Providing context for Smart Energy Cities

Baseline Analysis Method Manual

Baseline Analysis reports

Authors

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Contributors

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Introduction

This report summarises the work undertaken and methodology for producing the **City Baseline Analysis** as part of the EU-FP7 TRANSFORM project. Appended are the resulting **City Baseline Reports.**

The first deliverable from TRANSFORM is an outline of each city utilizing existing data; this is the City Baseline Analysis. As specified in the Transform proposal, the objective of the analysis is to produce a clear outline of each of the participating cities in the Transform project. This outline should draw on existing materials to describe the city in terms of climate, energy assets, ambitions, and targets. The outline should also include information on energy production, energy flows and energy efficiency, where possible.

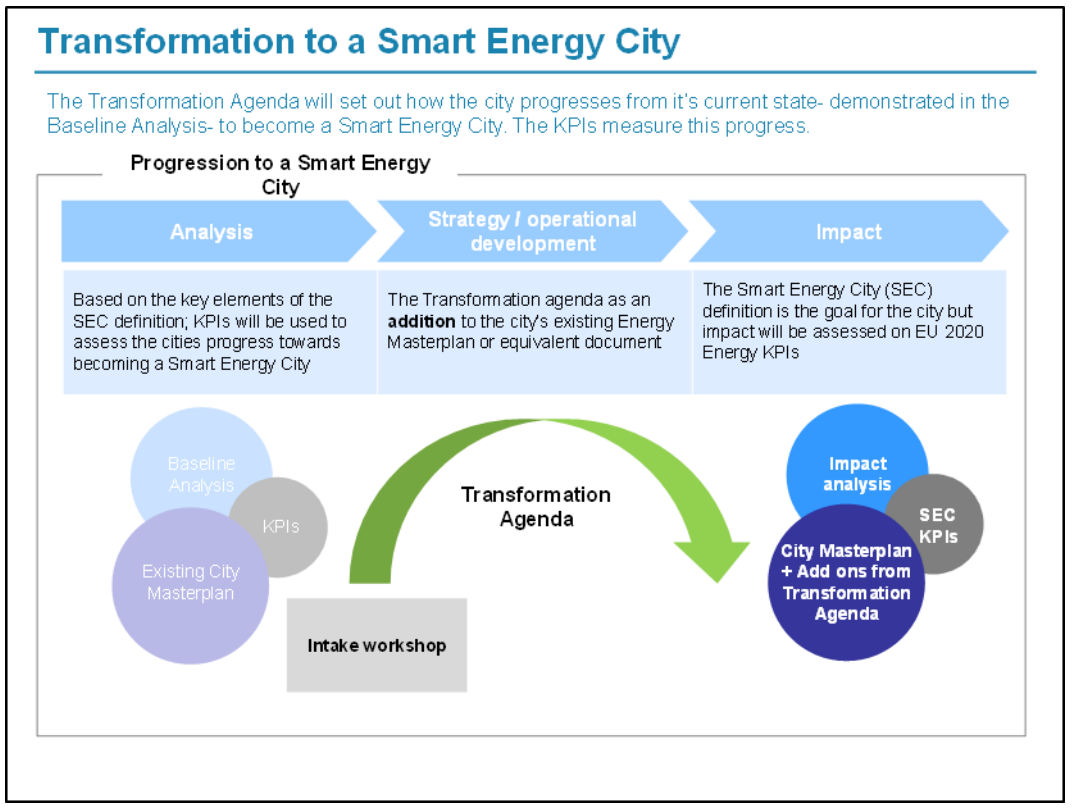


Figure 1. Illustration of the Transform progress including the positioning of the City Baseline Analysis

The role of the City Baseline Analysis is to hold up a mirror to each of the participating cities and to illustrate their current status across a range of sectors. The City Baseline Analysis should provide a snapshot in time of each city; this is a reference point, from which the Transformation Agenda will define the process to become A Smart Energy City.

The Smart Energy City Definition including the key elements and Key Performance Indicators (KPIs) have also been developed as part of work package 1 will provide a set parameters or metrics against which a city can monitor their progress (see fig. 1).

The results of this work can be found in the following reports:

1. Definition of a Smart Energy City;
2. Becoming a Smart Energy City, state of the art of 6 TRANSFORM cities;

The findings of the baseline analysis are displayed in a series of six short reports; one per city. These are the City Baseline reports; the starting place from which the cities will begin their transition to Smart Energy Cities.

As well as providing a point of reference, each city will be able to use their City Baseline Analysis report in their intake workshop. The analysis will help them to decide the areas they would like to focus their efforts.

Roles and workflow

The Baseline analysis was carried out by WP1 overseen by the City of Copenhagen as WP1 leader.

Arup lead on the creation of the questionnaires, collection of data and development of the baseline reports.

Figure 2. 'Creating the baseline analysis'- workflow

1) 2) The process began with Arup producing a draft questionnaire to be issued to the cities, for more information on the baseline questionnaire see section 1.3. This draft was reviewed by the other active parties in WP1: Accenture, DTU and the City of Copenhagen.

3) A blank questionnaire was then issued to each of the cities.

4) 5) Once the data was received from the cities, the most suitable data was then used to draft Baseline Reports. Where appropriate, the data was also supplemented with additional research. Hamburg and Amsterdam have produced an invaluable 'Status-quo report' detailing the characteristics and ambitions of Hamburg and Amsterdam. It has been suggested that all 6 cities

6) A gap-analysis was then carried out, and the draft reports were returned to each city with suggestion of how to improve their data.

7)8) The cities then provided updates to their data, and the baseline reports were revised and issued.

The Baseline questionnaire- data collection

Each city was issued with a blank copy of the questionnaire to populate. This self-assessment asked a series of questions about each city's current state.
Questions (or 'hard KPIs') were asked regarding the cities status across six sectors: Energy, Waste, Water, Transport, Buildings and ICT. The questions were divided thematically into these six sectors so that the questionnaire could be easily divided up amongst the departments within the city authority. Aligning the structure of the questionnaire as closely as possible with organisational structure of the cities allowed cities to respond more efficiently.

Questions were selected on the following basis:

- To provide a broad coverage across the cities sectors;
- Answers could be easily provided by the cities using existing data with minimal calculation or analysis; and
- In line with previous work carried out by Arup and Accenture on Smart Cities.

The questionnaire also contained a 'powers' assessment tool; this is used to establish a city authority's level of influence in each sector. For each of the six sections, the city was asked to report their level of influence over the visions, budgets and policies.

Building the reports- The analysis

The reports produced are a series of 2-page dashboards. Maximising the use of graphics, the reports provide a 10 minute overview of the quantitative data available on the city.

The 'powers table' issued in the baseline questionnaire was used to produce a graphic illustrating the city's control/influence over each sector. For each sector (i.e. water, waste, energy), and under each area of influence (i.e. set vision, budgetary control, etc.) cities were asked to nominate their level of power (i.e. Sets vision, no influence, etc. The diagram illustrates in relative terms, where the city has power, and at what stage in the process they can assert this power.

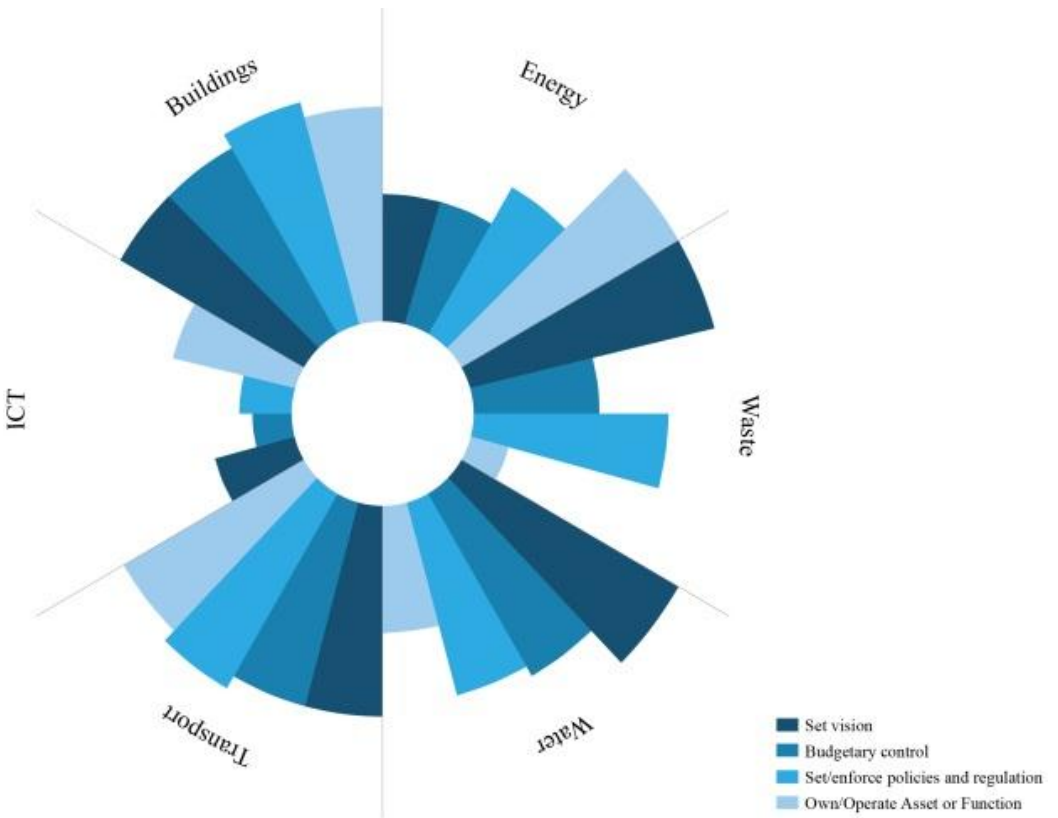


Figure 3. Diagram illustrating city influence over different sectors

Reflection- Improvements to the process

In terms of improvements to the process of producing the City Baseline Analysis, below are some points observed by WP1 and fed back from the cities.

Improving the efficiency of data collection

- Better definition of responsible parties within the cities;
- Greater use of local partners in data collection; and
- Greater customisation to the questionnaire to individual city requirements.

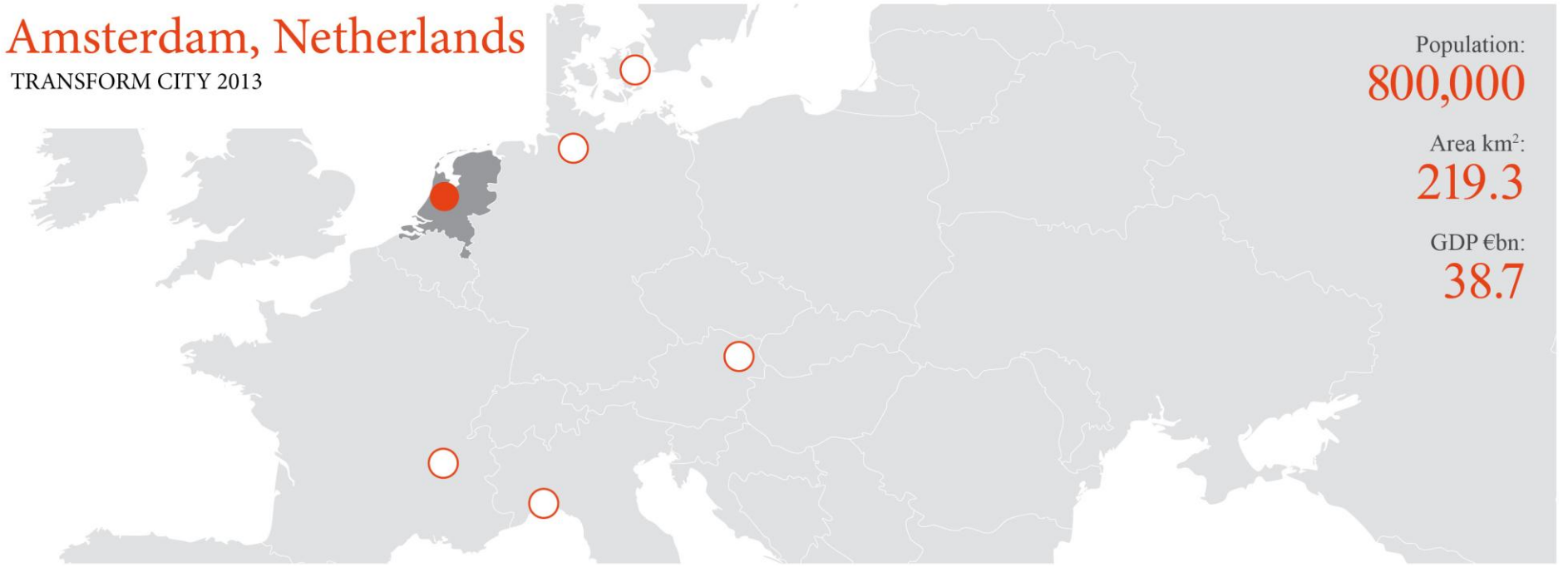
Functionality and additional value of the baseline analysis process

- Cities gained an insight into their data availability;
- Level of detail in the questionnaire allowed cities to realise what they do and do not know;
- Cooperation between stakeholders was strengthened through the data collection process; and
- Data collection and questionnaire formed an important intervention to start TA process;

