WP 4: INTEGRATING CARBON REDUCTION IN DECISION MAKING AND KEY BUSINESS PROCESSES

Business Cases, Procurement, Financing and Capacity-Building

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The partners of this project are:

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

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Notice

This document and its contents have been prepared and are intended solely for the five Ticket to Kyoto partners (moBiel, RATP, RET, STIB and TfGM) for their information and use in relation to the Ticket to Kyoto project, WP4 – Optimising policies and regulations for CO_2 reduction in the public transport sector.

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Executive summary

Ticket to Kyoto

The Ticket to Kyoto project has been established to reduce CO_2 emissions in public transport through more environmentally friendly behaviour and changes in infrastructure. The project's five partners are:

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

The project took place over four years (2010 to 2014), co-financed by the INTERREG IVB North West-Europe Programme. Its key goal is to *"introduce the principle of low CO_2 emissions as the new standard for public transport providers"*.

WP4 - Optimising policies and regulations for CO_2 reduction measures

To reach this goal the project has identified five key actions plans delivered within a series of five work packages (WP). Atkins was commissioned to assist the partners with WP4 - Optimising policies and regulations for CO_2 reduction measures.

WP4 focuses on the interactions between public transport operators and authorities and their stakeholders, including local government, suppliers, maintenance operators, as well as the policy and legal context within which they operate.

The work was undertaken in two stages:

- An initial study undertaken in 2011/12 identified a set of 10 recommendations for partners to optimise *"policies and regulations for CO_2 reduction measures"* within their context;
- This report presents the result of work undertaken in 2013/14 to further develop four of the recommendations included in the 2012 report:
  - Recommendation 2 - Improvement to business cases process and guidance (all partners);
  - Recommendation 3 - Capacity building and tools (TfGM);
  - Recommendation 6 - Using ESCO and EPC models (RET and TfGM); and
  - Recommendation 8 - Including GHG performance in procurement process (all partners).

Business case processes and guidance (R2)

T2K partners regularly use a range of appraisal indicators including some or all of the following: payback period (often required to be less than three years, with up to six years accepted in some cases), Discounted Cash Flow (DCF), Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return (IRR), full life financial impact on organisation, Life Cycle Cost (LCC) or Total Cost of Ownership (TCO). Some partners noted that although DCF analysis is generally used, simple payback (without DCF or any further analysis) is sometimes used on smaller projects. Some partners have developed spreadsheet templates or specialist software to undertake the financial appraisal element of the business case.

Environmental (and wider) impacts are not always included in these business case/appraisal processes however and energy use (electricity or fuel) is often considered only as part of wider operating costs rather than identified as a separate cost in the financial analysis. This seems to be especially true for smaller projects or projects which do not require any external funding (for example from another public body or government department).

Partners generally expressed interest in further developing their business case and appraisal techniques and standards to improve consistency and comparability and take account of wider impacts such as energy use and associated emissions where possible. However, some expressed the view that the process should not become too onerous as staff resources are limited and some projects are relatively small. The principle of “proportional appraisal” should be applied – where the effort required to include a benefit (or disbenefit) outweighs the advantage of taking it into account, it should not be quantified but a qualitative assessment can be included instead.

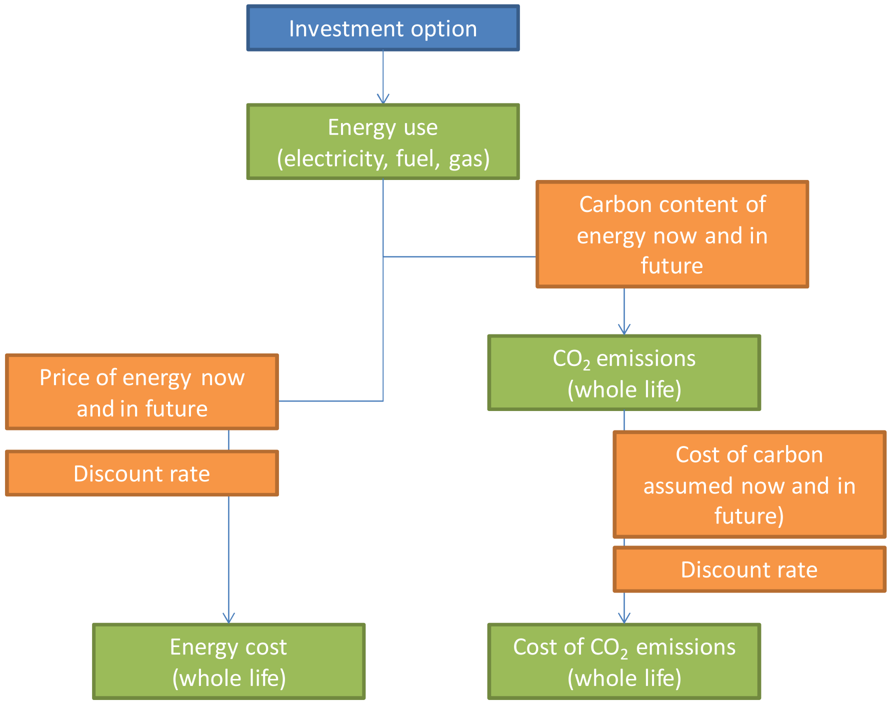
Appraisal methods and assumptions

The choice of appraisal method and/or indicator can have a significant impact on the energy efficiency (and related carbon emissions) of a project or organisation. For example, although easier to calculate, the simple payback period tends to be overly simplified to assess options with a long term impact on energy use and maintenance costs.

DCF analysis and the use of holistic methods such as TCO and LCA do not however guarantee an energy efficiency friendly appraisal. Appraisal results can be significantly influenced by the assumptions made to support the calculations, as shown in Figure E.1. It is therefore important that key assumptions used in appraisal processes are clearly identified, used consistently (to enable comparison between investment options) and can be tested to identify any (unintended) bias against energy efficient/ low carbon options. This study considers the impact of assumption selection with regard to:

- Appraisal period;
- Discount rates;
- Future energy prices;
- Carbon intensity of energy used; and
- Cost of carbon.

Figure E.1: Impact of selected assumptions on whole life emissions, energy and carbon costs



Appraisal template

Work undertaken under WP4 included the development of a spreadsheet tool to show examples of best practice for projects financial appraisal, focusing on how energy use and associated carbon emissions and costs can be expressly considered in the analysis.

The spreadsheet tool is provided to T2K partners with this report and provides partners with the "dashboard" required for them to visualise how energy and carbon data can be included in the appraisal and business case process.

Summary of findings and next steps

Partners generally expressed interest in further developing their business case and appraisal techniques and standards to improve consistency and comparability and take wider impacts such as energy use and associated emissions into account. Table E.1 provides a summary of partner progress so far and next steps in the development of business case processes to support energy efficient investment.

Table E.1: Summary of findings and next steps by partner

T2K partner	Business case processes and guidance – Summary of findings and next steps
moBiel	Established appraisal methods, including government guidelines used for larger projects Importance of appraisal/business case process remaining simple and “proportionate” Next steps - Limited need for further developments linked to review of assumptions used (e.g. linked to the planned change of energy mix in Germany)
RATP	Established financial appraisal methods and dedicated software includes consideration of energy use and resulting emissions but methods and software are not used systematically. It often depends on the project manager’s level of awareness with regard to energy use and emissions Some assumptions based on government guidelines but need for data on projected changes (energy cost, carbon intensity, cost of carbon) and existing assumptions need to be updated in some cases Next steps - Need to better include environmental considerations (energy, carbon) in dedicated tool and to ensure that tool is used widely/consistently; need to require further support on assumptions and projection from government agencies
RET	Project management methods established (based on Prince 2) but limited inclusion of energy use/carbon consideration in financial appraisal at present Appraisal process needs to remain simple to be undertaken by project managers who might not have financial appraisal knowledge but needs to be more consistent Next steps – Enhance current processes and formats to better include consideration of energy use and associated emissions
STIB	Project management methods established. Financial appraisal methods under review and further development being undertaken Appraisal assumptions linked to energy and emissions and tools being developed in parallel to WP4 work, building on good practice and information exchange from T2K project Next steps – Finalising new appraisal methods and assumptions and ensuring consistent use across the organisation
TfGM	Established project management and business case/financial appraisal methods, including government guidelines used for larger projects Spreadsheet tool available for project managers Strong set of appraisal assumptions developed at national level (energy prices, carbon intensity, shadow cost of carbon) Next steps - Limited need for further developments linked to resources and the need for decision-makers to develop further knowledge of energy/environmental issues

Including GHG performance in the procurement process (R8)

Building on existing practices and guidance, this part of the study explored how the GHG/sustainability performance of services and products purchased by T2K partners could be improved through the procurement process.

The Chartered Institute of Purchasing and Supply (CIPS) proposes the following definition for sustainable procurement: "*socially and ethically responsible purchasing which aims to minimise the organisation's environmental impact (including through the supply chain) and deliver economically sound solutions*".

The European Commission defines Sustainable Public Procurement (SPP) as public authorities seeking to achieve the appropriate balance between the three pillars of sustainable development - economic, social and environmental - when procuring goods, services or works at all stages of the project. Green Public Procurement (GPP) is defined as public authorities seeking to procure goods, services and works with a reduced environmental impact throughout their life-cycle.

The principles of sustainable procurement should result in reduced environmental damage and costs by:

- Questioning the need to buy;
- Reducing quantities;
- Saving energy, water and resources;
- Promoting re-use and recycling; and
- Minimising risk (e.g. negative publicity, environmental risks).

At the European level, new public procurement directives were adopted by the European Parliament in 2014 and Member States have to transpose the directives into national law by January 2016. Two key objectives of the reform were to facilitate taking account of environmental, social and innovation factors and to provide more flexibility in procedures and timelines, complemented by greater use of e-procurement. The new directives give greater prominence to LCC as a means of calculating costs, including the cost of environmental externalities such as GHG emissions, with the methodology to be indicated in advance in the tender documents.

There is a wealth of resources available at European or national (and in some instances regional) level to support project managers and procurement teams in developing specifications which aim to minimise environmental impacts. This includes the European Commission's common GPP criteria, which provide examples of criteria and requirements for purchasing authorities to use, in line with Eu regulations.

T2K partners are generally aware of these resources and are generally committed to sustainable procurement. All partners have identified some examples of the application of sustainability criteria to their purchases. Partners however noted that delivering their commitment to sustainable procurement requires staff resources and buy-in from procurement and legal teams, who can be risk averse, for example when considering the use of new requirements in specifications.

Table E.2: Summary of findings and next steps by partner

T2K partner	Including GHG performance in the procurement process – Summary of findings and next steps
moBiel	Established approach Next steps - Limited need for further developments
RATP	Established approach and good practice examples provided Next steps – Further progress in including environmental considerations (energy, carbon) in procurement process, supported by business case/financial appraisal developments
RET	Established approach and good practice examples provided Next steps – Enhance current processes to better include consideration of energy use and associated emissions
STIB	Established approach supported by regional requirements and good practice examples provided Next steps – Enhancements linked to progress with appraisal methods and assumptions to be applied consistently, including for the procurement process
TfGM	Established approach based on national framework Next steps - Limited need for further developments mainly linked to resources and the need for buyers, project managers and procurement officers to develop further knowledge of energy/environmental issues

Third party involvement – using ESCO and EPC models (R6)

RET and TfGM expressed an interest in further investigating the potential for using Energy Service Companies (ESCOs) or Energy Performance Contracts (EPCs) within their organisation. Background information on ESCOs/EPCs was updated and presented to RET and TfGM at workshops, where the barriers to energy efficiency investment and the potential to involve third parties were discussed.

Definitions

The European Commission defines the various models considered as follows:

- **Energy Service Company (ESCO)** - a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria;
- **Energy Performance Contracting/Contracts (EPC)** - a contractual arrangement between the beneficiary and the provider (normally an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement; and
- **Third Party Financing (TPF)** - a contractual arrangement involving a third party (in addition to the energy supplier and the beneficiary of the energy efficiency improvement measure) that provides the capital for that measure and charges the beneficiary a fee equivalent to a part of the

energy savings achieved as a result of the energy efficiency improvement measure. That third party may or may not be an ESCO.

Additionally, **Energy Supply Companies (ESCs)** were also discussed with RET and TfGM, where third party invest in low carbon/renewable energy equipment on behalf of a customer and recovers the cost of the investment by selling the energy produced to the grid (and providing low carbon energy to the customer).

Benefits and drawbacks

Table E.3 presents a summary of benefits and drawbacks from ESCO and EPC models. This shows how third party involvement might help to address some key barriers to energy efficiency investment for public transport authorities but can also be difficult to implement within the public transport sector. ESCOs would generally be expected to charge an additional 8 to 10% (when compared to in-house delivery) although it can be difficult to identify this additional charge where an ESCO provides finance as well as technical expertise (what is cost of capital and what is technical expertise cost).

Table E.3: ESCO and EPC models – Summary of benefits and drawbacks

Benefits	Drawbacks
Access to capital/credit for energy efficiency investment	Loss of control of equipment and plant (installing, maintaining)
Reduced energy costs and emissions	Resistance within the organisation against outsourcing
Reduced technology risk	Lack of in-house expertise to establish EPC type contracts and manage the long term relationship
Financial risk reduced or transferred	Lack of supplier expertise in transport sector (relatively new sector in the UK)
Reduced search and transaction costs	

The ESC model usually involves a third party delivering low carbon/renewable energy (e.g. wind or solar). The financial case for this type of investment strongly depends on the price of energy, including any subsidies/support tariffs and/or Certificates of Origin available. The financial case might vary between energy sources as prices and incentives are likely to differ. Table E.4 presents a summary of benefits and drawbacks from ESC models.

Table E.4: ESC model – Summary of benefits and drawbacks

Benefits	Drawbacks
Access to capital/credit for renewable energy investment	Loss of control of equipment and plant (installing, maintaining)
Reduced energy costs and emissions	Requires long term commitment from land/building owner
Reduced technology risk	Resistance within the organisation against outsourcing
Financial risk reduced or transferred	Lack of in-house expertise to establish this type of contracts and manage the long term relationship
Reduced search and transaction costs	Lack of supplier expertise in transport sector

Next steps

RET and TfGM identified a limited scope for potential third party involvement, as shown in Table E.5, and agreed that they would continue to watch developments in this emerging sector as they might need third party support in the future.

Table E.5: Summary of findings and next steps by partner

T2K partner	Using ESCO and EPC models – Summary of findings and next steps
RET	Parallel study undertaken to review the potential for renewable energy investment for RET (technologies and investment options) Limited need for third party involvement, mainly linked to technical expertise Next steps – Development of renewable energy strategy based on parallel study recommendations and keeping abreast of developments in the ESCO/EPC and ESC market in the Netherlands
TfGM	Limited need for third party involvement mainly linked to technical expertise and potential for further involvement identified with new build projects Next steps - Investigate the possibility of involving a third party in the development and delivery of a new build project to deliver additional energy efficiency/renewable energy investment; keeping abreast of developments in the ESCO/EPC and ESC market in the UK transport sector
Other partners	Limited scope and need for third party involvement due to a range of factors Next steps – Keeping abreast of developments in the ESCO/EPC and ESC market

Capacity building and tools (R3)

Some T2K partners identified the issue of the lack of staff resources with the skills and capacity to implement energy efficiency and sustainability recommendations as a key barrier. TfGM decided to act on this issue by developing a tool to assist buyers, project managers and contract managers in considering energy use and associated carbon emissions as well as wider environmental and sustainability issues when planning a project or procuring equipment or services. The RET team has therefore been involved in the early stages of the tool's development.

Purpose of the tool

The purpose of the tool was discussed at an initial workshop with TfGM staff in March 2014 and is summarised below:

- Focus on small projects, maintenance programme (as another TfGM tool is being developed in parallel, considering large construction projects);
- Support consideration of energy use, carbon and wider environmental impacts across the organisation's activities;
- Support legal compliance by identifying potential areas where advice might be required;
- Improve personal responsibility for considerations beyond a specialist Environmental Team;

- To be used by buyers, project/contract managers and project teams;
- To provide a proportional approach (e.g. light touch for small projects but addressing low value/high risk and cumulative effect issues if possible).

Tool structure

The tool has been designed to prompt buyers, project managers and contract managers to consider the potential environmental and sustainability impacts of decisions they make related to projects, maintenance and purchasing. It prompts users to consider impacts from two different perspectives:

- Considering potential issues arising from a project or planned purchase from the environmental/sustainability impact perspective – inviting a high level reflection on the most relevant issues and what can be done to avoid or mitigate them; and/or
- Considering potential issues and mitigation measures by type of material or service to be used or procured – encouraging a detailed consideration of the potential to reduce the impact of small projects and purchases on a day-to-day basis through the use of specifications and labels.

Next steps

The tool has been developed specifically for TfGM and therefore focuses on the UK context (legal requirements and government commitments). It would however be possible to adapt the tool to reflect the context of other T2K partners, especially as many references included in the tool are relevant at the European level.

Partners are likely to want to review the tool developed for TfGM once it is completed and might decide to adapt it for their own use or retain some of the information included in the tool for their own guidance.

Introduction

Ticket to Kyoto

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The project took place over four years (2010 to 2014), co-financed by the INTERREG IVB North West-Europe Programme. Its key goal is to *"introduce the principle of low CO_2 emissions as the new standard for public transport providers"*.

WP4 - Optimising policies and regulations for CO_2 reduction measures

To reach this goal the project has identified five key actions plans delivered within a series of five work packages (WP). Atkins was commissioned to assist the partners with work package 4 - Optimising policies and regulations for CO_2 reduction measures.

WP4 focuses on the interactions between public transport operators and authorities and their stakeholders, including local government, suppliers, maintenance operators, as well as the policy and legal context within which they operate.

The work was undertaken in two stages:

- An initial study undertaken in 2011/12 identified a set of 10 recommendations for partners to optimise *"policies and regulations for CO_2 reduction measures"* within their context[1];
- This report presents the result of work undertaken in 2013/14 to further develop four of the recommendations included in the 2012 report:
  - Recommendation 2 - Improvement to business cases process and guidance (all partners);
  - Recommendation 3 - Capacity building and tools (TfGM);
  - Recommendation 6 - Using ESCO and EPC models (RET and TfGM); and
  - Recommendation 8 - Including GHG performance in procurement process (all partners).

