

**Analysis of the European energy system
under the aspects of flexibility and technological progress**

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Deliverable

**D6.2 Workshop: Lifecycle methods for sustainability
assessment of energy systems scenarios**

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Lead author(s):	Nils Brown (KTH)
Reviewer(s):	Katrin Seddig (KIT-IIP), Stephanie Heitel (Fraunhofer ISI)

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Document history

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1. Short description of the event

1.1 WORKSHOP PLANNING AND PROCEEDINGS

The workshop was carried out as a stakeholder consultation exercise in the development of life cycle assessment (LCA) based environmental and social assessment for the future energy systems for the EU considered in the REFLEX project. The specific aim of the workshop was therefore to consult LCA experts and policy makers on a proposed framework methodology for the social and environmental life cycle assessment of future energy systems scenarios.

The workshop was organized as a satellite event at the Society for Environmental Toxicology And Chemistry (SETAC) annual conference 2017, 10 am – 12 noon on May 9th, 2017 at the SQUARE conference centre in Brussels, Belgium.

Invitations to the workshop were distributed by email to the following groups:

- Invitees to the earlier REFLEX public workshop in Brussels, November 2016 (including many DG Energy employees)
- PRé Consultants' LCA discussion list
- Employees at DG Environment
- Personal contacts

The invitation that the target group received is shown in Figure 1 below. As a result of this distribution, a total of 28 people registered for the event, covering researchers, practitioners and policy makers. A total of 20 external stakeholders attended the event, including many that had not previously registered for the event. Please see Table 1 and Table 2 for more information.

The workshop started with a presentation by Nils Brown (KTH Royal Institute of Technology) covering the REFLEX project's organization, overall goals, goals of Work Package 6 and setting up the problem to be addressed in the workshop. Please see Appendix 1 for the slides used. The presentation lasted 25 minutes including questions. After this attendees were divided into 3 breakout discussion groups. Two groups focussed on environmental LCA-related issues in the proposed framework (led by Lei Xu and Maryegli Fuss respectively, both KIT Karlsruhe Institute of Technology). Please see Appendix 2 for the poster used in these presentations. One other group focussed on social LCA-related issues in the proposed framework (led by Elisabeth Ekener, KTH Royal Institute of Technology). Please see Appendix 3 for the slides used in this discussion. These parallel sessions lasted 30 minutes each. After this participants were reorganised into two further parallel discussion groups, both focussing on the integration of social and environmental assessment in the proposed framework. Please see Appendix 4 for the poster used in this discussion. Pictures of the breakout sessions in progress are shown in Figures 2 to 4.

After this, participants were offered coffee whilst the outcomes of each of the breakout discussion groups were collated by the whole Work Package 6 team. The last 20 minutes consisted of a plenary discussion about the main issues arising in the breakout groups led by Nils Brown. Appendix 1 also contains slides that were used to support this discussion.



1.2 WORKSHOP OUTCOMES

The workshop succeeded in gathering together practitioners and academics from all over Europe as well as North America and Africa all of whom have a shared interest in the topic covered by the workshop. In particular, from an environmental LCA perspective there was much interest in how technologies under development could be considered from a future LCA perspective (specifically small scale batteries for use in cars or in homes). The need to differentiate between different kinds of biomass in the assessment and the possible consideration of rebound effects were also brought up. Other topics raised from an environmental perspective were the way of specifying a functional unit for the entire energy system, and the notion that novel materials could affect technology functionality. From the perspective of social LCA, discussions centred around the use of existing support tools for social LCA, such as the social hotspots database and the PSILCA database. From a top-down perspective it was proposed that social aspects used for the assessment also be explicitly related to an external sustainability framework, for example the UN sustainable development goals. The topic of integrating social and environmental assessments was avidly discussed. One notable issue raised in this discussion was how life cycle impact categories should be considered from each perspective so as to be complementary (midpoint or endpoint). Another issue was how results should be presented and it was proposed that aggregated, single-score results should be presented alongside disaggregated results. Some attendees argued that multi-criteria decision tools should not be used for aggregating results of social and environmental assessments as it attempts to make parallels between fundamentally incommensurate assessment outcomes. Others suggested that multi-criteria based aggregation is necessary to provide some transparency to otherwise implicit weightings between different assessment outcomes.

