

Horizon 2020

Societal Challenge: Improving the air quality and reducing the carbon footprint of European cities



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Full project title:

Integrated Climate forcing and Air pollution Reduction in Urban Systems

MS15 Evaluation of existing plans in cities

WP 6 Developing pathways to green, smart and healthy cities

Lead beneficiary: USTUTT



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1 Introduction and executive summary

ICARUS WP6 main objective is to develop visions of green cities with clean air, close to zero or negative carbon footprint and maximal wellbeing, as well as to develop a pathway for the realisation of these visions in the next 50 years and propose first steps down that road in the form of a concrete plan towards achieving these visions in the participating cities.

Despite the clear interconnections between Carbon Footprint (CFP) and Air Quality (AQ), policies to control GHG emissions and to improve air quality are still considered separately arriving often to contradictory results. ICARUS aims at developing an integrated approach to address simultaneously the needs for reductions in air pollution levels and CFP of cities and to identify the optimal combination of technical and non-technical measures with co-benefits in air quality and climate change mitigation.

The identification and evaluation of current plans and concepts for future urban areas is an important step towards the development of city-specific visions. Especially pathways towards green, healthy and smart cities should take the existing, short-term concepts and long-term visions within the respective city into account.

This document, therefore, aims to describe and evaluate the existing plans for the participating cities in ICARUS: Athens, Basel, Brno, Copenhagen, Ljubljana, Madrid, Milan, Stuttgart, and Thessaloniki. It gives a structured overview of recent plans and concepts addressing air pollution and climate change mitigation in the respective city. The concepts are then described with regard to their environmental objectives, covered sectors (e.g. households, buildings, transport) and the time horizon of the proposed measures or policies. The present status in the cities on establishing long-term visions and related implementation of changes is also provided. Based on these information one can examine, which city has a policy to get on the track for rendering the vision reality. The list of plans will be updated throughout the project lifetime as soon as new concepts are made public.

Furthermore, ambitious plans in other European cities are briefly described which can serve as a first starting point for further development of the ICARUS city visions.



2 Evaluation of existing plans in the 9 cities

This document will be used as a census of the existing plans of the participating cities in ICARUS (Athens, Basel, Brno, Copenhagen, Ljubljana, Madrid, Milan, Stuttgart, and Thessaloniki) that address air pollution and climate change mitigation at local and national level. The concepts with regard to the environmental objectives, the covered sectors (f.e. households, buildings, transport) and the time horizon of the proposed measures or policies constitutes a step forward to the development of smart, green and healthy city-visions. The table below summarizes the existing plans in ICARUS cities.

Table 1 Existing plans in ICARUS cities in regards to the sector covered and the time horizon of the measures/actions

Action Plans	Athens		Basel		Brno		Copenhagen		Ljubljana		Madrid		Milan		Stuttgart		Thessaloniki	
	2020/ 2030	2050	2020/ 2030	2050	2020/ 2030	2050	2020 2030	2050	2020/ 2030	2050	2020/ 2030	2050	2020/ 2030	2050	2020/ 2030	2050	2020/ 2030	2050
Air Quality Plan			√		√				√		√		√		√			
Climate Change Action Plan:	√		√	√	√		√	√	√	√	√		√		√	√		
Sustainable Energy Action Plan	√			√	√		√	√	√		√		√		√	√	√	
Sustainable Urban Mobility Plan- SUMP					√				√				√		√		√	
Noise reduction Plan											√				√			



2.1 Evaluation of existing plans in Athens/Attica

Several municipalities in Attica region have adhered to the Covenant of Mayors to join efforts on local climate and energy actions. Each municipality has developed the “Sustainable Energy Action Plan” focusing on actions at different sectors (buildings, transport and waste management) to address energy issues. The reduction target set in CO₂ is 20% up to 2020.

The City of Athens has adhered to Mayors’ initiatives such as the Compact and the Covenant of Mayors to actively join global efforts to mitigate climate change and reduce greenhouse gas emissions in the City. In the year 2017, the city presented the Climate Change Action Plan, developed in collaboration with the C40 Cities Network and the Resilience and Sustainability Office, consisting of two parts: the Part A “Mitigating Climate Change: reducing GHG emissions in the city of Athens” and the Part B “Climate Adaptation Strategy: making Athens a greener and cooler City”. The plan focuses on actions that aim at reducing energy consumption and related costs of municipal infrastructures, but also of the city overall, and mostly deals with short-term measures with a time horizon until 2020 and mid-term until 2030. For selecting the climate actions, the City of Athens was based on a greenhouse gas emissions inventory which was for the first time developed in 2015 and is GPC compliant. The reduction target set in GHG emissions is 40% until 2030. Athens is now fully compliant with the Global Covenant of Mayors for Climate and Energy¹.

The Athens Resilience Strategy up to 2030, developed with the support of 100 Resilient Cities – Pioneered by the Rockefeller Foundation –, presents a series of distinct, yet, connected actions with a clear vision of how the city can best cope with the increasing interdependency of shocks and stresses. The Strategy is framed in four pillars, 65 actions and 53 supporting actions. The Athens Climate Change Adaptation and Mitigation Action plan has been integrated in the Green Pillar of the Resilience Strategy and together with other existing operational plans will act as a holistic approach to make the city able to withstand climate change and environmental challenges.

At national level, the Greek Government, by adopting (Law 3851/2010) specific developmental and environmental policies, proceeded with the increase of its national goal (from 18% to 20%) regarding the participation of RES in gross final energy consumption [4]. This objective is composed of 40% participation of RES in electricity production, 20% in heating and cooling and 10% in transport.

The National Energy Strategy Committee elaborated an in-depth and long term analysis of the Greek energy system (three scenarios were examined evaluating alternative measures and policies for the fulfillment of national and European targets) in order to propose an Energy Road Map [5] of Greece for the period 2020-2050. Reducing dependence on imported energy, maximizing the penetration of renewables, achieving a significant reduction in emissions of carbon dioxide (CO₂) by 2050, and reinforcing the protection of final consumers are the main pillars of the national energy planning.

According to the revised National Waste Management Plan which is supplementary to the National Waste Prevention Strategic Plan (JMD 51373/4684/25-11-2015), the national policy on waste management is oriented to the following main targets for 2020: 50% of the aggregate Municipal Solid Waste to be prepared for re-use and to be recycled through separate collection of recyclables and bio-waste; and landfill to constitute only the final treatment option and to be limited to less than 30% of aggregate MSW quantities.

¹ <https://www.globalcovenantofmayors.org/cities/athens/>

Table 2 Existing plans for air pollution and carbon footprint reduction in Athens

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
Climate Change Mitigation Plan: Reducing GHG emissions /Athens Resilience Strategy for 2030	Climate Change	<u>Target:</u> 40% greenhouse gas emissions reduction (compared to 2014 when the first GHG Inventory was performed for the City)	<ul style="list-style-type: none"> Residential sector; national energy saving programs; use of natural gas; dedicated campaigns to raise citizens' environmental awareness, (28% reduction) Commercial and Municipal sector; energy upgrade of municipal buildings and public lighting; installation of PV; use of RES; promote nZEB (41% reduction) Transport; upgrading municipal fleet, promote eco-driving, SUMP (41% reduction). Solid Waste; organic waste diversion from landfills (100% reduction) Manufacturing Industries and Industrial processes (21% reduction) 	2030	City of Athens (relevant departments)
Climate Change Adaptation Plan /Athens Resilience Strategy for 2030	Climate Change	Increase the city's resilience and protect the citizens from the repercussions of increasing urban temperatures and heatwaves (On average, the period 2005-2014 Athens experienced 32 days per year with daily maximum temperature over 35°C)	<ul style="list-style-type: none"> Enhance green infrastructure in the city; create pocket parks, parklets, green and blue corridors, green roofs. Promote and establish sustainable water management in all urban green areas Use of bioclimatic design and sustainable materials in built environment. Regulate new pedestrian streets Awareness campaign #coolathens – TREASURE application; enhance network of municipal "Cool Centers"(increase of 25%); citizen and private sector engagement ; establish public water fountains (increase 20% 	2020 Short term / 2030 Mid term	City of Athens (relevant departments, platform partners)

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			access points to drinkable water)		
Climate Change Adaptation Plan / Athens Resilience Strategy for 2030	Air pollution	Enhance air quality in the City by 10% reduction in air pollutants concentration	<ul style="list-style-type: none"> • Development of Sustainable Urban Mobility Plan • Enhance use of Public Transportation • Low Emission Zone 	2030	City of Athens (relevant departments), Ministry of Environment and Energy, OASA
Athens Resilience Strategy for 2030	Climate Change	Establish sustainable and equitable energy system	<ul style="list-style-type: none"> • Promote renewable energy cooperatives 	2020 Mid-term	City of Athens, Ministry of Environment and Energy
Athens Resilience Strategy for 2030	Climate Change	Increase green infrastructure in the City	<ul style="list-style-type: none"> • Integrate natural systems into the urban fabric • Sustainable water management • Promote local culture • Engage citizens 	2020	City of Athens (relevant departments)
Athens Resilience Strategy for 2030	Air pollution	Promote sustainable mobility; Support and enhance natural environment; Promote residents' well-being and ameliorate their quality of life	<ul style="list-style-type: none"> • Transport: Sustainable Urban Mobility Plan; urban cycling plan (designed consistently with the Regional Cycling plan); increase pedestrian zones in the city; raising attractiveness of public transport 	2020 Mid-term	City of Athens (relevant departments)
Athens Resilience Strategy for 2030	Waste management	Establishment of a Resilient Waste management action plan	<ul style="list-style-type: none"> • Sustainable Waste management action plan • Circular economy 	2020	City of Athens (relevant departments)
Sustainable Energy Action Plans	Energy	Reduce CO ₂ emission by 20% until 2020	<ul style="list-style-type: none"> • Energy • Transport • Buildings • Renewable Energy Sources 	2020	Municipalities of Attica region



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
National Renewable Energy Action Plan (Directive 2009/28/EC)[4]	Renewable Energy	Target of a 20% share of renewable energy in the gross final energy consumption	<ul style="list-style-type: none"> Penetration of RES technologies in electricity production (40%), heating & cooling (20%) and transport (10%). 	2020	Ministry of Environment & Energy
National Waste Management Plan[6]	Waste management	Sustainable waste management	<ul style="list-style-type: none"> 50% of the aggregate Municipal Solid Waste to be prepared for re-use and to be recycled through separate collection of recyclables and bio-waste; Landfill to constitute only the final treatment option and to be limited to less than 30% of aggregate MSW quantities. 	2020	Ministry of Environment & Energy

References

- <http://www.100resilientcities.org/strategies/>
- <https://resilientathens.files.wordpress.com/2017/06/cap-part-a-mitigation-plan.pdf>
- <https://resilientathens.files.wordpress.com/2017/06/cap-part-b-adaptation-plan.pdf>
- <http://www.ypeka.gr/LinkClick.aspx?fileticket=CEYdUkQ719k%3D>
- <http://www.ypeka.gr/LinkClick.aspx?fileticket=Xm5Lg9NOeKg%3D&tabid=367&>
- <http://www.ypeka.gr/Default.aspx?tabid=238&language=el-GR>

2.2 Evaluation of existing plans in Basel

The city and canton of Basel has been very active in the energy field and sees itself as a pioneer on a number of levels, such as 100% renewable electricity production, strict regulations for new buildings, and a levy and an incentive tax on electricity. While several plans and concepts have been developed, a visionary plan with a long time horizon that includes all sectors and covers air pollution, climate change and health does not exist.



