Supported by INTELLIGENT ENERGY EUROPE

ECORailS

Energy efficiency and environmental criteria in the awarding of regional rail transport vehicles and services

Deliverable 16:
Results Analysis Report

Version:
[08]
Status:
[PU]

Draft: **Project manager WP 5** **Approval**
Dan Caraman
IRD

dan.caraman@integralconsulting.ro

Acronym:
ECORailS

Title:
Energy efficiency and environmental criteria in the awarding of regional rail transport vehicles and services

Distribution:

Partic N°	Participant name	Participant short name	Country code
CO	TSB Innovation Agency Berlin GmbH FAV – Transport Technology Systems Network	TSB FAV	DE
CB 2	Senate Department for Urban Development	SenStadt	DE
CB 3	Pro Rail Alliance	ApS	DE
CB 4	KCW GmbH	KCW	DE
CB 5	Berlin University of Technology	TUB	DE
CB 6	Trafikstyrelsen	TSY	DK
CB 7	Transportforskningsgruppen I Borlänge AB	TFK	SE
CB 8	Province administration of Brescia	PoB	IT
CB 9	Università Commerciale “L. Bocconi”	CBO	IT
CB 10	Università di Roma “La Sapienza”	ULS	IT
CB 11	Integral Consulting RD	IRD	RO
CB 12	CFR Timişoara – National Society of Railway Transport	CFR	RO
CB 13	Universitatea POLITEHNICA din Timişoara	PUT	RO
CB 14	Budapest University of Technology and Economics	BME	HU
CB 15	Agenzia della Lombardia Orientale per i Trasporti e la Logistica	ALOT	IT

Content

Summary

The present deliverable is structured to provide a full description of results achieved within ECORailS activities during the working period up to date. Work Package 5 aims at analysing and validating project works and to prove that the project objectives have been fulfilled. The WP has an input-output oriented approach by gathering all relevant information that may lead directly or indirectly to the proof of fulfillment of the project results and providing feedback and recommendations after the analysis and validation. In addition to the compulsory ECOrailS defined objectives, due to the project special aims and structure, WP5 also takes into consideration the needs of the users which represent real life requirements.

The Deliverable is structured in a linear manner and aims to present the works undertaken in the project by analysing released deliverables and their direct/ indirect contribution to the project's objectives followed by the conclusive test results, recommendations and conclusions.

The analysis of the deliverables is done in chapter 3 which covers all main deliverables of the project and analyses and determines the way they have contributed to the achievement of the project objectives. The analysis is done exclusively form a WP5 point of view.

Chapter 4 represents the main part of the deliverable and analyses the results of the tests benchmarked against the project objectives and the users' inputs provided on the structure of the defined site stakeholder groups and site working groups. The analysis is done taking into account the test objectives, methodology and results and by drawing conclusions on their plausibility.

The conclusions and recommendations which will result will then be included in the Guidelines alongside the test conclusions and recommendations and define the final version of the Guidelines which will make the object of the future D17 Validation Report.

1. Introduction

This document presents the analysis, evaluation of the ECORailS project's results. On the basis of the evaluation, WP5 will provide an outline of recommendations for the implementation of the Guidelines and suggestions for its further development. One key note concerning this deliverable is that the analysis refers to the second draft (D 20) while the subsequent validation report will refer to the final version (D 22).

The evaluation process covers the whole period of the project progress and stands for the modality in which Work Package 5 – "Evaluation and Validation" assumed the role of ECORailS "Watchdog", analyzing project works through the beneficiary's (the user's) eyes, focusing on the test results.

Following the evaluation and validation process, WP5 aims at providing a set of conclusions and recommendations in order to put into application a high performance Guidelines, useful as a decision support for the decision makers in PTAs, TOCs, IMs – for an energetically and ecologically efficient awarding process for rolling stock and regional railway transport services.

The basic documents on which the analysis report is built:

WP5 Validation Strategy
Annex 1 to Contract IEE/08/690/SI2.528422 – Description of the Action
Minutes of the 4th Editorial group meeting in Berlin, 7-8.03.2011
The listed deliverables in Chapter 3

The role of WP5 ("Evaluation and Validation") in the project

WP5 participates in the project activities of WP2, WP3, WP4 and WP6 by collecting information from these WPs to make the necessary proposals from the validation perspective, as well as to create the data basis and the know-how underlying the validation strategy elaboration.

Based on qualitative criteria for assessing the Guidelines performance (enhancement of environmental awarding, integration into the awarding process), the indicators and the set of criteria have to be applied according to the implementation of the Guidelines in other European regions alongside suggestions on the further development of the Guidelines including future promotion strategies.

Internal Work Cycle of the document (elaboration – partner feedback - completion)

With a view to pursuing the accomplishment of project objectives and of internal correlation, all the proposals and deliverables from the other WPs are analyzed from the perspective of WP5.

There has been, and still exists a continuous and efficient dialogue between WP5 and the other WPs so that all materials are elaborated according to the general and specific project objectives (the three levels). Based on the results obtained during the tests from WP4 – in the 4 locations, WP5 elaborated a synthesis of recommendations for the improvement of the Guidelines and suggestions for further development.

2. Work premises

Deliverable 16: Results analysis report is one of the key deliverables of Work Package 5 which aims to document and analyse the project's results from the perspective of the tests in the four regions. The current analysis is based upon the project's objectives which are set as benchmark and the user's needs and requirements which represent high quality targets which the project needs to achieve. The analysis is done according to the provisions made in D15: Validation Strategy and Exercise Plan and contains all self-imposed requirements of a results analysis report.

We find noteworthy to mention that the current deliverable is analyzing the results of the tests which were based on the second draft version of the Guidelines (D 20). Due to the organic nature of the Guidelines, they were constantly improved. The actual intermediary versions of D 20 which were actually tested in the four regions were v02 and v04. The final version of the Guidelines will contain both the recommendations from the tests and recommendations from the present Results Analysis Report and will be the object of the future D17 – Validation Report.

General objectives of the ECORailS project

The project objectives are viewed as compulsory to achieve and thus are kept in the entire Deliverable as benchmark for the analysed results.

Quantitative energy and CO2 emission savings:

- 5% in comparison to current awarding
- 10% with regard to the currently used rolling stock
- In the long term: System-wide improvement of energy efficiency for regional railway by 15% by 2020

Qualitative performance indicators - manageability of the Guidelines

- Efficiency of the Guidelines for developing the awarding procedure
- Flexibility and adaptability to the users' needs and particularities
- Acceptability and participation
- EU wide applicability

WP5 Validation Strategy

The Validation Strategy is the main deliverable documenting the methodology of elaborating the Evaluation Report (D16) and the validation Report (D17). Taking into consideration the objectives that the Guidelines must fulfill, the validation activity must safeguard the achievement of these goals and ensure that the end product (Guidelines) is realized according to the objectives mentioned in the description of the project but it must also correspond with the expectations and requirements formulated by the users. In this regard the main goal of Deliverable 15 "Validation strategy including validation exercise plan" was to create a comprehensive strategy that documents the future evaluation and validation activities in order to establish the main validation goals, validation methods, requirements and potential feedback integration.

User needs and requirements

Due to the distinct organization proposed in WP4 under D12 Pilot applications management plan, the interactions with the stakeholders were organized into two structures: site working group and

site stakeholder group. The site working group was comprised of project partners involved in the tests and a core of relevant users while the site stakeholder group united a larger number of users. The users involved in the site working group were able to express their opinions and directly shape the works done in the tests which ensured that their opinion is included in the test works and conclusions. The members of the site stakeholders group were consulted once the tests made progress and were asked to provide feedback regarding the current works and the Guidelines. This constant state of interactions with the users ensured that the test results and works were done also according to their needs and particularities.

3. Analysis of the deliverables

The analysis of the main deliverables elaborated during the lifetime of the project represents a support action in order to determine the contribution of said deliverables towards the achievement of the project's objectives. It is self implied that some deliverables only provide an indirect contribution, but nonetheless useful to be documented.

Deliverables to be analysed:
D 8 - Technological overview with regard to energy efficiency and environmental performance, ready to be integrated into the final Guidelines version
D 11 - Legal input for the final Guidelines version
D 12 - Pilot applications management plan
D 13 - Report on the preparation of the pilot applications including test methodology
D 14 - Report on pilot applications and test reports from the four regions
D 19 - 1st draft version of Guidelines
D 20 - 2nd draft version of Guidelines ready for pilot applications

It is important to distinguish which deliverable contributed to the achievement of which performance indicator and in which degree. The most important results concerning the quantitative performance indicators were achieved within the tests and documented in D14 - Report on pilot applications and test reports from the four regions. In addition to the quantitative performance indicators, D14 also documents the manageability of the Guidelines and it represents, in fact, the main source of information regarding the achievement of the project's first and second performance indicators (quantitative performance indicators and manageability).

The first and second draft versions of the Guidelines are of course relevant due to the fact that they provide useful insights on how the Guidelines evolved.

Subsequent mentioned deliverables only provide a supporting, albeit important role in achieving the project's performance indicators. For example D8 and D11 were built of the basis on D6 – "Technological overview with regard to energy efficiency and environmental performance, ready to be integrated into the guidelines" and D7 – "Integration of technological feedback from the User Platform and the consortium into the guidelines" and respectively D9 – "Integration of technological feedback from the User Platform and the consortium into the guidelines" and D10 – "Integration of legal and economical feedback from the User Platform and the consortium into the guidelines", and provide a basis for the content of the Guidelines.

One of the most complex tasks of the entire project was to provide a manageable set of Guidelines which could be used to elaborate an awarding procedure for rail vehicles and services on a regional level. The manageability of the Guidelines has two defining components: content and structure. The analysis of the deliverables is relevant because they provide the basis for the content of the Guidelines hence, contribute indirectly to the Guidelines' manageability.

D 8 - Technological overview with regard to energy efficiency and environmental performance, ready to be integrated into the final Guidelines version

Deliverable 8 is the main contributor with technological and some economical aspects in the Guidelines. At the core of D 8 lays D 6 which is a solid deliverable containing the most relevant operational measures and technologies which could lead to improved energy efficiency. The deliverable provides an extensive analysis of the technological measures which provides a good base for the content of the Guidelines. The second deliverable which serves as a base for D 8 is D 7 which further refines the information provided in the previous deliverable (D 6) but this time more focused on the needs of the PTA. The deliverable encompasses detailed information on how to use direct and indirect indicators in order to measure energy consumption. The highlight of the deliverable at hand is the elaboration of a Pilot Catalogue of technologies containing the most promising and most desired by PTAs technologies and operational measures. These technologies were analyzed in detail and were included into the guidelines.

WP5 provided some feedback regarding the works in WP2 especially regarding D 7. The feedback focused mainly on the way the information is presented as the content was already good. Comments referred to the inclusion of a SWOT analysis in the future D 8.

D 11 - Legal input for the final Guidelines version

Deliverable 11 provides legal and economical aspects for the Guidelines. Like D 8 is build upon two other deliverables – D 9 which provides a detailed outlook on the legal framework in each project participant country, provides a first look on the direct indicators which would be used to define energy efficiency criteria and defines the risks and chances when including energy efficiency criteria in the awarding procedure and D 10 which details the phases of a typical awarding procedure and comments the means to include energy efficiency and environmental criteria in each phase and provides some useful comments for political level users regarding the importance of energy efficiency. The content of the deliverables elaborated n WP3 is good and provides a good base of content to be included in the Guidelines. Comments made by WP5 focused just like for the previous deliverable on the structure of the deliverable rather than the content. Feedback was given to focus only on legislation which is relevant for energy efficiency and environmental criteria rather than general awarding laws

D 12 - Pilot applications management plan

Deliverable 12 is a solid document detailing the steps necessary to be taken in the execution of the tests in order to achieve the results and provides a detailed outlook on the test requirements, scenarios and reporting. D 12 sets the foundation of achieving (indirectly) the projects quantitative performance indicators but more important its qualitative performance indicators.

D 13 - Report on the preparation of the pilot applications including test methodology

In conjunction with Deliverable 12, Deliverable 13 sets the foundation for the execution of the tests in the four areas. D 13 sets the base of the evaluation of the quantitative performance indicators and provides the basis for their evaluation.

D 14 - Report on pilot applications and test reports from the four regions

Deliverable 14 is the prime source for the evaluation of the projects' quantitative performance indicators and manageability of the Guidelines. More details concerning the conclusions of the tests can be found in the subsequent chapter four.

