CIRCULAR IMPACTS

Methodology for the case studies

Funded by the European Union

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With thanks to interviewed experts:

Project coordination and editing provided by Ecologic Institute.

Manuscript completed in June 2017

This document is available on the Internet at: [optional]

Document title	Methodology for the case studies.
Work Package	
Document Type	
Date	20 June 2017
Document Status	

ACKNOWLEDGEMENT & DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation Programme under Grant Agreement No 730316.

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1 :: Introduction

This document is about the methodology and selection of the case studies. It is meant as a guideline for the case studies, and together with the other reports in this work package can be a source of information for policy officers, interest groups and researchers evaluating or performing impact assessments of circular economy policies or specific circular economy projects. The methodology was developed to ensure that the case studies focus on the overall impacts of the circular economy. The frame of the methodology is a step-by-step approach, which will be described in sections 3 and 4 of this document. In section 2 we describe the selection of the case studies.

The methodology for the case studies is described in this document, whereas the case studies themselves, using this methodology, are provided in the workshop papers and will be summarized in the final report of this work package. The purpose of the case studies is to show how an analysis of the impacts of circular economy processes may go beyond the direct impacts. We do not only study the impact at a sector or chain level, but focus on potential influences on society as a whole, i.e. for the environment, productivity in the sector and related sectors, consumers, imports and exports, and employment. Next to this, possibilities to scale up the circular process and enabling factors and barriers for implementation are analysed. Based on this also policy options are formulated.

Many initiatives for the circular economy are still in a pilot phase. Therefore, future developments are important. For example, what are the effects of upscaling the business case, both for profitability and social effects? We propose to focus the analysis on expected developments of the business case and the final impacts when the transition has been completed.

2 :: The choice of the case studies

The choice of case studies is:

- Nutrient recycling
- Sustainable building
- From product to service
- Critical raw materials
- And added: literature review of biofuels and other renewable energy sectors.

The case studies are selected in such way that the main processes of the circular economy are covered. In 'The Circular Economy – A review of definitions, processes and impacts' (deliverable WP2) an overview is given of these main circular economy processes, see box 1.

Box 1. Main circular economy processes

USE LESS PRIMARY RESOURCES

- Recycling
- Efficient use of resources
- Utilisation of renewable energy sources

MAINTAIN THE HIGHEST VALUE OF MATERIALS AND PRODUCTS

- Product life extension
- Remanufacturing, refurbishment and re-use of products and components

CHANGE UTILISATION PATTERNS

- Product as service
- Sharing models
- Shift in consumption patterns

Source: Deliverable 2.1 - Circular Economy: A review of definitions, processes and impacts (WP2)

All main circular economy processes, mentioned in Box 1, are covered by the case studies selected. The case study on Nutrient recycling covers the processes of 'Recycling'. The case study on Sustainable building covers the processes 'Efficient use of resources', but also 'Remanufacturing, refurbishment and re-use of products and components'. The case study From product to service covers the three processes (i.e. Product as service, Sharing models and Shift in consumption patterns) included in the category 'Change Utilisation Patterns'. Furthermore, it is expected that the case study From product to service will also cover the issue of Product life extension, since in this case the producer remains the owner and therefore has an interest in extending the life of the product. Finally, the case study on Biofuels and other renewable energy sectors covers the process 'Utilisation of renewable energy sources'.

The case studies are also in line with the EU action plan for the circular economy published by the European Commission in December 2015. Critical Raw Materials and sustainable buildings (construction and demolition) are two of the five priority areas of the action plan. Nutrient recycling is explicitly mentioned as one of the elements in the chapter "From waste to resources", while "from product to service" is explicitly mentioned as one of the options to introduce circular economy aspects on the consumer side. The review of biofuels and renewable energy fits into biomass and bio-based products priority area of the action plan.

An additional important criterion for the selection of the case studies was the availability of industry partners in the sectors that were willing to support the case study.

