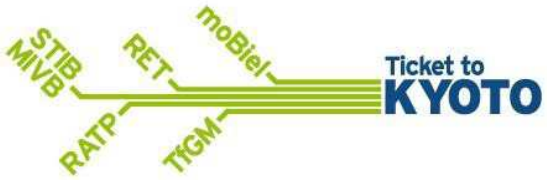

WP 3: ELABORATING CO_2 STRATEGIES

Carbon balance

November 2013

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The partners of this project are:

- STIB (Brussels, Belgium) as lead partner
- TfGM (Manchester, UK. Formerly GMPTE)
- moBiel (Bielefeld, Germany)
- RATP (Paris, France)
- RET (Rotterdam, The Netherlands).

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Executive summary

The objective of this document is to provide details on:

- the methodology applied to build a tool to establish the carbon balance of public transport operators;
- the Carbon balance monitored by the 5 partners with the Carbon footprint tool.

This report proves that the choice of the studied scope linked to the emission factors data (especially for electricity) influences the results of the carbon balances. The direct comparison of the footprints of the five partners is thus an awkward exercise.

Introduction

Five European public transport companies have joined forces to reduce CO_2 emissions in 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 CO2 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, CO2 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 CO2 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 CO2 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 multilevel 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 fill 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).

- **Provide a longer term CO_2 reduction strategy to 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 carbon balance of four operators and one transport authority for Manchester. It presents how the tool was chosen among existing tools, what were the adaptations done to fit at best to the public transport specificities. At last, the carbon balances of the 5 partners is presented and commented.

1. Existing tools

There are many solutions available to enable the evaluation of GHG emissions. The first step in the WP3 tool's building consisted in comparing existing solutions to the specific needs of the project.

Tools and methods for GHG evaluation propose two types of tool:

- **A compensation focus**
  A large majority of them from private supporters answers the companies' needs for offsetting. Those tools allow users to compensate their emissions by buying CO_2 credits, or by financing projects in developing countries without proposing an exhaustive count of the emissions. So, they don't fit with the WP3 objectives.

- **A reduction focus**
  Other tools, with an emphasis on reduction meet the objectives of a comprehensive measurement and verification of emissions for the T2K project's partners, who want to be able to build a strategy depending on the emission profile of public transport companies.

Existing tools to calculate company carbon footprints, in the line with the WP3 objectives can be freely available open solutions or licensed proprietary solutions.

Depending on the language used or local regulation, the dissemination potential is different.

To facilitate the tool deployment, the operational quality of the methodology is analysed.

Public transport companies can be large companies (like RATP) or medium-sized ones (like moBiel). This required the selected solution to be relevant for a range of different organisational structures and sizes.

The chosen tool has to be the best compromise between the following criteria:

- Reduction oriented
- Open solution
- European dissemination
- Fast setting up for all companies

The Bilan Carbone® and the GHG Protocol were already used respectively by RATP and TfGM. Therefore, the focus is on those methods.

Both methods are reduction oriented solutions; products and methods documentations are free (since 2011 the Bilan Carbone® in its 7th version has a license, but the studied version was the 6th and is still free).

The steps to implement a carbon footprint are the following:

- **Definition of scope**
  The first step is to assess the scope of the activity of your company that you want to include in your carbon footprint (network, sub-contractors, buildings, etc…)
  The broader the scope of the assessment is, the easier it will be to highlight all the sources on which it is possible to act in order to reduce the overall effect on climate change.

- **Data collection**
  The second step is to collect data corresponding to the physical flows that concern the entity (energy, people, objects, raw materials, etc…)
  Thanks to emission factors, those flows are converted into CO_2 equivalent emissions.

- **Analysis of results and action plan**
  The last step is to analyse the results obtained and prepare an action plan in order to reduce the greenhouse gas emissions.

The tool should help to conduct these three steps.

1.1. The GHG protocol

The GHG Protocol aims to count GHG emissions in order to reach a good evaluation of the emissions either direct or induced by an activity and to propose a concrete action plan to reduce them.

The method is published by the non-profit organisation, specialized in research and political analysis of questions related to resources management, WRI (World Resources Institute) and the international association WBCSD (World Business Council for Sustainable Development). They aim at becoming major actors of sustainable development.

The GHG Protocol is implemented by means of Excel sheets and guidance documentation. There are two modules: a methodology for counting the emissions from a company and a methodology for calculating the reductions of emissions.

The targeted public is wide: companies, local authorities, public departments, non-governmental organisation… The language of the methodology is English and it is a worldwide reference.

