

# Roadmap 2000-Watt Society





## **Publishing details**

### **Publisher**

City of Zurich  
Environmental Delegation of the City Council  
P.O. Box, 8021 Zurich

Tel. 0041 44 412 43 07  
[www.stadt-zuerich.ch/2000watt](http://www.stadt-zuerich.ch/2000watt)

November, 2016

### **Editing**

Rahel Gessler and Bettina Volland (UGZ)

### **Translation**

sein gmbh, Rüti ZH

### **Design, layout and print**

Printshop, Zurich

### **Info graphics**

pooldesign, Zurich

1	2	3	4	5
<b>Management Summary</b>	<b>Introduction</b>	<b>A great deal has been achieved: Where we stand today</b>	<b>Where there is further potential for reduction</b>	<b>Directions of impact, areas of action and measures</b>
	2.1 Goal and purpose		4.1 Primary energy	5.1 Consumption
	2.2 Contents		4.2 Greenhouse gas emissions	5.2 Settlement
	2.3 Basics and approach		4.3 Primary energy consumption with further measures	5.3 Buildings
	2.4 Delimitation		4.4 Greenhouse gas emissions with further measures	5.4 Energy supply
	2.5 Development			5.5 Mobility

# Contents

1	Management Summary	6
2	Introduction	8
	2.1 Goal and purpose	8
	2.2 Contents	8
	2.3 Basics and approach	8
	2.4 Delimitation	9
	2.5 Development	9
3	A great deal has been achieved: Where we stand today	12
4	Where there is further potential for reduction	14
	4.1 Potential to reduce primary energy	16
	4.2 Potential to reduce greenhouse gas emissions	17
	4.3 Potential to reduce the primary energy consumption with further measures	18
	4.4 Potential to reduce greenhouse gas emissions with further measures	18
5	Directions of impact, areas of action and measures: Where to start in the long term	20
	5.1 Consumption: Resource-friendly production and consumption	22
	5.2 Settlement: Concentrating settlement area in high quality and developing it efficiently	24
	5.3 Buildings: Constructing, operating and renovating them in a climate-friendly and energy-efficient manner	26
	5.4 Energy supply: Increasing the usage of renewable energies and waste heat	30
	5.5 Mobility: Reducing burdens caused by traffic	34

6	7	8	9
<b>Synergies and conflicts of interest</b>	<b>Prioritisation of the most effective measures</b>	<b>Conclusion and next steps</b>	<b>Glossary</b>
6.1 Sufficiency and consumption 6.2 Urban concentration 6.3 Implementation of energy measures in buildings 6.4 Transformation of energy supply 6.5 Aviation and attractiveness of location 6.6 General challenges	7.1 Assessment criteria 7.2 Most effective measures		

6	<b>Synergies and conflicts of interest</b>	<b>36</b>
6.1	Sufficiency and consumption	36
6.2	Urban concentration	36
6.3	Implementation of energy measures in buildings	36
6.4	Transformation of energy supply	37
6.5	Aviation and attractiveness of location	37
6.6	General challenges	38
7	<b>Prioritisation of the most effective measures</b>	<b>40</b>
7.1	Assessment criteria	40
7.2	Most effective measures	41
8	<b>Conclusion and next steps</b>	<b>44</b>
9	<b>Glossary</b>	<b>46</b>



## Roadmap 2000-Watt Society

The complete overview graphic of the roadmap plus explanations can be found on the attached A2 poster.



# 1 Management Summary

How far has the City of Zurich come on its journey towards a 2000-Watt Society? What approach should be adopted, and what additional measures are required if this goal is to be achieved? Possible answers to these questions can be found in this roadmap, which shows the project's intermediate status and provides guidance on recommended actions.

This paper shows that the City of Zurich has already achieved a great deal. Since 1990, the consumption of primary energy has been reduced by 1,000 watts per person to the current annual figure of 4,200. In terms of greenhouse gas emissions, there has been a reduction of 1.5 tonnes – to approximately 4.7 – per person and year. However, it has also become apparent that neither the measures that have already been implemented nor those resolved will suffice to achieve the goals of the 2000-Watt Society. According to current estimates, these measures would lead to a consumption of 3,500 watts (rather than 2,500 watts) – or 3.5 tonnes of CO<sub>2</sub> equivalents (rather than 1 tonne) – per person and year by 2050.

Nonetheless, this roadmap proves that the 2000-Watt Society is a feasible proposition, even if political decisions are required at municipal, cantonal and federal level to ensure that the necessary additional measures are initiated. These measures should be defined in such a way that they do not restrict the quality of life in Zurich in any way.

A scenario analysis reveals that the following approaches would be highly effective: fossil-fuelled heating systems should be replaced – either by decentralised systems with renewable energies or by heating networks that use waste or environmental heat. Nuclear power should be replaced entirely by renewable electricity. Energy consumption in buildings should be reduced by introducing more efficient devices, implementing more energy measures in redevelopments, and thoroughly reviewing building specifications. The CO<sub>2</sub> emissions of motorised private transport and air traffic should be reduced. Furthermore, a more sustainable diet and a reduction of the demand for consumer goods would make a considerable contribution towards reducing grey energy and emissions.

Based on this scenario analysis, the roadmap presents the most important measures that are currently being implemented or are planned. It also reveals which further, highly effective measures should be examined more closely at federal, cantonal and municipal level. Arranged according to five directions of impact, these measures are compiled in graphic and tabular form on the attached A2 poster.

The roadmap also names possible conflicts of interest when measures are implemented – be it in changing consumer behaviour, greater urban concentration, energy-focused building refurbishment, transforming the energy supply, or aviation. Another challenge is the City of

Zurich's restricted scope of action due to its dependence on decisions at cantonal and federal level. Furthermore, any measure's economic, social and ecological dimensions must always be weighed up against one another if the goal of sustainable development is to be met.

This roadmap's most effective measures were assessed in terms of quality with regard to their financial feasibility, their effects on the three dimensions of sustainability, and any obstacles to their implementation. This rough assessment reveals that most longer-term measures are in the remit of the Canton of Zurich and the Swiss Government. Indeed, those with the greatest potential for climate protection are exclusively their domain. Such measures include introducing more stringent energy regulations for buildings, a CO<sub>2</sub> tax on motor fuels, and measures in aviation. As far as the City of Zurich is concerned, many of the most effective measures have already been implemented or are planned. In Zurich, it is a matter of achieving an even broader impact in the future, and/or pressing ahead to implement existing measures. These include ensuring a sustainable diet in public organisations, high-quality consolidation, incorporating 2000-Watt requirements in planning procedures, improving the energy and environmental footprint of Zurich's own buildings, developing and expanding energy networks in order to utilise waste heat derived from waste and cleaned sewage or environmental heat, and continuing to develop the City's Urban Traffic Strategy.

In order to be able to react to new technical and socio-political parameters, a roadmap status report shall be drawn up every four years and the City Council informed of any adjustments that may have to be made to the strategy and the range of measures involved.

2.1 Goal and purpose  
2.2 Contents  
2.3 Basics and  
approach  
2.4 Delimitation  
2.5 Development



## 2 Introduction

The City of Zurich is on its way to a 2000-Watt Society. Where is it in the process? Where does the course have to be set so that it actually achieves its goal? Where does additional potential lie and where are efforts required that go beyond the measures already running and decided upon? Answers are provided by this roadmap.

### 2.1 Goal and purpose

The 2000-Watt Society roadmap

- shows to the City Council in a clearly structured presentation the current interim status on the way to a 2000-Watt Society.
- provides recommendations for actions for the further development of the 2000-Watt policy as an orientation framework.

### 2.2 Contents

The roadmap summarises what has already been achieved on the way to the 2000-Watt Society (Chapter 3). It examines how close the City of Zurich comes to the goal if the ongoing and planned measures are implemented.

It also shows in what areas there is the greatest potential for the reduction of energy consumption and greenhouse gas emissions (Chapter 4). It pools sectoral considerations on five directions of impact (consumption, settlement, buildings, energy supply, mobility) and assigns areas of action to them. Per direction of impact, the roadmap shows which measures are already ongoing, are planned or would have to be verified (Chapter 5). In the process, it indicates the dependencies on the cantonal and federal policy and shows on what level the implementation of a measure lies (municipal, cantonal, federal). Chapter 6 outlines synergies and conflicts of interest and

derives specific challenges which have to be overcome in the implementation of measures. Finally, in Chapter 7 the most important measures are assessed and prioritised with regard to financing, effect on the sustainability dimensions and obstacles to implementation.

### 2.3 Basics and approach

The roadmap builds on the existing planning and control instruments. These are specifically the Energy Master Plan, the strategy «Urban Traffic 2025», the «7 Milestones» programme, the Regional and Municipal Structure Plan and the Environmental Master Plan. It also ties to the Strategies 2035 of the City of Zurich.

The roadmap brings together sectoral considerations in an integral, topic-overarching approach focusing on the energy and CO<sub>2</sub> objectives of the 2000-Watt Society. This is done firstly on the level of scenario calculations and secondly on the level of directions of impact, areas of action and measures. A tabular, qualitative compilation of the most effective measures facilitates a quick overview of the benefits, the costs, the risks, the responsibilities and the feasibility. Derived from this, a prioritisation is proposed that is intended to act as a decision aid in the context of limited resources and competencies.



The roadmap has also brought together various scenario calculations in the areas of buildings, energy supply and mobility. This permits specific statements on how great the potential of different packages of measures to reduce the primary energy demand and greenhouse gas emissions is and to what extent the goals can be reached on the municipal territory. In addition, the roadmap adheres to a comprehensive understanding of the 2000-Watt Society by also taking the energy consumption and the emissions into account that the population and industry cause outside of the municipal territory (grey energy, grey emissions).

## 2.4 Delimitation

The roadmap on the 2000-Watt Society is based on current knowledge. It was drawn up with a specific focus on the energy and climate policy goals. It cannot anticipate either the future technical, social or economic developments.

A successful implementation of the 2000-Watt policy and measures requires that, in the interest of a sustainable development, the effects of measures on ecology, society and economy are regularly analysed and adjustments and/or supplements can be carried out in a flexible way.

## 2.5 Development

The roadmap was designed and developed by the GUD/UGZ project team (Bruno Hohl until October 2015 / François Aellen since October 2015, Reto Bertschinger, Rahel Gessler and Bettina Volland).

The work was accompanied from a technical perspective by the Committee Specialist Pool for the 2000-Watt Society:

- Dr. François Aellen, Environmental and Health Protection Service Zurich (UGZ), management since October 2015
- Bruno Bébié, Department of Public Utilities and Transport (DIB)
- Reto Bertschinger, Department of Health and the Environment (GUD)
- Rahel Gessler, Environmental and Health Protection Service Zurich (UGZ)
- Bruno Hohl, Environmental and Health Protection Service Zurich (UGZ), management until October 2015
- Annick Lalive d'Épinay, Building Surveyor's Office (AHB)
- Sandra Nigsch, City Planning Office (AFS)
- Benno Seiler, Urban Development Zurich (STEZ)
- Christina Spoerry, Civil Engineering Office Zurich (TAZ)
- Bettina Volland, Environmental and Health Protection Service Zurich (UGZ)
- Erich Willi, Civil Engineering Office Zurich (TAZ)

## What does the 2000-Watt Society mean for Zurich?

2008, with a large majority of 76.4%, the residents of Zurich said yes to a sustainable development and to the 2000-Watt Society. Specifically, this means that Zurich

- in the long term wants to reduce its energy consumption to 2,000 watts per person. This means an annual consumption of 17,520 kilowatt hours per person and year. The Energy Master Plan defines as a milestone for the year 2050 an interim target of 2,500 watts. This interim target is derived

from the target value for the CO<sub>2</sub> emission and assumptions on increasing efficiency and on the expansion of renewable energies.

- wants to reduce its CO<sub>2</sub> emission to one tonne per person and year by 2050 (measured in CO<sub>2</sub> equivalents, CO<sub>2</sub>-eq).
- promotes renewable energies and energy efficiency.
- will not be renewing its participations in nuclear power plants.

The following **interim targets** are defined in the Energy Master Plan for the municipal area:

Year	2020	2035	2050
Primary energy per person	4,000 watts	3,200 watts	2,500 watts
Greenhouse gas emissions per person and year	4 t CO <sub>2</sub> -eq	2.5 t CO <sub>2</sub> -eq	1 t CO <sub>2</sub> -eq

The grey energy and the grey emissions of the energy carriers are taken into consideration in these target values. The grey energy and the grey emissions that are used outside of the municipal territory for goods and services but are consumed in the City are not included. These data belong, according to the specifications of the 2000-Watt balance sheet accounting, not to the balance sheet of the municipalities and cannot be collected for Zurich either. Nevertheless, the roadmap also focuses on it.

goals for the municipal territory than the national 2000-Watt Programme that defines as target values for 2050 of 3,500 watts per person and 2 tonnes of CO<sub>2</sub>-eq per person and year ([www.2000watt.ch](http://www.2000watt.ch)).

