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Ingenuity for life

Metropolitan Solutions 2016

Savvas Verdis / Katrin Mueller

Planning with technologies

Answers for infrastructure and cities.

Siemens Sustainable Cities Initiative

Why the Crystal?

- A **sustainable cities initiative by Siemens**. Supporting long term cooperation with cities for infrastructure solutions

- A **platform for global collaboration** amongst key players in urban sustainability

- A **centre to discuss and learn** about the challenges cities are facing and possible solutions to reduce their environmental impact.

- **Home for thought leadership** on urban sustainability providing experts to exchange ideas.

Case studies

San Francisco · Minneapolis · Vienna · Munich · Nanjing

New Bedford · Riverside · Copenhagen · Helsinki · Wuhan

Mexico City · London · Berlin · Shenzhen · Ningbo

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How do the same technologies perform differently from city to city?

ISTANBUL

BOGOTA

Bus Rapid Transit
EMBARQ-Study
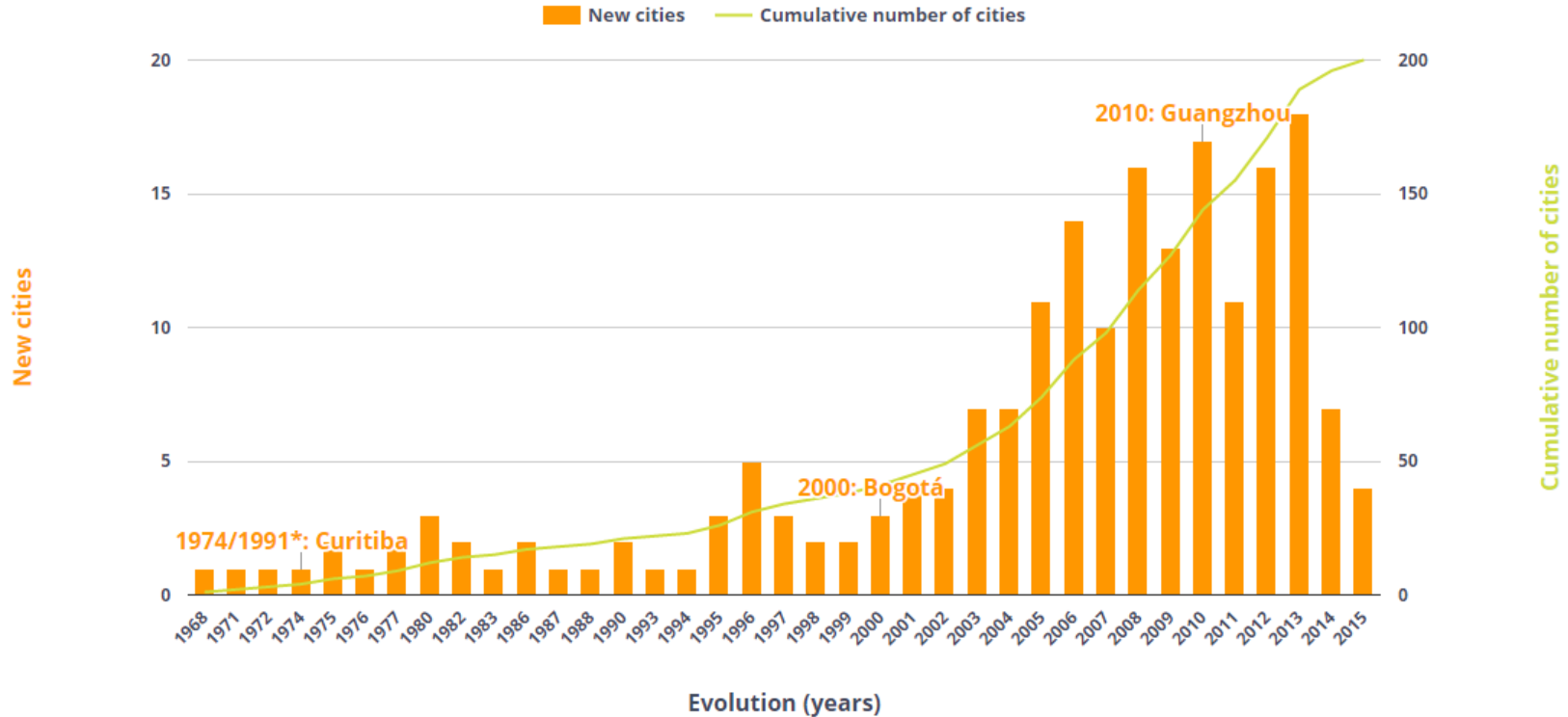
SIEMENS
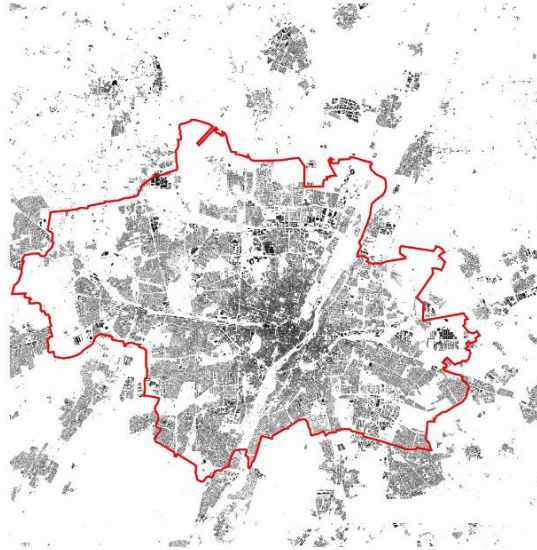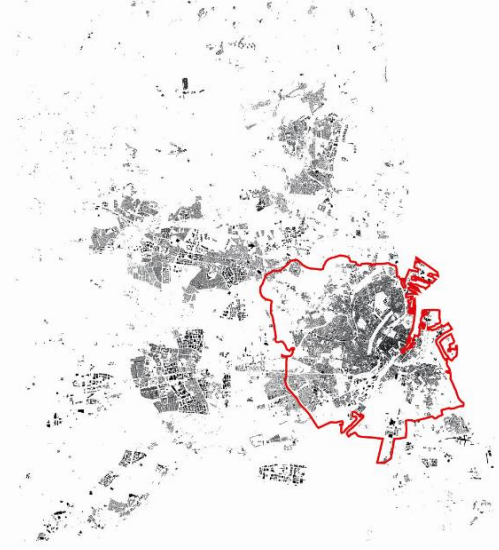
Cities are unique and technologies should be tailored
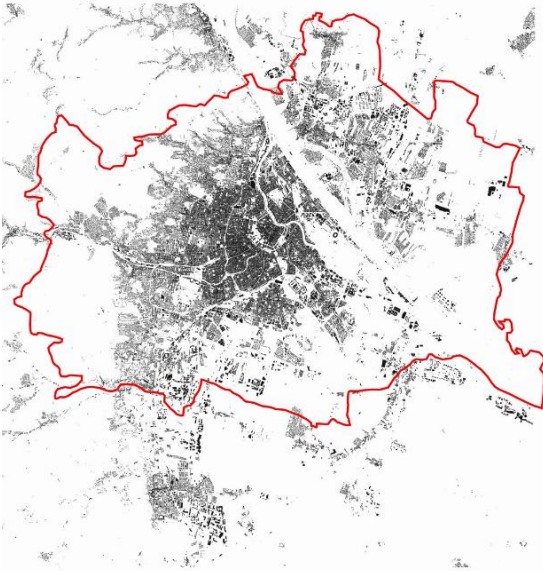
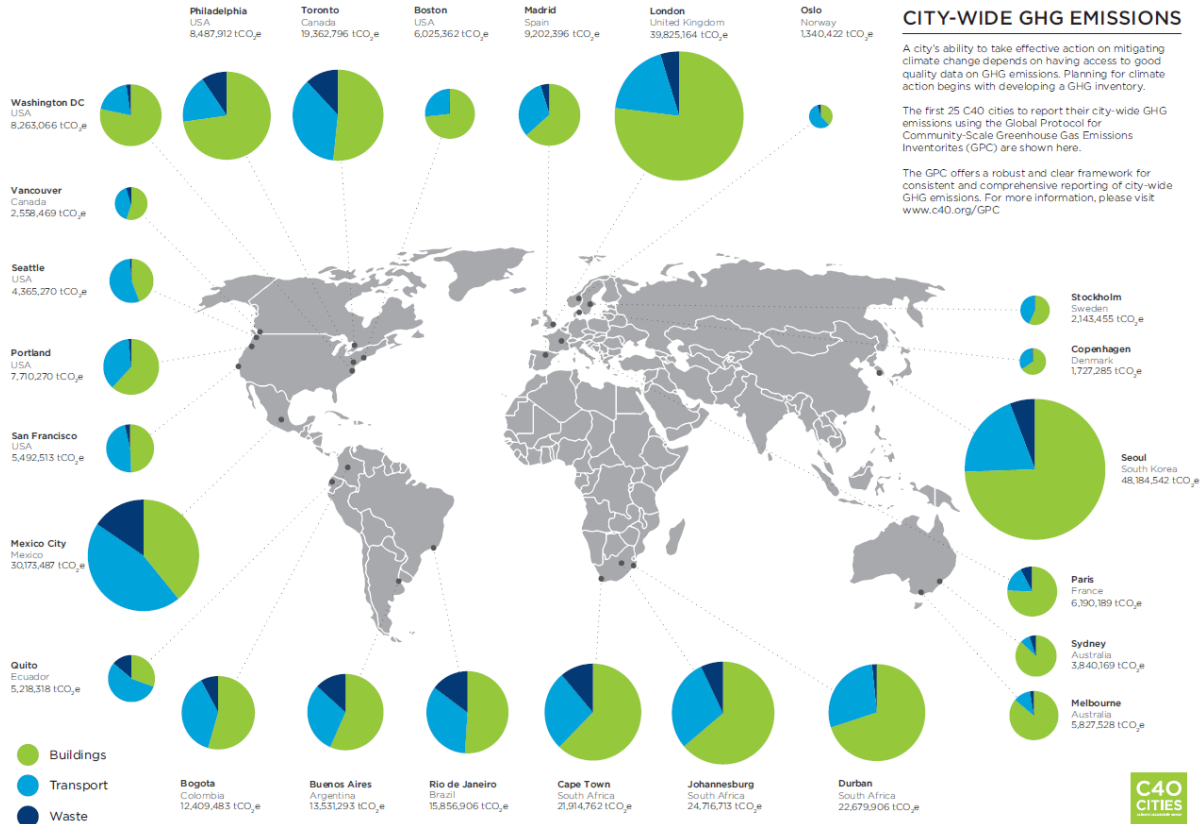
VIENNA