Baseline Analysis reports

Amsterdam, Netherlands

TRANSFORM CITY 2013



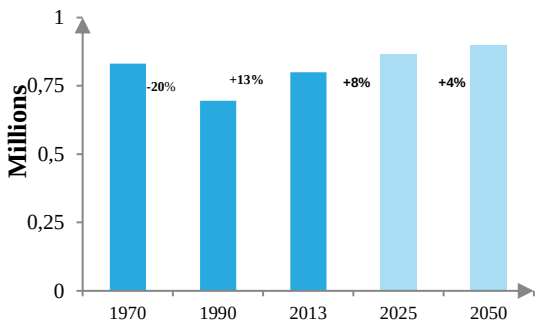
Population: **800,000**

Area km²: **219.3**

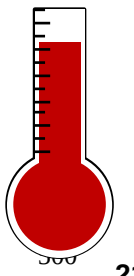
GDP €bn: **38.7**

KEY FACTS

Population 800,000



Temperature range



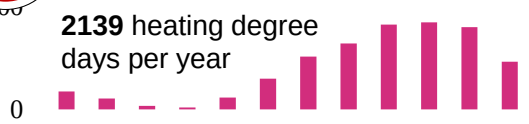
Max 35 ºC

Min -24 ºC

Climate

776 mm average rainfall per year

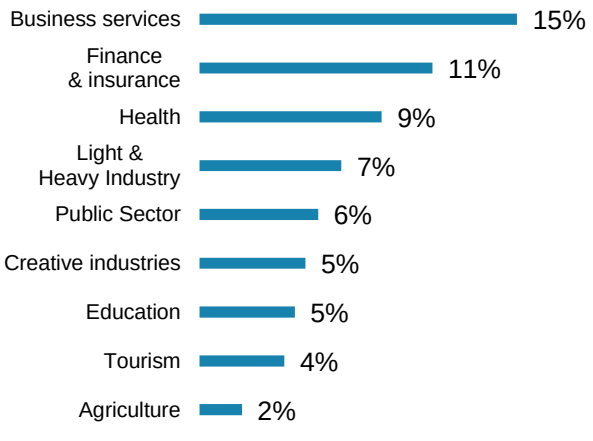
9.7 ºC average temperature



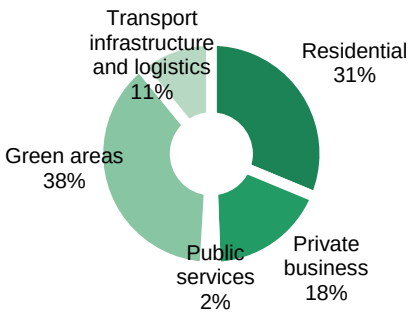
2139 heating degree days per year

Economy

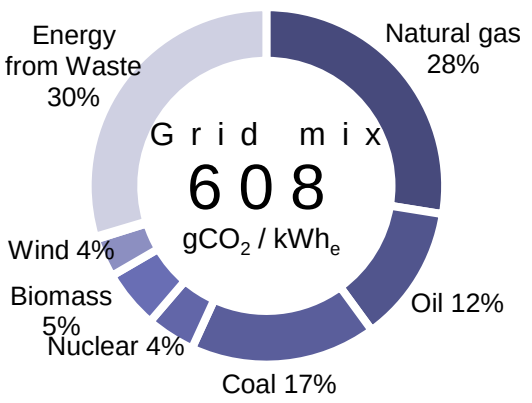
€ 38 billion GDP

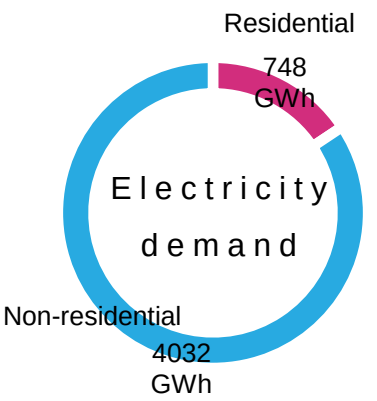


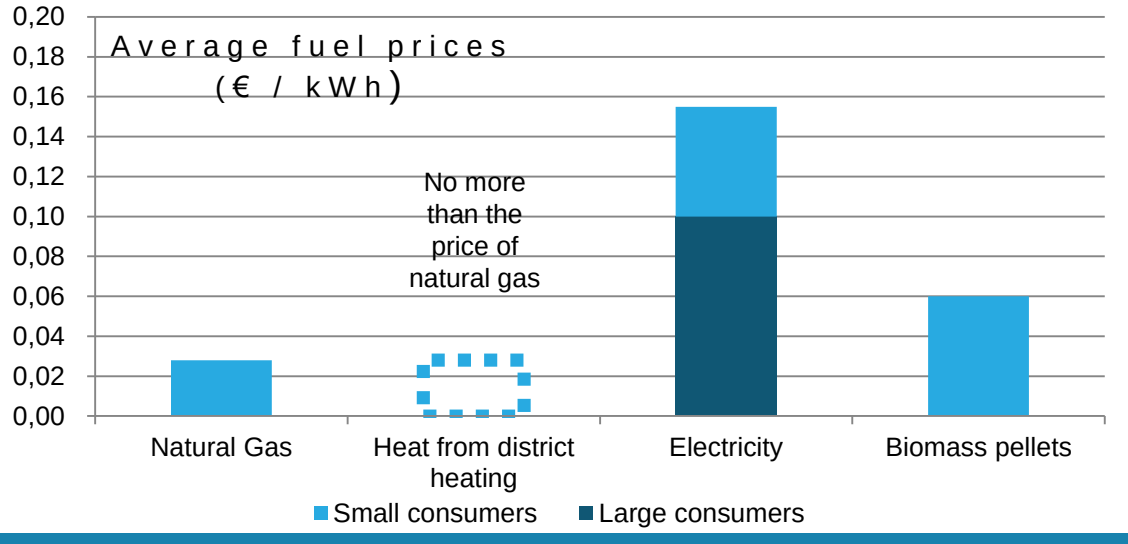
City land use



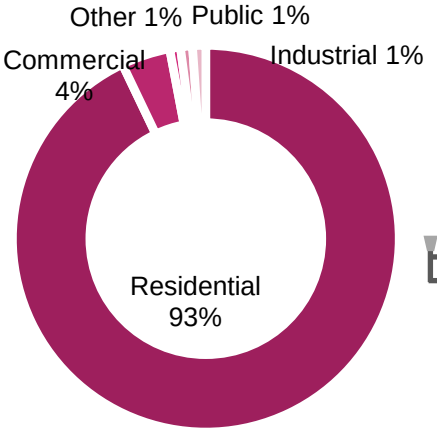
ENERGY



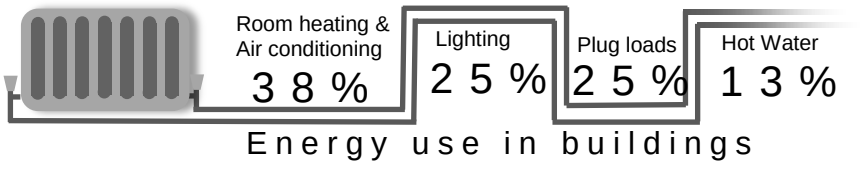




BUILDINGS



From 2015 all new construction in the city must be **climate-neutral**. This means that the building-related energy consumption will be reduced as far as possible by means of insulation (while retaining proper ventilation) and the remaining energy demand will be met from sustainable sources.



TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

AMSTERDAM
THE NETHERLANDS

TRANSFORM CITY 2013

Total city-wide emissions

5,094,000

metric tonnes of CO_2 equivalent (CO_2e) per year

2011

The “Amsterdam Definitely Sustainable 2011 – 2014” programme focuses on 4 pillars:

- **Climate and energy**
- **Mobility and air quality**
- **Sustainable innovative economy**
- **Materials and consumers**

GHG REDUCTION TARGET

Amsterdam aims to reduce overall GHG emissions by

40%

by 2025

(based on a 1990 baseline)