The GHG Protocol defines direct and indirect emissions as follows:

- direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity,
- indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

The GHG Protocol further categorizes these direct and indirect emissions into three broad scopes:

- Scope 1: all direct GHG emissions;
- Scope 2: indirect GHG emissions from consumption of purchased electricity, heat or steam;
- Scope 3: other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. transport and distribution losses) not covered in Scope 2, outsourced activities, waste disposal, …

1.2. The Bilan Carbone® method from ADEME

The aim of the Bilan Carbone® method is to measure de GHG emissions in order to reach a correct evaluation of the emissions either direct or induced by an activity or a territory. Once the evaluation is done, a concrete action plan with short and long-term objectives to reduce them is proposed.

The Bilan Carbone® method was developed by the ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie / Environmental and Energy Command Agency) in 2004. The licence was free until 2011, but in order to get it, it was compulsory to follow a training course. The last version developed directly by ADEME is V.6.1. In 2011, the ADEME chooses the Association Bilan Carbone (ABC) to foster the Bilan Carbone®. The association now has the mission to promote and develop the methodology.

The Bilan Carbone® is, first and foremost, a system. It involves the construction of a project for evaluating and reducing GHG emissions.

It consists of 6 key steps:

1. Develop awareness of the greenhouse effect;
2. Define the scope of study;
3. Gather data;
4. Process and analyse the results;
5. Establish a plan of action for reductions;
6. Implement the plan.

The Bilan Carbone® method enables the evaluation of GHG emissions caused by all the physical processes that are necessary for the existence of an organization.

One of the fundamental points of the method consists of putting on an equal footing:

- GHG emissions that take place directly within the entity;
- Emissions that take place externally from the entity, but that are the counterpart of processes that are necessary to its existence in its current form.

These emissions are stated as a carbon dioxide equivalent, and can be entered directly into the account or, where applicable, estimated. In the case of estimation, the quantity of GHG emitted is obtained by multiplying an activity data collected by an emission factor. The uncertainty in this estimation is calculated by considering the uncertainties of the emission factor and the activity datum.

The Bilan Carbone® accounting tool is software consisting of an Excel file in which all data are consolidated to provide the final results. It is readable and flexible, and allows the prioritization of emissions by size. This prioritization is an essential stage for the construction of reduction action plans.

1.3. Choice of the tool

Both methods are reduction oriented and allow to follow the three defined steps: definition of the scope, data collection and analysis of results and action plan.

Looking at European dissemination the GHG Protocol is a worldwide reference compared to the Bilan Carbone® that stays mostly is a local reference system despite the fact it is translated in English.

The biggest difference between both solutions lives in the complexity of implementation in companies. Indeed, both existing softwares are built on Excel accompanied with explanatory documents, but the GHG Protocol proposes several sheets different and not compiled, while the Bilan Carbone® only consists of a single file.

The Bilan Carbone® tool enables faster implementation for all partners and was therefore selected for the WP3 carbon footprint. In 2010, the Bilan Carbone® was still free and the available version of the tool was V6.1.

2. Adaptation to public transport

In order to take into account the transport sector characteristics, some adaptations and recommendations have been implemented to the Bilan Carbone® tool.

The tool is divided into sections on energy, cooling fluids, materials and services, packaging, freight, waste, transport of persons, use of products, end of life of products and the depreciation of fixed assets. It was necessary to remove sections not relevant to transport: packaging, manufacturing, use and to modify the energy section, so it includes four new categories adapted to the partner's characteristics: traction energy consumption, station energy consumption, workshops and depots energy consumption and office building energy consumption. This made it possible to give energy an important place in the accounting tool consistent with the place it represents for transport operators.

The following paragraphs detail the different adaptations and recommendations per section.

2.1. Emissions related to energy use

This source covers:

- direct use of fuels, of fossil or organic origin (also called biofuels), for transport, heating, industrial processes and the production of electricity or vapour for the entity's own use,
- electricity and vapour purchased, including for heating.

In the case of electricity, the CO_2 content of the energy has a major impact on calculated emissions, the method to define the appropriate emission factor is the method recommended by the Bilan Carbone® method.

Depending on how it is produced (using coal, gas, nuclear power, hydroelectric power, solar power, etc., with these different sources called "primary energy"), electricity's "carbon equivalent content", i.e. the quantity of greenhouse gas that had to be emitted to obtain one kilowatthour of electricity varies significantly. This means that specific care must be given to this section, and this method proposes values that distinguish between the following two cases:

- the company consumes network electricity, provided by a distributor who does not tell who their suppliers are : the company can use the country's average network values;
- The company has a contract with a single producer : it can use the producer's emissions factors. In fact, even if the electrons that reach the company are physically produced by the closest power stations, the producer has produced electricity at the company's request by generating the corresponding greenhouse gas emissions.

Only supplier offers which guarantee additional renewable electricity production (i.e. production which is not financed through the buy-back scheme but by individual contracts between producer and supplier) may be accounted for in this carbon footprint based on the life cycle assessment content of the different production resources used.