By assembling in one room stakeholders with highly-specialized knowledge relating directly to the work of REFLEX and work package 6, key objectives were achieved. Firstly, the aims and objectives of REFLEX were communicated to this highly specific and otherwise hard to reach target group. Secondly, important feedback was acquired from the group at an important time in the project that will be very useful in future development of the framework for LCA-based social and environmental assessment in work package 6 for future energy systems in the European Union. The outcomes will then be applied in deliverable 6.3, the report on social and environmental impacts of the future energy systems modelled.

2. INVITATION

The invitation emailed to the target group is shown in Figure 1 below.

Workshop on social and environmental LCA of energy scenarios for the European Union – Tuesday 9th May 10 am, SETAC Europe conference

The problem addressed in this workshop is that energy scenarios produced by energy systems models and used to support EU policy decisions are not assessed from a broad environmental or social perspective.

The aim of this workshop therefore is to consult LCA experts and policy makers on a proposed framework methodology for the social and environmental life cycle assessment of future energy systems scenarios.

Key questions addressed are:

- What are the most important **methodological** considerations for this LCA application?
- How can this LCA application enhance the **policy impact** of energy systems modelling?

We will:

- Present the current status of sLCA and eLCA of future energy systems and technologies
- Present the REFLEX framework methodology
- Codevelop answers to the workshop's key questions
- Introduce participants to the Horizon 2020 project REFLEX and its contribution in this area

Schedule

09.45: Welcome

10.00: Presentation by workshop leaders:

- Nils Brown, KTH Royal Institute of Technology, Stockholm
- Elisabeth Ekener, KTH Royal Institute of Technology, Stockholm
- Maryegli Fuss, KIT Karlsruhe Institute of Technology

11.00: Discussion of key questions with participants

11.45: Conclusions

COFFEE will be served!

Register online here

Admission to this satellite event is FREE, but if you are not otherwise attending the SETAC Europe conference you are required to pay €50 *on the door* for admission to the conference center

Web: www.reflex-project.eu

Date Tuesday, 9th May 2017

Venue

SETAC Europe conference,
Meeting Studio 206,
SQUARE conference center,
rue Mont des Arts,
1000 Brussel

Contact

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 KTH Royal Institute of Technology
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 Stockholm Sweden

Maryegli Fuss, maryegli.fuss@kit.edu
 Lei Xu, lei.xu@partner.kit.edu
 KIT Karlsruhe Institute of Technology
 Institute for Technology Assessment and Systems Analysis (ITAS)
 Karlsruhe, Germany

Figure 1: Invitation to workshop sent to the target groups

3. INITIAL REGISTRATION

Table 1 below shows the list of the 28 people initially registered for the event, by name and affiliation.

Table 1: Initial registration for the event

Name	Organization
Sebastian Gras	EC DG ENER
Tim Grant	Lifecycles.
Chris Mutel	PSI
Angeline de Beaufort	consultant
Ruben Verhaegen	3E
Anne Bouter	IFPEn
Nicole Unger	University of Natural Resources and Life Sciences, Vienna
Marieke Reijalt	European Hydrogen Association EHA
Daniel Garraín	CIEMAT
GRUSON JEAN FRANCOIS	IFP ENERGIES NOUVELLES
Marta Baltrusiewicz	Western Norway Research Institute
Ruth Dominguez Sanchez	F+P
Tamar Opher	Technion - Israel Institute of Technology
Wenjie Liao	Institute of New Energy and Low-Carbon Technology Sichuan University
Isabela	Butnar
Ashok Sekar	RIT
Miguel Fernandez Astudillo	Sherbrooke University
Paolo MASONI	ENEA
Blanca Corona	Utrecht University
Carlos Moyano	Centro Tecnológico Naval y del Mar
Antonino Marvuglia	Luxembourg Institute of Science and Technology (LIST)
Eleanor Drabik	CEPS
Zoltán Rakonczay	European Commission
Kirstine Schiebel	ERM
Sureau Solène	Université Libre de Bruxelles
Paritosh Deshpande	NTNU, Norway
Annie Levasseur	CIRAIG, Polytechnique Montreal
Petra Zapp	Forschungszentrum Juelich GmbH

4. FINAL ATTENDANCE

Table 2 shows the list of participants at the event by name and affiliation. Some of those that were registered were not ultimately able to attend the event. However, other people with highly-relevant knowledge that were initially not registered attended, as can be seen by a comparison of Tables 1 and 2.