WATER

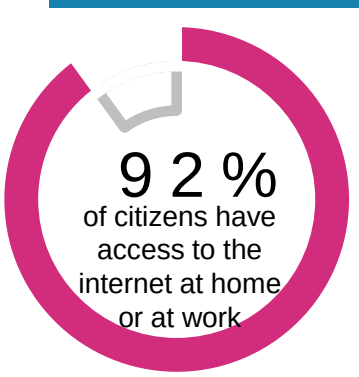
100%

Surface Water

Water treated per day

260 million m^3

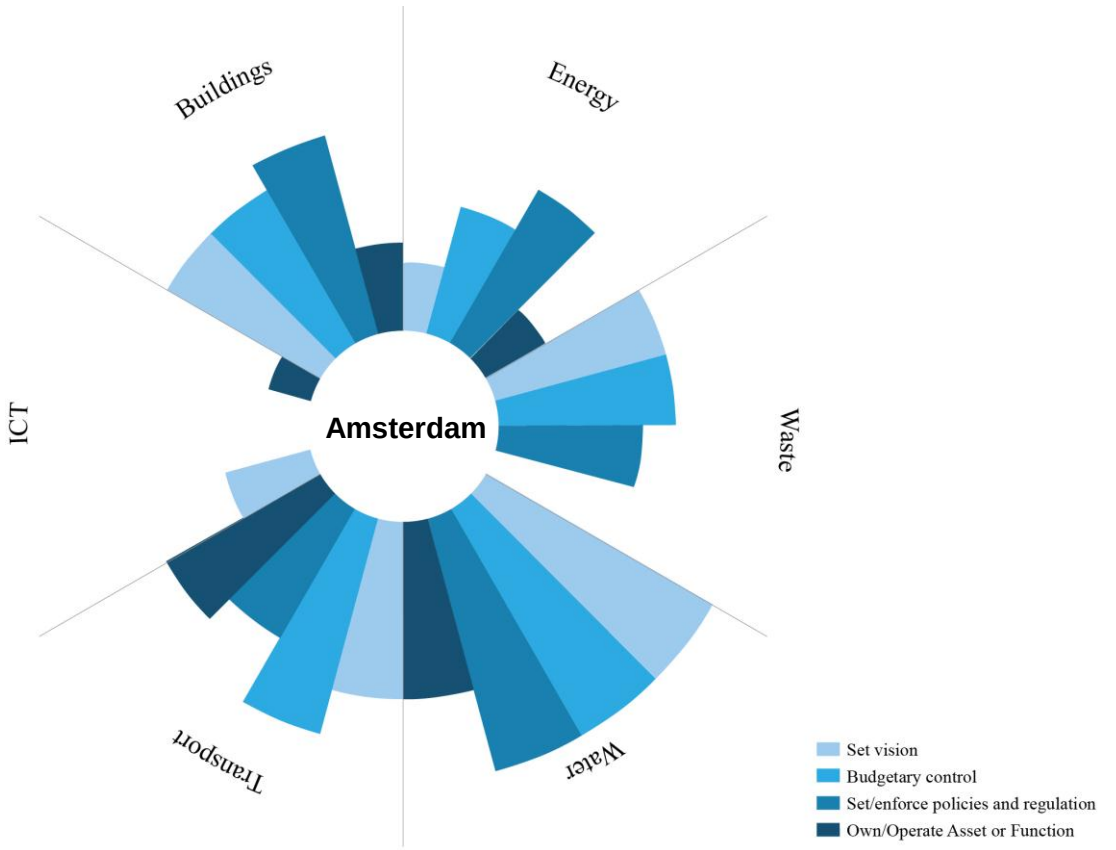
ICT



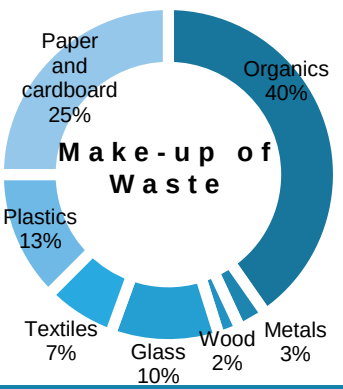
250,000

Registered wireless hotspot users

POWERS



WASTE



1.15 kg

of waste generated per person per day

zero

waste to landfill

TRANSPORT

400km

of cycle lanes

67%

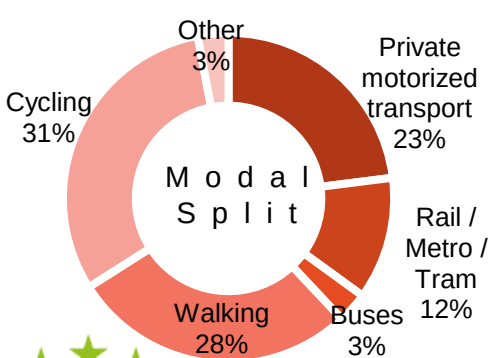
are segregated

350

On street electric vehicle charging points

Intermodal ticketing system

80% of citizens are members

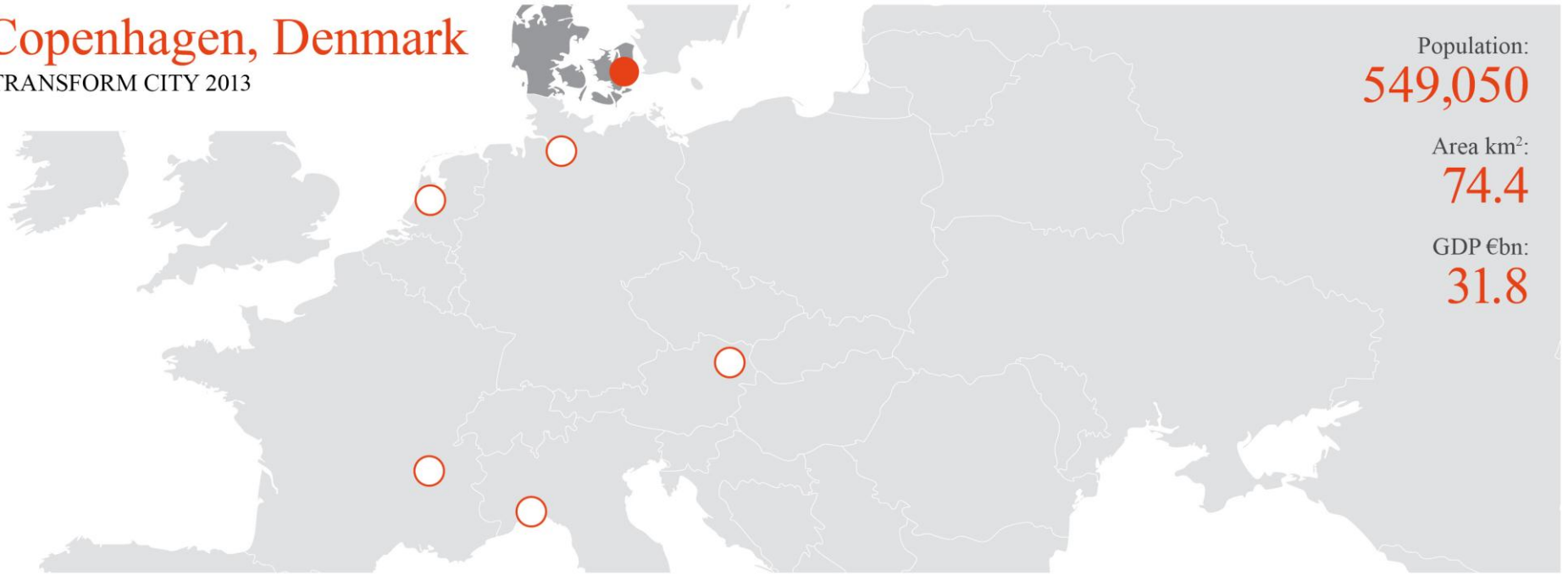


www.amsterdam.nl

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

Copenhagen, Denmark

TRANSFORM CITY 2013



Population:
549,050

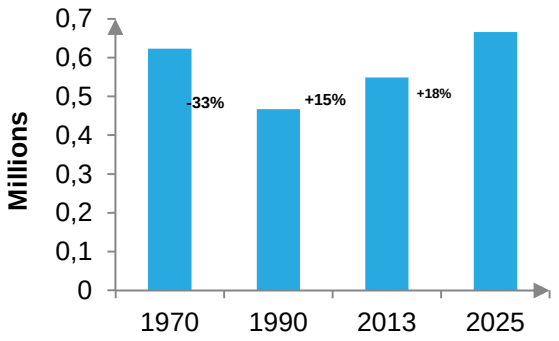
Area km²:
74.4

GDP €bn:
31.8

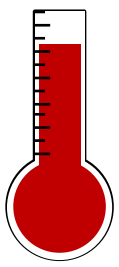
KEY FACTS

Population 550,000

15% increase 1990 – 2013



Temperature range



Max
36.2ºC
1974

Min
-31.2 ºC
1982

Climate

712 mm average rainfall per year

11 ºC average temperature

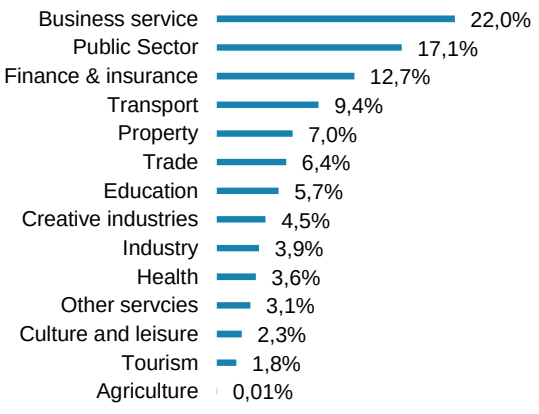
City budget

€ 12,000 per capita

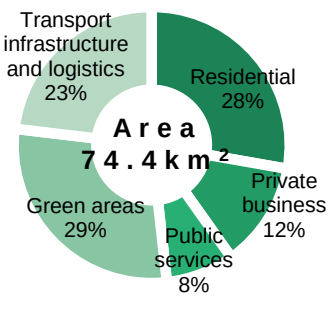
Economy

€ 35 billion GDP

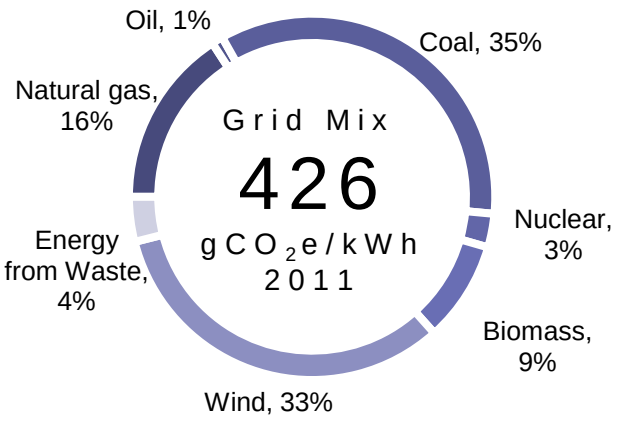
€ 63,000 GDP per capita

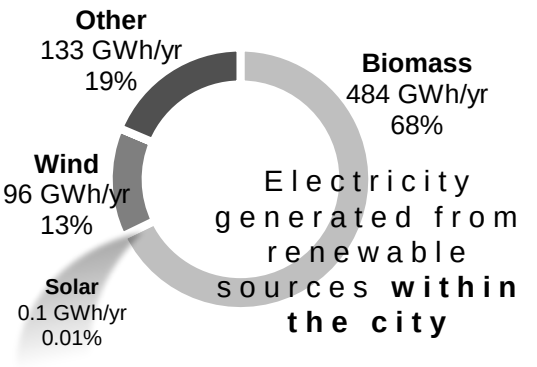


City land use



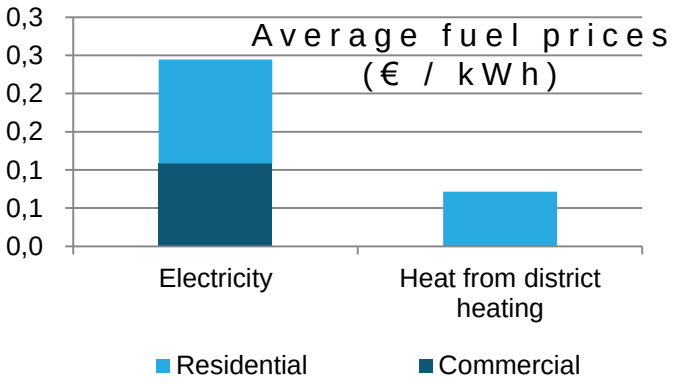
ENERGY



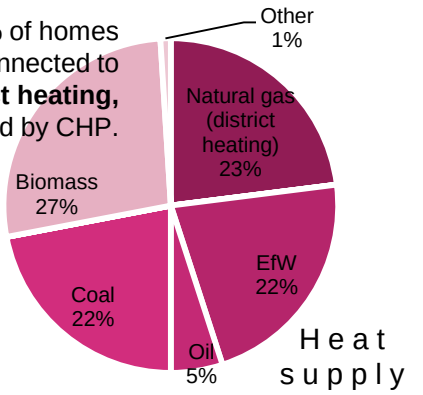


Primary energy consumption of Copenhagen **6,878** GWh / yr

Including 2,463 GWh of electricity per year



98.3% of homes are connected to **district heating,** produced by CHP.



WATER

Water use is reportedly falling - approaching

100l/capita/day

Most of the city has a joint system where stormwater and waste water is discharged for processing in central treatment plants. Separate sewer systems only exist in the part of the city which is close to the ports.

Combined

Rainwater and wastewater system

100 %
Ground Water

Water delivered per day

31.8
million m³

100% of all domestic users buildings are

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

COPENHAGEN, DENMARK TRANSFORM CITY 2013

Total city-wide emissions

2,124,312

metric tonnes of CO_2 equivalent (CO_2e) per year

2012

GHG REDUCTION TARGET

Copenhagen aims to reduce overall GHG emissions by

20%by 2015

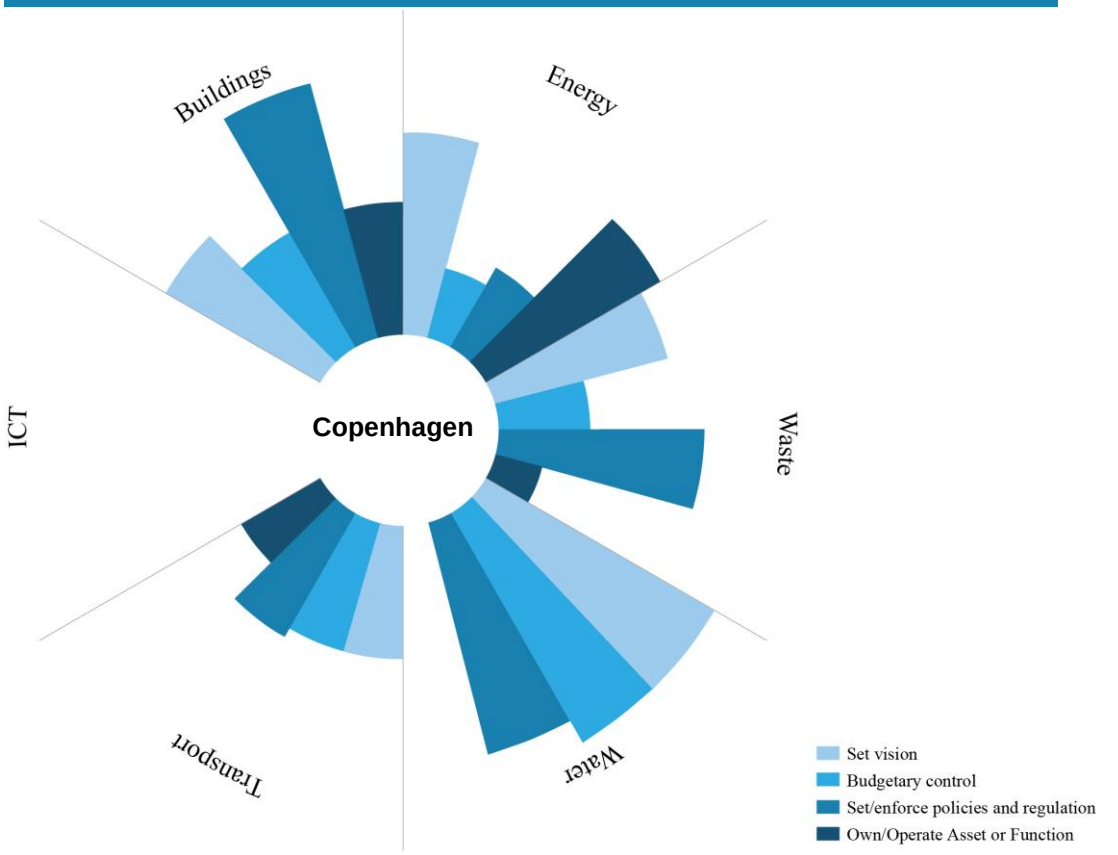
(achieved in 2011)

100%

By 2025

(based on a 2005 baseline)

POWERS



WASTE

Better utilisation of waste is prioritised, so as many resources as possible are reused and less is incinerated.

Targets:
1. Reduce the amount of waste for incineration by 20%
2. Ensure 45% of household waste is reused by 2018

Waste produced in the city

400 kg/person/year

100%

Formal waste collection coverage in the city

Accounts for 4% of electricity and 22% of district heating

TRANSPORT

411km of cycle lanes

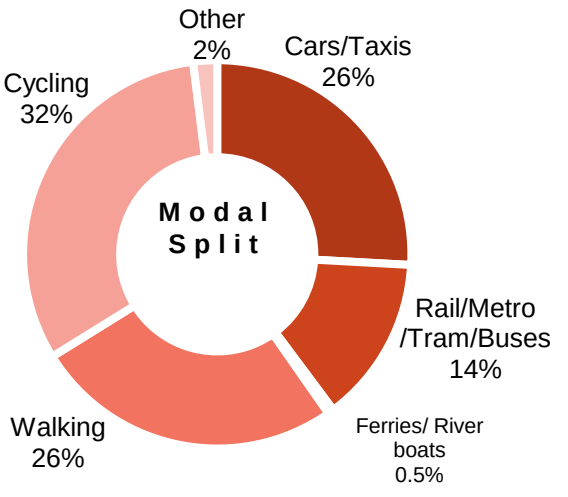
94% are segregated

High provision of facilities for cyclists has led to a large proportion of journeys being undertaken by bicycle. 32%

If the use of cars is necessary, the goal is that the large majority of them use electrical, hydrogen or are hybrids. Transport must contribute to making a greener, smarter and healthier city in 2025

129 On street electric vehicle charging points

Intermodal ticketing system



Transport is a main part of the Climate Plan 2025. Copenhagen is focused on making cycling, walking or using public transport the most attractive means of transport for Copenhageners to get around the city.

ICT

Copenhagen's vision is that all Copenhageners have digital access to public services.