Area: 414.6 km²
Population: 1.8 million

MUNICH

Area: 310.4 km²
Population: 1.4 million

COPENHAGEN

Area: 86.25 km²
Population: 570.000

Cities are unique in emissions and its root causes

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CITY-WIDE GHG EMISSIONS

A city's ability to take effective action on mitigating climate change depends on having access to good quality data on GHG emissions. Planning for climate action begins with developing a GHG inventory.

The first 25 C40 cities to report their city-wide GHG emissions using the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventorites (GPC) are shown here.

The GPC offers a robust and clear framework for consistent and comprehensive reporting of city-wide GHG emissions. For more information, please visit www.c40.org/GPC

Philadelphia USA 8,487,912 tCO$_2$e
Toronto Canada 19,362,796 tCO$_2$e
Boston USA 6,025,362 tCO$_2$e
Madrid Spain 9,202,396 tCO$_2$e
London United Kingdom 39,825,164 tCO$_2$e
Oslo Norway 1,340,422 tCO$_2$e

Washington DC USA 8,263,066 tCO$_2$e
Vancouver Canada 2,558,469 tCO$_2$e
Seattle USA 4,365,270 tCO$_2$e
Portland USA 7,710,270 tCO$_2$e
San Francisco USA 5,492,513 tCO$_2$e
Mexico City Mexico 30,173,487 tCO$_2$e
Quito Ecuador 5,218,318 tCO$_2$e

Stockholm Sweden 2,143,455 tCO$_2$e
Copenhagen Denmark 1,727,285 tCO$_2$e
Seoul South Korea 48,184,542 tCO$_2$e
Paris France 6,190,189 tCO$_2$e
Sydney Australia 3,840,169 tCO$_2$e
Melbourne Australia 5,827,528 tCO$_2$e

Bogota Colombia 12,409,483 tCO$_2$e
Buenos Aires Argentina 13,531,293 tCO$_2$e
Rio de Janeiro Brazil 15,856,906 tCO$_2$e
Cape Town South Africa 21,914,762 tCO$_2$e
Johannesburg South Africa 24,716,713 tCO$_2$e
Durban South Africa 22,679,906 tCO$_2$e

- Buildings
- Transport
- Waste

C40 CITIES

Step 1: Develop a baseline with over 300 data points

General
5 data points

Population
City population, density and growth

Emission targets
Targets for CO_2, NO_x and PM_{10}
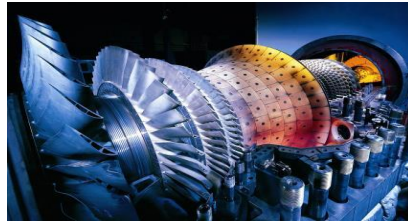
Energy
50+ data points

Consumption
City`s annual energy consumption from electricity, heating and cooling.

Source mix
City`s consumption source mix for electricity, heating and cooling.