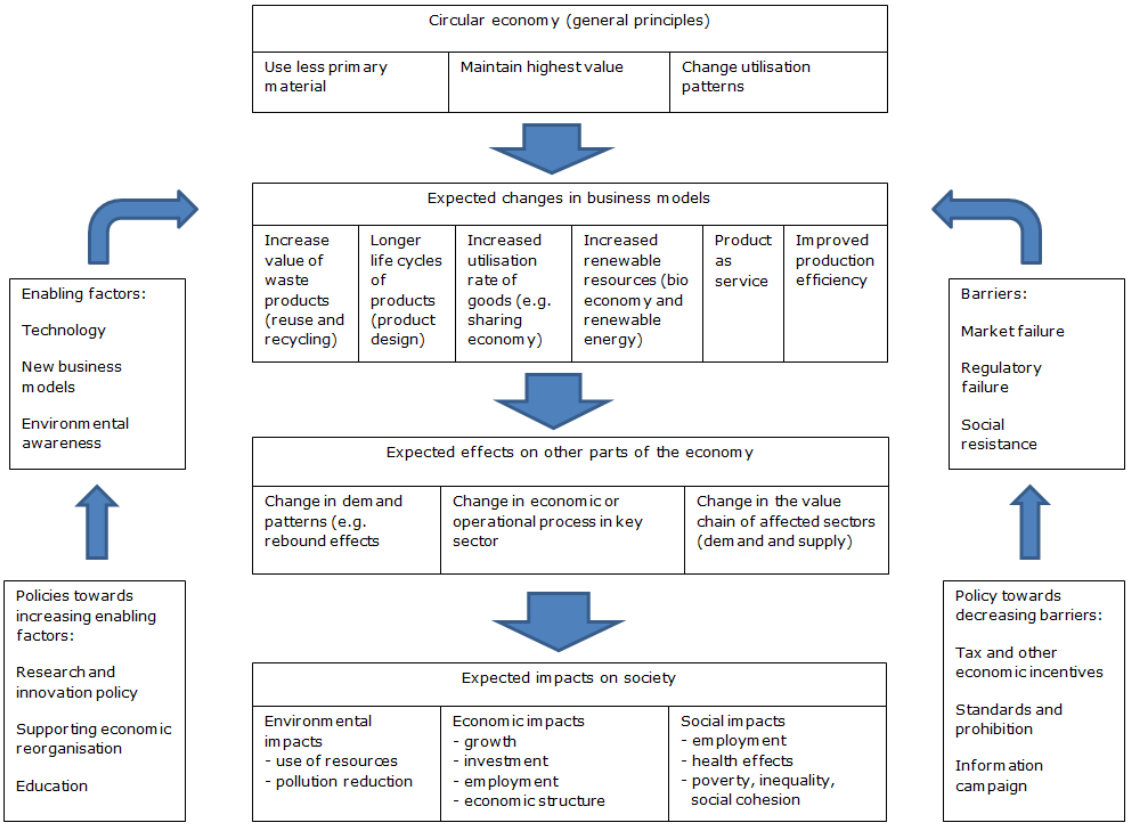
3 :: Overall framework

A step-by step approach was developed to structure the case studies. The main characteristics of this approach are:

- It is based on overall framework, see scheme below
- It distinguishes physical and economic flows
- It has an emphasis on indicators
- It has an emphasis on policy options and policy evaluation
- It distinguishes between potentials and conditions, i.e. conditions that have to be fulfilled in order to realize the potentials;
- Policy options can be derived from these conditions, i.e. on which aspects may policy intervention be relevant in order to fulfil the conditions necessary to realize potentials.
- An explicit step for a broader perspective is incorporated in the case studies, especially on alternative innovations

The structure of the case studies fits within an overall framework, depicted by scheme 1.

Scheme 1: Overall framework to describe the transition towards a circular economy



We distinguish in our approach the following steps:

Step 1: Defining the baseline

Step 2: Defining the new business case

Step 3: Changes in the key sector

Step 4: Effects on other parts of the economy

Step 5: The impact on the environment and society

Step 6: Are alternatives available?

Step 7: Policy options

Step 8: Overall conclusions

Notice that the steps do not have to be performed sequential.

