The Stockholm Royal Sea Port Greenhouse Gas Baseline Report According to the Requirements of the Clinton Climate Initiative and Stockholm 3.0

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Introduction

The Stockholm Royal Sea Port (SRS) is an urban development in the northern parts of central Stockholm focusing on low environmental impact, primarily through low energy use as well as a high usage of renewable energy.

SRS's Goals Relating to Climate Change

The SRS aims to become a fossil fuel free and climate positive urban development under the requirements of the Clinton Climate Initiative's (CCI) Climate Positive framework (CCI, 2011) by the time the entire area is built, around 2030. As a point of reference of how ambitious the goals are, the City of Stockholm is to become a fossil fuel free by 2050 and has an emission target of 3.0 ton CO2e/capita for 2015.

This Report – The SRS Baseline

This report outlines the SRS baseline for greenhouse gases (GHG). The baseline is the *first of* a two-step process to becoming a climate positive (climate+) urban development. The second is to create a roadmap for the urban development, which outlines the specific steps/actions to a climate+ outcome.

Note that the results presented in this report come from a calculation tool developed for the CCI framework that has been modified after special requirements for the case of Stockholm Royal Seaport.

The baseline includes the following parts:

- **The SRS system boundaries:** The system boundaries define which emissions are included and which emissions are not included in the baseline.
- **The baseline metrics:** Here the *metrics* for calculating the baseline emissions are described focusing on how to calculate energy demand and how to calculate the GHG emissions from the energy used. Here are also some basic data about the SRS development presented (number of residents, workers, areas etc.)
- **Calculation of emissions:** The energy demand is quantified and emissions calculated for the three emission categories in the baseline. Data quality is assessed briefly and emissions summarized for the baseline.
- **Background data:** Relevant supporting tables for calculations follows in appendixes.

One Report – Two Presented Baselines

The City of Stockholm has worked actively with both mitigation and adaptation of climate change since the mid-1990s and has well established metrics for calculation of the city's GHG emissions in place. There are some differences between how emissions are calculated between CCI's framework and how the rest of the city calculates the emissions. This report therefore contains two baseline calculations, one according to the principles of the CCI framework and one according to Stockholm's traditional way of calculating GHG emissions (henceforth referenced to as Stockholm 3.0). This is done so that the data in the baseline is comparable for those who work with the Stockholm 3.0 goal such as operative bodies within Stockholm city.

SRS System Boundaries

When creating the SRS GHG baseline the SRS system boundaries are defined. The system boundaries define which emissions are taken into account and which fall outside of the scope and are not included. There are three primary emission categories in the baseline, emissions from energy, transportation and waste. To determine which emissions are included geographic, activity based, temporal and life cycle (LCA) system boundaries are defined. The general system boundary is SRS's geographical area and activities within the area leading to GHG emissions. In some cases activities lead to emissions outside the geographical boundary such as the use of electricity, treatment of waste and transportation. The boundary is then expanded to encompass LCA based emissions of energy carriers and fuels used and for accounting of credits. Credits can be generated within the SRS area or in the surrounding local area through physical infrastructure such as energy, waste, transportation, water or other relevant systems or by decisions made through the SRS's climate positive process. In each primary emission category emissions and credits are tracked for the urban development according to the climate positive framework.

The following major assumptions have set the scope for the SRS baseline calculations:

Local Assumptions

The baseline is calculated for the new developments planned in the Stockholm Royal Seaport based on the norms and projected data for the first building phase of SRS (Norra 1 & Västra). Another option would have been for example to use the current area (mix of older residential housing, offices and brown field) as the baseline. However since significant changes will be made throughout the area the projected values are more representative. All data, calculations, references and assumptions will be presented as well as comment on uncertainties where those are identified. The baseline calculations are based on projected values for the first building phase or a representative area in Stockholm and scaled up for the whole development area when in operation. Where possible the year of reference for background data or statistics used is 2010.

Table 1 summarises a comparison between the principles and parameters in the CCI framework and Stockholm 3.0 following with a more detailed description of the system boundaries within each emission generating category. The CCI and the Stockholm 3.0 baseline numbers are expressed in the same way, GHG emissions in tonnes of carbon dioxide equivalents (CO2e) and CO2e per capita but since they system boundaries are somewhat different slight differences may occur (see table1). Note also that as the Stockholm 3.0 has emission categories that are out of scope for this study (Overhead emissions) the **total per capita GHG emissions** for the Stockholm 3.0 presented are not comparable to those of the rest of Stockholm.

Table 1 Summary of emissions included and excluded in CCI and Stockholm 3.0

	Clinton	Stockholm 3.0
Target(s)	Climate positive < 0 ton GHG emissions **once the entire area is operational**	City: 3.0 ton CO2e/cap 2015, fossil fuel free 2050 Urban district: fossil fuel free by 2030, climate positive < 0 ton GHG emissions
Unit of measure	Ton CO2e/cap (residents and workers) 49 000 persons in total	Ton CO2e/cap (residents only) 19 000 persons in total
Boundary principle	Direct and indirect emissions stemming from to activities directly related to SRS's geographical area	Direct and indirect emissions stemming from to activities directly related to SRS's geographical area
Data use	Life cycle based data regarding fuels and energy carriers. Emissions and emission reductions from **the collection, transport and treatment** of waste.	Life cycle based data regarding fuels and energy carriers. Emissions and emission reductions from **the collection, transport and treatment** of waste.
Energy	Emissions from heating, cooling and electricity. Emission reductions from local energy production	Emissions from heating, cooling and electricity. Emission reductions from local energy production
Transportation	40 % of <u>**all**</u> trips starting/ending within SRS Private trips (residents) Commuting trips (both residents and workers) Business trips (both residents and workers) Goods and services **Not included:** Long distance travel	100 % of emissions from transportation stemming from activities directly related to SRS's geographical area: Private trips (residents) Commuting trips (residents) Business trips (workers) Goods and services **Not included:** Long distance travel
Waste	Emissions and emission reductions from the collection, transport and treatment of waste.	Emissions and emission reductions from the collection, transport and treatment of waste.
Overhead emissions	Excluded due to geographical boundary	Emissions for use of services, for instance: Hospitals Public buildings
Consumption	Emissions <u>not</u> included	Emissions <u>not</u> included
Building phase for infrastructure and buildings in the area	Emissions <u>not</u> included	Emissions <u>not</u> included

Energy

The energy system boundary includes emissions from projected energy use for buildings and respective operation, infrastructure, water use and credits for energy production from on- site renewables. The system boundary includes both direct emissions and the corresponding LCA emissions for production and distribution of heating, cooling, water and electricity as well as emissions and credits for locally produced renewable clean energy. Operation of infrastructure and treatment of waste water is also accounted for within the energy category. There are no differences in the included emissions between CCI and Stockholm 3.0.

Transportation

Traffic and transportation emissions are calculated for resident and workers travels and transportation for goods and service. Transportation is one area where CCI and Stockholm 3.0 differs from each other. In CCI the system boundary includes 40 % of all emissions from trips starting in or ending in SRS. In Stockholm 3.0 100 % of the emissions of all transportation activities that are directly related to the area are included. This means that residents private trips and commuting are included while their business trips are excluded. The rationale for this is that most of the residents are assumed to be working someplace else. As for the workers private trips and commuting are excluded since they are assumed to be living outside of SRS while business trips are included since the companies that own the vehicles are located within SRS. For all vehicle fuels the system boundary in both frameworks is expanded to include LCA emissions of GHGs.

Waste

The system boundary includes all emissions resulting from waste within the SRS geographical boundary and include emissions from the collection, treatment and disposal/recycling of waste. Credits for energy recovery and substitution of virgin material by recycled material from waste are accounted for especially in line with the CCI framework/standard. Any heat or biogas resulting from wastewater treatment is considered to be excess clean energy and is included as an energy credit under local production.

Baseline Metrics – Yearly Per Capita Emissions once SRS is Operational

The result of the baseline is the per capita carbon dioxide equivalents (CO2e) expressed in metric tonnes [ton CO2e/cap]. The **emissions per capita are expressed as yearly emissions per the sum of residents and workers when the entire urban district is operational**. Since the city of Stockholm uses a slightly different metric for the rest of the city focusing on solely on the emissions per resident a complimentary per capita emission is also calculated (City of Stockholm, 2010). This per capita is expressed as ton per residential capita [ton CO2e/res cap] and only divides the emissions by the number of residents instead of the residents and workers. As a point of reference Stockholm city has a target to reduce emissions to 3.0 ton CO2e/res cap in 2015.