D 19 - 1st draft version of Guidelines

The first draft version of the Guidelines is the first attempt to put in a unified manner all information concerning the inclusion of energy efficiency and environmental criteria in an awarding procedure, alongside with all relevant legislation, political arguments and technological solutions. In terms of content the first draft of the Guidelines showed a lot of potential however in terms of structure and ease to use it still needs improvements. Two major flaws in terms of manageability can be determined. Firstly the information included in the first draft was not approved by the users (which is understandable at this stage) and secondly the plethora of information was not structured well enough. The potential for improvement is however very visible and the evolution of the Guidelines (to draft versions and one final version) left room for improvement. However, the first draft of the Guidelines has a merit that it is a first attempt to gather under a single document issues regarding the strategic importance of saving energy by compiling credible political arguments and also the operational importance and means to save energy by describing energy efficiency operational measures, technologies and indicators.

Energy efficiency quantitative indicators

There are elements conductive to meeting the objectives aimed at improving the energy efficiency level of the rail activities, by applying the Guidelines instructions and information into the future award procedures. Mention should be made of:

a) Part I, chapters 4, 5, 6
b) Part II chapters 4, 5, 7
c) Part III chapters 4, 5, 6, 7, 9.

However the arguments to save energy should be backed by technological an operational measures' potentials and the means to put them into practice. For example some operational measures clusters have indicated requirements concerning the energy efficiency to be considered in awarding, but these should have to be extended or more explicitly presented in order to be considered in an awarding procedure.

Also the potentials and limits of all indicators should be considered in the final version.

Quantitative indicators referring to CO2 reduction

The present Guidelines Draft tackles in a simplified manner the issue of enhancing the environment protection level by adopting new technological / operational solutions, even if this stands for a major aspect of ECORailS objectives. It would be recommended to separately present the indicators referring to CO2 reduction throughout the Guidelines.

A dedicated presentation of environmental criteria especially those related to CO2 emissions reduction is useful to be presented in the final version.

Results regarding related effects

There are no important elements in this Guidelines variant to support the appraisal of related effects.

We propose that in the following Guidelines variant there should be also included data referring to these aspects, the concrete evaluation modality and specific indicators corresponding to each technology / equipment (modality of estimation / calculation, modality of measurement etc.) as well as modules of calculation / estimation of the direct indicators (for the rolling stock type / service the award procedure is referring to) according to the specific indicators applied, their share, and to their evolution within LCC. Some indicators regarding related effects e.g. noise have been identified and approached. However the systemic approach Energy efficiency, environmental effects and related effects for various solutions and technologies is a very effective way to develop the indicators. The potential to develop this chapter in future versions of the guidelines is still great.

The identification of more related effect indicators and effects must be made to meet the project's requirements.

Economical effects of the reduction of operational costs or due to operational measures, social effects like the attractiveness of rail transport to the public that are generally referred in this first draft have to be more explicitly presented

Flexibility and adaptability to the users' needs and particularities

The measures aimed at supporting the meeting of the users' requirements in the award processes are approached within some limits in D 19. The modality in which the energy efficiency- and environment protection criteria can be applied in the award processes, is presented ever since Part I, chapter 2. In Part II there are also presented some relevant legal aspects which can assist the users with applying EE/EF criteria within the award processes. However, more concrete requirements from the users and the modality in which the Guidelines will be usable to them are not visible in this first draft version.

In its current form it approaches most relevant issues regarding energy efficiency and environmental criteria in the awarding of rail services and vehicles
The content is however not clearly structured but the chapters are distinctively themed. Although it is too early in the development of the Guidelines to address "pure" flexibility and adaptability criteria, the potential of the Guidelines to excel in this area is good.

For example effort to restructure some chapters for a more coherent presentation could be useful. For example: Reorganization of two chapters "4.1. Legal, administrative and market consequences" and "4.15. Legal consequences" to create only one chapter "Legal, administrative and market consequences"

Efficiency of the Guidelines for developing the awarding procedure

There are favorable premises for the Guidelines application to entail an improvement in the award processes by introducing first-priority criteria aiming to EE/EF. However, the efficiency level of the Guidelines application is low at the moment.

In this stage the Guidelines present in a different relevant types of awarding - example according to the object of the award procedure (vehicles or services) and the type of the subjects (PTA or TOC), but while the information is relevant it should not make the object of emphasis.

The Guidelines also clearly present the state-of-the-art in the field and a series of good practice examples that should aid stakeholders to make an awarding decision and this part should be further developed.

The Legal and economical frameworks presented in detail have a strong beneficial impact upon the development of the awarding procedure is one of the strong point of the first draft of the Guidelines and should be structured as good as possible in order to keep just the core information.

Acceptability and participation

The evaluation of this indicator was not possible at this stage of the Guidelines elaboration. Only the second Draft version of the Guidelines will be made widely available and will also be tested. This will allow a direct assessment of its acceptability by the users.

EU wide applicability

D 19 includes elements in favour of the process of the project results multiplication to the other EU member states (Guidelines application in the rail procurement European processes). However, it is foreseen the necessity of a better synthesis and approach (logical scheme) for the future Guidelines drafts, so that, in its final form, this document may be used, without any major restraints (legal, technological, political etc.) in all EU member states.
It is necessary to elaborate a plan in order to increase the awareness of the potential users as to the must of including the Guidelines specifications into the basic documents of the award process.
The Guidelines should be conceived so as to allow for its permanent upgrading with new data referring to technologies, operative measures, legislation etc.

The Guidelines could be applicable at EU level first of all because it is based on the European legislation framework in the rail transport area and specific awarding process

Emphasis was put on three relevant chapters of the Guidelines: “European law relevant for awarding and tendering”, “Relevant European and national law concerning energy efficiency and environment” and “Considerations for the adjustment of European and national law in terms of energy-efficiency criteria”, which shows the concern regarding the EU wide applicability of the Guidelines

Sum-up

Draft 1 of the Guidelines (D 19) reaches some of the objectives set, even if information still needs better structuring.

We consider we must have in view certain completions, mainly issues referring to environmental protection, a criterion less detailed in the present Guidelines approach. Moreover, in the following variants which will also include the information received from the users who have consulted the documentation and the pilot applications results, the Guidelines structure should be revised in the context of the logical unfolding of the document, starting from definition elements, theory etc. up to concrete steps to be made by a user in order to successfully making use of the Guidelines instructions in the award procedures.
A material (chapter / subchapter) should be elaborated, through which the users should be provided a useful working tool in making certain decisions of including EE / EF criteria into the award procedures and measuring the benefits resulted following this approach.
Considering those presented in the D 19 Evaluation, we appreciate that the material provides good potential and be further enhanced.

D 20 - 2nd draft version of Guidelines ready for pilot applications

This is the version of the Guidelines that the evaluation report focuses on. In chapter three of this deliverable we will only make an overview of the status of the deliverable and improvements made compared to the first draft version of the Guidelines. One general remark worth making is that compared to the previous version of the guidelines many improvements have been made especially regarding the content. Relevant information was included while less relevant ones were eliminated or planned to be included in an annex. However in terms of structure, the second version of the Guidelines also has a bulky feel especially since information available in other sources was included in the guidelines instead of referring said sources.

Energy efficiency quantitative indicators

There are elements conducive to meeting the objectives aimed at improving the energy efficiency level of the rail activities, by applying the Guidelines instructions and information into the future award procedures. Mention should be made of:

a) Chapter 4, Subchapter 4.3
b) Chapter 5 and especially
c) Chapter 6

Compared to the previous version of the Guidelines, the current state offers the premise to determine the benefits in terms of energy efficiency. The direct, indirect and specific indicators included in Guidelines represent a reliable way to reduce the energy consumption. However, even if some mention on the advantages and limitation of these indicators is presented, there is no clear mention on how to include them in an awarding procedure. One noteworthy issue is that a great deal of energy efficiency sources has been identified within the Guidelines which could potentially lead to a good evaluation of the quantitative energy efficiency benefits.

Quantitative indicators referring to CO2 reduction

The present Guidelines Draft tackles in a more detailed manner the issue of enhancing the environment protection level by adopting new technological / operational solutions compared to the previous version of the Guidelines which signifies a major improvement in the development of the Guidelines. Chapter 6 of D20 handles the issue especially well by treating energy efficiency issues and environmental issues in a common manner. However the actual quantification of CO2 reductions is lacking in same areas as quantitative Energy efficiency indicators i.e. the actual use of the indicators in an awarding procedure.

Results regarding related effects

Compared to the pervious version of the Guidelines major progresses were made to include noise and other pollutants. Chapters 4 and 5 contain many references to noise as an important byproduct of rail transport which is important to be reduced in the same manner as CO2 emissions and energy consumption. An entire Subchapter (6.14) is also dedicated to noise and noise reduction which has increased substantially the importance of this issue within this version of the Guidelines.

Economical effects of the reduction of operational costs or due to operational measures, social effects like the attractiveness of rail transport to the public that are generally referred in this draft have to be more explicitly presented however in order for the final version of the Guidelines to achieve its full potential.

Flexibility and adaptability to the users' needs and particularities

The measures aimed at supporting the meeting of the users' requirements in the award processes are approached within D 20. The modality in which the energy efficiency- and environment protection criteria can be applied in the award processes, is presented ever since chapter 3 and subsequent chapters. In chapter 2 are also presented legal aspects which can assist the users with applying EE/EF criteria within the award procedures. The Guidelines cover a large range of cases in which it can be applied explicitly (acquisitions of rolling stock, services with different rolling stock ownership). Within Chapter 4, the awarding procedure is split into seven phases each with its own particularities from the standpoint of inclusion of EE/ENV criteria. While this has potential to provide clear picture regarding the inclusion of EE/ENV criteria, due to the high content and plethora of information, the chapter it can be confusing to read.

Efficiency of the Guidelines for developing the awarding procedure

There are favorable premises for the Guidelines application to entail an improvement in the award processes by introducing first-priority criteria aiming to EE/EF. In terms of content the Guidelines

have retained all relevant information from the previous version while introducing new relevant information and eliminating less relevant information. However the process is not fully complete and some less relevant info is still present. Regarding the structure of the second draft of the Guidelines this is one area in which the Guidelines must be improved in order to achieve a good level of manageability.

There is lots of information on “how to award” rather than “how to includ energy efficiency and environmental criteria in awardings”. Information on how to award is considered less relevant by the users, however the inclusion of energy efficiency criteria in a subject of high interest and should be presented in a clear and concise manner without detailing the stages of an awarding procedure.

Acceptability and participation

The users have manifested their interest in the project results by actively participating at dissemination events. They have provided input and feedback and overall valuable information which will help shape the final version of the guidelines. However the guidelines are regarded as hard to use due to the large amount of information which must be assimilated.

EU wide applicability

Even the first version of the Guidelines provided a good base to be used on a EU wide level. The second draft version of the guidelines is more specific in this matter by referring even more to EU legislation, norms and tech-recs which are universally applicable. However on an expert level there are some restraints (i.e. compulsory national legislation) which makes more difficult the assessment of EU wide applicability.

Sum-up

While clear improvements compared to the previous version of the Guidelines have been made, some issues concerning the Guidelines’ manageability remain. The structure of the Guidelines must be simplified in order to make available all necessary information in a well defined linear manner.

4. Results analysis

The following chapter aims at shortly presenting the test and works done within the test and comment on the plausibility of the results and the methodology employed. Based on the analysis of the results, recommendations additional to the ones resulting from the tests will be made in order to improve the Guidelines and achieve a fully useable final form.

4.1 Test Specifications

4.1.1 Specific objectives of the tests

Øresund

The overall goal of the test site Øresund has been to determine, whether the Guidelines can be used in connection with the tendering process used in Trafikstyrelsen, Denmark.
More specifically, the tendering documents used for last tendering process in connection with the cross border traffic across the Øresund have been used for the test.
It has also been tested, whether the energy efficiency and CO2-reduction targets set out in the ECORailS project could be met, when using the guidelines.

