smartset
Efficient Urban Freight Transport

Co-funded by the Intelligent Energy Europe Programme of the European Union

SMARTSET SET OF UPDATED IEE COMMON PERFORMANCE INDICATORS | D8.1

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1. LIST OF TABLES, FIGURES AND ABBREVIATIONS

1.1. List of tables

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1.3. List of abbreviations

This table provides an overview on all abbreviations used in this document.

Abbreviation	Full name | Explanation
CO_2	Carbon dioxide
GWh	Gigawatt hour
toe	Tonne of oil equivalent
UFT	Urban Freight Terminals
IEE	Energy – Europe programme of the European Union
CPI	Common Performance Indicators

Table 1: Abbreviations used in this document

2. ABOUT SMARTSET

Transport of goods, both on long distances and within cities contributes to a substantial part of the total emissions generated from the transport sector, as well as congestion. Up to 20% of traffic, 30% of street occupation and 50% of greenhouse-gas emissions are generated by freight.

The SMARTSET project will develop and show how freight transport in European cities and regions can be made more energy-efficient and sustainable by a better use of freight terminals. To reach this overall goal, the project will provide examples of good practice that can support cities, regions and countries to contribute to the European Union „20-20-20" targets[1] for reduction in carbon dioxide emissions and improvement in energy-efficiency.

SMARTSET targets	Reduction by 2016	Reduction by 2020
Reduction of CO_2 emissions in tonnes	9,422 tonnes per year	29,193 tonnes per year
Reduction of energy consumption in tonnes	1,310 toe per year	4,819 toe per year
Reduction of energy consumption in GWh	15 GWh per year	56 GWh per year

Table 2: SMARTSET targets during project duration (by 2016) and beyond (by 2020)

SMARTSET is structured around three core aspects for creating successful and attractive terminals:

- **Market based business models** provide an outline for various strategies and distribution solutions to be implemented through organizational structures, processes and systems.
- In order to make city centres more attractive, the **introduction of clean and energy-efficient vehicles** for last mile distribution and the use of intermodal transports is facilitated as well.
- **Incentives and regulations** improve the possibility to make the business models profitable and financially sustainable.

SMARTSET is a project, co-funded by the Intelligent Energy – Europe programme of the European Union (IEE) and is composed of 14 partners, coming from Austria, Germany, Italy, Sweden and the United Kingdom. It will run from 01.05.2013 until 30.04.2016.

[1] The climate and energy package is a set of binding legislation which aims to ensure the European Union meets its ambitious climate and energy targets for 2020. These targets, known as the "20-20-20" targets, set three key objectives for 2020:

- A 20% reduction in EU greenhouse gas emissions from 1990 levels
- Raising the share of EU energy consumption produced from renewable resources to 20%
- A 20% improvement in the EU's energy efficiency

3. IMPACT ASSESSMENT

There is a need to consolidate large volumes of freight and improving the access and attractiveness to major transport interchanges and Urban Freight Terminals (UFTs) and to limit individual freight deliveries. SMARTSET aims to do that and showcase how to successfully implement UFT schemes in medium size and big cities, campus areas, external commercial centres and sensitive inner city areas. The project will also demonstrate successful examples of shifting transport modes from regular trucks for long distances to rail and explore other sustainable modes of transport.

The IEE Common Performance Indicators include:
1. The sustainable energy investment triggered;
2. Renewable energy production triggered;
3. Primary energy savings; and
4. Reduction of the greenhouse gas (GHG) emissions.

This document provides the methodology used for the calculation of the IEE Common Performance Indicators (CPI): 2, 3 and 4 for the SMARTSET project. We envisage that there will be no investments triggered in sustainable energy production by European stakeholders as a result of the project.

The estimates were based on Method 1 in the EACI guidelines for the calculation of common performance indicators[2].