Calculations and how Data is Presented

Two basic types of calculations are used in the document, firstly calculations on the emission generating activity concerning different types of energy used (from buildings, transportation etc.) and secondly, the transformation of the energy use into GHG emissions.

Calculations Regarding Energy Use

The activities (heating of a building, energy from transportation etc.) are generally calculated using the energy demand expressed for example as energy per square meter or liters of vehicle fuel per kilometer multiplied by the total applicable surface area or person kilometers. The general formula is presented with the example of energy use in buildings:

General formula regarding energy use:
*Energy demand per square meter [kWh/m^2, year] * square meters [m^2] = Energy demand per activity [kWh/year]*

Calculation Regarding GHG Emissions

GHG emissions are generally calculated using the fuel or energy use from an activity multiplied by an emission factor expressed as grams of CO2e per kWh of the fuel or energy carrier in kind. Using the same example as above for the energy demand in the buildings the GHG emissions are calculated as:

General formula regarding GHG emissions:
*Energy demand per activity [kWh of fuel X/year] * Emission factor [g CO2e/kWh of fuel X] = Emissions for activity [g CO2e/year]*

Emission Factors

In terms of emission factors all emissions are calculated as carbon dioxide equivalents (CO2e) which includes the fossil components of carbon dioxide (CO2), methane (CH_4) and nitrous oxide (N_2O). All emission factors presented include both the direct emissions from combustion of the respective fuel or energy carrier as well as the life cycle emissions from production and distribution of the energy.

SRS Basic Parameters

The basic parameters for the SRS development will be used throughout the document, namely the projected number of apartments, residents, workspaces and the total surface areas divided by types of buildings. Those can be found below:

Residents and workers once the whole SRS has been built:
10 000 Apartments
19 000 Residents
30 000 Works spaces with 30 000 workers

Projected surface areas being built:
1 143 400 m^2 of multi-family housing
712 330 m^2 of office space
84 015 m^2 of commercial space
9 500 m^2 of schools

Working material City of Stockholm as of 2012-02-18 (Christina Salmhofer, 2012)

Data quality and Aims of the Data Collected in Relation to SRS

Since the SRS development takes place over a long period of time (+15 years) data and data quality will change over time. As an effort to base the calculations on the most reliable data available a hierarchy of data has been developed for the SRS development. The aim is to whenever possible use SRS specific (projected) data. If such data is not available, data specific to the city of Stockholm or Stockholm county is to be used and finally data specific to Sweden or the Nordic countries. The following terms are used to describe the certainty of the data used.

Data is usually either:

- Projected: Typically gathered from local plans such as building plans/permits etc.
- Estimated: Typically gathered from similar developments or in some cases where no difference is expected between a resident/worker in the SRS area and the surrounding city/region/country.
- Statistical: Data from national, regional or city databases.

Calculation of emissions from the three emission categories

Energy

The energy emissions category consists of 4 subcategories, Energy use in Buildings, Water use in Buildings, Energy use for maintenance of Infrastructure and Local energy production.

Buildings energy demand

Energy efficiency in buildings is suspected to change significantly over the next years and since SRS is built in phases over time the energy requirements will vary between phases. The baseline for energy use in buildings is therefore based on the projected demand in the first build phase as a point of reference though the energy requirements per square meter are not as strict as planned for in subsequent phases. The projected energy demand is based on calculations made by WSP (Larsson & Persson, 2012) and corresponds to be 25 % lower than current standard, Swedish building code nr 18 (Boverket, 2011) for the respective type of building (multi-family houses, offices, commercial spaces and schools). For each building type the energy use is separated into heating, hot water, cooling, building electricity and depending on building types either residential or commercial electricity use. Each energy use is measured in the same way, kilowatt-hours per square meter and year [kWh/m^2, year]. The total emissions are then summarized by public, commercial and residential energy use.

Table 2 Energy requirements for buildings in the baseline (Larsson & Persson, 2012) and the corresponding surface areas (see appendix 1).

Energy by type/Buildings by type	Residential	Offices	Commercial	Schools
Heating [kWh/m2, year]	42,5	35	25	55
Hot water [kWh/m2, year]	25	2	2	10
Cooling [kWh/m2, year]	0	20	35	0
Building electricity [kWh/m2, year]	15	25	20	15
Residential/commercial electricity [kWh/m2, year]	30	50	80	35
Total energy demand [kWh/m2,year]	112,5	162	132	115
Surface area [m2]	1 143 400	712 330	84 015	9 500

Assumptions: In the baseline the projected energy use for the first build phase represents the entire area. This is likely an overestimation of energy use, especially for the later build phases.

Emissions from Heating and Cooling

Summary	
Data quality	Estimations of energy use based on projected data for the first build phase.
Further data needs/missing data	The projected data should be replaced by actual measured data as soon as possible.

Energy consumption for heating, hot water use and cooling for the entire SRS are calculated using the projected surface areas of SRS combined with the projected demand as presented in table 3. Emissions are calculated based on the average fuel mix and production in the district heating system in Stockholm for the years 2007-2009. Emissions are allocated between heat and electricity by physical energy units and calculated with Swedish emission factors (Värmeforsk, 2012) as presented in appendix 2.

The calculation formulas used:

Heating demand [GWh/year] = (Heating + hot water use per m^2 *[kWh/*m^2*, year]) * surface area [*m^2*]*

Emissions from heat use [ton CO_{2e}*/year] = Heating demand [kWh/year]* emission factor district heating system [g* CO_{2e}*/kWh]*

Emissions from cooling demand [ton CO_{2e}*/year] = cooling per* m^2 *[kWh/*m^2*, year]) * surface area [*m^2*] * 1/7 * emission factor for district heating system [g* CO_{2e}*/kWh]*

District heating emission factor 2007- 2009: 96,08 g CO2e/kWh

Table 3 Total annual emissions from heating and cooling demand

	District heat demand [GWh/year]	Emissions from heat use *[ton* CO_{2e}*/year]*	Cooling demand [GWh/year]	Emissions from cooling *[ton* CO_{2e}*/year]*
Residential	77,2	7415,4	0	0
Offices	26,4	2532,2	14,3	195,5
Commercial	2,3	217,9	2,9	40,4
Schools	0,6	59,3	0	0
Total in SRS	106,4	10 225	17,2	236

Summary of emissions	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
Residential	7 415,4	0,151	0,390
Public	59,9	0,001	0,003
Commercial	2986,2	0,061	0,157
Totals	**10 461**	**0,213**	**0,550**

Emissions from electricity use

Summary	
Data quality	Estimations of energy use based on projected data for the first build phase.
Further data needs/missing data	The projected data should be replaced by actual measured data as soon as possible.

Electricity use for the entire SRS are calculated using the projected surface areas of SRS combined with the projected demand as presented in table 3. Emissions are calculated based on the average fuel mix and production in the Nordic electricity mix for the years 2005-2008 and Swedish emission factors (Värmeforsk, 2012) as presented in appendix 2.

The calculation formulas used:

Electricity use [GWh/year] = Building and household/commercial electricity per m^2 *[kWh/*m^2*,year] * surface area [*m^2*]*

Emissions from electricity use [ton CO_{2e}/year] = electricity use [kWh/year] emission factor Nordic electricity mix [g CO_{2e}/kWh]*

Emission factor Nordic electricity mix 2005-2008: 69,73 g CO_{2e}/kWh]

Table 4 Total annual emissions from electricity use

	Building electricity demand [GWh/year]	Emissions from building electricity *[ton CO_{2e}/year]*	Residential/ commercial electricity use [GWh/year]	Emissions from Residential/ commercial electricity use *[ton CO_{2e}/year]*
Residential	17,2	1195,9	34,3	2391,9
Offices	17,8	1241,8	35,6	2483,5
Commercial	1,6	117,2	6,7	468,7
Schools	0,1	9,9	0,3	23,2
Total in SRS	36,8	2 565	76,9	5 367

Summary of emissions	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
Residential	3 587,8	0,073	0,189
Public	33,12	0,001	0,002
Commercial	4 311,1	0,088	0,227
Totals	**7 932**	**0,162**	**0,417**

Water

Summary	
Data quality	Estimated data based on water need per person from the last phases of Hammarby Sjöstad (Pandis & Brandt, 2009) as well as calculations made by WSP (Rydberg & Hellstedt, 2012).
Further data needs/missing data	

Projected water use and embodied energy:

Embodied energy to produce 1m^3 of drinking water: 0,39 kWh/m^3 (Stockholm water company)
Embodied energy to distribute 1m^3 of drinking water: 0,09 kWh/m^3 (Stockholm water company)
Embodied energy to collect 1m^3 of sewage water: 0,04 kWh/m^3 (Stockholm water company)
Embodied energy to clean 1m^3 of sewage water: 0,31 kWh/m^3 (Stockholm water company)

Leakage from the water distribution system is estimated to be 24% and into the wastewater system 35%. Based on key numbers for residents' water use and workspaces, 150 l/person, day and 45 l/person, day respectively, as well as the efficiency in the Stockholm water-and wastewater system the total energy use for supplying water and treating wastewater for SRS is 1 636 784 kWh/year (Rydberg & Hellstedt, 2012).

