POCACITO

european post-carbon cities of tomorrow

CASE STUDY ASSESSMENT REPORT

MALMÖ

IVL SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE

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I INTRODUCTION

This report presents the results of the initial assessment conducted in the case study city Malmö. The initial assessment is based on the key performance indicators selection as defined in D1.2.

II APPROACH AND METHODOLOGY

II.I MODEL AND CONCEPT

We followed the joint methodology and instructions for the data collection as introduced by the leader of WP3.

The original time plan was postponed. The following key performance indicators were selected to capture the transition of a current city to post-carbon city (D1.2). Some of the data collected for the case study of Malmö however differ in i) years covered, ii) geographical coverage or iii) the exact indicator variable. The actual collected dimensions are listed at each indicator in chapter V.

Table 1: Suggested list of key performance indicators

DIMENSION	SUB-DIMENSION	INDICATOR	UNIT	YEAR
SOCIAL	Social Inclusion	Variation rate of unemployment level by gender	Percentage	2003-2012
		Variation rate of poverty level	Percentage	2003-2012
		Variation rate of tertiary education level by gender	Percentage	2003-2012
		Variation rate of average life expectancy	Average Nº	2003-2012
	Public services and Infrastructures	Variation rate of green space availability	Percentage	2003 2012
	Governance effectiveness	Existence of monitoring system for emissions reductions	Yes/No Description	2013
ENVIRONMENT	Biodiversity	Variation rate of ecosystem protected areas	Percentage	2012
	Energy	Energy intensity variation rate	Toe/euro Toe	2003 2012
		Variation rate of energy consumption by sectors	Percentage	2003 2012
	Climate and Air Quality	Variation rate of carbon emissions intensity	Ton CO_2/euro Ton CO_2	2003 2012

DIMENSION	SUB-DIMENSION	INDICATOR	UNIT	YEAR
		Variation rate of carbon emissions by sector	Ton CO_2	2003 2012
		Exceedance rate of air quality limit values	Nº	2010 2012
	Transport and mobility	Variation share of sustainable transportation	Percentage	2001 2011
	Waste	Variation rate of urban waste generation	Kg/person/year	2007 2012
		Variation rate of urban waste recovery	Percentage	2007 2012
	Water	Water losses variation rate	m^3/person/year	2003 2012
	Buildings and Land Use	Energy-efficient buildings variation rate	Percentage	2007 2012
		Urban building density variation rate	Nº/ km^2	2003 2012
ECONOMY	Sustainable economic growth	Level of wealth variation rate	eur/person	2003-2012
		Variation rate of GDP by sectors	Percentage	2003-2012
		Employment by sectors variation rate	Percentage	2003 2012
		Business survival variation rate	Percentage	2008,2009,2010
	Public Finances	Budget deficit variation rate	Percentage of city's GDP	2003-2012
		Indebtedness level variation rate	Percentage of city's GDP	2003-2012
	Research & Innovation dynamics	R&D intensity variation rate	Percentage	2003-2012

II.II DATA COLLECTION PROCESS

The data were collected from following sources:

- National statistics – SCB Statics Sweden;
- European statistics – Eurostat;
- Data collected on the city level by the city office.

The data on the city level were obtained from the local authorities as they are not part of publicly available statistical databases. If not otherwise indicated, the data was collected for the municipality of Malmö.

III OVERVIEW OF THE CASE STUDY CITY

III.I TERRITORY

The city of Malmö is situated in the Skåne region on the southwest coast of Sweden, with direct connection to Denmark via the Öresund bridge. The territory of the case study covers the area of 332.64 km^2, whereof 156.87 km^2 land, and encompasses the municipality of Malmö with its about 313,000 inhabitants (2013).

Figure 1: Malmö municipality in the Skåne region

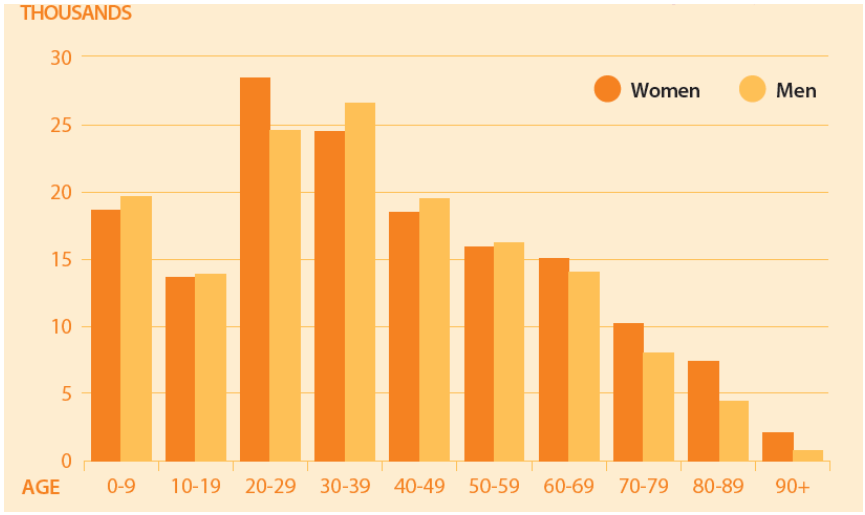
Figure 2: Detailed map of Malmö municipality.

III.II POPULATION

In twenty years, the average inhabitant of Malmö has become three years younger. The most typical resident of Malmö today is a 29-year-old woman or a 30-year-old man. With 312,994 inhabitants, Malmö is Sweden's third largest city (31 Dec. 2013). The population increased by 5,236 people (+1.7%) in 2013. Both net birth and net migration are positive.

Malmö is a young city – almost half of the population is under 35 (49%). 71% of households consist of single parent or single person households (2013). 31% of the city's inhabitants were born abroad – the largest groups were born in Iraq, the former Yugoslavian countries and Denmark. All in all, about 178 countries are represented among the Malmö citizens [10].

Figure 3: The Malmö population by age group and sex in 2013 [10]



III.III ECONOMY

Malmö's gross regional product (GRP) amounted to SEK 123,356 million in 2011 (+55% in ten years). It is mainly service production that has increased. GRP per capita was SEK 410,000. Total disposable income in Malmö was SEK 47,238 million (+53% in ten years). Disposable income per capita was SEK 157,000.

Table 2: Structure of enterprises in Malmö 2013: Number of workplaces by number of employees.

SECTOR	0 EMPL	1-2	3-9	10-49	50-249	250-499	500+	TOT
Agriculture, forestry and fisheries	701	30	12	0	0		0	743
Manufacturing	610	185	189	132	39	3	1	1159
Energy, water, waste	49	18	14	13	9	1	0	104
Construction	1038	384	234	154	39	1	0	1850
Commerce	2423	1017	1123	480	69	3	0	5115
Transport and warehousing	366	324	159	93	21	8	2	973
Hotels and restaurants	385	333	330	143	11		0	1202
Information and communication	1571	427	240	134	37	4	0	2413
Financial and insurance services	478	116	84	42	10		1	731
Real estate activities	2214	421	134	55	7		0	2831
Law, economics, science and technology	4453	1226	518	239	44	2	0	6482
Rental, real estate, travel, support services	803	283	223	142	59	3	3	1516
Public administration, defence etc.	5	11	31	32	39	5	2	125
Education	643	92	174	236	65	3	0	1213
Healthcare, social services	774	305	281	282	52	4	4	1702
Culture, entertainment and recreation	2292	241	102	54	8	1	0	2698
Other services	1718	375	184	66	9		0	2352
Other	77							77
Total	**20600**	**5788**	**4032**	**2297**	**518**	**38**	**13**	**33286**

IV KEY STRATEGIES AND PROJECTS

Many of the Malmö strategies and plans focus on the time up to 2020. Below, main plans, strategies and projects for the city are presented.