If electricity other than previously defined (originally guaranteed) is not traceable (i.e. the producer guarantees X% of electricity with known origin but cannot explain the method of production used to obtain the rest of the electricity), the company must apply the average electricity emissions factor by default. If the distributor is unable to give the producers used, but can guarantee that these producers came from a small group of producers, you can take the average of this group for the "untraced" part, weighted of course by the respective productions of these producers.

The adapted carbon footprint spreadsheet provides four tabs, almost identical, for filling in energy consumption details. This function allows the user to separate energy consumption into four different sub-sets, differentiating between:

- energy use by traction,
- energy use by stations,
- energy use by workshops and depots,
- energy use by office buildings.

Those new sections will allow detailed overview of the origin of energy consumption that causes GHG emissions.

The section of energy use by traction is adapted to the transport, especially for electricity use. Indeed, this independent section allows different rates of electrical losses for this purpose. The traction voltage is medium, this means that the losses are lower, it is possible to use a 3% rate instead of the usual 8% for traditional use.

The three other sections about energy used by buildings (stations, workshops and depots or office buildings) are all the same as energy traction use.

2.2. Activity emissions excluding energy use

This section includes all emissions due to other processes than burning fossil fuels. The transport sector will be concerned only for use of refrigerants that create leaks of cooling fluids, which often have very high GHG content.

2.3. Emissions related to inputs

The term “inputs” covers everything that physically enters the company, except for durable goods (machines-tools, buildings, infrastructures, rolling stocks,…) which depreciate. These are dealt with in the last section.

The scope of this section is very wide including all the purchases of the company. This will take into account incoming materials like steel, glass, plastic purchases, but also tertiary service expenses for consulting, reception, cleaning…

2.4. Emissions related to goods transport

This section includes emissions due to goods transport because of burning fuel, gas leaks if air conditioning circuits exist and indirect emissions because of vehicles or transport infrastructures and upstream emissions.

This takes into account both internal and external (incoming only in the case public transport) freight.

2.5. Emissions related to the transport of people

In this section three types of journeys are distinguished: employee commuting, business travel and travel by visitors or customers (including first and last mile by network’s user).

The particular case of public transport stays in the fact that employees coming to work with the public transport operated by the operator must not be included in this section. Indeed the energy used to transport them is traction energy already taken into account in the first section of energy use. The operator has to identify those journeys in order to remove them from this section otherwise it is double counted.

2.6. Emissions related to the direct waste

These emissions sources deal with the end of life processing of waste. This takes into account the processing of the waste disposal only.

2.7. Emissions related to the depreciation of fixed assets

This source is intended to distribute over several years the emissions which correspond to the use of sustainable goods required by the company or tertiary activity like buildings, rail infrastructures, rolling stock, IT equipment…

2.8. Overview of the total CO_2 emissions

This paragraph presents the results of the five carbon balance analyses done by the partners with the "T2K tool".

Each partner chooses a specific boundary for the global assessment of its CO_2 emissions. The specific perimeter had to include at least the minimum perimeter defined previously. This was almost done, except for some items because of a lack of available data. Those points were identified as areas for improvement for the next carbon footprint assessment.

The following table presents the emissions of GHG in tons of CO_2 equivalent for each partner on each item.

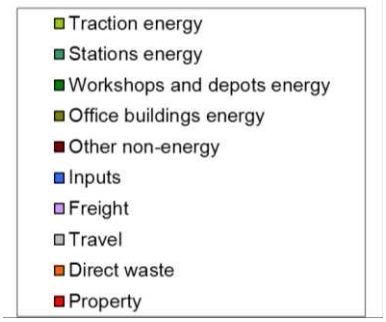
	Traction energy	Stations energy	Workshops and depots energy	Office buildings energy	Other non-energy	Inputs	Freight	Travel	Direct waste	Property	TOTAL
moBiel	10 923	847	1 123	20				157	58	2 446	**15 575**
RATP	353 172	30 697	47 228	9 027	11 256	76 746	2 925	49 966	8 429	107 122	**696 569**
RET	18 220	228	5 538	108				685			**24 779**
STIB	70 006	8 437	13 276	3 274	1 093	25 817	3 447	7 323	1 227	45 545	**179 445**
TfGM	55 756	10 301	1 281	5 358	223		20	959	503		**74 401**

For all partners, the first emissions source is energy, whatever the scope of the balance and the size of the company.

