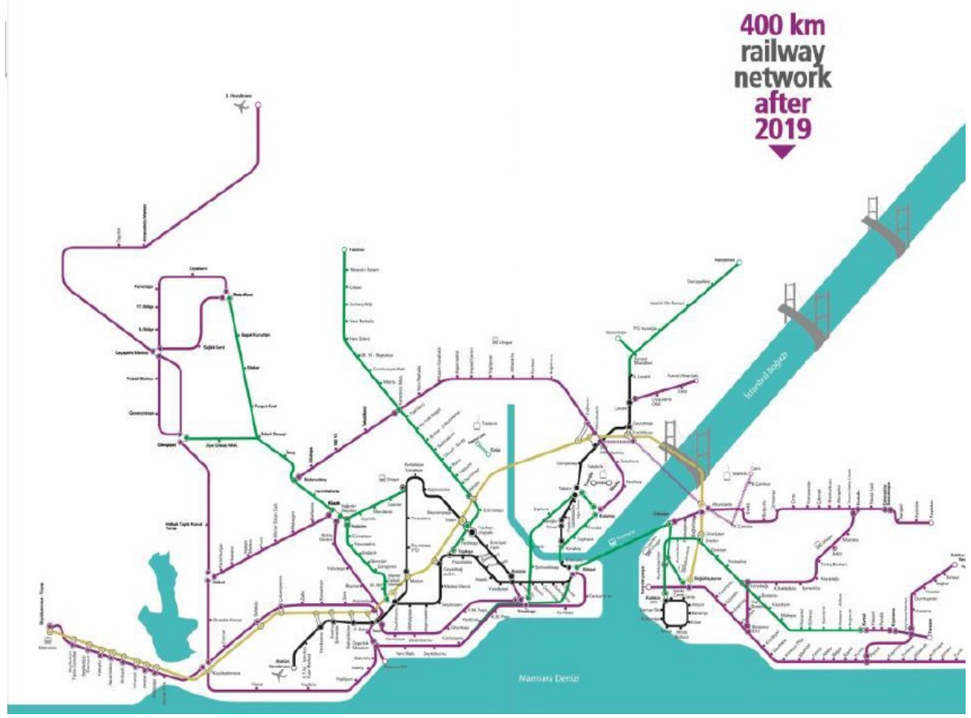
Istanbul has selected two focus areas for the R4E project:

SMART MOBILITY

- Smart public transport
- Smart traffic management





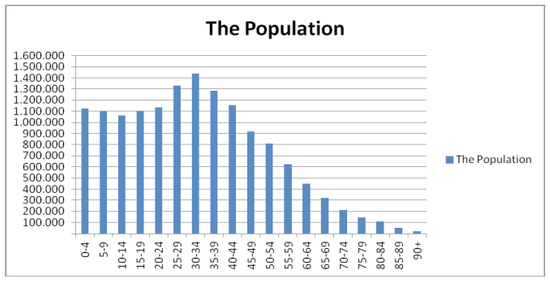


Demographical aspects

Number of inhabitants
Total: 14.377.018
Men: 7.221.158
Women: 7.155.860

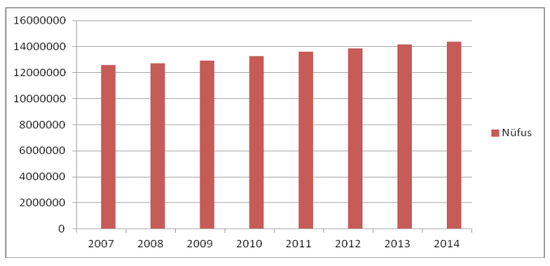
Graph: Age structure of the population

Source: Turkish Statistical Institute



Graph: Population trends

Source: Turkish Statistical Institute



Social aspects

Table: Level of education of citizens

	Primary Education	Secondary Education
Educational Year	Net schooling ratio (%)	Net schooling ratio (%)
1997-1998	84,74	37,87
1998-1999	89,26	38,87
1999-2000	93,54	40,38
2000-2001	95,28	43,95
2001-2002	92,40	48,11
2002-2003	90,98	50,57
2003-2004	90,21	53,37
2004-2005	89,66	54,87
2005-2006	89,77	56,63
2006-2007	90,13	56,51
2007-2008	97,37	58,56
2008-2009	96,49	58,52
2009-2010	98,17	64,95
2010-2011	98,41	66,07
2012-2013	98,86	93,09
2013-2014	99,57	94,52

Table: Connectivity level: penetration grade of smart phones, percentage of houses with broadband 1

Source: Turkish Statistical Institute

		Computer %			Internet %		
		Total	Men	Women	Total	Men	Women
Computer and Internet Usage	Turkey	49,9	60,2	39,8	48,9	59,3	38,7
	Cities	59,0	69,0	49,1	58,0	68,1	48,0
	Urban areas	29,5	40,1	19,3	28,6	39,2	18,4

Smart Phone Usage in Turkey: 19%

Source: Turkish Statistical Institute

Table: Unemployment rate

Year	Province name	Unemployment rate (%)
2013	Istanbul	11.2
2012	Istanbul	11.3
2011	Istanbul	11.8

There are 670.756 disabled people in Istanbul which means around 3% of population.

Table: Percentage of people that require special care/needs

Number of People Who Needed Care Between 2006 -2015	
Total Number of Care Request	**4.723**
Number of People Whose Request Accepted	**3.624**
Number of Patient Inspection Visits	**6.694**
Number of Medical Care Provided at Home	**12.394**
Number of Nursing Care/ Physical Therapy	**14.629**
Prescription	**16.599**
Medicine	**57.657**
Number of Medical Care Provided at Hospital	**1.959**

Source: Istanbul Family and Social Policies Provincial Directorate

Economical aspects

Income per head in comparison to the national average income : Average yearly income per family in Turkey in 2013: 29.479 TL

Source: Turkish Statistical Institute

The most strong industry, business, transportation, advertisement and financial entities are located in Istanbul. 40% of national income is obtained from industry, 30% of it is obtained from business and the rest of it is available from other sectors. The part of agriculture is only %1. Istanbul composes the main source of Turkish budget Approximately 37% of total taxes are collected from Istanbul. Other sectors are agriculture and stockbreeding, fishery industry, forestry, mining, transportation, highway, railway, seaway, airline and Bosporus.

Source: IMM

Business sector has 27% share, transport and communication sector has 15% share and industry employment has 20% share in local economy.

MAIN SERVICE AREA	ACTIVITY/PROJECT NUMBER	PERCENTAGE (%)	EXPENSES in 2015 (THOUSAND TL)	PERCENTAGE (%)
DISASTER MANAGEMENT	22	2,9	246.590	2,7
ENVIRONMENTAL MANAGEMENT	100	13,3	1.385.352	15,3
RECONSTRUCTION MANAGEMENT	55	7,3	204.505	2,3
CITY AND SOCIETY ORDER MANAGEMENT	24	3,2	179.635	2,0
CULTURAL SERVICES MANAGEMENT	112	14,9	483.007	5,3
HEALTH ASSISTANCE MANAGEMENT	5	0,7	109.700	1,2
SOCIAL SUPPORT SERVICE MANAGEMENT	89	11,9	1.138.339	12,6
TRANSPORTATION SERVICES MANAGEMENT	188	25,1	3.620.153	40,0
GENERAL MANAGEMENT	155	20,7	1.681.888	18,6
TOTAL	**750**	**100**	**9.049.170**	100

Maintenance costs

Historical/Cultural aspects

Istanbul has several associations.

ASSOCIATION (Istanbul)	Sayı
PREVENTION OF CRUELTY TO ANIMALS, ENVIRONMENT AND WILDLIFE ASSOCIATIONS	337
PEDIATRIC ASSOCIATIONS	3
TURKISH SOLIDARITY ASSOCIATIONS	134
DISABLED ASSOCIATIONS	171
EDUCATION RESEARCH ASSOCIATIONS	559
SUSTENTATION SOCIAL VALUES ASSOCIATIONS	267

Source: http://www.dernekler.gov.tr/

- Particular cultural matters for adoption of innovative solutions
- "Seker Otobüs" Children Events
- Summer Cinema
- Documentaries
- Documentary of Haliç
- Documentary of Companions of Prophet Muhammad
- Women of East/Istars at the Door Festival
- Woman and Sufism
- Meeting with Mevlana
- 4. Istanbul Meeting for freedom of thought
- Islamic Countries Culture Week
- Advertising Activities
- Book Fair
- Memorial Meetings
- Symposiums
- Feshane Activities
- Children's Film Days
- Oversea Istanbul Culture Days
- Istanbul Culture Days in Damascus
- Oversea Tourism Advertising Fairs

Source: www.ibb.gov.tr

Environmental aspects

Green areas

Metropolitan Surface Area	5.400.320.000 m²
Forested Land (Source: Regional Forest Directorate)	2.424.200.000 m²
Total Green Space cared by IMM	48.308.248m²
New Green Space done by IMM in last 6 years	18.198.315 m²
Total Green Space of District and Town Municipalities	29.152.880 m²
Total Green Space of IMM, District and Town Municipalities	77.461.128 m²
Green Space per capita (Population of Istanbul 12.782.960)	6.05 m²

Source: IMM

Monthly maximum temperature, 2013 (°C)

June	July	August	September	October	November	December
40,7	42,7	41,0	37,2	32,3	25,8	16,8
40,4	42,2	41,0	40,6	32,9	24,7	12,2
40,6	41,8	40,4	38,7	31,5	24,8	13,8
41,5	41,5	40,5	38,2	32,0	27,0	16,9
37,8	40,3	40,8	40,3	33,3	28,9	20,5
38,5	39,9	39,5	37,1	31,4	26,6	17,2
38,5	39,8	39,4	37,1	31,5	25,6	18,2
39,9	39,7	39,2	36,8	30,3	25,6	18,6
38,2	39,5	39,5	37,5	28,7	23,8	11,7
39,1	39,3	40,4	37,8	31,5	26,0	16,6

Monthly minimum temperature, 2013 (°C)

June	July	August	September	October	November	December
-0,2	2,6	3,5	-3,4	-9,0	-11,9	-27,1
1,0	3,1	4,2	-2,6	-6,8	-7,9	-22,5
1,7	7,5	7,7	2,2	-4,7	-8,4	-29,1
1,6	3,7	5,8	0,5	-5,7	-7,3	-23,5
6,5	12,2	11,9	5,5	-0,6	-1,6	-18,5
8,5	14,2	13,9	7,3	1,2	-0,1	-23,9
7,6	11,0	12,8	5,8	-0,1	-1,1	-12,3
9,8	16,7	16,2	9,8	3,7	1,7	-14,4
3,4	5,1	5,8	1,4	-4,0	-5,8	-18,3
8,6	13,9	13,5	4,9	-1,6	-4,8	-13,5

Source: Turkish State Meteorological Service

Factors Affecting Climate

- Mathematical position
- Geographical Formations (Level, direction of mountains, aspects)
- Position according to sea
- Direction of wind
- Centre pressure

Source : IMM Disaster Coordination Center

Climate conditions

Projects implemented by the Istanbul Metropolitan Municipality (IMM) to improve air quality and to reduce GHG emissions :
1) To minimize the rate of solid waste going to landfill providing maximum material recovery by mechanical and biological treatment of municipal solid waste with high organic content and to reduce 171,000 tons of CO2-e/year GHG emissions generating alternative fuel (solid recovered fuel- SRF).

2) To reduce GHG emissions through waste transfer stations used for transfer of waste from garbage trucks into silos and semi-trailers of bigger volume for onward transportation to landfill. Usage of transfer stations lowers amount of GHG emissions by reducing traffic towards landfill.

3) CO2 reduction from heat and power (CHP) generation in wastewater treatment and sludge dewatering units of Istanbul Water and Sewage Administration (ISKI).

4) The efforts on increasing green areas and reforestation.

5) The use of energy efficient equipments (thermostatic valve, solar collectors, lighting sensor etc.) in the houses produced by KIPTAS municipal company of IMM.

6) The estabilishment of 274 solar collectors in the facilities of IMM.

7) The estabilishment of healthy charging infrastructure for electric vehicles,

8) The efforts of IMM Art and Vocational Training Courses (ISMEK) to raise awareness of housewives about efficient consumption of energy in daily life,

9) The project of ISKI on the effects of climate change on some important water resources in Turkey including Istanbul as a pilot region,

10) The efforts on increaing the rail system,

11) The use of LED and solar energy for traffic signalization,

12) The use of online crossroad system in traffic signalization,

13) The efforts on intelligent transportation systems (ITS),

14) The efforts on promoting public transport,

15) Renewal of the bus fleet of IMM (buses working with compressed natural gas (CNG), buses with Euro 5 standards),

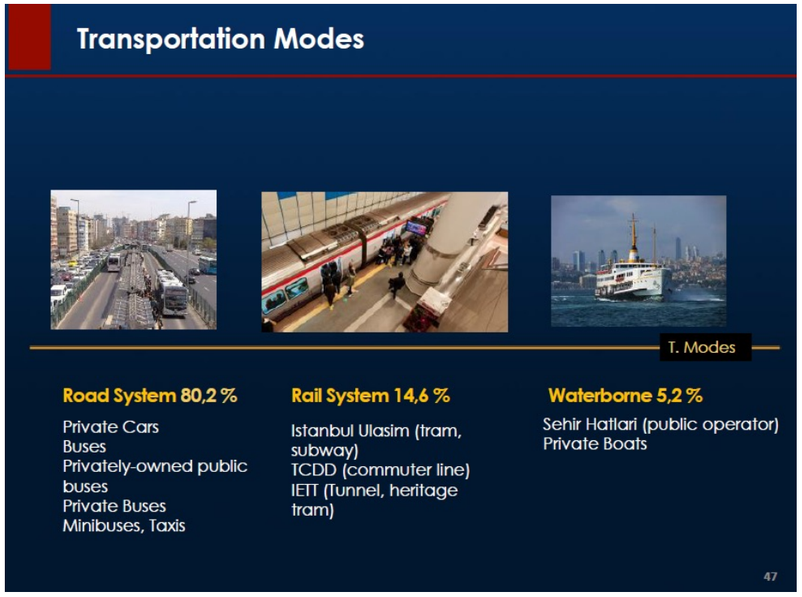
16) The efforts on changing transportation modes (increasing marine transportation, extending bike lanes).

17) The project "Development of a GIS Based Decision Support System for Urban Air Quality Management in the City of Istanbul" was performed within the frame of the LIFE Third Countries Programme for the term February 1, 2007- January 31, 2009. A decision support system for urban air quality management was developed for the first time for a metropolitan city in Turkey within the scope of this study. According to the results of the study, Istanbul Metropolitan Municipality has prepared an action plan titled "Istanbul Air Quality Strategy".

18) In an effort to identify the largest sources of GHGs in Istanbul and to determine targeted initiatives that will achieve the greatest economic and carbon savings, the GHG inventory report, the first publicly available report for Istanbul, was prepared.

The reporting year selected for the inventory is 2010 as the data for this year the most complete at the time of developing the inventory. The inventory includes emissions from carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).

SMART MOBILITY



Bicycle roads and pedestrian areas

According to Istanbul Transportation Master Plan Households Research Report, 50.72% of travels are performed with motor vehicles and 49.28% are performed on foot. It is necessary not to rule out pedestrian travels due to it has a huge ratio as 49.28%. The main sources of environmental and transportation problems are motor vehicles. Traffic problems can be solved if bicycle and pedestrian transport are supported in short distance travel. By this way, traffic congestion will decrease and at the same time people will have a chance to do sport. To extend and make it attractive this environment friendly system, IMM Transportation Planning Directorate has carried out a planning and designing project for bicycle and pedestrian roads in Istanbul.

"Rider and Pedestrian Transportation System" has created in Istanbul for 630 km long road. To provide route continuance, approach roads are added to 630 km and total road network will extend to 1004km. Within the scope of "Rider and Pedestrian Transportation System" routes are divided into 4 group as first, second, third and fourth priority bicycle roads as 2023 objectives. The concept projects of first and second priority roads are ready for implementation.