IV.I STRATEGIES AND ACTION PLANS

STRATEGY/ACTION PLAN FACTSHEET	
Title	Comprehensive plan for Malmö
Dimension of KPIs	All
Period	2014-…
Strategy/Action Plan description	
Objective	The three areas of sustainability are mutually dependent and intricately linked – neither can be achieved without the others. The goal is to create an attractive and sustainable city with a robust urban structure for a growing population. The overall objectives are: • Social balance and good living conditions • Economic dynamism and sustainability • Resource efficient society and environmental robustness
Measures	Strategies, maps and environmental assessment
Targets	• Close, dense, green mixed-function city Malmö's should mainly grow by inward expansion. This means mainly expanding within the city's outer ring road. Creating a more dense city will lead to a reduced consumption of resources. Walking, cycling and public transport will form the basis of the transport system. • A regional driver of green growth and employment Growth-oriented ventures to further the welfare of the people of Malmö and increasing chances of employment and financial security are of central importance to the development of the city. Furthering regional cooperation is a key priority. Copenhagen-Malmö-Lund are to form a coherent metropolis and generate a vibrant economy in the Öresund region. • The city as a venue for culture and democracy Urban spaces are important for desirable social development, shared venues for

	human contact and for stimulating democracy and inclusion. Reducing the public health divide within the city has high priority. The city is also socially strengthened by public participation and it is essential that steps are taken to increase participation in the planning processes.
Links and Contacts	
Promoter	City of Malmö
Document/website	The comprehensive plan consists of different parts: strategies, maps with planning guidelines and an environmental impact assessment. All parts of the plan can be seen at www.malmo.se/op **English summary:** http://malmo.se/download/18.1256e63814a61a1b34c1b34/1418996678792/OP_english_summary_hemsida.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Green plan
Dimension of KPIs	Environmental
Period	2003 - …
Strategy/Action Plan description	
Objective	Sector plan, advisory document for the physical planning
Measures	Green policy, mapping of green areas and their content, strategy
Targets	General goals: • Increase the total green area in Malmö • Protect valuable green areas from exploitation Recreational goals: • Create a variation of parks and nature/recreational areas to fulfil the “green needs” of Malmö citizens • Realize a green network with easy access within the whole municipality Biological targets: • Enrich the number of species and biotopes in the municipality • Strengthen the different landscape types within the municipality and create characteristic areas for each type.
Links and Contacts	
Promoter	City of Malmö (4 offices)

Document/website	http://malmo.se/download/18.7de6400c149d2490efb90a32/1417528807150/Gr%C3%B6nplanPopwebb.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Malmö City environment program
Dimension of KPIs	Environmental/physical
Period	2001 - …
Strategy/Action Plan description	
Objective	A basis for guidelines regarding lighting, paving, small buildings, colouring and more.
Measures	Description of the characteristics of Malmö city.
Targets	Protecting and enhancing the city characteristics.
Links and Contacts	
Promoter	City of Malmö
Document/website	http://malmo.se/download/18.7de6400c149d2490efbfc9/1416578190093/Malm%C3%B6stadsmilj%C3%B6programwebb.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Storm water strategy
Dimension of KPIs	Environmental
Period	2008
Strategy/Action Plan description	
Objective	A basis for storm water handling (not including run-off from agricultural soils)
Measures	• Clarification of responsibilities • Rules and recommendations for storm water projects • Classification of storm water and recipients • Preventive measures and activities
Targets	Ensure ground water and recipient quality and prevent flooding.
Links and Contacts	

Promoter	City of Malmö and water stakeholders
Document/website	http://malmo.se/download/18.7de6400c149d2490efb1062/1416578198402/Dagvattenstrategi_2008.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Traffic program
Dimension of KPIs	Economy/Environment
Period	2012-2017
Strategy/Action Plan description	
Objective	Provide strategies and measures for a sustainable traffic system
Measures	• Prioritise pedestrians, biking and public transport • Reduce car traffic shares in the centre of the city through policy measures • Promote clean, efficient and quiet vehicles and transports • Influence long term travel behaviour through communication and marketing • Develop an overall traffic plan for concrete action
Targets	Clean transport targets: • Climate emissions reduction by 20% from 1990-2017. • In 2017, nitrogen oxide emissions should be lower than the quality norm value 40 µg/m3in all of Malmö. Long term target is an annual mean of 20 µg/m3. • Particle emissions still in line with quality norms in 2017. Quiet transport targets: • No residents should be exposed to noise more than 5dBA above the levels 30dBA (equivalent level) and 45dBA (maximum level). • Prioritised environments (schools and preschools) should not exceed the targets of 55dBA (equivalent level) and 70dBA (maximum level). • Measures should be taken by prioritised parks and environments. Efficiency target: • Energy use in transport should decrease by 15% during the program period (compared to use 2001-2005). Sustainable transport target: • The share of pedestrian, bike and public transport shall increase so that

	maximum 30% of all travel and half the commuting into the city is made by car in 2030.
Links and Contacts	
Promoter	City of Malmö
Document/web site	http://malmo.se/download/18.7de6400c149d2490efb90bb9/1417529640559/trafikmiljopgm_web.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Biking plan
Dimension of KPIs	Environment/social
Period	2012-2019
Strategy/Action Plan description	
Objective	Malmö shall be an internationally acknowledged biking city where it is easy and safe to bike. The bike, together with pedestrian and public transport should be the traffic norm in the city.
Measures	Measures in five areas: 1. Strengthening the biking profile of Malmö 2. Operational measures for increased safety and comfort 3. Large scale infrastructure measures 4. Small infrastructure measures 5. Measures for better parking
Targets	Increase the share of biking from 23% in 2008 to 25% in 2013 and 30% in 2018.
Links and Contacts	
Promoter	City of Malmö
Document/ website	http://malmo.se/download/18.3744cbfb13a77097d8748de/1383643894338/Cykelprogram+f%C3%B6r+Malm%C3%B6+stad+2012-2019+2012-10-30.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Pedestrian plan
Dimension of KPIs	Environment/social