Timisoara

The specific test objectives for the Timisoara pilot application were as follows :

- Integrating the requirements related to energy and economic efficiency, as well as to emission reduction, and related effects into an awarding documentation for rolling stock (DMU / EMU). Principles, recommendations and examples have been indicated for:
  - Technical Specification so that the technical parameters will be provided for in an unitary way in the offers, and their verification conditions and method to be also pointed out. Means of elaboration of the requirements without imposing solutions but stimulating the offerers to propose optimum solutions to reduce LCC energy and emmissions.
  - Criteria and ways of assigning points for the offers' evaluation so that the tenderers become interested in offering the most performant and efficient technical solutions, that also provide for the reduction of energy consumption, emission levels and life cycle costs (LCC).
  - The inclusion in the contract form from the awarding documentation of some provisions that assure the verification of the parameters offered and the actual liablity of offerers for their fulfillment and the offerers' involvement in verifying/optimizing the paramenters' values in exploitation (bonus/malus – penalties, etc.)
- Evaluation of quantitative indicators according to the ECORailS objectives based on tests, calculations, good practice examples
- Evaluating the Guidelines and drawing up recommendations with the view of improving its content and its manageability.

Lombardy

Pilot Application Lombardy has three main objectives, which have been selected by combining the general aims of ECORailS with the local expectations:

- To increase the stakeholders' awareness of the potentials for saving energy and for reducing the environmental impact of regional rail, including calculations or estimations about the reachable targets.
- To use the ECORailS Guidelines for improving the present Public Service Contract with new EE/ENV clauses, since competitive tendering is, at present, not in force in Lombardy.
- To receive feedbacks about the ECORailS Guidelines and the strategy for Lombardy from a wider panel of stakeholders.

Berlin

The main objectives of the Berlin test site workshops were:

- Consideration of the relevant risks for PTAs and TOCs, resulting from developments during the contract period, as there are
  - framework conditions rooting in public rail transport demand
  - energy prices
  - legal environmental requirements (e.g. ambient noise regulation) and juridical decisions
- Provision of information
  - For consumption and emission reduction potentials as well as cost estimiations
  - LCC approaches
  - Further
- Reality check of the Guidelines test version by the Site Stakeholder Group (SSG) acting as a **„Sounding Board"**
- Understanding about the interests of the different stakeholders (PTA, TOC, Manufacturing Industry)
- Test of the Guidelines in particular for the phases preparation and elaboration regarding
  - Comprehensiveness and correctness of contents
  - Perceivability
  - Completeness

4.1.2 Test site descriptions

Øresund

In the Øresund region the train service consist of two parallel regional train systems running between Nivå (DK) – Kastrup (Copenhagen Airport) (IR4 EMUs) and Elsinore (DK) – Kastrup (and further on towards Malmö (S)) (ET EMUs). The two systems supplement each other and deliver a 10 minute frequency service on main part of the line. On the central part of the line an hourly service runs through the night every weekday.

The Guidelines have been tested when selecting the types of technology to be used, as well as to determine how to implement the use of the desired technology. The choice of technologies merely serves to determine the feasibility of these technologies in the Øresund rails services, and on the basis hereof to evaluate the energy saving potential in the current rails services.

Timisoara

The Timisoara test site had as object the elaboration, based on the Guidelines, of an awarding documentation for the procurement of rolling stock (respectively of 10 DMU and 10 EMU).

An awarding documentation has been elaborated, that is different in terms of principles from the similar documentations realized until this moment, in terms of elaboration, but also as principles for drawing up the offers and respectively of evaluating the offers, taking into consideration the requirements for reducing the energy/fuel consumption, the emissions and the life cycle costs.

Within the Timisoara test, the following main activities have been performed:

- pilot application's planning and management
- definition and collection of the baseline
- definition and completion of the database with users and stakeholders interested in being informed with regard to the test and in providing effective feedback
- overview of the technologies mentioned in ECORailS (83 technologies and operational measures) and selection of the proper ones according to the object of the awarding documentation (10 DMUs and 10 EMUs); 10 technologies / operational measures were selected.
- analysis and selection of recent similar awarding documentations
- analysis and selection of data with regard to the currently used rolling stock
- elaboration of an awarding documentation with the inclusion of requirements for the reduction of the energy/fuel consumption, exhaust emissions, noise and life cycle costs

Within Timisoara tests, actual line tests were performed with the existing rolling stock, by measuring and registering the fuel or energy consumption under various operating conditions, different driving styles, for various train configurations and by making additional calculations in order to define and quantify some parameters.

A large number of measurements and statistics were made related to current train service on various routes and in various operating conditions (electrified/non-electrified tracks, different modes of configuration of DMU/EMU, different weather conditions winter/summer, parking, different number of passengers etc.).
The data was collected from ECORailS catalogue of operational technologies and measures, examples of tenders, norms, technical documentations from suppliers or specialized literature from other related projects (Railenergy, Prosper, Event, Repid, Ravel etc.).

The working scenarios drawn up in the Timisoara site were based on real references, checked within the current practice, filtrated through requirements from applicable standards and norms, covered by scientific calculations and arguments.
For each item in the requirements stipulated in the ECORailS Specifications, specific data were collected / elaborated under the test, according to the paragraphs above.
The overall methodological approach used in the Timisoara test was to analyse the results and computation based on decision matrices with balance point, namely:

1. The pessimistic criterion (Wold).
2. The optimistic criterion (Wald).
3. Probable value determining through the criterion of the extremes (Hurwitcz), the criterion of the regrets (Savage) and the criterion of the balance (Baye Laplace).

This analysis was made based on the data collected / measured / calculated according to the three criteria, in order to determine the optimistic/pessimistic coefficient, or anticipated value calculation.

Lombardy

Main object of the Lombardy Pilot Application is **direct awarding of regional rail services**. During the test, **the present public service contract between Region Lombardy and the TOC called LeNORD has been reviewed** to understand which changes are needed to follow the approach proposed by the ECORailS Guidelines. As the starting point is without any experience in the contracts about energy measurement and saving, a progressive approach was developed, including a set of legal clauses ready to be used when preconditions are reached. For example, an incentive scheme has been designed to be put in practice when the energy monitoring system is working and tested.

All clauses are part of a legal document, called Memorandum of understanding, binding not only the PTA and the TOC, but also asking for cooperation with the Infrastructure Managers on key issues within their competence, like the way the costs of electricity are charged to the TOCs. The PTA Lombardy Region and the TOC Trenitalia-LeNORD (which is taking over from LeNORD) are going to sign a letter of intent where they support the ECORailS approach and declare their willingness to make the clauses operating.

As today no monitoring of energy consumption is in force in Lombardy, **two lines have been selected (Valcamonica diesel line and the Milan suburban S3 electric line), where a baseline was calculated and test runs have been done to show some reachable potential**. Both lines are part of the above mentioned public service contract, which covers the whole regional service.

The Pilot Application Lombardy covers the following **measures and technologies** among those proposed by the ECORailS Guidelines:

- **Strategic and regulatory approach (Part I of the Guidelines)**:
    - The whole set of actions proposed by ECORailS, including regulatory improvements and changes regarding the infrastructure and the design of train paths
- ➔ *this is the core part of the proposal of Memorandum of understanding*

- **Operational measures (Part II of the Guidelines)**:
    - Monitoring of energy consumption
    - Energy efficient driving
- **Technologies: (Part II of the Guidelines)**:
    - Energy meters / diesel flow meters
- ➔ *for these operational measures and monitoring technologies clauses have been written to establish an effective monitoring and to incentive more efficient operations using the existing rolling stock*

- Other technologies have been chosen to improve the environmental performances of regional rail and infrastructures in Lombardy, but they have not been directly tested during the Pilot Application:
    - On-board use of braking energy in diesel-electric rolling stock
    - On-board use of braking energy in electric DC 3kV rolling stock
    - Braking energy recovering by super-capacitors in fixed installation

- **Legal measures (Text modules developed in the Pilot Application)**:
    - A new legal clause to be used in future commissioning of rolling stock, called “RAM plus” clause, which combines the LCC approach supported by the Guidelines with the currently used in Italy Reliability Availability Maintainability warranty.

➔ *the other technologies and the new RAM plus clause are part of a middle-term approach accompanied by the provision of new rolling stock and some infrastructural upgrade. Without any existing systemic monitoring data the impact of these system wide measures may be only object of broad estimations.*

The Pilot Application was done by a Site Working Group made by the project partners ALOT and Province of Brescia and by representatives from the Transport Directorate of Region Lombardy and from the Ferrovie Nord Group (including LeNORD TOC and FERROVIENORD Infrastructure Manager). The SWG analysed the present public service contract and prepared the proposal of improvements; Ferrovie Nord organised and performed the test runs and provided data; a Site Stakeholders Group was involved in meetings and asked to fill-in questionnaires to give their feed-back about both the Guidelines and the Pilot Application.

Berlin

Berlin, as a test site with high population density, covers city connections and links to rural areas. There are different types of regional passenger rail services in the Berlin area, including connections inside the city (mainly by the City Railway “S-Bahn”) and fast connections between the city and the surrounding regions and towns in the Federal State of Brandenburg (Regional-Express trains and Regional-Bahn trains).

Chosen from the wide range of regional rail varieties, the following awarding will be the basis for a more detailed description of railway services. It is a virtual test case in order not to hinder the discussion process within the Stakeholder Side Group (SSG), facing the competitive situation regarding awarding of Regional Railways Transport Passenger Services in the Berlin-Brandenburg region.

The Berlin pilot application is based on the awarding of virtual Regional-Express train lines RE 74, 75, 76

• annual production: a total of 12.5 million train*km:

- in Berlin: 2.8 million train*km per year;
- in Brandenburg: 9.7 million train*km per year;
    - with diesel traction: 1.5 million train*km per year;

• maximum speed: 160 km/h (electric), 120 km/h (diesel);

• contract duration: 12 years;

• probable start of operation: December 2014;

• vehicles:

- electric traction: double-deck EMU or locomotive-hauled double-deck trains for about 190 coaches;
- diesel traction: sets of two-cars DMUs or the respective number of coaches (one floor).

The pilot application in Berlin exemplifies a process centered around the awarding of services through a call for tender, rather than direct procurement, as direct awarding is not ordinarily permitted in accordance with VgV §4 (Verordnung über die Vergabe öffentlicher Aufträge - Order about the assignment of public orders).

The Berlin pilot application is designed to review present awarding documents developed for competitive tender. The Guidelines will be presented to a User Platform at every step of their development, with the User Platform functioning as a sounding board to check for completeness, conciseness and reliability of content.

Furthermore, the pilot test is designed to identify and minimise potential risks to both PTAs and TOCs regarding:

- market related conditions
- energy prices
- legal requirements

The central issues facing the User Platform concern the management of older vehicles and the monitoring of environmental and energy components.

According to the defined test case, two Regional-Express lines are chosen as a baseline for the Berlin test site:

- *from North-West Brandenburg to Berlin:*
  RE 6: Wittenberge – Neuruppin – Hennigsdorf – Berlin-Spandau, DMU operated
- *from Federal State of Saxony-Anhalt via South-West Brandenburg, Berlin-Stadtbahn and Berlin Schönefeld Airport to the southern surrounding hinterland closed-by:*
  RE 7: Dessau – Bad Belzig – Berlin Stadtbahn – Wünsdorf-Waldstadt, operated with loco hauled trains, electric traction

4.2 Analysis activities

4.2.1 Means of evaluation of the quantitative performance indicators

Øresund

In the Øresund test site the Guidelines have been tested regarding usability in the elaboration phase (Phase B according to the guidelines). The following tendering documents describing the Øresund train service were used for the test:

- Volume of service and service characteristics (Bilag 2 Trafikbetjening)
- Rolling stock (Bilag 3 Rullende materiel)
- Staff (Bilag 6 Personale)
- Incentive schemes (Bilag 8 Incitamentsordninger)
- Operators contract with the infrastructure manager (Bilag 10 Operatørkontrakt med Banedanmark)
- Reporting (Bilag 12 Rapportering)
- Description of the tender (awarding criteria and assessment) (Tilbudsgrundlag)

The Guidelines are consulted to elaborate on above mentioned tendering elements, with the goal of updating the text modules of the individual tendering documents.

Rolling stock (Rullende materiel, bilag 3)
Due to the fact, that the EMUs used in the service are quite new, and the one type of rolling stock is equipped with dual system features, for test purposes it is assumed, that no operator will provide his own rolling stock for the services.

For the Øresund traffic, kWh per seat km could be used as a KPI, but the energy consumption per train set km has the same value to the PTA, since it is as well calculable and monitorable, as kWh per seat km.