The link between scheme 1 and the eight steps is as follows:

We start with describing the current (linear) business model which is the baseline, and the new (circular) business case (step 1 and 2). In order to describe why the new business case fits within the concept of a circular economy, we explain how it contributes to the general principles of a circular economy (see first row of scheme 1) and to the business models for a circular economy (see second row). The new business model is made possible thanks to enabling factors e.g. technology improvements, but probably it faces also some barriers, such as regulations which may have been useful in a linear economy but are counterproductive in a circular economy (see scheme, blocks on the right and left). We describe expected developments of the business case and its impact when the transition has been completed.

Step 1 and 2 are descriptive. In step 3 we add quantitative information for the key sector, especially on changes in economic and operational processes (see third row, in the middle). Important are changes in both physical and monetary flows. In order to visualize the physical flows one may make use of a flow chart. Next, (monetary) values are added to these flows. These values together with information on investments are steps towards a cost-benefit analysis.

Changes in the key sector will have an effect on demand patterns and other sectors (see third row, left and right). In order to understand indirect effects and rebounds one has to evaluate the effects of the new business model on other parts of the economy. This is done in step 4. Our time horizon is again when the transition has been completed.

Next, in step 5, we can describe the impact of the new business model on the environment, the economy and social impacts (see fourth row). To be able to perform this step smoothly, it is important that from the beginning we distinguish between physical flows and monetary flows, and that we pay attention to employment effects and consequences for international trade.

Innovations are an answer to environmental or social problems, e.g. sustainable energy sources are an answer to exhaustibility of fossil energy and carbon emissions. Often, several solutions are developed at the same time, e.g. solar based energy, wind energy, bio-energy etc. When focusing on one innovation, one has to keep in mind that there are other, competitive, innovations developed at the same time for the same problem. These other innovation may be develop quicker or more efficient. In step 6 therefore we examine whether other innovations may become competitive.

Next we come to formulate policy options, which is step 7. Often, policies are formulated in order to increase enabling factors, and to decrease barriers (see scheme, blocks on right and left). Furthermore, a distinction should be made between the potential of the new business case, and conditions under which the potential can be realised. Policy options are formulated to improve the conditions needed.

The final step, step 8, is about overall conclusions. What did we learn about the new business case, and its environmental, social and economic impact. And which policy recommendations can be derived from the analysis.

The task sheets, i.e. which kind of information should be the result of the case studies, are as follows. For both the old (linear) and new (circular) business model information is needed on:

- Inputs used (both material and labor), and where do these inputs come from;
- Output (both products and emissions), and where do these outputs go to;
- The process (and if possible, information on circular loops);
- If relevant, visualize this with a flow chart. The flow chart gives information on physical flows.
- These physical flows are completed with estimates of the values of the flows, i.e. monetary information;
- Investments needed for the new business model.
- Externalities in production that may be reduced by the circular opportunity
- Welfare effects of the externalities that may be reduced
- Does the circular opportunity create skills or knowledge that gives a competitive advantage or that can be exported to other regions of the world?

All case studies will be based on a desktop literature review, expert interviews, and a workshop with experts to check the outcomes of the case study with expert views.

4 :: Step-by-step approach structuring the case studies

Some general remarks have to be kept in mind when working on the case studies:

- Important is to make clear the argumentation behind a case study, i.e. the line of reasoning should be transparent;
- Describe who are the winners and who are the losers, e.g. towards employment;

- Describe direct effects, but also indirect effects and rebounds;
- Towards the baseline: how will the sector develop anyway, i.e. without the new business case;
- Which results are specific for the case study, and which more general conclusions may be drawn from it.

Below we elaborate on each step defined above.

4.1 Step 1: Defining the baseline

This step will give an overview of the existing situation, including the context and the current (linear) business case. The current business case is called the baseline. Both the context and the current business case are presented in a descriptive manner.

Part of the context may be: why is this case study chosen, is resource depletion a problem nowadays or foreseen in the near future, are emissions a problem, are there social or environmental issues at stake, etc.