Overview: Since the year 1990 an air pollution plan is periodically produced. For each period the emissions are analyzed, implemented measures are assessed and if necessary new measures are proposed. The primary objective of the plan is to meet the regulatory limit of air pollutants. In the past decades there were several concepts focusing on energy and climate change aspects. A prominent plan is the “Vision: 2000-Watt-Gesellschaft”, a vision developed by Swiss Federal Institute of Technology in Zurich. The aim is to reduce primary energy output to an average of 2000 Watt per person by 2050. If implemented worldwide this target would make it possible to meet the 2°C climate change objective and ensure a sustainable energy supply. Basel adapted this vision as the first pilot region in 2001.

The most recent policy is the energy concept which was approved by the cantonal parliament in 2017. It only focuses on CO2 reduction and does not include mobility. The goal is to reduce CO2 emissions to 1tonne per person by 2050 and increase the percentage of renewable energy to 90% of the total energy. Short- and medium-term measures were implemented with the concept.

The most relevant policies, visions and concepts for Basel regarding air pollution and climate change are listed in **Table 3**.

Table 3 Existing plans for air pollution and carbon footprint reduction in Basel

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
2000-Watt-Gesellschaft, Pilotregion Basel (2001) (vision energy consumption)	Climate Change	Reduce primary energy consumption to 2000 Watt per person	<ul style="list-style-type: none"> ▪ Energy saving and efficiency ▪ Transportation: fleet composition, mileage, behavioral changes ▪ Sustainable urban development 	2050	Canton of Basel-City, Amt für Umwelt und Energie, Industrielle Werke Basel, Novatlantis ETH, FHNW
Kantonales Energiegesetz (energy concept)	Climate Change, focus on energy	<ul style="list-style-type: none"> ▪ Limit CO2 emissions to 1t CO2 per year and person, increase renewable energy to 90% of the total energy by 2050 ▪ District heating up to 80% CO2-free 	<ul style="list-style-type: none"> ▪ Energy production, saving and efficiency ▪ Buildings 	2050/ 2020	Canton of Basel-City

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		(waste and wood only) by 2020 <ul style="list-style-type: none"> ▪ Maintain electricity 100% renewable 			
Gegenvorschlag zur Städte-Initiative (2010) (popular initiative on traffic reduction)	Air Pollution	Reduce traffic by 10% by 2020 (starting in 2010, highways are not included).	<ul style="list-style-type: none"> ▪ Transportation 	2020	Canton of Basel-City
Luftreinhalteplan beider Basel 2016 (air quality plan)	Air Pollution	Durable Improvement of air quality	<ul style="list-style-type: none"> ▪ Buildings/Households ▪ Transportation ▪ Industry 	-	Canton of Basel-City, Canton of Basel-Country, Lufthygieneamt beider Basel.

2.3 Evaluation of existing plans in Brno

The city of Brno has been working over the past years on different plans and visions in order to improve air quality and to reduce greenhouse gas emissions in the city. These plans are focusing on different aspects: e.g. air quality, sustainable mobility, waste management, and are summarized in Table 4.

Two different plans exist in Brno concerning the air quality: the plan for improving air quality (PIAQ) and the action plan for improving the air quality (APIAQ). While the PIAQ was developed in 2012 and the actions described in it are planned within the semi long-term, APIAQ is a short term policy plan (i.e. 2020), which is re-evaluated every year. The aims of these plans are similar, i.e. actively reducing air pollution under the statutory legal limits and



raising the public awareness of health protection. In comparison to PIAQ, APIAQ identifies the specific competencies and the responsibilities for implementing these measures up to the level of individual departments of the municipality, as well as it determines the different steps and related deadlines for the fulfillment of the different measures. Given that transport is estimated to be the main source of air pollution in Brno, many measures from the APIAQ were interconnected with those from the Sustainable Urban Mobility Plan (SUMP), which build on the vision of the development of urban mobility, approved by the Council of Brno on 8/03/16. This SUMP aim at seeking and finding the potential of sustainable urban transport services with the help of citizens, urban, regional and state authorities.

In addition, in 2017, the city of Brno joins the Covenant of Mayors for Climate and Energy which aim at reducing CO2 emissions by at least 40% by 2030 and at increasing its resilience by adapting to the impacts of climate change. In order to reach these goals, the city of Brno will realize a Sustainable Energy and Climate Action Plan (SECAP) by June 2019. Moreover, in 2016, the city of Brno stated its principles regarding the development of adaptation to climate change, which is mainly related to the water sustainability and to the reduction of heat while the measures concerning the air quality are described in the PIAQ. At the current state, there no exists in Brno some plans or policies related to air quality and climate change that are looking at the long-term (i.e. 2050). However, since March 2017, the city of Brno is currently working on its Strategy for 2050 (www.bрно2050.cz), which should be available by Autumn 2018.

Table 4 Existing plans for air pollution and carbon footprint reduction in Brno

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
Akční plán zlepšování kvality ovzduší (Action plan for improving the air quality) (2017)	Air pollution, climate change	<p>Main objective: Improving the air quality to achieve the legal limits until the year 2020</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ▪ Low emission zone ▪ Smog situation abatements ▪ Optimisation of the streets cleaning ▪ Optimisation of the grass cutting ▪ Increase of the vegetation cover ▪ Air quality protection within the procurements 	<ul style="list-style-type: none"> ▪ Transport: identification of targeted area based on modelling simulations, improvement of traffic control, establishment of a rapid information system and a complex system for smog situations, improvement of the efficiency of the cleaning vehicles, changes in the fleet composition, ▪ Energy saving and efficiency: improvement of the efficiency of the cleaning vehicles, ▪ Sustainable urban development 	2020 (re-evaluated every year)	DoE, DoT, CDV, ME, SFŽP, CHMI, NIPH, DPMB, BKOM, city districts, VZMB, DoO, DoI, KŽP, KI, DoCI, DoYS



		<ul style="list-style-type: none"> ▪ Improvement of the communication (web) regarding the public awareness on air quality ▪ Improvement of the waste management system ▪ Improvement of the ventilation system within municipal buildings 	<ul style="list-style-type: none"> ▪ Citizens involvement (https://www.brnenskeovzdusi.cz/) ▪ Waste management (Compost bonuses for city gardeners, city-wide interdiction for incineration activities during the weekend) ▪ Households/buildings 		
Plán udržitelné mobility města Brna (Plan for the sustainable mobility in the city of Brno) (2017)	Air pollution, climate change (noise)	<p>Main objective: Seeking and finding the potential of sustainable urban transport services with the help of citizens, urban, regional and state authorities</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ▪ Improvement of the parking policy regarding air quality ▪ Evaluation of the feasibility of the electro-mobility ▪ Reduction of the emissions due to the municipal fleet ▪ Increase the use of public transportation: quantifiable target: >80% satisfied customers and >52% use in public transportation ▪ Development and support of cycling activities ▪ Reduction of the number of cars per households, quantifiable target: 20% reduction ▪ Development of the regional 	<ul style="list-style-type: none"> ▪ Transport: emission-related parking prices, development of electric vehicles for different municipal institutions, changes in the fleet composition, development of the public transport system, improvement of the cycling infrastructure, development of car-pooling and car-sharing infrastructures, improve the availability of trains, ▪ Sustainable urban development: smart navigation system, ▪ Citizens involvement: motivating citizens to use public transportation and cycles instead of personal car ▪ Energy 	2020/2030/2050	DoE, CDV, SFŽP, ME, ZOO, VZMB, PHSmB, DoIA, DoFB, relevant city companies



		<p>trains, quantifiable target: Increase of 20% compared to 2014 of the transport uses compared to the individual car transportation on reference routes</p> <ul style="list-style-type: none"> ▪ Reduction of the emission of GHGs, quantifiable target: four times lower emissions in 2050 compared to 2010 or 1 tonne of CO2 eq. reduction per person per year ▪ Shift of the distribution of transport towards higher usage of sustainable transport (i.e. bikes, pedestrians, public transport) 			
<p>Program pro zlepšení kvality ovzduší statutárního města Brna (Plan for improving the air quality) (2012)</p>	<p>Air pollution</p>	<p>Main objective: Improving the air quality to achieve the legal limits Specific objectives:</p> <ul style="list-style-type: none"> ▪ Improvement of the boiler usage, quantifiable target: limit emission factor for NOx of 70 mg/kWh ▪ Improve the ecological impact of the public transportation ▪ Reduction of the heat losses in distribution networks ▪ Reduction of the erosion due to unpaved and grassless surfaces, quantifiable target: number of m2 of unpaved and 	<ul style="list-style-type: none"> ▪ Energy: Usage of newer boilers with lower emission factors ▪ Transport: changes in fleet composition ▪ Sustainable urban development 	<p>From 2012</p>	<p>DPMB, heating plants of Brno, VZMB</p>