Table 2: Final attendees at the event

Name	Organization
Chris Mutel	PSI
Anne Bouter	IFPEEn
Nicole Unger	University of Natural Resources and Life Sciences, Vienna
Daniel Garraín	CIEMAT
Miguel Fernandez Astudillo	Sherbrooke University
Paolo MASONI	ENEA
Blanca Corona	Utrecht University
Antonino Marvuglia	Luxembourg Institute of Science and Technology (LIST)
Kirstine Schiebel	ERM
Sureau Solène	Université Libre de Bruxelles
Annie Levasseur	CIRAIG, Polytechnique Montreal
Petra Zapp	Forschungszentrum Juelich GmbH
Onwurah Arinze	University of Nigeria, Enugu
Tobias Junne	German Aerospace Center e.V. Environment
Simona Scalbi	ENEA
Karin Fazeni	Linz Energy Institute
Guillermo San Miguel	UPM
Grazia Barberio	ENEA
Till Bachmann	EIFER

5. WORKSHOP PROGRESS

Presentations and posters used in the workshop are given in the appendices. Figures 2 to 4 show the workshop breakout sessions in progress.



Figure 2: Maryegli Fuss leads a breakout discussion group on environmental LCA. Photo: Nils Brown



Figure 3: Lei Xu leads a breakout discussion group on environmental LCA. Photo: Nils Brown



Figure 4: Elisabeth Ekener leads a breakout discussion group on social LCA. Photo: Nils Brown

6. APPENDIX 1 – INTRODUCTION AND CONCLUSIONS

The following pages show the powerpoint slides used to present the introduction and conclusions at the workshop.

Reflex
Analysis of the
European Energy System

WORKSHOP ON SOCIAL AND ENVIRONMENTAL LCA OF ENERGY SCENARIOS FOR THE EUROPEAN UNION

Nils Brown - KTH
Elisabeth Ekener - KTH
Maryegli Fuss - KIT
Lei Xu - KIT

Tuesday 9th May 10 am,
SETAC Europe conference

Author/Institute 1
2017-05-11

REFLEX – Who we are

Nils Brown
Elisabeth Ekener

Maryegli Fuss
Lei Xu

KIT
Karlsruhe Institute of Technology
Karlsruhe

Fraunhofer
Fraunhofer Institute for System and
Innovation Research
Karlsruhe

ESAR - Energy System Analysis Agency
Karlsruhe

TEP
TEP Energy
Zürich

Universität Utrecht
Utrecht

KTH
KTH - Royal Institute of Technology
Stockholm

TECHNISCHE UNIVERSITÄT DRESDEN
Technische Universität Dresden
Dresden

AGH
AGH - University of Science and
Technology
Krakow

TRT
TRT TRASPORTIE TERRITORIO di
Milan

Reflex
Analysis of the
European Energy System

Nils Brown, KTH Royal Institute of Technology

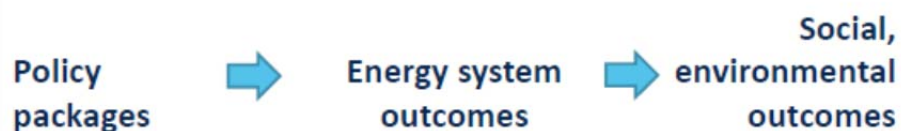
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2017-05-11

REFLEX – Analysis of the European energy system under the aspects of *flexibility* and *technological progress*

- Horizon 2020
- May 2016 until April 2019

AIM: To analyse and evaluate the development towards a **low-carbon energy system** with focus on **flexibility options** in the EU to support the implementation of the **SET-Plan**

REFLEX – Analysis of the European energy system under the aspects of *flexibility* and *technological progress*



What will be an optimal combination of flexibility options?

How do these technologies and policy measures affect the environment, economy and society?

We need to assess... an energy system for a positive, sustainable global vision



5

Policy assessment with energy systems models



Integrate climate change measures in policy



Substantial share of renewable energy



Energy efficiency







Affordability

6

Nils Brown, KTH Royal Institute of Technology

2017-05-31









✗ Energy systems models

- Eutrophication
- Acidification
- Land use
- Toxicity
- Photochemical Oxidants
- Resource use (fossils, metals, minerals etc.)

