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INTRODUCTION

LCA and LCC approaches can evaluate the environmental load and cost of a product, process or activity throughout its life cycle. LCA can serve to improve the overall environmental performance of a product, or it can be the basis for communicating achievements of the manufacturer towards sustainable production. Moreover, LCC will also guide the optimization actions according to its results, e.g. by identifying possible economic or financial bottlenecks within the supply chain.

Work Package 8 aims to perform the LCA and LCC analysis of the application of the SOCRATCES technology. In order to conduct life cycle assessments, the evaluation method and strategy for the data collection will be developed in a first step. The LCA will take into account energy stored/consumed/produced, material consumption, emissions, potential risks, land use, toxicity. The LCC assessment is a method for evaluating all relevant costs over time of a project, product or service. It takes into reference initial costs, including capital investment, purchase and installation costs; future costs, including energy costs, financing costs, maintenance costs, capital replacement costs, operating costs; and any resale, salvage, or disposal cost, over the life-time of the project, product or measure [1, 2]. The ecological and economic assessment will include all processes starting from calciner through storage reservoirs, carbonator and power block.

The most challenging task for WP8 will be to collect the process data for all process steps (mass balance, energy consumption/generation and specific costs) for the SOCRATCES technology but also for the alternative processes.

1. METHODOLOGY

1.1. Fundamental information

1.1.1. Stages of LCA

Life cycle assessment analysis is a technique for assessing the environmental aspects and potential impacts associated with a product of interest and includes the accomplishment of the following tasks:

- Compiling an inventory of relevant inputs and outputs of a product system.
- Evaluation of the potential environmental impacts associated with those inputs and outputs.
- Interpretation of the results of the inventory analysis and impacts assessment phases in relation to the objectives of the study. [3]

The LCA analysis has been established since the late 1990ies and it is based upon the life cycle assessment methodology, as described in the ISO-standards 14040:2006 and 14044:2006 [4-5]. Accordingly, to the ISO-standards, an LCA has four major stages: goal and scope definition, inventory analysis, impact analysis and results interpretation (Figure 1).

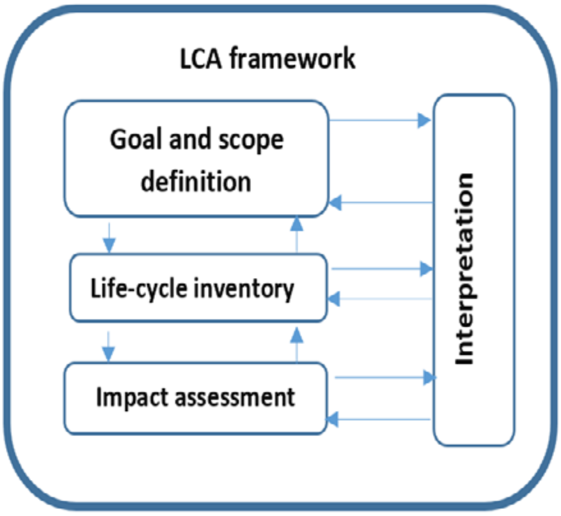

Figure 1. Stages of LCA [4-5]

1.1.2 Goal and scope definition

Goal and scope definition are the first phase of any life cycle assessment. Six aspects should be addressed and documented during the goal definition: intended application of the results (marketing, product development, product improvement, strategic planning, etc), limitations and assumptions, reasons for carrying out this study and decision – context and target audience of the results (shareholders, executives, engineers, consumers, etc), comparative studies to be disclosed to the public and commissioner of the study [6].

The **overall goal** of the LCA is *assessing the environmental profile of the SOCRATCES technology and evaluation of energy and waste flows associated with calcium looping thermal energy storage system over different stages of its life cycle.*

When deriving **the scope** of an LCA study from the goal, the following scope items should be clearly described and considered: functional unit, reference flow, description of the system, system boundaries, allocation procedures, impact categories and impact assessment method, data requirements, data assumption, limitations, data quality requirements, and reporting type.

Whereas, for the LCC the scope of the evaluation is *assessing the total cost of SOCRATCES implementation for each configuration within the project, with the aim of clear understanding where the economic burdens are exhibited and if net benefits arising from the technology implementation are offsetting the expenses.*

This study is carried out to quantify the total revenues and complete costs of the SOCRATCES systems; the main goal of this study is to evaluate all the economic and financial impacts of the core activity systems designed throughout its life cycle, where the expenses are coming from purchases, such as machinery and raw material. Furthermore, the main revenues derived from the application are those produced by selling all the outputs obtained from the system which are, in this case, the electricity generated from the power cycle linked to the carbonator.

