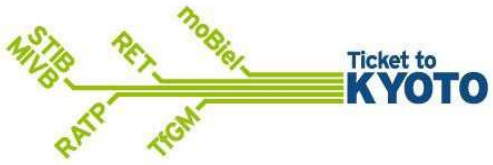

WP 3: ELABORATING CO_2 STRATEGIES

Choice and analysis of indicators to monitor GHG emissions

April 2013

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- moBiel (Bielefeld, Germany)
- RATP (Paris, France)
- RET (Rotterdam, The Netherlands).
- TfGM (Manchester, UK, formerly GMPTE)

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Executive summary

The objective of this document is to provide details on:

- the methodology applied to choose a set of indicators commonly monitored;
- a definition of all those indicators and their goal;
- an overview of the first results after a one-year monitoring.

Introduction

Five European public transport companies have joined forces to reduce CO_2 emissions from public transport. Their actions are centralized through a European project, Ticket to Kyoto (T2K - www.tickettokyoto.eu) that mobilises public transport companies and their stakeholders to take action against climate change.

The greenhouse effect is a natural phenomenon that allows life on earth. Indeed, several gases, called greenhouse gases form a barrier around the surface of the globe allowing to retain the heat of the sun sent back by the earth. With this natural greenhouse effect, the mean temperature of our planet is 15°C against -18℃ otherwise.

Our lifestyle generates greenhouse gases emissions in a quantity widely superior to what the planet can recycle. These gases then accumulate in the atmosphere and retain more heat than in their natural state. This is called the “additional greenhouse effect”, which causes global warming and alters our climate.

For decades, the greenhouse gas emissions – GHG – of transport have increased. Trips are longer and the number of vehicles in circulation has increased. The transportation of goods and people represents 15% of the world emissions of greenhouse gases; In Europe, it accounts for 20%. Projections of future greenhouse gas emissions all forecast an increase in the proportion of emissions from transport. But this part is underestimated because GHG emissions due to transports do not only come from energy use, but also from all the embedded emissions related to vehicles, infrastructures, air conditioning, and so on.

Public transport represents the most sustainable alternative to private cars because it enables the transportation of a large number of passengers. In order to maintain and increase passenger numbers, public transport GHG emissions must be low and environmental performance exemplary.

The aim of this project is to implement the principle of low CO_2 emissions as a new standard for urban public transport in order to contribute significantly to the governments’ CO_2 reduction objectives.

Transport is a high and growing contributor to CO_2 emissions and the sector continues to be extremely dependent on fossil fuels. This is particularly sensitive in urban areas (80% of the West-European population). Increased use of public transport, coupled with its de-carbonisation, will play a significant role in meeting EU carbon targets, by reducing the emissions from private cars.

The goal of this Work Package 3 “Elaborating CO_2 strategies” is, for each partner, to develop a long term strategy for CO_2 and energy reduction by 2020. These strategies are developed jointly by the partners, however in order to do this, common methodologies and tools to measure and compare GHG emissions, needed to be developed.

With the Ticket to Kyoto project, the involved partners are rather in advance compared to the public transport sector in taking into account carbon and energy efficiency. But, generally, CO_2 and energy efficiency measures have a low priority in the strategy of public transport organizations. They are often considered “out of core business”, thus not even mentioned, or just for a weak environment involvement, without defined targets, nor budgets.

Development of a clear CO_2 strategy enables a greater focus on carbon and its strategic importance, and is a necessary first step towards embedding best practice in carbon management within an organisation. It also enables to increase the weight of carbon and energy in decision making.

This Work Package is composed of two main parts:

- The definition of common methodologies measurement and reporting of carbon footprint and indicators, so that it is possible to. Today, CO_2 calculations can vary a great deal between different organisations, and may not meet the required International standards. A direct application will be to develop and improve CO_2 calculators, which are a good tool to alert both the staff (commitment at work) and the public (for their modal choices in transport) to the CO_2 consequences of their choices.

- The development of strategies for each partner, with the benefit of partnership working to improve overall quality. Stakeholders should be involved in the development of this strategy: local multi-level governments, suppliers, beneficiaries of the project, including end users. The definition of the resources needed to implement this strategy is also part of this work.

Any other public transport company should then be able to duplicate the steps the partners have taken to calculate their emissions and develop a strategy to address them. Therefore the elaboration of methods and definitions of indicators are an important part of this Work Package.

Three actions are defined to complete this objective:

- **CO_2 and carbon footprint methods**
  This action defines valid CO_2 measurement methodologies that can cover all the companies' activities.

- **Definition and follow-up of common indicators**
  This action identifies a series of indicators that will allow the company's long-term CO_2 emissions to be monitored. Within the same action, the CO_2 trip calculators for customers will be fine-tuned, (e.g. to be able to provide precise data for CO_2 emissions for different kinds of public transport offers).