[1] See Ticket to Kyoto, Contextual Drivers for CO_2 Reductions in Public Transport, Atkins, 2012 (available at www.tickettokyoto.eu/publications - accessed April 2014)

This report

This report documents the findings of the study, including all evidence and information identified through the study process. It supplements a summary report produced to disseminate the findings across the five partners.

- **Section 1** presents the results of evidence gathering and workshops undertaken with the five partners focusing on **business case and project appraisal** processes, and includes an introduction to the template for financial appraisal, showing how energy use and associated carbon emissions and costs can be expressly considered by partners;

- **Section 2** focuses on the inclusion of **CO_2, environmental and sustainability considerations into the procurement process**, showing examples of good practice from partners and elsewhere;

- **Section 3** summarises the findings of reviews and discussions around **third party involvement models for energy efficiency (e.g. ESCO, EPC)** undertaken with RET and TfGM; and

- **Section 4** introduces the results of the work undertaken with TfGM on **capacity building and tools** to encourage energy efficiency and CO_2 reductions within the organisation, presenting the "sustainability tool" developed for TfGM, to support project managers, procurement officers and contract managers in their day to day roles.

The choice of appraisal method and/or indicator can have a significant impact on the energy efficiency (and related carbon emissions) of a project or organisation. For example, although easier to calculate, the simple payback period tends to be overly simplified to assess options with a long term impact on energy use and maintenance costs.

1. Business case processes and guidance (R2)

1.1. Objectives and methodology

The 2012 report identified a need to better understand and potentially improve business case processes and guidance in order to support investment in low energy/low carbon initiatives. This was based on the realisation that there was a lack of agreed practice and assumptions amongst some T2K partners when considering the impacts of proposed investment. For example, it was clear that assumptions were made on future energy prices which were not always realistic and potentially resulted in less energy efficient solutions being implemented. Also, the approach to adopt in terms of carbon assessment and the cost of carbon was unclear, and whole life cost assessments were not always undertaken or completed.

Building on the recommendations from the 2012 report, the five T2K partners expressed an interest in taking this recommendation forward and aimed to:

- Analyse and understand current practices for example with regard to energy prices used, cost of carbon emissions, whole life costing/total cost of ownership, discount factors, net present value analysis and sensitivity analysis;
- Identify and assess relevant decision making processes within each organisation;
- Identify and evaluate best practice, amongst the five partners and beyond;
- Identify possible options for sustainability (including energy use and CO_2 emissions) to be better integrated within the business case/decision making process; and
- Develop a "dashboard" to provide a visual representation of the data to be used in the business case/decision process.

To meet these objectives, the study team:

- Gathered information and data from the five partners and other organisations as relevant;
- Facilitated workshops to discuss business case and appraisal practice with each of the five partners;
- Developed two spreadsheet tools to facilitate good practice exchange and support the development of tools within individual partner organisations
  - One tool presents simple examples of financial appraisal using the discounted cash flow (DCF) method and offers the possibility for users to test the impact of various assumptions on financial appraisal results – some results from the tool are included as examples in the following sections; and
  - The second tool is set up as an indicative template for financial appraisal, showing how energy use and associated carbon emissions and costs can be expressly considered in the analysis, providing the "dashboard" required by the partners to visualise how energy and carbon data can be included in the appraisal and business case process. A description of the tool, including screenshots, is included in Section 1.6.

1.2. Scope

The work undertaken for this section examines how decisions to invest in equipment or services are made by the five partners and what costs, benefits, advantages and drawbacks are taken into account when considering possible options. Examples and recommendations focus on improving the consideration of energy efficiency and carbon emissions as per the T2K project objectives and does not intend to present a comprehensive review of business case processes for each of the five partners.

A wide range of decisions

The range of decisions, which can be taken by the T2K partners, varies with their organisational structure and wider governance context. For example, RET specifies and purchases buses to run bus services in the Rotterdam area, but TfGM procures services from private bus operators for parts of the bus network only. The vehicles in use in Greater Manchester are specified/ purchased by TfGM only in a minority of cases, with private operators usually making these decisions.

T2K partners provided examples of recent investment decisions that will have an influence on their energy use and associated emissions. For example, moBiel noted that recent investment decisions for the organisation have included rolling stock procurement (rail and bus), renovation of buildings including depots and lighting at stations and depots. RET identified projects such as the procurement of metro vehicles, heating for track switches and data centres for IT.

The decision process examined here is closely linked to the procurement process considered in more detail in Section 2. The appraisal of the costs and benefits of investment options forms part of a sound procurement process. This aspect is however considered separately here, as appraisal is often undertaken before the procurement process starts. It might also restrict the procurement process at a later stage by allowing only a few options to be considered once the principles supporting the investment decision have been agreed.

For example, a decision to invest in lighting maintenance might be made on the basis of the lowest capital cost for the organisation due to financial constraints at the time the decision is made. This might lead to tungsten lamps being chosen instead of LED due to their lower purchase cost, even though they are less energy efficient and have a higher whole life cost.

TfGM identified recent building programmes (new build or major refurbishments) where LED lighting had not been specified from the start. This was either due to the delay between specifications being developed and the project being implemented (with LED technology not being seen as sufficiently robust at specification stage several years ago) or due to value engineering processes at the end of the design phase focusing on reducing construction costs. LED lights were then retrofitted to these buildings within the first few years of operations using maintenance/small capital investment budgets as the investment offers good value for money when operational costs are accounted for.

Definitions

Financial appraisal is an analysis conducted to determine the merit of an item or project, taking account of established criteria including costs and impacts (and their valuation). Various methods can be used to undertake a financial appraisal including (but not limited to):

- **Cost benefit analysis** (CBA) can be used to calculate and compare the benefits and costs of a project, decision or government policy. In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money (discounted), so that all flows of benefits and costs over time are expressed on a common basis (net present value).

- **Whole life cost** (WLC), **life cycle cost/analysis** (LCC/A) or **total cost of ownership** (TCO) are methods which aim to include a wider range of costs and benefits that CBA, by looking at the wider impacts of a project, where possible from "cradle to grave"[2]. Costs considered usually include the financial costs as well as the environmental and social costs which are generally more difficult to quantify. Typical areas of expenditure which are usually included in WLC/TCO include, planning, design, construction and acquisition, operations, maintenance, renewal and rehabilitation, depreciation, cost of finance and replacement or disposal.

The results of the financial appraisal are usually included in a **business case** document, which captures the reasoning for initiating a project or task. The business case usually presents some information on the background to the project, the expected benefits, the options considered (with reasons for rejecting or carrying forward each option, including the option of doing nothing), the expected costs of the project and the expected risks[3].

1.3. Financial appraisal methods and impacts on energy efficiency

Financial appraisal methods overview

Table 1.1 presents a summary of the main appraisal methods generally used by organisations when considering the merit of an item or project. These range from the simple payback method, focusing on how long it will take for the investment costs to be repaid through savings resulting from the investment, to TCO and LCA analysis, which aim to quantify as many positive and negative impacts as possible throughout the project's life.

Whilst many organisations continue to base decisions purely on simple payback assessments, it is established good practice to use a DCF approach in appraising energy efficiency and other sustainable (e.g. water saving) investments. The International Federation of Accountants notes in its International Good Practice Guidance[4] that: *"Project and investment appraisals and capital budgeting, which involve assessing the financial feasibility of a project, should use Discounted Cash Flow (DCF) analysis as a supporting technique to compare costs and benefits in different time periods, and calculate net present value (NPV). NPV utilizes DCF to frame decisions— to focus on those that create the most value.*

[2] From creation to disposal; throughout the life cycle (i.e. raw material extraction, materials processing, manufacture, distribution, use, repair and maintenance and disposal or recycling)

[3] European guidance is available (although not recently updated) from the Commission's Guide to cost-benefit analysis of investment projects Structural Funds, Cohesion Fund and Instrument for Pre-Accession, 2008 (http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/guide2008_en.pdf). International guidance is also available as part of the ISO14000 family (for example including ISO 14031 Environmental performance evaluation and the ISO 14040 series on Life Cycle Assessment)

[4] International Good Practice Guidance: Project and Investment Appraisal for Sustainable Value Creation, International Federation of Accountants (IFAC), August 2013. www.ifac.org/publications-resources/project-and-investment-appraisal-sustainable-value-creation-1

Techniques such as real options analysis can be used to enhance NPV as part of managing risk, as well as return for projects, where there is uncertainty and greater flexibility is required".

Table 1.1: Summary of main appraisal methods

Appraisal method	Description	Advantages	Disadvantages
Simple payback	Divides the project costs by the annual savings to show how long it will take to recoup the initial outlay	Simple method, easy to understand	Does not consider long term impacts (for example additional savings after pay-back period), does not account for value of money over time (discounting), ignores lock-in and path dependency issues
Average rate of return (ARR)	Compares expected profit with money invested over the life of the asset/project (average annual return divided by initial outlay *100)	Simple method, which accounts for costs/savings over lifetime of project	Does not account for value of money over time (discounting), ignores lock-in and path dependency issues
Discounted cash flow (DCF)	Accounts for all the project's current and future costs and savings, which are aggregated into a single lifetime figure, with due allowance made for the fact that cash flows in the far future have less weight than those in the near future (discounting) Provides indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit/Cost Ratio (BCR also known as Profitability Index)	Considers all monetised costs and benefits over the lifetime of the investment	Slightly more complicated method, requires users to be familiar with concepts, significant impact of chosen assumptions (discount rate, appraisal period), frequently not all impacts are taken into account/ monetised/ quantified, ignores lock-in and path dependency issues
Total Cost of Ownership (TCO)	Uses DCF approach, but includes all costs and savings from procurement to disposal	As with DCF, including as many impacts as possible	Can be complex and time consuming
Life cycle analysis (LCA - cradle to grave)	Uses DCF approach and includes all the production processes and services associated with a product/project through its life cycle, from the extraction of raw materials through production of the materials which are used in the manufacture of the product, over the use of the product, to its recycling and/or ultimate disposal	Holistic appraisal approach considering upstream and downstream activities	Can be complicated and sometimes very onerous to undertake, issues with data availability/accuracy (assumptions)

In any case, good practice requires that consideration is given to the following aspects:

- outputs and outcomes of the project (realistic, unintended);
- range and realism of options considered within the business case;
- completeness of the list of costs and impacts and their appropriate valuation (proportionate to the funds involved, outcomes at stake and the time available);
- adequacy of the investigation of the sensitivity of the results to variations in key parameters;
- discount rates applied and their impact on the results; and
- risks faced by the project and their implications.

T2K partners regularly use business case and financial appraisal methods and report on a range of appraisal indicators including some or all of the following: payback period (often required to be less than three years, with up to six years accepted in some cases), Discounted Cash Flow, Net Present Value, Benefit Cost Ratio, Internal Rate of Return (IRR)[5], full life financial impact on organisation, Life Cycle Cost (LCC) or Total Cost of Ownership (TCO). Some partners noted that although Discounted Cash Flow analysis is generally used, simple payback (without DCF or any further analysis) is sometimes used on smaller projects.

Some partners have developed spreadsheet templates (TfGM, STIB – template in development) or use bespoke software (RATP – GISOR-ICARE, see Figure 1.1) to undertake the financial appraisal element of the business case.

RATP's GISOR-ICARE software has been developed specifically for the organisation by the Finance Department and is used by Financial Controllers ("Controleurs de Gestion"). Project Managers don't have access to the software and need to work with their Controller. Feedback from RATP indicates that at present, the software might not always be used, even for "modernization projects". Its use is developing however although the energy elements of the evaluation might not always be filled in.

TfGM includes business case development and project appraisal within the organisation's wider Project Management Procedures (PMP), which govern the project lifecycle via Gateway Review Panels as shown in Table 1.2[6]. TfGM has also developed an Investment Appraisal Guidance document[7] to support staff in preparing business cases.

[5] Also known as economic rate of return (ERR) or discounted cash flow rate of return (DCFROR), defined as the rate at which the present value of all future cash flow is equal to the initial investment or in other words the rate at which an investment breaks even

[6] From the "initiation stage" to the "development stage". Additional PMP stages include "Implementation" and "Close-out"

[7] Investment Appraisal Guidance version 3, TfGM, Transport Solutions Development, Transport Strategy Directorate

Environmental (and wider) impacts are not always included in these business case/appraisal processes however and energy use (electricity or fuel) is often considered only as part of wider operating costs rather than identified as a separate cost in the financial analysis. This seems to be especially true for smaller projects or projects which do not require any external funding (for example from another public body or government department).

Partners generally expressed interest in further developing their business case and appraisal techniques and standards to improve consistency and comparability and take account of wider impacts such as energy use and associated emissions where possible. However, some expressed the view that the process should not become too onerous as staff resources are limited and some projects are relatively small. The principle of "proportional appraisal" should be applied – where the effort required to include a benefit (or disbenefit) outweighs the advantage of taking it into account, it should not be quantified but a qualitative assessment can be included instead.

Figure 1.1: Screenshot from RATP GISOR-ICARE software

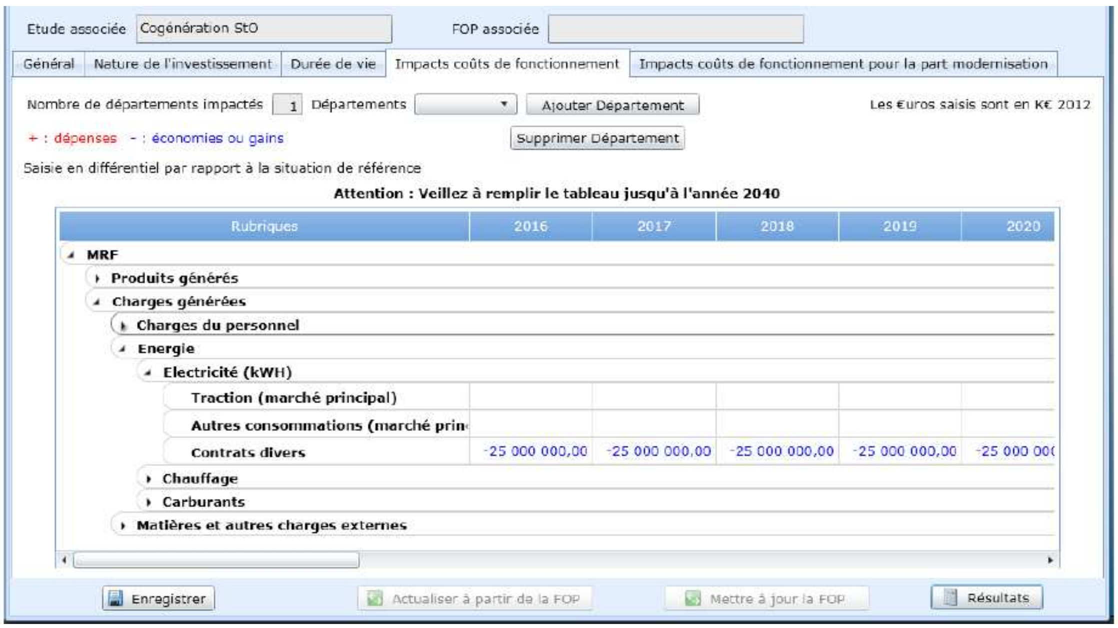


Table 1.2: Overview of TfGM PMP requirements and sustainability/environmental considerations

PMP stages	PMP requirements	Sustainability/environmental considerations
Initiation	Project Initiation Document (PID) • used to establish initial project boundaries, strategic alignment of the project, Key Business Priority (KBP) to which it will contribute • usually indicative information at this stage	Description of the anticipated financial and non-financial benefits required (even in qualitative form at this stage) – can include environmental benefits although not explicitly referred to Description of key risks to the project with suitable mitigating actions required – no explicit reference to environmental risks **Mandatory signatures** - all TfGM projects must consult with internal departments[8] on: • equality impact assessment (EqIA) • **energy resource requirements** (impact on CRC[9] payments) • **environmental impact**
	Gateway 1 – PID approval	
Pre-development	Outline Business Case (OBC) consists of three sections: • Strategic fit - why the project is needed • Options appraisal – to demonstrate that a wide range of options has been considered (including "do nothing" and/or "do minimum") • Recommendation – on which of the options to develop further Additional requirements as per TfGM Investment Appraisal Guidance	Investment appraisal includes: • a financial analysis of the implications of the project for TfGM (always included) • a social cost-benefit analysis (can be excluded) • sensitivity tests (no reference to energy costs) Key financial indicators included in OBC include: • Pay-back period (initial capital costs and annual revenues over first six years), • Net Present Value (using full life discounted costs and benefits) • Benefit to capital cost ratio (using full life discounted costs and benefits compared to additional capital costs to TfGM • Total TfGM cost ratio (using full life discounted costs and benefits) No direct reference to energy use/costs or emissions included in OBC pro-forma **TfGM Investment Appraisal Guidance includes valuation of noise, air quality and greenhouse gases impacts** (as per UK government guidance)
	Gateway 2 – Preferred option	
Development	Scheme development Full Business Case (FBC) including: • Strategic fit • Appraisal • Commercial aspects • Achievability • Recommendations	Content similar to Outline Business Case but with more detailed information No direct reference to energy use/costs or emissions included in FBC pro-forma
	Gateways 3a – FBC approval and 3b – Funding and consents	

8 TfGM are currently reviewing how best to ensure energy, carbon, environmental and wider sustainability impacts are considered whilst also enhancing knowledge and awareness across the organisation (see capacity building).

9 The Carbon Reduction Commitment (CRC) Energy Efficiency Scheme is a mandatory UK Government scheme which requires participating organisations to buy allowances for each tonne of CO_2 emitted (Scope 1 emissions only), with the current price set at £12 per tonne of CO_2. TfGM is not currently part of the CRC scheme but could be required to participate in the future.

Energy efficiency and appraisal methods

The choice of appraisal method and/or indicator can have a significant impact on the energy efficiency (and related carbon emissions) of a project or organisation. For example, although easier to calculate, the simple payback period tends to be overly simplified to assess options with a long term impact on energy use and maintenance costs.

Table 1.3 shows appraisal indicator results for a fictional scheme to replace 250 traditional tungsten lamps (business as usual), considering three replacement options[10]. This clearly shows that different indicators might support the selection of different options. In this example, compact fluorescent lights appear to be the best option when considering Payback and Benefit Cost Ratio (BCR), but LED lights show the best results when considering Net Present Value (NPV).