The **functional unit** is the quantified definition of the function of a product. The future technologies must have the equivalent functional units. Part of defining a functional unit is the definition of a reference flow, which is the measure of product components and materials needed to fulfil the function, as defined by the functional unit. The data collected during the inventory phase is related to the **reference flow**. An appropriate selection of the functional unit is crucial because, different functional units can lead to different results for the same product system and the data used in the LCA must be calculated or scaled in accordance with the reference flow, moreover the revenues gained by the electricity produced from SOCRATCES, which is most likely, the main income generated are assigned to the output streams (i.e. direct sales of electricity to the grid).

In this context, taking into account the previous considerations about systems studied over literature review, the mutual work driven for both environmental and economic assessment and in accordance with the main goals of the SOCRATCES project, the functional unit selected for this project is **1 kW of thermal energy stored** over specific lifetime for the SOCRATCES systems [7].

The functional unit could be subject of amendments if the specifications coming from the system development drastically change.

The **system boundaries** define which technological units will be included in or excluded from the system considered. A process flow diagram shows the processes and their relationships. The Figure 2 shows a generic process flow diagram for with all processes included in LCA and LCC evaluations.

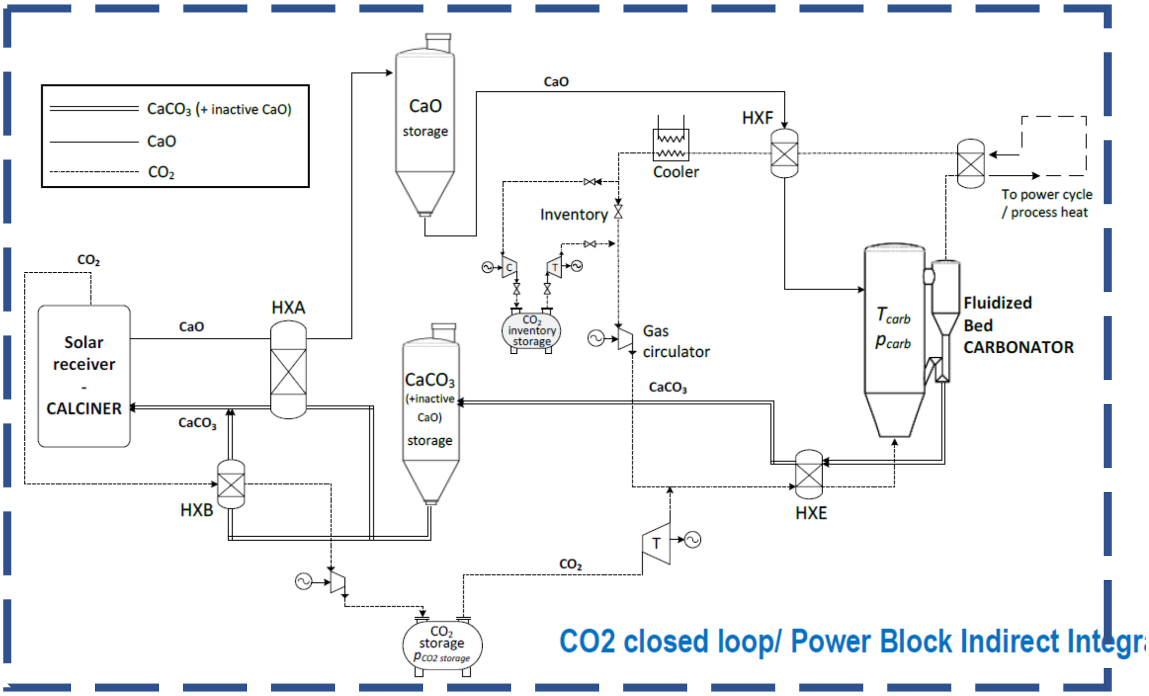

Figure 2. Flow diagram of a CaL- CO_2 closed Brayton cycle integration for energy storage in CSP plants (source: Grant Agreement)

There are four main options to define the system boundaries used: cradle-to-grave, cradle-to-gate, gate-to-grave and gate-to-gate. For the present studies, considering the remarks of the literature review about the systems, it was decided to use **cradle-to-grave** approach, which includes the material and energy production chain and all processes from the raw material extraction through the production, transportation and use phase up to the product´s end of life treatment [8, 9], as also shown in general representation, in Figure 3.