Grid losses
City`s transmission and distribution losses per KW generated power.

Transport
120+ data points

Passenger
Annual passenger kilometer travelled inside the city borders and the split between travel modes.

Freight
Ton kilometers of goods transported within the city borders annually, with split between road and rail.

Public transport service
Length of network, number of vehicles and capacity utilization for passenger transport modes.

Vehicles and fuel source
Private vehicles, taxis and trucks fleet distribution.

Roads and infrastructure
Road network, traffic management and streetlights

Buildings
80+* data points

Floor space
City`s total floor space, per building category.

Electricity usage
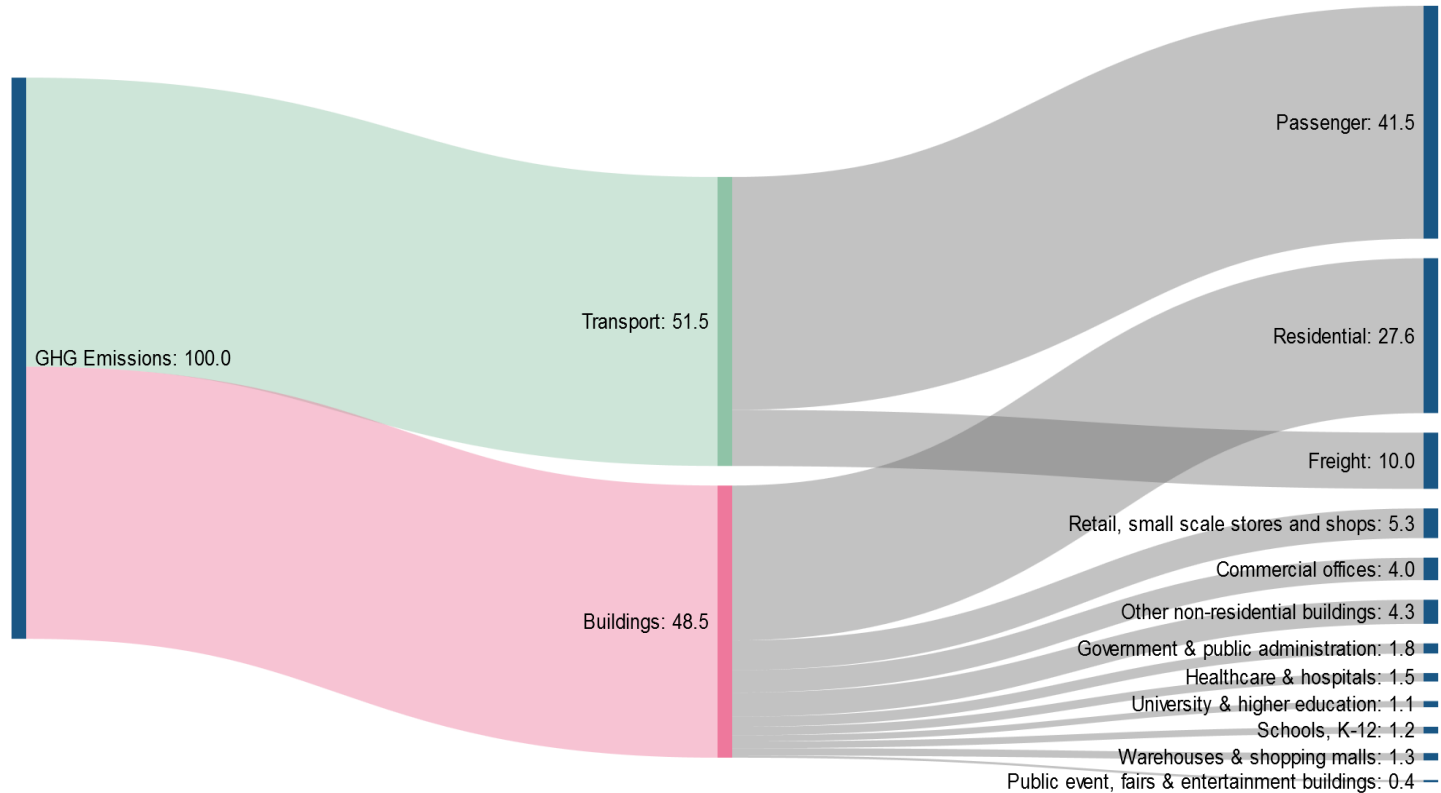The share of electricity split between lighting, ventilation appliances, per building category.

Building envelope
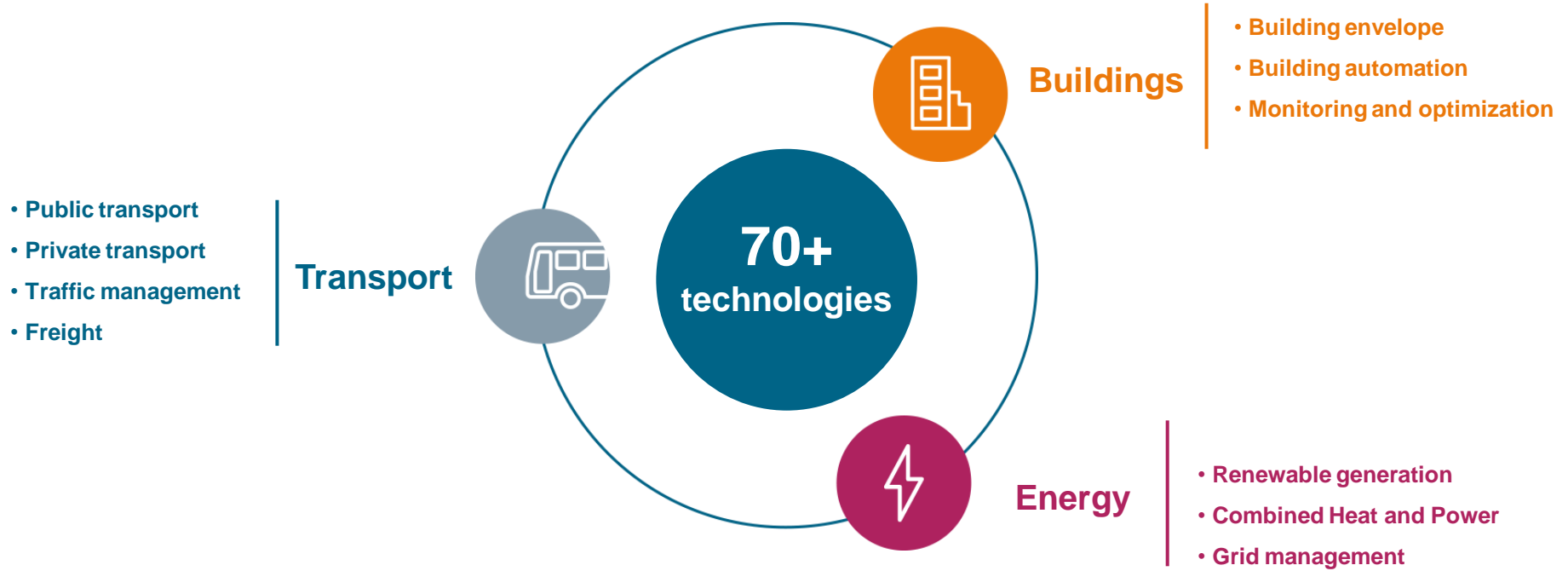The share of losses from heating and cooling building space, per building category.