IT Strategy priorities divided into five categories:
Citizens, businesses and users Municipality tasks Employees Managing IT development Operation and development of the IT platform

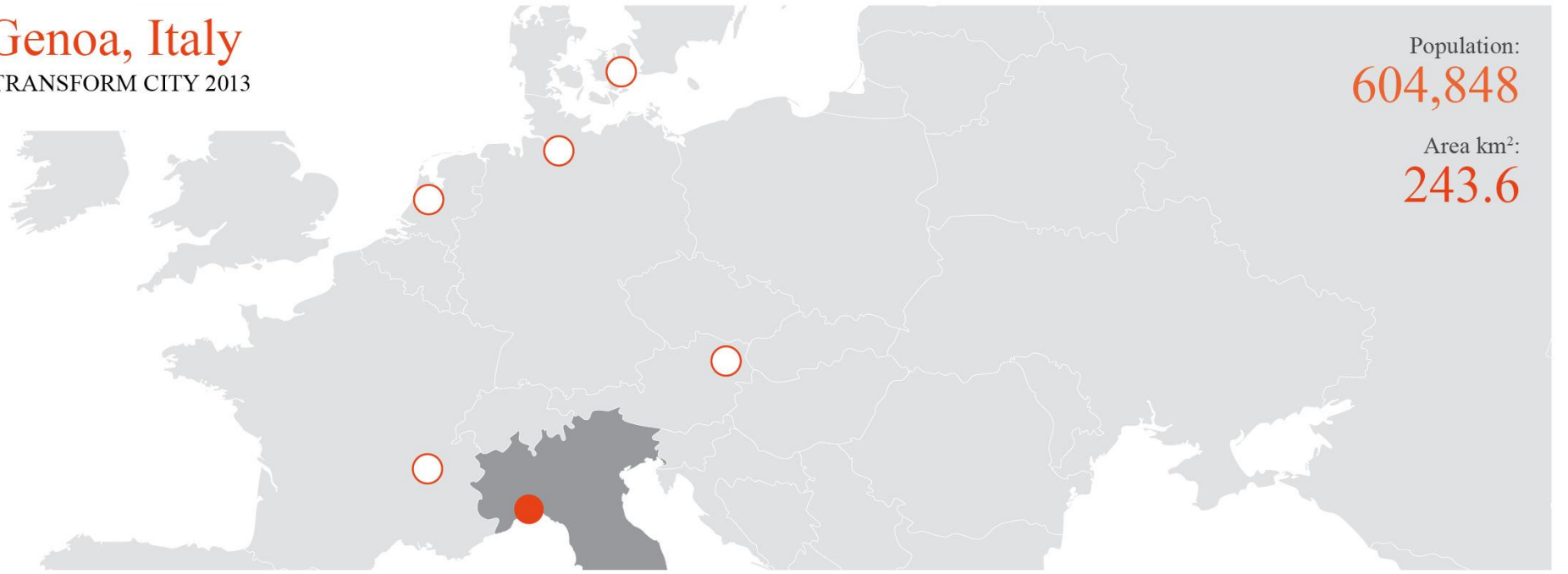
The city has an Open Data strategy, where the city's data are available for citizens, business etc. to access and use

www.kk.dk

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

Genoa, Italy

TRANSFORM CITY 2013



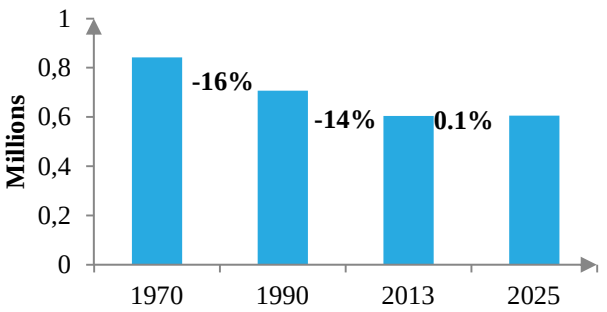
Population:
604,848

Area km²:
243.6

KEY FACTS

Population 605,000

14% decrease 2002 – 2012



Climate

14-20 ºC average temperature

1014 mm
average rainfall per year

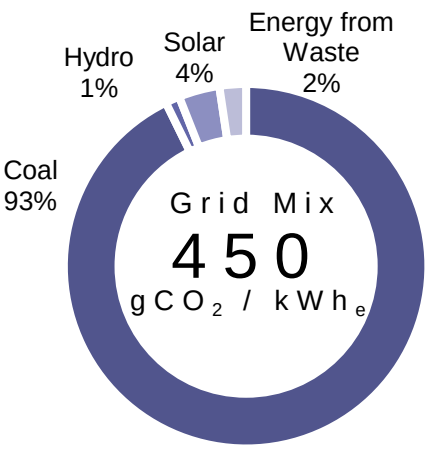
Frequent flooding events
Extreme floods experienced in **2010 & 2011**

Economy

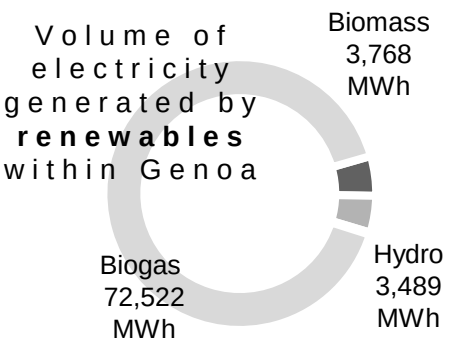
Average disposable income of
€17,045
per capita
(2011)

GDP per capita
€ 27,792
per capita
(2009)

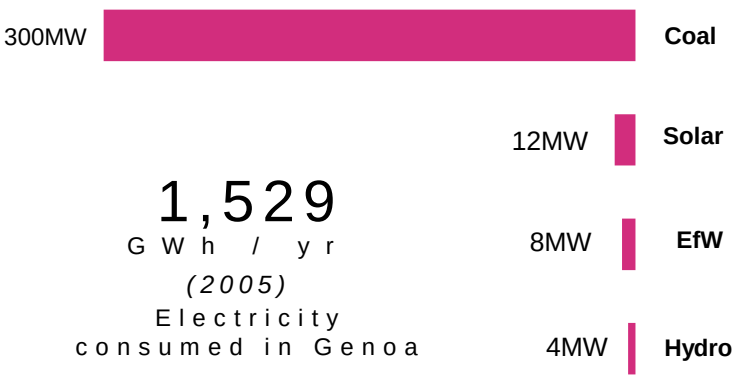
ENERGY



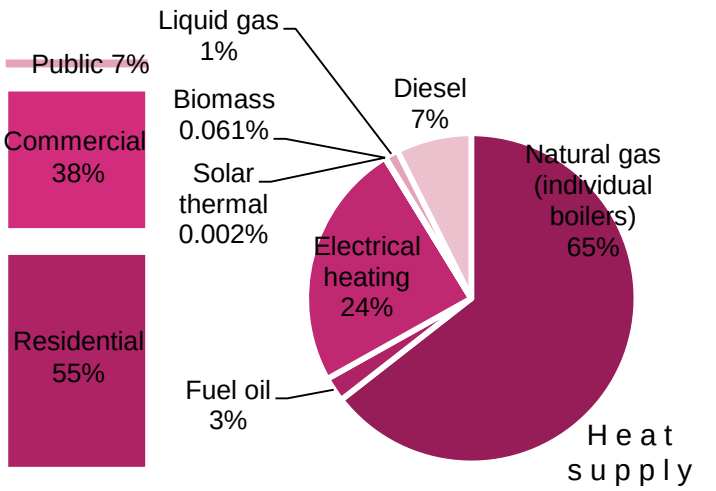
8,077
GWh per year
Primary energy consumption
2005



Generation assets owned by Genoa



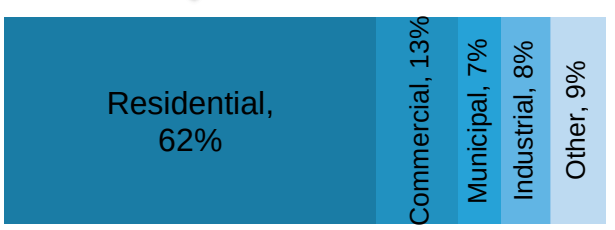
1,529
GWh / yr
(2005)
Electricity consumed in Genoa



WATER

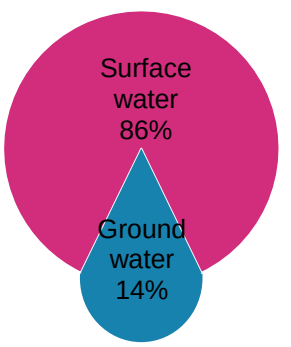
Combined
Rainwater and wastewater system

23,000 tonnes of CO_2/year
Generated from supplying water



wastewater treated per day
0.17
million m³

Genoa's water supply by source



TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

GENOA, ITALY

TRANSFORM CITY 2013

Total city-wide emissions

2,271,913

metric tonnes of CO_2 equivalent (CO_2e) per year

2005

GHG REDUCTION TARGET

Genoa aims to reduce overall GHG emissions by

23.7%

by 2020

(based on a 2005 baseline)

ICT

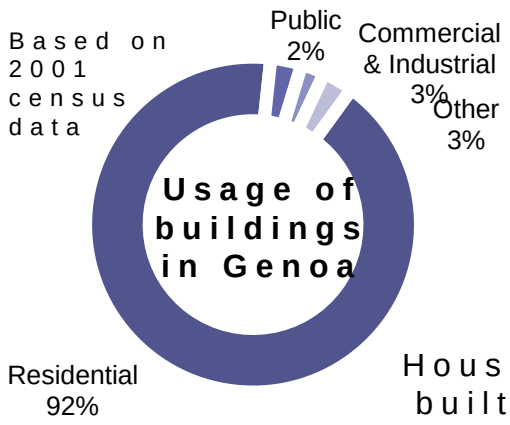
92 Wireless hotspots

www.comune.genova.it

Ensuring participation & transparency

registered wireless hotspot users **19,241**

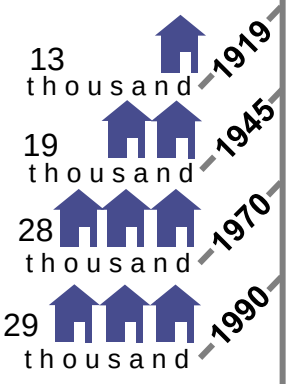
BUILDINGS



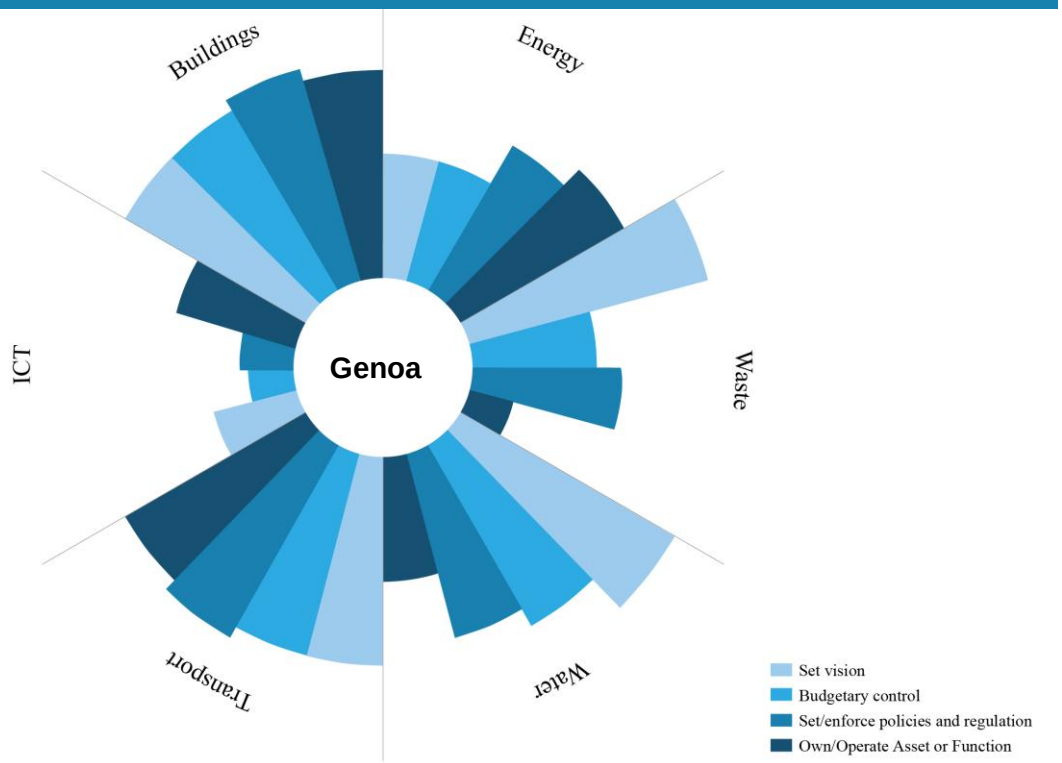
Space conditioning makes up **96%** of building energy use

