The STIB Carbon and Energy Strategy for 2030

May 2014

MIVB STIB

.brussels

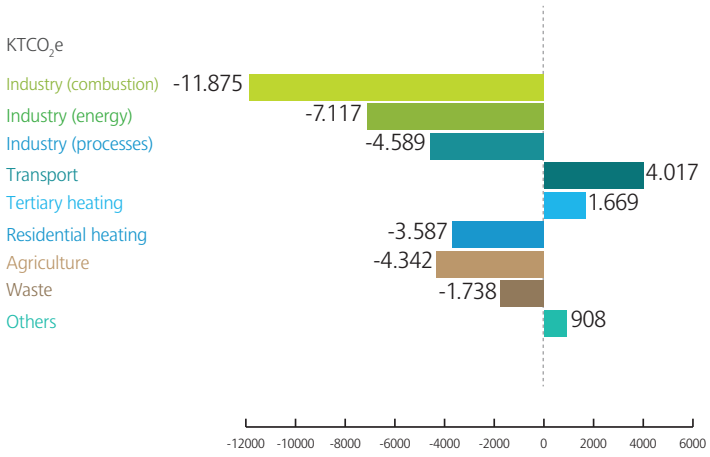
Introduction

The Brussels-Capital Region (RBC) is experiencing major demographic growth and facing up to major mobility-related challenges, both in relation to the environment, to congestion and quality of life. During the last 10 years, the number of STIB journeys has increased by almost 80%. This spectacular increase will continue in the coming years, which makes it necessary to anticipate and manage greenhouse gas (GHG) emissions from public transport, and this, in a rapidly changing energy context.

With regard to the European Union's Climate and Energy package[1], Belgium has committed itself to:
- reduce its CO_2 emissions by 15% between now and 2020 as compared with 2005,
- increase its share of renewable energies by 13% for all sectors, including 10% for the transport sector, and finally,
- improve its energy efficiency by 18%.

Although currently the share of this commitment between the Belgian regions has not yet been fixed, the European Union is preparing to set out its commitment for 2030. The figures of -40% GHG and 27% of renewable energies are currently discussed at European level.

In this more and more restrictive context, the transport sector has become a major source of greenhouse gas in Belgium, both in terms of growth and in absolute values. In fact, the emissions from this sector have increased by 19% in 2012 compared to 1990, representing 21% of the emissions for Belgium in 2012, against 14% in 1990[2]. Although a large part of these emissions is attributed to freight transport, passenger transport is also an important contributor.



Evolution by sector (2012 compared to 1990, in kilotonnes CO_2 equivalent)

The reduction of GHG by passenger transport in RBC will inevitably involve an increase in the modal shares of walking, cycling but also public transport. In this context, STIB has a major role to play. It is at the heart of an integrated, multimodal and low carbon transport solution.

STIB is therefore committed to the double challenge of increasing its transport offer while reducing its CO_2 emissions and its energy consumption. At the end of four years of excellent collaborative work[3], alongside public transport operators from Paris, Manchester, Rotterdam and Bielefeld, STIB has adopted a carbon and energy strategy for 2030. The strategy is based on a scope established in compliance with the international standards in force and covering both direct emissions and a part of indirect emissions. Based on an initial diagnosis carried out for the year 2010, the identification of parameters of influence and a set of actions, STIB studied different scenarios which would allow it to reduce its emissions in relation to a reference scenario.