✓ Life cycle assessment (e)

7

✗ Energy systems models

- Affordability of energy services
- Human health
- Access to clean water
- Food vs. Fuel
- Safe transport systems
- Decent work
- Labour rights
- Safe working environment

✓ Life cycle assessment (s)

8

Assessing the energy system for a positive, sustainable global vision

ESM + eLCA + sLCA



9

What has been done so far?

ESM + LCA

Future energy
technologies

Environmental life cycle assessment

Some social aspects considered sometimes

Nils Brown, KTH Royal Institute of Technology

10

2017-05-31

Inventory for future technologies and scenarios

Scenario consistency

Inductive principles:

Technological potential

Policy normative

Trend extrapolation

AGENDA for the workshop

10.00 – 10.20 – Introductory presentation

10.20 – 10.50 – Breakout group session 1

10.50 – 11.20 – Breakout group session 2

10.20 – 11.35 – COFFEE

11.35 – 11.55 – Plenary discussion

11.55 – 12 noon – Final conclusions

THANK YOU FOR YOUR PARTICIPATION

Ongoing work in the REFLEX project

Topics:

Environmental:

- System boundary for whole energy system:
 - Which kind of technologies – CHP, micro, batteries, which kind of batteries, use phase of batteries
 - Secondary use of batteries
 - Which kinds of novel technologies
 - Rebound effects?
 - Use the term 'secondary energy use' instead of demand ??
 - Expand the system to the whole system?
 - Biomass needs special categories to be considered
- Assessing multi-products and multi-services simultaneously
 - Specific functional unit not needed
 - Satisfaction of energy requirements
- Technological progress in the future
 - Do novel materials affect functionality of technology



Ongoing work in the REFLEX project

Social:

- What social issues should be used?
 - Social hotspot database starting point or PSILCA
 - Mapping to SDGs
- How to include and handle positive social issues in the assessment
- How to perform evaluations of social issues in future scenarios (being partly qualitative)

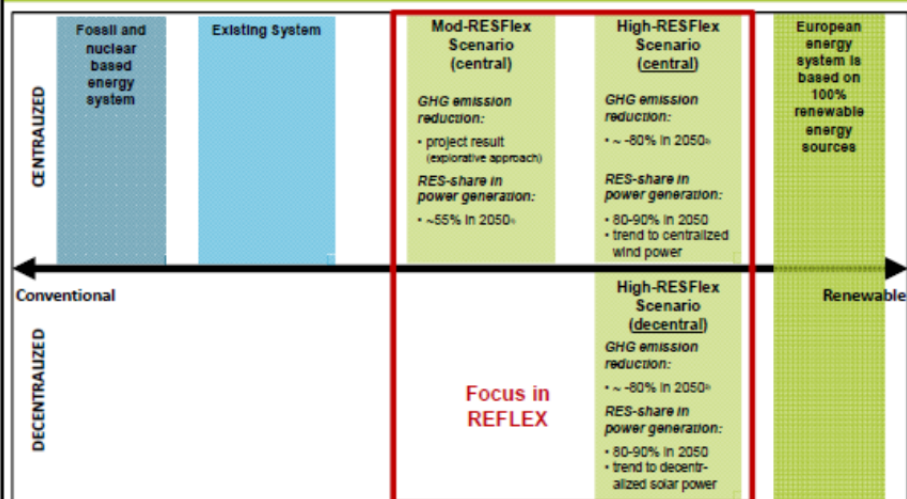


Ongoing work in the REFLEX project

Integration:

- How to have a clear system definition fulfilling both requirements (respecting limitations and relevance of each methodology)?
 - Not necessary to have the same system boundaries (many sessions)
 - Clear about cut-off criteria in each perspective
 - Does and environmental attributional or consequential approach make a difference?
 - Consistency in choosing impacts for each perspective – midpoint for environmental or endpoint for social
 - Geographical resolution can be a question
- How is the best approach to provide *results* – what are the pros and cons of highly-aggregated or not
 - Be clear about what are environmental and what are social results
 - Decisions should be left to stakeholders
 - Single score useful to avoid people focussing on CO₂-equivalents
- What are the pros and cons of MCDA and if this is a good solution to affect decision makers?
 - *What sustainability paradigm do we want to express/reflect?*
 - *MCDA outcomes depend on methodological choices*
 - *MCDA unphilosophical approach*

Possible scenarios for shaping the European energy system – Focus in REFLEX



7. APPENDIX 2 – POSTER USED IN DISCUSSION OF ENVIRONMENTAL LCA

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E-LCA of energy scenarios for the European Union

Topic 1:

To perform an LCA to the whole energy systems:

- ✓ What processes shall be included?
- ✓ What processes shall be excluded?
- ✓ On what level of detail?
- ✓ How shall the results be aggregated?