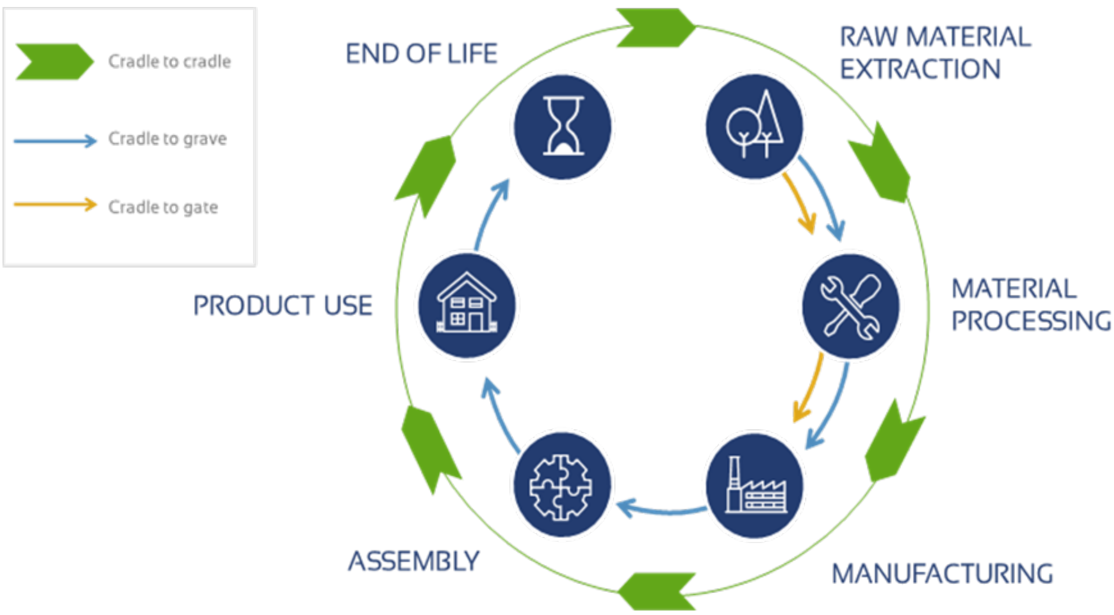

Figure 3. System boundaries definition

This selection does not differ for the LCC study where any phase of an activity's or product's life cycle need to be included in the economic assessment. Therefore, also for the economic assessment, the cradle-to-grave system boundaries will be undertaken.
Data quality will be documented to define the required properties of the data for the study. The following aspects will be considered for the data quality: data acquisition (calculation, measurements or estimations, the quantity of primary data used and how many are coming from literature and integrated database source), time-reference (the time of collection and possible changes), geographical reference (country/region), technology (the source for the secondary data is literature, database, older technologies), precision, completeness, consistency and reproducibility.

1.1.3 Life cycle inventory (LCI)

The inventory analysis involves the compilation and quantification of input and output for the analysed system, collection and compilation of the data. Figure 5 shows the process of the setting up of the inventory [6]. As data collected and more is learned about the SOCRATCES technology, data requirements or limitations may be changed in the data collection procedure.

Data collection implies the gathering of quantitative and qualitative data for every process in the system. The data can be classified as following: energy input/storage, production, raw material input, products, waste, and emission to air, water and soil. The data collection sheet can be found in Annex (Table3).

Before calculating the life cycle inventory, the following steps should be completed: validation of the collected data should be done using the mass and energy balances, the collected data has to be related to unit processes and to the functional unit. These steps are required to generate the LCI for each unit process and for the overall product system. The LCI of the whole system is the sum of all LCIs involved.

Related to the economic assessment and within this stage, all the main capital, consumption and operating costs, as well as revenues through the entire life cycle included in SOCRATCES project and in relation to the functional unit will be gathered and grouped in an inventory. For this objective, a systematic template for data collection is prepared (see Table 4 in Annex).

There are different options for obtaining data for the studies. In this case, it will be possible to access to semi-industrial and industrial data thanks to participation of technology development partners; their financial/business teams are required to provide information for the inventory analyses, which is updated continuously as soon as new refinement from the partners are coming in.

Usually, this is the longest and most intensive task of LCC because the partners in the consortium, by means of a spreadsheet properly and timely provided to the evaluator, must fill it up with the data required for the assessment. It is very important to build a strong communication with technology development partners by filling the spreadsheet, phone calls to provide comprehensive and correct inputs for this analysis.

The results will be introduced in the following format:

- *Life Cycle Costs*: all the expenses and possible revenues over the time horizon of the assessment in no-cumulative (prices are not summed up over time) and cumulative (prices are summed up over time, plus net benefits evolution) calculations.
- *CAPEX amounts*: all the capital expenditures grouped at the lifetime of the project and the time horizon of the assessment.

- *OPEX amounts*: all the operational and consumption expenditures grouped at the lifetime of the project and the time horizon of the assessment.
- *Relevant figures*: total and annual values expenditure, revenues and net benefits at the lifetime of the project and the time horizon of the assessment.