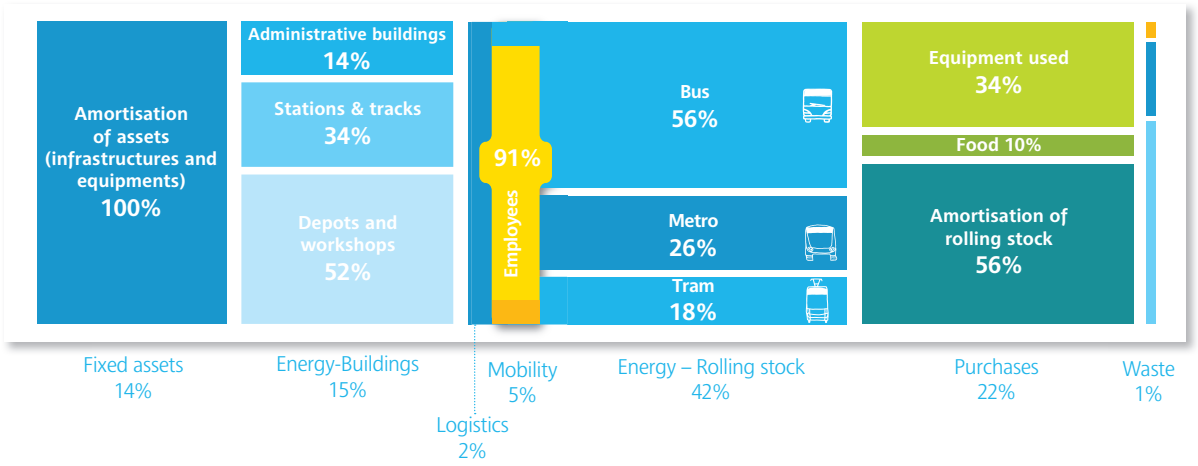
The future is uncertain. It will depend of technological developments and political choices. The results of this study provide guidance on future trends and allow STIB to define a commitment. The interpretation of the results should however remain cautious given the margin of uncertainty inherent in such prospective work.

[1] For 2020, the EU Climate and Energy Package sets out additional objectives:
• to reduce GHG emissions by at least 20% compared with 1990; even by 30% in the event of an international agreement;
• to increase the use of renewable energy sources to achieve 20% of final energy consumption, including 10% in the field of transport
• to increase energy efficiency by 20%.
[2] Source: Greenhouse gas emissions in Belgium - http://www.climat.be
[3] Through the Ticket to Kyoto European project aiming at reducing CO_2 emissions in public transport – www.tickettokyoto.eu

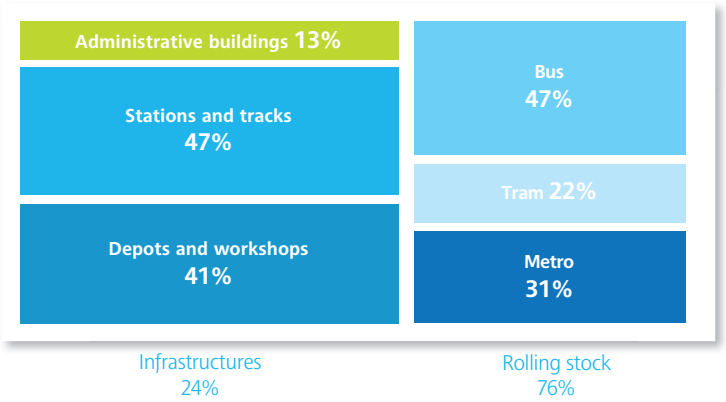
Diagnosis for 2010

STIB estimated its GHG emissions for 2010 to be around **170 kilotonnes of CO_2-equivalent** [4-5].

The traction energy of rolling stock represents the main source of emissions (42%), particularly because of the consumption of diesel by buses. Infrastructures represent a second source of emissions, followed by emissions linked to the manufacture of purchased materials and services, the movement of persons and other indirect sources.



In addition, STIB's energy bill amounted to €32M in 2010. Three quarters of this expenditure was attributed to traction energy, half of which can be attributed to bus diesel.



[4] GHG emissions are expressed in tonnes of CO_2 equivalent (tCO_2e). These emissions are calculated by multiplying the activity data (ex: litres of fuel, kWh consumed, km covered by employees, …) by emission factors which express the quantity of GHG emissions per unit of activity (tCO_2e/litre, tCO_2e/kWh, tCO_2e/km, etc.). These emission factors come from scientific databases which are regularly updated.

[5] STIB has chosen to use the electricity emission factor of its supplier regardless of certificates called "Guarantee of Origin" (GO) of its electricity contract. They actually ensure the traceability of green electricity but do not provide guarantees for the accounting of emissions.

Parameters of influence

Based on the 2010 diagnosis, STIB identified and analysed the main variables which significantly alter its energy consumption, its GHG emissions and its investment decisions.

• **The transport provision:** The transport provision is the main internal factor of influence on STIB's energy consumption and GHG emissions. In fact, the energy consumed by rolling stock is the main source of GHG emissions. In its management contract, STIB predicts a significant increase in its transport provision between now and 2017 (+21%). For the 2017-2030 period, STIB aims to increase its transport provision yet more by almost 60%, to achieve more than 14 billion seats-km, with in particular a considerable expansion in the metro transport provision which will have more than doubled between 2010 and 2030.