Rider and Pedestrian Transportation System Priority Table

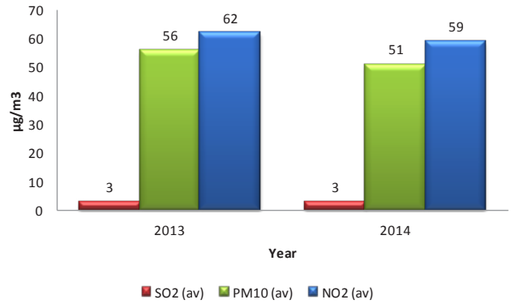
	ASIA (KM)	EUROPE (KM)	TOTAL(KM)
1. PRIORITY	27	40	67
2. PRIORITY	20	61	81
3. PRIORITY	40	98	138
4. PRIORITY	276	442	718
TOTAL	**363**	**641**	**1004**

24 km long road From Bakırköy IDO to Alibeyköy, 4.5km long road from Eminönü to Besiktas Square and 32.5km long road from Üsküdar to Kartal are decided to construct as first priority. UTK2008/24-23 (UTK: Transportation and Traffic Circulation Committee) numbered decision for aforementioned routes has been taken and transferred to put into practise to General Directorate of Public Works and Engineering.

Source: www.ibb.gov.tr

CO2 emission per capita in 2010 has been estimated as 3.31 tCO2e.

Air quality data



Noise data

IMM Directorate of Environmental Protection has prepared road-related draft noise maps along routes used by more than 6 million vehicles per year in Istanbul since 2010. Road-related draft noise maps of Bayrampasa, Esenler, Gaziosmanpasa, Sultangazi, Eyüp, Kasıthane,sisli, Beyoslu, Besiktas Sarıyer, Fatih, Zeytinburnu, Bakırköy, Üsküdar, Atasehir were completed. The noise maps for the remaining districts are being prepared. According to the data of prepared maps:

378.800 of 5.224.554 people are exposed to total noise values of above 55 and 90.400 people are exposed to total noise values of above 65 dBA*.

246.600 of 5.224.554 people are exposed to total noise values of above 50 dBA and 119.400 people are exposed to total noise values of above 55 dBA*.

GHG Inventory of Istanbul - 2010

Source Category	GHG Emission tCO2e	% contribution to total carbon footprint	Emissions Source	GHG Emission tCO2e	% contribution to source category	% contribution to total carbon footprint
Stationary Units	26,781,623	61.1%	Residential Buildings	15,282,654	57%	34.9%
			Commercial/ Institutional Facilites	4,872,008	18%	11.1%
			Energy Generation	0	0%	0.0%
			Industrial Energy Use	6,626,962	25%	15.1%
			Other Emissions	0	0%	0.0%
			Fugitive Emissions	0	0%	0.0%
Mobile Units	13,309,358	30.4%	On-Road Transportation	10,008,732	75%	22.8%
			Railways	76,248	1%	0.2%
			Water-Borne Navigation	2,130,383	16%	4.9%
			Aviations	1,093,994	8%	2.5%
			Off-Road	0	0%	0%
Waste	2,371,376	5.4%	Solid Waste Disposal	1,598,736	67.4%	3.6%
			Biological Treatment of Waste	0	0%	0.0%
			Incineration and Open Burning	4,357	0.2%	0.0%
			Wastewater Treatment and Discharge	768,283	32.4%	1.8%
Industrial Processes and Product Use (IPPU)	1,363,741	3.1%	Industrial Processes and Product Use (IPPU)	1,363,741	100%	3.1%
TOTAL	**43,826,098**					

Way of working

Departments in the municipality:

MAIN SERVICE AREAS
DISASTER MANAGEMENT
ENVIRONMENTAL MANAGEMENT
RECONSTRUCTION MANAGEMENT
CITY AND SOCIETY ORDER MANAGEMENT
CULTURAL SERVICES MANAGEMENT
HEALTH ASSISTANCE MANAGEMENT
SOCIAL SUPPORT SERVICE MANAGEMENT
TRANSPORTATION SERVICES MANAGEMENT
GENERAL MANAGEMENT

Recent projects

1. Pedestrian roads

(To extend Carbon free zone) Pedestrianization projects are increased. Bicycle paths has been planned and put into practice.

- Total Current Bicycle Roads in Istanbul : 88,3 km
- Completed Construction Project / Planned to Construct : 106,1 km
- Ongoing Construction Project : 67,7 km
- Target Bicycle Road of Istanbul Metropolitan Municipality : 1.050 km

2. SARIYER HACIOSMAN – BELGRAD FOREST BICYCLE ROAD

This road has been planned to construct in 2015 and is 6,5 km long. It reaches out from Sarıyer Hacıosman Metro Station and follows Büyükdere Bahçeköy - Maresal Fevzi Çakmak Street-Valide Sultan Street-Bahçeköy Forest Faculty route to Belgrad Forest entrance. It is planned to connect this new road to current bicycle path which is located in the forest. This integrated project is important for sustainable and uninterrupted transportation. By this way, comfortable travel for riders is aimed. They may use their own bicycles or may rent from ISPARK- Bicycle Rent System.

- Increasing low commissioned public transport vehicles
- Extending rail system network
- Decreasing private cars by supporting public transportation
- Supporting the use of electric vehicles

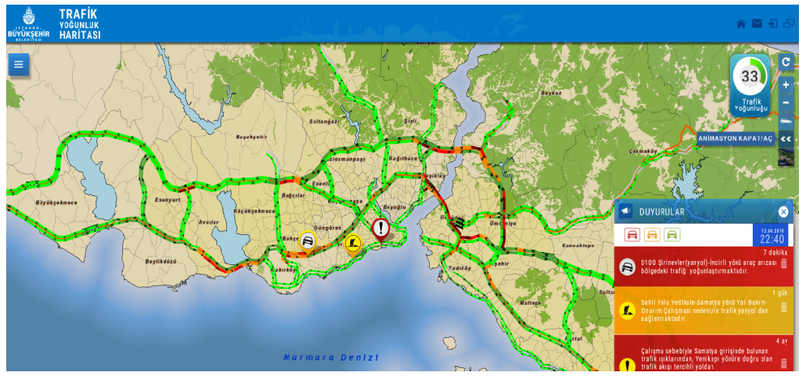
Today's reality: smart traffic management

IMM has a Traffic Control Centre (TCC) operating since 2003 to provide 24/7 online traffic information to the public. TCC Call Centre staff directs drivers to less crowded routes so they do not get stuck in traffic jam and waste time and energy while releasing harmful gases. By deploying Variable Message Signs that provide both congestion status and estimated travel times, IMM aims to optimise the use of its road network and direct drivers to alternative routes. Moreover, IMM has both web and mobile traffic applications that provide online traffic camera streams, estimated travel times, online parking information, weather information, road works announcements etc. which affect traffic in Istanbul.

Traffic Control Centre

Tunnel Control Centre

Variable Message Signs



IMM Traffic Density Map

"IBB CepTrafik" Mobile Traffic App

Traffic Sensor Powered by Solar Energy

Ambition: Personalised, smooth, safe traffic in Istanbul 2050

SMART MOBILITY

1

Personalised travel advise

In 2050, individual travellers are valued and facilitated by personalised travel advise. Smart technologies and apps enable personalised route planning. Communication between vehicles, drivers and infrastructure allows individual signalling.

Green behaviour is encouraged by a range of personalised, sustainable options.

Strategic ambitions

- In 2050 everyone has it's own route-planner using smart apps and technologies provided. There is no need to ask anyone else for your own discretion.
- In 2050 we have individual signalisation so that communication with vehicles and drivers is possible.
- In 2050 green behaviour is stimulated

2

Fast, smooth traffic flows

In 2050, people value fast, smoothly flowing traffic, free from congestion. Automated systems support smooth traffic flows through the city. Mass transport solutions are attractive thanks to flexible charging and working hours. Alternative routes and transport modes are conveniently available.

People value better air quality and choose healthier options such as walking and cycling.

Strategic ambitions

- In 2050 traffic congestion is not among the primary 10 problems in Istanbul.
- In 2050 people move faster and fluently through the city, experiencing no congestion and using new transport modes (walking, cycling etc.). There is better air quality to stimulate healthier living and more walking and cycling.
- In 2050 there is no congestion due to the use of automation and automated solutions
- In 2050 we have low emissions and a healthy environment.

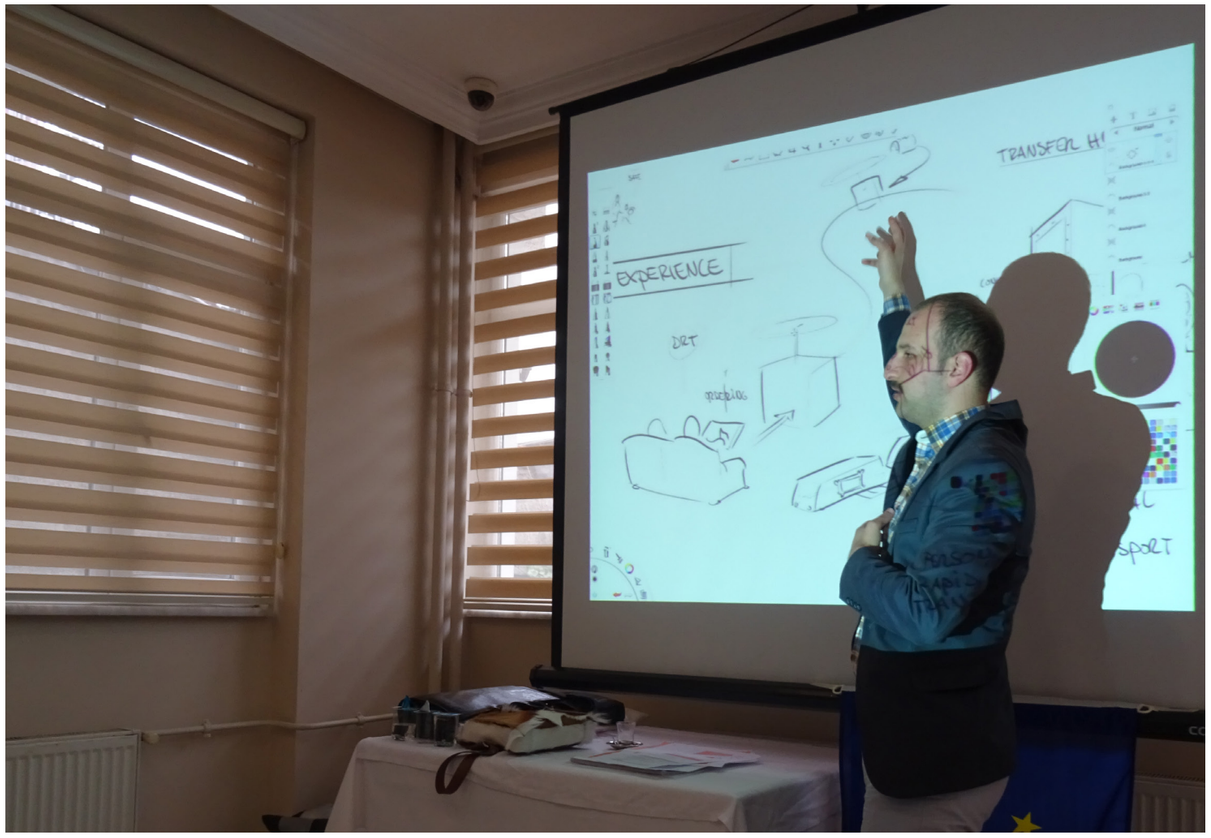
3

Traffic safety

In 2050, people in Istanbul value traffic safety. Smart safety measures help to avoid accidents and traffic violations. Vehicles are equipped with smart solutions and options to communicate, both with other road users and with the infrastructure.

Strategic ambitions

- In 2050 we have safe traffic management by communication between vehicles and infrastructure. Vehicles are equipped with smart safety measures to avoid accidents.
- In 2050 Istanbul will be in world top 5 regarding traffic safety statistics.



Creating the visual of the desired future scenarios

VISION DEVELOPMENT

SMART MOBILITY

Vision development

The aim of Step 2 is to develop visions for the cities on 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 take place in this step: Future Telling research and the development of the desired future scenarios in the cities.

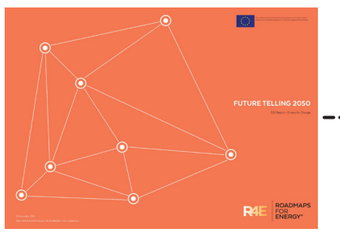
Future Telling

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 of Smart Buildings, Smart Mobility and Smart Urban Spaces in particular. The Future Telling research method develops context-related possible future scenarios in a creative and imaginative way and leads to Drivers for Change for liveable Smart Cities in 2050.

The method is briefly described on the following pages and more elaborate in the Future Telling 2050 D2.1 Report — Drivers for Change.

Developing desired future scenario's

Of the 18 Drivers for Change for Smart and Sustainable Cities, the cities chose four Drivers for Change for each focus area that relate best to their specific contexts and ambitions. Together with the ambitions of step 1, these are used to develop the desired future scenarios for the focus areas.



Future Telling 2050 - D2.1 report - Drivers for Change

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

Scenario Workshops

The desired future scenarios for the selected focus areas of 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 city to facilitate 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 by making specific additions. Based on the outlined vision, they carry out a further in-depth exploration of the main elements of the vision. In all the sessions, the participants interactively build a visualisation of the desired future scenario. See also the pictures of the workshops on the previous page.

The result of the vision development step is a visualisation of the desired future scenario in an A0-format poster. The poster shows the visual together with a brief explanatory text. A common visual language is used to make sharing easier and to facilitate discussion among the cities on common and specific aspects of the visions.

City scenario workshops

Day 1 - Focus area 1	Day 2 - Focus area 2	Day 3 - Reporting
Outlining the vision · Exploring the drivers for change in relation to the future of the city · Selecting the main elements of the vision	**Outlining the vision** · 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 · Exploring the future the city and the main elements of the vision · Enriching the vision with specific additions	**Enriching the desired future scenario** · Exploring the future of the city and the main elements of the vision · Enriching the vision with specific additions	

Programme of the scenario workshops in the cities

Joint Vision Workshop

In a joint meeting in Istanbul the cities presented their desired future scenarios to each other, and held in-depth discussions to understand the common and specific needs in their visions.

This Joint Vision Workshop served two purposes:

· To enable cross-city learning. The cities gain a deeper understanding of the vision development process, enabling them to improve their own vision with inspiration from others.

· To describe the needs as input for the roadmapping step.

The Joint Vision Workshop finalised the activities of Step 2 and prepared for Step 3.

Day 1 Finalising Step 2	**Poster exhibition of the city visions** · The cities share their desired future scenarios for the focus areas
	Learning from each other's visions · In-depth discussion on common and specific needs described in the visions
Day 2 Preparing for Step 3	**Presentation of the Roadmapping process** · Sharing of interim results of the roadmapping desk study
	Identifying topics and experts for the roadmap interviews · Selecting topics for the roadmapping interviews and making a list of suggested experts using the networks of all partners

Programme of the Joint Vision Workshop

R4E ROADMAPS FOR ENERGY

ISTANBUL METROPOLITAN MUNICIPALITY

Future Telling & selection drivers for change

SMART MOBILITY

Future Telling research

The future is unpredictable and elusive. Recent changes in technology, ecology, economics and society have already led to significant changes.

The expectation is that the complexity that people and organisations experience will only increase further in the years ahead. A number of current Drivers for Change will lead to radical changes in the future. For example, new developments in information technology will create opportunities that we cannot imagine today. These will undoubtedly change our lives significantly, including the way we shop, travel, move, communicate and work. Another example is the increasing level of social connectivity, which will drastically affect the relationships between organisations and their strategies. Even today, disruptive developments in many areas are challenging us to redesign our world.

This constant process of change has also become more complex: developments are so rapid that the future is unpredictable, based on our knowledge and models of the past and present. Predictions based on analysis appear pointless. The new complexity is characterised by simultaneous developments with far-reaching effects. We need a new way to visualise the future, with all the opportunities and challenges that it will bring – an approach that is creative, imaginative and research-oriented. Even though we can't predict the future, we can create a range of possible context-related future scenarios. These desired scenarios will direct our decision-making, from short-term actions to long-term consequences.

In the R4E project, the Future Telling research method is used to develop possible, context-related future scenarios in a creative, imaginative way. This implies a structured method to map the expertise and ideas of the thought leaders. The process focuses on Smart Cities, in particular using analysis to gain insight into the Drivers for Change for cities in 2050.