In addition to these target values for the balance sheet accounting on the municipal territory there are other 2000-Watt balance sheet accounting instruments with different system limits. For instance, the SIA efficiency path is used for the assessment of the 2000-Watt conformity of buildings; this path takes grey energy and emissions into full consideration.

The City of Zurich has set more ambitious

**6**  
**Synergies and  
conflicts of interest**

**7**  
**Prioritisation of the  
most effective  
measures**

**8**  
**Conclusion  
and next steps**

**9**  
**Glossary**

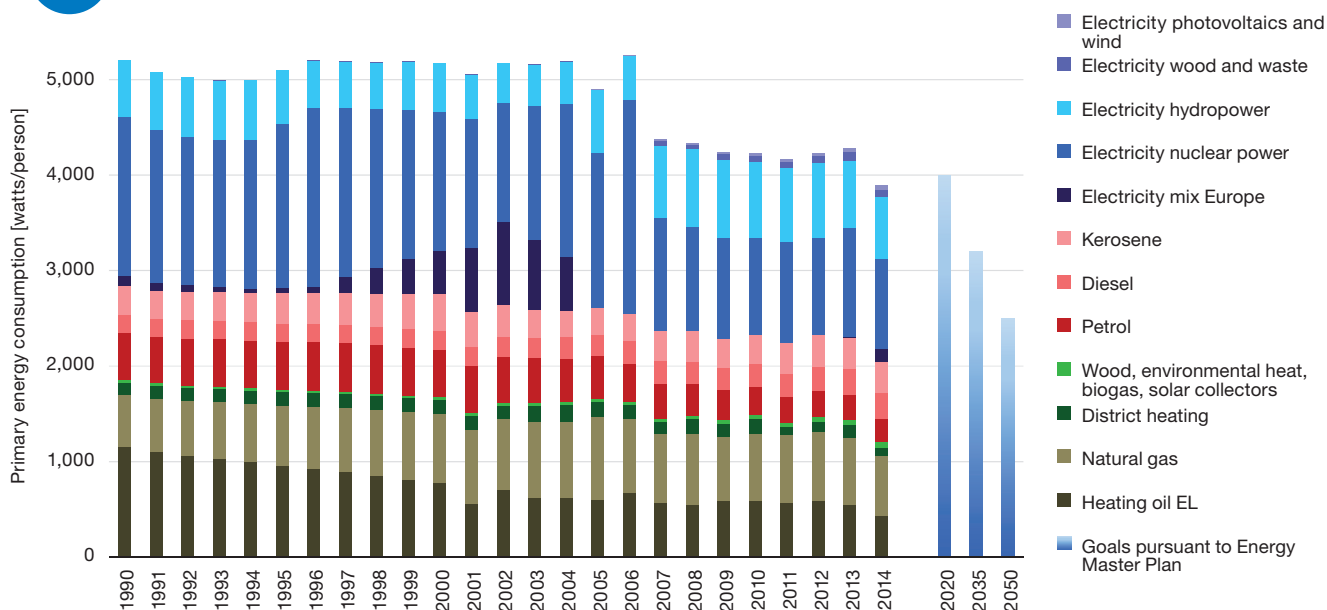


# 3 A great deal has been achieved: Where we stand today

Already before the entrenchment of the 2000-Watt Society in the municipal code, the City of Zurich has undertaken efforts to reduce the energy consumption and the greenhouse gas emissions on the municipal territory. Since then, it has taken various other measures. The effect didn't fail to materialize.

Since 1990, the primary energy consumption has fallen to around 4,200 watts per inhabitant on average over the last five years (cf. Fig.1).

Over the same period of time, the share of renewable energies increased by 11% to 19%.

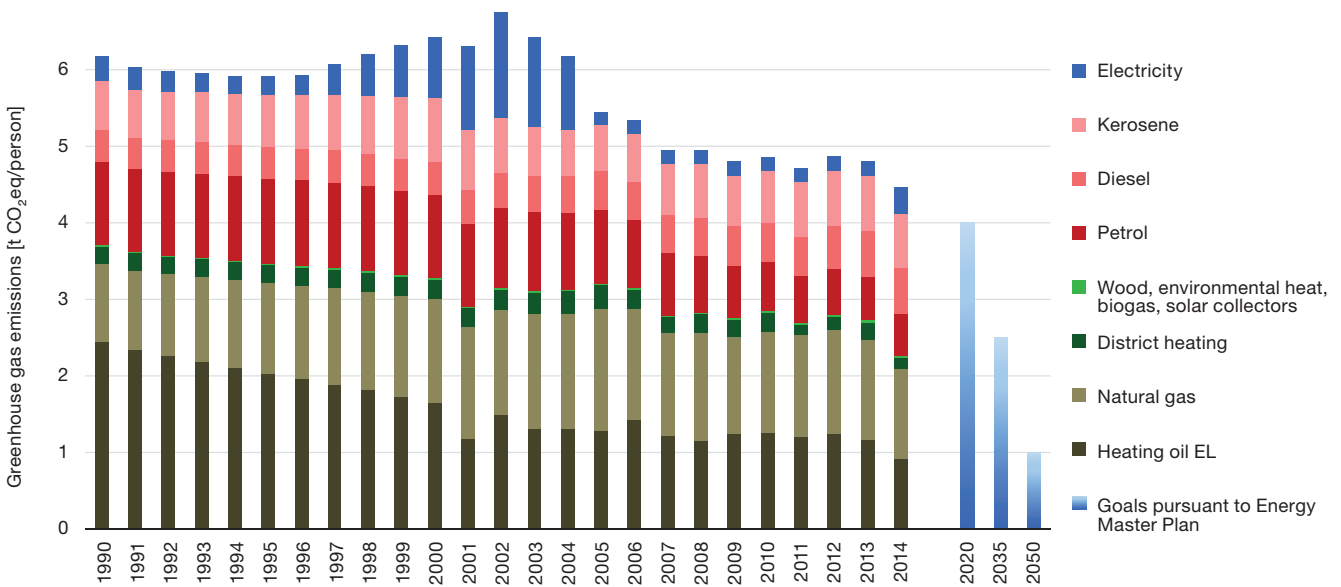


Source: Environmental and Health Protection Service Zurich, data correct as of September 2015

**Fig. 1: Primary energy record; development of the primary energy consumption per person in the City of Zurich between 1990 and 2014, without climate correction**

The biggest contribution to reducing primary energy consumption is attributable to the greening of the electricity mix. From 2007, ewz – Zurich Municipal Electricity Service - introduced a number of electricity products that consist solely of renewable energies. At the same time, the private clients received an electricity product as a standard feature that is 100% renewable. This resulted in the share of efficiently produced electricity in the electricity supply being substantially increased and at the same time the share of the nuclear power produced with high primary energy effort being reduced. Since 2015, ewz has supplied all customers who do not have a market licence solely with 100% renewable electricity. This leads to expectation of a further reduction in nuclear power for 2015. Energy could be saved in the buildings through refurbishment of windows, roofs and facades. Regarding mobility, consumption has also fallen slightly, whereas an increase overall was registered in Switzerland.

Over the last 25 years, greenhouse gas emissions have declined by around 1.5 tonnes to around 4.7 tonnes per person and year (cf. Fig. 2).



Source: Environmental and Health Protection Service Zurich, data correct as of September 2015

**Fig. 2: Greenhouse gas record; development of the greenhouse gas emissions per person and year in the City of Zurich between 1990 and 2014, without climate correction**

The main contribution to reducing the greenhouse gas emissions came from the building sector. Firstly, the refurbishment of buildings with regard to their heat technology led to a reduction in the heat requirements. Secondly, many oil heating systems were replaced by gas heating systems that cause around 20% fewer greenhouse gas emissions. In addition, oil heating systems have also declined in favour of district heating and heat pumps. The peak that is discernible in the greenhouse gas emissions from electricity around 2002 is attributable to a system change in the balance sheet accounting methodology. Since the introduction of the electricity declaration obligation in 2006, the electricity that ewz purchases is no longer assigned to the emissions of the EU mix but rather the emissions of the electricity actually purchased. As the ewz emission mix has not included any electricity produced by fossil means since 2005, there was a substantial reduction in the greenhouse gas emissions from the consumption of electricity in the record. Regarding mobility, the greenhouse gas emissions fell slightly in the City of Zurich between 1990 and 2014; this was in contrast to Switzerland as a whole, where an increase was posted.



## 4 Where there is further potential for reduction

With the measures already taken, the energy consumption and the greenhouse gas emissions can be reduced further in the future. The City Administration has an exemplary record in various areas, for instance in its own buildings. However, this is not sufficient to reach the goals of the 2000-Watt Society for the overall municipal territory, as a scenario analysis shows.

In the scenario analysis, two already existing scenario studies from the areas of building/energy supply (concept energy supply 2050) and mobility were merged, two scenarios drawn up and compared with one another. The calculations assume a lower growth in population than the current forecasts predict. Due to the per capital targets for the 2000-Watt Society, however, it is to be expected that a higher increase in the number of inhabitants would only change the results slightly. The calculations in the area of building/energy supply for the year 2050 were stored at around twice the level of the energy prices today.

The scenario «Ongoing and planned measures» takes into account the measures already running and initiated and shows their future effect. The calculations show that the energy consumption between 2010 and 2050 only falls by around 700 watts to 3,500 watts per person (cf. left-hand bar in Fig. 3). That is 1,000 watts above the intended target of 2,500 watts per person. Greenhouse gas emissions even fall by only around 1.6 tonnes to around 3.5 tonnes CO<sub>2</sub> equivalent per person and year – instead of as required to 1 tonne per person and year (cf. left-hand bar in Fig 4).

- 4.1 Primary energy
- 4.2 Greenhouse gas emissions
- 4.3 Primary energy consumption with further measures
- 4.4 Greenhouse gas emissions with further measures

Is the 2000-Watt Society within the realms of the possible at all in Zurich? If so, where would the City have to start? And where should the canton and the federal government start? Answers are given by the scenario «Further measures» that assumes a bundle of measures not yet adopted today. In the field of mobility, for instance, it is assumed that the Strategy Urban Traffic 2025 will be fully implemented by 2025 and that the measures will be continued until 2050. In addition, numerous measures are stored for the scenarios at the levels of city, canton and federal government that have been pooled into seven starting points. The seven approaches and their potential for reducing the energy consumption and greenhouse gas emissions are discernible in Figures 3 and 4 (right-hand bar). The measures included in the approaches are explained in the following sections.