• **The workforce:** For 2010, the variable share of STIB's workforce directly correlated with the transport provision has been estimated at around 40% of staff. Following the predictions for the transport provision, the number of STIB employees will border on 9,000 full-time equivalents by 2030.

• **The surface area of buildings:** Although the total surface area of stations will change very little, the surface area of other heated buildings will increase between now and 2030, following the construction of new depots and workshops. In the end, by 2030, the total surface area of STIB buildings could amount to more than 550,000 m^2, making an increase of around 20% in comparison with 2013.

• **Energy costs:**

› STIB has experienced a significant increase in its energy bill in recent years (more than 50% between 2007 and 2012). This increase is partly due to the increase in STIB consumptions (around 10%), but mainly to increases in energy prices and in particular that of electricity (increases respectively of around 40% and 50%). Efforts to introduce energy efficiency carried out in recent years by STIB have fortunately been able to reduce the impact of energy price increases on the company's bill.

› On the basis of price change scenarios established by the International Energy Agency (for diesel and gas) and by the European Climate Foundation (for electricity), and taking into account the change in other variables presented above, STIB has estimated that its energy bill would increase in a range between 70% and 115% by 2030 compared to 2010. In the worst-case scenario, STIB's annual energy bill could reach more than €70 million by 2030 (in other words an annual increase of 4%), or 25% more than in a constant price scenario.

Actions aiming to reduce emissions

Through extensive internal consultation, STIB has identified more than **fifty actions** covering

- Rolling Stock
- Buildings
- Purchases
- Company's mobility plan
- Waste
- Production of renewable energies

Each one of them has been characterised in accordance with the following criteria:

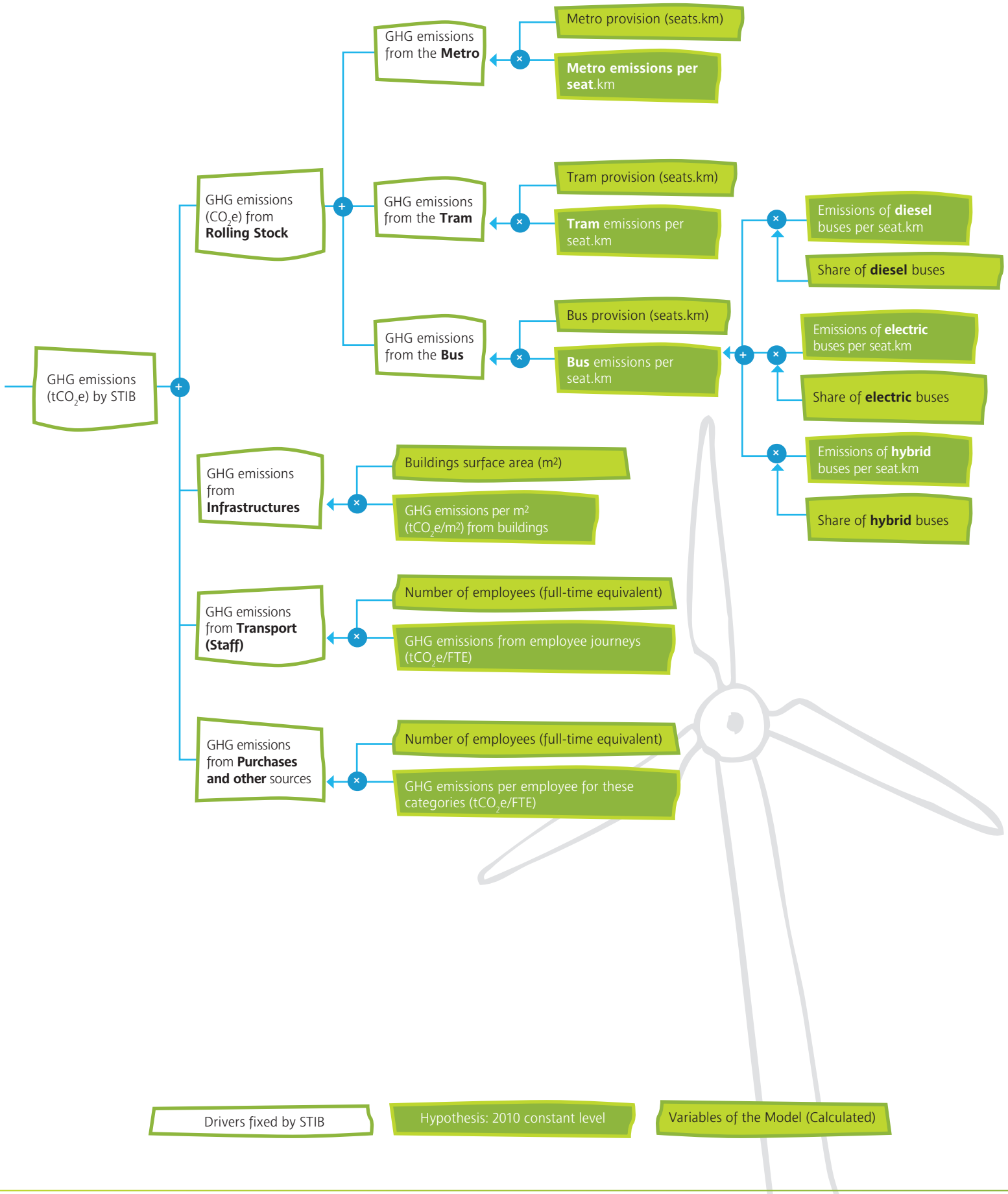
Criteria	Examples of indicators
GHG emissions	Quantities of CO_2 avoided by the action
Energy	Impact of the action on the energy consumption reduction in kWh (electricity, gas and diesel)
Total financial costs	Capital expenditures (CAPEX), operating costs (OPEX), benefits linked to energy costs,… required by the action
Timing for implementation	Number of years required to implement totally the action and reach its full potential
Human investments	Number of additional FTEs necessary to implement the action
Impact on reputation	Scale representing the impact on reputation (e.g.: from «negative or neutral» to «very positive»)
Difficulty of implementation	Pioneer or proven technology, expressed qualitatively