Thought leaders

Finding suitable Drivers for Change requires both broad and specialist views. The research involves 25 interviews with thought leaders holding different views on smart and sustainable energy in cities. A broad spectrum of experts with a visionary scope was chosen from knowledge institutes, companies, consultancies and profit or non profit organisations. Their expertise was both general on (smart) cities, and specific on mobility, buildings and urban spaces.

To overcome possible cultural bias, the experts were drawn from all over Europe, and even included thought leaders from the USA. These thought leaders are introduced on the following pages. For the interviews, the requested expertise of the thought leaders was not specifically their future vision, but their knowledge of important influences in their own fields. The Future Telling method inspired them to use their knowledge to visualise future trends and to describe possible future scenarios in rich stories. In fact, the richness of those stories makes them fertile input for the R4E project.

Future Telling card set

The Future Telling method uses a set of 52 cards showing general future trends derived from an extensive research project by The Hague University of Applied Sciences. The cards are shown on the previous page. They are used to trigger ideas by the research participants, and to inspire them to tell rich stories about how they think these trends will influence the future.

Structured interviews

The Future Telling card set is used in the interview. The interviewees are asked to identify relevant future trends and to tell stories about how they imagine these trends could develop.

The card set with a broad collection of general trends helps in the interviews with specialists by making them consider all the relevant directions (social, technological, economic, ecological, political and demographic), and at the same time to consider more distant future scenarios. The trends that are presented on the cards trigger their thinking, and inspires them to give rich descriptions of how they see the future developing in relation to energy in cities in 2050.

The interviews contain three main questions:

1. Sort the 52 trends on the cards into three categories:
   - Not relevant in the context of smart and sustainable energy in cities
   - Already relevant now
   - Relevant in the future

2. Take the selected cards in the category 'relevant in the future' and pick the 10 cards that in your opinion will have the greatest impact on quality of life (or lack of it) in cities in the context of smart and sustainable energy. (The interviewees can also add missing trends which they regard as important.)

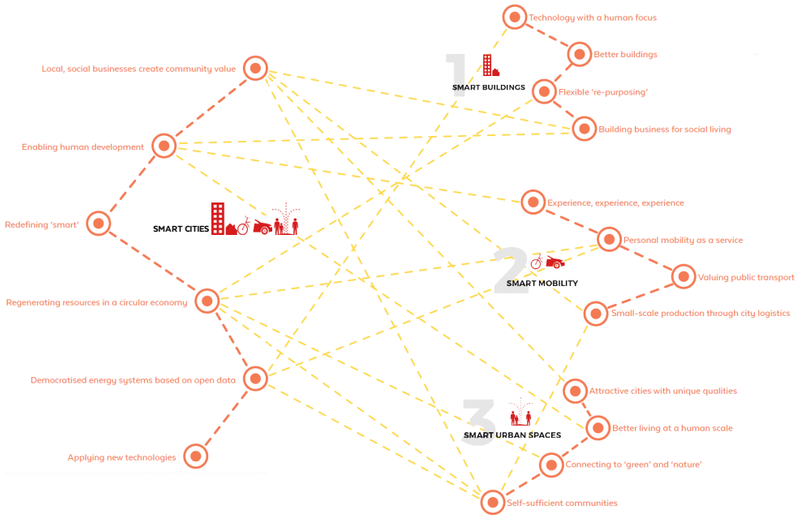
3. Tell stories about how you imagine these 10 trends will develop and what the future in cities will look like.

Drivers for Change

A limited yet representative number of Drivers for Change are distilled from the large volume of expert material. In this phase, the data from the interviews is analysed by means of clustering, selecting and comparing the quotes by the thought leaders. The clustering is based on both commonalities and contradictions in the statements by the experts on the specific topics.

A Driver for Change needs to address the topic of a cluster, as well as to point in the directions that the future might take. So for each cluster, a short title and a description are given to capture the richness of that cluster. The quotes by the though leaders serve as an inspiration to paint richer stories of the possible new future scenarios.

The analysis led to 18 Drivers for Change for the future of sustainable and liveable cities in 2050. We identified Drivers for Change at the general and smart city levels, as well as more specific Drivers for Change for the future of buildings, mobility and urban spaces.



18 Drivers for Change resulted from the Future Telling research

For an complete description, please refer to the complete report on Future Telling 2050 - D2.1 report Drivers for Change.

Selection of Drivers for Change

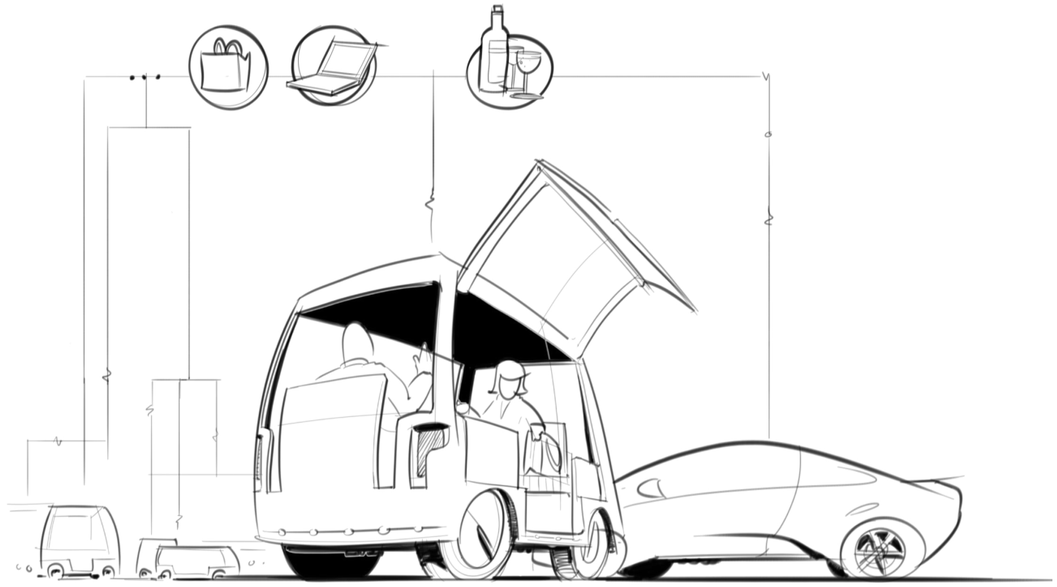
For the focus area Smart Traffic Management the city of Istanbul selected four Drivers for Change:

- Personal mobility as a service
- Technology with a human focus
- Valuing public transport
- Applying new technologies

The following pages give brief descriptions of the chosen Drivers for Change, stating the essence of the changes. These are supported by a few quotes from the experts.

Personal mobility as a service

In 2050, technology enables autonomous vehicles. These take affordable personal mobility to a whole new level. Technology makes sharing easy, so everyone has access to a vehicle whenever they need it. It also facilitates the transition to a circular economy, gradually replacing legacy systems with cleaner, safer options. Stakeholder resistance is overcome by the availability of complete, resilient system that meet the needs of city dwellers in full.



This Driver for Change represents the following clusters of quotes of the thought leaders:

a. Mobility as a service
b. Sharing vehicles
c. Autonomous driving, flying etc...

FT7.10. The sharing of resources and products, like Uber and Airbnb show that systems work. Such systems become more relevant and make society more socio-democratic and sharing. This is an important trend for cities. Somehow it will also impact sharing of energy. It will not be so conscious as with Airbnb, but in energy sharing will also take place. When you install solar cells on your house. You do it because you want to have cheap electricity, or because you want to be disconnected from the grid yourself. But it also because you want to give your surplus energy to your neighbourhood. ...

FT11.05. ... People will want everything as a service, more and more. Not wanting to buy anything. How far will that go? ... In mobility I am pretty sure that is how it is going to be. Why would you want to a vehicle: you only need it like 10% to get you everywhere. The strange thing is that it requires hard thinking to see why we would have public transport as we have it now. Trains maybe, but buses? Why would you have a masses option in automated vehicles?

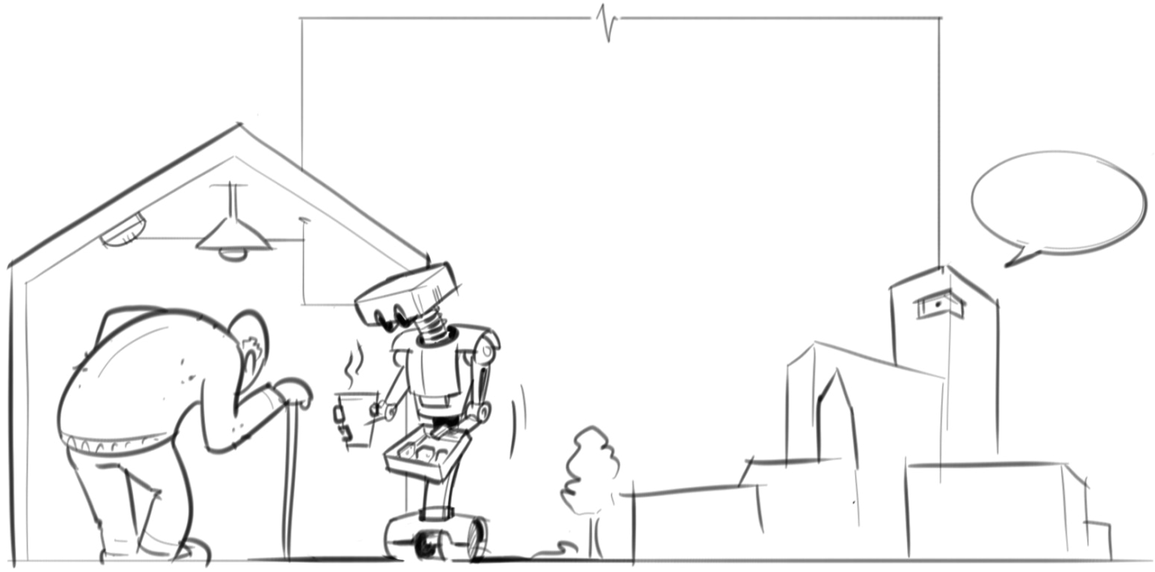
FT3.04. In mobility there is already a demand to take us seamlessly from A to B, that is not new. But the technology will be increasingly there to provide it. Your behaviour will also be changing, because you are just ad hoc or just in time you will change e.g. the reservation of a meeting room when the time schedule is changing. The system is already there to make all these transactions and negotiations possible. It is possible in a very complex system to manage your own agenda, but also to make sure that agendas are aligned and more effectively combined. Even optimising for personal travel time or optimising the average optimum travel time for all the people who want to be transported at the same time. Those kind of management techniques will be there, and make things more efficient. The technology will give us what we want best, not to plan too much, but still allow us to be spontaneous. It is about "I want it know, I want to be with whom I want to be" and the system will make it possible.

FT3.05. In essence we don't want to be thinking too much about the whole system, but want our individual needs satisfied. We hope for the system to arrange it. It will probably become so complex that you need to rely on the system. If want to deviate it interferes with everything else, even your own agenda, and all the other things you are planning. So the relation between the individual needs and the global transportation needs will be in the system. Because the individuals will be less and less capable to adjust themselves, as they cannot oversee the total system. Now the system has still some predictability, with the traffic information that is available you can plan it a little bit with your car navigation. It is not too complex to understand. But when it combines more and more, e.g. your agenda, different transport means, etc, it will be less and less transparent how the whole system is behaving, so you will rely more on the system. Your own cock-pit will deal with your own preferences and can also suggest better planning advice, and persuade you to change your behaviour a bit. You will be able to discuss with it.

SMART MOBILITY

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.



This Driver for Change represents the following clusters of quotes of the thought leaders:

a. Smart systems with a human touch

b. Improving quality of life with robotic support and home care systems

FT22.12. It is important to invest constantly. So people understand immediately the advantages of new technologies for sustainability in buildings and houses. Just to save electricity or for condition, because they immediately save money. That is very easy to understand. This requires a change for the experts to develop good scenario's. Not in the far future, or even the future, it starts right now. They have to present in a way that people easier understand.

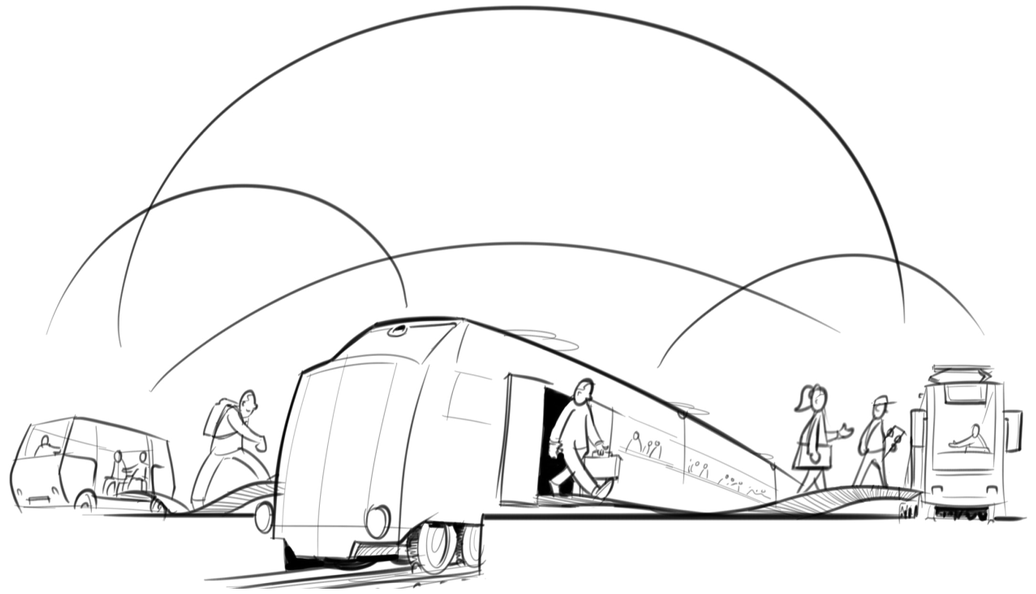
FT15.13. Now today there is things you can do in the home and around to save energy. … The value in Euros is not worth much. And I don't think honestly that most home owners want to reduce their energy bill either. They just don't want it to go up. … We have the technology to help you do that. Some of these technologies even mean that they can help to reduce your bill. So you could save 5 Euros a month. If you could translate that 5 Euros into something that is valuable. So if you say look, if you allow us to join you, or to involve you in this response-demand program, you will see no reduction in your home comfort, the heating will be on, etc. And we will take those credits and with those credits, we will give you another system in the elderly home where your mother lives, 300 miles away. It is very simple, you can set a scenario, that if the lights do not get on between 7-8 in the morning, or she doesn't put the kettle on between 7-8, then we will send you a text message and you can ring her up to see if she is alright. … So instead of the 2 or 3 Euros, translate that into a service that is very cheap to deliver but of a very high value to the individual. The challenge around utilities is to engage with the customers.

FT23.01. … This is the weak part of the story. If we do not speak about these weak elements of the society in the suburbia, then there is no way to talk about energy. Energy is invisible, people do not see it and do not understand it. They do not know where energy comes from and they do not connect the fact that you have energy and that creates problems in terms of emissions and pollution. So if you do not connect to that idea that energy has an impact on everybody, then you can never win.

FT 15.17. … Interesting will be the lighting. If you want more lighting, and you want to turn the switch, you are actually saying 'I want more light for reading'. Now the building can do anything to his ability to analyse and see if it does so by letting more lights in from using the blinded windows or change the transparency of the walls. It will do whatever the most efficient solution is to give you what you need. And then as a last resort, okay turn the light on. The switch of tomorrow is just a sensor and the robotic support mechanism will change walls, windows, blinds, everything to help you get what you need.

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.



This Driver for Change represents the following cluster of quotes of the thought leaders:

a. Affordable, accessible, seamless and attractive

FT13.30. One other thought line we are starting to explore is the impact of door to door services, the concept of collaborative or shared mobility. … If you believe in this scenario to happen of the fully connected traveller, then probably the urbanite may opt out of the mass transport systems. He may no longer choose the bus or the metro. If you believe systems like Uber for instance, who promise door to door transport, and shared mobility services are more and more organised in a way that you do not have to bring back the car to where you got it and you can leave the bicycle close to your door, then you will be tempted away from mass transport. And if you look at the impact of such a scenario then that will be very big. … And would you then care about spatial structure when transport becomes available at all places at all times.

