

Future possibilities for district heating in sustainable cities



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Sustainable Cities - Global Challenge



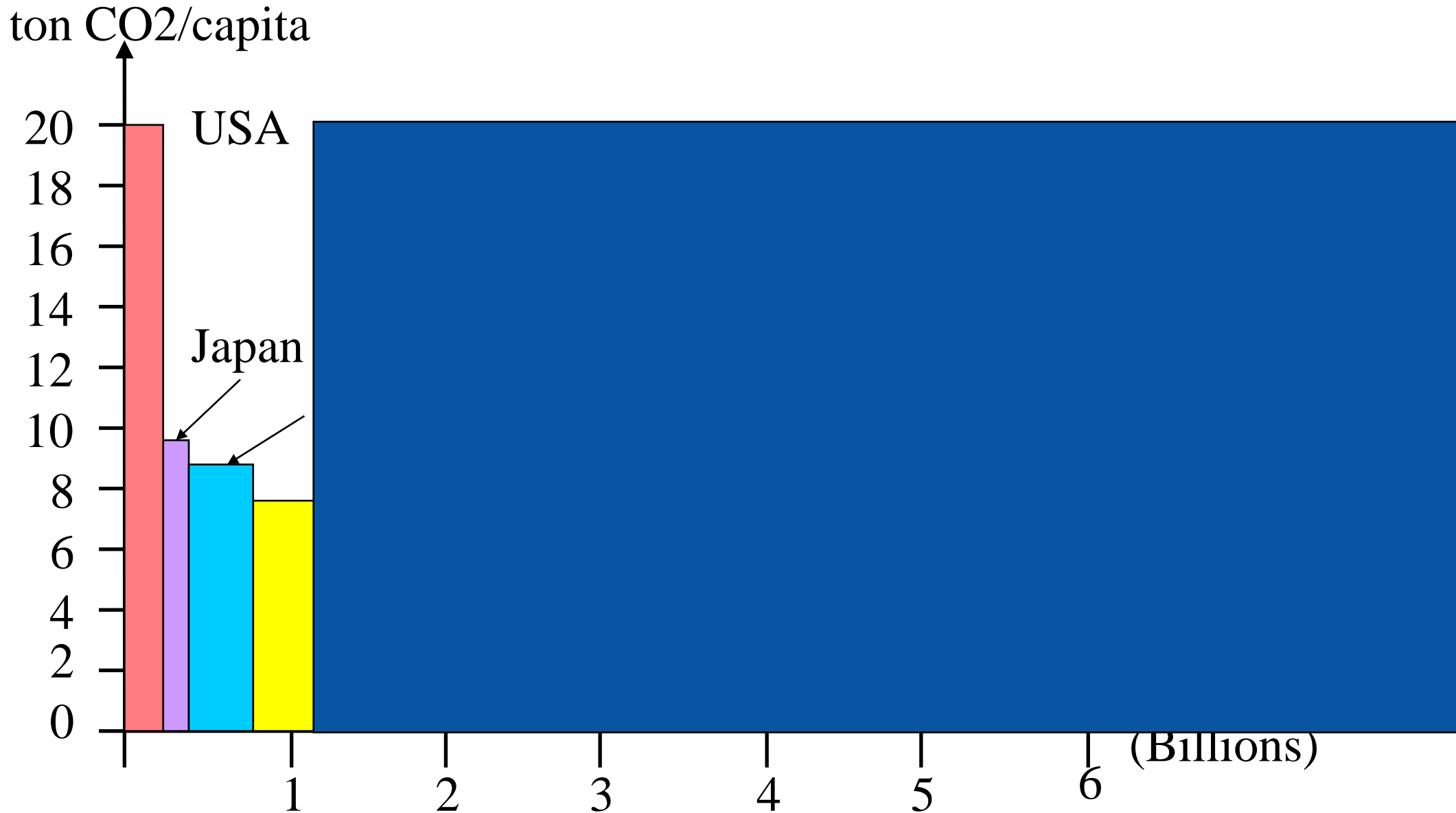
- From 6 to 9 billion people in 2050
- Rapid urbanisation – 400 million new urban citizens in China in the near future
- In Europe the cities have already been built
- Energy Security – more than 40% of the energy use
- Energy, water, natural resources, chemicals, and waste
- Large and cost-effective improvement potential

Energy in Europe



building sector is responsible for 40% of energy use

Sustainable Cities - Global Challenge



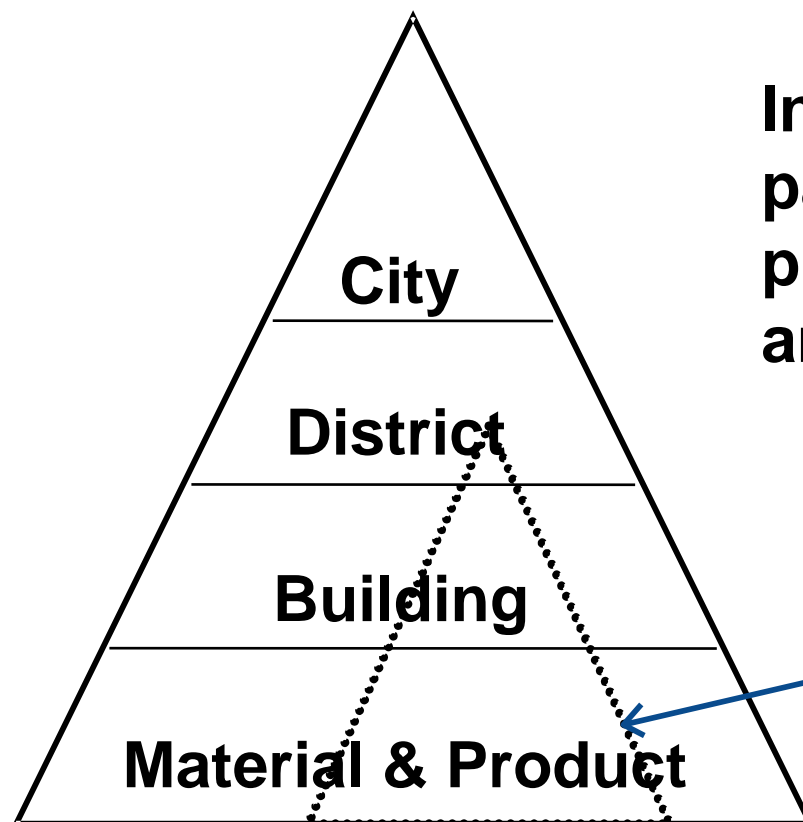
Sustainable Cities



- A good life
- Equitable and efficient use of the world's natural resources
- Low emissions of greenhouse gases and renewable energy supply
- Closed sewerage and waste water systems
- Prevent the release of toxic substances into the environment
- Biodiversity

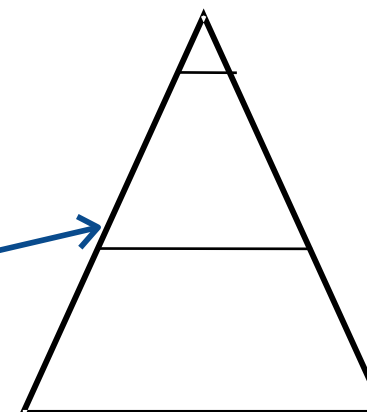
The vision for Gothenburg 2050

Sustainable Cities = Sustainable buildings ?



Full system and life cycle perspective

Integration needed for all parts: the materials & products, building, district and city



Part-system and/or life cycle perspective

District heating and cooling a part of the sustainable solution year 2020?