Table 1.3: Appraisal indicator results for an example scheme to replace lighting equipment

Lighting replacement option (compared to business as usual scenario over 10 years)	**Payback period** (years)	**NPV** (€)	**BCR**
Tungsten halogen	0.58	8,374	3.57
Compact fluorescent	**0.26**	35,626	**14.73**
LED	0.58	**38,127**	9.98

A time based assessment using DCF and a holistic approach (as far as possible), enables better consideration of the following:

- Long term energy savings, which can also decline over time as the efficiency of equipment declines;
- Changing energy prices over time;
- Changing costs of carbon (where included);
- Maintenance costs, which may not be the same each year and might differ according to the chosen option; and
- Lifetime of the measure (replacement cycle, which might also differ according to the chosen option).

[10] Example drawn from the tool developed for T2K partners to present simple examples of financial appraisal using the discounted cash flow (DCF) method and test the impact of various assumptions on financial appraisal results. All assumptions made for this example are summarised in the tool. Assumptions and values are for illustration purposes only.

1.4. Energy efficiency and appraisal parameters and assumptions

DCF analysis and the use of holistic methods such as TCO and LCA do not however guarantee an energy efficiency friendly appraisal. Appraisal results can be significantly influenced by the assumptions made to support the calculations. It is therefore important that key assumptions used in appraisal processes are clearly identified, used consistently (to enable comparison between investment options) and can be tested to identify any (unintended) bias against energy efficient/ low carbon options. This section considers the impact of assumption selection with regard to:

- Appraisal period;
- Discount rates;
- Future energy prices;
- Carbon intensity of energy used; and
- Cost of carbon.

The selection of the appraisal period and discount rate(s) and assumptions made on future energy costs and the carbon content of energy at the start of the project and in the future can have significant impacts on financial results as summarised in Figure 1.2 and Figure 1.3 and explained in more detail in the following sections.

Figure 1.2: Overview of project lifecycle showing energy use, costs and emissions

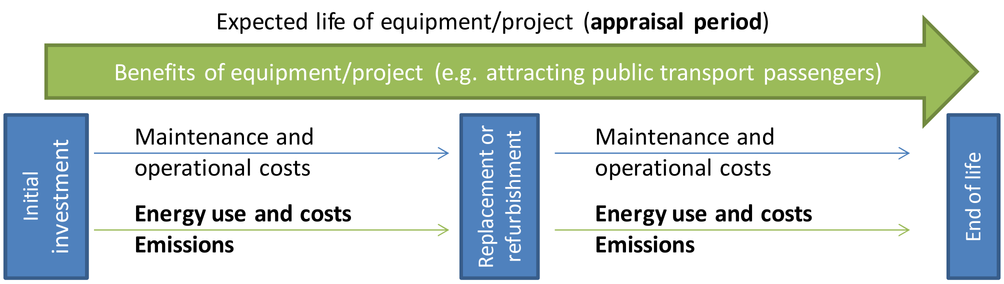
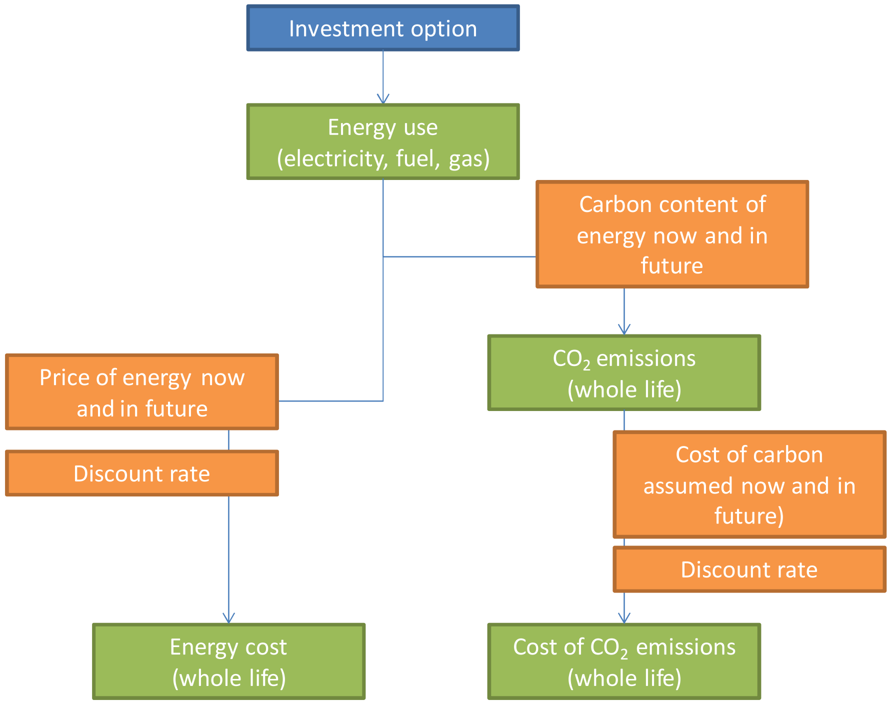


Figure 1.3: Impact of selected assumptions on whole life emissions, energy and carbon costs



Appraisal period

The chosen appraisal period should start with the project start year and end with the last year of the operating period. It should include both the investment period and the operating period, which is generally linked to the useful life (expected life) of the assets considered. For some projects, a number of assets with varying useful life lengths are included in the proposed investment and the selection of the appraisal period requires a degree of professional judgment.

In some countries, government guidance requires a set appraisal period to be used for large transport projects. For example, UK Government guidance recommends 60 years to be used as a standard appraisal period. Some sectors also have developed their own set of guidance as shown for the rail industry in Europe in Table 1.4.

In terms of energy efficiency, on the one hand, if the period selected is too short, the appraisal risks ignoring some energy savings and maintenance/replacement costs or savings (for example, with LED lights, replacement is usually much less frequent than with traditional lights, resulting in significant savings over longer periods). On the other hand, if the selected appraisal period is too long, the appraisal risks accounting for costs or benefits which will not arise as the assets' life might be shorter than anticipated, or the asset might be replaced with new/improved technology during the period.

Table 1.4: Examples of indicative useful life for railway components[11]

Railway components	Indicative useful life
Large embankments in stable grounds	100 years
Drainage works	80 – 100 years
Electrification facilities (distribution and sub-stations)	10 – 50 years
Passenger cars for long distance and regional services (speed over 120 km/h)	25 years
Passenger cars for suburban and metropolitan services (speed under 120 km/h)	15 years

T2K partners tend to select appraisal periods depending on the type of investment under consideration. For example, moBiel tends to use 10 to 12 years for buses, but 30 years for tramway rolling stock. RET uses a maximum period of 12 years for buses and 30 years when considering rolling stock investment for rail vehicles. TfGM's Investment Appraisal Guidance document[7] requires the appraisal period to cover the period to the estimated end of the life of the proposed assets or 60 years (whichever is the shortest), with financial information for the first 6 years of the project to be shown in more detail.

The choice of appraisal period often requires professional judgment and therefore needs to remain with the project promoter/manager. Partners have however noted that they would be able to improve on current practices in some cases by providing internal guidelines to ensure that similar types of investment are appraised over similar periods to improve consistency and comparability.

[11] Source: RailPAG (www.eib.org/attachments/pj/railpag_en.pdf)

Discount rates

The discount rate is the annual percentage rate at which the present value of a future unit of currency is assumed to fall away through time. When using DCF analysis, both costs and benefits are discounted at a chosen discount rate. The discount rate should represent the opportunity cost of capital adjusted for risk[12]. This requires an element of professional judgement but many organisations have an established policy for what discount rate to use.

In some countries, the discount rate to be used in appraisal by public sector organisations or for public sector investment is set by the government. For example, in the UK, guidance from the Government is included in the Green Book (Appraisal and Evaluation in Central Government)[13]. This includes advice on the discount rate to be used in appraisal, setting the default discount rate at 3.5%[14]. The same rate is recommended in EU guidance[15]. French Government guidance sets the discount rate at 4% for the appraisal of major transport infrastructure projects[16].

Table 1.5 presents the value of €1 over a 30 year period when discount rates of 2, 3.5 and 5% are applied. It shows the importance of the selected discount rate. This is especially true when options have high costs (e.g. replacement, maintenance) or benefits in the longer term as a higher discount rate will reduce their impact. In all case, the discount rate used in appraisal should be clearly stated and used in a consistent manner across investment proposals to allow for comparisons.

Table 1.6 shows NPV and BCR results for a fictional scheme to replace 250 traditional tungsten lamps (business as usual), considering three replacement options and applying two different discount rates[17]. Although the change of discount rate does not change the option with the best results for a given indicator, it does change the value of those indicators quite significantly, especially where a relatively long appraisal period is chosen (20 years in this case).

[12] *"Opportunity cost means that when we use capital in one project we renounce to earn a return in another project. Thus we have an implicit cost when we sink capital in an investment project: the loss of income from an alternative project"* Source: Guide to cost-benefit analysis (Structural of investment projects Fund-ERDF, Cohesion Fund and ISPA), Evaluation Unit DG Regional Policy European Commission (http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/guide02_en.pdf)

[13] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent (Accessed January 2014)

[14] Based on the Social Time Preference Rate and with adjustments for example for long term investments (beyond 30 years)

[15] Guide to cost-benefit analysis of investment projects Structural Funds, Cohesion Fund and Instrument for Pre-Accession, 2008 (http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/guide2008_en.pdf)

[16] Source: Instruction Cadre relative aux méthodes d'évaluation économique des grands projets d'infrastructures de transport, 25 Mars 2004, mise à jour le 27 mai 2005 (www.developpement-durable.gouv.fr/IMG/pdf/04-05-2010_-_Annexe_2_Evaluation_socio-economique.pdf), reduced to 3.5% between 30 and 50 years and to 3% after 50 years. German Government guidance can be found in the recommendations for economic appraisal for roads ("Empfehlungen für Wirtschaftlichkeitsuntersuchungen an Straßen") and the standardised appraisal method for regional and local public transport investments ("Standardisierte Bewertung von Verkehrswegeinvestitionen des öffentlichen Personennahverkehrs"). Dutch guidance can be found in the "OEI-guideline"

[17] Example drawn from the tool developed for T2K partners to present simple examples of financial appraisal using the discounted cash flow (DCF) method and test the impact of various assumptions on financial appraisal results. All assumptions made for this example are summarised in the tool. Assumptions and values are for illustration purposes only.

Table 1.5: Example discount rates and factors over a 30 year period

Year	**Discount rates**		
	2%	3.5%	5%
0	€1	€1	€1
1	€0.98	€0.97	€0.95
5	€0.91	€0.84	€0.78
10	€0.82	€0.71	€0.61
20	€0.67	€0.50	€0.38
30	€0.55	€0.36	€0.23

Table 1.6: Appraisal results for an example scheme to replace lights – different discount rates

Lighting replacement option (compared to business as usual scenario over 20 years)	**NPV** (€)		**BCR**	
	3% discount rate	6% discount rate	3% discount rate	6% discount rate
Tungsten halogen	24,233	17,533	5.08	4.75
Compact fluorescent	94,842	69,569	**23.17**	**21.38**
LED	**103,632**	**75,819**	17.55	15.88

T2K partners tend to use discounted cash flow analysis and therefore apply a discount rate when undertaking project financial appraisal.

moBiel, RATP, RET and TfGM have an agreed discount rate which is used across the organisation (based on the organisation's costs of access to capital, risk, etc). Rates currently in use are 4.5% for moBiel and TfGM, 4% for RATP and 6% for RET. These rates are adjusted, usually by the organisation's finance department, depending on financial markets and the organisation's access to capital.

moBiel, RATP and TfGM also use discount rates included in Government guidance where required. For example, the rate used by TfGM on projects requiring Government funding is 3.5% for the first 30 years and 3% thereafter as recommended by the UK Government. National guidance from the German Government is to use a 3% discount rate, and 2.5% is retained by the Dutch Government[18].

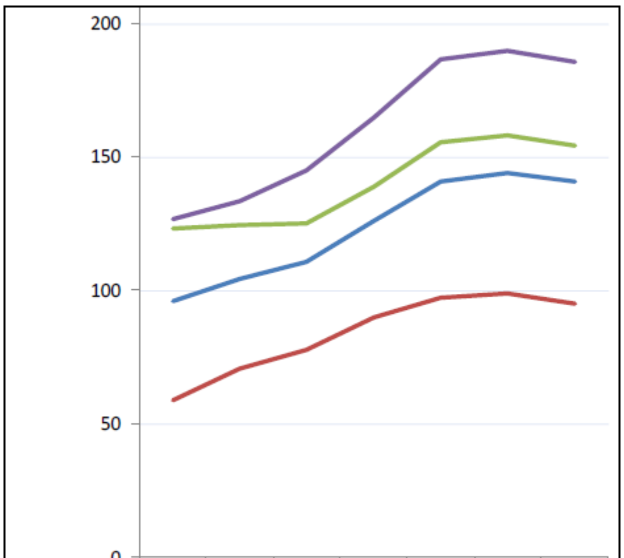
[18] Source: International Comparisons of Transport Appraisal Practice, Mackie P. and Worsley T., Institute for Transport Studies, University of Leeds, 2013 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209530/final-overview-report.pdf)

Future energy prices

Based on the experience of recent years, T2K partners generally expect energy costs to increase in the future (as detailed overleaf) but assumptions on future energy prices used in appraisal vary widely between organisations (and sometimes within the same organisation).

At any one time, there are various forward projections of energy prices available. Figure 1.4 shows a projection for electricity prices published by the European Commission in 2010. This shows significant increases in electricity prices to 2025 (average increase of 2% per year between 2010 and 2025, compounded increases of between 1.64 and 2.09%), with prices decreasing slightly between 2025 and 2030 (average reductions of 2 to 4% per year over the period, compounded reductions of between 0.42 and 0.82% per year).

Figure 1.4: After tax electricity prices in €/MWh published by EU Energy Trends[19]



	2000	2005	2010	2015	2020	2025	2030
Average	96	104	110	126	141	144	141
Industry	59	71	78	90	97	99	95
Services	123	124	125	139	155	158	154
Households	127	133	145	165	186	190	186

Some individual member states also produce national projections. For example, the UK Government regularly updates projections to be included in project appraisal as below[20]:

- Retail price for electricity (industrial use)
    - Historical: 2001 to 2012, +6% per year

[19] Source: EU Energy Trends to 2030, 2009 update, published 2010 (http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2030_update_2009.pdf) (Accessed in December 2013)

[20] Source: Updated energy and emissions projections, UK Department of Energy & Climate Change, 2013 (https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2013)

- o Low prices scenario: 2013 to 2020, +5% per year
- o High prices scenario: 2013 to 2020, +8% per year
- o Long term scenario: 2020-2030: +2% per year

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

A study commissioned by the German Ministry for Economics and Technology modelled the future prices of unleaded fuel for private vehicles as follows[21]:

- Historical prices: 2007 – 2012, -0.6% per year
- Future prices - short term 2012 – 2020: +0.6% per year
- Future prices - long term 2020 – 2030: +0.2% per year

When considering the cost and benefits of an energy efficient project or of equipment options with an impact on energy use, the assumptions made on the future cost of energy can have a significant impact on appraisal results.

Table 1.8 shows NPV and BCR results for a fictional scheme to replace 250 traditional tungsten lamps (business as usual), considering three replacement options and applying two different assumptions on future energy costs increases (1% per year and 5% per year)[22]. Although the change of future energy cost assumption does not change the option with the best results for a given indicator, it does change the value of those indicators significantly, especially where a relatively long appraisal period is chosen (20 years in this case).

[21] Source: Institut für Energiewirtschaft und Rationelle Energieanwendung (IER) / Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI) / Zentrum für Europäische Wirtschaftsforschung (ZEW), 2010 Die Entwicklung der Energiemärkte bis 2030 (ftp://ftp.zew.de/pub/zew-docs/gutachten/Energieprognose_2009_Hauptbericht.pdf - Accessed March 2014)

[22] Example drawn from the tool developed for T2K partners to present simple examples of financial appraisal using the discounted cash flow (DCF) method and test the impact of various assumptions on financial appraisal results. All assumptions made for this example are summarised in the tool. Assumptions and values are for illustration purposes only.

Table 1.7: Appraisal results for an example scheme to replace lighting equipment – different energy price assumptions applied

Lighting replacement option (compared to business as usual scenario over 20 years)	**NPV** (€)		**BCR**	
Increase in electricity cost assumed	1% per year	5% per year	1% per year	5% per year
Tungsten halogen	14,135	24,233	3.38	5.08
Compact fluorescent	61,663	94,842	**15.42**	**23.17**
LED	**66,846**	**103,632**	11.68	17.55

T2K partners have varying approaches to forecasting the cost of energy and including this parameter into their business case and appraisal process.

moBiel uses existing data on the likely trends in the electricity and fuel markets to forecast price increases over a five to six year period (for example, current assumption on diesel price is an increase of €0.05 per year). For longer periods, moBiel uses data from a sophisticated model owned by the mother company (Stadtwerke Bielefeld, a power generation company).

For RATP, the organisation's Finance Department recommends using an assumption of an increase of 2% per year for energy costs. In recent years, actual increases (estimated at 7% annually) have proven that this 2% assumption was unrealistic. A recent RATP procurement process for buses used assumptions of 5% annual increase in the cost of diesel fuel for vehicles and 2% annual increase for gas.

RET noted that future energy prices are uncertain. Assumptions currently used by RET are for liquid fuel prices to increase by 5% per year. Electricity prices are however assumed to decrease by between 3 and 5% per year up to 2018. This assumed reduction is justified by the Netherlands' access to renewable energy and excess capacity in Germany and Norway.

Within STIB energy costs are usually considered as part of operational costs when assessing the merits of a proposed investment. There is however no agreed assumption on future trends for energy costs, leading to different assumptions being used for different projects.

TfGM tends to use projections provided by the UK Government (as shown above).

Carbon intensity of energy used

When calculating the impact of an investment on carbon emissions, it is important to use consistent emission factors which are regularly updated and take account, where possible, of future trends in carbon intensity (for example, accounting for a planned move to renewable electricity generation or the inclusion of biofuels in transport fuels).

National average carbon intensity for the electricity produced and consumed in the five T2K partner countries varies widely as shown in Table 1.8. This is mainly due to differences in the energy mix. For example, nuclear energy provided 76% of France's energy use in 2011, compared to 52% in Belgium, 23% in Germany, 18% in the UK and 4% in the Netherlands. The Netherlands and the UK used higher shares of gas for electricity production and Germany a higher proportion of coal. The share of renewable energy also varied between countries with the highest share in Germany (16%) and the lowest in Belgium (6%) in 2011. As policies are implemented across EU Member States to reduce greenhouse gases emissions, the carbon intensity of electricity and transport fuels is likely to reduce in the future.