In defining the baseline, it is important to describe current inputs, outputs and processes, and expected changes in the (near) future, i.e. without the new business case. Which investment opportunities would be realized without specific policy measures to stimulate the circular economy?

4.2 Step 2: Defining the new business case

This step will give an overview of the new business case in a descriptive manner. It is described in terms that are later useful for estimating the impacts on society.

In defining the new business case, it is important to describe why it fits within the idea of a circular economy. Therefore, how does the business case make use of (one or more of) the general principles of the circular economy. And furthermore, what are the expected changes in the business model.

Changes in the business model are described along three aspects:

- Do the inputs needed for the process change, including labour (And where they are bought or hired)?
- Does the process change (e.g. more energy efficient)?
- Do the outputs of the process change (products, waste streams, emissions)? Does the use value of the finished products by users change (e.g. energy efficiency)?

Furthermore, which enabling factors play a major role in this business model. And are there barriers that influence the business model negatively. Here a distinction may be made between potential of the business case and conditions under which these potentials may be fulfilled.

Finally, in which phase of development is the business: is it operative, is it in a pilot phase, or is it in business for a longer time already. What are expected future developments, and what is the expected situation when the transition is completed. Important expected future developments may be:

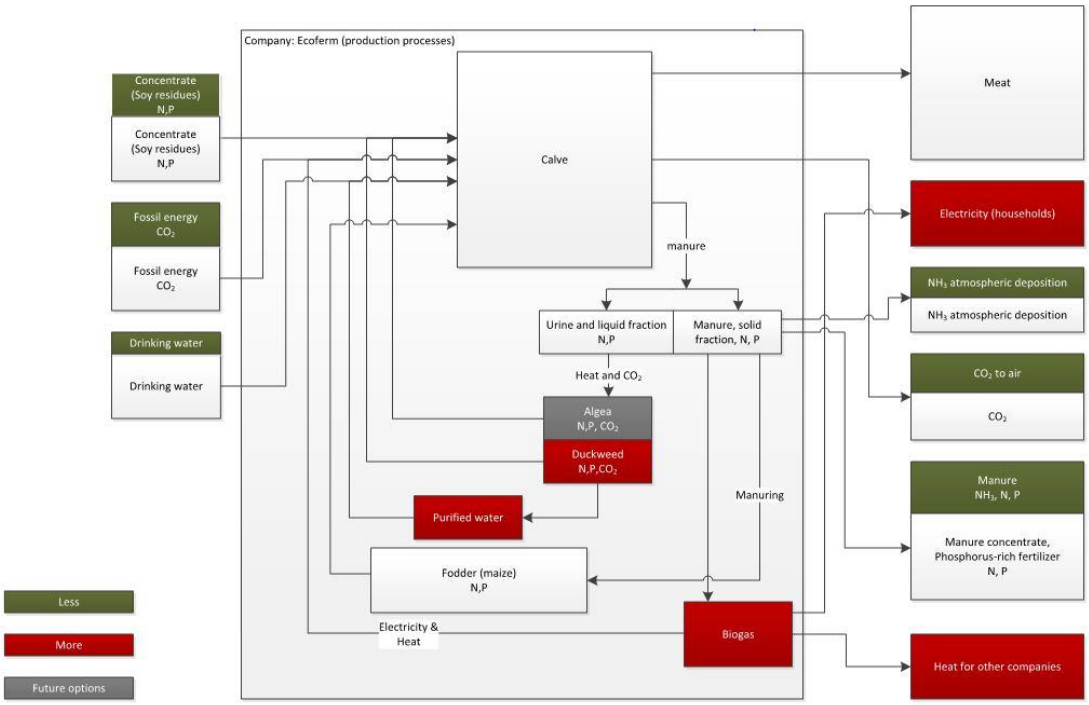
- Expected future improvements in technology
- Expected economies of scale in the future. (Or diseconomies of scale: is it a niche market which is served and is there a possibility that the market becomes satiated by oversupply or consumer disinterest.)
- In case of upscaling the business model, how does it influence either the positive or the negative impacts on society.