Calculations:

Total energy use: 1 636 784 kWh/year * Nordic emission factor 69,73 = 114,1 ton CO2e

Summary of emissions	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
Totals	**114**	**0,002**	**0,006**

Local Energy Production

Locally produced clean energy will be produced in a number of different places in the SRS. So far biogas from wastewater sludge has been identified in the baseline.

Biogas from wastewater sludge

Summary	
Data quality	Projected data based on statistics from Stockholm.
Further data needs/missing data	None before actual measurements can be carried out.

In the baseline it is assumed that all biogas is generated from the public waste water system. The following biogas production is estimated by WSP based on previous experience and available technology (Rydberg & Hellstedt, 2012):

Residents' water use: 150 l/person, day resulting in 81,5 kWh biogas/person, year

Workers' water use: 45 l/person, day resulting in 24,46 kWh/biogas/person, year

The total amount of biogas generated by the SRS wastewater system:

*19 000 residents * 81,5kWh/person, year + 30 000 workers * 24,46 kWh/person, year = 2 282 300 kWh/year*

It is also assumed that the biogas produced is not used directly in the SRS area. Some of it will of course be used in the SRS but to avoid the risk of it being double counted it is for accounting purposes assumed that all is exported outside the system boundary. It is also assumed that 100 % of the biogas replaces gasoline E5 as a vehicle fuel. The corresponding credit per kWh of biogas is therefore: *emission factor* $_{Gasoline\ E5}$ – *emission factor* $_{biogas}$ *= (280,44 – 25,40) g CO2e/kWh = 255,04 g/kWh*

The total credit generated is: *2 282 300 kWh/year * 255,04 g CO2e/kWh = 582,1 ton CO2e*

Summary of credits	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
Biogas totals	**582**	**0,012**	**0,031**

Infrastructure

Summary	
Data quality	Estimated data based on in the case of city operation the city of Stockholm and on the street/traffic lights an area similar in size of SRS
Further data needs/missing data	The city operations data needs to be updated to see if biogas vehicles will possible be used. Traffic and street light data needs to be updated once data becomes available.

Emissions from infrastructure include emissions from the maintenance of roads and their surrounding infrastructure including traffic lights, lighting, snow removal etc.

Annual projected energy use and emissions from infrastructure in SRS:

City operations:

Basic data: Diesel fuel used for municipal city maintenance, Stockholm 2015: 335 000 000 kWh/year
Projected population, Stockholm 2015: 829 800 persons
Emission factor, diesel fuel (5 % RME): 279,31 g CO2e/kWh
References: Business as usual scenario 2015 (Fahlberg et. al, 2007), Vision 2030
Assumptions: The data for energy used is at the moment on a city wide level. It is therefore assumed that resident in SRS will use an equal share of diesel fuel per year as the rest of the city for infrastructure.
Calculations:
Diesel fuel per person/year in Stockholm 2015: *335 000 000 kWh/829 800 = 403,7 kWh/person, year*
Total annual diesel fuel use in SRS: *403,7 kWh/person, year * 19 000 residents = 7 670 300 kWh/year*

Annual emissions from infrastructure: *7 670 300 kWh/year * 279,31 g CO2e/kWh = 2 142,4 ton CO2e/year*

Street/traffic lights:

Basic data: 1000 streetlights (60W/light), 1000 traffic lights (120W/light) (both LED, hence the number) used a total of 4 200 hours/year. All street and traffic lights in Stockholm uses green electricity (hydro power).

Total energy use: *1000 * 60 W * 4200 hours + 1000 * 120 W * 4200 hours = 756 000 kWh/year*

Total emissions: 756 000 kWh/year * 69,73 g CO2e/kWh = 52,7 ton CO2e/year

Summary of emissions	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
City operations – road maintenance	2 142,4	0,044	0,111
Traffic/Street lights	52,7	0,001	0,003
Totals	**2 195**	**0,045**	**0,116**

Transportation

Summary	
Data quality	Traffic measured in person km (PKM) and by mode of transportation for residents and workers is based on travel studies from Stockholm city 2006, Stockholm inner city 2006 and the CERO transportation database. Transportation of goods and for daily service is based on studies for Stockholm city 2007. The emissions are calculated from the current vehicle fleet in Stockholm County (2010) and the latest fuel economy and emission factors for the respective mode of transport.
Further data needs/missing data	Since travel trends and emissions from traffic will change due to changes in technology as well as behaviour and public transport availability these calculations need to be updated regularly. Developments that might draw in large number of visitors, for example a shopping centre, tourism attractions and traffic connected with the harbour are not accounted for but will affect the traffic in the area.

Note:

Emissions from transport can be accounted for in different ways depending on which perspective is taken, eg. How the system boundaries are set and who is responsible for them. Two results are presented below; according to the CCI framework and the Stockholm accounting method for comparison. Note that besides difference in trips calculations the CCI framework assigns 40% of emissions from all transportation generated from the area accounted for.

Energy use and emissions for personal transportation

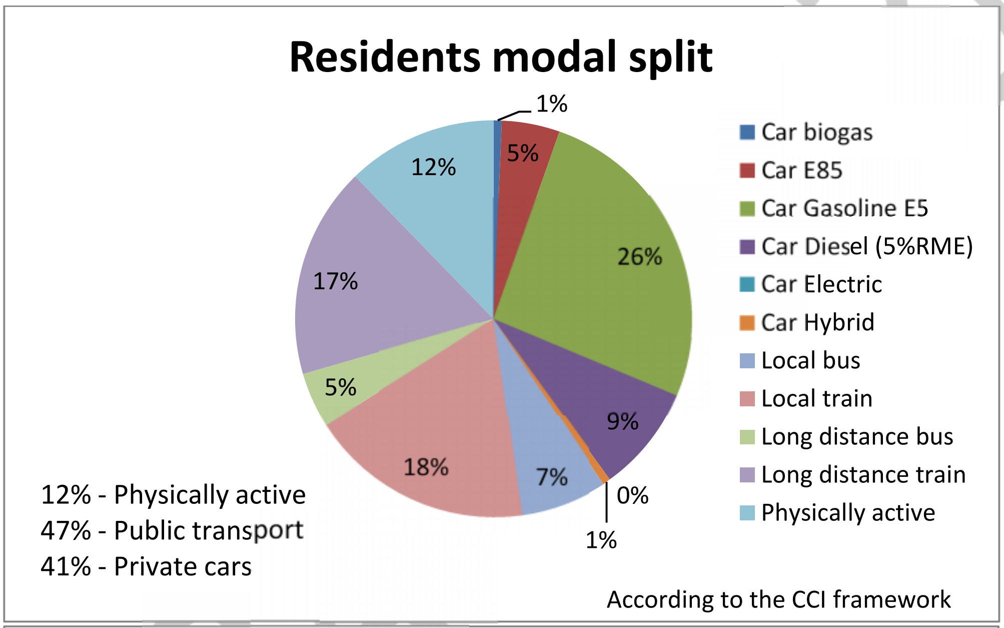
Traffic generation from personal transportation

The personal transportation is based on analysis of data from a travel study done in Stockholm the spring 2006 (Ericson and Fried, 2006). It represents trips starting and finishing in Stockholm inner city. For residents all daily trips are included, private, commute and business but for workers only commuting trips were available. For workers business trips the statistics were therefore complemented with data from similar analysis from The Cero database (Rytterbro et al, 2011) as well as distribution of modes within the public transport. Generated traffic and distribution by mode of transport is presented in table 5 and 6 below, a more detailed distribution of trips is presented in Appendix 3. No flight or boat transport is accounted for in these studies and not taken into account in the emission calculation. It is further assumed that residents travel 365 days/year while workers only travel 226 days/year (Department of Finance, 2009).