Table 1.8: National electricity carbon intensity (based on electricity consumed)

National electricity mix[23]	Belgium	France	Germany	Netherlands	UK
Electricity carbon intensity (gCO_2/kWh)	224.8	70.9	672.2	413.3	508.5

Assumptions on the carbon intensity of the energy to be used by proposed projects and investments vary widely between partners (and also sometimes between projects promoted by the same organisation). Some partners tend to use carbon intensity data provided by their current energy provider rather than national averages. Others are required by government guidance to use national average emission factors.

Table 1.9 presents the UK Government's assumptions on the carbon intensity of petrol, diesel and electricity in 2014 and in future years. The carbon intensity of petrol and diesel is assumed to decrease to 2020 through the use of additional (second generation) biofuels to meet EU and UK Government targets. The carbon intensity of electricity is assumed to decrease in the long term as the UK develops its low carbon and renewable electricity sources further.

Table 1.9: CO_2 emissions per litre of fuel burnt/kWh of electricity used (UK example)[24]

Year	**Petrol** (kg CO_2/litre)	**Diesel** (kg CO_2/litre)	**Electricity** (kg CO_2/kWh)
2014	2.1670	2.4981	0.3735
2020	2.0300	2.4134	0.3735
2030	2.0300	2.4134	0.2612
2040	2.0300	2.4134	0.0365
2050 & onwards	2.0300	2.4134	0.0226

[23] Source: Technical Paper Electricity-specific emission factors for grid electricity, Econometrica, August 2011 (http://ecometrica.com/assets//Electricity-specific-emission-factors-for-grid-electricity.pdf)

[24] Source: WebTAG Unit 3.3.5 The Greenhouse Gases Sub-Objective, UK Department for Transport (www.dft.gov.uk/webtag/documents/expert/pdf/U3_3_5-ghg-120723.pdf) (Accessed in January 2014)

T2K partners have adopted different approaches to the assessment of greenhouse gases emissions within the business case process.

moBiel notes that both the average German electricity mix and resulting carbon intensity and Bielefeld specific data can be used to inform investment decisions. For Ticket to Kyoto business cases, the Bielefeld data was used. As Germany has committed to stopping nuclear production of electricity by 2018, the German electricity mix and associated carbon intensity will change drastically in the coming years and the impacts of these changes are difficult to assess at present.

In France, current carbon intensity data is provided at the national level by the French Environment and Energy Management Agency (ADEME). No projections are provided at present. The data provided to support emission reporting is relatively complex as it attempts to account for the relatively large variations in the carbon intensity of electricity produced and used in France, depending on the production process used. For example, the carbon intensity of electricity used by heavy rail vehicles is considered as very low as this mode has a relatively constant usage level and is therefore assumed to use "base" production, mainly from nuclear and hydro sources[25].

RET has been procuring 100% green electricity since 2008 (from renewable sources only, mainly using hydro power from Norway). RET can use this contract to report a very low carbon intensity for the electricity used by the organisation. Current and future carbon intensity of electricity has therefore not been considered further by the organisation.

STIB does not have an agreed standard assumption on electricity carbon intensity but some project appraisals and STIB's Carbon Strategy have used intensity data provided by STIB's electricity supplier (currently estimated at 192 g CO_2/kWh). Some projects have used different values, for example, the recent TCO analysis for metro rolling stock procurement assumed electricity carbon intensity at 203 g CO_2/kWh.

TfGM tends to use data and projections provided by the UK Government (as shown above).

[25] Source: Information CO2 des prestations de transport, Application de l'article L. 1431-3 du code des transports, Guide méthodologique, ADEME 2012 (www.developpement-durable.gouv.fr/IMG/pdf/Guide_Information_CO2-2.pdf)

Cost of carbon

Actual carbon costs

Some sectors of the economy are already faced with explicit costs for greenhouse gases emissions through taxation or trading. The EU Emissions Trading System (EU ETS)[26] is the most obvious case across EU member states, targeting industrial greenhouse gas emissions.

In the UK, the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme[27] requires many medium to large organisations to buy allowances to cover their energy related emissions from stationary assets (Scope 1 only, energy for transport is excluded) at a current rate of £12 (~ €13.80) per tonne of CO_2. TfGM is not currently subject to CRC payments but could be included in the scheme in the future[28].

These schemes represent real out-going cash flows for the organisations concerned and the expectation is that the cost of carbon will increase over time[29] and that organisations will be encouraged to mitigate the financial impact by reducing emissions through, for example, energy efficiency measures.

Valuing carbon for appraisal purposes

Other sectors of the economy are yet to be confronted with carbon trading in a direct way and consequently the cost of carbon does not yet present itself as a direct and real negative cash flow but is rather hidden within the cost of energy.

Irrespective of this, in certain jurisdictions public sector organisations are required to include a cost of carbon in investment appraisals. Some non-public sector organisations such as the APS Group[30] and Puma[31] have also adopted the cost of carbon in investment appraisals for corporate responsibility reasons, using costs from estimates of the social cost of carbon or off-setting costs.

There is a range of methods which can be adopted to include the cost of carbon in appraisal, including:

- **Market price** - reflects the value of traded carbon emissions (for example, through the EU ETS or other trading/offsetting schemes):
    - Reflects the cost of abatement on the market but no unique values and a lot of variations between markets considered and year on year;

[26] See http://ec.europa.eu/clima/policies/ets/index_en.htm (Accessed in January 2014)

[27] See https://www.gov.uk/crc-energy-efficiency-scheme for more information (Accessed in January 2014)

[28] In France, a new carbon tax is to be included in existing taxes on transport fuels (petrol and diesel), heating fuel and gas used for heating. The cost of carbon is set at €7 for 2014 (without any impact on the end user during the first year as the additional cost will be offset by a reduction in other taxes), €14.5 in 2015 and €22 in 2016 (without cost offsets). This should result in an additional €1.30 for 50 litres of petrol and €1.45 for 50 litres of diesel in 2015.

[29] Although this has historically not been the case for the EU ETS scheme

[30] http://ems.iema.net/practitioner-14/casestudies

[31] http://about.puma.com/wp-content/themes/aboutPUMA_theme/media/pdf/2011/en/ghgv1116.pdf

- **Social cost** (shadow price)[32] - measures the full cost of an incremental unit of carbon (or greenhouse gas equivalent) emitted now, calculating the full cost of the damage it imposes over the whole of its time in the atmosphere (externality):
  - o Initially adopted by the UK Government (based on the Stern Review), the social cost aims to reflect the full cost of externalities but a lot of uncertainty on the level of impact for different greenhouse gases emissions, different emissions pathways, etc;
- **Marginal abatement cost** - reflects the cost of reducing emissions to a set level/agreed target (rather than the damage if those emissions continue):
  - o Method currently used by the EU in various studies, the French Government and the UK Government. Values are based on the targets set at EU and national level and aim to ensure that policies or schemes developed are consistent with the emissions reductions targets adopted at a regional/national, EU and UN level.

At EU level, a range of values are quoted by various studies and reports including for example:

- €15/tonne of CO_2 in 2010, increasing to €65/tonne of CO_2 by 2030[33], which can be extrapolated to €120/tonne of CO_2 by 2050;
- €25/tonne of CO2 in 2010 (central value, within a range of €7 to €45/tonne), increasing to €55/tonne of CO_2 by 2030 (central value) and to €85/tonne of CO_2 in 2050 (central value, within a range of €20 to €180/tonne)[34].

French Government guidance[35] sets the price of carbon to be used in appraisal at €27/tonne of CO_2 (€100/tonne of carbon) for the period 2000 to 2010, increasing by 3% per year after 2010. This leads that the value of a tonne of CO_2 being set at €49 in 2030 and at €89 in 2050. It is important to note that these costs were estimated in relation to France's commitments within the Kyoto protocol and that these targets are likely to be tightened through the EU's proposal to increase its emissions reduction target from 20% to 30% by 2020 (on 1990 levels). This is likely to result in higher marginal abatement costs for all Member States and would require carbon prices based on these targets to be reviewed.

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[32] The shadow price of any good is the increase (or decrease) in social welfare brought about by providing one more (or one less) unit of that good. Thus the shadow price of carbon is defined as the social cost of emitting a marginal tonne of carbon (or the social benefit of abating a tonne). Source: Review of DEFRA paper: "The Social Cost of Carbon and the Shadow Price of Carbon: what they are, and how to use them in Economic Appraisal in the UK", Simon Dietz, September 2007 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/243830/simon-dietz.pdf - Accessed January 2014)

[33] Source: Handbook on estimation of external costs in the transport sector, Produced within the study Internalisation Measures and Policies for All external Cost of Transport (IMPACT), CE Delft, 2008 (http://ec.europa.eu/transport/themes/sustainable/doc/2008_costs_handbook.pdf); Limiting Global Climate Change to 2 degrees Celsius The way ahead for 2020 and beyond, Impact Assessment Summary, SEC, 2007

[34] Recommendations from CE Delft in 2008, as above

[35] Source : Instruction Cadre relative aux méthodes d'évaluation économique des grands projets d'infrastructures de transport, 25 Mars 2004, mise à jour le 27 mai 2005 (www.developpement-durable.gouv.fr/IMG/pdf/04-05-2010_-_Annexe_2_Evaluation_socio-economique.pdf)

In the UK, the Government has developed a methodology for carbon valuation[36] to be used in policy/scheme appraisal based on the estimated abatement costs per tonne of carbon dioxide equivalent to achieve the government's emissions targets[37]. As shown in Table 1.10, these costs are higher than those proposed at EU level or currently recommended by French Government guidance. They are however quite close to those from the 2008 French Commission on the shadow price of carbon[38], which recommended values of €32/tonne of CO_2 in 2010, increasing to €100/tonne in 2030 and to €200/tonne in 2050 (within a range of €150 to €350).

Table 1.10: UK guidelines, non traded sector[39], £ per tonne of CO_2e for use in appraisal (2010 prices)[24]

Year	Low	Central	High
2014	28.44	56.87	85.31
2020	31.09	62.18	93.28
2030	36.27	72.55	108.82
2040	69.96	139.92	209.87
2050	103.64	207.28	310.92
2100	69.43	277.73	486.03

Table 1.11 shows appraisal results for a fictional scheme to replace 250 traditional tungsten lamps (business as usual), considering three replacement options[40]. Results are shown with and without the inclusion of a carbon cost (for this example, a relatively low cost of carbon as assumed in the first year, €15.6/tonne, increasing to €52.9 after 10 years, €110.5 after 20 years). Although the inclusion of a carbon cost does not change the option with the best results for a given indicator, it does change the value of those indicators quite significantly (even with a relatively low cost of carbon assumed).

[36] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal (Accessed in January 2014)

[37] The UK Climate Change Act 2008 sets a target of 80% reduction in greenhouse gases by 2050 (on 1990 levels)

[38] La valeur tutélaire du carbone, Rapport de la commission présidée par Alain Quinet, Centre d'Analyse Stratégique, 2009 (www.ladocumentationfrancaise.fr/var/storage/rapports-publics/094000195/0000.pdf) (Accessed in February 2014)

[39] Traded sector values are based on expected EU ETS allowance prices

[40] Example drawn from the tool developed for T2K partners to present simple examples of financial appraisal using the discounted cash flow (DCF) method and test the impact of various assumptions on financial appraisal results. All assumptions made for this example are summarised in the tool. Assumptions and values are for illustration purposes only.

Table 1.11: Appraisal indicator results for an example scheme to replace lighting equipment – with and without carbon costs

Lighting replacement option (compared to business as usual scenario over 20 years)	**NPV** (€)		**BCR**	
Carbon costs	Excluded	Included	Excluded	Included
Tungsten halogen	17,533	19,866	4.75	5.25
Compact fluorescent	69,569	77,236	**21.38**	**23.62**
LED	**75,819**	**84,320**	15.88	17.55

moBiel and RET do not currently include any assumptions on the cost of carbon in their business case and appraisal processes. The other three partners tend to include an assessment of carbon costs, using a range of methods and assumptions.

For example, RATP guidance on appraisal for “modernising investments”[41] notes that for projects where the cost of energy use forms a significant proportion of operational costs, CO_2 emissions have to be included in the appraisal and monetised. The value set in RATP’s GISOR-ICARE software is €48/tonne of CO_2 (without adjustment for future years). RATP notes that there are issues with the GISOR-ICARE software being used when an investment means that energy and carbon savings will occur outside of RATP’s remit (relatively rare). The example was given of a proposal to install a CHP plant at a depot, with the electricity generated being sold to the grid, where the software did not allow for the associated carbon savings to be estimated.

STIB does not always include carbon costs in its appraisals but has done so in some instances. Values assumed vary depending on the project. For example, the recent TCO analysis for metro rolling stock procurement assumed a cost of €75/tonne of CO_2.

TfGM tends to use data and projections provided by the UK Government (as shown in Table 1.10).

[41] “Modernisation projects” are identified in RATP guidance as separate from “renewal projects” and “compliance to legal requirements” projects, with the last two not subject to appraisal in Gisor-Icare. Source: Champ pilotage de la performance investissement, Fiche Pratique : Mesurer la rentabilité d’un investissement de modernisation, RATP, 2013 (not published)

Multi-criteria analysis and wider benefits

Multi-criteria analysis (MCA) is a tool to compare alternative projects or options where a range of objectives and criteria have to be met[42]. It can be used to gather the views of a range of stakeholders to the project and assess its performance against a wide range of objectives, often including environmental considerations such as:

- Air quality;
- Noise;
- Water;
- Waste;
- Biodiversity;
- Use of natural resources;
- Health;
- Landscape/townscape;
- Heritage.

The impact of the proposed investment against these objectives can be monetised in some cases. In other cases, the assessment is done on a qualitative basis, often using an agreed scoring scale, for example from "strongly negative" to "strongly positive" impact.

T2K partners are aware of multi-criteria analysis methods. moBiel currently uses MCA for a range of projects (although not rolling stock procurement). Aspects taken into account in a qualitative manner (not monetised) include noise, air quality, safety, health, impact on the organisation's image (where relevant).

RET has used MCA to prioritise T2K projects. Although MCA is not standard practice for RET, the organisation uses indicators of wider impacts (some of them in qualitative form) alongside financial appraisal results, including customer/employee satisfaction, safety, health impacts, disruption to services, impact on patronage (number of public transport users and/or distances travelled), ratio of costs/subsidies covered by the region.

In Brussels, regional partners (including STIB) are currently working to develop a new socio-economic appraisal method for transport projects, which includes a relatively detailed multi criteria analysis. STIB's existing pro-forma for project appraisal already includes a qualitative scoring system to assess the impact of the proposed project on public transport service quality. Impacts for project managers to consider include: interchange, comfort, frequency, punctuality, journey time and information[43].

In the UK, large major transport projects are subject to the requirements of Government guidance on transport appraisal (set out in WebTAG)[44], which includes multi-criteria analysis.

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[42] For more detail on MCA, see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7612/1132618.pdf (Accessed in February 2014)

[43] Source: Appraisal pro-forma, "Secure Drive" project example, STIB (not published)

[44] See https://www.gov.uk/transport-analysis-guidance-webtag (Accessed in February 2014)

1.5. STIB case study – Developing energy efficiency assumptions

STIB were interested in using the information and experience gathered through the Ticket to Kyoto WP4 work to develop assumptions to be used in the organisation's appraisal method, which is currently being developed. In line with the objectives of T2K WP4, this work has focused on energy/carbon related assumptions and was based on information from other T2K countries.

It was agreed that the choice of appraisal period should be left to the project manager, maybe with some guidance and indicative periods provided in a business case and appraisal guidance document under development. It was also agreed that the choice of discount rate should be left with STIB's finance department, with guidance to be developed to encourage a consistent approach across all projects.

This section therefore presents a discussion of possible information sources and assumptions for future energy prices, electricity carbon intensity and a (shadow) cost of carbon to be used in appraisal. Further discussions were then held within STIB's teams to develop the draft assumptions presented at the end of the section.

Future energy prices

Research work undertaken on behalf of STIB within the T2K project recommends the use of forecasts from the International Energy Agency (IEA)[45] to support assumptions for the future cost of fossil fuels (diesel, petrol and gas). For electricity prices, the study recommends the use of more local data sources (European level or below) as the price of electricity depends strongly on its sources (production costs) and distribution costs.

Electricity prices

In 2011, a review of Belgium's energy outlook[46] was undertaken for the "Bureau du Plan". The study developed a range of scenarios to assess possible energy strategies for the country and their impacts on energy prices and emissions. Under the Business as Usual scenario[47], energy costs (per unit used) were estimated to increase by 80% for the industrial sector between 2005 and 2030, representing an average 3.2% increase per year (compounded annual increase of 2.38%). Scenarios which aim to reduce greenhouse gases emissions were assessed to result in slightly higher increases in energy cost, showing average annual increases between 3.3 and 3.4% (compounded annual increases between 2.45 and 2.51%).

The review did not look beyond 2030 and it is therefore difficult to provide assumptions for later years. EU modelling (see Figure 1.4) shows small reductions in electricity prices of between 0.42 and 0.82% per year over the period 2025 to 2030.

The outputs of this study were considered at a workshop with STIB staff and compared with other data provided by STIB consultants Climact (based on European values and projections). The STIB team

[45] www.iea.org

[46] Perspectives énergétiques pour la Belgique à l'horizon 2030, Bureau du Plan, 2011 (www.plan.be/admin/uploaded/201111170832500.vp_energie2011_web_fr.pdf - Accessed March 2014)

[47] Scénario à politique inchangée

intends to develop assumptions based on an average of values from the Belgian study and EU data, including low and high values for sensitivity testing. For values up to 2017, STIB currently proposes to use the actual cost of electricity under STIB's current contract (negotiated to 2017).

Fossil fuel prices

There are some projections of fuel prices available for EU countries but it is important to note that *"forecasting fossil fuel prices in the long term is extremely challenging as it depends on a large number of unknowns, such as future economic growth rates across the world, development of new technologies, global climate change policies, strategies of resource holders, and so on"*[48].

