

Development of National LCA Database Roadmaps, including further Development of the Technical Helpdesk for National LCA Databases

Deliverable D 4.1: final roadmap report for Brazil

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Table of Contents

Introduction.....	1
Background.....	1
Target audience and intended use of roadmap report	2
The roadmap establishment process	3
Baseline assessment and stakeholder mapping.....	3
Stakeholder consultations	4
National Database Working Group.....	5
Roadmap report writing process.....	5
Dissemination activities	6
Roadmap for developing a national LCA database	8
Vision and goals.....	8
Organization and finances.....	8
Governance and management.....	8
Funds and financing	9
Human Resources	10
Data and database.....	10
Database hosting and access	10
Data needs and availability	11
Data quality requirements and review	11
Promotion of LCA uptake in policymaking	12
Data-related activities during roadmap process	13
Roadmap implementation plan	14
Governance and infrastructure	14
Identify priorities for inventories and data quality and review requirements	16
Creating funding opportunities	17
Interoperability converter	20
Life cycle inventory capacity building	21
Risk management	23
Conclusions and recommendations	23
Acknowledgments.....	23
References	24
Appendix A - NDWG meetings.....	25
Appendix B – Results of the poll	26
Appendix C – Photos	30

Figure Index

Figure 1: Strategic Roadmap Process	3
Figure 2: SICV onto PBACV governance	8
Figure 3: SICV's governance	9

Table Index

Table 1: Maturity assessment self evaluation of LCA implementation in Brazil	4
Table 2: Activity schedule	6
Table 3: Program of the public audience held during BRACV 2019, June 27th, UTFPR, Auditorium Campus Curitiba	6
Table 4: Action plan and risk analysis on database management identification	15
Table 5: Action plan and risk analysis on inventory priority identification and data quality requirement	16
Table 6: Action plan and risk analysis on resource mechanism identification	19
Table 7: Action plan and risk analysis for interoperability	20
Table 8: Action plan and risk analysis for capacitation	22

Introduction

Background

The field of life cycle assessment (LCA) is growing in Brazil because of the actions of several stakeholders. It started at the end of this past century in research institutes (CETEA) and universities (UTFPR, UnB and USP) and has since been expanding with the Brazilian Life Cycle Assessment Program (PBACV), coordinated by the Brazilian Institute of Science and Technology (IBICT) and the National Institute of Metrology, Quality and Technology (INMETRO), and supported by the Brazilian Association of Life Cycle (ABCV), Brazilian Company of Agricultural Research (Embrapa), LCA Business Network (Rede ACV) and other institutions (Maia et al., 2017).

In light of the large quantity of data required for the conduction of LCA studies, the necessity for harmonization of life cycle data (Shonan Guidance, UNEP and SETAC, 2011), the existence of data available on international LCA databases and that those international databases might not represent the reality when it comes to national processes, it has become necessary to conduct more discussions regarding the LCA studies in Brazil.

The first initiative aiming for a national LCA database took place with the *Environmental Life Cycle Inventory for Brazilian Industries* project funded and commissioned by the Ministry of Science, Technology, Innovation and Communication (MCTIC) in 2006, through the Funding Agency of Studies and Projects (FINEP). Since then, a lot of effort has been given into capacitating and promoting events to discuss and support LCA studies that focus on the national reality.

In 2010, the PBACV was created (Conmetro, 2010), which “aims to give continuity and sustainability to LCA actions in Brazil, with a goal to support the sustainable development and the environmental competitiveness on Brazilian industrial production and to promote access to internal and external markets”. Within the scope of PBACV, one of the strategic themes is the Life Cycle Inventory (LCI) along with Life Cycle Impact Assessment, Environmental Labeling and Capacity Building. Currently, there are two Technical Committees (TC) related to the life cycle database within PBACV: The Database TC, focused on IT, and the Inventory TC, aimed at datasets.

As a result, in 2015, the national life cycle database (SICV) was launched, being hosted and managed by IBICT. Nowadays, SICV has 22 datasets (seven unit processes and 15 aggregated life cycle inventories). Furthermore, in order to facilitate the data supply to SICV, several capacity building events were held, and a minimum set of data quality requirements was published in the guide Qualidata (IBICT, 2016).

Although the efforts to build an informational structure had advanced, there weren't meaningful increases on inventories available in SICV. However, IBICT identified 130 potential data sources in LCA academic publications. Additionally, the Government of Switzerland contributed, through the *Sustainable Recycling Industries (SRI)* project funded by Swiss State Secretariat for Economic Affairs (SECO) and implemented by the ecoinvent Association, to the increase of: awareness, capacity building and datasets available for SICV Brazil. This project resulted in more than 600 people trained and around 500 life cycle datasets freely available to SICV and the general public. The datasets are not yet in the Brazilian database due to different formats, but conversion efforts are ongoing.

Thus, the aim of this project is to support the improvement of databases by the Development of a Brazilian LCA Database Roadmap, following the general guidelines and recommendations for establishing roadmaps developed within the project, aimed at national LCA database development, the databases access, and promoting its interoperability with other data sources. This national effort is part of an international project on roadmaps for developing LCA databases, which is implemented under the project *Resource Efficiency through Application of Life cycle thinking (REAL)*, funded by the European Commission and commissioned by the UN Environment through the Life Cycle Initiative.

Besides that, the objective of the present project is to contribute to the activities of the project's International Working Group (IWG) and to the development of the Technical Helpdesk for LCA National Databases for the support the development of databases globally. The project consortium is led by theecoinvent Association (Switzerland), and further consists of the Technological Federal University of Paraná (Brazil), Escuela Superior Politécnica del Litoral, Escuela Politécnica Nacional, Ministry of Environment and Conservación Internacional Ecuador (Ecuador), the National Environmental Engineering Research Institute and Confederation of Indian Industry (India), University of Cape Town (South Africa), the National Cleaner Production Centre Sri Lanka (Sri Lanka), and Uganda LCA Network (Uganda).

Target audience and intended use of roadmap report

The target audience of the Strategic Roadmap of SICV is composed of the decision makers, public and private sectors, as well as the academy and other civil society organizations.

The public sector needs more complete information that could base public policies aimed for sustainability, and the Strategic Roadmap can help showing the LCA data relevance for this matter, as well as the necessity of support for the public sector to introduce national products on more environmental demanding markets.

For the private sector, the Strategic Roadmap seeks to show the importance of a good LCA database to reach markets that are concerned with environmental problems, such as those that are based on the information of the environmental profile of a specific product or process. To achieve this, it is necessary for data to follow minimum quality requirements, as well as providing mechanisms for data confidentiality when necessary.

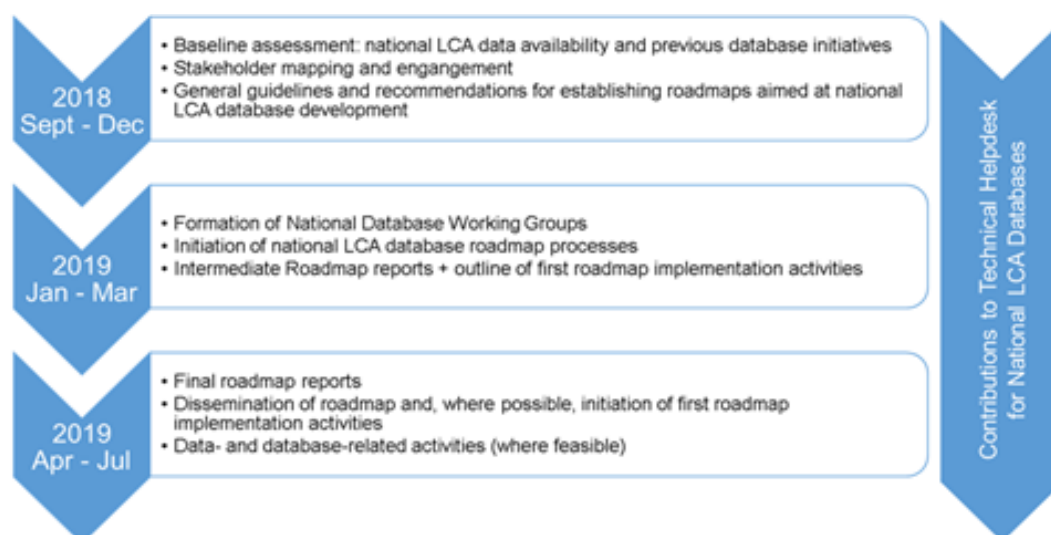
As for the academia and tertiary sector, this document aims to present the appreciation of acting in LCA, showing the knowledge demand on the matter.

From the support to increase the database's scope, the Strategic Roadmap aims to multiply the implementation of LCA, helping for better environmental information available for decision making.