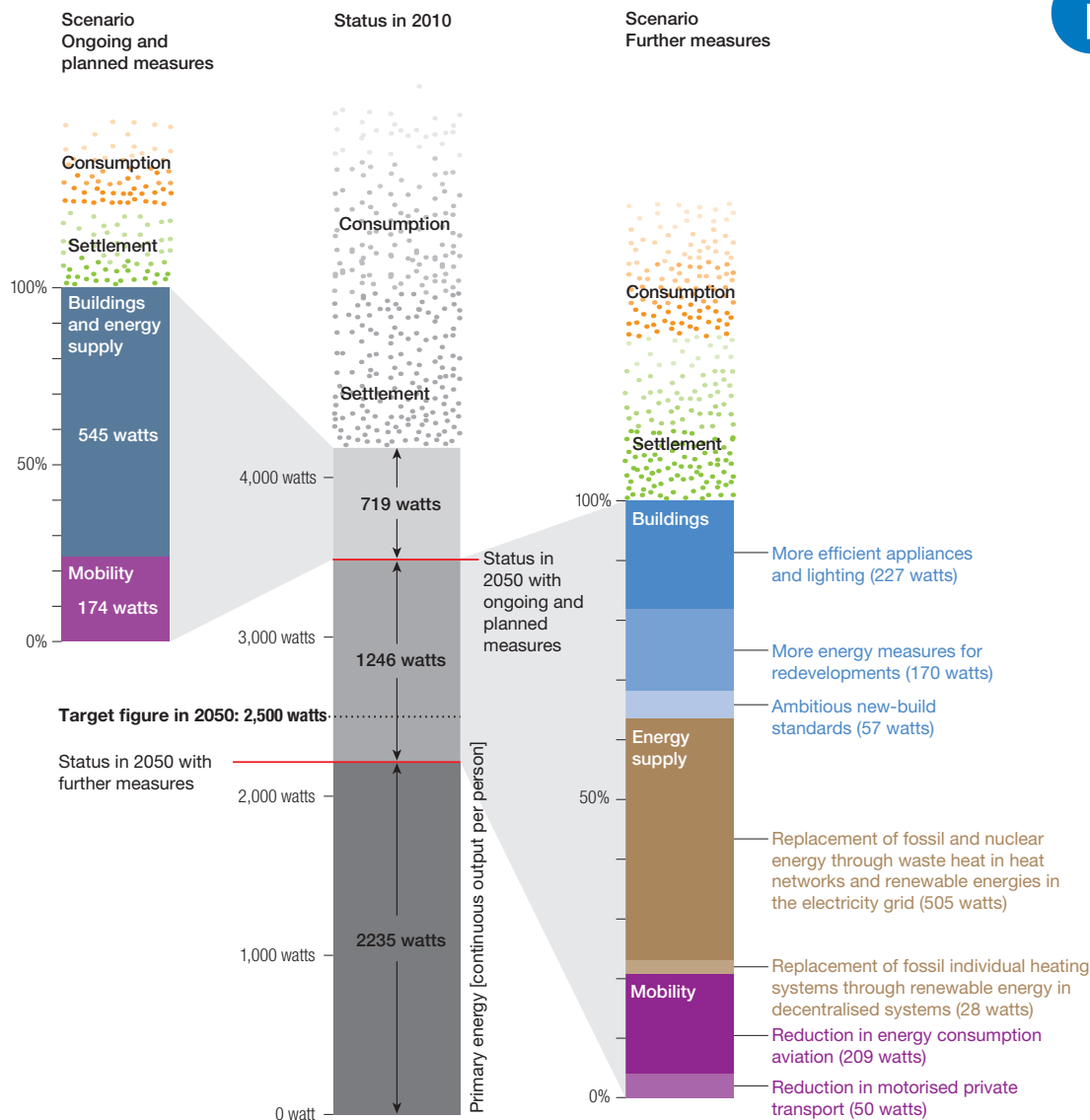
The scenario «Further measures» shows: If the ongoing measures are substantially increased and supplemented with other measures of the city, canton and federal government in the areas buildings, energy supply and mobility, the City of Zurich can reach the 2000-Watt Society. A number

of political decisions at all levels would be necessary for this. And all would be called upon in the implementation: private individuals, business, city, cantons and federal government.

The scenarios were drawn up with a focus on energy and climate protection policy. The effect of the bundle of measures in the areas of society and business was not assessed during these scenario studies. A very rough qualitative assessment on a selection of measures is done by the roadmap in Chapter 7. Detailed assessments on the effect of measures are to be carried out within the framework of the specific further development of the energy and climate protection policy, and form an important component of the effective configuration and implementation of further measures in the political process.

- 4.1 Primary energy
- 4.2 Greenhouse gas emissions
- 4.3 Primary energy consumption with further measures
- 4.4 Greenhouse gas emissions with further measures

## 4.1 Potential to reduce primary energy

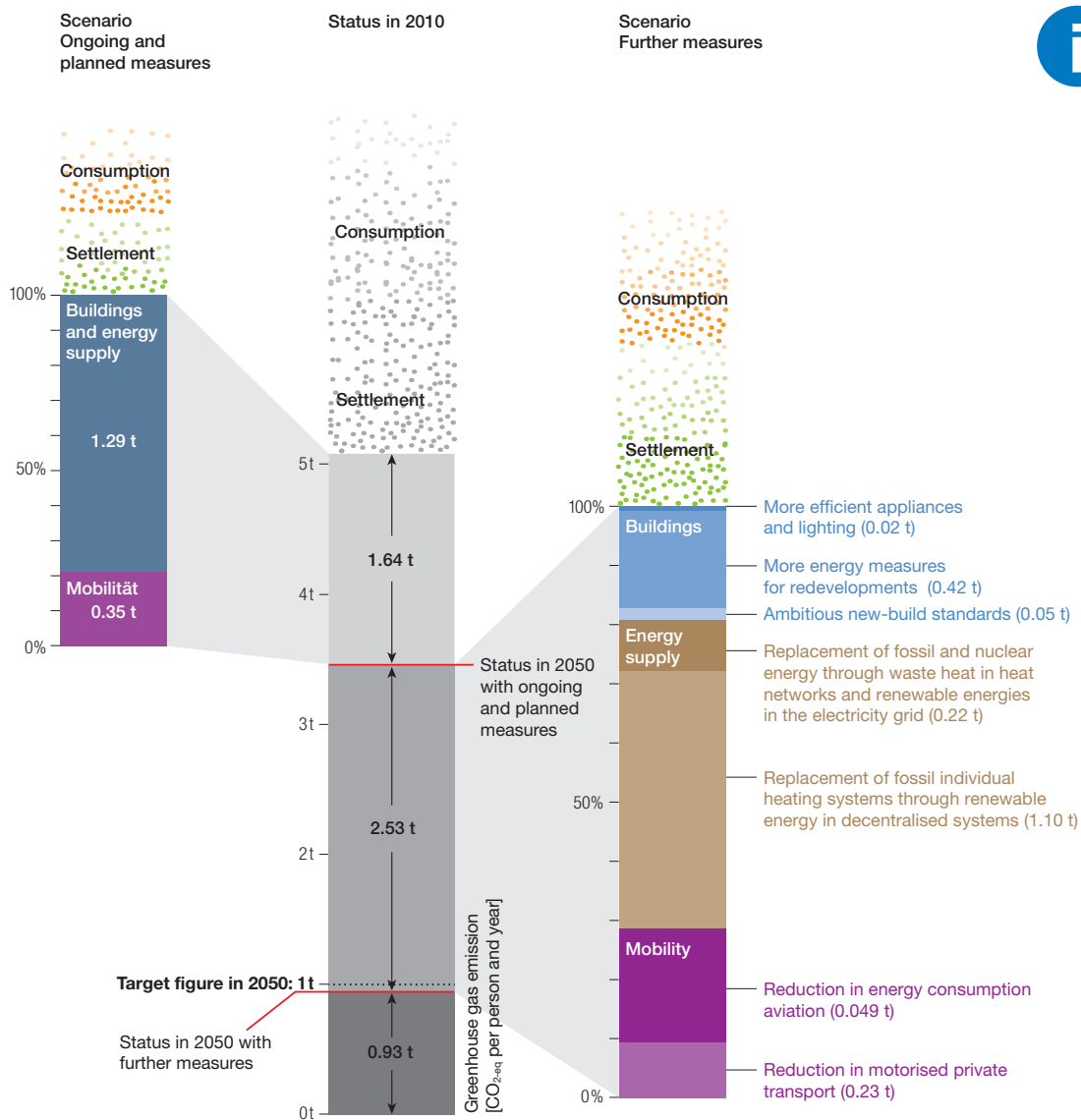


**Fig. 3: The potential of the two scenarios «Ongoing and planned measures» and «Further measures» to reduce the primary energy consumption**

In the left-hand bar, the chart shows the effect of the scenario «Ongoing and planned measures». The right-hand bar shows seven important approaches from the areas of buildings, energy supply and mobility with which it manages in the scenario «Further measures» to reduce the primary energy consumption for the entire municipal territory until 2050 to the target figures of the 2000-Watt Society. The effect of measures in the areas of consumption and settlement development on grey energy is only depicted in schematic form. Due to missing data, no quantitative statements can be made.



## 4.2 Potential to reduce greenhouse gas emissions



**Fig. 4: The potential of the two scenarios «Ongoing and planned measures» and «Further measures» to reduce the emissions of greenhouse gases**

In the left-hand bar, the chart shows the effect of the scenario «Ongoing and planned measures». In the right-hand bar seven important approaches are visible from the areas of buildings, energy supply and mobility with which it manages in a scenario «Further measures» to reduce the greenhouse gas emissions for the entire municipal territory by 2050 to the target figures of the 2000-Watt Society. The effect of measures in the areas of consumption and settlement development on the grey emissions is only depicted in schematic form. Due to missing data, no quantitative statements can be made. The status in 2010 differs slightly from the annual figure for 2010 in the greenhouse gas record in Chapter 3 as the balance sheet accounting methodology has since been developed further.

- 4.1 Primary energy
- 4.2 Greenhouse gas emissions
- 4.3 Primary energy consumption with further measures
- 4.4 Greenhouse gas emissions with further measures

### 4.3 Potential for reducing the primary energy consumption with further measures

Replace fossil fuels and nuclear power with waste heat and renewable energies – this approach has the greatest potential for using less primary energy (cf. Fig. 3, brown areas). Specifically, the following assumptions are stored for the scenario «Further measures» in the area of energy supply: Considerably more buildings than today are heated with heat from waste, cleaned waste water or with biogas. A significant increase in heating networks and the energetic improvement of the building shells of existing properties make this possible. In addition to the households, all business customers also only buy electricity from renewable sources in 2050, despite the liberalisation of the electricity market.

Other great potential for reduction is discernible in the equipment and renovation of buildings (blue areas). A substantial energy saving is possible if efficient devices and lightings are increasingly used. The prerequisite, however, is that only small rebound effects occur. The scenario assumes that within the framework of ordinary redevelopments substantially more building shells are optimised with regard to energy and that intelligent building technology is used. Finally, measures that reduce the energy consumption of aviation also have an important effect (dark red area). In addition, measures in the areas of consumption and settlement should also contribute to reducing grey energy. However, no quantitative statement on this is possible due to a lack of scenario calculations.

### 4.4 Potential to reduce greenhouse gas emissions with further measures

In decentralised heating systems, increasingly using local environment energy instead of fossil fuels – this approach shows the greatest potential to reduce greenhouse gas emissions (cf. Fig. 4, light brown area). The scenario «Further measures» assumes that the percentage of fossil fuels in the heat supply of buildings will fall from 85% today to 10% in 2050 – among others, because the statutory requirements of heat generation will be substantially tightened. In addition, it is assumed that energy measures are also more frequently implemented in redevelopments and at the same time the energy-related requirements of buildings increase substantially (mid-blue area).

Similarly great potential as in the building sector exists in aviation. The scenario assumes that the flight movements and the energy demand will decline slightly and that half of the kerosene will be replaced by bio fuel (dark red area). With motorised private transport too, there is still potential, although Zurich compared to Switzerland overall has already reached a very low level (light red area). A whole range of further measures contribute to a further reduction in greenhouse gas emissions in motorised private transport, including a further tightening of the CO<sub>2</sub> threshold value for new cars, a CO<sub>2</sub> tax on motor fuels, the promotion of electromobility and the introduction of a mobility pricing. Measures in the areas of consumption and settlement should also contribute to a

reduction in the grey emissions. Quantitative statements, however, are not possible as there are no scenario calculations on this.

As a comparison of Figures 3 and 4 shows, the same measures have a greatly varying effect on the primary energy consumption and greenhouse gas emissions. Measures to reduce the consumption of electricity, for instance, result in a reduction in the primary energy consumption. However, they only reduce the greenhouse gas emissions slightly as the electricity mix in Zurich virtually does not contain any fossil percentages. Conversely, the replacement of fossil individual heating systems with decentralised systems with renewable energy results in a substantial reduction in the greenhouse gas emissions but brings little change in the primary energy consumption. For decentralised heating systems with renewable sources of energy have a similarly high primary energy consumption as fossil fuel-powered decentralised systems.



## 5 Directions of impact, areas of action and measures: Where to start in the long term

Five directions of impact with areas of action depict in what areas measures will be necessary in order to reach the goals of the 2000-Watt Society.

Five directions of impact with areas of action (cf. Fig. 5) are derived from the potentials identified in Chapter 4. The measures not only include a broad application of efficient solutions but also sufficiency aspects that are associated with changes in behaviour. They also include approaches in order to reduce grey energy and grey emissions that are incurred outside of the City.

In the sections 5.1 to 5.5, the roadmap shows for each direction of impact what the central measures are in order to reach the goals of the 2000-Watt Society.

The complete overview graphic of the roadmap plus explanations can be found on the attached A2 poster.