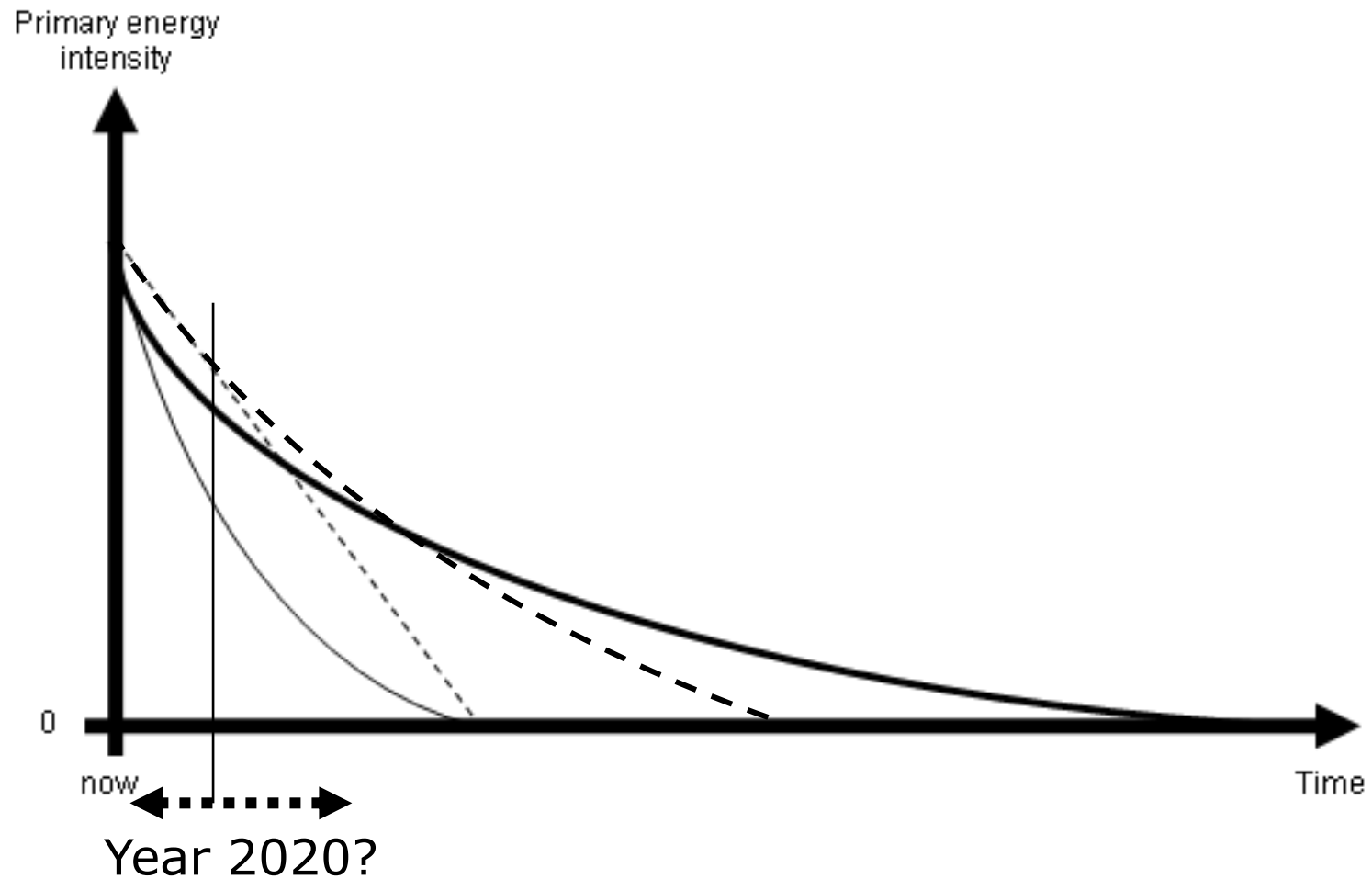
Source: Symbio City Hammarby Sjöstad



Viikki – Helsinki, Finland

Paths towards sustainability

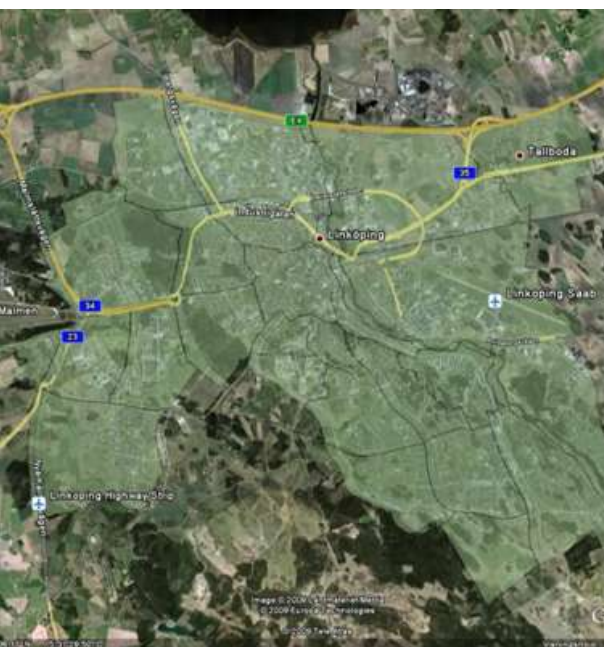
– rate of change



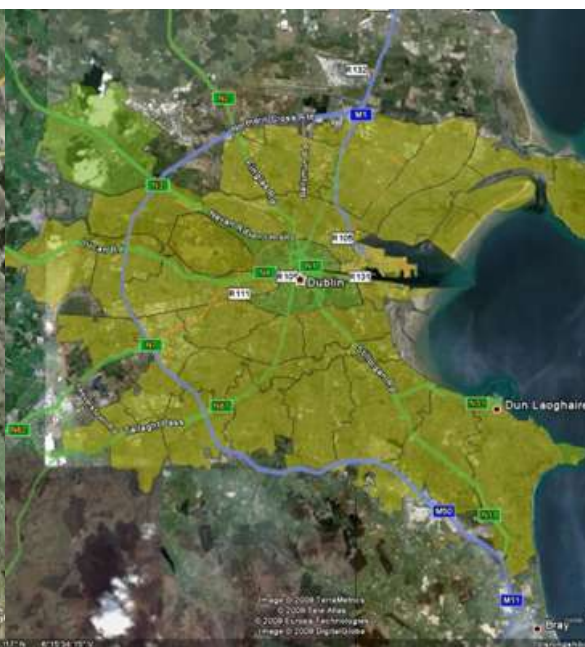
Paths towards sustainability – rate of change for energy efficiency (EE) with or without district heating (DH)

	Widespread expansion of district heating	No expansion of district heating	Year 2020
Plan & Control	<ul style="list-style-type: none"> • DH implemented or DH upgrade • 4% EE 	<ul style="list-style-type: none"> • No DH or No DH upgrade • 4% EE 	36% energy efficiency in buildings
Market & Policy	<ul style="list-style-type: none"> • DH implemented or DH upgrade • 2% EE 	<ul style="list-style-type: none"> • No DH or No DH upgrade • 2% EE 	

	Population (thousands)	Employees (thousands)	City territory (km²)	Exploited area (km²)	District division (#)
Linköping	112	62	59	21	26
Dublin	1 178	519	295	209	34 / 1131*
Madrid	3 695	1 707	604	551	128
Tallinn	460	244**	160	95	8 / 101***