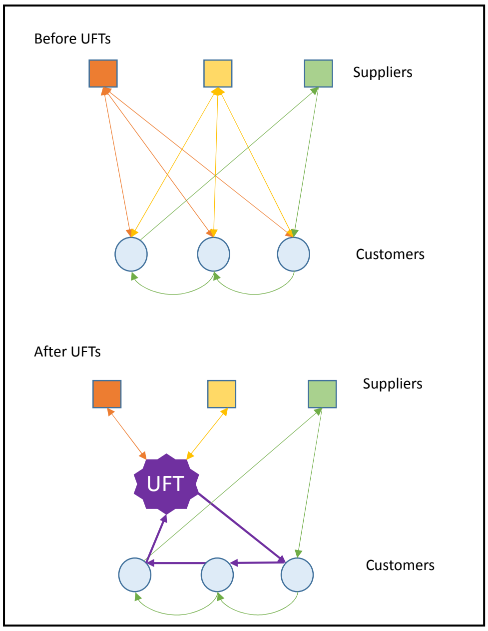
- The **short terms impacts** are based on the assumption that 5 terminals are operating under market based conditions in Gothenburg, Sundsvall, Padova, Rome and Newcastle. Three Business models are developed for terminal schemes in Berlin, Graz and Forlì which are assumed not be in operation during the project period but become operational soon after the project, definitely by 2020.
- The **longer term impacts** of the project are based on two assumptions: initially the impacts of their expansion to serve the whole city and thereafter their replication in other cities in the region and/or country thanks to other project activities. The experience and knowledge gained from partner cities will be presented through networking and dissemination activities to encourage other cities to implement UFT solutions.

Please note that the values for energy consumption and GHG emissions stated in this report are the exact values from the calculations and not rounded to whole numbers in order to help us trace the values at a later date.

[2] Executive Agency for Competitiveness and Innovation (EACI), Guidelines for the calculation of common performance indicators March 2013

4. METHODOLOGY IN DETAIL

4.1. Impacts and scope



To achieve the estimations of energy and emission reduction from the UFT schemes in this proposal, the SMARTSET consortium has undergone an ambitious process of establishing baselines of the present situation and credible projections for the end of the project and therefore its long term effects.

The City of Gothenburg has together with Trivector coordinated this work, consulting experts in freight, logistics and the environmental effects of transport. The main variables were put together in a calculation template (see attached Excel file for details) and then distributed to the partners.

Except for Rome and Sundsvall, all other cities used this template to estimate their scheme's likely effects on greenhouse emissions and energy use. The methods used by Rome and Sundsvall are described in section 3.3.2.

The causal chain explains the link between the outcomes and impacts used within this calculation model. In a nutshell, calculations are based on the number of freight deliveries in the city (area), their frequencies, total vehicle km travelled (and number of stop-starts), vehicles used (conventional and clean and energy efficient fuel), and consequent energy use (toe/year) and greenhouse gas emissions (t CO_2/year) from freight transport before and after the UFT scheme(s).

We also envisage that there will be renewable energy triggered as a result of the introduction of the electric and clean energy vehicles at the proposed UFTs.