*per building category:

Residential, non-residential

Step 1: GHG Emissions Baseline of a City

Step 2: Choose from over 70 technologies

Buildings
- Building envelope
- Building automation
- Monitoring and optimization

Transport
- Public transport
- Private transport
- Traffic management
- Freight

70+ technologies

Energy
- Renewable generation
- Combined Heat and Power
- Grid management

Step 2: Choose from Building Levers

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Commercial buildings
17 levers

Commercial Wall Insulation

Commercial Double/Triple Glazing

Commercial Efficient Lighting

Demand Oriented Lighting

Building Efficiency Monitoring

Building Performance Optimization

Demand Controlled Ventilation

Heat Recovery

Commercial Building Envelope

Remote Monitoring

Efficient Motors & Drives

Room Automation, HVAC

Room Automation, HVAC & Lighting

Room Automation, HVAC & Lighting + B

Building Automation, BACS C

Building Automation, BACS B

Building Automation, BACS A

Residential buildings
6 levers

Residential Wall Insulation

Residential Double/Triple Glazing

Residential Building Envelope

Residential Efficient Lighting

Home Energy Monitoring

Home Automation

Step 2: Choose from Transportation Levers

Transport
38 levers

Metro: New Vehicles	Freight Tram	Demand Oriented Street Lighting
Metro: New Line	Freight Rail-Electrification	LED Street Lighting
Metro: Reduced Headway	BRT Electrification Switch to electric vehicles	Smart Street Lighting
Metro: Automated Train Operation	GNG Bus / GNG Car	Intelligent Traffic Light Management
Metro: Regenerative Braking	E-Bus / E-Car	Intermodal Traffic Management
Regional Train: Automated Train Operati	Hybrid Electric Bus / Hydrogen Car	Low Emission Zone (Truck)
Tram: New Line	E-Taxi / Plug-in Hybrid Car	Eco Driving Training
Tram: New Vehicles	E-BRT New Line / Hybrid Car	Urban Bike Sharing
Tram: Automated Train Operation	E-Ticketing / E-Car Sharing	Cycling Highway
Tram: Regenerative Braking	E-Highways	Occupancy Dependent Tolling
		City Tolling

Step 2: Choose from Energy Levers

Energy
10 levers

Photovoltaic

Wind Power Generation

Combined Cycle Gas Turbine

Combined Heat and Power

Network Optimization

Smart Grid for Monitoring and Automation
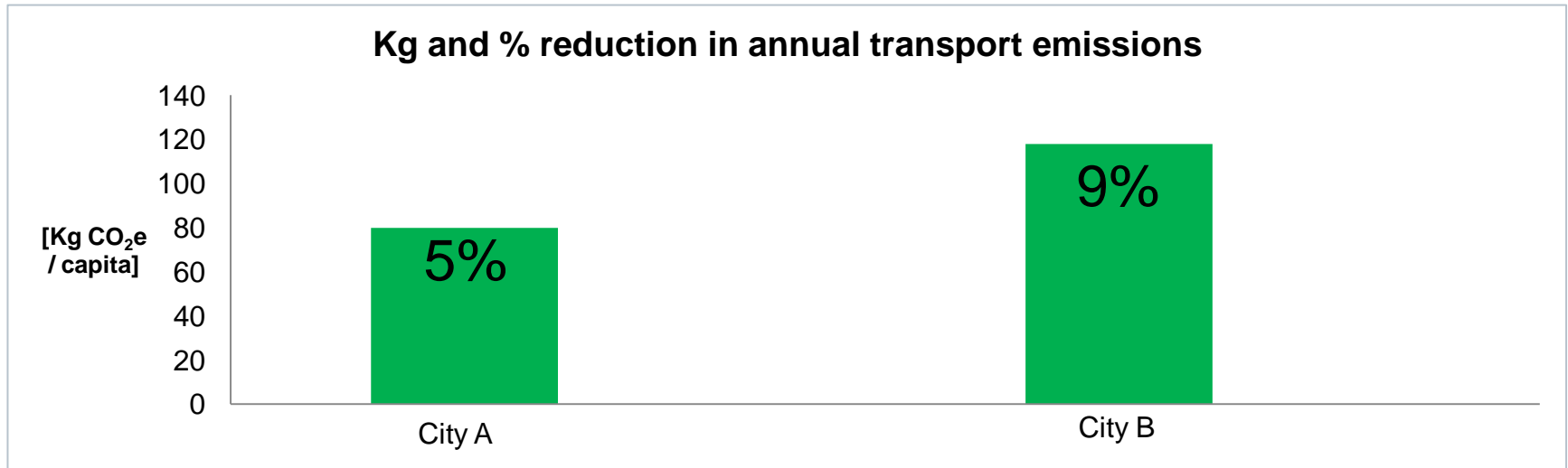
Power System Automation & Optimized Network

