CO2MPARE

CO2 Model for Operational Programme Assessment in EU Regions

Improved carbon management with EU Regional Policy

Final Report

Project commissioner and project team

Commissioned by the European Commission, Directorate-General for Regional and Urban Policy under the supervision of Mikel Landabaso - Head of Unit, assisted by Maud Skäringer - Policy Analyst on energy and Mathieu Fichter - Team Leader on 'sustainable growth'.

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Project consortium

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EXECUTIVE SUMMARY

Supporting national and regional authorities in balanced decision making

The CO_2MPARE model supports national and regional authorities in making balanced decisions for their investment portfolio under their regional development programmes, in particular under their Operational Programmes of EU Regional Policy. The EU's climate objectives require that investments across the EU are channeled towards low-carbon development. The carbon impacts of investments should therefore be seriously considered in the decision making process of regional development programmes.

Assessing carbon impact of EU Regional Policy programmes

The CO_2MPARE model informs national and regional authorities on the impacts that the investments under various Operational Programmes can have in terms of CO_2 emissions. Knowing which investments lead either to additional emissions or rather to emission reductions, and what the overall impact of a programme is, represents the first step towards investment decisions that have decarbonisation co-benefits.

CO_2MPARE estimates the combined carbon impact of all activities that take place under a programme, and provides insights into the relative contributions of the different themes. Through its high aggregation level, it allows comparison of investment scenarios rather than individual projects. As such, it aims to support informed decisions on investment strategies rather than project investment decisions. In doing so, it also helps to build and develop a 'carbon culture' within the authorities directly or indirectly in charge of managing Regional Policy Operational Programmes. The model is primarily aimed at Operational Programmes co-financed by the European Regional Development Fund (ERDF).

Key success factors

The CO_2MPARE model has several attributes that make it an attractive tool for national and regional policy makers.

1. It provides information on emission impact of a programme at various levels of detail.
2. It requires only input on financial data from users, which makes it quick and easy to use.
3. It can compare emission impacts of alternative investment options.
4. It provides outputs in graphical as well as table formats.
5. It uses regionally specific data for regionally relevant results.
6. It is flexible towards user needs on specification of outputs.
7. It comes with a practical user tutorial and developer guidance.

1.
Introduction

EU Regional Policy has impacts on CO_2 emissions

EU Regional Policy is an investment policy. It aims to support job creation, competitiveness, economic growth, improved quality of life and sustainable development. With its investments, it supports the delivery of the Europe 2020 Strategy.

EU Regional Policy also serves to express the EU's solidarity with less developed countries and regions, concentrating funds on the areas and sectors where they can make the most difference. The policy aims to reduce the significant economic, social and territorial disparities that still exist between Europe's regions.

During the period 2007-2013, the EU will invest a total of 347 billion euro in Europe's regions, to be complemented also by national and regional co-financing. The funding helps, for example, to improve transport and internet links to remote regions, boost small and medium-sized enterprises in disadvantaged areas, invest in a cleaner environment and improve education and skills. EU funding is also invested in innovation, developing new products and production methods, energy efficiency and tackling climate change.

The European regions thus support a wide variety of projects to promote their regional development goals. Many investments, such as e.g. road construction or renewable energy projects, have a significant impact on CO_2 emissions, positive or negative.

Climate goals require channeling investments to low-carbon development

The EU aims to reduce greenhouse gas (GHG) emissions by 20% in 2020, compared to 1990. On the longer term (2050), a reduction of 80-95% is targeted. National or regional governments, as well as cities, may also have set additional reduction targets. Achieving these targets requires that the carbon intensity of the economy is considerably reduced. Therefore, investments across the EU, including those resulting from EU Regional Policy, need to be channeled towards projects that contribute to decarbonisation.

CO_2MPARE assists policy makers in their investment decisions

National and regional policy makers need to be aware of the carbon impact of their development programmes. Knowing e.g. which investments lead to additional emissions, which investments lead to emission reduction, and what the overall impact of a programme is, is an essential first step on the road to considering alternatives that have a decarbonisation co-benefit. The CO_2MPARE model developed in this project is a tool that can assist policy makers in considering the regional, national and European climate goals in their development programmes. It is made publicly available, for voluntary use by regional or national policy makers or all other interested parties alike.

2.
The CO_2MPARE model

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2.1 Financial input to carbon output

The CO_2MPARE model uses financial inputs to estimate the carbon outcomes of a programme. It divides the budget of an Operational Programme over the physical activities that take place in the projects financed. It guides the user to disaggregate the budget stepwise, over main programme themes, subthemes, and theme elements and then uses a set of standardized activities ('Standardized Investment Components', 'SICs') to define the actual activities that take place.

The model uses a database with region specific economic and physical indicators. This database allows the model to calculate the CO_2 impact from spending a given amount on a standardized investment component in the given region. Re-aggregation of these CO_2 impacts over theme elements, sub-themes and main programme themes, provides the programme level carbon impact.

For a proper valuation of the outputs, it is essential to understand that model results reflect the impact of investments compared to a situation in which the investments would not take place. Impacts are evaluated against a 'frozen baseline', which implies that the model assumes that no autonomous changes in emission factors or activity level per euro occur over time.

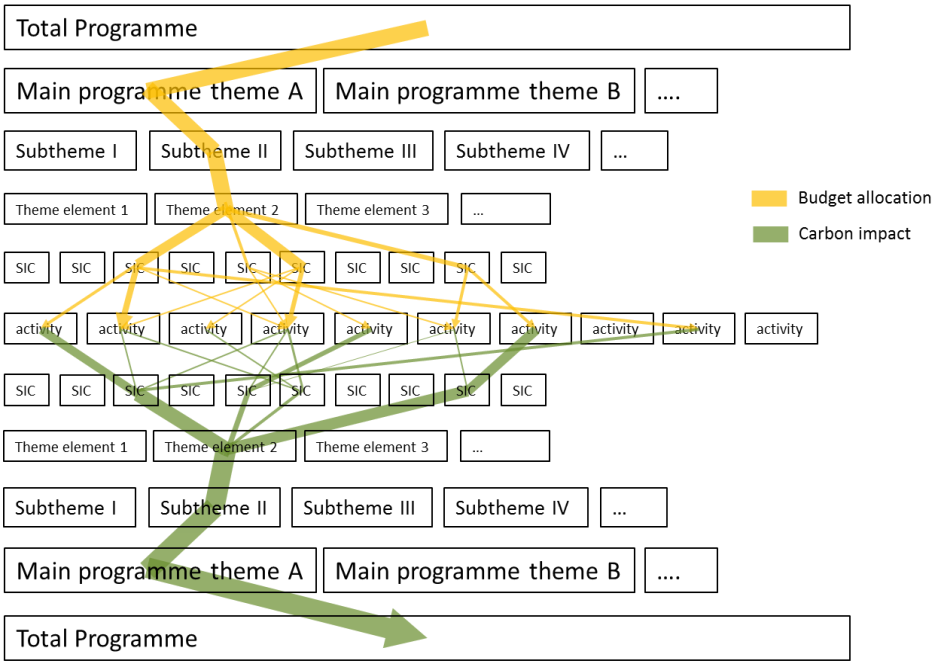


Figure 1 From financial input to carbon impact

2.2 Key model outputs

Carbon impact of the Operational Programme

The model calculates, in kilotons of CO_2, the total cumulative emission impact of a programme. This emission indicator includes emissions from the construction and the operation phases of all the projects in the programme, summed over their expected lifetimes.