Period	2012-2018
Strategy/Action Plan description	
Objective	Put focus on pedestrians in urban planning and increase the number of pedestrians.
Measures	The overall measures include: • Walking path plan (including demonstration paths) • Guidelines for handling of walking paths in the planning process • Safety measures around walking paths and bike tunnels • Provide walking paths to public transport stops/stations • Include walking paths in the city travel planning app and city maps • Better signs • Etc.
Targets	Targets of the measures are: • Increase the number of pedestrians • Higher priority of pedestrians in urban planning • Increased health and well being • Enhanced availability and access for pedestrians
Links and Contacts	
Promoter	City of Malmö
Document/website	http://malmo.se/download/18.d8bc6b31373089f7d9800079234/1383643710678/NV+Fotg%C3%A4ngarprogram+webben.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Security program
Dimension of KPIs	Social
Period	2010-
Strategy/Action Plan description	
Objectives	• Define the strategy for security work • Suggest measures • Support daily security work
Measures	Strategies and measures cover the areas:

	• Planning • Traffic and availability • Lighting • Trees and bushes • Littering and vandalism • City orientation and street names • Public life • Citizen dialogue and influence
Targets	Decrease the perceived feeling of insecurity in Malmö public spaces
Links and Contacts	
Promoter	City of Malmö
Document/web site	http://malmo.se/download/18.7de6400c149d2490efb104c/1416578196928/tryggheteprogram.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Energy strategy
Dimension of KPIs	Environment
Period	2009 – (currently being revised)
Strategy/Action Plan description	
Objective	Renewable energy system 2030
Measures	Measures in the areas of energy efficiency (public private and industry), types of energy generation, planning and communication, etc.
Targets	• 20% decrease in energy use 2009 to 2020 (compared to the period 2001-2005). • 50% renewable energy in the common energy mix 2020. • 30% decrease in city companies and administration by 2020. • 100% renewable energy in city companies and administration by 2020.
Links and Contacts	
Promoter	City of Malmö
Document/website	http://malmo.se/download/18.76105f1c125780a6228800039868/1383647015917/Energistrategi-Kf+2009-12-17.pdf

STRATEGY/ACTION PLAN FACTSHEET	
Title	Strategic Development Plan for Anti-Discrimination Work in the City of Malmö
Dimension of KPIs	Social
Period	2012-2019
Strategy/Action Plan description	
Objective	The City of Malmö shall be an open, inclusive city in which equal rights and opportunities for all people are the prevailing norm.
Measures	n.a.
Targets	Impact targets for 2016: Social perspective. By 2016, the City of Malmö has: • active collaboration with civil society, associations and organisations, as well as individual people in the city's development work in the area of human rights and anti-discrimination. Operational perspective. By 2016 the City of Malmö has: • target-oriented work under way for the equal distribution of power and influence for all people, regardless of background and affinity. • based on reviews conducted of its own activities, set up targets and commitments for discrimination (which must be included in operational plans and budgets). • in collaboration with and under the leadership of the Town Planning Office, developed a joint model for norm-critical audits of its own activities. Employers' perspective. By 2016, the city of Malmö has: • active competence development work under way for the municipality's employees in the area of discrimination. • implemented the City of Malmö's Plan for an Equal Opportunity HR Policy. • work under way in accordance with the Municipal Council's target that the proportion of employees with a foreign background at all levels shall match the proportion in the total population.
Links and Contacts	
Promoter	City of Malmö

Document/web site	http://malmo.se/Kommun--politik/Sa-arbetar-vi-med.../Antidiskriminering/Strategisk-utvecklingsplan.html

STRATEGY/ACTION PLAN FACTSHEET	
Title	Cultural strategy
Dimension of KPIs	Social
Period	2014-2020
Strategy/Action Plan description	
Objective	In 2020, the Sustainability of Malmö has increased by means of art and culture.
Measures	• Develop an action plan with measures during 2015-2016 • Execute and follow up the action plan during 2016-2020 • Use of five strategies and connected targets
Targets	Five targets connected to the strategies: 1. Easy access to art and culture for all citizens; the most culturally active city in 2020. 2. Art and cultural facilities is a major reason for people move to Malmö, and to stay in the city. 3. Malmö 2020 has the best conditions for cultural actors. 4. The cultural public debate in 2020 is open and visual, and is recognised regionally, nationally and internationally. 5. In 2020, art and culture contributes to learning and education among school children and the general public.
Links and Contacts	
Promoter	City of Malmö
Document/website	http://malmo.se/download/18.76b7688614bb5ccea096ad6a/1426086846575/Kulturstrategi_2015FINALwebb.pdf

IV.II KEY PROJECTS

PROJECT FACTSHEET	
Title	'Bo01 - City of Tomorrow' /Western harbour development
Dimension of KPIs	All
Area of implementation (city, neighbourhood, etc.)	Development of a sustainable district in the Western harbour
Implementation period	2001 - ongoing
Project description	
Aims	The aim is for the district to be an internationally leading example of environmental adaptation of a densely built urban environment. It will also be a driving force in Malmö's development towards environmental sustainability.
Activities	Bo01 was the first development stage of Västra Hamnen (The Western harbour) one of Malmö´s growth areas of the future. The area is typical of urban redundant industrial land with contamination and affected environment. The area has, at the same time, many positive aspects in its location by the sea and next to the beach and the city centre. A fundamental ecological approach to planning, building and construction was a key tool in the creation of the district.
Promoters/Beneficiaries; Partnership	n.a.
Financing	Public and private (?)
Outcomes and impacts	Green buildings with smart IT systems for climate, open storm water system, renewable energy, refuse suction system, soil decontamination projects etc…
Links and Contacts	
Promoter	Environmental department, Malmö
Website	http://malmo.se/English/Sustainable-City-Development/Bo01---Western-Harbour.html
Contact E-mail	miljo@malmo.se

PROJECT FACTSHEET	
Title	Malmö´s path towards a sustainable future – health, welfare and justice
Dimension of KPIs	Social
Area of implementation (city, neighbourhood, etc.)	Social investment policy
Implementation period	2013 -
Project description	
Aims	Deepening the analysis of the causes of the growing health inequities in the population of Malmö. Part of the assignment was to work from scientifically based strategies to reduce health inequities.
Activities	Objectives and actions within the areas: • Everyday conditions for children and young people • Residential environment and urban planning • Education • Income and work • Health care • Changed processes for socially sustainable development
Promoters/Beneficiaries; Partnership	Malmö City executive board appointed an independent commission, cooperating with a number of advisors, academia, city administrations, NGOs and many more stakeholders.
Financing	Public (?)
Outcomes and impacts	Final report with compilation of objectives and actions
Links and Contacts	
Promoter	Commission for a Socially Sustainable Malmö
Website	www.malmo.se/kommission Final report: http://malmo.se/download/18.51821d07143bab87ba7c4ac/1392805314379/malm%C3%B6kommisionen_rapport_engelsk_web.pdf

V CASE STUDY CITY ASSESSMENT

This chapter includes details on the actual collected indicators for the case study Malmö. We indicate the actual geographical coverage and data source for each indicator. The collected data were inserted on the joint online platform created by the WP3 leader.

V.I ENVIROMENTAL PERFORMANCE

The indicators on environmental performance were provided by representatives from the national and municipal statistics. Detailed sources are listed for each indicator. Most of the data are available only for some years, and not collected or reported regularly. Thus the variation rates of the indicators are not known.