Smart Metering

On Shore Power Supply in Harbors

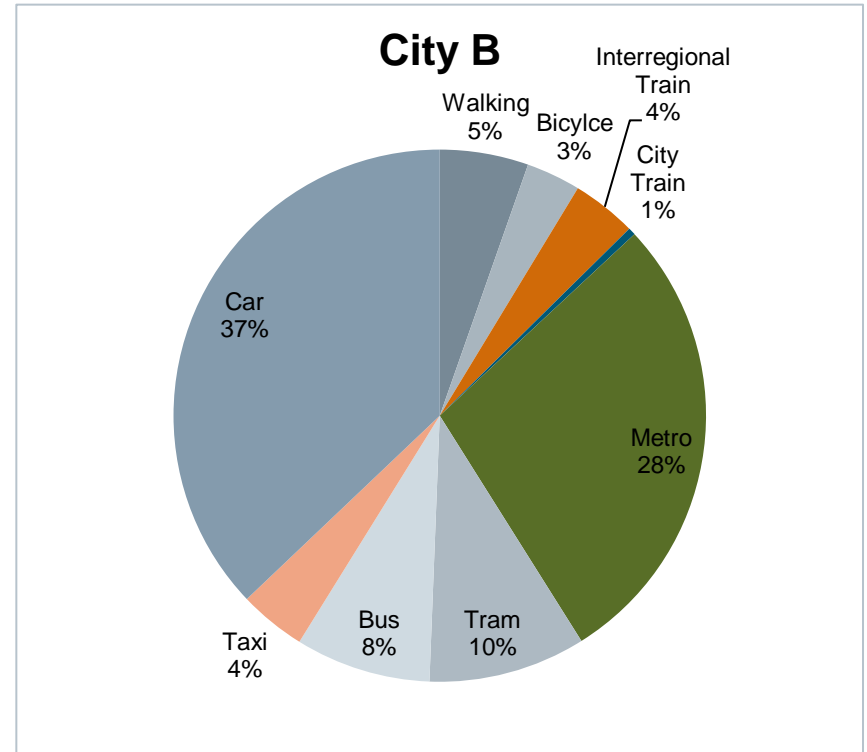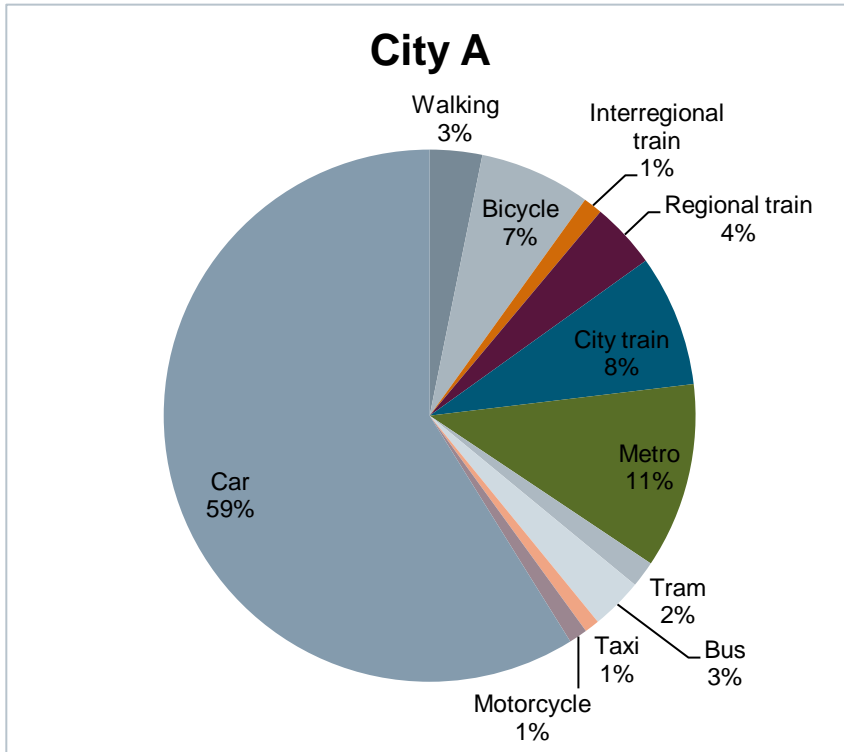# Impact of replacing 20% of car fleet with electric cars

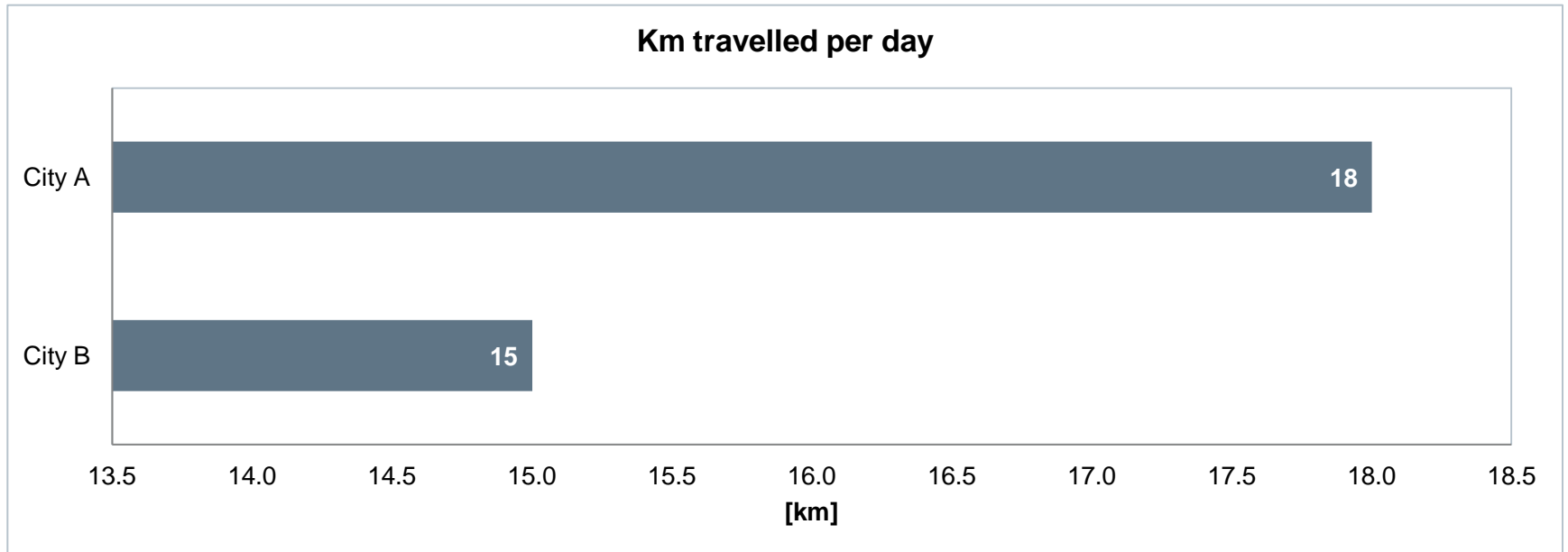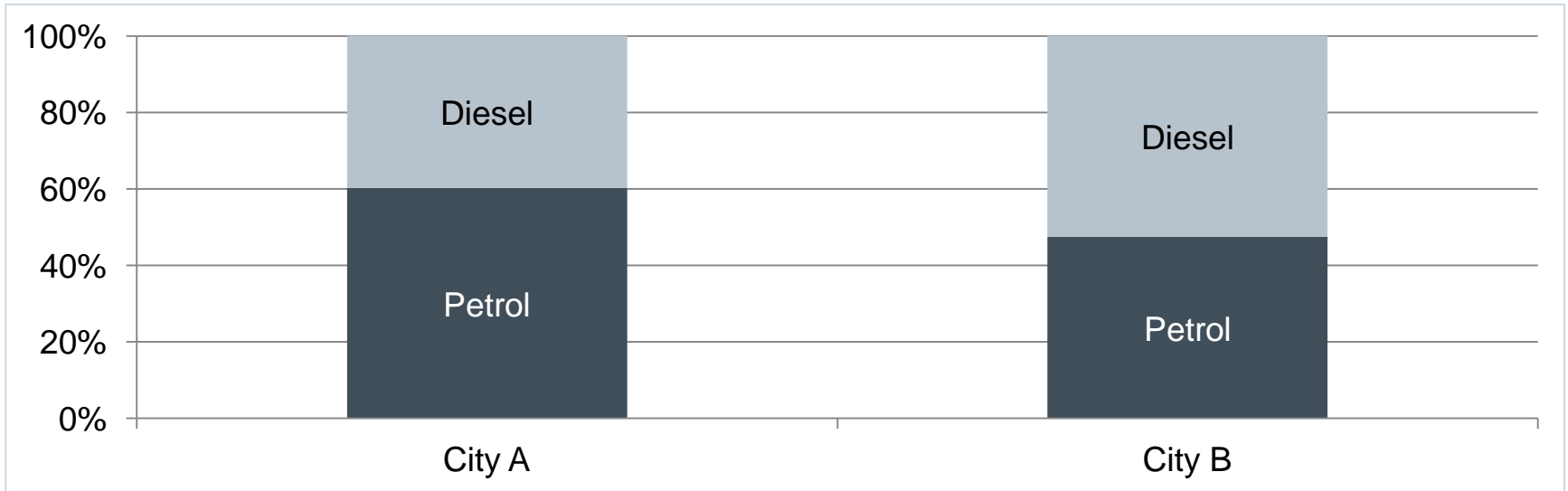# Impact of replacing 20% of car fleet with electric cars