UK projections for fuel prices (presented in Section 0) are based on data on oil prices from the US Energy Information Administration (EIA) Annual Energy Outlook (AEO)[49], also accounting for domestic policies (such as taxes and incentives). The 2014 AEO analyses three main scenarios (reference, high oil prices and low oil prices), with oil prices projections for the period 2012-2040 ranging from a decrease of 33% to increases of 27% (reference scenario) and 83%. The reference scenario shows annual price variations as follows:

- -1.80% per year for the period 2012 to 2020;
- +2.11% per year for the period 2021 to 2030; and
- +1.74% per year for the period 2031 to 2040.

Although these projections are for international oil prices and do not account for additional taxes and the impact of EU or national/regional policies, it would be possible for STIB to apply them to current diesel prices for appraisal purposes.

Another possible option is to use the International Energy Agency (IEA) data as published annually in the Agency's World Energy outlook and other Agency publications. This was the option favoured by the STIB team at a workshop where these options were discussed.

Gas prices

The IEA notes that *"the market for natural gas (is becoming) more global, with potential implications for pricing"*[50]. There is some uncertainty on future gas prices due to this globalisation as well as the diversification of supply (shale gas from North America) and increasing global demand.

The 2011 review of Belgium's energy outlook[46] undertaken for the "Bureau du Plan" notes that natural gas use is projected to increase by 10% between 2005 and 2030 under the Business as Usual scenario. Scenarios which aim to reduce greenhouse gases emissions were assessed to result in a reduction of

[48] Source: Fossil Fuel Price Projections, DECC, 2013 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212521/130718_decc-fossil-fuel-price-projections.pdf) (Accessed in February 2014)

[49] See latest release at http://www.eia.gov/forecasts/aeo/er/early_prices.cfm (Accessed in February 2014)

[50] Source: World Energy Outlook 2013, factsheets, IEA (www.iea.org/media/files/WEO2013_factsheets.pdf - Accessed April 2014)

natural gas use between 6 and 12% over the 2005-2030 period, with reductions mainly due to energy efficiency investment in heating for households. The study quotes previous studies providing projections for natural gas prices and showing increases as follows:

- 2008 study: 3.5% increase over the 2020-2030 period[51];
- 2010 study: 23.3% increase over the 2020-2030 period[52].

It is however important to note that the changes to gas supplies have taken place since these projections were undertaken, undermining the reliability of this data. A more recent EU Commission report[53] show natural gas import prices for the EU increasing from approx. $50 to $70 per barrel of oil equivalent (boe) between 2010 and 2015 and to $80 per boe by 2020. Import prices are then projected to remain relatively stable to 2050 (between $70 and $90 per boe). The report notes that *"in the longer term, gas prices do not follow the upward trend of oil price. This is mostly due to the very large additional undiscovered resources that were factored in, including unconventional gas. More importantly, natural gas prices stabilise at a level that is still high enough to ensure economic viability of unconventional gas projects"*.

Projections provided by the UK Government for project appraisal show gas prices (retail price for industrial use) evolving as below[54]:

- Historical: 2001 to 2012, +10% per year (average)
- Low prices scenario: 2013 to 2020, -2% per year (average)
- High prices scenario: 2013 to 2020, +5% per year (average)
- Long term scenario: 2020-2030, 0% per year (average)

Taking this information into account, an assumption of a stable price for gas prices up to 2030 could be used by STIB for appraisal purposes.

[51] Source: Bossier F., D. Devogelaer, D. Gusbin and F. Verschueren (2008), Impact of the EU Energy and Climate, Package on the Belgian energy system and economy, Federal Planning Bureau, as quoted in Perspectives énergétiques pour la Belgique à l'horizon 2030, Bureau du Plan, 2011

[52] Source: EU energy trends to 2030 – update 2009, as quoted in Perspectives énergétiques pour la Belgique à l'horizon 2030, Bureau du Plan, 2011

[53] EU Energy, Transport and GHG Emissions Trends to 2050, Reference Scenario 2013, EU Commission, 2013 (http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf - Accessed April 2014)

[54] Source: Updated energy and emissions projections, UK Department of Energy & Climate Change, 2013 (https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2013)

Carbon intensity of energy used

The coming years will result in a lot of change for the electricity sector in Belgium, moving away from nuclear production and relying much more on gas and renewable energy sources. Projections of electricity energy intensity for Belgium were included in the 2011 review of Belgium's energy outlook[46] and are summarised for the various scenarios assessed in Table 1.12.

Table 1.12: Electricity carbon intensity projections - 2011 review of Belgium's energy outlook

Scenario	**Electricity carbon intensity (gCO_2/kWh)**		
	2005	2020	2030
Business as usual	230	201	332
Scenario Reference 20/20	230	181	232
Scenario Nuclear 20/20	230	125	68
Scenario Reference 30/20 flex	230	174	143
Scenario Reference 30/20 int	230	160	144
Scenario Nuclear 30/20 flex	230	114	45
Average all scenarios	*230*	*159.2*	*160.7*

Using this data, it is possible to consider an average of all the scenarios considered in the study to provide assumptions on future carbon intensity to be used in appraisal by STIB (as there is no indication of which scenario is the most likely to be realised in the research). This would result in a 2.43% annual decrease in electricity carbon intensity being applied between 2005 and 2020. Carbon intensity for the period 2020 to 2030 could be assumed to remain constant (or to increase by 0.06% per year).

STIB teams have so far used carbon intensity data for electricity from their energy provider (carbon intensity of energy produced by the provider, not accounting for any green certificates purchased for the STIB contract). STIB's current contract is negotiated to 2017 and STIB teams do not expect much change in the carbon intensity of electricity produced by their provider over that period.

After discussions at a workshop, the STIB team noted that they are likely to continue with this practice and to assume that the carbon intensity of the electricity used by STIB would remain constant in future years (consistent with the proposed assumption for the period 2020 – 2030 presented above).

Another option considered during the workshop was to base the carbon intensity of electricity used in appraisal on the average intensity for Belgium, as French and UK partners are required to do by government guidelines.

Cost of carbon

Estimates of the cost of carbon for Belgium (based on EU wide abatement costs for the non-ETS sector) were included for two of the scenarios developed for the 2011 review of Belgium's energy outlook[46] and are summarised in Table 1.13.

Table 1.13: Carbon costs projections - 2011 review of Belgium's energy outlook

Scenario	**Cost of carbon, non-ETS sector** (€/tonne of CO_2)	
	2020	2030
Scenario Reference 30/20 flex	30.2	66.1
Scenario Reference 30/20 int	55.4	61.7
Average all scenarios	*42.8*	*63.9*

These values are comparable to EU level estimates ranging between €15 and €25/tonne in 2010, €55 and €65 in 2030 and €85 and €120 in 2050. On this basis, the following values could be included in appraisal for STIB: €25/tonne of CO_2 in 2010, increasing to €65/tonne of CO_2 by 2030 and to €100/tonne of CO_2 by 2050.

Current STIB assumptions

Table 1.14 presents an overview of the draft assumptions developed by STIB following the analysis and discussions summarised above.

Table 1.14: STIB draft appraisal assumptions for energy prices (excluding taxes)

	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2025**
Electricity (€/MWh, 2013 prices, undiscounted)									
Average	**77.9**	**78.4**	**81.1**	**83.4**	**85.7**	**88.0**	**90.3**	**92.5**	**91.4**
Scenario "2DS"	77.9	78.4	81.0	83.8	86.6	89.4	92.2	95.0	91.2
Scenario "4DS"	77.9	78.4	80.2	82.1	84.0	85.9	87.7	89.6	89.3
Scenario "6DS+"	77.9	78.4	82.1	84.3	86.5	88.6	90.8	93.0	93.7
Diesel (€/MWh, 2013 prices undiscounted)									
Average	**110.4**	**114.7**	**119.4**	**124.5**	**129.6**	**134.7**	**139.6**	**144.3**	**150.9**
Scenario "2DS"	110.9	114.4	118.9	124.0	129.4	134.7	139.6	143.8	145.6
Scenario "4DS"	110.9	115.2	120.1	125.2	130.4	135.6	140.6	145.3	152.4
Scenario "6DS+"	109.6	114.4	119.3	124.2	129.0	133.9	138.8	143.6	154.6
Gas (€/MWh, 2013 prices, undiscounted)									
Average	**38.2**	**40.4**	**42.9**	**45.7**	**48.6**	**51.4**	**54.2**	**56.7**	**62.0**
Scenario "2DS"	38.6	41.0	44.1	47.7	51.5	55.2	58.7	61.7	64.1
Scenario "4DS"	38.6	40.5	42.8	45.4	48.1	50.7	53.2	55.5	62.2
Scenario "6DS+"	37.6	39.7	41.8	44.0	46.2	48.4	50.6	52.9	59.7

It is important to note that these values are still in draft at this stage and will be subject to regular reviews once incorporated within STIB's appraisal process. Average values are derived using values from several scenarios developed by STIB's consultants based on European and international projections. As there is no indication of the likelihood of a specific scenario occurring (probability), the STIB team has decided to use average values for their appraisal process. The team also proposes to use values from Scenario "2DS" and Scenario "6DS+" to undertake sensitivity analysis.

The Scenarios used in STIB's assumptions are those developed by the International Energy Agency (IEA) in its 2012 Energy Technology Perspective report[55], where:

- Scenario "2DS" assumes that the rise in global temperatures is limited to 2℃ by 2100, through the development of a sustainable energy system with reduced GHG and CO_2 emissions;
- Scenario "4DS" assumes that the rise in global temperatures reaches 4℃ by 2100, reflecting current pledges by countries to cut emissions and boost energy efficiency; and
- Scenario "6DS+" assumes that the rise in global temperatures reaches 6℃ by 2100, with energy use and CO_2 emissions increasing by a third by 2020 and almost doubling by 2050.

[55] See http://www.iea.org/etp/etp2012/ - accessed April 2014

1.6. Case study – Developing an appraisal template

As noted above, work undertaken under WP4 included the development of a spreadsheet tool to show examples of best practice for projects financial appraisal, focusing on how energy use and associated carbon emissions and costs can be expressly considered in the analysis.

The spreadsheet tool is provided to T2K partners with this report and provides partners with the "dashboard" required for them to visualise how energy and carbon data can be included in the appraisal and business case process. Screenshots from the tool are included for reference overleaf. Please note that all figures shown are for illustration purposes only and are not based on an actual project.

The spreadsheet tool includes:

- A front tab, where project details can be recorded such as project title, project manager, etc;
- An assumptions tab, to record assumptions used for the financial appraisal process including details of investment options considered, appraisal period and first year of appraisal, expected energy use, discount rate, energy data (cost of energy, carbon intensity) and cost of carbon (if included in appraisal) – shown in Figure 1.5;
- Energy focused appraisal tabs (one for each option considered), calculating energy use over the chosen appraisal period and estimating energy costs and related emissions as well as carbon costs (if included) – shown in Figure 1.6;
- Summary appraisal tabs (one for each option considered), accounting for project benefits and other costs, clearly showing energy related information (based on the energy focused appraisal tab), discounting costs and benefits using the chosen discount rate and showing results for a range of appraisal indicators including Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Ratio (BCR) – shown in Figure 1.7.

Additional elements of best practice are also included in the tool such as:

- Clear log of all assumptions used to support the financial appraisal;
- Assumptions used in each tab clearly presented at the top of the tab for ease of reference;
- Comprehensive log of data sources used to support assumptions, including the possibility to note when assumptions will need to be updated;
- Clear calculation details presented for each step of the analysis for ease of reference and to support checks; and
- All units clearly stated.

The tool also enables sensitivity analysis to be conducted, as key parameters and assumptions can be changed and results compared (by creating different versions of the spreadsheet or copying the energy focused and summary appraisal tabs within a same spreadsheet).

Figure 1.5: Assumptions tab - example

Investment options

Business as usual scenario refers to continuing to invest in diesel powered buses
The replacement of a fleet of 20 buses is assumed
Annual revenue is an estimate of the net revenue - the income from fares, subsidies etc - operational costs (including maintenance and staff salaries)
Annual revenue estimated to be the same for both options

Time period for appraisal	60	years (maximum of 60 years)
First year for appraisal	2014	

	Business as usual	Hybrid bus
Capital investment (euros)	2,000,000	5,000,000
Expected life (years)	20	20
Diesel use (litres/year)	1,040,000	610,000
Electricity use (kWh/year)	0	0
Change in vehicle efficiency	If scenario fleet has a vehicle efficiency component input manually on Energy sheet.	

Expected Revenue per annum

	Business as usual	Hybrid bus	
Ticket sales/pax	2000	2000	€000s
Fare recovery & fines	3	3	€000s
Advertising revenue	300	300	€000s
Other revenue	200	200	€000s

Expected costs per annum

	Business as usual	Hybrid bus	
Maintenance costs	100	100	€000s
Staff costs	300	300	€000s
Training costs	20	20	€000s
Other operational costs	0	0	€000s

Discount Rate

Assumed discount rate is constant between time periods illustrated below

Discount rate	6.00%	for first	30	years
	3.00%	thereafter		

Energy Parameters

Electricity

Carbon content of electricity 192 g CO2/kWh Source: STIB

Change in carbon content of electricity

Start year	End Year	% change
2005	2020	-2.43%
2021	Onwards	0.00%

Source: STIB

Electricity cost in 2013 0.1 €/kWh

Annual percentage change in cost of electricity

Start year	End Year	% change
2013	2031	2.45%
2031	Onwards	0.00%

Source: STIB

Oil/diesel

Carbon content of diesel 2580 gCO_2/l Source: DEFRA UK Emission factors (CO2 emissions for diesel average biofuel blend)
Increase in fuel efficiency 0.00% per annum

It is assumed that the carbon content of diesel does not change throughout the assessment period

Oil/diesel cost in 2013 1 €/litre

Annual percentage change in cost of fuel

Start year	End Year	% change
2013	2020	-1.80%
2021	2030	2.11%
2031	2040	1.75%
2040	2080	0.00%

Source: EIA Annual Energy Outlook

It is assumed that the percentage change in the cost of fuel remains constant within each time period

Cost of carbon

Forecast change in cost of carbon

Year	Cost €/tonne of CO_2	Compound growth rate
2010	25	-
2030	65	5%
2050	100	2%

Source: based on Belgium Energy Outlook 2011

Figure 1.6: Energy focused appraisal tab - Example

Scenario:
Business as usual

Assumptions:

Diesel consumption	1040000	l/year
Diesel cost in Year 1 of assessment	1	€/litre
Carbon content of diesel (ccd)	2580	gCO_2/l
Increase in fuel efficiency	0.00%	per year
Electricity consumption	0	kWh/year
Electricity cost in Year 1 of assessment	0.1	€/kWh
Carbon content of electricity	192	g CO2/kWh
First year of assessment	2014	
Assessment period length	60	years

Percentage change in diesel cost	-1.80%
from	*2013*
to	*2020*
Percentage change in diesel cost	2.11%
from	*2021*
to	*2030*
Percentage change in diesel cost	1.75%
from	*2031*
to	*2040*
Percentage change in diesel cost	0.00%
from	*2040*
to	*2080*

Percentage change in electricity cost	2.45%
from	*2013*
to	*2031*
Percentage change in electricity cost	0.00%
from	*2031*
to	*Onwards*
Change in carbon content of electricity	-2.43%
from	*2005*
to	*2020*
Percentage change in electricity cost	0.00%
from	*2021*
to	*Onwards*

Carbon cost in 2010	25	€/tonne of CO_2
Carbon cost in Year 1	30	€/tonne of CO_2
Increase in carbon cost	5%	
from	*2010*	
to	*2030*	
Increase in carbon cost	2%	
from	*2030*	
to	*2050*	

Calculations:

	Year	Calculation Details	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Year number	-		1	2	3	4	5	6	7	8	9	10
Diesel costs	Annual percentage change in diesel cost (a)		% per year	-	-1.80%	-1.80%	-1.80%	-1.80%	-1.80%	-1.80%	2.11%	2.11%	2.11%
	Diesel cost (b)	$(b)_{previous year} \times (1 + (a)_{current year})$	€/litre	1	0.98	0.96	0.95	0.93	0.91	0.90	0.92	0.93	0.95
Diesel use	Fuel efficiency improvement per year (c)		%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Vehicle efficiency (user defined) (d)		%										
	Diesel use per year (e)		l/year	1040000	1040000	1040000	1040000	1040000	1040000	1040000	1040000	1040000	1040000
	Change in diesel use (reduction presented as -ive) (f)		l/year										
	Total diesel use per year (g)	(e) + (f) x (1 - (c)) x (1 - (d))	l/year	1040000	1040000	1040000	1040000	1040000	1040000	1040000	1040000	1040000	1040000
Diesel total cost	Diesel Cost (h)	(b) x (g)	€/year	1040000	1021280	1002897	984845	967118	949709	932615	952293	972386	992904
Electricity costs	Annual percentage change in electricity cost (i)		% per year	-	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%
	Electricity cost (j)	$(j)_{previous year} \times (1 + (i)_{current year})$	€/kWh	0.1	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12
Electricity Use	Electricity use per year (k)		kWh/year	0	0	0	0	0	0	0	0	0	0
	Change in electricity use (reduction presented as -ive) (l)		kWh/year										
	Total electricity use per year (m)	(k) + (l)	kWh/year	0	0	0	0	0	0	0	0	0	0
Electricity total cost	Electricity Cost (n)	(j) x (n)	€/year	0	0	0	0	0	0	0	0	0	0
Carbon cost	Increase in carbon cost (o)		% per year	-	5%	5%	5%	5%	5%	5%	5%	5%	5%
	Carbon cost per tonne (p)	$(p)_{previous year} \times (1 + (o)_{current year})$	€/tonne of CO_2	30	31.75	33.30	34.93	36.64	38.43	40.31	42.28	44.35	46.52
Carbon use	Change in carbon content of electricity (q)		% per year	-	-2.43%	-2.43%	-2.43%	-2.43%	-2.43%	-2.43%	0.00%	0.00%	0.00%
	Carbon content of electricity (r)	$(r)_{previous year} \times (1 + (q)_{current year})$	g CO_2/kWh	192	187.33	182.78	178.34	174.01	169.78	165.65	165.65	165.65	165.65
	Carbon (CO_2) from Diesel (s)	(g) x (ccd) / 1000000	tonnes	2683	2683	2683	2683	2683	2683	2683	2683	2683	2683
	Carbon (CO_2) from Electricity (t)	(m) x (r) / 1000000	tonnes	0	0	0	0	0	0	0	0	0	0
	Total Emissions (u)	(s) + (t)	tonnes	2683	2683	2683	2683	2683	2683	2683	2683	2683	2683
Carbon total cost	Carbon cost (v)	(p) x (u)	€/year	81206	85180	89348	93720	98307	103117	108163	113456	119008	124832
Summary	Total cost, including carbon (w)	(h) + (n) + (v)	€000s	1121206	1106460	1092245	1078565	1065424	1052827	1040778	1065749	1091395	1117736
	Total cost, excluding carbon (x)	(h) + (n)	€000s	1040000	1021280	1002897	984845	967118	949709	932615	952293	972386	992904