The model also provides an indicator for relative carbon impact. This ´carbon content´ indicator shows how close the programme is to compensating its own emissions. This 'carbon content' indicator runs from 100 to -100 and also includes the life-time emissions from all projects in the programme. A programme that only contains emitting activities would score 100, while one that only contains emission reducing activities would score -100. A programme that scores 0, is carbon neutral: i.e. it produces the same amount of emissions as it reduces over the lifetime of its activities.

Carbon impact per investment theme or theme element

In order to provide more detailed information concerning the origin of the emissions, the model also shows emissions per programme theme (Figure 2), theme element, or standardized investment component. This allows a policy maker aiming at reducing the carbon footprint of the programme to focus the attention on the programme elements with the highest expected impacts.

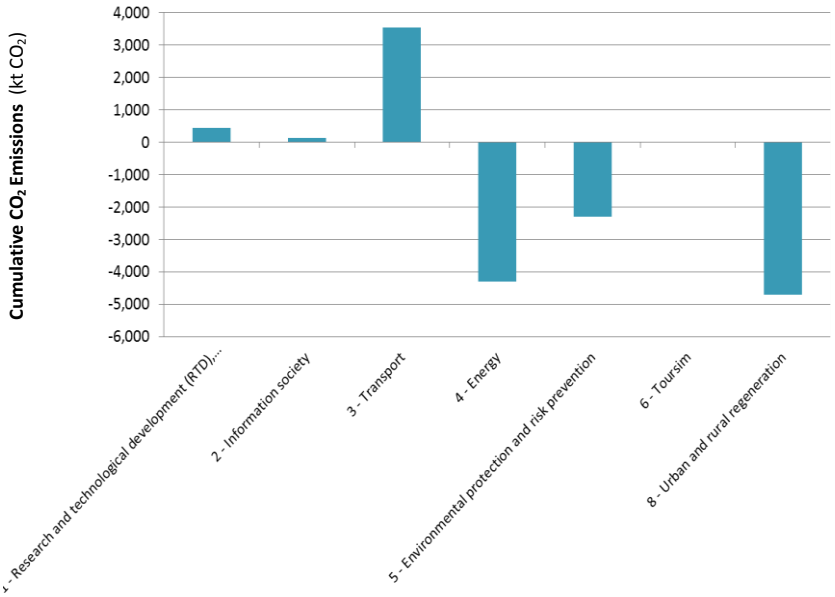


Figure 2 Example of cumulative CO_2 emissions per programme theme

Construction vs operational phase of a project

The model provides construction and operation related emissions separately. This allows the user to evaluate the relative importance of the different project phases. Some projects financed through an Operational Programme may emit a significant part of their emissions during the construction phase, whereas the emission impacts of other may mainly be caused during the operational phase of the project. Generally, construction activities lead to additional emission, whereas the operational phase may lead to additional emissions or emission reductions.

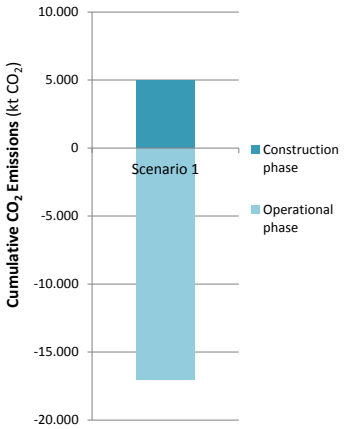


Figure 3 Emissions in construction vs construction phase

Direct vs indirect emissions

As it can be important for policy makers to be able to distinguish between direct and indirect emissions, the model differentiates between these two emission categories. Direct emissions are defined as those that occur immediately on the site of the project, whereas indirect emissions may be related to e.g. the energy used for producing materials, electricity generation, or an increase in traffic caused by the project. Part of the indirect emissions may occur outside the policy maker's jurisdiction and may therefore be more difficult to have influence on.

Cumulative emissions per phase	Scenario 1 *kt CO2*
Construction phase ($ktCO_2$)	**4.982**
Direct emissions (eg. Fuel for machinery)	*3.102*
Indirect emissions (eg. Workers transport)	*1.880*
Operational phase ($ktCO_2$)	**-17.033**
Direct emissions (eg. Heat consumption)	*-8.082*
Indirect emissions (eg. Modal shift, Electricity)	*-8.951*

Figure 4 Direct vs indirect emission

Flexible evaluation period

In addition to the full lifetime impact of a programme, policy makers may also be interested in the effects over a shorter timeframe. The model therefore offers the possibility to adjust evaluation period to the desired temporal scope. This may be motivated, for example, by specific emission targets over a given period. Technical arguments for evaluation over a shorter timeframe are that much can change over the expected lifetime of most projects, which can make the result over long timeframes less robust. Moreover, lifetimes per project may not be equal, which means the temporal boundary of a full life time assessment is not clearly defined.

Temporal profile of carbon balance

The model also provides an overview of the temporal profile of emission impacts for a programme cumulated over time. This adds important insight to policy makers, such as the operational time that is required for the programme to reach carbon neutrality. Emissions related to construction generally occur at the start of the project, whereas, for example, compensating emission reductions during the operational phase only occur over the course of the project lifetime.

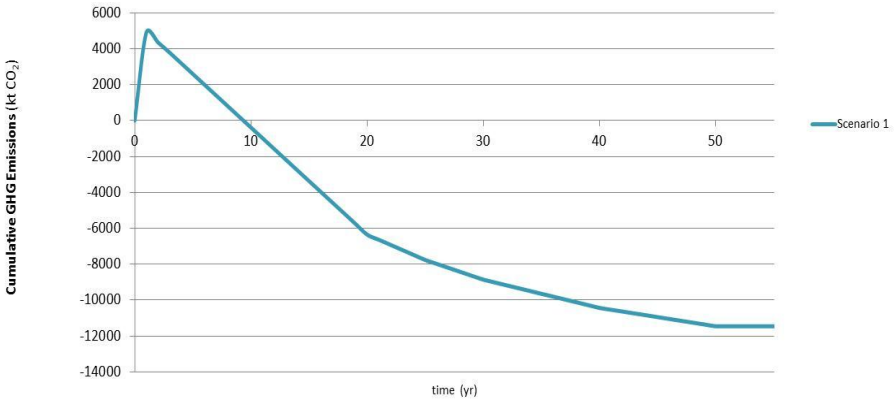


Figure 5 Temporal profile of carbon balance

2.3 Compare budget allocation decisions

The model allows the user to define and compare different 'scenarios' that represent alternative budget allocations for an Operational Programme. Presenting scenario results side by side allows the user to clearly see the ways in which the different allocations lead to changes in the carbon impact. Allocation differences may exist on the macro-level, or they can consist of more subtle changes in a programme focus.