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		grassless surfaces			
Sustainable Energy and Climate Action Plan (SECAP) (2019)	Climate change (adaptation and mitigation measures)	Main objective: Reducing CO2 emissions by at least 40% by 2030 and increasing its resilience by adapting to the impacts of climate change	All sectors except industry sector	Action plan will be finished in June 2019.	DoE, DoT, ME, DoI, BKOM, DPMB, Author of Action plan (not yet known)
Zásady pro rozvoj adaptací na změnu klimatu ve městě Brně: s využitím ekosystémově založených přístupů (Principles for the Development of Adaptation to Climate Change in the City of Brno: Using Ecosystem-Based Approaches) (December, 2016)	Adaptation of cities to climate change	This plan is related to the water sustainability and reduction of heat. Other parts of this plan like implementations for city greenery are also included in the, already described Air Quality plan	<ul style="list-style-type: none"> ▪ Energy ▪ Transport ▪ Sustainable urban development ▪ Infrastructure 	2016-2050	UrbanAdapt project (http://urbanadapt.cz/cs), finished in 2016. Project results used in Strategy for Brno 2050

Abbreviations: DoE (Department of Environment), DoT (Department of Transport), CDV (Centre for Traffic Research), ME (Ministry of Environment), SFŽP

(State Fund for Environment), **CHMI** (Czech Hydrometeorological Institute), **NIPH** (National Institute for Public Health), **DPMB** (Brno Public Transportation), **BKOM** (Brno road transportation company), **VZMB** (Public Greenery City Company), **DoO** (Department for Organisation, ORGO), **DoI** (Department of Investments), **KŽP** (Environment Committee), **KI** (Committee for Investments), **DoCI** (Department of City Informatics), **DoYS** (Department of Youth and Sports), **ZOO** (Zoological garden), **PhSmB** (Funeral and cemetery services of the city of Brno), **DoIA** (Department of Internal Affairs), **DoFB** (Department of Financing and Budget), **SAKO Brno** (Waste management company owned by the city of Brno)

2.4 Evaluation of existing plans in Copenhagen

Table 5 Existing plans for air pollution and carbon footprint reduction in Copenhagen

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
Copenhagen Energy Vision 2050 (2015)	Energy	<p>General: short term: CO2-neutral energy supply in Copenhagen by 2025 long term: 100% renewable energies in Denmark by 2050, Copenhagen with key role</p> <p>Specific: 2020: 12% reduction of primary Energy supply (to 2006), 35% renewable energy of entire E.-System (incl. transport), 50% wind power, 10% biofuels or renewables in transport sector, 40% CO2-Em. Reduction (to 2006) 2030: No coal in E-System, No Oil in heat supply 2035: 100% renewable in E-</p>	<ul style="list-style-type: none"> • Electricity; • Heating and cooling; • industrial; • transport <p>Means: Local involvement; implementation of Smart Energy System; heat savings in buildings; large-scale heat pumps; flexible fuel-efficient power plants; low-temperature district heating; more public transport; electrification of transport sector</p> <p>Roadmap (initiatives starting by...): Today: The investments in heat savings; connection of new houses with district heating; decrease in the district heating temperature to low-temperature district heating; fuel savings in industry and electricity savings; Testing and demonstration of large-scale heat pumps for district heating; lowering the biomass demand through other sources such as industrial waste heat, waste</p>	short term 2020 and long term goals 2050	Project: City of Copenhagen, 4DH – 4 th Generation District Heating, Sustainable Energy Planning Research Group at Aalborg University



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		<p>and heating Sector 2050: 100% renewable (incl. transport & industry)</p>	<p>incineration, and geothermal sources; Demonstration of large-scale solar thermal resources; use of local or sustainable biomass resources, e.g., through certification is needed → Biomass certification; make a clear long-term plan for photovoltaic, onshore wind power and offshore wind power, and additionally make short-term implementation action plans; Transport planning and increased investments in public transport infrastructure; Less investment should be made in new roads; Implementing electric vehicles, Hybrid battery electric vehicles with simply range-extendors; Testing and demonstration of biomass gasification and electrolysis technology 2020-2030: Implementation of flexible power plants 2030-2050: Large-scale transformation in the transport sector; Implementation of Large-scale gasification of biomass, electrolysis for the production of hydrogen for hydrogenation and fuel synthesis plants</p>		

2.5 Evaluation of existing plans in Ljubljana

Table 6 Existing plans for air pollution and carbon footprint reduction in Ljubljana

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
Air Quality Plan for Ljubljana (Odlok o načrtu za kakovost zraka)	Air quality	Improve air quality – reduce PM10 <ul style="list-style-type: none"> - Reduction of the heating of residential and commercial premises in which liquid or solid fuels are used as energy products; - Use of fuel to heat rooms that release lower particulate emissions if they have this possibility; - Use of public transport; - Reduction of passenger cars use; - Reduction of exposure to air pollution by avoiding outdoor activities in cases of increased pollution. 	<ul style="list-style-type: none"> - Increased utilization and expanding district heating systems - Identification of possibilities and promotion of micro-systems for district heating - Increase in connecting facilities to the gas network - Further encouragement of the replacement of existing combustion units with more appropriate means - Advice for retailers to regulate low-pollution heating - Recommendation for ensuring the quality of wood fuels in small combustion units - Education and creation of a special website for the intelligent use of wood biomass - Recommendation on banning the use of coal in small combustion units - Conducting more rigorous monitoring of the burning of waste in small combustion units - Implementation of local energy concepts - Recommendations for informing and promoting the reduction of heat losses of buildings - Exact recording of small combustion units - Implementation an integrated transport strategy – SUMP - Increased share of walking 	3 years; 2020	City of Ljubljana



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<ul style="list-style-type: none"> - Increased share of bicycle use - Increased share of public transport use - Decreased use of personal cars - Promotion of the development and implementation of mobility plans and sustainable mobility - Decrease of vehicle speed on sections of motorways and express roads - Prohibition of heavy freight vehicles on the northern Ljubljana bypass - Control over vehicles with excessive emissions - Renovation of public passenger transport vehicle fleet - Renovation of utility vehicle fleet - Renovation of city administration vehicle fleet - Promotion of a safer driving techniques - Promotion of electromobility - Optimization of winter spraying and salting of roads - Recommendation for the enforcement of environmental management systems - Recommendation for reduction of fugitive emissions - Recommendation for the use of Best Available Technologies - Recommendation for the reduction of releasing dust from landfills, construction 		



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			sites and driving surfaces - Greening the city - Establishment of a special air quality website - Conduct a permanent cross-sectoral socio-economic analysis for the planning of measures - Education and awareness about the quality of ambient air - Reduction of fireworks use in the area of the municipality - Inclusion of air quality assurance in municipal legal acts		
Local energy concept for the City of Ljubljana	Energy	Basic Strategic Objectives: - 25% share of RES in end-use energy consumption in 2020 (EU - Climate Energy Package); - 20% improvement in energy efficiency by 2020 in relation to the expected use - reduction of GHG emissions by 20% by 2020 (EU - Climate Energy Package). -Effective energy planning at the local community level.	SPECIFIC MEASURES - Construction of a Gas steam unit (PPE) in district heating plant - Setting up of CHP - gas phase 2 for the district heating system after 2020 - Energy utilization of waste (WTE) - Replacement modernization of the top boilers in TOŠ - Reduction of heat losses in the district heating network (4% reduction losses), reducing the use of electricity for system operation - Extension of the district heating network and natural gas utilisation - Replacement of the energy source for heating of public buildings to natural gas or district heating system	Short term 2020	City of Ljubljana



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			- Promote EEU and RES measures in all segments of energy use		
SUMP – transport policy	Mobility	<p>SUSTAINABLE MOBILITY STRATEGIC GOALS</p> <p>The main objective of the municipality's transport policy is to redistribute the choice of means of transport in these shares by 2020:</p> <ul style="list-style-type: none"> • One third of all routes in the city should be made on foot and by bicycle, • One third of all routes in the city should be done by public transport and taxis, • One third of all routes in the city should be done with a passenger car. 	<p>PILLAR 1: More people walking</p> <ol style="list-style-type: none"> 1. Higher share and greater satisfaction of pedestrians in traffic at the level of the whole city. 2. Better access to the pedestrian zone. 3. A greater share of schoolchildren walking to schools. 4. Transformation of surfaces for pedestrians so that they are accessible and safe for all users. <p>PILLAR 2: More people cycling</p> <ol style="list-style-type: none"> 5. A higher proportion journeys done by bicycle. 6. Better access for cyclists. 7. Increased share of cyclists from neighboring municipalities. 8. Providing support infrastructure for cyclists. <p>PILLAR 3: Increased use of public passenger transport</p> <ol style="list-style-type: none"> 9. Change in travel habits - a higher proportion of passengers with PPP. 10. In the case of traffic jams - faster travel times of buses in comparison to passenger cars are guaranteed. 11. A faster and more comfortable trip to the destination without interchange. 12. Urban railway development on existing 	<p>Short/ mid term</p> <p>2020/ 2030</p>	City of Ljubljana



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<p>railway tracks. *</p> <p>13. Renewed Bus and Railway Station Ljubljana. *</p> <p>14. Easier to combine different types of traffic.</p> <p>15. Modern and environmentally-friendly bus fleet.</p> <p>PILLAR 4: Optimized motor traffic</p> <p>16. Less car journeys</p> <p>17. Less daily migrants who drive to work to the city.</p> <p>18. An effective parking policy.</p> <p>19. A renovation of roads and intersections for greater safety of cyclists and pedestrians and faster flow of PPP and passenger car traffic.</p> <p>20. Less pollution.</p> <p>21. Green urban logistics.</p>		
Municipal spatial plan of Ljubljana	Land-use planning	The main goal is to ensure the state of natural elements and processes (air, water, soil, biotic ingredients), which will place Ljubljana among the European cities with the highest quality of living.	<p>Concrete objectives/measures in the field of environmental quality are:</p> <p>1. reduce the impact of urbanization on climate change and adapt to climate change:</p> <ul style="list-style-type: none"> - to reduce greenhouse gas emissions from energy facilities (heating plant, fireplaces); - to reduce greenhouse gas emissions by reducing the need for personal transport and by promoting the use of public transport, cycling and walking, 	Mid/ long term 2030/ 2050	City of Ljubljana

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<ul style="list-style-type: none"> - promote the construction of energy-saving buildings, - to reduce the effect of the heat island by preserving uninhabited areas in the corridors of dominant winds and by preserving urban forest areas; 		

2.6 Evaluation of existing plans in Madrid

Air quality, energy and climate change policies and strategies have been traditionally treated in an independent and isolated manner. However, scientific studies and policy analysis showed that challenges linked to air pollution and climate change, need a joint treatment and a coherent and integrated management policy. As a result, ¹**Plan A: Air Quality and Climate Change Plan of the City of Madrid** (hereinafter Plan A), approved in 2017, encompassed as its hallmarks the strategic combination of air quality and climate change.