Linköping



Dublin

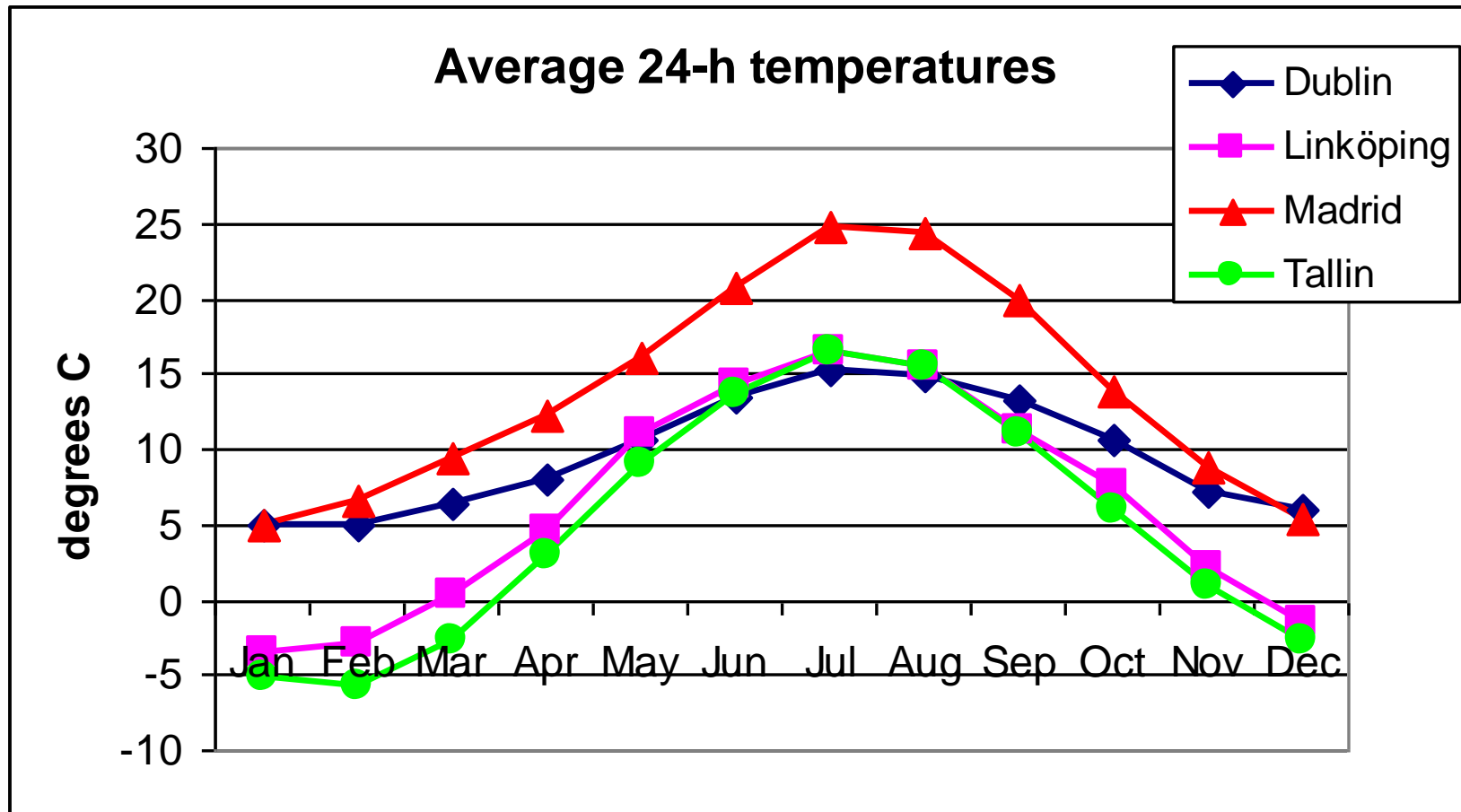


Madrid



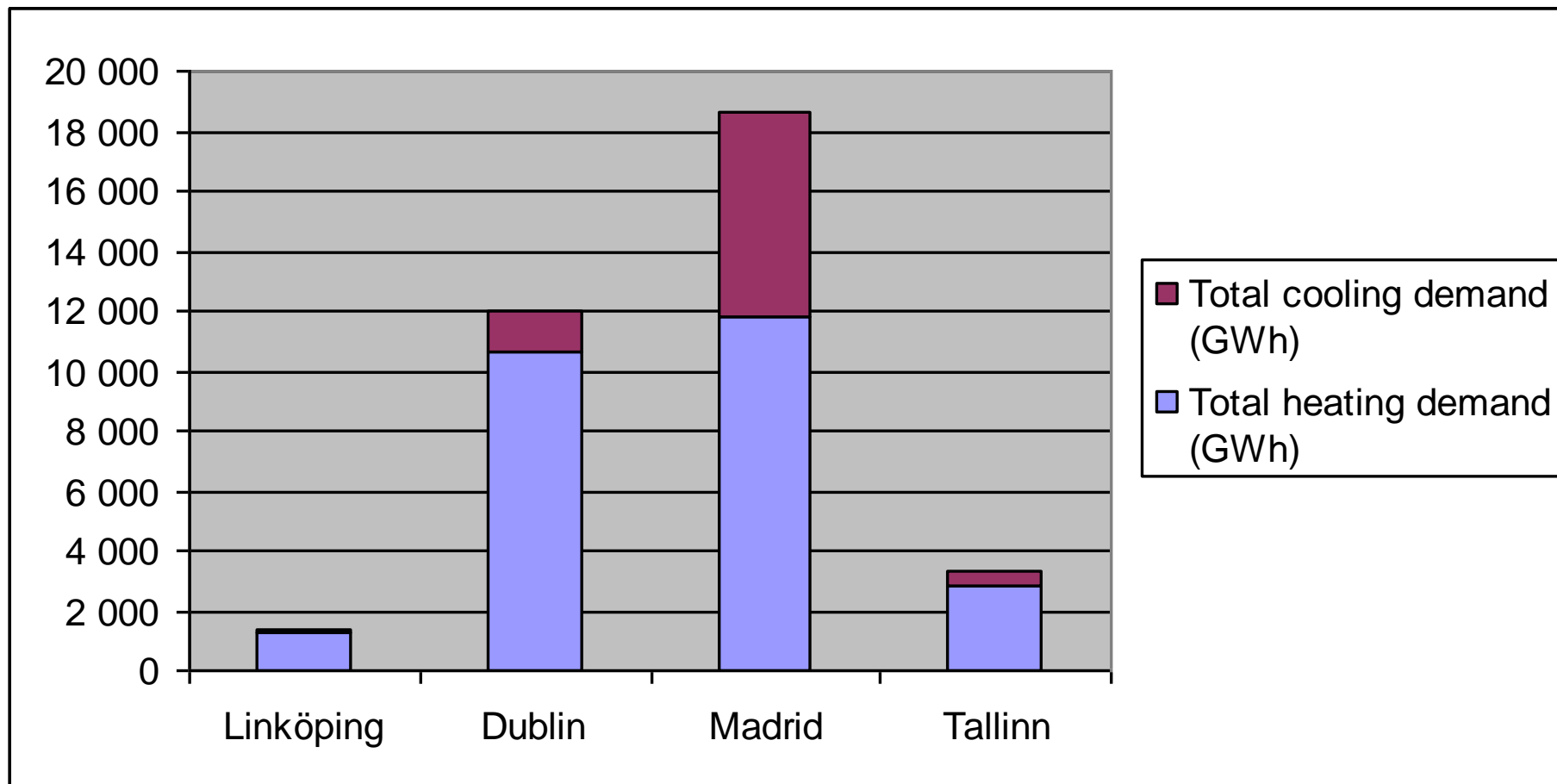
Tallinn

Climate in the cities

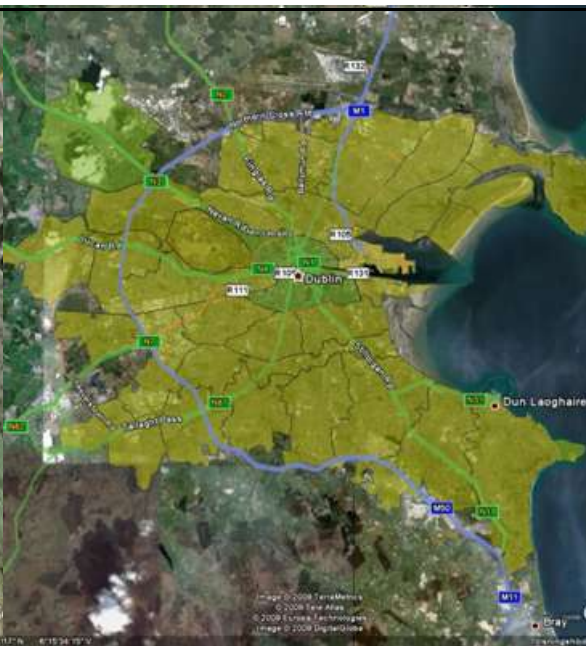
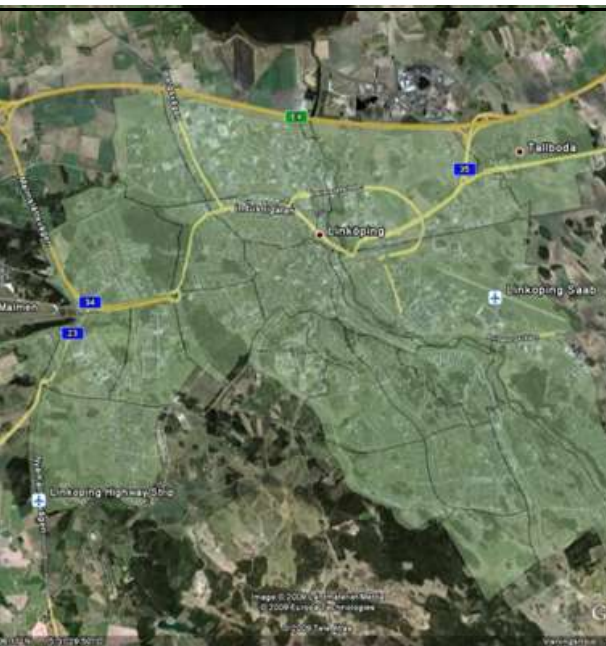


The monthly average 24h temperatures for the cities (World climate, 2009)

Heating and cooling demand in the cities



	Total heating demand (GWh)	Heating demand/inhabitant (kWh/inh.)	Heating demand per inhabitant + employee (kWh/(inh.+emp.))	Average heating demand density (GWh/km ² exploited area)
