WP 3: ELABORATING CO_2 STRATEGIES IN PUBLIC TRANSPORT

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- 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 goal of this report 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 organisation, adoption by the management of their company, and their implementation.

This report presents the methodologies followed by five public transport companies (Bielefeld, Brussels, Manchester, Paris and Rotterdam) to build to their carbon strategy. The first part summarises how the CO_2 strategy is integrated in the Ticket to Kyoto (T2K) project and how other work packages contribute to the elaboration of the strategy.

The second part presents how to build a strategy describing steps of the methodology taking into account the transport context.

Finally, this report presents the main issues of CO_2 strategy for Public Transport, identifying potential risks and technical challenges.

To illustrate the process, the top 15 CO_2 reduction actions based on the 5 partners' knowledge and experience, is proposed to help public transport companies focus on the most effective solutions taking into account investments, whole-life costs and human resources.

1. The T2K project in a few words

Five European public transport companies have joined together in a four-year project (2010 - 2014) to reduce CO_2 emissions in public transport through more environmentally friendly behaviour and changes in infrastructure. Their goal is to introduce the principle of low CO_2 emissions as the new standard for public transport providers.

To reach this goal the project is divided into five major action plans:

- Exchanges on 'best practices' in order to achieve Quick Wins that reduce CO_2 emissions in the short term or with a short payback time.
- Initiatives on new practices and techniques. These are larger investments focussing on energy efficiency, energy recovery and energy production.
- Development of strategic plans that will target low CO_2 emissions for local public transport by the year 2020.
- Understanding of public transport energy context so that policies and regulations can be adapted to facilitate the efforts of public transport companies in favour of raising their impact on climate change.
- Mobilisation of the stakeholders and the public to act against climate change. Public awareness-raising campaigns and events encouraging external stakeholders to reduce their own energy use and carbon emissions.

These five action plans contributed to the development of a CO_2 reduction strategy in public transport. The methodology and results of the work achieved by partners is presented in this report.

The project's five partners are:

- moBiel, Bielefeld, Germany;
- RATP, Paris, France;
- RET, Rotterdam, Netherlands;
- STIB, Brussels, Belgium; and
- TfGM, Manchester, United Kingdom.

The Ticket to Kyoto project is led by STIB and is co-financed by the INTERREG IVB North West-Europe Programme.

2. Carbon strategy: methodology

2.1. Understanding context

Before developing a strategy and action plans, it is important to place public transport in its global context. This section explains that whilst transport in general is a significant source of global greenhouse gas emissions (GHG), public transport itself represents a small proportion of this.

2.1.1. Climate change and transport

The greenhouse effect is a natural process ensuring a steady Earth surface temperature (~15℃) that allows life on earth to survive and thrive. The Earth's atmosphere is made up of four main naturally occurring greenhouse gases (GHG) that are responsible for the greenhouse effect: water vapour, carbon dioxide, methane and nitrous oxide. These gases absorb some of the heat radiating from the planet, trapping it and radiating it back down to the surface. This is called the greenhouse effect. Without the natural greenhouse effect, the average temperature at Earth's surface would be below the freezing point of water (-18℃).

Our lifestyle generates greenhouse gas emissions in a quantity widely superior to what the planet can recycle. The increase in gases accumulates in the atmosphere causing further heat retention than in their natural state. This is called the "additional greenhouse effect", which causes global warming and alters our climate.

For decades, GHG emissions attributed to transport has significantly increased. Trips are longer and the number of vehicles in circulation has increased. The transportation of goods and people represents 15% of the world's emissions of greenhouse gases. In Europe, it accounted for 24% of greenhouse gas emissions in 2009, with road transport by far the largest contributor. Projections of future greenhouse gas emissions all forecast an increase in the proportion of emissions attributed to transport. However, this is certainly underestimated when factoring in embodied emissions related to vehicles, infrastructures, air conditioning, and so on.

2.1.2. Public transport issue

Transport as a whole, is a significant and growing contributor to global GHG emissions and the sector continues to be extremely dependent on fossil fuels. This is particularly sensitive in urban areas that represent 80% of the West-European population. Increased use of public transport, coupled with its de-carbonisation and reduced emissions from more efficient private cars, will play a significant role in meeting EU carbon targets.

Public transport represents the most sustainable alternative to private cars mainly because it enables the transportation of a large number of people. Hence, while public transport belongs to a sector characterised by growing GHG, it is part of the solution to decrease these emissions.

Through the Ticket to Kyoto project, the five partners are leading the public transport sector in taking into account energy efficiency and carbon emissions. Generally, it can be assessed that carbon and energy efficiency measures have a low priority in the strategies of public transport organisations. They are often

considered “out of core business”, excluded from the decision-making process and without defined targets or budgets. In addition, public transport itself is often perceived to be inherently a “sustainable solution”.

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

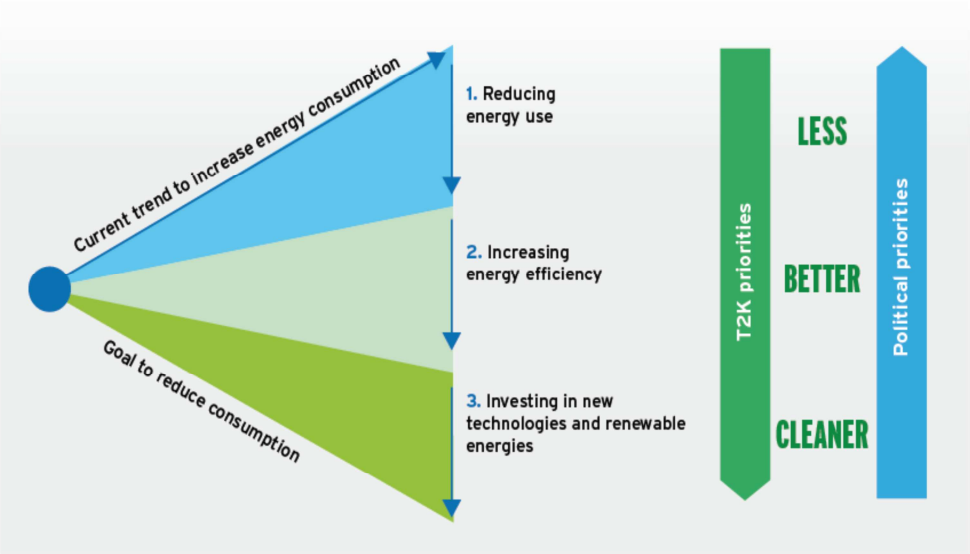
2.1.3. T2K and the Negawatt concept

Within the context of a public transport company, potential carbon reduction measures must be identified and studied to see whether and when they can be implemented and what impact they can have on energy and carbon emissions reduction.

As a first step, the T2K partners recommend reducing energy use and improving energy efficiency through small-scale investment before considering larger investment in low-carbon and renewable energy technologies. As it it often said “The cleanest energy is the energy you do not consume”. In that sense, it is better to consume less energy than for example to produce renewable energy in order to compensate the emissions of an unnecessarily high energy use.

The priorities are:

- Reduce energy use (less)
- Improve the efficiency of existing systems (better)
- Invest in new, low-carbon technologies and renewable energies (cleaner).



Source: Association Negawatt, STIB, 2011

The first two priorities can be achieved by implementing energy-saving measures without the need for major investment. The energy that can be saved is a direct result of energy conservation or increased

efficiency. Public transport companies will often gain more by reducing their energy use and developing energy saving strategies that will directly impact on their energy bills through reduced revenue costs.

Reducing energy use and improving energy efficiency are unlikely to be sufficient to meet an ambitious carbon reduction target set in a company's carbon strategy. Investment in the transport systems are the core business of a public transport company: rail or road fleet renewal or refurbishment, new infrastructure, renovation of stations, depots and workshops will have a large impact on energy efficiency. Companies must evaluate investments in new energy-saving systems with typically higher capital costs but often greater energy reduction potential in the long term. Investing in renewable energy production systems will be the last phase in the process.

2.1.4. Ticket to Kyoto recommendations "Elaborating CO_2 strategies"

This report is the second part of Work Package 3: 'Elaborating CO_2 strategies'. The goal is for each partner to go further in developing a long term strategy for CO_2 and energy reduction by 2020. A common methodology for public transport companies is proposed in this report, pooling the results of the partners' experiences and deliverables of other Work Packages. Shared methodologies and tools to measure and compare GHG emissions have been developed in the previous part of this Work Package.

Work Package 3 is composed of two parts:

- The definition of common methodologies, measurement and reporting of carbon footprint and carbon indicators. CO_2 calculations can vary greatly between different organisations, and may not meet the required International standards. A direct application of carbon indicators and common methodologies is to develop and improve CO_2 calculators, which are informative tools to raise awareness both to staff (commitment at work) and the public (for their transport modal choices), 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 governments, suppliers, beneficiaries of the project, including the travelling public.

Other public transport companies should then be able to duplicate the steps partners have taken to calculate their emissions and develop a strategy to address them.

Three actions are carried out to achieve the objective:

- **CO2 and carbon footprint methods**
  This action defines an appropriate CO_2 measurement methodology that can cover all activities and services of public transport companies. This is the subject of the report: "*Elaborating a CO_2 strategy - Carbon balance*"[1].

