

Calculation of Magnitudes of Possible Roadmapping Actions and Credits

- **According to the Clinton Climate Initiative and Stockholm 3.0**

Stefan Johansson

Hossein Shahrokni

Anna Rúna Kristindóttir

Nils Brandt

Division of Industrial Ecology

Royal Institute of Technology, KTH, Stockholm, Sweden

TRITA IM 2012:12

Table of Contents

Introduction..... 3

Magnitudes of Possible Road Mapping Actions 3

 Building Electricity - 30 % Local Generation Through Solar PV 3

 Phase 2 Energy Demands for Residential Buildings 3

 Climate Neutral Transportation - Residents..... 4

 Summary – Magnitudes of Roadmapping Actions and Per Capita Emission Reductions 4

Magnitudes of Possible Credit Actions..... 5

 Electrification of the Harbor..... 5

 50 % of worker commuting by climate neutral transportation 5

 Summary – Magnitudes of Credit Actions and Per Capita Emission Reductions..... 6

References..... 7

DRAFT Version

Introduction

This report is used together with the GHG baseline report for SRS (Johansson et al., 2012) and all methods of calculation, system boundaries, assumptions etc. are the same as those made in that report.

To calculate the magnitudes of emission reductions from a few possible roadmapping actions the overall SRS environmental program, the environmental program for the second build phase and other public documents have been used. Note that these actions represent magnitudes of emission cuts and **DOES NOT** represent actual roadmapping actions decided by any stakeholders.

Magnitudes of Possible Road Mapping Actions

Building Electricity - 30 % Local Generation by Solar PV

According to SRS's environmental program for the second build phase (Stockholms stad, 2009) a goal is to have 30% of the building electricity should be generated locally using Solar PV cells. Using the projected annual building electricity use together with emission factors from the Nordic electricity mix and Solar PV cells the total savings are calculated as (Johansson et al, 2012):

Building type	Annual Electricity use [kWh/year]	Nordic mix emissions [ton CO2e/year]	Solar PV [ton CO2e/year]	Emission savings [ton CO2e/year]
Residential	5 145 300,00	358,78	154,36	204,42
Commercial	504 090,00	35,15	15,12	20,03
Offices	5 342 475,00	372,53	160,27	212,26
Public	42 750,00	2,98	1,28	1,70
Total annual savings [ton CO2e/year]				438,41

Source: Johansson et al, 2012

Phase 2 Energy Demands for Residential Buildings

According to the environmental program for SRS's second build phase residential buildings should use no more than 55 kWh of energy per m² and year and of those 55 kWh/m², year no more than 15 should be used for building electricity (Stockholm, 2009). Using the differences in energy use between the baseline and phase 2 demands together with the emission factors for the Nordic electricity mix and Stockholm district heating mix the annual emission savings can be calculated as.

Energy use	Baseline [kWh/m ² , year]	Phase 2 [kWh/m ² , year]	Emission factor [g CO2e/kWh]	Emission savings [ton CO2e/year]
Heating+ hot water	67,5	40	98,45	3 095
Building electricity	15	15	69,73	0
Total annual savings [ton CO2e/year]				3 095

Source: Johansson et al, 2012

Climate Neutral Transportation - Residents

According to the overall environmental program one goal for residential transportation (commuting and private trips) is to focus on climate neutral transportation for residents and workers. To illustrate this in magnitudes of emission reductions this has been interpreted into an optimistic scenario where 50 % of residential transportation takes place by electric car and a moderate scenario where 50 % of it takes place by hybrid cars.

Mode of transport	50% PKM/year [PKM/year]	Emissions [g CO2e/PKM]	Emission [ton CO2e/year]
<i>Optimistic</i>			
Car E5	18 022 683,34	170,81	3 078,40
Electric car		11,56	208,38
		Total savings [ton CO2e/year]	
			2 870,02
<i>Moderate</i>			
Car E5	18 022 683,34	170,81	3 078,40
Electric car		136,65	2 462,73
		Total savings [ton CO2e/year]	
			615,67

Source: Johansson et al, 2012

Summary – Magnitudes of Roadmapping Actions and Per Capita Emission Reductions

The magnitudes have been summarized as both absolute reductions and per capita emission reductions according to Stockholm 3.0 in the table below.

Road mapping actions	Emission Reductions [ton CO2e/year]	Per Capita Emission Reductions [ton CO2e/cap, year]
Solar PV – 30 % of building electricity	438	0,02
Phase 2 - demands	3 095	0,16
Residents Gasoline → Electric car	2 870	0,15
Residents Gasoline → Hybrid car	616	0,03

Magnitudes of Possible Credit Actions

Through public documents a number of credit actions connected to SRS have been identified.