The roadmap establishment process

The process to develop the strategic roadmap followed the steps: a) current situation assessment; b) stakeholders mapping; c) national working group formation; d) definition of the working schedule; e) development of a preliminary report; f) public consultation; g) public dissemination; h) final document review; i) final document publication in both English and Portuguese. The activity schedule is presented on Figure 1.

Figure 1: Strategic Roadmap Process



Baseline assessment and stakeholder mapping

The baseline assessment and stakeholder mapping began with a desktop assessment and in consultation with IBICT that manages the Brazilian LCA Database (SICV) (Ugaya, 2018). The baseline assessment results showed that there are several actors on LCA in Brazil at the public and private sector, academia and civil society representatives, several networks aiming for similar objectives and collaborating among them. As a result, a large number of LCA studies were performed, the number of publications is growing, and there are several capacity building activities. From the public sector perspective, it is highlighted the inclusion of life cycle in national policies and public calls:

- The inclusion of life cycle on the Solid Waste National Policy, though restricted to life cycle thinking;
- The publication of LCI call by CNPq in 2018, nevertheless limited to the development of only 40 inventories;
- The *RenovaBio* policy, considering the life cycle perspective for biofuels;
- The publication of FINEP calls (2018 and 2019), linked to sanitation and resources.

To increase the use of LCA, one of the main concerns is the need of a national database as the inventories currently available in international databases usually do not reflect the situation of the national processes (this has been pointed out in the first federal project in 2006 and repeated since 2008, at the Brazilian Life Cycle Management Conference of the ABCV and since 2015, at the Brazilian LCA Forum).

Even though several networks and governmental program (PBACV) exists, except for some isolated activities, there is no clear mechanism.

In Table 1 it is shown the baseline assessment of the level of implementation of LCA in Brazil based on a maturity assessment over key elements/aspects to be addressed in the database roadmaps according to the International Working Group (IWG, 2018) and the current situation in Brazil. As it can be seen, although in some aspects (governance, infrastructure and interoperability) the current status of maturity in the country was considered to be high (adulthood), the training, use and datasets availability at SICV have a less maturity level (adolescence) and finally, the worst situation is the financing mechanism, which is still in its infancy.

Table 1: Maturity assessment self-evaluation of LCA implementation in Brazil

Item	Maturity level		
	Child	Adolescent	Adult
Governance	Not formalized		Clear structure, with papers and defined responsibilities
Capacitation	Doctor and master studies	Some training	Spread throughout all courses, in all levels
Use of LCA	Academic studies	Implementation of some cases in organizations	Public and private use
Financing	Seed Money from research institutions or international	Financing from government institutions for initial activities	Independent financing stability from external financing
Infrastructure	Spreadsheet developed by one person or team	Spreadsheet developed by several groups	IT implementation
Data sets	Few datasets elaborated for studies	Considerable amount of non harmonized datasets available, without harmonization with Qualidata	LCA database with constant updates and large number of datasets
Interoperability	Not interoperable datasets	Datasets can be used in different platforms, but with some extra work	Interoperable LCA databases, connected with GLAD

Stakeholder consultations

To encompass as much stakeholders as possible, four main activities took place, two of them before the roadmap development: the identification of key representatives to be included in the National Database Working Group (NDWG, see next section) and the identification of inventories development capacity and two, afterwards: the public consultation and public audience.

1. Identification of capacity for LCI development

This activity took place after the first meeting of the National Database Working Group (NDWG), in which it was raised the question “how big is the capacity to develop inventories in Brazil”? Based on this, UTFPR developed a form with 10 questions reviewed by members of the NDWG. After the implementation of the suggested changes, the form was sent by email to participants of past events (CBACV, BRACV, and LCA from A to Z) and others and was published on IBICT’s website. In total, there were 1128 direct invitations that could be forwarded. The preliminary results are presented in section Appendix B – Results of the poll.

2. Stakeholders involvement

With the aim of involving other stakeholders, besides the participants of the previous step, the news of the launch of a Working Group to develop the SICV's National Roadmap was published at IBICT's website and shared in social media including the days for public and audience consultation.

After the development of the SICV National Roadmap, a public consultation period was in place, from June 10th till the public audience on June 27th within the III Brazilian LCA Forum (BRACV 2019) at UTFPR, in the city of Curitiba. After the public audience, a meeting of the NDWG took place at June 28th, which aimed to discuss the main points raised during the public consultation and audience. An extra week was agreed among the participants to increase the number of comments from the public.

National Database Working Group

To develop the SICV's National Roadmap, it was important to include the relevant stakeholders. Therefore, based on the stakeholder assessment, four main groups were identified: public sector, private sector, academia and research and civil society representatives. Within this context, it was attempted to identify the representativeness of each stakeholder at the sector:

- For the public sector, the PBACV (represented by the Inmetro and the IBICT and the Technical Committees);
- For the private sector, the Rede ACV;
- For the academia, research and others, the ABCV.

The NDWG was initially formed by:

- ABCV (Prof. DSc. Gil Anderi);
- IBICT (Dr. Tiago Braga and Dr. Thiago Rodrigues);
- Embrapa (Dr. Marilia Folegatti);
- Inmetro (Dr. Cristiane Sampaio; MSc. Regiane Brito);
- Rede ACV (Luiz Gustavo Ortega);
- UTFPR (Prof. Dr. Cássia Ugaya, link with IWG).

During the first NDWG meeting the group was invited to suggest other actors that could contribute. It was considered that NDWG members were representing all relevant stakeholders, nevertheless, it should include someone that could contribute to the financing mechanism and Bruno Nunes, general coordinator of MCTIC, was included in the group.

To allow the discussion of the SICV's National Roadmap among participant members, six virtual meetings were done (see Appendix A - NDWG meetings) and another meeting took place after BRACV 2019.

Roadmap report writing process

The development of the strategic roadmap text was as followed:

- Discussion in NDWG's and individual meetings;
- Development of the draft;
- NDWG review;
- Dissemination;
- Public consultation/audience;
- Discussion in meeting about raised points;

- Translation;
- Inclusion of final contents, result of the discussions in the public consult/audience and forwarded meeting;
- Review of the content.

Given the difficulties in finding common timeframe for the meetings of the NDWG participants, in the first meeting a process to develop the report was suggested. A draft developed by UTFPR based on each meeting and then the remaining members of the working group could add any input. With the suggestions included, the members reviewed the text before the public consultation. One important topic discussed in several meeting was the implementation plan, which was split in three groups: IBICT, Embrapa and UTFPR.

Table 2 presents the schedule and the institution responsible for each activity. In the last line, it is listed the meeting date.

Table 2: Activity schedule

Activities	February	March	April	May	June	July	Responsible
1. Existent Capacity Identification							UTFPR
2. Stakeholder Involment							IBICT/UTFPR
3. Inventory Priorities							Embrapa
4. Resources Machanism Identification							MCTIC/IBICT/Inmetro
5. Converter Progressing							IBICT/UTFPR
6.1 Initial Text Elaboration							UTFPR
6.2 Working Group Revision							UTFPR
6.3 Final Revision							UTFPR
6.4 Translation							UTFPR
7.1 Public Consultation							IBICT
7.2 Public Audience							UTFPR
Meetings	18/02/2019	18/03/2019	15/04/2019	15/05/2019	28/06/2019	10/07/2019	

Dissemination activities

Besides the stakeholder consultation and the publication of the NDWG activities, the main dissemination activities are the public consultation and public audience. The public audience were done with the participants of BRACV 2019, which took place on June 27th in the Auditorium at UTFPR, Campus Curitiba. The program is shown in Table 3 and the photos are available at Appendix C.

A presentation of the roadmap was followed by an explanation of the process to the audience, followed by a presentation of the implementation and discussion of the roadmap. All comments were registered and discussed afterwards to improve the final version of the text.

Table 3: Program of the public audience held during BRACV 2019, June 27th, UTFPR, Auditorium Campus Curitiba

Time	Program
16:00	Welcome
16:05	Short overview of the roadmap process and main topics covered
16:20	Audience process
16:30	Audience
17:55	Final remarks
18:00	Closing session

Once the review process is finalized, the roadmap will be published at the IBICT's website. It is also foreseen to develop a video to disseminate the roadmap, which will demand the script definition, recording, editing and publishing the video. The script

definition will be prepared till the first week of July and it is expected to record the videos during the second week. The deadline to publish the video is October 2019.

On March 18th the divulgation of NDWG took place on IBICT's website and a survey about capacitation and inventory related suggestions for LCA in Brazil was sent on March 29th to more than 1000 persons, including PBACV, the Rede ACV and some event attendants (CGGCV, BRACV and LCA from A to Z). Besides the survey, the date of public consultation and audience was informed and prerelease about the elaboration of the Strategic Roadmap project on the events: LCA of Biochar, Biocycles, and Soil Meeting of Paraná.

The project was also announced on PBACV's Management Committee on March 25th and the preliminary document was launched on August 29th at the MCTIC (photos are available at Appendix C).