- **Definition and follow-up of common indicators**
  This action identifies series of indicators that allows the companies to monitor long-term CO_2 emissions. Within the same action, the CO_2 trip calculators for customers has been fine-tuned, (e.g. to be able to provide precise data for CO_2 emissions for different kinds of public transport

[1] This report is available on the Ticket to Kyoto website : Carbon Footprint

modes). These are the subjects of the two reports: "*Elaborating a CO_2 strategy - Choice and analysis of indicators to monitor GHG emissions*" [2] and "*Elaborating a CO_2 strategy - Specification for the trip calculator for Public Transport*" [3].

- **Provide a longer term CO_2 reduction strategy for each partner**
  Once an accurate carbon footprint and CO_2 indicators are defined, partners are able to identify together how to build the CO_2 strategy, step by step. The strategy should cover CO_2 emissions reduction until 2020 at least.

When applicable, partners have consulted 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). The T2K project has found that organisations involved in public transport provision have very different contexts. It ca often be the case where, local regional or other public authorities set the CO_2 emissions or energy consumptions reduction objectives, that the public transport organisation or operator has to work towards..

The final beneficiaries, such as the general public, associations and suppliers should also be informed or involved in the development of a CO_2 reduction strategy through different kinds of exchanges such as communication actions or workshops.

2.2. Influencing parameters

This paragraph aims to describe the specific context of public transport. Detailed information is available in the Ticket to Kyoto report "*Contextual drivers for CO_2 reductions in public transport*"[4].

2.2.1. Regulations

Although EU-level targets and initiatives do not specifically target the public transport sector at present, some important regulations on vehicles, fuel and building efficiency as well as procurement support the partners' efforts to improve their energy efficiency and reduce CO_2 emissions.

Transport activity

The most important regulation for the public transport sector is the Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles (2009/03/EC). The 'Clean Vehicles' Directive aims at a broad market introduction of environmentally-friendly vehicles. It requires energy and environmental impacts linked to the operation of vehicles over their whole lifetime to be taken into account in all purchases of road transport vehicles. Today, this remains the only common regulation specifically with carbon emissions for the transport sector in Europe.

The new European standard EN 16258:2012 on "*Methodology for calculation and declaration of energy consumption and GHG emissions of transport services (freight and passengers)*" proposes a common basis for EU transport companies to inform their consumers on CO_2 equivalent emissions of transport

[2] This reports is available on the Ticket to Kyoto website : Indicators

[3] This report is available on the Ticket to Kyoto website : Trip Calculator

[4] This report is available on the Ticket to Kyoto website : Contextual drivers

services. But until now its use remains voluntary. The French regulation on transport information isn't in compliance with the EU requirements that will lead to a weak use of this for companies subjected to this regulation.

Buildings

Transport companies are also concerned in the same way as all European companies by new building regulations on energy performance coming from the strengthened requirements at the European level (Directive 2010/31/EU on the energy performance of buildings). For instance, new build or major renovation projects have to respect minimum energy performance requirements from 2013. Next steps will gradually come to "nearly zero energy buildings" for buildings occupied by public authorities from 2019, then to "very high energy performance" for all buildings from 2021. Member States have already transposed EU public procurement requirements into various regulations and policy instruments to improve the energy efficiency of buildings, for example through building regulations and planning requirements. As they are concerned parties, transport companies have to satisfy these regulations.

Regulations to come

More recently, the new Energy Efficiency Directive was published in order to meet the EU energy efficiency target of a 20% reduction in energy use by 2020. It imposes on Member States to prove that energy providers will save 1.5% of their energy sales every year through the implementation of energy efficiency measures at costumers' premises. Among measures listed in the Directive, large companies will have to make an energy audit at least every four years, from the end of 2015. The implementation of these new requirements will begin in mid-2014. Transport companies will be concerned and have to comply as they are public companies.

National regulations

Examples of national or local regulations supporting better understanding of energy use and further investment in measures to reduce emissions are numerous. The main examples of requirements for countries represented within the T2K project are in France and the United Kingdom:

- France:
  - Emission reporting at the organisation level every three years from 2012
  - Information to customers and/or passengers about CO_2 emissions of the journey from 2013
  - "White certificates" generated by energy savings measures are required by authorities from energy providers otherwise they have to pay a penalty (this regulation is already in line with the Energy Efficiency Directive)
  - "Green" requirements to new commercial building leases (above 2,000 m2) from 2012 and for existing leases from 2013
- United Kingdom:
  - Local Planning Authorities requiring a significant proportion of the energy needs of new developments to be met through on site renewable energy generation;
  - Compulsory reporting on energy use and carbon emissions for large public and private sector organisations through the CRC (Carbon Reduction Commitment) Scheme;

- The Energy Companies Obligation (ECO) places legal obligation on larger energy suppliers to deliver energy efficiency measures to domestic energy users with the aim of reducing CO_2 emissions.

The above regulations and requirements together with future interventions contribute to the achievement of ambitious national targets and ultimately lead Europe in meeting the binding targets of the Kyoto Protocol.

2.2.2. Reduction targets

EU leaders have made a challenging unilateral commitment that, by 2020, Europe would:

- cut its emissions by at least 20% (on 1990 levels);
- source 20% of its energy consumption from renewable sources;
- achieve a 20% reduction in primary energy use by improving energy efficiency.

These targets are known as the "20-20-20" targets and EU leaders have also reserved the possibility to increase the emission reduction target to 30% if other major emitting countries in the developed and developing world commit to do their fair share under a future global climate agreement.

Effort sharing targets are different for each countries of the T2K project, taking into account effort already done.

T2K partner country	Effort sharing target (by 2020, on 2005 levels)
Belgium	-15%
France	-14%
Germany	-14%
Netherlands	-14%
UK	-15%

Effort sharing targets have generally not been translated into specific transport sector targets with the following exceptions amongst T2K partners:

- Germany has adopted a transport sector target of a 21% reduction in CO_2 emissions by 2012 (compared to 1990 levels);
- France has a transport sector target of a 20% reduction in CO_2 by 2020 to get back to 1990 levels.

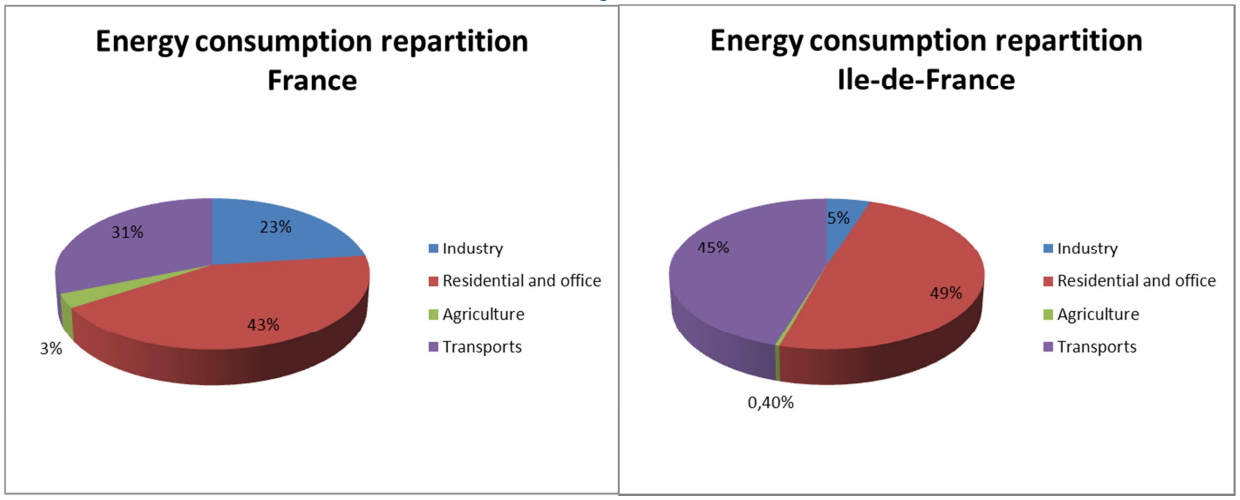
Target type	National transport sector target	Regional/local target	T2K partner target
moBiel	21% reduction in CO_2 by 2012 (on 1990 levels)	City of Bielefeld target at 40% reduction in emissions by 2020 (on 1990 levels) across all sectors	
RATP	20% reduction in CO_2 by 2020 to get back to 1990 levels	STIF regional transport strategy target to reduce transport emissions by 20% by 2020 (on 2005 levels)	Reduction in GHG emissions of 15% by 2020 (on 2004 levels, adjusted for additional services)
RET	As per EU level targets	City of Rotterdam Climate Initiative: 50% reduction in emissions by 2025 (on 1990 levels)	50% reduction in emissions by 2025 (on 1990 levels)
STIB	As per EU level targets	Brussels Region EU Covenant of Mayors target for all sectors: 20% reduction in emissions by 2020 (on 2005 levels)	-40% in seat-km emissions in 2030 compared to 2010
TfGM	UK Climate Change Act (all sectors) with a target of 34% reduction in CO_2 by 2020 and 80% by 2050 (on 1990 levels)	Manchester Climate Change Strategy target of 48% reduction in emissions by 2020 (on 1990 levels)	Reduce carbon emissions by 75% by 2018 (on 2007/08 levels) and be zero carbon by 2033

Following the White Paper of 28 March 2011 "*Roadmap to a Single European Transport Area: Towards a competitive and resource efficient transport system*", all reduction targets have to contribute to the global European objective to cut carbon emissions in transport by 60% by 2050 compared to 1990 levels. The consequence for public transport will be that road transports will have to become even more efficient.