- **Develop a longer term CO_2 reduction strategy for each partner**
  Once the trustable method and CO_2 indicators are defined, partners will develop together a CO_2 chapter within the strategic plan of their organisation. The strategy should cover the CO_2 emissions reduction until 2020.

When applicable, partners will consult key stakeholders that could support or be affected by this strategy in order to ensure their buy-in (in particular from local government and suppliers). They will also inform and involve the final beneficiaries, such as the general public, through different communication actions too.

The goal is to identify and report on all steps leading to the development and approval of a carbon strategy: identification, development, validation by decision makers within their organization, adoption by the management of their company, and follow up of their implementation modalities.

This report deals with the indicators' definitions and monitoring in the first two parts. Their role in strategy is to follow the greenhouse gas emissions' reduction linked to the company's services. Those indicators are complementary with the carbon balance which takes into account the whole GHG emissions linked to the company's activity.

1. Methodology to define indicators

The methodology to define the T2K indicators is composed of five steps:

- benchmark of existing indicators in the field of transport services or equivalent activities that could be representative of the performances partners want to observe;
- identification of the goals of those indicators;
- listing of available data to identify the possible indicators common to all partners;
- listing of relevant indicators;
- choice of the T2K performance indicators.

1.1. Benchmark

The first step consists in benchmarking existing and published indicators in the field of transport services or equivalent activities.

21 transport companies or affiliated structures were identified for the benchmark:

England: **TfGM,** Transport for London (**TfL**), **Arriva;**

The Netherlands: **RET, GVB** (tram, bus, metro and ferry services in Amsterdam), **Connexxion,** Nederlandse Spoorwegen (**NS**);

Belgium: **STIB,** Société Nationale des Chemins de fer Belges (**SNCB**), **De Lijn** (Public transport company of the Flemish region), Société Régionale Wallonne du Transport (**SRWT**) ;

Germany: **moBiel,** Deutsche Bahn (**DB**), Berliner Verkehrsbetriebe (**BVG**), Verband Deutscher Verkehrsunternehmen (**VDV**);

France: **RATP,** Société Nationale des Chemins de fer Français (**SNCF**), **Veolia Transport, Kéolis ;**

Other: Mass Transit Rail (**MTR**), Société de Transport de Montréal (**STM**).

Out of those 21 entities, 17 were studied and 14 proposed some environmental indicators about climate change:

- RET
- Connexxion
- NS

- STIB
- SNCB
- De Lijn
- SRWT
- VDV (national value for Germany)
- RATP
- SNCF
- Véolia Transport
- Kéolis
- MTR
- STM

The statistical results of the benchmark are gathered in the following table:

Number of companies	21
Number of companies studied	15
Number of companies with data	14
Number of companies with g CO2e/pax.km	**4**
Number of companies with g CO2/pax.km	4
Number of companies with global CO2 emissions	4
Number of companies with global GHG emissions	2
Number of companies with g CO2/km	1
Number of companies with g CO2e/km	1
Number of companies withe g CO2e / seat.km	1
Number of companies with only direct emissions	2
Number of companies with direct and indirect emissions	**8**
Unknown	4

Most of the indicators are ratios of emissions for a relevant quantity in terms of transport. The main one is the “passenger.kilometer”. Global emissions are also communicated.

1.2. Identification of goals

To build relevant indicators, the goals of figures have to be defined.

The tables of Annex 1 gather all benchmarked indicators from the 14 companies.

It details the following points for each available indicator:

- the name,
- the unit,

and, if available:

- the goal of indicators,

- the scope of monitoring,
- the methodology used.

When they are given, goals of indicators are always defined to assess technical and/or operating performance. Sometimes there are linked to a policy or a reduction objective.

When indicators are ratios, the scope of calculation is always energy traction. The figures are monitored so as to allow comparison between them.