7,500 homes to be build in the next **10 years**

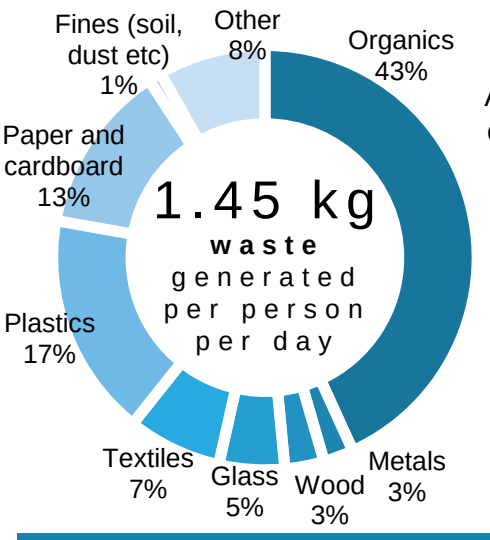
Housing stock built prior to



POWERS

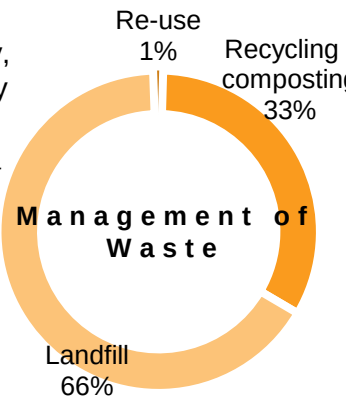


WASTE

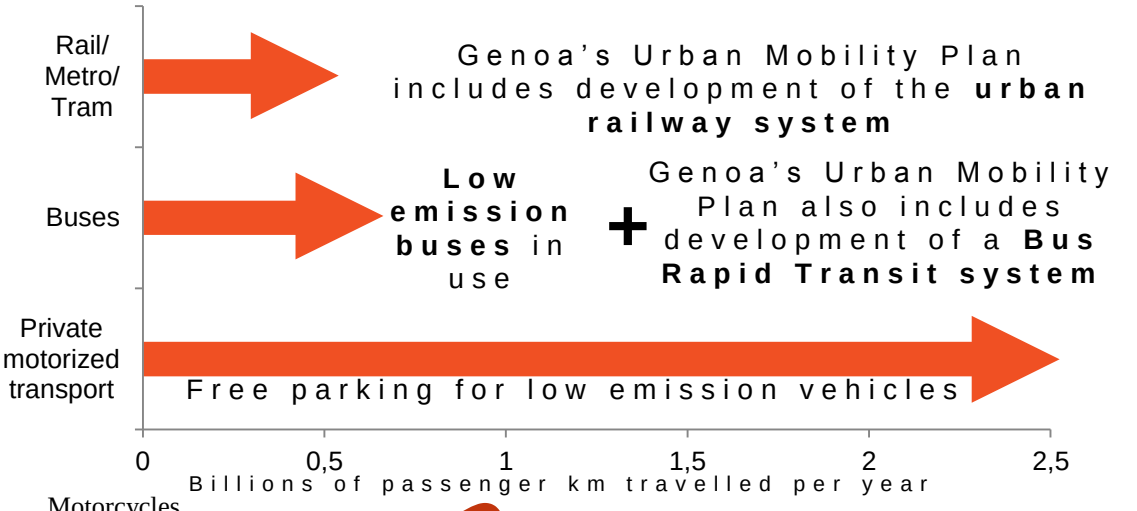


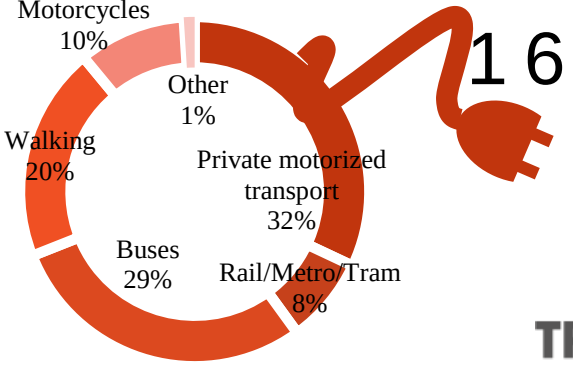
Amiu is a public company, owned by the municipality of Genoa who have recently commissioned a **new recycling plant.**

Genoa's citizens are offered **economic incentives** for using recycling sites of for composting at home.



TRANSPORT





16 On street electric vehicle charging points

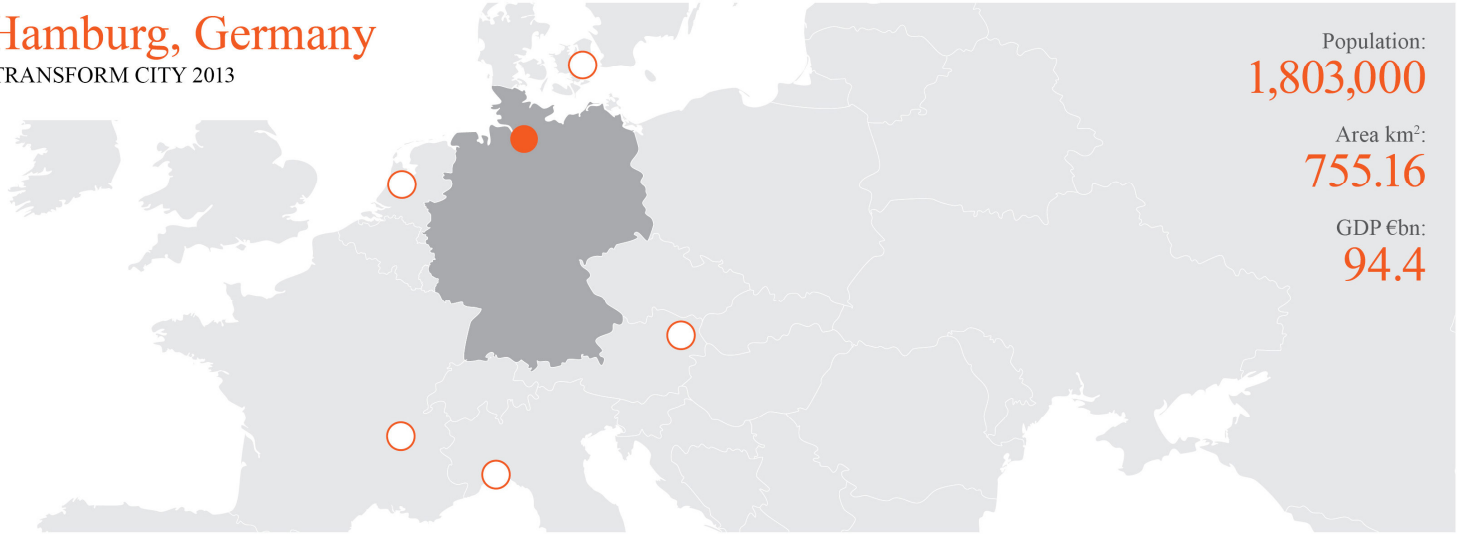
3.8 km of cycle lanes

37% are segregated

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

Hamburg, Germany

TRANSFORM CITY 2013



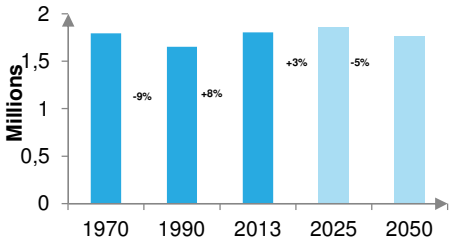
Population:
1,803,000

Area km²:
755.16

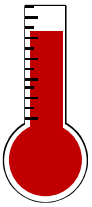
GDP €bn:
94.4

KEY FACTS

Population 1.8m



Temperature range



Max
37.7ºC

Min
-29.1 ºC

Climate

733 mm average rainfall per year

8.7 ºC average temperature

City budget

€ 6,159 per capita

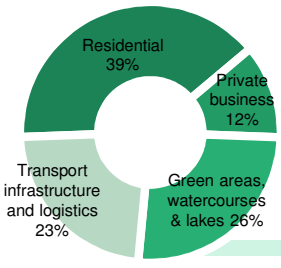
Economy

€ 94 billion GDP

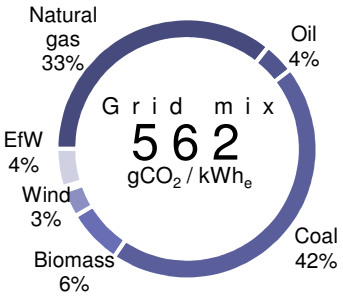
€ 52,400 GDP per capita

Business services	61.3%
Light Industry	12.8%
Finance & insurance	6.1%
Health	5.6%
Public Sector	4.7%
Education	3.1%
Heavy Industry	2.7%
Creative industries	2.1%
Tourism	1.7%
Agriculture	0.1%

City land use



ENERGY



Primary energy consumption of Hamburg

69,744

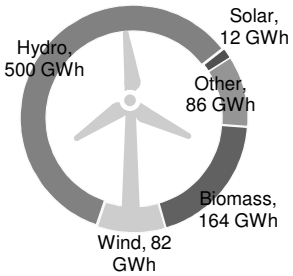
GWh / yr

(2010)

with

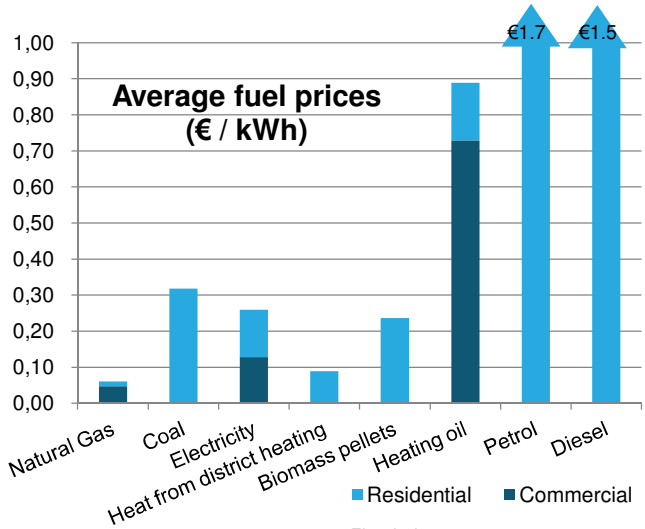
2.5%

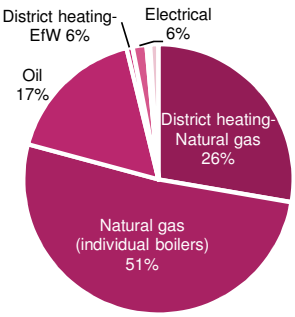
of total energy demand covered by renewable energy production



Hamburg has established a city-owned energy supplier- Hamburg Energie. This organisation, in cooperation with the city, tackles the challenges of furthering energy efficiency measures, low carbon heating, energy storage and virtual power plants.

The city authority currently owns just over 25% of the cities energy networks. In September 2013 a referendum will be held on the municipalisation of all Hamburg's of gas and power grids.





Heat supply

74 km²

of port spaces

Hamburg Port

- Generates €50,000 per capita
- 11,000 ships per year
- 1,800 employees
- 220 trains per day

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

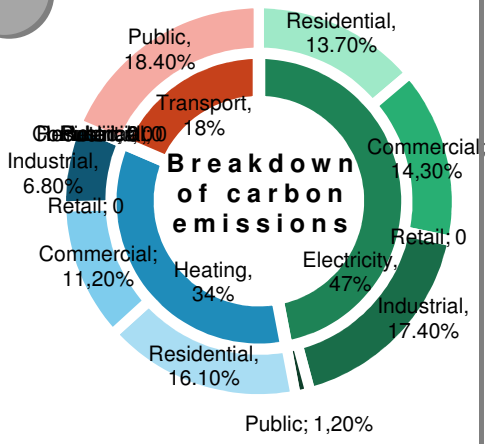
HAMBURG, GERMANY — TRANSFORM CITY 2013

Total city-wide emissions

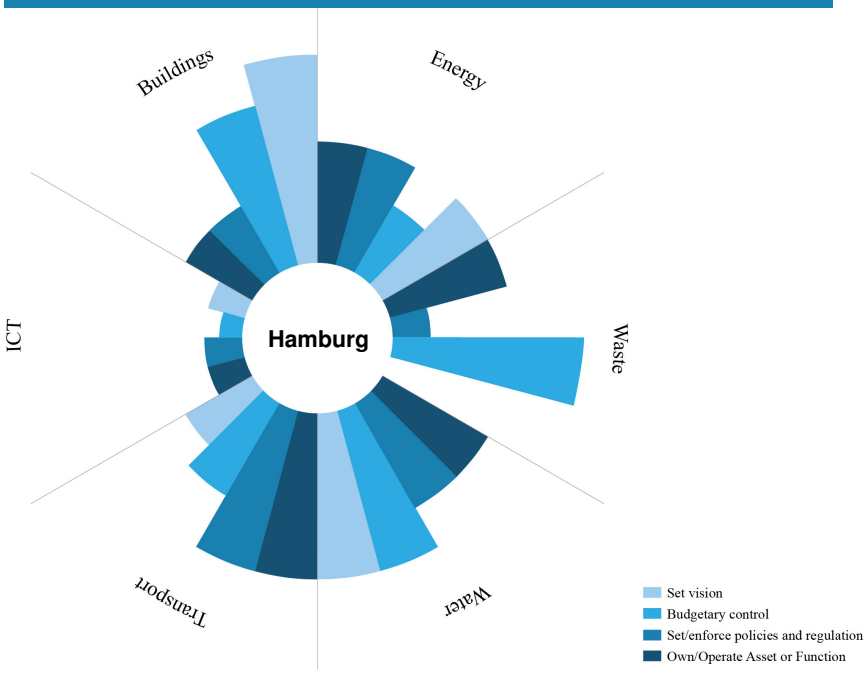
11,445,000

metric tonnes of CO_2 equivalent (CO_2e) per year

2009



POWERS



GHG REDUCTION TARGET

Hamburg aims to reduce overall GHG emissions by

40% by 2020

(based on a 1990 baseline)

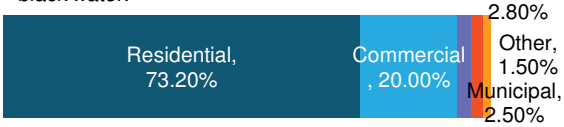
Per capita emissions have already been reduced by 15% compared to 1990.

WATER

The Hamburg Water Cycle is a water management project which will be implemented at two locations in Hamburg. It aims to separate grey water, black water and storm water for separate treatment ; this will both increase drainage capacity and maximise the reclaiming of nutrients from black water.

wastewater treated per day

0.45 million m^3



It is currently mandated that all buildings shall be on a metered water supply.