2.2.3. France and Great Paris issue

Since the French Grenelle law on environment was adopted, the objective, at the national level, is to decrease energy consumptions by 2% per year from 2015 and by 2.5 % per year from 2030. Figure 1 represents the breakdown of National and Ile-de-France Region energy consumption.

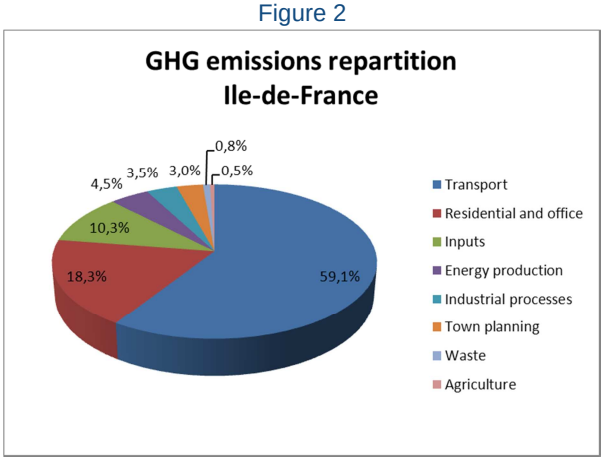
Figure 1



Source: ADEME, ARENE, Energy in Ile-de-France dashboard, 2012 edition, 2008 data

Figure 1 and Figure 2 show that transport is the main issue for France and especially for the Ile-de-France Region because of its high urban density. In Ile-de-France, transport represents 45% of the total energy consumption and almost 60% of the emissions of the territory and is the largest emissions' source by far.

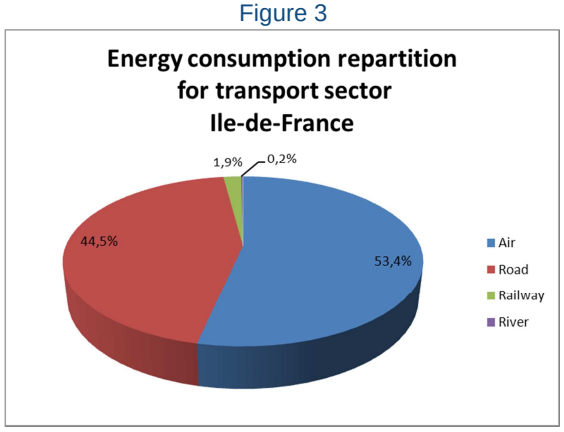
Figure 2



Source: Bilan Carbone® of the Ile-de-France Region

After air transport (the Region has three airports that represents more than half of the energy consumption associated with transport), road transport represents almost 45% as represented in Figure 3 below.

Figure 3



Source: ADEME, ARENE, Energy in Ile-de-France dashboard, 2012 edition, 2008 data

Even though transport energy consumption appears to have stabilised recently, the energy consumed by all transport modes rose significantly by around 25% by 2008 compared to 1990 and explains largely the increase of the Region's transport energy use.

In the field of transport, a decrease in energy consumption could only be achieved by modernising the rolling stock fleet, optimizing the flow of road vehicles (modal shift towards public transport, reduction in congestion, speed limitation) and by promoting density and diversity in urban areas which limit the length of travel journeys. The future Scheme of Urban Travels of the Ile-de-France will set a goal of 2% reduction for road traffic between 2006 and 2020.

By improving the mobility in Ile-de-France, the so-called "Great Paris Express" (the public transport railway project for the Region), should result in the Ile-de-France Region reducing individual car use and thus road traffic energy consumption through an increase in the use of public transport. The impact of the transport network on the renovation and the densification of urban areas could also permit it to reduce the energy consumptions from the residential and tertiary sectors.

2.2.4. Stakeholder needs analysis and new technologies implementation

In addition to European and national regulations, the partners have to take into account several other external parameters to build their carbon strategy. Survey results (public surveys for new lines and lines' extensions, global commercial surveys) and the development of new environmental organisations that check the environmental impact of transport projects, has revealed that stakeholders' needs and expectations to sustainable development issues increased in the last few years, particularly towards transport. The main external stakeholders to transport companies are as follows:

- Clients / Passengers
- Neighbourhood
- Authorities
- Transport operators/authorities
- Environmental organisations

- Other organisations
- Politics
- Local Businesses
- Municipalities
- Suppliers
- Energy providers
- Public works companies
- Regulators
- Unions
- Transport federations (lobbying organisation): UITP, UIC, UTP in France, CPT in UK.

Even if public transport is the natural choice for sustainable transport in cities, public transport companies have to improve their environmental performance to remain the preferable option with pressure from the continued improvements being made to cars such as energy efficiency, hybrids and other alternative fuelled vehicles.

Involving external stakeholders

Stakeholder needs and expectations have to be taken into account in order to prioritise carbon reduction actions and to adjust the level of CO_2 targets. It's important to maintain communication with stakeholders and involve them in the common interest and objective of carbon emission reduction. It can enable companies to gain new passengers on their networks, whilst improving their corporate image in general.

Stakeholders can be directly involved in CO_2 strategy development by participating in workshops, focus groups or participating in surveys organised by the companies themselves.

Using customer needs to improve service quality

When public transport companies take account of the customer's needs and expectations, sustainability can often be a source of inspiration and innovation for transport service design and delivery. Elements that are now inherently part of the public transport service provision come from service quality improvements directly linked to sustainability concerns:

- Sustainable mobility,
- Intermodal travels,
- Door to door travel,
- Multimodal information...

It is clearly apparent that working to meet the needs and expectations of customers is mutually beneficial.

Technology watch and innovation

New technologies can often represent both risks and opportunities for companies. In recent decades, there has been acceleration in the development of new technology with a low-carbon and energy efficient emphasis, such as: LED lighting, heat pumps (ground-source and air-source), Combined Heat and Power (CHP), small-scale wind turbines, fuel cells, hybrid and electric buses and energy recovery braking

systems. There are a plethora of available technologies that can lead to increased energy efficiency and the reduction of carbon emissions for public transport companies.

Companies have to dedicate time and resources to investigate the applicability and economic case for investing in these technologies for their own buildings and vehicles.

Low-carbon and energy efficient technology has to become standard practice for the design and procurement activities of public transport companies. They must be integrated among the technical solutions used by the companies as often and as simply as classical technologies. That is the reason why public transport companies have to develop a real knowledge on sustainable technologies in general and theoretically. Companies should have dedicated resources to keep abreast of latest technological developments that have the potential to achieve further efficiencies in terms of energy and carbon. Technological innovation can be very technical, so experts may have to be recruited or internal staff adequately trained.

Elaborating a strategic plan to reduce CO_2 emissions provides an opportunity to analyse and evaluate potential technologies and the impacts they can have on achieving a certain target. Once technologies have been evaluated from an impact and applicability perspective, companies have to change the way they proceed when preparing business cases and designing projects, in order to integrate new and more “environment friendly” solutions in the projects or services they intend to launch. Design teams will also have to learn about financial analysis tools such as “Life Cycle Costs”, in order to evaluate the sustainable solution.

To learn how to integrate new technologies in transport projects, partnerships like Ticket to Kyoto are a highly beneficial way of working. They enable companies to investigate and test new solutions with reduced financial risk, thanks to European Union subsidies and with a large technical knowledge base, thanks to partnership working.

An important point to be addressed is the short term nature of innovation that is sometimes difficult balance with the long term nature of public transport projects. The innovative technology has to be implemented at the right time, which can be seen as a risk, because it may come late in the project delivery lifecycle where it can be difficult to integrate into a project that is already scheduled and financed. The majority of low-carbon technology on the consumer market today didn’t exist 10 years ago. The challenge faced by sustainable development teams in public transport companies is to convince project managers that they can integrate such technologies with minimum risks.

The T2K project enabled the 5 partners to implement investments in many different fields in order to prove that innovative solutions are effective. Through these investments, but also through the Quick Wins, partners have proven that the environmental issues facing public transport today can be overcome. Not only can significant CO_2 reduction be achieved, but also significant cost savings.

2.2.5. Internal influencing parameters: company long term objectives alignment and management involvement

Corporate business strategy and long term objectives

The corporate business strategy is the means by which a company sets out to achieve its objectives. It is recommended that the Carbon Strategy should be directly aligned with the overarching corporate strategy, in order to integrate with the everyday life of the company.

Teams of technicians and experts should be trained and mobilised. Financial teams should have the right tools to evaluate the company's projects in a "sustainable way". Sustainable development teams and experts should be engaged and integrated amongst other strategists at the earliest opportunity in the development of the corporate business strategy.

As far as possible, corresponding budgets for the implementation of identified actions and investments to achieve the Carbon Strategy objectives should be planned and allocated.

All employees are responsible for the implementation of the business strategy as they will enable it to achieve its objectives. Likewise, the Carbon Strategy should also be integrated into everyday working and business as usual activities in order to achieve its CO_2 reduction target. Performance contracts of departments, teams and individual employees of the company can be utilised in order to integrate sustainable development and nurture a CO_2 reduction conscious workforce; focused on the Carbon Strategy's specific and clear targets.

T2K has been the first step to involve partners' staff, not only technicians, but also key decision-makers and financial personnel.

Management and organisation

It is important to engage with and gain the buy-in of managers by specialists in sustainable development to raise awareness of the importance of achieving CO_2 reduction objectives.