Roadmap for developing a national LCA database

Vision and goals

SICV's vision is the same of those from PBACV: to support the sustainable development, environment competitiveness growth of the Brazilian production sector and to support the development of public policies and decision making with environmental information (Inmetro, 2010a).

The objectives of SICV Brazil are:

- I. To disclose life cycle information;
- II. To raise LCI and LCA capacity building;
- III. To develop and provide inventories development methodology, with quality and consistency;
- IV. To develop, implement and spread the Life Cycle Assessment Database, linked to industries and academia.

Besides that, PBACV aims to:

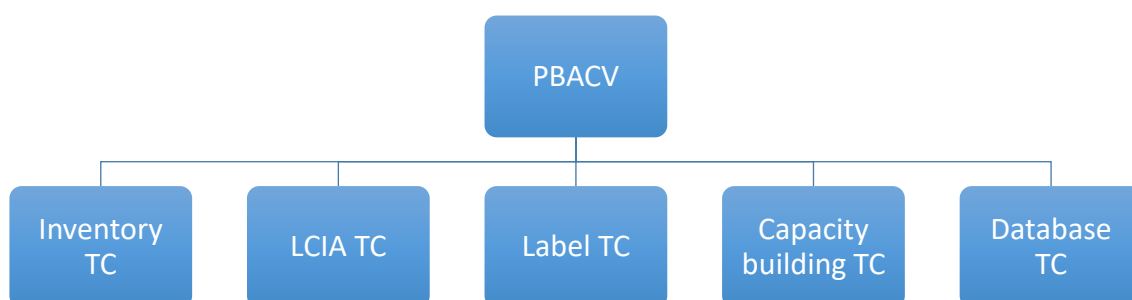
- I. Promote the use of studies of environmental impacts onto public policies definition and at the improvement of environmental performance at companies;
- II. Develop programs of conformity assessment;
- III. Develop and provide methods for LCA application;
- IV. Identify the main environmental impact categories for Brazil.

Organization and finances

Governance and management

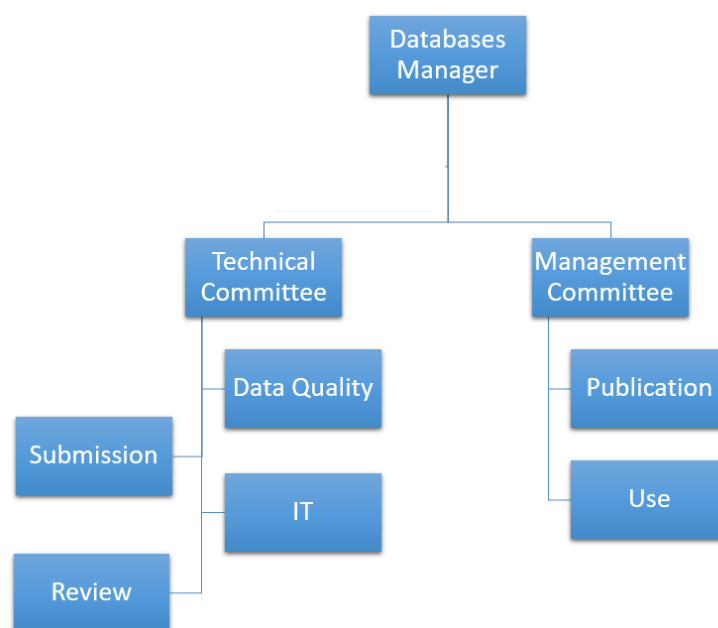
The addition of SICV Brazil onto the structure of PBACV and their current governance is presented at Figure 2. The database manager is IBICT, which is currently the leader of PBACV's technical committee on databases, counting with a data quality manager and an IT technician on the team. Data review is a casual and external activity.

Figure 2: SICV onto PBACV governance



The suggested model for SICV's governance (corresponding to the TC of databases and management) aims to adapt the current proposal in IBICT (2016), a research based on Sectorial Dialogues coordinated by IBICT, where the TC manager is supported by an advisory committee which is supported by a technical committee and the management committee, as in Figure 3.

Figure 3: SICV's governance



The database manager is IBICT, which is currently the main coordinator of the Database TC in PBACV, who coordinates the management and technical committee with the support of the advisory committee. It is recommended that the advisory committee is formed by at least one representative of the inventories and capacity building TC's of PBACV, at least one representative from the private sector (as potential suppliers and users) and one representative of a funding agency. The advisory committee should be responsible to develop the roadmap of the database in short, medium and long term.

As for the management committee, the manager is responsible for the publication and the usage of the database while the manager of the technical committee is formed by IT professionals trained in LCA, responsible for the data quality, the IT infrastructure, the submission and review processes (including the identification of reviewers).

Funds and financing

As the first option, the financing of the national database (SICV) would be done using public funds to maintain the system, plus public call for tenders funded by the public and private sector. However, it is noticeable that the private sector support will only be accomplished with clear benefits from the database.

The MCTIC considers LCA as a relevant tool for environmental assessment and for competitiveness of national industries and released, with CNPq, by the end of 2018, a public call to support research projects focused on life cycle inventory following Qualidata requirements. With this, MCTIC aims to use LCA to contribute with Brazilian agenda on bioeconomy.

The business sector considers LCA as an important tool. There are two different positions, one concerned that LCA becomes mandatory in sustainable procurement, due to the huge amount of small size companies in the economy and on the other side, the Rede ACV considers LCA to be an important tool and considers a priority to adapt inventories, as LCA provided added value to their products.

Considering this situation, to increase the engagement of both parts, some alternatives would be:

- Promote companies that do or provide data for LCA;
- Disseminate the benefits of LCA implementation by companies that found value in using LCA;
- Facilitate the use of LCA;
- Facilitate the development and supplying inventories to SICV.

Thus, it is recommended by the working group to identify the key people on the public and private sectors to raise awareness. A roundtable on BRACV 2019 discussed the subject. More details for future activities regarding this aspect in the Implementation Plan.

Human Resources

Database Management

The main points regarding the database management are the knowledge needed both from the IT perspective (ease of use and data security, for example) as well as the link to LCA. Therefore, a continuous capacity building is needed, especially to follow the international trends related to data formats, quality requirements and interoperability (see section on database interoperability).

Human Resources for LCI and SICV Brazil

The results of the survey to identify the state of human resources for LCI and SICV Brazil, the demand of capacity building and how to raise the data supplier are shown in Appendix B.

All-in-all, most of the studies developed were performed in academia, only 7% of all the studies developed were certified and the reason the inventories were not submitted to SICV Brazil were mainly three: the complexity, the lack of recognition and the data confidentiality.

The respondents suggested main courses of action (see Figure A.12 in Appendix B): awareness raising, incentives, capacity building, dissemination, partnerships and legal requirements. More details in the Implementation Plan.

Data and database

Database hosting and access

SICV Brazil is hosted and maintained by IBICT, which provides support with technical information to dataset providers and is responsible for the review management and inventory publication, at first free to users. This business model depends on the resource availability. It is recommended, however, backup plans in the case of the lack of resources.

There is a possibility of connecting to independent secondary nodes, interlinked below SICV. The datasets available on secondary nodes are not necessarily connected to SICV and are of responsibility of the institution where it is hosted.

Data needs and availability

Data needs

Having in mind the resource limitation, the definition of priority data in SICV is required. In a previous process led by the PBACV's Inventories TC, a list of priority datasets was performed, combining Rede ACV demands (more used datasets) and national environment impact contribution (Chiumento and Ugaya, 2016).

Some of the listed datasets were developed during the SRI project. Thus, it is relevant to make a new prioritization round. Furthermore, it should also consider the environmental impact models recommended by the Life Cycle Impact Assessment Research Network for the Brazilian conditions (RAICV, 2019) as well as other international recommendations (UN Environment and SETAC, 2016 and JRC, 2011).

The priority list can be obtained as a demand of the user point of view, for example, the datasets that are often used in any life cycle (some materials, energy, etc.).

All in all, it is relevant to identify the data collection priorities for SICV Brazil database. More details are shown in the Implementation Plan.

Data availability

Besides prioritization, it's important to highlight that there are datasets already available or that will be available in the short term that can be included in SICV Brazil:

- Datasets from the SRI project are already available freely to SICV Brazil, however, due to formats difference they are still not in the database. In this sense, some actions are taking place (see Implementation Plan);
- A survey performed by IBICT resulted in around 130 publications with potential to generate datasets;
- The CNPq's call aims to the development of inventories (1 to 2 years).

Therefore, the implementation process should include these data availability. More details regarding the achievements during the course of this project is in section on data-related activities.

Data quality requirements and review

Gerhardt et al. (2019) evaluated the use of Qualidata, concluding that it needs to be updated or complemented with new requirements, especially regarding data quality and a dataset quality score. Besides the original authors, other participants can be involved and discussions regarding the inclusion of minimum requisites and orientations for dataset conception, as well as a minimum elementary exchange group to be covered by the inventories. It is essential the inclusion of Inmetro know by the experience in the quality field.