The first step of the *Plan A* structure is carry out the diagnosis of the current situation regarding contaminants, regulatory framework, physical and socioeconomic characteristics, among other issues. Air quality and pollutants and greenhouse gases emissions analysis and their contribution by sources are also scheduled. On the other hand, results obtained from the previous Air Quality Plan achieved during 2011-2015 period will be evaluated, and future scenarios developed under several hypotheses. Finally, measures are structured in different action programs: (1) sustainable mobility, (2) urban regeneration, (3) climate change adaptation, and (4) public awareness and collaboration with other administrations. Plan A also includes an impact analysis, as well as a monitoring and an evaluation plan. Two horizons have been considered in the Plan A timeframe: (1) short-term horizon, 2020 for the achievement of the air quality objectives required by the regulations, and (2) long-term horizon, 2030 for the energy transition and consolidation of the low emissions city model.

Other recent plans of special interest are ²*Plan for the sustainable use of Energy and Climate Change Prevention for the City of Madrid* (2014) and the ³*Action Plan on Acoustic Pollution of Madrid* (2011), are also detailed below:


Table 7 Existing plans for air pollution and carbon footprint reduction in Madrid

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
¹ Plan A: <i>Air Quality and Climate Change Plan of the City of Madrid</i> (2017)	Air pollution and Climate change	<p>SPECIFIC OBJECTIVES:</p> <ul style="list-style-type: none"> • Implement air quality legislation at European and national level. • Achieve particulate matter air quality levels according to the World Health Organization guideline values. • Reduce GHG emissions of Madrid by at least 40 % by 2030, compared with 1990 levels. • Fulfill the commitment to reduce 50% of GHG emissions caused by urban mobility in 2030, compared to 2012. • Develop an adaptation strategy to the effects of climate change, reducing urban vulnerability to the risks associated with global warming. 	<p>MEASURES:</p> <p>(1) Sustainable mobility:</p> <ol style="list-style-type: none"> 1. Zero Emissions Central Area. 2. Redesign the main traffic distribution routes and periphery-center connection. 3. Prioritization of pedestrian mobility. 4. Improvement and expansion of the bicycle network and mobility. 5. Extension of the public bicycle system and coordination with the system of the Madrid Regional Transport Consortium. 6. Parking regulation according to air quality criteria. 7. Speed limitation in metropolitan accesses and M-30 orbital motorway. 8. Intermodal parking network in the metropolitan crown. 9. Preferential routes and traffic light prioritization for buses of the Municipal Transport Company of Madrid. 10. Reserved infrastructure for public transport. 11. Expansion and renewal of the fleet of the Municipal Transport Company of Madrid: towards a low emission fleet. 12. Taxi: promote a switch to low emission vehicles. 13. Taxi service optimization according to environmental criteria. 14. Urban freight distribution: optimization of 	2020 & 2030	<ul style="list-style-type: none"> - Madrid City Council. - Madrid Regional - Transport Consortium. - Municipal Transport Company of Madrid. - Community of Madrid. - Spanish Government.



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<p>management reservations for loading and unloading on public roads.</p> <p>15. Urban freight distribution using low emission vehicles.</p> <p>16. Public-private collaboration in order to innovate and make urban logistics processes more efficient.</p> <p>17. Renovation of the vehicle park.</p> <p>18. Low-emission municipal service fleets.</p> <p>19. Sustainable work mobility plans.</p> <p>20. Recharge network for electric vehicles and supply of alternative fuels.</p> <p>21. Boost to the shared mobility initiatives.</p> <p>(2) Urban regeneration:</p> <p><i>(2.1) Low emissions and energy efficiency urban management</i></p> <p>22. Regeneration and rehabilitation of neighborhoods.</p> <p>23. Promotion of efficient low-emission air conditioning systems.</p> <p>24. Distributed generation and use of renewable energies.</p> <p>25. Reduction of emissions in waste management.</p> <p><i>(2.2) Energy management in buildings and municipal facilities</i></p> <p>26. Energy monitoring and consumption management of municipal facilities.</p>		

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<p>27. Interventions in buildings and municipal facilities.</p> <p>28. Incorporation of sustainability criteria in municipal contracting.</p> <p>(3) Climate change adaptation:</p> <p>29. Climate change adaptation.</p> <p>(4)Public awareness and collaboration with other administrations:</p> <p>30. Public awareness and collaboration with other administrations.</p> <p>IMPACT ANALYSIS:</p> <p>1. Atmospheric emissions effects.</p> <p>2. Impact on air quality levels.</p> <p>3. Impact on health.</p>		
<p>²Plan for the sustainable use of Energy and Climate Change Prevention for the City of Madrid (2014)</p>	<p>Climate change; focus on energy</p>	<p>STRATEGIC OBJECTIVES:</p> <ul style="list-style-type: none"> • Reduce GHG emissions of Madrid city by at least 35% by 2020, compared with 2005 levels. • Reduce the final energy intensity by 20%. • Generate 10% of the consumed energy in Madrid by the municipality. • Reduce the import of 	<p>MEASURES:</p> <p>(1)Energy supply and distribution:</p> <ul style="list-style-type: none"> - Supply of alternative and less polluting resources. - Efficient energy distribution systems. <p>(2)Energy supply and distribution:</p> <ul style="list-style-type: none"> - Provision of alternative and less polluting resources. - Efficient energy distribution systems <p>(3)Energy generation:</p>	<p>2020</p>	<ul style="list-style-type: none"> • Madrid Council

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		<p>petroleum products (excluding kerosene) by 20%.</p> <ul style="list-style-type: none"> • Increase the contribution of pedestrian and cyclist mobility and public transport in the modal split. • Reduce GHG emissions associated with road transport by 20%. • Reduce final energy consumption in the residential, commercial and institutional sector by 10%. • Encourage access to information, awareness and citizen participation, and training for municipal staff in the field of energy and climate change. • Reduce the vulnerability of the Madrid city to the effects climate change. <p>SPECIFIC OBJECTIVES:</p> <ul style="list-style-type: none"> • Reduce the final energy consumption in buildings and municipal facilities by 25%. • Increase the municipal energy 	<ul style="list-style-type: none"> - Distributed generation and renewable energy. <p>(4)Final energy consumption:</p> <ul style="list-style-type: none"> - Energy efficiency in building, planning and uses of public space. - Energy efficiency in buildings and municipal facilities. - Energy efficiency in mobility and transport. - Energy efficiency and environmental criteria in municipal contracting. <p>(6)Adaptation to climate change:</p> <ul style="list-style-type: none"> - Urban adaptation to climate change impact. <p>(7)Diagnostic and monitoring systems:</p> <ul style="list-style-type: none"> - Systematic monitoring of energy and climate variables. - Integration of information technologies and intelligent systems. 		



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		<p>production by 20%.</p> <ul style="list-style-type: none"> • Develop an infrastructure to supply alternative fuels and electric recharge for transportation. • Reduce the municipal fleet carbon footprint by 50%. • Encourage models of governance, management and local hiring that promote an efficient and responsible use of resources with environmental and energy criteria. • Develop tools and systems in order to obtain, analyze and access to the energy and emissions information of Madrid City. 			

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
³ Action Plan on Acoustic Pollution of Madrid (2009; 2011 updated)	Noise pollution	<p>OBJECTIVES:</p> <ul style="list-style-type: none"> • Reduce currently noise levels in order to decrease the number of people exposed to values higher than the limit specified in the acoustic quality objectives. • Preserve the acoustic environment in the quiet areas. • Strengthen the citizen information channels in order to provide the most recent information on issues related to noise. This measure will enable establishing mechanisms to encourage citizen collaboration to Manage Environmental Noise. 	<p>MEASURES:</p> <ol style="list-style-type: none"> 1. Awareness and education against noise pollution. 2. Sustainable mobility. 3. Actions to control noise caused by night entertainment. 4. Urban landscape actions. 5. Town planning. 	2015	Madrid Council

These plans are available at the Madrid City Council website:

¹ http://www.madrid.es/UnidadesDescentralizadas/Sostenibilidad/CalidadAire/Ficheros/PlanAireyCC_092017.pdf

² www.madrid.es/UnidadesDescentralizadas/Sostenibilidad/Espelnf/EnergiayCC/02PECCH/Ficheros/PECCH2020.pdf

³ http://www.mambiente.munimadrid.es/opencms/export/sites/default/calair/Anexos/Revision_Plan_Accion_Acustica.pdf

2.7 Evaluation of existing plans in Milan

Many policies briefly resumed in Table 8 envisage integration policies as win-win strategies to improve the air quality and carbon footprint in the city of Milan. The municipality launched several measures to face air pollution and traffic congestion including two innovative road price schemes applied to the



historical center, the first, started in 2008 and called 'Ecopass', based on the 'polluter pays principle', and the second and definitive scheme, launched in January 2012, called 'Area C', which combine a Congestion Charge scheme with the banning of the most polluting vehicles. Possible perspectives of road pricing schemes are going to be discussed in the Sustainable Urban Mobility Plan (SUMP) process, just started. The municipality of Milan, together with other major European cities, has developed a substantial effort joining some important agreements among which: (i) ICLEI's "Cities for Climate Protection" campaign (ii) Signed the "World Mayors and Local Government Climate Protection Agreement" (iii) Joined the "Covenant of Mayors" initiative, promoted by the European Commission. The adherence to these agreements testifies the willingness to implement mitigation goals and promote shared sustainable practices for climate change mitigation in the urban environment. Thus the municipality of Milan has adopted a Sustainable Energy and Climate Action Plan as a synthesis and framework for the goals it intends to fulfil within the European "20,20,20" package. It has to be highlighted that local plans mostly deal with short-term measures and policies with a time horizon until 2020.