A macro level difference could mean moving the budget between main programme themes, e.g. from transport infrastructure towards energy infrastructure. Smaller, finer level changes could imply changing the distribution of funds between standardized investment components within a theme element, or even between different characterizations of individual investment components. This way, budget may be shifted e.g. from projects building 'standard' houses towards projects that build energy efficient housing.

The model outputs may thus be very useful in informing policy makers that are involved in budget allocation decisions and their support staff. After such a decision has been made at a macro-level, the outputs can guide those involved with the investments details towards those themes that may require special attention because of their potential emission impact.

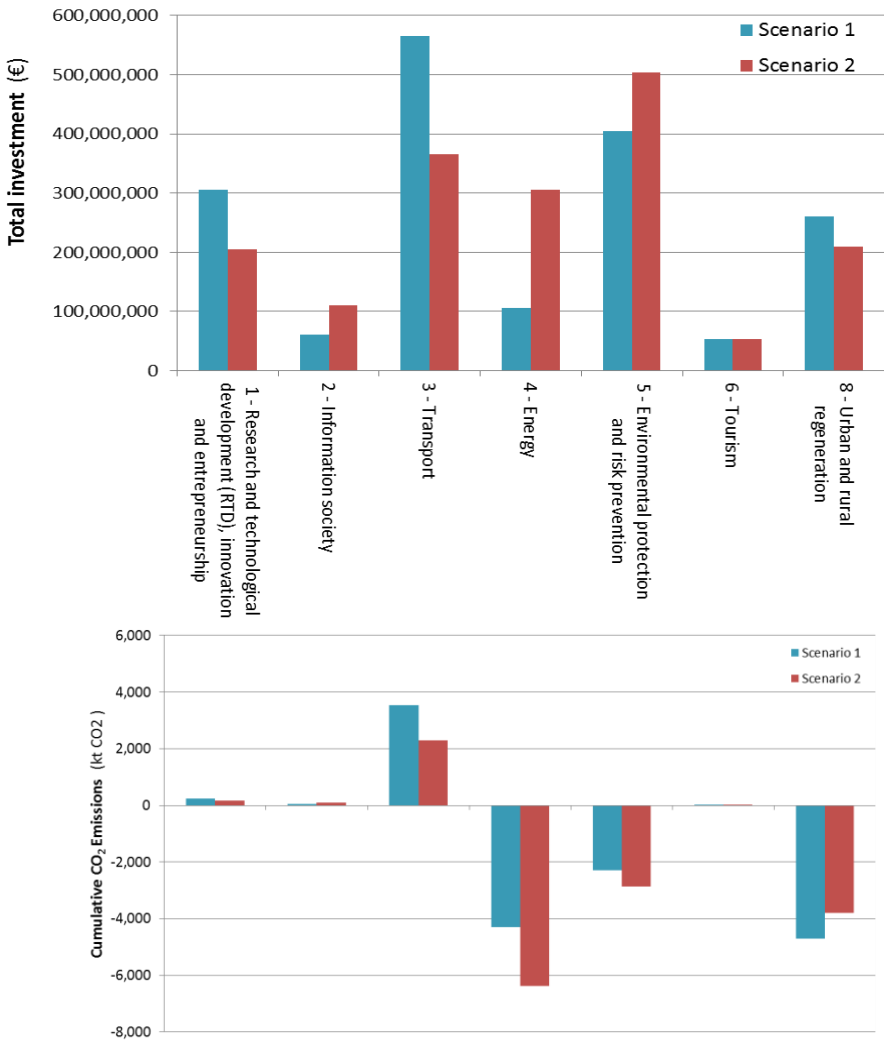


Figure 6 Comparison of investments (above) and emissions (below) per programme theme in two scenarios

2.4 Regionally relevant results

The model is designed as a decision support tool on a regional level. The model uses regionally specific data, so that results optimally correspond to regional circumstances. After all, for a similar investment, emission impact may differ significantly between the regions in Europe. Due to differences in e.g. economy, geography, or traffic, the impact of a euro invested in a road construction project in a mountainous region in Greece may differ significantly from the impact of the same investment in e.g. a region in the Netherlands. Moreover, different regions generally focus on different programme themes, and theme elements, and may fund different types of activities even within a theme element. Using regionally specific data, the model is able to take these differences into account.

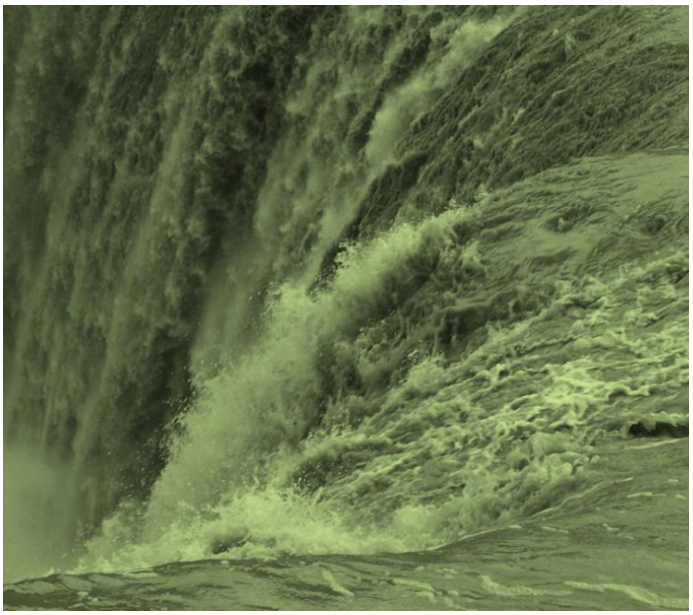
2.5 User control over level of customization

The model allows the user to optimize the balance between effort put in and the level of customization of result according to needs. In some cases, a ´quick and dirty´ assessment will suffice, whereas in other cases an assessment that includes more details on the specific investment scenario or more regionally specific data is required. Almost all values used in the model are adjustable to user needs, which provides full control to customize outputs. However, default values are available for all model inputs. This allows the model user to adjust only those values that have the most relevance to decision making without wasting time on those with less policy relevance.

2.6 User tutorial and technical guidance

The model has been designed with special attention for user friendliness. However, the user of any new tool may always encounter some technical or operational challenges. Therefore, a *user tutorial* and a *technical background and guidance document* accompany the model. The user tutorial is aimed at day-to-day users and explains the background and purpose of the model, offers step by step assistance and practical guidance for use of the model. The technical background document is aimed at model developers that aim to prepare the model for first use in a region, or are interested in further development of the model.