As PBACV's goal is to improve the competitiveness of Brazilian products, it is crucial that the database can be used to obtain Environmental Product Declarations recognized worldwide, that is, meeting the requirements of specific certification schemes, for example, the Product Environmental Footprint (PEF) and Organizational Environmental Footprint (OEF) of the European Commission.

Promotion of LCA uptake in policymaking

The National Policy for Solid Waste, proposed by the Ministry of Environment, used for its conception the product life cycle thinking, focused on the final destination.

The *RenovaBio*, was launched by the Ministry of Mines and Energy in 2018 based on LCA and the agriculture and energy sector as a Brazilian contribution directly to the Paris Agreement. It is recommended that this policy include other impact categories, as water scarcity and to identify the implementation of similar public policies in other sectors.

It is recommended to identify the implementation of public policies in other sectors like chemicals, mining, construction and others.

Data-related activities during roadmap process

Interoperability with the Global LCA Data Access (GLAD)

The database format of SICV Brazil is ILCD and the database is connected to the *Global LCA Data Access (GLAD)* network, however not all inventories are in GLAD, as they are not according to GLAD requirements or demand conversion.

Besides that, theecoinvent Association prepared a procedure in order to convert ecospold2 data to GLAD's metadata descriptor files, which UTFPR tested for six SRI datasets. Currently these files are in process of validation to be connected to GLAD.

Interoperability between data formats

The objective of the data conversion activity was to convert data from the ecospold2 format to the ILCD format to include SRI datasets into SICV Brazil with minimum data losses and from the scratch as a learning process.

To achieve this objective, an IBICT and UTFPR team was formed and two approaches were proposed:

- Survey of LCI format converters, preferably open source, to allow modifications;
- Development of a list to compare the fields from both formats.

There were three converters available, all of them from Greendelta (olca-conversion-service, olca-converter and openlca converter). A comparison of results between the documentation (what they convert) and the list resulted in the selection of olca-conversion-service.

Most of the fields identified as convertible in the list are already included in the converter, so the primary idea to develop an own code was aborted to date and the converter was used. For those fields that did not match with the list (for example, 'energyValue' and 'specialActivityType' from ecospold2), few modifications will be done on the source code to include them.

Once the converter was selected, it was applied to the Embrapa's datasets (a total of 115) with good converting results as it kept the information structure on the following cases:

- Information about allocation;
- Identification of product exchange;
- Uncertainty;
- Variables and mathematical relations.

However, there were still some issues that are not solved, due to the fact that there are some specifications in ecospold2 that do not exist in ILCD. Although the conversion aims for minimum information loss, because the format structure is different from one another, not all fields in ecospold2 have possible conversion to ILCD (as is the case of Pedigree Matrix, that has no single field on ILCD). In these cases, the information was included in comment sections or modified to be included somewhere else (for example, instead of publishing the Pedigree values only the variance was included in the uncertainty).

Regarding the interoperability, the action plan includes the responsibilities, resources and risks are presented in the Table 6. The deadline to include the SRI datasets to SICV Brazil in middle July. A presentation of preliminary results was held during BRACV 2019.

Roadmap implementation plan

Based on all the aspects raised, an implementation plan was developed including recommendations for i) the governance and infrastructure; creating funding opportunities,

Governance and infrastructure

In view of the SICV's limitations regarding governance and infrastructure, it is recommended that three objectives should be reached: to improve the management governance for SICV Brazil, improve the infrastructure, and increase the LCA capacity of the IT system developers. Therefore, the actions, responsibilities, deadlines and necessary resources (defined in demanded hours of work) and associated risks are presented in Table 4.

As for the first objective, three actions are proposed to be achieved till the end of October 2019:

- to perform a critical analysis of the database management governance, starting from the current document and the recommendations in IBICT (2016);
- to validate the recommendations for the SICV management governance;
- to implement the governance structure.

To improve the capacity on LCA for IT system developers, it is foreseen the development of webinar, course validation and then the release of LCA training till the end of November this year.

The third objective is to improve the infrastructure with a dedicated server, which ought to be concluded by the end of January 2021. It is noticed that the risks of all three objectives are small.

Identify priorities for inventories and data quality and review requirements

Aiming to identify the priority list of inventories to be developed, two main goals were defined: the priority itself and the promotion of the development and submission of the inventories into SICV Brazil.

For the first objective, it was settled to perform three actions from the development of criteria to the final definition of the prioritized inventories to be set until October 2019 as shown in Table 5. The risks are lower to medium for the inventory definition, whereas high for the second objective, as it depends on the resources availability to promote events.

The objectives for the data quality and review requirements are to validate the Qualidata, to develop the inventory review process and to create a specific guide to evaluate data quality.

Table 4: Action plan and risk analysis on database management identification

THEME	OBJECTIVES	GOALS	ACTIONS	RESPONSIBILITY	RESOURCES*	RISKS	DEADLINE
Governance and management	Build and develop a management governance structure for SICV.	To obtain the SICV management governance	Critical analyses of the main management governance structure, management and use of international database of product life cycle inventories.	IBICT with support from external institution and experts	40h	Prob =high; Impact =small; Risk = small	October/2019
			Validate the recommendations for the SICV management governance	PBACV + invited	4h	Prob = high; Impact =medium; Risk = small	
			Implement the governance.	IBICT	40h	Prob = medium; Impact =medium; Risk = small	
HR for management, IT	LCA training for the system developers	Development of webinars	Elaborate a LCA course for computing professionals.	IBICT (Gabriel Duarte) + UTFPR (José Savioli)	30h	Prob = medium; Impact =high; Risk = small	september2019
		Course validation	Validate the LCA course for computing professionals.	IBICT + UTFPR			October/2019
		LCA Training	Offer the LCA course to the computing professionals.	IBICT (Gabriel Duarte) + UTFPR (José Savioli)	30h	Prob = medium; Impact =high; Risk = small	November/2019
Database hosting	Structure the environment for hosting a database	Adapt the environment for receiving big scale inventories	Buy equipment	IBICT	R\$70.000,00	Prob = small; Impact =high; Risk = small	January/2021
			Install and set up equipment.	IBICT	30h	Prob = high; Impact =high; Risk = small	
			Migrate SICV to our server.	IBICT	40h	Prob = high; Impact =high; Risk = small	

* when in hours, per person involved

Table 5: Action plan and risk analysis on inventory priority identification and data quality requirement

THEME	OBJECTIVES	GOAL	ACTION	RESPONSABLE	NECESSARIES RESOURCE	RISK	TERM
Priority and availability of inventories	Define the priority of inventories for SICV	Priority list of inventories	Create criteria for the inventories prioritization of SICV.	Inventories WG and DB from PBACV	30h		Oct-19
			Promote research with stakeholders, objectifying the inventories prioritization to SICV.	PBACV + stakeholders			
			Consolidate priority inventories list to SICV	Inventories WG and DB from PBACV			
	Promote the development and availability of the priority inventories to SICV.	Sensitize one strategic partner in, at least on economy sector related to the inventories prioritized by the SICV	Identify strategic partners to the economy sector related to the priority inventories to SICV.	Inventories WG and DB from PBACV	10h		Oct-19
			Promote events for strategic partners awareness to the economy sectors related to priority inventories to SICV.	Training WG do PBACV with support from ACV de A a Z.	30h		Oct-20
			Guide the strategic partners towards the creation of the prioritized	Training WG do PBACV with support from ACV de A a Z.	30h		Dec-20
			Guide the strategic partners towards the submission of priority inventories to SICV.	Training WG do PBACV with support from ACV de A a Z.	30h		Dec-20
Data quality and review requirements	Validate the Qualidata guide	Qualidata guide updated	Check the classification adequation of each requirement (mandatory, recommended and optional).	Directly: Juliana Gerhardt e Thiago Rodrigues	40h	Prob = small; Impact = high; Risk = medium	August/2019
			Check the requirements, reduce misinterpretation of the current guide.	invite previous authors: Marília Folegatti, Cássia Ugaya, Tiago Braga, Diogo Silva, Eduardo Toshio			
			Check the classification to decrease bias of data providers				
			Best way to presents the results and submit an opinion about that.				
	Inventory review	Technically reviewed inventories	Discuss possibilities of standardizing the technic review.	TG Inventories of PBACV	workshop with stakeholders (8h)	Prob = small; Impact = medium; Risk = small	October/2019
			Create forms for reviewing process	TG Inventories of PBACV			
			Identifying economic and professional benefits for attracting reviewers.	TG Inventories of PBACV			
	Create a specific guide for data evaluation and quality.	Identifying a strategy to develop the guide	Select between the Qualidata review and developing a new guide.	Qualidata 1 Authors+ stakeholders	workshop with stakeholders (8h)+	Prob = medium; Impact = medium; Risk = small	October/2019
					12 meetings (2h) + 16h to finish the version.		
		Create a specific guide for quality data evaluation			At least 240h		October/2022

Creating funding opportunities

Although the interest and the existence of PBACV, Rede ACV and other LCA networks, LCA is part of the Brazilian government agenda from time to time, being necessary actions with the government. In this sense, some strategies must be adopted as shown in the plan of action for funding mechanisms in the Table 6, including the business model, awareness raising in the public and private sector, LCA demand creation and to strengthen PBACV. Funding sources depend on the type of business model. The Working Group also understand that the more people are aware and concerned about the topic, the more funding will be available. In this sense, it was included in this session the stakeholder engagement, the value added, LCA in public policy and capacity building.