According to the CCI framework the trips accounted for in the transport category are all daily trips for residents and both commuting and business trips for workers. This differs from the way transport is conventionally calculated in Stockholm where only private and commuting trips are accounted for for residents and only business trips for workers within the area. The personal transportation is therefore summed up according to these two perspectives in table 5 and 6 respectively.

Table 5 Total personal transportation by mode of transport calculated according to CCI framework.

	Residents (19 000 persons & 365 days travelled)			Workers (30 000 pe & 226 days travelled)		
Mode of transportation	Share of all trips	Average distance [PKM/res day]	Annual distance [PKM/year]	Share of all trips	Average distance [PKM/worker day]	Annual distance [PKM/year]
Car	41%	9,31	64 585 442	39%	11,96	81 071 827
Local bus	7%	1,62	11 259 193	16%	5,02	34 057 132
Subway	18%	4,17	28 930 586	30%	9,27	62 827 360
Commuter bus	5%	1,04	7 187 855	1%	0,35	2 348 332
Commuter train	17%	3,94	27 353 926	10%	3,12	21 172 870
Walking/bicycle	12%	2,81	19 494 285	4%	1,29	8 740 179
Total		22,89	158 811 500		31,03	210 217 967



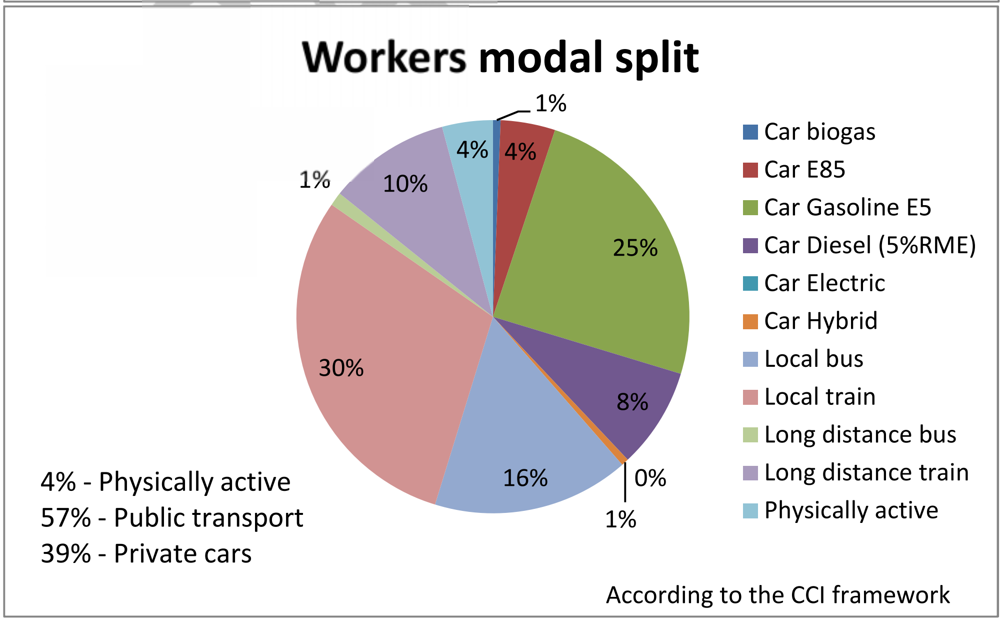
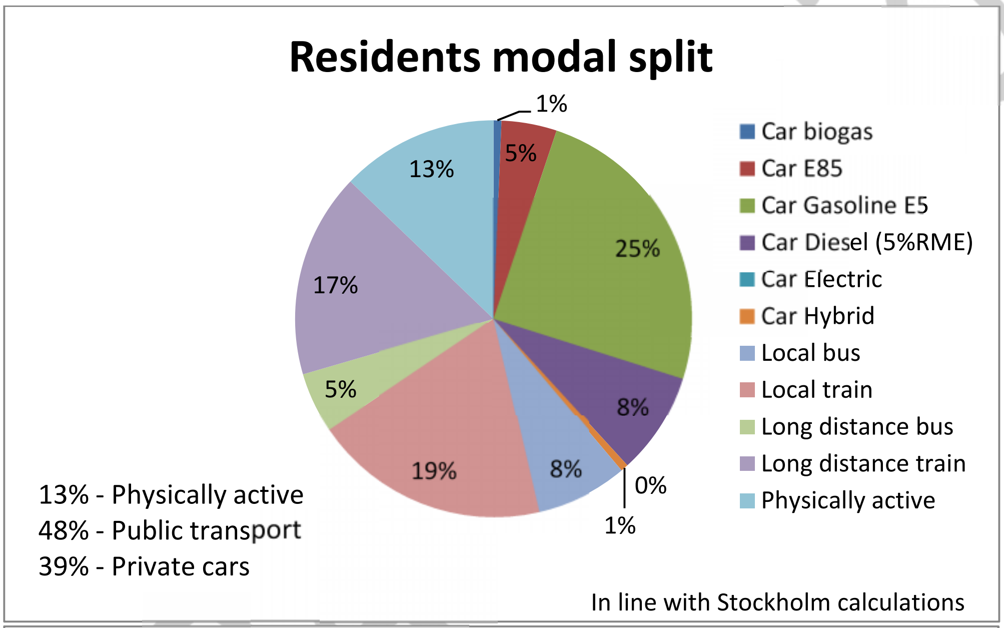


Figure 1 Modal split for residents and workers respectively, trips accounted according to CCI.

Table 6 Total personal transportation by mode of transport calculated according to the Stockholm perspective.

	Residents (19 000 persons & 365 days travelled)			Workers (30 000 pe & 226 days travelled)		
Mode of transportation	Share of all trips	Average distance [PKM/res day]	Annual distance [PKM/year]	Share of all trips	Average distance [PKM/worker day]	Annual distance [PKM/year]
Car	39%	8,15	56 547 804	81%	7,05	47 809 256
Local bus	8%	1,59	11 003 414	2%	0,17	1 180 479
Subway	19%	4,02	27 907 470	3%	0,26	1 770 719
Commuter bus	5%	1,04	7 187 855	0%	0	0
Commuter train	17%	3,50	24 284 576	12%	1,04	7 082 867
Walking/bicycle	13%	2,70	18 703 695	2%	0,17	1 180 479
Total		21,00	146 635 000		8,7	59 023 967



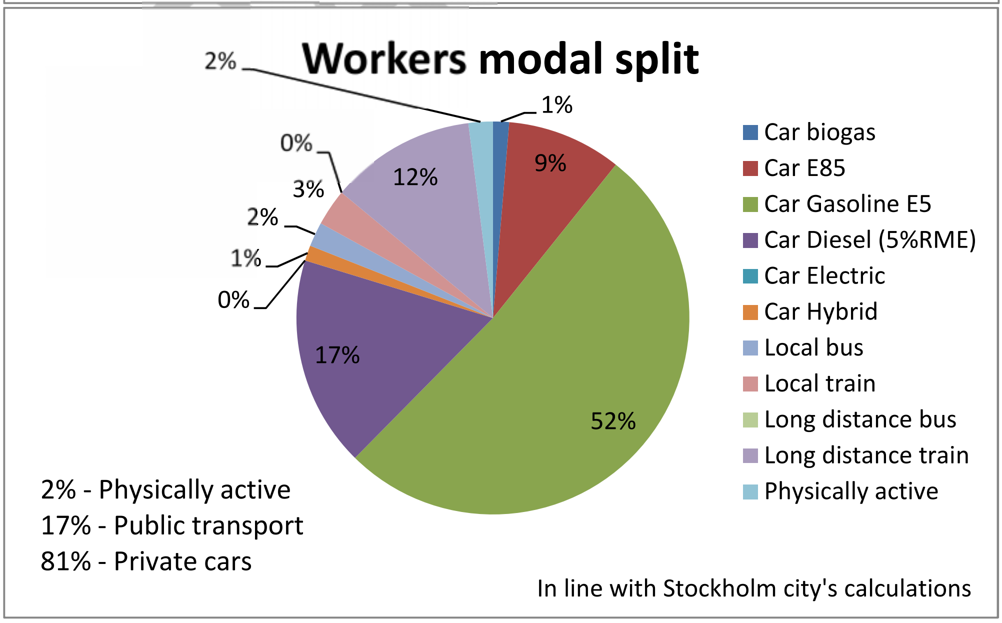


Figure 2 Modal split for residents and workers respectively, trips accounted according to Stockholm city´s perspective.