3.
Development process



Three key components of CO_2MPARE´s development process are considered to contribute to the model's strengths.

- **Needs assessment**. A combination of top down and bottom up needs assessment helped define the functional scope of the model. Existing assessment tools were scanned for practical approaches and prospective users´ needs identified.
- **Model development**. An interactive process between data collection and technical model development was used throughout the project.
- **Regional involvement**. The model was developed in close cooperation with prospective users at national and regional authorities. Policy makers from five test regions provided inputs on users' needs, and feedback on the subsequent versions of the model that they tested.

3.1 Needs for a new tool

Key requirements

Apart from its functional objective and geographical scope, three principal criteria for the model were identified at the start of the project:

- *flexibility* - the model should be applicable in each of the (~300) EU regions, and allow for programme assessments based on limited as well as more extensive input details.
- *data requirements* - the model should limit data need for regional users, be able to effectively deal with *missing data* and at the same time keep a good level of *accuracy* in terms of input data and resulting output.
- *user friendliness* - the model should be easy to use and easy to interpret while providing sufficiently detailed results to inform policy makers.

Due to sometimes conflicting attributes towards these criteria, finding the right balance to deliver the optimal tool for CO_2 assessment of programmes to regional authorities was considered an important challenge.

Scoping of existing models

After identifying these very generic model requirements, existing models and tools were reviewed for possible suitability or useful attributes. Various approaches and methods for the assessment of GHG and CO_2 impacts of regional programmes and projects were reviewed. The review concluded that none of the existing modelling practices could sufficiently address all requirements; however, some useful partial approaches and critical challenges were identified. Thus, insights from the review justified the development for a new tool and helped to develop practical approaches towards some of the key functionalities of the model.

Top down model needs

The review took into account models and procedures ranging from those designed specifically for (narrow) CO_2 assessment of projects to those for integrated assessment of the interactions between the economic, energy and environmental systems at multi-country or global scale. It was concluded that for the purpose of the project, models for CO_2/GHG impact assessment of policies and investments at different geographical scale were the most relevant. In particular, the model NECATER, which was developed with a regional focus to support French regional authorities in achieving carbon neutrality of their Operational Programmes, proved to provide various useful properties. The NECATER model has therefore inspired the development of various aspects of the CO_2MPARE model.

Bottom up model needs

Next to top down assessment of optimal model functionality, needs were also assessed following a bottom up approach. Prospective users of the model at national and regional authorities were asked to comment on initial ideas and subsequently on early versions of the model. This allowed to align the model properties optimally to the demands of policy makers for model outputs.

3.2 Data collection and model development

Iterative process of data collection and model development

The model's value for the user depends largely on availability of relevant data. For this reason, the availability of data in the test regions was one of the principal criteria for definition of the model algorithms. The collection of data - differing in geographical scope (European, national, regional) and/or in their nature (financial data or indicators in physical units) - strongly influenced the development of the model and determined the level of information in terms of CO_2 emissions that CO_2MPARE can currently deliver. Data collection and model development evolved in parallel and with mutual feedbacks.

The initial contours of the data needs were drawn based on the previous experience of one of the consortium partners with developing the NECATER model. A first screening of the data available in the test regions and of the most relevant data sources, including data from national and EU statistics, showed some data gaps with respect to particular sectors and categories of data. For some of these gaps, further data search in scientific literature and in case studies was successful. However, for data that should be provided at regional scale, it was assumed that if data was difficult to find for the test regions, it would likely also be difficult for other regions when deploying the model locally. Therefore, missing data in some cases also necessitated revising the chosen methodology altogether.

Data collection

Data collection was carried out in each test region by the consortium partner from the same country to facilitate interpretation and provide assistance to the regional administration. Regional authorities were able to provide data that would otherwise be unavailable to the consortium partners, proving the value of collaboration in the model development process.

Three main categories of data turned out to be necessary for model development:

- *Operational Programme related*: data related to the architecture and budget distribution of Operational Programmes in the test regions.
- *Project activity related*: data involved in the calculation of CO_2 emissions from financed projects.
- *Regional context related*: data on various relevant regional socio-economic characteristics.

Project activity related data were further split based on their geographical coverage and level of detail:

- *Territorialized data*: specific to each region, they can be defined at a regional or national scale. Examples are: carbon content of electricity, thermal regulation for buildings construction, potential for power generation from renewable energy sources, etc.
- *Global scale data*: common for all the regions. For example: emission coefficients for materials; emission factors for renewable energy sources and fossil-fuelled power plants.

Activity related data is essential for calculating CO_2 emissions on a detailed level. Hence, the higher the quality of data for specific ratios, the more accurate the CO_2 estimate produced by the model.

3.3 Involvement of relevant authorities

Involvement of relevant authorities: a key for success

The model aims to help EU Regional Policy Managing and Implementing Authorities to make informed choices and involvement of relevant authorities has been regarded as a fundamental success factor in view of developing a model that meets users' requirements. Models are highly dependent on the operational needs of both direct users and decision-makers and they are also constrained by operational issues, such as users' technical skills, information and data collection capacity, available time for model use etc. In order to minimize the risk of a mismatch, a concerted approach with the test regions was set up prior to the beginning of model development. To this end, regional representatives were called to play an active role in model development by providing inputs with respect to users' needs, support in data collection, and

feedback on the different versions of the model that they tested. Through this approach, the model development took place in close interaction with prospective users. The following table provides an overview of the major phases of interaction with the test regions.

Table 1 Major phases of involvement of the test regions in model development

Model development phase	Interaction format	Objectives and expected outcomes
Start up	First bilateral workshops	- Ensure regional involvement in the project - Provide regional partners with more details about the project - Identify the needed input from the regions - Ensure a shared view on the outcomes of the project - User needs assessment - First feedback on model purpose
First version	Second bilateral workshops	- Stimulate regional involvement - Presentation of a first version of the model - First user testing of the model - Feedback and views of the regions on model functionality, inputs, outputs, methodology, interface
Finalisation	Common workshop with test regions	- Presentation of the latest version of the model, both basic and expert mode - Final user testing of the model - User knowledge of the technical aspects of the model - User knowledge of the operational aspects of the model - Feedback of the regions on model functionality, inputs, outputs, interfaces

Feedback from the different regions often addressed different aspects, depending on specific interests, needs and expertise of regional participants. Major feedback topics ranged from the role of the model (in the next programming period), technical aspects related to the use of the model, and more specific methodological clarification and practical points[1]. The feedback received on the model's functionality were processed by consortium partners in order to implement the most recurring and relevant ones in subsequent versions of the model. The regions showed large interest throughout the project and contributed to improvements of various aspects of the model.

A final test for correct interpretation and representation of the regional Operational Programme in the model, and for model functionality in general, was performed by analyzing the model outputs for each of the five test regions. This test proved that model results in general are useful for to gain insight in the main determinants for programme impacts.