Preliminary idea:

- Include: All technologies (from cradle to grave) related to primary energy consumption, e.g. power/heat generation technology, diesel consumption for mobility, as well as transmission, storage.
- Exclude: Technologies related to secondary energy consumption.
- Reason: double counting & comparison

Topic 2:

To assess multi-products or multi-services simultaneously:

✓ How to define the functional units?

Preliminary idea:

- Option 1: Provision of 1 MWh of energy services, e.g. 1 MWh of electricity/heat production for electricity/heat generation technologies, 1 MWh of oil consumption for mobility
- Option 2: Provision of energy services/products for each demand sector: per person km and tonne km for mobility.

Topic 3:

Considering the technological progress in the future:

✓ How to perform ex-ante LCA of future parts of this energy system?

Preliminary idea:

- Technology: refer to the learning curves used in the energy systems models, e.g. efficiency, life time, capacity, etc. to adapt model parameter.
- Energy mix
- Raw materials: literature review to adapt the input of raw materials for generation technologies
- Adaption with regard to the emissions as well as technology progress of raw materials production

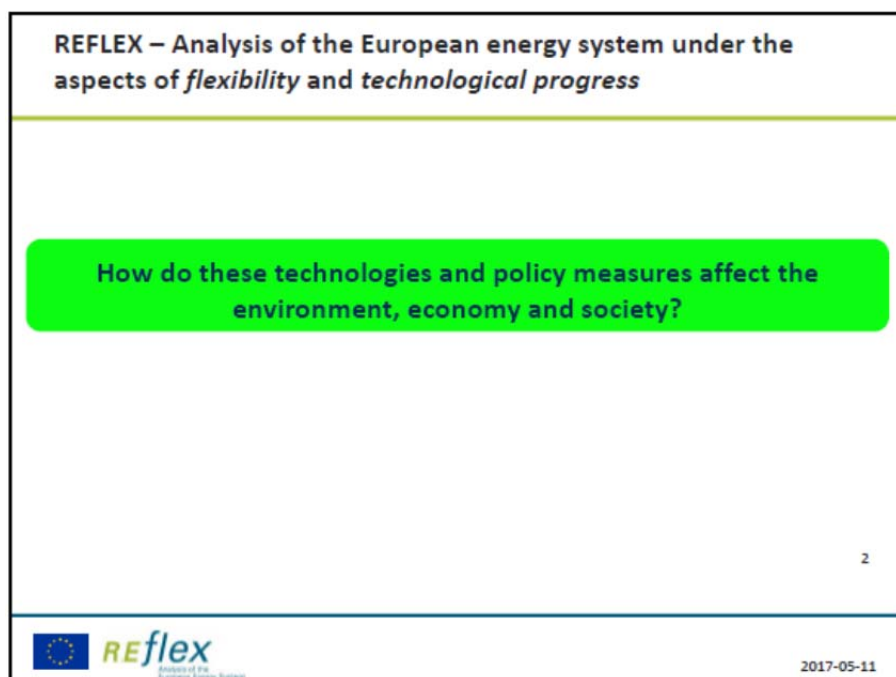
REFLEX – SELES – system boundaries definition