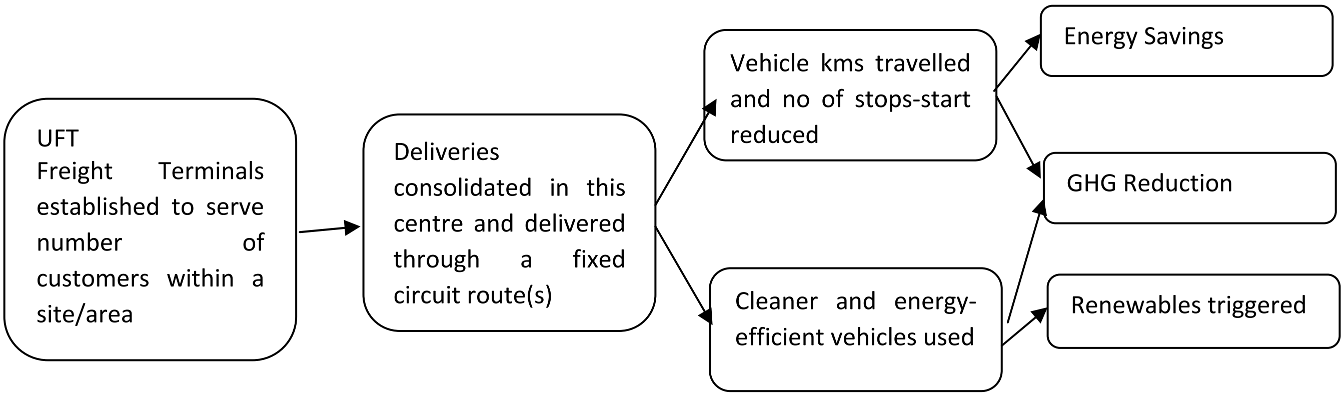


Figure 1: *Mapping Outputs to impacts*

4.2. Assumptions for baseline and extrapolation

4.2.1. Global assumptions and parameters

Assumptions, parameters and adjustment factors were necessary to calculate the energy used and greenhouse emissions both before and after a UFT scheme is implemented. The areas in which the assumptions (where possible based on real figures otherwise estimates) were made, parameters (evidence based) and the adjustment factors used are shown below. The accompanying excel file shows the values used for each site.

The site specific assumptions and parameters used in calculating the impacts can be found in detail in the accompanying excel file.

Assumptions

- Number of shops which have their own distribution routes
- Average number of deliveries per shop per day
- Percentage of deliveries made with fixed route/circuit deliveries (%) - % of deliveries that will NOT be influenced by the UFT, the rest are included in the calculations
- Saved distance covered for the vehicles when goods are left at the terminal (km) Distance that will be saved with the UFT
- Length of the fixed route/circuit (in Km) for the UFT
- Percentage of heavy trucks in the distribution fleet
- Number of delivery days per year
- Percentage of light trucks in the distribution fleet
- Number of fixed routes/circuits per day -city deliveries for the UFT

Parameters used

- Fuel consumption in inner city, liter per 10km - heavy truck

- Fuel consumption in the inner city, liter per 10km - light truck
- Fuel consumption in mixed conditions, liter per 10km - heavy truck
- Fuel consumption in mixed conditions, liter per 10km - light truck
- Fuel consumption per stop/start - heavy truck (liter)
- Fuel consumption per stop/start - light truck (liter)
- Fuel consumption - electric vehicle kWh/10km
- Fuel consumption per stop - electric vehicle (kWh)

Adjustment factor

- Adjustment factor - kg CO2 per liter diesel
- Adjustment factor - kWh per liter diesel
- Adjustment factor - kg CO2 per kWh electricity

The calculations are firstly based on the experience of freight transport and distribution in the SMARTSET cities today. The calculations are based on the assumptions regarding:

- the number of shops/stores/workplaces etc that are estimated to be customers of the terminal scheme
- the number of deliveries today to these shops/workplaces and the total number delivery days/year.

Secondly, the calculations need also to take into account the assumptions regarding how distribution is made today. In general,

- Large transport operators such as DHL, Schenker etc often have well established schemes with relatively optimised freight routes.
- The terminal schemes primarily focus on that proportion of vehicles belonging to smaller freight operators making individual deliveries with a lower load rate.

Thirdly, assumptions on vehicle performance – both for conventional and “alternative” (fully electric or hybrids) - have been included in the calculations. Emissions from vehicles are highest on distribution routes with multiple stops and starts. Therefore, in calculating vehicle performance, the distance they drive and the number of starts and stops has been taken into account.

- A conventional heavy vehicle is estimated to consume about 0,5 litres of diesel for each start and stop.
- Alternative vehicles (electric and LNG) also consume energy and generate emissions. This was estimated to be 0,01 kWh for electric vehicles and 0,16 KWh for LNG vehicles.