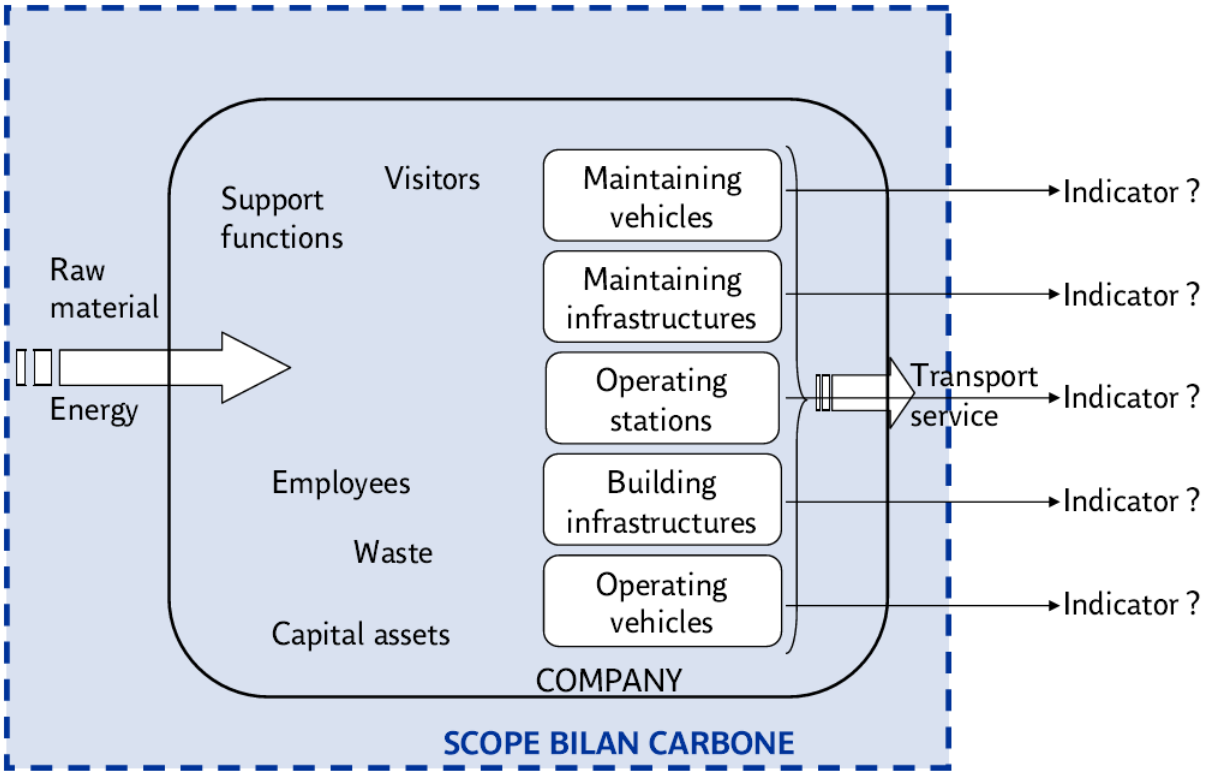
The published indicators mainly concern traction energy, i.e. the energy used for vehicles operations but without distinction of sources. MTR is the only company that goes a step further by publishing indicators in the different fields that impact the carbon balance like frigorific fluids, property, etc.

Public transport companies have different activities including vehicle maintenance, infrastructure maintenance, stations operation and infrastructure construction.

Once a company knows its emissions, it will be able to:

- evaluate the global level of its emissions;
- identify the main sources of its emissions;
- elaborate an emissions reduction plan;
- report the global evolution of these emissions by integrating this issue on its dashboard, and evaluate the possible reduction of its action plan.

The indicators will allow to follow the achievements done by the company to reduce its impact per field (train operation, facility management,…).



1.3. List of available data

Indicators are a combination of technical and commercial figures of the companies like whole energy, buildings energy or traction energy consumptions, number of passengers or kilometres travelled. The breakdown of available figures allows the definition of more or less detailed information. Emission factors of each kind of energy will then allow the creation of CO_2 ratios from energy data.

Taking into account that indicators have to be updated yearly, it is important to choose figures which do neither require a large amount of work concerning data collection nor risk to fluctuate year after year because of a lack of calculation control.

1.4. Relevant indicators

The following table gathers some possible indicators and informs about the available data for every partner.

	STIB	moBiel	TfGM	RATP	RET	TOTAL
Traction energy consumption per vehicle		X			X	2
Traction energy consumption per km of network			X			1
Traction energy consumption per vehicle.km				X		1
Traction energy consumption per place.km	X	X	?	X		**4**
Traction energy consumption per pax						0
Traction energy per pax.km	**?**	**X**	**X**	**X**	**X**	**5**
Stations energy consumption per station						0
Stations energy consumption per km of network						0
Stations energy consumption per square meters of station	**X**	**?**	**X**	**?**	**X**	**5**
Stations energy consumption per pax	?		X			2
Workshop energy consumption per vehicle						0
Workshop energy consumption per workshop				X		1
Workshop energy consumption per square meter of workshop	**X**	**X**	**X**	**X**	**X**	**5**
Workshop energy consumption per employee in workshop						0
Office building energy consumption per site						0
Office building energy consumption per square meter	**X**	**?**	**X**	**X**	**X**	**5**
Office buildings energy consumption per employee						0
Traction + station energy consumption per km of network			X			1
Traction + station energy consumption per place.km				X		1
Traction + station energy consumption per pax						0
Traction + station energy consumption per pax.km			X	X		2
Workshops + Office buildings energy consumption per square meter		X	X	X		3
Workshops + Office buildings energy consumption per employee						0
Workshops + Office buildings energy consumption per building						0
Traction + station + workshop energy consumption per place.km				X		1
Traction + station + workshop energy consumption per pax.km			for tram	X		2
Whole energy consumption per place.km	X			X		2
Whole energy consumption per pax.km			X	X		2
Whole energy consumption per annual turnover		X	X		X	3
Share of renewable energy consumption on the whole consumption	**X**	**X**	**X**	**X**	**X**	**5**
Station + Office + workshop consumption per square meter	X					1
Station energy consumption per departure			X			1
Workshop + Office per pax.km			X			1
Traction + station + workshop per km of network			for tram			1