There are some areas of deficiency for the future integration of air pollution and climate change policies. Firstly there is a scarce involvement of the private sector in the implementation of the policies designed by the municipal authorities. The absence of SME's in particular will affect the progressive success of integration policies by diminishing their sustainability over the long term. On the other side citizens participation in the development of policies is increasing: bottom-up approaches are essential not only to promote inclusiveness but also to foster a wider uptake of policy measures. The implementation of integration policies is a major challenge in the outskirts of the city of Milan: this is identified as a major drawback as the development of an efficient transportation system in the suburban areas allows for the full realization of the initiatives applied to the centre of the city. The development of an efficient and coherent transportation network in the neighbouring areas, is therefore identified as a priority. Knowledge and implementation of integration policies could be improved even if the municipality has developed very different policies and projects that take into consideration air pollution and climate change at the same time.

Table 8 Existing plans for air pollution and carbon footprint reduction in Milan

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
Ecopass (2008)	Air pollution and Climate change, (noise)	<ul style="list-style-type: none"> ▪ Reduce particulate matter emissions by 30% in the "Cerchia dei Bastioni" (city centre); ▪ Reduce the number of incoming cars by 10%; ▪ Boost the public transport system by reinvesting 	<p>Transport: Mobility and traffic management; raising attractiveness of public transport; reduced emissions from vehicular traffic at the urban level; detection of the number of transits in the city centre.</p> <p>Implementation of a more sustainable transportation plan with significant innovations (especially for the suburban neighbourhoods);</p>	2012 (followed by "Area C")	Municipality of Milan; Municipal Transport Company of Milan (ATM); Agency for Mobility-Environment-Territory (AMAT, a technical organization owned by the Municipality of Milan)

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		Ecopass charges to enter into the city centre.	improvement of the bus and tram transport system by investing on the traffic light system and by modifying some of the routes that connect the centre to the suburbs. Fleet composition, mileage, behavioral changes.		
Area C (2012)	Air pollution and Climate change, (noise)	a road pricing measure in order to improve life conditions of those who live, work, study and visit the city. "Area C" is the restricted traffic zone in the center of Milan (C as Cerchia Bastioni; more restrictive conditions than those under ECOPASS). <ul style="list-style-type: none"> ▪ to decrease vehicular access to the city centre and traffic congestion; ▪ to improve public transport networks; ▪ to reduce pollutant emissions caused by traffic and to reduce health risk related to air 	All the income from Area C are reinvested in projects for sustainable mobility, e.g.: new Park and Ride; Improvement of bike sharing system; Public transport (fleet renewal and increased frequency) index of congestion, parking occupancy, numbers of Metro passengers, the speed of public transport, number of tickets sold and the number of fines issued are some of most important indicators that are processed. <ul style="list-style-type: none"> • Traffic average reduction • Traffic average reduction outside Area C • Reduction in the numbers of most polluting vehicles • Increase of cleaner vehicles 	without a specific target year	Municipality of Milan; Municipal Transport Company of Milan (ATM); AMAT (a technical organization owned by the Municipality of Milan)



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		<p>pollution;</p> <ul style="list-style-type: none"> ▪ to increase the share of sustainable travel modes and to raise funds for its further development. 	<ul style="list-style-type: none"> • Increase in public transport running speed • Reduction in number of accidents • Reduction of emissions of pollutants from traffic in the Area C 'Cerchia dei Bastioni' 		
Smart City European Innovative Partnership of Smart Cities and Communities ,EIP-SCC. (2011)	Air pollution and Climate change; Energy consumption	<ul style="list-style-type: none"> ▪ improve urban life through more sustainable integrated solutions ▪ development of innovative solutions for major environmental, societal and health challenges facing European cities, through energy and transport management and ICTs ▪ EU's 20/20/20 climate action goals 	<ul style="list-style-type: none"> ▪ Energy saving and efficiency: reducing high energy consumption and green-house gas emissions. ▪ Transport: improve air quality and reduce traffic congestion. ▪ Sustainable urban development: Strategic Implementation Plan with policy recommendations, increasing the visibility of such policy options and enhancing their reliability. 	2020 mid-term goals and a vision of a future city	European Union; Municipality of Milan.
Sharing Cities, Horizon 2020	Energy consum	<ul style="list-style-type: none"> ▪ Involvement of citizens for the creation of 	<ul style="list-style-type: none"> ▪ Training / education: in order to boost citizens participation the municipality of 	2020 short-	City of Milan, London, Lisbon, Bordeaux,

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
(2016)	Air pollution.	<p>services aimed at sharing and integrating citizens into their neighbourhood.</p> <ul style="list-style-type: none"> ▪ improve the energy efficiency of building ▪ Mobility: new modes for shared mobility ▪ Milan, London and Lisbon are the part of a consortium that intends to adopt an innovative approach to respond to some main environmental challenges, mainly how to break down carbon emissions of buildings and how to improve air quality. ▪ development of a sharing platform for the management of data: a common standard to be applied to different cities as to ensure up scaling 	<p>Milan has developed a system encouraging good behaviours.</p> <ul style="list-style-type: none"> ▪ Energy efficiency: 25 thousands square metres have been chosen as a pilot case, for a total of 5 private and 2 public buildings. Development of a integrated energy management systems and 300 smart streetlights equipped with Wi-Fi sensors of various type along the streets of Milan. ▪ Transport: the project will provide citizens with 60 electric car-sharing vehicles, two car-sharing vehicles per apartment, 150 electric bicycles. These newly introduced means of transportation will create 14 new stations, 76 electric charging outlets, 125 smart parking bays, 10 shared electric vehicles reserved to the transportation of goods and cargo. ▪ Cross-cutting: 1. Aggregate demand and deploy smart city solutions; 2. Deliver common and replicable innovative models; 3. Attract external investment; 4. Accelerate take-up of smart city solutions; 5. Pilot energy efficient districts; 6. Shift thinking irreversibly to local renewable energy sources; 7. Promote new models of e-mobility; 8. Successfully engage with citizens; 	term goals	Burgas, Warsaw



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		and reliability	9. Exploit city data to maximum effect; 10. Foster innovation at local level, promote the creation of new businesses and jobs		
Urbact III - Boosting Social Innovation (2015)	Urban planning	<ul style="list-style-type: none"> ▪ Share experiences and pilot cases with other cities and to promote new sustainable solution. ▪ Improve sustainable urban strategies planning in cities. 	Capacity Building; City Management; Entrepreneurship & Small and medium-sized enterprises participation; Sharing Economy; Social Innovation	2018 short-term goals	European Union; City of Milan with other 11 European cities
Sustainable Energy and Climate Action Plan – PAES (2014)	Air pollution; Climate change; Energy	<ul style="list-style-type: none"> ▪ Reduce of 20% CO₂ emissions by 2020 (ref: 2005) 	Emissions have been partitioned in 4 main sectors: <ul style="list-style-type: none"> ▪ civil sector (direct emissions from combustion for space heating in residential buildings, tertiary and public buildings) ▪ energy sector (direct emissions from energy production in CHP plants and waste to energy plants located within city boundaries and indirect emissions attributable to imported electricity) ▪ transportation (emissions from public, private and freight transport) 	2020 short and mid term goals	Municipality of Milan



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<ul style="list-style-type: none"> ▪ industry and tertiary (emissions from industrial processes and non-combustion emissions of the tertiary sector) <p><u>Reduction measures</u></p> <ul style="list-style-type: none"> ▪ Transportation sector: further development of public transport; development of bicycle mobility; development of “car sharing”; development of “car pooling”; development of Demand Responsive Transport; Improvement of private cars’ efficiency; Other measures to reduce private car use; increase of motorcycle use in place of cars; freight transport management; Improvement of commercial vehicles’ efficiency; Improvement of public transport efficiency. ▪ Residential sector: Improvement of energy efficiency in existing residential flats; Improvement of energy efficiency in new residential flats; Boiler Fuel switch (from heating oil to natural gas); Energy saving and energy efficiency in end-uses (residential). ▪ Tertiary sector: Improvement of energy efficiency in existing commercial buildings; Improvement of energy efficiency in new commercial buildings; Energy saving and 		



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
			<p>energy efficiency in end-uses (commercial).</p> <ul style="list-style-type: none"> ▪ Public buildings (Municipality of Milan): Improvement of energy efficiency in existing municipal buildings; Energy saving and energy efficiency in end-uses (municipal buildings); Energy saving and energy efficiency in end-uses (public lighting). ▪ Energy Production: Improvement of efficiency in energy production; Photovoltaic solar power for building uses; District heating. ▪ Waste: Waste to energy plant connected with district heating. ▪ Agriculture and green areas: Conservation agriculture; Increase of public urban green areas (tree planting) 		
<p>Sustainable Urban Mobility Plan – PUMS (2015-2017)</p>	<p>Air pollution, Energy, Urban planning, noise pollution</p>	<ul style="list-style-type: none"> ▪ Ensure high accessibility, reduce dependency on private vehicles and redistribute space in favour of active mobility ▪ Reduce road accidents and barriers in access to mobility services, reduce 	<ul style="list-style-type: none"> ▪ Transports: pollution and noise abatement measures; road safety standards; car-use reduction actions; measures to encourage car pooling and car sharing; actions to reduce congestion; sustainable mobility across the metropolitan region; public transport quality and efficiency; integrated rail system and services; accessibility in new urban development; cycling commuting in the city; 	<p>2020 – 2030 short and mid term goals</p>	<p>Municipality of Milan</p>

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
	n	<p>the exposure to noise and air pollutants</p> <ul style="list-style-type: none"> ▪ Reduce air pollutants and greenhouse gases emissions ▪ Ensure economic balance to mobility system and internalise environmental, social and health costs 	<p>parking policies; smart mobility; urban freight logistics; city for all, city without barriers; better bike transport; better routes and connections for pedestrians</p> <ul style="list-style-type: none"> ▪ Information – training: information campaign targeted toward Milan residents and meetings between authorities, stakeholders, and citizens 		

2.8 Evaluation of existing plans in Stuttgart

In the past few years, several plans and concepts addressing air pollution control and climate change have been developed in the city of Stuttgart. All concepts have different thematic focuses like mobility or energy, and concentrate either on the air pollution or the climate change aspect of the considered sectors. The most recent and important plans are listed below (Table 9). The local plans mostly deal with short-term measures and policies with a time horizon until 2020 or until 2030. An exception is the energy concept (rough vision for 2050) and the project MASTERPLAN 100% Klimaschutz (100% climate protection). The project MASTERPLAN 100% not only shows the longest time horizon but also includes a strategic roadmap for an almost climate-neutral Stuttgart city until 2050 (95% greenhouse gas reduction in 2050 compared to 1990). It covers measures and policies on short-, mid-, and long-term implementation scales aiming to fulfill either a conservative trend or a more ambitious master plan scenario for 2050. However, even the ambitious city scenario and related long-term developments show rather a relatively moderate trend development of urban activities than a visionary redesign of the city. General trends like increasing digitalization and electrification are taken into account, but for example the implementation of autonomous vehicles is not considered. Only the mobility plans combine, to some extent, measures related to climate change and air pollution although the proposed measures of the other concepts often also affect both fields. The vision of a green Stuttgart should therefore include the integrated aspect of the traffic development and mobility plans regarding air pollution and greenhouse gas mitigation along with the long-term and inter-sectoral approach of the energy concepts (energy concept, MASTERLAN 100%). An ambitious vision for a future green and healthy Stuttgart addressing air pollution, climate change and human health at the same time does not yet exist.

