SCORE LCA SEMINAR
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Ecostatis

IFP Energies nouvelles

RECOMMANDATIONS PRATIQUES POUR L’ACV PROSPECTIVE / REFERENCES ET EXEMPLES DANS LE DOMAINE DE L’ÉNERGIE

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AGENDA

- Goal of the study and deliverables
- Main results of the study
- User feedbacks
- Questions
GOAL AND DELIVERABLES

**Requirement specifications**

Aims:

- Provide a state of the art of existing inventories and assess these inventories
- Provide recommendations on how to use these inventories in LCA
- Exemplify with practical examples

3 required sections : 1. literature review ; 2. prospective LCA specificities ; 3. Methodology

**Deliverables**

- History and state of the art of prospective methods applied to energy and resources studies
- State of the art of prospective LCA (pLCA) ; design of a pLCA typology
- Mapping of actors and institutes in the fields of pLCA and prospective studies
- Survey on practices in pLCA and prospective studies
- Design of a methodology to guide LCA practitioners through prospective LCAs
METHODOLOGY

Objectives

To provide a practical framework allowing guiding LCA practitioners in using prospective studies and conduct prospective LCAs

... Not prescribe, along questions and needs, one or several datasets from literature, since the literature is too large to consider an exhaustive mapping of its values or even references.

Here the objective is to help the practitioner specifying its needs and then understanding, characterising and comparing available data in order to develop a critical analysis and argue its prospective data selection during life cycle inventory.

Considering the inherent complexity of studying future socio-economic systems (multiple issues, dimensions and scales), their « non-predictability », the increasing large amount of energy and resource scenarios, the diversity of underlying methods and the discrepancy of ensuing results, reducing the number of bibliographic references by recommending a small amount of datasets does not make sense.

Selecting a sample of scenarios can only be done case-by-case, regarding the question, the contexts and the objectives of the LCA. The following methodology therefore constitutes a practical framework aiming at supporting an LCA practitioner during his/her analysis and sorting of the available information.
After WW2 : modern times of prospective studies :

- USA : industrial-military complex, worries linked with resource shortage, nuclear apocalypse and environmental externalities
  - (i) : Establishment of an independant and multi-disciplinar think tank composed of mathematicians, physicists, economists, sociologists and psychologists (Research and Development Project – RAND) as soon as 1948.
  - (ii) : Development of formal prospective methods such as the Delphi method or the so-called scenario method.

- France: centered on long-term national planification issues with a more humanist and utopist vision (normative)
- Some kind of rationalisation:
  - (i) : prevalence of technological scenarios:
  - (ii) : design of alternative scenarios in most of the studies
  - (iii) : professionalisation of the field
### T1 - STATE OF THE ART ON PROSPECTIVE STUDIES

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Prospective Studies Structuring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temps ancien : réflexion intellectuelle</td>
<td>Prévision magique, divination, prophétie, utopie</td>
</tr>
<tr>
<td>1945-1960 : rationalisation et mise en place des cadres méthodologiques</td>
<td>Prévalence de la prospective technologique aux Etats-Unis, prospective planificatrice et normative en France, construction de scénarios alternatifs de manière systématique, professionnalisation, mise en place d'établissements en France et aux Etats-Unis, diffusion des travaux, écriture d'ouvrages</td>
</tr>
<tr>
<td>1990-2000 : fragmentation de la discipline et monde unipolaire</td>
<td>Précédence de la prévision, montée des études critiques, fragmentation en différents champs disciplinaires, diminution de la pluridisciplinarité, marginalisation de la discipline</td>
</tr>
<tr>
<td>2000- : réunification dans un monde multipolaire et instable</td>
<td>Retour aux préoccupations des années 1970 : énergie et environnement, mondialisation des contraintes et besoin du politique d'alerte des futurs, prospective stratégique et créativité en entreprises, intégration R&amp;D, stratégie, marketing</td>
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**Prospective studies structuring**

- **Prospective:** transversal science aiming at defining and studying potential futures in order to help decisions and actions.

- **Two types of forces contribute to the future of social-economic systems:**
  - **Change forces:** « drivers » corresponding to:
    - Technological evolution (new technologies, progress...)
    - Economic evolutions (prices, policies)
    - Social evolutions (lifestyles, behaviours)
  - **Inertia forces:** « restoring » forces linked with:
    - Technology: limited technological progress, high costs
    - Economy
    - Policies
    - Structure; bureaucracy, particular interests
Axe 1 : Aim of the project

**Polarity:** exploratory vs decisionnal scenarios

**Characteristics:**
- Subject
- Client
- Point of view
- Scales
Axe 2 : Development process

- **Polarity**: intuitive vs formal approach

- **Characteristics:**
  - Type of data (quantitative / qualitative)
  - Type of model and use
  - Organisation and means
  - Orientations / constraints linked with the context of the study
Axe 3 : Scenario content

**Polarity:** complex vs simple

**Characteristics:**
- Time
- Space
- Sector
- Variable nature and limiting conditions
- Dynamics and deviation level
- Uncertainties in quantitative models
In the field of energy, 12 detailed studies according to the aforementioned typology:

- ADEME visions énergétiques 2030 - 2050
- BP Energy outlook
- Enerdata Global Energy Scenarios to 2040
- World Energy Council Composing Energy Futures for 2050
- Etc.
T2 – PROSPECTIVE LCA TYPOLOGIES

Main topics:
- Energy
- Transport

Two types of studies:
- Photography at time $t$
- Evolution between $t_{\text{initial}}$ and $t_{\text{final}}$
3 objective typologies

(a) LCA of an existing product or a range of existing products at a future time horizon