This was the basis for the choice of indicators. If data were not initially available to monitor indicators, partners found a methodology to have a first approach of the indicator.

1.5. Choice

The Ticket to Kyoto partners finally defined eight indicators: six are energy indicators and two are CO_2 indicators. Those indicators cover the whole range of the transport companies' activities. They also take into account all the different kinds of energy.

Among the indicators, six will be published; the other two will be used to interpret results.

The public operator can choose to monitor a global figure for the whole company or a figure per mode. For traction performances, a figure per mode is highly recommended.

The following tables gather the "T2K indicators".

Mandatory and published indicators

Values are given per year	Unit			2010		2011		2012	
				local emission factor	european emission factor	local emission factor	european emission factor	local emission factor	european emission factor
Traction energy consumption per passenger.kilometer	kWh / pax.km	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							
Stations energy consumption per square meter	kWh / m²	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							
Workshops and depots energy consumption per square meter	kWh / m²	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							
Office buildings energy consumption per square meter	kWh / m²	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							
Share of renewable energy	%	Values per energy	Electricity						
			Gas						
			Steam						
			Fuel						
		Values for whole company							
CO2 equivalent emissions due to traction energy consumption per passenger.kilometer	g CO2e / pax.km	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							

Mandatory and not published indicators

Values are given per year	Unit			2010		2011		2012	
				local emission factor	european emission factor	local emission factor	european emission factor	local emission factor	european emission factor
Traction energy consumption per place.km	kWh / pl.km	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							
CO2 equivalent emissions due to traction energy consumption per place.km	g CO2e / pl.km	Values per mode	Regional railway						
			Metro						
			Tramway						
			Bus						
			Ferry						
		Values for whole company							

Those models have been filled in by moBiel, RATP, RET, STIB and TfGM according to the next chapter definitions and used to elaborate the summary tables presented at the end of this report.

2. Definitions of the performance indicators

This paragraph presents the definitions of performance indicators chosen for public transport companies within the framework of Ticket to Kyoto.

First, common definitions allow us to define the perimeter of the selected performance indicators. This point is very important to build a common understanding of information given by these figures and their evolution year after year.

The performance indicators are figures that give a comprehensive overview of the company's energy performance per activity, especially regarding the public transport energy performances and its impact on climate change.

These indicators allow us to answer both internal and external questions. For the company itself, they are figures that provide concrete information about the impact of energy or CO_2 strategy action plans on energy performance. For stakeholders and passengers, these figures will allow to analyse the public transport company and the transport offer's impact, to compare environmental performance of modes (road and railway for instance) and to raise the travellers awareness about their choices.

Indicators are linked to the company's contextual evolution. They take into account a wide panel of fields:

- technical evolution of equipments (rolling stocks, heating systems…),
- evolution of the transport offer (strengthening, new line creation…),
- variation of transport traffic (economic crisis…),
- use of buildings (new rolling stocks purchase that temporarily decreases maintenance operations…),
- energy purchases (electrical provider change…),
- weather conditions (harsh winter, hot summer…),
- …

2.1. General definitions

2.1.1. Tank to Wheel assessment

Tank to Wheel assessments are all the assessments related to the vehicle processes (like the fuel combustion in a vehicle).

2.1.2. Well to Wheel assessment

Well to Wheel assessments include all assessments related to both vehicle and energy processes, i.e. all the steps required to produce and distribute a fuel starting from the primary energy resource.

2.1.3. Station

The station is the space dedicated to the “public transport”.

The track’s surface is excluded from the station’s surface.

Shops are excluded from the whole station’s consumption and surface.

Bus stops and tram stations in open air are excluded when they are not delimited. In those spaces, lighting is often done by the public infrastructure and not dedicated to the “transport space”.

Open air stations are included when passengers cannot go directly from the station to another public space.

The station includes also every space that participates to the transport offer, this means principally technical rooms or associated offices dedicated to the operating of vehicles (especially for underground areas).