ICT

Accountability — Live data

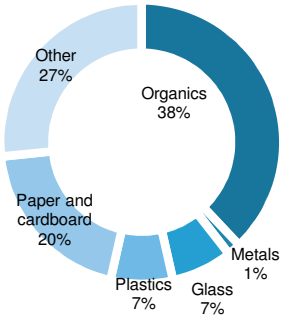
Connectivity — Open data

Contact with the city authority

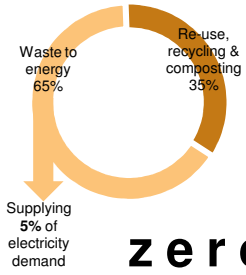
Follow Hamburg on Twitter @hamburg_de

www.hamburg.de

WASTE



Stadtreinigung Hamburg (SRH) is a Hamburg owned waste management company responsible for the management of residual waste, bulky waste, bio-waste, paper waste and organises the recycling, energy recovery and disposal of all waste streams



zero waste to landfill

TRANSPORT

100 On street electric vehicle charging points

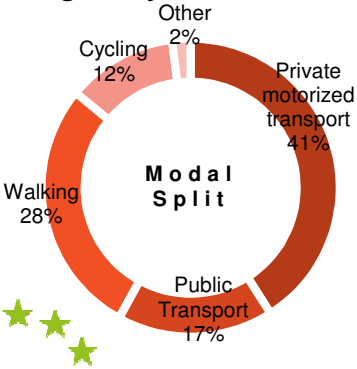
1,700 km of cycle lanes

200 km are segregated

27.7 bn passenger kms travelled by Rapid Transit Rail every year

Intermodal ticketing system

The city also has over 1,200 buses; 38 of which a low emission models..



TRANSFORM — TRANSFORMATION AGENDA FOR LOW CARBON CITIES

Lyon, France

TRANSFORM CITY 2013

Population: 1,281,971

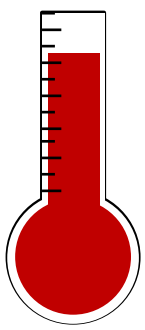
Area km²: 527

GDP €bn: 56.1

KEY FACTS

Population 1.3m

Temperature range



Max 40.5ºC

Min -24.6 ºC

Climate

835 mm average rainfall per year

11.39 ºC average temperature

Economy

€ 56 billion GDP

€ 42,831 GDP per capita

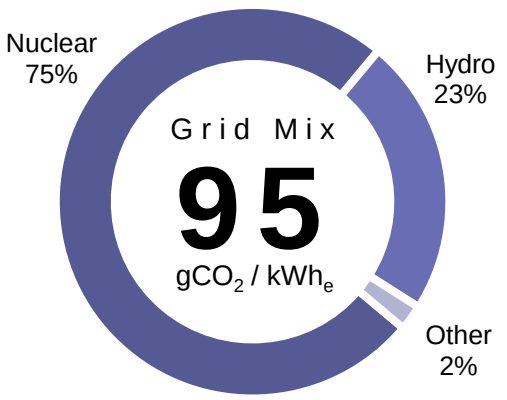
€ 19,286 disposable income per capita

4 actions clearly identify in Lyon's Sustainable Energy Action Plan (2011):

1. To develop biomass heating district,
2. Support to organize wood market at regional level
3. To drive the territory and the private and public entities in the development of renewable energy
4. To ease implementation of smart grids for private companies

Lyon has created a specific administrative entity to define the energy strategy and put in place an operational action plan.

ENERGY



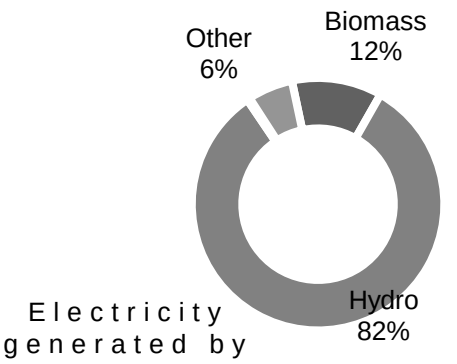
Primary energy consumption of Lyon

40,000 GWh / yr

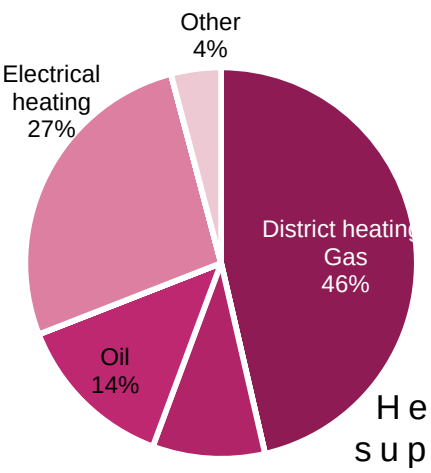
(2006)

175,000

Number of residences installed with smarter energy meters since 2011

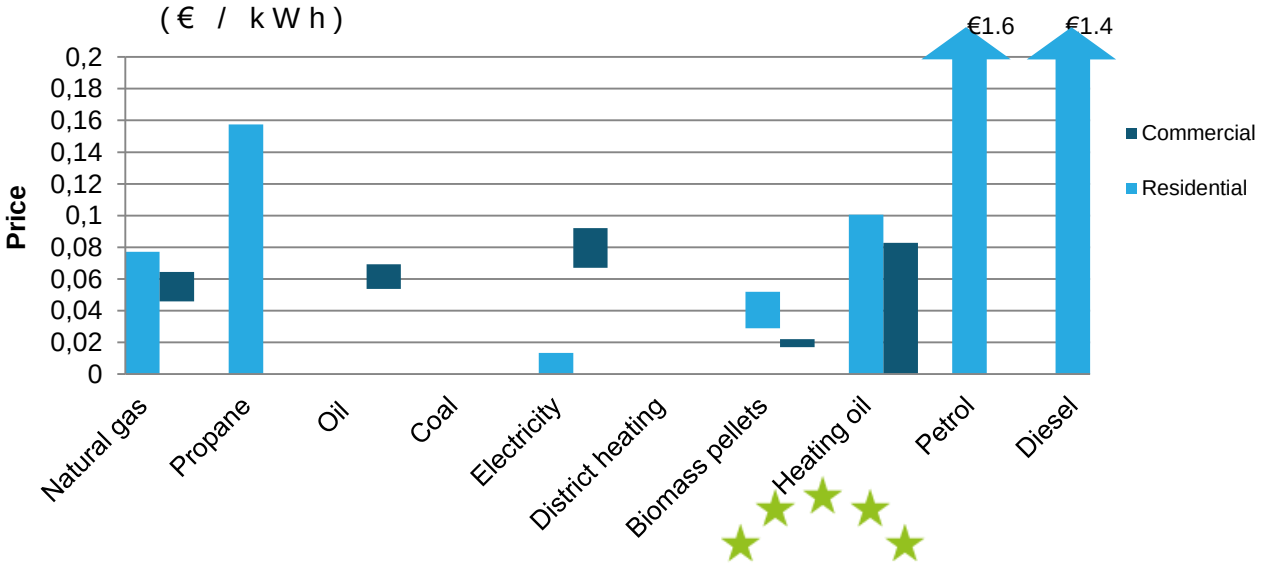


Electricity generated by renewables in Lyon (per annum)



Heat supply

Average fuel prices (€ / kWh)



TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

LYON, FRANCE

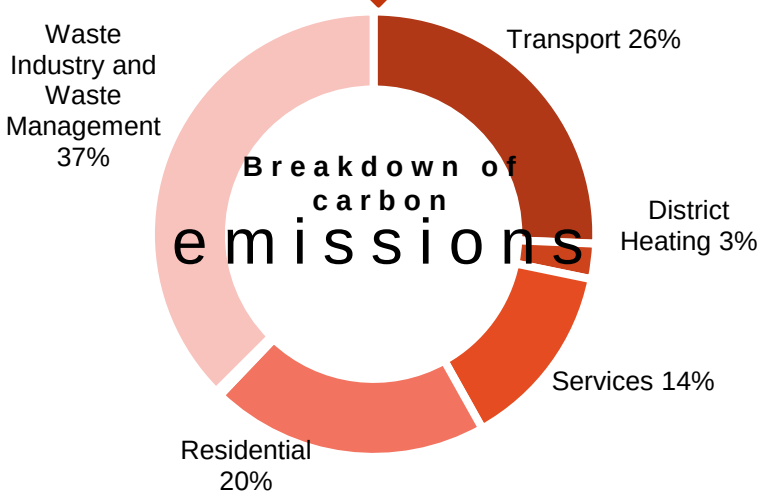
TRANSFORM CITY 2013

Total city-wide emissions

7,500,000

metric tonnes of CO_2 equivalent (CO_2e) per year

2006



GHG REDUCTION TARGET

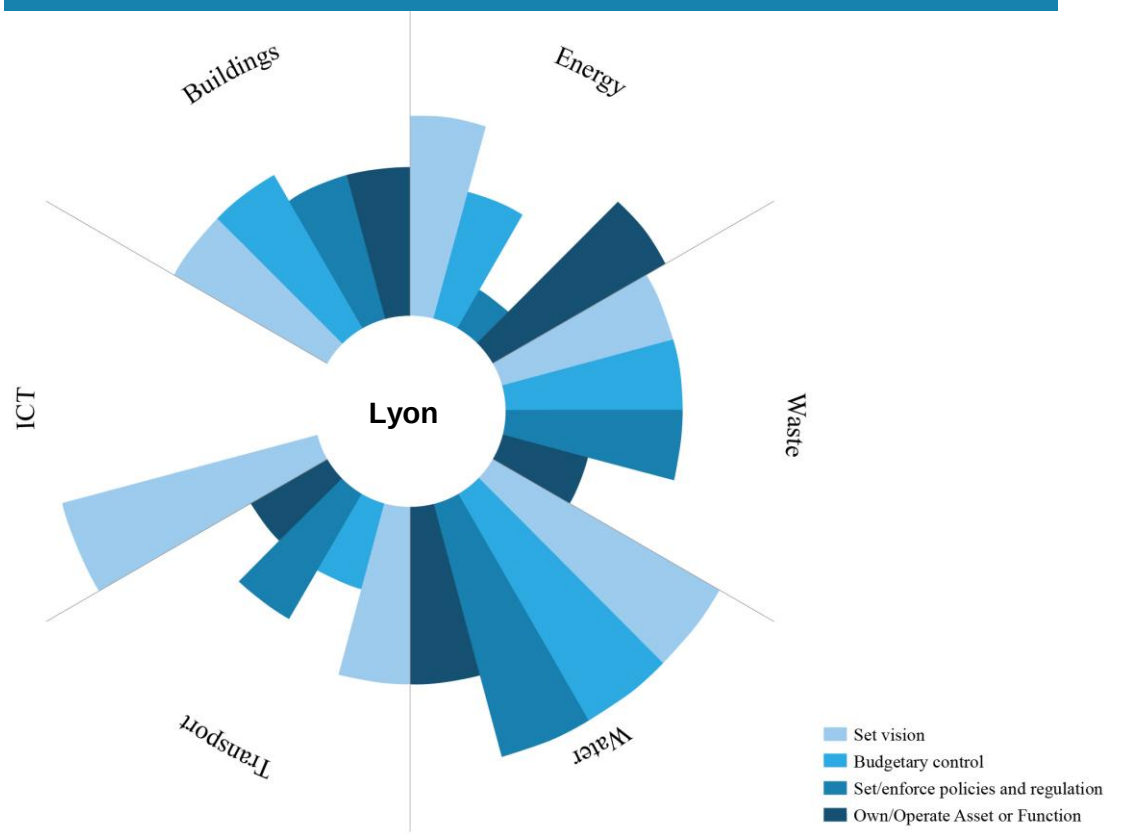
Lyon aims to reduce overall GHG emissions by

20%

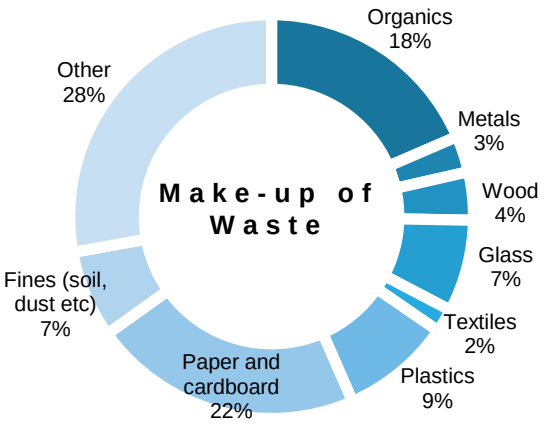
by 2020

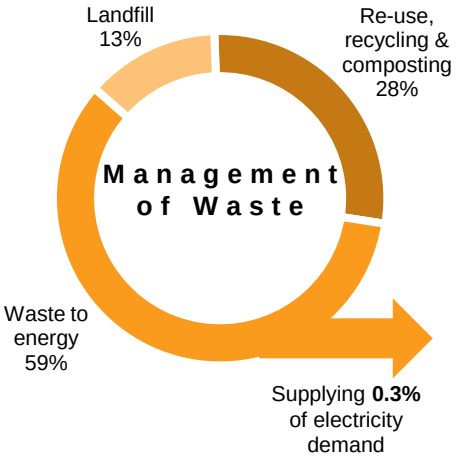
(based on a 2000 baseline)

POWERS



WASTE





WATER

wastewater treated per day

230

million m^3

Lyon enforces a strong policy on rainwater re-infiltration to resupply the water table and to ensure sewage systems function well.