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Kg and % reduction in annual transport emissions

[Kg CO$_2$e / capita]

City A — 5%
City B — 9%

Modal share

City A

- Walking 3%
- Interregional train 1%
- Bicycle 7%
- Regional train 4%
- City train 8%
- Metro 11%
- Car 59%
- Tram 2%
- Bus 3%
- Taxi 1%
- Motorcycle 1%

City B

- Walking 5%
- Bicylce 3%
- Interregional Train 4%
- City Train 1%
- Car 37%
- Metro 28%
- Taxi 4%
- Bus 8%
- Tram 10%

Passenger Transportation

Annual passenger kilometer travelled inside the city borders

Km travelled per day

City	[km]
City A	18
City B	15

13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

[km]

Car fleet

Composition of vehicle fleets by fuel source.

Electricity mix (powering the electrical car)
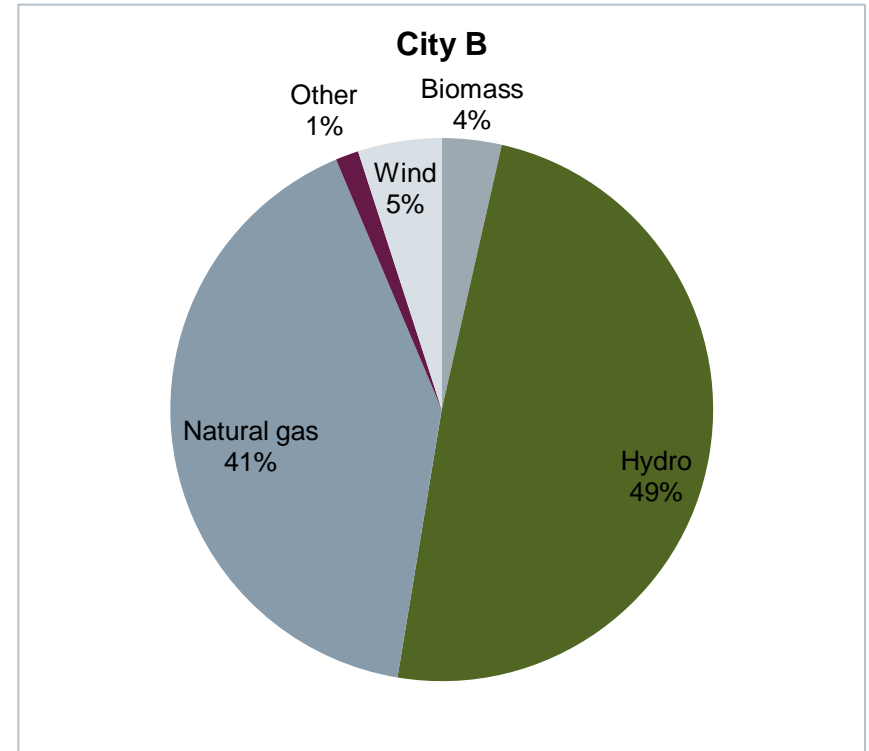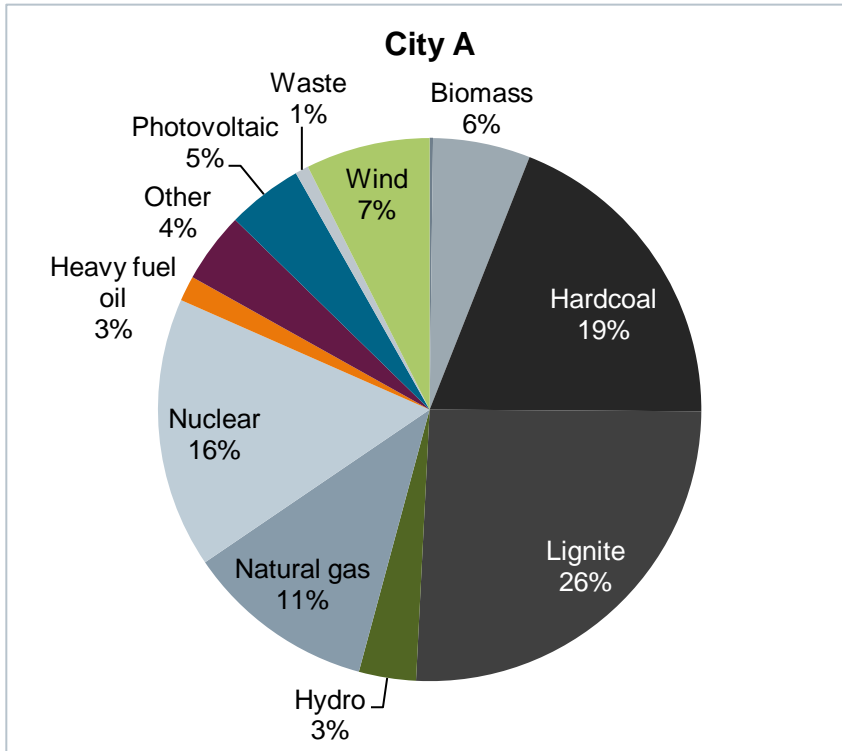
City A

- Waste 1%
- Photovoltaic 5%
- Other 4%
- Heavy fuel oil 3%
- Nuclear 16%
- Natural gas 11%
- Hydro 3%
- Lignite 26%
- Hardcoal 19%
- Biomass 6%
- Wind 7%