Emissions from personal transportation

Energy use for respective transport mode is based on statistics for vehicle types and fuel use in Stockholm County 2010 (Swedish bureau of statistics) as presented in appendix 3. Emissions are calculated based on fuel economy, fuel emissions factors (Värmeforsk, 2012) and load factors representative for the year 2010-11. The emission factors are presented in appendix 2.

Note: In accordance with the CCI framework 40 % of the total travels (PKM) are allocated to the SRS baseline. And note also that the trips accounted for differ between the CCI framework and the Stockholm perspective.

Table 7 Total annual emissions from personal transport in SRS divided by mode of transportation.

	CCI transport emissions		Stockholm transport emissions	
	Residents	Workers	Residents	Workers
Mode of transportation	[ton CO2eq/year]	[ton CO2eq/year]	[ton CO2eq/year]	[ton CO2eq/year]
Walking/bicycle	0	0	0	0
Car – Gasoline E5	2 813	3 538	6 157	5205
Car – Diesel (5% RME)	919	1 556	2011	1700
Car – Biogas	0,01	0,01	0,02	0,01
Car – Ethanol E85	231	291	506	427
Car – Electric	0,01	0,02	0,03	0,02
Car – Hybrid	55	70	121	102
Local bus	19	56	45	5
Subway	0,6	1,3	1,4	0,09
Commuter bus	92	30	230	0
Commuter train	1,42	1,1	3,2	0,9
Total	4 130	5142	9074	7441

Summary of emissions	Annual traffic [PKM/yr]	Ton CO2e/year	Ton CO2e/cap	
CCI framework	396 029 467	9 273	0,19	Divided by residents and workspaces
Stockholm perspective	204 658 967	16 515	0,87	Divided with residents only

Energy use and emissions from goods and services:

According to the reference scenario for GHG emissions for the city of Stockholm (Fahlberg et al, 2007) the annual goods and service traffic is estimated per resident and from the projected number of residents the following emissions originate from the transportation of goods and services in SRS.

Table 8 Traffic and annual emissions from goods and service transport refers to Stockholm in general but only 40% of the emissions generated accounted for in line with the Clinton framework.

Emissions from transportation of goods and services in SRS				
Summary of emissions	Annual traffic [VKM/res,yr]	Ton CO2e/year	Ton CO2e/cap	Ton CO2e/res cap
Light diesel trucks	122,77	279,3	0,0147	0,037
Heavy diesel trucks	94,44	495,9	0,0261	0,065
Trailer trucks	59,02	539,6	0,0284	0,071
Totals		**1 316**	**0,069**	**0, 173**

*These numbers do not consider special effects of restricted heavy traffic due to the green zones in Stockholm inner city.

Waste

Summary	
Data quality	The waste generated per resident is based on official statistics that include all waste collected which Stockholm city is in charge of. Other projected waste generation for commercial and public activities is based on estimates from field experts. Greenhouse gas emissions are representative for Swedish waste management and emission factors are based on official waste treatment statistics 2006.
Further data needs/missing data	There are further needs to gather data, especially expanding the number of fractions from offices and schools/daycare centers. In some cases waste fractions are not optimal and further studies should be made over time to better represent the material flow in the area. Emission factors are based on a static split between waste treatment methods within each stream and their efficiency for 2006. Changes in waste treatment methods within material fractions can therefore not be reflected in the emission factors. To reflect changes in waste treatment as for example increased material recycling within a special fraction an additional level of detail needs to be applied, eg. special emission factors for each material fraction and each treatment method.

Data on waste generation and collection by waste fractions for residents is based on statistics for Stockholm city (STAR, 2011). For workspaces and other activities waste generation was estimated with help from specialist within the field from Stockholm city and consultants (Millers- Dalsjö D, 2012).

Greenhouse gas emissions are calculated based on results from a study on environmental effect for Swedish waste (SUNDQVIST & PALM, 2010). The study presents greenhouse gas emission factors for selected waste streams based on their management for the year 2006 and the then current collection and treatment method.

Emissions from waste systems can be tricky to calculate since the waste flows are dynamic, both in terms of the amount (weight) of waste as well as its composition and treatment methods and would require an extensive datasets and modelling of flows and emissions. In this study simplified static emission factors are used as the most representative available model. Furthermore is the system boundary in the CCI framework limited to the handling and treatment of waste but from a life cycle perspective the main share of emissions mainly originates in the so called upstream phase, when producing the goods and material that end up in the waste stream. For these two reasons do the waste emissions results not reflect improvements according to the waste management principles as they should even though they are still the most effective from a global climate effect point of view. However, note that in most cases the static emission factors will probably represent a slight "over estimation” of emissions since the distribution between treatment methods is likely to be more environmentally favourable and travel distances etc. in the greater Stockholm area between collection points and treatment sites are relatively short compared to the national average.

Waste generation

Residents:

In the baseline the waste generated per resident is based on the average for Stockholm 2010 and statistics for collected and sorted waste in separate fractions according to table 9.

Table 9 Annual household waste generated (STAR, 2011; FTIAB, 2010) and scaled up for 19000 residents in SRS.

Annual household waste generated divided by fractions		
Waste Fractions	**Weight [kg/person]**	**Total annual weight [ton/year, SRS]**
Mixed MSW* (incl. food waste)	250,5	5 510
Bulk waste	166,7	3 168
Gardening waste	6,4	122
Packaging waste	84	
Glass (both colored and clear)	26,1	496
Paper packaging	7	134
Newspapers	47,2	
Metal packaging	1,2	48
Plastic packaging	2,5	896
Electronics	12,2	233
Hazardous waste (painted wood etc)	2,6	49
Total	522,6	9 929

*Municipal Solid Waste (MSW) amounts are calculated assuming the generation is 9 kg/resident, week in an apartment buildings and 11 kg/res, week for single family houses (Millers- Dalsjö D, 2012) and calculated with respective resident statistics for Stockholm 2010 (City of Stockholm, 2010).

The statistics on waste generation for households do not include batteries, pharmacy products and waste from vehicles though they are collected and treated in separate systems.

Public (Schools and daycare centers):

The generation for waste in schools is based on the assumptions that 20% of the residents are students, 3800 persons, they generate daily waste as the other workspaces, according to table 10 though with the restriction that the schools are only occupied about 10 months of the year. Then the total waste generation in schools planned in SRS would be 662 ton/year (excluding bulk waste and hazardous fractions).

Commercial activities:

Statistics and key numbers on waste generation from commercial activities are not easily available. That is partly due to lack of motives to publish it and the fact that waste generation varies greatly in terms of total volume and type for different kinds of activities. In the planning phase it is highly uncertain which kind of activity will take place in the area and therefore not feasible to do a thorough inventory on the projected waste. In later updates when the area is operational however more data should be gathered.

Waste generation for commercial activities in general as well as its distribution between waste fractions is therefore based on estimations from field experts (Millers- Dalsjö D, 2012). The estimations were done when dimensioning the waste collecting system for Södra Värtan in the Stockholm Royal Seaport where most of the commercial activity will be located. The total waste volumes were scaled up for 30 000 workplaces and refer to planned distribution of activities for 84% offices and those alike, 4% hotel and 12% retail, by area (SWECO, 2012). The waste generation numbers for commercial activities is only calculated for "daily waste" and therefore excludes the fractions bulk waste, hazardous waste and larger amounts of electronics (WEEE).

Table 10 Generation of waste from commercial activities and distribution of fractions (SWECO, 2012).