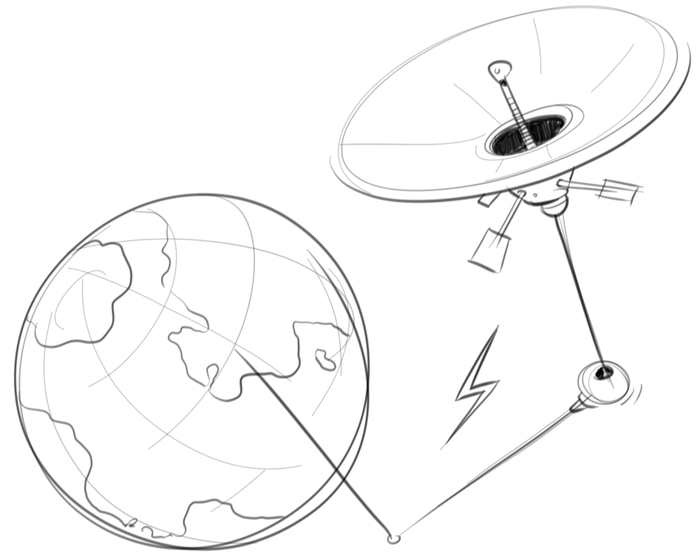
FT19.05. … the way we look at it now with each city having its own public transport corporation for trains, trams, buses, subways. But in a few years all this can be replaced by self-driving cars. There is a new technology coming up, and it is going to change the way of thinking. Suppose we stop this large scale, mass public transport or we limit it to heavy trafficked areas only, and self-driving cars are just open for use by everybody who want to use them. … If we do that, what would be the problem? What is the kind of issue that might be coming up? These questions hook up to the question to what kind of values do we want to design our cities in the future. That is the most relevant question: what values do we have? One of the important values in Europe is inclusiveness. Public transport is now enabling people who do not have a lot of money to take part. It is these values that are important. It is the same for energy: inclusiveness is important to prevent energy poverty. …

FT20.06.One thing that pops into my mind now is also in this inequality is public transport and the affordability of public transport. … Transport needs to be affordable for people, they need to be able to travel easily from A to B. It is already now not affordable anymore, and I cannot see how that can be sustainable for the future. … we have to rethink buses, trams, trains. Make sure people can move around in your city.

FT24.08 The hope is that in future that big cities that really want to improve quality of life that they have the right influence on the operator to ensure that they invest in customer satisfaction, and not only in earning money.

Applying new technologies

In 2050, a range of new technologies are available and affordable. Some of them are already in development, others are still unknown. Cities apply those technologies in new solutions that contribute to the quality of life, and in particular to the creation of smart buildings, smart mobility and smart urban spaces.



This Driver for Change represents the following cluster of quotes of the thought leaders:

a. Applying new technological solutions to increase quality of life in cities

FT7.17. There is another trend that is now not included: in 2050 humanity has moved into space. We will have much more activity in space, on the moon, on asteroids. ... When we succeed to harvest energy in space and beam it to earth it will be a revolution.

FT2.15. We will have our first test satellite up with solar power in 2017. We might be able to have the worlds first beaming of solar energy from space.

FT5.01. In 2050 I imagine that they are looking for the new world in space, out of our world. ...and maybe, if we will create a much better world than this one, there will be no-one left on this planet.

FT8.11. ...Technology will make diseases extinct. ... To be honest I do not know how feasible this is by 2050, surely aids, maybe not distinct, but under control. But if the key could be unlocked, for cancer for instance, I think this would have a huge impact on people's lives. Also because we will be getting older, so the more that you can cut out these kind of things would contribute to premature deaths, but also having an impact on the quality of live ...

FT10.13. ... I am not saying that by 2050 we will have an infinite amount of energy, but we will have so much that we can consider things like the 'beam-me-up-Scotty' type of stuff or space travelling.

FT5.07. ... Technology will enter all kinds of fields and disciplines, so this will happen everywhere.

FT2.12. Maybe the sweet spot is fabrication in the city, in vertical farms or whatever, 3D printing food. If I want a cup of coffee, I'll print the cup. The table will be a 3D printer, printing up my cup. One of the divisions in Carnegie University has a project on programmable matter. At the moment they are little units, but their idea is to have them at micrometre scale, where the particles are basically magnets, they change colour, they've got behavioural autonomy and swarm collective intelligence. It is basically very fine dust that can take form and shapes and lock into. It may sound as fantasy now, but this sort of thing will be there in 2050. ...

FT15.06. Today all buildings have an AC grid (alternating current), some today have a DC grid (direct current). By 2050 there will be DC grids. The majority of the assets in the buildings will be DC.

Creating the visual of the desired future scenarios

SMART MOBILITY

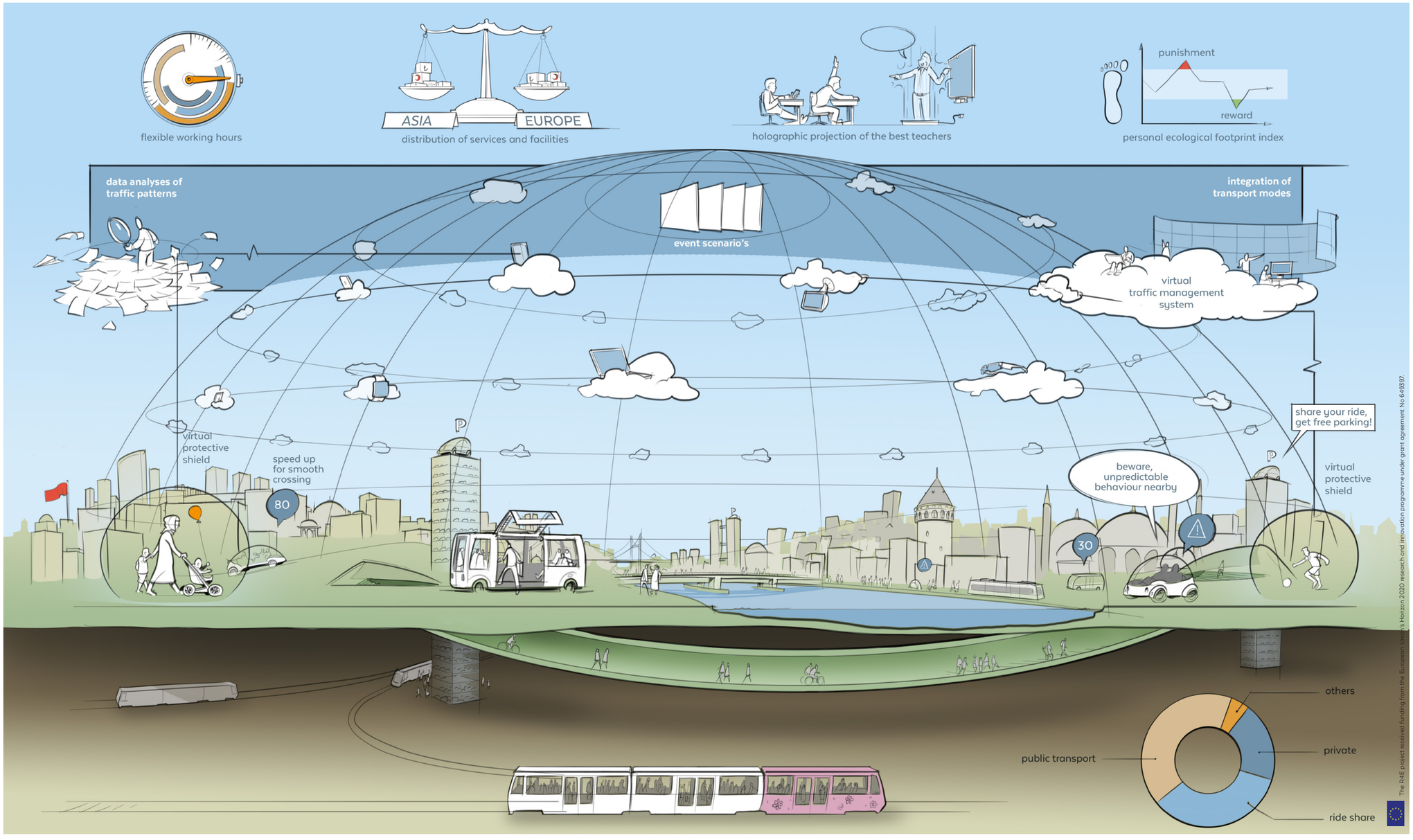
ISTANBUL METROPOLITAN MUNICIPALITY

PERSONALISED, SMOOTH, SAFE TRAFFIC IN ISTANBUL 2050

In 2050, individual travellers in Istanbul are valued and facilitated by personalised travel advise. Smart technologies and apps enable personalised route planning. Communication between vehicles, drivers and infrastructure allows smart signalling. Green behaviour is encouraged by a range of personalised, sustainable options.

People value fast, smoothly flowing traffic, free from congestion. Automated systems support smooth traffic flows through the city. Mass transport solutions are attractive thanks to flexible charging and working hours. Alternative routes and transport modes are conveniently available. People value better air quality and choose healthier options such as walking and cycling.

Traffic is safe. Smart safety measures help to avoid accidents and traffic violations. Vehicles are equipped with smart solutions and options to communicate, both with other road users and with the infrastructure.



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

Elements of the desired future scenario are:

Smart traffic management system

All traffic in Istanbul is managed through a single, safe, reliable and efficient system. The system connects all public and private vehicles, devices and road users and is accessible from anywhere. Data is collected to analyse the traffic movements and provide real-time (event-driven) smart traffic management.

Compact smart e-vehicles:

People make use of personalised services based on compact smart vehicles. Vehicles are sustainable (using recycled materials and with zero-emissions) and are charged at widely available charging stations using renewable energy sources. The service allows easy reservation, flexible payment and pick-up/drop-off at any point. Personal profiles (e.g. including a network of friends) and connection to the smart system provide routes and options to share rides with friends.

Strategic demand management

People travel less because high-quality services are available remotely. Remote health monitoring and preventive health services reduce the need to visit distant hospitals. High-quality training and education are available in all districts, for example through holograms of excellent teachers. Flexible school and working hours and relocation of offices spread the demand for travel. Ride-sharing and air-cargo drones reduce road traffic. Ride-sharing is safe and efficient thanks to easy reservation and accessibility (e.g. special, cheaper parking for shared cars).

Sustainable, healthy behaviour

Citizens have adopted healthy lifestyles. Activity levels are measured by wearable devices, and more walking is rewarded by privileged services. The use of private cars has been reduced. The new generation of people care about sustainability and use the system to make optimal choices (balancing costs, emissions, time, social aspects etc.).

Version 15 June 2016

LIGHT HOUSE expertise in smart lighting & smart cities @ TU/e

R4E ROADMAPS FOR ENERGY®


Tünel Yolları
12,44 km
5,77 km
92,27 km
55,74 k

ROADMAPPING

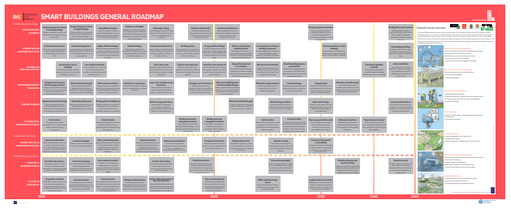
SMART MOBILITY

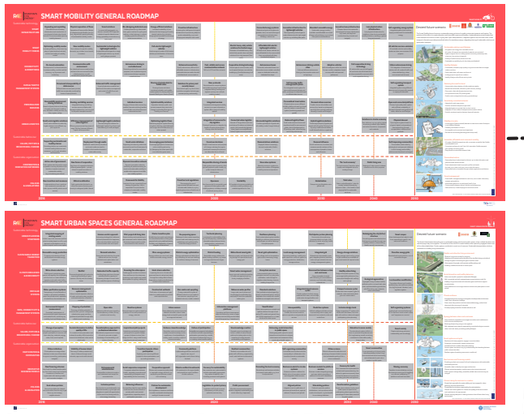
Roadmapping

The aim of Step 3 is to develop specific roadmaps for the cities in the selected focus areas. A roadmap shows all existing and future technologies and other relevant developments that enable the achievement of the desired future scenarios by 2050. Two main activities take place in this step. Firstly, the roadmapping research to define the general roadmaps. Secondly, the definition of milestones for the years 2020 and 2030, and local solutions and research projects to create city-specific roadmaps.

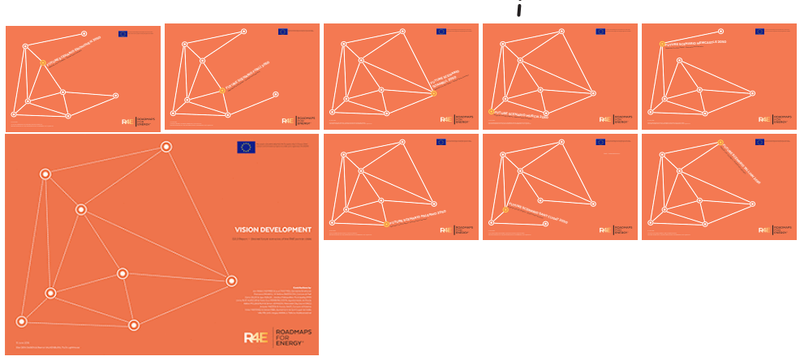
General roadmaps

Desk studies and expert interviews are conducted to collect input for the roadmaps. The roadmaps explore the options to achieve the cities' desired future scenarios. The resulting General Roadmaps for Smart Buildings, Smart Mobility and Smart Urban Spaces provide input for the city-specific roadmaps.





Smart Buildings General Roadmap - D3.2 report,
Smart Mobility General Roadmap - D4.2 report,
Smart Urban Spaces General Roadmap - D5.2 report



Vision Development - D2.2 report - Desired future scenarios of the R4E partner cities

Roadmap Workshops

The city-specific roadmaps are created in a series of workshops held in each of the partner cities. These Roadmap Workshops consist of programmes with three sessions in each city.

In the first session, the policy-makers and city representatives select the topics from the general roadmaps as focus for the city-specific roadmap. This choice is based on their specific ambitions and context. They also define intermediate milestones for 2020 and 2030 on the path to their desired future scenarios.

Then, for each of the focus areas, local stakeholders (companies, citizens, public and private organisations and knowledge institutes) are invited to take part in the roadmapping sessions. With all the available knowledge of potential developments and the given focus of the city, the local stakeholders generate project proposals for (local) solutions and research proposals, as a first step towards the project portfolio. See also the pictures of the workshops on the previous page.

The results of the Roadmap Workshops are reported in the same format for each of the cities, facilitating cross-learning between the cities.

City roadmap workshops	Focus and milestones	Focus area 1	Focus area 2
	Making choices for the focus and intermediate milestones in the city specific roadmap to realise the Desired Future Scenarios for the two focus areas.	**Completing the roadmap** • Identifying (local) solutions and research projects needed to reach the city's desired future scenario • Reflecting on results and identifying missing solutions and research projects	**Completing the roadmap** • Identifying (local) solutions and research projects needed to reach the city's desired future scenario • Reflecting on results and identifying missing solutions and research projects

Programme of the roadmap workshops in the cities

Joint Roadmap Workshop

In a joint meeting in Newcastle, the cities presented their city-specific roadmap enriched with current projects and proposals for new projects, and held in-depth discussions to understand the common and specific learning objectives and opportunities for joint projects. The Joint Roadmap Workshop served two purposes:

- To enable cross-city learning. The cities gain a deeper understanding of the roadmapping process, and can improve their own roadmaps with inspiration from others.
- To describe the common learning ambitions as input for the Project Portfolio step.

The Joint Roadmap Workshop finalised the activities of Step 3 and prepared for Step 4, in which the project portfolio will be further developed.