City B

- Other 1%
- Biomass 4%
- Wind 5%
- Natural gas 41%
- Hydro 49%

Step 3: Results: Technology impacts
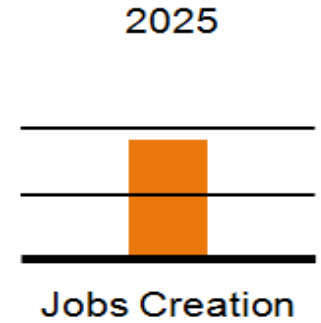

Implementation rates

Emissions savings

Cost efficiency

Job creation

Step 3: Results: Technology impacts (example)

	Implementation rates	Emissions savings	Cost efficiency	Job creation
e-Mobility	20%	4%	0.8	800
Building Retrofit	30%	6%	0.5	2,500
Renewable Energy	20%	12%	1.3	1,200
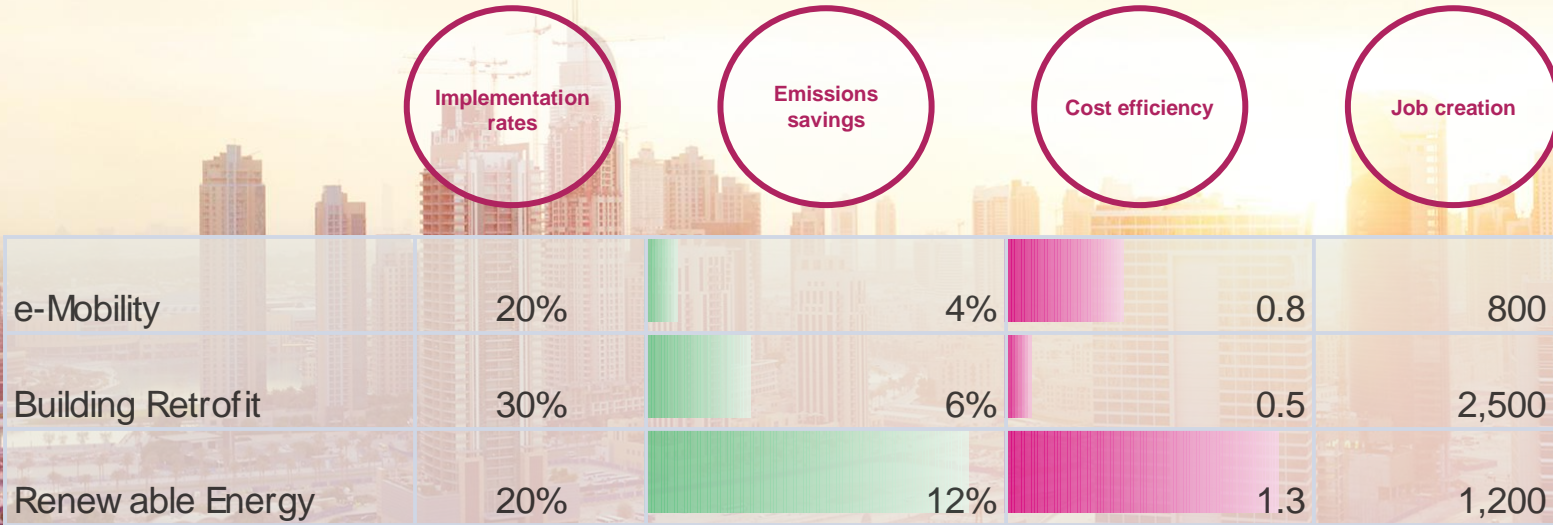
Planning through KPIs rather than solutions

In order to improve a city's KPIs
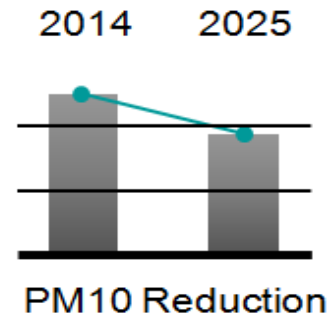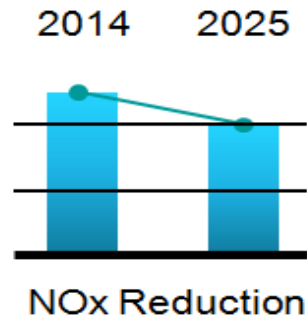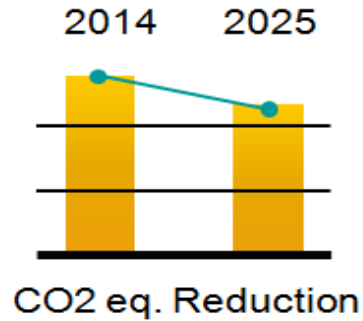
Cities are unique in targets

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Europe
GHG emissions reduction targets

City	Target
Copenhagen	100% by 2025
Stockholm	100% by 2050
Oslo	95% by 2030
Helsinki	92% by 2050
London	60% by 2025
Berlin	40% by 2020
Amsterdam	40% by 2025

Americas
GHG emissions reduction targets

City	Target
Seattle	100% by 2050
Portland	80% by 2050
Washington DC	80% by 2050
Houston	36% by 2016
Los Angeles	35% by 2030
Vancouver	33% by 2020
Buenos Aires	33% by 2030
São Paulo	30% by 2012
New York	30% by 2030
San Francisco	25% by 2017
Boston	25% by 2020
Santiago de Chile	20% by 2020

Asia
GHG emissions reduction targets

City	Target
Seoul	40% by 2030
Tokyo	25% by 2020
Wuhan	20% by 2015

Australia
GHG emissions reduction targets

City	Target
Melbourne	100% by 2020
Adelaide	100% by 2020
Sydney	70% by 2030

Africa
GHG emissions reduction targets

City	Target
Johannesburg	30% by 2025

Case study: Copenhagen

Copenhagen

How can the city incentivise their private sector?