Annual waste generated by commercial activities divided by fractions		
Waste Fractions	**Annual generation per workspace (all activities) [kg/workspace, year]**	**Total annual weight [ton/year, SRS]**
Mixed MSW (incl. food waste)	94	2814
Bulk waste	-	-
Gardening waste	-	-
Packaging waste		
Glass (both colored and clear)	7	222
Paper packaging	80	936
Cardboard	-	1467
Metal packaging	3	86
Plastic packaging	25	752
Electronics	3	96
Hazardous waste	-	-
Total	212	6374

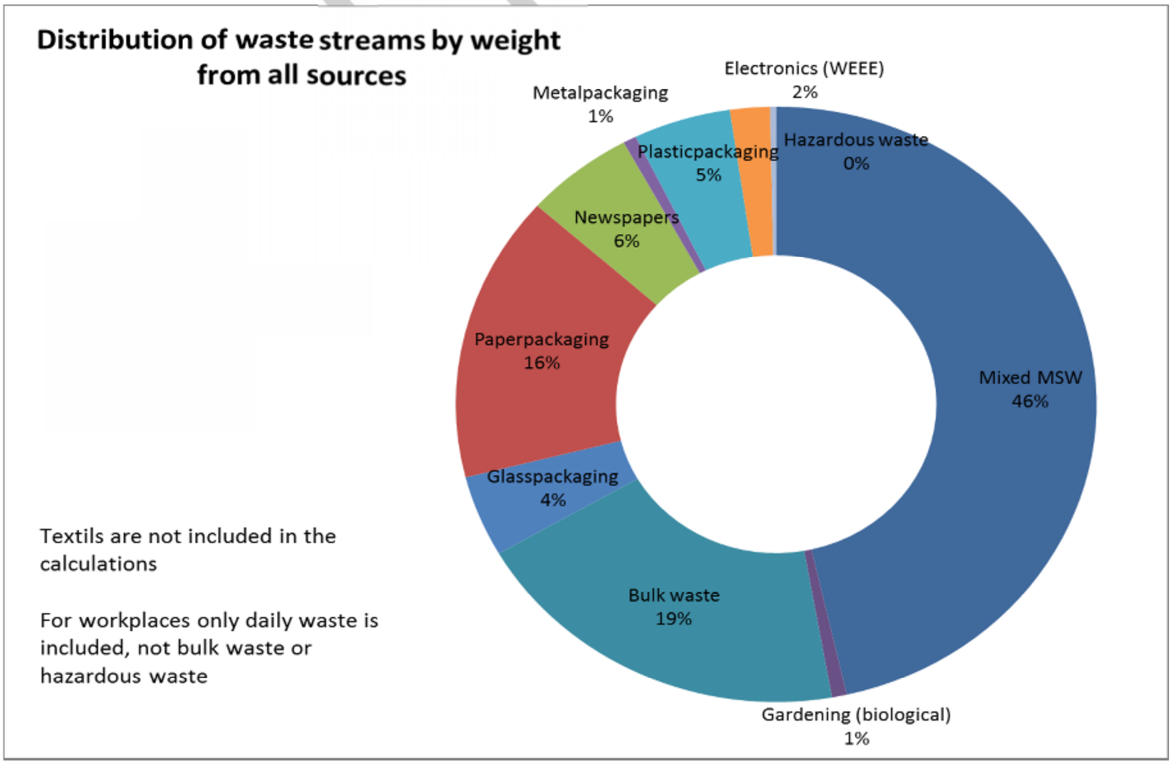


Figure 3 Distribution of waste by material weight, total from all sources accounted for.

Emissions from waste

Emission factors for the handled waste streams are derived from a study on the Swedish waste treatment system 2006 (Sundqvist & Palm, 2010) and is based on the then current compilation of waste streams, collection rates, treatment technologies used and their performance. The limitations of this were explained earlier. Note also that results are likely to differ from calculations from other CCI candidates as the emission calculation tool was provided with a waste model from the US. EPA called WARM. The Swedish waste emission factors are not Stockholm specific but though both geographically better representative than the US model and based on more recent studies.

Table 11 Division of treatment methods in Sweden 2006 for the selected material fractions (Sundqvist & Palm, 2010)

Waste Fractions	Waste treatment division	Comments
	Material recycling/ Incineration/ Landfilling	
Mixed MSW (incl. food waste)	7% / 85% / 8%	
Gardening waste	100% / 0% / 0%	Exl. by-products
Bulk waste	15% / 71% / 20%	
Glass (both coloured and clear)	100% / 0% / 0%	
Paper packaging (incl. newspaper and cardboard)	79% / 16% / 5%	
Metal packaging	99% / 0% / 1%	Exl. by-products
Plastic packaging	29% / 70% / 1%	Exl. by-products
Electronics	100% / 0% / 0%	
Hazardous waste*	-	

*weighted for the mix of 63% impregnated wood, 24% mixed chemical residues, 10% solvent residues and 3% oil residues all classified as hazardous waste.

According to the CCI framework the emissions from the treatment of waste exclusively should be accounted for as debits and the possible saved emissions from recycling and substitution of virgin material should be accounted separately as credits. Emission factors for waste are therefore presented for the different phases in the waste lifecycle according to the following division:

A: Emissions in the production (upstream) phase of the wasted material
B: Emissions from the waste treatment (collection included)
C: Saved emissions in recycling by substituting virgin material or recovering energy

Waste emissions debits in the baseline are then calculated with emission factors in column B and credits with column C. The production of the wasted material or so called upstream emissions are not accounted for within the current framework but are discussed in a separate chapter below.

Table 12 Greenhouse gas emission factors for the selected waste streams in Sweden (Sundqvist & Palm, 2010).

Waste Fractions	**Greenhouse gas emission factors [ton CO2eq/ton waste]**				
	A. Production of material (upstream)	B. Waste treatment (direct emissions, recycling scenario =0)	C. Saved emissions by recycling	Netto waste treatment (B + C)	Netto Waste stream (A + B + C)
Mixed MSW (incl. food waste)	3,0	0,38	-0,43	-0,05	3,0
Gardening waste	0,2	0,01	-0,41	-0,4	-0,2
Bulk waste	3,5	0,04	-0,14	-0,1	3,4
Glass	0,6	0,19	-0,23	-0,04	0,5
Paper (incl. newspaper & cardboard)	0,4	0,24	-0,42	-0,18	0,2
Metal packaging	1,8	0,17	-0,78	-0,61	1,2
Plastic packaging	1,9	2,51	-0,99	1,52[1]	3,4
Electronics	1,8	0,31	-0,36	-0,05	1,7
Hazardous waste*	0,2	0,4	-0,67	-0,3	0,3

*weighted for the mix of 63% impregnated wood, 24% mixed chemical residues, 10% solvent residues and 3% oil residues all classified as hazardous waste.

As emissions from waste incineration are also accounted for in district heating system there is a risk for double accounting. In the SRS case the emissions from waste incinerations due to district heating use are smaller than the emissions from the incineration of waste as a treatment so the emissions already accounted can simply be subtracted from the total waste emissions. In the Stockholm district heating system 2005- 2008 the mixed MSW stood for 13,8% of the total emissions and non-household waste (bulk waste, plastics, paper and other semi- industrial waste) for 8,8%. The emissions from district heating demand in the baseline for SRS are 10 477 ton/year which gives 1446 ton/year from MSW and 922 ton/year from non-household waste that are accounted for within the energy category already. These are therefore subtracted from the emissions from waste treatment.

[1] Plastics are the only waste stream that does not have a negative net emission factor for the waste treatment. This is caused by a its high fossil content and current large rate of incineration which is likely to decrease due to implementation of regulations on increased material recycling.

Table 13 Total annual emissions from waste treatment in SRS

Waste Fractions	**Waste handled**	**Greenhouse gas emissions [ton CO2eq/year]**		
	all sources [ton/year]	B. Waste treatment (only direct emissions)	C. Saved emissions by recycling and energy recovery	Netto waste treatment (B + C)
Mixed MSW (incl. food waste)	7 574	2 878	-3 257	-379
Gardening waste	122	1	-50	-49
Bulk waste	3 168	127	-443	-317
Glass	718	136	-165	-29
Paper (incl. newspaper & cardboard)	3 433	824	-1 442	-618
Metal packaging	109	19	-85	-66
Plastic packaging	800	2008	-792	1 216
Electronics	329	102	-118	-16
Hazardous waste*	49	20	-33	-13
Total	16 302	6 115	-6 386	(-271)
Already accounted emissions from incineration of waste		-2368		
		3 747		-2 621

Summary of emissions	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
Waste treatment	3 747	0,089	0,197
Credits for recycling and energy recovery	6 386	0,164	0,336
Net (excluding upstream emissions)	**-2 621**	**-0,067**	**-0,138**

Waste and Consumption:

Consumption of goods is a large driver for greenhouse gas emissions but also a tricky subject both to measure and manage. The aim is to include consumption in the accounting of greenhouse gas emissions for SRS in later phases though it is excluded in the current CCI baseline. A share of the emissions from consumption can be estimated by looking at the upstream emissions for waste with the help of life cycle data. This is of course a very rough estimate for the consumption and probably represents the lower end of the span as it only accounts for the production of the material that ends up in the waste stream and not the material that is consumed. In other words we estimate emissions from the production of packaging material but not the food that it contained.