Fourth, assumptions on CO2 emissions from and the energy intensity of diesel, LNG and electricity have been included. These are:

- 3 kilos of CO2 emissions per litre diesel (Including emissions from production and distribution of the fuel)
- 10 kWh per litre diesel
- 0,02 kg CO2 per kWh electricity
- 1,99 kg CO2 per kg LNG

Please note that the emissions and fuel use factors that are used in calculations are an average to reflect the fact that the fuel efficiency of the fleet as a whole will improve and emissions/km reduce over the lifetime of the project, and then onwards to 2020.

However a few alterations have been necessary to reflect the nature of the schemes in the following cities.

Newcastle

Site 1: Newcastle's inner city UFT application is a stockpiling proposal for a big shopping centre. The assumption is that the stockpiling operation will half the number of deliveries to Eldon Square. Adoption of electric vehicles is also expected. However this is not taken into account in the calculations.
Site 2: The assumption is that by the end of the project at least 30% of all the university establishments and by 2020 all of them would be served by the UFT. Moreover, the deployment of electric vehicles is also envisaged.

Padova
The calculation for Padova has been doubled since the development of the service is foreseen both by electric and LNG vehicles.

4.2.2. Deviations from the common model

Two cities have developed a different approach for estimating the impacts of their UFT schemes, to reflect their somewhat different nature.

Sundsvall
The scenario for the calculation is conversion of cargo from road to rail on the long haul distance and use of green distribution in the Sundsvall urban area. The assumption is that in long term perspective one train will run between Malmö border to Sundsvall a distance about some 950 km every weekday, 250 days yearly. One train running with full trainload northbound and one trainload empty back southbound. In the short term two train equivalents will run. These containers or wagons will be spread in current system or run separately in new trains when time has come. For calculation for road there is trucks running accordingly the the same amount of load each way.

The method used to quantify the figures for saved emissions are EcoTransIT used by major railway companies in Europe. For further information, please see Annex I.

The impact calculations are only based on shifting long distance road transport to rail. The last mile distribution to Birsta commercial centre have not been included in the calculations.

Rome

Rome's calculations were based on the increased number of clean fuel and electric vehicles used for the deliveries in the short term (during the project) and the long term (end of project till 2020).

Assumptions include:

Trips/day	3.4
km/trip	10
Working day (semester)	115
Conversion factor tep/kwh (IEA/OCSE)	11630

Parameters used for the vehicle emissions (g/km) include:

Hybrid vehicles	60
LPG Vehicles	180
Metan Vehicles	180
Electric Vehicles	0
Conventional vehicles	370

4.3. Estimating short term impacts

Short term impacts are estimated using Method 1 in the EACI guidelines on calculating. Here, the causal chain is relatively straightforward: consolidating deliveries in an UFT will reduce the distance travelled for freight distribution and in addition to this using energy efficient alternative vehicles instead of conventional fossil fuel vehicles for delivery will reduce both energy consumption and CO2 emissions.

The short term impacts were based on:

- 5 terminals operating on market based conditions in Gothenburg, Sundsvall, Padova, Rome and Newcastle and
- 3 Business models developed for terminal schemes in Berlin, Graz, Forli which are assumed not be in operation during the project period.

The ambitious yet credible targets of SMARTSET are to reduce energy consumption by 15 GWh and 9422 tonnes of CO2/year. The significant contribution of the Sundsvall scheme is notable: this is due to its impact on long distance as well as short distance freight movements.