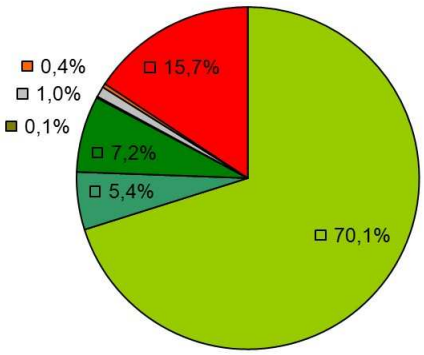
This data is presented in the five following graphs.

Each graph shows the prioritization of sources for the partner. They are not directly comparable because of the difference of perimeter.

Overview of the total CO_2 emissions



moBiel



Year of data: 2010

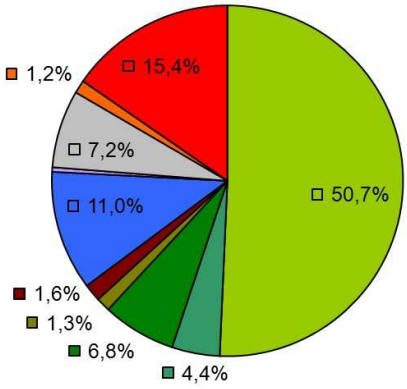
Scope:

- T2K scope,
- Direct waste,
- Property (buildings, rolling stocks, cars, furniture, IT equipment).

Comments:

The frigorific fluid losses are missing in the T2K scope because of a lack of available data. This point is identified as to be improved for the future carbon balance.

RATP



Year of data: 2008

Scope:

- T2K scope,
- Inputs (most important items),
- Freight (incoming only),
- Travel (commuting),
- Direct waste,
- Property (buildings, rolling stocks, some stations furniture, tramway tracks, cars, furniture, some tools and machines, IT equipment).

Comments:

The 2011 carbon balance (not presented here) enabled an improvement of data collection for inputs and of the commuting assessment methodology. It also includes an extension of the property perimeter with some new estimations of the infrastructure impact.

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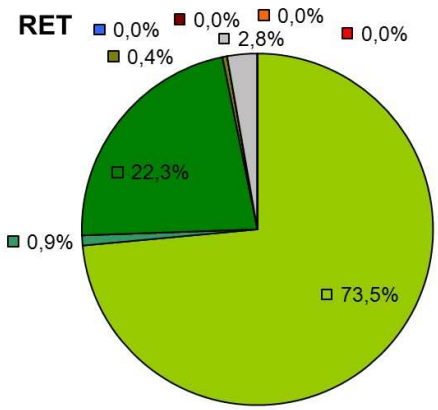
<td> 
</td>
<td>Year of data: 2010

Scope:

• T2K scope

Comments:

The chosen emission factor for electricity is very low because it takes into account the purchase of green electricity. This is not the T2K recommended accounting method (pages 13-14).

The frigorific fluid losses are missing in the T2K scope because of a lack of available data. This point is identified as to be improved for the future carbon balance.</td>
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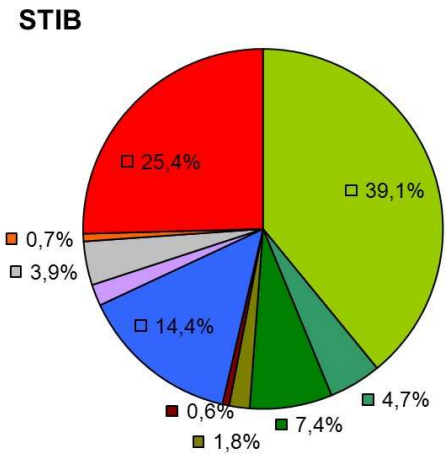
<td> 
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<td>Year of data: 2010

Scope:

• T2K scope,
• Inputs (meals and other items in monetary ratios),
• Freight (internal and incoming),
• Travel (commuting),
• Direct waste,
• Property (buildings, cars, IT equipment).

Comments:

STIB has chosen a very large scope for thos 2010 carbon footprint analysis in order to narrow it down to the most pertinent scope for the future.</td>
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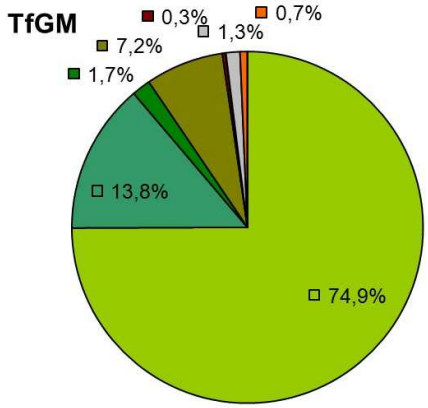
<td> 
</td>
<td>Year of data: 2010

Scope:

• T2K scope,
• Freight (internal),
• Travel (commuting),
• Direct waste.