To give an idea about what this category could have for emissions we present the upstream emissions from the waste streams accounted for in the baseline below:

Table 14 Total annual emissions from waste in SRS with production included

Waste Fractions	Waste handled	Greenhouse gas emissions [ton CO2eq/year]		
	all sources [ton/year]	A. Production of material (upstream)	Netto waste treatment (B + C)	Netto Waste stream (A + B + C)
Mixed MSW (incl. food waste)	7 574	22 723	-379	22 344
Gardening waste	122	25	-49	25
Bulk waste	3 168	11 087	-317	10 770
Glass (both coloured and clear)	718	431	-29	402
Paper packaging (incl. newspaper and cardboard)	3 433	1 373	-618	755
Metal packaging	109	196	-66	130
Plastic packaging	800	1 520	1 216	2 736
Electronics	329	591	-16	575
Hazardous waste	49	10	-13	3
Total	16 302	37 955	-271	37 634

These emissions only cover a share of the emissions from a consumption point of view but are almost as large as the total result from all the other categories which shows the importance of including consumption as category for emission mitigation.

In the current baseline two kinds of credits have been included, biogas production from sludge and virgin material substitution and energy recovery through waste recycling and incineration. The emission savings are traditionally seen as being "free" in the sense that the emissions from production are allocated to the consumed product and not the waste stream. But when consumption is not included in the system boundaries it can be questionable to include only the benefits and not the whole cost for waste treatment actions. This kind of green washing critic could be met by including the upstream emissions for waste though the consumption emissions in general were left for further work.

Emissions from incineration of waste:

The development of the use of waste as a fuel for the CHP generation is a very interesting question from a system perspective where the goals from the two sectors can be seen as contradicting. Whereas within the waste treatment the aim is to minimize waste generation and increase sorting and material recycling which should result in decreased amounts of incinerated waste, the waste incineration is one of the cheaper and more environmentally friendly fuels available for the district heating sector. Hopefully there will be balance where the environmental benefit is optimised on a large scale but from a SRS perspective the share of SRS mixed MSW is minimal in the total CHP generation in Stockholm area and will therefore not be studied in this case.

Baseline Totals and Analysis

The baseline totals are summarized as:

Summary of emissions	Ton CO2e	Ton CO2e/cap	Ton CO2e/res cap
Energy	20 120	0,516	1,059
Buildings			
- Heating & cooling	10 461	0,213	0,550
- Electricity	7 932	0,162	0,417
Water	114	0,002	0,006
Energy production	- 582	-0,012	-0,013
Infrastructure	2 195	0,045	0,116
Transportation (CCI/Stockholm 3.0)	10 589 / 17 831	0,276	0,938
Waste	3 747	0,002	0,006
- Energy and material recovery	-6 386	-0,164	-0,336
Totals (CCI / Stockholm 3.0)	**28 070 / 35 312**[2]	**0,720**	**1,859**[2]

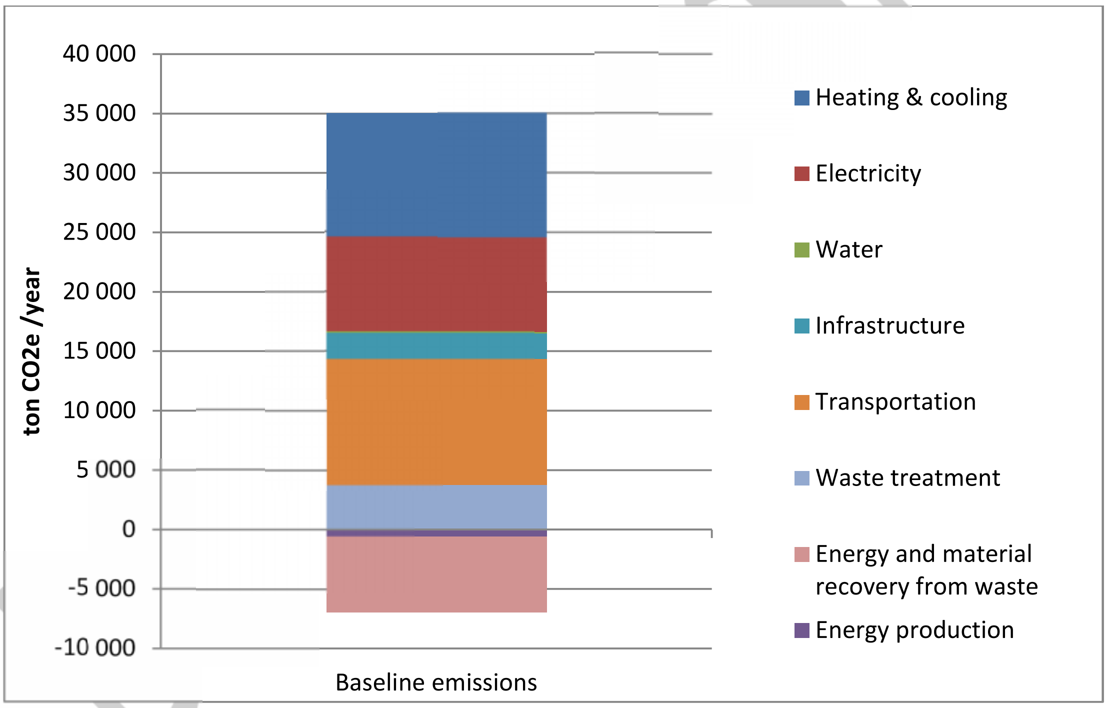


Figure 4 CCI Baseline emissions for Stockholm Royal Seaport

Energy:

Energy use in buildings clearly should be an area of interest for road mapping actions. In the baseline heating (& cooling) represent 37 % of the total emissions and electricity use 28%. The energy demand is larger for heating and cooling purposes but another influence is also that the Nordic grid electricity mix is currently less GHG intensive per kWh than the district heating mix.

[2] Totals for Stockholm 3.0 refer only to the emission categories Energy, Transport and Waste and not Overhead emissions which makes them not comparable to the total for the rest of Stockholm. The calculations within each category should though be comparable.

There are only relatively small amounts of local energy production included in the baseline. The numbers included in the baseline is based on an average production in Stockholm and it is possible that there might be more biogas generated in SRS due to technological developments in the waste management system as well as possible road mapping actions (waste churns notably). Technological improvements in the wastewater collection and plants could also increase the amount of biogas generated.

The emissions from water in the SRS area are almost zero due to the systems low energy requirements as well as their investments in clean energy. Water demand minimization efforts are however important from a more general sustainability point of view.

The infrastructure emissions included in the baseline are mainly from the city operations (snow clearing, sanding, road maintenance etc.), which are based on a Stockholm average. Technological improvements (biogas powered vehicles, heated sidewalks etc.) are possible emission cuts to be made in the area. The emissions from street and traffic lights are currently uncertain but will have a very limited impact on emissions since the city invests in clean electricity to power its utilities.

<u>Transportation:</u>

Transportation is a key emitter and even with the 40 % CCI accounting principle stands for 38 % of the total SRS emissions. The key emitter for both residents and workers are the emissions from cars, representing roughly 40 % of PKM travelled per day and 98 % of emissions in both cases. Transportation emissions are likely to change over the time until SRS becomes fully operational. The fuel economy of vehicles is likely to become more efficient as well as a continuing shift from fossil fuel powered vehicles to renewable ones. As soon as more detailed data about traffic projections and final decisions are made on key infrastructure parts (tram lines, busses etc.) even more detailed data can be developed.

<u>Waste:</u>

Since the Swedish waste treatment system is already mature when it comes to material sorting, recycling and energy recovery waste emissions are relatively low. However since we have only accounted for downstream emissions and not the emissions resulting from the production of waste, which is the main source of emissions when it comes to waste this is still a very important area for road mapping actions, both behaviour related aiming to reduce waste generation and with technical support (e.g. vacuum collection system) increase the sorting and recycling efficiency.

Note! Urban systems can include a range of material flows which can be considered to be both a source of emissions from waste treatment and as a resource for another process (e.g. energy or material). This includes a risk for double accounting of emissions for these emission sources. In the SRS baseline two such flows have been identified: Firstly emissions from incineration of waste (a share of MSW, Bulk waste, Plastics and Paper) that can both be seen as a treatment of a waste fraction and as a fuel in the district heating system. And secondly the biogas production from sludge which is also considerate to be a waste water treatment and as well as energy production from a local renewable source. The biogas production has been handled and is described within the energy category and the incineration of waste within the waste category.