Linköping	1 257	11 252	7 237	60.2
Dublin	10 634	9 028	6 269	50.9
Madrid	11 850	3 207	2 194	21.5
Tallinn	2 800	6 091	n.a.	31.5



Linköping

10 GWh/km²

100% (95-98%)

Dublin

>60 GWh/km²

23% (0)

Madrid

>60 GWh/km²

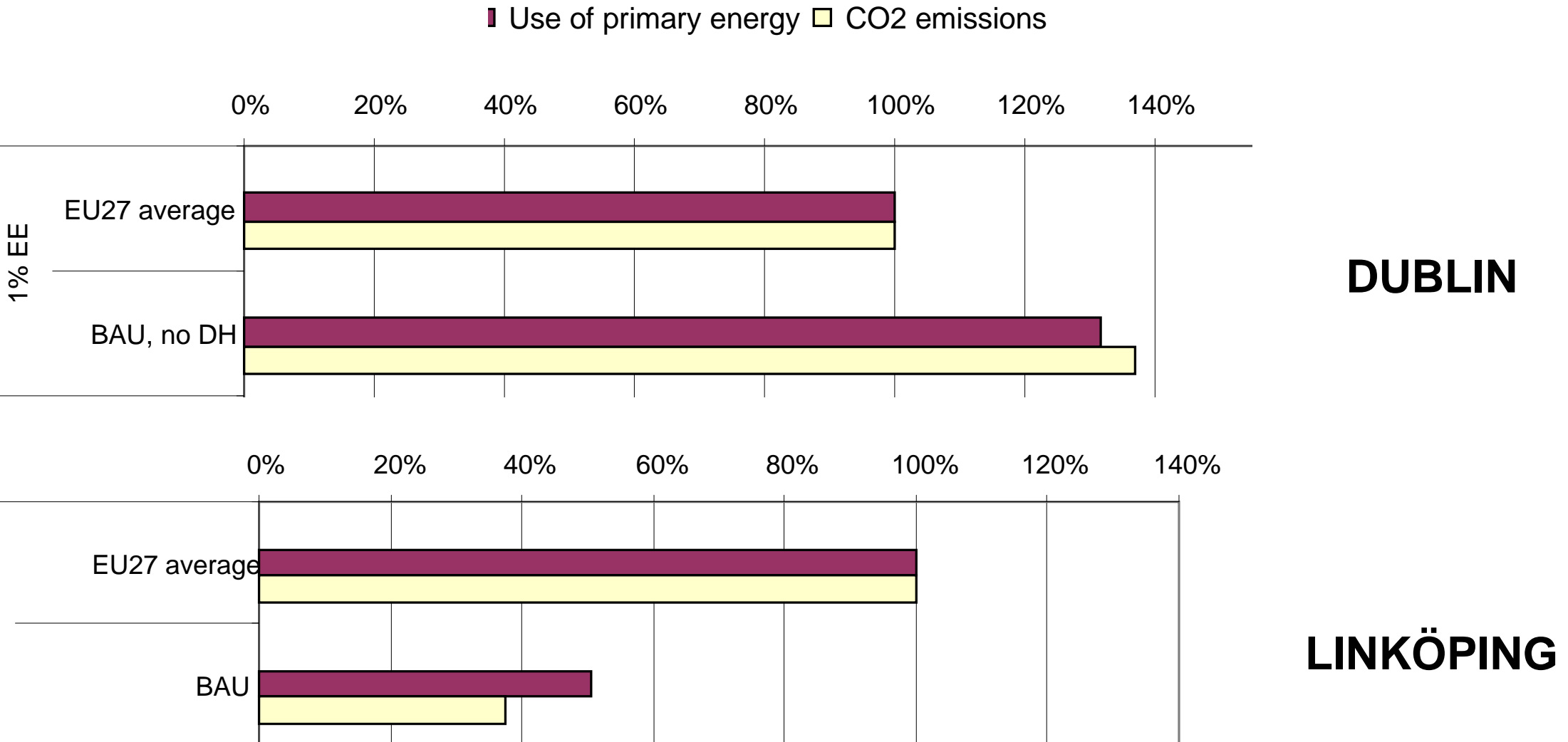
40% (0)

Tallinn

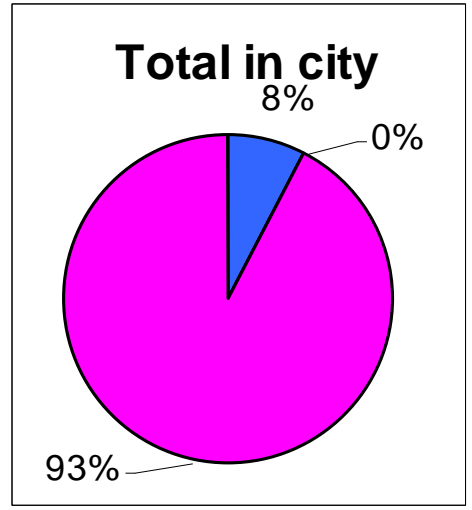
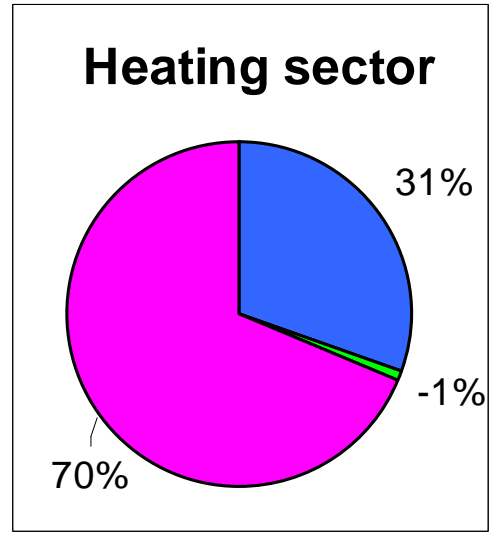
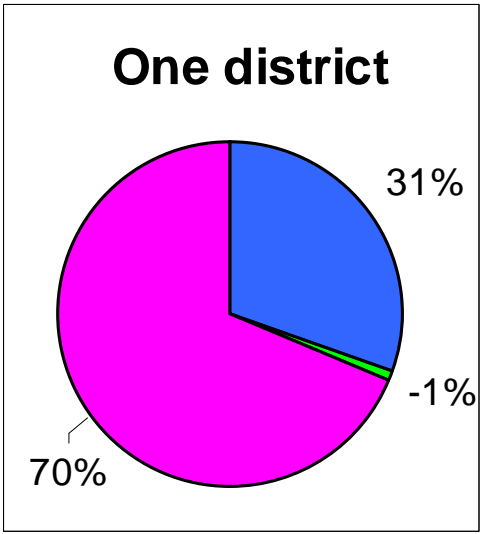
10 GWh/km²