4.3 Step 3: Changes in the key sector

This step provides quantitative information on changes in the key sector or chain, due to the introduction of the new business case.

The main questions are: What are expected changes in the operational processes and what are economic changes in the key sector? What is the difference between the new business case and the baseline in material use, emissions, workforce needed, financial changes, etc.?

Step 3a: Describe as far as possible (quantitatively) changes in materials, emissions, employment, investments, output, trade, etc. due to the new business model. Are there expected savings, e.g. on materials, compared to the baseline. Or is a new product introduced? Here a flow chart may be illustrative. An example of a flow chart is given below:



A flow chart provides insight in physical flows of input and output, combined with processes and circular loops. Next, quantitative values may be given for these physical flows, and if possible, the monetary value of these physical flows may be revealed.

Step 3b: Describe as far as possible (quantitatively) the private cost-benefit analysis of the new business case, including consequences for the price of the product produced. It is important to know to what extent it will be develop automatically because private benefits are higher than private costs and the return on investment is higher than in the baseline. And if not, what is the problem that must be solved.

What is the expected situation after the transition has been completed, both for the operational processes and economically.

4.4 Step 4. Expected effects on other parts of the economy

In this step a broader view on the effects of the new business case is investigated by taking into account other parts of the economy. This is important since we will not only study direct effects in the key sector or key chain, but also indirect effects in other parts of the economy.

Changes in one sector will often effect changes in other sectors. First, inputs and outputs of the key sector are demand and supply for other sectors, and therefore will influence the other sectors. One of the inputs is labour, influencing employment and labour income. Second, the circular alternative replaces other processes such as

mining. A decreased demand of primary resources will influence international trade. Third, the circular alternative may influence markets and transport, so for example the harbour may have to adjust to changes of commodity flows as a consequence of the development of the circular economy. As far as possible all these effects should be described in the case study.

If the circular alternative increases national income, this income will be spend and therefore demand of polluting or resource using commodities may increase. This may reduce the effect of the circular economy on resource savings and pollution. However, this so-called rebound effect will be the same for all case studies, and therefore it is not necessary to analyse this in the context of the case studies except when special effects are to be expected.

In summary, it is important that the case study provides an indication on employment effects, changes in trade and changes in product prices for all sectors that are influenced by the introduction of the circular business case.

To explain the reasoning above, we give an example in Textbox 1.

Textbox 1: an example of indirect effects

Phosphate is more and more recycled from wastewater, by wastewater treatment plants. This requires an investment of the wastewater treatment plant, and furthermore, it changes its position from an organisation which executes a service to an organisation which, in addition, also produces a product and has to sell it. Furthermore, it has a (negative) influence on the import of phosphate rocks, mined in e.g. Morocco. Because the substitute is produced in the EU, this implies a rise in the trade surplus of the EU and an increase the trade deficit of resource exporting countries. The reduction of demand for phosphate rock will mean less employment in those countries exporting phosphate, less employment in harbours where phosphate is imported, and more employment in wastewater treatment plants since they enlarge their business. Phosphate is, among others, used to make fertilizer, so recycled phosphate influences the inputs used and the process of making fertilizer. However, it does also have an effect on other products containing phosphate and which are more and more recycled, e.g. animal manure and wasted food (these are indirect effects, on other sectors). When the supply of phosphate increases (thanks to recycling) the price of phosphate will go down, which has a negative effect on the business model for recycling (rebound effects). In short: several developments are going on concerning phosphate recycling, which makes it an interesting case with many interactions. In this step we will focus on expected changes, due to the new

Again, describe the situation after the transition has been completed.

4.5 Step 5: The impact on society

In this step we analyse the impact of the new business model on society, which is the essence of our research. The described impact should be the sum of the direct and indirect effects described in the steps before.

When we know the changes in the key sector and changes in other parts of the economy, we are able to say something about the impact on society. Especially since we made a distinction, in step 3 and 4, between material flows (including emission), financial consequences and consequences for the work force. Furthermore, the flow chart, optional in step 3, will be of use in this part of the research.