To do this, one should include managers as soon as possible in the creation of environmental policies. Upstream working groups, brainstorming sessions, prioritisation of actions based on proven methodologies proposed by carbon experts are all essential both to identify actions and to communicate progress that is being to fight climate change.

In the same way as already mentioned, companies must develop skills and appetite for low carbon technologies and develop sustainability consciousness amongst finance and procurement teams. It is important to realise that with improved environment/sustainable performance, cost savings can be achieved.

Progress is being made; however, it is not yet the norm for businesses to integrate CO_2 and energy-performance criteria in tenders from suppliers in projects and in the purchasing process. Financial tools and business management must be adapted and life-cycle cost analysis standardised in business practice.

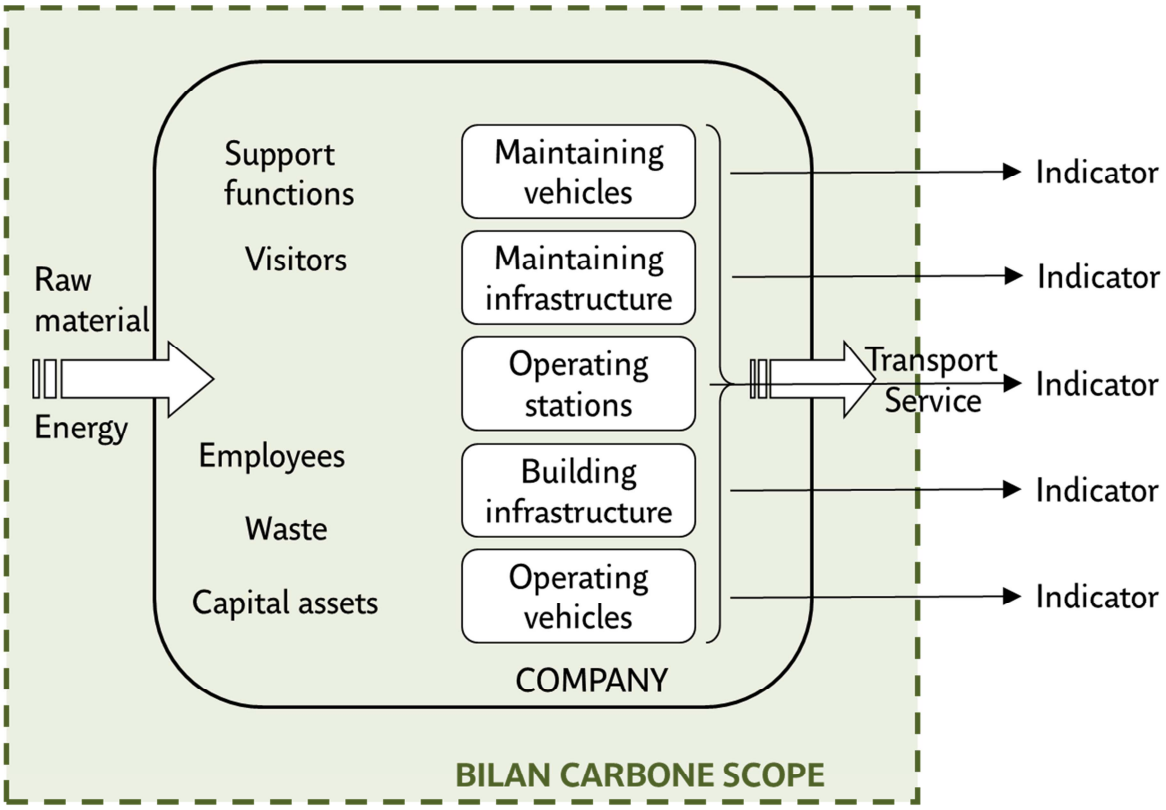
Ticket to Kyoto has again provided the opportunity for partners to progress this issue, particularly within Work Package 4, devoted to the analysis of institutional and commercial settings, and benchmarks between different companies on integration of CO_2 and energy-performance criteria in projects, and procurement processes.

2.3. Establishing the knowledge and analysing data

This paragraph deals with the knowledge basis that is required in order to start elaborating a CO_2 reduction strategy. Two kinds of measurement will allow transport companies to identify the main emitting sources of the company's activity and follow their evolution over time depending on production units. More detailed information about the tools is available in the two reports "Elaborating a CO_2 strategy – Carbon balance" and "Elaborating a CO_2 strategy – Choice and analysis of indicators to monitor GHG emissions".

Indicators and carbon footprint are calculated with the technical and commercial figures of the companies. In order to obtain relevant results to elaborate the reduction strategy, it is fundamental to consider which data are available and their level of accuracy. If any essential data is not available, the company must change its reporting process to make this data available on periodic basis otherwise it will not be able to measure action plan impacts on CO_2 emissions.

The following diagram represents the main transport companies' activities and flows. The process of analysis is based on both carbon footprint and indicators. The carbon balance will first allow companies to determine the main CO_2 emission sources within the company's activities. Relevant indicators will then enable them to follow the fluctuation of the main emitting sources year after year. The results of action plans of the CO_2 reduction strategy will finally be assessed through the indicators evolution and the next carbon balance that will show if the main emitting sources have changed.



2.3.1. Available data

Carbon footprint

The carbon footprint starts from the physical flows that concern the company (flows of people, objects, energy, raw materials, etc.) and calculating their associated GHG emissions generated by means of the emission factors. The calculation of the carbon footprint should not necessarily occur every year, because its goal is first to evaluate the main sources of GHG emissions. Input data has to be collected and analysed from all over the company's activities and services:

- Energy consumptions detailed by use (traction, stations, workshops and depots, office buildings),
- GHG losses,
- Incoming materials (metal glass, agricultural products, raw materials, packing, etc.),
- Services (computer and telecommunications services, maintenance, upkeep and cleaning, training, advertising, fees of lawyers, accountants, etc.),
- Freight (internal and external),
- Transport of people (commuting, business travel, visitors' travel),
- Direct waste and sewage,
- Properties

- Type: real estate, vehicle, computer equipment, production machine…
- Size: surface, number, weight…
- Lifespan

The data from all these factors can be assessed in different units of measurement (volume, weight, number of units, energy quantity). In exceptional circumstances, when no other data is available, the monetary value may be used.

Indicators

Indicators are a combination of technical and commercial figures. For example, total 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 energy or CO_2 ratios from energy data.

Taking into account that indicators have to be updated yearly, it is important to choose figures which don't require a large amount of data collection or have risk annual fluctuation because of a lack of calculation control. Concerning energy data that is the centre of the subject and traffic data that is the production unit of transport, the company has to make them available.

2.3.2. Decision tools

Carbon footprint

The French Bilan Carbone® tool was selected by the partners for the carbon footprint of transport companies. The method aims to reach a correct evaluation of emissions caused by all the physical processes that are necessary for the existence of an organisation. 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.

The results are presented in carbon equivalent and in CO_2 equivalent.

It allows companies to follow three steps: definition of the scope, data collection and analysis of results and action plan. In 2010, the Bilan Carbone® was free[5] and the available version of the V6.1 tool enables a fast implementation. 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. The tool allows users to make adaptations they need:

- The scope of each balance can be chosen depending on the objective to be achieved.

[5] The license use for the V7 of the Bilan Carbone® tool costs between 150€ and 1 300€ depending on the company size. For public companies, it cannot exceed 500€.

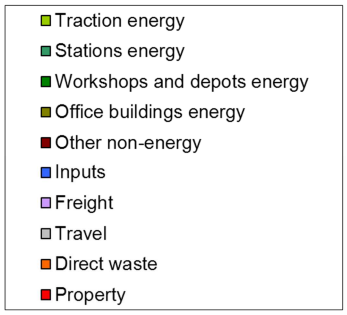
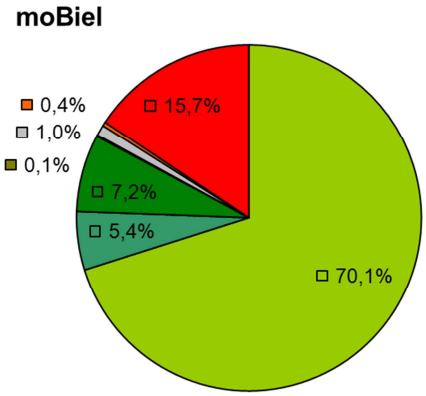
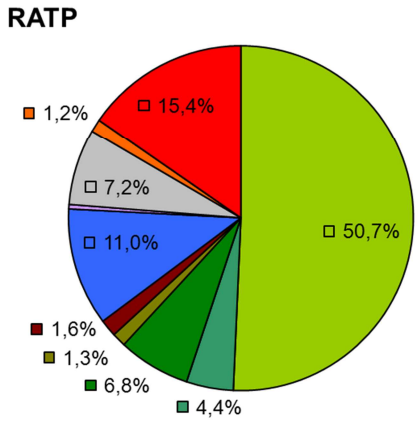
- Emission factors are proposed, but they can also be set freely (changed or added).