CPH 2025 CLIMATE PLAN

A GREEN, SMART AND CARBON NEUTRAL CITY

observed

target
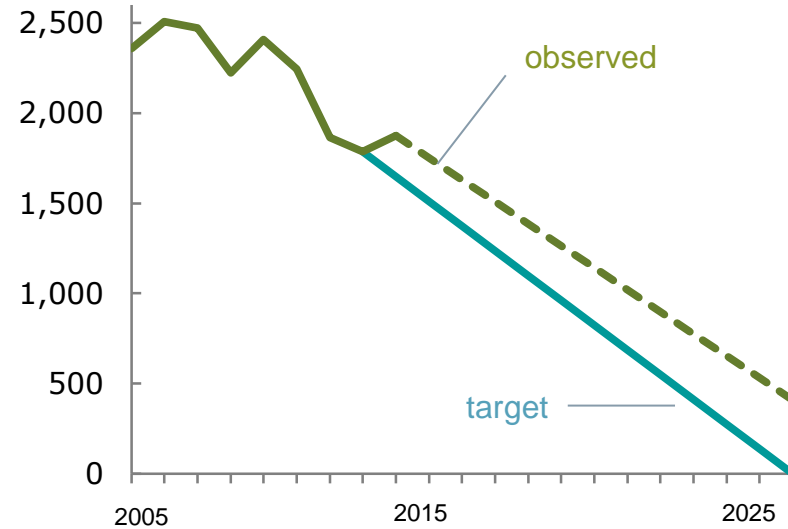
20-30% gap

Case study: Copenhagen

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40 building owners own 20%

6 technologies 10% reductions

5 mill. EUR investment per year

18.000+ jobs to the local economy

Case study: Mapping Vienna's scenarios

Vienna First
Technologies implemented

- Increased CHP contribution
- Residential wall insulation
- Residential double/triple glazing
- Commercial wall insulation
- Commercial double/triple glazing
- LED street lighting
- Metro ATO
- CNG cars
- Hybrid electric vehicles
- Intermodal traffic management

Vienna Accelerated
Technologies fit to Vienna's strategy

- Photovoltaic power generation
- Residential efficient lighting
- Residential home energy monitoring
- Commercial efficient lighting
- Commercial demand oriented lighting
- Commercial building efficiency monitor
- Commercial building performance optimization
- Demand controlled ventilation
- Metro – new line
- Urban bike sharing
- Plug in hybrid electric car
- Electric bus
- Intelligent traffic light management

Vienna Experimental
Additional technologies to be implemented

- Residential home automation
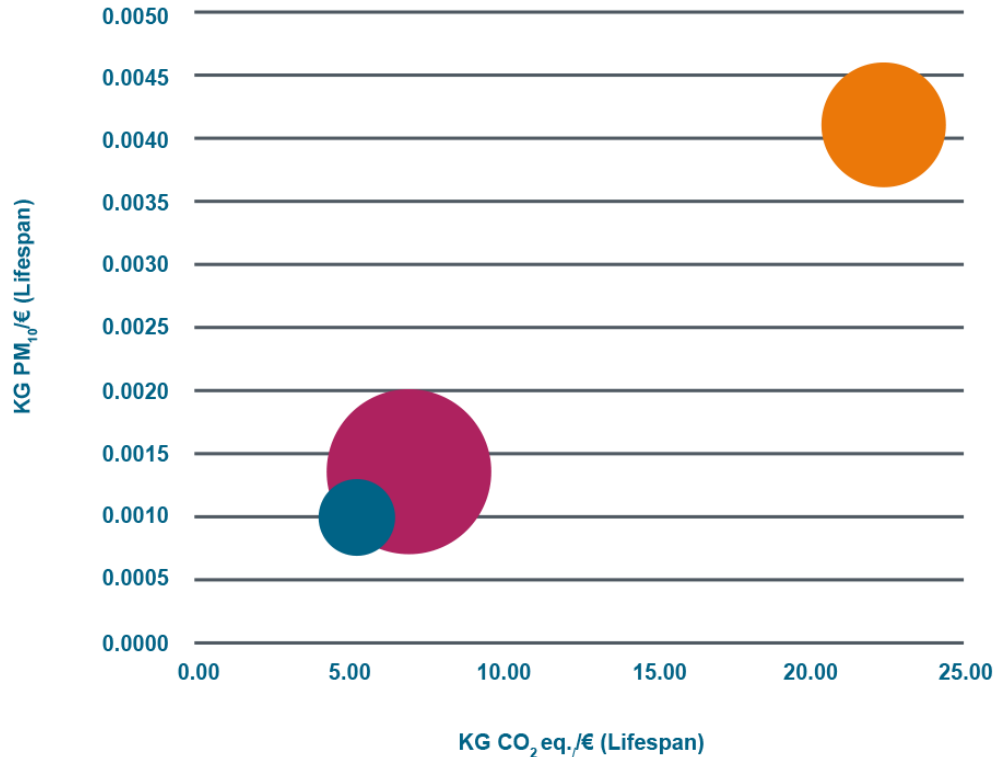- Commercial heat recovery
- Hybrid electric bus
- Train - ATO
- Electric cars
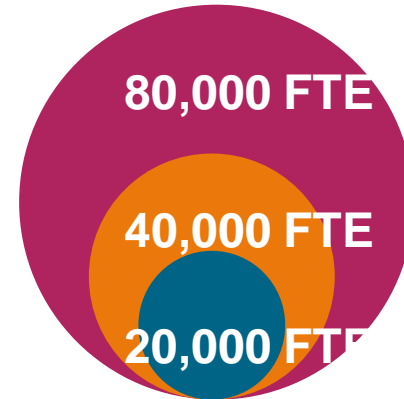- Electric taxis
- Demand oriented street lighting
- Electric car sharing

Case study: Mapping Vienna's cost efficiencies

KG PM_{10}/€ (Lifespan) vs KG CO_2 eq./€ (Lifespan)

Comparisons per scenario

- Vienna First
- Vienna Accelerated
- Vienna Experimental

80,000 FTE
40,000 FTE
20,000 FTE

Jobs creation

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Planning through KPIs rather than solutions
based on the city's individual baseline

The CyPT path

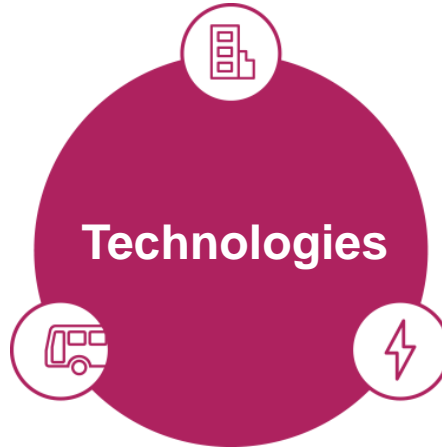**Build emissions baseline**

The CyPT builds a unique city baseline based on your city data.

The CyPT path

Build emissions baseline

Technologies

The CyPT builds a unique city baseline based on your city data.

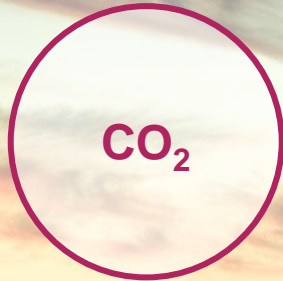Team of city experts collaborate to determine the most appropriate technologies for achieving targets.

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The CyPT path

Build emissions baseline

The CyPT builds a unique city baseline based on your city data.

Technologies

Team of city experts collaborate to determine the most appropriate technologies for achieving targets.

Results

Results calculate a cost-benefit analysis of the environmental and economic impact of technologies.

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The CyPT outcomes (KPIs)

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GHG

Air quality

Economy

CO_2

PM10

NO_x

Jobs

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