Day 1 Finalising Step 3	Learning from each other • Presentation of current projects and proposals for new projects • Gaining understanding of the current strengths and challenges of the R4E partner cities
Day 2 Preparing for Step 4	Identifying cross-city learning objectives • Selecting common ambitions • Formulating cross-city learning objectives as input for the Project Portfolio step

Programme of the Joint Roadmap Workshop

R4E ROADMAPS FOR ENERGY

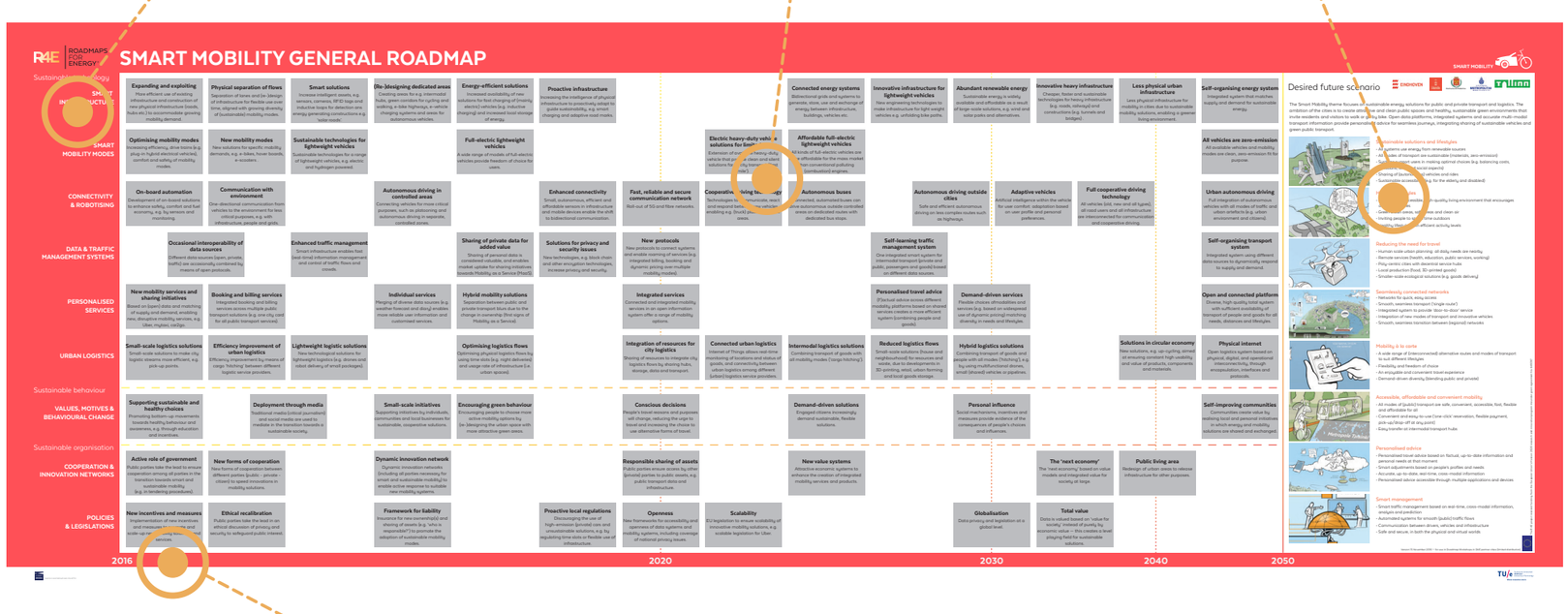
How to read the general roadmap

The resulting General Roadmap contains four important elements:

- The timeline from now (2016) to the visions for 2050 as described in the desired future scenarios of the cities (see D2.2 — Report Vision Development for the full set of desired future scenarios).
- The eight common needs in the desired future scenarios as described by the cities in the Joint Vision Workshop (see also D2.2) are indicated at the end of the timeline in 2050 as the goal of the roadmap.
- The relevant topics for the focus area on which developments are required to achieve the desired future scenarios. These topics cover sustainable technologies, sustainable behaviour and sustainable organisations.
- The options that will become available in the short or longer term for each of the topics.

Each topic has a timeline showing the developments that are relevant to that topic.

The image shows the elements of the General Roadmap.



Elements of the Smart Mobility General Roadmap

Relevant topics for Smart Mobility

In the general roadmap, timelines are created for the topics that require developments to achieve the desired future scenarios in 2050. The topics selected for the Roadmap Smart Mobility are described briefly here.

Sustainable technologies

The first element needed to achieve the sustainable energy ambitions is the availability of sustainable technologies. A wide range of sustainable technologies is already available, and new technologies are constantly being developed. But unfortunately there is not always a consensus on the best option for the future. The Roadmap Smart Mobility includes the following technology developments:

SMART INFRASTRUCTURE

Smart Infrastructure is about the physical infrastructure and energy systems relating to mobility. Specifically, this topic includes the engineering, (re-)design, maintenance and role of the physical infrastructure in terms of roads, city squares, urban areas, bridges and tunnels. The topic also applies to energy systems in terms of charging infrastructure and (connected) energy systems. It therefore has close links to Smart Buildings and Smart Urban Spaces.

SMART MOBILITY MODES

Smart Mobility Modes is about the different types of (sustainable) mobility, including the development of the required technologies. More specifically, this topic applies to the development, implementation and use of sustainable and smart mobility modes such as cars, trucks, bikes and drones.

CONNECTIVITY & ROBOTISING

Connectivity & Robotising describes developments in ICT infrastructure, communication technologies and autonomous driving. Connectivity & Robotising applies to all forms of intelligent in-vehicle solutions that allow vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-person and vehicle-to-grid communication. The topic also includes (semi-)autonomous vehicles and ICT-related developments such as 5G, since these contribute to a connected and automated mobility system.

DATA & TRAFFIC MANAGEMENT SYSTEMS

Data and Traffic Management Systems includes developments relating to transport systems and the increasing use of different types of data, including those relating to the shift towards Mobility as a Service. Data can and will be generated and communicated by the digital infrastructure and communication technologies as described by the Connectivity and Robotising topic. This data topic also applies to the management of transport systems, the developments relating to data interoperability between service providers, data protocols, and personal data and privacy issues.

PERSONALISED SERVICES

Personalised Services include the availability of mobility services, developments in public transport and those relating to applications allowing for mobility à la carte and Mobility as a Service. The Personalised Services topic is also about the development of specific (personalised) services. These are based on different types of data such as open, personal and real-time traffic data, and are aimed at matching supply and demand. As such, this topic also includes the blend of public and private mobility services and personalised travel advice.

URBAN LOGISTICS

In general, Urban Logistics is about logistics solutions and developments that affect the logistics flows in cities. More specifically, it include aspects relating to the (integrated) transport of goods across the whole urban logistics system, integrating multiple urban logistics flows, and the development of new solutions for urban logistics.

Sustainable behaviour

One of the crucial elements of a sustainable city is the behaviour of citizens. Making a collective shift to more sustainable solutions and energy-saving alternatives requires awareness. In many cases, the available technologies are not sufficiently attractive to gain acceptance in mass markets. The Roadmap Smart Mobility includes the following behavioural developments:

VALUES, MOTIVES & BEHAVIOURAL CHANGE

Values, Motives and Behavioural Change includes the way citizens can play an active role in behavioural change, driven by different values and reasoning over time. Small-scale initiatives, the role of the media and healthy behaviour are some of the aspects covered.

Sustainable organisation

Last but not least, the element of sustainable organisation is addressed. How can we organise the collaboration between relevant parties (public, private, citizens) to achieve the desired future scenarios? Because the technology is not yet mature, new business models are needed to enable learning processes, and these can be modified and updated as necessary. The Roadmap Smart Mobility includes the following organisational developments:

COOPERATION & INNOVATION NETWORKS

Cooperation and Innovation Networks describes how forms of cooperation between different types of organisations (public and private) will evolve over time to speed innovation and new mobility solutions. Among the aspects covered are active roles of multiple stakeholders, and sharing of assets.

POLICIES & LEGISLATION

Legislative changes and the right policies are important factors in the developments relating to Smart Mobility. This topic includes the developments in this field. More specifically, it applies to developments relating to legislative aspects, and frameworks and measures to enable the creation of Smart Mobility systems.

The city specific roadmap

The general roadmap describes the developments on a timeline, indicating when experts estimate that those development will be broadly available. For the cities to create their specific roadmaps, they were asked to focus on the topics that are most relevant for them to reach their own desired future scenarios. The cities create milestones for 2020 and 2030, describing what they will look like when their own developments and city projects have evolved. In this way each city can indicate the focus and pace that it will need to achieve. Projects can then be proposed on this basis to define (local) solutions or research leading to further realisation of the roadmap.

R4E ROADMAPS FOR ENERGY®

SMART MOBILITY GENERAL ROADMAP

Sustainable technology

SMART INFRASTRUCTURE

Expanding and exploiting
More efficient use of existing infrastructure and construction of new physical infrastructure (roads, hubs etc.) to accommodate growing mobility demand.

Physical separation of flows
Separation of lanes and (re-)design of infrastructure for flexible use over time, aligned with growing diversity of (sustainable) mobility modes.

Smart solutions
Increase intelligent assets, e.g. sensors, cameras, RFID tags and inductive loops for detection ans energy generating constructions e.g. 'solar roads'.

(Re-)designing dedicated areas
Creating areas for e.g. intermodal hubs, green corridors for cycling and walking, e-bike highways, e-vehicle charging systems and areas for autonomous vehicles.

Energy-efficient solutions
Increased availability of new solutions for fast charging of (mainly electric) vehicles (e.g. inductive charging) and increased local storage of energy.

Proactive infrastructure
Increasing the intelligence of physical infrastructure to proactively adapt to guide sustainability, e.g. smart charging and adaptive road marks.

SMART MOBILITY MODES

Optimising mobility modes
Increasing efficiency, drive trains (e.g. plug-in hybrid electrical vehicles), comfort and safety of mobility modes.

New mobility modes
New solutions for specific mobility demands, e.g. e-bikes, hover boards, e-scooters .

Sustainable technologies for lightweight vehicles
Sustainable technologies for a range of lightweight vehicles, e.g. electric and hydrogen powered.

Full-electric lightweight vehicles
A wide range of models of full-electric vehicles provide freedom of choice for users.

Electric heavy-duty vehicle solutions for limited range
Extension of available heavy-duty vehicle that provide clean and silent solutions for in-city transport ('last mile').

CONNECTIVITY & ROBOTISING

On-board automation
Development of on-board solutions to enhance safety, comfort and fuel economy, e.g. by sensors and monitoring.

Communication with environment
One-directional communication from vehicles to the environment for less critical purposes, e.g. with infrastructure, people and grids.

Autonomous driving in controlled areas
Connecting vehicles for more critical purposes, such as platooning and autonomous driving in separate, controlled zones.

Enhanced connectivity
Small, autonomous, efficient and affordable sensors in infrastructure and mobile devices enable the shift to bidirectional communication.

Fast, reliable and secure communication network
Roll-out of 5G and fibre networks.

Cooperative driving technology
Technologies to communicate, react and respond between new vehicles, enabling e.g. (truck) platooning in all areas.

DATA & TRAFFIC MANAGEMENT SYSTEMS

Occasional interoperability of data sources
Different data sources (open, private, traffic) are occasionally combined by means of open protocols.

Enhanced traffic management
Smart infrastructure enables fast (real-time) information management and control of traffic flows and crowds.

Sharing of private data for added value
Sharing of personal data is considered valuable, and enables market uptake for sharing initiatives towards Mobility as a Service (MaaS).

Solutions for privacy and security issues
New technologies, e.g. block chain and other encryption technologies, increase privacy and security.

New protocols
New protocols to connect systems and enable roaming of services (e.g. integrated billing, booking and dynamic pricing over multiple mobility modes).

PERSONALISED SERVICES

New mobility services and sharing initiatives
Based on (open) data and matching of supply and demand, enabling new, disruptive mobility services, e.g. Uber, mytaxi, car2go.

Booking and billing services
Integrated booking and billing services across multiple public transport solutions (e.g. one city card for all public transport services).

Individual services
Merging of diverse data sources (e.g. weather forecast and diary) enables more reliable user information and customised services.

Hybrid mobility solutions
Separation between public and private transport blurs due to the change in ownership (first signs of Mobility as a Service).

Integrated services
Connected and integrated mobility services in an open information system offer a range of mobility options.

URBAN LOGISTICS

Small-scale logistics solutions
Small-scale solutions to make city logistic streams more efficient, e.g. pick-up points.

Efficiency improvement of urban logistics
Efficiency improvement by means of cargo 'hitching' between different logistic service providers.

Lightweight logistic solutions
New technological solutions for lightweight logistics (e.g. drones and robot delivery of small packages).

Optimising logistics flows
Optimising physical logistics flows by using time slots (e.g. night deliveries) and usage rate of infrastructure (i.e. urban spaces).

Integration of resources for city logistics
Sharing of resources to integrate city logistics flows by sharing hubs, storage, data and transport.

Connected urban logistics
Internet of Things allows real-time monitoring of locations and status of goods, and connectivity between urban logistics among different (urban) logistics service providers.

Sustainable behaviour

VALUES, MOTIVES & BEHAVIOURAL CHANGE

Supporting sustainable and healthy choices
Promoting bottom-up movements towards healthy behaviour and awareness, e.g. through education and incentives.

Deployment through media
Traditional media (critical journalism) and social media are used to mediate in the transition towards a sustainable society.

Small-scale initiatives
Supporting initiatives by individuals, communities and local businesses for sustainable, cooperative solutions.

Encouraging green behaviour
Encouraging people to choose more active mobility options by (re-)designing the urban space with more attractive green areas.

Conscious decisions
People's travel reasons and purposes will change, reducing the urge to travel and increasing the choice to use alternative forms of travel.

Sustainable organisation

COOPERATION & INNOVATION NETWORKS

Active role of government
Public parties take the lead to ensure cooperation among all parties in the transition towards smart and sustainable mobility (e.g. in tendering procedures).

New forms of cooperation
New forms of cooperation between different parties (public - private - citizen) to speed innovations in mobility solutions.

Dynamic innovation network
Dynamic innovation networks (including all parties necessary for smart and sustainable mobility) to enable active response to suitable new mobility systems.

Responsible sharing of assets
Public parties ensure access by other (private) parties to public assets, e.g. public transport data and infrastructure.

POLICIES & LEGISLATIONS

New incentives and measures
Implementation of new incentives and measures to promote and scale-up new mobility solutions and services.

Ethical recalibration
Public parties take the lead in an ethical discussion of privacy and security to safeguard public interest.

Framework for liability
Insurance for new ownership(s) and sharing of assets (e.g. 'who is responsible?') to promote the adoption of sustainable mobility modes.

Proactive local regulations
Discouraging the use of high-emission (private) cars and unsustainable solutions, e.g. by regulating time slots or flexible use of infrastructure.

Openness
New frameworks for accessibility and openness of data systems and mobility systems, including coverage of national privacy issues.

Scalability
EU legislation to ensure scalability of innovative mobility solutions, e.g. scalable legislation for Uber.

2016 2020

Connected energy systems
Bidirectional grids and systems to generate, store, use and exchange of energy between infrastructure, buildings, vehicles etc.

Innovative infrastructure for lightweight vehicles
New engineering technologies to make infrastructure for light weight vehicles e.g. unfolding bike paths.

Abundant renewable energy
Sustainable energy is widely available and affordable as a result of large-scale solutions, e.g. wind and solar parks and alternatives.

Innovative heavy infrastructure
Cheaper, faster and sustainable technologies for heavy infrastructure (e.g. roads, railways) and constructions (e.g. tunnels and bridges) .

Less physical urban infrastructure
Less physical infrastructure for mobility in cities due to sustainable mobility solutions, enabling a greener living environment.

Self-organising energy system
Integrated system that matches supply and demand for sustainable energy.

Affordable full-electric lightweight vehicles
All kinds of full-electric vehicles are more affordable for the mass market than conventional polluting (combustion) engines.

All vehicles are zero-emission
All available vehicles and mobility modes are clean, zero-emission fit for purpose.

Autonomous buses
Connected, automated buses can drive autonomous outside controlled areas on dedicated routes with dedicated bus stops.

Autonomous driving outside cities
Safe and efficient autonomous driving on less complex routes such as highways.

Adaptive vehicles
Artificial intelligence within the vehicle for user comfort: adaptation based on user profile and personal preferences.

Full cooperative driving technology
All vehicles (old, new and all types), all road users and all infrastructure are interconnected for communication and cooperative driving.

Urban autonomous driving
Full integration of autonomous vehicles with all modes of traffic and urban artefacts (e.g. urban environment and citizens).