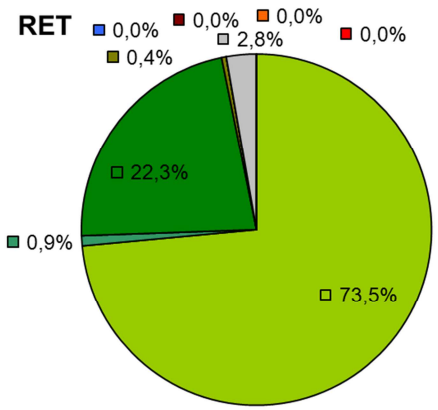
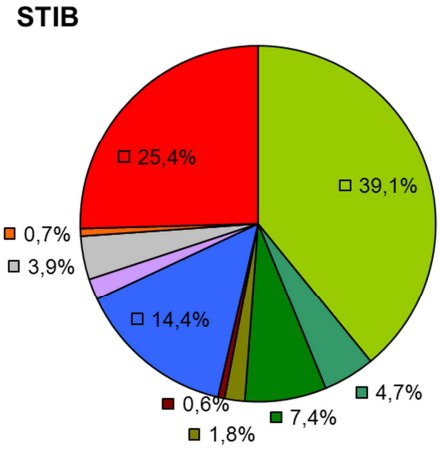
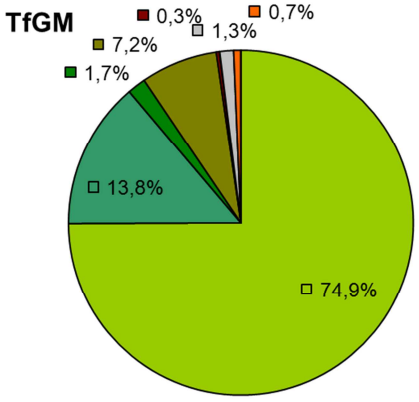
In order to take into account the general transport sector characteristics, some adaptations and recommendations have been implemented to the Bilan Carbone® tool by the partners. It was necessary to remove sections not relevant to transport: packaging, manufacturing, use, and also to modify the energy section. It now includes four new categories adapted to the partner's characteristics: traction energy consumption, station energy consumption, workshops and depots' energy consumption and office building's 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 five following graphs present the carbon balances and the prioritisation of sources of the five partners. They are not directly comparable because of the difference of perimeter.

The T2K scope mentioned in the following table refers to the minimum scope chosen for the public transport carbon footprint:

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

Overview of the total CO_2 emissions	
	**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.
	**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.

	**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.
	**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 that 2010 carbon footprint analysis in order to narrow it down to the most pertinent scope for the future.
	**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.

The first emissions source is energy, whatever the scope of the balance and the size of the company. Others items may also be of importance when evaluated. For instance, the inputs item that includes materials and service purchases and the property item that takes into account the companies' assets are often underestimated, but they already belong to the main emitting sources.

Indicators

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 answer both internal and external questions. For the company itself, these figures provide concrete information about the impact of energy or CO_2 strategy action plans on energy performance. These figures allow stakeholders including passengers to analyse the public transport company and their operational impact, to compare environmental performance of modes (road and railway for instance) and to raise awareness about traveller choices.

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

- Technical evolution of equipment (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…),

Common definitions are given in the report "*Elaborating a CO_2 strategy - Choice and analysis of indicators to monitor GHG emissions*" 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 each year.

Eight key indicators were defined within the project; six are energy indicators and two are CO_2 indicators:

- Traction energy consumption per passenger.kilometre (kWh/pax.km)
- Energy consumption in stations per square metre (kWh/m²)
- Energy consumption in workshops and depots per square metre (kWh/m²)
- Energy consumption in office buildings per square metre (kWh/m²)
- Share of renewable energy (%)
- CO_2 equivalent emissions due to traction energy consumption per passenger.kilometre (CO_2 gram equivalent / pax.km or CO_2 geq / pax.km)
- Traction energy consumption per seat.kilometre (kWh/pl.km)

- CO_2 equivalent emissions due to traction energy consumption per seat.kilometre (CO_2 gequivalent / pl.km or CO_2 geq / pl.km)

Among these indicators, the first six on the list were published in 2010; while the other two are used to interpret results. Values per seat.kilometre only give indications regarding technical performance information, but do not take into account the commercial part of the transport even though values per passenger.kilometre integrate both technical and commercial dimensions.

The following table presents indicators for the five partners monitored with their chosen emission factors for the year 2010.

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		

moBiel's energy consumption indicators for office buildings and workshops and depots are the same because the existing metering and repartition tools don't allow distinctions between the two to be made. This point was identified as an improvement for next calculations.

The regional railway results for traction energy of RET are included in the metro values. RET's bus energy consumption per passenger.kilometre and emissions are high compared to others networks. It appears that this is the consequence of a different approach for operating the network in 2010. However, indicators per seat.kilometre are more comparable and the energy efficiency of the buses is high.

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 subsidises operators to run bus services on routes which otherwise would not be commercially viable in order to maintain and increase social mobility. 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[6] 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.

The emissions indicators are assessed with following emission factors.

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	-	-	-

The CO_2 emissions presented in the following table have been monitored with the same European emission factor (0,420 kg CO_2e / kWh) for all partners. This factor is higher than all local factors used by partners for their own monitoring, except for TfGM.

The emissions for 2010 can be compared from one partner to another without taking into account the influence of the origin of electricity.

[6] Department of Environment, Food and Rural Affairs (Defra), UK government department

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		-	-	-	-	-

2.3.3. Partners' examples

Prospective scenario analysis: STIB example

At the beginning of the Ticket to Kyoto project, STIB first defined an objective to reduce energy consumption by 8.5% by 2017 on 2010 levels, calculated at equal activity. STIB is committed to this target in its 2013-2017 management contract with its transport authority. Within the project, STIB also launched its Carbon Balance analysis on data from year 2010 using the common tools defined in Work Package 3. This analysis enabled STIB to go to another level with its Carbon and Energy Strategy finalised in May 2014 which covers the period 2010-2030.

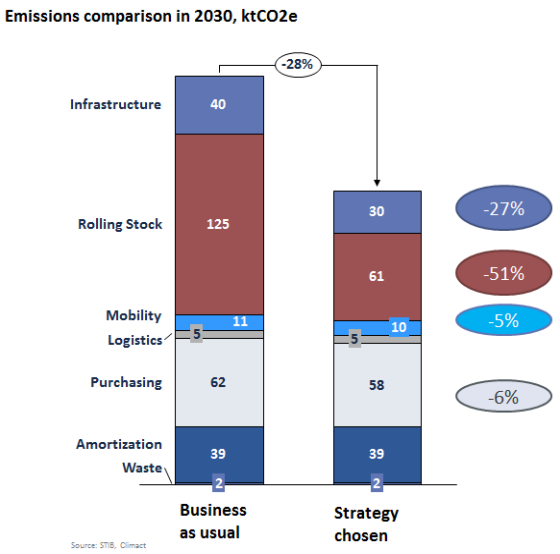
The first step for elaborating this strategy consists in the definition of a reference scenario. On the chosen scope combining direct and indirect emissions for the year 2010, the whole GHG emissions are estimated at 170 ktons of CO_2 equivalent. The rolling stocks energy is identify as the main emitting source representing 42% of the carbon balance. In the same year, the STIB energy bill rose to 32 M€, 75% for rolling stock and 25% for infrastructure. Taking into account several influencing factors such as the patronage forecasts (expected to double by 2030 compared to 2010), infrastructure extensions and human resources growth, the GHG emissions were forecasted to reach 285 ktons of CO_2 equivalent in 2030 (i.e. a yearly increase of 3%). The reference scenario was defined in that way for the considered period 2010-2030. The corresponding energy bill would rise to 55 M€ with a constant energy prices' hypothesis and 65 M€ in the worst energy price scenario in 2030.

Many actions have been identified with STIB experts to limit the CO_2 emissions and energy costs. More than fifty concrete actions were selected, covering the rolling stock, buildings, purchases or renewable energy production equipment. A combination of these actions was chosen for the definition of an ambitious and realistic scenario. This scenario will reduce emissions by 30% and the annual energy bill by 25 M€ in 2030 (lower hypothesis with a constant energy prices) compared to the baseline scenario, and this despite a doubling of transport provision[7]. This scenario is capitalising on previous commitments for the 2013-2017 period. Most significant actions are related to the rolling stock including the electrification of the bus fleet. Related emissions (direct and indirect emissions due to energy

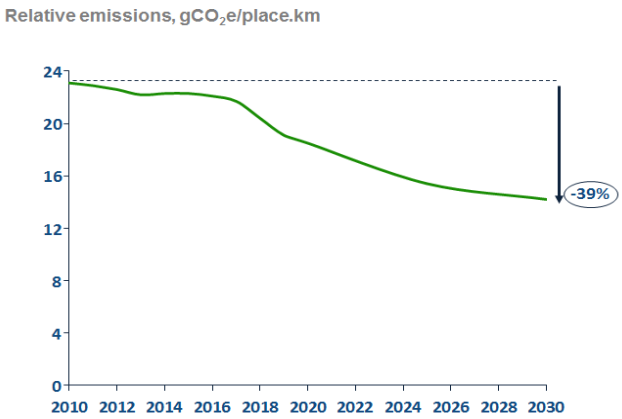
[7] The emissions for this prospective scenario cover three types of emissions: direct emissions (mainly related to the fuel consumption of vehicles and buildings STIB), indirect emissions from purchased energy (electricity) and indirect emissions from sources other than those directly controlled by the STIB. This last category includes upstream emissions from STIB operations (materials purchased, staff travel, etc...) and downstream emissions (waste, etc..)

consumption per seat.kilometre offered) will decrease significantly, by 40% in 2030 compared to 2010. The additional investments required for this ambitious scenario are offset by the gains on the energy bill, making scenario cost-effective in 2030.