2.1.4. Workshop and depot

Workshops and depots are the buildings dedicated to the storage of vehicles and to the maintenance operations that are carried out on vehicles or infrastructures. All the workshops and depots that are dedicated to public transport are taken into consideration, whoever the owner of the building may be: operator, infrastructure manager or transport authority.

All the surfaces inside the building (enclosing walls and roof), whether or not heated, are considered as part of the workshops or depots. Inside track surfaces are included. Outside covered surfaces are not included.

2.1.5. Office building

Office buildings are the buildings dedicated to internal or external service activities (all industrial activities are excluded). Both owned and hired buildings are taken into account.

In case of a mixed-use building without a detailed consumption distribution, the most impacting use will determine the building’s category (office/workshop or depot).

2.1.6. Passenger.kilometer (pax.km)

The cumulative sum of the distance ridden by each passenger on the network, per mode... It is calculated by multiplying the number of passengers by the average distance travelled by each passenger.

2.1.7. Place.kilometer (pl.km)

The amount of places offered on the whole network, per mode... It is calculated by multiplying the overall distance travelled by each vehicle by its capacity to transport passengers (4 people per square meter is the reference value).

2.2. Mandatory indicators definitions

2.2.1. Traction energy consumption per passenger.kilometer (kWh/pax.km)

This is the traction energy consumption from tank to wheel of a network, per mode… divided by the passenger.kilometer (pax.km) of this network, this mode… It is an assessment of the energy performance to transport a passenger on one kilometre taking into account both technical and commercial performances.

This indicator has two complementary goals:

- follow the evolution of the energy performance of a network, a mode…year after year. Rolling stocks renewal, driving rules, transport service offer modification and number of passengers are influencing this indicator.

- compare energy performance between networks or modes…

2.2.2. Energy consumption in stations per square meter (kWh/m²)

This is the energy consumption in stations divided by the total surface of stations.

The goal of this indicator is to evaluate the energy performance of stations, quantify the impact of actions on energy consuming equipments such as lighting, IT equipments, energy recovery… This is a global indicator.

2.2.3. Energy consumption in workshops and depots per square meter (kWh/m²)

This is the energy consumption in workshops and depots (consumptions of outside areas, like parking if existing, are also included) divided by the total surface of workshops and depots. This indicator concerns heating, lighting, industrial process…

The goal of this indicator is to evaluate the energy performance of workshops and depots. It will help for instance to quantify the impact of buildings renewal, insulation improvement, process optimization, behaviour modifications… This is a global indicator that has to be linked to context evolution like weather conditions.

2.2.4. Energy consumption in office buildings per square meter (kWh/m²)

This is the total energy consumption of office buildings divided by the corresponding surface (owned and hired).

The goal of this indicator is to evaluate the energy performance of office buildings. It will help for instance to quantify the impact of buildings renewal, insulation improvement, behaviour modifications, facility management… This is a global indicator that has to be linked to context evolution like weather conditions.

2.2.5. Share of renewable energy (%)*

Renewable energy is any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use. Renewable energy is obtained from the continuing or repetitive flows of energy occurring in the natural environment and includes low-carbon technologies such as solar energy, hydropower, wind, tide and waves and ocean thermal energy as well as renewable fuels such as biomass.

The share of renewable energy indicator is the ratio of the renewable energy consumption coming from energy purchases (R) on the total energy consumption (C).

$$\% = R / C$$

If the company produces renewable energy (P) itself, two cases will be possible:

- the production is consumed : % = (R + P) / (C + P), production is added to renewable energy consumption and total energy consumption
- the production is sold : % = R / (C – P), production is deducted from total energy consumption as bonus.
- if only a part of the renewable energy is sold the renewable part of the energy is counted in the R and in the C energy.

This indicator will allow to evaluate the share of "low CO_2-emissions" energy in the total energy consumption of the company and to quantify the actions in favour of renewable energies year after year.

2.2.6. CO_2 equivalent emissions due to traction energy consumption per passenger.kilometer (CO_2 gram equivalent / pax.km or CO_2 geq / pax.km)

This is the total amount of emissions inferred by traction energy consumption, i.e. from well to wheel of a network, a mode… divided by the passenger.kilometer (pax.km) of this network, this mode…

It is an assessment of the CO_2 emissions that are necessary to transport a passenger on one kilometre taking into account both technical and commercial performances.

As with the traction energy consumption performance, this indicator has two complementary goals:

- follow the evolution of CO_2 emissions performance of a network, a mode…year after year.
- compare CO_2 emissions performance between networks or modes…

This indicator is part of the coming European standard on a common methodology for the calculation, declaration and report of energy use and greenhouse gas (GHG) emissions of a transport service. It is also the emission factor necessary to monitor the emission of a trip knowing the distance of that trip.