Self-learning traffic management system
One integrated smart system for intermodal transport (private and public, passengers and goods) based on different data sources.

Self-organising transport system
Integrated system using different data sources to dynamically respond to supply and demand.

Personalised travel advice
(F)actual advice across different modality platforms based on shared services creates a more efficient system (combining people and goods).

Demand-driven services
Flexible choices ofmodalities and services (e.g. based on widespread use of dynamic pricing) matching diversity in needs and lifestyles.

Open and connected platform
Diverse, high quality total system with sufficient availability of transport of people and goods for all needs, distances and lifestyles.

Intermodal logistics solutions
Combining transport of goods with all mobility modes ('cargo hitching').

Reduced logistics flows
Small-scale solutions (house and neighbourhood) for resources and waste, due to developments in 3D-printing, retail, urban farming and local goods storage.

Hybrid logistics solutions
Combining transport of goods and people with all modes ('hitching'), e.g. by using multifunctional drones, small (shared) vehicles or pipelines.

Solutions in circular economy
New solutions, e.g. up-cycling, aimed at ensuring constant high usability and value of products, components and materials.

Physical internet
Open logistics system based on physical, digital, and operational interconnectivity, through encapsulation, interfaces and protocols.

Demand-driven solutions
Engaged citizens increasingly demand sustainable, flexible solutions.

Personal influence
Social mechanisms, incentives and measures provide evidence of the consequences of people's choices and influences.

Self-improving communities
Communities create value by realising local and personal initiatives in which energy and mobility solutions are shared and exchanged.

New value systems
Attractive economic systems to enhance the creation of integrated mobility services and products.

The 'next economy'
The 'next economy' based on value models and integrated value for society at large.

Public living area
Redesign of urban areas to release infrastructure for other purposes.

Globalisation
Data privacy and legislation at a global level.

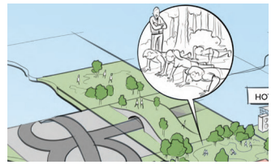
Total value
Data is valued based on 'value for society' instead of purely by economic value — this creates a level playing field for sustainable solutions.

2030 2040 2050

Desired future scenario

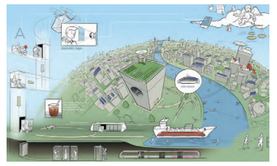
The Smart Mobility theme focuses on sustainable energy solutions for public and private transport and logistics. The ambition of the cities is to create attractive and clean public spaces and healthy, sustainable green environments that invite residents and visitors to walk or go by bike. Open data platforms, integrated systems and accurate multi-modal transport information provide personalised advice for seamless journeys, integrating sharing of sustainable vehicles and green public transport.

Sustainable solutions and lifestyles
- All systems use energy from renewable sources
- All modes of transport are sustainable (materials, zero-emission)
- Systems support users in making optimal choices (e.g. balancing costs, emissions, time and social aspects)
- Sharing of (autonomous) vehicles and rides
- Sustainable accessibility (e.g. for the elderly and disabled)



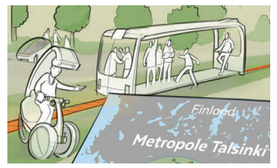
Healthy lifestyles
- Comfortable, accessible, high-quality living environment that encourages outdoor activities
- Green urban areas, safe areas and clean air
- Inviting people to spend time outdoors
- Healthy lifestyles with efficient activity levels

Reducing the need for travel
- Human scale urban planning: all daily needs are nearby
- Remote services (health, education, public services, working)
- Poly-centric cities with decentral service hubs
- Local production (food, 3D-printed goods)
- Smaller-scale ecological solutions (e.g. goods delivery)

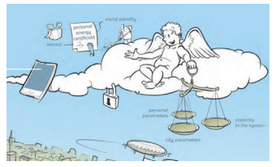


Seamlessly connected networks
- Networks for quick, easy access
- Smooth, seamless transport ('single route')
- Integrated system to provide 'door-to-door' service
- Integration of new modes of transport and innovative vehicles
- Smooth, seamless transition between (regional) networks

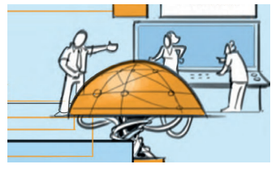
Mobility à la carte
- A wide range of (interconnected) alternative routes and modes of transport to suit different lifestyles
- Flexibility and freedom of choice
- An enjoyable and convenient travel experience
- Demand-driven diversity (blending public and private)



Accessible, affordable and convenient mobility
- All modes of (public) transport are safe, convenient, accessible, fast, flexible and affordable for all
- Convenient and easy-to-use ('one-click' reservation, flexible payment, pick-up/drop-off at any point)
- Easy transfer at intermodal transport hubs



Personalised advice
- Personalised travel advice based on factual, up-to-date information and personal needs at that moment
- Smart adjustments based on people's profiles and needs
- Accurate, up-to-date, real-time, cross-modal information
- Personalised advice accessible through multiple applications and devices



Smart management
- Smart traffic management based on real-time, cross-modal information, analysis and prediction
- Automated systems for smooth (public) traffic flows
- Communication between drivers, vehicles and infrastructure
- Safe and secure, in both the physical and virtual worlds

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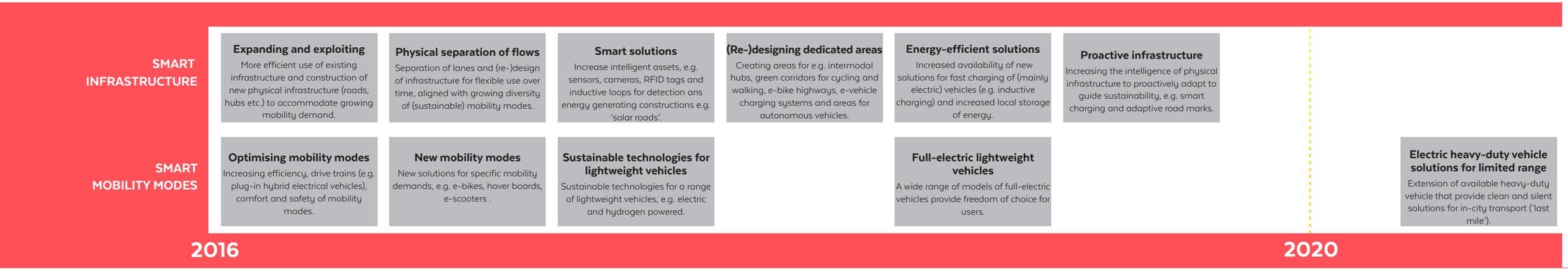


Smart Infrastructure

Short-term developments

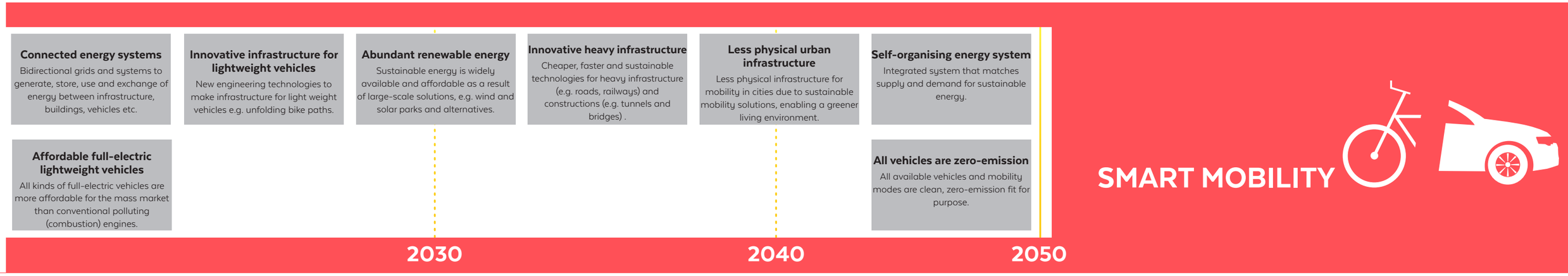
- In the short term, new infrastructure continues to be constructed (mainly outside the city centres), and current infrastructure is used more efficiently to accommodate the growing demand for mobility.
- Separation of lanes and (re-)design of infrastructure allows flexible use of infrastructure over time, aligned with growing diversity of mobility modes. In addition, the creation of new areas or the re-creation of existing areas allows for dedicated areas such as green corridors, e-bike highways and e-vehicle charging systems.
- More (fast) charging solutions and solutions for local energy storage are in place.
- The increase in intelligent assets allows for a more intelligent (proactive) infrastructure. Intelligent infrastructure could, for example, proactively drive sustainability in cities by guiding users of electric vehicles to charging stations or by automatically banning vehicles with high emission levels from city centres.

Mid-term developments

- Connected energy systems allow for the generation, storage, use and exchange of energy between infrastructure, buildings and other assets.
- New engineering technologies are in place to make lightweight infrastructure (e.g. unfoldable bike paths and footpaths).
- Sustainable energy is largely available in the medium term as a result of large-scale solutions such as wind and solar parks. The resulting abundant sustainable energy is affordable for all.

Long-term developments

- In the long term, new engineering technologies are in place to build heavy infrastructure. This results in cheaper, faster and more sustainable ways to build and maintain heavy infrastructure such as roads, railways and constructions such as tunnels and bridges.
- Finally, a wide range of sustainable mobility solutions, less physical infrastructure and an integrated energy system enable a greener living environment in which sustainable energy supply and demand can be organised efficiently.



Smart Mobility Modes

Short-term developments

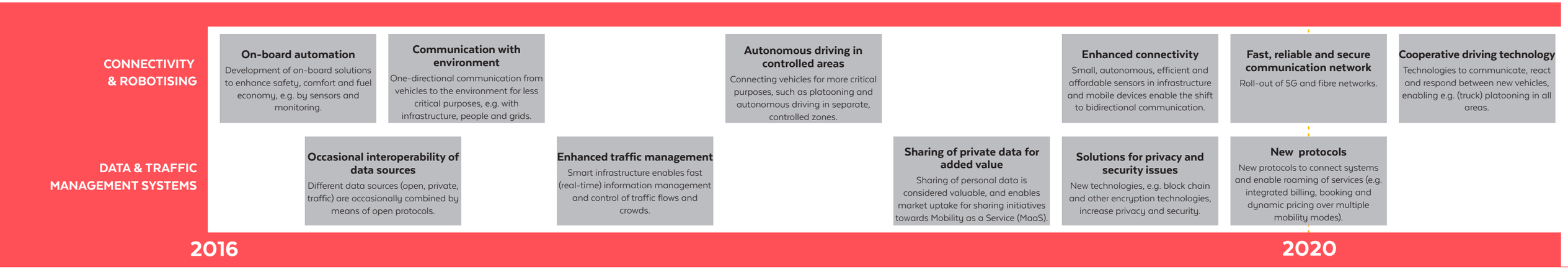
- In the short term there are incremental improvements in vehicle drivetrains, comfort and safety. As well as optimising current mobility modes, new mobility modes are also emerging as solutions for specific mobility demands, such as e-bikes, hoverboards and e scooters.
- Over time, but still in the short term, sustainable technologies enable a wide range of lightweight (electric or hydrogen-powered) vehicles. The range of lightweight vehicles is accompanied by increasing availability of full-electric vehicles, giving users freedom of choice.

Mid-term developments

- In the mid-term, a limited range of heavy-duty vehicles is available. More specifically, the available range of heavy-duty vehicles increases, providing clean and silent solutions for in-city transport.
- In addition to the developments in heavy-duty vehicles, all kinds of sustainable (mainly electric) vehicles are more affordable for the mass market than conventional, polluting vehicles. From this point on, the numbers of sustainable vehicles grow faster than the traditional, polluting vehicles.

Long-term developments

- In the long term, all available vehicles and mobility modes are clean, zero-emission and fit for their intended purposes. But it will still take a very long time before all vehicles on the road are clean and non-polluting.



Connectivity & Robotising

Short-term developments

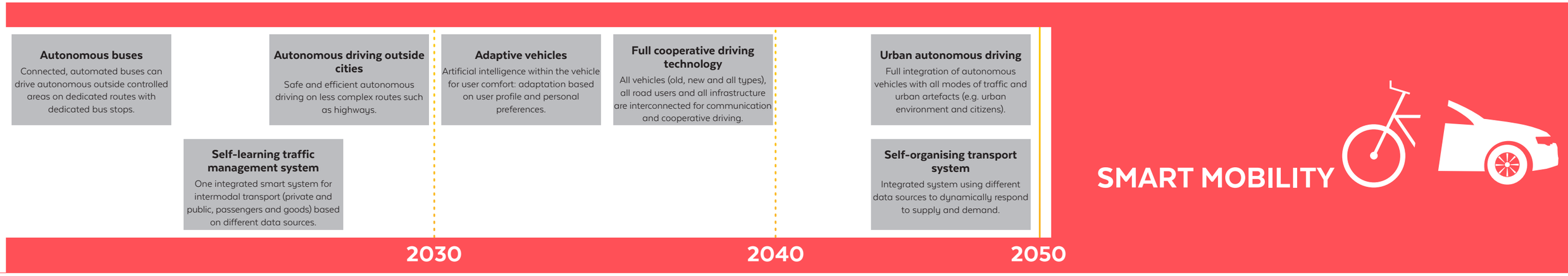
- Short-term developments in connectivity and robotising can first of all be relate mainly to in-vehicle automation and autonomous driving in controlled areas. This means that the development of in-vehicle solutions enhances safety, comfort and fuel economy, e.g. by means of sensors and monitoring. In addition, autonomous driving is possible in separate controlled zones.
- Secondly, short-term developments in connectivity and robotising are related to one-directional communication. Later in this period, enhanced connectivity enables a shift to bidirectional communication. More specifically, one-directional communication between vehicles and their environment shifts over time towards bidirectional communication. This will be enabled by efficient, affordable sensors in infrastructure and mobile devices.

Mid-term developments

- In the mid-term, the experts predict developments relating to the creation of a fast, reliable and secure communication network, enabled by the roll-out of high-speed 5G and fibre networks. In addition, cooperative driving technologies to communicate, react and respond between new vehicles enable forms of ‘platooning’ of vehicles in almost all areas. Autonomous buses and autonomous driving outside cities are expected to be possible (on a larger scale) by the end of the mid-term period.

Long-term developments

- Long-term developments in connectivity and robotising relate mainly to adaptive vehicles, full cooperative driving technology and finally autonomous urban driving. Artificial intelligence, fully interconnected and communicating vehicles (both old and new) and full integration of autonomous vehicles with other modes of traffic and urban infrastructure are some of the core aspects of these long-term developments.



Data & Traffic Management Systems

Short-term developments

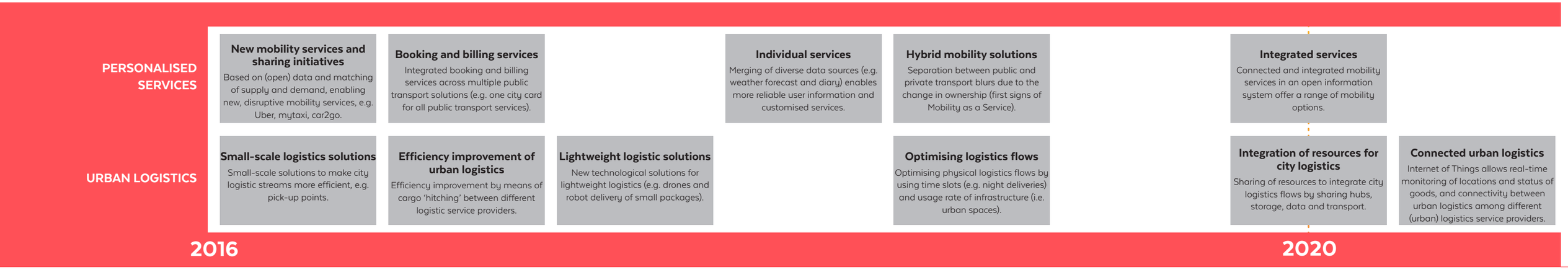
- In the short term, several main developments can be identified. The first developments relate to the interoperability of different data sources. The creation of a fully interoperable platform is perhaps the main challenge in creating complete, sophisticated data & traffic management systems. Currently open protocols allow different data sources to be combined and integrated on an occasional basis. This kind of occasional interoperability of multiple data sources continues to increase over time.
- Recognition of the value of data drives the market uptake of sharing initiatives towards Mobility as a Service. This valuing of data is already visible, but this development is likely to increase over time. In addition, the development of new protocols enables the interconnection of systems and roaming of services across multiple mobility modes. However, this requires new solutions to address privacy and security issues.
- Enhanced traffic management is already happening. The increasing amount of smart infrastructure speeds the potential of enhanced traffic management. Smart infrastructure also enables fast (real-time) information management and control of traffic flows and crowds.