Comments:

TfGM transposed its GHG Protocol into the Bilan Carbone®. As a transport authority, the perimeter of activities is different from other partners, as it does not directly operate public transport services</td>
</tr>
</table>

3. The T2K scope : mandatory CO_2 emissions

On the basis of this adapted tool, the partners of the T2K project have defined together the items that were important for public transport and on which they could act in order to reduce the total amount of emissions of the transport companies.

All emissions sources have been classified in two categories: compulsory emissions, which must be reported and optional emissions.

In the compulsory GHG emissions, we find:

- Emissions related to energy use by traction,
- Emissions related to energy use by stations,
- Emissions related to energy use by workshops and depots,
- Emissions related to energy use by office buildings,
- Activity emissions excluding energy use,
- Emissions related to internal freight,
- Emissions related to professional journeys.

Those mandatory sections allow to propose a minimum common scope including the main emissions for transport activity. The emissions monitored for this section concern field on which transport companies can act through concrete actions.

Other sections are optional:

- Emissions related to inputs,
- Emissions related to incoming freight,
- Emissions related to commuting,
- Emissions related to the direct waste,
- Emissions related to the depreciation of immobilised properties.

It should be noted that commuting is also an interesting point to study for transport operators because most of employees are bus or rolling stock drivers. Those workers have to start or finish their working day

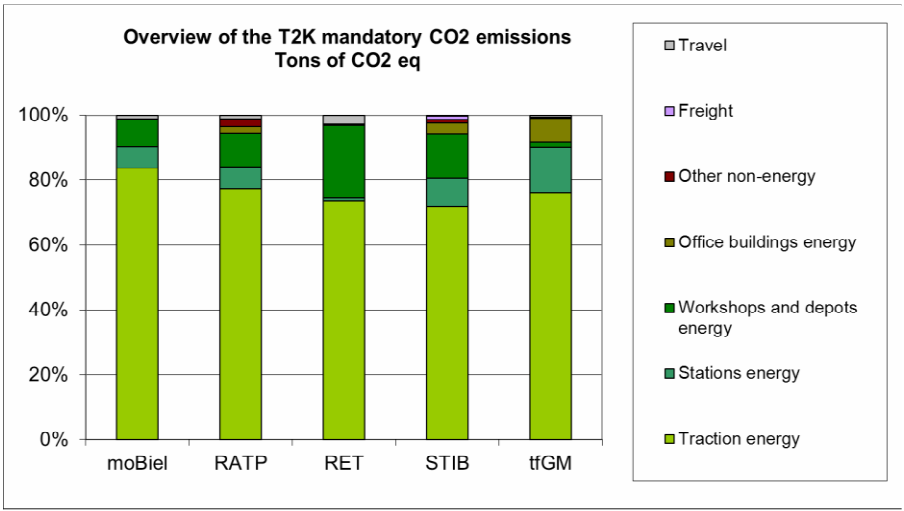
before and after service hours. The management of their allocation taking into account their travel to come at work is a key to reduce those emissions.

In the following graphs, we have compared the partners on almost the same scope of carbon balance based on the mandatory emissions; we have called it the “T2K scope”.

The electricity emission factors are presented in the following table:

	Electricity emission factor (gCO2e/kWh)	Source
moBiel	205	Electricity supplier
RATP	84	National production in 2006
RET	15	Electricity supplier estimation (including green certificates)
STIB	176	Electricity supplier
TfGM	506	National production in 2006

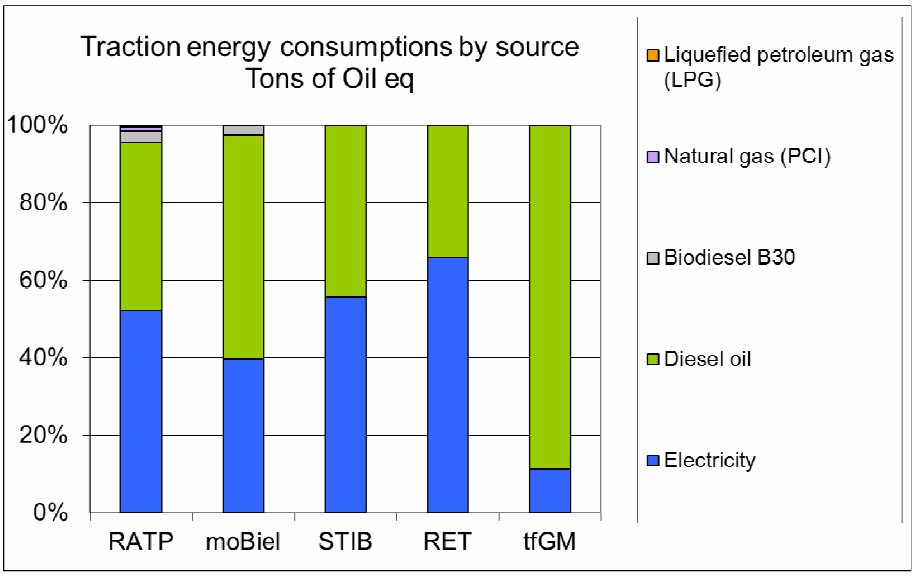
3.1. Overview of T2K mandatory CO_2 emissions