Table 9 Existing plans for air pollution and carbon footprint reduction in Stuttgart

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved participants)
KLIKS Klimaschutz-konzept Stuttgart (1997) (climate protection concept)	Climate change	Limiting CO ₂ emissions to the “unavoidable limit”	<ul style="list-style-type: none"> ▪ Energy: renewables, public buildings, reducing the energy use and heat losses, energy consulting ▪ Transportation: fleet composition, mileage, behavioral changes 	(2005) 2010	City of Stuttgart; Amt für Umweltschutz; Heusch & Boesefeldt GmbH; Steierwald Schönharting & Partner GmbH
Fortschreibung Klimaschutz-konzeptes KLIKS (2007) (update of climate protection concept)	Climate change	Reference to EU goals: reduction of CO ₂ emissions by 20% until 2020 with 1990 as reference; no further aims described	<ul style="list-style-type: none"> ▪ Sustainable urban development ▪ Energy saving and efficiency ▪ Traffic development ▪ Soil and water protection ▪ Wastewater and waste management 	2010 forecast till 2020 short-term goals	City of Stuttgart; Amt für Umweltschutz
Verkehrsentwicklungs-konzept 2030 (2014) (traffic concept)	Air pollution and Climate change, (noise)	Preserve Stuttgart as attractive business location and dwelling place with high quality of living	<ul style="list-style-type: none"> ▪ Transport: Mobility and traffic management; raising attractiveness of public transport; better bike transport; better routes and connections for pedestrians 	2030 mid-term	City of Stuttgart; Public transportation corporations (SSB, VVS); Regional association Stuttgart (Verband Region Stuttgart VRS)
Aktionsplan: Nachhaltig mobil in Stuttgart (2016)	Air pollution and Climate change,	Improvement of livability in Stuttgart through: less air pollutants, less noise, less traffic jams,	<ul style="list-style-type: none"> ▪ Transportation: Inter-modality and networks; public transport; commuter transport; city-owned mobility; regional mobility; motorized individual transport; non-motorized transport; economic 	>2013; without a specific target	City of Stuttgart; Public transportation corporations (SSB, VVS)

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved participants)
(sustainable mobility in Stuttgart)	(noise)	less stress Quantifiable target: <u>20% less conventional passenger cars in the city of Stuttgart</u>	transport; public relations activities;	year	
Energiekonzept: Urbanisierung der Energiewende (2016) (energy concept)	Climate change; focus on energy	<ul style="list-style-type: none"> ▪ In <u>2020</u>: 20% reduction of primary energy consumption compared to 1990, 20% renewable energies ▪ In <u>2050</u>: Climate-neutral City Stuttgart → Reduction of primary energy consumption to 65% of 1990, covering remaining energy demand with renewables (milestones for 2030 and 2040) 	<ul style="list-style-type: none"> ▪ Municipal properties; ▪ Buildings, living, citizens; ▪ Industry and commerce; ▪ Transportation; ▪ Energy supply; ▪ Citizens and stakeholder involvement 	2020, rough vision for 2050 mid-term measures and goals	City of Stuttgart; Stadtwerke Stuttgart GmbH; EnBW; cooperative enterprise for gas and energy supply (Stuttgarter Netze Betrieb GmbH & Stuttgart Netze GmbH → 2019: only Stuttgart Netze GmbH); Energieberatungszentrum Stuttgart e.V. (EBZ); Industry, services and trade
Luftreinhalteplan (2017)	Air pollution	Durable improvement of air quality; meeting the <u>limit values for air pollutants given by the</u>	<ul style="list-style-type: none"> ▪ Transportation (wide range of measures), ▪ Households/ Buildings (very limited) 	2020/ 2021 short-term	Ministry for Transportation BW; LUBW; Regierungspräsidium

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved participants)
(air quality plan)		EU (Air quality directive 2008/50/EG);		measures and goals	Stuttgart; City of Stuttgart
Masterplan 100% Klimaschutz (2017) (master plan 100% climate protection)	Climate change	Climate-neutral city Stuttgart 2050: 95% greenhouse gas reduction compared to 1990	<ul style="list-style-type: none"> ▪ Manufacturing business; ▪ Commerce, trade and services ▪ Municipal properties; ▪ Private households; ▪ Transportation 	2050 long-term goals and a vision of a future city	City of Stuttgart; Fraunhofer institute for building physics (Institut für Bauphysik IBP); University of Stuttgart Chair for transport planning and traffic control systems

2.9 Evaluation of existing plans in Thessaloniki

Table 10 Existing plans for air pollution and carbon footprint reduction in Thessaloniki

Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
Sustainable Energy Action Plan	Energy	Reduce CO ₂ emission by 20% until 2020	<ul style="list-style-type: none"> • Energy • Transport • Buildings • Renewable Energy Sources • Waste management 	2020	Municipalities of Thessaloniki
Sustainable Urban Mobility Plan	Air quality	1. Increase/enhance the use of Public Transport (PT):	<ul style="list-style-type: none"> • Transport (wide range of measures): Mobility and traffic management; increase intermodality between public transport means; raising attractiveness and promotion 	2020	Thessaloniki Public Transport Authority (ThePTA), Thessaloniki Metropolitan Authority,



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		<ul style="list-style-type: none"> - Total PT ridership: +50% by 2020 - Average PT occupancy: +25% by 2020 - Average PT commercial speed: +25% by 2020 2. Decrease of car flows (in central area): <ul style="list-style-type: none"> - Off-street parking supply: -30% by 2020 - On-street parking supply: -30% by 2020 3. Growth of active transport (in centre area): <ul style="list-style-type: none"> - Walking share in modal split: +25% by 2020 - Cycling share in modal split: +15% by 2020 4. Pollution abatement <ul style="list-style-type: none"> - Decrease of pollutant emissions already 	<p>of public transport; integrated parking policy; increase transport by cycling and walking.</p>		<p>Municipalities of Thessaloniki</p>



Name of concept or plan (year)	Field	Primary objectives of the plan	Covered sectors (measures or impact analysis)	Time horizon	Institutions (editor and involved parties)
		measured in the area (SO ₂ , O ₃ , CO, NO ₂ , PM ₁₀ : -25% by 2020			
Thessaloniki Resilience Strategy for 2030	Air quality, Noise, Climate Change, Energy, Urban Planning	<ol style="list-style-type: none"> 1. Shape a thriving and sustainable city with mobility and city systems that serve its people. 2. Co-create an inclusive city that invests in its human talent 3. Build a dynamic urban economy and responsive city through effective and network governance 4. Re-discover the city's relationship with the sea - Integrated Thermaikos Bay 	<ul style="list-style-type: none"> • Transport • Buildings • Energy • Waste Management • Socio-economic • Industry • Culture • Environment 	2030	City of Thessaloniki, Metropolitan Development Agency of Thessaloniki SA.
National Renewable Energy Action Plan (Directive 2009/28/EC)[4]	Renewable Energy	Target of a 20% share of renewable energy in the gross final energy consumption	<ul style="list-style-type: none"> • Penetration of RES technologies in electricity production (40%), heating & cooling (20%) and transport (10%). 	2020	Ministry of Environment & Energy



3 On the road towards green and healthy cities in Europe – visions in other European cities

This chapter extends the scope from the ICARUS cities to other European cities. There are many visionary approaches for urban design in Europe. The following section gives an overview of some examples that might serve as a first orientation for developing long-term visions for the ICARUS cities.

Table 11 Existing plans for air pollution and carbon footprint reduction in other European cities

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
Copenhagen Energy Vision 2050	Energy	<p>General: short term: CO2-neutral energy supply in Copenhagen by 2025 long term: 100% renewable energies in Denmark by 2050, Copenhagen with key role</p> <p>Specific: 2020: 12% reduction of primary Energy supply (to 2006), 35% renewable energy of entire E.-System (incl. transport), 50% wind power, 10% biofuels or renewables in transport sector, 40% CO2-Em. Reduction (to 2006) 2030: No coal in E-System, No Oil in heat supply 2035: 100% renewable in E- and heating Sector 2050: 100% renewable (incl. transport & industry)</p>	<p>Means: Local involvement; implementation of Smart Energy System; heat savings in buildings; large-scale heat pumps; flexible fuel-efficient power plants; low-temperature district heating; more public transport; electrification of transport sector</p> <p>Roadmap (initiatives starting by...): Today: The investments in heat savings; connection of new houses with district heating; decrease in the district heating temperature to low-temperature district heating; fuel savings in industry and electricity savings; Testing and demonstration of large-scale heat pumps for district heating; lowering the biomass demand through other sources such as industrial waste heat, waste incineration, and geothermal sources; Demonstration of large-scale solar thermal resources; use of local or sustainable biomass resources, e.g., through certification is needed → Biomass certification; make a clear long-term plan for photovoltaic, onshore wind power and offshore wind power, and additionally make short-term implementation action plans; Transport planning and increased investments in public transport infrastructure; Less investment should be made in new roads; Implementing electric vehicles, Hybrid battery electric vehicles with simply range-extendors; Testing and demonstration of biomass gasification and electrolysis technology</p> <p>2020-2030: Implementation of flexible power plants</p> <p>2030-2050: Large-scale transformation in the transport sector; Implementation of Large-scale gasification of biomass, electrolysis for the production of hydrogen for hydrogenation and fuel synthesis plants</p>	Electricity; heating; cooling; industrial; transport



Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
<p>Smart city Wien</p> <p>Vision 2050 Roadmap for 2020 and beyond</p>	<p>Energy, climate change, city planning</p>	<p>2020: Reduction of CO2-Emissions per Capita by 21% (compared to 1990)</p> <p>2050: Reduction of CO2-Emissions per Capita by 80%; 50% renewable Energy of Gross domestic consumption; 60% final energy consumption reduction per capita (c. to 2005); Modal Split 86% not-MIT, 14% MIT (motorized individual transport)</p>	<p>City planning/development: Comprehensive consideration of solutions for the whole city for the definition and development of target areas of city development; planning of the overall infrastructure and traffic system based on the premise of highest energy efficiency and emission reduction; City district planning under energy (efficiency) aspects; addressing and mobilization of citizens to raise awareness of energy efficiency and climate protection; close and continuous coordination with the city and the surroundings for highest energy efficiency and climate friendliness; establishing a “nearly zero energy”-Standard by 2020; differentiated utilization of renewable energy sources in combination with buildings; zero emission provision of electricity, at least for housing technology demand, continued to household demand; raising the rates and quality of refurbishing for housing with high potential and cost-benefit (up to 3% of refurbishable housing by 2020); raising of refurbishing rate for non-housing (refurbishable) by 2% by 2030; considering shorter life cycles of many non-housing buildings it is to pay attention to significantly raise the demolition/ replacement rate to impede economically inefficient refurbishing; avoiding cooling buildings by AC</p> <p>Mobility: Usage of IT and communications technology for shortening routes; providing info systems for intermodal path chains and shortening mobility times; demand-orientated expansion of local public transport and complementary transportation; “recapturing public spaces” as a foundation for attractive routes and holding areas; encouraging the mixed usage in city areas and buildings; Setup of a flexible, intermodal, always available mobility services as foundation of public transport and new means of mobility; easy access to city mobility for all; strong networking and compatibility of different public and individual transportation; conversion to low-pollution, low-noise, energy- and resource efficient transport system; creation of more space in public areas for pedestrians and bikers by reduction of individual transports; Necessity of a mix of conventional and biofuels as propulsion for various types of hybrid cars as intermediate solution to even more environmentally friendly powertrains; Variety of electric cars fitting to their utilization; walking and biking as city friendly forms of mobility</p> <p>Usage of different energy forms: Creation of flexible, adaptive and future-robust energy</p>	<p>City planning/development; mobility; new building and refurbishing; Usage of different energy forms; change in mentality towards usage and consumption of energy</p>

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
			<p>infrastructure with current plants and grids as foundation; integrating various energy carriers (e.g. gas, electricity, heat, cold) in a unitary controlled smart grid; changing the user behavior by the means of in-time information (smart meter, smart home); integration of decentralized energy plants in the grid; deployment of highly efficient, smart energy technology; long-term grid security and security of supply; reduction of dependence on imports; Strengthen the usage of gas out of RE for electricity, heat, cooling by central or decentral CHP; establishing of the field synthetic gases; usage of gas out of RE for mobility; Usage of wind and water energy; accessing RE in the vicinity for Vienna; expansion of preemptive and ownership rights of suppliers; Forcing the usage of Solar energy, geothermal energy;</p> <p>Change in mentality towards usage and consumption of energy: Increasing the motivation and acceptance to promote energy saving measures; information and communication; creating a consciousness for energy and presenting alternatives; raising acceptance and understanding for energy saving technology; creating (financial) appeals for change; battling energy poverty</p>	
Delft smart city 2050	Energy	2050: "energy neutral" → No carbon emissions from fossil fuels within Delft's municipal boundaries; keen to ensure secure, affordable and clean energy supply	<p>Energy: 3 steps towards sustainability: 1. Conserve energy, 2. Reuse residual flows, 3. Sustainably generate to meet remaining demand; biomass</p> <p>Mobility: 3 steps: 1. Reduce → less mobility, through spatial planning and working (f.ex.) 2. Change → encourage people to switch to public transport, cycling walking, car sharing 3. Make more sustainable → encourage people to buy sustainable vehicles and fuels, like electric cars and green gas; make pollution modes of transport more sustainable (e. cars, e.g. park & charge)</p> <p>Heating: increase use of thermal grids/district heating, use of smart grid; solar heating</p> <p>Domestic (energy consumption): 1. Conserve → consumption awareness and insulation 2. Replace gas by residual and sustainable heat 3. Use of solar energy ALSO domestic consumption can be made largely energy-neutral if: 1. The potential of the thermal grid is used to the full 2. Any homes that are not connected to the thermal grid are insulated to</p>	Energy, mobility, heating, energy consumption (domestic/commercial)

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
			<p>energy label A standard 3. All homes in Delft are fitted with solar panels, but smart electricity grid required to match the supply and demand</p> <p>Commercial (energy consumption): 1. 2. 3. For sustainability → the same as domestic</p>	
<p>Milton Keynes Imagine 2050 Strategy</p> <p>2014</p>	Climate change	<p>Near zero carbon city with high quality of life for all by 2050 → near zero net carbon emissions</p>	<p>Buildings and energy: All new buildings built to zero carbon standard; existing buildings to near zero carbon standard; MKC leads by example using building stock; encourage use of the most efficient electric appliances; replace all use of fossil fuels by maximizing renewable energy use; maximum energy efficiency by district heating and CHP</p> <p>Travel: travel in MK will produce zero carbon emissions; reduce car use by encouraging cycling, walking bus and rail; increase use of low carbon vehicles; need to travel is reduced by better technology</p> <p>Waste & Water: 70% of domestic waste is recycled, with maximum 5% landfilled; maximise production of energy from waste; maximise non-domestic recycling; all collection vehicles to be low carbon; zero carbon water treatment; reduce water use to achieve no increase in total water consumption</p> <p>Smart city & Community: enable smart grid network data collection and public use of data; encourage/support projects, partnerships and new technologies; integration of services/networks e.g. public transport & energy; encourage/support community led initiatives e.g. energy education and energy production</p> <p>Green space & Food: urban and rural green space will be used more efficiently for leisure, food growing, biomass fuel and carbon storage; encourage local food production; encourage low carbon diets</p>	<p>Buildings & energy generation; travel; waste & water; smart city & community; green space & food</p>
<p>Vision 2050 Villach</p> <p>2012</p>	Energy	<p>2020 / 2050: Villach's vision can be expressed in terms of four central strategic mission statements:</p> <ol style="list-style-type: none"> 1. Villach combines life quality and innovation 2. The city of Villach sets 	<p>The roadmap indicates timeframes for the implementation of the following topics:</p> <ul style="list-style-type: none"> - Testbed for local RES - Social Acceptance - Financing Models - Regulation & Executive - Monitoring & Statistics - Research & Development 	<p>Buildings, Energy grids, alternative systems of supply and (waste?) disposal, mobility,</p>

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
		<p>priorities in an efficient usage of resources</p> <p>3. Villach is known for its exemplary energy efficiency</p> <p>4. Being an international benchmark the city of Villach attracts new enterprises</p>	<ul style="list-style-type: none"> - Education - Tools & Systems - Infrastructure - Customer Integration - Strategic Planning - Active Entrepreneurship <p>The Action Plan includes measures and demonstration actions for the time period 2012-2015:</p> <ul style="list-style-type: none"> - Mobility (e.g. Strategic Spatial Planning, Partner-Cities) - Buildings (e.g. Project "Building retrofit") - Energy Networks (e.g. Demo Project „Smart Grid“) - Communication (e.g. Stakeholder Dialog, Awareness Raising, Education) 	<p>communication and information</p>
<p>„Masterplan 100 % Climate Protection“ – Frankfurt am Main 2050</p> <p>2013</p>	<p>Climate change</p>	<p>100 % reduction of carbon emissions by 2050</p>	<p>Note that the study shows multiple different ways of achieving the goal and settles not on a clearly specified roadmap or the like. To account for this in the following the different scenarios for the different branches are listed. Further information on scenarios on the city as a whole can be found in the document provided by the link on the first page.</p> <p>Power: Benchmark scenario – Electrical power demand: In the tertiary sector, only half of the electrical powersaving measures are implemented; the employees at their workplaces have not been sensitised to the topic. For this reason, the savings are only around 10 %. In households, all appliances are replaced, but not with A+++ appliances. As user behaviour does not change, there are no further savings; overall the consumption in households drops by 18 %. Industry can retain the consumption level of 2010, but not reduce it. Overall the power demand drops by 7.3 %. Compared to the overall energy consumption of 2010, around 2.6 % of final energy can be saved.</p> <p>With-measures scenario – Electrical power demand: The tertiary sector fully exploits all power saving potential; furthermore, there are savings through altered user behaviour at the workplace. By 2050, the overall savings lie at 46 %. The electrical power demand can be reduced from 2,970 GWh (2010) to 1,603 GWh (2050). In</p>	<p>(Households), Power, heat, transport</p>

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
			<p>households, all the household appliances have been replaced by new A+++ appliances. The population has been sensitised to the rational use of power. Therefore around 58 % of the electrical power demand is saved: Consumption drops from 1,028 GWh to 432 GWh. Because industry has also implemented the proposals from the study, the electrical power demand is reduced by approx. 20 % from 2,582 GWh to 2,066 GWh. The total electrical power consumption of all three areas drops by 38 % to 4,080 GWh in the with-measures scenario. Demand increases due to the growing significance of electricity for heat and transport. In the heating sector, it is the large number of thermal pumps and power-to-heat applications; in the traffic sector, electric cars and hydrogen HGVs/vans dominate road transport in 2050. The expansion of underground, rapid-transit and regional trains as well as trams requires more electrical power. The associated increase totals 773 GWh.</p> <p>However, overall, the savings dominate by far: The electrical power demand in the year 2050 amounts to 5,140 GWh and thus lies around 22 % lower than in the initial year 2010.</p> <p>Heating: Benchmark scenario – Heat demand Residential and non-residential buildings in Frankfurt are not all upgraded. As in the tertiary sector, the rate lies at 50 %. The replacement of central circulation pumps by local speed-regulated pumps has not been carried out. In the industrial sector, only small efficiency measures are implemented, however, the heat demand has been kept constant. In households, the thermal heat demand drops by 35 %, in the tertiary sector by 45 %. The overall heat consumption declines by 25 % from 11,713 to 8,801 GWh. Compared to the overall energy consumption in 2010, final energy consumption in the heating sector drops by around 16 %.</p> <p>With-measures scenario – Heat demand By 2050, all residential and non-residential buildings in Frankfurt will have been retrofitted; circulation pumps will have been replaced. In the industry sector, heat demand is reduced through more efficient structuring of production and the exploitation of waste heat potential. Heat consumption in industry is reduced by 1,077 GWh to 3,230 GWh (25 %). Whereas heat consumption in the initial 2010 was almost evenly distributed across the three sectors, industry dominates in 2050 with a share of 62 %. Major savings are achieved in the tertiary sector. Here, through complete energy efficient</p>	