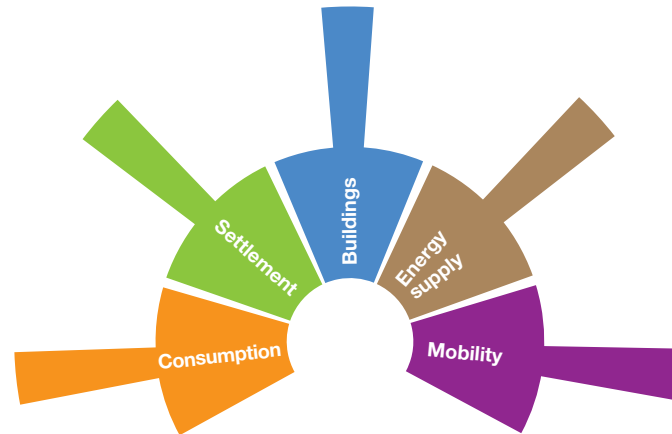


The City of Zurich is already implementing many measures. A selection of the essential is listed in the roadmap, as are the most important ongoing measures for which the canton and federal government are responsible (●—). Numerous other activities are in planning and preparation, at city level as well as at cantonal and federal level (○—). Depending on the direction of impact, the scope of the City is

of varying size. Often, canton and federal government are important and in places decisive stakeholders.

In order to reach the goals of the 2000-Watt Society, however, substantially more in-depth activities are necessary on the levels of city, canton and federal government. In the sections 5.1 to 5.5, the roadmap lists under «Further measures» a selection of possible measures that according to scenario calculations and expert appraisals could make an effective contribution to the attainment of the 2000-Watt targets (☼—). The selection is not exhaustive. Rather, it corresponds to a momentary snapshot in the context of the current energy and climate policy. The discussion about a specific configuration and implementation of further measures is to be conducted within the framework of the ordinary political processes.

The order and the positioning on the time axis (before or after 2020) show in what order and what period of time a measure is planned or should be introduced. Measures with a particularly strong effect are discernible by a thicker line and bold font.



**Consumption: Resource-friendly production and consumption**

- Goods and products: Reviewing requirements and consuming in an environmentally conscious manner
- Producing food in an ecological manner and using with consideration
- Closing materials cycles: Promoting reuse, recycling and utilisation
- Developing and promoting new forms of consumption and production

**Settlement: Concentrating settlement area in high quality and developing it efficiently**

- Reducing area consumed for living, working and infrastructure
- Implementing attractive, mixed and urban concentration
- Reducing need for motorised private traffic

**Buildings: Constructing, operating and renovating them in a climate-friendly and energy-efficient way**

- Reducing requirements of buildings and services (e.g. space)
- Optimising existing properties from an energy perspective
- Designing new buildings for minimum energy consumption
- Using energy-efficient materials and devices
- Supplying properties with renewable energy

**Energy supply: Increasing usage of renewable energies and waste heat**

- Expanding production of electricity from renewable sources
- Ensuring purchase of renewable electricity in the liberalised electricity market
- Increasing heat generation and usage from local renewable sources and waste heat

**Mobility: Reducing burdens caused by traffic**

- Increasing attractiveness of public transport/bicycle/walking
- Reducing cross-border motorised private traffic
- Using efficient, climate-friendly drive concepts
- Reducing CO<sub>2</sub>-emissions of aviation

**Fig. 5: The five directions of impact with the respective areas of action**

## 5.1 Consumption: Resource-friendly production and consumption

We not only use energy in heating, lighting or when we move, we also do so when we consume goods and services and when we eat. Those who repair a product instead of buying a new one or select a service that requires fewer resources contribute to a lower consumption of energy and lower greenhouse gas emissions. The same applies when somebody eats seasonal food and reduces his or her consumption of meat. Even stronger than in the City of Zurich is the effect outside because many foods and other goods and services are imported and with them also grey energy and grey emissions.

If fewer short-lived and resource-intensive goods and services are consumed, the consumption of energy and greenhouse gas emissions are also reduced. The first step towards this is to review and lower the need for new goods. In addition, environmentally friendly and energy-efficient production processes as well as long-lasting and repairable products contribute to a resource-friendly consumption. An important lever here is in the production and in a considered handling of foods. Closing the materials cycle as well as possible, whether through reuse, recycling or utilisation, is an important place to start.

The City of Zurich can only exert a very restricted influence on the consumption because the most important stakeholders are private consumers as well as commerce

and industry. The focus is on the following possibilities:

- Role model effect through optimum own procurement and supply and disposal processes in the City Administration.
- Support of private initiatives, e.g. through notification or procurement of low-cost facilities for repair cafés, swap markets, etc.

The following measures in the area of consumption are already being implemented, planned or to be discussed as further measures (cf. Fig. 6).

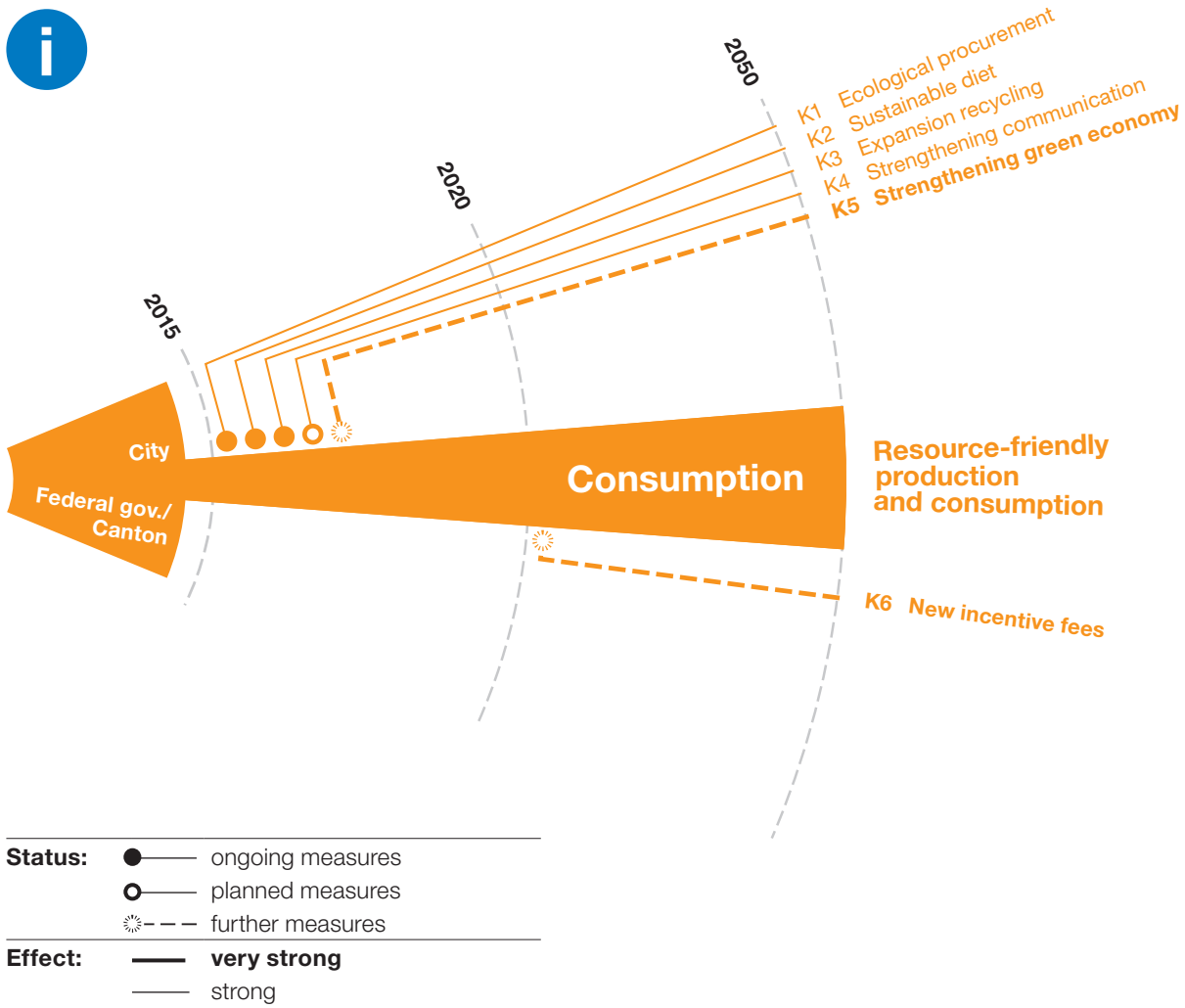


Fig. 6: Direction of impact consumption with ongoing, planned and further measures

### Ongoing measures of the City of Zurich

● — **Ongoing:** The City makes a direct contribution by purchasing goods and services according to comprehensive sustainability criteria. Over the past few years, it has taken a number of initiatives for a more sustainable and climate-friendly diet and less food waste (Menu Plus in municipal cafeterias, initiatives for less food waste in nursing homes).

Within the «Öko-Kompass» («Eco Compass») consulting, it communicates the corresponding know-how to small and medium-sized enterprises.

The City has a well-functioning recycling infrastructure and is constantly optimising its processes. For instance, since 2016, slag from waste combustion has been subject to a process to recover metal.

## Planned measures of the City of Zurich

🔗 — **Planned:** To support the 2000-Watt targets, information and sensitisation of population and business can make an important contribution. The City is therefore planning to strengthen the communication on the 2000-Watt Society.

## Further measures of the City of Zurich

☀️ — **Further:** It needs to be checked whether the City supports the diverse initiatives of private stakeholders in the area of the green economy more strongly or enters into corresponding partnerships – for instance, in the areas of resource-friendly products, repair, sharing or plastics recycling.

## Further measures of the canton and of the federal government

☀️ — **Further:** As effective further instruments, new incentive fees would have to be discussed at federal level, for instance on spaces or raw materials. This should create additional incentives for sustainable consumption.

## 5.2 Settlement: Concentrating settlement area in high quality and developing it efficiently

Settlement structure has a significant influence on energy consumption and the greenhouse gas emissions. It influences, for instance, the distances that are covered every day for the way to work, to the shops or to leisure activities – not just within the municipal territory but also between the City and the agglomeration. The energy supply

is also linked to the settlement development, for instance the usage of waste heat from industry and service for the heating of residential premises.

Savings can be realised if as the result of consolidation, considerably more people live and work on the same space, in particular if at the same time attention is paid to a lower individual consumption of space for living, working, transport and infrastructure. If at the same time the energy supply is changed over, for instance, from fossil energy to waste heat usage in a heating network, additional great potential for savings can be exploited. The decisive aspect when implementing a high degree of urban concentration is that the areas offer a high quality of life. This means in particular that different usages such as living, working, shopping and leisure as well as attractive open spaces are mixed. Consolidated areas facilitate a good opening up for public transport and for cycling and pedestrian traffic («City of short distances»). In addition, the costs for the public sector can be reduced in the area of transport and infrastructure in areas with urban concentration.

In settlement development, the City of Zurich has a significant scope of action. The following measures are already being implemented, planned or to be discussed as further measures (cf. Fig. 7):