98% (68)

Comparison of energy efficiency in Dublin and Linköping in 2020 – Business as usual



Primary Energy Resources

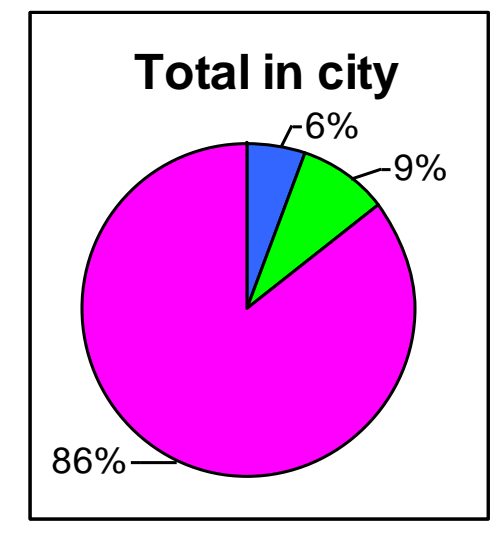
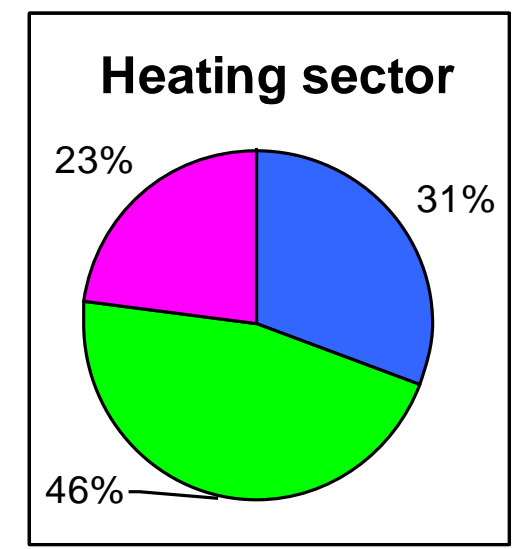
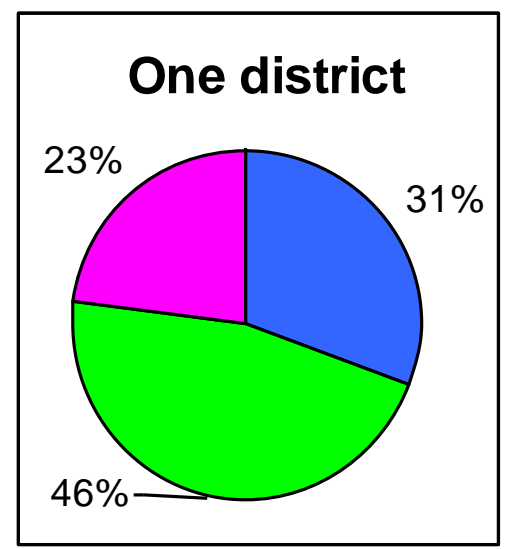


100% = BAU in one city district

100% = BAU in the heating sector (896 GWh)

100% = BAU in the whole city (3 623 GWh)




CO₂-emissions



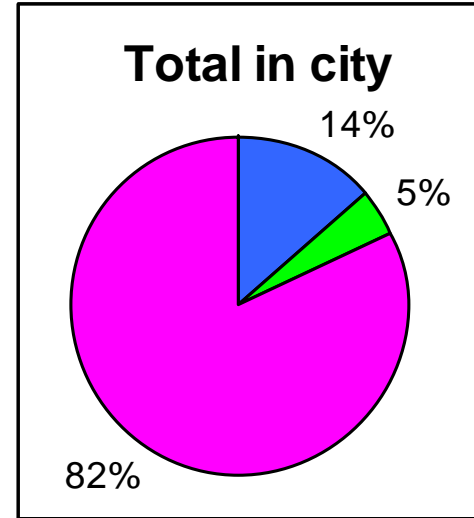
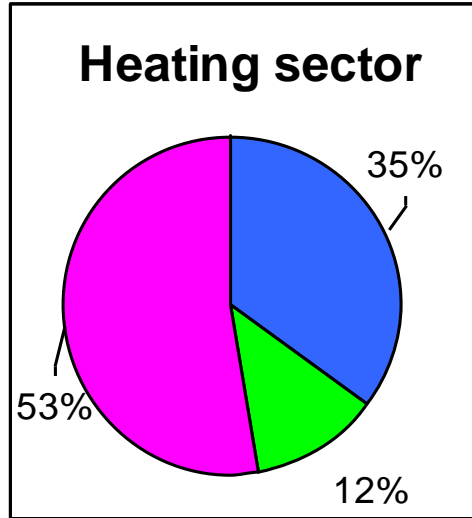
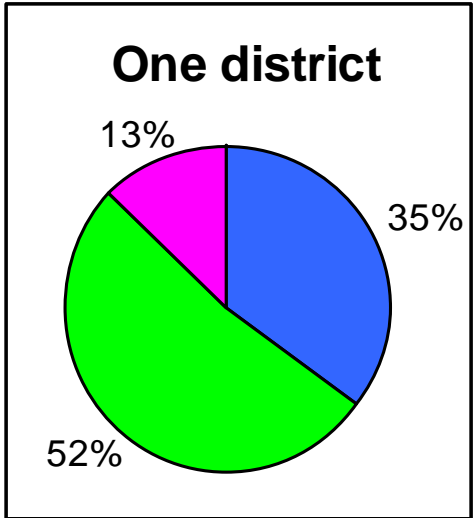
100% = BAU in one city district

100% = BAU in the heating sector (133 kton)

100% = BAU in the whole city (713 kton)