* There is a lack of European definition for renewable energy.

2.3. Additional indicators definitions

2.3.1. Traction energy consumption per place.kilometer (kWh/pl.km)

This is the traction energy consumption (from tank to wheel) of a network, per mode… divided by the place.kilometer (pl.km) of this network, this mode…

The goal of this indicator is to evaluate the energy performance of a network, per mode… taking into account technical performance only. It allows comparison of modes or networks including the impact of rolling stocks renewal, driving rules, transport service offer modification and so on. The commercial performance has no impact on this indicator.

2.3.2. CO_2 equivalent emissions due to traction energy consumption per place.kilometer (CO_2 gram equivalent / pl.km or CO_2 geq / pl.km)

This is the total amount of emissions inferred from traction energy consumption, i.e. from well to wheel of a network, per mode… divided by the place.kilometer (pax.km) of this network, this mode…

This indicator will allow the evaluation of the transport performance in terms of CO_2 emissions including technical performance only. Commercial performance has no impact on this indicator.

3. First results for a one-year monitoring

3.1. Emission factors

The following table gathers national emission factors for the five countries of T2K partners:

Mean national and European values for emission factors in **CO2 equivalent**

Energy	Unit	Germany	France	Netherlands	Belgium	UK	Europe
Electricity	kg CO2e / kWh	0,404	0,078	0,394	0,260	0,505	0,420
Gazole	kg CO2e / litre	3,17	3,17	3,17	3,17	3,17	3,20

The following table gathers emission factors chosen by each partner to assess the emissions indicators.

T2K partners mean values for emission factors in **CO2 equivalent**

Energy	Unit	moBiel	RATP	RET	STIB	TfGM
Electricity	kg CO2e / kWh	0,205	0,053	0,015	0,177	0,505
Gazole	kg CO2e / litre	2,94	3,17	3,14	2,94	2,94
B30	kg CO2e / litre	-	2,87	-	-	-
GNV	kg CO2e / litre	-	3,36	-	-	-

3.2. Indicators for the local emission factors

The following table gathers indicators for the five partners monitored with their chosen emission factors (see previous table).

Mandatory and published indicators

Values for year 2010	Unit			moBiel	RATP	RET	STIB	TfGM
Traction energy consumption per passenger.kilometer	kWh / pax.km	Values per mode	Regional railway		0,09	0,17		
			Metro		0,07		0,15	
			Tramway	0,14	0,06	0,21	0,18	0,07
			Bus	0,37	0,34	0,75	0,35	0,53
			Ferry			9,35		
		Values for whole company		0,22	-	0,25	-	0,31
Stations energy consumption per square meter	kWh / m²	Values per mode	Regional railway		213	174		
			Metro		482		-	
			Tramway	-	0	-	-	-
			Bus	-	0	-	-	253
			Ferry			-		
		Values for whole company		92	-	-	285	-
Workshops and depots energy consumption per square meter	kWh / m²	Values per mode	Regional railway		-	-		
			Metro		-	-	-	
			Tramway	-	-	-	-	251
			Bus	-	-	-	-	21
			Ferry			-		
		Values for whole company		253	317	237	227	202
Office buildings energy consumption per square meter	kWh / m²	Values per mode	Regional railway		-	-		
			Metro		-	-	-	
			Tramway	-	-	-	-	-
			Bus	-	-	-	-	-
			Ferry			-		
		Values for whole company		253	285	253	256	152
Share of renewable energy	%	Values per energy	Electricity	22%	0%	-	30%	-
			Gas	0%	0%	-	0%	-
			Steam		0%	-		-
			Fuel	4%	8%	-	7%	-
		Values for whole company		-	3%	60%	19%	41%
CO2 equivalent emissions due to traction energy consumption per passenger.kilometer	g CO2e / pax.km	Values per mode	Regional railway		5	3		
			Metro		4		28	
			Tramway	30	3	3	35	34
			Bus	101	112	229	106	143
			Ferry			2790		

The moBiel consumptions' indicators for office buildings and workshops and depots are the same because the existing metering and repartition tools don't allow distinguishing those two different uses. This point is identified as a future improvement option.

The regional railway results for traction energy of RET are included in the Metro values. RET bus consumptions and emissions per passenger.km are high compared to others networks. It appears that this is the consequence of a different approach for operating the network in 2010. Indeed, indicators per place.km are more comparable and the energy efficiency of the buses is high. Those figures are going to evolve during the next two years because of a decrease of the offer and the increase of traffic on the network.

In the UK transport is de-regulated outside of London, which means that the majority of services are operated on a commercial basis by private companies. TfGM does not operate any transport services, but

pays for bus services to run on routes which provide a socially necessary service but are not profitable enough to attract commercial operators without subsidy. It is these services which are included within TfGM's carbon footprint. Whilst TfGM does not operate these services, TfGM does have operational control over them as they specify the services that should be run.