In case the accuracy of the data provided by the consortium partners are not satisfactory, several sources will be considered, such as literature review and estimations, Figure 4 shows the scale of preferences:

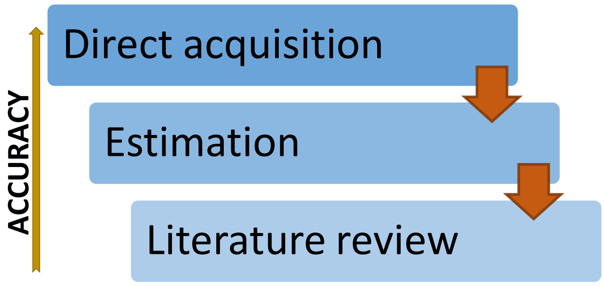

Figure 4: Data collection preferences

It is possible to identify the accuracy of data collection preferring direct acquisition of the data needed over the other options as the most accurate procedure to undertake.

The initial investments costs and the revenues from selling electricity developed will be based also on data from several sources such as scientific papers and estimations, if not properly provided or if unreliable data were received from the partners.

1.1.4 LCA software, database and environmental impact methodology

The LCI will be performed using the software "Umberto NXT LCA" incl. "ecoinvent v3". The software umberto NTX LCA uses graphic modelling of the product/process life cycle, and allows analyzing, assessing and visualizing the environmental impacts in different impact categories.

The first step is drawing the life cycle model or process map. Specification of the processes and activities in the model is the next step, before the calculation of the material and energy flows, and the life cycle impact assessment can be launched. The results are displayed graphically and in tables. The life cycle model can be displayed as Sankey diagrams, both for material and energy flows, as well as for weighted "impact flows", i.e. the environmental impact loads cumulated along the stages of the life cycle.

The integrated database ecoInvent v3 gives a large variety of internationally collected and verified data on different products, materials and services (in total approx. 9.000) and can be used to model raw material and energy supply chains or end-of-life treatments paths.

Impact assessment methods provided by datasets suppliers are also included into the software and can be used to calculate the scores for different impact categories.

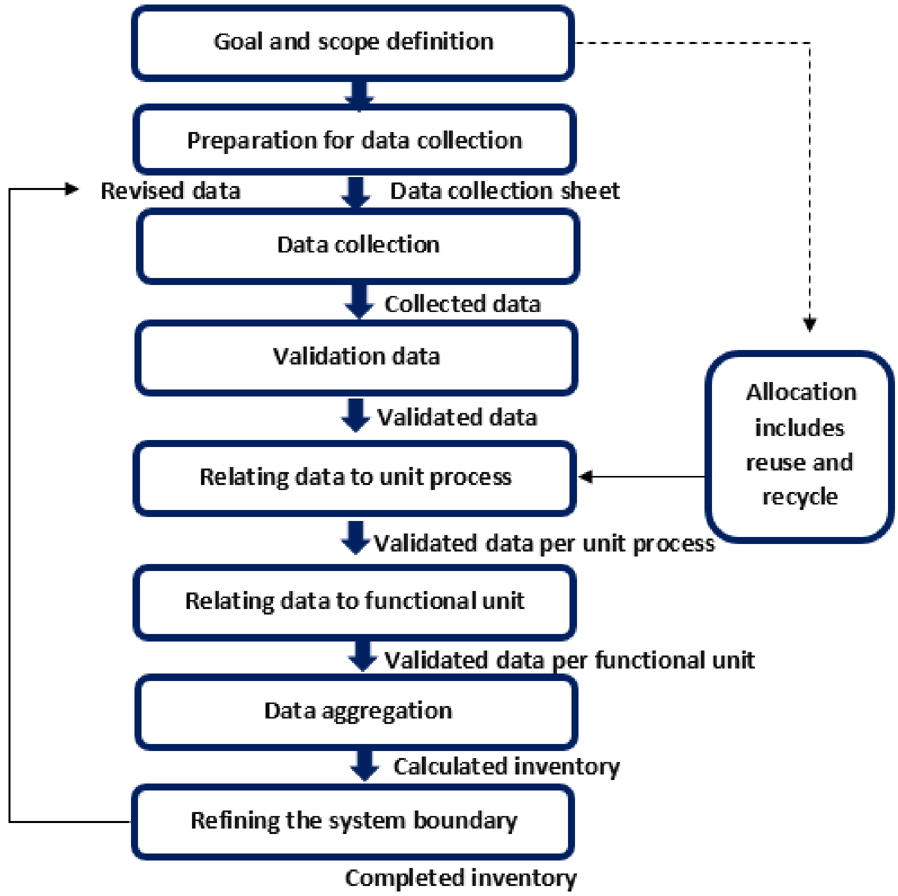

Figure 5. Data collection and calculation process [6]

1.2. Life cycle impact assessment (LCIA)

LCIA identifies and evaluates the amount the significance of the potential impacts arising from LCI and there is primary energy consumption, resource consumption, greenhouse potential, ozone depletion potential, acidification potential, photochemical ozone creation, water emissions, solid waste emissions, toxicity potential, risk potential and land use. Environmental impacts will be determined on the basis of six main aspects: the consumption of energy, depletion potential, the consumption of raw materials, resulting emissions, the toxicity potential and the abuse and risk potential. The emissions category includes water emissions, wastes and air emissions. The air emissions consist of global warming (GWP), ozone depletion (ODP), acidification (AP) and photochemical ozone creation (POCP) [10]. Based on these environmental impacts, weaknesses and potentials can be easily described and improved. Data acquisition and calculation will be done according to ISO 14040.