- Business model

As mentioned, the preferred business model (Plan A) of the SICV Brazil is to be free of charge to all with the financing from the public sector supported by the private sector. Nevertheless, this will depend on the resource availability. The Working Group recommend three backup plans in the case the first choice is not successful.

Plan B is that the financing is similar to Plan A, nevertheless the data access is free solely for researchers, education and the public sector.

Plan C financing differs from Plan B by charging everybody for the data access.

At last, in Plan D, the database is maintained by the private sector and the all users are charged.

- Stakeholders engagement

LCA can support competitiveness and innovation, therefore to engage agencies that have these goals are needed to promote funding mechanisms. A preliminary list of these agencies is CNPq, CAPES, FINEP, ANEEL, ANP and MDIC. A more comprehensive list is also part of the action plan as shown in Table 6. Once the agencies are listed, the key persons need to be identified and then awareness must be risen.

IBICT and Inmetro must be aligned to strengthen the PBACV's TCs efforts and to engage the funding agencies, for example, in BRACV and PBACV.

- Add value in LCA

There is a duality of reactions from companies from those interested in using national data and others that are concerned that LCA turns to be mandatory. Thus, creating mechanisms to support financially those that supply LCA data (either organizations or academia, research institutes and tertiary sector) will contribute to give value for the data and increase the data availability in SICV Brazil.

Another action that may support the data availability is to show the private sector the benefits of LCA for the business.

LCA can support the decision process and show the potential environmental impacts or benefits of the new technology, which are linked to some of the calls for proposals of research funding agencies such as CNPq, CAPES and FINEP:

- Create an specific knowledge area for LCA (similar to Assistive Technologies or Renewable Energy) that is independent to define the rules of the area linked to what is relevant to the success of LCA in the country;
- Release calls for proposals linked to innovative products by giving high scores to the proposals that includes LCA to assess the environmental impact of projects or/and publish datasets in SICV Brazil;
- Create demand to keep capacitated people working in the topic.

For the academy, it's important that a model is proposed to include and add value to publications of inventories on the curriculum, therefore raising the recognition on the data production for national LCA.

- LCA in public policies

To increase the implementation of LCA in public policies and identify possibilities for replicating RenovaBio, four objectives are proposed:

- the consolidation of LCA method (for example, by including other impact categories, such as water footprint);
- to raise awareness in the public sector on opportunities of using LCA in environmental policies, such as the move from LCT to LCA in the National Solid Residues Policy;
- the identification of key actors in other sectors besides biofuels to replicate the case of Renovabio and;
- to raise at least one sector to replicate Renovabio.

- Awareness raising and capacity building in LCA

To create critical mass in LCA, it is crucial to promote courses on LCA for the public and private sector, for the civil society and institutions that have interest or involvement with LCA, especially to raise awareness and introduce LCA, which may enable the inclusion of LCA in public procurement and increase the interest in supporting LCA.

Besides that, discussions about the subject in BRACV 2019 brought the necessity of bringing the LCA, with training and courses, to the IT area, for more people with this knowledge to be engaged and contribute to the development of the database.

Interoperability converter

As mentioned in data-related activities section above, part of the interoperability was performed during this project, as also shown in Table 7. Although the converter supported the data conversion from ecospold2 to ILCD, there were still some minor points that need to be automatized which is foreseen to be finalized by mid-July.

Table 6: Action plan and risk analysis on resource mechanism identification

THEME	OBJECTIVES	GOALS	ACTIONS	RESPONSIBILITY	RESOURCES*	RISKS	DEADLINE
Business Model	Financing resources	Definition of a SICV's business model	Plan A - maintained by the public/private resources - free access to all	PBACV Coordination Committee		High risk	BRACV 2021
			Plan B - maintained by the public/private resources - free access for research, education and the public sector			Medium risk	BRACV 2023
			Plan C - maintained by the public/private resource - paid access for all			Medium risk	GCV 2024
			Plan D - maintained by the private resource - paid access for all				After GCV 2024
Increase LCA usage and available resources	Raise awareness on LCA relevance for public and private sectors	Select Life Cycle Initiative material on awareness, translate and make it available		PBACV's Capacitation TC with help from ACV de A a Z	30h	Medium risk	until 2021
Strengthening PBACV	Align with IBICT and Inmetro new management	Budget availability for PBACV	Meeting between new management of Inmetro and IBICT	IBICT and Inmetro	4h	Prob + medium; Impact + high; Risk + high	Jun-19
	Engage public and private financing institutions	Financing for PBACV	Identify key actors in public financing institutions (MCTIC, FINEP, CNPq, CAPES, ANP, ME, ANEEL, MAPA, APEX, Unesco, etc...) and private institutions (LCA Network, bancas)	Management Committee of PBACV	30h	Prob + low; Impact + high; Risk + medium	Jun-19
			Reach at least one financial institution	Management Committee of PBACV	30h	Prob + low; Impact + high; Risk + medium	Dec-19
LCA implementation in the public policies.	Consolidate the LCA method (RenovaCalc) used by Biofuel National Police (RenovaBio).	Optimize RenovaCalc, in order for it to meet the regulatory agency demands (ANP), as well as the productive sector and seek to align it with	Identify the optimization opportunities in RenovaCalc through the continuous monitoring of stakeholder's manifestation in the ANP.	Embrapa, IBICT, ANP and partners	40h	Prob + low; Impact + high; Risk + medium	until 2023
			Implement optimization at RenovaCalc	Embrapa, IBICT, ANP and partners	80h	Prob + low; Impact + high; Risk + medium	
	Sensitize the governmental sector about LCA application opportunities in the environmental policies, including sustainable procurement	Sensitize the main users of LCA, in relation to their potential of application of environmental policies.	Identify the main users of LCA in the governmental sector.	Coordination Committee of PBACV, MCTIC, MME, MAPA, MMA	20h	Prob + low; Impact + high; Risk + medium	Oct-19
			Promote awareness events about the potential of LCA application in the environmental policies.	Training TG do PBACV with support from LCA de A a Z.	30h	Prob + medium; Impact + high; Risk + high	Dec-20
Identify possibilities for replicating RenovaBio on other sectors	Identify key actors for other sectors (bioelectricity, chemicals, plastics, energy, import/export products with climate change emission reduction compromise and ODS)	Identify key actors for other sectors on the next meeting of the management committee of PBACV	Brainstorming during BRACV 2019	Management Committee of PBACV	30h	Prob + low; Impact + high; Risk + medium	Jun-19
	Sensitize key actors for other sectors	Sensitize at least one sector	Conduct meetings with potential key actors	Management Committee of PBACV	30h	Prob + medium; Impact + high; Risk + high	Dec-19
Regulate actions related to LCA on PNRS			Identify related legislation of PNRS and articulate with MMA	Management Committee of PBACV	4h	Prob + low; Impact + high; Risk + medium	Dec-19
			Present as experts to help at the elaboration of regulation	Management Committee of PBACV	30h	Prob + low; Impact + high; Risk + medium	Dec-19

* when in hours, per person involved

Table 7: Action plan and risk analysis for interoperability

THEME	OBJECTIVES	GOALS	ACTIONS	RESPONSIBILITY	RESOURCES (per person involved)	DEADLINE
Data format and interoperability	Convert the Ecoinvent data from Ecospold2 to ILCD using the OpenLCA converter and the own data validator	Data correspondence.	Make a data conversion table; Clarify any doubts about the data correspondancy with ILCD and Ecoinvent people; Finish the conversion table for the validator; Meeting to share the correspondance and discuss previous algorithm ideas	Gabriel Duarte and José Paulo Savioli	40	17/may
		Program de validator based on the correspondences made	Analyse the correspondences already made and how to asses each one; Build an information file without using conversion; Create and algorithm that can check and validate using OpenLCA conversion; Create and algorithm that can log all validator's mistakes	Gabriel Duarte and José Paulo Savioli	Possible work trip to programming dataset.	Mid June
		Test the modified converter and verify the validator's results using the OpenLCA conversion and verifying data with the validator.	Test the validator code efficiency using datasets in the Ecospold2 format; Test the results through the comparison and test in LCA software.	Gabriel Duarte and José Paulo Savioli	40	Mid june
		Convert the validated inventories	Convert the avilable data from Ecoinvent	Gabriel Duarte and José Paulo Savioli	40	mid July
		Presentation at BRACV			2	26-Jun

Life cycle inventory capacity building

Last, there is a need for increasing the number of LCI capacitated people in the country. For this, it is recommended that the PBACV's Capacitation TC interact with other projects, as LCA from A to Z and LCA Network, to combine efforts and increase the efficiency of the actions of the different stakeholders. Table 7 presents more details about the action plan and risk analysis.