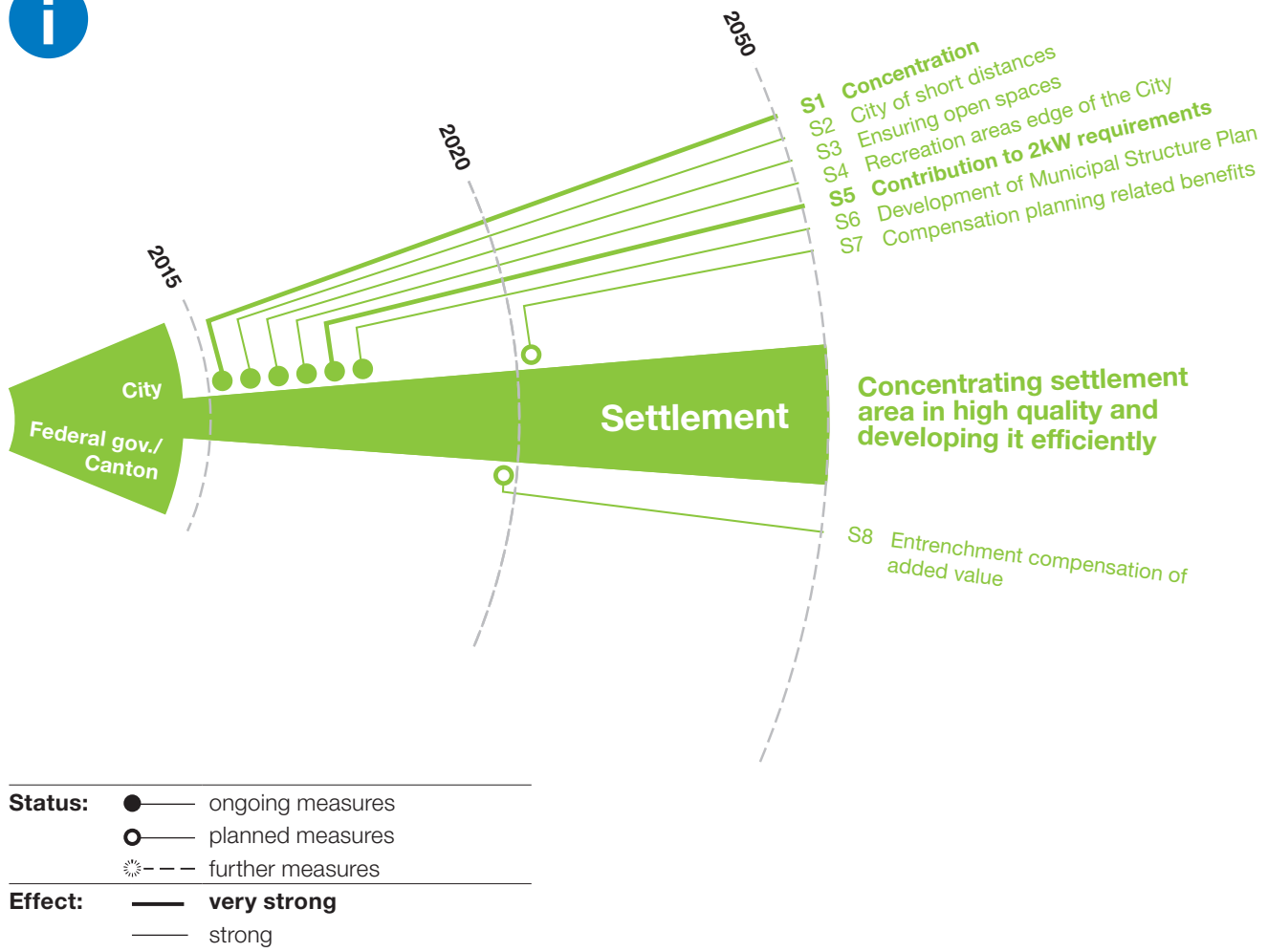


Fig. 7: Direction of impact settlement with ongoing, planned and further measures

### Ongoing measures of the City of Zurich

● **ongoing:** The City of Zurich is promoting settlement design compliant with the 2000-Watt strategy with planning specifications. It is specifying this in the Municipal Structure Plan for Settlement, Landscape and Public Buildings. This is aligned to the Municipal Energy Planning and the Municipal Structure Plan for Traffic. And it uses its scope in design plans,

special construction regulations and district development guidelines. The goal is a dense, polycentric city well developed around the public transport hubs, with a high quality of life. Zurich has to be able to develop further as a residential, economic and scientific location. An appropriate provision of open spaces and recreational areas is ensured. Public transport, cyclists and pedestrians have priority.

### Planned measures of the City of Zurich

**Planned:** The City uses its scope to compensate for planning-related benefits. If, for instance, the utilisation of a plot of land is increased, the City can quantify and exploit the resulting value added. These revenues help to cushion the costs for additional public interests and infrastructures that are triggered by the increase in population.

### Further measures of the City of Zurich

**Further:** Currently, there are no further measures under discussion. In order to specifically exploit the existing potential, the ongoing and planned measures are to be consequently implemented and developed further. A particular focus here is on good collaboration between the Municipal Energy Planning and the Structure Plan for Settlement, Landscape and Public Buildings. As a result, optimum use can be made of e.g. sources of environmental energy such as waste heat or lake water.

### Planned measures of the canton and of the federal government

**Planned:** The canton of Zurich is planning to entrench the specifications regarding the compensation of planning-related benefits in cantonal law by 2019.

### 5.3 Buildings: Constructing, operating and renovating them in a climate-friendly and energy-efficient manner

There is great potential for the reduction in primary energy consumption and greenhouse gas emissions in buildings. Firstly they

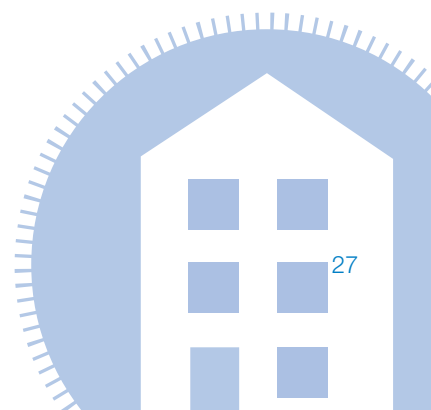
require energy in the operation for heating, hot water, lighting or cooling. In addition, the grey energies and emissions that are incurred during production of the construction materials are not to be underestimated. Finally, the sizing, for instance of apartments or flats, is also decisive: If more people live or work on the same space, energy consumption and emissions per person fall.

Operating energy can be saved by ideally insulating buildings, equipping them with efficient lighting and devices and controlling them with optimum building technology. Greenhouse gas emissions can be avoided by replacing fossil fuels with renewable energies and by heating, cooling and preparing hot water via the use of waste heat. And finally, the choice of building materials as well as the effective occupancy of buildings are reflected directly in the energy and resource record.

The basic competence to regulate the building sector by law is in the hands of the canton. It also distributes a large percentage of the funding. The City of Zurich has the following possibilities:

- Construction, repair, management and maintenance of the City's own buildings and the buildings in municipal ownership pursuant to 2000-Watt specifications.
- Consulting for builders
- Influence on design plans, special building regulations, site developments (cf. Chapter 5.2.)

The following measures are already being implemented, planned or to be discussed as further measures (cf. Fig. 8):



- 5.1 Consumption
- 5.2 Settlement
- 5.3 Buildings
- 5.4 Energy supply
- 5.5 Mobility

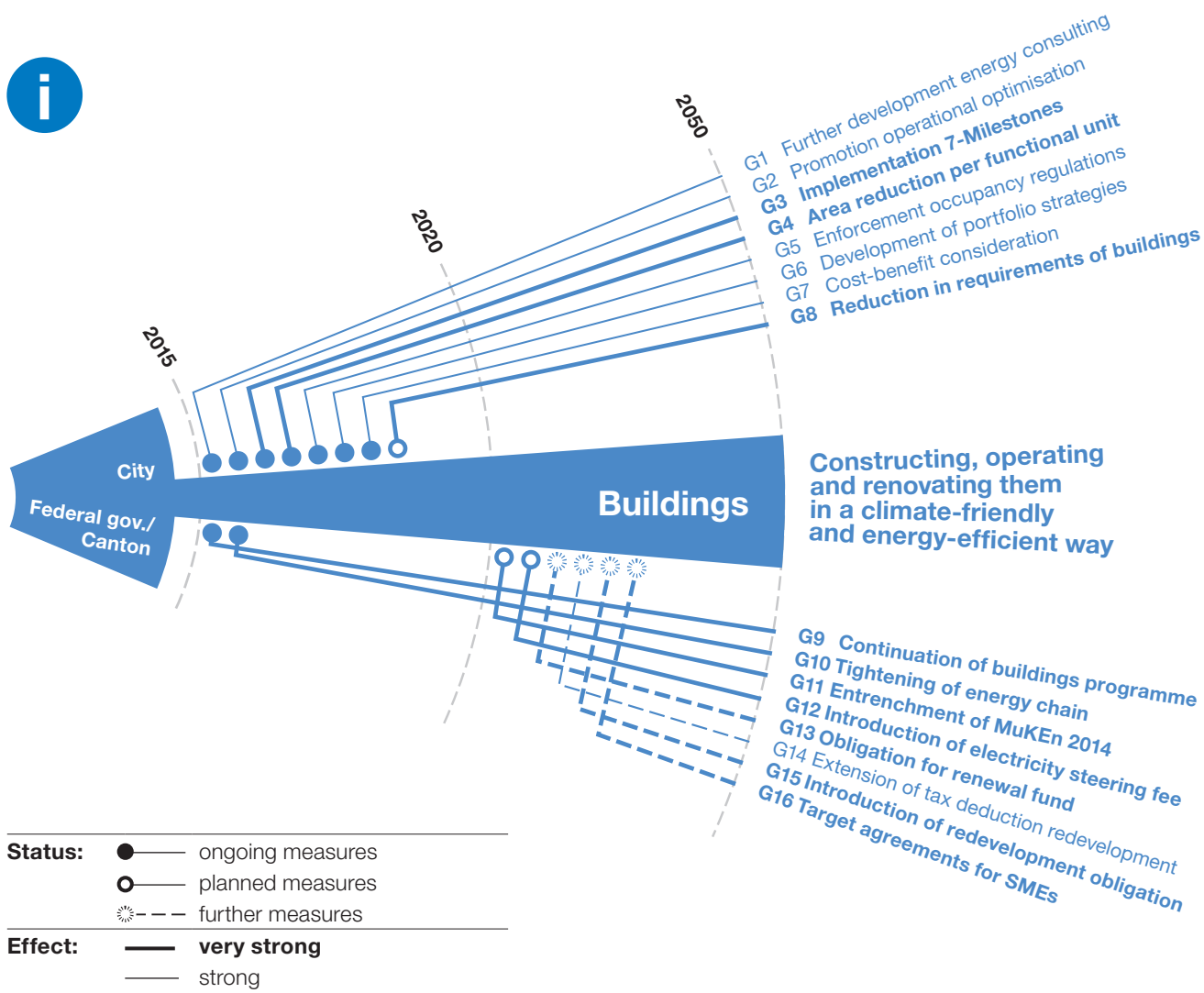


Fig. 8: Direction of impact buildings with ongoing, planned and further measures

**Ongoing measures of the City of Zurich**

● — **for the City's own buildings:** The programme «7 Milestones on environmentally friendly and energy-efficient building» makes specifications on energy efficiency, renewable energies, efficient devices, building materials, grey energy, mobility and operation with the City's own buildings. Since the programme started in 2001, more than 500 000 m<sup>2</sup> of energy reference area has been newly built or

redeveloped in accordance to the 7 Milestones.

In order to get the overall municipal portfolio of buildings in an energy-efficient condition in the long term, whole portfolios of buildings, for instance school buildings or nursing homes, have been analysed over the last few years. Scope for implementation in the individual property can thus be ideally used and ideal solutions with regard to energy

that are also cost-efficient can be realised. In its own properties, the City has a direct influence on the consumption of space: It is enforcing occupancy regulations for municipal apartments. With workplaces, usage standards and space specifications are adjusted to modified work models such as part-time or home office work and to advancing digitalisation. In addition, it is checked during the planning of public buildings where the same function can be ensured with a reduced need for space.

With each specific building project, the 2000-Watt requirements are implemented as well as possible taking cost-benefit considerations into account. The City is continually optimising the ongoing measures in its own buildings and in the advising of private home owners. In the process, it also uses the insights from the study programme 7 Milestones whose financing is adopted every year by the City Parliament and from the energy research programme of the City of Zurich.

● — **For private buildings:** In 2009, the City enhanced its range of energy consulting through the energy coaching programme for home owners. More than 800 property owners have already benefit from this comprehensive consulting. In the future, special attention is to be paid to the specialist support of architects and the optimisation of operations.

#### **Planned measures of the City of Zurich**

○ — **Planned:** The most important cost driver in the implementation of the City's own buildings

are the numerous requirements that today are placed on the buildings and the services offered in them. It is to be checked in what areas the requirements could be reduced, for example in the technical equipment and through a further reduction in the space required per functional unit.

#### **Ongoing measures of the canton and of the federal government**

● — **Ongoing:** The model regulations of the cantons in the energy sector (MuKE) of 2008 were adopted into cantonal law in 2009. Stricter requirements of heat insulation and heat supply of buildings thus apply. In addition, energy-related redevelopments and the usage of renewable energies in buildings are being funded via the buildings programme. The financial funds for this originate from the CO<sub>2</sub> tax of the federal government and of the canton.

#### **Planned measures of the canton and of the federal government**

○ — **Planned:** Important decisions are pending at cantonal and federal level. The new model regulations of the cantons in the energy sector (MuKE 2014) are to be entrenched in cantonal law in 2021. The energy consumption limits of new buildings thus fall and renewable energies are also being used in existing properties. The federal government wants to continually tighten up the minimum standards for electricity applications in the building sector. The Federal Council is also planning a change from a funding to a promotion system in climate and energy policy from 2021 onwards. As an element of which an electricity incentive

fee is to be introduced.

### Further measures of the canton and of the federal government

☀ — **Further:** The following further measures are conceivable at cantonal and federal level:

- Statutory obligation to set up a renewal fund when a property changes hand
- Extension of fiscal deduction period for overall redevelopments
- Redevelopment obligation for buildings with a poor energy record (cf. canton of Geneva)

Another measure that could be considered is whether the obligation to an ongoing increase in efficiency in the usage of energy and electricity that currently applies for large-scale consumers (article regarding large-scale consumers) should be expanded to small and middle sized enterprises SMEs.