(b) LCA of a product upscaled from laboratory to commercial deployment

(c) LCA of a whole sector (e.g., transportation, energy) associated with prospective scenarios
T2 – ONLINE SURVEY

Online survey of LCA practitioners and prospective studies experts. 62 feedbacks. Main feedbacks:

- Lack of transparency of available data and studies
- Lack of skills to use the models and analyse the available studies
- Confusion between prospective and consequential approaches
T3 - METHODOLOGY

Structure and foundation

3 steps: goal and scope of the study, LCI, interpretation

Guidance at every step: serie of questions, decisional tree (LCI) along with examples from the 2 case studies

Structure: ISO 14040-44 standards

Questions and recommandations are limited to the specificities of prospective parts of the LCA

Prospective and pLCA typologies

Survey of LCA practitioners and prospective studies experts

Examples for every steps: practical cases from the 2 case studies.
- LCA of a b-segment electric vehicle sold in France in 2030, business as usual context
- LCA of the European passenger car fleet in Europe between 2016 and 2050
1.1 Goal definition

- Which typology (a, b, c)?
- Context? Decision-maker = practitioner?
- Scenario based on trends or open scenario?
- Ideological biases?
- Exploring possibilities or ways to reach an objective?
1.2 Types of changes

- Study of a decision or a change?
  - Yes: is the change internal or does it extend beyond the studied system?
  - Yes: consequential LCA.

1.3 Time horizon (short / medium / long term)

3 levels defined by the degree of visibility and uncertainty on data relative to the sector rather by an absolute time horizon

- Short-term: extrapolation of existing data and current policies
- Long-term: data are very uncertain and extrapolation is not direct. The system might experience technological ruptures or radical changes of behaviours. Future policies (social, economic, industrial, taxes, energies, etc.) are vague or unknown.
- Medium-term: between short and long term.
T3 – METHODOLOGY / STEP 1

1.4 Product or system of products
This step allows precising the type and amount of data to collect

- **One product / service:** prospective technical data needed
- **Range of products:** prospective technical data + economic and political data to assess future uses and market shares

1.5 Functional unit (FU)

- **Time-validity** of FU?
- Different FUs for different scenarios?
- FU shall specify whether:
  - LCA is a **photography** at a given time horizon
  - LCA is studying the **evolution** between now and a given time horizon (trajectory)
1.6 Perimeter / foreground-background

Prospective data depending on: time horizon and internal dynamics of the sector, ie:
- Prospective data are required if the sector is dynamic enough in the time horizon considered.
- Prospective data also required if important background system has a faster dynamic than foreground system.

1.7 Environmental characterisation: choice of impacts

Can be linked with time horizon because relevance can decrease with time horizon, especially for:

- Impacts based on **scarcity**: CML2001 Abiotic Depletion Potential, Water scarcity
- Impacts based on **economic modelling**: ReCiPe resources, externalities
- Impacts based on **damages**: endpoint methods
- Normalised **impacts**: european equivalent.
1.8 Allocation methodologies

*methods and allocation values can become obsolete in a prospective context:*

- Coproduct considered as a waste at $t_{\text{initial}}$ and having a value at the time horizon considered
- Economic allocations valid at $t_{\text{initial}}$ only
T3 – METHODOLOGY / STEP 2

2 steps to collect LCI data

- **Step 1**: 2-step identification of prospective parameters to study
- **Step 2**: Data collection
2.1 Identification of prospective parameters / values

- Conduct a **first attributional LCA at** $t_{initial}$ and identify environmental **hotspots**

- If hotspots are **likely to change** at the time horizon considered
  $\rightarrow$ select these parameters (**group E1**) for prospective data search

- If non business as usual scenarios are retained: identify breakthroughs and potential deviations and widen data search
  $\rightarrow$ select these parameters (**group E2**) for prospective data search
2.2 LCI according to a decision tree

6 questions to help the practitioner, according to:
- Time horizon
- Available resources
- Available data
- Adequacy between available data and goal of the study
Étape 2

Q1 : Horizon temporel futur à considérer (t) = Court Terme ?

Oui

Q2 : Moyens affectés à l’étude suffisants pour approfondir ?

Oui

Extrapolation tendances passées pour p et/ou EDS sur paramètres isolés p (évolutions arbitraires +/- x%) et/ou consultations d’experts

STOP ⇒ on conserve l’ACV-A

Non

Q3 : Données disponibles ?

Oui

Q5 : Adéquation objectifs et contexte de l’étude (axe 1 typologie) ?

Oui

Q6 : Adéquation avec méthodes de production des scénarios, dimensions spatiale / temporelle / sectorielle etc. (axes 2 et 3 de la typologie) ?

STOP ⇒ on conserve l’ACV-A

Non

Q4 : Moyens affectés à l’étude suffisants pour approfondir ?

Oui

Génération de nouvelles valeurs : définition de fourchettes de valeurs via méthodes +/- formalisées et/ou consultations d’experts

Non

Extrapolation tendances passées et/ou EDS (cas extrêmes, évolutions arbitraires +/- x%)

Non

 Sélection des valeurs pour l’inventaire (si plusieurs jeux ⇒ EDS)

Sélection des valeurs avec / sans ajustements et / ou EDS

Recherche de données pour p et horizon temporel visé t

EDS : Etudes de sensibilité
METHODOLOGY / STEP 3

Interpretation

- Data grouping and **scenario** construction

**Critical analysis**, according to:

- Study limitations, linked with hypotheses
- Comparaison between $t_{initial}$ and $t_{final}$
- Relevance of characterisation factors
- Use of external data for relevance
Publications

- Publication FR → *Revue de l’énergie* (T1 2017)
- Publication EN → *Energy Policy* (S1 2017)
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