[1] More detail on users' feedback is provided in Appendix B

4.
Discussion and recommendations

Any use of a new tool may lead to some initial operational or more technical challenges. For CO_2MPARE, possible key challenges related to regional deployment, to learning and using the model, and to interpreting results have been identified and are discussed below. Further discussion can be found in the *user tutorial* and *technical background and guidance document* that accompany the model.

4.1 Preparations for first use in a region

Preparing the model for first use in a region

One of the model's key strengths is that it provides regionally specific results. In anticipation of first use, the model database therefore needs to be updated with regionally applicable parameter values. Additionally, it is recommended to define a default regional programme architecture, that can be used to test different scenarios that may be considered within a region. Regionalization of the model only needs to be performed once for each region. Once this regionalization process has been completed, the model can be used by all policy makers throughout the region, and provides result that relate to the specific regional circumstances.

Updating data to reflect regional conditions

The model uses several thousand parameter values in its calculations. In order for the model to produce regionally relevant results, these values should reflect the regional conditions. The generic model is provided with default values, which partially need to be adjusted to represent the regional situation.

Data collection and subsequent regionalization of the model can require significant effort and resources. However, some parameters may be expected to show larger variation across the regions of the EU than others. The model is therefore provided with a data management function that helps to focus on the most sensitive parameters. The data management function helps the user to identify ratios that should be regionalized in priority and modify their values. Prioritization may reduce the data collection need and the related workload. Once a regionalized version of the model is available, only occasional updating of the data is required.

4.2 Evaluating programmes with CO_2MPARE

Obviously, a policy maker using the model may only interpret the results correctly if the main characteristics of the model and its limitations are well understood. Main issues for consideration are described hereafter.

Garbage in, garbage out

As in any model, specific results in CO_2MPARE depend largely on data quality. Not only should data values correctly represent the described activity in the model, but also the user should be alert that the actual projects in the programme should match with the properties of the selected standardized investments category in the model. A proper understanding of CO_2 emission assessments can help to flag obvious mismatches and is therefore recommended for properly evaluating the outcomes.

Outputs should be interpreted as approximation

Users should be aware that CO_2MPARE results can only be interpreted as approximations. Due to the categorization and high aggregation level, results are to be used as comparative elements and not as absolute, highly robust figures. At the detail level, mismatches between model input and actual project properties may easily occur. Moreover, any carbon assessment is surrounded with uncertainties that can be less or more important for one type of activities or another. Nevertheless, the model provides a good insight into what type of projects is emitting or compensating and should be used as a comparative tool to test different type of investment schemes. The model provides uncertainty ranges for various outcomes in the model and in the results spreadsheet.

Inputs requirements

The model uses different types of inputs to assess carbon emissions of programmes, from financial data, to physical indicators. A high level of expertise on the Operational Programme (budget allocations, typologies of projects funded and physical indicators associated, etc.) will improve the accuracy of the results. Nevertheless, the model has been designed to provide relevant results, albeit at a higher aggregation level, even when little information is available. This allows that, for example, a user can enter financial budget allocations only and still obtain results for the programme that is being evaluated.

Scope of evaluation and assumptions

Any model uses assumptions to generate output. Users should be aware of the different scopes (temporal, financial and geographical) of the evaluation in the model and of the baselines assumed, to understand what is included in the results and what is not. The most important assumptions are described within the model. Further understanding of the assessment procedure may be obtained from the algorithms used for calculation in the model, which are also available. It is important to understand that, due the use of regionally specified data, the model can be used for comparisons within regions only and does not allow comparisons between regions.

User expertise and the full scope of the model

The CO_2MPARE model is aimed to be used by two types of users: policy makers at environmental / climate authorities, and those at Operational Programme Managing Authorities. Each of these user types has its own expertise; however, individually they may be sometimes lack the time or necessary technical knowledge to fully benefit from the potential of the model. Environmental authorities generally are well experienced with emission and environment related indicators, but may sometimes have less knowledge of issues related to the regional Operational Programmes (e.g. knowledge concerning project classification, budget allocations over a programme, etc.). Operational Programme authorities on the other hand will usually have a better understanding of the programme mechanisms, but may not have similar expertise in environmental assessment and may thus have difficulties in calibrat-

ing the model or interpreting results. It is thus recommended that environmental / climate and Managing Authorities work in close collaboration to fully exploit the model's functionality. Alternatively, authorities may require assistance from third parties that can provide the missing expertise.

4.3 Expanding CO_2MPARE's added value

Two recommendations that can add further value for use of the model in practice are:

- Expanding the model use beyond its original purpose
- Interacting with other regions on model results or related issues.

Increasing use beyond the original purpose

The CO_2MPARE model has been developed as a very flexible tool for programme assessment. It is adaptable to any programme that includes projects that can be represented by the Standardized Investment Components integrated in the model. This means that its use does not need to be limited to the preparations of the ERDF Operational Programmes only, but can be used for evaluation of other programmes as well. Using it beyond the scope of its original purpose may increase the model's value for the region significantly. The development of a new regional development programme funded through the ERDF is a relatively infrequent activity after all.

Moreover, apart from only occasionally using it for decisions on the contours of the Operational Programme, the model may be used for decisions on a more detailed level of the programme, that are generally taken during the programming period. These two additional uses of the model increase the model´s value for the region and simultaneously contribute to maintaining a certain level of expertise.

Benefits of cooperation between regions using CO_2MPARE

Interaction and mutual feedback on the use of CO_2MPARE are likely to lead to additional value for model users. Regions may share experiences on model use, e.g. tips to facilitate the use of CO_2MPARE, solutions to difficulties encountered, or practical approaches to analysis and result interpretation. Several channels can be imagined as a support for sharing experiences on a voluntary basis, like e.g. forums or existing regional networks. Moreover, cooperation may also help to safeguard the availability of model expertise for the region.

Additional benefits may be achieved by cooperating with neighboring or comparable regions in Europe in the regionalization process. The workload of regionalization may be reduced through economies of scale. For example, values for a given parameter often can be found for several regions at a same time (e.g. in a national study, or national statistics) or are needed at national scale anyway. Regions may thus benefit from joining effort, or from investigating or keeping track of whether relevant data is already available in partner regions.

Appendix A. Example analysis result

This annex presents some examples of model results in order to explain the possibilities and limitations of the model. For some outputs, possible implications for follow up by policy makers are indicated. The examples are taken from a scenario created as a part of the model development process in one of the test regions. Shown values and figures are sometimes adjusted to increase the instructional value of the example. Examples therefore do not always represent the actual situation in a given region. Conclusions for actual policy interventions can therefore not be drawn from the presented examples.

Scenario overview and carbon content indicator

Several highly aggregated scenario indicators are shown in a comprehensive overview. The overview shows the overall budget of the scenario, differentiated between EU contribution and other, and several emission indicators.