Risk management

According to the risks raised in each topic, the higher risk identified to populate the database consists of the lack of funding from the public and private sectors. In this sense, it is important to identify key people on these institutions and raise awareness for the financing to be available as shown in the sections above, as well as stimulate the engagement of institutions that have interest or are involved in LCA.

Table 8: Action plan and risk analysis for capacitation

THEME	OBJECTIVES	GOALS	ACTIONS	RESPONSIBILITY	RESOURCES (per person involved)	DEADLINE
HR for inventory development	Training for SICV	Training material development	Develop and review SICV's training material	Thiago Rodrigues (GCV 2018 and ACV de A a Z) and José P. Savioli	30h	Jun-19
		Material testing	Pilot training using material from BRACV 2019	IBICT and ACV de A a Z	3h	Jun-19
		Inclusion on LCA courses	Incorporate at least 5 LCA courses	Capacitation TG from PBACV with help from ACV from A to Z	6h	until 2021
		Long distance learning	Webinars	Capacitation TG from PBACV with help from ACV from A to Z	30h	until 2021
		Train the trainers	Identify professionals for advanced learning	Researches of Strategic Roadmap and inventory authors identified in Lury (2019) and on event Populating... (IBICT and UNEP, 2015)	4h	until 2020
			SICV's training at least once per year	Capacitation TG from PBACV with help from ACV de A a Z	3h	until 2021

Conclusions and recommendations

The results show that, despite having a network of interested stakeholders in LCA, LCI and the confirmed necessity for a database, to support the SICV, there is still more to be done. All this impact could be amplified by the promotion of awareness and capacitation of the public sector, private sector and other institutions with interest or engaged in LCA, which would promote investments for the SICV to prosper and would, ultimately, lead to a contribution for the sustainable development.

Acknowledgments

The National Working Group on Databases thanks the LCA survey respondents, Fernanda Belizario Silva (IPT), Jaqueline Barbosa do Nascimento Poole (EFI) and Adrisson Carvalho de Loreto (UTFPR) that sent their comments about the text and its content and those who participated on discussions about the roadmap topics on BRACV 2019 and other events.

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Appendix A - NDWG meetings

Date	Time	Participants	Excused	Subject
18/02/19		Tiago Braga e Juliana (IBICT)		Presentation of the objectives of the roadmap
	14:00	Cristiane Sam paio (Inmetro)		Brainstorming - strategic and technical aspects
	-	Yuki Kabe (representando o Luiz Ortega, da Rede ACV)	Bruno Nunes (MCTIC)	Definition of the next steps
	15:30	Marília Follegatti (Embrapa)	Gil Anderi (ABCV)	Definition of the schedule
		Cássia Ugaya (UTFPR)		Other
				Clarification points raised during last meeting
18/03/19	13:30	Tiago Braga e Juliana Gerhardt (IBICT)	Bruno Nunes (MCTIC)	Minutes approval
	-	Cristiane Sam paio (Inmetro)	Gil Anderi (ABCV)	Ongoing process
	14:30	Cássia Ugaya e José Paulo Savioli (UTFPR)	Luiz Ortega (Rede ACV)	Discussion on each Roadmap point
			Marília Follegatti (Embrapa)	Maturity level assessment
				Definition of next steps
25/03/19	10:50	Bruno Nunes (MCTIC)		LCA relevance
	-	Cássia Ugaya (UTFPR)		Resources for LCI and LCA
	12:00			LCA commitment
				Other
25/03/19	16:00	Luiz Ortega (Rede ACV)		Roadmap process
	-	Cássia Ugaya (UTFPR)		Point of view from the private sector
	16:30			
15/04/19	14:00	Tiago Braga, Thiago Rodrigues, Juliana Gerhardt (IBICT)	Bruno Nunes (MCTIC)	Poll partial results
	-	Cássia Ugaya e José Paulo Savioli (UTFPR)	Gil Anderi (ABCV)	Next steps
	15:30	Marília Follegatti (Embrapa)	Luiz Ortega (Rede ACV)	Responsibilities and deadlines
			Cristiane Sam paio (Inmetro)	Risks
				Other
13/05/19	14:00	Thiago Rodrigues, Juliana Gerhardt (IBICT)	Tiago Braga (IBICT)	
	-	Cássia Ugaya, José Paulo Savioli (UTFPR)	Bruno Nunes (MCTIC)	Discussion on the action plans
	15:30	Marília Follegatti (Embrapa)	Gil Anderi (ABCV)	New meeting dates
			Luiz Ortega (Rede ACV)	
			Cristiane Sam paio (Inmetro)	
24/05/19	14:00	Thiago Rodrigues, Juliana Gerhardt (IBICT)	Tiago Braga (IBICT)	
	-	Cássia Ugaya (UTFPR)	Bruno Nunes (MCTIC)	Discussion on the action plans
	15:00	Marília Follegatti (Embrapa)	Gil Anderi (ABCV)	
			Luiz Ortega (Rede ACV)	
			Cristiane Sam paio (Inmetro)	
03/06/19	13:30	Thiago Rodrigues, Juliana Gerhardt (IBICT)	Tiago Braga (IBICT)	
	-	Cássia Ugaya (UTFPR)	Bruno Nunes (MCTIC)	Final remarks on the action plans
	14:30		Gil Anderi (ABCV)	
			Luiz Ortega (Rede ACV)	
			Cristiane Sam paio (Inmetro)	
			Marília Follegatti (Embrapa)	

Appendix B – Results of the poll

The Figures A.1 to A.12 show the results of the poll Identification of capacity in LCA inventories development. The first four figures show the characteristics of the respondents (16,8%):

- Most of them are PhD or Masters Degrees (71%);
- There is an evenly distribution of people in the public sector, private (including consulting) and academia;
- Most of the respondents (73%) have a medium knowledge level of LCA (performed an unrecognized LCA study);
- 66% are working with LCA for more than two years.