Cumulative energy demand implies the cumulative life cycle energy consumed during product production, use and disposal. All forms of energy are calculated kWh/kg solid fraction.

Depletion potential or amount of key materials consumed, is currently calculated in terms of kg material per kg of the target product. Resources are defined as a fundamental building blocks needed to produce a product (e.g. coal (raw material for electricity manufacturing), oil, gas, sulfur, iron, phosphorus, sand, copper, etc.). One should keep in mind, that the weighting of the individual raw material consumption values is based on available resources and demand for the specific materials. The lower the reserves of a raw material and the higher the worldwide rate of consumption, the scarcer that resource is and, therefore, the higher the weighting factor it is assigned. The following resources depletions can be referred to this impact category:

- Fossil depletion (FD), reported as kg-oil - equivalent
- Metal depletion (MD), reported as kg Fe - equivalent
- Water depletion (WD) (m^3)

Emission values are initially calculated separately as water, air, and soil emissions.

Water emissions include both the total amount of emissions in water and the ecological impact of the chemical being emitted. The following emissions can be referred to this impact category:

- Marine ecotoxicity (Meco), reported as kg 1,4 -DCB- equivalent
- Marine eutrophication (ME), reported as kg N- equivalent
- Fresh water ecotoxicity (FWeco), reported as kg 1,4 – DCB - equivalent
- Fresh water eutrophication (FEW), reported as kg P - equivalent

Air emissions are calculated in terms of mass of generated per kg of sugar mixture. The following emissions can be referred to this impact category:

- Global warming potential (GWP), reported as CO_2 equivalent
- Photochemical oxidant formation (POCP) - kg NMVOC, reported as ethylene equivalent
- Ozone depletion potential (ODP) - kg chlorofluorocarbon -11 - equivalent
- Particulate matter formation (PMF) with an aerodynamic diameter smaller than 10 mm

The air emissions are weighted with a factor reflecting their potency regarding the global warming, acidification and ozone depletion potential.

Solid (waste) emissions account for all materials disposed of in a landfill. Recycled or reused materials are not considered as solid waste. The following impacts can be related to this impact category:

- Terrestrial acidification (TA), reported as kg SO_2 - equivalent
- Terrestrial ecotoxicity (TE), reported as kg 1,4 - dichlorobenzene - equivalent

Land Use is an assessment of the environmental impacts on biodiversity through land use and land transformation and it is quantified as m^2 a/ kg of the sugar mixture.

- Agricultural land occupation (m^2a)
- Natural land transformation (m^2)
- Urban land occupation (m^2 a)

Toxicity potential should be assessed both for the product and for entire pre-chain chemicals used to manufacture the product. The following impact are related to this category:

- Human toxicity (HT), reported as kg 1,4 – dichlorobenzene - equivalent
- Ionising radiation (IR), reported as kg U235 – equivalent

Risk potential reflects the danger of accidents in the manufacture, use and recycling of the product. The values used for the individual products are not absolute but only comparative. The following assessment quantities used are the statistical data from the employers´ accident insurance associations on workplace accidents, transportation accidents, abuse risks, plant safety, fire behavior, etc.

1.3. LCC methodology

The major target for this assessment is the identification of all the expenses occurring throughout SOCRATCES, thus the principal expenditures of the entire life cycle phases to be introduced into the calculations, are expressed here below [1]:

- CAPEX → Capital-linked costs (e.g. initial investments, installations).
- OPEX:
  - Consumables → Consumption-linked costs (e.g. raw materials, waste materials, energies).
  - Operation → Operation-linked costs (e.g. labour force, taxes).
- Other costs → Any other additional costs (e.g. indirect costs).

Within the project, the selling-prices of the generated outputs should be also included in the calculations, if they are known, otherwise, estimations and approximations can possibly be used, they should be determined under discussion with the consortium partners and be ultimate and definitive for the final assessment. Certainly, the electricity produced coming from different scenarios and configurations will generate the main profit of the project and it does not include IP revenues, including patents, designs and procedures, which are beyond the scope of this study.

The data introduced into the calculations mainly consist of market prices for the energy consumed, raw materials used and byproducts treated and the extent of the required investments, as well as further financial and technical base assumptions, such as interest rates and equipment life spans.