Incentive schemes (Incitamentsordninger, Bilag 8)
Registration and monitoring of energy consumption should be made on a monthly basis. Separate registration and monitoring should be made for energy consumption in service and out of service.
A bonus/ malus scheme should be setup to encourage the operator to optimise his energy performance. Break even is the base line energy consumption per train set km, alternatively per seat km.

The bonus/ malus scheme should follow the principles of the other bonus/malus schemes (for instance regularity) to ensure transparency and manageability in the contract period. In principle, the setup described in the Guidelines could be used, with the adaption of incentive and penalty levels to the actual situation.

Description of the tender (awarding criteria and assessment) (Tilbudsgrundlag)
The weighting of energy efficiency is to be included in description of the tender. The overall weighting scheme consists of three elements:
Price (50%)
Quality (30%)
Deliverability (20%)

Energy efficiency should be covered by “quality”, which then also cover quality of traffic, rolling stock (organisation of maintenance), stations (maintenance and operations), distribution and passenger services.
Energy efficiency would appear alongside other qualitative requirements, but without any significant weighing in the overall assessment of a bid. However, a bidder would have to describe his solution, and this description would be part of the contract. The operator would then have a specific contractual obligation to fulfil.

The energy savings could be calculated into CO2 savings. In the period investigated, DSB was buying 100% green electricity from renewable sources, so one could argue that no CO2 savings have been made. The contrary argument is that when you save green energy, this energy becomes available for the general market and thereby replaces some of the “conventional” electricity produced from the Danish national mix of both renewable and fossil sources.

Therefore, the following calculation can be made:
National energy CO2 intensity for Denmark (according to www.ecopassenger.org) is 302 g/kWh. This value could be discussed as well since there are several values on the table, depending on the political focus (Kyoto protocol, EU emission trading, production vs. consumption mix, balance with combined heat production etc.)

As the total potential saving estimated is 6,9 GWh, the estimated saving equals 6900 MWh x 0,302 kg/Mwh = 2084 kg or approximately 2 tons of CO2.
For details see ANNEX9 Calculations Oresund test site

Timisoara

In the Timisoara test site through the description submitted and by filling in the required forms, the tenderer should account for and quantify the proposed variant based on the following elements (referred to in what follows and in the awarding documents, as „*ECORailS Criteria*"):

- Difference in terms of energy consumption during service [kWh, kWh/Seat, kWh/pkm]
- Differences in terms of harmful emissions levels (Emissions: g CO_2/pkm, g NO_x/pkm, Noise etc.)
- Life Cycle Costs (LCC) – life cycle is herein considered 30 years
- Technical advantages or advantages in terms of utilization (as well as the modality in which they influence the values above)
- Advantages in terms of fiability and reliability in service
- The difference in price (*if any*) an optional version (equipment / technology etc.) is likely to induce in the total purchase price as compared to the tenderer's standard version.

In order to evaluate the quantitative indicators within the test, the following main stages were covered:

a) There were selected 10 technologies / operational measures considered the most applicable and recommended for the specific character of the selected rolling stock, the local operation conditions and the maximization of the ECORailS objectives efficiency in the next awarding documentations.

b) For each of the 10 selected technologies / operational measures, there were performed tests especially conceived in order to measure the consumption in various configuration- and driving versions, to check the consumptions according to the operation conditions for all the auxiliaries and for various operation regimes (start up, free running, braking, parking, lighting, heating, ventilation, air conditioning etc.). Based on the above and on the measurements, there were determined the actual consumptions and their variation according to various parameters.

c) There were also analyzed statistic data and measurements from the actual service operation registered throughout a year at Timisoara local railways company for all the vehicles types in actual service and on various transport routes.

d) Based on the above and on additional calculations, the consumptions related to each analyzed scenario were determined by taking into consideration the consumptions evolution according to the parameters in service, the rolling stock- and equipment characteristics, the operation- and driving modality etc.

e) The table in Annex 5 - ""Timisoara test site fuel saving calculations" shows the synthesis of the comparisons between the actual data (as measured) and those calculated according to the scenarios and the technical data set as reference points for the vehicles with the best configuration as per the new documentations and ECORailS criteria recommended and detailed in the awarding documentation.

f) Although the comparisons were made based on accurate measures and calculations, a pessimistic scenario and ann optimistic one, respectively, were also considered, by taking into account possible operation modes, climatic conditions, loading degree, driving modality and other parameters. According to this, analyses on decisional matrices with equilibrum point were finally made for each of the 10 technologies / operational measures selected, thus determining the "probable" variant.

g) The results obtained were also compared to the data available in the specialized literature, various suppliers' documentations, the data in the Guidelines and in the annexes, the data from other projects (Railenergy, Prosper, Event, Repid, Ravel etc.) etc.

h) Under WP 5 activities based on the Timisoara Test Report ("Report on ECORailS test performance – Timisoara Site", 26 pages) and its annexes (14 Annexes, 36 pages – as per the list of annexes "W4_BD List of annexes" – also attached to the present deliverable (Annex 9),

these methodologies, the results obtained and the elaborated documents were analyzed and validated.

i) The above methodology and the test results were checked by the specialists operating the current rolling stock for the regional passenger railway transport in Timisoara. These were also submitted to and agreed by the experts invited to the Bucharest Workshop of 10 February 2011, experts from the National Society of Railway Passenger Transport 'C.F.R. Calatori'- S.A., the Romanian Railways Authority (AFER), CFR Timisoara – National Society of Railway Transport, the National Authority for Regulating and Monitoring Public Procurement (ANRMAP), the Romanian Railway Group (GFR).

Lombardy

As explained in paragraph 4.1.1 of D16, the pilot application Lombardy aimed to introduce the ECORailS Guidelines approach in the direct awarding of regional rail services (that means to update the Public Service Contract). The Memorandum of Understanding among the Regional Government, the regional Train Operating Company TRENORD and the regional Infrastructure Manager FERROVIENORD developed by the ECORailS pilot application will become part of the new PSC. The technologies and operational measures mentioned in the Memorandum of Understanding have been selected by the Site Working Group among those listed in the ECORailS Guidelines and technical annexes (see paragraph 4.1.2 of D16), where their potentials in terms of energy saving is reported from the most updated literature and research projects. These data are also available through the Railenergy Calculator (http://www.railenergy.eu/ /calculator.aspx).

No systematic and comprehensive set of energy consumption data is at present collected in Lombardy (and in Italy) for the regional rail services, which can be used to measure the "before ECORailS" scenario, except for the litres of fuel at refilling for the diesel rolling stock. As the ECORailS project did not finance a widespread campaign of quantitative measurement of the energy consumption, during the pilot application the available data for diesel traction were collected and one day of on-field tests was performed with the help of the Trenord TOC for the electric traction. Therefore, for the "before ECORailS" scenario the following data have been reported in paragraph 4.4.3. of D14 (see the attachments):

- for the diesel traction line Valcamonica (Brescia - Edolo), the litres of fuel refilled for each vehicle and month from July 2009 to June 2010;
- for the electric DC 3kV line S3 (Milano Cadorna – Saronno), the average consumed energy registered by an energy meter compliant with the international standards during two trips done on 15th December 2010.

In spite of the above mentioned restrictions, the reported data for the "before ECORailS" scenario in Lombardy were plausible in comparison with those reported for other test sites, as shown in the annexes of D14 (paragraph 8.1.2).
Coming to the "after ECORailS" scenario, the Memorandum of understanding commits the Regional Government and the regional TOC and IM to develop an Operational Plan to progressively implement a monitoring system and operational measures to reduce energy consumption in Lombardy. The Operational Plan is aimed to reach targets compliant with the ECORailS KPIs:

a) 5% by the upgrading of the present awarding (the PSC) with operational measures such as an energy consumption monitoring system, personnel training and eco-driving, together with a stronger involvement of the IM in the design of optimal paths;
b) 10% by introduction of new rolling stock into service (when a public financial help will be available);
c) 15% by introduction of innovative technologies in addition to the above mentioned solutions: the needed technological improvement concerns both the on-board use of braking energy in electric stock and the braking energy recovering by super-capacitors in fixed installation.

The above mentioned technologies and operational measures are not in use at present in Lombardy; it was therefore possible for the SWG to assume their average potentials (as reported in the technical annex of the Guidelines) as targets to reach by implementing the ECORailS approach. The analysis of the available quantitative data (energy consumption for the diesel rolling stock) and two measurement sessions were also added to show the feasibility of the 5% and 10% targeted KPIs in Lombardy:

a) Eco-driving was tested in two measurement sessions of which on for diesel traction (4 test runs) and one for electric traction (2 test runs): all sessions confirmed that the reachable energy savings are in line with the range mentioned in the ECORailS Guidelines and greater than the targeted 5% (the results are reported at paragraph 4.2.2.1 of D16 and in Annex 1 and Annex 2 Lombardy).
b) The comparison between the energy consumption data of the older and newer rolling stock in Valcamonica confirmed the reachability of relevant advantages in terms of energy saving when new and lighter diesel vehicles are introduced (the results are reported at paragraph 4.2.2.2 of D16 and in Annex 3 Lombardy). No energy meters were available on the old rolling stock to make possible the comparison the newer vehicles, like those involved in the test runs.

For the other technologies and operational measures envisaged by the Operational Plan for a system-wide improvement of the regional rail service in Lombardy – involving the recovery of the braking energy and a full renewal of the fleet – on-field tests and measurement were not possible, as the concerned vehicles and infrastructure do not exist not. The assessment of the 15% KPI therefore relies on the potentials declared in the Guidelines technical annex and on simulations (see paragraph 4.2.2.3 of D16).

Berlin

The tests performed within the Berlin-Brandenburg pilot application consisted of the following major steps:

- Simulation of energy consumption and CO_2 emissions of vehicles which are currently in operation at RE 6/RE 7 lines on the one hand and which will be in operation (from December 2012) at RE 7 line (EMU class 442/443) and at RE 1 line (as an example for a modern loco-hauled train with class 182 “Taurus”), based on the awarding of the Stadtbahn network.
- Deep discussion of the Guidelines with the members of the SWG and development of EE/ENV criteria.

- Discussion and plausibility check of the developed EE/ENV criteria with the members of the SSG.
- Evaluation of the Guidelines' test version (V04 of D 22) by the SSG with the help of questionnaires

Energy consumption tests consisting of a numerical simulation have been done with different train configurations:

	Regional-Express line **RE6** (diesel traction)	Regional-Express line **RE7** (electric traction)
Before: trainsets which are currently in operation	DMU: class 646/946 (GTW 2/6 - Adtranz, Bombardier, Stadler)	Loco-hauled train: class 143 (LEW Hennigsdorf) without energy recovery with 3 double deck middle coaches (class DBuz 747) and 1 double deck control cab coach (class DABbuzf 760)
After: trainsets which will be in operation from December 2012 according to the "Stadtbahn network" awarding done in 2009	DMU: class 646/946 (GTW 2/6 - Adtranz, Bombardier, Stadler)	Loco-hauled train: class 182 (Taurus – Siemens) with 3 air-conditioned double deck middle coaches (class DBpz 752), not older than 1998 and 1 double deck control cab coach (class DBpbzf 763), not older than 1998; for comparison with the current situation at line RE 7; with a similar configuration in operation at Regional-Express line RE 1
		EMU: class 442/443 (Talent 2), Bombardier, five-part

Therefore a model which connects the track data like speed limits, curve radius, distance between stations and gradients with the vehicle model was built. The simulation was done as suggested in the TecRec 100-001.

Furthermore the current test versions of the Guidelines have been discussed with the SSG, mainly the phases A – Preparation and B – Elaboration (Guidelines test).

8 stakeholders – amongst them 4 participants from PTAs responded to the WP5 questionnaire provided within the last phase of the Guidelines tests. The answers are based on **test version V04 of D 22**.

4.2.1.1 Energy efficiency / CO2 reduction comparison with the current awarding (5%)

Øresund

The Øresund test is performed as a simulated tendering process covering phase A Preparation and phase B Elaboration, according to the Guideline's definition of a tendering process. The overall goal of the test has been to determine, whether the Guidelines can be used in connection with the overall tendering process used in Trafikstyrelsen, Denmark. More specifically, the tendering documents used for last tendering process in connection with the cross border traffic across the Øresund have been used for the test.