Actions with the greatest potential for reducing CO_2 emissions are those which relate to rolling stock, in particular the gradual electrification of buses.

The renewable installations considered for this carbon and energy strategy have been limited to photovoltaic and wind turbine systems. It should be noted that by 2030, even in a proactive scenario involving improvements in energy efficiency, STIB's electricity consumption will still be high, reaching more than 350 GWh. It would therefore be necessary to have around 70 "on-shore" wind turbines to produce this energy in a renewable way and therefore to be able to attempt to eliminate the GHG emissions from its electricity consumption.

Modeling

In order to evaluate the impact of the different measures on the overall objective for the reduction in STIB's CO_2 emissions, the following model has been considered.



Reference and alternative scenarios

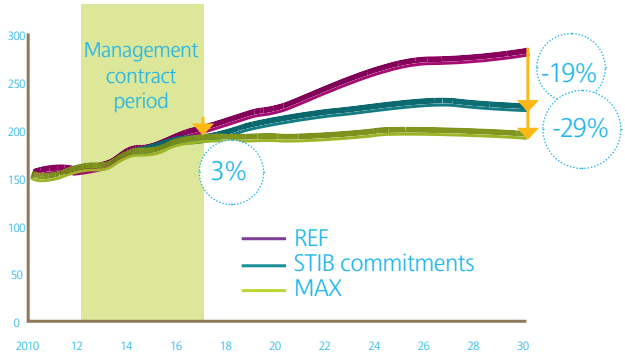
Following the model defined above, three alternative scenarios have been drawn up and quantified.

Scenario	Description	Action plan
REF	The **reference scenario** extrapolates GHG emissions between 2010 and 2030, on the basis of predictions for the development of STIB's transport provision (management contract until 2017 then STIB estimation until 2030), of the number of employees and the surface area of its buildings. The technologies remain unchanged as compared to 2010.	This scenario represents the «business as usual» situation and does not include the implementation of new actions.
STIB commitments	This scenario illustrates the impact of the **commitments** already made by STIB in particular through its management contract for 2013-2017.	The main actions reside in an objective to reduce energy consumptions by -8.5% for buildings and rolling stock by 2017 in comparison with 2010, calculated considering a constant activity.
MAX	Considered as the **"maximum realistic"** according to the experts consulted, this scenario pushes all levels of ambition to their maximum with the introduction of new measures at the end of the 2013-2017 management contract. This implies that STIB will be concentrating until 2017 on the commitments undertaken in the management contract and that it will then implement the new actions identified, with the maximum effort possible.	This scenario includes both more in depth applications of the «STIB commitments» scenario and new actions. And so the main actions of this scenario are as follows: • Purschase of new buses emitting less GHG per kilometre (hybrid and electric buses); • Increase of tram and bus lanes and improvement in their commercial speed; • Stepping up of energy efficiency measures for buildings; • Monitoring and reduction in unnecessary purchases; • Production of renewable energies.