### 5.4 Energy supply: Increasing the usage of renewable energies and waste heat

Electricity is supplied via the electricity grid. A small but growing number of households and companies also uses solar power from their own roof. Many properties in the City of Zurich also obtain the energy for heating and hot water from a pipeline grid, for instance gas and district heating. From what sources the electricity, heat or cooling comes from and how well the districts are developed with heating and cooling networks from renewable sources or waste heat has a very strong influence on the 2000-Watt targets: Around

40% of the entire potential for reduction in primary energy lies in the energy supply. For greenhouse gases, the share is even higher, at 50%.

In power supply, the savings in primary energy can be generated through a complete substitution of nuclear energy with renewable energies. In heat supply, the primary energy consumption can be reduced through an increased usage of waste heat from waste and cleaned waste water. With the reduction of greenhouse gas emissions, the focus is on replacing fossil-fuelled individual heating systems with a decentralised renewable heat supply or, if the prerequisites are given, connecting the corresponding property to an energy network that is operated with renewable energy or waste heat.

The City of Zurich has various starting points:

- Great scope exists in pipeline-bound energy: around 60% of the energy that is used in the City of Zurich is distributed via pipeline networks that are in public ownership (electricity grid, heating and cooling grids from waste combustion, from waste heat and renewable sources, gas grid).
- Heat, cooling and electricity supply of the City's own buildings (cf. Chapter 5.3 Buildings)
- Financial incentives for the changeover to renewable energies in addition to programmes of the federal government and canton

– Consulting for private builders (cf. also Chapter 5.3 Buildings)

The following measures are already being implemented, planned or to be discussed as further measures (cf. Fig. 9):

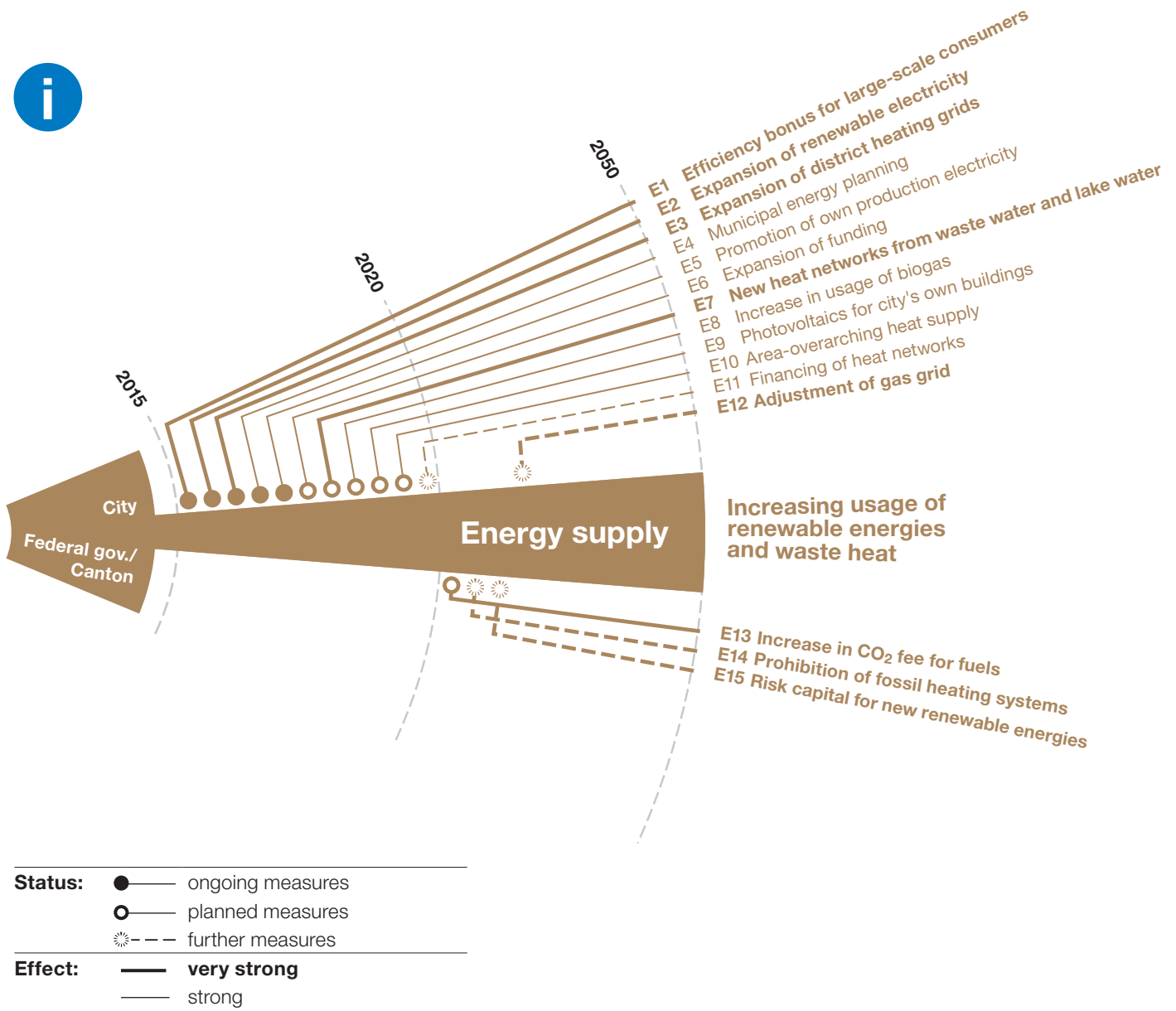


Fig. 9: Direction of impact energy supply with ongoing, planned and further measures

## Ongoing measures of the City of Zurich

● — **Ongoing:** In the production and supply of energy, the City has been implementing effective measures via the municipal companies ewz and ERZ and via Energie 360° AG for years.

Today, the product «Zurich Heat» from ERZ is 80% CO<sub>2</sub> neutral, not least thanks to the wood-fired thermal power plant Aubrugg. In order to distribute the waste heat from waste recycling and the wood-fired heat and power plant as efficiently as possible, the district heating grids are being continually consolidated and expanded.

In 2006, ewz introduced various products with solely renewable electricity. Private customers are supplied with one of them as a standard feature. The result: The percentage of renewable energy in the sale of electricity increased strongly to almost 70% by 2014. Since 2015, ewz has supplied solely products with 100% renewable electricity in its supply areas as part of its basic supply service. Pursuant to the ewz electricity future, the production of electricity from renewable sources is being continually expanded. The advancing liberalisation of the electricity market, however, is restricting the influence of the City to a share of renewable energies that is as high as possible in the sales of electricity. The large-scale customers who are already active today in a free market can freely select the quality of electricity. This explains the percentage of non-renewable electricity in the energy record (cf. Fig. 1).

The changeover from oil to gas heating systems is an intermediate step to the changeover to a largely renewable heat supply. Over the last two decades, it has contributed greatly to reducing greenhouse gas emissions. Energie 360° AG has promoted the sale of biogas via its natural gas grid for several years. 2% of the sold gas was biogas in 2014. Since 2015, the standard gas product has been 5% biogas. A percentage of this originates from the Werdhölzli fermentation plant, where the City has produced biogas since 2013.

With the efficiency bonus from ewz, business customers benefit from reduced tariffs when they increase their energy efficiency pursuant to the agreed targets. The model now meets 68% of the electricity entitled to a bonus.

With the electricity saving fund, the City of Zurich has promoted efficient devices, solar collectors, photovoltaic systems and heat pumps since 1991. Between 2010 and 2013, the production of solar power in the municipal area has doubled to a good 9 GWh. Since 2014, ewz has offered two new solar power options: Firstly, customers can acquire investments in solar power systems directly; secondly, ewz supports home owners in the implementation of photovoltaic systems on their own roof.

For its own requirements, the City of Zurich purchases 100% green electricity. It is striving a supply with renewable energy for the generation of heat and any cooling requirements in the City's own buildings.



### Planned measures of the City of Zurich

○ — **Planned:** The electricity saving fund is to be replaced by a new funding instrument. It is to have the same purpose but to be based on a more stable financing.

A great effect is to be expected by the planned development and expansion of infrastructures with which the City wants to use waste heat from cleaned waste water and heat and cooling from lake water.

Energie 360° AG wants to increase the share of biogas in the overall sales of gas further.

For the City's own properties, a strategy is being developed for the production and own use of solar power. In addition, the City wishes to implement area-overarching heating and cooling networks in order to provide major municipal properties and if applicable also private residents with renewable energy or waste heat.

### Further measures of the City of Zurich

☀ — **Further:** In addition to the consistent implementation of the ongoing and planned measures, the following further measures in the municipal area should be checked:

- New funding and financing models and/or accompanying measures (e.g. energy zones) for the development of large-scale new heating and cooling networks on the basis of environmental and waste heat sources.
- Mid-term adjustment of the gas grid coordinated to the Municipal Energy Planning,

the ongoing grid planning of Energie 360° AG and the owner strategy of the City of Zurich.

### Planned measures of the canton and of the federal government

○ — **Planned:** The federal government is planning to increase the CO<sub>2</sub> tax on heating and process fuels further. This effective measure remains an important element of the energy and climate policy also in the planned transfer from a funding to a incentive system.

### Further measures of the canton and of the federal government

☀ — **Further:** The following further measures have a high potential and are to be checked at cantonal and/or federal level:

- Prohibition of fossil-fuelled heating systems in new buildings and replacement of systems as an important element of an amendment to the MuKE n.
- Risk capital for projects with new technologies such as deep geothermal heat or large-scale storage for electricity or heat in order to be able to drive the breakthrough of pioneering concepts forward.

- 5.1 Consumption
- 5.2 Settlement
- 5.3 Buildings
- 5.4 Energy supply
- 5.5 Mobility

### 5.5 Mobility: Reducing burdens caused by traffic

Motorised private transport and aviation can make an important contribution to achieving the goals of the 2000-Watt Society. Around 25% of the total potential for reduction in energy and greenhouse gases can be found in mobility. A large percentage can be assigned to aviation. A major effect can be achieved if more efficient, climate-friendly drives are developed and increasingly used, and aviation and motorised private transport decline. A supportive effect here is the expansion of

public transport and of bicycle and pedestrian traffic.

The major regulative decisions in transport are made at the federal and cantonal level. The international level is also decisive for aviation. The City of Zurich can primarily exert an influence on the services offered in overland transport. The following measures are already being implemented, planned or to be discussed as further measures (cf. Fig. 10):