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Appendixes

1. SRS planning parameters

Surface Areas SRS	m2
Residential	1143400
Offices	712330
Commercial	84015
Schools	9500

Population	Persons
Residents	19000
Workers	30000

2. Emission factors

Stationary combustion	gCO2e/kWh	Reference
Biogas (200 bar)	25,40	Calculated from IVL 2011
Diesel (pure)	288,64	Calculated from IVL 2011
Diesel (2% RME)	276,00	Calculated from IVL 2011
Diesel (5% RME)	279,31	Calculated from IVL 2011
Ethanol (pure)	48,39	Calculated from IVL 2011
Ethanol E85	124,27	Calculated from IVL 2011
Ethanol E95	65,80	Calculated from IVL 2011
FAME RME	85,30	Calculated from IVL 2011
Gasoline (pure)	285,50	Calculated from IVL 2011
Gasoline E5	280,44	Calculated from IVL 2011
LNG (1 bar)	218,90	Calculated from IVL 2011
LNG (200 bar)	218,90	Calculated from IVL 2011
Stationary combustion		
Biomass	15,92	Calculated from IVL 2011
Bio fuels	15,92	Calculated from IVL 2011
Blast furnace owen gas	1076,40	Calculated from IVL 2011
City gas	279,00	Calculated from IVL 2011
Coke	400,40	Calculated from IVL 2011
Coke owen gas	166,90	Calculated from IVL 2011
Fuel oil 1	289,20	Calculated from IVL 2011
Fuel oil 2-5	301,39	Calculated from IVL 2011
Hard coal, brown coal	384,08	Calculated from IVL 2011
Household waste	136,65	Calculated from IVL 2011
Industrial waste	89,76	Calculated from IVL 2011
Kerosene	263,20	Calculated from IVL 2011
LD converter gas	674,00	Calculated from IVL 2011
Marginal electricity - coal	1233,78	
Natural Gas, LNG	249,38	Calculated from IVL 2011
Peat	424,61	Calculated from IVL 2011
Pine oil	0,80	Calculated from IVL 2011
Propane, buthane, LPG	245,20	Calculated from IVL 2011
Renewable Energy & Nuclear Power		
Hydro power	1,36	Calculated from IVL 2011
Nuclear power	0,98	Calculated from IVL 2011
Wind power	3,66	Calculated from IVL 2011
Wave power	22,80	Calculated from IVL 2011
Solar PV	30,00	Calculated from IVL 2011
Solar Heat	50,86	Calculated from IVL 2011
Important Energy Mixes		
Nordic Electricity mix 2005 - 2008	69,73	IVL 2011
Stockholm District Heating mix 2007- 2009	98,45	IVL 2011
District Cooling (1/7 share of the district heating emissions)	14,06	Fortum 2012

3. Transport parameters

Personal transportation distance and mode

The input to travel distance and distribution between modes of transport (car, public transport and physically active) is based on an analysis from Ida Kristofferson Sweco, 2012-03-15 on data from travel study for Stockholm inner city 2006 (Ericson och Fried, 2006). Except for business trips for workers that is based on the Cero database (Rytterbo et al, 2011) but travel distance adjusted according to the general relation between the studies (travel distances were about 33% lower for the inner city study than in Cero´s model). To complement that, data from the Cero database was used to estimate the distribution between public transport modes. All car trips are then distributed according to the 2010 vehicle fleet (SCB, 2010).

Table 15 Trips by mode of transport and activity (references detailed below).

		Residents					Workers			
		19000	pers	365	travel days/year		30000	pers	226	travel days/year
			Modal split %	PKM/yr, person	Total PKM/year			Modal split %	PKM/yr, person	Total PKM/year
Private trips	Average distance/ pers, day (km)	12,9	100%	4708,5	89 461 500					
	Car	45%								
	Car biogas	1,63%	0,73%	34,5	655 000					
	Car E85	11,64%	5,24%	246,7	4 687 920					
	Car Gasoline E5	63,74%	28,68%	1350,6	25 661 437					
	Car Diesel (5%RME)	21,41%	9,64%	453,7	8 620 968					
	Car Electric	0,004%	0,00%	0,1	1 722					
	Car Hybrid	1,57%	0,70%	33,2	630 496					
	Public transport tot	41%								
	Local bus	16%	7%	311,4	5 916 002					
	Local train	26%	11%	498,2	9 465 604					
	Long distance bus	16%	7%	311,4	5 916 002					
	Long dist. train	42%	17%	809,6	15 381 606					
	Physically active	14%	14%	659,2	12 524 610					
Commuting trips	Average distance/ pers, day (km)	8,1	100%	2956,5	56 173 500		22,3	100%	5039,8	151 194 000
	Car	29%					22%			
	Car biogas	1,63%	0,47%	13,9	265 047		1,63%	0,36%	18,0	541 190
	Car E85	11,64%	3,38%	99,8	1 896 972		11,64%	2,56%	129,1	3 873 368
	Car Gasoline E5	63,74%	18,49%	546,5	10 383 930		63,74%	14,02%	706,8	21 202 619
	Car Diesel (5%RME)	21,41%	6,21%	183,6	3 488 485		21,41%	4,71%	237,4	7 123 027
	Car Electric	0,004%	0,00%	0,0	697		0,004%	0,00%	0,0	1 423
	Car Hybrid	1,57%	0,45%	13,4	255 131		1,57%	0,34%	17,4	520 943
	Public transport tot	60%					73%			
	Local bus	15%	9%	267,8	5 087 411		30%	21,74%	1095,9	32 876 653
	Local train	55%	33%	970,6	18 441 866		55%	40,38%	2035,2	61 056 641
	Long distance bus	4%	2%	66,9	1 271 853		2%	1,55%	78,3	2 348 332
	Long dist. train	26%	16%	468,6	8 902 970		13%	9,32%	469,7	14 089 994
	Physically active	11%	11%	325,2	6 179 085		5%	5%	252,0	7 559 700
Business trips	Average distance/ pers, day (km)	1,9	100%	693,5	13 176 500	RVU 2006 /CERO :67%	8,7	100%	1967,5	59 023 967
	Car	61%					81%			
	Car biogas	1,63%	0,99%	6,9	130 774		1,63%	1,32%	25,9	777 868
	Car E85	11,64%	7,10%	49,3	935 969		11,64%	9,43%	185,6	5 567 304
	Car Gasoline E5	63,74%	38,88%	269,7	5 123 446		63,74%	51,63%	1015,8	30 475 139
	Car Diesel (5%RME)	21,41%	13,06%	90,6	1 721 223		21,41%	17,35%	341,3	10 238 133
	Car Electric	0,004%	0,00%	0,0	344		0,004%	0,00%	0,1	2 045
	Car Hybrid	1,57%	0,96%	6,6	125 882		1,57%	1,27%	25,0	748 767
	Public transport tot	33%					17%			0
	Local bus	5,9%	1,94%	13,5	255 779		11,76%	2%	39,3	1 180 479
	Local train	23,5%	7,76%	53,8	1 023 116		17,65%	3%	59,0	1 770 719
	Long distance bus	0,0%	0,00%	0,0	0		0,00%	0%	0,0	0
	Long dist. train	70,6%	23,29%	161,5	3 069 349		70,59%	12%	236,1	7 082 876
	Physically active	6%	6%	41,6	790 590		2,00%	2%	39,3	1 180 479

- pink cells are inputs from the urban development planning (Christina Salmhofer, 2012).
- yellow cells are input parameters from analysis on travel study for Stockholm inner city 2006 (Ida Kristofferson Sweco, 2012, Ericson och Fried, 2006).
- green cells are inputs from the CERO database - SRS results (Rytterbo et al., 2011).
- white boxes present the distribution between vehicles and it is the same for all car trips (SCB, 2010).

The vehicle park in the baseline

Cars:	Fuel type used	Energy use kWh/PKM	Distribution between vehicles within mode (SCB, 2010)
Car biogas	Biogas 200 bars		1,6%
Car E85	85% Ethanol (5% Gasoline)		11,6%
Car Gasoline E5	Gasoline (5% Ethanol blend)		63,7%
Car Diesel (5%RME)	Diesel (5%RME)		21,4%
Car Electric	Electricity		0,004%
Car Hybrid	Other hybrid		1,6%

Public transport:	Fuel type used
Local bus	95% Ethanol
Subway	Electricity
Commuter bus	Diesel 2% RME
Commuter train	Electricity

Goods and service transport

Traffic from goods and services is based on study for Stockholm city (Fahlberg et al., 2007).

	Vkm/year,resident	Energy Use kWh/VKM	Emission Factor gCO2e/kWh
Light Truck - Diesel	122,8		
Heavy Truck - Diesel	94,4	2,5	276,0
Trailer Truck - Diesel	59,0	4,4	276,0