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
			<p>modernisation, replacement of circulation pumps, etc. heat consumption has been reduced by approx. 73 % from 3,576 GWh to 955 GWh. Households also save 73 % of heat consumption, which declines from 3,830 GWh to 1,034 GWh.</p> <p>Overall, heat consumption drops by 55 % to 5,219 GWh. Thus, between 2010 and 2050 it is possible to save around 6,483 GWh of heat.</p> <p>Transport: Benchmark scenario – final energy transport The final energy demand sinks by approx. 29 % (1,252 GWh) by 2050. The greatest potential saving (approx. 47 %) lies in MPT, as some users change over to alternative drive due to the rising petrol prices. In local public transport, the electrification of the bus fleet and more efficient engines result in a 20 % saving in final energy. Due to the increase in vehicle miles travelled, van and HGV traffic consumes 13 % more energy. Thus, in 2050, half the final energy consumption is accounted for by MPT, 43 % by the road haulage sector and only 7 % by local public transport. The consumption of petrol declines, but power demand rises by 13 %.</p> <p>With-measures scenario – final energy transport Electricity now accounts for 78 % of the final energy consumption (2010: 5 %). Petrol consumption sinks by 97 %, diesel consumption by 75 %. The hybrid vehicles in MPT, the busses in local public transport as well as HGVs and vans run on biofuel. The lion's share of savings is achieved in MPT (minus 2,475 GWh), as many travellers drive electric cars or use public transport. MPT now only accounts for 38 % of final energy consumption (previously 66 %). In local public transport, 90 GWh are saved by more efficient engineering and driver assistance systems. Its share in final energy consumption rises from 7 to 18 %. The largest energy demand now comes from the transport sector with 44 % (2010: 27 %). Here it has been possible to save 711 GWh.</p> <p>Overall, final energy consumption in the traffic sector has been reduced by 75 % in 2050. Instead of the previous 4,362 GWh now only 1,086 GWh are being consumed.</p>	
Helsinki-Urban Plan, Vision 2050	Urban Planning	Vision 2050: Helsinki will be an urban, rapidly growing rail transport network city with expanding central	Transport: The traffic vision stresses the crucial role of public transport and, especially, the light rail network. Commuter trains and the metro will offer fast rail connections between the central areas and other parts of Helsinki. The light rail network will complement this traffic system, making it a highly efficient network. The city will be concentrated along the	Transport, Urban Planning, Climatic



Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
		<p>areas coupled with other developing centers.</p>	<p>transverse traffic routes, the expanding centres and in what are currently highway-like areas.</p> <p>Economy: The business and centres theme depicts an internationally competitive, attractive urban area. High-productivity zones are concentrations of top business expertise, and their influence is felt in the success of the entire Helsinki area and Finland.</p> <p>Green and blue Infrastructure: The green vision emphasises the importance of Helsinki's proximity to the sea and that of its green spaces. The significance of green spaces is heightened in an increasingly dense city. In 2050, Helsinki will be a green-network city, in which green spaces, the sea and recreational services are easily available to city residents. Improvements to water traffic provide the opportunity to develop recreational and tourism services and other searelated lines of business. Seaside housing is also part of the future Helsinki. Different kinds of attractive housing experiments have been enabled in certain marine areas.</p> <p>Climatic Change Adaptation and Mitigation: The future city enables sustainable energy solutions, while also taking regulations and requirements pertaining to climate change control into account. Helsinki is committed to reducing its greenhouse emissions by 30% from the 1990 level by the year 2020. Helsinki is aiming to achieve greenhouse emission-free operations by 2050. The methods of city planning for reducing climate emissions include the densification of the city structure, promotion of sustainable transports, and the enabling of sustainable energy solutions in the city.</p> <p>Urban Planning: The majority of housing in Helsinki was located in the central areas as recently as the 1950s. Suburbanisation and the development of non-urban centres, which has taken place over the last decades, have significantly transformed the Helsinki region's structure and focal point, with the importance of the central areas and Helsinki's role diminishing, in contrast to the rest of the region.</p>	<p>Change, Infrastructure, Economy</p>
<p>London Infrastructure Plan 2050 (update March 2015)</p>	<p>Infrastructure</p>	<p>Vision 2050: London will be environmentally, financially, economically and socially sustainable and at the</p>	<p>Transport: Pollution levels will be very low. Ultra low-emission vehicles will be more widely used.</p> <p>Green Infrastructure: all new built developments will include more green cover, including greenways, pocket parks, roof gardens and green roofs and walls. A comprehensive network of greened cycle routes for all types of journeys and cyclists will be in place</p>	<p>Transport, Infrastructure, Energy</p>

Name of concept or plan	Field	Primary objectives of the plan	Means of achievement / Roadmaps / etc.	Covered sectors
		forefront of technology.	<p>Digital Connectivity: Digital connectivity is rightly considered the fourth utility. Vital for many businesses, access is also becoming essential for all citizens to take part in modern society.</p> <p>Energy: London’s energy infrastructure must supply energy securely and reliably, provide affordable and cost-competitive energy, and deliver an 80% reduction in carbon dioxide emissions by 2050, in line with Mayoral and national government policy.</p> <p>Circular economy: significantly reduce the amount of waste being disposed of, by helping London move towards a circular economy, where materials are reused, remanufactured or recycled rather than thrown away.</p> <p>Water: sustainably managing water security, quality, drainage, wastewater and flood risk will be considered.</p> <p>Housing and social Infrastructure: Housing, schools, hospitals and a whole range of social infrastructure will play a critical role in supporting London’s continued growth and sustainability. They need to be planned alongside other aspects of infrastructure, both to ensure that communities are liveable and that a comprehensive approach is taken when considering the funding and financing of the city’s infrastructure.</p>	
Paris Climate Action Plan			<p>By 2020, the city will accelerate the actions of the previous Climate Plan, reducing GHG emissions and energy consumption in Paris by 25% compared to 2004 levels and reaching a 25% share of renewable energy powering the city.</p> <p>By 2030, an operational action plan will be put in place to deliver the objective of reducing GHG emissions by 50%, reducing consumption by 35% and reaching a 45% share of renewable energy in the city.</p> <p>Finally, the goal for 2050 is to build a carbon neutral city, 100% reliant on renewable energy.</p>	

The information presented in Table 11 has been provided by the following online resources:

- Copenhagen Energy Vision 2050
summary: http://vbn.aau.dk/files/209592939/Copenhagen_Energy_Vision_2050_executive_summary.pdf
complete: http://vbn.aau.dk/files/209592938/Copenhagen_Energy_Vision_2050_report.pdf



- Smart city Wien – Vision 2050, roadmap for 2020 and beyond, action plan for 2012-15
<https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008218.pdf>
- Delft smart city <http://luzarchitecten.nl/sites/default/files/Delft%20Smart%20City%20final%20report.pdf>
- Barcelona towards energy self-sufficiency by 2050:
http://www.energie-cites.eu/db/Barcelona_100_RES.pdf
- Milton Keynes Imagine 2050 Strategy:
<https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=12&ved=0ahUKEwiH-LDt3KzYAhWD-gQKHQEIARsQFghkMAs&url=https%3A%2F%2Fwww.milton-keynes.gov.uk%2Fassets%2Fattach%2F21002%2FImagine%25202050%2520Strategy%2520Final%2520Draft.pdf&usg=AOvVaw1jENVLixp0obcKP Kss6NZ>
- Vision 2050 – Villach strives for innovative energy concepts:
<http://www.smartcities.at/assets/Projektberichte/Endbericht-Langfassung/BGR08-2012-K11NE2F00012-Villach-v1.0.pdf>
- Masterplan 100 % Climate Protection – Frankfurt am Main:
https://www.frankfurt.de/sixcms/media.php/738/170124_Masterplan%20Broschu%CC%88re_ENG_bf_pdfua.pdf
- HELSINKI CITY PLAN, Urban Plan – the new Helsinki city plan, Vision 2050:
https://www.hel.fi/hel2/ksv/julkaisut/yos_2013-23_en.pdf
- London Infrastructure Plan 2050 (updated version March 2015):
<https://www.london.gov.uk/what-we-do/business-and-economy/better-infrastructure/london-infrastructure-plan-2050>
- City of Paris, Plan Climat Air Energie territoriale, PCAET revised in 2017:
https://www.c40.org/press_releases/city-of-paris-passes-its-new-air-quality-energy-climate-action-plan



4 Conclusion

All participating cities in ICARUS (Athens, Basel, Brno, Copenhagen, Ljubljana, Madrid, Milan, Stuttgart, and Thessaloniki) show an outstanding environmental consciousness and have developed plans addressing climate and energy aspects as referred in the report. The local/regional policies and measures described have a more short- and medium- term vision (2030) rather than a long-term vision (2050). Only in some cities exist national plans with a vision of 2050 as in the case of Stuttgart (MASTERPLAN 100% Klimaschutz), Ljubljana (Vision of Slovenia 2050), Copenhagen (Copenhagen Energy Vision 2050) and Basel (2050 Vision: 2000-Watt-Gesellschaft). An energy roadmap for 2050 exists also for Greece. ICARUS cities have developed local plans that address climate change aspects (all cities), air quality (Basel, Brno, Ljubljana, Madrid, Milan, and Stuttgart), sustainable urban mobility (Brno, Ljubljana, Milan, Stuttgart, and Thessaloniki) and only 2 cities (Madrid and Stuttgart) have developed a noise reduction plan. The long-term visions that will be developed in ICARUS should therefore strive on simultaneous consideration of air pollution and greenhouse gas mitigation along with an inter-sectoral approach addressing aspects like sustainable urban mobility & planning and smart energy & buildings.