The scope of the calculation is the total traffic on the Danish side of Øresund, Kystbanen, this traffic is operated by DSBFirst using Øresund trainsets (Litra ET, two-system electric multiple units) and regional trainset from DSB (Litra ER, electric multiple units). The calculation methodology is taken from the EU project Railenergy which has just finalised the development of an online decision support tool which is freely available at www.railenergy.eu/calculator/calculator.aspx. The energy calculation methodology is in line with the principles within UIC/UNIFE TecRec 100_001 (http://tecrec-rail.org/100_001) as well as the UIC leaflets 330 (environmental passengers transport)) which has just been issued 2010-12-17. Due to the fact that it is the main result of a successfully finalised EU project, the Railenergy decision support tool is reliable way to determine energy efficiency potentials. Moreover, the input data is based on real data provided by the Train operator company hence, very reliable.

Timisoara

According to the methodology and the evaluation methods described in the Timisoara site description, for each of the technologies requested through the new awarding documentation, their effect was calculated from the point of view of the reduction in energy/fuel consumption, level of exhaust emissions and LCC, as compared to the DMU that would have been obtained through the current awarding documentations. See also point 4.2.1.

In order to determine the improvements generated by the ECORailS concept, for each of the new requirements, separate evaluations have been made, determining one value for each of the hypotheses: pessimistic, optimistic and probable. These evaluations took the form of laborious calculations based on values measured during special tests, on the statistic data of long-term measurements (1 year) and on a large number of trains. Such calculations were applied particularly for: the modality of train forming, optimized driving, energy recovery/storage braking, and choice of diesel engine. For the rest of the ECORailS requirements, the evaluations (based on statistic and experimental data, the actual situation in Romania, and so on) have been correlated with the evaluations provided for in reliable specialized sources, like the Guidelines, related projects (Railenergy, Event, Prosper, Diesel Rail Study), recent tenders for innovative vehicles, manufacturers' brochures and promotional materials and also own experience.

All these new requirements were compared against the awarding documentations for recently acquired rolling stock. Even if the new acquisitions detain better technical characteristics than the old rolling stock currently in exploitation, they still lack state-of-the-art features/ equipment,

therefore high potentials for improvement in terms of EE and Env performance were obtained. As an indication of the technical performance of the vehicles recently acquired (basis for 5% comparison), internal analysis made by our team of rail experts/engineers were made based on the technical features described in the vehicles' Specification and dedicated literature, manufacturers' brochures and recent similar tenders.

From a methodological point of view, all the calculations/estimations made are feasible since they were realized in accordance with the provisions of the relevant UIC Leaflets (for e.g., UIC 176, 330, 345, 410, 540, 546, 553, 555, 565-3, 567-2004, 612, 624, 651-2002, etc.), European Norms (EN 50483-2, EN 13129-1:2004, EN 13272:2001, etc.), Technical Recommendations (TecRec no. 100_001) and so on, sources accepted at European level.

For details see Appendix 5 - Timisoara test site fuel saving conclusions

Lombardy

For both Valcamonica and S3 lines energy saving was at first estimated by comparing the present performance ("baseline") with the achievable potentials when operational measures will be operative keeping the same rolling stock.

The activities were focused on the collection of the key basic datum which is energy consumption, measured as kWh for electric traction and liters of fuel for diesel traction. Liters have been changed in kWh according to a fixed conversion rate (1 liter = 10.08 kWh). By following the standard calorific value of the diesel oil, each litre of consumed fuel (the only datum measured by the rolling stock and available) was converted in 0.85 kg. Each kilo of diesel fuel has a calorific value of 10,200 kcalories or 11.86 kWh. External conditions like the temperature and the humidity usually influence the litre/weight rate of the diesel fuel: such a situation is taken into account when a yearly set of data is used, as ECORailS made to estimate the Valcamonica baseline and to compare the old and the newer diesel rolling stock. On the other hand, the test runs were feasible only during one day in summertime.

Then, all direct indicators proposed by the ECORailS Guidelines have been calculated to evaluate the performances. These indicators have been considered by the SWG very useful to be used in a static perspective to evaluate past operations. On the other hand, they should be carefully managed when incentives are based on them because each indicator is calculated by sharing two phenomena, each of them dependant by its own factors. The SWG was also convinced of the important of side conditions, like the weather, speed restrictions and not regular circulation.

1. Baseline (= current awarding) energy consumption was collected as follows:
    - Valcamonica line: fuel is usually measured by TOC's employees in the tank at refilling time. Official checks are regularly made when asked by the tax policemen. These data have been used to compare the performances of different classes of rolling stock today used on this line.
    - S3 line: no baseline data are available because energy meters are not installed in Lombardy. LeNORD is testing a meter only on one EMU, therefore it was used an approximate measurement during 2 test runs.
2. Results (= comparison with current awarding):

- Valcamonica line: energy efficient driving, supported by the Guidelines as operational measure in the Pilot Catalogue, was tested by 4 test runs. There were used two different drivers with specific tasks: a) first driver: to optimize fuel consumption (without electronic assistance in the cab); b) second driver: to drive speedy and without attention to fuel consumption. The second driver consumed 16% more energy than the other, in spite of a 5% reduction of the travel time.
  These results are coherent with the inputs given by the ECORailS Guidelines (5-10%, with a maximum of 20% reachable in special cases). Therefore, the SWG is confident that 5% reduction in comparison with current awarding is a feasible target for the regional rail service in Lombardy with diesel traction.
- S3 line: 2 test runs were done to have estimation about the impact on electric traction of different driving styles. The measured gap of energy consumption was about 8%, but it was clear that, on very crowded lines like S3, energy consumption in real life is heavily affected by traffic conditions.
  The SWG is convinced that only a systemic monitoring system allows a reliable evaluation of the reachable targets, but the 5% saving results supported by ECORailS seems to be feasible also in the case of electric traction.

The reduction of CO_2 emissions:

- Valcamonica line: Region Lombardy decided to replace the whole diesel fleet three years ago, therefore all vehicles will be compliant with the Euro IIIA and Euro IIIB standards within 2012. Noteworthy to mention that reductions will be directly dependant on fuel savings generated by the new types of engines
- S3 line: CO_2 reductions influenced by the TOC are only reachable by energy saving, therefore it can be drawn the same outcome as above before.

Berlin

For the Berlin test case the test version V04 of D22 have been evaluated during the workshop process with the stakeholders. Compared to current awarding an achievement of 5 % for improving energy efficiency and reduction of CO_2 emissions is conceivable.

This result is based on the following arguments:

- Answers of the stakeholders to the questionnaires due to the presented and discussed EE/ENV criteria
- Assumption that operational measures (eco-driving, parked-train mode) and timetable optimisation as described in the Guidelines with a potential of at least 5 % will be applied systematically.
- Simulations have shown that there is a significant difference between the Talent 2 and Taurus train configurations in terms of energy efficiency and CO_2 emissions. It should be stated that only the better train configuration will be offered by the TOCs if the EE/ENV criteria become higher weighted in future awarding procedures.

4.2.1.2 Energy efficiency/ CO2 reduction comparison with currently used rolling stock (10%)

Øresund

In the Øresund test site the data collection is divided into the baseline configuration (technical and operational) and identification of energy saving measures. This survey covers the ER and ET trainsets in service for DSBFirst. DSBFirst operates a fleet of 20 ER and 90 ET EMU train sets for the Øresund contract in total.

"In service" data

For these screening calculations it is assumed that the HVAC units are the only energy consuming non-traction component on-board. This is not 100% correct but it gives a good, conservative indication of the saving potential.

"Out of service" data

The "out of service" load profile for ER and ET has been determined in corporation with the maintenance engineers at DSBFirst Helgoland. These values are plausible but subject to revision due to unclear data material.

The very high parked train hours for ER are due to the fact that these trainsets mainly serve as rush hour traffic capacity. In agreement with the maintenance engineers at DSBFirst Helgoland, two scenarios for parking have been developed: *Low* and *High*. At the moment the *High* scenario is closer to reality than the *Low*.

The input data used being comprised of real energy consumption data and potentials provided by the above mentioned Railenergy calculator ensure that the test results are plausible considering the above described restrictions.

The energy savings could be calculated into CO2 savings. In the period investigated, DSB was buying 100% green electricity from renewable sources, so one could argue that no CO2 savings have been made. The contrary argument is that when you save green energy, this energy becomes available for the general market and thereby replaces some of the "conventional" electricity produced from the Danish national mix of both renewable and fossil sources.

Therefore, the following calculation can be made:
National energy CO2 intensity for Denmark (according to www.ecopassenger.org) is 302 g/kWh. This value could be discussed as well since there are several values on the table, depending on the political focus (Kyoto protocol, EU emission trading, production vs. consumption mix, balance with combined heat production etc.)

The projected savings in the Danish site of ECORailS is 6,9 GWh according to the tables bellow:

Total baseline (ER low + ET)	**Total potential savings**	**Total new baseline** (ER low + ET)
GWh	GWh	GWh
53,6	6,9	46,7

ET

Indicator	M.U.	Baseline performance	New performance	Sawings	
KPI 1	Wh / gross tkm	44	39	5	11,36%
KPI 2	Wh / seat-km	29	26	3	10,34%

ER (Low)

Indicator	M.U.	Baseline performance	New performance	Sawings	
KPI 1	Wh / gross tkm	51	40	11	21,57%
KPI 2	Wh / seat-km	34	26	8	23,53%

In this instance, the estimated energy saving equals 6900 MWh x 0,302 kg/Mwh = 2084 kg or approximately 2 tons of CO2.

Timisoara

The testing procedure was the same with the one used to determine the energy efficiency potential compared to the current awarding, but the comparisons were made against the currently used rolling stock. The results obtained were analysed with all technical data or measurements on all types of rolling stock currently used in Timisoara both on diesel and electric lines.

According to the provision from "WP4 test – Timisoara area: Report regarding the ECORailS test execution", the reduction of CO2 emissions will be directly proportional with the reduction in fuel consumption, respectively:

- 8,5 % compared to current awarding (ECORailS objective: 5%):
- 12 % compared to currently used rolling stock (ECORailS objective: 10%):

As previously mentioned, in order to determine the improvements generated by the ECORailS concept, for each of the new requirements, separate evaluations have been made, determining one value for each of the hypotheses: pessimistic, optimistic and probable. These evaluations took the form of laborious calculations based on values measured during special tests, on the statistic data of long-term measurements (1 year) and on a large number of trains. Such calculations were applied particularly for: the modality of train forming, optimized driving, energy recovery/storage braking, and choice of diesel engine. For the rest of the ECORailS requirements, the evaluations (based on statistic and experimental data, the actual situation in Romania, and so on) have been correlated with the evaluations provided for in reliable specialized sources, like the Guidelines, related projects (Railenergy, Event, Prosper, Diesel Rail Study), recent tenders for innovative vehicles, manufacturers' brochures and promotional materials and also own experience.

All these new requirements were compared against the currently used rolling stock by the Timisoara Regional (base for 10% comparison). Even just by starting from the fact that the Timisoara fleet is composed of outdated second-hand rolling stock, great potentials for improvements in terms of EE and ENV performance are obvious. As an indication of the technical performance of the currently used vehicles, actual measurements of the trains' operational performance (in terms of energy consumption and level of exhaust emissions) under various exploitation regimes and conditions were made. These measurements were considered for the entire period of year 2009 and were provided as year averages. The fuel/energy consumption was differentiated for summer and winter, for heating and air-conditioning and for active and reactive energy. In what concerns the establishment of the level of emissions, the software program Corinair accepted at EU level, was used, to transform the fuel/energy consumed into different types of exhaust emissions, including CO2 emissions, based on universally accepted mathematical relations (provided for in the UIC Guide of environmental indicators). Other supplementary data with regard to train type, weight, forming, capacity, number of passengers, occupancy level, etc. were also collected and constituted important elements in the analysis.
From a methodological point of view, all the calculations/estimations made are feasible since they were realized in accordance with the provisions of the relevant UIC (for e.g., UIC 176, 330, 345, 410, 540, 546, 553, 555, 565-3, 567-2004, 612, 624, 651-2002, etc.), European Norms (EN 50483-2, EN 13129-1:2004, EN 13272:2001, etc.), Technical Recommendations (TecRec no. 100_001) and so on, sources accepted at European level.
For details see Appendix 5 - Timisoara test site fuel saving conclusions.

Lombardy

The Pilot Application of the ECORailS Guidelines in Lombardy did not involve a renewal plan for rolling stock because both S3 and Valcamonica lines benefit of recent or new rolling stock bought by the Regional Government from the year 1998 (the last EMUs and DMUs will be delivered within 2011).

Anyway, the analysis of baseline data available for Valcamonica line allowed a comparison between old and new diesel units, which were bought a couple of years ago without using energy efficiency criteria. The results strongly support the choice to replace the rolling stock built in the 90s or before. The lighter new DMUs with comfort functions, like air conditioning and information system, perform well better than the old basic diesel cars (10% less energy consumption measured as kWh/seat*km, 37% less measured as kWh/gross tonne*km). To compare the data a train-set made by 2 old DMUs was considered, offering the same number of seats than the new DMU.

Further savings reachable by using EE/ENV criteria when more recent rolling stock is replaced are not predictable in the Pilot Application. The new diesel fleet bought by Region Lombardy has innovative technologies like braking energy recovering by super-capacitors on board equipment, but no calculations were possible because the trains will be delivered in Spring 2011.

Berlin

According to the energy consumption tests described in paragraph 4.2.1, the following results have been obtained:

	Regional-Express line **RE6** (diesel traction)	Regional-Express line **RE7** (electric traction)
Before: trainsets which are currently in operation	<u>GTW2/6 single traction VBB (550 kW)</u> ▪ 108 seats ▪ Traction energy consumption at 25% seating capacity utilisation: 3.2 kWh/train km (0.97 l/train km) ▪ Mean value of energy consumption for comfort functions: 1.5 kWh/train km (0.47 l/train km) CO_2 emission: 3.8 kg/train-km	<u>Class 143 train set VBB (3540 kW)</u> ▪ 478 seats ▪ Traction energy consumption at 25% seating capacity utilisation: 11.9 kWh/train km ▪ Mean value of energy consumption for comfort functions: 0.8 kWh/train km ▪ CO_2 emission: 7.5 kg/train-km
After: trainsets which will be in operation from December 2012 according to the "Stadtbahn network" awarding done in 2009	<u>GTW2/6 single traction VBB (550 kW)</u> ▪ 108 seats ▪ Traction energy consumption at 25% seating capacity utilisation: 3.2 kWh/train km (0.97 l/train km) ▪ Mean value of energy consumption for comfort functions: 1.5 kWh/train km (0.47 l/train km) ▪ CO_2 emission: 3.8 kg/train-km	<u>Class 182 train set VBB (6400 kW)</u> ▪ 478 seats ▪ Traction energy consumption at 25 % seating capacity utilisation: 9.4 kWh/train km ▪ Mean value of energy consumption for comfort functions: 1.5 kWh/train km ▪ CO_2 emission: 6.45 kg/train-km <u>Class 442 VBB (3030 kW)</u> <u>5-part vehicle</u> ▪ 300 seats (273 standing (4 people/m²)) ▪ Traction energy consumption at 25% seating capacity utilisation: 4.6 kWh/train km ▪ Mean value of energy consumption for comfort functions: 1.4 kWh/train km ▪ CO_2 emission: 3.55 kg/train-km

Energy saving's potential

In case of the baseline RE7 the comparison of the currently operated class 143 train set with the future operated class 182 train set shows that energy savings for

- traction only of about 21 %
- traction and comfort functions of about 14 %

should be possible. These are minimum saving potentials in order to get realistic values for minimum savings to be reached with the next awarding. These values could be the basis for respective awarding text modules. Using the EMU class 442 VBB configuration (VBB) for future RE7 services, as planned from December 2012, the energy saving's potential will be much higher.

In case of baseline RE6 services not changes of energy consumption will be expected for the nearest future because of no changes in use of vehicles for the before and after cases are foreseen.

CO_2 emissions saving's potential

For the electric traction (RE7) the CO_2 emissions will be change proportional to the change of energy consumption as long as the energy mix will remain the same. That means also the CO_2 emissions saving's potential will remain the same than the energy saving's potential. With increasing share of energy from renewable sources also the CO_2 emissions saving's potential will increase. At the moment for each kWh energy which is generated for railways 592 g CO_2 will be produced [Source: EcoPassenger, Final report, 2008 (Table 5)].

So the usage of a class 143 train set produces 7.5 kg CO_2 per train km. The usage of a class 182 train set will lead to 6.45 kg CO_2 per train km. For the class 442 multiple unit it is 3.55 kg per train km.

For the diesel traction (RE6) the CO_2 emissions will be change proportional to the change of diesel consumption. The use of biodiesel will not have comparably effects than the change of energy mix with an increased share of electric energy from renewable sources. Additional CO_2 emissions saving's potential may occur with usage of xTL-fuels also known as second generation of bio-fuels. This is possible because these fuels do not have the same disadvantages regarding aggressiveness and viscosity towards the engine and fuel pipe systems as biodiesel. The usage of these fuels may lead to reduction of the CO_2 emission by about 60 %.

The CO_2 emission of the diesel traction can be calculated using the following assumptions: complete combustion, the molar weight of diesel fuel is estimated by using Tridecane $C_{13}H_{28}$, density of diesel is 0.85 kg per litre and a heat value of diesel of 11.8 kWh per kg. Taking these assumptions into account the outcome of the CO_2 emissions calculation is 2.64 kg CO_2 per litre diesel fuel.

A GTW2/6 multiple unit consumes up to 1.44 litre diesel per train kilometre. This leads to CO_2 emission of 3.8 kg per train kilometre.

These results have also been checked in terms of plausibility and confirmed by trend by the members of the SSG during the workshop process.

4.2.1.3 System wide energy efficiency and CO2 reduction by 2020 (15%)

Timisoara

The method used in the Timisoara test to estimate the system wide energy efficiency by 2020 is a linear forecast in uncertain conditions taking into consideration several factors. The main factors that influence energy consumption in the railway sector are the evolution of the volume of transport activity in Romania, the evolution of the railway transport market share and increase in transport capacity. All these indicators may lead to decreasing energy consumption levels compared to the potential energy reduction when energy efficiency-related measures are applied. For example the simple facts that railway increases its market share compared to the road transport market share will lead to a reduction in the overall energy consumption and CO2 emissions.
If however railway transport will increase its market share and simultaneously apply energy efficiency principles, the effects are much greater.

The selected factors are relevant for the system wide energy consumption and their level and evolution is taken from official Strategies and Plans of the Romanian Railways - "Program of restructuring and economic-financial stabilization of the Romanian railway for passenger transport „CFR Călători" – SA" (October 2010) making them reliable to use. The forecast has three levels of probability. A pessimistic level for energy efficiency which corresponds to the potential identified compared to current rolling stock (i.e. 15,85%), which signifies that even if nothing changes in terms of technological innovation and no rolling stock is acquired over the course on 2011-2020, the potential identified still remains. The Optimistic level corresponds to the ideal albeit unachievable conditions in which all factors evolve according to the official plans and strategies and the ECORailS criteria will be fully used in each planned awarding session. The probable level for the system wide energy efficiency by 2020 was calculated by taking into account that all influencing factors will exert their full influence by due to technological restraints not all planned procurements for rolling stock would be capable to be more energy efficient that the previous awarding. The probable level for the system wide energy efficiency by 2020 is 27,56%. Considering these three levels of probability the actual energy efficiency potential is most likely situated in the vicinity of the probable scenario value which is well above the project objective of 15%.

The forecasting method used in the Timisoara test site to estimate the system wide energy efficiency that can be achieved by 2020 is a reliable method based on factors taken from official sources. The end results of the tests are in these conditions plausible and correct from an analysis point of view. Furthermore, the results obtained in the Timisoara pilot are compliant with the targets set by the project's objectives.

Lombardy

The comprehensive set of measures and technologies presented by the Guidelines, together with the clear explanation of regulatory, infrastructural and prerequisite needed, strongly convinced the SWG that only a system-wide strategy can allow reaching the ambitious 15% reduction target supported by ECORailS.

For this reason most effort were devoted to the preparation and discussion of the above mentioned Memorandum of understanding, which selects in a clear way the measures to be implemented in Lombardy over a 10-15 years period. The starting point is the establishment of a monitoring

system, which will allow the estimations needed to decide challenging targets for the whole regional service and a time schedule.

A simulation was done during the ECORailS project to give a very broad feeling of the achievable results on the Region-wide scale if the measures listed in the Memorandum will be put in practice. They will include a fleet renewal plan – to have a complete replacement of the vehicles built before 1998 – and infrastructural improvements (substations), especially for re-use of braking energy in electric DC 3Kv traction. The Railenergy project Calculator was used for the simulation.

Berlin

For the Berlin test case the test version V04 of D22 has been evaluated by the SWG and the SSG during the workshop process with the stakeholders. Regarding a system wide achievement of 15 % wide for improving energy efficiency and reduction of CO_2 emissions by 2020 the estimations of the stakeholders are not homogenous.

Taking into consideration the calculation results mentioned in section 4.2.1.2, which are based on the of the Stadtbahn network awarding procedure with no quantitative requirements of EE/ENV criteria, it is probably to reach the system wide targets by 2020 when including EE/ENV criteria as described in the Guidelines into future awarding procedures.

4.2.1.4. Analyzing results that refer secondary effects.

The effects resulted from rail transport or in direct relation to it are highly complex and have a wide influence.

Direct effects refer to passenger- and freight transport proper to the destination place in order to meet social requirements. Indirect effects are manifest in a wider economic- social- and environmental milieu, with an impact on regional socio-economic development, life quality, biodiversity and environment quality.

Firstly, considering that transport is a public service, it will have a determining role on almost each and every component of life quality.

Among the most serious effects transport has on human health, are those related to the harmfulness of CO, NOx, CO_2, SO_2 emissions, volatile organic compounds, suspended particles etc., that is pollutants which may cause acute and chronical respiratory distresses and other diseases.

Noxious gases contribute both to an increase in the atmosphere acidity and to the formation of tropospheric ozone, with direct and / or indirect effects on all the environment components (vegetation, fauna, soil, water). The presence of heavy metals affects soil- and water quality, as well as the health of flora and fauna.

As to phonic pollution, the high noise- and vibration levels cause stress with a major impact on health condition. Traffic- induced noise affects individuals in most various ways, causing both lack of comfort and health conditions.

At paragraphs 4.2.1.1, 4.2.1.2 and 4.2.1.3, based on the tests performed in the 4 areas, there were analyzed and quantified the direct results which may be obtained by applying ECORailS concepts in terms of fuel- and emissions reductions, respectively. The results obtained and evaluated in various conditions through various methodologies proved that ECORailS objectives could be reached both under the actual conditions and in prospect.

Moreover, by reducing fuel and noxious factors as well as by applying the technologies and operational measures indicated, related effects – with an important social and economic impact – will be entailed. Among these, let us mention:

a) A considerable saving in energy consumption and reduction in noxious factors (emissions, noise) affecting people, biodiversity and the environment quality

Reduced energy consumption has positive monetary effects for both the Administrations and the TOCs. For example, in Lombardy approximately 50% of the TOC's operating costs are subsidised by the Regional Government and in 2008 for the regional TOC the cost of electricity was 8% of the total cost or, speaking of the subsidy, 17% of the money paid every year by the Region. When the 15% energy saving target supported by ECORailS is reached, the monetary benefit will be like a 2,5% reduction of the subsidy paid by the Administration. Such a saved budget can be devoted to improve the quality and attractiveness of the regional rail service, with a social benefit in terms of lower use of private cars and other more pollutant means of transport. On the other hand, to save energy is a good way to cope with its increasing prices. For example, from 2003 to 2008 the energy cost for each kilometer of regional train produced in Lombardy had on average a raise of 6% per year.

As to emissions reduction:

- Pollutants emitted on site by the diesel rolling stock, like in the diesel lines involved in the Lombardy, Berlin and Timisoara pilot applications: this implies less health hazard due to harmful chemical substances for the people living close to the railway.
- Pollutants emitted where the electricity is produced, according to the regional energy mix of sources: for example, 83% of the electricity provided by the regional rail infrastructure in Lombardy is in fact produced by using fossil fuels, while, on the contrary, in Denmark the Infrastructure Manager states to use only electricity coming from renewable sources.
- CO2 corresponding to the whole amount of energy saved.

Where the pilot applications envisage also the renewal of the fleet and actions to reduce the noise emissions by the rolling stock (brakes), noise reduction has again secondary benefits for the people living close to the railways and monetary benefits for the Regional Government and for the Infrastructure Manager who can save the money usually spent to build barriers.