Equipment life spans may not match the temporal boundaries set in the project. To deal with it, the introduction of two parameters is needed:

- *Remnant value* is related to the value of an asset (e.g. machinery) when it is not fully depreciated, it is expressed in terms of either percentage or absolute value of depreciation of its initial value.
- *End of life value* concerns the costs of the disposal and/or correct treatment of an asset after reaching their life span, it might be either positive or negative according to the end of life scenario.

Figure 8 depicts the methodological approach for the LCC assessment including the cost-revenue structure of the entire processes (some of the expenditure examples at categories level are shown), the input data are categorized, grouped and treated with additional parameters and, at the end, presented as total and annual ranks in cumulative and no-cumulative terms as well as their shares:

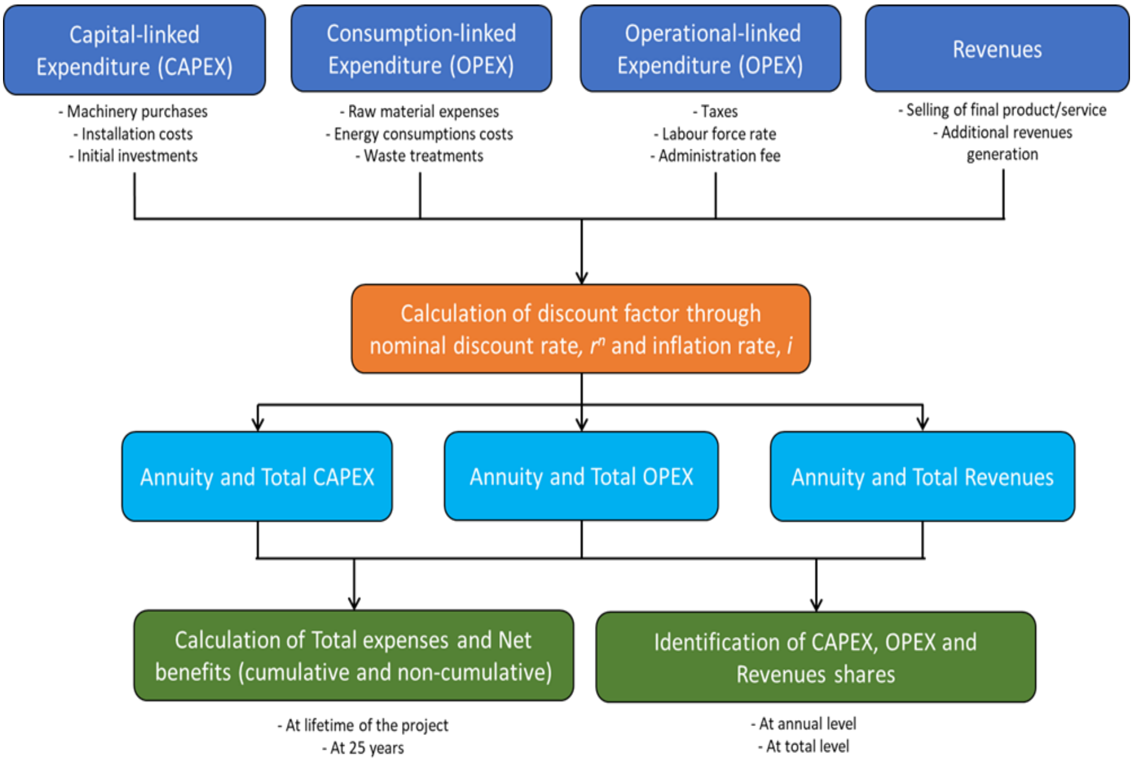

Figure 8: Methodological approach for the LCC assessment

Procurement costs are widely used as the primary (and sometimes unique) criterion for equipment or system selection. This single purpose criterion is simple to use, but risks to lead to incomplete assessments or incorrect decisions, that do not take into account the value of money over time [11].

Indeed, a fundamental factor within the LCC concept is time adjustments: amendments to place money values expended or received over time on a comparable basis are necessary for the valid assessment, because any money today does not have constant value over time. There are two reasons for this disparity in value: money has real earning temporal-wise potential among alternative investment opportunities, and future revenues or savings always carry some risk and, secondly, in an inflationary economy, purchasing power of money erodes in time.

Present Value (PV) approach is used to reflect the capital costs: it is used in capital budgeting to analyze the profitability of an investment or project; determining the value of a project is challenging because there are different manners to measure the value of future cash flows: because of the time value of money, a euro earned in the future will not be worth as much as one earned today. The discount rate in the PV formula is a technique to take it into account.

Furthermore, there are various ways of identifying the discount rate, although a common method is using the expected return of other investment choices with a similar level of risk [12].

Both CAPEX and OPEX input data are usually expressed as “constant euros”, regardless the moment in time at which the expenditure occurs. Nevertheless, the PV of future or past money flows is taken into account and calculated with the final goal of considering both the cost of capital – i.e. the loss of value of money that is hold in a capital asset and cannot be used for other investments and profits – and inflation – i.e. the fall of the purchasing power of the considered currency related to a rise of prices over time.