Figure A.1: Education level of respondents

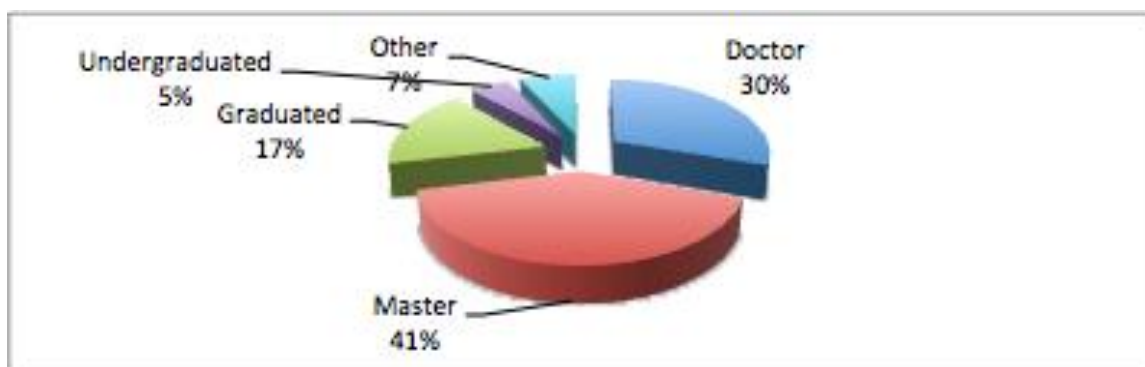


Figure A.2: Economic sector they act

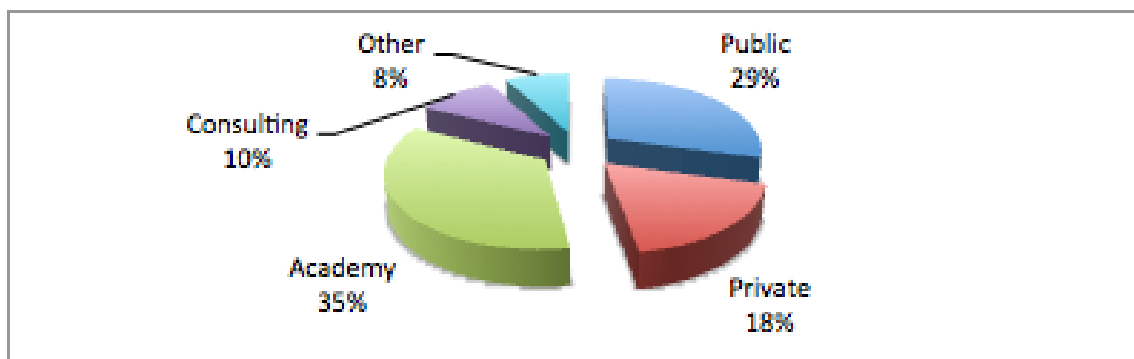


Figure A.3: Level of LCA knowledge

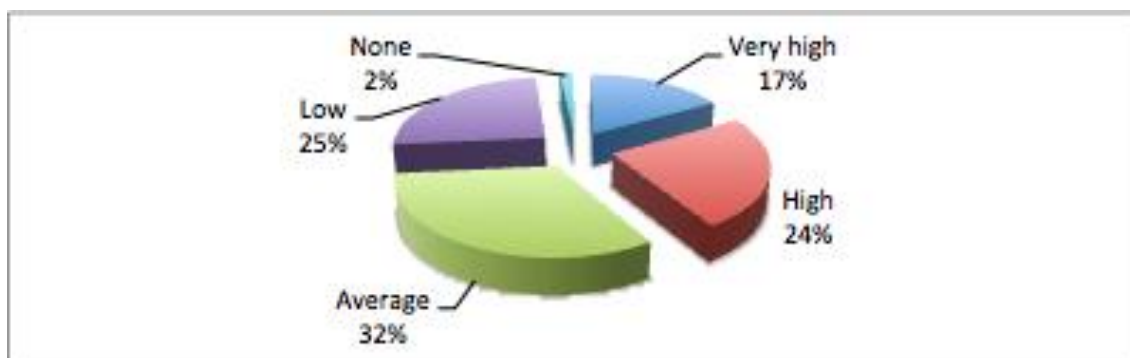
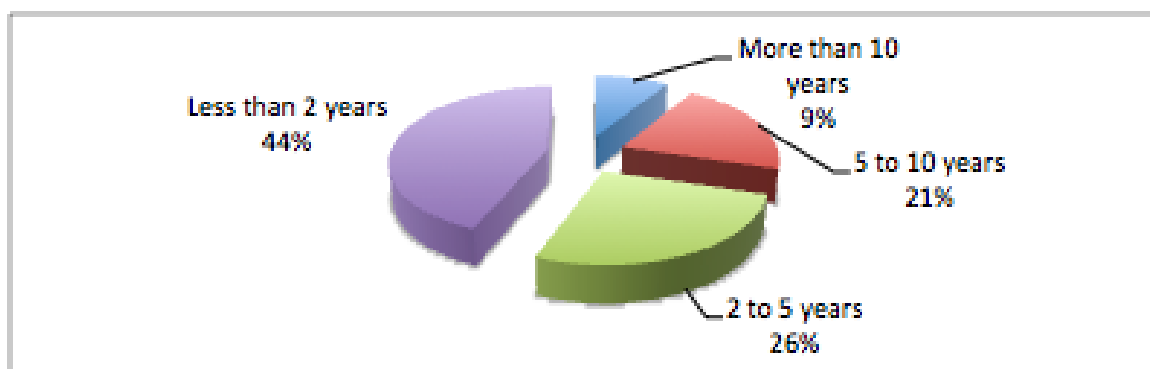
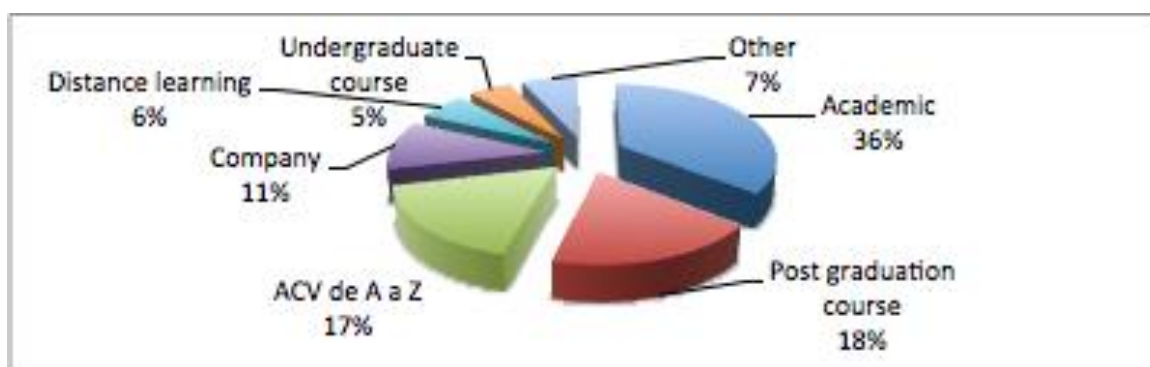


Figure A.4: Years of experience in LCA



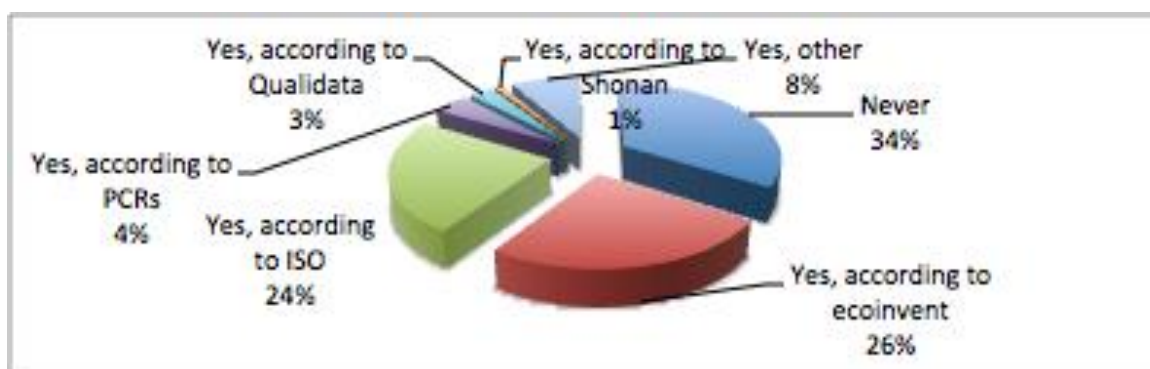
While asked how the LCA learning process occurred, most of them responded that it was during their post-graduates (36% in their own studies and 18% in courses), followed by other courses (LCA from A to Z – ACV de A a Z, in person and online training) as shown in Figure A.5.

Figure A.5: How respondents learned LCA



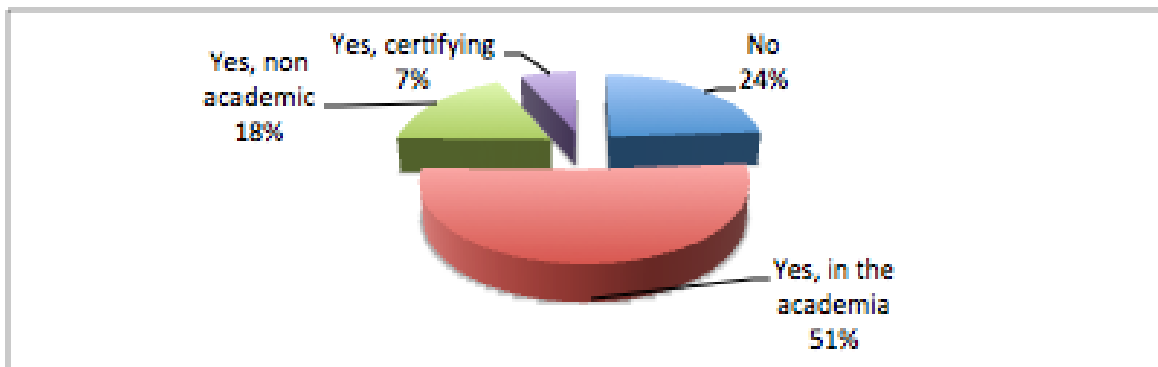
34% of the sample never developed a datasets. Those that did develop followed mostly ecoinvent and ISO requirements, with very few attended Qualidata, PCRs and Shonan Guidance (Figure A.6).