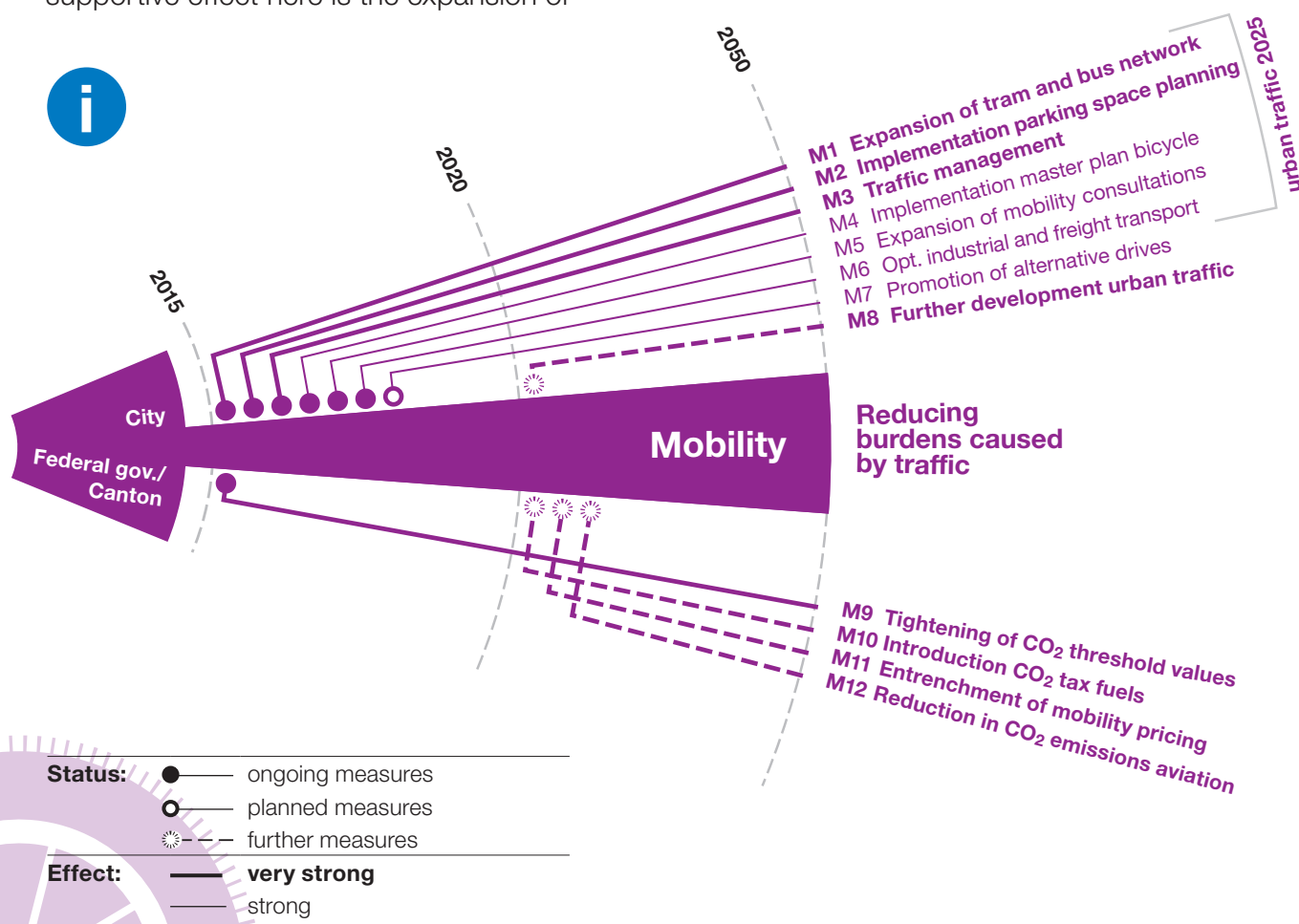


Fig. 10: Direction of impact mobility with ongoing, planned and further measures

### Ongoing measures of the City of Zurich

● — **Ongoing:** The City has long been sounding out its scope for action in overland transport. In the modal split, public transport increased from 30% in 2000 to 39% in 2010. The Strategy «Urban Traffic 2025» has been running since 2012. This overarching instrument of transport policy gives an additional boost to the existing mobility strategy. The network and services for tram and trolleybus are being expanded. The City influences the motorised traffic volume via the planning and management of parking space and via the planning and implementation of pioneering infrastructure projects. Higher tariffs for parking spaces are planned in the so-called white zone. The City controls the volumes of traffic via traffic lights, access restrictions and other measures of traffic management. A City logistics concept is in preparation for commercial traffic. In addition, the City is driving the expansion of the cycling network forward via the Cycling Master Plan and offers mobility consulting in order to support the switch to public and cycling and pedestrian traffic.

### Planned measures of the City of Zurich

○ — **Planned:** In addition to the ongoing further development of Urban Traffic 2025, the City is planning to change over to alternative drives even more with its own vehicle fleet, e.g. through the use of electromobility and biogas vehicles. It is thus complying with the specifications of the municipal vehicle policy.

### Further measures of the City of Zurich

☼ — **Further:** In order to strengthen public transport and cycling and pedestrian traffic further, it needs to be checked at city level whether the

Urban Traffic 2025 Strategy can be supplemented in a next phase with additional measures of a controlling effect. A further expansion of public transport, the promotion of electromobility and other alternative drives, the increased implementation of home office and measures to adjust the traffic volume of motorised private transport can be considered as measures.

### Ongoing measures of the canton and of the federal government

● — **Ongoing:** At federal level, the CO<sub>2</sub> threshold values for new cars are continually being tightened.

### Further measures of the canton and of the federal government

☼ — **Further:** At the federal level, two measures have been under discussion for some time that could substantially reduce greenhouse gas emissions in particular but also the energy consumption of land transport:

- Introduction of a CO<sub>2</sub> tax on motor fuels
- Entrenchment of a mobility pricing at federal level as the basis for control measures for the traffic volume

In order to reduce the CO<sub>2</sub> emissions from aviation, the issue would have to be submitted by the federal government within the framework of international bodies. Various alternative measures are conceivable: CO<sub>2</sub>-dependent take-off and landing fees, a CO<sub>2</sub> quota per airport, fuel customs or the integration of aviation in CO<sub>2</sub> emissions trading.



## 6 Synergies and conflicts of interest

Synergies and conflicts of interest result from the directions of impact, areas of action and measures of the roadmap. These can occur both within the roadmap 2000-Watt Society and towards goals of other municipal strategies or between the three dimensions of sustainability. Important synergies and conflicts of interest are shown in the following areas.

### 6.1 Sufficiency and consumption

A diet that consists predominantly of plant-based products and only to a small extent of animal products protects the climate and also has a positive effect on health. Today, the population has become increasingly aware of these contexts. Sharing has also recently been given a boost under the buzz word «Sharing Economy». In this way, and also through increased repair and a usage of long-lasting goods for as long as possible, consumption and the usage of grey energy and grey emissions fall.

At the same time, such developments run counter to the mechanisms of the current growth society. The direct area of influence of the City is also restricted to its own budget, where it can generate effect in particular in the procurement of goods and in the implementation of planning and construction projects. The City can have a role model function via attractive examples.

### 6.2 Urban concentration

In order to be able to accommodate the growing population, the City has to have more urban concentration. This offers the opportunity of reducing the individual consumption of space for living, working and infrastructure. More compact areas can be

developed more efficiently and more cost-effectively with infrastructure and public transport. If the usage is well mixed, they also offer short distances. In addition, the prerequisites are favourable in order to operate area and district heating grids on the basis of renewable energies and waste heat.

In addition to these positive effects, however, challenges also have to be overcome. Where there is urban concentration, additional public infrastructures such as school buildings and open spaces – a cost factor – are required. At the same time, recreational areas and low-cost industrial and housing areas are increasingly under pressure. A greater density also entails more activities in the municipal area. Conflicts in usage and neighbourhood can be the result.

### 6.3 Implementation of energy measures in buildings

If the heat insulation of buildings is optimised, this has several positive consequences: It not only requires substantially less heating warmth; renewable energies can also be used more, for instance through geothermal probes or air-to-water-heat pumps. In addition, within the framework of a redevelopment project, the own production of heat or electricity can also be implemented on roof or facade areas.

6.1 Sufficiency and consumption

6.2 Urban concentration

6.3 Implementation of energy measures in buildings

6.4 Transformation of energy supply

6.5 Aviation and attractiveness of location

6.6 General challenges

But there are also challenges in the implementation of energy measures. Solutions that are ideal from an energy perspective are made more difficult or expensive through other requirements in the public interest such as freedom from obstacles, preservation of monuments, fire police or statics. Conflicts in usage can arise if, for instance, roof areas should also be used at the same time for the production of heat and electricity, as an exterior space, as a location for building technology and for ecological roof greening. In addition, the redevelopment of a building always results in an increase in value – even without specific energy measures. This makes the purchase price and rental rates more expensive both with private as well as with the City's own properties.

## 6.4 Transformation of energy supply

New and extended heat networks on the basis of waste heat or renewable sources extend the range of 2000-Watt-compatible sources of heat. At the same time, the construction of new networks must take place in coordination with the grids that already exist. For economic reasons, a territory is ideally only to be developed with one pipeline grid. If new networks with renewable energies are developed in areas with existing gas development, the future role of gas grid and natural gas needs to be clarified.

In the liberalised electricity market, the customers can freely select the electricity

quality again. The City can thus influence less closely how much renewable electricity is obtained on the municipal territory. The electricity mix can worsen as a result.

In the interest of grid stability, not only the production of solar power in the municipal territory but also its direct usage or interim storage is to be promoted in future.

## 6.5 Aviation and attractiveness of location

Fewer flight movements mean fewer greenhouse gases. However, the City does not have any direct jurisdiction to influence the greenhouse gas emissions of aviation. Here, the canton, federal government and international organisations are the leading stakeholders.

Depending on measures and their coordination with the surrounding countries, restrictions in aviation can jeopardise the attractiveness of location of the City and of the metropolitan region of Zurich.

## 6.6 General challenges

From a more general, higher-level perspective, the following three challenges also prove to be pivotal:

- The City or the City Administration respectively only has limited influence on the attainment of the 2000-Watt objectives. In individual areas, it can take steps to implement it itself; in others, however, merely create the necessary prerequisites and offer incentives. Ultimately, private individuals also decide how they as consumers or builders or in the choice of the means of transport implement the goals of the 2000-Watt Society in their professional and private everyday life.
- On a regulatory level, the City has already strongly exploited its scope. Now the canton and the federal government have an obligation to implement the energy strategy of the federal government. This is a strong lever in order to transform energy supply and usage.
- In the sense of a sustainable development, when developing and implementing energy policy and climate policy measures, a consideration needs to be made between ecological, social and economic targets of the City.

**6**  
**Synergies and  
conflicts of interest**

**7**  
**Prioritisation of the  
most effective  
measures**

**8**  
**Conclusion  
and next steps**

**9**  
**Glossary**

6.1 Sufficiency and consumption

6.2 Urban concentration

6.3 Implementation of energy measures in buildings

6.4 Transformation of energy supply

6.5 Aviation and attractiveness of location

6.6 General challenges



## 7 Prioritisation of the most effective measures

The measures with the greatest effects were subjected to a rough assessment. For this purpose, the specialists assessed how great the effect of the individual measures is on the energy consumption and the greenhouse gas emissions, how well the measures can be financed, how they have an effect on the economy, society and environment and how high the obstacles to implementation are. The measures were prioritised on the basis of these assessments.

The assessments of the experts are of a purely qualitative nature and depend strongly on the assumptions made and the configuration of the measures. With regard to the further development of the municipal 2000-Watt programme, this prioritisation aims to focus the decision makers on the most effective measures. This also in light of the limited resources and the different responsibilities. The assessments of the measures and the prioritisations are compiled in Figure 11.

### 7.1 Assessment criteria

Firstly, the most effective planned and continuing measures were assessed and secondly also measures already in implementation but that still have a lot of additional potential (ongoing measures).

The assessment of the reduction effect with regard to primary energy and greenhouse gas emissions on the municipal territory is depicted with triangles of varying size. The assessments on the financial feasibility, on the effects on the economy, society and environment as well as on the obstacles to implementation are symbolised by a three-

stage traffic light scale.

- The financial feasibility of the measure by the public sector can be easy, medium or difficult. This depends on whether the perpetrators pay for the financing of a measure or whether public funds are required for an investment. Depending on the measure, the city, canton or federal government is responsible for the financing.
- Positive or negative effects can occur in the effect of the measure on the three dimensions of sustainability (economy, society and environment). In the middle (yellow), few effects are to be expected or a combination of positive and negative effects.
- Depending on the complexity of the measure, the number of parties involved and conflicts of interest that occur, the obstacles to implementation in the political process are classified as low, medium or high.
- From an overall assessment, there is ultimately a prioritisation of the measures in the last column. It differentiates whether a measure falls under the jurisdiction of the canton/federal government or the City. This



7.1 Assessment criteria

7.2 Most effective measures

column aims to serve as a decision aid as to which measures are to be viewed in depth and implemented with priority.

## 7.2 Most effective measures

Figure 11 makes clear that a large percentage of the measures with a high impact lies in the jurisdiction of canton and federal government. Within the realms of its possibilities, the City should influence the development and implementation of these measures in higher-level jurisdiction.

Measures with a very high potential for reducing greenhouse gas emissions are solely in the hand of canton/federal government.

These are:

- Entrenchment of the model regulations of the cantons in the energy sector (MuKEN 2014) in cantonal legislation
- Increase in CO<sub>2</sub> tax on heating and process fuels
- Prohibition of fossil heating systems in new buildings and replacing heating systems
- Introduction of a CO<sub>2</sub> tax on motor fuels or increase in the petroleum tax
- Entrenchment of mobility pricing in federal law
- Reduction in CO<sub>2</sub> burdens caused by aviation

Of the measures in municipal jurisdiction, the following show the greatest impact:

- Sustainable diet in public facilities
- Urban concentration

- Contribution of the 2000-Watt requirements in planning procedures
- Improvement in energy and ecological record of the City's own buildings
- Expansion of district heating grids to use waste heat from waste combustion
- Development and expansion of networks to use waste heat from cleaned waste water and heat/cooling from lake water
- Further development of the Urban Traffic Strategy

As the overview shows, the majority of the most effective measures in municipal jurisdiction are already in the phase of implementation or planning today. However, it also becomes clear in what areas the development towards the 2000-Watt Society could be driven forward even more strongly than it has been up to now and what new thematic fields should be opened up.