Table 3: Actual collected indicators and their coverage for the environmental dimension

SUB-DIMENSION	INDICATOR	UNIT	YEAR	GEOGR. COVER.
Biodiversity	Variation rate of ecosystem protected areas	Percentage	2007 & 2013	Municipality
Energy	Energy intensity variation rate	Toe/euro Toe	2003 & 2011	Municipality
	Variation rate of energy consumption by sectors	Percentage	2003 & 2012	Municipality
Climate and Air Quality	Variation rate of carbon emissions intensity	Ton CO_2/euro Ton CO_2	2000 & 2011	Municipality
	Variation rate of carbon emissions by sector	Ton CO_2	2000 & 2012	Municipality
	Exceedance rate of air quality limit values	Nº	2010 & 2012	Municipality
Transport and mobility	Variation share of sustainable transportation	Percentage	2003, 2008 & 2013	Municipality
Waste	Urban solid waste generation	Kg/person/ year	2007 & 2012	Municipality
	Variation rate of urban waste recovery	Percentage	No data	n.a.
Water	Water losses variation rate	m^3/person/ year	No data	n.a.
Buildings and Land Use	Energy-efficient buildings variation rate	Percentage	No data	n.a.
	Urban building density variation rate	Nº/ km^2	2010	Municipality

ECOSYSTEM PROTECTED AREAS

Variation rate of the municipality surface area (km^2) covered by Natura 2000 network and national network of protected areas registered. The data is valid for Malmö municipality [8].

Table 4: Share of ecosystem protected areas.

Year	Proportion Natura 2000 of surface area over total Malmö municipality area (%)
2007	2.1
2013	4.5

ENERGY INTENSITY VARIATION RATE

This indicator presents annual primary energy consumption by GDP for 2003 and 2011. The energy consumption for Malmö municipality per capita is 2.1035 tonne of oil equivalent (toe) and 2.0350 toe in 2003 and 2011 respectively. The GDP for the municipality were 35,440 Euro and 45,400 Euro in 2003 and 2011. The number of inhabitants was 267,171 and 302,835 in 2003 and 2011. Two different indicators were required for the report; primary energy consumption (toe) for Malmö municipality and primary energy in GDP (toe/Euro). The above numbers give:

2003

$$\frac{2.1035\ \frac{\text{toe}}{\text{cap}}}{35440\ \frac{\text{Euro}}{\text{cap}}} = 0.000060\,\frac{\text{toe}}{\text{Euro}}$$

$$2.1035\ \frac{\text{toe}}{\text{cap}} \cdot 267\ 171\ \text{cap} = 561\ 994\ \text{toe}$$

2011

$$\frac{2.0350\ \frac{\text{toe}}{\text{cap}}}{45400\ \frac{\text{Euro}}{\text{cap}}} = 0.000045\ \frac{\text{toe}}{\text{Euro}}$$

$$2.0350\ \frac{\text{toe}}{\text{cap}} \cdot 302\ 835\ \text{cap} = 616\ 269\ \text{toe}$$

Table 5: Energy intensity

Year	2003	2011	Change
Toe	561 994	616 269	+9.7 %
Toe/Euro	0.000060	0.000045	-25 %

Sources: [9; 10; 11; 12; 13]

VARIATION RATE OF ENERGY CONSUMPTION BY SECTORS

Table 6: Variation rate of energy consumption by sector in toe and % of total

Primary energy consumption by sectors in toe	2003		2012	
Total	571 700	100 %	618 789	100 %
Household	186 672	33 %	188 645	31 %
Building industry	63 816	11 %	71 023	11 %
Agricuture, forestry and fisheries	2 025	0 %	2 035	0 %
Public sector	49 682	9 %	56 327	9 %
Transports	153 729	27 %	170 391	28 %
Other services	115 776	20 %	130 369	21 %

The indicators measure the primary energy consumption by different sectors, identifying the sectors that are more energy intense and therefore need more action towards being more efficient. Data for Malmö municipality [14].

VARIATION RATE OF CARBON EMISSIONS INTENSITY

This indicator assesses the carbon emissions due to energy consumption. It is the ratio between CO2 emissions and local GDP. Data needed this indicator follow. The GDP per capita were 32,120 Euro and 45,400 Euro for 2000 and 2011 respectively. The total carbon dioxide emissions for 2000 and 2011 were 1 318 600 tons and 1 751 530 tons. The population in Malmö was 259,579 and 302,835 in 2000 and 2011. This gives:

2000

$$\frac{1\ 381\ 600\ \text{ton CO2}}{32\ 120\ \frac{\text{Euro}}{\text{cap}} \cdot 259\ 579\ \text{cap}} = 0.000166\ \frac{\text{ton CO2}}{\text{Euro}}$$

2011

$$\frac{1\ 751\ 530\ \text{ton CO2}}{45\ 400\ \frac{\text{Euro}}{\text{cap}} \cdot 302\ 835\ \text{cap}} = 0.000127\ \frac{\text{ton CO2}}{\text{Euro}}$$

Table 7: Variation rate of carbon emissions intensity

Variation rate of carbon emissions intensity	2000	2011	Change
Ton CO2	1 381 600	1 751 530	+26.8 %
Ton CO2/Euro	0.000166	0.000127	-23.5 %

Data for Malmö municipality [10; 12; 15; 16; 17]

VARIATION RATE OF CARBON EMISSIONS BY SECTOR

This indicator assesses the measurement of CO2 emissions per sector. This indicator helps identify the most inefficient sectors where more actions should take place in order to contribute to a sustainable economic growth.

Table 8: Variation rate of carbon emissions per sector

Year	2000	2012
Total (kton CO2)	1318,6	1606,1
Work machines and tools (kton CO2)	50,0	74,0
Industry and energy (kton CO2)	734,0	1158,4
Road transport (kton CO2)	489,0	348,4
Transport, other (kton CO2)	45,6	25,3

Data for Malmö municipality [18]

EXCEEDANCE RATE OF AIR QUALITY LIMIT VALUES

The indicator quantifies the number of annually exceedances registered for the following pollutants: Ozone (O3), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2), and particles with a diameter of 10 microns or less (≤ PM10) and particles with a diameter of 2.5 microns or less (≤ PM2.5).

According to the World Health Organization, the exceedance of air quality limit values considers the following exceeding values:

- O3 threshold Information 100 µg/m3 8-hour mean
- NO2 threshold Alert for 40 µg/m3 measured for annual mean and 200 µg/m3 1-hour mean
- SO2 threshold Alert 20 µg/m3 24-hour mean and 500 µg/m3 10-minute mean
- PM 2.5 threshold Alert 10 µg/m3 annual mean and 25 µg/m3 24-hour mean
- PM 10 threshold Alert 20 µg/m3 annual mean and 50 µg/m3 24-hour mean.