The questions to be answered in this part of the research are: How does the new business case have an influence on 1) the environment, especially on the use of resources and on emissions, 2) on the economy, especially on productivity, investment, and employment, and 3) what is the social impact, especially on employment, health, and inequality.

The impacts must be defined in a specific manner. Concerning employment it is important to know whether the increase or decrease of employment takes place in an area which relatively high unemployment rates or not, e.g. the difference between cities (with harbours) and the countryside. So a distinction between regions and skill levels is essential. For example, in the case of phosphate recycling employment may be

generated in some regions with relatively high unemployment for low skilled labour, while for example activities in the harbour, probably a region with low employment, may be reduced. What are the skill levels for the people involved and is this the type of labour that is for some reason unemployed?

> Textbox 2: an example of crowding out labour
>
> Less imports of phosphate rocks will decrease employment in harbours. On the other hand, recycling phosphate, for example from wastewater, may increase employment. But suppose that for recycling phosphate from wastewater, specific skills and know-how is needed, which is not abundant. Than a consequence may be that other sectors are crowded out, and that total employment is not increased.

Again, describe the situation after the transition has been completed.

4.6 Step 6. Are alternatives available?

Often parallel developments take place. In this step the question is whether the business case which is elaborated on is actually the best answer to the problem that has to be solved.

Even if a new business case seems to work out well compared to the baseline, better alternatives may be available. For example, it may be that harvesting phosphorus from sludge through precipitation has net social benefits, but investment in this technique with a recovery rate of only 15% may prevent investments in more efficient techniques. So, it is always important to evaluate all relevant opportunities to solve a problem, and not only to compare the new business model with the current business model.

So the question here is: which alternatives are developed which may become competitive with the business case described in the case study? And are these alternatives expected to become more profitable in the future? Or more sustainable?

4.7 Step 7: Policy options

In this step insights gained in the previous steps are used to formulate policy options in order to facilitate positive effects on society to the max.

The understanding we won in the steps described above is used here to define the key obstacles for the business case, and the policy options that could address those obstacles.

A distinction may be made between enabling factors and barriers. For example, which enabling factors could be supported by policy makers, such as research and innovation policies, supporting economic reorganization, or education.

Institutions which once were useful in the linear economy may have become an obstacle for the transition towards a circular economy. Which barriers could be decreased by policy makers, e.g. legislation. For example, in the case of phosphate recycling, it may be that it is only profitable if the price of fertilizer would include also prices for greenhouse gas emissions and externalities in fossil fertilizer production in mining.

4.8 Step 8. Overall conclusions

This step should give an overview of the results of the case study.

What are overall conclusions concerning the business case. What are overall conclusions concerning the impact. And what are the main policy recommendations.

5 :: Practical issues for the case studies

5.1 Work flow

- The schedule below is for the first case study. The case studies that have their workshops later may take a little bit more time.
- June-July: Step 1 and 2. And first interviews with experts.
- August-October: Step 3, 4, 5, 6 and 7. Final interviews with experts.
- October: workshop paper for the case sustainable building
- November: workshop paper for the case nutrient recycling
- December: workshop paper for the case critical raw materials
- December/January: workshop paper for the case product to service
- January 2018: Report on impacts of biofuels and renewable energy
- March 2018: report on all case studies.
- Workshop are in the month after the paper is finished, and reporting about each workshop is at the end of the month of the workshop, i.e. the last report on the workshop must be finished at the end of February 2018.

5.2 Communication during the case studies

During the development of the case studies the following communication with the steering group and experts is planned:

1) Steering Group will be contacted to provide comments on the papers before the workshop
2) Selected experts (e.g. policy makers, industry experts etc) will be provided the papers before the workshop
3) The final versions of the papers will be made available to the public after the workshops

6 :: Concluding comments

This report gives an outline of steps to be accomplished for the case study reports. During development of the case studies the methodology may be further developed, while the outcomes of the case studies will be used as inputs for the impact assessment in work package 5.

List of partners

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