TfGM has data on scheduled mileage for subsidised bus services. This data is converted to fuel figures by using standard Defra conversion factors for buses outside of London. This means that the fuel usage data and the carbon emissions that are associated with them assume that GM buses are average for the UK, and do not necessarily reflect the specific carbon intensity of buses in GM, where low carbon buses make up approximately 10% of the fleet.

3.3. Indicators for the European emission factors

Those CO_2 emissions have been monitored with the same European emission factor for all partners. This factor is higher than all local factors used by partners for their own monitoring except for TfGM.

The emissions can be compared from one partner to another without taking into account the influence of the origin of electricity.

Mandatory and published indicators

Values for year 2010	Unit			moBiel	RATP	RET	STIB	TfGM
CO2 equivalent emissions due to traction energy consumption per passenger.kilometer	g CO2e / pax.km	Values per mode	Regional railway		36	73		
			Metro		31		66	
			Tramway	61	26	90	83	28
			Bus	110	112	230	115	155
			Ferry			2848		
		Values for whole company		-	-	-	-	-

Annex 1

Company	Country	Name of indicator	Unit	Goal	Scope	Methodology details (if available)
RET	Netherlands	GHG emissions for bus traffic	g CO_2e/pax.km	Clear insight in CO_2 emissions in the Rotterdam area in the reference year 1990	Industry, transport, and buildings	A source approach was used in the measurement of CO_2 emissions. All CO_2 emissions in the Rotterdam area have been looked at. For the bus the passenger kilometers are calculated with the assumption that a bus has 50 places and 20% of the places are used. Source: Base line survey CO_2 emissions of Rotterdam Climate Initiative (RCI)
		GHG emissions for rail traffic	g CO_2e/pax.km	Clear insight in CO_2 emissions in the Rotterdam area in the reference year 1991	Industry, transport, and buildings	All CO_2 emissions in the Rotterdam area have been looked at. When calculated with the source approach, the CO_2 emissions for tram and metro traffic are zero. If calculated with the user approach then a CO_2 emission factor of 451 gCO_2e/kWh is used and a correction factor of 87% grey energy is used. The Rotterdam municipality uses a source approach to calculate the GHG emissions. Source: Base line survey CO_2 emissions of Rotterdam Climate Initiative (RCI)
Connexxion	Netherlands	CO2 indicator connexxion	g CO_2/km	Connexxion aims to reduce its CO_2 emissions and improve air quality by reducing air emissions.	rolling stock of the company	
NS	Netherlands	GHG emissions for rail traffic	g CO_2e/pax.km		passenger kilometers, seat kilometers, energy production (grey/green)	
			g CO_2e / seat.km			
STIB	Belgium	CO_2 emissions per pass.km & per modes of transport (bus, tram, metro)	g CO_2e/pax.km	- To measure the evolution of CO2 emissions by modes of transport and by pass.km - To allow comparison of differents modes of transport (PT/Car)	Bus traction energy	Evaluation on tank to wheel, based on energy consumption, all lines
					Tram traction energy	Evaluation based on electricity production (consumption), considering the purchase of green energy
					Metro traction energy	
SNCB	Belgium	Total CO_2 emissions specific from passenger transport	t CO_2	To measure the evolution of CO_2	Direct & indirect CO_2 emissions	
		CO_2 emissions per passenger per km	g CO_2e/pax.km	To allow comparison of differents modes of transport, at different time of day		
De Lijn	Belgium	CO_2 emissions/km*passenger bus & tram	g CO_2e/pax.km			
SRWT	Belgium	CO2 emissions/km/passenger	g CO_2e/pax.km	- To measure the evolution of CO2 emissions induced by one passenger on a distance of one km. - To allow comparison of different modes of transport	Traction (fuel for buses and electricity for metro) Non-traction energy (electricity, heating of buldings, traction enegy for service vehicle) Not included, LCA of general goods	CO2 Emissions/km/passenger = Total CO_2 emissions / (Total transported passengers * Average length (km) done by one passenger)
		Competitive ecological burden	passengers/vehicle	To give the number of passengers permanently required in a TEC vehicle to ensure that this mode of transportation is more efficient than a car from CO_2 emissions point of view		passengers/vehicle = (Total CO_2 emissions / Total km) * (Average number of passenger per car in Wallonia / Average CO_2 emissions per car)