-  Energy efficiency
-  District heating
-  Emissions /Resources after

Primary Energy Resources

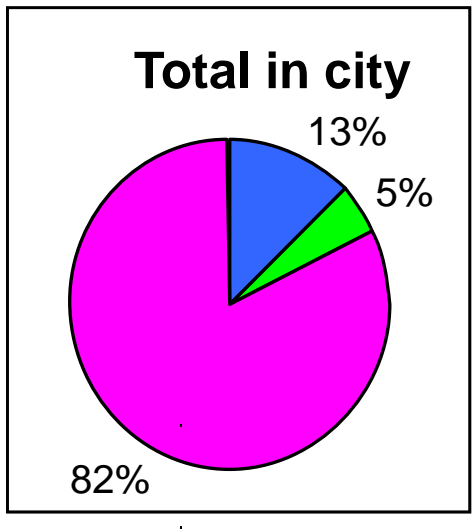
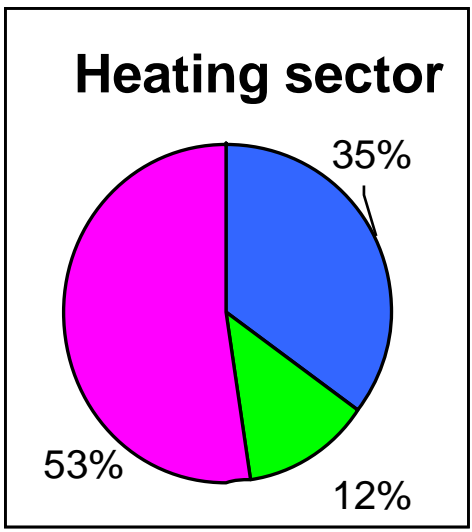
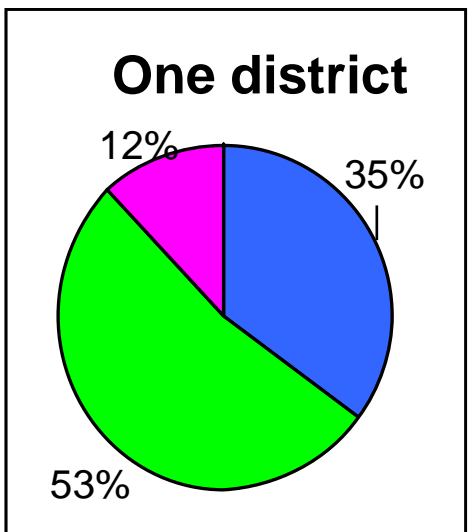


100% = BAU in one city district

100% = BAU in the heating sector (17 512 GWh)

100% = BAU in the whole city (45 312 GWh)




CO₂-emissions



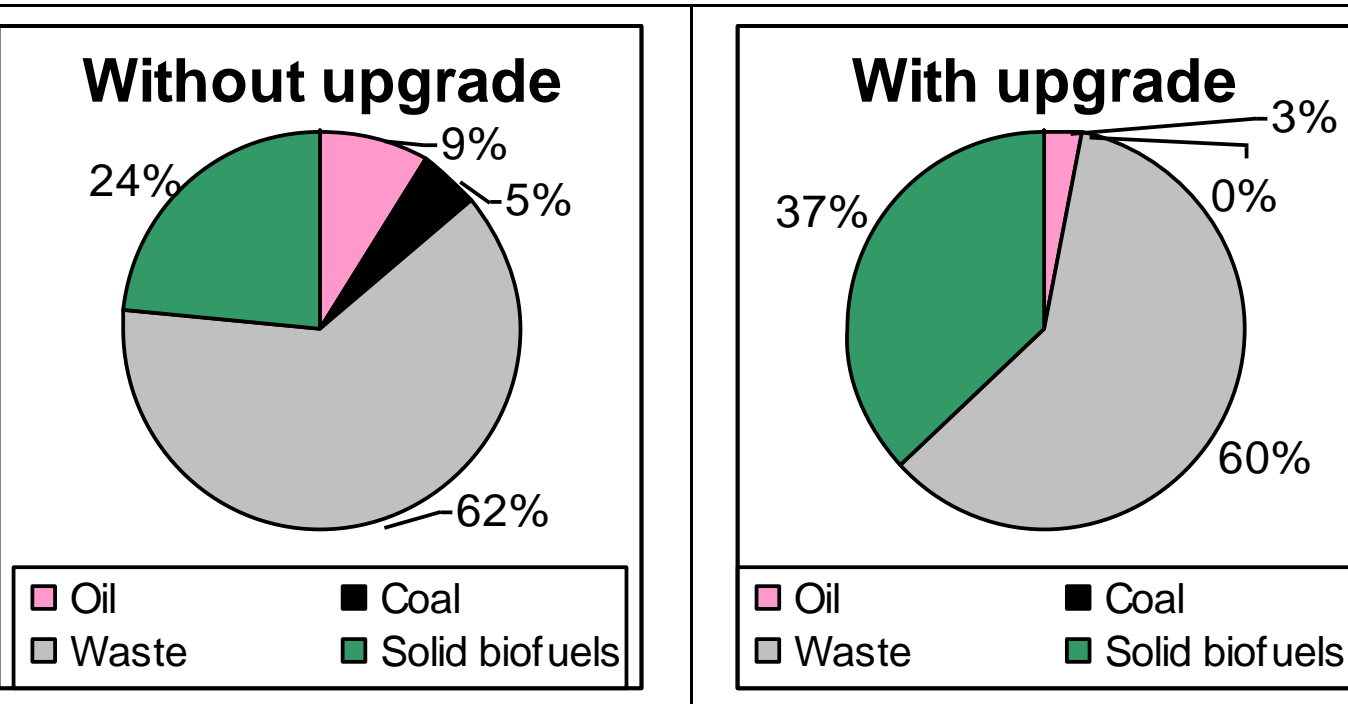
100% = BAU in one city district

100% = BAU in the heating sector (3 645 kton)

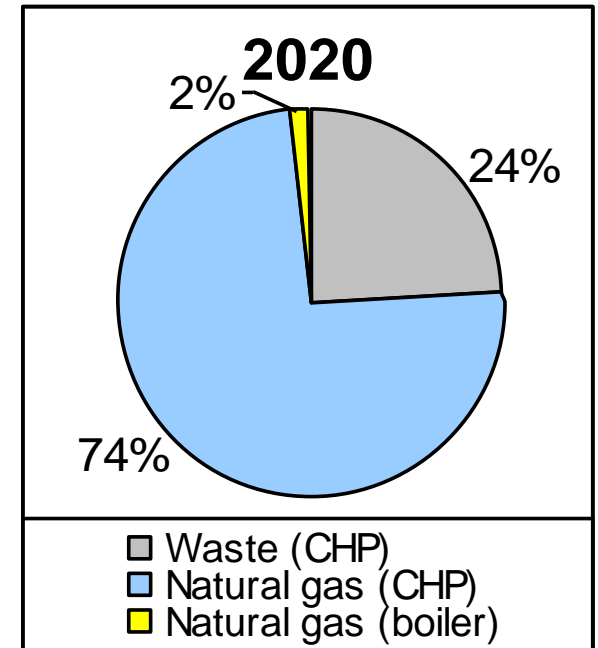
100% = BAU in the whole city (9687 kton)

-  Energy efficiency
-  District heating
-  Emissions /Resources after

District heating

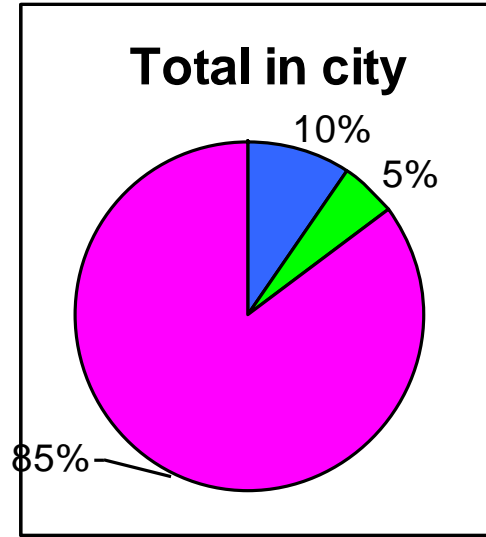
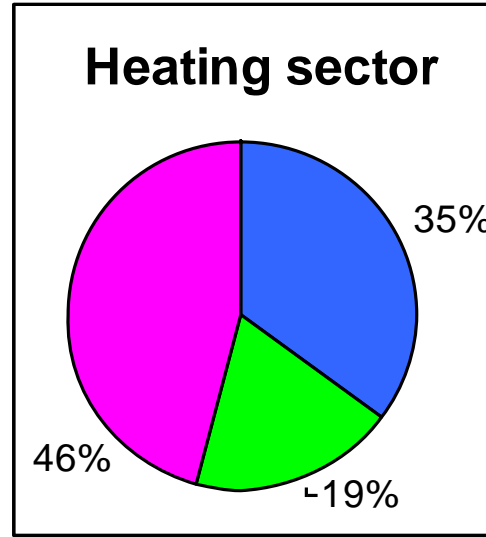
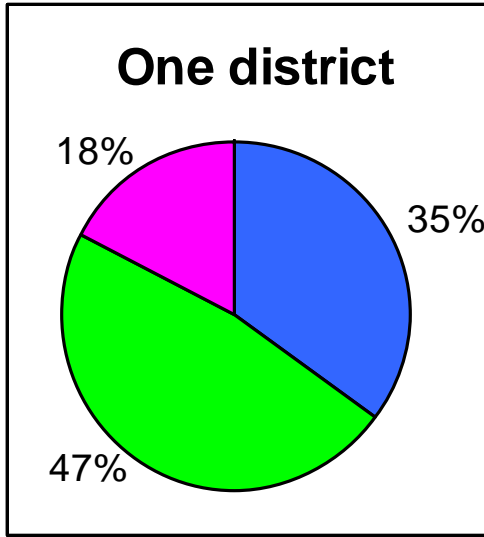