40,000

tonnes of CO_2 emitted annually from supplying the city's water supply

100%

Ground Water

Water metering is mandatory for all domestic, industrial & commercial users

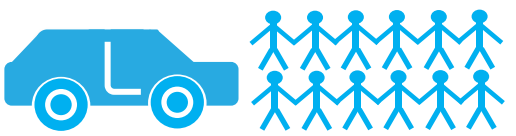
TRANSPORT

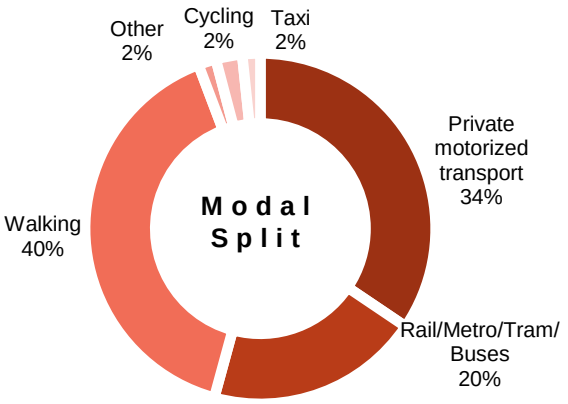
9,000

people are subscribed to Lyon's official car share scheme

20%

use it once a week





Lyon's Transport Targets

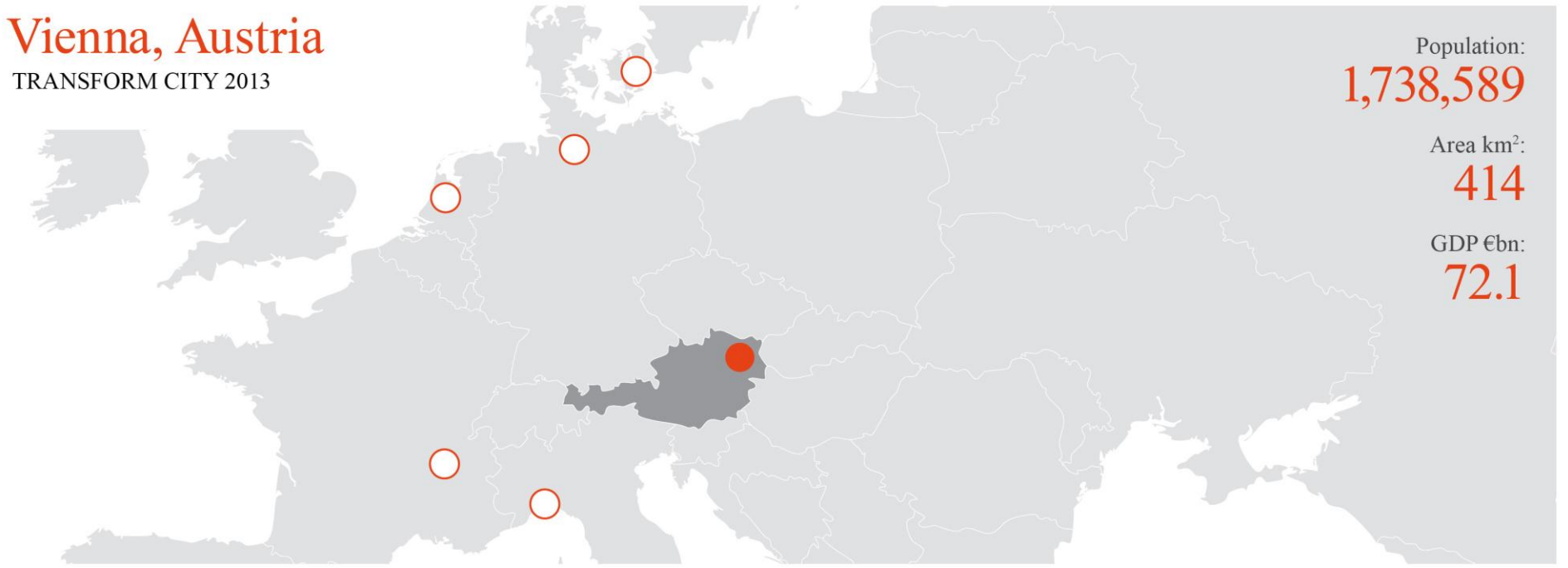
- reduce car use in favour of modes through parking policy and road space sharing
- establishing strong lines of public transport
- improving flow and regularity of major bus routes
- establishing a intermodal transport pass

Intermodal ticketing system

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

Vienna, Austria

TRANSFORM CITY 2013



Population:
1,738,589

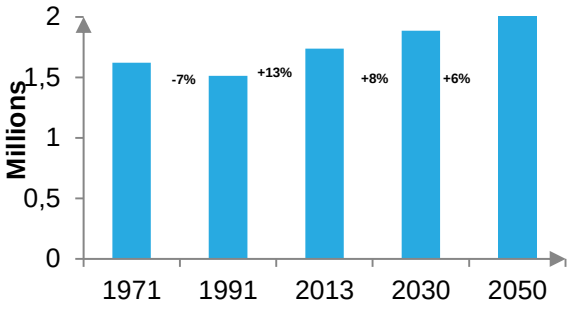
Area km²:
414

GDP €bn:
72.1

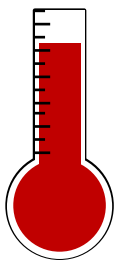
KEY FACTS

Population 1.7 m

10% increase 2002 – 2012



Temperature range



M a x
38.3ºC
08 Jul '57

M i n
-26.3 ºC
11 Feb '29

Climate

673 mm average rainfall per year

11 ºC average temperature

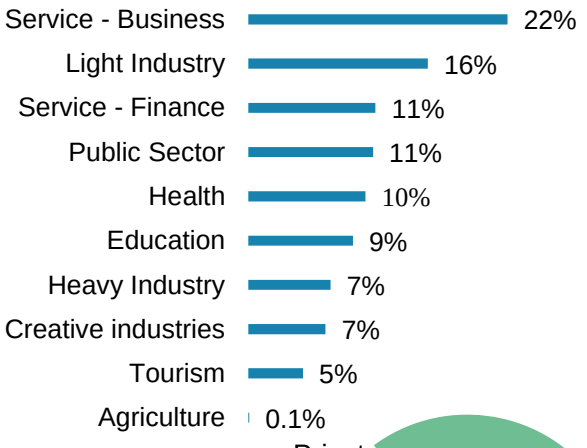
City budget

€ 7,029 per capita

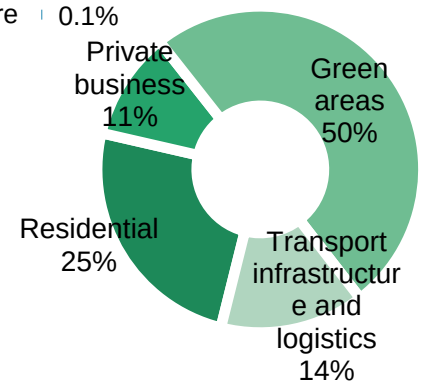
Economy

€ 72 billion GDP

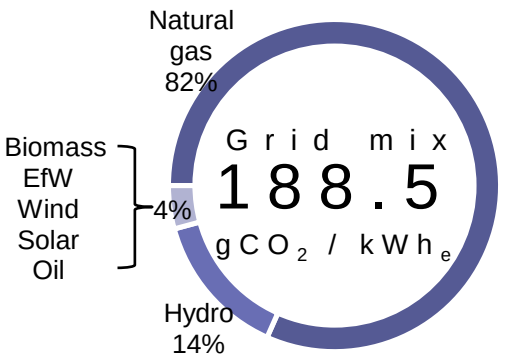
€ 42,600 GDP per capita



C i t y l a n d u s e



ENERGY

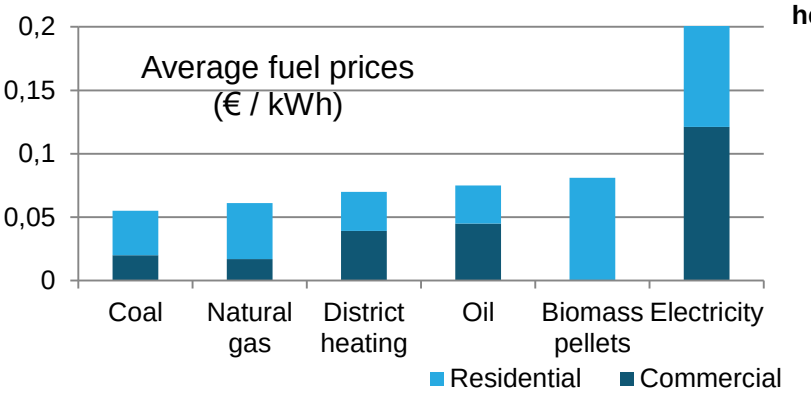


P r i m a r y e n e r g y c o n s u m p t i o n o f V i e n n a

46,627

G W h / y r

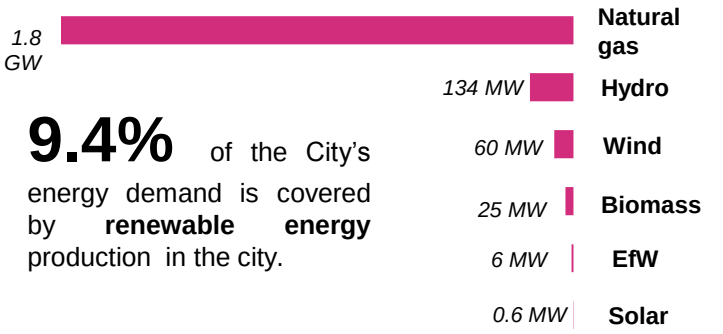
(2 0 1 0)



Vienna consumes **8,294 GWh** per year of electricity.

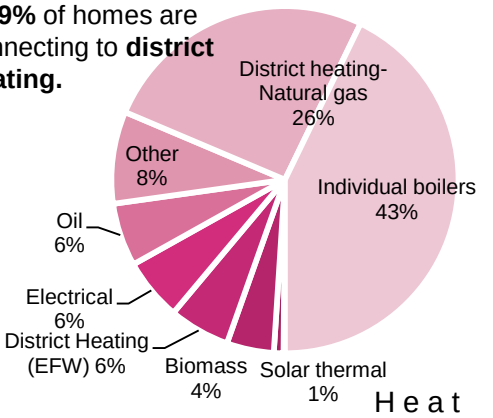
The City benefits from a relatively low carbon electricity supply, with over 90% electricity being supplied by from natural gas or hydro-power.

G e n e r a t i o n a s s e t s o w n e d b y V i e n n a



9.4% of the City's energy demand is covered by **renewable energy** production in the city.

37.9% of homes are connecting to **district heating.**



H e a t s u p p l y

WATER

The City of Vienna distributes water by a gravity fed system ; using no pumping energy in supplying almost all major areas.

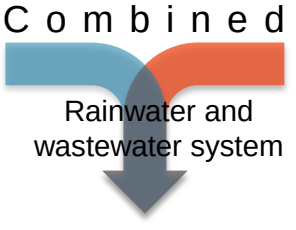
Vienna's water treatment plant in Simmering achieves purification levels of 98 to 99 per cent. By 2020 a sludge treatment plant will be developed which will provide enough renewable energy to power the plant.

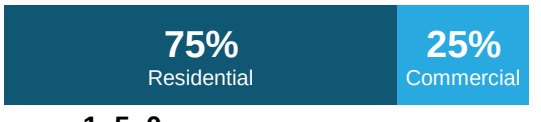
w a s t e w a t e r t r e a t e d p e r d a y

0.54

m i l l i o n m ³

C o m b i n e d





1 5 0 l i t r e s W a t e r c o n s u m p t i o n p e r c a p i t a p e r d a y

It is currently mandated that all buildings shall be on a metered water supply.

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

VIENNA, AUSTRIA

TRANSFORM CITY 2013

Total city-wide emissions

9,194,000

metric tonnes of CO_2 equivalent (CO_2e) per year

2006

188,505

Jobs in sustainability & green energy jobs throughout Austria

GHG REDUCTION TARGET

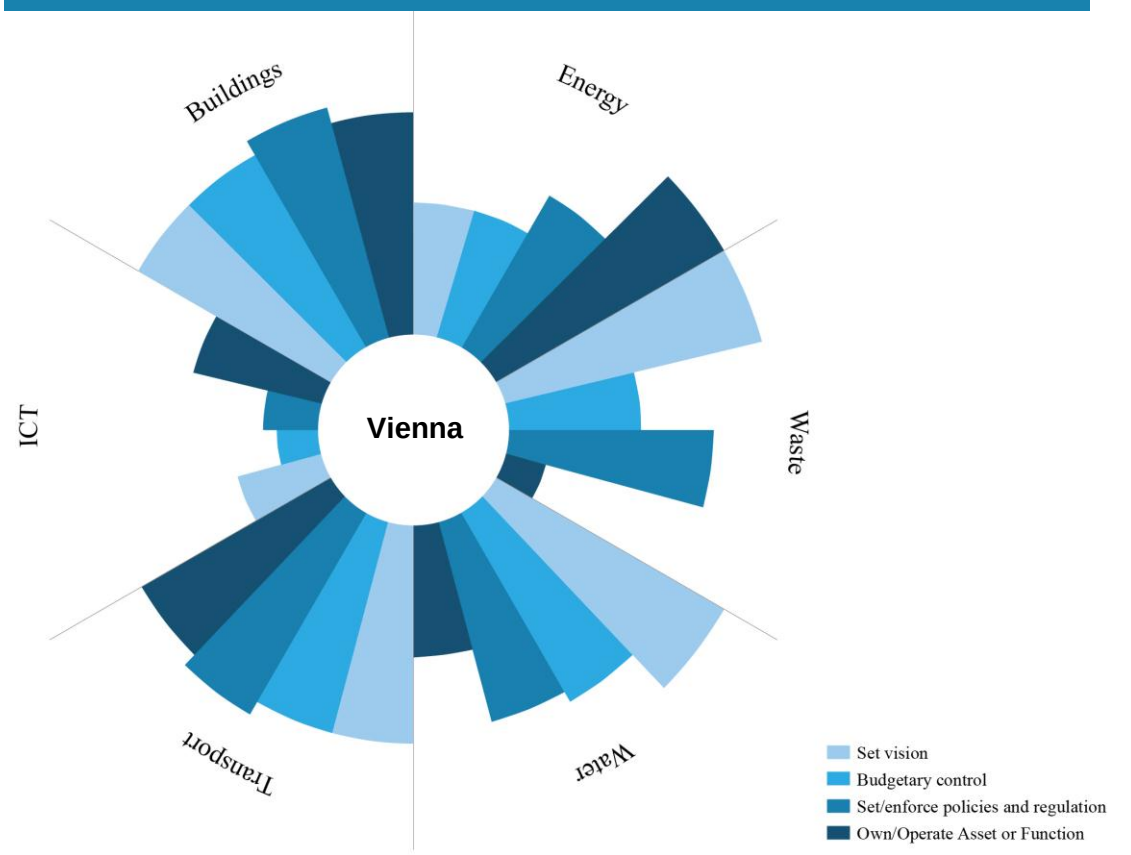
Vienna aims to reduce overall GHG emissions by

21%

per capita by 2020

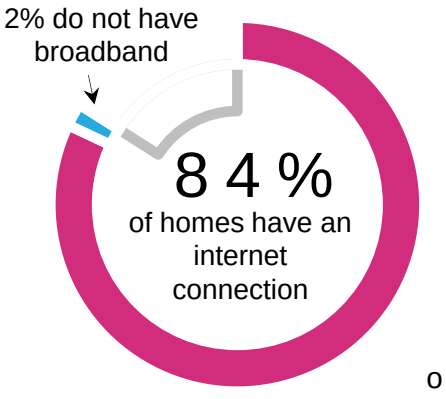
(based on a 1990 baseline)

POWERS



ICT

The City of Vienna is constantly expanding the ICT services for its citizens. The ICT strategy is based on the business strategy of the City of Vienna. ICT supports in particular the two cornerstones of administrative modernization: **customer focus** and **efficiency**.