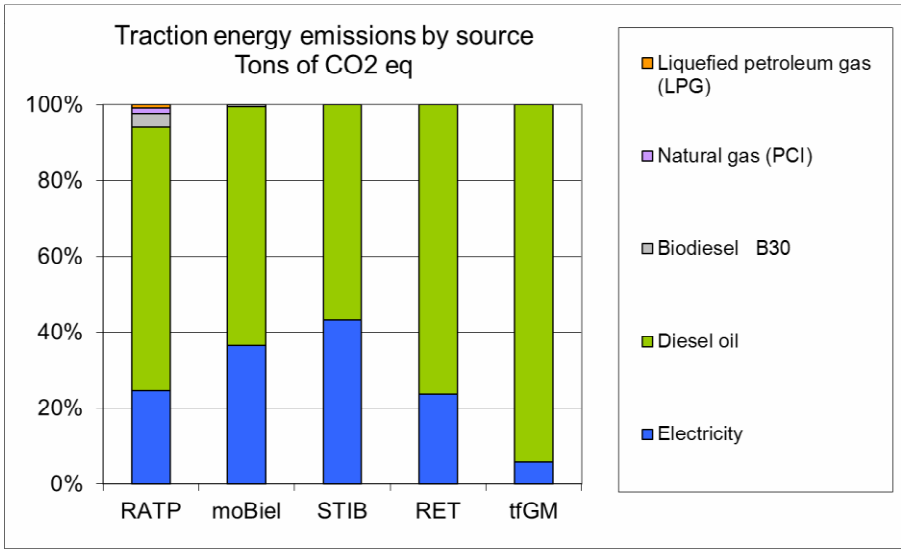


Energy is a big part of this scope. Traction energy represents from 70% to more than 80% of this scope. Traction energy includes both fuel consumption and electricity consumption.

3.2. Traction energy consumptions and emissions by source

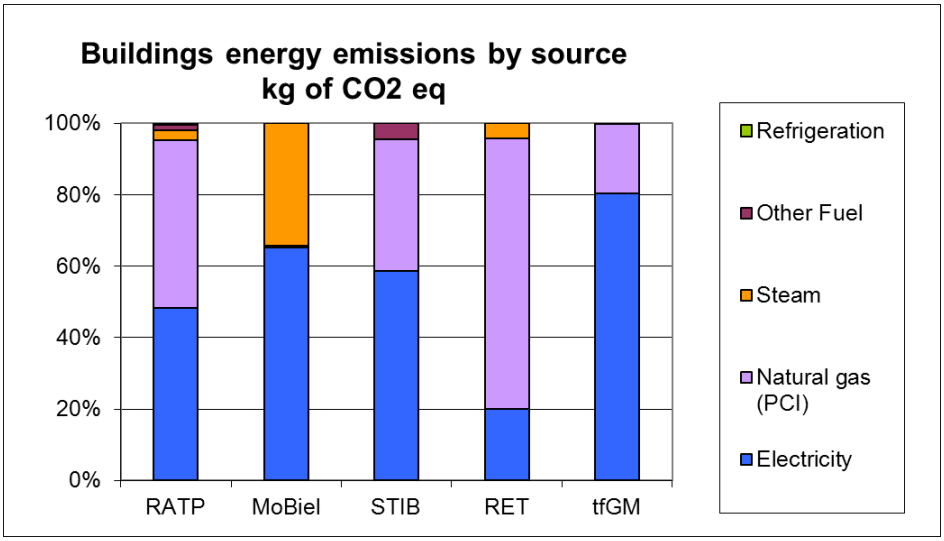
The two following graphs represent the breakdown of traction energy consumptions and emissions depending on the source. These views allow assessment of the impact of a source taking into account its share in the consumptions.





Emissions due to fuel consumption represent more than 40% of the emissions for all the partners, even if they operate railway modes.