First, it has been needed to introduce the discount rates parameters: the real discount rate represents the prevailing rate of interest on borrowed funds, also known as nominal discount rate, less inflation rate. The rate of interest of borrowed funds reflects, in turn, the cost of capital, real discount rates used in life-cycle cost analysis [13].

According to the following formula, the real discount rate is expressed [14]:

$$r_r = \frac{r_n - i}{1 + i}$$

Where:

- r_r = real discount rate.
- i = inflation index.
- r_n = nominal discount rate.

The nominal discount rate is an element used to discount and transform future cash flows into present value costs. It is usually country and sector specific and, for the European-based project, an average from EU member state (both Euro and No-Euro zone) is taken; the inflation index can be withdrawn from the Consumer Price Index.

They would be fixed for the assessment and coming from annual average rate of change in the Statistical Data Warehouse of the European Central Bank and from EU webpage. Both values are taken from the latest updates of the sources [15, 16].

In the Table 1, an example of the two parameters are displayed:

Inflation rate [Last update: August 2018]	0.02
Nominal discount rate [Last update: August 2018[1]]	0.015

Table 1. Inflation and nominal discount rates examples

Hence, PV factor can be calculated as:

$$F(n) = \frac{1}{(1 + r^r)^n}$$

$$PV(n) = F(n)\, V_n = \frac{V_n}{(1 + r^r)^n}$$

Where:

- V_n = cost values, grouped by category (CAPEX, OPEX, etc.), at a certain year n.
- n = number of years, where $0 \leq n \leq n_p$.
- n_p = total considered lifespan of the project or time horizon of the analysis.
- F(n) = discount factor, always less than or equal to 1.

The possible life cycle times for LCC analyses usually vary drastically according to the technology, investments and expertise in the industry sector; they usually represent the general limit of the analysis also for the environmental LCA, as it is assumed that after this period new materials or

[1] This value is an average which come from long-term interest rate for EU28 considering the following countries: Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Austria, Portugal, Slovenia, Slovakia, Finland, Bulgaria, Czech Republic, Denmark, Croatia, Romania, Sweden, United Kingdom, Lithuania, Luxembourg, Malta, Netherlands, Hungary and Poland.

technologies might gain the market. Moreover, discount and inflation rates assumptions lose relevance after several years.

The time horizon of the assessment has been set to 25 years: the longer the planning horizon, the more important the life-span of the product appears. Therefore, this needed to be carefully considered. You may consider using the contract period as the planning horizon, however this may still risk having a too short-term perspective to realize the potential benefits of durable products that naturally have a longer life expectance. This is also important when finding the remnant value or end-of-life costs [11].

Usually, the CAPEX values do not need to be actualized, as it assumed, they occur during the first year of the analysis and, regularly, when they reach the end of life in order to be replaced entirely. In case they occurred in the past or they are paid in different rates an update is required, as well as an allocation if they serve also for other production processes or services either inside or outside the system considered in SOCRATCES.

Eventually, the sum of all the PV are presented in their total and annual forms at the key years of the assessment (the lifetime of the project and the time horizon of the assessment).

In a second stage, a *Cost-Benefit Analysis (CBA)* provides an economic framework to evaluate the viability of a proposed or operating project [17]. It is the most useful tool when a single study is analysed or even in cases of more complex policy, to determine whether the program's total economic benefits exceed the costs as well as when alternative products or systems are compared to see which one achieves the greatest benefit. It can be defined as the systematic gathering of technical and financial data regarding a given business situation or function [18].

CBA also weighs those costs against the money value of program benefits. Typically, analysts focus on costs from benefits to obtain the net benefits of the technology considered:

$$Net\ benefits = Total\ revenues - Total\ costs$$

In cases of negative net benefits, they are referred to as net costs. This analysis requires a series of assumptions and, ultimately, the detailed interpretation of the analyst; indeed, the major difficulty with CBA is often the difficulty to place money values on all (or most) costs and benefits [20].

Finally, the *Return On Investment (ROI)* of the expected returns and financial inputs from a given project is calculated. The results of this analysis can be used to evaluate alternative options and can strongly support a proposal for resource allocation and management endorsement. It is important to understand the purpose and business objectives and benefits that a CBA project is expected to realize [18, 20].

$$ROI\ [\%] = \frac{(Total\ revenues - Total\ costs)}{Total\ costs}$$

ROI is measured as a percentage to allow easy comparison with returns from other investments.

Based on the costs identified, provided by the prior LCC assessment, the cost benefit of the materials, products and processes are assessed. This study will aim to determine whether the proposed productions are economically feasible for whether bringing them to the market or not. CBA is a practice that will be calculated only once LCC assessment is complete.