The figure below presents the emissions in 2030 for the different categories of the company (infrastructure, rolling stock, mobility, logistics, purchasing, assets and waste) for the baseline scenario ("business as usual") and for the chosen strategy. Infrastructure and rolling stock are the two categories that benefit from the highest impact.



The figure below presents the evolution of the direct and indirect emissions (For STIB, perimeter to be clearly defined) of the STIB per seat.kilometre.



Until 2017, STIB will concentrate on the objectives of the management contract with its transport authority and the definition of new priorities for the 2018-2022 period based on the Carbon and Energy Strategy. For example, electrification of buses, which is one of the most important projects to reduce emissions, will be progressed following the evolution of the available technology.

Linking local targets with actions: moBiel example

As a subsidiary company of Stadtwerke Bielefeld GmbH, the city-owned energy provider for Bielefeld, moBiel is a public transport company that operates tramway and bus services. Within this context, local political targets are not only transferred by an authority-operator-relation but also by direct ownership. In return, Stadtwerke group provides a lot of expertise in energy production, energy reduction or energy efficiency for political decisions. The local target was strategically defined in the Bielefeld city councils decision from 2007 to initiate a permanent climate change campaign. CO_2 emissions have to be reduced by 40% (compared to 1990 levels) and the share of the local network load has to reach 20% by 2020.

At the beginning of the T2K project it was already clear, that the coal based share of the electricity production should be reduced by shutdown of the local coal power plant at the end of 2012. The Fukushima nuclear disaster marked a turning point for German energy policy. Stadtwerke must now additionally eliminate nuclear energy production by 2018. Nuclear energy is the main source (44%) of electricity in the Bielefeld energy mix. Discussions were therefore focussed on how to decarbonise and denuclearise energy production in Bielefeld with the transport sector outside of the focus. The Ticket to Kyoto project has provided an excellent platform to improve focus and actions to reduce carbon in public transport sector and the wider transport sector.

moBiel as Stadtwerke's public transport branch had carried out some remarkable improvements before the Ticket to Kyoto project. With the "eco-profit"-competitions, local companies shared their knowledge to boost energy efficiency in their buildings and workshops. This experience was a good starting point for the T2K Quick Win work package. Before the T2K project, moBiel had not assessed its CO_2 emissions. In the framework of Work Package 3, the first calculation of the emissions for the 2010 data was carried out. External consultancy and internal knowledge (mainly from Stadtwerke departments) was linked with a very helpful knowledge exchange in the partnership. Special attention was given to aspects of data-mining for best results in carbon footprinting.

The carbon footprint studies created a valuable foundation for the action in the T2K framework and for the coming period. More than 70% of moBiel's carbon emissions come from traction energy. This confirms the importance of the braking energy recovery investments, carried out with the help of the T2K funding. moBiel forecast to reduce traction energy consumption for its tramways by more than 5%. moBiel's other investment, temperature serving point heating, also contributes to this important part of their carbon emissions. moBiel's have also constructed a Green Station, a promotion point for electromobility in intermodal situations (electric cars, e-bikes)[8].

Next to these important investments, a moBiel strategy will integrate actions which are discussed within the T2K partnership. Stadtwerke Bielefeld GmbH and the subsidiary moBiel will continue to steadily improve the company's energy management as a condition for better and further improvements. Ecodriving programmes for bus and tram drivers and staff awareness campaigns about energy wasting behaviour will ensure long lasting effects beyond the T2K project.

The work package was completed by studies carried out by the Wuppertal Institut regarding staff mobility and the importance of tramway network extension for local carbon reduction targets. The staff mobility study provides advice about various scenarios for climate-friendly staff commuting. The evaluation of tramway and bus services shows that nearly 70% of carbon emissions avoided by using public transport

[8] This report is available on the Ticket to Kyoto website : Energy Savings

in Bielefeld is through increased tramway use. Network extensions therefore present a further potential for significant CO_2 reductions. In addition to tramway development, the electrification of the bus network will be important: the task for the coming decade is the operational reliability of electric buses and charging stations.

The carbon strategy of moBiel will be finally defined after the T2K period. Some conditions remain unclear; the most important question is depending on a citizen referendum (May 2014) on proposed tramway network extension. The success of the Ticket to Kyoto project has laid the foundations and conditions for this vision. This will help to improve the cities climate campaign targets and ensure the leading position of public transport for climate friendly mobility.

Reduction targets and action plans: TfGM example

Prior to the Ticket to Kyoto project, sustainability had been a key priority for TfGM for a number of years, with a dedicated Environment team for over a decade. TfGM has an environmental management system (EMS) to ensure legal compliance and continuous improvement in its environmental performance and has been accredited to ISO 14001 since 2008.

TfGM approved an Energy Strategy in 2009 setting targets for an annual reduction in energy use and approved its first Climate Change Strategy in 2010, shortly before the start of the Ticket to Kyoto project. This strategy set clear annual carbon reduction targets in line with the UK national low carbon transition plan, designed to enable the UK to meet its commitments to the Kyoto Protocol.

TfGM had already committed to a 13.5% reduction in its carbon emissions by 2014/2015 (compared to a 2007/2008 baseline) prior to Ticket to Kyoto, with the action plan primarily focused on savings through energy efficiency projects. The Energy Strategy was therefore the key delivery mechanism, and set out clear energy management improvement aims, using specialist energy management software (Systems Link) and specialised resources in the formation of an Energy Officer role, responsible for delivering the targets. These included the introduction of smart metering, monitoring and targeting of energy use, the delivery of an energy saving investment programme and a range of measures to embed energy management and change staff behaviour to deliver further reductions.

The Climate Change Strategy also focused on four other key areas: renewable energy, staff and business travel, sustainable procurement, adaptation and further research and development to embed carbon reduction as an organisation wide priority; the Ticket to Kyoto project was the key mechanism for TfGM to enable this.

TfGM participated in the Carbon Trust funded Local Authority Carbon Management Programme in 2010, alongside the Ticket to Kyoto project, to assist in the development of a detailed carbon reduction action plan and strategy. This provided TfGM with a structured approach, and specialised technical and change management support, in order to develop and embed a low carbon approach throughout the organisation.

The first stage was to develop a project plan, get a Director to act as project sponsor and establish a carbon management team and a carbon management steering committee. This ensured that there was clear ownership and clarity on roles and responsibilities as well as senior support and a mechanism for identifying and removing barriers to progress.

The second stage was to develop a project execution plan, and the first action was to hold initial brainstorming sessions to identify any potential ideas and ensure the expertise and knowledge of staff in all areas of the business was utilised. The carbon management team was used at this stage, and included representatives from all areas of the business, including public facing staff and areas such as Finance and Communications as well as those with a clearer direct impact on carbon emissions such as IT and Fleet. These sessions were used to develop an initial log of ideas, without any consideration as to their likely effectiveness - this helped to keep a central records of anything later de-prioritised, gave staff confidence to suggest their views and helped staff feel that their contributions were valued. Further technical ideas were developed by undertaking site based energy audits, and reviewing strategies, action plans and reviewing publically available, technical guidance and reports.

The second stage was to prioritise this initial list of ideas, which was done in team sessions again, using a very simple ease and effect matrix (shown below) to rapidly review and prioritise each idea.

		Ease of Implementation		
		Easy	**Moderate**	**Difficult**
Effect on Emissions	**Very Effective**			
	Moderate			
	Ineffective			

TfGM has already been analysing and calculating its annual energy use and carbon footprint prior to the Ticket to Kyoto project and continued this annual exercise to monitor performance towards targets. At the same time, TfGM also undertook a detailed analysis of its future potential emissions trajectory, utilising knowledge of known and prospective changes to develop three future emissions scenarios: business as usual, high emissions and low emissions. In addition, three future cost scenarios were also reviewed, including low, central and high future energy and carbon costs. These were used to identify the financial value at stake to TfGM, and develop the case for action to senior management and the Carbon Management Steering Committee. This analysis showed that TfGM's carbon emissions could be reduced by 50% through schemes already identified and that the value at stake was over £20 million over a 10 year period. This time consuming part of the project was a critical action to gain organisational wide support for carbon reduction.

Over a two-year period, TfGM utilised specialised staff to further develop the carbon saving projects identified as a priority by the Carbon Management Team. These included energy saving schemes, fleet management actions, and communications and awareness campaigns. Alongside this, TfGM continued to implement energy and carbon saving work both within and alongside the Ticket to Kyoto project.

Finally, a detailed action plan was developed and a Carbon Strategy was drafted. The Carbon Strategy included key themes, actions, targets and measures that would be used to monitor progress. A separate, detailed action plan was developed alongside the strategy, which would be a “live document” regularly updated as new actions were developed.

Action plan prioritisation: RET example

RET is the main operator of public transport for bus, tram and subway in the area of the Rotterdam city region. The technical department of RET handles services for maintenance and investments of rolling stock, stations and railway infrastructure. RET also operates passengers’ river transport by ferries. The Rotterdam city region is responsible for the organization of the public transport of Great Rotterdam.

As many cities and regions in Europe, Rotterdam is currently facing the challenge of meeting European air quality standards. Therefore, Rotterdam is focusing on a wide series of measures which improve air quality, including zero-emission public transport.