Table 9: Exceedance of air quality limit values

Pollutant	Criteria	Year 2010		Year 2012	
		Urban background	Street-scape	Urban background	Street-scape
Ozone	threshold Information 120 µg/m3 8-hour mean (number of days)	1	2	5	1
	Mean value annually (µg/m3)	51.7	44.4	55.5	46.2
Nitrous oxides	threshold Alert for > 36 µg/m3 (number of days)	10	136	5	99

	200 µg/m3 1-hour mean (number of days)	0	0	0	0
Sulphur dioxide	Mean value annually (µg/m3)	2.1	-	1.3	-
	Maximum value hour mean (µg/m3)	40.4	-	11.4	-
PM 2.5	Mean value annually (µg/m3)	13.5	13.7	Not available	12.6
	25 µg/m3 24-hour mean (number of days)	34	33	12	25
PM 10	Mean value annually (µg/m3)	15.9	20.5	16.1	20.7
	50 µg/m3 24-hour mean (number of days)	3	4	3	9

Measuring results from three stations were used for Ozone and Nitrous oxides, two stations measuring the concentrations in the urban background and one in streetscape. The results for the urban background were taken as an average from the two stations for the different pollutants. For PM 2.5 and PM 10 two stations were available, one in streetscape and one for urban background. Only urban background is measured for sulphur dioxide.

The measuring stations was in running 99 % for NO2, 98 % for O3, 99 % for SO2, 93 % for PM 2.5 and 97 % for PM 10, annually. Data for Malmö municipality [19; 20; 21; 22].

VARIATION SHARE OF SUSTAINABLE TRANSPORTATION

This indicator provides details relating to trends for passenger transport in their travels. It measures the number of residents that use sustainable transportation methods such as bus, company or school collective transportation, metro/underground, train, bicycle, ship, walk or other methods in their travels. Data for Malmö municipality [23; 24].

Table 10: Modal share of transportation

Transport mode	Modal share 2003 (%)	Modal share 2008 (%)	Modal share 2013 (%)
Car	52	41	40
Bus	10	10	14
Train	3	4	7
Bicycle	20	23	22
Walking	14	20	15
Other	1	2	2

URBAN SOLID WASTE GENERATION

Total urban solid waste production in 2007 and 2012 kg/person/year. The indicator is calculated on the total amount of city urban solid waste generated per capita in kilogram.

The categorization of the city urban solid waste will cover the following waste classes: paper, plastic, glass, metals, textiles, and organics.

Table 11: Total urban solid waste

	2007	2012
Total urban solid waste in Malmö (kg/cap/year)	370,2	329,3

Data for Malmö municipality under the assumption that the amount biological waste is the same for 2007 as it was 2012 (although a new reporting system was used then), 13 kg. Textiles are not included [25; 30].

VARIATION RATE OF URBAN WASTE RECOVERY

This indicator has not been collected due to lack of data.

WATER LOSSES VARIATION RATE

This indicator has not been collected due to lack of data.

ENERGY-EFFICIENT BUILDINGS VARIATION RATE

This indicator has not been collected due to lack of data.

URBAN BUILDING DENSITY VARIATION RATE

Table 12: Urban density in 2010

	2010
Registered buildings	49 244
Total surface land area	156,9
Ratio (Number of/km2)	313,9

Data for Malmö municipality. No data available for previous years for this indicator [33; 34].

V.II SOCIAL PERFORMANCE

The overview of actual collected indicators representing the social performance of the city, their geographical coverage is listed in Table 13. Each indicator is shown in more detail below.

Table 13: Actual collected indicators for the social dimension

SUB-DIMENSION	INDICATOR	UNIT	YEAR	GEOGR. COVER.
Social Inclusion	Variation rate of unemployment level by gender	Percentage	1996-2014	Municipality
	Variation rate of poverty level	Percentage	2008-2013	Swedish municipalities
	Variation rate of tertiary education level by gender	Percentage	2003-2012	Municipality
	Variation rate of average life expectancy	Average Nº	2003-2011	NUTS 3 (Skåne county)
Public services and Infrastructures	Variation rate of green space availability	Percentage	2000 & 2005	Malmö urban area
Governance effectiveness	Existence of monitoring system for emissions reductions	Yes/No Description	2013	Municipality

VARIATION RATE OF UNEMPLOYMENT LEVEL BY GENDER

The target group covers people of the ages 16-64. The figure shows the evolution of the unemployment rate by gender. Both registered unemployed and people in activity support are included. Data for Malmö municipality [1].

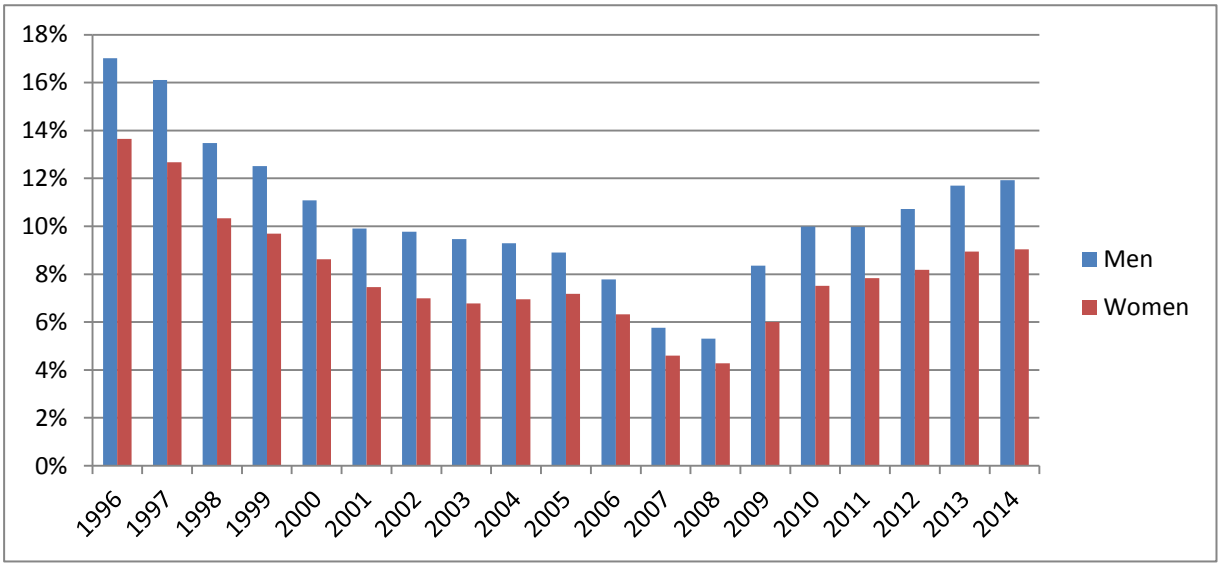


Figure 4: Variation rate of unemployment level by gender

VARIATION RATE OF POVERTY LEVEL

The indicator sums up the number of persons who are at risk of poverty, severely materially deprived or living in households with very low work intensity. The data is not Malmö specific, but there is a small difference between major cities and other municipalities in relation to all Swedish municipalities, why it can be expected that Malmö is in the range between the blue and the red stack. Though, there are no major trends for the time period, 2008-2013 [2].