Linköping



Dublin

Primary Energy Resources

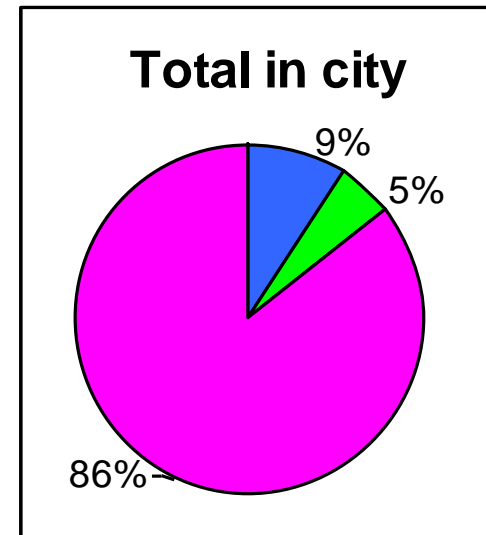
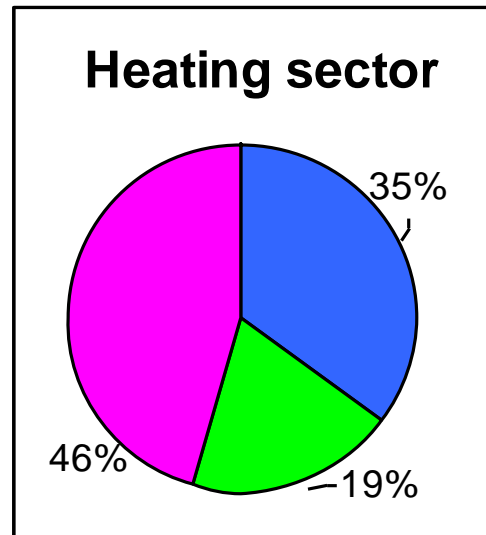
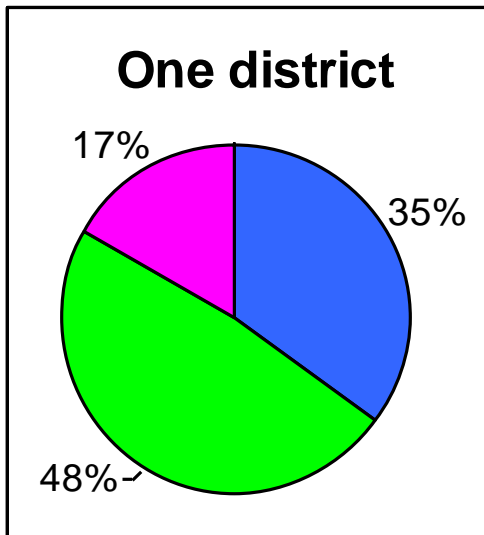


100% = BAU in one city district

100% = BAU in the heating sector (20 438 GWh)

100% = BAU in the whole city (72 866 GWh)

CO₂-emissions



100% = BAU in one city district

100% = BAU in the heating sector (4 138 kton)

100% = BAU in the whole city (15 537 kton)

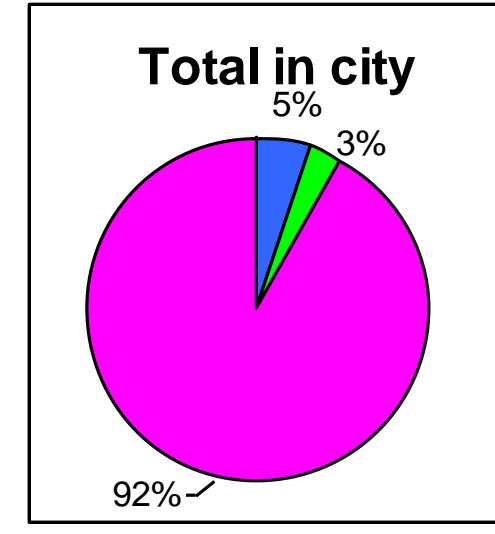
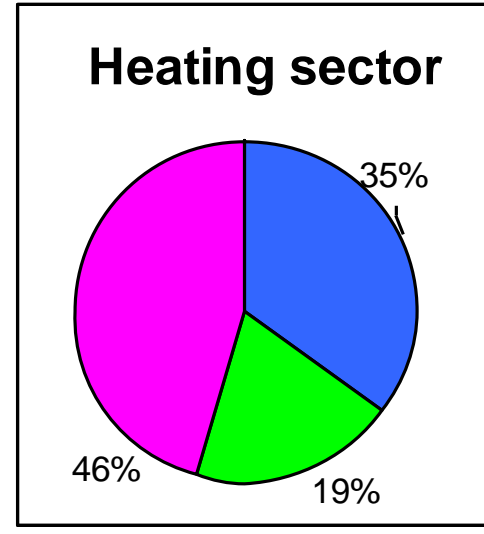
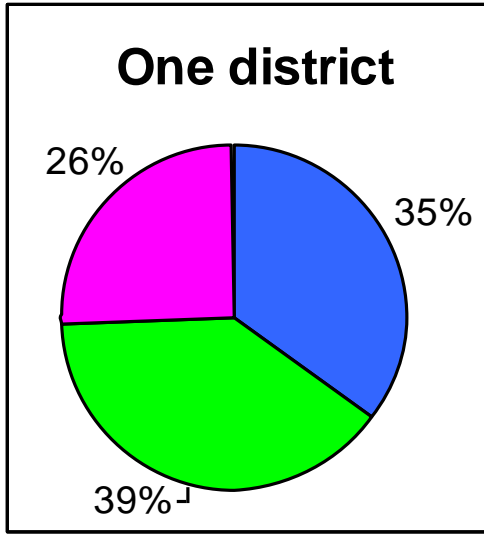
Energy efficiency