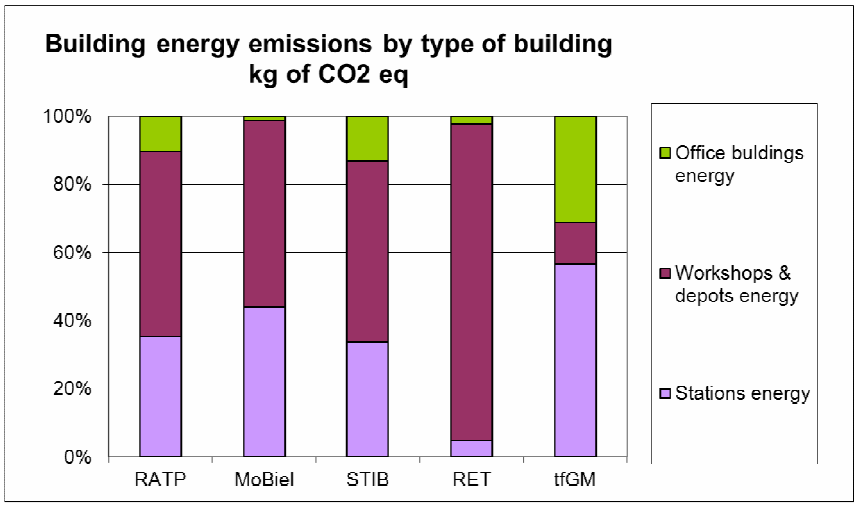
3.3. Buildings energy emissions by source



The emissions are directly linked to the heating system. This point is the result of the conception choice of the buildings. It can also be interesting to study the potential solutions in case of refurbishment.

Refrigeration emissions are not representative because no data was available for two partners. The share of this emissions source will probably increase in the future. It is important for the partners to create and enhance the reliability of refrigerant data collection.

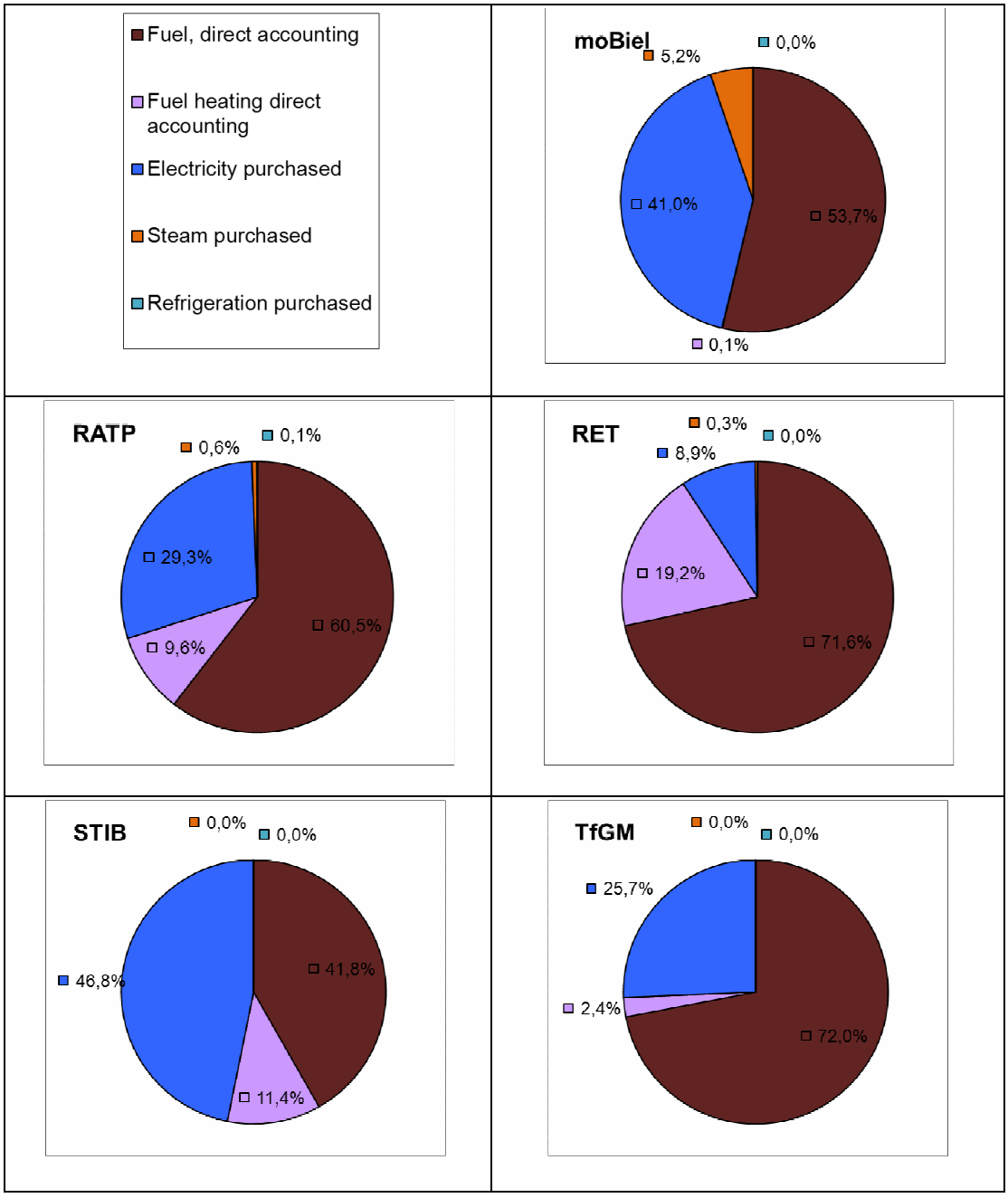
3.4. Buildings energy emissions by type of building