The Rotterdam city region aims at making the mobility system in the city region more sustainable. RET, the main public transport company of the region, is now focused on sustainable business activities and has taken its social responsibility. Since 2007, RET has an agreement with the Rotterdam Climate Initiative, in which it commits to reach 50% CO_2 reduction for bus transport to be realized by 2025 compared to the 2007 levels. Three axes are defined to reach the reduction: clean use, clean vehicles and clean energy. RET wants to contribute to the aims of the municipality, the Rotterdam city region and the Ministry of Infrastructure and Transport in the long term.

Until 2010, the beginning of the T2K project, RET had no assessment of its CO_2 emissions. In 2011, the first calculation of the emissions for the 2010 data was carried out, helped with the knowledge’s exchanges possible within the partnership, an external consultant and an internship.

As the RET objectives are based on the 1990 levels of emissions, the company had to estimate them. Some figures were not anymore available, even though others had never been measured at that time. Making some hypothesis, RET obtained a figure as reference. Between 1990 and 2012 several reduction measures were implemented, partly in the context of the T2K-project. For example:

- Purchase of green electricity;
- Reuse of braking energy for tram and metro within the T2K project;
- Lights out in metro stations outside service hours within the T2K project;
- New sustainable tram depot within the Tramstore 21 project.

In brief, RET went through the seven followings stages to elaborate its strategy:

- Identification of drivers and ambition
- Determination and analysis of the reference situation: the carbon footprint on 2012 data is used as a reference for the CO_2 reduction Strategy
- Identification of ‘hot spots’ to propose a first list of actions
- Identification of a long actions list (issued from discussions and brainstorming based on technical data provided by experts

- Specification of a short list of prioritised actions, using a multi criteria analysis: CO_2 emission reduction, investment, payback time, internal and external visibility, staff requirement customer's acceptance. Short term actions have a payback time of maximum 6 years and long terms actions over 6 years.
- Determination of SMART reduction targets based on input from RET staff
- Decision making, based on explicit business cases, implementation, monitoring of progress and communication of results

RET already went through all stages except the last one that will be carried out in the coming years.

The outcome of this exercise is the following list that presents the most promising actions:

- Lower inner temperature of working areas in workshops;
- Switch off of HVAC in vehicles after the end of service;
- Ecodrive for metro, tram and bus;
- Insulation of heat pipes;
- Daylight control for the use of cabin lights in vehicles.

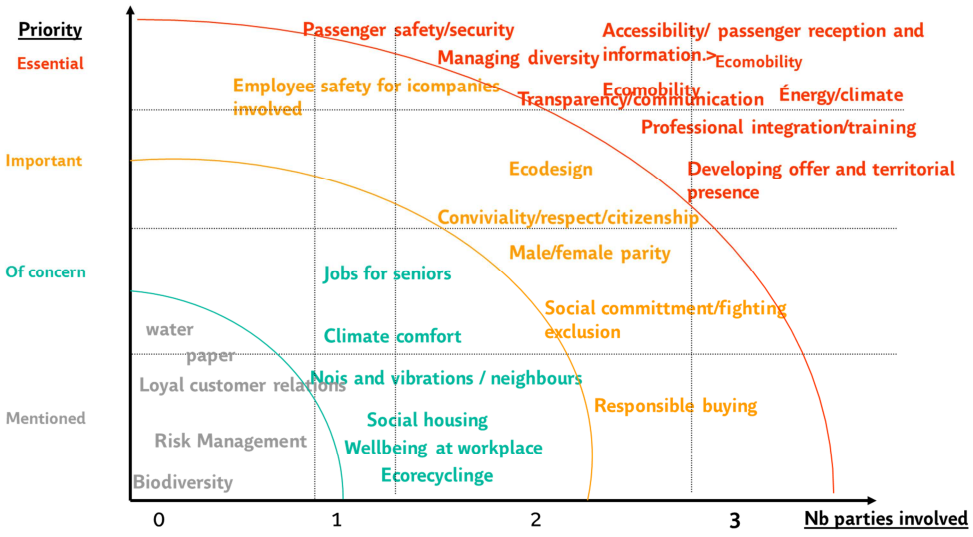
The responsible structures of RET will develop these actions to validate their implementation from 2014 and after.

Mobilising stakeholders: RATP example

In 2009, when RATP decided to elaborate its own environmental strategy, many workshops and interviews were done by the sustainable development team in order, not only to learn from the stakeholders about the environmental expectations they had about RATP, but also to assess the level of importance of their different needs.

RATP proposed first a sectorial analysis based on an analysis of the risks and the opportunities in terms of sustainable development. The following points were handled: stakes, context, RATP assessment, best practices, objectives, action plan.

For six months, various stakeholders were consulted, among these labor unions, employees, elected representatives of Ile-de-France, associations (environment, consumers, professional integration and organization for the handicapped). The prioritization of actions was then led by the sustainable development team with the assistance of all the department of RATP based on stakeholders' contributions. This allowed RATP to define the company's commitments and the main actions to be carried out.



The results of this work enabled RATP to define the 4 main issues to include in its environmental strategy:

- N°1: developing ecomobility to propose a global service offer as an alternative solution to the individual use of the car such as car sharing, operators' cooperation, passengers' information…).
- N°2: saving energy and fighting climate change by reinforcing the RATP reduction objectives and raise them to 15% reduction of energy consumption and CO_2 emissions by 2020 (compared to 2004 levels).
- N°3: acting in favour of passenger and neighbourhood health in reducing air, noise and vibration pollutions.
- N°4: Setting an example in professional practices by reducing industrial risks and resources' consumptions, making ecodesign the basis of RATP's engineering teams and involving suppliers in the sustainable development policy.

These new elements allowed RATP to combine the action plan issued from the Bilan Carbone® monitored in 2005 and 2009 with the different commitments of the sustainable development policy. The objective is to deal with all the CO_2 emissions sources linked to the RATP's activities in order to reduce them.

The following table presents the crossing between the Bilan Carbone®'s action plan and the sustainable development policy of the RATP.

	Energy	Direct emissions	Freight	Inputs	Travel	Waste	Assets
Ecomobility					Ecomobility		
Energy & climate	Energy						
Passengers and neighbourhood health		Thermical comfort					
Be an example in professional practices		Ecodesign	Sustainable purchases			Waste	Ecodesign, Ecomanagement, Life Cycle Costs

3. CO_2 strategy in Public Transport: main issues

Due to their activity, transport companies are directly subjected to different structural elements which they have to face:

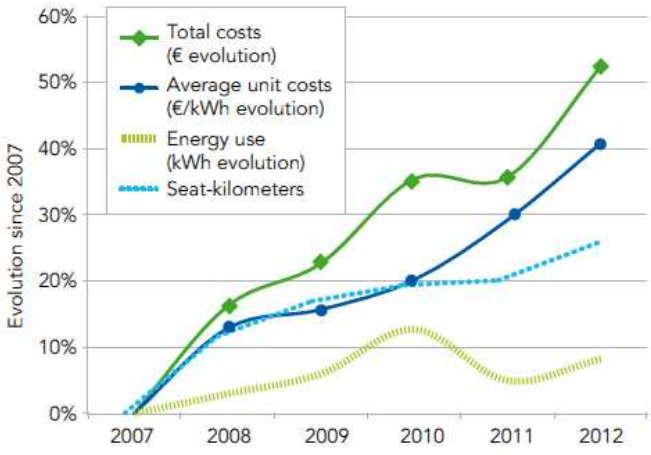
- A non-insignificant contribution to GHG emissions as seen previously,
- A significant increase of the energy prices which seems to be a long term trend,
- A progressive increase of the risks of supply in oil productions and electricity.

This paragraph aims to present to public transport companies the financial impact they will probably have to face with their energy purchases and propose an action plan in favour of energy reduction in light of the five partners' experience. This action plan should allow companies to reduce both their CO_2 emissions and their energy bill including of course their dependence on fossil resources.

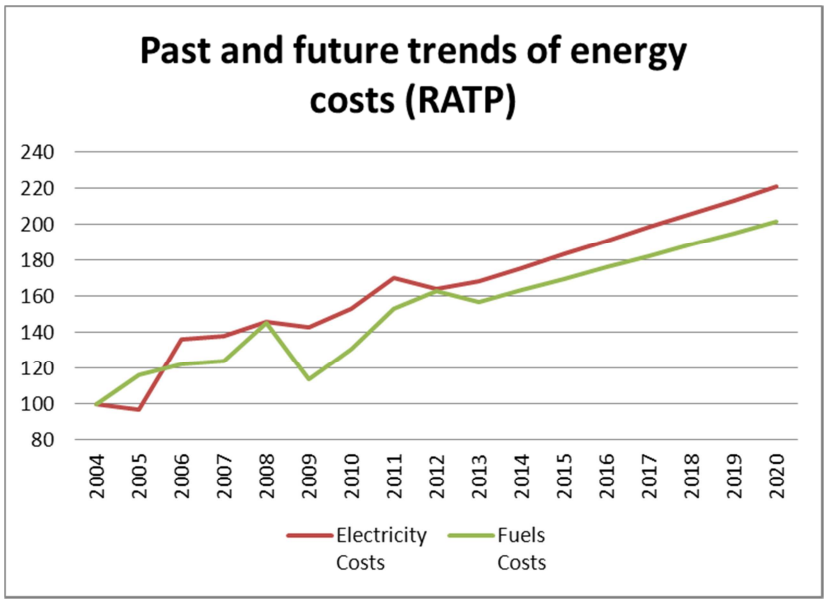
3.1. Energy costs and external dependence

Based on the experience of recent years, the T2K partners generally expect energy costs to increase in the future but assumptions on future prices used in appraisal vary widely between organisations.