District heating

Emissions

/Resources after

Primary Energy Resources

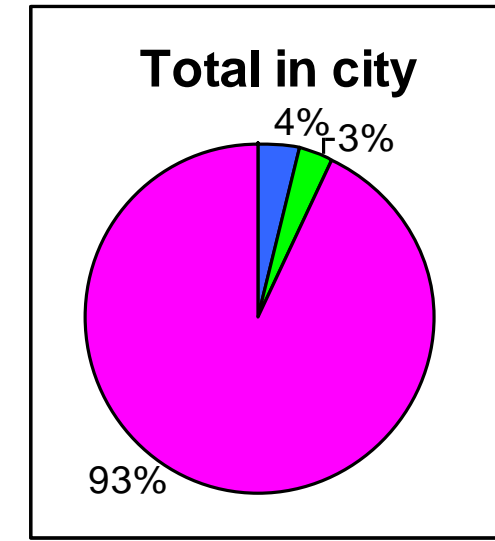
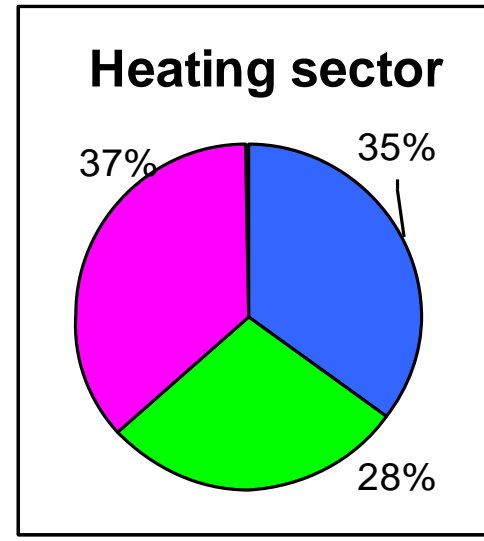
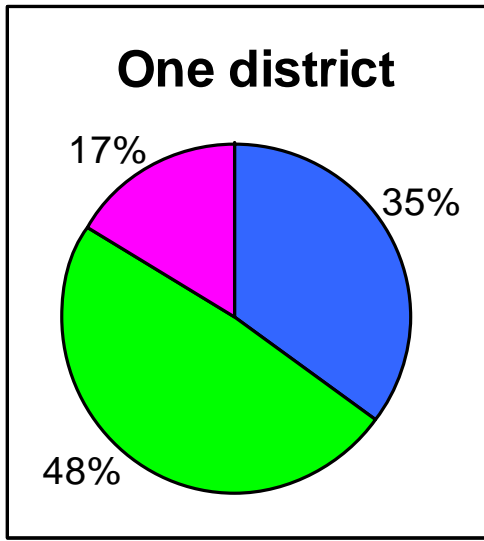


100% = BAU in one city district

100% = BAU in the heating sector (2 585 GWh)

100% = BAU in the whole city (17 002 GWh)




CO₂-emissions



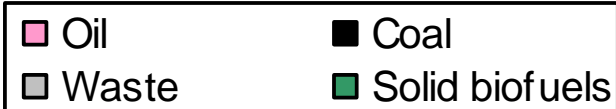
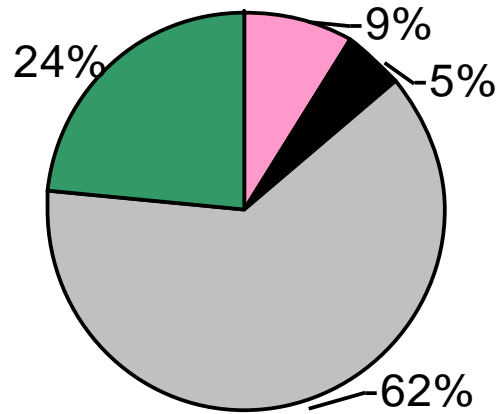
100% = BAU in one city district

100% = BAU in the heating sector (416 kton)

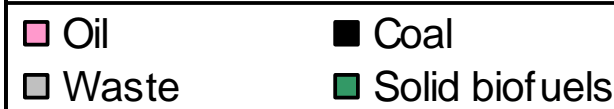
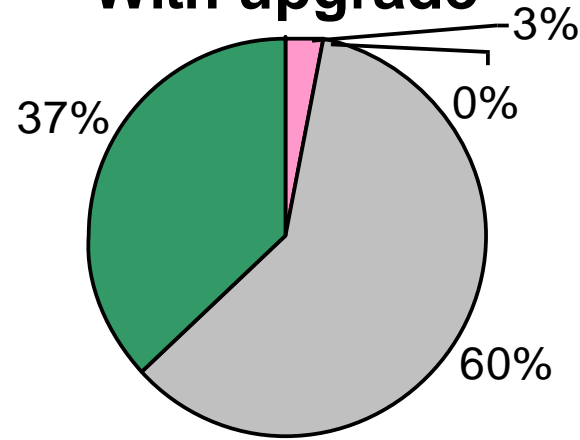
100% = BAU in the whole city (3 664 kton)

-  Energy efficiency
 -  District heating
 -  Emissions
- /Resources after

Without upgrade

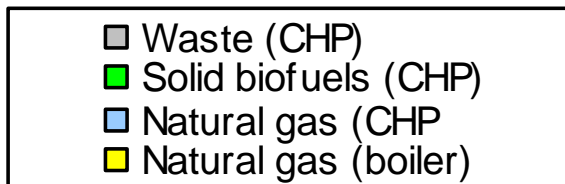
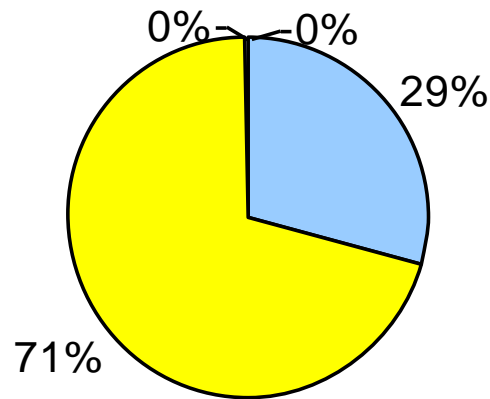


With upgrade

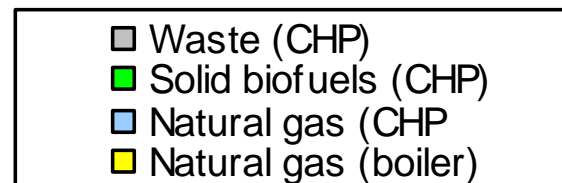
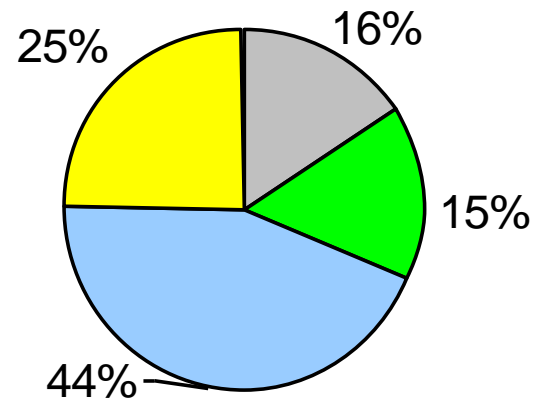


Linköping

Without upgrade

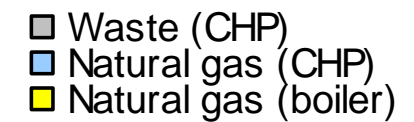
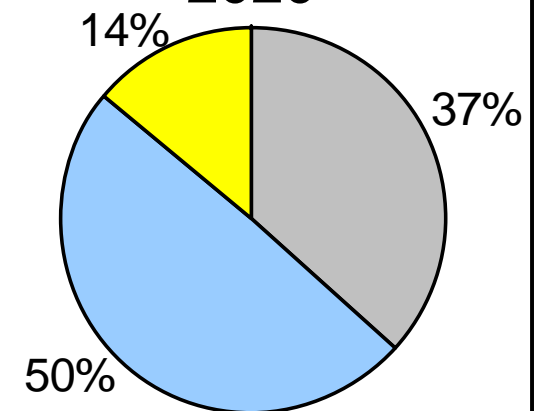


With upgrade



Tallinn

2020



Madrid

Conclusions

- On a district level where district heating is introduced both the primary energy resource use and the CO₂ emissions can be lowered by approximately 50%
- If also energy efficiency measures is introduced the reduction of emissions and primary resource use can be as large as 80%
- If DH is introduced (only in the most profitable areas) the total CO₂-emissions of the Cities can be lowered by 5%
- In a city where district heating already exist energy efficient measures in the buildings shows the greatest potential for reduction
- In a city with DH the introduction of renewable energy sources lowers the CO₂ emissions quite fast

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Thank you for your attention!