The TfGM profile is different from other partners because as a transport authority they do not operate the transport services. TfGM subsidises the service so that private operators will run them, except for non-profitable lines

The RET profile is the consequence of the electricity emission factor choice (cf page 20).

3.5. Total energy emissions by source



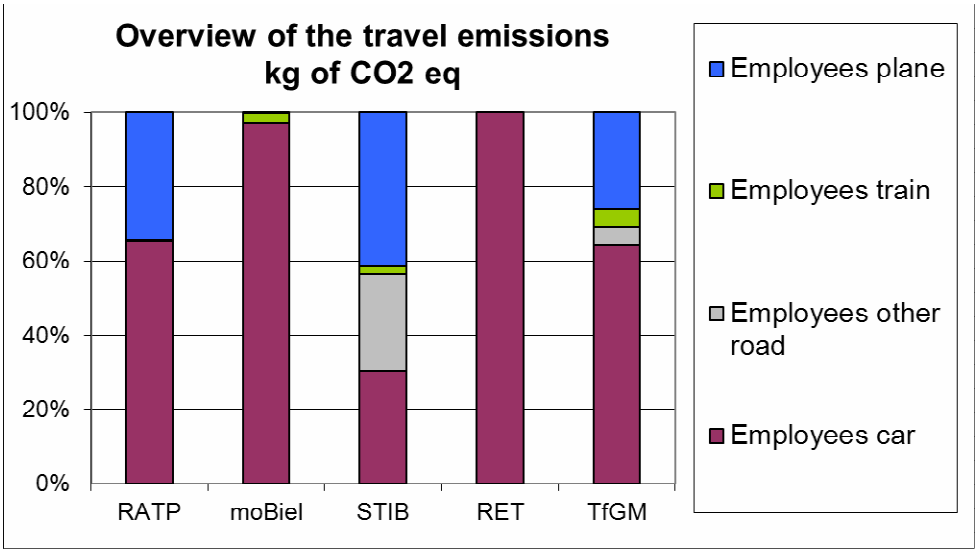
For all consumption profiles of transport companies, the share of emissions due to the use of fuel (traction or heating) is the most important. In partners CO_2 reduction actions plans, the effort has to be prioritized on this item.

The share of electricity is linked to the emissions factors used. Depending on production countries or suppliers the share is varying, but remains still low compared to emissions from fuel burning.

3.6. Overview of the travel emissions

This graph presents the emissions induced by the travel of employees during work time.

RET had no available data on plane and train journeys.



Those emissions are directly linked to the company policies that can promote train more than plane, propose electric cars to the staff, etc…

Cars are of course an important share of the emissions because of the spread of the networks through the cities. Maintenance operations induce lots of journeys.

Remark:

The accounting of commuting is not mandatory in the "T2K scope". It is however highly recommended to assess those displacements. Indeed, most employees are in drivers, maintenance or services teams. They have to begin or end their working day outside service hours; this means they cannot use public transport. The transport company should be involved in the way they travel for commuting: proposing them to work as closely as possible to their home place or helping them car share for instance.

4. Perspectives

The content of this report associated with the report published in 2012 within the framework of the WP3 entitled : « Choice and analysis of indicators to monitor GHG emissions » allowed to establish a profile of consumption for organizations in charge of the public transport, to identify monitoring indicators of the energy-climate performances relevant for the sector and to organize into a hierarchy emissions sections. They so gather the data necessary for the elaboration of a strategy of reduction of GHG emissions in public transports. The results are presented with full transparency to illustrate at best the approach such as it had upstream been defined.

The established methodology of GHG emissions accounting allowed every partner to determine its emissions on the wished or possible scope on the condition of respecting a minimal scope defined thanks to most experiment partners. The obtained carbon footprints confirm that the notion of scope is fundamental in the analysis of the results. The used emission factors are also determining in the type of obtained results.

Therefore the choice of the scope combined with the emission factors (chosen or statutory) implies that the partners' results are not directly comparable.

The presentation of the strategy will be the subject of the third report which will try to propose effective solutions adapted to the transport sector. This step of the approach development will probably lead partners to reconsider the scope of the GHG emissions assessment exercise. So, the results presented here can evolve during the various steps of hierarchical organization to come.

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