STIB compared the increase of the total energy costs, the average energy unit costs, the energy consumptions and the transport offer (see graph below). A quick overview of these patterns of evolution shows that the total cost increased by more than 50% during the five past years partly because of the increase of the transport offer, but mainly because of the energy unit cost raise. Indeed, the efficiency of the transport has already improved over the past five years.



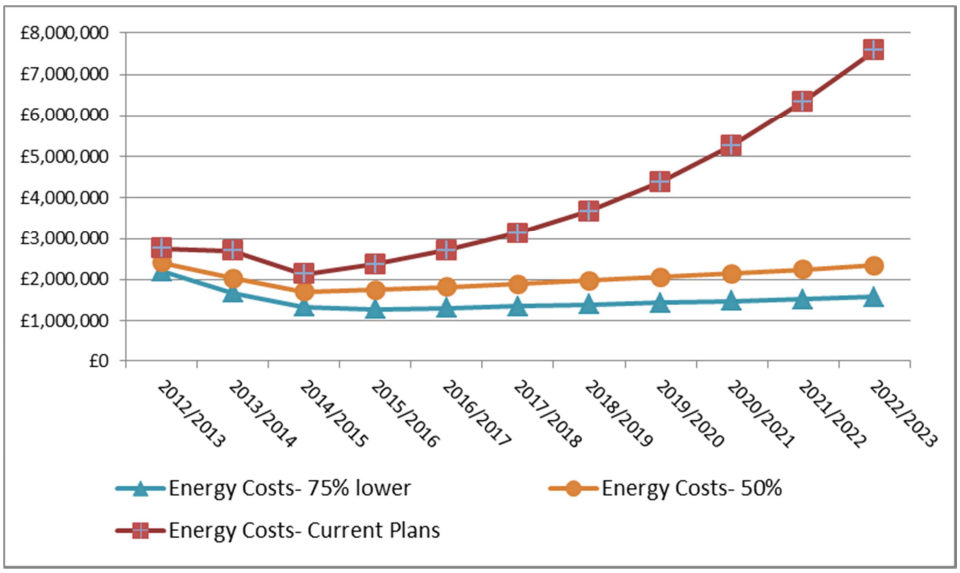
RATP also sustained a strong increase of energy prices over the 2004-2013 period. As shown below, if the average raise (about 7% per year) of the prices keep the same for the coming years, RATP could expect its energy bill to be by 2020 at least twice what it was in 2004 (for the same level of transport offer). The global transport offer of RATP already rose by 16% in 2013 compared to 2004 levels and new tramway lines and metro extensions are already programmed next years.



Some individual Member States also produce national projections. This is the case of the UK Government that regularly updates projections to be included in project appraisal as below:

- Retail price for electricity (industrial use)
  - Historical: 2001 to 2012, +6% per year
  - Low prices scenario: 2013 to 2020, +5% per year
  - High prices scenario: 2013 to 2020, +8% per year
  - Long term scenario 2020-2030: +2% per year
- Retail price for road transport fuels (private vehicles)
  - Historical: 2001 to 2012, +3% per year
  - Low prices scenario: 2013 to 2020, +0% per year
  - High prices scenario: 2013 to 2020, +2% per year
  - Long term scenario 2020-2030: between +0% and +2% per year

The graph below shows the energy bill's projections for TfGM taking into account the official energy price evolution for three scenarios: current plans, 50% reduction objective and 75% reduction objective. This gives a rough estimate of efforts that should be done to maintain the energy bill during the next 10 years.



Due to the rarefaction of fossil resources that impacts mainly fuel, added to the fact that fuel burning is more CO_2 emitting than electricity use, the transport companies should concentrate their efforts firstly on reducing their fuel consumption.

3.2. Top 15 actions reduction

As presented in the partners' example, the last step of the carbon strategy consists in setting up an action plan that describes the way the company implements actions to meet the targets. In order to establish the planning and forecast the investments, business cases shall be thoroughly assessed from a technical and financial point of view. A detailed financial appraisal may be required as well as the analysis of funding and third party involvement opportunities.

This part first proposes a prioritisation method and then offers a fast and easy solution with a ready-made panel of actions issued from works the five partners have experienced during the Ticket to Kyoto project. This action plan includes the results of others work packages, especially "Achieving Quick Wins" and "Investing to reduce CO_2 emissions", but also some elements of the work on "Optimising policies and regulations for CO_2 reduction measures".

3.2.1. Prioritization methodology

Once relevant actions have been identified, they should be characterized to facilitate their comparison and prioritisation. It is important to evaluate the impact of each action on the company's activity.

This characterization requires experts to select criteria and to weight them depending on the company's priorities. The criteria shall at least evaluate the impacts on the energy and CO_2 emissions. Others criteria can be freely chosen depending on the company's policy or priorities. At this stage, the prioritisation is high-level and is not aiming at deeply analysing the potential actions. Actions can be gathered by field like traction energy, stations energy,…

Within this work package, partners chose to assess actions on the following criteria (this is a non-exhaustive proposal list):

- Capital costs
- Operational costs
- Energy savings
- Carbon emissions reduction
- Ease of implementation (technology)
- Employees' involvement
- Impact on corporate image

Partners also chose a weighting for each criteria, taking into account the overall objectives to reduce energy consumption and CO_2 emissions and the hardening of financial constraints. The following table proposes a weighting from 1 to 5 for the previous list of criteria.

Capital costs	Operational costs reduction	Energy savings	GHG reduction	Easy implementation	Employees involvement	Impact on corporate image
5	3	4	3	2	1	3

The method consists then in ranking the potential actions with the use of this multi-criteria analysis. By selecting the actions with the highest global score, a short list of actions can be established. This stage allows choosing actions that can be implemented first and foremost to reduce the carbon emissions of the company. A periodic review of action plan will then allow the company to reappraise actions regarding what has been done and update action plan.

3.2.2. Top 15

Using this methodology, the five partners have established the following main actions' list. According to the experience gained during the project, most efficient actions are part of the fields presented in the table below. The prioritisation will depend from the activity and the properties of the company which will define the scope of possible reductions.

	Traction energy	Station energy	Workshops and depots energy	Office buildings energy	Transversal action	Operators concerned
Energy monitoring		X	X	X		All operators
HVAC improvements	X	X	X	X		All operators
Combined heat and power systems			X			Workshop's owner
Lighting optimisation and relighting	X	X	X	X		Mainly railways operators
Escalators and lifts improvements		X				Railways operators
Point and rail heaters	X		X			Railways operators
Energy recovery from braking (Métro and light rail	X					Railways operators
Eco driving (Métro, light rail and bus)	X					All operators
Start and Stop (bus)	X					Bus operators
Renewable energy production systems	X	X	X	X		Medium and big sized operators
Eco building					X	Medium and big sized operators
Staff awareness					X	All operators
Staff travel plans					X	Medium and big sized operators
Stakeholders awareness					X	All operators
Green procurement and CO_2 content					X	All operators

A prioritisation proposal by field based on the number of citations for each field of CO_2 emissions is following:

1. Traction energy
2. Workshops and depots energy
3. Office buildings energy
4. Stations energy
5. Transversal actions
6. Other energy (direct emissions of fluid with a warming power)

4. Conclusion

After four years of collaboration, the results of the Ticket to Kyoto Work Package 3 are very positive. All partners are now able to assess their impact on climate change and have identified their working priorities to reduce their own carbon footprints. Each company either has or is shortly going to have action plans and energy and CO_2 reduction targets that will assist in the development of their carbon strategy.

Depending on the partner's state of advancement, the benefits obtained from the partnership varies.

For moBiel, the partnership allowed the company to carry out its CO_2 footprinting for the first time. The company benefitted from advanced knowledge in partner cities, especially at RATP. The intense discussion for adequate scope and database was fundamental for an applicable solution, also useful for smaller companies. The local climate protection targets could now be connected to the most effective and best-to-implement actions. Furthermore, it will be interesting to assess the impact of investments (e.g. braking energy recovery) on the carbon footprint of moBiel.

The Ticket to Kyoto project enabled RATP to challenge what was developed within the climate-energy policy of the company over the past years. It first appears that tools used by RATP to establish the knowledge basis were efficient and in line with the needs of other transport companies. To share action plan and prioritization with the other partners is going to boost the approach initiated ten years ago.

RET considers that collaboration between partners was particularly fruitful for the monitoring of the CO_2 footprint and the indicators. The outcomes of these tools developed within the partnership were comparable and useful for discussion about differences and similarities. The topics occurring in the partners' CO_2 strategies showed the related problems and solutions.

The Ticket to Kyoto project enabled STIB and RET to have a deep understanding of concepts related to Carbon, concept it didn't manage in such details before. Sharing results of its Carbon Balance with partners and comparing its emissions has helped in defining the actions integrated in its Carbon and Energy Strategy.

The benefits of the collaborative approach to developing carbon strategy were also important for TfGM. Reducing carbon emissions in a public transport company required actions across every area and is a complex and challenging task. It is not possible for anyone to be an expert in everything, so the Ticket to Kyoto project has given TfGM access to the expertise and knowledge of partners, who can support and review projects as they are developed, acting as a critical friend or sharing lessons from similar projects on their estate.

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