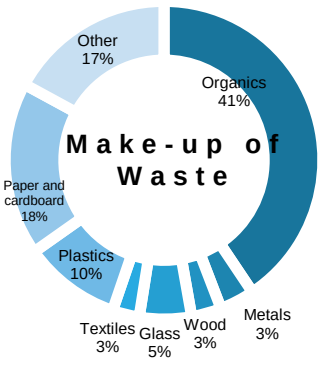


The city also has an intermodal e-ticketing system in place and over 400 wireless hotspots.

99%

of homes to have **super-fast broadband** by 2020

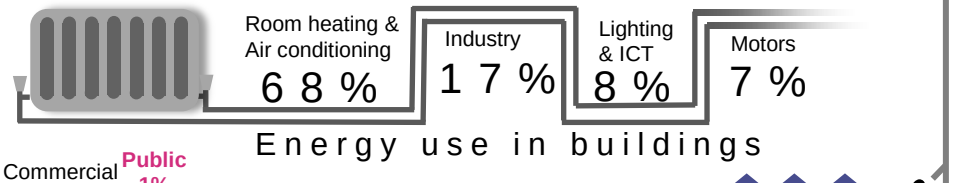
WASTE

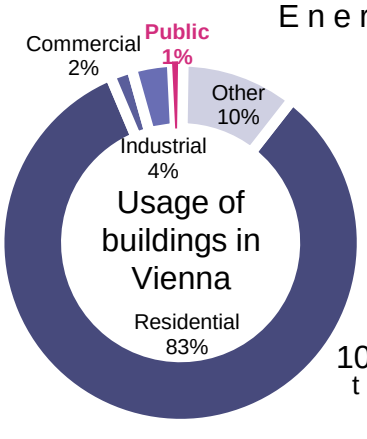


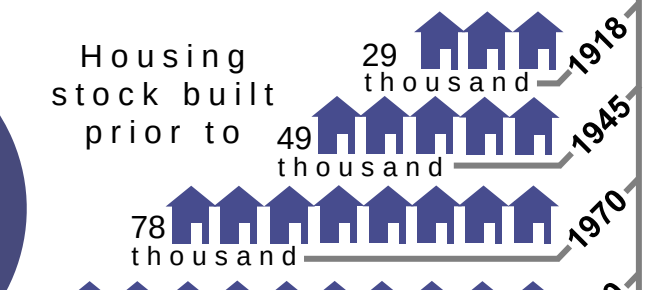
Vienna's waste goals:

- Reducing waste generation
- Increasing re-use
- Treatment and landfilling of waste within the city boundaries
- Increasing the material recycling rate
- Increasing the efficiency of waste incineration

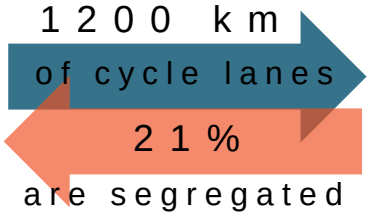
BUILDINGS





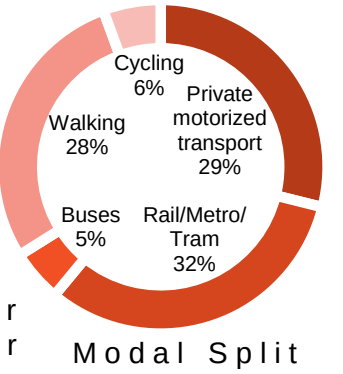


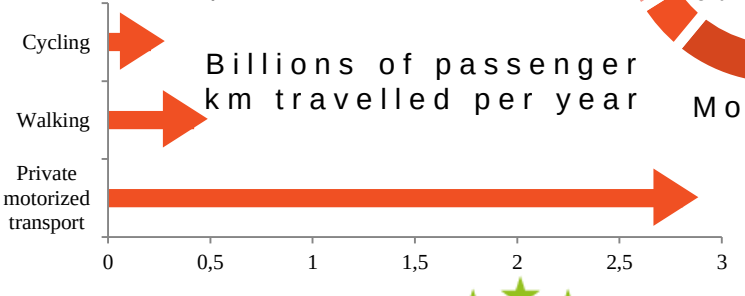
TRANSPORT



Vienna's 2003 Transport Master Plan is the City of Vienna's strategic transport concept, setting clear transport policy priorities while also leaving room for local, regional and global developments.

Transport Master Plan was developed within a cooperative consulting process, with the active participation of several departments both within and outside Vienna City Administration. Local citizens were also involved in an involvement and information process.





TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

Blank report

City, Country

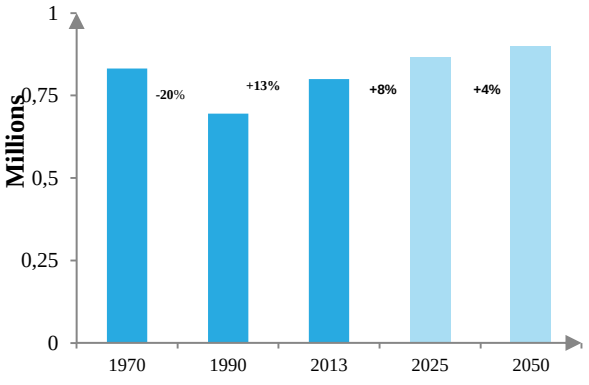
Population:
Value

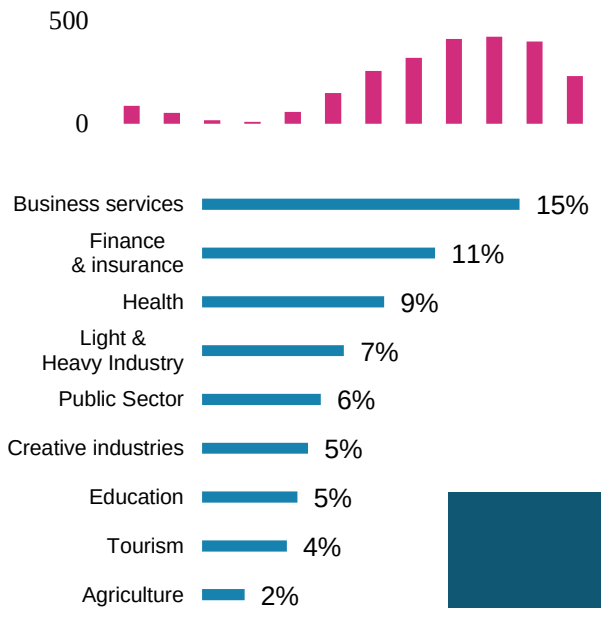
Area km²:
Value

GDP €bn:
Value

Main copy
- Arial font
- 10-14 pt
- Left justified

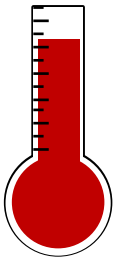
GRAPHICS

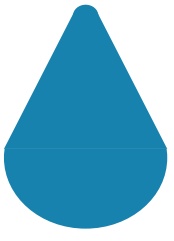


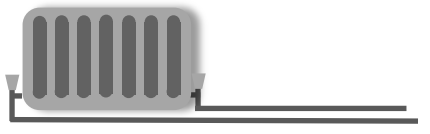


Housing stock built prior to

[VALUE] thousand date





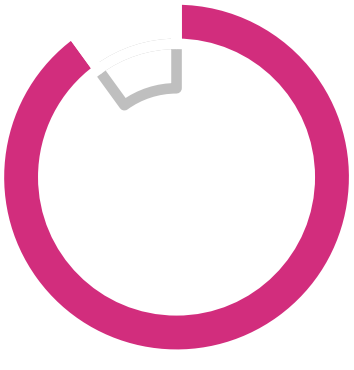


Total city-wide emissions

[VALUE]

metric tonnes of CO_2 equivalent (CO_2e) per year

[REF YEAR]



- **Dividing line**
- 2.5pt
- R127 G127 B127

TEXT

- **Headline text**
- 14 pt, Arial capitals
- 3 pt expanded character spacing

- **Headline box**
- 1.2 cm height
- R24 G130 B174

City

- **Banner title**
- 24 pt
- R240 G80 B35

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

CITY
COUNTRY

TRANSFORM CITY 2013

GHG REDUCTION TARGET

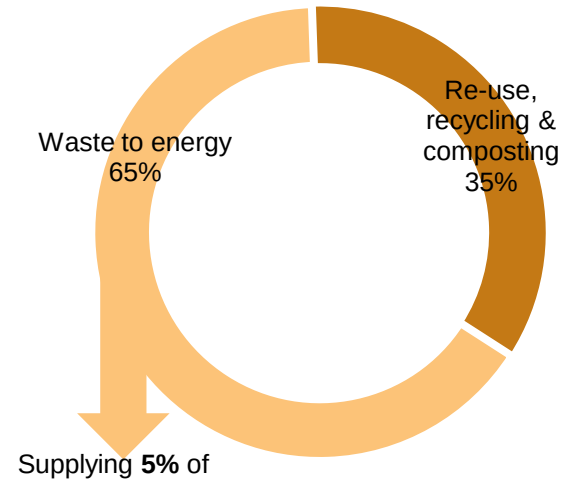
[CITY] aims to reduce overall GHG emissions by

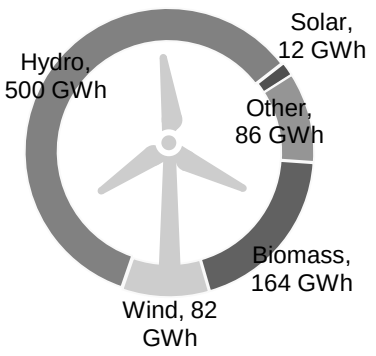
[TARGET]%

By [TARGET YEAR]

(based on a [YEAR]baseline)

DOUGHNUT DIAGRAMS



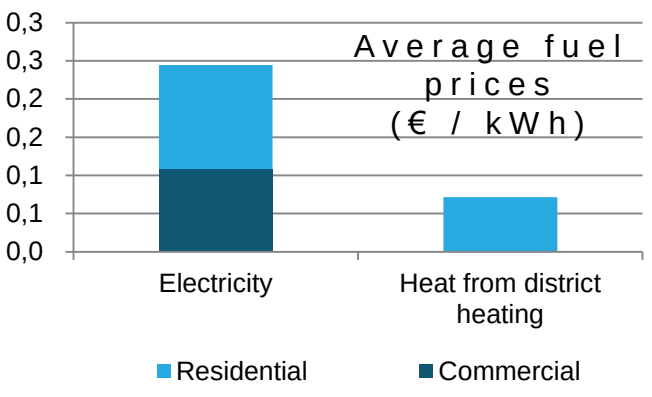


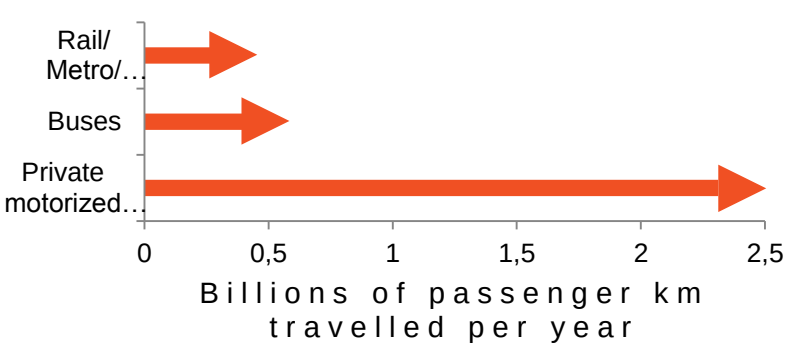
- 3 pt white border

POWERS

- Graphic created using Adobe illustrator
- Responses were averages across each sector
  (i.e. average of responses for ‘city roads’, buses’ and ‘rail’ gives a score for ‘transport’)
- Each sector has four types of influence:
  - set vision;
  - own/operate asset or function;
  - set/enforce policy/regulation; and
  - budgetary control.

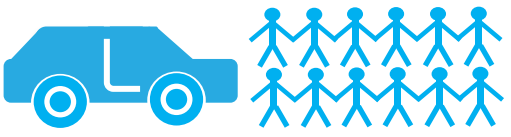
FUEL PRICE DIAGRAMS





Combined

Rainwater and wastewater system

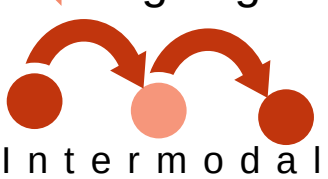


[VALUE]km

of cycle lanes

[Value]%

are segregated



Intermodal ticketing system

TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES