Title:

Workshop 3 Documentation

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1 Introduction

1.1 The third workshop

The third eLCAr Stakeholder Workshop took place on December 6th, 2012 in Wolfsburg Germany. During the course of the project two previous Stakeholder Workshops have been held:

- 12th June, 2012 in Zurich, Switzerland
- 9th October, 2012 in Aachen, Germany

The first Stakeholder Workshop was used to analyse Stakeholder needs and expectations towards the guidelines. During the second Stakeholder Workshop, major parts of the guidelines, the chapters about goal and scope definition and LCI, were presented and the contents being discussed with the stakeholders.

From both workshops, valuable feedback could be drawn, which considerably affected the course of the project. The third workshop was named “Guidelines and Training Materials”. An almost complete draft version of the guidelines was available before the workshop. This draft version was also handed out to the stakeholders during the workshop. The only chapter that was not part of the draft version was chapter 3, which will be a short introduction to LCA in general. Guideline sections that had not been disclosed before were presented and their content discussed. For the sections that had been presented during the second Stakeholder Workshop, the changes made, the majority of them due to stakeholder feedback, were presented.

In addition, the use of the guidelines as a whole was presented, as well as the developed Training Materials and testing of the guidelines.

This document describes the realization of the stakeholder workshop (chapter 2) and the presentations held or rather the subsequent discussions (chapters 3, 4, 5 and 6). In the end, these will be summed up and the conclusions drawn from it, which will influence the finalization of the guidelines and the remaining time until the end of the project, are presented in chapter 7.

1.2 Workshop Agenda

A detailed overview of the workshop agenda is given below.

Table 1: Workshop Agenda

Time	Agenda/ Topic
09:00	Registration & Coffee
09:15	
09:30	Welcome and Introduction to the workshops aims
09:45	Presentation of the final structure and the new general chapters (LCIA, review needs etc.)
10:00	
10:15	Introduction of the section about electricity production mix (appertaining to LCI)
10:30	
10:45	*Coffee Break*
11:00	Goal and Scope definition: Overview and changes since Workshop 2
11:15	
11:30	
11:45	LCI: Overview and changes since Workshop 2
12:00	
12:15	
12:30	*Lunch*
12:45	
13:00	
13:15	
13:30	How to use the Document
13:45	
14:00	
14:15	*Coffee Break*
14:30	Results from testing the guidelines
15:00	Introduction of the different Learning materials types
15:15	
15:30	*Coffee Break*
15:45	Feedback session
16:00	
16:15	
16:30	
16:45	Wrap up & Goodbye
17:00	End

2 Workshop Setup

The workshop was structured into three sessions and an additional dedicated feedback session.
The first session started with a short welcome presentation, including the presentation of the project and workshop aims. Directly afterwards, the content-related part of the workshop started with the presentation of the structure of the whole guidelines document. An overview over the new general chapters was given and the section about electricity mix, which appertains the chapter on LCI, but had been excluded from the second workshop, was shown in greater detail.

The second session was dedicated to the chapters, which had been presented during the second workshop. They have undergone revision and have been partly reworked with strong regard to the stakeholder feedback and the conclusions, which the project consortium has drawn from the second stakeholder workshop.
Goal definition and Scope definition were presented in a presentation, the chapter on LCI was divided further in order to cover each life cycle phase (namely production, use and end-of life) thoroughly.

After the lunch break, the focus turned to more overarching aspects. The third session started with the topic “how to use the guidelines” to give the stakeholders insights in how the guidelines as a whole can be used and how the interdependency matrix and the common parameter platform can support their analyses.
Also the method of how the guidelines shall be tested and first results of the on-going testing were shown.
The session was closed with an overview over the methodological concept behind the training materials which are developed along with the project. Examples of the different training material types were shown to give the stakeholders a detailed idea what they can expect after the end of the project.

To enable an open discussion, a question round was introduced after every presentation. When extensive topics or too many questions came up to cover the discussion during the session, the open points were documented visibly for all in order to take these topics up again during the dedicated feedback session.

The dedicated feedback session was scheduled as the last session of the workshop in order to enable the discussion of all documented open topics as well as further questions on the guidelines as well as the overall course of the project. This feedback session as well as other feedback opportunities given throughout the day was characterised by lively discussions between stakeholders and consortium members as well as between stakeholders among each other. Valuable hints and remarks were given, which will be used to further strengthen the guidelines during their finalization.

All presentation slides can be downloaded from
http://www.elcar-project.eu/downloads/workshop-3/presentations/

3 Course of Discussion: Guidelines

3.1 Final structure and new general Chapters

In this session, an overview of the development of the guidelines throughout the project was given and the new parts of the guidelines, which were not available in the version presented at workshop 2, were presented.

Firstly, the main steps which led to the current version of the guidelines were summarized. Here, the scope of the guidelines and the relationship to the European Green Car Initiative were described and the main issues addressed in the first eLCAr workshop (WS1) and how these were key for setting the foundations of the guidelines were discussed. Based on the feedback from WS1, a first version of the guidelines was developed which covered the chapters on Goal Definition, Scope Definition and Life Cycle Inventory Analysis. The first version focused on these three chapters since these cover the key methodological choices in the realization of an LCA. The document was presented at WS2 and feedback from the stakeholders was collected. Based on this feedback, the new version of the guidelines was developed, which was then presented at WS3. This version also included a number of new chapters which had not been part of the guidelines before.

In the second part of the presentation the new chapters were presented. The first new chapter is “Technological context”. Here, the technological scope of the guidelines was described and what is meant by “electric vehicle” was explained. Also, the interdependency matrix was presented. This tool can be used by practitioners working on a specific component to understand whether they have to include other components or even the entire vehicle in their LCA due to the possible influence which various devices in the vehicle can have on each other. Then the main parts of the common parameter platform (CPP) were shown. After identifying what components of the vehicle need to be included in the analysis through the interdependency matrix, the CPP can be used as guidance for the quantitative definition of the system. In the CPP general vehicle parameters like life expectancies of vehicles, vehicle classes and the typical performance of some key components, are discussed.

Finally, the general ILCD chapters, which had not yet been covered, were described. These are the chapters on Life Cycle Impact Assessment, Interpretation, Reporting and Critical Review. These are generic in nature but very specific in what needs to be done to stay within the ILCD framework. As such, little room for adaptation to the electric mobility topic is available. Therefore, short summaries of the main issues described in the general ILCD and the corresponding provisions were given while other parts were referenced in order to avoid repeating the information which is already available in the general ILCD.

3.2 Overview and changes since WS 2: Goal definition

The discussion after the presentation, that gave an overview over the chapter “Goal definition” and the changes made since the second stakeholder workshop was rather brief. It focused on the decision context and the distinction between foreground and background system.

3.3 Overview and changes since WS 2: Scope definition

During the workshop the main aspects of the scope chapter were presented: functional unit (presented along with goal definition), LCI modeling framework, system boundaries, preparing the impact assessment, data representativeness, comparisons, review needs and reporting. The suggestions from the 2nd workshop on the life time and system boundaries of batteries were incorporated in the chapter "Technological context". A question was asked regarding the requirement of specific data for the foreground system in Situation B. It was of interest if the use of learning curves is suggested in the guidelines and if in general suggestions are given on how to obtain data for future technologies. The consortium replied that recommendations are given on data collection of future technologies but there is no recommendation on specific methodologies. It was suggested to include further information on the data collection in Situation B.

3.4 Overview and changes since WS 2: LCI

3.4.1 Production and EOL

Initially, the main steps in the development of an LCI were recapitulated. For the production phase some key issues were presented: the identifying of processes within the system boundaries, the collection of primary and secondary data, the main components in the vehicle and the related recommendations for modelling. Due to the feedback during the last workshop (WS2) a few changes in the corresponding chapters of the guideline were conducted. These changes concerned the battery production, the foreground and background system and some provisions. Comments on the battery life time and definition are now addressed in chapter 4 (Technological context) of the guideline. For identifying the main processes in the foreground and background system, three possible situations, depending on the focus of the analysis and possibly existing part-system interactions, are stated in chapter 7 of the guideline. In chapter 7.1.1.4 to 7.1.1.10 some advices on topics which strongly depend on technical aspects were shifted from „Provisions" to „LCI recommendations", as they may be outdated in a few years.
After a short overview of some key issues in the end-of-life phase the corresponding changes in the guideline were presented: Minor changes in the provision 7.1.3.4 (battery), minor changes in the graph (now Figure 14) for the illustration of the shredder and separating processes and changes in the graph (now Figure 17) for solving multifunctionality on the example of metal recycling. In this example the recyclability substitution approach according to the ILCD is used and separate recycling processes for the production scrap and the end-of-life scrap are considered now. Thus, the appropriate credits for the corresponding net amounts of new and old scrap can be distinguished. Additionally, this concept allows addressing e.g. recycling technology changes or the distinct accounting of today's and future emissions.

3.4.2 Use phase

In this session the main aspects of the consumption calculation framework were presented and its main changes compared to the previous version were described.

The calculation framework subdivides the consumption contributions in 4 parts:

- Basic drive consumption
- Consumption due to heating and air conditioning

- Consumption due to auxiliaries
- Consumption due to battery and charger losses

Firstly, the key influences in basic drive consumption were addressed, including vehicle characteristics and driving cycles. Also, how to use the Willans approximation for deriving the electric energy taken from the battery, starting from the mechanical energy at the wheels, was described. The discussion covered the contribution coming for basic motion as well as recuperation.

Then, the contributions due to heating and air conditioning were addressed. It was shown how to model, based on weather statistics, when to consider the comfort devices to be needed. Moreover, the impact of defogging and pre-heating was also discussed. These were two issues which had been suggested from stakeholders at WS2 to be included.

Finally, an update on the part on auxiliaries based on new literature was given and the key elements in the contributions from the charging and battery losses were discussed.

At the end of the presentation it was commented from one of the attendants that the precise definition of the mean cycle speed used in the evaluation of the recuperation contribution needed to be added in the guidelines in order to avoid misinterpretation. Also, during the feedback session it was commented that vehicle mass has a strong influence on recuperation and that, for a given driving cycle and vehicle, the recuperation contribution can be computed exactly. It was replied that two possibilities are presented in the guidelines concerning these points. A precise computation of the recuperation contribution can be made if the drivetrain characteristics are known and the main steps for doing this are described in the document. The second approach does not get into the details of the drivetrain and for this one it may be possible to take also into consideration the influence of the mass.

3.4.3 Electricity production Mix

The electricity mix and network aspects have not been presented in the previous versions of the guidelines and have been newly introduced in the latest version of the guideline and within a special session in workshop 3.

Regarding the section about electricity production mix, the following aspects were presented and discussed during the workshop:

- Electricity mix used for the EV charging and its influence on the results of the use phase
- Average or generic electricity mix data for Situation A
    - National, time specific electricity mixes have to be used.
    - EU-27 electricity mix data has to be included into the analysis
- Mix of marginal technologies for Situation B
    - From a time-related perspective, the average data for electricity mix cannot be used for a study
    - Electricity generation mix data that are based on future scenario data and best available technologies should be used

- Electricity generation in the foreground system of the LCA
  - The electricity mix has to be included as primary data based on a detailed model of the electricity generation
  - This approach has to be chosen also for LCAs of Vehicle-2Grid services of EV fleets
- Electricity mix as secondary data
  - Existing data sets can be used (e.g. European Reference Life Cycle Database (ELCD)
- Depending on the charging method, the impact on the distribution grids should be considered in some LCA studies.

After the presentation, the following issues were discussed.

- **Influence of the production mix in general**

  At the end of the presentation, a question was asked how to interpret the different addressed issues and influences of the production mix in general. The reply was that in situation A it is contributed to all consumers. Average consumption mix is proposed for this situation. Charging models will influence the use of production mix.

- **Guidance for identifying marginal technologies and their allocation**

  Another participant asked for more guidance to identify marginal technologies and allocation of these as e.g. a battery producer does not have the necessary LCA expertise in such questions. In addition, he asked how a new coal power plant would be attributed to electric vehicles only or also as a part of the electricity mix.
  The guidelines are not able to provide the needed marginal technologies for different countries and time horizons that are needed for the studies in situation B. Nevertheless, some indicators will be included that will help practitioners to deal with this situation and to support their decision regarding marginal technologies.

- **Differentiation between situation A and B**

  There was also a further question about an existing “switch” for the decision between Situation A and B, because in the ILCD framework no “switch” is given. Another participant assumed that as a general conclusion, ILCD is not very precise about these situations. A and B are the basis for a consequential approach in theory. In practice, using an attributional model for a consequential situation approach is easier. It was replied that if you go with situation B you would not be able to break it down to single cars. Therefore, the guidelines were intended to set a focus on situation A. Nevertheless, the guidelines will include some help regarding the distinction between situation A and B addressing the “situation-topic” but it’s hard to handle and a general problem of LCA studies.

- **Influence of charging strategies**

  Participants asked about smart charging vs. dumb charging and when, where and how the charging behavior influence the grid and how this challenge will be addressed in the guidelines. In addition, another question was raised regarding the consideration of electricity storage system. Moreover, some questions were asked how to correctly contribute EV with renewable energies in LCAs.
  The answer was that these questions are aspects of situation B and need therefore more modeling in most cases using complex energy system models that are normally not freely available. Nevertheless, without specific models a correct evaluation of the ecological impact is

not possible within a LCA study. To answer the questions realistically, the energy system within a country including the electric vehicles (or storage devices) have to be analyzed as a whole. Admittedly, this results in allocation problems if the impact of a single car should be assessed. Despite the difficulties, it is more realistic and appropriate for the conduction of a consistent study with a time scope for 2020 and later to use situation B instead of A.

4 How to use the guidelines

4.1 Content of the Presentation

The use of the guidelines was presented with the help of an example. The example used was a comparative assertion between two batteries. A company that produces batteries wants to know the overall effects of changing the current technology, producing a battery (type A) with energy density of 100 Wh/kg to a new battery technology producing batteries (type B) with the energy density 120 Wh/kg.

Like every LCA, the study starts with the goal definition containing the six aspects necessary for this step. The provisions given in Chapter 5 of the Guidelines state all of these aspects separately. An additional provision clarifies that it has to be evaluated carefully whether any part-system interaction might occur in order to define whether these have to be taken into account.

Practitioner who are not familiar with electric vehicles as a whole system can find support in chapter 4 – technological context.

This sections starts with the definition of electrical vehicles like they are understood throughout the guidelines. The components of electric vehicles are described and typical parameters like their weight are given. This collection of data is called Common Parameter Platform (CPP).

To find out, whether there are any part-system interactions to be considered one can use the Interdependency Matrix (IM). The IM states which other components are influenced directly by a certain component. The IM will be available in an electronic format, and a roll-over-hint will be given that describes the mechanism of influence. For example, the statement in the current version regarding the influence of the Li-ion battery on the power electronics is "*Voltage of the Li-ion battery may have an influence on the necessary size and performance of the power electronics*". The practitioner is supported with information about a possible influence and can evaluate whether there is a change in voltage in order to know whether to evaluate this interaction in detail or not.

The use of the IM should be iterative in order to cover even indirect influences. The number of iteration needs to be chosen with respect to the goal and scope definition as well as to the system under study. Concerning the battery example, after three iterations it is found that in addition to the Li-ion battery also power electronics, e-motor, transmission, SBSS, body (frame) and the energy demand during the use phase need to be included in the foreground system.

With this information, the practitioner can continue to the next step; Scope definition.

The LCI chapter gives guidance and provisions for all life-cycle phases. The approach should of course be in accordance with the goal and scope definition. For the use phase, a driving cycle and consumption model that is adequate for the goal and scope definition should be chosen. In this case, the aim is to depict real-life consumption including charging losses, auxiliaries, heating, cooling etc.

For the phases production and End-of-Life there are specific sections for the different components. For dimensioning the components of the car, using CPP and IM can be used as support. After finishing the model, the LCI can be calculated.

Conducting the LCIA and finalizing the study is following the ILCD handbook closely.

4.2 Course of Discussion

Feedback by the stakeholders was given directly after the presentation as well as during the dedicated feedback session.

Regarding the CPP, the adequate place was discussed. So far, the CPP is integrated in Chapter 4-technological context of the guidelines. One participant suggested moving the CPP to an Annex instead.

Valuable remarks on specific values presented in the IM were made and discussed. Oftentimes these were connected to another lively discussed aspect: The values given in the current version of the IM are either 0 or 1 and only direct influences are stated. Regarding the scale, it was suggested to further differentiate the scale, e.g. from “+ +” to “- -“. It was explained that this had been included in a previous version of the IM (see documentation of first stakeholder workshop), but it was found that it is hardly possible to do this in a consistent way.
Which components change and to which extend still needs to be evaluated carefully by every practitioner. The IM gives a hint for the starting point of this evaluation. Keeping it quite reduced makes it possible to have a clear representation.

As for the often-discussed question whether to include only direct or even indirect interdependencies, different opinions where stated. It was agreed, that stating only direct influences would support a better understanding of the system as the mechanism of influence can be stated. On top of that, stating only direct interactions helps to avoid the massive influence that the car weight would have otherwise.
Another remark that was given was to reformulate parts in order to be more technology-open. For example, one column in the IM is named “Li-ion battery”. Replacing this term by “battery” would broaden the applicability of the guidelines.

Remarks on certain values of the CPP, the IM or the level of detail in which these are given are welcome until the end of the year.

5 Testing the Guidelines

The eLCAr guidelines aim at providing a high quality of LCA studies as they offer support during the conduction of the LCA and provide an easy handling. However, the impact of new guidelines is not directly assessable, because it often depends on the opinion of the practitioners and their subjective evaluation. Therefore, assessment and testing of the guideline is necessary. The following two aspects are addressed in the context of the testing of the guidelines:

- the **quality of LCA studies** covers the comparison of the final studies and LCA results and
- the **usability** contains all factors defining the usefulness and handling of the guidelines for the users.

The most important aspect for the quality of guidelines is the quantitative and qualitative impact of the used guidelines on LCA studies and especially on the results of these studies. During the presentation, the results of the testing have been presented with the following summary.

- The choice of the electricity mix and the determination of the consumption have the highest impact on the quantitative LCA results.
- The recommendations given in the guidelines allow a better comparison between LCA studies (e.g. by using the same electricity mix (EU-27 mix)).
- A checklist allows a quick overview if all relevant points are considered and described in the study. Missing points can be identified and added.
- → Studies using the eLCAr guidelines will contain the most important LCA aspects that have to be mentioned in studies.
- The results, the spread of the LCA based on the complete guidelines, are currently analyzed.

At the end of the presentation, a participant recommended to highlight the importance of the electricity mix. The importance of the electricity mix will be included in the guidelines by providing a sensibility study varying important parameters in the model by using minimal and maximal values as well as a percentage variation (+/- 10%). The results will be used to generate a list of important parameters having the highest impacts on the LCA results for EV. No other questions have been asked.

6 Introduction of the different Learning Materials

First insights into the training materials concept had already been presented during the second eLCAr stakeholder workshop. The third workshop provided the opportunity to present the methodological concept more thoroughly and show hands-on examples for the different learning modes.
The methodological concept has to meet the challenge of a very broad and diverse target group. Hence, a modular approach has been developed. This is indicated by an e-car icon, which is shown in Figure 1. It will tag all training materials to enable recognition. The different parts of the car are highlighted in different colours to present the different modules, which are available.

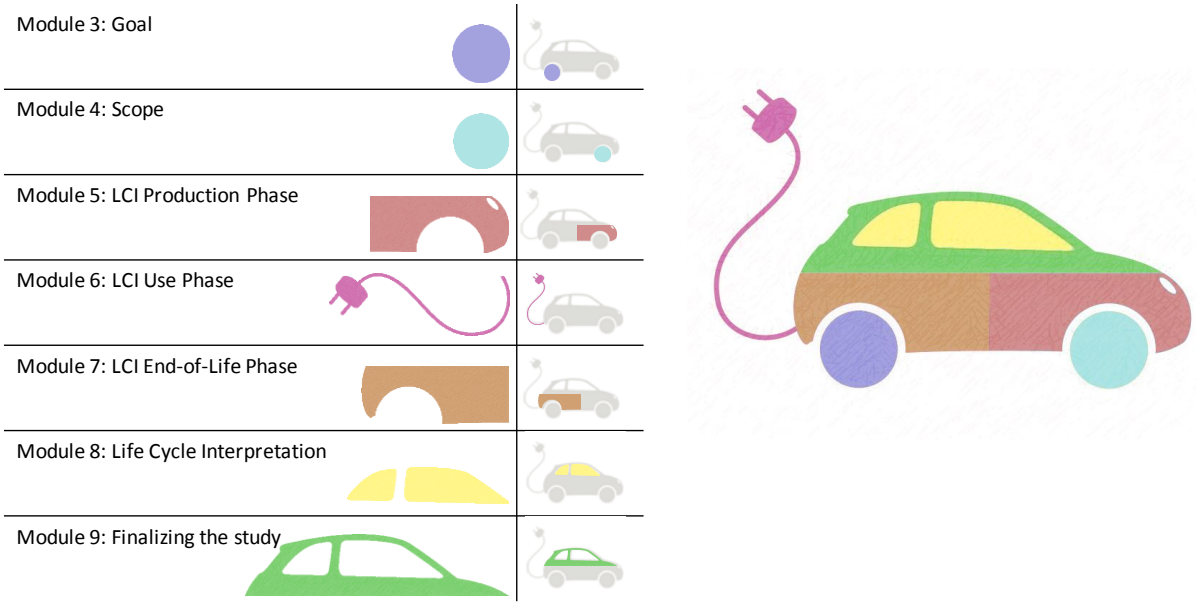

Figure 1: The icon shown on the right side of the figure will tag all training materials. As shown on the left side, the different parts of it will be highlighted to differentiate between the available modules.

Not only are different modules available, but also will each of the modules be offered in three different training types. Figure 2 gives an overview of the different training types, which namely are

- Seminar Training
- Training with a self-learning script
- e-Learning

All modules are self-contained, so that any practitioner or practitioner to be can choose which modules he wants to learn in which training mode and in which order. This enables suitable materials for beginners as well as more experienced users who only aim for refreshing a certain aspect of LCAs on electric vehicles and their components. To facilitate learning the contents, interactive elements will be frequently included.

Figure 2: This graph shows the different training types which are available and their key components.

During the workshop, a part of the self-learning script was shown as well as trainer slides for the seminar training that contain complete slide-decks for all modules along with explanations about the important contents of the slides.
The moodle platform was presented as well. To facilitate its use, user-guides for trainers and learners are included. Parts of a Web-based-training (WBT), which is basically an animated slide-deck with narration that can be controlled by the learner, was shown.

A detailed description of both the methodological concept as well as the learning modes can be found in the Technical Briefing Notes for the third Stakeholder Workshop.

During the following question round, only limited feedback was given. Questions were mostly pointing out organizational topics, e.g. about scheduling the training and the necessary amount of time. In informal exchanges, especially the presented WBT was mentioned in a very positive way.

The consortium concludes from this, that the realization of conclusions drawn from the previous workshop (see documentation of second eLCAr Stakeholder Workshop) on contents and extend of the different training materials are approved by the stakeholders.

7 Conclusions for further proceeding of the project

General chapters: No feedback or request for changes was expressed by the stakeholders at the end of the session describing the new chapters of the guidelines. However, during the feedback session a comment on the importance of reporting the LCIA results highlighting the contributions coming from the various life phases was made. A statement concerning the importance of choosing a suitable representation of the LCIA results, in order to be able to identify from which parts of the system the dominant contributions come, will be added in the reporting chapter. As planned, the current version will also be expanded with an introductory chapter on the main aspects of LCA.

Goal definition: More explicit guidance will be developed to help determining the decision context and, related to that, distinguishing foreground from background system.

Scope definition: No serious changes were seen necessary during the workshop. Only for the section on data collection for situation B, advice will be included how to address future technologies.

LCI Use phase (Consumption calculation framework): As summarized above, at the end of the presentation on the consumption calculation framework, an attendant commented on the need of a clear definition of the mean driving cycle speed used in the evaluation of the recuperation. The exact definition of the mean driving cycle speed will therefore be added in the text. During the feedback session another attendant commented that the influence of the mass on recuperation was not visible in the methodology presented at the workshop. It was replied that the possibility of extrapolating the influence of the mass would be analysed and, if possible, integrated in the model.

Overarching aspects: Throughout the guidelines attention will be given to technology open formulation to avoid early outdating of the given advice.
The interdependency matrix is going to be revised. Thereby indirect effects will be excluded to enhance its clarity.
Time aspects which are not considered in LCA methodology were discussed controversially during the workshop especially regarding end-of-life processes. However, the current version of Figure 17 allows addressing e.g. recycling technology changes or the distinct accounting of today's and future emissions.

Training materials: Training materials will be developed as planned, adapting to the changes that are made in the guidelines.

Summing up the workshop, the consortium agreed that it resulted in very positive overall-result. Interesting discussions took place and valuable feedback was given. Though, the majority of the feedback concerned very detailed questions and no remarks about the overall concept of the project were made. So the course of the project will be followed as scheduled and the conclusions drawn for the remaining time of the project will influence the finalization of the guidelines as well as the development of the training materials and the testing of the guidelines.

Annex A – List of Participants

Name	Surname	Institution
Chan	Jia-Uei	ThyssenKrupp Steel Europe
Cossutta	Matteo	University of Nottingham
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Freire	Fausto	ADAI (University of Coimbra)
Helmers	Eckard	Environmental Campus Birkenfeld
Helms	Hinrich	IFEU
Jungmeier	Gerfried	Joanneum
Maas	Heiko	Ford (Forschungszentrum Aachen GmbH)
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Renzoni	Robert	University of Liège
Simon	Balint	Helmholtz Insitute Ulm for Electrochemical Energy Storage
Spielmann	Michael	PE International
Sternberg	Inbal	Betterplace
Thierry	Baert	SOLVAY Specialty Polymers
Walk	Wolfgang	ELVA consortium
Wulf	Christina	Technische Universität Hamburg-Harburg
Zimmermann	Benedikt	Karlsruher Institut für Technologie