Electrification of the Harbor

In an application to the Climate Investment Program (KLIMP) funded by the Swedish Environmental Protection Agency (SEPA) Stockholm has made a rough estimation that some of the ferry traffic could switch from diesel fuel to electricity while idling in port (Stockholm, 2007). According to the application 1 200 m³ of diesel fuel could annually be replaced by electricity. To demonstrate the magnitudes of possible emission reductions two different calculations have been made, one where the diesel fuel is replaced by the Nordic electricity mix and one where it is replaced by wind power.

Annual energy use: $1\,200\text{ m}^3 * 9,790\text{ MWh/m}^3 = 11\,748\,000\text{ kWh}$

Annual emissions (Diesel): $11\,748\,000\text{ kWh} * 276,00\text{ g CO}_2\text{e/kWh} = 3\,242\text{ ton CO}_2\text{e/year}$

Annual emissions (Nordic electricity): $11\,748\,000\text{ kWh} * 69,73\text{ g CO}_2\text{e/kWh} = 819\text{ ton CO}_2\text{e/year}$

Annual emissions (Wind power): $11\,748\,000\text{ kWh} * 3,66\text{ g CO}_2\text{e/kWh} = 43\text{ ton CO}_2\text{e/year}$

Energy source	Annual energy use [kWh/year]	Emissions [g CO ₂ e/kWh]	Emissions [ton CO ₂ e/year]
<i>Optimistic</i>			
Diesel fuel	11 748 000	276,00	3 242
Wind Power		3,66	43
Total savings [ton CO ₂ e/year]			3 199
<i>Moderate</i>			
Car E5	11 748 000	276,00	3 242
Nordic mix		69,73	819
Total savings [ton CO ₂ e/year]			2 423

50 % of worker commuting by climate neutral transportation

According to the overall environmental program one goal for workers' transportation (commuting trips) is to focus on climate neutral transportation. To illustrate this in magnitudes of emission reductions this has been interpreted into an optimistic scenario where 50 % of workers' transportation takes place by electric car and a moderate scenario where 50 % of it takes place by hybrid cars.

Mode of transport	50% PKM/year [PKM/year]	Emissions [g CO ₂ e/PKM]	Emission [ton CO ₂ e/year]
<i>Optimistic</i>			
Car E5	10 601 309,59	170,81	1 810,78
Electric car		11,56	122,57
Total savings [ton CO ₂ e/year]			1 688,21
<i>Moderate</i>			
Car E5	10 601 309,59	170,81	1 810,78
Electric car		136,65	1 448,63
Total savings [ton CO ₂ e/year]			362,15

Summary – Magnitudes of Credit Actions and Per Capita Emission Reductions

The magnitudes have been summarized as both absolute reductions and per capita emission reductions according to Stockholm 3.0 in the table below.

Road mapping actions	Emission Reductions [ton CO2e/year]	Per Capita Emission Reductions [ton CO2e/cap, year]
Harbor- Diesel → Nordic mix	3 199	0,17
Harbor- Diesel → Wind power	2 423	0,13
Workers' Gasoline → Electric car	1 688	0,09
Workers' Gasoline → Hybrid car	362	0,019

DRAFT Version

References

Johansson, Rúna Kristinsdóttir, Sharokni, Brandt, 2012b. The Stockholm Royal Sea Port Greenhouse Gas Baseline Report According to the Requirements of the Clinton Climate Initiative and Stockholm 3.0 . TRITA IM: 2012:09, Division of Industrial Ecology, KTH, Royal Institute of Technology, Stockholm, Sweden.

Stockholms stad, 2007. Elanslutning av fartyg – KLIMP ansökan.

Stockholms stad, 2009. Miljökrav vid byggande av bostäder och lokaler – etapp norra 2. Retrived from http://www.stockholm.se/Fristaende-webbplatser/Fackforvaltningssajter/Exploateringskontoret/Hjorthagen-Vartahamnen-Frihamnen-Loudden/Informationsmaterial/Norra-Djurgardsstaden_flash/Etapp-norra-210/

Stockholms stad, 2010. Övergripande program för miljö och hållbar stadsutveckling i Norra Djurgårdsstaden (Stockholm Royal Seaport). Retrived from <http://www.stockholm.se/-/Nyheter/Klimat--Miljo/Miljoprogram-for-Norra-Djurgardsstaden/>

DRAFT Version