The graphs below illustrate the evolution of STIB's energy bill and its relative and absolute emissions under each of these scenarios.

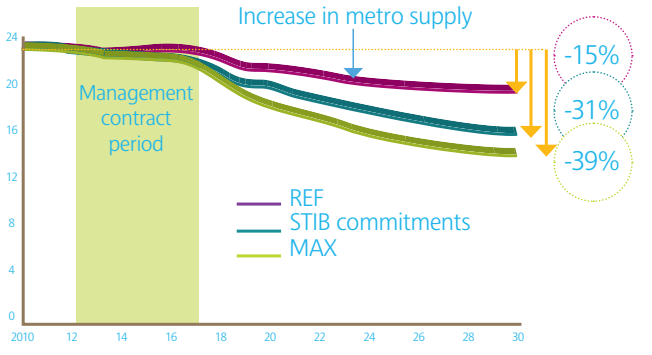
The change in **overall emissions** by STIB is represented by this first graph for the three scenarios. The "MAX" scenario will allow STIB to keep its emissions constant from 2017 onwards, and this despite the significant expansion of the transport provision.

Changes in emissions in accordance with 3 scenarios, $ktCO_2e$

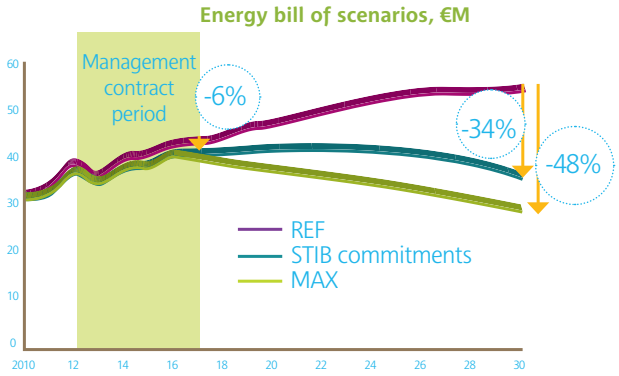


With regard to **relative emissions**[6] gCO_2/seat-km offered, the reference scenario already demonstrates a gradual reduction in emissions per seat-kilometre due to the increase in the modal share of the metro in STIB's transport provision (the metro is the mode with the lowest emissions). The "MAX" scenario reinforces this tendency by reaching a reduction of 40%. We should reiterate that relative emissions here cover the entire scope of the carbon and energy strategy, and therefore not only emissions from traction energy as shown in the Journey Planner[7]. In comparison to the reference scenario, direct emissions will be reduced by 50% by 2030 with the "MAX" scenario.

Relative emissions in accordance with the scenarios, gCO_2e/seat.km

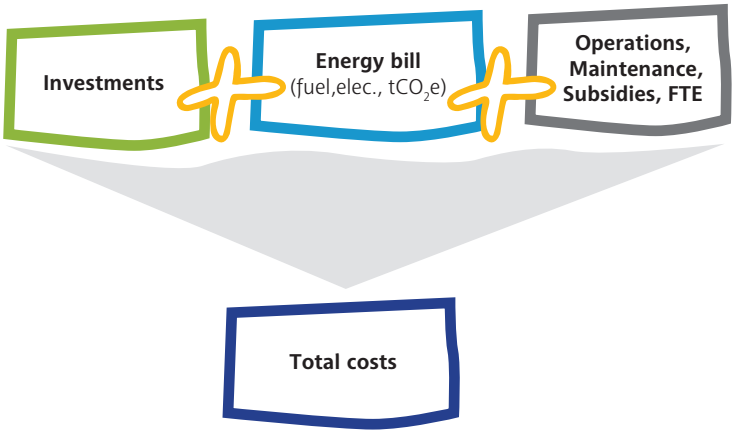


The annual **energy bill** covers expenses for the purchase of diesel, gas and electricity (for traction and for buildings). In order to facilitate the comparison between the scenarios, the energy bill is evaluated on the basis of energy prices (€/kWh) for 2010 considered as constant until 2030[8].The energy bill corresponding to the reference scenario will amount to around €55 million in 2030. The "MAX" scenario would enable STIB to reduce its energy bill by half compared to the reference scenario.