Figure 1.7: Summary appraisal tab - Example

Project appraisal template - costs & benefits sheet

Scenario:

Business as usual

Assumptions:

	First year of appraisal period	2014		
	Duration of appraisal period	60	years	
	Capital investment	2000	€000s	
	Life cycle	20	years	
	Discount rate	6.00%	for	30 years then 3.00% thereafter
Annual revenue	Ticket sales/pax	2000	€000s	
	Fare recovery & fines	3	€000s	
	Advertising revenue	300	€000s	
	Other revenue	200	€000s	
Annual costs	Maintenance costs	100	€000s	
	Staff costs	300	€000s	
	Training costs	20	€000s	
	Other operational costs	0	€000s	

Initial costs & benefits estimates (€000s undiscounted, in Year 1 prices)

				Total	2014	2015	2016	2017	2018	2019	2020
					1	*2*	*3*	*4*	*5*	*6*	*7*
Capital costs (in Year 1 prices) (a)			(b) + (c) + (d)	**6000**	2000	0	0	0	0	0	0
including	Initial investment	(b)		**2000**	2000	0	0	0	0	0	0
	Renewal	(c)		**4000**		0	0	0	0	0	0
	Other capital costs	(d)		**0**							
Operational costs (in Year 1 prices) (e)			(f) + (g) + (h) + (i) + (j) + (k)	**114903**	1541	1526	1512	1499	1485	1473	1461
including	Maintenance costs	(f)		**6000**	100	100	100	100	100	100	100
	Staff costs	(g)		**18000**	300	300	300	300	300	300	300
	Training costs	(h)		**1200**	20	20	20	20	20	20	20
	Energy cost*	(i)		**75143**	1040	1021	1003	985	967	950	933
	Carbon cost*	(j)		**14560**	81	85	89	94	98	103	108
	Other operational costs	(k)		**0**	0	0	0	0	0	0	0
	* see energy sheet										
Revenue (in Year 1 prices) (l)			(m) + (n) + (o) + (p)	**150180**	2503	2503	2503	2503	2503	2503	2503
including	Ticket sales/pax	(m)		**120000**	2000	2000	2000	2000	2000	2000	2000
	Fare recovery & fines	(n)		**180**	3	3	3	3	3	3	3
	Advertising revenue	(o)		**18000**	300	300	300	300	300	300	300
	Other revenue	(p)		**12000**	200	200	200	200	200	200	200

Discounted costs

Discount factor applied (dc)	1.00	0.94	0.89	0.84	0.79	0.75	0.70

				Total	2014	2015	2016	2017	2018	2019	2020
Capital costs		(q)	(r) + (s) + (t)	**2890**	2000	0	0	0	0	0	0
including	Initial investment	(r)	(b) x (dc)	**2000**	2000	0	0	0	0	0	0
	Renewal	(s)	(c) x (dc)	**890**	0	0	0	0	0	0	0
	Other capital costs	(t)	(d) x (dc)	**0**	0	0	0	0	0	0	0
Operational		**(u)**	(aa)	**31370**	1541	1440	1346	1258	1177	1101	1030
including	Maintenance costs	(v)	(f) x (dc)	**1821**	100	94	89	84	79	75	70
	Staff costs	(w)	(g) x (dc)	**5462**	300	283	267	252	238	224	211
	Training costs	(x)	(h) x (dc)	**364**	20	19	18	17	16	15	14
	Energy cost	(y)	(i) x (dc)	**20624**	1040	963	893	827	766	710	657
	Carbon cost	(z)	(j) x (dc)	**3099**	81	80	80	79	78	77	76
	Other operational costs	(aa)	(k) x (dc)	**0**	0	0	0	0	0	0	0
Discounted Revenue		**(ab)**	(ac) + (ad) + (ae) + (af)	**45575**	2503	2361	2228	2102	1983	1870	1765
including	Ticket sales/pax	(ac)	(m) x (dc)	**36416**	2000	1887	1780	1679	1584	1495	1410
	Fare recovery & fines	(ad)	(n) x (dc)	**55**	3	3	3	3	2	2	2
	Advertising revenue	(ae)	(o) x (dc)	**5462**	300	283	267	252	238	224	211
	Other revenue	(af)	(p) x (dc)	**3642**	200	189	178	168	158	149	141
Present Value Benefits		(PVB)	(ab)	**45575**	2503	2361	2228	2102	1983	1870	1765
Present Value Costs (including carbon)		(PVC)	(q) + (u)	**34261**	3541	1440	1346	1258	1177	1101	1030
Present Value Costs (excluding carbon)		(PVC_{ii})	(q) + (u) - (z)	**31162**	3460	1360	1266	1180	1099	1024	954
Net Present Value (including carbon)		(NPV)	PVB - PVC	**11314**	-1038	921	882	843	806	770	735
Net Present Value (excluding carbon)		(NPV_{ii})	PVB - PVC_{ii}	**14413**	-957	1002	961	922	884	847	811

NPV (including carbon)	PVB - PVC	11314	€000s
NPV (excluding carbon)	PVB - PVC_{ii}	14413	€000s
IRR (including carbon)		84%	
IRR (excluding carbon)		101%	
BCR (including carbon)	PVB / PVC	1.33	
BCR (excluding carbon)	PVB / PVC_{ii}	1.46	

1.7. Summary

This section focused on business case and financial appraisal processes and assumptions to support investment in low energy/low carbon initiatives.

Discussions with partners show that although all of them use some form of financial appraisal and business case process to support investment decisions, this is often not used consistently across the organisation and some of the methods and assumptions used can penalise energy efficient investments.

T2K partners regularly use a range of appraisal indicators including some or all of the following: payback period (often required to be less than three years, with up to six years accepted in some cases), Discounted Cash Flow, Net Present Value, Benefit Cost Ratio, Internal Rate of Return (IRR), full life financial impact on organisation, Life Cycle Cost (LCC) or Total Cost of Ownership (TCO). Some partners noted that although Discounted Cash Flow analysis is generally used, simple payback (without DCF or any further analysis) is sometimes used on smaller projects.

Environmental (and wider) impacts are not always included in these business case/appraisal processes however, and energy use (electricity or fuel) is often considered only as part of wider operating costs rather than identified as a specific cost to the organisation. This seems to be especially true for smaller projects or projects which do not require any external funding (for example from another public body or government department).

Some partners have developed spreadsheet templates or use bespoke software to undertake the financial appraisal element of the business case. Partners were generally interested in good practice examples of spreadsheet tools, especially when considering energy and carbon impacts. This led to the development of the tool presented in Section 1.6.

Partners generally expressed interest in further developing their business case and appraisal techniques and standards to improve consistency and comparability and take wider impacts such as energy use and associated emissions into account. Table 1.15 provides a summary of partner progress so far and next steps in the development of business case processes to support energy efficient investment.

Table 1.15: Summary of findings and next steps by partner

T2K partner	Business case processes and guidance – Summary of findings and next steps
moBiel	Established appraisal methods, including government guidelines used for larger projects Importance of appraisal/business case process remaining simple and “proportionate” Next steps - Limited need for further developments linked to review of assumptions used (e.g. linked to the planned change of energy mix in Germany)
RATP	Established financial appraisal methods and dedicated software includes consideration of energy use and resulting emissions but methods and software are not used systematically. It often depends on the project manager’s level of awareness with regard to energy use and emissions Some assumptions based on government guidelines but need for data on projected changes (energy cost, carbon intensity, cost of carbon) and existing assumptions need to be updated in some cases Next steps - Need to better include environmental considerations (energy, carbon) in dedicated tool and to ensure that tool is used widely/consistently; need to require further support on assumptions and projection from government agencies
RET	Project management methods established (based on Prince 2) but limited inclusion of energy use/carbon consideration in financial appraisal at present Appraisal process needs to remain simple to be undertaken by project managers who might not have financial appraisal knowledge but needs to be more consistent Next steps – Enhance current processes and formats to better include consideration of energy use and associated emissions
STIB	Project management methods established. Financial appraisal methods under review and further development being undertaken Appraisal assumptions linked to energy and emissions and tools being developed in parallel to WP4 work, building on good practice and information exchange from T2K project Next steps – Finalising new appraisal methods and assumptions and ensuring consistent use across the organisation
TfGM	Established project management and business case/financial appraisal methods, including government guidelines used for larger projects Spreadsheet tool available for project managers Strong set of appraisal assumptions developed at national level (energy prices, carbon intensity, shadow cost of carbon) Next steps - Limited need for further developments linked to resources and the need for decision-makers to develop further knowledge of energy/environmental issues

2. Including GHG performance in the procurement process (R8)

2.1. Objectives and methodology

The 2012 report identified the opportunity for T2K partners to select suppliers and products on the basis of their energy use and carbon performance or at least to give performance in these areas a stronger influence on purchasing decisions.

There are already some legal obligations (for example the Clean Vehicles Directive) as well as EU and national/regional level guidance on sustainable procurement. Building on existing practices and guidance, this section explores how the GHG performance of services and products purchased by the partners could potentially be improved through the procurement process.

All T2K partners expressed an interest in investigating the potential for further consideration of energy use and carbon performance in purchasing decisions, although moBiel decided not to host workshops or training sessions. Background information on sustainable procurement was updated and presented to RATP, RET, STIB and TfGM staff at workshops where the barriers to sustainable procurement and good practice examples were discussed. This section therefore presents updated information on sustainable procurement and how it could be implemented by T2K partners as well as recommendations, which apply most specifically to RATP, RET, STIB and TfGM.

2.2. Definitions

The Chartered Institute of Purchasing and Supply (CIPS) proposes the following definition for sustainable procurement[56]: "*socially and ethically responsible purchasing which aims to minimise the organisation's environmental impact (including through the supply chain) and deliver economically sound solutions"*.

The European Commission[57] defines Sustainable Public Procurement (SPP) as public authorities seeking to achieve the appropriate balance between the three pillars of sustainable development - economic, social and environmental - when procuring goods, services or works at all stages of the project. Green Public Procurement (GPP) is defined as public authorities seeking to procure goods, services and works with a reduced environmental impact throughout their life-cycle.

The principles of sustainable procurement should result in reduced environmental damage and costs by:

- Questioning the need to buy;
- Reducing quantities;
- Saving energy, water and resources;

[56] Source: Chartered Institute of Purchasing and Supply (CIPS) www.cips.org/Documents/Products/Sustainable_Procurement_Review_%20new_logo.pdf

[57] Source: http://ec.europa.eu/environment/gpp/versus_en.htm - accessed April 2014

- Promoting re-use and recycling; and
- Minimising risk (e.g. negative publicity, environmental risks).

2.3. Sustainable procurement in practice

EU legislation and guidance

EU directives

In 2004, two directives[58] to modernise European legislation on public procurement were adopted, including specific references to the possibility of including environmental considerations in the contract award process, allowing for example[59]:

- The inclusion of environmental requirements in technical specifications;
- The use of eco-labels;
- Setting social and environmental conditions for the performance of contracts;
- Requiring economic operators to demonstrate they have met their environmental obligations;
- Requiring economic operators to demonstrate they can perform a contract in accordance with environmental management measures; and
- Applying award criteria based on environmental characteristics.

New public procurement directives were adopted by the European Parliament in 2014[60] and Member States have to transpose the directives into national law by January 2016. Two key objectives of the reform were to facilitate taking account of environmental, social and innovation factors and to provide more flexibility in procedures and timelines, complemented by greater use of e-procurement.

The new directives give greater prominence to LCC as a means of calculating costs, including the cost of environmental externalities such as GHG emissions. In order to ensure that LCC is transparent and embodies equal treatment, the methodology must be indicated in advance in the tender documents and accessible to all interested parties. The methodology must also be based on objectively verifiable and non-discriminatory criteria and the data required can be provided with reasonable effort by 'normally diligent' operators, including those from outside of the EU[61].

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[58] Directive 2004/18/EC covers public works contracts, public supply contracts and public service contracts and Directive 2004/17/EC covers the procurement procedures of entities operating in the water, energy, transport and postal services sectors

[59] Source: http://ec.europa.eu/environment/gpp/eu_public_directives_en.htm - Accessed April 2014

[60] Directive 2014/24/EU (which replaces the 'Classic' Procurement Directive 2004/18/EC), Directive 2014/25/EU (which replaces the 'Utilities' Procurement Directive 2004/17/EC) and Directive 2014/23/EU on the award of concession contracts

[61] Source ICLEI (http://www.sustainable-procurement.org/newsroom/special-features/new-eu-procurement-directives-and-spp-opening-the-floodgates/ - accessed April 2014)

EU guidance and tools

The European Commission has developed common GPP criteria for priority sectors. Common criteria offer examples of criteria and requirements which can be set by the purchasing authority, in line with EU regulations. Priority sectors were selected through a multi-criteria analysis including: scope for environmental improvement; public expenditure; potential impact on suppliers; potential for setting an example to private or corporate consumers; political sensitivity; existence of relevant and easy-to-use criteria; market availability and economic efficiency[62]. Examples of common criteria currently available include:

- Cleaning products and services – for example excluding products which contain substances that included in the list foreseen in Article 59 of Regulation (EC) No 1907/2006 (the REACH Regulation);
- Office IT equipment – for example requiring products to meet the latest ENERGY STAR standards for energy performance[63];
- Construction – for example requiring the architect to demonstrate sufficient experience with environmental building design;
- Transport – for example requiring vehicles which do not exceed a set CO_2 emission value (according to the vehicle technical sheet) or meet a specific Euro standard; and
- Electricity – for example requiring a minimum percentage of electricity from renewable energy sources and/or high efficiency cogeneration and awarding additional points for electricity supplied from renewable energy sources above the minimum requirement in the specification.

The EU GPP website also provides a GPP toolkit[64] which includes guidance on how to integrate environmental criteria at each stage of a public procurement process, considering:

- Definition of the subject matter;
- Description of the minimum technical specifications which all bids need to comply with;
- The selection criteria related to the capacity of bidders to perform the contract;
- The award criteria on the basis of which the contracting authority will compare the offers; and
- The contract performance clauses to be included in the contract.

A wide range of additional EU or international level guidance and resources is available, including:

- ICLEI Sustainable Procurement Resource Centre[65] - provides a wide range of information on procurement criteria, policies and strategies, tools and guidance, good practice cases, studies and reports, labels, etc;

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[62] Source: http://ec.europa.eu/environment/gpp/gpp_criteria_en.htm - Accessed April 2014

[63] Available at www.eu-energystar.org - Accessed April 2014

[64] Available at http://ec.europa.eu/environment/gpp/toolkit_en.htm - Accessed April 2014

- Procura +[66] - an ICLEI led sustainable procurement campaign which aims to support public authorities in implementing sustainable public procurement, promote their achievements and foster exchange on good practice from public procurers and experts internationally;

- Smart SPP[67] – a European project on sustainable procurement which developed an Excel tool to support life cycle analysis;

- International Green Purchasing Network (IGPN)[68] – an international organisation which collects and disseminates information on global Green Purchasing activities; and

- Marrakech Task Force on Sustainable Public Procurement[69] – an international task force led by the Swiss Government under the United Nations Environment Programme (UNEP), which aims to enable governments to organise their public procurement more sustainably.

All T2K partners are aware of the resources available at EU level and have some experience of including environmental criteria in a range of purchasing decisions. Examples include:

- cleaning products and services – where the use of specific products is banned or restricted as they are harmful to the environment;

- vehicles – where minimum Euro standards or maximum tailpipe emission limits have been requested;

- uniforms – where organic materials and take-back (re-use or recycling) schemes have been requested; and

- catering services – where locally sourced and/or seasonal products are preferred.

Both RATP and STIB noted that they devote some time and resources to checking the claims of suppliers and compliance with requirements set out in the procurement process or contract. For example, STIB noted that visits to depots were undertaken to check products used by cleaning contractors and that checks were conducted with their catering supplier with regard to locally sourced food products for the canteen. RATP noted that fuel consumption for buses and business vehicles was monitored and some vehicles had been returned to manufacturer in instances where performance was much lower than expected (taking account of variables such as route, driver, etc).

Some partners noted that it could sometimes be difficult for project managers and procurement teams to develop and agree innovative approaches to sustainable procurement as the risk of a supplier challenging new approaches has to be taken into account.

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65 Available at http://www.sustainable-procurement.org/home/ - accessed April 2014

66 Available at http://www.procuraplus.org/ - accessed April 2014

67 Available at http://www.smart-spp.eu/index.php?id=6988 - accessed April 2014

68 Available at http://www.igpn.org/ - accessed April 2014

69 See http://www.unep.fr/scp/marrakech/taskforces/pdf/Procurement2.pdf - accessed April 2014

Case study – City of Nantes (France) Sustainable Procurement practices[70]

Nantes is a city in western France, with a population of approximately 283,000 inhabitants. It employs 4,686 officers and has an annual budget of €451 million.

The city's procurement strategy and long standing involvement with the Fair Trade movement means that environmental and social clauses are often inserted into tender documents although the City notes that there are still significant barriers including inadequate supply and costs. An overview of sustainable practices already in place is given below.

- Public Food Catering - Seasonal products are encouraged and where this is not possible, imported products like coffee, tea, fruit juices and chocolate should be from Fair Trade sources. 11% of the food served in school canteens (from 1,763,000 meals in 2012 for 89 canteens and 144 schools in Nantes) is biological and local. The biological products already introduced are: apples, milk, yoghurt, carrots, cabbages, dates, dry apricots and bread, as well as fair trade rice.

Textiles – Between 90% and 100% of cotton t-shirts and sweatshirts worn by officials are from organic and Fair Trade sources.

Paper - Since 2013, 100% of the paper bought by the City has been from recycled sources (label Blue Angel).

Wood - The certification of sustainable forest management is required: PEFC timber for European wood products and FSC for exotic products. If the raw wood markets meet these requirements (from 70% in 2007 to 100% in 2012), much work remains to be done for wood products (40%).