Company	Country	Name of indicator	Unit	Goal	Scope	Methodology details (if available)
STM (Montréal)	Canada	Direct GHG Emissions from fixed sources	t CO_2e	-		
		Direct GHG Emissions from mobile sources	t CO_2e	-		
		Total GHG Emissions	t CO_2e	-		
		Per km	g CO_2e / km	-		
		Per km*passenger	g CO_2e/pax.km	Target 2020 = 45g CO_2e/passenger		
VDV (national values)	Germany	GHG emissions from bus traction energy	g CO_2e/pax.km	to measure the evolution of CO_2 emissions by modes of transport and by pass.km to allow comparison of different modes of transport (PT, car, coach, airplane)	energy consumption	emission category: WTW: primary energy consumption and total emission including the energetically significant resources of Diesel
		GHG emissions from regional rail traction energy	g CO_2e/pax.km		energy consumption	emission category: WTW: primary energy consumption and total emission including the energetically significant resources of Diesel and traction power
		GHG emissions from metro, tram, underground	g CO_2e/pax.km		energy consumption	emission category: WTW and TTW: direct energy consumption and emissions at the vehicle
RATP	France	GHG emissions from bus traction energy	g CO_2e/pax.km	Technical performance analysis. Follow the evolution.	bus traction energy	Evaluation on well to wheel, based on energy consumption, all lines
		GHG emissions from rail traction energy	g CO_2e/pax.km		rail traction energy	
Véolia transport	France	CO_2 direct emissions	t CO_2	Performance of bus fleet	traction energy	No details available
		CO_2 indirect emissions	t CO_2	Performance of bus fleet	traction energy	No details available
		CO_2 total emissions	t CO_2	Performance of bus fleet	traction energy	No details available
SNCF	France	CO_2 emissions from train traction energy	t CO_2	Performance of trains	rail traction energy	No details available; also given : energy consumption per source
Kéolis	France	CO2 total emissions	t CO_2	Performance of all networks	traction energy	No details available
MTR	Hong Kong	GHG inventory - rail operations and maintenance and in-house support	t CO_2e	Performance of trains and rail		
		GHG inventory - feeder bus services	t CO_2e	Performance of bus operation		
		GHG inventory - Refrigerants	t CO_2e	Impacts of refrigerants		
		GHG inventory - Electricity railway operations	t CO_2e	Performance of train operation		
		GHG inventory - property investment and management	t CO_2e			
		GHG inventory - electricity headquarters	t CO_2e			
		GHG inventory - water consumption and sewage treatment	t CO_2e			
		GHG inventory - waste disposed to landfill - railway extension projects	t CO_2e			
		GHG inventory - Corporate paper use	t CO_2e			
		GHG inventory - Staff flights	t CO_2e			
		GHG inventory - Total	t CO_2e			

Ratio per pax.km
Ratio per km
Global emission
Other

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Glossary

moBiel

Information on climate protection programme can be found here:

http://www.bmu-klimaschutzinitiative.de/

Information on climate protection

Regierung des Landes Nordrhein-Westfalen (2011): Eckpunkte des Klimaschutzgesetzes NRW. Düsseldorf

Information on CO_2 reduction

Umweltbundesamt (200): CO_2-Emissionsminderung im Verkehr in Deutschland. Mögliche Maßnahmen und ihre Minderungspotenziale. Ein Sachstandsbericht des Umweltbundesamtes. UBA 5/2010.

www.umweltdaten.de

www.umweltbundesamt.de

Further information:

IFEU, Öko-Institut, IVE RMCON (2010): Ecological Transport – Information Tool for Worldwide Transports. Methodology and Data. 2nd Draft Report. Berlin, Hannover, Heidelberg

www.wupperinst.org

RATP

The French legislation

- about buildings' energy consumption can be found at:

  http://www.legifrance.gouv.fr/affichTexteArticle.do;jsessionid=134455584D34493D5F1870C8E26355BE.tpdjo06v_2?idArticle=LEGIARTI000020950512&cidTexte=LEGITEXT000020950462&dateTexte=20110506

- about CO_2 information can be found at:

  http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000024710173&fastPos=5&fastReqId=862737049&categorieLien=cid&oldAction=rechTexte

- about greenhouse gas balance can be found at:

  http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000024353784&fastPos=4&fastReqId=616690991&categorieLien=id&oldAction=rechTexte

RET

Report on CO_2 emissions of the heavy railways in The Netherlands: contains data on CO_2 effects in the design, construction, operation, maintenance and demolition of the track. All the elements of the rail system were taken into account, i.e. both the infrastructure and equipment.

http://www.railforum.nl/wp-content/uploads/2012/10/RapportageKKDZ-CO2voetafdruk-NL-spoorketen_definitief.pdf.

TfGM

Information on how to measure carbon emissions in line with UK government guidance can be found here:

http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

Information on UK conversion factors can be found here:

http://www.defra.gov.uk/publications/2012/05/30/pb13773-2012-ghg-conversion/