STIB has also calculated the differential in total costs of the scenarios which incorporate investments, the energy bill, operational costs and FTEs.

Annual investments are calculated as additional costs in relation to the reference scenario. For example, for an electric bus, only the difference in price between an electric bus and a diesel or hybrid bus is taken into account. The energy bill has already been defined above. Finally, operational costs for maintenance and management are also calculated as a difference in relation to the reference scenario. They also incorporate, where applicable, subsidies, sale of energy produced and additional staff.



This study indicates that the additional investment phase necessary for the "MAX" scenario is compensated for by the gains in the energy bill, so that these scenarios will be profitable between now and 2030 despite the constant energy cost hypothesis.

And so, according to current hypothesis, the "Commitments" scenario would represent a reduction in annual spending of around €15M for the year 2030 as compared with the reference scenario. The "MAX" scenario would lead to a reduction of around €25M for the year 2030. In this case, the total costs of the "MAX" scenario would represent half of that of the reference scenario.

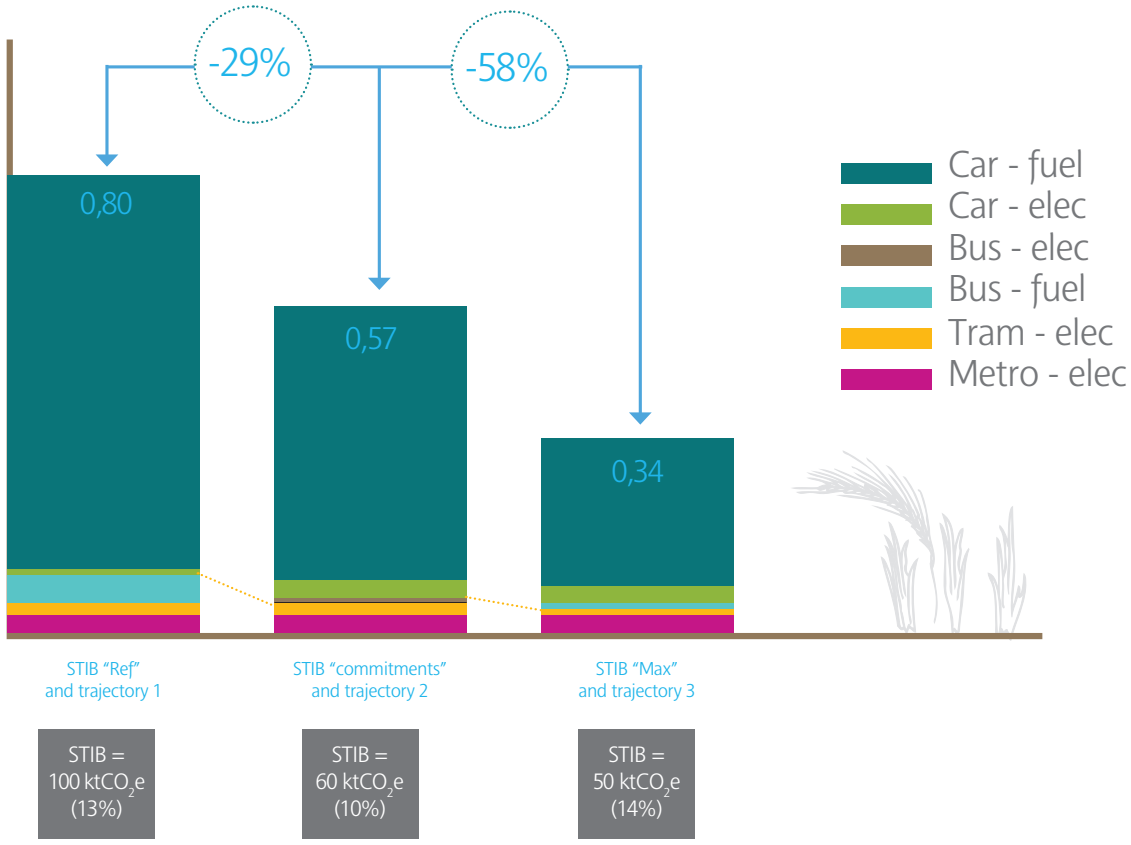
[6] Hypothesis of constant emission factors and vehicle occupation rate (2010 reference)
[7] http://www.stib.be
[8] Other scenarios incorporating different development trends in energy prices have also been considered