The City is currently trialling a new approach to include the consideration of GHG emissions in the procurement process. Working with suppliers, individual Departments have been tasked with identifying priority areas where meaningful CO_2 criteria could be introduced and standard criteria will be developed from these trials.

[70] Sources: Procura+ case study (www.procuraplus.org/en/participants/france-nantes/ - accessed April 2014) and Ville de Nantes, Rapport de Développement Durable 2013 (www.nantes.fr/files/live/sites/nantesfr/files/PDF/Publications/02-VDN/Dev-durable/Dev-durable-1/rapport-DD-13.pdf - accessed April 2014)

National/regional legislation and guidance - examples

Through discussions with partners, it became clear that regulation could be a key driver in the adoption of sustainable procurement practices and that guidance and tolls were generally welcomed to support the partners in establishing new processes and criteria. This section therefore does not propose to provide a comprehensive review of national and regional regulations and guidance applicable to the partners, but rather to offer an overview of the key elements identified through discussions with partners.

Regulation in the Brussels region – STIB's experience

In Belgium, STIB notes that the federal guide on sustainable procurement[71] has proved a useful tool to support the introduction of sustainable procurement within the organisation. Similar guides are generally available in all T2K countries.

The key driver for STIB however, has been the adoption of a directive on sustainable procurement in the public sector by the Brussels region[72]. The directive applies to the purchase of office supplies, IT, catering, cleaning, lighting, vehicles, clothing and energy. It requires public organisations in the region, including STIB, to:

- Appoint a person responsible for the implementation of sustainable procurement;
- Conduct a needs analysis before the initiation of the purchasing process;
- Aim to include environmental criteria for all contracts in scope; and
- Aim to include social and ethical objectives for the delivery phase of contracts where applicable.

Training sessions have been provided for organisations required to comply (including STIB), and a monitoring process is in place to evaluate how the directive is implemented, with data required from public sector organisations every two years.

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[71] "Guide des Achats Durables", available at http://guidedesachatsdurables.be/fr - accessed April 2014

[72] "Circulaire ministérielle sur les marchés publics durables en vigueur en Région de Bruxelles-Capitale", 2009 (http://www.bruxellesenvironnement.be/Templates/Professionnels/niveau2.aspx?maintaxid=11770&taxid=11770 – accessed April 2014)

Guidance and frameworks in the UK – TfGM's experience

In the UK, the business led Sustainable Procurement Task Force has developed the **Flexible Framework**[73] for sustainable procurement, a self-assessment tool for organisations to measure and monitor their progress on sustainable procurement over time[74]. The Framework considers five themes presented in Table 2.1.

TfGM has adopted the Flexible Framework and the organisation has reached Level 3 across the themes described in Table 2.1. TfGM has also voluntarily adopted the UK Government's Buying Standards[75] for key product and service categories.

The organisation is currently ISO14001 accredited and is therefore planning for changes to ISO14001, expected by mid-2015, which will result in sustainable procurement being considered as part of the accreditation. The new ISO 14001 Value Chain section will require organisations to develop and specify environmental requirements for the procurement of goods and services and communicate relevant environmental requirements to suppliers.

Table 2.1: UK Flexible Framework Level 3

People	Policy, strategy and communications	Procurement process	Engaging suppliers	Measurement and results
Targeted refresher training on latest Sustainable Procurement principles. Performance objectives and appraisal include Sustainable Procurement factors. Simple incentive programme in place.	Augment the Sustainable Procurement policy into a strategy covering risk, process integration, marketing, supplier engagement, measurement and a review process. Strategy endorsed by CEO.	All contracts are assessed for general Sustainability risks and management actions identified. Risks managed throughout all stages of the procurement process. Targets to improve Sustainability are agreed with key suppliers.	Targeted supplier engagement programme in place, promoting continual Sustainability improvement. Two way communication between procurer and supplier exists with incentives. Supply chains for key spend areas have been mapped.	Sustainability measures refined from general departmental measures to include individual procurers and are linked to development objectives. Simple measures based on achieving all aspects of the Practicing level of the Flexible Framework are put in place and delivered.

73 Available at https://www.gov.uk/government/publications/sustainable-procurement-in-government-guidance-to-the-flexible-framework - accessed April 2014

74 In the UK, the Social Value Act 2012 requires authorities entering into public services contracts and agreements (such as TfGM) to consider: (1) how what is proposed to be procured might improve the economic, social and environmental well-being of the relevant area, and (2) how, in conducting the process of procurement, it might act with a view to securing that improvement.

75 Available at http://sd.defra.gov.uk/advice/public/buying/ - accessed April 2014

TfGM has recently revised its **Corporate Social Responsibility (CSR) policy**, including the following objectives:

- Carbon - to reduce CO_2 emissions from energy use within TfGM buildings, becoming a zero carbon organisation by 2033 and contribute to the delivery of a 48% cut in CO_2 from transport emissions in Greater Manchester by 2020;
- Nature - to ensure no net loss of biodiversity when we are building new infrastructure and where possible enhance and expand spaces for wildlife across the transport network;
- Water - to use water more efficiently and ensure we don't contribute to local flooding or water pollution;
- Waste - to reduce the waste that we create, reusing where possible and recycling where not;
- Responsible Consumption and Trade - to reduce the impact of the things we consume and stimulate a market for sustainable products and services supporting the growth of a green economy and skills in Greater Manchester;
- Economy - to develop a transport system that supports sustainable economic growth;
- Health and Wellbeing - to develop a transport system that enables people to improve their health and wellbeing;
- Equality - to champion equality within our workforce and develop a transport system that contributes to social inclusion;
- Culture and heritage - to develop a transport system that connects people to cultural activities and the opportunities they provide; and
- Climate change adaptation - to make sure we are prepared to adapt to future changes in climate and have a resilient transport network in Greater Manchester.

TfGM has also developed a **Responsible Procurement Charter**. The charter is seen as an integral part of TfGM's procurement process, *"defining the way we work and the way we want our partners and suppliers to work"*. It aims to encourage *"transparency, adherence to laws, regulations, minimum standards and continuous improvement"*[76]. When signing the charter, suppliers are asked to commit to:

- Ensuring legal compliance;
- Ensuring that equal opportunities principles as applied by TfGM are reflected in their own commitments and their suppliers' commitments;
- Adopting fair pay and fair employment and labour practices;
- Encouraging community involvement (including minimising disruption to communities);

[76] Source: Transport for Greater Manchester Responsible Procurement Charter

- Reducing the environmental impact of products and services;
- Mitigating and adapting to climate change; and
- Continuous improvement in relation to all areas of responsible procurement.

TfGM Environment and Procurement teams have generally conducted **procurement spend analysis** every two years. For the analysis, the data on the organisation's overall spend is downloaded from the SAP system and analysed in Excel to identify the top suppliers and contracts, high risk goods and services purchased, etc. Sustainable procurement risks have been assessed using multi-criteria analysis and the teams' knowledge as summarised in Table 2.2.

Table 2.2: High and medium risk spend areas identified by TfGM

High risk spend areas	Medium risk spend areas
• Facilities, buildings and maintenance services • Design and construction • Metrolink contracts	• Cleaning • Staff expenses • Subsidised bus services • Subsidised rail services • Vehicles and fleet • Bus purchase

Case study – BS 8903 and NF X 50-135

BS 8903 is a British Standard[77] developed to present the principles and a framework for procuring sustainably. As there is no international standard on sustainable procurement at present[78], BS8903 has been used by organisations globally to assess their progress against sustainable development principles.

The standard covers a range of areas including the procurement process, leadership and governance, people, risk and opportunity, engagement and measurement. It provides examples of specification approaches and criteria, including sustainable development issues and advice on training approaches for different levels of staff within organisations.

The French standardisation body AFNOR published a standard (NF X 50-135) in 2012[79], proposing recommendations to policy makers and buyers who wish to initiate a sustainable procurement process. The standard aims to reflect the seven core subjects of ISO 26000 (Social Responsibility).

[77] Available at http://shop.bsigroup.com/ProductDetail/?pid=000000000030203003 – accessed April 2014

[78] As noted above, ISO14001 will include a less detailed section on procurement from 2015

[79] Available at www.boutique.afnor.org/normes/resultats/60406f7b-9dab-4ff9-b3b4-72d700a12e5c - accessed April 2014

Case study – UK Government Buying Standards[80]

The UK Government Buying Standards (GBS) are product specifications pre-developed to enable public authorities to include them in their tendering process. Where applicable, the specifications show minimum requirements as well as best practice examples. There are around 50 standards in a range of product areas, including:

- Construction and construction products;
- Cleaning products and services;
- Electrical goods;
- Food and catering services;
- Furniture;
- Horticulture and park products and services;
- Office ICT equipment;
- Paper and paper products;
- Textiles;
- Transport; and
- Water using products.

Case study – RATP procurement of phones/ communications equipment[81]

RATP recently undertook a procurement exercise to renew desk and mobile phones across the company. Variations to the specifications were accepted and the sustainable development criteria represented 5% of the total score. This led to the selection of a contractor offering:

- The use of recycled telephones, estimated to divide CO_2 emissions by a factor of four when compared to the use of new handsets;
- The use of an offset scheme sponsoring an environmental association; and
- Telephone recycling when reaching end of life.

[80] Available at http://sd.defra.gov.uk/advice/public/buying/ (accessed April 2014)

[81] Source: RATP procurement department

Case study – Implementing the Clean Vehicle Directive

The EU's Clean Vehicle Directive[82] 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 as covered by the public procurement Directives and the public service Regulation. For T2K partners, this has mainly led to reviews of the procurement process for buses.

Three options to account for the energy and environmental impacts of the vehicles are given by the Directive, with purchasing organisations able to:

- Set technical specifications (Option 1);
- Include energy and environmental impacts as award criteria (Option 2a); or
- Use a monetised value of CO_2 and other air pollutants (Option 2b - the rules to do so are set out in the Directive and the Commission provided a tool to support calculations[83]).

A 2013 report provides early feedback on the Directive's[84] implementation across the EU. It noted that *"anecdotal evidence from Germany seemed to show that authorities had mainly used option 1 and Option 2a"* (to a lesser extent), with Option 2b probably the least used, mainly due to difficulties regarding its application. *"London, Vienna and Romanian public transport operators all specify the environmental standards with which vehicles to be purchased have to comply, while Barcelona estimates the life cycle costs of the vehicle along with other factors". "Manufacturers indicated that more public authorities have been evaluating life time costs and impacts of vehicles, rather than just focusing on purchasing costs"*.

The experience of the implementation of the Directive varies amongst partners, as set out below.

RET, STIB and TfGM have mainly used Option 1, setting technical specifications such as minimum Euro standard or maximum emission levels. RET, STIB and TfGM also use life cycle analysis to compare the vehicles being offered, and noted that this includes anticipated fuel consumption over the life of the vehicle.

RATP adopted a different approach by including the vehicle's CO_2 performance in the technical score (4% of the technical score for buses and up to 20% of the technical score for cars), as well as taking account of the vehicle's anticipated fuel consumption through life cycle analysis. RATP explained that the technical score usually accounts for 30 to 40% of the total score with the remaining 60 to 70% allocated to price (considering whole life cost). It was noted that although the proportion of the score allocated to carbon emissions within the technical score might be relatively small, it is possible for this score to make a difference (when proposed vehicles are similar with regard to price and technical and quality scores).

[82] The Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles, Directive 2009/33/EC, see http://ec.europa.eu/transport/themes/urban/vehicles/directive/ - accessed April 2014

[83] Available at www.cleanvehicle.eu – accessed April 2014

[84] Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM/2013/0214 final (http://eur-lex.europa.eu/legal-content/EN/ALL/;jsessionid=yTd2TDqG6VpqpDCR8m0P6TQHY87kgtMmryPBXvCyqpLYwnMnHrCm!365571571?uri=CELEX:52013DC0214 – accessed April 2014)

As noted in the 2013 report on the implementation of the Directive[84], many national governments, cities and T2K partners already had objectives or policies which were more ambitious than the Directive in their aim to reduce vehicle emissions.

For example, RET has purchased buses with Euro V and EEV engines since 2007. Since 2010, RET has launched two pilot projects using hybrid buses and has leased 10 full electric company cars and a number of hybrid cars. RET is currently developing a new project for the use of full electric, hydrogen and fuel cell buses.

RET also leases 10 full electric company cars and a number of hybrid cars at present. If RET procures or leases new company vehicles, the first option is to lease electric or hybrid, or highly efficient traditional vehicles. This policy was introduced in 2011 and since the introduction approximately 80-100 vehicles have been replaced.

Case study – RATP bus procurement[85]

RATP issues approximately one tender per year to procure buses to run services on a total of 350 routes across the area. Contracts are let for a period of 3 to 5 years, using the European tender process. The procurement decision is based on performance, taking into account the economic and technical performance of the proposed vehicles.

The economic/ financial score represents 60% of the final score and is based on total cost of ownership analysis, including:

- Cost of bus and fixed installations (usually around 35% of the LCC);

- Cost of fuel consumption (based on a Standardised On-Road Test cycle – SORT cycle) and pollution control additives (usually around 40% of the LCC); and

- Maintenance costs, including preventive, corrective, and accident-vandalism (around 25% of the LCC).

The technical score represents 40% of the final score and includes:

- Scores against technical specifications (more than 500); and

- Technical scores from experts (design, mechanics, drivers).

[85] Source: RATP (presentation on bus procurement not publicly available)

2.4. Summary

Building on existing practices and guidance, this section explored how the GHG performance of services and products purchased by T2K partners could be improved through the procurement process.

At the European level, new public procurement directives were adopted by the European Parliament in 2014 and Member States have to transpose the directives into national law by January 2016. Two key objectives of the reform were to facilitate taking account of environmental, social and innovation factors and to provide more flexibility in procedures and timelines, complemented by greater use of e-procurement. The new directives give greater prominence to LCC as a means of calculating costs, including the cost of environmental externalities such as GHG emissions, with the methodology to be indicated in advance in the tender documents.

There is a wealth of resources available at European or national (and in some instances regional) level to support project managers and procurement teams in developing specifications which aim to minimise environmental impacts. T2K partners are generally aware of these resources and partners are generally committed to sustainable procurement. Partners however noted that delivering this commitment in practice requires staff resources and buy-in from procurement and legal teams, who can be risk averse, for example when considering the use of new requirements in specifications.

Table 2.3: Summary of findings and next steps by partner

T2K partner	Including GHG performance in the procurement process – Summary of findings and next steps
moBiel	Established approach Next steps - Limited need for further developments
RATP	Established approach and good practice examples provided Next steps – Further progress in including environmental considerations (energy, carbon) in procurement process, supported by business case/financial appraisal developments
RET	Established approach and good practice examples provided Next steps – Enhance current processes to better include consideration of energy use and associated emissions
STIB	Established approach supported by regional requirements and good practice examples provided Next steps – Enhancements linked to progress with appraisal methods and assumptions to be applied consistently, including for the procurement process
TfGM	Established approach based on national framework Next steps - Limited need for further developments mainly linked to resources and the need for buyers, project managers and procurement officers to develop further knowledge of energy/environmental issues

3. Third party involvement- Using ESCO and EPC models (R6)

3.1. Objectives and methodology

The 2012 report identified the potential for T2K partners to make use of new financing models in the energy efficiency sector such as Energy Services Companies (ESCOs) and Energy Performance Contracting (EPC). The main advantages for T2K partners would be that no financial outlay is required from the public transport organisations and that the third party takes on the majority of investment risks. This type of approach could also help partners to unlock European funding as some EU funding instruments have been set up to support this type of public-private partnership.

RET and TfGM expressed an interest in investigating the potential for using ESCOs/EPCs (or similar funding instruments) within their organisation. Background information on ESCOs/EPCs was updated and presented to RET and TfGM at workshops, where the barriers to energy efficiency investment and the potential to involve third parties were discussed. This section presents an updated analysis of third party financing models, which are relevant to all partners, and recommendations which apply more specifically to RET and TfGM.

3.2. Definitions

The European Commission Energy Services Directive[86] defines the various models considered here as follows:

- **Energy Service Company (ESCO)** - a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria[87];
- **Energy Performance Contracting/Contracts (EPC)** - a contractual arrangement between the beneficiary and the provider (normally an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement; and
- **Third Party Financing (TPF)** - a contractual arrangement involving a third party (in addition to the energy supplier and the beneficiary of the energy efficiency improvement measure) that

[86] Energy End-use Efficiency and Energy Services 2006/32/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0064:en:pdf)

[87] This model differs from Energy Service Provider Companies (ESPCs), which provide a service for a fixed fee or as added value to the supply of equipment. ESPC may have some incentives to reduce consumption, but these are not as clear as in the ESCO approach. Often the full cost of energy services is recovered in the fee, so the ESPC does not assume any risk in case of underperformance. EPSC is paid a fee for their advice or equipment rather than being paid based on the results of their recommendations (source: http://iet.jrc.ec.europa.eu/energyefficiency/esco - accessed April 2014)

provides the capital for that measure and charges the beneficiary a fee equivalent to a part of the energy savings achieved as a result of the energy efficiency improvement measure. That third party may or may not be an ESCO.

Additionally, **Energy Supply Companies (ESCs)** were also discussed with RET and TfGM, where third party invest in low carbon/renewable energy equipment on behalf of a customer and recovers the cost of the investment by selling the energy produced to the grid (and providing low carbon energy to the customer).

3.3. How does it work?

Energy Performance Contracting

In practice, models involving a third party can include one or more of the following roles (but remain flexible depending on the customer's requirements):

- Funding the investment;
- Advising on best technical option(s);
- Procuring and installing equipment;
- Maintaining equipment (in some cases); and/or
- Guaranteeing the savings.