City	Energy (GWh/year)	Energy (toe)	CO2 (tonnes/year)
Berlin	0	0	0
Forli	0.0	0	0
Gothenburg	-0.1	-8	-28
Graz	0.0	0	0
Newcastle	-0.2	-16	-56
Padova	-0.6	-52	-206
Rome	-0.2	-18	-61
Sundsvall	-14.0	-1216	-9070
Total	**-15**	**-1310**	**-9422**

Table 3: Minimum savings (during the project) - Berlin, Forli and Graz terminals will not be operational

4.4. Estimating long term impacts

SMARTSET has the potential to be the first major step towards a significant optimisation of freight transport in a longer perspective. The longer term aim for SMARTSET – in line with the EU policies mentioned – is to bring about a fundamental shift in the way that goods are delivered in European cities and regions, and to ensure that freight transport is decoupled from its negative effects on the environment, society and the economy. SMARTSET aims to contribute to cleaner, safer and more efficient future freight transport and to sustainable development in cities. Not only have the local implementations in the SMARTSET cities the potential to be up scaled to larger geographical areas, the ambitious outreach and exploitation of the results can generate duplications in other cities. For long term impacts we assume that all partner cities continue with their activities at the same intensity, primarily because once the market based UFT are implemented along with appropriate regulations and incentives to encourage uptake, we assume that this will create a snowball effect.
We have estimated both the long term impacts of the project in terms of maximum and minimum values, based on different levels of uptake:.

- Minimum impacts in 2020 for energy, carbon and renewable energy production triggered were calculated as a result of the direct impact of the SMARTSET project. Thus are based on the maximum enlargement of the UFT activities in the 8 participating cities. In order to do that each city has estimated an enlargement factor (see table 4) to be used as a multiplier for the long term impacts.
- Maximum impacts in 2020 assumed that the influence of the project has spread and similar UFT solutions were replicated in other cities in SMARTSET countries. In order to do that each participating city has indicated the likely number of cities (see table 4) that would transform their urban freight deliveries in their countries.

Please note that in Sundsvall's case, it was assumed that the scheme would run full capacity after the SMARTSET project completed. Therefore the estimated long term impacts reflects this assumption.

The short term impacts were based on the assumption was that the scheme would only run with 2/5 of its capacity.

The following table illustrates the two multipliers which were used for extrapolating the short term impacts to long term impacts.

City and Country	MINUMUM IMPACT Multiplier (for a larger area)	Number of cities for replication - incl SMARTSET cities	MAXIMUM IMPACT Multiplier for replication in similar cities
Berlin (DE)	2	33	6
Forli (IT)	3	6	18
Gothenburg (SE)	3	6	18
Graz (AT)	3	6	18
Newcastle (UK)	3	6	18
Padova (IT)	1.5	6	9
Rome (IT)	4	5	20
Sundsvall (SE)	NA	NA	NA

Table 4: Multipliers used for extrapolation

As above per the methodology used above, the SMARTSET consortium has estimated the following long term minimum and maximum potential savings (assuming that all terminals are fully implemented and operational).

City	Energy (GWh/year)	Energy (toe)	CO2 (tonnes/year)
Berlin	0	-36	-152
Forli	-0.5	-46	-163
Gothenburg	-0.3	-24	-84
Graz	-0.3	-23	-80
Newcastle	-0.6	-48	-169
Padova	-0.9	-78	-309
Rome	-0.8	-70	-245
Sundsvall	-35.0	-3041	-22675
Total	**-39**	**-3367**	**-23878**

Table 5: Minimum savings (for the longer term - to 2020)

[3] 4 cities (but just half as big as Berlin

City	Energy (GWh/year)	Energy (toe)	CO2 (tonnes/year)
Berlin	-1	-107	-457
Forli	-3.2	-278	-981
Gothenburg	-1.7	-144	-507
Graz	-1.6	-137	-481
Newcastle	-3.4	-290	-1014
Padova	-5.5	-471	-1853
Rome	-4.1	-352	-1227
Sundsvall	-35.0	-3041	-22675
Total	**-56**	**-4819**	**-29193**

Table 6: Maximum savings (for the longer term - to 2020)

4.5. Estimating renewable energy triggered

Short term and long term impact calculation of the renewable energy triggered was based on the introduction and increased use of the electric and clean energy vehicles at the proposed UFTs.