An important indicator in this overview is the *carbon content indicator*. This is the main indicator that can inform regional authorities of the carbon impact of the investments in the scenario. As explained earlier, this indicator assesses how close a programme is to compensating its emissions. For instance, the scenario overview in Table 2 shows a carbon content indicator of -40, which indicates that during the lifetime of the projects the given regional programme would result in emission reductions compared to a scenario in which the programme would not be implemented. Apart from the carbon content indicator, the model provides a summary of the OP's emissions during both the construction and the operation phase, as well as the total cumulative emissions that are generated during the entire lifetime of the projects in the programme. This provides policy makers with an indication of the magnitude of carbon emissions/reductions from the programme.

Table 2 Overview of general scenario result, including carbon content

ID Scenario :	20
Date of creation :	16/11/2012
Last modification :	15/11/2012
EU expenses (k€) :	2.619.022
No EU expenses (private & other public)(k€) :	2.619.022
Total (k€):	5.238.044
Construction phase emissions (kt CO2):	4.982
Operation phase emissions (kt CO2):	-17.033
Total cumulative emissions (kt CO2):	-12.050
Duration of CO2 evaluation (year):	Lifetime of projects
Carbon content indicator :	-40

Theme level results

Results on the next level of detail show total investment and emission impacts per main programme theme. The budget distribution of the scenario gives preliminary information about the regional situation and the main activities financed within the programme.

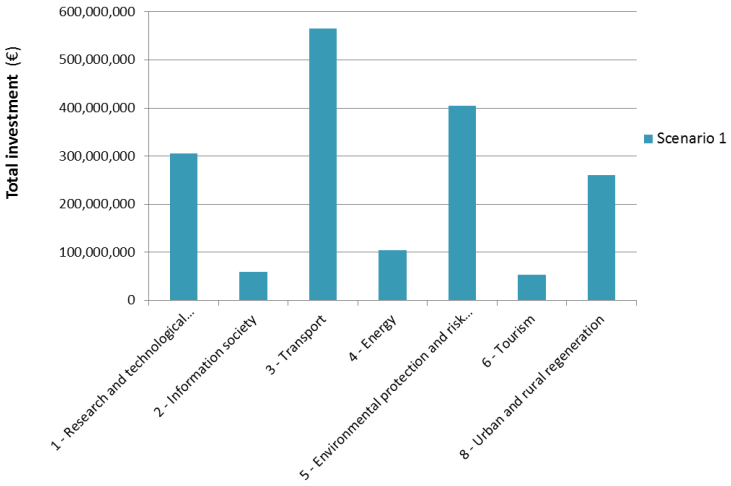
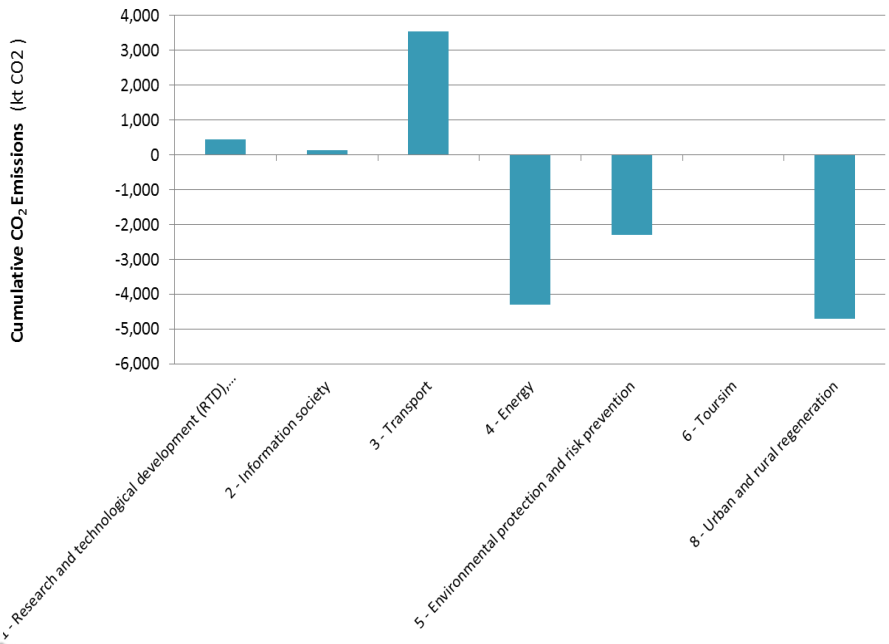


Figure 7 Total investment per main theme in Scenario 1

The model presents the budget distribution towards the main programme themes in a graph (See Figure 7), and also in a table to allow easy further processing (not shown). For example, the distribution of funds per theme in the case of the presented scenario 1, shows that most of the resources are devoted to "Transport" and "Environmental protection and risk prevention" followed by "Research and technological development, innovation and entrepreneurship". This provides policy makers with an insight to the relative financial weights and contributions of the different themes.



The corresponding emission results (Figure 8) show that the largest additional emission impact is expected due to investments in "Transport", and that investments in "Urban and rural regeneration", "Energy" and "Environmental protection and risk prevention" are expected to lead to emission reductions compared to a no-investments baseline.

Figure 8 Cumulative CO_2 emissions per main theme in Scenario 1

Theme element level results

The model also provides a results overview on the more detailed level of theme elements. An excerpt of such an overview is presented in Table 3.

Table 3 Total investment and CO_2 emissions per theme element

Total investment** (k€) **and CO2 Emissions** (kt CO2) **per theme element

ID level 1	ID level 3	Programme architecture - level 1	Programme architecture - level 3	Test region 1			
				€	kt CO2	kg CO2/€	g CO2/€/year
1	1	Research and technological development (RTD),	RTD activities in research centres	25,000,000	19	*0.8*	*4.0*
1	3	Research and technological development (RTD),	Technology transfer and improvemer	20,000,000	16	*0.8*	*4.0*
1	6	Research and technological development (RTD),	Assistance to SMEs for the promotion	260,000,000	202	*0.8*	*4.0*
2	10	Information society	Telephone infrastructures (including	50,000,000	39	*0.8*	*4.0*
2	12	Information society	Information and communication tech	10,000,000	8	*0.8*	*4.0*
3	16	Transport	Railways	340,000,000	391	*1.1*	*6.0*
3	18	Transport	Mobile rail assets	45,000,000	52	*1.1*	*6.0*
3	23	Transport	Regional/local roads	30,000,000	429	*14.3*	*74.0*
3	24	Transport	Cycle tracks	1,000,000	3	*2.9*	*14.9*
3	25	Transport	Urban transport	10,000,000	36	*3.6*	*18.5*
4	40	Energy	Renewable energy: solar	38,000,000	-1,902	*-50.1*	*-259.4*
4	41	Energy	Renewable energy: biomass	18,000,000	-901	*-50.1*	*-259.4*
5	44	Environmental protection and risk prevention	Management of household and indus	50,000,000	-1,959	*-39.2*	*-203.0*
5	45	Environmental protection and risk prevention	Management and distribution of wat	150,000,000	866	*5.8*	*29.9*
5	46	Environmental protection and risk prevention	Water treatment (waste water)	74,000,000	465	*6.3*	*32.5*

This table combines the budget distribution, total CO_2 emissions, emissions per Euro invested and the annual emissions per Euro invested for each theme element. This table allows policy makers to assess the main drivers for the overall expected emission performance of their regional programme. Results on this level may e.g. provide indications to policy makers about which theme elements to monitor, in order to be able to track the actual performance of the programme as it is implemented.