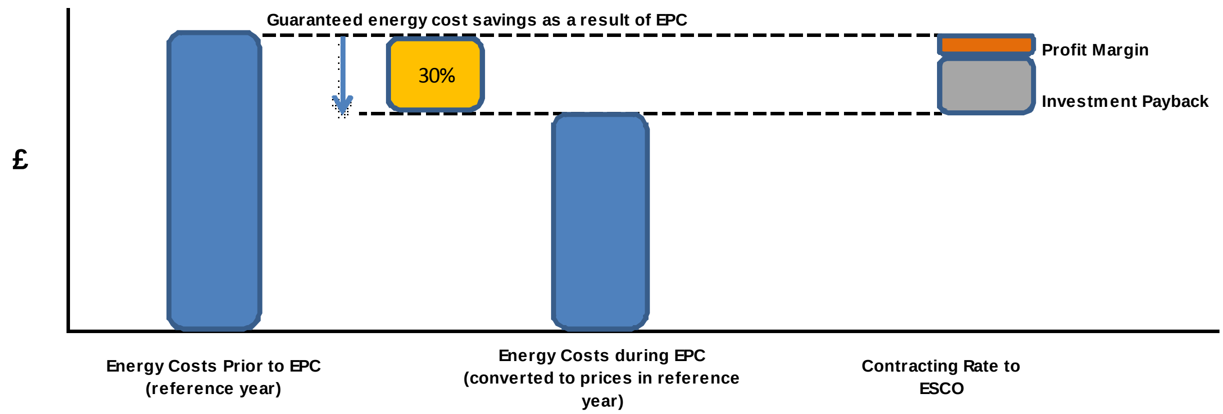
Models implemented are generally base on the "Golden Rule" (illustrated in Figure 3.1): The expected savings on energy bills should be at least as big as the total repayments of the investment/loan, including interest and other fees, so that after the loan is repaid the customer benefits from lower energy bills[88].

Energy Performance Contracts (EPCs) usually focus on energy efficiency and include the following stages:

- Feasibility, development and design of energy efficiency projects and development of Monitoring and Verification (M&V) plan;
- Installation of equipment;
- Ongoing M&V of energy savings, usually using International Performance Measurement and Verification Protocol (IPMVP); and
- Energy savings guarantee for life of loan.

[88] The risk of energy prices falling over the term of the EPC/ESCO contract can usually be addressed within the model. For example, with an EPC based on an initial energy spend on €4 million per year and a projected reduction in energy use/costs of €1.2 million per year, a 10% reduction in energy costs would result in a shortfall of €120k in the energy savings (which are used to repay the loan). Overall energy costs for the customers would however also reduce by €280k, more than making up for the shortfall in financial savings under the EPC contract.

Figure 3.1: The Golden Rule - EPC guaranteed savings model example



The funding for the equipment and its installation might come from the customer, the ESCO's own funds or through third party funding, either through a loan direct to the customer (from the customer's bank for example) or a loan to the ESCO.

Table 3.1 presents a summary of benefits and drawbacks from ESCO and EPC models. This shows how third party involvement might help to address some key barriers to energy efficiency investment for public transport authorities but can also be difficult to implement within the public transport sector. ESCOs would generally be expected to charge an additional 8 to 10% (when compared to in-house delivery) although it can be difficult to identify this additional charge where an ESCO provides finance as well as technical expertise (what is cost of capital and what is technical expertise cost).

Table 3.1: ESCO and EPC models – Summary of benefits and drawbacks

Benefits	Drawbacks
Access to capital/credit for energy efficiency investment	Loss of control of equipment and plant (installing, maintaining)
Reduced energy costs and emissions	Resistance within the organisation against outsourcing
Reduced technology risk	Lack of in-house expertise to establish EPC type contracts and manage the long term relationship[89]
Financial risk reduced or transferred	Lack of supplier expertise in transport sector (relatively new sector in the UK)
Reduced search and transaction costs[90]	

[89] For example, it is important the customer is required to respect the conditions stated in the Monitoring and Verification Plan (for example with regard to equipment operating conditions or maintenance regime). A breach of these conditions could result in lower than anticipated savings for the customer.

[90] This include the costs to the organisation of determining which goods/equipment should be purchased, at what price and how, procurement/purchasing process costs and monitoring and enforcement costs.

Energy Supply Companies

The ESC model usually involves a third party delivering low carbon/renewable energy (e.g. wind or solar) through the following stages:

- Development and design of renewable energy projects;
- Installation and maintenance of equipment; and
- Energy (and Certificates of Origin) sold on market and/or used by customer.

Energy considered can include electricity, steam, other heat, cooling and compressed air. Production options considered usually include wind, solar, biomass and geothermal.

The financial case for this type of investment strongly depends on the price of energy, including any subsidies/support tariffs and/or Certificates of Origin available. The financial case might vary between energy sources as prices and incentives are likely to differ. Table 3.2 presents a summary of benefits and drawbacks from ESC models.

Table 3.2: ESC model – Summary of benefits and drawbacks

Benefits	Drawbacks
Access to capital/credit for renewable energy investment	Loss of control of equipment and plant (installing, maintaining)
Reduced energy costs and emissions	Requires long term commitment from land/building owner
Reduced technology risk	Resistance within the organisation against outsourcing
Financial risk reduced or transferred	Lack of in-house expertise to establish this type of contracts and manage the long term relationship
Reduced search and transaction costs	Lack of supplier expertise in transport sector

3.4. The potential for third party involvement for RET

RET key objectives

As for many other public transport organisations, a key priority for RET is to reduce costs and improve efficiency in delivering public transport services in the area. Other objectives for the organisation include using less energy (resulting in cost savings), using more renewable sources of energy (already 100% green electricity contract) and reducing CO_2 emissions per passenger km.

Stadsregio Rotterdam, the transport authority for the area, has signed up to the objective to reduce CO_2 emissions in the area by 40% by 2025 (compared to 1990 levels). Sustainable transport, including low emission vehicles, is very much at the centre of the region's strategy to achieve this objective.

Potential for third party involvement

A workshop took place with RET staff (in December 2013) to assess the potential for third party involvement to support RET in improving its energy efficiency and/or producing renewable energy.

The ESCO/EPC model, focusing on energy efficiency, was identified as looking attractive in principle, mainly due to the strong technical skills such a contract could bring in a challenging and fast evolving area. It was acknowledged that RET would struggle with this level of detailed technical knowledge in-house. Feedback from workshop participants shows less interest in funding options as there is a view that RET should be able to fund the required equipment themselves if there is a valid business case.

The ESC model, where a third party invests to produce renewable energy on behalf of RET, was also seen as potentially interesting. RET noted that options to produce solar or wind energy had been considered at a recent new depot, but that doubts on whether there was a valid business case for the investment led to the proposals being abandoned. RET has also been approached to see if they would be interested in connecting one of their depots to industrial heat sources (depots located close to industrial areas). This has not been taken forward at present due to doubts as to whether there is a valid business case.

Case study – Considering renewable energy options for RET[91]

RET commissioned consultants Ernst & Young to investigate options for investment in renewable energy. The consultants reported on the advantages and drawbacks of a range of technologies and investment options. Technologies considered include solar (photovoltaic and thermal), wind (offshore and onshore), biomass, hydro and geothermal. Investment options assessed include: buying green electricity (as currently done by RET), buying green energy certificates (separately from electricity purchase), Power Purchase Agreements (green energy from a specific project) and direct investment in green energy production.

[91] Source: Duurzame energieopties voor RET, Ernst & Young, 2014

It was noted that any third party involvement would need to consider RET's governance and contractual context, as RET recently started to compete with other operators to secure public transport contracts in the region. The bus contract was awarded to RET in 2012, until 2019. RET's rail concession (for both metro and tram) expires in December 2016. At present, RET have a "high level agreement" with Stadsregio Rotterdam for the next rail concession until December 2026 but negotiations on the details of this agreement have yet to start. Any changes in RET's operator status in the region would have obvious impacts on potential agreements with third parties if RET were to cease to operate public transport services in the area and manage buildings and depots linked to the services.

Case study - Rotterdam Swimming Pools ESCO

The **Rotterdam Swimming Pools ESCO** was the first maintenance and energy performance contract in the Netherlands. The City of Rotterdam outsourced all management and maintenance work for its nine municipal swimming pools for 10 years to Strukton and Hellebrekers Technieken. The objectives of the contract were to improve energy efficiency, reduce CO_2 emissions and improve water and air quality. A 34% reduction in energy costs is expected, as well as a 15% reduction in maintenance costs. The required investment was financed by Strukton, with interest and repayments covered by savings in energy costs for Gemeente Rotterdam (under the energy performance contract).

Next steps for RET

Feedback from the workshop indicates that RET's interest in third party financing arrangements is limited. This stems from the view that RET should usually be able to fund investment if a business case can be made, and does not usually require third party financing support. There is however some interest in the technical knowledge and support an ESCO/EPC type arrangement could bring to RET teams.

RET commissioned specialist consultants in the Netherlands to review the potential for renewable energy investment for the organisation. The study analysed a range of technologies and investment options as detailed below. Recommendations on a renewable strategy investment from RET will be developed based on the findings from this study and might include the involvement of third parties where additional funding or technical knowledge is required.

Next steps for RET:

Develop the company's renewable energy strategy based on findings from the study on renewable energy investment options.

Keep abreast of developments in the ESCO/EPC and ESC market in the Netherlands.

3.5. The potential for third party involvement for TfGM

TfGM key objectives

TfGM is soon to adopt its first Carbon Strategy in 2014. The Strategy sets a target to reduce TfGM's organisational carbon emissions by 75% by 2018, from 2007/2008 levels, and to become a zero carbon organisation by 2033.

These are ambitious targets for the organisation and were estimated to result in financial savings of up to £25 million over the 2014-2024 period[92].

As a region, Greater Manchester has set a target of a 48% reduction in regional carbon emissions by 2020, from 1990 levels, across all sectors[93]. TfGM will need to work with partners and stakeholders to contribute towards reducing emissions associated with transport[94].

Case study – Proposed public ESCO in Greater Manchester

There are proposals for a public ESCO in Greater Manchester. A feasibility study[95] commissioned by "Manchester is my Planet"'[96] in 2007 identified two potential pilot projects to trial an ESCO approach and two areas where ESCOs could be developed, namely, school buildings and local authority buildings.

Potential for third party involvement

A workshop took place with TfGM staff (in February 2014) to assess the potential for third party involvement to support TfGM in improving its energy efficiency and/or producing renewable energy.

Feedback from the workshop identified that, as for RET, securing the required capital to fund an investment in energy efficiency (or other types of projects) would not usually be an issue as long as there is a convincing business case for the proposed investment (with a relatively short payback period – usually around three years and no more than six years).

Although access to capital was therefore not seen as a barrier, TfGM staff identified other issues potentially hindering energy efficiency investment in the organisation:

- Need to secure revenue funding to develop options, prepare business case for investment, investigate potential funding options (including EU sources or third party involvement), manage projects and operate and maintain the equipment once purchased;

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[92] Source: TfGM Carbon Strategy, 2014

[93] Source: Greater Manchester's Climate Change Implementation Plan 2013 (http://www.agma.gov.uk/cms_media/files/gmccsimplementationplansummary2013.pdf?static=1 – accessed June 2014)

[94] TfGM is the executive arm of the Greater Manchester Combined Authority (representing the ten Greater Manchester local authorities) and has such is responsible (with the local authorities and other partners where relevant) for delivering the policies and targets set by the Authority

[95] Available at http://manchesterismyplanet.com/strategy/esco-feasibility-study - accessed April 2014

[96] Manchester is my Planet is a partnership of people and organisations from across Greater Manchester, working together to tackle climate change (see http://manchesterismyplanet.com/)

- Budgetary constraints (often from Government or other external sources) and value engineering have the potential to reduce opportunities to maximise energy efficiency outcomes in new building design and construction;
- Training requirements for staff operating or maintaining new equipment and need to have in house staff (or external independent support) who know at least as much as suppliers to specify the right equipment, monitor performance, etc;
- Need to monitor product/equipment performance once procured/installed and go back to provider if not satisfactory (risk of under-performance perceived as high with new energy efficient technologies); and
- Energy efficiency schemes usually lack visibility (when compared to renewable energy schemes for example) and this results in lower levels of interest in proposals.

Case study - TfGM Energy Manager Post

TfGM had enhanced its internal capacity to improve energy efficiency by creating an Energy Manager post for the organisation. The business case for creating the post was based on the energy savings estimated to result from the post creation, which were assessed to more than cover the cost of the post.

Workshop participants identified the following area where third party involvement could potentially address some of these barriers and result in improved energy efficiency for TfGM:

- For new build projects, a third party offering capital funding and technical expertise could potentially be brought in after the value engineering stage to deliver energy efficiency options included in the initial design proposals but excluded from the construction stages to reduce capital costs; and

Case study – Transport for London EPC[97]

The RE:FIT framework[98] was established for public sector organisations in the Greater London area, to simplify the procurement of ESCO services. It uses European Local Energy Assistance (ELENA) funding to provide administration support, appoint ESCOs to the framework and monitor progress but brings no funding for energy efficiency projects. ESCOs bring technical expertise and guaranteed savings.

Transport for London (TfL) and Honeywell have worked together under the RE:FIT framework between 2008 and 2011 to retrofit 22 buildings with energy conservation measures including heat recovery, solar thermal, boiler upgrades, combined heat and power (CHP) and draft proofing.

This retrofit programme has been estimated to result in a 16% saving in costs (£500k per year), with a payback period of eight years and a reduction in CO_2 emissions of 2,500 tonnes of CO_2 per year.

[97] Source: http://www.refit.org.uk/case-studies/transport-london/ - accessed April 2014

[98] See http://www.refit.org.uk/ - accessed April 2014

Next steps for TfGM

Feedback from the workshop indicates that TfGM's interest in third party financing arrangements is mainly linked to the provision of technical expertise and a specific area where energy efficiency investment is not always straightforward to deliver at present.

Next steps for TfGM:

Investigate the possibility of involving a third party in the development and delivery of a new build project to deliver additional energy efficiency/ renewable energy investment. Initial steps could include the selection of a pilot project and initial discussions with potential third parties to test the market.

Keep abreast of developments in the ESCO/EPC and ESC market in the UK, especially in the transport sector

3.6. Summary

Both RET and TfGM wanted to explore the potential or third party involvement to support energy efficiency and renewable energy investments. Options including third party financing and technical expertise related to energy efficiency as well as third party involvement in the development of renewable energy sources were considered. Both organisations identified a limited scope for potential third party involvement and agreed that they would continue to watch developments in this emerging sector as they might need third party support in the future.

Table 3.3: Summary of findings and next steps by partner

T2K partner	Using ESCO and EPC models – Summary of findings and next steps
RET	Parallel study undertaken to review the potential for renewable energy investment for RET (technologies and investment options) Limited need for third party involvement, mainly linked to technical expertise Next steps – Development of renewable energy strategy based on parallel study recommendations and keeping abreast of developments in the ESCO/EPC and ESC market in the Netherlands
TfGM	Limited need for third party involvement mainly linked to technical expertise and potential for further involvement identified with new build projects Next steps - Investigate the possibility of involving a third party in the development and delivery of a new build project to deliver additional energy efficiency/renewable energy investment ; keeping abreast of developments in the ESCO/EPC and ESC market in the UK transport sector
Other partners	Limited scope and need for third party involvement due to a range of factors Next steps – Keeping abreast of developments in the ESCO/EPC and ESC market

4. Capacity building and tools (R3)

4.1. Objectives and methodology

The 2012 report identified the issue of the lack of staff with the skills and capacity to implement energy efficiency and sustainability recommendations. moBiel, RET and TfGM identified this as a key issue for their organisation at the time.

TfGM decided to act on this issue by developing a tool to assist buyers, project managers and contract managers in considering energy use and associated carbon emissions as well as wider environmental and sustainability issues when planning a project or procuring equipment or services as well as through operating and decommissioning phases of a project. The tool will also support the implementation of TfGM's "strategic CO_2 reduction plan" developed under Work package 3 of the Ticket to Kyoto project.

RET have expressed an interest in the tool and its development, although they did not request a tool developed specifically for the organisation. The RET team has therefore been involved in the early stages of the tool's development through face to face discussions with the Atkins team, and the final tool developed for TfGM will also be presented to RET.

The purpose of the tool and its target audience were discussed at an initial workshop with TfGM staff in March 2014 and summarised below:

- Focus on small projects, maintenance programme (as another TfGM tool is being developed in parallel, considering large construction projects);
- Support consideration of energy use, carbon and wider environmental impacts across the organisation's activities;
- Support legal compliance by identifying potential areas where advice might be required;
- Improve personal responsibility for considerations beyond a specialist Environmental Team;
- To be used by buyers, project/contract managers and project teams;
- To provide a proportional approach (e.g. light touch for small projects but addressing low value/high risk and cumulative effect issues if possible).

4.2. Overview of TfGM sustainability tool

The tool has been designed to prompt buyers, project managers and contract managers to consider the potential environmental and sustainability impacts of decisions they make related to projects, maintenance and purchasing. It prompts users to consider impacts from two different perspectives:

- Considering potential issues arising from a project or planned purchase from the environmental/sustainability impact perspective – inviting a high level reflection on the most relevant issues and what can be done to avoid or mitigate them; and/or
- Considering potential issues and mitigation measures by type of material or service to be used or procured – encouraging a detailed consideration of the potential to reduce the impact of small projects and purchases on a day-to-day basis through the use of specifications and labels.

First approach - environmental/sustainability impact perspective

Through the first approach, the tool invites users to consider potential impacts and mitigation measures across the following nine categories:

- Climate change adaptation & resilience;
- Energy use (& related GHG emissions);
- Air quality and emissions (other than related to energy use);
- Biodiversity / ecology;
- Waste / contaminated land;
- Water (quantity and quality);
- Disturbances (noise, vibrations, light);
- Landscape/townscape; and
- Social and socio-economic issues.

For each category, the tool provides further information on the potential impacts and mitigation options to be considered, covering:

- Legal requirements;
- National policies and targets;
- Greater Manchester targets and policies;
- TfGM targets and policies;
- Quantification methodology (where applicable);

- Examples of good practice and additional information.

Second approach - issues and mitigation measures by type of material or service

The second approach has been developed by reviewing current day-to-day projects, planned maintenance and small investment proposals provided by TfGM and considering which equipment, materials and services were the most relevant to project manager and contract managers within the organisation. The tool therefore considers the following categories:

- Buildings;
- Cleaning;
- Electrical goods;
- Furniture;
- Horticulture and park services;
- ICT equipment;
- Transport; and
- Water using products.

For each category, it presents:

- A summary of key environmental impacts to be considered
- References to UK Government Buying Standards (where applicable) and other standards (where relevant)
- References to good practice examples, case studies or guidance (where available).

4.3. Relevance for other T2K partners

The tool has been developed specifically for TfGM and therefore focuses on the UK context (legal requirements and government commitments). It would however be possible to adapt the tool to reflect the context of other T2K partners, especially as many references included in the tool are relevant at the European level.

Partners are likely to want to review the tool developed for TfGM once it is completed and might decide to adapt it for their own use or retain some of the information included in the tool for their own guidance.

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