By reducing polluting emissions by 10%, external related costs are also reduced by 0.96 Euro/1000 pkm, while by reducing noise level by 5-10%, external related costs are reduced by 0.2 Euro/1000 pkm down to 0.38 EURO/1000 pkm.[1]

Air- and soil pollution (direct discharges and from the emissions in the air – oil products, engine fuels, chemical substances), the emissions with sulphur content (with effect on soil,

[1] INFRAS / IWW study on the environmental impact of transport

waters, ecosystems and building erosion), deforestations, the impact on the natural and cultural heritage, Greenhouse Gas (GHG) etc. are largely (almost in totality, actually) engendered by car transport. For these reasons, any reduction in car transport, following rail transport development and enhancement (see the proposals for technologies / operational measures and ECORailS effects) implicitly brings about a reduction in these indirect effects.

b) Higher quality comfort

It is reached by improving travel conditions (lower noise level, fewer vibrations, lighting quality, heating / ventilation / air-conditioning quality, regular service / punctuality), adequate conditions for people with low mobility, the possibility of carrying out various activities during the travel (access to telephone, internet, computer etc.), transport as close as possible to the destination place (railway stations are located in central areas of heavy traffic and best interconnected with various other means of mass transit – underground trains, tramways, trolleybuses, bike hiring etc.).

c) Traffic safety

The number of surface transport serious accidents (dead and injured people) is practically caused exclusively by car traffic. In Romania only, there were registered between approximately 9000 and 7000 accidents per year (resulting in between 2.845 and 2.478 casualties /years) [2] were registered every year, during the last 20 years.

The European Rail Traffic Management Systems (ERTMS) foreseen through the European and national directives and strategies, including the modality in which these requirements are stipulated in ECORailS documents regarding the rail vehicles and services to be purchased, further lead to rail transport safety and regular service. Car transport specific does not allow for a spectacular safety enhancement, while the ever growing number of vehicles and the dependence on the human factor, on the atmosphere- and traffic conditions still expose to the hazard of accidents, bottlenecks, delays in traffic etc.

d) The application of technologies and performant software shall be reflected in considerable extra benefits: smoother driving, cuts in the maintenance expenses, fleet management optimization, regularity, more comfort.

The use of the “GreenSpeed” product (site Oresund) to save traction energy is associated with the following added benefits according to DSB and the developer Cubris:

- Reduced Maintenance:

By reducing the number of accelerations and brakings as well as keeping the maximum speed as low as possible maintenance costs can be kept to a minimum. GreenSpeed will never recommend a speed higher than necessary and will always calculate the most efficient braking profile while considering variations in the topography.

- Punctuality

GreenSpeed’s first priority is to keep within the timetable. If the train is delayed GreenSpeed will guide the driver to run on schedule, of course by energy efficient means. The train will always arrive on time, when possible, with minimal energy consumption.

- Safety

[2] Sustainable transport strategy for 2007-2013 and 2020,2030, Romanian Government, Ministry of Transport

GreenSpeed handles all information required to do the advanced mathematical calculations necessary to arrive on time, such as position, timetable and speed limitations. This means that the driver can be more focused on safety related aspects.

- Working Environment

Released from doing complicated calculations the driver's workload is reduced and there is no need to be concerned about getting to the station in time. GreenSpeed will always give the best recommendations to run on schedule and adapt to the current situation regardless of outside influences.

- More Satisfied Customers

GreenSpeed's recommendations will have a noticeable effect on the customers' experience. Not only will the customers see an immediate improvement in punctuality but they will also have a more comfortable trip as they are not exposed to unnecessary vibrations and jerks because of the smooth speed profile.

e) Enhanced attractiveness of rail transport

Both following the above (paragraphs "a" - "d") and the implementation of certain technological and operational measures (e.g. train configuration according to necessities etc.), it is possible that commercial speed may rise, trains may be scheduled according to the local demand (according to hours / days / traffic), travel costs may be reduced, a better regularity and punctuality may be achieved, passengers' safety and comfort may be enhanced etc.

For instance, the tests in Timisoarea test site proved that it is only by selecting rolling stock by taking into account ECORailS criteria – DMUs with optimized configuration (fewer cars, more efficient loading, lower axle load, flexibility at configuration, better adherence, higher fiability etc.) that considerable fuel savings can be reached (approx. 30%) and proportionally lower noxious factors. On the other hand, as diesel traction engine is the main fuel consumer, optimum choice is of tremendous importance. The option for a latest generation engine contributes to an approx. 10% reduction of fuel consumption and to a proportional reduction in polluting emissions.

f) Social impact – is also determined by various related effects: an increase in the population mobility, a better social cohesion, a higher degree of people's accessibility to public transport, people's better qualification and employment (e.g. equipping with IT systems – vehicle driving, operation and LCC follow up call for another structure and qualification of the personnel. Social impact is also determined through the related services developed alongside rail transport: services related to the means of transport fabrication / operation / maintenance and infrastructure, commercial services, advertising etc.).

g) Efficient resource utilization

It is the most important and handy means of reducing costs. ECORailS project explains and tries to impose these measures by basically changing the modality related to the procurement of railway means of transport and services, so that the documentation requirements and the evaluation criteria should lay more sress on costs, consumptions and emissions throughout the service life, as compared to the current minimum price criterion – a currently prevailing or even exclusive criterion (e.g. with tenders in Romania).

For instance, in the case of Timisoara test site, the analysis of costs allocation per train shows the big share of: energy / fuel, maintenance, mechanic, train personnel, shunting, within the

total cost of expenses. Costs monitoring and optimization – as per ECORailS recommendations – leads to an average LCC cut off by approx. 21%, with a possible further rise in the percentage in some cases.

ECORailS documentation explains all that, as well as the modality in which LCC monitoring and optimization should be organized, alongside other measures relatively easy to apply (optimized driving, parked train expenses, energy savings utilization etc.).

The application and imposing of these concepts brings about an emulation of rolling stock suppliers and rail transport services, to no longer focus on getting the minimum acquisition price, but on developing innovative technologies and operational measures with impact on costs-, consumptions- and emissions reduction throughout the service life. This issue was stressed by all the representatives of the rolling stock- or rail services suppliers who participated in the Brescia Workshop of 09 – 11 December 2009, and particularly in the final Berlin Workshop of 23 May 2011.

h) The transfer of a high number of passengers (whom used to travel by automobiles, buses, planes) towards rail transportation.

Through this transfer – expected as a result of the advantages and direct and indirect effects enumerated, as well as a result of the European and national strategies that support the rail and multimodal transportation, inclusively as a follow-up of the improvements foreseen through ECORailS – implicitly, the savings that result from the higher level of consumption and emissions from the road and air transportation add up (the exhaust emissions of rail transportation per passenger*km are 70 times lower that those generated by planes, and 50 times lower than those generated by cars[3]), the number of victims from accidents is much higher in road transportation than in rail transportation, the traveling time shorter than for road transportation (and even compared to air transportation – taking into consideration the embarking time and the travel time to the airport), as well as the efficient utilization of the travel time by the passengers, the reduction of the necessary parking places, etc.

All these elements highly influence the indicators reflecting the factors of life quality: health state, family and community's life, mobility, safety and security, the quality of the environment, etc.

The above related effects are hard to quantify with precision, but they are obvious and have been highlighted by those who have run the tests in all the four areas, but also by users within the workshops organized (in Brescia, Berlin, Bucharest, Copenhagen), and respectively through presentations and discussions taken place at the final workshop from Berlin, from the 23rd of May 2011, with the participation of many users from different European countries (PTAs, IMs, transport operators, manufacturers, stakeholders) .

4.2.2 Means of evaluation of the qualitative performance indicators

Øresund

The result from the workshop in the Øresund test shows that the test version of the Guidelines is not entirely manageable. A large part of the information in the Guideline was considered not relevant for the objective of the project and the structure of the Guideline was not considered as user friendly.

[3] Philippe Mellier, President AlstomTransport – RailwayPro Magazine - 25.05.2011

Evaluation criteria should not be in the contract according to the testing group. Environmental criteria should be used when it is relevant and it must be possible to evaluate these requirements. The testing group requested a writing of pre-qualification and points out that this could be of use when it comes to evaluation of the activities.

The following areas are suggested to be included in the Guidelines:
The testing group accentuates the following requirements:

- Requirements that have environmental effect – "environmental drivers" –that gives economical revenue.
- Focus on the most economical environmental requirements
- Functional requirements instead of technical requirements. Technical requirements could be outdated within a short period of time.

Also the Øresund test results indicate that the Guidelines should give support and help to set requirements in the procurement process. It is important however that said requirements would not lead to potential clashes of interest.
One of the aspects derived from the Øresund conclusions is that the testing group requested information about how to evaluate the requirements that are placed. Environmental requirements should be distinctively highlighted and enough information should be provided in order to make them easier to evaluate. The site working group pointed out the fact that some charts lacked proper explanations which made them difficult to read and interpret. The SWG members believed that it would be helpful to have future examples of how to actually perform some calculations in terms of scoring. A blend of goals and requirements should ensure in the future that only the best offers are selected as winners not the least bad.

Timisoara

In terms of manageability of the Guidelines, the results of the Timisoara test site are consistent with the observations made in Chapter 3 of this evaluation report.

After performing a test of the Guidelines under the Pilot Application from Timisoara Site, it has been indicated by the SWG and SSG that the Guide's concept is very useful and that it holds a lot of strong points, but the general feeling is that the test version is not sufficiently manageable enough. Therefore, the stakeholders requested the drafting of a much more concise form that explains as clearly as possible the modality of introducing and evaluating the ECORailS criteria into the awarding documentations.

Flexibility and adaptability to the needs and particularities of Timisoara test region

Within the Timisoara test site it was found that the Guidelines contained general indications in terms of which performance indicator would best be suited in the case of vehicle awarding - as the Guidelines showed in chapter 5.2.2, "kWh per seat km" was selected. However the test conclusions indicate that the Guide could be more practical by giving more concrete examples of how the ECORailS indicators (direct, indirect, specific) could be requested for in the awarding documentation, graded and prioritized during the evaluation phase, and monitored during the contract period/service life.

A very important chapter in what concerns the test from Timisoara is the one dedicated to the Life Cycle Costs. The present form of this chapter does not provide the necessary basis for an LCC driven procurement of railway vehicles. The conclusions from the Timisoara site indicate that the Guidelines should focus on teaching the PTAs/TOCs on how to request the costs on the entire

lifecycle so that the offers could be easily compared and evaluated, and not how to calculate the LCC which is the task of the manufacturers/tenderers.

Efficiency of the guidelines for developing the awarding procedure in test site Timisoara

In regards to the simulation of the awarding procedure, the Timisoara pilot was made in its majority based on the specialized literature, related projects, manufacturers' brochures and advertising materials, and own experience, and in a lesser degree on the Guidelines, which do not fully explain in a practical manner all matters related to the inclusion of energy efficiency and environmental criteria in the different steps of the awarding process.

The Timisoara test site sees a lack of manageability and proposes to shorten the information and to structure the Guidelines in a better way.

Acceptability and participation by the Timisoara Site Stakeholders Group
The Site Working Group from Timisoara has appreciated very highly the action to simulate an awarding procedure based on real data from the Timisoara region. The fact that all necessary data was received shows the commitment and the interest the main stakeholders.

The members of the Site Stakeholders Group generally view the ECORailS initiative as very useful for Romania and made this point very clear in all User Platform Meetings and the Workshop and Dialogue Event in Bucharest. However, they believe that in the present form, the Guidelines isn't manageable enough, and efforts should be made towards its shortening and streamlining of information

Lombardy

The evaluation of manageability of the ECORailS Guidelines was another key output of the Pilot Application Lombardy. Guidelines should be able to meet several needs indeed: flexibility and adaptability to the users' needs and particularities, efficiency for developing the awarding procedures, acceptability by the stakeholders, EU wide applicability.

To check this, the draft version of the Guidelines released on 15th November 2010 (D22, version 2) was read and used by the SWG to develop the EE/ENV improvements of the present public service contract. Part I gave an useful picture about what to do by a PTA to improve the energy efficiency and the environmental performance of the regional rail service (the strategic and political decisions), while Part II and the Annexes provided the relevant advices to write the new legal clauses. Such new legal clauses were written by the SWG, according to the local needs and legal standards.