Standardized Investment Component (SIC) level results

A different cross-section of the results is provided by the results aggregated per SIC. Aggregation per SIC leads to results grouped by type of activity funded by the programme, rather than by investment theme. Investment in different themes may lead to similar activities being executed in the end. A graphical presentation of emission impact per SIC is provided in Figure 9; a graph for the budget distribution over SICs is also available in the model.

Table 4 Overview of emission impact details per SIC

Theme	SIC	Scenario 1				
		Total *kt CO2*	Construction *kt C02*		Operation *kt C02*	
			Direct	Indirect	Direct	Indirect
Building	Building construction	1,238	7	104	607	520
	Building refurbishment	-116	4	64	-129	-55
	Building demolition	-2,512	0	27	-2,091	-448
Transport	Rail construction	-22	1	22	0	-46
	Rail renovation	57	2	56	0	0
	Rail electrification	-369	1	13	0	-383
	Road construction	546	158	38	0	351
	Road renovation	19	0	19	0	0
	Cycling infrastructure	-1	0	0	0	-1
	Public transportation infrastructure	3	0	7	4	-8
	Maritime and inland-waterway infrastructure	16	0	6	0	9
	Port infrastructure	1,926	2	76	512	1,336
	Airport infrastructure	0	0	0	0	0
Energy	Energy switch equipment	0	0	0	0	0
	Fossil fuel energy	0	0	0	0	0
	Renewable centralised energy	-1,741	0	146	31	-1,919
	Renewable decentralised energy	-142	0	16	1	-159
	Energy efficiency	-6,272	0	1	-475	-5,797
Waste and water	Wastewater treatment	197	0	107	19	71
	Water supply treatment	157	0	17	0	140
	Waste management infrastructure	-2,195	0	5	362	-2,562
Others	Reforestation	-6,921	1	0	-6,921	0
	Equipment	1,035	0	1,035	0	0
	Civil engineering	3,032	2,911	121	0	0
	Immaterial services	13	13	0	0	0
	Configurable SIC	0	0	0	0	0

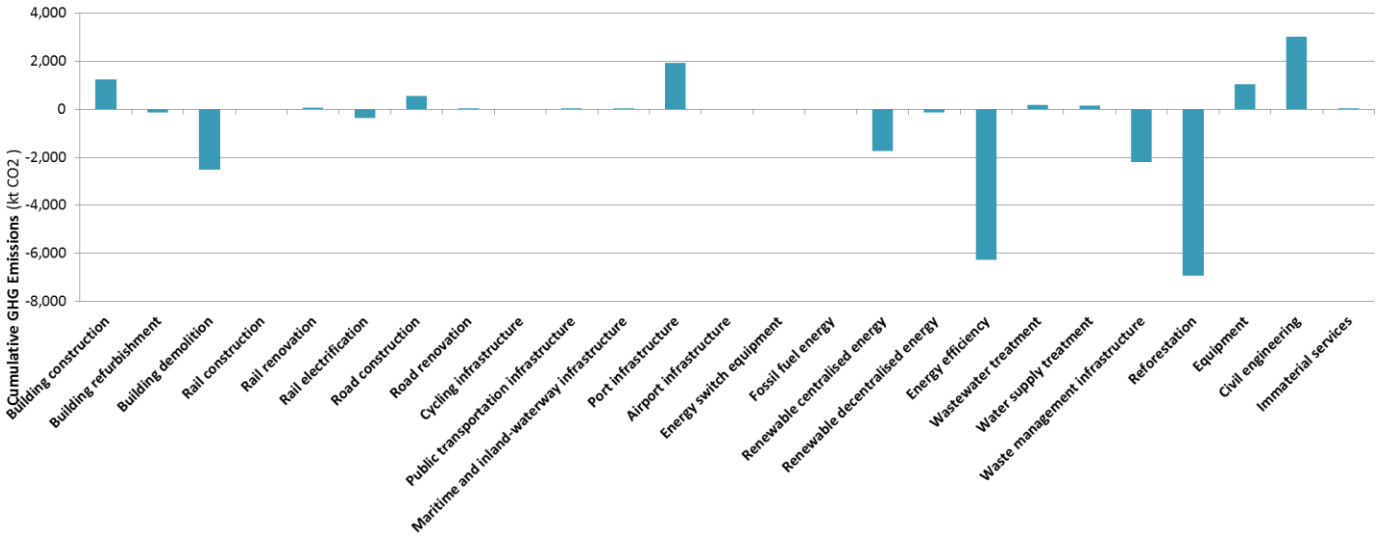


Figure 9 Overview of cumulative emission impact per SIC

The comparison between SICs and their carbon consequences can help policy makers to include carbon-related considerations and performance into project selection criteria and decision making. Table 4 provides more detail on the temporal and geographical scope of emissions per SIC. It informs users on the phase when emissions take place (construction or operation) and whether the emissions are direct or indirect.

Emission profile of cumulative CO_2 emissions

CO_2MPARE also provides insight in the cumulative impact of the programme over time. Figure 10 shows such an emission profile for a given investment scenario. For correct interpretation of this figure it is important to understand that the model simplifies reality by assuming that all investments occur in the first year of the programme, and the construction phase for all projects last one year. This implies that the first year in the graph illustrates the total construction phase emissions expected from the programme. The graph shows that the construction phase activities in the programme lead to additional emissions. In this example, emissions begin to decline after the construction year, signaling that the operational period leads to emission reductions.

The effects of the programme can be seen to last much longer than the 7-year period of programme implementation itself. Emissions decline continuously in this scenario and in just below 10 years the emission reductions due to the programme compensate the initial additional emissions from the construction phase.

The graph does not show a linear trend, but shows a gradual diminishing of additional emission reductions. This is due to the fact that effects from activities are assumed to end after their assumed lifetime. Not all activities have the same lifetime, so effects may continue for one and not for the other. For example, the angle at the 20th year of operation is due to the assumed ending of the effect of energy efficiency measures, which contributes significantly to the reduction trend in the first 20 years.