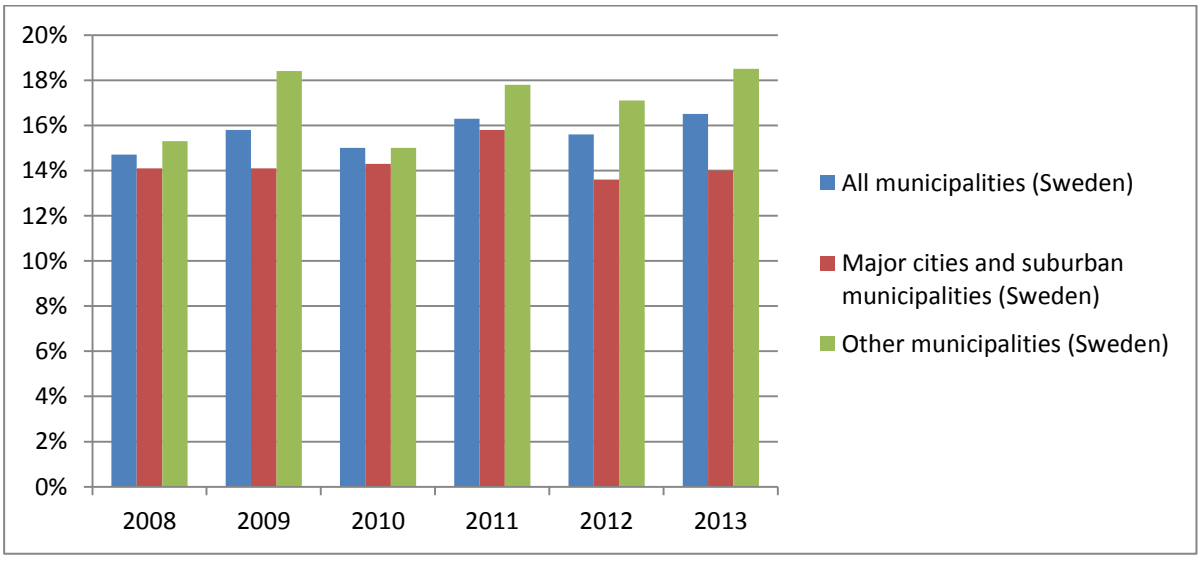


Figure 5: Variation rate of poverty level.

VARIATION RATE OF TERTIARY EDUCATION LEVEL BY GENDER

Based on Malmö municipality, data available for one third of the population which is extrapolated. It is important to notice that the numbers change depending on the definition of a tertiary education. In this case all tertiary education-levels are included. If a minimum of three years of tertiary education is valid, the numbers would drop about 10 percentage points [3].

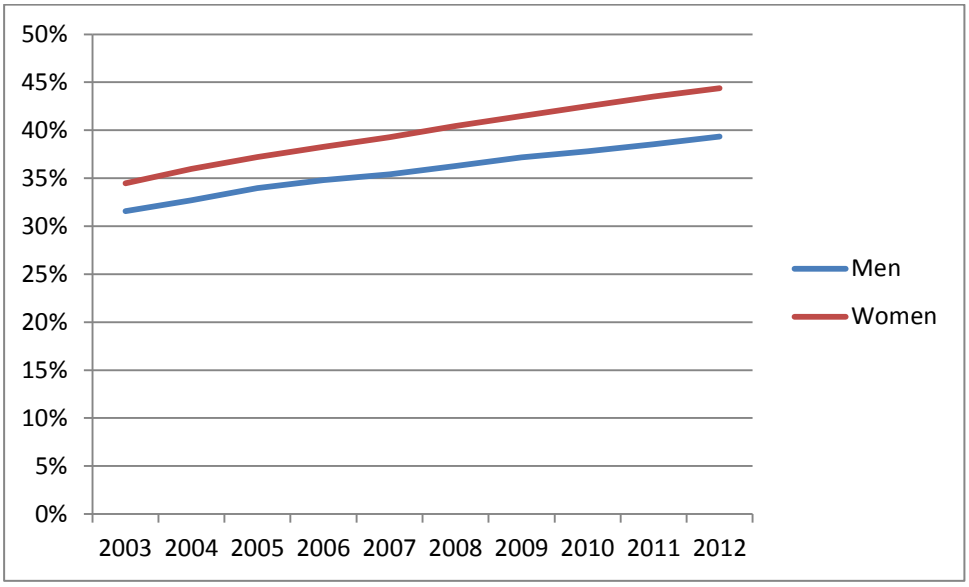


Figure 6: Variation rate of tertiary education level by gender (2003-2012)

VARIATION RATE OF AVERAGE LIFE EXPECTANCY

Evolution of the average number of years of life expectancy. Statistics based on Skåne County (NUTS 3), average of men and women at birth [4].

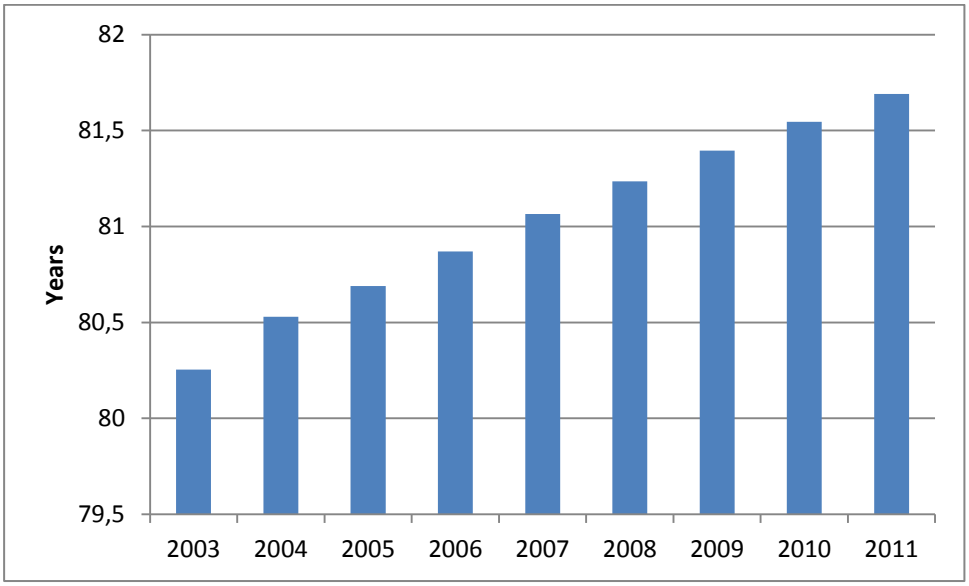


Figure 7: Variation rate of average life expectancy

VARIATION RATE OF GREEN SPACE AVAILABILITY

The indicator aims to assess the variation rate of the surface area (km2) of public green (urban forests, parks or green spaces) space availability. This is based on the Malmö urban area, i.e. not the entire municipality [5; 6].

Table 14: Green area and green area variation rate

Year	2000	2005
Total green area (km2)	38,34	39,52
Total land area (km2)	69,62	72,43
Variation rate of green space availability	55 %	55 %

All green space within the urban city limit, such as common parks and open grass areas, impediment, gardens and green spaces between houses and roads are included in green spaces according to SCB.