### Prioritisation of the most effective measures

Measures	Implementation status	Effect on primary energy		Effect on greenhouse gases		Financial feasibility	Effect			implementation hurdles	
		a		a			on Economy	on Society	on Environment		
		medium	strong	very strong	medium	strong	very strong	● easy ● medium ● difficult	● positive ● little ● negative	● positive ● little ● negative	● positive ● little ● negative
<b>Consumption</b>	<b>K2</b>	Sustainable diet in public facilities (local, seasonal, preferably plant-based, reduction in food waste)	●	▶	▶	●	●	●	●	●	●
	<b>K5</b>	Strengthening of the green industry (e.g. resource-friendly products, repair, sharing, plastics recycling)	●	▶	▶	●	●	●	●	●	●
	<b>K6</b>	New steering fees for other resources (e.g. areas, raw materials)	●	▶	▶	●	●	●	●	●	●
<b>Settlement</b>	<b>S1</b>	Identification of concentration potential and area planning for areas with special usages	●	▶	▶	●	●	●	●	●	●
	<b>S5</b>	Contribution of the 2000-watt requirements in planning procedures (design plans, special construction regulations, etc.)	●	▶	▶	●	●	●	●	●	●
	<b>S6</b>	Development of municipal structure plan settlement, landscape and public buildings in close consultation with energy planning	●	▶	▶	●	●	●	●	●	●
<b>Buildings</b>	<b>G3</b>	Improvement in energy and eco record of the city's own buildings: implementation of 7 Milestones, portfolio strategies, area standards, reduction in requirements of buildings	●	▶	▶	●	●	●	●	●	●
	<b>G4</b>		●	▶	▶	●	●	●	●	●	●
	<b>G6</b>		●	▶	▶	●	●	●	●	●	●
	<b>G8</b>		●	▶	▶	●	●	●	●	●	●
	<b>G11</b>	Entrenchment of the model regulations of the cantons in the energy sector (MuKEn 2014) in cantonal legislation	●	▶	▶	●	●	●	●	●	●
	<b>G12</b>	Introduction of electricity steering fee	●	▶	▶	●	●	●	●	●	●
<b>Energy Supply</b>	<b>E3</b>	Development of district heating grids to use waste heat from waste combustion	●	▶	▶	●	●	●	●	●	●
	<b>E7</b>	Development and expansion of networks for the use of waste heat from cleaned water and heat/refrigeration from lake water	●	▶	▶	●	●	●	●	●	●
	<b>E12</b>	Adjustment gas grid (target grid planning Energy 360° AG)	●	▶	▶	●	●	●	●	●	●
	<b>E13</b>	Increase in CO <sub>2</sub> tax on fuels	●	▶	▶	●	●	●	●	●	●
<b>Mobility</b>	<b>M8</b>	Further development Strategy Urban Traffic (e.g. expansion of public transport, adjustment of traffic volume motorised private transport, alternative drives, home office)	●	▶	▶	●	●	●	●	●	●
	<b>M9</b>	Tightening of CO <sub>2</sub> threshold values for passenger vehicles and commercial vehicles	●	▶	▶	●	●	●	●	●	●
<b>Mobility</b>	<b>M10</b>	Introduction of CO <sub>2</sub> tax on fuels or increase in petroleum tax	●	▶	▶	●	●	●	●	●	●
	<b>M11</b>	Entrenchment of mobility pricing in federal law	●	▶	▶	●	●	●	●	●	●
	<b>M12</b>	Reduction of CO <sub>2</sub> burdens caused by aviation, e.g. through CO <sub>2</sub> dependent fuel taxation or take-off and landing fees	●	▶	▶	●	●	●	●	●	●

Fig. 11: Most effective measures, assessed and prioritised

7.1 Assessment criteria  
7.2 Most effective measures

Priority for follow-up

d

- Priority 1
- Priority 2
- Priority 3

Canton/ Federal gov.	City

Comment

Further strengthening existing approaches and initiatives. The effect of the measure becomes substantially greater when similar private initiatives increase on the municipal territory and can develop more widespread impact.

Growing consumer awareness opens up opportunities for resource-efficient products and new sharing and further use offers.

As a medium-term supplement to the planned climate and energy steering taxes, additional incentives could be created for an economical handling of resources. Budget-neutral configuration.

Making use of synergies with increase in energy efficiency and usage of renewable energies. Effect on target attainment is in part indirect via higher population density per area, i.e. lower consumption per person.

Early contribution facilitates synergies with further requirements and cost-efficient solutions.

Increased implementation opportunities for networks from renewable sources of energy.

Ensuring financing via new financing models. Using opportunities for savings through reduction in the requirements of buildings.

Planned adjustment to the law in the canton of Zurich in 2021.

Creates incentives to save electricity and for own production and usage. Note evasion effects in the liberalised electricity market. Complete redistribution.

Important impulses for the construction industry. Increase in the value of the properties. Risk of increase in rent costs.

Financial burden for owners of public and private properties. Increase in the value of the properties. Risk of increase in rent costs. Implemented in the canton of Geneva.

Streamlined process and financial incentive (e.g. efficiency bonus) is the requirement for a successful implementation.

Check funding of the implementation through supplementary financing models and other accompanying measures.

Check funding of the implementation through supplementary financing models and other accompanying measures.

Sufficiently long-time horizon required for adjustment (15 years).

Very effective steering fee.

Highly effective specification. Gradual implementation necessary. There must be realisable alternatives for heat supply.

Financing from CO<sub>2</sub> tax or taxes.

Contribution of city to reduction in CO<sub>2</sub>. Financing of public transport projects through national road and conurbation funds. Expansion of public transport is requirement for reduction of motorised private transport

Effective measure with effective implementation.

Very effective steering fee.

New, integral financing model at federal, cantonal and municipal level for entire ground transport (motorised private transport, public transport, etc.). Substitute for other taxes (e.g. petroleum tax).

Airport of national importance and important employer. internationally coordinated measures necessary.

Notes

- a Absolute, for entire municipal territory
- b Through public sector (corresponding stakeholder)
- c Complexity, number of parties involved, conflicts in aims
- d Appraisal based on partial assessments

Implementation status		
		Ongoing measures
		Planned measures
		Further measures

## 8 Conclusion and next steps

The roadmap shows that the City of Zurich is on a good path within the framework of their possibilities for action. Particularly over the last few years, it has taken a number of supplementary measures; others are in planning. This positive dynamic is fundamentally attributable to important political programmes and control processes: For instance, to the Energy Master Plan, the Strategy «Urban Traffic 2025», the «7 Milestones» programme, the Regional and Municipal Structure Plan or the Environment Master Plan and to major investments by ewz, ERZ, Energie 360° AG, and others.

At the same time, the analysis makes clear that this is not sufficient to reach the goals of the 2000-Watt Society. And it makes clear: There is potential for further reduction in the energy consumption and greenhouse gas emissions. However, further measures are required to exploit it. And in addition to the City, all other stakeholders are also called upon to reach the 2000-Watt Society, without any restriction in the quality of life: private individuals, business, canton and federal government.

A rough qualitative assessment of the most effective measures shows that most of the further measures lie in the area of competence of canton and federal government. The measures with the greatest climate protection potential are even solely in their hand. These include the tightening of the energy regulations in the building sector, the introduction of CO<sub>2</sub> taxes on motor fuels or

also the reduction in the CO<sub>2</sub> burden caused by aviation.

The municipal lever for further reduction in the primary energy consumption and greenhouse gas emissions lies in particular in generating substantially more broad impact with a number of ongoing or planned measures or programmes of measures. These include sustainable diet in public facilities, a high-quality urban concentration in combination with a target-compliant energy supply, the introduction of 2000-Watt requirements in design plans and special construction regulations, the improvement of the energy and ecological record of the City's own buildings, the development and expansion of energy networks to use waste heat from waste and cleaned waste water and of environmental heat and the further development of the «Urban Traffic» Strategy.

The roadmap serves as a basis for the further development of existing measures and to check new measures. The insights from the roadmap are adopted by the responsible organisations into the existing cross-departmental or service-internal programmes. The City Council defines the organisation for the effective implementation of the 2000-Watt Society. Environmental and Health Protection Service Zurich UGZ is responsible for the reporting and further development of the roadmap.

A status report is to be drawn up on the roadmap every four years; this report is aligned to the other reporting. It details

the target attainment and the status of the implementation of the measures. It is also indicated in what areas the municipal implementation strategies and the ranges of measures would have to be adjusted if necessary. It is thus possible to respond to changing boundary conditions.

## 9 Glossary

### **2000-Watt Society**

Cf. text box on page 10.

### **CO<sub>2</sub> equivalents, CO<sub>2</sub>-eq**

Cf. greenhouse gas emissions.

### **Energy networks / heating grids**

An energy network links several buildings with heat pipes. Heat and, depending on requirements, also cooling, is obtained or exchanged via this pipeline system. Large sources of waste heat from technical processes or heat or cooling from the environment can thus be used – for instance, from lake water, river water, groundwater or cleaned waste water. In addition, through the networking of buildings used for different purposes, it is possible to use, for instance, the waste heat from data centres for the heat supply for a residential development.

### **Public district heating**

Public district heating is an energy network that is operated on behalf of the public sector and predominantly uses waste heat and renewable energies. Currently in Zurich, the usage of waste heat from waste combustion (incl. wood-fired heat and power plant) is deemed to be public district heating.

### **Grey energy / grey emissions**

Grey energy denotes the energy that is required for the production, transport, storage, sale and disposal of a product or a service. In an analogous manner, we also speak of grey (greenhouse gas) emissions. The consideration of grey energy paints a more

realistic picture of consumption that own consumption causes worldwide.

### **Article on large-scale consumers**

The article on large-scale consumers in the cantonal energy law (Article 13a) aims for companies with a high consumption of energy to increase their energy efficiency. Large-scale consumers are deemed to be companies with a heat consumption of more than 5 gigawatt hours or an electricity consumption of more than 0.5 gigawatt hours per site of consumption and year. These companies have to analyse their energy consumption and implement reasonable measures to reduce consumption or conclude a target agreement with the construction department. An average increase in the energy efficiency of 2% per year is expected as a guidance figure.

### **Green economy**

Green economy denotes a means of operation that handles natural resources in a sustainable manner, improves resource efficiency and thus strengthens the performance of the economy and welfare overall.

### **Lifecycle of buildings**

The lifecycle of a building incorporates all phases from production of the building materials and the construction to the operation and dismantling and the disposal of construction materials. The grey energy of the construction materials is playing an increasing part in the energy consumption of a building over the entire lifecycle. As the buildings are becoming increasingly efficient,

the percentage of operating energy in the overall energy consumption declines over the total lifecycle.

### **Primary energy consumption / Continuous output primary energy**

Until the energy arrives at the user as heat for heating, as electricity for lighting or as petrol for transport, the energy has to be produced, refined, transported and converted. The energy requirements for this is added to the energy volume effectively consumed and the total denoted as primary energy consumption.

### **Rebound effect**

A rebound effect develops when the gain in efficiency, for instance through economical devices is rescinded in its entirety or in part because more powerful or more devices are used. An example of this is the ever bigger television and computer screen or the growing number of technical devices in households (smartphones, tablets etc.)

### **Sufficiency**

Sufficiency stands for resource-friendly behaviour and reticence in the consumption of goods and services. Sufficiency cannot be achieved through technical measures but instead requires a change in thinking, changes in behaviour by the individual and, if applicable, conscious saving.

### **Greenhouse gas emissions**

Greenhouse gases hold back the reflected rays of the sun and thus ensure additional warming of the Earth's atmosphere. In addition

to the most important greenhouse gas CO<sub>2</sub> there are other climate-relevant gases such as methane, laughing gas or CFC. In accordance with their greenhouse effect, the emissions are converted into CO<sub>2</sub> equivalents. The total, climate-relevant emissions can thus be grouped together as greenhouse gas emissions.

### **Watt**

Watt (W) is the unit indicating the electrical output. The output states how much energy a device uses per second. A watt corresponds to an energy turnover of one joule per second. In 10 hours, a 100-watt bulb uses 1 kilowatt hour (kWh) of energy. A continuous output of primary energy of 2,000 watts as the 2000-Watt Society strives for results in a primary energy consumption of 17,520 kilowatt hours (kWh) per year.







**City of Zurich**

Environmental Delegation of the City Council  
P.O. Box, 8021 Zurich

Tel. 0041 44 412 43 07

[www.stadt-zuerich.ch/2000watt](http://www.stadt-zuerich.ch/2000watt)