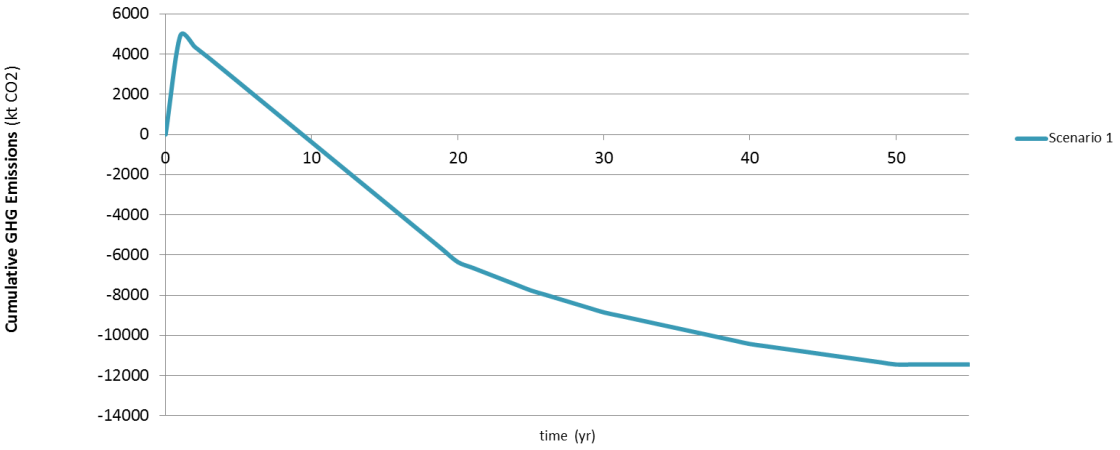


Figure 10 Emission profile for the investment scenario

Appendix B. Conclusions from user feedback survey

The CO_2MPARE model has been developed in cooperation with and tested in 5 EU regions. This appendix provides a summary of the conclusions of test-user feedback. Several literal quotes from the representatives are inserted to highlight a point.

> "The model provides an estimate of the carbon content of the programme and this information is certainly useful to identify the achievement of targets for reducing CO_2 emissions imposed by the Europe 2020 strategy"
>
> *Representative of the Puglia region*

Model usefulness

The representatives of the test regions consider the model to be very useful overall. It is believed that the model provides sufficiently useful information to support decisions on future Operational Programmes. The representatives also believe that the model can be used for other purposes, apart from ex-ante evaluation of future Operational Programmes. They also suggest that in the future, the model scope could be expanded to include other environmental effects/impacts and e.g. give specific data for energy-related emissions (avoided or added). The representatives realize that, in order to retrieve more precise regional results, some of the ratios will need to be updated with more specific regional values and data from projects.

> "In general the model is useful to support planning processes (comparison/generation of alternatives) and Strategic Environmental Assessment"
>
> *Representative of the Emilia-Romagna region*

The representatives believe that carbon consequences will be considered in the decisions on the future Operational Programme and that the model can provide useful assistance. They note that in the case a future Operational Programme should contain new types of projects, the model allows their incorporation, and it will be important to carefully associate them with the components of the current SICs. The current model seems sufficiently flexible in defining the categories of expenditure and SICs.

Model results

The representatives of the test regions think that presented model results are useful for the evaluation of an Operational Programme. The model provides sufficiently accurate information concerning the historic situation and it should be easy to update data to represent the future. The representatives have confidence in the model results. The disaggregation of model outputs in direct and indirect emissions is considered as essential and very useful for decision makers. In current assessments and evaluations, there is usually no distinction between direct and indirect emissions. The representatives also think that the distinction between emissions during the construction and operational phases is very important in the assessment. They agree that it is important to have the flexibility in terms of being able to adjust the evaluation period - they even think that it would be a mistake not to do so (meaning that they agree with the current flexibility of the model).

The representatives propose that further model development could consider including additional outputs. Outputs such as energy consumption, energy production, basic environmental indicators (NO_x, SO_x and particular matters), material consumption, water consumption, waste generation, etc. could provide added value to the model.

> "Output in terms of other parameters would certainly be useful (e.g. for comparison of sectors or regions with regard to energy consumption)"
>
> *Representative of the Czech Republic*

Graphical interface of the model

The representatives are satisfied with the graphical interface of the model. They expressed the belief that the interface is easily usable. Most of the test users consider the visualization of the result sufficient. Some users suggested further graphic improvements, for instance more complex graphics and comparative graphs. The test users also made some suggestions for further improving the user interface.

Methodology

In terms of methodology, the representatives of the test regions feel that the methodology used in the model is sufficiently robust and provides a very good approach to the CO_2 assessment. Some representatives however, state not to be sufficiently aware of the model's limitations. As the user tutorial and tech-

nical background and guidance document were not yet completed at the moment of model testing, some representatives expressed the need for clearer explanations for some of the algorithms used in the emission calculation – or at least brief, basic explanations. Most of the representatives have limited experience with CO_2 assessment, but those who have previous experience in CO_2 assessment of programmes or projects are positive about the results.

> "The model results seem more accurate than previous assessments exercises made in the past in my region"
>
> *Representative of the Emilia-Romagna region*

Training needs

When the representatives evaluated the amount of time required to use the model, they estimated 1-2 days to build a new complete Operational Programme framework and at least 2 weeks full time to understand and effectively use the model. They said that in order to use the model effectively, experience in regional planning and good knowledge of the MS Excel software is recommended.

> "It is necessary to have adequate training to understand the model and to manage the data entry (6-12 hours)"
>
> *Representative of the Emilia-Romagna region*

Ratios

Most representatives believe that the model gives sufficient background information about the ratios in the calculations. Some representatives think that ratios demand further development and specialization, and that the ability to adapt ratios adds value to the model. All representatives are sure that they have sufficient knowledge to adapt the ratios used in the model, at least in basic mode, and do not need external assistance for doing this. They appreciated the presence of bibliographic sources of the ratios.

An important suggestion for improvement of the model and sharing experiences includes a freely accessible online database, which could contain values

for ratios. It is suggested that such an external database should be maintained by an independent organization responsible for quality control.

Roll out to other regions and future management of model data and versions
The representatives believe that the EC has a crucial role in managing the dissemination and maintenance of the model. Some representatives think that the EC could promote the use of the model in all European regions and support a training period in each of the regions and organize workshops to help to analyze the results.

> "The EU should promote the use of the model from the programming phase to the monitoring of investments. In addition, the EU should coordinate the use of model in the different regions, and to validate changes and updates of the model that will be proposed by the regions"
>
> *Representative of the Puglia region*

According to the representatives, organizing some form of central coordination, such as a focal point for questions and sharing experience or data, would be a very good idea. Several representatives think that before general implementation of the model in a new region, a period of training will be needed.

> "I feel that the CO_2MPARE model could be very useful in our common ambition to reduce the emission of greenhouse gasses. It will need attention both from the EU to make sure that 'everybody' knows about this model and on the regional level that people have the knowledge to apply the CO_2MPARE for their ERDF projects."
>
> *Representative of the Zuid-Holland region*

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