EXISTENCE OF MONITORING SYSTEM FOR EMISSIONS REDUCTIONS

To become a post-carbon city, cities should define their own targets related to CO2 emissions and put them in place. Thereby, the indicator existence of monitoring system for emissions reductions was introduced and intends to check if cities are complying with the targets they set, evaluating the effectiveness of the policies and strategies implemented to reduce CO2 emissions.

Results:

Yes. Malmö municipality has a target of 40 % emission reduction until 2030 (CO2) compared to 1990. This is monitored and reported on a yearly basis in order to indicate whether the target will be fulfilled by 2030. Today´s forecast is that this target will be difficult to achieve [7].

V.III ECONOMIC PERFORMANCE

The overview of actual collected indicators representing the economic performance of the city, their geographical coverage and data source is listed in Table 15Table 13. Each indicator is shown in more detail below.

Table 15: Actual collected indicators for economic dimension

SUB-DIMENSION	INDICATOR	UNIT	YEAR	GEOGR. COVER.
Sustainable economic growth	Level of wealth variation rate	eur/person	2003-2011	Municipality
	Variation rate of GDP by sectors	Percentage	2003-2012	NUTS 2
	Employment by sectors variation rate	Percentage	2003 2012	NUTS 2
	Business survival variation rate	Percentage	2008,2009,2010	Municipality
Public Finances	Budget deficit variation rate	Percentage of city's GDP	2003-2011	Municipality
	Indebtedness level variation rate	Percentage of city's GDP	2003-2011	Municipality
Research & Innovation dynamics	R&D intensity variation rate	Percentage	2003-2013	National level (one NUTS 3)

LEVEL OF WEALTH VARIATION RATE

Cities with a strong economic activity are most prepared to face the challenges and difficulties of the transition process towards a "post carbon city". They normally have more resilience towards economic changes and uncertainty. Data for Malmö municipality, GDP per capita [10; 13; 17].

Table 16: Level of wealth variation rate

Level of wealth variation rate	
Years	GDP (€/cap)
2003	35 990
2004	37 650
2005	38 760
2006	40 970
2007	43 190
2008	44 850
2009	44 300
2010	43 190
2011	45 400
Change (2003-2011)	+ 26.1 %

VARIATION RATE OF GDP BY SECTORS

Weight of economic sectors in GDP (%). Results based on Sothern Sweden (NUTS 2) [26].

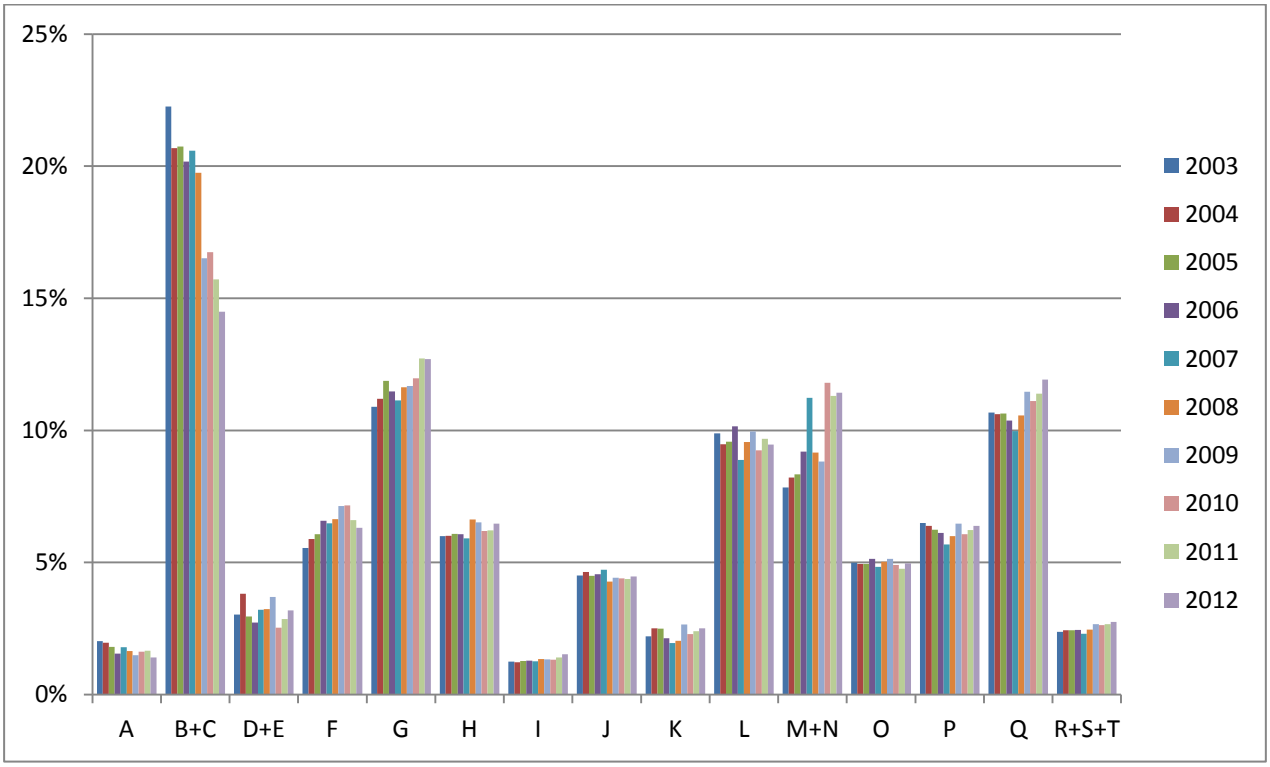


Figure 8: variation rate of GDP by sectors.

letter	SECTOR
A	AGRICULTURE, FORESTRY AND FISHING
B	MINING AND QUARRYING
C	MANUFACTURING
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES
F	CONSTRUCTION
G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES
H	TRANSPORTATION AND STORAGE
I	ACCOMMODATION AND FOOD SERVICE ACTIVITIES
J	INFORMATION AND COMMUNICATION
K	FINANCIAL AND INSURANCE ACTIVITIES
L	REAL ESTATE ACTIVITIES

M	PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES
N	ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES
O	PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
P	EDUCATION
Q	HUMAN HEALTH AND SOCIAL WORK ACTIVITIES
R	ARTS, ENTERTAINMENT AND RECREATION
S	OTHER SERVICE ACTIVITIES
T	ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; U0NDIFFERENTIATED GOODS- AND SERVICES-PRODUCING ACTIVITIES OF HOUSEHOLDS FOR OWN USE
U	ACTIVITIES OF EXTRATERRITORIAL ORGANISATIONS AND BODIES