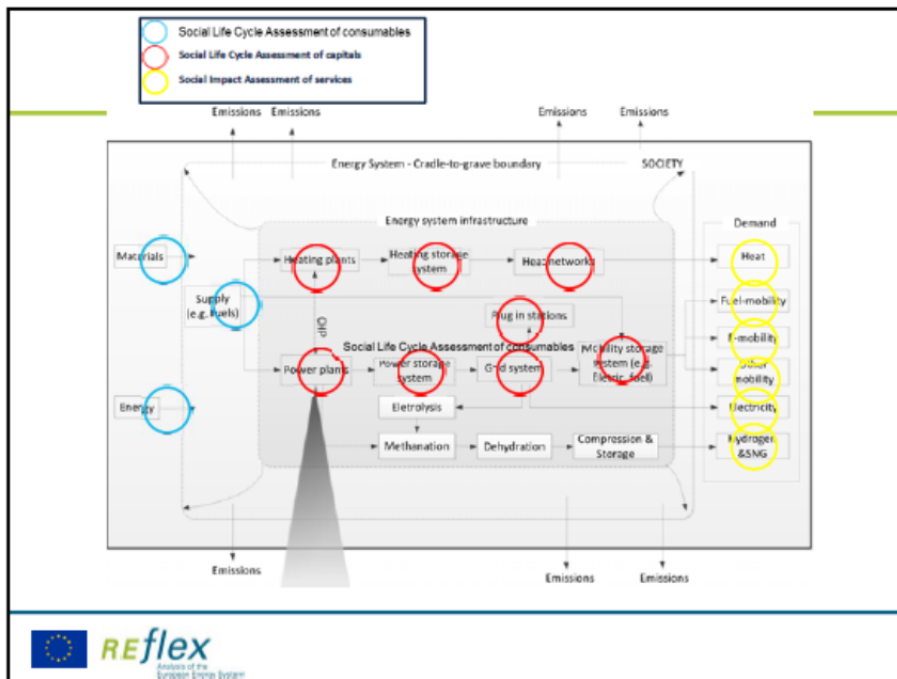
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8. APPENDIX 3 – PRESENTATION SLIDES USED IN DISCUSSION OF SOCIAL LCA

The following pages show slides used in the breakout discussion on social LCA.





Finding: Social assessment poorly designed and structured in many cases in literature

Problem 1: No standardized social issues

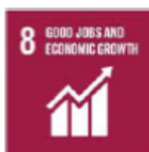
- A plethora of social issue where identified in the literature review
- A number of these issues might aim at assessing the same thing, but language is not standardized
- The selection of issues seems randomly conducted, and no measures seems to be taken to assure that a good coverage of the most relevant issues is achieved
- What source of social issues should be used.

Social aspects found in literature

- Equity
- Accessibility
- Employment
- Compliance
- Alignment with sustainable development
- Aesthetic values
- Recreation opportunities
- Economic security
- Education
- Culture
- Public acceptance
- Regional self-determination
- Import dependencies
- Effect on public spending
- Social cohesion
- Landscape Noise
- Ecological justice
- Security of supply
- Dignity and rights
- Competence
- Political stability and legitimacy
- Avoiding vulnerability
- Effects social areas
- Social justice
- Fair internat. distribution of energy
- Transport safety
- Quality of landscape
- Taxes
- Injuries
- Wages