Figure A.6: Dataset production for LCA



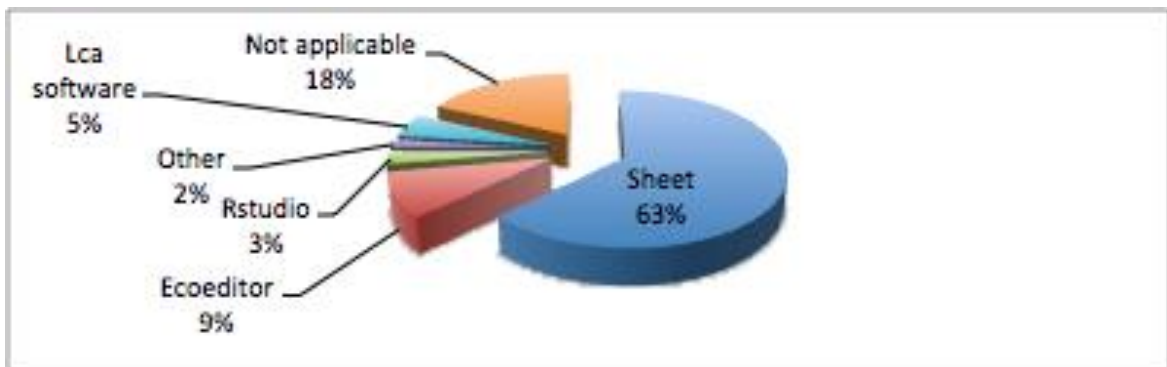
As most of the studies were in the post-graduation studies, most of the reviewing process were also in academia (51%, in Figure A.7), which does have different requirements than an LCA inventory. Only 7% of the studies had third part certification.

Figure A.7: Datasets reviewed



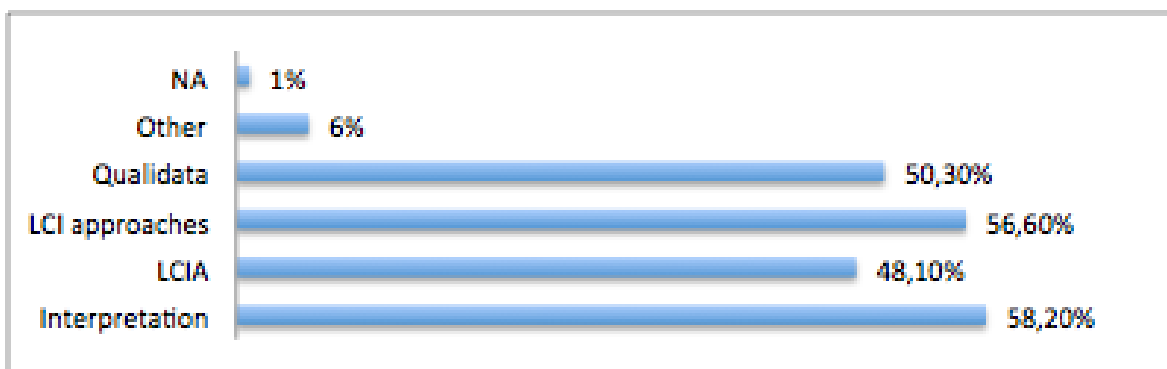
Spreadsheets are the most common tool to develop the inventories (63%), followed by ecoeditor and LCA software as shown in Figure A.8.

Figure A.8: Technology used for datasets elaboration



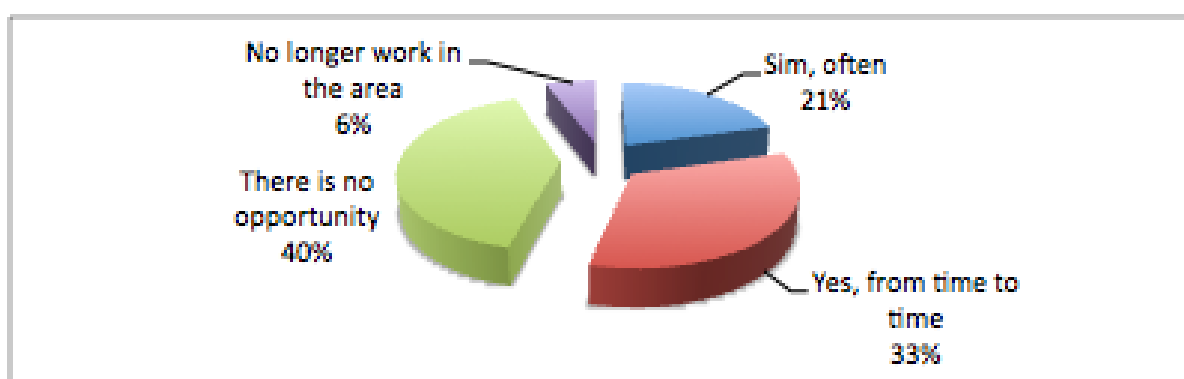
At last, the respondents presented the demand for capacity building, whose main themes are listed at Figure A.9.

Figure A.9: Necessity of capacitation



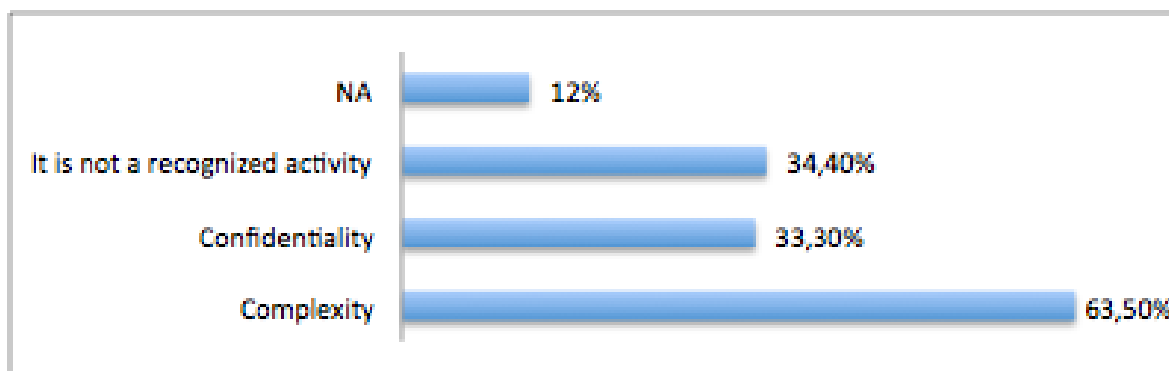
Another aspect that calls attention is the percentage of respondents that have no opportunity of continuing their elaboration of datasets or that do not act in the area anymore (46%), as shown in Figure A.10. Most respondents that claimed not having the opportunity came from the academic area. The analysis of the reasons will be present for the final document.

Figure A.10: Continue to produce datasets?



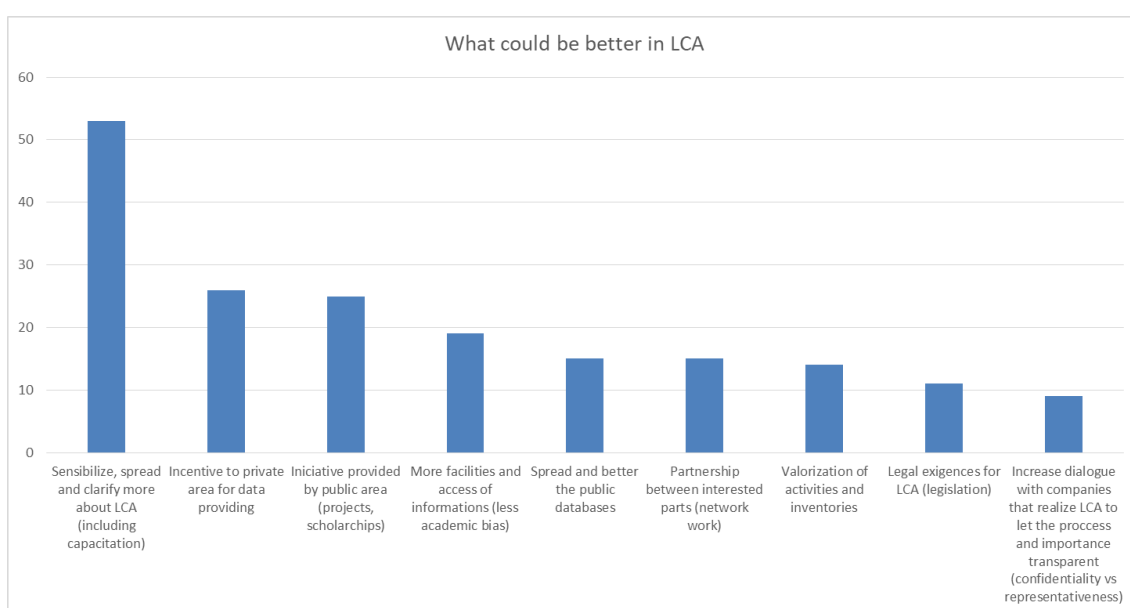
Considering those that developed datasets, the reasons why only few of them were available in SICV was presented. 63,5% of the people who respond claim that the complexity is the main factor, followed by the fact that this activity is not recognized and then the data confidentiality (Figure A.11).

Figure A.11: Difficulty to provide inventories to the database



Finally, the last question asked was, what is necessary to raise interest on data providing for SICV Brazil, as shown in Figure A.12.

Figure A.12: Suggestions to raise interest on data providing for SICV Brazil



Appendix C – Photos

Public Audience at BRACV 2019, UTFPR



Dissemination at MCTIC