Mid-term developments

- The development of new protocols is likely to increase over time, and this development also continues to intensify in the mid-term period, allowing an increase in the interconnection of systems and roaming of services across multiple mobility modes. Self-learning traffic management systems begin to emerge as a result of the enhanced traffic management system and the increase in connectivity. These integrated smart system allow the management of intermodal transport of passengers and goods, using different (secure) data sources.

Long-term developments

- The creation and use of a self-organising transport system is already possible and applicable within a (secure) small-scale environment. However, an integrated system that uses different data sources to dynamically respond to supply and demand of goods, services and passengers on a large scale is still some years away.



Personalised Services

Short-term developments

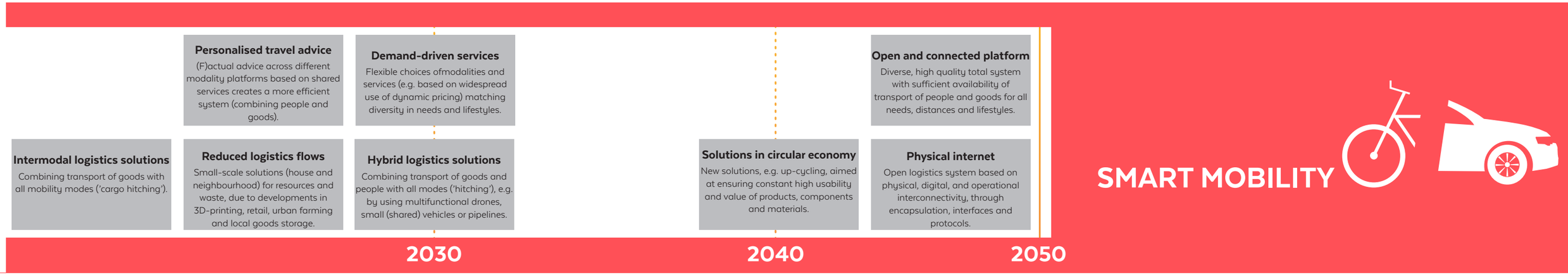
- In the short term, the number of new mobility services and sharing initiatives is likely to increase. This is mainly due to the increase in (open) data and matching of supply and demand, which enables new mobility services that could potentially disrupt the market. Integrated booking and billing services across multiple public transport solutions such as an a single city card for all public transport services, as well as individual, personalised services, enable more reliable and convenient services.
- By the end of the short term, at around the beginning of 2020, there is a shift from hybrid mobility solutions towards more integrated services. The separation of public and private also blurs over time, due to the change in ownership. In addition, connected and integrated mobility services in an open information system will offer a range of mobility options.

Mid-term developments

- New protocols to connect systems and enable roaming services allow better connected and more integrated services. Factual, up to date advice across different modalities and based on shared services creates a more efficient mobility system that combines services and the transport of goods and peoples. In the long term, this development results in demand-driven services.

Long-term developments

- In the long term, demand-drive services allow for flexible choices of modalities and services matching a wide range of needs and lifestyles. These demand-driven services are enabled by a fully open and connected platform. The result is a diverse and high-quality total system that offers sufficient capacity for all transport needs – for people and goods, for all distances and for all lifestyles. However, it will still take a couple of years and some conditions need to be met before all these services are available on a large scale.



Urban Logistics

Short-term developments

- In the short term, small-scale logistics solutions are further developed making city logistics flows more efficient, for example by using pick-up and drop-off points, and these solutions become more widely available. Efficiency improvements by means of cargo 'hitching' between logistics service providers and the development of new technological solutions for lightweight goods logistics are two developments that reach maturity and are ready for market uptake in the short term.
- Optimising physical logistics flows by exploiting time slots, for example night deliveries and higher usage of infrastructure such as urban spaces, have already been implemented on a local scale. By the end of the short term, these developments are widespread.

Mid-term developments

- The integration of resources for city logistics is a development that occurs by the end of the short term and in the beginning of the mid term period. Sharing of resources is more common and allows the integration of city logistics flows. The sharing of hubs, storage facilities, data and transport solutions is seen as a straightforward solution for urban logistics.
- In the mid-term the Internet of Things (IoT) allows extensive real-time monitoring of the locations and status of goods. In addition to real-time monitoring, IoT will allow increased connectivity of urban logistics among different service providers. The connectivity of urban logistics and the market uptake of Mobility as a Service allow intermodal logistics solutions, combining goods transport with all mobility modes (cargo 'hitching').
- Small-scale solutions (home and neighbourhood) for resources and waste resulting from developments in 3D printing, retail, urban farming and local goods storage allow logistics flows in urban areas to be reduced by the end of the mid-term period.

Long-term developments

- Hybrid logistics solutions are widely available, using all mobility modes to transport goods and people. These developments emerge in line with those already referred to in connectivity, personal services and data & traffic systems. Overall, the result is an open logistics system based on physical, digital and operational interconnectivity through embedded interfaces and protocols. These long-term developments are also known as the physical internet.
- Solutions in circular have the potential to disrupt urban logistics flows. New solutions, products, components and materials are designed to constantly maintain the highest value and efficiency.

Values, Motives & Behavioural Change

Short-term developments

- Values, motives and behavioural change are about the way citizens can play an active role in their own behavioural change, driven by different values and reasoning over time. In the short term, this is made possible by promoting bottom-up movements towards healthy behaviour and awareness, for example with education and incentives. The role of the media is crucial for people's values, motives and behavioural change relating to the use of smart, sustainable mobility solutions. Both traditional (critical) journalism and new (social) media are used in the short term to support and facilitate the transition towards a sustainable society.
- Small-scale initiatives for sustainable and cooperative solutions by individuals, communities and local business are more widespread in the short term. This develops in line with the encouragement of green behaviour so people choose more active mobility options (e.g. bikes or walking). For this purpose, the urban space is redesigned with more green, liveable and attractive areas.

Mid-term developments

- Mid-term developments show that people's thinking and reasons for travelling will change due to technological developments and MaaS (Mobility as a Service), which reduces the urge to travel and increases the choice of alternative ways of travel. The shift in people's thinking and reasons for travelling enables demand-driven solutions, in which engaged citizens increasingly demand sustainable and flexible solutions.

Long-term developments

- Social mechanisms, incentives and measures provide help to show people the consequences of their choices by the end of the mid-term and the beginning of the long term. By the end of the long-term period self-improving communities emerge. More specifically, in the long term these communities create value through local and personal initiatives to share and exchange energy and mobility solutions.

Demand-driven solutions
Engaged citizens increasingly demand sustainable, flexible solutions.

Personal influence
Social mechanisms, incentives and measures provide evidence of the consequences of people's choices and influences.

Self-improving communities
Communities create value by realising local and personal initiatives in which energy and mobility solutions are shared and exchanged.

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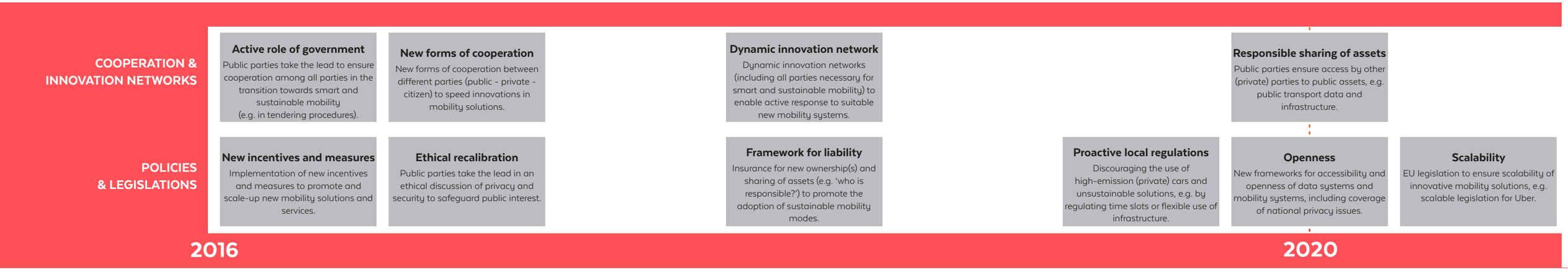
SMART MOBILITY



Cooperation & Innovation Networks

Short-term developments

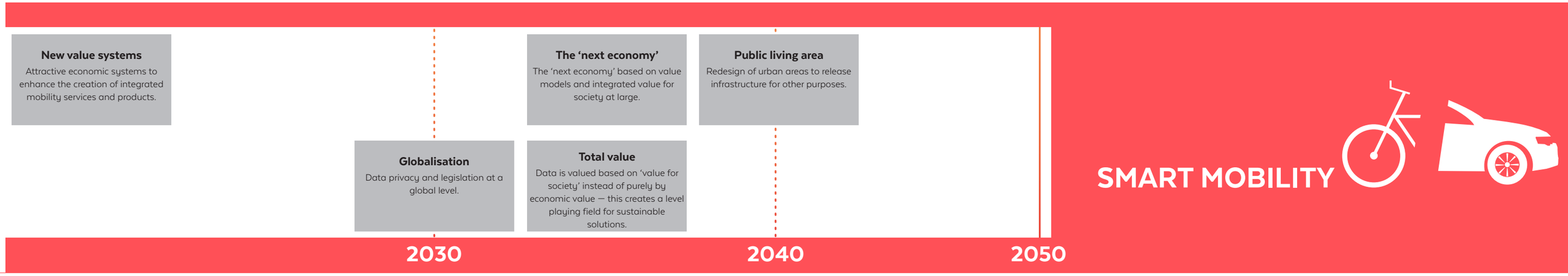
- Cooperation and innovation networks describe how new forms of cooperation between different types of organisations (public–private) evolve over time, speeding innovation and the roll-out of new mobility solutions. In the short term, public parties take active roles in ensuring cooperation between all those involved in the transition towards smart mobility; this is a trend that is already taking place. New forms of cooperation between the different parties – public, private and citizens – are established to speed innovation and the roll-out of new mobility solutions.
- Dynamic innovation networks, including all parties needed for smart mobility solutions, enable an active response to new mobility systems in the short term. Public parties play a leading role in this process by ensuring that other (private) parties have access to public asset such as data, transport data and infrastructure.

Mid-term developments

- As a result of the sharing of assets and other developments, a new value system emerges in the mid term. This is based on attractive economic systems that enhance the creation of integrated mobility services and solutions.

Long-term developments

- In the long term, expected developments relate to the 'next economy', based on value models and overall value for society at large. Finally in the long term, redesigned urban areas release infrastructure for other purposes.



Policies & Legislation

Short-term developments

- Legislative changes and the right polices are important factors in the developments relating to Smart Mobility. In the short term, the implementation of new incentives and measures is stimulated and new mobility solutions and services are scaled-up. In this phase, public parties play an important leadership role in the ethical discussion of privacy and security to safeguard public interest. Technological developments in data security are an important factor in allowing and enabling the discussion of ethical recalibration.
- Frameworks for liability continue to develop in the short term. The availability of insurance for new asset ownerships and sharing models drives the penetration of sustainable mobility modes and the shift towards Mobility as a Service. Proactive local regulation encourages the adoption of smart, sustainable mobility solutions. At the same time it discourages the use of polluting vehicles, for example by regulating time slots or flexible use of infrastructure.

Mid-term developments

- In the mid-term, there is more openness in terms of new frameworks for accessibility of data systems and mobility systems. The openness of these data and mobility systems takes into account national privacy issues. The way national privacy is handled, together with EU legislation, also enables the scaling-up of innovative mobility solutions, for example with scalable legislation for taxi services such as Uber.

Long-term developments

- Frameworks and long-term legislation at both national and EU level ensure global data privacy. In the long term, experts expect to see a total value system in which data is value for its societal benefits instead of purely in terms of economic value. This creates a level playing field for sustainable solutions.

R4E ROADMAPS FOR ENERGY®

SMART MOBILITY ROADMAP ISTANBUL - TRAFFIC MANAGEMENT

Sustainable technology

SMART INFRASTRUCTURE

Expanding and exploiting
More efficient use of existing infrastructure and construction of new physical infrastructure (roads, hubs etc.) to accommodate growing mobility demand.

Physical separation of flows
Separation of lanes and (re-)design of infrastructure for flexible use over time, aligned with growing diversity of (sustainable) mobility modes.

Smart solutions
Increase intelligent assets, e.g. sensors, cameras, RFID tags and inductive loops for detection ans energy generating constructions e.g. 'solar roads'.

(Re-)designing dedicated areas
Creating areas for e.g. intermodal hubs, green corridors for cycling and walking, e-bike highways, e-vehicle charging systems and areas for autonomous vehicles.

Energy-efficient solutions
Increased availability of new solutions for fast charging of (mainly electric) vehicles (e.g. inductive charging) and increased local storage of energy.

Proactive infrastructure
Increasing the intelligence of physical infrastructure to proactively adapt to guide sustainability, e.g. smart charging and adaptive road marks.

SMART MOBILITY MODES

Optimising mobility modes
Increasing efficiency, drive trains (e.g. plug-in hybrid electrical vehicles), comfort and safety of mobility modes.

New mobility modes
New solutions for specific mobility demands, e.g. e-bikes, hover boards, e-scooters .

Sustainable technologies for lightweight vehicles
Sustainable technologies for a range of lightweight vehicles, e.g. electric and hydrogen powered.

Full-electric lightweight vehicles
A wide range of models of full-electric vehicles provide freedom of choice for users.

MILESTONE 2020
People can make better travel decisions by taking advantage of in-car/mobile apps to get live, instant traffic information and route options. Road infrastructure has been redesigned to provide intermodal hubs, green corridors for cycling and walking, and e-vehicle charging points. Public bodies ensure cooperation of all parties in setting up a single transport authority for effective planning and coordination.

Electric heavy-duty vehicle solutions for limited range
Extension of available heavy-duty vehicle that provide clean and silent solutions for in-city transport ('last mile').

CONNECTIVITY & ROBOTISING

On-board automation
Development of on-board solutions to enhance safety, comfort and fuel economy, e.g. by sensors and monitoring.

Communication with environment
One-directional communication from vehicles to the environment for less critical purposes, e.g. with infrastructure, people and grids.

Autonomous driving in controlled areas
Connecting vehicles for more critical purposes, such as platooning and autonomous driving in separate, controlled zones.

Enhanced connectivity
Small, autonomous, efficient and affordable sensors in infrastructure and mobile devices enable the shift to bidirectional communication.

Fast, reliable and secure communication network
Roll-out of 5G and fibre networks.

Cooperative driving technology
Technologies to communicate, react and respond between new vehicles, enabling e.g. (truck) platooning in all areas.

DATA & TRAFFIC MANAGEMENT SYSTEMS

Occasional interoperability of data sources
Different data sources (open, private, traffic) are occasionally combined by means of open protocols.

Enhanced traffic management
Smart infrastructure enables fast (real-time) information management and control of traffic flows and crowds.

Sharing of private data for added value
Sharing of personal data is considered valuable, and enables market uptake for sharing initiatives towards Mobility as a Service (MaaS).

Solutions for privacy and security issues
New technologies, e.g. block chain and other encryption technologies, increase privacy and security.

New protocols
New protocols to connect systems and enable roaming of services (e.g. integrated billing, booking and dynamic pricing over multiple mobility modes).

PERSONALISED SERVICES

New mobility services and sharing initiatives
Based on (open) data and matching of supply and demand, enabling new, disruptive mobility services, e.g. Uber, mytaxi, car2go.

Booking and billing services
Integrated booking and billing services across multiple public transport solutions (e.g. one city card for all public transport services).

Individual services
Merging of diverse data sources (e.g. weather forecast and diary) enables more reliable user information and customised services.

Hybrid mobility solutions
Separation between public and private transport blurs due to the change in ownership (first signs of Mobility as a Service).