City	Short term	Long term (Max)	Long term (Min)
Berlin	0.0	25.3	8.4
Forli	0.0	3.8	0.6
Gothenburg	0.1	1.0	0.2
Graz	0.0	0.9	0.2
Newcastle	12.5	224.9	37.5
Padova	21.5	193.6	32.3
Rome	0.0	0.0	0.0
Sundsvall	0.0	0.0	0.0
Total	**34.1**	**449.4**	**79.1**

Table 7: Renewable Energy production triggered (toe/year)

5. UPDATED IEE COMMON PERFORMANCE INDICATORS

Table below summarises the values for the updated IEE Common Indicators as a result of the **review** process. The cities were asked to review their calculations in the light of the most recent data availability, some of the partner cities' assumptions and understanding of the baseline and the schemes have changed since the values provided in Annex I.

<table>
<tr><th>Overall objective</th><th>Target within the action duration</th><th>Target by 2020[4]</th></tr>
<tr><td rowspan="4">To contribute to the EU 2020 targets on energy efficiency and renewable energy sources</td><td>0 Cumulative investment made by European stakeholders in sustainable energy (Euro)</td><td>0 Cumulative investment made by European stakeholders in sustainable energy (Euro)</td></tr>
<tr><td>34 Renewable Energy production triggered (toe/year)</td><td>449 Renewable Energy production triggered (toe/year)</td></tr>
<tr><td>1 310 toe/year of primary energy savings compared to projections.</td><td>4 819 toe/year of primary energy savings compared to projections.</td></tr>
<tr><td>9 442 tonnes of CO_2/year of reduction of greenhouse gas emissions.</td><td>29 193 tonnes of CO_2/year of reduction of greenhouse gas emissions.</td></tr>
</table>

Table 8: SMARTSET Updated IEE Common Performance Indicators

[4] based on maximum estimated values

Co-funded by the Intelligent Energy Europe Programme of the European Union

6. ANNEXSES

6.1. Annex I - General information about EcoTransIT

The transport of goods causes energy consumption, carbon dioxide emissions and exhaust emissions. More and more logistics providers as well as cross border companies want to know the eco-impact of freight movements by various transport modes, in order to reduce this impact. Consequently, the Institute for Energy and Environmental Research (ifeu) from Heidelberg, the Öko-Institut from Berlin, the Rail Management Consultants GmbH (RMCon/ IVE mbH) from Hanover developed the objective EcoTransIT-Tool in order to quantify the emissions from freight transport. This Project was initiated by five European railway companies in 2000- DB Schenker Rail, Schweizerische Bundesbahnen (SBB), Green Cargo AB, Trenitalia S.p.A, Société Nationale des Chemins de Fer Français (SNCF). New partners have subsequently joined: Red Nacional de los Ferrocarriles Españoles (RENFE) and Société Nationale des Chemins de fer Belges (SNCB). All project partners provide information for the database and constantly update the tool according to national policies and state-of-the-art information.

EcoTransIT identifies the environmental impacts of freight transportation in terms of direct energy consumption and emissions during the operation of vehicles during the transport of products. Moreover, the calculation covers the indirect energy consumption and emissions related to production, transportation and the distribution of energy required for operating the vehicles. There are many factors that determine the level of the environmental impacts in freight transport. An exhaustive array of influencing factors serves as the basis in computing impacts. This allows the user to alter the factors of the EcoTransIT application, according to a company's individual conditions.

Used by companies of all sizes, EcoTransIT is as pertinent to the study of large-scale flows as it is to the analysis of an individual movement. The input parameters and the process of analysis are proof of the tool's refinement:

- For each mode of transport a GIS-system details the routes taken by the goods
  The computations integrate any transhipments at frontier crossings, or those occurring in piggybacking
- The volumetric weight of the transported cargo allows a precise assessment of the size of the trains
- The type of loading locations (rail station, harbour, airport, roadway platform) enables accurate modelling to reflect reality
- EcoTransIT compares the energy consumption and emissions of freight transported by rail, road, ship and aircraft. It also takes into account the intermodal transport services and the different technical standards of the vehicles.