The SWG made a practical use of the Guidelines: its feedbacks are therefore mainly the result of internal discussions and have been reported in the Lombardy Intermediate Site Report and in Deliverable 14 Pilot Applications. A key feed-back from the SWG was about the Guidelines' adaptability to the users' needs and particularities: the Lombardy SWG believes that it is not avoidable for a Guidelines' user – both PTA and TOC – to develop by himself the awarding and contractual texts, which are so much influenced by the local conditions and regulatory context. The Guidelines should therefore be streamlined in a way focused mainly on key general advices and, about the technological issues, on clear criteria, helpful to support a better choice. Only this approach can successfully deal with the present different starting point in European countries about the monitoring of energy consumption and the use of environmental criteria.

For a broader collection of evaluations about the ECORailS Guidelines by their potential future users, the most relevant Italian stakeholders were involved in the Pilot Application as external observers of the process. Most of them took part to the meeting hold in Brescia on 17th December 2010, where they analyzed in details the Guidelines contents and structure.

Berlin

The evaluation of manageability of the ECORailS Guidelines was another key output of the Pilot Application Berlin-Brandenburg. Guidelines should be able to meet several needs indeed: flexibility and adaptability to the users' needs and particularities, efficiency for developing the awarding procedures, acceptability by the stakeholders, EU wide applicability.

In general a positive response was given by the stakeholders, based on the evaluation of test version V04 of D22. The most positive results was reached by the argument, that it is necessary to have an EU wide applicable set of Guidelines for the awarding of passenger rail vehicles and services at regional level.

Beside practical advices given to PTAs especially in Part II of the Guidelines, It has been clearly stated that it is essential to address not only the administrative but also the political level for improving the framework conditions for including of EE/ENV criteria into awarding procedures. Therefore Part I of the Guidelines will give good advice.

Regarding manageability it was a consensus of the SSG, that the Guidelines (test version V04 of D22) is still too long. Useful hints for a better Guideline's structures have been given by the SSG.

4.3 Results and observations

It is clear that the level of the quantitative performance indicators obtained in each test site is plausible. Each test site has a different approach when determining the quantitative performance indicator, each suited to the regional specifics. The methods used in each test site are correct from a methodological point of view and cover, real line tests, calculations, estimations, simulations, forecasts, use of decision support tools provided by another EU project. By employing these various methods all test sites showed that the project's quantitative objectives can be achieved. However, all conclusions point out that the test version of the Guidelines did not fully cover the testing needs. The structure of the Guidelines should be simplified. The arguments to save energy could be much more convincing and the means to save energy could be much more visible and usable.

The Guidelines are useful because they clearly show which key choices, technological and regulatory criteria should be taken into account by a PTA willing to implement a energy saving and more ambitious environmental strategy. All Italian stakeholders expressed this positive confidence in the Guidelines. The conclusions from the German test site go in the same direction and highlight the relevance of the "strategic" chapters.

The results from Øresund test workshop give the overall impression that the framing is too general. More substantial and structured information/issues should be included. The testing group from Øresund also found a large part of the information in the Guidelines not relevant to the objective of

the project. The group believes the structure of the Guidelines is not user friendly and not entirely manageable

However, the Guidelines fall short to explain in a practical manner all matters related to the inclusion of energy efficiency and environmental criteria in the different steps of the awarding process. The information provided still needs to be more structured, shortened and to the point. The necessary information is included in the Guidelines but due to its structure it is not easy to use.

Some of the proposals made in the Guidelines are adequate. The testing group accentuates however the following requirements: Requirements that have environmental effect – "environmental drivers" – that gives economical revenue, Focus on the most economical environmental requirements, Functional requirements instead of technical requirements.

The Guidelines could be more practical by giving more concrete examples of how the ECORailS indicators (direct, indirect, specific) could be requested for in the awarding documentation, graded and prioritized during the evaluation phase, and monitored during the contract period/service life. As of this point the information presented in the Guidelines is somewhat adequate to elaborate an awarding text.

The contents of chapters 4 and 5 and of the annexes give all minimum advices for the elaboration of concrete awarding texts. The Lombardy SWG believes that no big changes in the usual way the PTAs evaluate tenders or write public service contracts are implied by the ECORailS approach explained by the Guidelines. The practical job tested in the Pilot Application is to add criteria and public service obligations to the usual awarding texts. When doing this, technical expertise in most cases must be added to the existing knowledge of the PTA. A key aspect of such technical expertise is the estimation of the LCC for the relevant technologies. The Guidelines of course can not provide all this by themselves, but a clear guide about the relevant sources of technical knowledge – including the European standardisation process – could be an improvement to be added in the final version.

Overall, the stakeholders involved in the pilot application have appreciated the quality of some chapters, but efforts towards making the Guidelines more targeted and manageable are still in order. At this stage the Guidelines are not sufficiently manageable to allow their successful use.

The potential is there and will be achieved once feedback from the four test sites will be integrated.

The draft version of the Guidelines needs of course improvements to become shorter and easier to be read and used in real life. A clearer and more user-oriented structure could be useful to make it easier for the users to find relevant information for their specific needs, which can be grouped as: awarding of services (by competitive tendering or direct awarding), awarding of rolling stock (included or not in the awarding of services), measurement and monitoring of energy consumption, CO_2 and noise.

The information presented in the Guidelines is acceptable and adequate according to the Romanian stakeholders due to the fact that within the Bucharest Test results workshop the users appreciated as important the issues concerning energy consumption and were convinced that the results achieved in the tests can be replicated also in real life operation. They however recommended that further emphasis should be put on the scoring schemes and offer evaluation procedures.

All information presented in the Guidelines has been evaluated acceptable and adequate both by the SWG and the SSG of he Lombardy test site. Most of them were highly convinced of the Guidelines impact and usefulness and all participating PTA, TOC and manufacturers are open to their use in next awarding procedures.

The Guidelines' contents are surely transferable to other regions, especially if they will be streamlined as explained above in paragraph 4.2.1.4. The Pilot Applications, as explained by Deliverable 14, did not show relevant technical differences in the test sites, but, on the other hand, they underlined that the cultural and regulatory starting points differ significantly in the project partners' countries. ECORailS covers all these situations and the Guidelines rightly should support both countries without a widespread environmental culture and countries willing to enhance their environmental performance. The Italian stakeholders were unanimous in asking a support from the European Union – as recent regulations are doing for the bus sector – especially to have mandatory basic conditions in every country, like energy meters installed on all vehicles.

Since all specifications regarding energy efficiency, CO2 emissions, noise and other related effects were taken from the European or international legislation, norms and recommendations there is a high plausibility that the guidelines could be used in other EU regions with similar effects.

5. Recommendations

One of the key recommendations regarding the improvement of the Guidelines would be to shorten the content of the Guidelines focusing only on the key novelty points that the project brings.

The introduction (chapter 1) should be more focused on the element of novelty that the project brings, its necessity and benefits, and less focused on the organization of public transportation

services and other unnecessary information, unrelated to the object of the project. The second chapter should be reduced and streamlined towards explaining why the Guide's application in future awarding procedures is necessary and why it is in the users/stakeholders' best interest. The chapter dedicated to the legal framework is too detailed; at least chapter 3.1 should only enumerate briefly the legislation promoting economy, energy efficiency and environmental aspects.

The second part dedicated to the practical and working level contains useful information but must avoid the references to the normal awarding procedure, as the people interested in these chapters already have the necessary knowledge to prepare a "classic" awarding documentation. In this sense, chapter 4 should be heavily shortened and cleaned of all the tables because they are subjective and do not bring any effective support for the elaboration of the awarding documentation. Chapter 5 being the technical one should focus on clearly defining the modality of integrating, evaluating and monitoring the ECORailS criteria. It should provide advices and instructions with regard to the use of the new criteria, together with concrete examples and best practices. On the same note, , the Guidelines could also be more practical by giving more concrete examples of how the ECORailS indicators (direct, indirect, specific) could be requested for in the awarding documentation, graded and prioritized during the evaluation phase, and monitored during the contract period/service life.

One noteworthy aspect is that the test versions of the Guidelines do not lack in terms of content but rather structure.

The chapter dedicated to the Life Cycle Costs should focus on teaching the PTAs/TOCs on how to request the costs on the entire lifecycle so that the offers could be easily compared and evaluated, and not how to calculate the LCC which is the task of the manufacturers/tenderers.

The Guidelines should indicate that the tendering document should contain the requirement needed for the operator to describe, which steps he would take to ensure energy efficient use of the rolling stock (in and out of service). This description should be used by the PTA to evaluate the offers, thus be included in the overall evaluation scheme.

According to some test results, the Guidelines do not support the concrete at the moment the elaboration of text modules, regarding the reporting and monitoring of the KPI(s).

The following areas are suggested to be included in the Guideline:

- Requirements that have environmental effect – "environmental drivers" – that gives economical revenue.
- Focus on the most economical environmental requirements
- Functional requirements instead of technical requirements. Technical requirements could be outdated within a short period of time.

6. Conclusions

The tests were done according to the test methodology and management plan as described in the appropriate deliverables D 12 - Pilot applications management plan and D 13 - Report on the preparation of the pilot applications including test methodology. It is noteworthy to mention the constant involvement during the tests of PTAs and other stakeholders which ensured the good quality of the works.

The objectives of the tests in the four regions were achieved and each site managed to perform testing of the Guidelines according to the regional needs and particularities.

Varied methods which took into consideration regional specificity were used in each test site in order to obtain the quantitative performance indicators. The methods used are reliable and range from calculations/ estimations/ simulations to real track tests and usage of tools developed in other EU projects. The methods used in each test to obtain the quantitative performance indicators are reliable, the input data was taken from reliable sources and the results are plausible. The scenarios elaborated for the system wide energy efficiency by 2020 are constructed on feasible inputs which make the estimations and forecasts to be relatively accurate.

Overall, the test version of the Guidelines is decent in terms of content. The tests have found however some points which should additionally be included in order to cover all relevant aspects in terms of inclusion of energy efficiency and environmental criteria in the awarding of rail vehicles and services.

The main critical issues identified in the test versions concern the manageability. The Guidelines must be improved in this aspect in order to be fully useable in real life procurements. This implies lots of text shortening and keeping information clear to the point without any additional information. There is a lot potential for improvement and if the recommendations made in this deliverable and in the test reports are taken into consideration that the final version of the Guidelines will have a high quality booth in terms of structure and content and be fully manageable and usable.

While the test version of the Guidelines met the needs of the Italian and the German test sites, the Danish and the Romanian test sites do not consider the test version as appropriate. The Romanian test pointed out the need for additional information about technologies and LCC methodology and the Danish test requires focus on functional criteria. Furthermore, the tests showed that concrete text modules need to be elaborated according to merely individual situations. That means that the Guidelines with an estimated no. of 40-45 pages must be very well structured to cover the needs of all European PTAs. However, they can clearly give advices how to integrate EE/ENV criteria in different situations. The Guidelines can in general focus on showing clearly at which steps of an award procedure EE/ENV criteria can be incorporated. The 5th chapter should focus on clearly structured advices how to apply the proposed criteria but avoid too detailed descriptions. Instead, additional technical information must be made available by references to the technical Annex of the Guidelines, to relevant ECORailS Deliverables and Working Papers as well as to other relevant documents. During the tests, a variety of text modules, covering a lot of different situations and criteria, have been developed to further aid PTAs.

Bibliography

1. D 8 - Technological overview with regard to energy efficiency and environmental performance, ready to be integrated into the final Guidelines version
2. D 11 - Legal input for the final Guidelines version
3. D 12 - Pilot applications management plan
4. D 13 - Report on the preparation of the pilot applications including test methodology
5. D 14 - Report on pilot applications and test reports from the four regions

6. D 15 - Validation Strategy including Validation Exercise Plan
7. D 19 - 1st draft version of Guidelines
8. D 20 - 2nd draft version of Guidelines ready for pilot applications
9. Individual test reports and Intermediate site reports
10. www.railenergy.eu/calculator/calculator.aspx

Appendix:

1. Verification Form Øresund
2. Verification Form Timisoara
3. Verification Form Lombardy
4. Verification Form Berlin
5. Timisoara test site fuel saving results
6. Valcamonica Eco-driving test
7. S3 baseline and eco-driving test
8. Valcamonica baseline and comparison among rolling stock classes
9. Calculations Øresund test site
10. W4_BD List of annexes Timisoara site.