Table 17: List of sectors

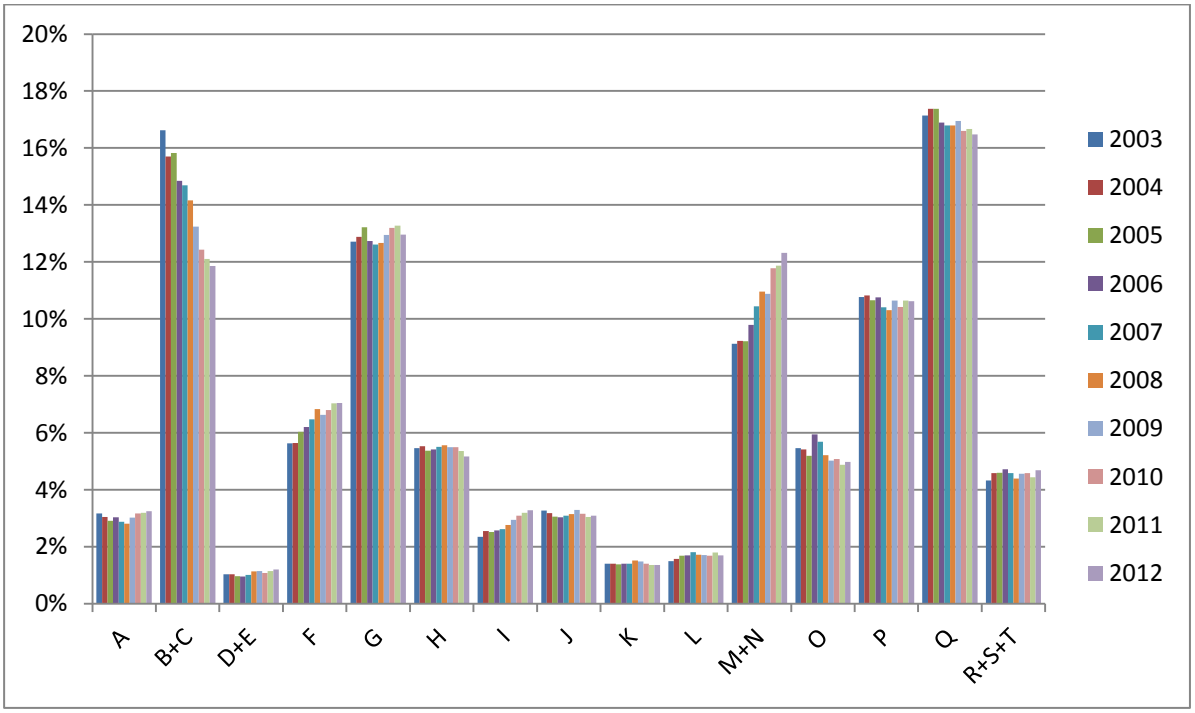
EMPLOYMENT BY SECTORS VARIATION RATE

Employment by economic activity sector (%). Employment ratio by economic activity sectors

This indicator shows the dynamics of the labor market and is an important mechanism to monitor and measure the weight of the different economic sectors in the total of the employed population.

Results based on Sothern Sweden (NUTS 2), and according to the RAMON - Reference and Management of Nomenclatures classification [26].

Figure 9: Employment by sectors variation rate. For sectors, see Table 17 above.



BUSINESS SURVIVAL VARIATION RATE

The business survival variation rate in Malmö is 68 % upon the three years 2008, 2009 and 2010 [27].

BUDGET DEFICIT VARIATION RATE

Percentage of city´s GDP. This indicator shows how the cities generate the necessary revenues to finance their activities, or if they need to seek external financial sources (indebtedness).

Table 18: Budget deficit, GDP and variation

Year	Budget deficit (€/cap)	GDP (€/cap)	Ratio (%)
2003	1001	35 990	2,8
2004	864	37 650	2,3
2005	877	38 760	2,3
2006	779	40 970	1,9
2007	1025	43 190	2,4
2008	1034	44 850	2,3
2009	927	44 300	2,1
2010	1235	43 190	2,9
2011	1287	45 400	2,8

The difference between all costs and benefits in a Swedish municipality is fully or partly financed by the government in tax equalization. In the above table this equalization is not included. Data as valid for Malmö municipality [10; 28].

INDEBTEDNESS LEVEL VARIATION RATE

Annual debt by GDP percentage of city´s GDP. Cities with a lower level of indebtedness are more resilient to challenges in the context of a post-carbon transition process.

Table 19: Indebtedness level, as % of GDP

Year	Indebtedness (€/cap)	GDP (€/cap)	Ratio (%)
2003	1 586	35 990	4.4
2004	1 426	37 650	3.8
2005	1 408	38 760	3.6
2006	1 337	40 970	3.3
2007	1 779	43 190	4.1
2008	1 578	44 850	3.5
2009	1 635	44 300	3.7
2010	1 670	43 190	3.9
2011	1 861	45 400	4.1

The indebtedness, GDP per person and the final ratio is presented in the above table. Data is valid for Malmö municipality. This includes both short and long term debts [29].

R&D INTENSITY VARIATION RATE

Total R&D expenditure as a % of GDP. The level of R&D expenditures is normally associated with the level of competitiveness of an economic area (country, region or city); the R&D is the first step towards the innovation as an important element of a post-carbon society. Data available for Sweden from 2003 to 2013 (see below). Data for Blekinge-Skåne region (NUTS 3) was only available for 2011, where the ratio was 4.5 %. This gives the 9th highest ratio of all European regions [30; 31].

Table 20: R&D intensity variation rate

Year	R&D intensity variation rate (%)
2003	3.6
2004	3.4
2005	3.4
2006	3.5
2007	3.3
2008	3.5
2009	3.4
2010	3.2
2011	3.2 (Blekinge/Skåne: 4.5%)
2012	3.3
2013	3.2

VI FINDINGS AND KEY CHALLENGES

Malmö is a young, multi-cultural city with high immigration numbers. It is a segregated city, with some recent evidence of social unrest, e.g. in the residential area of Rosengård. This presents a specific social challenge, addressed for example in the Strategic Development Plan for Anti-Discrimination Work (See section IV.I).

The current energy strategy sets very ambitious targets for 2020 in terms of energy use and renewable energy. These targets will be difficult to fulfil, and the strategy is currently under revision. Another challenge connected to carbon is that there is no protocol in use to calculate the carbon footprint of the city. Such a tool would be useful, and should also cover the consumption perspective, which is a great challenge. Sustainable transportation is on the right track, with model share of car travels at 40%, aiming for 30% in 2020. Actions are being taken to improve the biking network, but modal share of biking increases quite slowly.

Malmö is an innovative city, with a high level of R&D expenditure compared to other European cities. Economically, the GDP (€ per capita) shows a positive trend, while at the same time unemployment rates have been increasing since 2008, possibly due to the economic crisis in Europe. This presents a challenge related to economic inequity in the city. However, the initial assessment has not provided enough detailed data to investigate this issue in more depth.

VII CONCLUSIONS

The main environmental challenge in Malmö appears to be the dependence on fossil fuels. The top social hotspot is integration, while economically; the city is doing quite well according to our assessment. Malmö have proactive strategies and plans in place to address discrimination and social sustainability, such as the Commission for a Socially Sustainable Malmö that was selected in 2008. Hopefully, this work continues and has an impact beyond reports and suggestions. Social issues and culture were also highlighted by stakeholders in the vision and backcasting workshops, showing that this is a key issue to success for the sustainability of the city.

It remains to be seen what the revision of the energy strategy will bring in terms of new targets and actions to help the city on its path to post carbon. The work has to be a joint effort by energy industry, municipality and citizens, potentially aided by smart IT solutions to reduce energy use in households.

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