2. CONCLUSIONS

This report is the first step towards developing a full-competence technical LCC and LCA. The document explained the scope and the methodology for obtaining results. One of the strengths of LCC is to provide quantitative results and, combined with environmental assessment, it leads to complete information on how feasible the proposed technologies over the economic and environmental pillars of the sustainability are.

Because some of the data will need to be extrapolated and managed to production scale, it is important to be clear with the assumptions made. Indeed, it is essential for the next iteration, to receive data from the inventories as much close to the real industrial implementation as possible. One of the most critical issues for the LCC reports is considering all assumptions and definition issues, but also allocation matters.

The main conclusion extracted from this report is the definition of the overall system, it is fundamental to produce an understandable and thorough assessment, so that **1kW of thermal energy stored** and **cradle-to-grave** are the crucial specifications that will guide the entire assessment and all the iteration. LCC and economic assessments require a proper technical data management and it is necessary to update economic value when summing up costs in a certain timeframe.

The present report is considered a living document and will be updated throughout the project development.

Preliminary results, in terms of cost analysis and environmental impact, are planned to be presented in D8.3 and D8.5 within the same work package.

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ANNEX

The Life Cycle Inventory stage will be executed through a spreadsheet that will be circulated to the SOCRATCES partners in the upcoming months.

It mainly consists in two different tables, aiming the collection of all the data for expenses and revenues streams in SOCRATCES as well as their references, collected to foresee the quality of the data gathered.

Further instructions about how to fill up the inventory is provided on the first tab of the document.

Table 1: General facility parameters table from LCC spreadsheet

General facility parameters	Unit	Value	Reference
Total initial investment amount	€		
Operating hours per year	h/yr		

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Table 2: Input and output material collection for LCA

Mass and energy streams per unit process		Calcination		Carbonation		Power Block	
Inputs	**Unit**	**Value**	**Reference**	**Value**	**Reference**	**Value**	**Reference**
Used feedstocks materials							
Materials (specify % by wt)	kg						
Auxiliary materials							
Water (if existing)	kg						
Other auxiliary (please, specify source)	kg						
Other auxiliary (please, specify source)	kg						
Process energy							
Net Electricity consumption	kWh						
Other net consumption	kg						
Other inlet consumption (specify efficiencies)	kg						
Outputs	**Unit**	**Value**	**Reference**	**Value**	**Reference**	**Value**	**Reference**
Main products							
Main product (specify % by wt)	kg						
By-products							
By-product 1 (please, specify)	kg						
By-product 2 (please, specify)	kg						
By-product 3 (please, specify)	kg						
Emissions							
Air emissions (please, specify)	mg						
Water emissions (please, specify)	ml						
Soil emissions (please, specify)	mg						

Waste							
Wastewater (please, specify)	m^3						
Oil waste (please, specify)	kg						
Other liquid or solid residues (please, specify)	kg						
Material compositions							
Material composition of the used feedstock and its reference (input)							
Material composition of the main product and its reference (output)							
Material composition of by-products and its reference (output)							
Waste material composition and its reference (output)							
Other							
How do you treat waste? Sell, landfill, recycling, etc.							

Table 4: Expenses and revenues collection table from spreadsheet

Categories					
Capital-linked expenses (CAPEX)		**Specific investment amount (€)**	**Investment year**	**Service life (yr)**	**Reference**
Machinery	Process component 1 (please, specify)				
	Process component 2 (please, specify)				
	Process component 3 (please, specify)				
Periphery	External process (please, specify)				
	Please, specify				
Infrastructure	Please, specify				
	Please, specify				
Other	Please, specify				
	Please, specify				

Consumption-linked expenses (OPEX)	Specific cost		Consumed amount per year	Reference
	Unit	Value		
Waste materials	€/kg			
Process energy (electricity)	€/MWh			
Process energy (heat)	€/MJ			
Steam	€/m³			
Process water (from the grid)	€/m³			
Raw materials 1 (please, specify)	€/kg			
Raw materials 2 (please, specify)	€/kg			
Sewer charge (wastewater)	€/m³			
Other costs (please, specify)	€/m³			

Operation-linked expenses (OPEX)	Specific cost		Reference
	Unit	Value	
Labour force	€/yr		
Liability insurance	€/yr		
Other insurances	€/yr		
Servicing and inspection	€/yr		
Taxes	€/yr		
Administration (no labour cost)	€/yr		
O&M costs (please, specify)	€/yr		
Other cost (please, specify)	€/yr		
Other costs	**Specific cost**		**Reference**
	Unit	**Value**	

Please, specify	€		

Incomes/Sales	**Specific cost (purchaser's price)**		**Produced amount per year**	**Reference**
	Unit	**Value**		
Main product (please, specify)	€/kg			
By-products 1 (please, specify)	€/kg			
By-products 2 (please, specify)	€/kg			