Contribution of STIB to emissions by passenger transport in the Brussels-Capital Region

Since motorisation technologies and the modal distribution will certainly evolve between now and 2030, STIB has put the impact of its different scenarios into perspective with regional aims (modal shift and development in technologies)[9]. The figure below shows three combinations of modal split, degree of car engines development and STIB carbon scenario, from a low (left) to high (right) regional ambition. The main conclusions are as follows:

- As compared with the conservative scenario (located to the left in the graphic), passenger transport emissions may reduce by 30% to 60% in accordance with different combinations of modal shift, motorisation technologies and STIB's carbon strategy.
- In all scenarios, the contribution of the car to the sector's GHG emissions remains predominant, despite modal shifts and technological developments;
- Thanks to an ambitious carbon and energy strategy, STIB will be able to reduce GHG emissions in this sector by 5%, without taking into account the additional benefits engendered by modal shift and the development of motorisation technologies.

Emissions by the passenger transport sector in the RBC region in 2030 in accordance with different scenarios, $MtCO_2e$



[9] *Source : Mobility Observatory for the Brussels-Capital Region*

STIB's new carbon commitment towards 2030

At the end of this study, from amongst the scenarios drawn up, STIB has selected the "MAX" scenario which allows it to focus its resources in the short term on the commitments made in the 2013-2017 management contract before deploying new ambitious measures. During the 2013-2017 period, STIB will therefore strive to reduce its direct energy consumption by 8.5% as compared with 2010, for constant activity levels. From 2018 it will already be preparing the ground for the implementation of the actions identified in the "MAX" scenario.

This scenario is also attractive from a financial point of view, as the necessary investments are compensated for by the gains obtained on the energy bill even in a minimalist scenario of constant energy prices.

The most significant actions are those which relate to rolling stock, in particular the electrification of buses. We should note therefore, that this strategy is based on the necessary maturation of electric bus technologies, a sine qua non condition for achieving the fixed objective.

Relative emissions (direct and indirect emissions per seat-km offered) will reduce by 40% between now and 2030.

And so the main actions for this scenario are as follows:

Rolling stock

- Hybridisation then electrification of the bus fleet
- Energy recovery from tram and metro braking
- Metro, bus and tram ecodrive
- Renewal of tram fleet
- Improvement in commercial speed of the three modes
- Improvement in the effectiveness of the metro network with automation
- Optimisation of heating and ventilation of vehicles

Infrastructures

- Remote metering of building consumptions
- Awareness raising amongst staff of sustainable energy use
- Improvement of lighting in stations and depots
- Improvement in HVAC systems of infrastructures (including the deployment of new cogeneration units)
- Eco-construction of buildings
- Improvement in the incorporation of REU clauses for maintenance
- Production of renewable energy, mainly via photovoltaic technology
- Transition to a more sustainable food supply in STIB restaurants

In terms of renewable energy, in addition to the energy production projects on STIB sites (cogeneration and photovoltaic), STIB could become a partner in the development of regional renewable energy production projects. The relevance of this type of partnership will be estimated per project, when they have reached sufficient maturity. STIB will also seek to obtain the lowest possible emission factors for the energy it has to import.

In conclusion…

Between now and 2030 the STIB undertakes to reduce direct and indirect GHG emissions by 40% for journeys undertaken in its network (reference 2010) (gCO_2 per seat-kilometre offered). Within the scope of direct emissions alone, this reduction moves to 50%. In absolute values, STIB's emissions will only increase by 20% as compared with 2010 for a doubled transport provision.

So STIB will contribute to a 5% reduction in passenger transport emissions in the Brussels-Capital Region (considering unchanged behaviour). This figure will obviously be inflated by the reduction in GHG emissions induced by the modal shift from cars to public transport.

STIB therefore participates actively in the Brussels objective for the reduction of Region emissions in the transport sector, without counting the other benefits it will produce, notably in terms of congestion reduction and air quality improvement.

This study has been carried out with the support of the Climact consultancy as part of the Ticket to Kyoto project, funded by the Interreg IVB North-West Europe program.