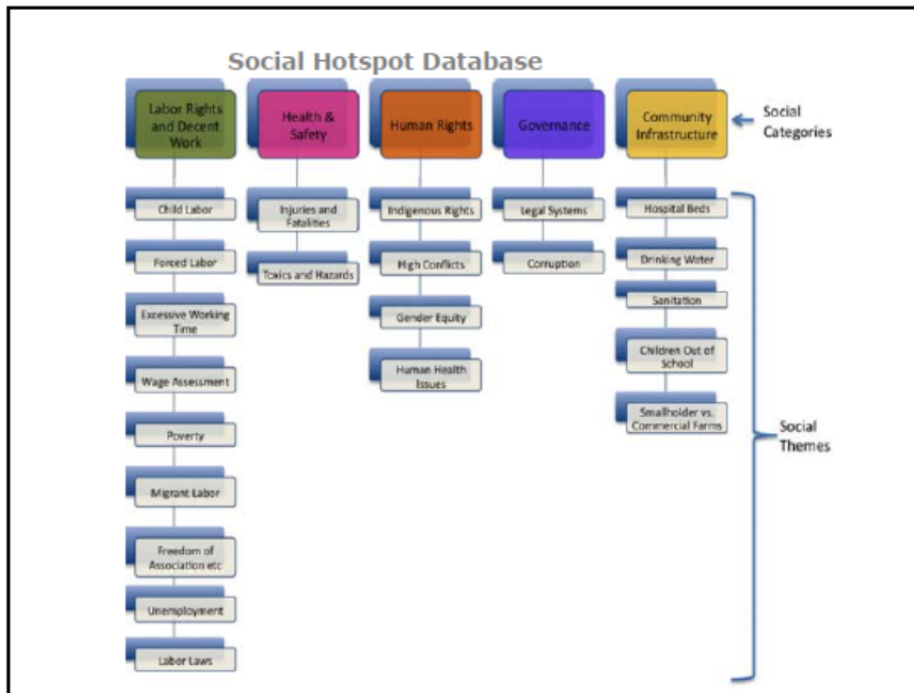


- Affordability of energy services
- Human health
- Access to clean water
- Food vs. Fuel
- Safe transport systems
- Decent work
- Labour rights
- Safe working environment



7

Stakeholder category	Sub category	Stakeholder category	Sub category
Worker	Freedom of Association and Collective Bargaining	Local community	Safe & Healthy Living Conditions
	Child Labour		Respect of Indigenous rights
	Fair Salary		Community engagement
	Working Hours		Local employment
	Forced Labour	Society	Secure living conditions
	Equal opportunities/Discrimination		Public commitments to sustainability issues
	Health and Safety		Contribution to economic development
	Social Benefits/Social Security		Prevention and mitigation of armed conflicts
Consumer	Health and Safety	Value chain actors	Technology development
	Feedback Mechanism		Corruption
	Consumer Privacy		Fair competition
	Transparency		Promoting social responsibility
	End of life responsibility	Local community	Supplier relationships
Local community	Access to material resources		Respect of intellectual property rights
	Access to immaterial resources		
	Delocalization and Migration		
	Cultural Heritage		



Finding: Social assessment poorly designed and structured in many cases in literature

Problem 2: Including positive social data in assessments

- Two databases for social data currently exist (SHDB and PSILCA), these contain only negative aspects (social risks)
- The defining and handling of positive social issues are poorly addressed in literature so far
- Discuss ways of including positive issues

Finding: Social assessment poorly designed and structured in many cases in literature

Problem 3: Social data for future scenarios

- Social data is of both quantitative and qualitative nature by definition
- How to estimate social data for future scenarios for and for qualitative data

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THANK YOU!

Author/institute

2017-09-11

9. APPENDIX 4 – POSTER USED IN DISCUSSION OF INTEGRATION OF ENVIRONMENTAL AND SOCIAL ASSESSMENTS



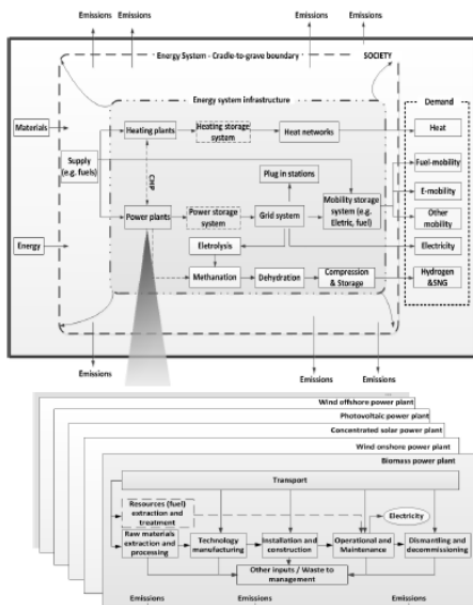
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REFLEX

Challenges for E-LCA + S-LCA of energy scenarios for the European Union

Designing Thinking

Topic 1: Clear system definition



REFLEX – SELES – system boundaries definition

- ✓ Relevance to draw up the system boundaries and functional unit:

- Attributional
- Comparison of processes

Topic 2: E-LCA and S-LCA

Alternatives for integration of environmental and social assessment:

- ✓ Illustrates the separate findings side by side
 - Is this a good approach?
 - What are the pros and cons?

Topic 3: Integration of E-LCA + S-LCA

- ✓ The use of MCDA for integration of the results into one final outcome is sometimes used.
 - What are the pros and cons?
 - Is this a good solution to assist decision makers? Clear and robust?
- ✓ With MCDA, a weighing needs to be done.
 - Who (i.e. which value system/world view) should be allowed to do the weighting (note! Even a 1:1 weighting is a actually a weighting!)

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