Integrated services
Connected and integrated mobility services in an open information system offer a range of mobility options.

URBAN LOGISTICS

Small-scale logistics solutions
Small-scale solutions to make city logistic streams more efficient, e.g. pick-up points.

Efficiency improvement of urban logistics
Efficiency improvement by means of cargo 'hitching' between different logistic service providers.

Lightweight logistic solutions
New technological solutions for lightweight logistics (e.g. drones and robot delivery of small packages).

Optimising logistics flows
Optimising physical logistics flows by using time slots (e.g. night deliveries) and usage rate of infrastructure (i.e. urban spaces).

Integration of resources for city logistics
Sharing of resources to integrate city logistics flows by sharing hubs, storage, data and transport.

Connected urban logistics
Internet of Things allows real-time monitoring of locations and status of goods, and connectivity between urban logistics among different (urban) logistics service providers.

Sustainable behaviour

VALUES, MOTIVES & BEHAVIOURAL CHANGE

Supporting sustainable and healthy choices
Promoting bottom-up movements towards healthy behaviour and awareness, e.g. through education and incentives.

Deployment through media
Traditional media (critical journalism) and social media are used to mediate in the transition towards a sustainable society.

Small-scale initiatives
Supporting initiatives by individuals, communities and local businesses for sustainable, cooperative solutions.

Encouraging green behaviour
Encouraging people to choose more active mobility options by (re-)designing the urban space with more attractive green areas.

Conscious decisions
People's travel reasons and purposes will change, reducing the urge to travel and increasing the choice to use alternative forms of travel.

Sustainable organisation

COOPERATION & INNOVATION NETWORKS

Active role of government
Public parties take the lead to ensure cooperation among all parties in the transition towards smart and sustainable mobility (e.g. in tendering procedures).

New forms of cooperation
New forms of cooperation between different parties (public - private - citizen) to speed innovations in mobility solutions.

Dynamic innovation network
Dynamic innovation networks (including all parties necessary for smart and sustainable mobility) to enable active response to suitable new mobility systems.

Responsible sharing of assets
Public parties ensure access by other (private) parties to public assets, e.g. public transport data and infrastructure.

POLICIES & LEGISLATIONS

New incentives and measures
Implementation of new incentives and measures to promote and scale-up new mobility solutions and services.

Ethical recalibration
Public parties take the lead in an ethical discussion of privacy and security to safeguard public interest.

Framework for liability
Insurance for new ownership(s) and sharing of assets (e.g. 'who is responsible?') to promote the adoption of sustainable mobility modes.

Proactive local regulations
Discouraging the use of high-emission (private) cars and unsustainable solutions, e.g. by regulating time slots or flexible use of infrastructure.

Openness
New frameworks for accessibility and openness of data systems and mobility systems, including coverage of national privacy issues.

Scalability
EU legislation to ensure scalability of innovative mobility solutions, e.g. scalable legislation for Uber.

2016 2020

LIGHT HOUSE

Connected energy systems
Bidirectional grids and systems to generate, store, use and exchange of energy between infrastructure, buildings, vehicles etc.

Innovative infrastructure for lightweight vehicles
New engineering technologies to make infrastructure for light weight vehicles e.g. unfolding bike paths.

Abundant renewable energy
Sustainable energy is widely available and affordable as a result of large-scale solutions, e.g. wind and solar parks and alternatives.

Innovative heavy infrastructure
Cheaper, faster and sustainable technologies for heavy infrastructure (e.g. roads, railways) and constructions (e.g. tunnels and bridges) .

Less physical urban infrastructure
Less physical infrastructure for mobility in cities due to sustainable mobility solutions, enabling a greener living environment.

Self-organising energy system
Integrated system that matches supply and demand for sustainable energy.

Affordable full-electric lightweight vehicles
All kinds of full-electric vehicles are more affordable for the mass market than conventional polluting (combustion) engines.

MILESTONE 2030
Istanbul has a smart traffic management system that integrates all publicly available mobility data collected from different sources to generate personalised travel advice. V2V/V2I systems enable a shift to bidirectional communication. Openness of data and mobility systems at national level results in new frameworks and personalised services. HOV lanes, walking and cycling options and low-emission zones help to optimise urban traffic flows.

All vehicles are zero-emission
All available vehicles and mobility modes are clean, zero-emission fit for purpose.

Autonomous buses
Connected, automated buses can drive autonomous outside controlled areas on dedicated routes with dedicated bus stops.

Autonomous driving outside cities
Safe and efficient autonomous driving on less complex routes such as highways.

Adaptive vehicles
Artificial intelligence within the vehicle for user comfort: adaptation based on user profile and personal preferences.

Full cooperative driving technology
All vehicles (old, new and all types), all road users and all infrastructure are interconnected for communication and cooperative driving.

Urban autonomous driving
Full integration of autonomous vehicles with all modes of traffic and urban artefacts (e.g. urban environment and citizens).

Self-learning traffic management system
One integrated smart system for intermodal transport (private and public, passengers and goods) based on different data sources.

Self-organising transport system
Integrated system using different data sources to dynamically respond to supply and demand.

Personalised travel advice
(F)actual advice across different modality platforms based on shared services creates a more efficient system (combining people and goods).

Demand-driven services
Flexible choices ofmodalities and services (e.g. based on widespread use of dynamic pricing) matching diversity in needs and lifestyles.

Open and connected platform
Diverse, high quality total system with sufficient availability of transport of people and goods for all needs, distances and lifestyles.

Intermodal logistics solutions
Combining transport of goods with all mobility modes ('cargo hitching').

Reduced logistics flows
Small-scale solutions (house and neighbourhood) for resources and waste, due to developments in 3D-printing, retail, urban farming and local goods storage.

Hybrid logistics solutions
Combining transport of goods and people with all modes ('hitching'), e.g. by using multifunctional drones, small (shared) vehicles or pipelines.

Solutions in circular economy
New solutions, e.g. up-cycling, aimed at ensuring constant high usability and value of products, components and materials.

Physical internet
Open logistics system based on physical, digital, and operational interconnectivity, through encapsulation, interfaces and protocols.

Demand-driven solutions
Engaged citizens increasingly demand sustainable, flexible solutions.

Personal influence
Social mechanisms, incentives and measures provide evidence of the consequences of people's choices and influences.

Self-improving communities
Communities create value by realising local and personal initiatives in which energy and mobility solutions are shared and exchanged.

New value systems
Attractive economic systems to enhance the creation of integrated mobility services and products.

The 'next economy'
The 'next economy' based on value models and integrated value for society at large.

Public living area
Redesign of urban areas to release infrastructure for other purposes.

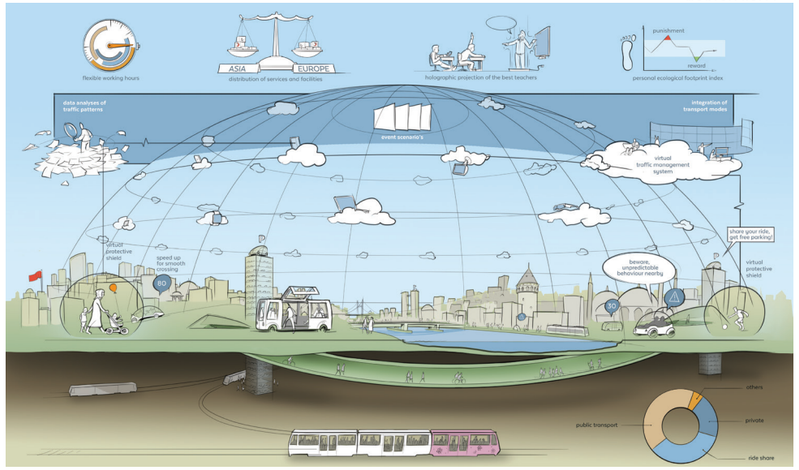
Globalisation
Data privacy and legislation at a global level.

Total value
Data is valued based on 'value for society' instead of purely by economic value — this creates a level playing field for sustainable solutions.

2030 2040 2050

Desired future scenario

ISTANBUL METROPOLITAN MUNICIPALITY



PERSONALISED, SMOOTH, SAFE TRAFFIC IN ISTANBUL 2050

In 2050, individual travellers in Istanbul are valued and facilitated by personalised travel advise. Smart technologies and apps enable personalised route planning. Communication between vehicles, drivers and infrastructure allows smart signalling. Green behaviour is encouraged by a range of personalised, sustainable options.

People value fast, smoothly flowing traffic, free from congestion. Automated systems support smooth traffic flows through the city. Mass transport solutions are attractive thanks to flexible charging and working hours. Alternative routes and transport modes are conveniently available. People value better air quality and choose healthier options such as walking and cycling.

Traffic is safe. Smart safety measures help to avoid accidents and traffic violations. Vehicles are equipped with smart solutions and options to communicate, both with other road users and with the infrastructure.

Elements of the desired future scenario are:

Smart traffic management system

All traffic in Istanbul is managed through a single, safe, reliable and efficient system. The system connects all public and private vehicles, devices and road users and is accessible from anywhere. Data is collected to analyse the traffic movements and provide real-time (event-driven) smart traffic management.

Compact smart e-vehicles:

People make use of personalised services based on compact smart vehicles. Vehicles are sustainable (using recycled materials and with zero-emissions) and are charged at widely available charging stations using renewable energy sources. The service allows easy reservation, flexible payment and pick-up/drop-off at any point. Personal profiles (e.g. including a network of friends) and connection to the smart system provide routes and options to share rides with friends.

Strategic demand management

People travel less because high-quality services are available remotely. Remote health monitoring and preventive health services reduce the need to visit distant hospitals. High-quality training and education are available in all districts, for example through holograms of excellent teachers. Flexible school and working hours and relocation of offices spread the demand for travel. Ride-sharing and air-cargo drones reduce road traffic. Ride-sharing is safe and efficient thanks to easy reservation and accessibility (e.g. special, cheaper parking for shared cars).

Sustainable, healthy behaviour

Citizens have adopted healthy lifestyles. Activity levels are measured by wearable devices, and more walking is rewarded by privileged services. The use of private cars has been reduced. The new generation of people care about sustainability and use the system to make optimal choices (balancing costs, emissions, time, social aspects etc.).

The R4E project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 643337.

The cities plotted the presented current and future projects on a matrix, indicating when the result of the project would be visible in the city (horizontally) and the expected impact on the city, in terms of energy or emission (vertically).

The cities worked together on themes with a potential to become a programme of projects.

PROJECT PORTFOLIO

SMART MOBILITY

Project portfolio

The aim of Step 4 is to develop a portfolio of projects that the cities can work on – individually or jointly – and that help them to reach their desired future scenarios. The cities created an overview of running projects, and in a joint meeting they selected common ambitions that they all want to pursue. The new projects have to explore many new ways forward. This means that new project proposals are worked out in specific project plans, all relating to the learning opportunities between cities. The financial opportunities are also explored in this step.

Joint workshop

In a joint meeting in Newcastle the cities presented current projects and proposals for new projects based on their city-specific roadmaps. They held in-depth discussions to understand their shared and specific learning objectives and opportunities for joint projects.

First, the cities presented their projects and plotted them on a poster to show when the results will be visible in the city and how they will impact energy and emissions in the city. The picture at the left on the previous page shows the result of this first part of the workshop.

Secondly, a marketplace was held in which city representatives could put forward themes for further development into project portfolios. A theme is a challenge to become a smart city with the ability to grow into a project programme. The themes build on the running and new projects presented by the cities.

In the marketplace, each city took on the role of 'seller' of a theme and proposed it to 'buyers'. The buyers supported the themes, and were able to enrich them by 'negotiation' to include objectives which they considered important. If three cities 'bought' a theme, it was accepted. The marketplace resulted in 14 themes. Together it was decided to merge some of these themes. This left 10 themes for further elaboration in groups.

Thirdly, the cities worked in groups to elaborate the themes by describing their objectives, relevant projects and innovation opportunities. The resulting rich discussion combined the insights of all the experts, and built on the visions and roadmaps.

The groups then presented their proposals in a plenary session, after which all the cities described their learning objectives related to the themes.

Towards a project portfolio

The themes defined in the joint workshop will be further developed into project portfolios that contain local projects in the cities, but also joint projects, all forming part of the project portfolio. The project portfolios are not included in this report as they will not be made public.

Running Projects Smart Mobility Istanbul - Traffic management

1 IBB Navi

It is a mobile navigation application developed by IMM. Travelers can reach their destinations in shortest time by following the routes created using live traffic information in Marmara Region especially in Istanbul. People can see all public transportation options in Istanbul and choose the optimum routes offered by İBB Navi to reach their destinations. They will be able to see live traffic information along with live traffic camera views.

2 SMART PARKING SYSTEM

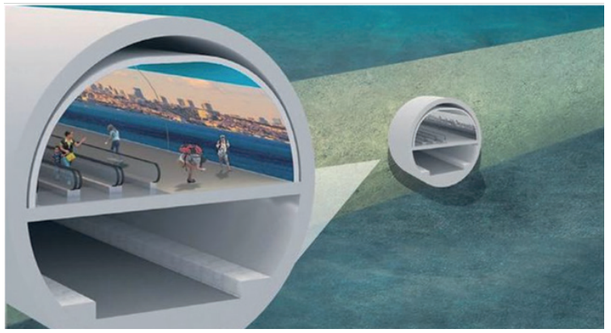
Smart Parking System is a LED-based dynamic parking lot information system developed by IMM's Department of Transportation. This system is used to provide real-time occupancy information of the closest parking lots to drivers on the roads. Parking lots' live occupancy information is displayed on LED screens and shown to drivers and it's updated 24/7 using live data transferred.

New Project Ambitions Smart Mobility Istanbul

SMART MOBILITY

1 ECOLOGIC TUNNEL UNDER BOSPHORUS

ISTANBUL METROPOLITAN MUNICIPALITY



This project will combine two continents (Asia and Europe) under Bosphorus. It will be two-storey tunnel; first floor will be dedicated for pedestrians and cyclists while the second floor will be dedicated for electric vehicles. Travelers will be able to cross between two continents by sustainable, ecologic tunnel. There will also be autowalk solutions for pedestrians within Istanbul's Ecologic Tunnel.

2 ELECTRICAL VEHICLE SHARING SYSTEM

ISTANBUL METROPOLITAN MUNICIPALITY

IMM will set up an electric vehicle sharing system in historic regions of Istanbul. This project will be integrated with existing public transport system in Istanbul and will help achieve IMM's ambition to have zero emission zones using sustainable electric vehicles in historic areas of the city.

3 EFFICIENT TRAFFIC MANAGEMENT SOLUTIONS

ISTANBUL METROPOLITAN MUNICIPALITY

To reduce the traffic congestion in Istanbul, IMM plans to deploy HOV (high occupancy vehicle) lanes and zero-emission zones in Istanbul. This project will help more efficient use of existing road capacity and healthier transport options to realize IMM's sustainable, green transport solutions/targets.

4 AUTONOMOUS ROAD INSPECTION SYSTEM

ISTANBUL METROPOLITAN MUNICIPALITY

This project will include an artificial intelligence software which runs in municipality's road inspection cars and will automatically identify missing, stolen, damaged traffic signs along with road markings which are deformed and non-functional. The software will detect all those cases and will automatically send them to IMM's control centre so that necessary field staff can be directed quickly.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SMART MOBILITY

The results in this project are co-created with many stakeholders in the cities. We would like to thank all participants for their valuable contributions.

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AMBITION, VISION & ROADMAP

SMART TRAFFIC MANAGEMENT ISTANBUL

D6.4 Final city report

This report contains the results of the ambition setting, vision development and roadmapping activities for smart mobility / smart traffic management in the city of Istanbul. Workshops were conducted with policy makers, strategy departments, integral project managers, department managers and external stakeholders and strategic partners to define a shared ambition, create a desired future scenario, develop a city specific roadmap and identify initial (local) solutions and research projects to achieve the desired future in the specific context of the city. The participants will continue working on the project portfolio.

This report is the final public deliverable of the Roadmaps for Energy (R4E) project. The R4E partners work together to develop a new type of energy strategy through visions and roadmaps for the 8 partners cities, in co-creation with local stakeholders. The project supports the development of visioning and roadmapping capacities within the municipalities to spur future development and implementation of innovative energy solutions.

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